

# Learning lucid dreaming and its effect on depression in undergraduates

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**Summary.** The present study tested two hypotheses: 1) that lucid dreaming could be effectively taught through an online intervention, and 2) that lucid dreaming can alleviate depression as mediated by LOC. Surveys consisting of (lucid) dream frequency and recall scales (Schredl & Erlacher, 2004; Doll, et al., 2009), Rotter's LOC scale (1966), and the most recent Beck Depression Index (BDI-II) (Beck et al., 1996) were completed by college students. The experimental group was instructed to keep dream diaries throughout the whole study. Two weeks after the preliminary survey they were presented with a lucid dreaming intervention, which instructed them to practice reality checks throughout the day in order to attain lucidity at night. Lucid dreaming frequency was found to be directly correlated with depression ( $p < 0.001$ ). Implications for therapy and suggestions for further research are suggested.

**Keywords:** depression; locus of control; lucid dreaming; control dreaming; BDI-II

## 1. Introduction

A small but emerging body of research suggests that benefits come to those who dream lucidly. Lucid dreaming is the awareness of being in a dream while continuing that dream without waking up (Blagrove & Tucker, 1994). Lucid dreaming is also complementary to and interactive with "control dreaming" (Purcell et al., 1993), the ability to consciously control aspects of a dream such as flight, transmuting the body, summoning characters, changing scenes, or otherwise interact with the dream (LaBerge, 1985; Gackenbach & Bosveld, 1989). In addition to being a fascinating experience, lucid dreaming has been shown to have mental health benefits. Lucid Dreaming Treatment, LDT, is a therapeutic tool that has led to decreased levels of nightmare frequency in the general population (Zadra & Pihl, 1997; Brylowski, 1990) as well as in PTSD patients (Spoormaker & van den Bout, 2006). Lucid dreaming has also been associated with greater overall mental health (Gackenbach & Bosveld, 1991; Gackenbach et al., 1987). For example, in a study by Doll, et al., (2009), Viennese volunteers were given surveys measuring mental health via the Trier Persönlichkeitsfragebogen (TPF) (Becker, 1989), an Austrian measure of mental health, as well as dream recall frequency and control (lucidity). The results of the study illustrated that frequent lucid dreamers, those with 2 lucid dreams a month or week, showed significantly better mental health (with depression as a sub-category) compared to rare-lucid and non-lucid dreamers. Though Doll et al.'s (2009) study illustrates the benefits of already being lucid, the researchers suggest that learning how to dream lucidly may have similar benefits for mental health and wellbeing, and articulate the need for a research agenda in this area.

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Though previous studies have utilized self-trained lucid dreamers (Doll et al., 2009; LaBerge, 1980a), the skill can be learned (LaBerge & DeGracia, 2000; LaBerge & Levitan, 1995, 1989; LaBerge et al., 1994; LaBerge, 1980b). There are two main types of lucid dreams: dream induced (DILD) and wake induced (WILD). WILD requires the difficult task of maintaining steady awareness from waking through sleeping and into dreaming; since "transitions directly from the waking state to the REM sleep state are very rare" (LaBerge & DeGracia, 2000, p. 278), this study focused on teaching DILD, an easier form of lucid dreaming to teach and learn. The two main approaches to DILD are a) self-inducing techniques and b) induction devices like Dreamlight (LaBerge & Levitan, 1995) or magnetic brain stimulation (Noreika et al., 2010), both of which are rather costly.

The most successful self-induction techniques are, in turn, comprised of two approaches: a) critical state testing (Tholey, 1983; Zarda et al., 1992) and b) reflection-intention (LaBerge & Rheingold, 1990). Critical state testing involves "reality testing" (LaBerge & Levitan, 1989), the act of continuously asking oneself "am I dreaming?" while awake, so as to continue to do so while dreaming and become lucid. Reflective-intention techniques involve reflecting on one's major dream signs (unstable text, fantastical imagery, etc.) before bed and intending to recognize them next time and become lucid (prospective memory). This technique is also known as Mnemonic Induction of Lucid Dreaming (MILD) (LaBerge, 1980b; LaBerge & DeGracia, 2000; LaBerge & Levitan, 1995). Another technique is the Wake-Back-to-Bed (WBTB) technique in which participants schedule an alarm to wake themselves an hour before their natural wake time, and upon waking, focus on entering the upcoming or re-entering the previous dream. Although the (WBTB) technique (LaBerge, 1994) is effective in heightening lucidity, it involves disturbing the sleep cycle and may thus be less appealing to (or healthy for) college students. Both reality-testing and MILD techniques are proven methods of teaching lucid dreaming; they pose relatively little interference with sleep or daily functioning of the learners, and were thus selected as the methods of choice for this study. Furthermore, although many individuals learn to dream lucidly from read-

ing about such techniques online, this study will be the first to test the effectiveness of such an impersonal approach, as well as the effects of lucid dreaming, once learned.

