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Article *in* Dreaming · September 2017

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Reality Testing and the Mnemonic Induction of Lucid Dreams: Findings From the National Australian Lucid Dream Induction Study

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Lucid dreaming is a learnable skill and has a wide range of potential applications. However, research in this area has been limited by a lack of effective and reliable lucid dream induction techniques. The present study provides a thorough investigation into 3 of the most promising cognitive lucid dream induction techniques—reality testing, wake back to bed (WBTB), and the mnemonic induction of lucid dreams (MILD) technique. A sample of 169 Australian participants completed a pretest questionnaire, provided baseline logbook data in Week 1, and practiced lucid dream induction techniques in Week 2. Results showed that the combination of reality testing, WBTB and the MILD technique was effective at inducing lucid dreams. Several factors that influenced the effectiveness of the MILD technique were identified, including general dream recall and the amount of time taken to fall asleep after finishing the technique. Recommendations for future research on lucid dream induction are provided.

Keywords: lucid dreaming, induction techniques, dream recall, methodology

A lucid dream is a dream in which the dreamer is aware that they are dreaming while the dream is still happening (LaBerge, 1985). In a recently published meta-analysis, Saunders, Roe, Smith, and Clegg (2016) found that an estimated 55% of adults have experienced at least one lucid dream in their lives, with 23% of adults experiencing lucid dreaming regularly (once per month or more) and some rare individuals having spontaneous lucid dreams almost every night (Fingerlin, 2013; Gackenbach, 1991; Schredl & Erlacher, 2011b; Snyder & Gackenbach, 1988). Although references to lucid dreaming can be found from over 2000 years ago (LaBerge, 1985), it was not until 1975 that the phenomenon was confirmed empirically. Hearne (1978) reasoned that, if the eye movements that characterize REM sleep correspond to the gaze of the dreamer, it may be possible to signal to the outside world during a lucid dream using a series of prearranged left-right eye

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We thank Thomas McAtee for his valuable assistance with data entry and data management.

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Dreaming
2017, Vol. 27, No. 3, 206–231

1053-0797/17/$12.00 http://dx.doi.org/10.1037/drm0000059

movements. Using electrooculography, he succeeded in recording such a signal that corresponded to the report of a lucid dream during unambiguous REM sleep. This was achieved independently by LaBerge (1980), and numerous other studies have since replicated these findings (e.g., Dane, 1984; Fenwick et al., 1984; Ogilvie, Hunt, Tyson, Lucescu, & Jeakins, 1982; Tholey, 1983). There was a subsequent surge of research into such topics as the phenomenology (see LaBerge & DeGracia, 2000), psychophysiology (see Schredl & Erlacher, 2011a), and potential applications of lucid dreaming. Potential applications include treatment of nightmares (Holzinger, Klösch, & Saletu, 2015; Lancee, van den Bout, & Spoormaker, 2010; Spoormaker & van den Bout, 2006), improvement of physical skills and abilities through rehearsal in the lucid dream environment (Erlacher & Schredl, 2010; Stumbrys, Erlacher, & Schredl, 2016), creative problem solving (Stumbrys & Daniels, 2010), and research opportunities for exploring consciousness and mind-body relationships (see Hobson, 2009). However, research on lucid dreaming has been limited by a lack of effective and reliable lucid dream induction techniques.

Lucid Dream Induction Techniques

A wide range of techniques have been developed for inducing lucid dreams (see LaBerge & Rheingold, 1991; Love, 2013; Stumbrys, Erlacher, Schädlich, & Schredl, 2012; Tholey, 1983). Some of these involve dream induced lucid dreams (DILDs), which occur when the dreamer realizes they are dreaming during a nonlucid dream (LaBerge & Rheingold, 1991). Other techniques are designed to help the practitioner enter a lucid dream directly from the waking state. These are known as wake induced lucid dreams (WILDs; LaBerge & Rheingold, 1991) and require a delicate balance of relaxation and unbroken conscious awareness during the transition into REM sleep. WILDs are considered more difficult to achieve, and WILD attempts carry an increased risk of experiencing sleep paralysis, which can be extremely unpleasant (Cheyne, 2003; Sharpless & Barber, 2011). DILD techniques are thus considered better suited to beginners and have been favored in lucid dream induction research. Stumbrys et al. (2012) further organized lucid dream induction techniques according to three broad categories. *Cognitive techniques* include all techniques that involve cognitive activities for inducing lucid dreams. These techniques do not require specialized equipment and are the most widely used for inducing lucid dreams. *External stimulation techniques* involve the presentation of stimuli such as flashing lights, acoustic stimuli, and mild electric shocks during REM sleep, which can be incorporated into the dream experience and serve as a cue to the dreamer that they are dreaming. *Miscellaneous techniques* cover techniques that do not fit into the other two categories such as the ingestion of specific substances that may promote lucid dreams (see LaBerge, 2004; see also Yuschak, 2006).

The two most widely studied cognitive techniques for inducing DILDs and the subjects of the present study are *reality testing* (LaBerge & Rheingold, 1991; Tholey, 1983) and the *Mnemonic Induction of Lucid Dreams* (MILD) technique (LaBerge, 1980; LaBerge & Rheingold, 1991). Reality testing involves examining one's surroundings multiple times throughout the day, questioning whether one is awake or dreaming, and then performing a reliable *reality test* to determine whether

one is awake or dreaming. Reality testing is important because of the strong tendency for the dreaming mind to explain away even the most obvious indicators that one is dreaming. One of the most popular reality tests involves rereading written text (written text tends to change upon second inspection in dreams; LaBerge & Rheingold, 1991). However, written text may not always be available, and some lucid dreamers favor the *inhalation test*, which involves closing one's lips and then attempting to inhale (see Love, 2013). Performing this action while dreaming can produce a contradictory sensation of air moving through one's closed mouth (presumably, this is because the muscles of the face and mouth but not those involved in respiration are inhibited during REM sleep). The rationale behind reality testing is that if it becomes habitual it will eventually be performed while dreaming, thereby leading to lucidity.

The MILD technique makes use of prospective memory, which is the ability to remember to perform planned actions in the future. While lying in bed and immediately prior to going to sleep, the practitioner repeats the phrase "next time I'm dreaming, I will remember that I'm dreaming" (or some variation) while imagining themselves becoming lucid in a dream. If successful, this intention will be remembered during subsequent REM sleep, and the dreamer will become lucid. The MILD technique is often combined with another lucid dream induction technique known as *Wake Back to Bed* (WBTB; LaBerge & Rheingold, 1991). This involves waking up after several hours of sleep (usually five to six hours) and remaining awake for a period of time (from as little as 10 min to more than one hour) before returning to sleep. WBTB not only increases mental alertness, but also provides an ideal time to practice the MILD technique. This is because REM sleep is entered more quickly and for longer periods as sleep progresses, and most dreams (including lucid dreams) occur during REM sleep (Nielsen, 2000; Stumbrys & Erlacher, 2012). Thus, the intention to remember that one is dreaming is more likely to be retained during REM sleep if the MILD technique is practiced after five to six hours of sleep.

