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EXPLORING THE ROLE OF NEED FOR COGNITION, FIELD INDEPENDENCE  
AND LOCUS OF CONTROL ON THE INCIDENCE OF LUCID DREAMS  
DURING A 12 WEEK INDUCTION STUDY

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ABSTRACT

This article reports an investigation of two proposed theories, the predispositional and experiential, regarding the association of personality variables to lucid dreaming incidence during a 12-week lucid dreaming induction programme. The study found no differences between those who did and did not report lucid dreams during the programme on baseline measures of Field Independence, Locus of Control or Need for Cognition. There was an observed significant change towards a Field Independent orientation between baseline and post tests for those successful at inducing a lucid dream; with no statistically significant differences for either Locus of Control or Need for Cognition. Results suggest that Field Independence may not be a predispositional characteristic for the successful induction of lucid dreaming, but an experiential result of having lucid dream experiences. We conclude that experiences within a dream state may have appreciable effects on waking cognition.

**KEYWORDS:** Lucid dreaming; Induction; Field Independence; Locus of Control; Need for Cognition.

INTRODUCTION

A dream in which the dreamer becomes aware they are dreaming is known as a 'lucid dream' (LaBerge & Rheingold, 1990). Lucid dreams occur for a large proportion of the population, however, for many, it is a novel and irregularly occurring phenomenon. In a recent meta-analysis, Saunders, Roe, Smith and Clegg

(2016) collected 34 studies of lucid dreaming incidence conducted between 1966 and 2016 involving 24,282 respondents. They found the weighted average estimate of the *prevalence* of lucid dreaming (i.e. the proportion who have experienced at least one lucid dream in their lifetime) was 55%, 95% CI [49%, 62%]. Using the classification system of Snyder and Gackenbach (1988), 23% [20%, 25%] were considered *frequent* lucid dreamers (experienced lucid dreams once a month or more).

Regarding onset, lucid dreams take two broad forms; they can be cultivated phenomena, instigated by devices or by consistent, effortful cognitive and perceptual training (Stumbrys, Erlacher, Schädlich & Schredl, 2012). Alternatively, they can occur spontaneously to individuals who do not seek to cultivate the experience (Bourke & Shaw, 2014). In accounting for why some people have lucid dreams while others do not, the former may possess cognitive aptitudes which function as predispositional factors to facilitate their becoming aware during a dream. Alternatively, these characteristics may themselves be cultivated, for example by employing cognitive training exercises (Stumbrys et al., 2012). In this paper, we explore the putative role of these characteristics in cultivated lucid dreaming, considering what may differentiate between people who report frequent, infrequent or no lucid dreams during an induction programme.

### *Lucid Dreaming and Cognitive Styles*

The most consistent individual differences observed between frequent, infrequent and non-lucid dreamer samples are Need for Cognition, Field Differentiation and Locus of Control (Blagrove & Hartnell, 2000; Blagrove & Tucker, 1994; Gackenbach, Heilman, Boyt & LaBerge, 1985; Gruber, Steffan & Vonderharr, 1995; Patrick & Durndell, 2004). As well as providing empirical evidence for a differential

effect, these variables suggest plausible mechanisms for that effect, as will be elucidated in the following sections.

### *Need for Cognition*

Frequent and infrequent lucid dreamers have been found to be significantly higher in Need for Cognition than non-lucid dreamers, but not significantly different from one another (Blagrove & Hartnell, 2000; Patrick & Durnell, 2004). Need for Cognition is considered a stable individual difference described as the motivation of an individual to engage with and receive enjoyment from effortful cognitive tasks, even in the absence of extrinsic incentives (Cacioppo & Petty, 1982; Thompson, Chaiken & Hazlewood, 1993). Blagrove and Hartnell (2000) proposed that lucid dreaming may be associated with a high Need for Cognition, as successful lucid dreaming induction has been shown to improve with the successful application of cognitive, mnemonic and attentional techniques while awake (Purcell, Mullington, Moffitt, Hoffmann, & Pigeau, 1986; Stumbrys et al., 2012). As effortful cognitive tasks they are the kind to which those high in Need for Cognition are inclined. Therefore these individuals may be better equipped to cope with the cognitive demands of successfully applying lucid dreaming induction techniques; particularly consistent motivation and perseverance in the absence of immediate reward (LaBerge, 1980) suggesting that for cultivated lucid dreaming, Need for Cognition may be a significant predispositional factor.

### *Field Differentiation*

Frequent lucid dreamers have been found to be significantly more Field Independent than infrequent and non-lucid dreamer groups (Gackenbach, Heilman, Boyt & LaBerge, 1985; Gruber, Steffan & Vonderharr, 1995; Patrick & Durnell,

2004). Field Differentiation was proposed by Witkin and Asch (1948a, b) to explain differences in the strategies employed to organise and extract information from one's visual cues in the environment. Field Dependent individuals experience difficulty in separating parts of their visual field from the complex whole and will attempt to understand information as it is presented, without engaging in any form of visual field restructuring. Field Independents possess an analytical perceptual style that allows them to distinguish an item in their visual field from its context and impose their frame of reference upon their perceptual surroundings (Witkin & Asch, 1948a, 1948b). Field Independents also have greater dreaming creativity, dream control for problem-solving (Cartwright, 1966), and greater dream recall (Goodenough, Witkin, Koulack, Lewis & Cohen, 1974; Schonbar, 1965). All are factors associated with lucid dreaming incidence (Belicki, Hunt, & Belicki, 1978; Blackmore, 1982; Blagrove & Tucker, 1994; Blagrove & Hartnell, 2000; Hearne, 1978; Wolpin, Marston, Randolph & Clothies, 1992). This evidence suggests an individual who is Field Independent may be predisposed to having more lucid dream experiences due to the way they perceive their environment and the increased autonomy they experience when navigating their waking world. This capacity, employed while dreaming may make them cognitively predisposed to detach themselves from their dream environment, enabling them to recognise incongruences with waking life which occurs within the dream and prompting the realisation that they are within a dream experience. Alternatively, the process of learning to acknowledge that one is dreaming on a regular basis may lead to developing a more detached frame of reference in one's dream experiences, which may subsequently impact the way an individual perceives their waking environment, leading to an increase in their field independent orientation. Therefore it is equally plausible to propose that Field

Independence may function as either a predispositional characteristic of dream lucidity, an experiential result of having lucid dreams or an aspect of both.