Studies have shown a positive link between lucid dreaming and internalized locus of control (LOC) (Blagrove & Hartnell, 2000; Blagrove & Tucker, 1994). LOC is the measure of how in control of their life an individual feels (Bar-Tal, 1977). Individuals with a strong internal LOC see themselves as active agents in shaping their external environments, whereas those with external LOC feel that outside forces (e.g. fate, chance, powerful others) control them (Rotter, 1966). Burger (1984) asserts that individuals with a high desire for control over their lives but an externalized locus of control are more likely to have suicidal thoughts and maladaptive behavioral patterns (i.e. seeking nonprofessional, rather than professional, help for depression). Empirical evidence also suggests that an individual's LOC is not set in stone; rather, it can be changed. For example, autogenic relaxation, a biofeedback technique of observing one's control over their own level of relaxation (measured by finger temperature & blood pressure), has shown significant success in moving from an externalized to internalized locus of control in adolescent alcoholics (Sharp et al. 1997). In addition to other biofeedback-based relaxation methods (Derkowski et al., 1983), shifting from externalized to internalized LOC can be achieved through natural methods like meditation (Bowen et al., 2006) or physical activity (Parsons & Betz, 2001; Nir & Neumann, 1995). Being a natural biofeedback system with its own virtual reality component, lucid dreaming could prove to be an effective method to internalizing locus of control.

Just as lucid dreaming combines the natural process of sleep with the biofeedback system of dreaming, (which may internalize LOC) lucid dreaming and LOC may combine to improve depression. An externalized LOC has been primarily correlated to depression in college students (Sandler & Lakey, 1982; Burger, 1984; Benassi & Sweeney, 1988; Lefcourt, 1966), whereas an internal locus of control is a prerequisite to adaptive functioning and is regarded among many researchers as an initial therapeutic goal (Lefcourt, 1966). The prevalence of depression and anxiety disorders in college students is estimated to be 15.6% for undergraduates and 13% for graduate students (Eisenberg, et al., 2007) which is much greater than the 6.7% prevalence in the general population (Kessler et al., 2005). Moreover, not only is depression common, studies of changes in depression over time suggest that they have increased significantly. For example, in one study using a cohort of Midwestern schools, depression rates doubled significantly between 1989-2001 (Benton et al., 2003), a trend mirrored in the Spring 2000 National College Health Assessment Survey (Kisch et al., 2005). Finally, depression has a negative effect on academic performance (Andrews & Wilding, 2004), is an enormous economic burden (Wang et al., 2003), and inhibits relational ability (Carnelley et al., 1994). Although some researchers believe that depression is an evolved response in order to focus analytical skills on, and garner outside help towards, solving an individual's problem (Thomson & Andrews, 2009): it is a detriment to the lives of college students, who could greatly benefit from alleviating their depressive symptoms, regardless of severity.

This study is intended to assess whether lucid dreaming can be effectively taught online to a group of college students and whether, once mastered, lucid dreaming can

increase internal LOC and, in doing so, reduce depression scores. It will test two hypotheses: a) Lucid Dreaming can be effectively taught online and b) depression scores are mediated by increases in internal LOC scores that change as a function of enhanced lucid dreaming.

I expect that some of the proposed relationships will vary by demographic group. As females experience more emotionally distressing dreams per year and lack of perceived control over dreams (Wolcott & Strapp, 2002), it is expected that females will find lucid dreaming more challenging to master. On the other hand, a lack of gender bias is possible, as Doll et al. (2009) found no significant gender difference for lucid dreamers and non-lucid dreamers. Furthermore, Schredl (2003) found that women have a higher dream recall frequency, which is correlated to lucid dreaming frequency and could neutralize the gender bias. Although a few studies mention the effect of personality differences (Prescott & Pettigrew, 1995; Blagrove & Hartnell, 2000; Schredl & Erlacher, 2004), most have been minimal in their statistical significance. LOC has been shown to change depending on race and ethnicity (Perry & Morris, 2006). Depression is clearly affected by counseling (Robinson et al., 1990), but less obviously so by spirituality (Nelson et al., 2002), and such sleep factors as medication and sleep time (Argargun et al., 1997).