Research on Lucid Dream Induction

Stumbrys et al. (2012) identified a total of 35 empirical studies in a recent systematic review of the lucid dream induction literature. Of these, 11 were conducted in sleep laboratories and 24 were field studies. Most studies (27) investigated cognitive techniques, with the majority (22) being field studies. A total of 10 studies investigated the MILD technique. One was a sleep laboratory study (Kueny, 1985), and the others were field studies conducted by LaBerge, Levitan and their colleagues (Edelstein & LaBerge, 1992; LaBerge, 1988; LaBerge, Phillips, & Levitan, 1994; Levitan, 1989, 1990a, 1990b, 1991; Levitan & LaBerge, 1994; Levitan, LaBerge, & Dole, 1992). Reality testing was investigated in nine studies. One of these was a sleep laboratory study (Dane, 1984), with the others being conducted in-field (LaBerge, 1988; Levitan, 1989; Levitan & LaBerge, 1994; Malamud, 1979; Purcell, 1988; Purcell, Mullington, Moffitt, Hoffmann, & Pigeau, 1986; Reis, 1989; Schlag-Gies, 1992). An additional field study investigating reality testing has been recently published (Taitz, 2011). Stumbrys et al. (2012) concluded that MILD and reality testing appear to be more effective than most other cognitive

techniques. However, one study found that reality testing did not increase lucid dreaming frequency (LaBerge, 1988), as did the more recent study by Taitz (2011). It is unclear how reality testing compares to MILD. One study found that reality testing was more effective at inducing lucid dreams (Levitan, 1989), but another found that MILD was superior (LaBerge, 1988). Other than the study by Taitz (2011), only two other lucid dream induction studies have been published following the review by Stumbrys et al. (2012). One of these investigated visual (flashing lights) and tactile (vibration) external stimulation techniques (Paul, Schadlich, & Erlacher, 2014), and the other applied transcranial DC stimulation (tDCS) to the dorsolateral prefrontal cortex (DLPFC) during REM sleep (Stumbrys, Erlacher, & Schredl, 2013b). Both of these studies reported poor success rates.

Unfortunately, it is difficult to compare the effectiveness of lucid dream induction techniques across studies due to widespread methodological limitations. Stumbrys et al. (2012) evaluated the studies included in their review using a methodological quality checklist, developed by Downs and Black (1998) that assesses quality of reporting, external and internal validity, and statistical power. Most (60%) studies were classified as poor quality, with the rest (40%) classified as moderate quality. Just over half of the studies were either unpublished doctoral dissertations or were otherwise not published in academic journals. The average score for all studies was 9.1 out of a maximum of 28, with no substantial difference between laboratory and field studies. Field studies investigating reality testing scored slightly higher at 11.5. Field studies investigating the MILD technique scored below average at 5.9 and were all published in a nonacademic magazine targeted to lucid dreaming enthusiasts. All 35 studies included in the review scored poorly on external validity, with participants mostly consisting of self-selected lucid dream enthusiasts or university students. Other common issues included insufficient statistical power (because of small sample sizes), lack of random allocation, and invalid or unreliable outcome measures.

Inconsistent operationalization of lucid dreaming rates is another problem in the empirical lucid dream induction literature, as well as the broader empirical literature on general dream recall (see Aspy, 2016; Aspy, Delfabbro, & Proeve, 2015). A common operationalization is the mean number of lucid dreams reported in a given period (dream count; DC). However, lucidity is often lost and regained within a single dream and may be attained in multiple separate dreams, especially among proficient lucid dreamers. This makes it hard to compare studies of proficient lucid dreamers with studies involving less proficient participants. Another operationalization is the percentage of all reported dreams that are lucid. This suffers the same limitations as DC but is also confounded with general (nonlucid) dream recall rates. The percentage of participants that experience lucid dreaming at least once while trialing a technique avoids the aforementioned problems, but is too insensitive to provide much insight into technique effectiveness on its own. A more suitable operationalization is lucid dream recall frequency (DRF; see Aspy et al., 2015), which is the proportion of days in a given period on which lucid dreaming is experienced irrespective of how many lucid dreams are reported. Mean DRF rates are less prone to being inflated by participants who have multiple lucid dreams within the same night or who are more likely to lose and then regain lucidity in the same dream, thus making it easier to compare findings from studies that have different sample characteristics.

A further psychometric consideration is that dream recall can be measured using both retrospective measures (which involve estimating one's dream recall for a recent specified time period such as the past month) and logbook measures (which involve keeping a daily record of one's dream recall). As discussed by Aspy (2016; see also Aspy, Delfabbro, & Proeve, 2015), logbook measures of dream recall tend to have higher internal validity and are more sensitive to daily fluctuations of dream recall, but may have lower ecological validity due to their tendency to enhance dream recall. This is because logbook measures require participants to spend more time thinking about and retrieving dream memories each morning. Retrospective measures avoid this enhancement effect and thus have higher ecological validity, but have lower internal validity due to their tendency to underestimate dream recall rates. An example of a retrospective measure of lucid dream recall frequency is the eight-point scale developed by Schredl and Erlacher (2004; see also Stumbrys, Erlacher, & Schredl, 2013a), which includes response options such as "Several times a week" and "About once a week."

One of the biggest limitations in the empirical lucid dream induction literature is the near-ubiquitous failure to measure variables related to how lucid dream induction techniques were practiced. Only one study (LaBerge, 1988), which investigated both MILD and reality testing in different experimental groups, reported correlations between the number of technique repetitions and lucid dreaming rates. This study found that the number of times the MILD phrase was repeated each night was correlated with lucid dreaming ($r = .12$). In contrast, the correlation between lucid dreaming and the number of reality tests performed was very small and nonsignificant ($r = .04$). However, it is difficult to interpret these findings because essential statistical and methodological information was not reported. More recently, Taitz (2011) reported having measured the number of reality tests performed by participants but provided no descriptive statistics, and this variable was not included in analyses. To properly assess lucid dream induction techniques and maximize their effectiveness, it is essential that variables related to technique practice are examined in addition to overall lucid dreaming rates.

Aims and Hypotheses

The present study forms part of a larger research project that also investigated issues related to the measurement of dream recall (see Aspy, 2016). The aim of the present study was to provide a thorough investigation into reality testing, WBTB, and the MILD technique. Baseline logbook data were collected during Week 1 of the study and then participants were randomly allocated to one of three experimental groups for Week 2. Because reality testing, WBTB and MILD are often used in combination, and in the interests of identifying a maximally effective approach to lucid dream induction, groups involving reality testing only (*reaction time (RT) only* group), reality testing and WBTB (*RT + WBTB* group) and reality testing, WBTB and MILD (*RT + WBTB + MILD* group) were compared. The *RT + WBTB* condition involved reading a document about lucid dreaming (see Section RT WBTB group), which controlled for the effects of thinking about lucid dreaming that are inherent to the MILD technique.

Hypotheses were as follows:

- Because the relationship between lucid dreaming and general dream recall rates is one of the most robust relationships observed in the empirical lucid dreaming literature (see Erlacher, Schädlich, Stumbrys, & Schredl, 2014), it was hypothesized that there would be significant positive correlations between general dream recall rates and lucid dreaming rates at both pretest and during Week 2.
- It was hypothesized that lucid dreaming rates would be significantly higher in Week 2 compared with Week 1 for all participants combined and for participants in each of the three Week 2 groups.

Exploratory analyses were also conducted to investigate relationships between lucid dreaming rates and a range of other variables described in Section Materials, including variables that operationalize the way in which lucid dream induction techniques were practiced.

Method

Participants

A total of 420 participants who passed the exclusion criteria (below) signed up for the study and completed the pretest questionnaire. A total of 169 participants went on to complete the full study. This final sample consisted of 94 (55.6%) females, 73 (43.2%) males and 2 (1.2%) participants who identified their gender as "other." The mean age was 38.3 (SD = 15.0) and ranged from 18 to 75. Most of the participants were employed nonstudents (n = 116, 68.6%), with 36 (21.3%) participants being students and 17 (10.1%) being unemployed or retired. Most participants (63.9%) had no prior experience with lucid dream induction techniques. Participants in the final sample heard about the study from a range of recruitment sources: 54 (32.0%) from physical posters or flyers distributed in public locations across the Australian states of South Australia, Victoria, and New South Wales; 32 (18.9%) from word of mouth; 24 (14.2%) from nationally televised news interviews with the first author; 23 (13.6%) from newspaper articles; 15 (8.9%) from radio interviews; 12 (7.1%) from social media; and 9 (5.3%) from other Internet sources. Participants were excluded from the study if they had been diagnosed with any kind of mental health disorder, sleep disorder, or neurological disorder; suspected they *might* have one of these disorders; were experiencing a traumatic or highly stressful life event that was interfering with their sleep; suffered from persistent insomnia or were unable to keep a regular sleep schedule; had experienced sleep paralysis more than once in the past 6 months; found it unpleasant to think about their dreams; or were under 18 years of age. All participants who completed the study entered a raffle to win one of five $200 gift vouchers or one of 10 $50 gift vouchers.