### *Locus of Control*

Frequent lucid dreamers have been found to be significantly more Internal in their Locus of Control orientation than non-lucid dreamers (Blagrove & Hartnell, 2000; Blagrove & Tucker, 1994) though infrequent and non-lucid dreamers have differed significantly in one study only (Patrick & Durndell, 2004). For Rotter (1966), Locus of Control refers to the way individuals differ in their perceived expectancies of the degree of control they have over events they experience. People with an Internal Locus of Control believe the events are for the most part dependent upon their actions and are thus within their control. Those with an External Locus of Control see them as due to fate, luck, chance or the will of powerful others and thus outside their control (Rotter, 1966). Research has shown Locus of Control is alterable through different interventions (Carlson, 1977; Flinton, 1998; Labbe & Welsh, 1993; Labbe, Welsh, Coldsmith, & Hickman, 1991; Marlatt, Pagano, Rose & Margues, 1984; Wallston, Stein, & Smith, 1994). For example, there are links between meditative practice and changes towards an internal Locus of Control orientation in juvenile delinquents (Flinton, 1998), software design professionals (Nayak, 2013), and male social drinkers (Marlatt, Pagano, Rose & Margues, 1984). This evidence suggests that Locus of Control is not a stable cognitive characteristic and can change through the influence of certain practice and experience, making plausible both predispositional and experiential interpretations in regards to its relationship with lucid dreaming.

Ultimately the relationship between lucid dreaming induction and Field Differentiation, Locus of Control, and Need for Cognition is still equivocal. With previous research comparing samples of lucid dreamers against non-lucid dreaming controls establishing differences between the groups, but the cause of these differences remains uncertain. Overall observed differences between dreamer types may be explained by two theories; the *predispositional* theory proposes the observed differences in cognitive style reflect pre-existing factors that increase the likelihood to experience lucid dreams either spontaneously or when following an induction programme of practice. Alternatively, the *experiential* theory proposes these observed differences in cognitive style are a consequence of having lucid dreams; the ways in which a lucid dreamer can interact with their dream environment has an influence on the way they perceive and cognise their conscious experience. From this perspective, the observed differences are therefore not a cause of lucid dreaming but a result. Determining which, or indeed a combination of these theories is accurate is the principle focus of this study.

An induction study is therefore proposed to investigate these theories, if the factors are predispositional, then differences will be observed before an individual experiencing lucid dreams which will be evident on baseline-tests of a novice lucid dreaming sample. If the experiential theory is correct, a change between baseline and post-test measures for those successful at inducing a lucid dream in comparison to those unsuccessful at inducing lucidity. To best increase the likelihood of usable data, the utilisation of an effective, cognitively-based lucid dreaming induction technique is necessary. The various possibilities of which will now be discussed.

### *Lucid Dreaming Induction*

Lucid dreaming induction techniques have been reviewed for their efficacy by Stumbrys et al., (2012) who argue that of the many available, three cognitively-based induction techniques appear promising methods. These are; the Mnemonic Induction of Lucid Dreams (e.g. Edelstein & LaBerge, 1992; Kueny, 1985; LaBerge, 1988); the Reality Testing method (e.g. Dane, 1984; Levitan & LaBerge, 1994; Purcell, 1988; Purcell, Mullington, Moffitt, Hoffmann & Pigeau, 1986) and Tholey's combined technique (Paulsson & Parker, 2006; Zadra, Donderi & Pihl, 1992). Also identified as effective was a complementary technique, Wake-Back-to-Bed 'WBTB' shown as effective particularly when used in conjunction with the MILD induction method (e.g. Edelstein & LaBerge, 1992; LaBerge et al., 1994). The evidence from Stumbrys et al., (2012) review implies that combined techniques may result in higher reported success rates for the induction of lucid dreams, though these techniques are not without issue (See Stumbrys et al., 2012) it appears the wisest approach for an induction study to adopt.

It is therefore argued a combined method, which utilises elements of the three most successful cognitive induction techniques, in conjunction with the temporal technique of wake-back-to-bed will afford the best conditions for the testing of both *predispositional* and *experiential* theories for the first time. It is unclear which theory is most appropriate to explain the relationship of the observed differences in Field Differentiation, Locus of Control and Need for Cognition; thus the experimental hypotheses are as follows:

*H<sub>1</sub>*: Participants who practise a programme of combined lucid dreaming induction techniques shall be significantly associated with success in achieving lucid dream experiences.



If the predispositional theory is supported, those who report a lucid dream during the induction programme will significantly differ from those who do not on baseline-test scores with a more internal Locus of Control ( $H_{2a}$ ), greater Field independence ( $H_{2b}$ ) and a higher Need for Cognition ( $H_{2c}$ ).