This study aims to build upon lucid dreaming and depression research. Beyond studying the effectiveness of lucid dream induction techniques, this study looks at the efficacy of teaching it through an online medium. In addition, although most research of LD include samples of self-trained lucid dreamers, all of whom may have come to learn the ability in different ways, this study will control for such variability by assuring that each participant who attains lucidity does so through the same instruction. Moreover, in developing a model of lucid dreaming's effect on depression as mediated by LOC, this study will replicate Doll et al.'s (2009) which examined the link between lucid dreaming and mental health (including depression). Their study used a German mental health scale called the TPF (Becker, 1989), whereas mine will quantify the results of lucid dreaming according to a scale widely used in America (BDI-II) (Beck et al., 1996). The results of my thesis may add to the theories of LOC, LD and depression by developing a working model between the three. Furthermore, results from this study could benefit future therapeutic applications of lucid dreaming. As Brylowski's (1990) case reports show lucid dreaming therapy reducing nightmare frequency, and the therapy has been applied against the nightmares associated with Post Traumatic Stress Disorder (Spoomaker & van De Bout, 2006). I am advocating utilizing this strategy against a more generalized mental issue - depression. If just the activity of learning to dream lucidly could ameliorate some of the symptoms of depression, it is worth further research. Perhaps directed lucid dreaming therapy, with patients confronting certain unapproachable family members (deceased or abusive) or overcoming phobias in the safety of their own mind, could be a new and useful way for individuals to improve their lives. Furthermore, self-directed lucid dreaming could improve general depression levels in large populations, all while they sleep.

## 2. Method

### 2.1. Participants

Study participants were recruited from Cornell university using three strategies: a web-based program for matching students with study participation opportunities (SUSAN), class-based recruitment by advertizing extra credit opportunities (in Human Development, Communications, Design and Environmental Analysis and Psychology courses) and through snowball sampling in which students with awareness of the study were also asked to invite their peers. Eligible students were 18 years or older, with no prior LD experience, and who were able to commit to participating for the entirety of the study. The initial sample consisted of 211 people, from which 14 were disqualified due to personal lucid dreaming training, 20 for previous lucid dreaming experience, and 2 for being under age 18, leaving a final sample of 175. Of these, 14.3% were males ( $n = 25$ ), 85.7% were females ( $n = 150$ ). Participants Races/Ethnicities included: 57.1% White ( $n = 100$ ), 21.1% Asian/pacific islander ( $n = 37$ ), 9.7% Other/biracial ( $n = 17$ ), 8.0% African American/Black ( $n = 14$ ), and 4.0% Hispanic/Latino ( $n = 7$ ). Estimated depression rates (according to BDI-II scores) for the undergraduate sample included: 70.9% with general depression (BDI-II score 0-14) ( $n=124$ ), 12.0% mild (BDI-II 15-20) ( $n = 21$ ), 9.7% moderate (BDI-II 21-29) ( $n = 17$ ), and 2.9% severe (BDI-II 30-63) ( $n = 5$ ), mirroring those of Eisenberg et al. (2007),

### 2.2. Measures

**Locus of Control Scale.** Rotter's (1966) Internal/External Locus of Control scale was used to assess locus of control. The scale includes 22 paired statements, each denoting high or low LOC. For each pair of statements, participants are asked to choose which one they identify with most (e.g. "Capable people who fail to become leaders have not taken advantage of their opportunities" versus "Without the right breaks one cannot be an effective leader"). External LOC statements are scored as "1" and internal LOC as "0". The average grade determines LOC: above .5 indicates external and below .5 indicates internal. Rotter's scale is the most widely used in clinical tests. Internal reliability coefficients for the Rotter scale are between .65 and .79 (Rotter, 1966). Friedland et al. (1992) found Rotter's LOC scale to have a test-retest reliability, with a one-month time lag, between .60 and .83.

**Beck Depression Inventory-II (BDI-II).** The test consists of 21 multiple choice questions on how participant felt within the past two weeks. For example, the question of "Past Failure" has 4 answers choices varying in degree with corresponding point values (values not shown to participants) – I do not feel like a failure (0), I have failed more than I should have (1), As I look back, I see a lot of failures (2), I feel I am a total failure as a person (3). Level of depression is determined by score: minimal (0-14), mild (14-20), moderate (20-29), and severe (29-63). This test is the second and most recent version of the reputable Beck Depression scale, and is correlated to DSM-IV criteria for depression (Brantley et al., 2000). The coefficient alphas of the BDI-II for college samples ranges from .89 (Whisman et al., 2000) to .93 (Beck et al., 1996). Validity and reliability were heavily supported by Whisman et al., (2000) and Beck et al., (1996).

**Lucid Dream Recall & Control Questionnaire.** A section of

the Dream Recall & Control Questionnaire was dedicated to measuring frequency of control and lucid dreams. Likert scale questions were adapted from Doll et al.'s (2009) questionnaire and asked participants how frequently they "Become aware of being in a dream and continue it without waking up (lucid dream)" and "Take control of the dream." Follow-up fill-in numerical questions were included to avoid potential ceiling effects of the seven-point scale. After the intervention, more lucid dreaming questions were asked. The question "How did you become lucid?" was posed to those who recalled a lucid dream that week, to differentiate between deliberate reality testing and spontaneous lucidity from dream-elements, such as monsters, location changes, etc. In addition, a participant fidelity question, "how often do you practice reality checks?" was presented to any participants attributing their lucidity to deliberate training, with a numerical scale to answer. "Which reality checks did you use?" was also added, with options for "finger stretching, light switching, and time/small text checking" which were suggested at the intervention.