Materials

Materials included an online pretest questionnaire and physical packages that contained an instructions sheet, Week 1 logbook, and a sealed envelope containing

materials for Week 2. This envelope had the words "Week 2 materials—do not open until Week 1 is complete" printed on the front to discourage participants from attempting the lucid dream induction techniques prematurely. All participants reported that they complied with these instructions. The Week 2 envelopes contained another instructions sheet, lucid dream induction technique documents, and a Week 2 logbook. Some of these materials are described in greater detail by Aspy (2016). In the present paper, pretest variables are identified by a capital "P" and logbook variables by a capital "L."

Pretest questionnaire. The pretest questionnaire included the following measures:

Demographic questions. Participants were asked to indicate their age, gender, occupation, and how they heard about the study.

General dream recall. Two retrospective measures of general dream recall were used. The first assessed DRF over the last week (*P DRF*; the percentage of days on which there was dream recall) by asking "How many days during the last week did you remember your dreams from the previous night?" Participants selected one of eight options from a drop-down menu ranging from "0 days" to "7 days." Following this, the number of separate dreams recalled over the past week was assessed by asking "On average, how many separate dreams do you usually remember per week?" Participants could select any whole number between 0 and 50 or "more than 50" from a drop-down menu. The mean number of dreams recalled per day (*P DC per day*) was attained by dividing responses by seven.

Lucid dream recall. A question adapted from Brown and Donderi's (1986) *Sleep and Dream Questionnaire* (SDQ) assessed retrospective DC dream recall for lucid dreams (*P DC lucid per month*):

> Lucid dreams are those in which a person becomes aware of the fact that he or she is dreaming while the dream is still ongoing. For example: 'I was in England talking to my grandfather when I remembered that (in real life) he had died several years ago and that I had never been to England. I concluded that I was dreaming and decided to fly to get a bird's eye view of the countryside. . .' Please estimate the number of lucid dreams you have had in the past month.

Participants answered by selecting any whole number from 0 to 30 or "more than 30" from a drop-down menu. A limitation of this measure is that it does not capture variation among infrequent lucid dreamers (< once per month). However, this measure was chosen in favor of Schredl and Erlacher's (2004) eight-point lucid dreaming scale due to concerns that their scale would not capture variance among frequent lucid dreamers (the most frequent response option in their scale is "Several times a week").

Prior lucid dream induction technique practice. Participants were asked "Have you ever tried to have lucid dreams by learning and then practicing a lucid dreaming technique?" (P lucid tech prior; "Yes" or "No"). Participants were then asked "How often have you practiced a lucid dreaming technique recently (in the past several months)?" (P lucid tech freq). Response options from Schredl's (2004) widely used dream recall measure were used (0 = *never*; 1 = *less than once a month*; 2 = *about once a month*; 3 = *two or three times a month*; 4 = *about once a week*; 5 = *several times a week*; and 6 = *almost every morning*). Responses were converted

to the approximate number of days per week using the following class means: 0 = 0; 1 = 0.125; 2 = 0.25; 3 = 0.625; 4 = 1.0; 5 = 3.5; 6 = 6.5.

Logbooks. Three different Week 1 logbooks were used. They each used a different primary measure of general dream recall but were otherwise identical. The Checklist logbook elicited brief titles for each dream recalled. The Narrative logbook elicited detailed written narratives of each dream recalled. The Quantity logbook prompted participants to rate the extent to which each dream was recalled (see Section General dream recall). Aspy (2016) provided a detailed comparison of these three types of logbooks and found that measures of general dream recall were most stable and reliable when presented in the Quantity logbook, with no differences in overall dream recall rates. These findings were anticipated prior to conducting the study, and the Quantity logbook was used in all three of the Week 2 groups (with additional questions related to lucid dream induction techniques described in Section Sleep-related questions).

Preliminary questions. Participants indicated the date of each logbook entry, allowing the number of days taken to complete all seven entries to be calculated. The total number of logbook entries made by each participant was also counted.

General dream recall. Participants were asked if they could recall anything specific about their dreams from the previous night and were asked to provide brief titles for each dream recalled. This allowed dream recall to be operationalized as both *dream recall frequency* (*L DRF*; the percentage of days on which there was dream recall) and *dream count* (*L DC per day*; the number of dreams recalled each day). Participants were also asked to rate the amount of content recalled from each dream using four categories provided. This operationalization is referred to as *dream quantity* (*L DQ*) and was developed by Aspy (2016) based on an earlier measure developed by Reed (1973). Category ratings are converted to numerical values ("Fragmentary" = 1, "Partial" = 2, "Majority" = 4, "Whole" = 8) and summed (higher scores indicate superior dream recall).

Lucid dream recall. Lucid dreaming was operationalized as DRF (the percentage of mornings when lucid dreaming was reported) because in many cases participants were unsure of how many lucid dreams they had, and in some cases lost lucidity and then regained it within the same dream. The following question was used: "Did you have any lucid dreams last night? (Lucid dreams are those in which a person becomes aware of the fact that he or she is dreaming while the dream is still ongoing)" ("yes" or "no"; *L DRF lucid*). Days when participants did not practice lucid dream induction techniques were excluded when calculating Week 2 *L DRF lucid* rates. The percentage of participants that experienced lucid dreaming at least once during Week 1 and during Week 2 was included as a second operationalization of lucid dreaming (*L lucid participants*). Participants were also asked "How long (approximately) do you think you were lucid dreaming? . . . minutes" (*L lucid duration min*).

Sleep-related questions. Participants were asked to estimate how much time they had spent sleeping (*L time asleep*): "How much time in total do you think you spent sleeping last night? . . . hours, . . . minutes." Participants also rated their subjective *sleep quality* (*L sleep quality*): "On a scale of 1 to 5, what was the overall quality of your sleep last night?" (1 = *terrible*; 2 = *poor*; 3 = *okay*; 4 = *good*; 5 = *excellent*). Participants indicated how tired they felt upon waking (*L tiredness on waking*) with the following question: "On a scale of 1 to 5, how tired do you feel this

morning?" (1 = *not at all tired*; 2 = *slightly tired*; 3 = *somewhat tired*; 4 = *quite tired*; 5 = *very tired*). Finally, participants indicated how sleep deprived they were the previous day (*L sleep dep yesterday*): "On a scale of 1 to 5, how sleep deprived were you yesterday?" (1 = *not at all*; 2 = *slightly*; 3 = *somewhat*; 4 = *quite*; 5 = *very*).

Lucid dream induction technique practice questions. The following question was used in all three Week 2 logbooks: "How many reality tests did you perform yesterday?" (blank space provided; *L reality tests*). In the *RT + WBTB* and *RT + WBTB + MILD* groups, the following additional questions were included: "Were you in the middle of a dream when the alarm woke you up to do the technique? ("yes," "no," or "unsure"; *L awoke while dreaming*); "On a scale of 1 to 5, how motivated did you feel about doing the technique after the alarm went off?" (1 = *not at all motivated*; 2 = *slightly motivated*; 3 = *somewhat motivated*; 4 = *quite motivated*; 5 = *very motivated*; *L technique motivation*); "On a scale of 1 to 5, how difficult was it to focus on the technique?" (1 = *not at all difficult*; 2 = *slightly difficult*; 3 = *somewhat difficult*; 4 = *quite difficult*; 5 = *very difficult*; *L difficulty focusing*); "How long (approximately) did it take for you to get to sleep after you did the technique? . . . minutes." (*L min back to sleep*). The following questions specific to the MILD technique were included for participants in the *RT + WBTB + MILD* group: "Did you fall asleep while you were still trying to do the technique?" ("yes" or "no"; *L asleep during technique*); "If you answered 'no' to the above question, how long (approximately) did it take for you to get to sleep after you stopped doing the technique? . . . minutes." (*L min back to sleep*); "How long (approximately) did you spend on doing the technique? . . . minutes." (*L technique min*); and "How many times (approx) did you repeat 'next time I'm dreaming, I will remember I'm dreaming'?" (blank space provided; *L technique repetitions*).