If the experiential theory is supported, there will be a significant increase in scores towards an Internal Locus of Control orientation ( $H_{3a}$ ) Field Independence ( $H_{3b}$ ) and a greater Need for Cognition ( $H_{3c}$ ) between baseline and post-test measures for participants who report success at inducing a lucid dream when compared to those who are unsuccessful.

## METHOD

### *Design*

For the first hypothesis a 2 x 2 factorial design was used to investigate the association between lucid dreaming successes (reported/not reported) between two conditions (lucid dream programme/control condition).

For the second and third hypotheses a 2 x 3 mixed factorial design was used to investigate differences in baseline score for Locus of Control, Field Differentiation and Need for Cognition and to compare change scores (between baseline and post measures) between those participants who reported lucid dreams and those who did not.

### *Participants*

A sample comprising 56 individuals reporting limited (1 or less in the last three years) or no previous lucid dreams was drawn from student and special interest groups in the London and Northampton areas. Participants were recruited via volunteer and snowball sampling methods around the University of Northampton

campus, at the Centre for Counselling and Psychotherapy Education's (CCPE) Dream Research Institute (DRI) in London and on a broadcast radio show. The sample ranged in age from 18-62 ( $M = 35.75$ ,  $SD = 12.06$ ), and was comprised of thirty-eight Female and eighteen Male participants. These participants were randomly assigned to the control ( $N = 25$ , 8M/17F) or experimental condition ( $N = 31$ , 10M/21F) by a random number generator. Due to attrition, only thirty-five participants in total (23 Female, 12 Male) provided usable data (by completing a minimum of baseline and post-assessments). For the six Male participants who did not provide data, three did not submit usable data from both experimental and control conditions. For the fifteen females who did submit usable data, eight were in the experimental condition and seven the control. Of the total sample, thirty-eight engaged on a semi-regular basis (once-twice a week or more) in some form of mindfulness-based practice (e.g. Yoga, meditation) with years of experiencing ranging from one to forty ( $M = 7.64$ ,  $SD = 8.82$ ). Participants with parasomnias or who were on medications that may be disruptive to their sleep were excluded from taking part.

### *Materials & Apparatus*

The self-assessment measures participants were requested to complete included the three cognitive characteristics of interest and a general biographical questionnaire. Four guidance documents relevant to each stage of the induction programme were also provided at intervals throughout the programme alongside twelve weekly instalments of a new dream diary that allowed participants to write their dream experiences for each day of the week and engage in dream-sign classification. This element enabled participants to identify the nature of characteristic dream features, a central component of the combined induction technique.

Need for Cognition was assessed using the Need for Cognition Scale (Cacioppo & Petty, 1982), comprised of eighteen items, with a 9-point response scale (score range -72 to +72). This scale has support for its internal reliability and validity across several studies (Cacioppo & Petty, 1982; Cacioppo Petty & Kao, 1984; Sadowski, 1993) and with consistency across time (Sadowski & Gulgoz, 1992; for a review see Cacioppo, Petty, Feinstein, & Jarvis, 1996). As an additional level of quality assessment, a Cronbach's alpha analysis was run on the data collected, which demonstrated the scale's internal reliability ( $\alpha = .89$ ).

Field Differentiation was measured initially with the paper version and later the online version of the Group Embedded Figures Test (GEFT; Witkin, Oltman, Raskin & Karp, 1971), which involves eighteen questions and six practice questions. The six practice questions were not scored but allow the participants time to acclimatise to the task. Once these were completed, participants worked through two sections of nine questions each, with a 5-minute timer set for each section — participants were not allowed to progress beyond a section until they had completed the tasks or the time for that section had run out. Scores were taken as either 0 or 1 for each simple object unsuccessfully/successfully identified, scores range from 0-18, with high scores representing high Field Independence. This test was developed by Mind Garden Inc., the license holders of the paper GEFT. An online version of the GEFT has been shown as highly comparable to the original paper version ( $R = .98$ , Wook-Sung & Shang-Ah, 2015).

Locus of Control was measured using the Multidimensional Locus of Control scale (Levenson, 1972), comprised of 24 questions that test internality, belief in powerful others and chance. Scores for each dimension range from 0-48, with a high score reflecting a high internal Locus of Control for internality and a high external

Locus of Control for belief in powerful others and chance. It has been shown to be a reliable and valid measure across several translated versions (Lao, 1978; Levenson, 1973, 1974; Rossier, Rigozzi, & Berthoud, 2002). As an additional level of quality assessment, a Cronbach's alpha analysis on the data collected demonstrated the scale was internally reliable ( $\alpha = .82$ ).

Guidance documentation was created that detailed the exercises participants would follow at each stage of the induction programme, with the first two relevant for the first four weeks of the programme. The first informed participants of the importance of keeping a dream diary and provided tips for recalling and recording dreams. At the end of each week, participants were to read back through their week's dreams looking for dream signs (commonly occurring incongruences with waking life). The second document concerned these dream signs, how to identify and classify them, using an adapted version of LaBerge and Rheingold's (1990) dream-sign inventory. The third and fourth were introduced at the end of week 4 and used until the end of the programme in week 12 which concerned three methods of lucid dreaming induction. The first, the Reality Testing technique as outlined by Purcell (1988), which involves spending time throughout the day testing the reality of one's environment to determine if one is currently within a dream. Achieved by attempting tasks that are impossible/possible only within a dream (e.g., trying to recall preceding events from the day, or violate the laws of physics by flying). By increasing one's familiarisation with one's 'dream-signs' (individualistic oddities incongruent with waking life that frequently occur in one's dreams). Reality checks are then performed throughout the day when something associated with this oddity occurs. Thus when an oddity next happens in a dream, a reality check is more likely to be automatically performed leading to the recognition that one is dreaming.