**Dream Recall Questionnaire.** In addition to measuring lucidity, the rest of the questionnaire was used to monitor the dream recall frequency of all dreamers as well as other relevant aspects of sleeping and dreaming. Dream recall frequency (DRF) was measured by a seven-point scale modified after Schredl's (2002) dream questionnaire, "how often do you remember your dreams?" (0 = never, 1 = less than once a month, 2 = about once a month, 3 = twice or three times a month, 4 = about once a week, 5 = several times a week and 6 = almost every morning.) The questionnaire was recorded to determine the DRF per week: 0 = 0, 1 = 0.125, 2 = 0.25, 3 = 0.5, 4 = 1.3, 5 = 3.0, 6 = 7 mornings with dream recall per week. Additional fill-in numerical questions were included to avoid potential ceiling effects. Also, a question about déjà rêve, the sensation one is experiencing an event previously dreamt, was added due to its significant correlation to DRF (Funkhouser & Schredl, 2010). The modified version of Schredl's (2002) seven-point scale was also applied to determine nightmare recall frequency, assumed to be the colloquial definition of a scary REM dream, as it has been significantly correlated with lucid dream frequency (Stepan-sky et al., 1998; Schredl & Erlacher, 2004).

Later surveys also included questions to determine participant fidelity. Such questions included, "when did you write down your dreams?" (morning, randomly, I didn't write down my dreams). An additional question adapted from Schredl et al. (1996), was posed to determine attitude towards dreams as either positive - "some dreams give me creative ideas or insight for my daily life," "I like talking with others about my dreams," neutral - "I am indifferent to my dreams," or negative - "dreams are a waste product of the brain."

**Demographics/Controls.** In the demographic portion, participants entered information regarding their gender, age, race/ethnicity, sleep or psychological medication/therapy intake, meditation frequency, alcohol/drug opinions, average weekday and weekend sleep times, sleep schedule consistency, and lightness of sleeping. The question "have you been sick this week and what have you been using for it?" was added as well.

### 2.3. Procedure

Initial group was invited to fill out a preliminary survey (see appendix). The survey consisted of a basic demographic

questionnaire, Rotter's (1966) LOC scale, Beck Depression Index - II (Beck et al., 1996), and the dream recall/control questionnaire. Upon the first survey, participants who already showed a previous experience with lucid dreaming were pinpointed as lucid dreamers and disqualified. As I wish to illustrate the beneficial effects of learning lucid dreaming, currently lucid dreamers would not have expressed the learning effects I hoped to observe.

At the end of the first survey, participants were randomly grouped. The control group was instructed to continue their normal sleeping routine while the experimental group was initially instructed to keep a notebook or pen and pad of paper by their bed, and to write as much of their dream as they remember in the morning. I did not ask for dream reports due to the high correlation between dream diaries and questionnaires in reporting dream recall ( $r = .557$ ,  $N = 285$ ) (Schredl, 2002). Both groups received 4 more weekly surveys with LOC, BDI-II, and dream questionnaires along with reminders to either continue sleeping normally or writing in their journal, as well as to avoid personal research about lucid or control dreams.

After 2 weeks, the experimental group was then given additional instructions on Reality Testing techniques of lucid dream induction (Tholey, 1983; Levitan, 1989), as explained in the literature review above. Participants were told that they would be taught how to control their dreams, that they should repeat "reality checks" throughout their waking day, in order to continue doing so while dreaming. Although previous research suggested to do reality checks randomly throughout the day, the best times were advised as when something bizarre occurs: a discontinuity, an improbable combination, or an improbable identity, or pretty much whenever they believe they might be dreaming. Participants were told that in dreams there are certain constancies that can be revealed through reality checks. Participants were given a brief description of the following reality checks (hands, print, and light) and their waking and dreaming reactions. In dreams, hands will appear abnormal (pixilated/blurry/disfigured) and can be stretched like rubber, relative to normal skin elasticity. Small print, particularly text and time, are inconsistent and change at a second glance (LaBerge, 1992), double takes on clocks and reading material would reveal such oddities. Furthermore, light levels in dreams are constant and cannot be changed by a light switch (Hearne, 1981); though participants were asked to practice only on-off tests, as an inability to turn on a light may be due to reasons other than being in a dream. Participants were also instructed to tell themselves before going to sleep that they will do a reality check and become lucid. In addition, participants were told to remain calm upon becoming lucid through deep breathing, and to either continue the dream with newfound awareness or change it however they wish. Participants were advised to rub their hands (LaBerge & DeGracia, 2000; LaBerge & Rheingold, 1990) together if the dream or their dream vision began to fade and to attempt to resist distraction from lucidity by the dream. After 2 more weekly surveys, participants were then debriefed and thanked for their participation.