Lucid dream induction technique documents. Participants were given different lucid dream induction technique documents depending on which of the Week 2 groups they were in.

RT only group. The "daytime lucid dreaming technique" document instructed participants to perform a minimum of 10 reality tests per day by first asking themselves "Am I dreaming?" The importance of genuinely considering the possibility that they are dreaming was emphasized. They were instructed to examine their surroundings for anything strange or inconsistent. They were then instructed to perform an inhalation reality test (see Section Lucid Dream Induction Techniques). Participants were asked to count the number of reality tests performed each day using one of several free tally counter apps available for iPhone and Android smartphones or by making marks on a piece of paper or the back of their hand. Participants were told that reality testing is most effective when practiced frequently and carefully, and that reality tests should be performed at a range of times and settings throughout the day (especially when something unusual or unexpected happens).

RT + WBTB group. In addition to the "daytime lucid dreaming technique" document, these participants were given a "nighttime lucid dreaming technique" document that outlined the WBTB technique. It instructed participants to set an alarm for five hours after going to bed and place it somewhere where they would have to get out of bed to turn it off. They were instructed to put a light on when their alarm went off, go to the bathroom if necessary, return to bed and then read

a document entitled "what to do if you have a lucid dream" before returning to sleep as they normally would. This document—which was given to participants in all three Week 2 groups—was approximately 700 words long and began by explaining several ways that lucid dreams can happen. It advised participants that if they became lucid, they should stay calm to avoid waking, perform a reality test, then stabilize the dream by rubbing the palms of their hands together vigorously and focusing on the physical sensations while repeating "this is a lucid dream" (LaBerge & Rheingold, 1991). Participants were asked to perform a reality test upon reaching the end of the document.

RT + WBTB + MILD group. Participants in this group were given the "daytime lucid dreaming technique" and "what to do if you have a lucid dream" documents, as well as a "nighttime lucid dreaming technique" document that outlined the MILD technique (LaBerge, 1980; LaBerge & Rheingold, 1991). Participants were instructed to set an alarm for five hours after going to bed, put a light on when their alarm went off and then sit upright in bed and try to remember a dream from just before they woke up (or any recent dream if they were unable to recall one). They were then told to go to the bathroom if necessary before turning off the light, lying down comfortably and repeating the phrase "next time I'm dreaming, I will remember that I'm dreaming." The importance of putting meaning into the words was emphasized. Participants were told to simultaneously imagine themselves back in the dream they had recalled and noticing something unusual or bizarre that makes them realize they are dreaming. Participants were told to repeat these steps until they either fell asleep or their intention was set. If their mind wandered, they were told to repeat the procedure so that the last thing they thought about was their intention to remember to recognize the next time they are dreaming. Participants were told that the longer they spend doing the technique the more effective it would be, and not to worry if it took a long time to fall asleep.

Procedure

Participants accessed the online pretest questionnaire using a web URL included in all promotional materials and media items. The questionnaire was hosted by the survey management website Survey Monkey and was configured so that participants could not navigate back to change their answers. Participants provided postal details so they could be sent materials via post. Participants thus completed the study in their own homes. Participants were randomly allocated to the nine possible combinations of the three Week 1 and three Week 2 groups. There was no significant difference between the number of participants in these nine combinations: $\chi^2(4, N = 169) = 1.89, p = .756$. Participants were told that the purpose of Week 1 was to gather baseline information about normal sleeping patterns and dream recall ability, and were asked not to attempt any lucid dream induction techniques or to improve their dream recall during this period. Participants filled in their logbooks immediately upon waking and were urged to complete all seven logbook days consecutively if possible. However, during Week 2 they were told that it is better to skip a day if they were feeling sleep deprived and to make up for it at the end. During

Week 2, participants practiced lucid dream induction techniques as per the instructions described in Section Lucid dream induction technique documents. Participants returned their completed logbooks using prepaid envelopes provided.

Results

Preliminary Analyses and Descriptive Statistics

Most variables were not normally distributed and nonparametric tests were used in all cases. Mann–Whitney tests indicated that the three Week 2 lucid dreaming groups did not differ on any of the pretest or Week 1 variables (for the sake of brevity, these analyses are not reported here). The ratio of males to females did not differ between participants who did and did not complete the full study: $\chi^2(1, N = 418) = 1.30$, $p = .254$. The proportions of participants who were employed nonstudents, students, and unemployed or retired did not differ among participants who did and did not complete the full study: $\chi^2(2, N = 420) = 4.30$, $p = .117$. Participants took 7.8 ($SD = 1.8$) days on average to complete an average of 6.8 ($SD = 0.9$) logbook entries during Week 2. Mann–Whitney tests indicated that participants who went on to complete the full study were not significantly different from those who did not on any pretest variables except for being 6.4 years older on average. In Week 2 of the study, participants spent (slightly) more time asleep compared with Week 1. These findings are presented with descriptive statistics in Table 1.

Independent samples Kruskal-Wallis tests were conducted to investigate group differences in Week 2 logbook variables and are presented with descriptive statistics in Table 2. Group differences reached statistical significance for two variables: *L time asleep*, and *L tiredness on waking*. However, upon applying a Bonferroni correction to control the Type I error rate and using an alpha level of .006 (.05/9), none of the group comparisons were statistically significant. Thus, post hoc comparisons were not conducted.

Relationships With Overall Lucid Dreaming Rates

Spearman rho nonparametric correlations were calculated to investigate relationships between both pretest and mean Week 2 lucid dreaming rates and other pretest and Week 2 variables, and are presented in Table 3. It was hypothesized that there would be significant positive correlations between general dream recall rates and lucid dreaming rates at both pretest and during Week 2. This hypothesis was supported. All pretest dream recall variables were related to *P lucid DC (per month)*. Correlations between these pretest variables and *L DRF lucid* were weaker and in most cases nonsignificant. This pattern was reversed for Week 2 general dream recall variables, which were more strongly and consistently correlated with *L DRF lucid* than with *P lucid DC (per month)*. These findings highlight the importance of avoiding comparisons between retrospective and logbook measures of dream recall (see Aspy, 2016). *P lucid tech prac* was weakly

Table 1
Descriptive Statistics for Pretest, Week 1, and Week 2 Variables With Mann–Whitney Tests for Pretest Differences Between Participants Who Did and Did Not Complete the Full Study and Wilcoxon Signed-Ranks Tests Between Week 1 and Week 2 Logbook Variables

	M (*SD*)		Mann–Whitney test			*M* (*SD*)		Wilcoxon test	
Pretest variable	Completed full study (*N* = 169)	Did not complete full study (*N* = 251)	*Z*	*p*	Logbook variable	Week 1 (*N* = 169)	Week 2 (*N* = 169)	*Z*	*p*
P DRF	44.3% (30.0%)	40.0% (27.1%)	1.17	.244	L DRF	77.1% (21.4%)	77.1% (22.9%)	0.11	.912
P DC (per day)	0.6 (0.6)	0.6 (0.6)	1.61	.108	L DC (per day)	1.7 (1.1)	1.8 (1.2)	0.27	.791
P DC lucid (per month)	1.5 (4.0)	1.4 (3.7)	0.34	.738	L time asleep	7.5 (0.8)	7.6 (0.8)	3.12	.002
P lucid tech prior	36.1% (48.2%)	30.7% (46.2%)	1.16	.247	L sleep quality	3.5 (0.5)	3.5 (0.5)	1.67	.095
P lucid tech freq	0.3 (0.9)	0.3 (1.0)	0.36	.719	L tiredness on waking	2.4 (0.7)	2.4 (0.8)	0.87	.386
P age	38.3 (15.0)	31.9 (13.0)	4.39	<.001	L sleep dep yesterday	1.9 (0.6)	1.9 (0.7)	0.48	.634

Note. P = pretest variable; L = logbook variable; DRF = dream recall frequency; DC = dream count.