The second method was the Mnemonic Induction of Lucid Dreams (MILD) as outlined by LaBerge and Rheingold (1990), which involves repeating while falling asleep a 'mantra' or affirmation to oneself regarding the actual nature of the dream experience. This auto-suggestion is used alongside a visualisation method of imagining oneself becoming lucid within one's most recent dream experience, before returning to the affirmation, alternating between both tasks until the onset of sleep.

The third method utilised was the Wake-Back-To-Bed technique (WBTB; Levitan, 1991), which aims to take advantage of the naturally oscillating ultradian Rapid Eye Movement (REM) cycle. This cycle occurs approximately every 90minutes, with the duration of time spent in REM becoming longer in each successive oscillation (Levitan, LaBerge & Dole, 1992). This method attempts to induce lucidity during the final and longest REM period of the night, with an immediately refreshed cognitive intention to lucid dream, taken from the waking state. The technique involves waking up a period (30-90 minutes) earlier than usual, spending some time (30-60 minutes) awake and thinking about lucid dreaming while going about one's morning, then returning to sleep while utilising a technique such as MILD. It is intended for this method to enable participants to avoid carrying the conscious intention to have a lucid dream through non-REM sleep to the first period of REM. Upon returning to sleep a longer period of REM will be experienced after a much shorter duration. Document 4 focused on these techniques and how they could be used in combination to promote lucid dream experiences best.

Furthermore, participants in the experimental condition received a light-pen and cue-bracelet. The light-pen comprised a biro pen customised by the researcher to

have the additional function of an inbuilt blue LED light; when the end of the pen was clicked the entire length of the pen would illuminate a dull blue. These were designed to ensure that if a participant woke in the middle of the night and had a dream they wished to record in their dream diary they could do so without potentially disturbing anyone else in the room. The cue bracelet was inspired by the work of Purcell (1988) and consisted of a 2.5cm wide black silicone wristband embossed in white on both sides with the question "Am I dreaming?". These bracelets were used as memory aids for participants to remind them to perform reality tests throughout the day.

### *Procedure*

In the first group meeting, participants were requested to complete a biographical information sheet and three counterbalanced self-assessment measures. Participants were randomly allocated to either the experimental or control condition using random allocation software. Participants in the waiting list control were thanked for their time, informed they would receive periodic e-mails from the researcher regarding lucid dreaming, but would not attend another physical meeting for twelve weeks. During which time they were requested not to engage in any form of lucid dreaming induction, but to let the researcher know should they have a lucid dream. Participants in the experimental condition received a folder including the first instalment of the participant dream diary (further instalments were sent periodically via e-mail), the first two participant guidance documents and a light-pen. For the next four weeks participants were requested to record their dreams, and at the end of each week asked to read them through looking for commonly occurring dream-signs (a precursor to successful lucid induction using the reality testing method). After the first week, a second group meeting allowed participants to reflect on their dreams and to practise

categorising their dream-signs. In the following three weeks, this process was repeated as a one-to-one meeting via phone, e-mail or Skype where participants discussed their dream recall and went over any identified dream-signs. Sharing regular dream reports verbally with the researcher was not essential; however, participants were required to report details of a lucid dream when experienced. Following the completion of week four, a third group meeting was held. In the case, that very few dreams were being recalled each week by the participant, this element of the programme was flexible in its duration and could be extended, though only one participant required this. Those who had not developed the dream recall to the required level continued to record their dreams for as long as necessary, whereas participants who had developed good levels of dream recall (5+ dreams per week) were provided with the third and fourth guidance documents (Induction techniques documents). These documents required participants to begin incorporating elements of the induction methodologies into their daily routine. To aid this process participant also received a cue-bracelet to act as a reminder to perform reality testing.

The induction programme ran for the next eight weeks, with weekly one-to-one progress meetings with the researcher via e-mail, Skype or telephone. At the end of the eight-week period, all participants from both conditions attended a final group meeting and were requested to complete another assessment of the individual differences measures. The waiting list controls were then provided with the opportunity to engage in the programme as appreciation for their time. A follow-up assessment for all cognitive style scales was completed six months after this final group meeting. Questions about continued lucidity practice and occurrence were also asked at this stage followed by participant debriefing.

*Ethics*

The study was designed to adhere to guidelines produced by the British Psychological Society (BPS, 2009, 2013, 2014), especially in respect to fully informed consent and right to withdraw. Ethical approval was obtained from the University of Northampton's Research Ethics Committee.