#### 2.4. Statistical Analysis

All data was uploaded onto a spreadsheet and analyzed using PASW Statistics 18 package (SPSS) as well as STATA/MP 11.1. The descriptive statistics were initially explored,

with an eye towards missing data, mis-entered data, and outliers. Cross tabulations of all continuous variables, frequencies of categorical variables, means, and standard deviations were determined. Participants were culled from the data-set due to initial deliberate lucid dream training ( $n=14$ ) or being underage ( $n=2$ ); there was no major demographic shift upon their absences. Univariate ANOVA tests were used to correlate multiple demographics to the variables of interest: LDF, LOC, and BDI-II in order to determine confounding variables. Means and standard deviations of variables of interest were also compared between experimental and control groups at 3 time points, to determine pre-test and post-test differences.

For the first hypothesis, a Generalized Linear Mixed Model with fixed and random effects (i.e. this repeated measure) was used to determine the correlation between group and lucid dreaming frequency. This analysis accounts for participants' repeated measures over time as correlated with their earlier data, a common longitudinal study problem.

For my second hypothesis, the Generalized Linear Mixed Model was again used to illustrate the mediation model between Lucid Dreaming, Depression, and LOC. This method established the regression relationships between LD (predictor) and BDI (as the outcome), LD and LOC (the predicted mediator), LOC and BDI, and finally between LOC+LD and BDI, which would have allowed for identification of a change in the coefficient between LD and BDI when the mediator is included. Coefficients reduced to 0 were deemed full mediation, whereas coefficients not fully changed were labeled partial mediation. After all the tests were run, a causal diagram (Baron & Kenny, 1986) was drawn to illustrate the mediation model.

### 3. Results

#### 3.1. Preliminary analysis

The first analysis conducted was to determine that the control group and experimental group were not significantly different at the onset of the study. An independent-samples t-test, comparing control and experimental groups along each demographic and their sub-groups revealed that both groups only differed along the demographic "other drug opinions" (Table 1).

#### 3.2. Lucid Dream Induction Training

The first hypothesis was intended to test whether lucid dreaming could be taught or enhanced via online intervention. First, demographic data was analyzed by univariate ANOVA to find confounding variables correlated with lucid dreaming frequency (LDF). I found that dream recall frequency ( $F(1,55) = 4.479$ ,  $p = .037$ ) and control dreaming frequency ( $F(1,55) = 23.513$ ,  $p < .001$ ) were positively correlated with LDF such that those with better (control) dream recall frequency were more likely to report lucid dreams. In addition, sleep schedule consistency trends towards a negative correlation with LDF ( $F(3,55) = 0.657$ ,  $p = .059$ ) while déjà rêve trends towards a positive correlation with LDF ( $F(1,55) = 3.397$ ,  $p = .068$ ). The rest of the demographic variables were not significantly correlated to LDF. To test the hypothesis itself, a repeated measure, generalized linear mixed model (GLMM) with controls for fixed (confounding variables) and random effects (variation/variability of individuals over time) was used to account for participants'

Table 1. Characteristic of Study Group (N=175)<sup>1</sup>

Characteristic	Experimental Group	Control Group	test	p-value
	<i>M (SD)</i>	<i>M (SD)</i>	<i>t</i>	<i>p</i>
Age	21.5 (2.00)	20.0 (1.00)	1.012	.313
Depression Score (BDI-II)	10.15 (7.59)	10.44 (8.73)	-0.232	.817
Average Sleep Weekends (hrs)	8.64 (1.16)	8.36 (1.09)	1.648	.101
Average Sleep Weekday (hrs)	7.01 (1.19)	6.84 (1.11)	0.973	.333
	<i>n (%)</i>	<i>n (%)</i>	<i>chi<sup>2</sup></i>	
Gender			.553	.581
Male	11 (12.8)	14 (15.7)		
Female	75 (87.2)	75 (84.3)		
Race/Ethnicity			.879	.380
Black	6 (7.0)	8(9.0)		
Hispanic	3 (3.5)	4(4.5)		
Asian	17 (19.8)	20(22.5)		
Other/Biracial	8 (9.3)	9(10.1)		
White	52 (60.5)	48(53.9)		
Health <sup>2</sup>				
Prescription Medication	19 (22.1)	17(19.1)	.487	.627
Sleep Medication	1 (1.2)	3(3.4)	-.974	.331
Mental Health Medication	8 (9.3)	4(4.5)	1.257	.211
Counseling/therapy	5 (5.8)	6(6.7)	-.251	.802
None	50 (58.1)	62(69.7)	-1.590	.114
Meditation Frequency			1.286	.200
Never	65 (75.6)	75(84.3)		
Infrequently	17 (19.8)	11(12.4)		
Frequently	4 (4.7)	3(3.4)		
Alcohol opinion			-.616	.539
No opinion	3 (3.5)	5(5.6)		
Not at all	15 (17.4)	15(16.9)		
Once a Month	11 (12.8)	10(11.2)		
Socially on weekends (1-3)	45 (52.3)	46(51.7)		
4+ a weekend night or more	12 (14.0)	13(14.6)		
Other Drug Opinions			2.059	.041**
No Opinion	15 (17.4)	6(6.7)		
One should never use drugs	43 (50.0)	51(57.3)		
Marijuana Socially	25 (29.1)	30(33.7)		
Marijuana Daily	3 (3.5)	0(0.0)		
Harder Drugs socially	0 (0.0)	2(2.2)		
Spirituality			-.105	.917
Very Spiritual	12 (14.3)	10(11.4)		
Somewhat	38 (45.2)	44(50.0)		
Not at all Spiritual	34 (40.5)	34(38.6)		