Table 2
Kruskal–Wallis Tests for Differences Between the RT Only, RT + WBTB, and RT + WBTB + MILD Groups in Week 2 Logbook Variables

	M (*SD*)				Kruskal–Wallis test	
Logbook variable	All participants (n = 169)	RT only (n = 68)	RT + WBTB (n = 54)	RT + WBTB + MILD (n = 47)	χ^2	p
L lucid duration minutes	11.3 (15.6)	9.2 (8.6)	13.0 (14.9)	11.6 (20.8)	1.96	.376
L reality tests	10.1 (4.5)	10.6 (5.6)	10.2 (3.7)	9.2 (3.5)	1.69	.429
L DRF	77.1% (22.9%)	75.7% (24.3%)	75.7% (25.7%)	81.4 (18.6)	0.41	.815
L DC (per day)	1.8 (1.2)	1.7 (1.2)	1.8 (1.2)	1.8 (1.1)	0.81	.668
L DQ	5.6 (5.7)	5.3 (5.8)	5.0 (4.4)	6.6 (6.7)	3.26	.196
L time asleep	7.6 (0.8)	7.6 (0.9)	7.9 (0.8)	7.4 (0.7)	7.33	.026
L sleep quality	3.5 (0.5)	3.5 (0.5)	3.4 (0.5)	3.4 (0.6)	3.68	.159
L tiredness on waking	2.4 (0.8)	2.2 (0.7)	2.5 (0.7)	2.5 (0.8)	9.08	.011
L sleep dep yesterday	1.9 (0.7)	1.8 (0.6)	1.9 (0.7)	1.9 (0.8)	0.90	.638

Note. L = logbook variable; RT = reality testing; WBTB = wake back to bed; MILD = mnemonic induction of lucid dreams; DRF = dream recall frequency; DC = dream count.

correlated with *P lucid DC* (*per month*) but not with Week 2 *L DRF lucid*, indicating that prior experience with lucid dream induction techniques did not influence the effectiveness of the techniques used in the present study. There was a significant positive correlation between pretest and Week 2 lucid dreaming rates. However, shared variance was only 9.6%. Age was positively correlated with both pretest and Week 2 lucid dreaming rates.

Lucid Dream Induction

It was hypothesized that lucid dreaming rates would be significantly higher in Week 2 compared with Week 1 for all participants combined and for participants in each of the three Week 2 groups. This hypothesis was partially supported. As can be seen in Table 4, dependent samples Wilcoxon's tests showed that *L DRF lucid*

Table 3
Spearman Rho Nonparametric Correlations Between Pretest and Week 2 Lucid Dreaming Rates and Other Pretest and Week 2 Variables

	P DC lucid (per month)	Week 2 DRF lucid
P DC lucid (per month)		.31**
P lucid tech freq	.11*	−.10
P age	.10*	.31**
P DRF	.28**	.15
P DC (per day)	.27**	.21**
L DRF	−.04	.08*
L DC (per day)	.07	.20**
L DQ	.21**	.25**

Note. P = pretest variable; L = logbook variable; WBTB = wake back to bed; MILD = mnemonic induction of lucid dreams; DRF = dream recall frequency; DC = dream count.
* $p < .05$. ** $p < .01$.

Table 4
Improvements in Lucid Dreaming Rates in Week 2 Compared With Week 1 for All Participants Combined and for Participants in Each Week 2 Group

	L DRF Lucid			Wilcoxon test	
Week 2 group	Week 1 *M* (*SD*)	Week 2 *M* (*SD*)	Improvement	*Z*	*p*
All participants (n = 169)	8.1% (17.8%)	11.3% (17.3%)	39.0%	2.27	.023
RT only (n = 68)	8.1% (17.8%)	7.6% (13.0%)	−6.8%	.27	.786
RT + WBTB (n = 54)	6.9% (15.7%)	10.7% (16.3%)	54.1%	1.04	.301
RT + WBTB + MILD (n = 47)	9.4% (20.0%)	17.4% (22.0%)	84.5%	2.94	.003

Note. L = logbook variable; RT = reality testing; WBTB = wake back to bed; MILD = mnemonic induction of lucid dreams; DRF = dream recall frequency.

was significantly higher in Week 2 than in Week 1 for all participants combined. The same was true for participants in the *RT + WBTB + MILD* group. *L DRF lucid* was higher in the *RT + WBTB* group in Week 2 compared with Week 1, but this difference was not statistically significant. *L DRF lucid* was slightly *lower* in Week 2 for participants in the *RT only* group, indicating that reality testing on its own was not effective at inducing lucid dreams. An independent samples Kruskal-Wallis test indicated that there were significant group differences in Week 2 *L DRF lucid* ($\chi^2 = 6.35$, $p = .042$). Post hoc pairwise comparisons revealed that the difference between the *RT only* and *RT + WBTB + MILD* groups was significant ($\chi^2 = 21.10$, $p = .035$). However, the differences between the *RT only* and *RT + WBTB* groups ($\chi^2 = 8.84$, $p = .816$) and the *RT + WBTB* and *RT + WBTB + MILD* groups ($\chi^2 = 12.26$, $p = .492$) were nonsignificant.

In addition to *L DRF lucid*, lucid dreaming was also operationalized as *L lucid participants*. A McNemar's test showed that for all participants combined, the proportion of participants that experienced lucid dreaming at least once during Week 2 (*L lucid participants* = 44.6%) was significantly higher than in Week 1 (*L lucid participants* = 27.7%): $\chi^2(1, N = 166) = 13.50$, $p \leq .001$. A binomial test—used because cell counts did not permit McNemar's test—showed that the increase in *L lucid participants* was significant in the *RT + WBTB + MILD* group (Week 1 = 27.7%, Week 2 = 53.2%, $p = .012$). The increases in *L lucid participants* were smaller and did not reach statistical significance in the *RT only* (Week 1 = 25.4%, Week 2 = 36.8%, $p = .077$) and the *RT + WBTB* (Week 1 = 30.8%, Week 2 = 46.3%, $p = .096$) groups. These findings provide partial support for the hypothesis that lucid dreaming rates would be significantly higher in Week 2 compared with Week 1 for all participants combined and for participants in each of the three Week 2 groups. A 3 × 2 Chi^2 test was performed to explore group differences in *L lucid participants*. Results indicated that there were no statistically significant group differences, $\chi^2(2, N = 169) = 3.16$, $p = .206$.

Relationships With Technique Practice Variables

A Spearman rho nonparametric correlation using data from each individual logbook day indicated that, for all participants combined, the number of reality

tests performed was not related to whether participants experienced lucid dreaming ($r_s = .05, p = .078, N = 1087$). This was also the case for participants in the *RT only* group ($r_s = .03, p = .501, n = 445$) and the *RT + WBTB + MILD* group ($r_s = -.02, p = .792, n = 281$). However, a significant correlation was observed for participants in the *RT + WBTB* group ($r_s = .17, p \leq .001, n = 361$). These findings are given greater consideration in Section Group Differences in Lucid Dream Induction. Spearman rho nonparametric correlations between *L DRF lucid* and variables that operationalize the way in which the WBTB and MILD techniques were practiced are presented with descriptive statistics in Table 5. In both the *RT + WBTB* and *RT + WBTB + MILD groups*, *L DRF lucid* was higher when participants had less difficulty focusing. *L DRF lucid* was also positively correlated with motivation to practice the technique, but only in the *RT + WBTB* group. Participants fell asleep while performing the MILD technique in the majority (79.9%) of cases. A 2 × 2 chi-square test indicated that this was not related to the likelihood of experiencing lucid dreaming: $\chi^2(1, n = 293) = 0.48, p = .487$. However, a significant negative correlation was observed between *L min back to sleep* and *L DRF lucid* (see Table 5). Indeed, this relationship is stronger than any of the other relationships with *L DRF lucid* observed in the present study. To further explore this relationship, occasions when participants did not fall asleep while performing the MILD technique and then took five minutes or less to fall asleep afterward were examined. This was achieved a total of 24 times by 14 participants. For these 24 occasions, Week 2 *L DRF lucid* ($M = 45.8\%$, $SD = 50.9\%$) was much higher than for all the other nights on which these participants practiced MILD ($M = 24.6\%$, $SD = 43.4\%$), suggesting that the MILD technique is most effective when sleep is achieved within five minutes of completing the technique. However, it should be noted that the baseline *L DRF lucid* rate for these participants during Week 1 was higher than average at $M = 20.4\%$ ($SD = 29.5\%$), which limits the generalizability of these findings. Notwithstanding, completing the technique and then falling asleep within five minutes was associated with an increase in *L DRF lucid* of 86.2% compared with all other MILD attempts for these 14 participants. Week 2 *L DRF lucid* was significantly lower when participants performed more MILD technique repetitions and spent longer doing so. However, when participants who fell asleep