RESULTS

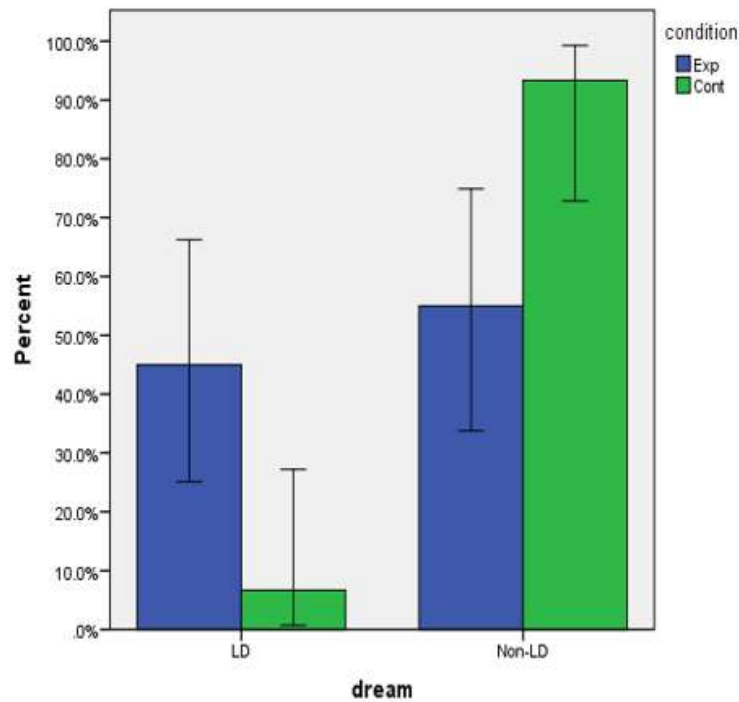
To test the first hypothesis, a Fisher's exact test was performed to examine the association between reported lucid dreaming and involvement in the lucid dreaming programme. The results indicated (Figure 1) a significant difference in lucid dreaming success with a prevalence of 45% (9/20) in the experimental group compared with 6% (1/15) for the control condition (one-tailed  $p = .015$ ,  $\phi = .42$ , 95% CI [.101, .66]).

These findings suggest the induction programme was effective at facilitating lucid dreams in those undertaking it.

Figure 1: A bar graph showing proportions and 95% CI of participants reporting successful lucid dream experiences against those who did not experience lucid dreams for both control and experimental conditions.



## Running Head: Incidence of lucid dreams during a 12-week induction study



The highest number of reported lucid dreams for a single participant was ten during the study's 12-week duration, showing that the technique was very effective for some individuals. Each time a participant reported a first lucid dream they were asked to provide a copy of the dream transcript for the researcher to make a judgement on the status of the dream experience as lucid — only in one instance was the experience deemed to lack the key quality of awareness to be considered lucid. Successful participants commented on the usefulness of the cue bracelet provided to them in the fourth week of the programme. This object, inspired by Purcell (1988), was initially devised to remind participants to perform reality-tests throughout the day. It turned out to be directly involved in the induction of lucid dream experiences for six of the nine participants who reported them. This technique was initially devised to remind participants to perform reality-tests throughout the day. It turned out to be directly involved in the induction of lucid dream experiences for six of the nine participants who reported them.

Its principle role, in the opinion of these participants, was for the bracelet itself to become the reality testing dream-sign which participants noticed, leading them to ask within the dream the 'critical question', "*Am I dreaming?*", for example one participant comments:

"...I was visiting some friends, and went to the shop to buy something to eat, as I opened the packet I found myself on my own in a bed, I decided to perform my reality test, I looked down at my wristband and read the words "am I dreaming?" I then looked away and closed my eyes really hard. When I opened my eyes and looked back, the wristband had transformed from the simple black rubber with white writing to being made out of some kind of highly reflective, shimmery wood. Around the wood there were small wooden planets revolving, the words had also changed, they read something like "And as I laid, lay, lay here I knew that I was" and at that point I knew I was dreaming and became lucid! I immediately attempted to fly and play with the physics of the dream..."

The age of participants in the experimental condition ( $M = 35.96$ ,  $SD = 10.95$ ) was shown to be non-significantly different ( $t(54) = .15$ ,  $p = .88$ ,  $d = .04$ , 95% CI [- .56, .48]) from the age of participants in the control condition ( $M = 35.48$ ,  $SD = 13.54$ ). The distribution of genders in both conditions was comparable, with 2/1 or near ratios between males and females for both the experimental condition ( $M = 7/ F = 13$ ) and the control condition ( $M = 5/ F = 10$ ). There was also no significant differences between the experimental and control conditions on baseline measures of Field Differentiation ( $U = 109.5$ ,  $p = .179$ ,  $r = .23$ , [- .11, .52]) the Internality Dimension of Locus of Control ( $U = 146$ ,  $p = .908$ ,  $r = .02$  [- .31, .35]) or Need for Cognition ( $U = 149.5$ ,  $p = .987$ ,  $r = .002$ , [- .331, .335]).

Descriptive statistics for baseline and post-test are presented for the internal dimension of Locus of Control, Field Differentiation and Need for Cognition. These are organised in Table 1 by a presentation of the primary between-groups factor, reported lucid dreaming success. While a 6 month follow up was intended, change scores are only reported between baseline and post measures due to participant attrition making it difficult to draw any meaningful conclusions from the meagre 6-month follow-up data gathered.<sup>2</sup>

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<sup>2</sup> Due to the high attrition rate, consideration was given for scores on baseline-test measures between those participants who completed the programme (defined as submitting both baseline and post-test data) and those participants who did not present more than the initial baseline-test measure. This analysis was to determine if those participants who withdrew were characteristically different in some way from those participants who completed. The Age of participants who completed ( $M = 34.28$ ,  $SD = 11.5$ ) and those who did not ( $M = 38.19$ ,  $SD = 12.85$ ) was found to be non-significantly different ( $t(54) = -1.176$ ,  $p = .245$ ,  $g = .32$  95% CI [-.27, .87]). Gender ratios in each group were also comparable, with 60.5% females and 39.5% males for participants which did complete the programme and 66.6% females and 33.4% males in the withdrawal group. Mann-Whitney U analyses further demonstrated no significant differences between withdrawal and completion groups on baseline measures of Need for Cognition ( $U = 315.5$ ,  $p = .5$ ,  $r = <.001$ , [-0.27, .27]), the internality dimension of Locus of Control ( $U = 334.5$ ,  $p = .79$ ,  $r = <.001$ , [-.26, .26]), or Field Differentiation ( $U = 237.5$ ,  $p = .08$ ,  $r = .03$ , [-.239, .235]).