Note. <sup>1</sup>The sum of subgroup numbers may not be equal to the total 175 because of missing data.

<sup>2</sup>Health was the only variable that had individual sub-measurements, and therefore individual statistical results.

Table 1 continued. Characteristic of Study Group (N=175)<sup>1</sup>

Characteristic	Experimental Group	Control Group	test	p-value
	<i>n</i> (%)	<i>n</i> (%)	<i>chi</i> <sup>2</sup>	<i>p</i>
Sleep Schedule Consistency			0.152	.879
Very Consistent	13 (15.1)	15 (16.9)		
Somewhat Consistent	49 (57.0)	47 (52.8)		
Somewhat Inconsistent	14 (16.3)	19 (21.3)		
Very Inconsistent	10 (11.6)	8 (9.0)		
Sleeper Type			0.139	.889
Light Sleeper	16 (18.8)	15 (16.9)		
Normal	49 (57.6)	56 (62.9)		
Heavy Sleeper	20 (23.5)	18 (20.2)		

Note. <sup>1</sup>The sum of subgroup numbers may not be equal to the total 175 because of missing data.

repeated measures as correlated with their earlier data, a common longitudinal study problem. The analysis revealed no significant correlation between group and lucid dreaming frequency. The average number of lucid dreams for the experimental group at the end of the survey was neither a significant increase from the experimental group at the beginning of the study nor significantly different than the control group at the end of the study (Table 2).

### 3.3. LD, LOC, and BDI-II

For the second hypothesis, a generalized linear mixed model was used to illustrate the mediation between lucid dreaming, depression, and LOC. First, demographic data was analyzed by univariate ANOVA to find variables confounding with LOC and BDI. The results show that ethnicity was significantly correlated with LOC ( $F(4,47) = 3.75, p < .05$ ), and the following variables were positively correlated with BDI-II ( $p < .05$ ): sleep medication  $F(1,50) = 6.98$ , counseling  $F(1,50) = 5.10$ , meditation  $F(2,50) = 3.94$ , average weekend sleep  $F(5,50) = 3.45$ , and spirituality  $F(2,50) = 5.27$ . Controlling for these confounding variables (fixed effects), as well as variation/variability among individuals over time (random effects), a generalized linear mixed model analysis was used: between LDF (predictor) and BDI (as the outcome), LDF and LOC, LOC and BDI, and finally between LOC+LDF and BDI. The GLMM revealed a significant correlation between LDF and BDI-II as well as between LOC and BDI-II (Figure 1), but not between LDF and LOC, therefore no mediation was possible and the regression between LDF+LOC and BDI-II was not run.

## 4. Discussion

In this study, I set out to test two hypotheses. The first hypothesis was that lucid dreaming could be effectively taught through an online medium. Since the online intervention used did not significantly increase the lucid dreaming frequency of the experimental group, this hypothesis is not supported, but results did echo previous finding that lucid dreaming is correlated with dream recall frequency (Schredl, 2004) and control dreaming frequency (Purcell et al., 1993). The second hypothesis was that lucid dreaming could alleviate depression as mediated by locus of control. While

not supported, this hypothesis did yield some interesting results. Testing of the second hypothesis showed no relationship between locus of control and lucid dreaming, invalidating any mediation model. The linear relationship between locus of control and depression supports previous findings, which show that LOC, moving from internal to external, predicts greater depression (Sandler & Lakey, 1982; Burger, 1984; Lefcourt, 1966; Benassi et al., 1988). A novel finding, however, is that depression is positively correlated with lucid dreaming frequency. These findings depart from previous literature by Doll et al. (2009), stating that lucid dreaming is beneficial for mental health (depression included). Rather, it seems as though lucid dreaming and depression symptoms are very curious bedfellows, as the results suggest that individuals with greater depression have more lucid dreams.