Table 5
Spearman Rho Nonparametric Correlations Between Week 2 Lucid Dreaming Rates and Variables That Operationalize the Way in Which the WBTB and MILD Techniques Were Practiced

	RT + WBTB group		RT + WBTB + MILD group	
	M (*SD*)	Correlation (r_s) with L DRF Lucid	*M* (*SD*)	Correlation (r_s) with L DRF Lucid
L difficulty focusing	2.7 (1.0)	−.11*	3.0 (0.9)	−.12*
L technique motivation	2.8 (1.0)	.11*	3.0 (1.0)	−.03
L minutes back to sleep	18.6 (14.3)	.11*	24.0 (25.7)	−.44**
L technique repetitions			17.4 (16.1)	−.12*
L technique min			8.5 (5.3)	−.16**

Note. All correlations are point-biserial and based on daily observations. L = logbook variable; RT = reality testing; WBTB = wake back to bed; MILD = mnemonic induction of lucid dreams; DRF = dream recall frequency.
* $p < .05$. ** $p < .01$.

while performing the technique were excluded, the correlations with *L technique repetitions* ($r_s = -.09$, $p = .168$, $n = 223$) and *L technique min* ($r_s = -.13$, $p = .057$, $N = 234$) became smaller and nonsignificant. This is given greater consideration in Section Technique repetitions and time spent on the technique.

Additional Exploratory Analyses

An independent samples Kruskal-Wallis test indicated that the type of logbook used in Week 1 was not related to Week 2 *L DRF lucid*: $\chi^2(2, N = 169) = 0.89$, $p = .641$. Similarly, a 3×2 Chi^2 test indicated that there was no significant difference in the proportion of participants in each Week 1 logbook group that experienced lucid dreaming during Week 2: $\chi^2(2, N = 169) = 1.18$, $p = .554$. Thus, writing out one's dreams for a week prior to practicing lucid dreaming techniques did not appear to be advantageous.

As noted in Section Relationships With Overall Lucid Dreaming Rates, for all participants combined *P lucid tech freq* was not significantly correlated with Week 2 *L DRF lucid*. The same was true for participants in the *RT + WBTB + MILD* group ($r_s = -.21$, $p = .159$). A 2×2 Chi^2 test indicated that whether participants experienced lucid dreaming during Week 2 was also not significantly related to whether they had attempted to practice lucid dream induction techniques previously (*L lucid participants* = 39.3%) or not (*L lucid participants* = 47.2%): $\chi^2(1, N = 169) = 0.98$, $p = .322$. The same was true for participants in the *RT + WBTB + MILD* group (previous experience: *L lucid participants* = 50.0%; no previous experience: *L lucid participants* = 54.3%): $\chi^2(1, N = 47) = 0.07$, $p = .797$. A Mann–Whitney test indicated that Week 2 *L DRF lucid* did not differ between participants with previous experience ($M = 9.4\%$, $SD = 16.5\%$) and without previous experience ($M = 12.4\%$, $SD = 17.7\%$): $Z(169) = 0.51$, $p = .692$. The same was true for participants in the *RT + WBTB + MILD* group (previous experience: $M = 9.5\%$, $SD = 11.2\%$; no previous experience: $M = 20.1\%$, $SD = 24.2\%$): $Z(1, N = 47) = 0.81$, $p = .480$.

A 2×2 Chi^2 test indicated that in the *RT + WBTB + MILD* group, lucid dreaming was associated with whether or not participants reported that they were dreaming when they were awakened by their alarm to perform the technique, $\chi^2(2, n = 285) = 7.16$, $\varphi = .16$, $p = .028$. Lucid dreaming was most likely when participants reported that they were not dreaming ($n = 75$, *L DRF lucid* = 25.3%), was less likely when participants were awakened while dreaming ($n = 96$, *L DRF lucid* = 17.7%), and was least likely when participants were unsure of whether or not they were dreaming ($n = 114$, *L DRF lucid* = 10.5%). However, because of the disproportionately large number of occasions when participants were unsure, it remains unclear whether or not waking from a dream before performing lucid dream induction techniques was related to lucid dreaming. This issue is given greater consideration in Section Sleep stage awakening. The same pattern of findings was observed for the *RT + WBTB* group, but was not statistically significant, $\chi^2(2, n = 358) = 2.53$, $\varphi = .08$, $p = .282$.

To further investigate factors that influenced the success rate of the MILD technique, differences in logbook variables between nights when MILD was and was not followed by lucid dreaming were investigated. These are presented in

Table 6
Mann–Whitney Tests for Differences in Week 2 Logbook Variables Between Nights When Lucid Dreaming Did and Did Not Occur Following Practice of the MILD Technique

	M (*SD*)		Mann–Whitney test	
Logbook variable	Lucid dreaming reported (n = 52)	No lucid dreaming reported (n = 251)	*Z*	*p*
L reality tests	9.3 (5.8)	9.5 (3.8)	0.26	.792
L difficulty focusing	2.6 (1.3)	3.0 (1.2)	2.08	.038
L technique motivation	3.1 (1.3)	3.0 (1.4)	0.57	.572
L minutes back to sleep	10.6 (21.1)	26.7 (27.4)	3.34	.001
L technique repetitions	13.9 (16.9)	18.7 (22.1)	2.05	.040
L technique minutes	7.7 (10.2)	8.8 (7.6)	2.76	.006
L DC (per day)	2.9 (2.1)	1.7 (1.4)	3.74	<.001
L DQ	14.4 (15.9)	5.3 (5.7)	4.92	<.001
L time asleep	7.6 (1.4)	7.4 (1.1)	1.13	.260
L sleep quality	3.7 (0.8)	3.4 (0.9)	1.96	.050
L tiredness on waking	2.0 (0.9)	2.6 (1.1)	3.77	<.001
L sleep dep yesterday	1.6 (0.8)	2.0 (1.1)	2.73	.006

Note. L = logbook variable; DC = dream count; DQ = dream quantity; MILD = mnemonic induction of lucid dreams.

Table 6. No significant differences were found for *L reality tests* and *L technique motivation*. When MILD was followed by lucid dreaming, participants had significantly less difficulty focusing, took less time to get back to sleep once they finished the technique, performed fewer technique repetitions, and spent slightly less time on the technique overall. However, upon applying a Bonferroni correction to control the Type I error rate and using an alpha level of .004 (.05/12), the findings regarding *L difficulty focusing* and *L technique repetitions* became nonsignificant. Findings regarding these two variables should thus be interpreted with caution. When MILD was followed by lucid dreaming, participants were significantly less sleep deprived the previous day, had marginally better sleep quality, and were significantly less tired the next morning. After applying the Bonferroni correction, only the finding regarding *L tiredness on waking* remained significant. These findings indicate that successful induction of lucid dreaming using the MILD technique did not compromise sleep quality. General dream recall was superior according to both measures used.

Discussion

The purpose of the present study was to provide a thorough empirical investigation into the effectiveness of three widely used cognitive lucid dream induction techniques—reality testing, WBTB, and the MILD technique. A pretest questionnaire was administered, and baseline logbook data were collected during Week 1. In Week 2, participants were randomly allocated to conditions that involved reality testing only (*RT only*), reality testing and WBTB (*RT + WBTB*), and reality testing, WBTB and the MILD technique (*RT + WBTB + MILD*). Results showed that the *RT + WBTB + MILD* condition was the most effective at

inducing lucid dreams. Results showed that the effectiveness of the MILD technique was influenced by several factors, including general dream recall and the amount of time taken to fall asleep after finishing the technique.