Table 1: Descriptive statistics for baseline and post measures of participant’s internality dimension of Locus of Control, Field Differentiation and Need for Cognition by lucid dream success

Variable	LD <sup>a</sup> success	Descriptive Statistic	Baseline	Post
Internality Dimension Locus of Control	Yes	n	10	10
		Mdn	30.5	32
		(IQR <sup>b</sup> )	(11.25)	(11.25)
	No	[95% CI]	[26, 38]	[25, 36]
		n	25	25
		Mdn	34	33
Field Differentiation	Yes	(IQR <sup>b</sup> )	(8)	(6)
		[95% CI]	[32, 36]	[31, 35]
		n	10	10
	No	Mdn	15	18
		(IQR <sup>b</sup> )	(6)	(1.25)
		[95% CI]	[11, 18]	[17, 18]
Need for Cognition	Yes	n	25	25
		Mdn	14	14
		(IQR <sup>b</sup> )	(10)	(10)
	No	[95% CI]	[11, 17]	[11, 17]
		n	10	10
		Mdn	31	34
No	(IQR <sup>b</sup> )	(28)	(24.25)	
	[95% CI]	[18, 44]	[22, 46]	
	n	25	25	
No	Mdn	34	30	
	(IQR <sup>b</sup> )	(25.5)	(24.5)	
	[95% CI]	[24, 44]	[21, 39]	

<sup>a</sup>Lucid Dreaming success    <sup>b</sup>Inter-Quartile Range

Testing the second hypothesis; Mann-Whitney U analyses were conducted to identify if any significant differences existed between those successful at experiencing a lucid dream and those who were not on baseline measures of the personality characteristics. No significant differences on baseline measures of Need for Cognition ( $U = 115.5$ , one-tailed  $p = .364$ ,  $r = .06$ , 95% C I [-.28, .38] ), the internality dimension of Locus of Control ( $U = 109$ ,  $p = .28$ ,  $r = .09$ , [-.25, .41] ), or Field Differentiation ( $U = 109.5$ ,  $p = .22$ ,  $r = .13$ , [-.21, .44] ) were found between those participants who reported a

lucid dream and those who did not. Due to the data being non-parametric and the necessity of hypothesis 3 requiring comparisons across both between and repeated factors, change scores were calculated between baseline and post measures of need for cognition, the locus of control and field differentiation. Table 4-2 demonstrates the changes scores for each of the three variables calculated as the median and IQR of post-baseline, and also as the percentage change between these two measures.

Table 2: Descriptive statistics for change scores presented as pre-post median and percentage change calculations.

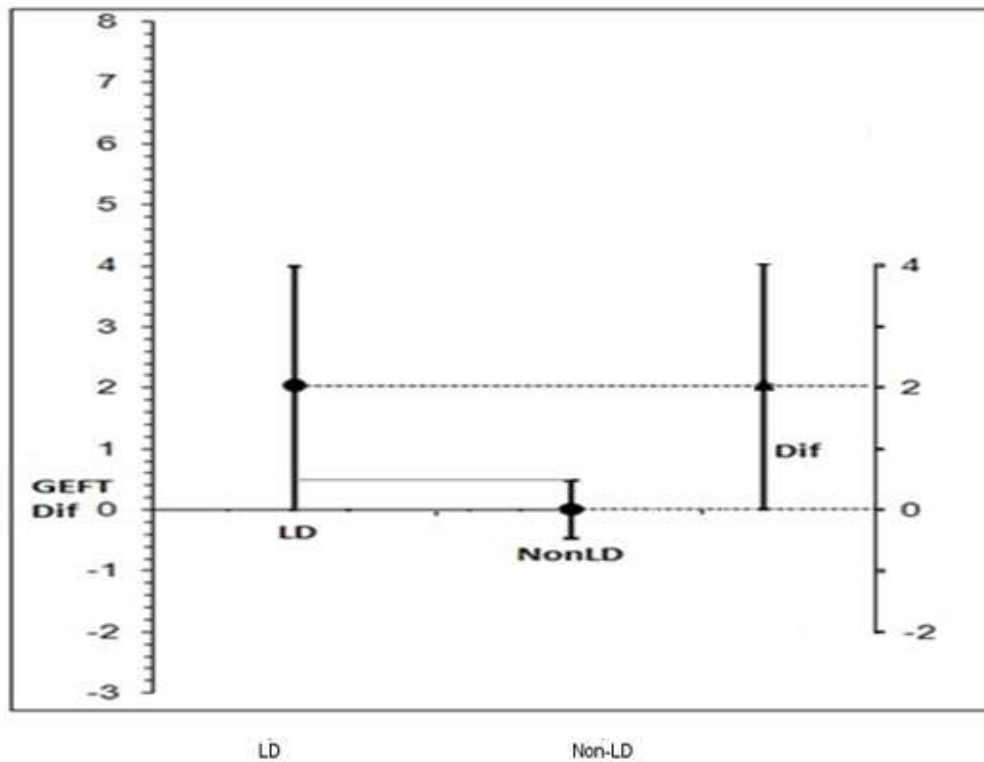
Variable	LD Success <sup>a</sup>	Post-Baseline Median	IQR <sup>b</sup>	% Change
Internality Dimension Locus of Control (ILOC)	Yes	.5	9.25	.02%
	No	0	5	0%
Field Differentiation (GEFT)	Yes	2	4.25	13%
	No	0	1.5	0%
Need for Cognition (NFC)	Yes	1.5	11	.04%
	No	-1	9	.03%