How might this finding be explained? The link between depression and lucid dreaming may come as a function of the fact that depression has been associated with greater REM sleep (Berger & Rieman, 1993), the stage associated with lucid dreaming. Sleep disturbances (insomnia/hypersomnia) is one of the nine diagnostic criteria for major depressive disorder in the past three DSM (Roberts et al., 2000), and is tested for by the BDI-II (Beck et al., 1996). As hypersomniacs sleep more, they may experience greater dream recall frequency attributed to extended sleep (Taub, 1970) and later morning awakenings (Wamsley et al., 2007). Furthermore, patients with insomnia have a higher dream recall frequency than healthy controls, due to more awakenings and (therefore more chances to remember their lucid dreams) (Schredl et al., 1998). Or perhaps training for lucidity, attempting to force consciousness at a time of passive rest, is stressing the student mind? Studies have shown the harm of extensive focused attention, and the necessity of non-directed attention (Kaplan, 1995). Could it be that the mind needs randomness, to let go of control and follow the dream like a white rabbit down its hole? Another possible explanation is that lucid dreaming is an evolutionary adaptation to the need for high introspection during times of stress and struggle. Such an explanation is in keeping with the theory of functional depression (Thomson & Andrews, 2009), which argues that depression serves an evolutionary purpose of forcing individuals to self-reflect on sources of distress as a

Table 2. Means and standard deviations of variables of interest by time and group.

Variable	Controls			Experimental			GLMM Sig.
	Time 1 M (SD)	Time 3 M (SD)	Time 5 M (SD)	Time 1 M (SD)	Time 3 M (SD)	Time 5 M (SD)	
LDF	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	Z = -1.34
LOC	0.54 (0.16)	0.57 (0.20)	0.60 (0.21)	0.52 (0.17)	0.53 (0.21)	0.56 (0.24)	Z = 1.06
BDI-II	10.44 (8.73)	10.70 (10.35)	8.53 (8.60)	10.15 (7.59)	8.36 (8.02)	8.06 (8.04)	Z = 0.77

Note. Controlled for mental health and sleep medication, counseling/therapy, meditation frequency, average weekend sleep, spirituality, and ethnicity.

step toward remediation. This theory suggests that the very symptoms of (general) depression: anhedonia, social isolation, rumination and hypersomnia limit the individual from focusing their analytical thinking on anything other than the source of depression, thus enhancing likelihood of problem focused action. Hagen (2003) states that the social costs to those dependent on the depressed individual increase the desire to help find a solution, either through their direct assistance or through professional help. Since dreaming is also known to function as a problem solving vehicle for the unconscious, lucid dreaming could be one more facet of this theory of functional depression, wherein the individual can actively and mindfully sort through their inner world, confer with their dream characters, find insight and bring resolution to the issues at hand.

So does lucid dreaming cause depression or does depression cause lucid dreaming? Since this intervention did not cause lucidity, there can be no claim to causality of depression. Before any implications and theoretical claims can be made, the relationship between lucid dreaming and depression requires further illumination. In order to do that, this study needs to be replicated with an eye towards the particular sub-groups of BDI-II scores.

Future researchers should note the strengths of this study, which include the fact that the on-line nature of the study gathered twice as many participants as expected. With e-mails reminding and linking to online surveys, and no need to physically go to a lab, participants were able to answer whenever was convenient for them during each study weekend. The fact that the survey, based on the latest dream-based blockbuster hit, "Inception," was advertized throughout campus and presented before relevant classes likely enhanced response as well. The combination of ease of participation, intrigue at the theme of sleep, and the large amount of extra credit attracted a large sample size to the study, allowed for a greater sample size to work with. Though no pilot test was run beforehand, no apriori power analysis could be conducted; as a post-hoc power analysis would not be helpful, future studies should test for power to determine if the large sample size in this study would be adequate. Despite the higher than expected sample size, however, this study's college sample is still not a generalizable population. In order to produce more generalizable results, I suggest generating a larger sample size through widespread recruiting across multiple campuses, offering monetary incentives to students outside the psychology-related majors, and testing for between-major differences. Perhaps utilizing a population with a more consistent sleep schedule (i.e. high school students or undergraduates at

summer school) would allow for better results. In addition, missing data, particularly in the LOC and BDI scales, may have biased results. Informal assessment of the cases of this missing data suggest that it is due to either forgetfulness, indecision between LOC statements, or discomfort with depression questions. Perhaps a Likert scale version of Rotter's (1966) LOC scale and another, less threatening depression survey would reduce missing data. Beyond missing data and sample size, the intervention method requires further reworking.