Group Differences in Lucid Dream Induction

The *RT + WBTB + MILD* condition was clearly the most effective at inducing lucid dreams. Participants in this group had a mean *L DRF lucid* of 17.4%, which is 84.5% higher than in Week 1. Furthermore, just over half of these participants (53.2%) experienced lucid dreaming at least once during Week 2, which is nearly twice as many as in Week 1. In the *RT + WBTB* group, mean *L DRF lucid* in Week 2 was 10.7%, which is 54.1% higher than in Week 1. However, this increase was less than that observed in the *RT + WBTB + MILD* group and was not statistically significant. The purpose of the *RT + WBTB* group was to control for the effects of waking up after five hours of sleep, thinking about lucid dreaming, and expecting that one might have a lucid dream as a consequence of practicing a lucid dream induction technique. Findings indicate that these effects are at most only partly responsible for the effectiveness of the MILD technique and thus support the theory that the MILD technique works by creating a mnemonic intention to remember that one is dreaming that is then later recalled during a nonlucid dream. The present study replicates several earlier field studies that have shown the MILD technique to be effective for inducing lucid dreams (Edelstein & LaBerge, 1992; LaBerge, 1988; LaBerge et al., 1994; Levitan, 1989, 1990a, 1990b, 1991; Levitan & LaBerge, 1994; Levitan et al., 1992). With the exception of one laboratory study (Kueny, 1985), the present study is the first investigation of the MILD technique that was not conducted by the creator of the MILD technique LaBerge or any of his research associates. Because it was clearly the most effective, the MILD technique is given in-depth consideration in Section Findings Related to the MILD Technique.

Contrary to hypotheses, reality testing on its own was not effective at inducing lucid dreams. Mean *L DRF lucid* in the *RT only* group was only 7.6% in Week 2, which was lower than the rate observed in Week 1. The percentage of participants that experienced lucid dreaming at least once during Week 2 was the lowest in this group at 36.8%, and was not significantly higher than in Week 1. These findings are consistent with those of Taitz (2011) and LaBerge (1988), who also found that reality testing on its own was ineffective. However, the present findings are at odds with other studies that have found reality testing to be effective (Levitan, 1989; Purcell, 1988; Purcell et al., 1986; Schlag-Gies, 1992). One possible explanation is that it takes longer than a single week (as in the present study) for the practice of reality testing to become habitual enough that performing reality tests while dreaming becomes likely. Reality testing was found to be effective when practiced for three weeks in the studies by Purcell (1988) and Purcell et al. (1986), and for eight weeks in the study by Schlag-Gies (1992).

Another possible explanation for the diversity in findings is that reality testing is substantially more effective if combined with other activities that assist with lucid dream induction. For example, Purcell (1988) observed significantly higher lucid dreaming rates in an experimental condition that involved reality testing, reading

over written dream narratives and becoming familiar with recurring anomalies that may serve as triggers for lucidity. Similar results were reported by Paulsson and Parker (2006), who asked participants to form the intention to have a lucid dream directly before going to sleep in addition to practicing reality testing throughout the day. This explanation is also supported by findings from the present study. The correlation between *L DRF lucid* and the number of reality tests performed was nonsignificant in the *RT only* group. However, the correlation was highly significant in the *RT + WBTB* group, which involved reality testing as well as waking up after five hours of sleep, reading about lucid dreaming and then performing a reality test before returning to sleep (see Section RT WBTB group). This may have primed participants to perform reality tests shortly before REM sleep. In the *RT + WBTB + MILD* group, this priming effect may have been negated by practicing the MILD technique. This might explain why the number of reality tests performed was not correlated with *L DRF lucid* in this group.

Findings Related to the MILD Technique

General dream recall. General dream recall was correlated with *L DRF lucid* and was significantly higher on occasions when practicing the MILD technique was followed by lucid dreaming. There are two likely explanations for this. The first is that heightened dreaming activity that leads to greater general dream recall is conducive to lucid dream induction. The other is that the occurrence of lucid dreams simply inflates general dream recall rates due to them being more vivid and memorable than most nonlucid dreams. Participants recalled 1.2 more dreams on average when practicing the MILD technique led to lucid dreaming, which at first glance appears consistent with the explanation that general dream recall rates were simply inflated by the occurrence of highly memorable lucid dreams. However, most lucid dreams occur during the course of nonlucid dreams and it is likely that at least a substantial portion of these dreams would have been recalled even if lucidity had not been attained. In light of this, the finding that participants recalled 1.2 more dreams on average when they experienced lucid dreaming tentatively suggests that there is indeed an effect whereby heightened dreaming activity that gives rise to superior general dream recall is conducive to lucid dream induction. If this is correct, it may be possible to increase the effectiveness of cognitive lucid dream induction techniques such as the MILD technique by enhancing dreaming activity during the night. This is given further consideration in Section Directions for Future Research.

Sleep stage awakening. Lucid dreaming was most likely when participants reported that they were not dreaming when they were awakened by their alarm to perform the MILD technique. Lucid dreaming was less likely if participants reported that they were dreaming and least likely when they were unsure of whether or not they had been dreaming. However, it remains uncertain whether waking up during a dream influences the effectiveness of the MILD technique. This is because participants were unsure of whether they had been dreaming in the majority of cases. If participants were not dreaming on most of the occasions when they were unsure, this would mean that lucid dreaming was less likely following awakening from dreamless sleep than the results indicate. On the other hand, the

fact that self-reported sleep stage awakening was significantly related to *L DRF lucid* in the *RT + WBTB + MILD* group but not the *RT + WBTB* group suggests that sleep stage awakening may indeed influence the effectiveness of the MILD technique in some way. This is given further consideration in Section Directions for Future Research.

Technique repetitions and time spent on the technique. On occasions when performing the MILD technique was followed by lucid dreaming, participants performed fewer technique repetitions and spent less time on the technique.

Furthermore, significant negative correlations were observed between *L DRF lucid* and both the number of technique repetitions and the amount of time spent on the technique. These findings appear counterintuitive, as one would expect that more technique repetitions and more time spent on the technique would assist in creating a strong mnemonic intention to remember that one is dreaming. However, upon closer inspection it was found that difficulty falling asleep after completing the technique was strongly related to both the number of technique repetitions (r_s = .48, $p \leq .001$) and the amount of time spent on the technique (r_s = .67, $p \leq .001$). Furthermore, the correlations between *L DRF lucid* and both technique repetitions and time spent on the technique became smaller and nonsignificant when they were recalculated using only occasions when participants fell asleep before completing the technique. These findings are consistent with the theory that the effectiveness of the MILD technique is highly dependent on being able to fall asleep quickly after creating a strong mnemonic intention to remember that one is dreaming. It appears that this mnemonic intention tends to become weaker when one takes longer to fall asleep after completing the technique.

Time taken to return to sleep. The strongest predictor of lucid dreaming following practice of the MILD technique was the amount of time it took for participants to fall asleep after they finished the technique. On occasions when participants were able to fall asleep in less than five minutes, *L DRF lucid* was very high at M = 45.8%. This rate is 86.2% higher than the mean *L DRF lucid* rate for all other nights on which these participants attempted the MILD technique (M = 24.6%). It should be noted that the Week 1 base rate for the 14 participants who managed to achieve this (M = 20.4%) was substantially higher than for all participants in the *RT + WBTB + MILD* group (M = 9.4%), which calls into question the generalizability of this finding. Notwithstanding, if this amount of improvement (86.2%) were extrapolated to all participants in the *RT + WBTB + MILD* group, this would yield a mean *L DRF lucid* rate of 32.4%. This is an exciting possibility because a lucid dream induction rate of this magnitude would make research into the potential applications of lucid dreaming highly feasible. A potential problem is that it may be difficult to fall asleep within five minutes of completing the MILD technique. Indeed, participants fell asleep before finishing the technique in the majority (79.9%) of cases. However, participants were told that it did not matter if they fell asleep while practicing the MILD technique or how long it took to fall asleep afterward. With altered instructions it may be possible to reduce both the likelihood of falling asleep prematurely and the amount of time required to fall asleep after completing the technique. This is given further consideration in Section Directions for Future Research.