<sup>a</sup> Lucid Dream success <sup>b</sup> Inter-Quartile Range

Mann-Whitney U-tests indicated no significant difference between successful lucid dreamers against non-lucid dreamers for changes in Need for Cognition scores ( $U = 116.5, p = .13, r = .19, 95\% \text{ CI } [-0.15, 0.49]$ ). Post-hoc power analysis demonstrated that the study was underpowered to find a significant medium sized effect with 80% power the necessary participant numbers would require  $n = 64$  in each condition. No significant differences were observed between successful and unsuccessful lucid dreaming participants for change scores on the internality dimension of Locus of Control ( $U = 123, p = .94, r = .012 [-0.32, 0.32]$ ). However, GEFT scores are significantly greater towards Field Independence for those successful at inducing a

lucid dream (Mdn change =2) when compared with participants who were unsuccessful (Mdn change = 0), with a medium-large effect size ( $U = 63.5, p = .01, (r = .40, [.08, .65])$ ).

Figure 2: Error graph showing group median difference scores and the difference between these for successful lucid dreamers and non-lucid dreamers for baseline and post Field Differentiation measures.



Due to this finding, further Wilcoxon-Signed ranks tests were conducted as exploratory analyses using Bonferroni-adjusted alpha levels of .025 per test (.05/2) to investigate simple effects between baseline and post-measures of Field Differentiation for participants who reported successfully inducing a lucid dream. These showed a medium sized significant effect towards Field Independence for the GEFT scores ( $r = .374, 95\% \text{ CI } [.05, .63]; Z = -2.21, p = .013$ ). For participants who did not report

experiencing lucid dreams, non-significant GEFT changes were observed ( $r = .09$ ,  $[-.25, .47]$ ;  $Z = -.583$ ,  $p = .28$ ).

## DISCUSSION

The findings demonstrate that significantly more lucid dreams were reported by participants in the induction condition compared with the wait-list control, suggesting that the combined induction technique was successful in encouraging cultivated lucid dreams, supporting the first hypothesis. The combination of the Wake Back to Bed, Mnemonic Induction and Reality Testing techniques was effective in inducing lucid dreams, with 45% of participants in the experimental condition reporting at least one lucid dream in comparison with 6% for the waiting-list control. Furthermore, given the cue bracelet's effectiveness in helping to facilitate lucid dreams, we recommend that researchers incorporate similar cue-bracelets into the design of future studies involving lucid dream induction techniques with a reality testing aspect.

Regarding the hypotheses pertaining to the predispositional theory (*H2a, 2b, 2c*), no significant differences in baseline measures were observed for Need for Cognition, Field Differentiation or Locus of Control between those successful at inducing a lucid dream and those who were not. The results, therefore, do not support the notion that these are predispositional characteristics. Low baseline scores may explain the lack of association between Need for Cognition and lucid dreaming success observed; it is possible a sample higher in baseline-test measures of Need for Cognition could lead to greater participant success. Therefore, while it cannot be ruled out as a potential predispositional factor, it can be concluded that it is not a necessary one for successful lucid dream induction. While this finding goes against the

suggestion that Need for Cognition is a predispositional characteristic of lucid dreaming as explored by Blagrove and Hartnell (2000) and Patrick and Durnell (2004) due to looking specifically at cultivated lucid dreaming the findings of this study are not directly comparable. Participants within the Blagrove and Hartnell (2000) and Patrick and Durnell (2004) studies may have been spontaneous lucid dreamers and not cultivated their experiences, thus these results do not challenge their findings. It is important, however, to note that for neither study is sample information of such detail reported. It is recommended that future studies fully report the nature of their lucid dreamer samples with regards to this characteristic (spontaneous or cultivated) and if cultivated, which technique is used. This information will allow for greater consideration to be given to characteristics which may predispose towards the facilitation of lucid dreams, and the identification of if there are clear differences between the spontaneous and cultivated lucid dreamer types.

The findings of no significant differences for Field Differentiation and Locus of Control baseline scores also implies these are not necessary predispositional characteristics that lead to an individual being more likely to experience a cultivated lucid dream.

Regarding the hypotheses for the experiential interpretation (*H3a, 3b, 3c*), the results show that a shift towards greater Field Independence occurs between baseline and post-assessment for those successful at inducing a lucid dream; individuals who did not report a lucid dream showed no average change in Field Differentiation. This evidence is consistent with previous studies which have demonstrated an association between Field Independence and lucid dreaming (Blagrove & Hartnell, 2000; Blagrove & Tucker, 1994; Gackenbach, Heilman, Boyt & LaBerge, 1985; Gruber, Steffan & Vondahaar, 1995; Patrick & Durnell, 2004). However, the findings imply



this is not a predispositional characteristic of lucid dreaming onset but a by-product of experiencing lucid dreams. This finding is analogous to the effects of meditation (defined as “the awareness that emerges through paying attention on purpose, in the present moment, and non-judgementally to the unfolding of experience moment by moment”, Kabat-Zinn, 2003, p. 145) on Field Independence. It has been demonstrated that meditative practice can effect Field Differentiation in children (Linden, 1973), high-school students (So & Orme-Johnson, 2001), college students (Fergusson, 1992; 1993), and adults (Davidson, Goleman & Schwartz, 1984; Sridevi & Krishna-Rao, 2003) moving them towards a more field independent orientation. Both Lucid Dreaming and Meditation are positively related (Gackenbach, 1990; Gackenbach, Cranson & Alexander, 1986; Hunt & McLeod, 1984; Hunt, 1987, 1991; Reed, 1978) and associated (Kühle, 2015; Pagal, 2014; Schredl, 2010; Stumbrys, Erlacher & Malinowski, 2015). Hunt (1987, 1989) claims both contain elements of detached receptivity and enhanced self-awareness at their core. Such a detachment from ones sensory-perceptual environment may be responsible for eliciting changes in the way an individual perceives their surroundings, leading to eliciting similar effects for an individual, moving them towards a greater field independent orientation. For lucid dreams, developing the ability to differentiate internally generated dream experiences from external reality while sleeping does appear to lead to an increased ability to discriminate between subjective perceptions and external stimuli in waking life, allowing an individual to take a more detached and analytical frame of reference to their surrounding environment.