As past studies (Spoormaker et al., 2006) have also suffered from a difficulty in significantly improving LDF, it is important to discern the most effective lucid training intervention. This intervention also did not significantly improve the lucid dreaming frequency of the experimental group; however, these results do not invalidate lucid dreaming as a learnable skill. I believe that the weaknesses of this lucid dreaming intervention were those of time, participant fidelity, and measurement. While LaBerge & Levitan (1989) state that non-lucid psychology students can learn to dream lucidly within two weeks, Tholey (1983) argues that the process takes up to a month or more for individuals at baseline; for the sake of future studies and even lucid dreaming therapy sessions, a longer training period may be necessary to see a significant increase in lucid dreaming frequency. To improve the chances of participant fidelity, future researchers should consider supplying notebooks and pens/pencils, which would allow more participants to write down their dreams, especially if the notebook is titled "Dream Journal." Whereas this study did not monitor fidelity (rate of dream journaling or reality checking) an online dream journal such as that found on lucidpedia.com could be useful as it can be checked for intervention compliance, although it is less accessible than a physical notebook and may also require dream journal judging. For reality check fidelity, perhaps a pager system could be used to remind participants to conduct reality checks. Finally, although EEG was economically unfeasible at this stage, future studies should consider a longer term sleep study using EEG recording devices, looking for LaBerge's (1980a) eye-rolling or Voss et al.'s (2009) lucid dreaming 40Hz EEG signature, for more reliable LDF scores than self-report measures. The ZEO sleep trainer is a portable EEG device that could be modified to signal lucidity. As REM is more powerful in the morning (Carskadon & Dement, 2000), the ZEO device would also record sleeping and waking times (unchecked in this study) in its in-depth, non-obtrusive sleep records. With these modifications in place, I truly feel that lucid dreaming can be learned online and better analyzed in respect to LOC and depression.

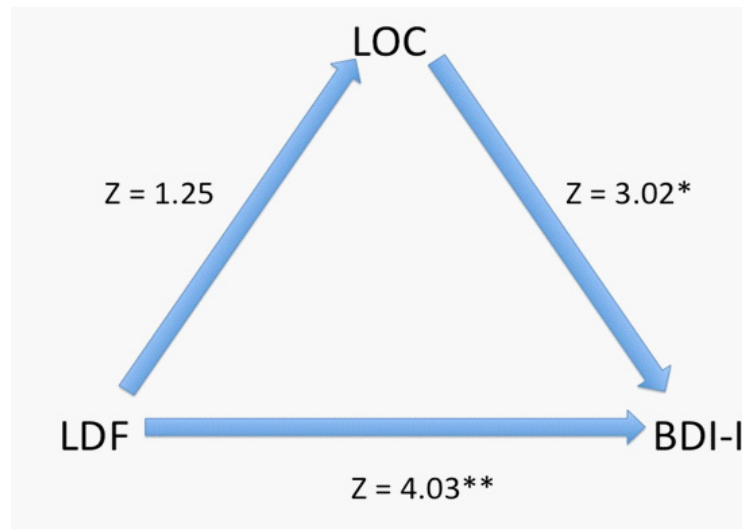


Figure 1. Mediation Model.

The results of this experiment did not support Blagrove & Hartnell's (2000) correlation between LOC and LDF, but there may yet be a mediation model between LDF, LOC, and BDI to discover. Future research should continue to look into the relationship between lucid dreaming and depression through the same lens of LOC, but from another angle. Pyszczynski & Greenberg (1987) have speculated that depressed individuals think a great deal about themselves (Gibbs & Rude, 2004), therefore, depression has more to do with simply LOC but valence as well. Do the good things happen because of fate? Do the bad things happen because of me? In addition, Burger (1984) asserts that individuals with a high desire for control over their lives but an externalized locus of control are more likely to have suicidal thoughts and maladaptive behavior patterns (i.e. seeking nonprofessional, rather than professional, help for depression). Future studies should utilize a more nuanced version of LOC, accounting for more factors and giving a clearer, more lucid picture on the effects of lucid dreaming as it pertains to locus of control - perhaps even a mediation model could be extrapolated from this future data.

Finally, if these findings could be replicated by future studies, it may lead to interesting changes in the field of dream research as well as some therapeutic implications. Lucid dreaming is more complicated than a means to an end of depression; rather, it may be a way for the mind to look within itself and learn something, while perhaps defying the laws of reality and having a bit of fun, too. Instead of immediately popping pills when signs of depression arise, the general population could use their natural introspection (and the lucid dreaming that comes with it) to seek resolution of their issues. Individuals could challenge the stigma of depression as a disease to be cured (a major issue in medication adherence), and consider the function of this condition as a path to further self-discovery and conflict resolution. In addition to lucidly interacting with one's own dream characters for answers and assistance, individuals can realize "depression" as a time to ask for help. As Cornell president David Skorton so aptly stated in response to the heightened need for improved mental health on campus, "if you learn anything at Cornell, please learn to ask for help. It is a sign of wisdom and strength" (university statement,

March 12, 2010). Reducing the stigma of depression as an unmentionable topic would allow more depressed individuals to reach out to psychiatrists and psychologists for the treatments that will best help them understand themselves, their dreams, and their depression. Therapists may also consider utilizing lucid dreaming therapy in their practice, especially with depressed patients, as lucid dreaming is higher in the depressed population, LDT may be more effective for the more severely depressed population. Though the field of lucid dream research requires additional study before implementation, this dream of a more lucid population should be a recurring one. If individuals will themselves to be free of depression, it is no dream; it is a lucid dream (Herzl, 1997).

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