Relationships with sleep quality. On occasions when practicing the MILD technique was followed by lucid dreaming, participants reported being significantly

less sleep deprived the previous day. This suggests that the MILD technique may be more effective if one is well-rested. However, this finding became nonsignificant after applying a Bonferroni correction, and must be interpreted with caution. On occasions when MILD led to lucid dreaming, participants reported that they felt significantly less tired upon waking. There were no other significant differences in sleep quality variables. Therefore, it appears that successful lucid dream induction using the MILD technique was not detrimental to sleep quality.

Accessibility of the MILD technique. Participants with prior lucid dreaming experience were no more likely to experience lucid dreaming and did not have higher mean *L DRF lucid* during Week 2 compared with participants with no prior experience, nor was *L DRF lucid* correlated with the frequency of previous lucid dream induction technique practice. This was the case for all participants combined and for participants in the *RT + WBTB + MILD* group specifically. Pretest lucid dreaming rates were significantly correlated with Week 2 *L DRF lucid*, but shared variance was only 9.6%. Shared variance was similarly low for participants in the *RT + WBTB + MILD* group at 11.2% ($r_s = .33$, $p = .022$). These findings indicate that it is not necessary to have prior experience with lucid dream induction techniques in order for the MILD technique to be effective, nor is it necessary to be a naturally prolific lucid dreamer. Thus, the MILD technique appears to be appropriate for people who are naive to lucid dreaming and effective within a short period of time.

Strengths and Limitations

The present study is the most methodologically rigorous lucid dream induction field study ever conducted and is based on a relatively large and highly diverse sample of participants from across Australia. The majority of previous lucid dream induction studies have used participants that were either self-selected lucid dreamers or undergraduate students. In contrast, the majority (63.9%) of participants in the present study had never attempted a lucid dream induction technique before and only 21.3% of participants were students. Although most participants who completed the pretest questionnaire did not go on to complete the full study, those who did were comparable to those who did not on all pretest variables, except for being significantly older (by 6.4 years on average). Thus, it appears that findings from the present study are generalizable to a wide range of people that are interested in learning to have lucid dreams. The present study has high ecological validity because participants trialed the techniques in their own homes using written instructions and without any contact from the experimenters, which reflects how people typically learn lucid dream induction techniques. A limitation of the present study is that the MILD technique was not trialed in isolation from reality testing. This was done in the interests of identifying a maximally effective approach to lucid dream induction. Although reality testing on its own was found to be ineffective in the *RT only* group, the possibility that reality testing contributed to the *L DRF lucid* rate observed in the *RT + WBTB + MILD* group cannot be ruled out. Further research comparing MILD on its own to MILD combined with reality testing would shed light on this. Another limitation is that lucid dreaming

techniques were only practiced for one week. This may not have been enough time for reality testing to become effective.

Directions for Future Research

Findings from the present study indicate that the effectiveness of the MILD technique could be improved with strategies designed to help participants develop a strong mnemonic intention to remember that they are dreaming and then fall asleep quickly without losing this intention. A one-size-fits-all approach is not likely to be effective and participants will probably need to be given a range of strategies for achieving an ideal level of wakefulness. For participants who are prone to falling asleep prematurely, turning on lights, spending more time reading about lucid dreaming, getting out of bed for a short period of time, or even writing out the phrase "next time I'm dreaming, I will remember that I'm dreaming" multiple times on paper may be helpful. In contrast, for participants who find it difficult to fall asleep after completing the technique, it will be important to minimize such stimulation. It remains unclear whether sleep stage awakening influences the effectiveness of the MILD technique. This issue is worth further investigation and this could be done in a sleep laboratory by comparing the effectiveness of the MILD technique following awakenings from various sleep stages. If there is indeed a sleep stage awakening that is most conducive to lucid dream induction, practitioners of lucid dream induction techniques could take advantage of this knowledge in the home setting using recently developed software applications that track sleep activity using the accelerometers in smartphones. Although these software applications are less accurate than the equipment used in sleep laboratories, they permit users to set alarms that go off when a specific sleep stage is detected. Users could set an alarm to wake them up during a sleep stage that is most conducive to lucid dreaming, thus increasing the effectiveness of cognitive lucid dream induction techniques that involve an awakening such as the MILD technique.

In the present study, general dream recall was higher when practicing the MILD technique was followed by lucid dreaming and was also correlated with overall *L DRF lucid* rates. This indicates that heightened dreaming activity is conducive to lucid dreaming. There is an abundance of anecdotal reports on the extensive online lucid dreaming forums (e.g., *Dream Views*, *LD4all*, *World of Lucid Dreaming*) indicating that certain substances are highly effective for increasing dreaming activity and also for inducing lucid dreams (see also Yuschak, 2006). Some of these substances influence the REM-on neurotransmitter acetylcholine and include acetylcholine esterase inhibitors such as Galantamine, Huperzine-A and Donepezil. To date, three studies have investigated the use of such substances for inducing lucid dreams. In a pilot study by LaBerge (2004), it was found that the odds ratio of experiencing lucid dreaming was extremely high at 0.75 on nights when 10 mg of Donepezil was administered, compared with only 0.03 for participants in a placebo condition. However, adverse effects including insomnia, sleep paralysis, and gastrointestinal symptoms were reported in some cases. In an unpublished study by LeMarca and LaBerge (2012, as cited in Sparrow, Hurd, & Carlson, 2016), participants who ingested Galantamine during a brief awakening (dose not specified) purportedly experienced a fivefold increase in lucid dreaming

compared with participants in a placebo condition. Most recently, participants in a survey of 19 lucid dreaming enthusiasts who used Galantamine for inducing lucid dreams reported that their Galantamine-induced lucid dreams were significantly longer and more vivid than their other lucid dreams and contained significantly less fear, threatening dream characters, violence, and darkness, with no increase in sleep paralysis (Sparrow et al., 2016). Another potential dream-enhancing substance with less risk of adverse side effects is vitamin B6. Ebben, Lequerica, and Spielman (2002) found that 240 mg of vitamin B6 (pyridoxine hydrochloride) increased the vividness, emotionality, bizarreness, and color of dreams when consumed before bed. However, this was only a small pilot study, and effects on lucid dreaming were not reported. It may be possible to combine acetylcholine esterase inhibitors, vitamin B6, or other potential dream-enhancing substances (see Yuschak, 2006) with cognitive lucid dream induction techniques such as the MILD technique to great effect, and research into this is certainly warranted.

External stimulation techniques represent another promising approach for increasing the effectiveness of cognitive techniques. Light stimulation appears to be the most effective (Stumbrys et al., 2012) and has been used in combination with the MILD technique in four studies. Findings from these studies indicate that this combination is more effective than the MILD technique on its own (LaBerge, 1988; LaBerge & Levitan, 1995; LaBerge, Levitan, Rich, & Dement, 1988; Levitan & LaBerge, 1994). Several commercially available devices designed to induce lucid dreams in this way have been created by LaBerge's research group, such as the *DreamLight*, *DreamLink,* and *NovaDreamer*, and various generic versions exist. These devices are designed to be used in the home setting and include an eye-mask with sensors that detect the eye movements that characterize REM sleep. Once REM sleep is detected, the device produces a series of flashing LED lights within the mask that are incorporated into the dream experience and serve as a cue that one is dreaming. With further research, the MILD technique in conjunction with light stimulation and the administration of a dream-enhancing substance could prove to be a highly effective approach to lucid dream induction.

Conclusions

The present study indicates that the MILD technique is effective for inducing lucid dreams within a short period of time and is suitable for a wide range of people, including people that are naive to lucid dreaming. Based on the present findings, several strategies for improving the effectiveness of the MILD technique were identified. Combining the MILD technique with substances that may enhance dreaming activity and with external stimulation may further enhance the effectiveness of the MILD technique. Lucid dreaming has a wide range of potential benefits and applications, and the only impediment to research in this area is the lack of effective and reliable lucid dream induction techniques. Thus, high quality empirical research on lucid dream induction should be considered a high priority among dream researchers.

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