The same effect was not confirmed however for either the internality dimension of Locus of Control nor for Need for Cognition, with non-significant changes reported for all participants in both conditions. Previous research

investigating Locus of Control and Need for Cognition identified significant differences were most pronounced between frequent lucid dreamers and non-lucid dreamer groups (Blagrove & Hartnell, 2000; Patrick & Durnell, 2004). This observation may be pertinent, as when using the definition provided by Snyder and Gackenbach (1988) only two of the participants in the current study are classified as frequent lucid dreamers (reporting one or more lucid experiences per month during the programme). The study may, therefore, have lacked sufficient numbers of frequent lucid dreamers to elicit an observable effect in Need for Cognition and Locus of Control. Another possible explanation for these findings is that the duration of the study was too short to capture an effect, which may be elicited only over a longer period. It is advised that future studies investigate the potential long term influence that becoming a frequent lucid dreamer may have on these cognitive characteristics.

A key limitation of this study is its reliance on self-report methods for the validation of lucid dream experiences. While these were written down in dream diaries and submitted to the researchers for judgement as to whether the dream was indeed lucid or not, this method is not as effective as sleep-laboratory validation (Stumbrys et al., 2012). Self-report methods are susceptible to errors common in retrospective recall (Hassan, 2005; Schacter, 1999) and these have been shown to impact on the accurate identification of lucid dream experiences (Snyder & Gackenbach, 1988). A technique was attempted to be utilised within this study involving a wireless wrist mounted EMG and frontal EEG in participants who reported at least one lucid dream during the duration of the programme, within their homes in an attempt to provide field validation of at least one of their lucid dreams. While piloting of the system was encouraging the technique was unsuccessful in this study and thus not reported on further. It is argued, however, that field validation of

lucid dreaming is an essential next step in increasing the validity of results gathered on the efficacy of lucid dreaming induction strategies and efforts to achieving this goal are most necessary. Additional methodological considerations regarding the induction programme need to be made from received participant feedback.

Participants highlighted they would have found an online community where they could engage with one another and discuss their progress beneficial, so as to bolster motivation. They also felt real meetings with the researcher should occur more regularly, particularly when the application of the method was not leading to results. A lack of actual meetings may explain the rather high attrition rates from the original sample (36%), since participants may have not felt engaged enough in the programme in its current form (four physical meetings with the researcher and weekly online discussions) or indeed engaged at all (control condition). The online element proposed above could be a useful aid in maintaining the motivation of participants within the experimental condition throughout the induction programme, especially when regular meetings with researchers is not possible. Though controls must be put in place to ensure no information regarding other forms of lucid dreaming induction is sharable within this space.

A further shortcoming is a lack of comprehensive protocol adherence documentation. While weekly discussions between participants and the researcher were included within the experimental design to ensure participants adhered to the protocol specific information — such as the number of times a reality test was performed or how regularly did they attempt the Wake Back to Bed technique — was not recorded. Providing participants with forms to complete at the end of each day in their dream diaries could have provided valuable information regarding the elements of the induction technique that were regarded as contributing to a lucid dreaming

occurrence; a very useful inclusion in any future study investigating the efficacy of the combined induction technique utilised within this study.

In summary, this study has provided evidence that the combined lucid dreaming induction method is an effective technique, and the application of a combination of methods supplemented by the cue-bracelet is recommended for future research. With regards to individual differences, Field Differentiation, Locus of Control and Need for Cognition require further investigation to fully clarify if and how they relate to lucid dreams in both their cultivated and spontaneous forms. Overall the evidence is suggestive, that none is an essential predispositional factor for cultivated lucid dreaming onset. The cognitive characteristic of Field Independence was found to be directly related to lucid dreaming experiences; not seemingly as a predispositional factor for lucid dreams but as a result of one's lucid experiencing impacting upon the way an individual perceives their waking world.

The identification of clear predispositional factors may lead to future studies having the capacity to screen for the selection of participants for whom lucid dream induction techniques will be most effective. Screening may subsequently increase success rates and allow for larger samples of lucid dreamers for larger scale research into the nature, limits and potential practical applications of lucid dreaming. These areas are varied, for example: problem solving (Stumbrys & Daniels, 2010) enhancing waking motor skills for athletes, musicians, dancers and sports professionals (Erlacher & Schredl, 2010; Stumbrys, Erlacher & Schredl, 2016) or potentially as a form of motor-rehabilitation, and curing nightmares (Spoormaker & Van den Bout, 2006; Spoormaker, Van den Bout & Meijer, 2003; Zadra & Pihl, 1997). These promising avenues of inquiry will greatly benefit from access to larger samples of lucid

dreaming participants. Furthermore, an understanding of which characteristics are experiential will provide information about the way our dreaming mind interacts with and influences our conscious experience, leading to lasting changes in waking cognitive and perceptual styles. Furthermore, this would provide evidence in support of a continuity between waking and dreaming cognition (Domhoff, 1996; Hall, 1966; Hartmann, 1998; Strauch & Meier, 1996).

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