Title: Spontaneous Lucid Dreaming Frequency and Waking Insight

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Running Head: Lucid Dreaming and Insight

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Abstract

Spontaneous lucid dreaming is characterised by the realization that the currently perceived reality is in fact a dream. As this ability differs between individuals specific cognitive abilities have been sought that might explain this variability. Here, 'insight' a key feature of spontaneous lucid dreaming is investigated. Frequent, occasional and non-lucid dreamers were compared on their successful performance of a Compound Remote Associate problem solving task, designed to measure insight. Results show that frequent lucid dreamers solve significantly more insight problems overall than non-lucid dreamers. This suggests that the insight experienced during the dream state may relate to the same underlying cognition needed for insight in the waking state.

Key words: insight, lucid dreaming, problem solving, compound remote association.

Introduction

Lucid dreaming is being aware of the fact that one is dreaming, whilst within a dream (Schredl & Erlacher, 2004). While lucid dreaming can be learnt (Stumpys, Erlacher, Schadilch, & Schredl 2012), it also occurs spontaneous. The frequency of spontaneous lucid dreams varies among individuals, with some being more likely to experience the phenomenon than others. Evidence suggests that as many as 82% (Schredl & Erlacher, 2004) of people report that they have experienced a lucid dream at least once in their lives. Estimates of the number of individuals who are spontaneous frequent lucid dreamers, defined as having a lucid dream more than once a month (Snyder & Gackenback, 1988) varies between 19% (Erlacher, Schredl, Watanabe, Yamana & Gantzert, 2008) and 37% (Schredl & Erlacher, 2004). Lucid dreaming also occurs spontaneously in children. Voss, Frenzel, Koppehele-Gossel & Hobson, (2012) assessed the tendency to lucid dreaming among 6 -18 year olds which are reported to have had no training. Lucid dreaming was found frequently even in the youngest group (6-7 year olds).

Gackenbach and colleagues identified the triggers of spontaneous dream lucidity in untrained student populations (Gackenbach 1982, Snyder & Gackenbach, 1988). Lucid dreams arouse out of the recognition of an incongruent element in 19.2 % of cases and in 67% of cases the dreamers 'just knew' from the 'dreamlike sense' of the dream (Snyder & Gackenbach, 1988 Gackenbach 2010). The remainder were preceded by nightmares.

Part of the reason that some people experience spontaneous lucid dreams appears to be linked to them having a particular cognitive strength in waking life. The most clearly established of these is the superior performance by frequent lucid dreamers on embedded figures tasks. This was first reported by Gackenbach, Heilman, Boyt & LaBerge (1985) and later replicated

(Patrick & Durndell 2004). Other correlations have also been reported. Gackenbach et al (1985) report some evidence for a relationship between frequent lucid dreaming and 'field independence' in a rod and frame measure. When controlled for handedness, male lucid dreamers showed superior performance to the non-lucid dreaming group. Blagrove, Bell, & Wilkinson (2010) explored the possibility that frequent lucid dreamers may have increased waking life attentional abilities in comparison to non-lucid and occasional lucid dreamers as measured by performance on the Stroop task. Results show some indication that frequent lucid dreamers did indeed perform significantly better at the incongruent condition of the Stroop task (where the word and ink colour are different) than occasional or non-lucid dreamers. This was found when the incongruent was compared to the neutral but not the congruent condition. More recently frequent lucid dreamers have also been shown to perform better than non-lucid dreams on the Idaho Gambling task (Neider, Pace-Schott, Forselius, Pittman & Morgan (2011) which measures complex cognitive abilities. Together, these results suggest that there may be perceptual or cognitive strengths that predispose people to spontaneous lucid dreaming.

The development of a cognitive skill may also lead to increased lucidity. Explicit techniques (Stumpys et al 2012) appear to increase the tendency to a way of thinking e.g. monitoring and evaluating on-going cognitive experiences that carries over to dreaming and enables the obtaining of lucidity. A similar explanation may apply to reports that practice in immersive gaming (Gackenbach, 2009) or meditation (Gackenbach, Cranson, & Alexander, 1986a) result in a higher frequency of lucid dream.

Cognitive dispositions or styles have also been linked to lucid dreaming. Most consistently, frequent lucid dreamers have been found to score highly on measures of internal locus of control (Blagrove and Tucker 1994, Blagrove and Hartnell, 2000, Patrick & Durndell 2004).

Grubber et al (1995) looked for links between the 16PF personality measure and lucid dreaming. The factor ‘subdued /independent’ was the only one to discriminate between frequent and infrequent lucid dreamers. This factor is reported to correspond to the field dependent/ independent dimension. Motivational measures also relate to frequency of lucid dreaming, for example, the ‘need for cognition’ which reflects engaging in and enjoying effortful cognitive tasks, (Blagrove and Hartnell 2000).

In spontaneous lucid dreaming ‘insight’ may be a key cognitive ability that underlies the variation in frequency in the general population. Untrained dreamers tend to become lucid either when they notice some inconsistency in the dream or notice its dreamlike character (Gackenbach, 1982). Here the dreamer can be considered to have ‘insight’ (Voss, Schermelleh-Engel, Windt, Frenzel, & Hobson, 2013) into their current situation. They realise that despite the overwhelming reality, the only explanation must be that they are in fact dreaming. While the mechanisms underlying ‘insight’ in waking cognition are not well understood, the term is used to explain a clear and sudden understanding of how to reach a problem’s solution. It is thought to occur when a person forms novel connections between concepts, or breaks free of certain restraints that have caused an impasse (Bowden, Jung-Beeman, Fleck & Kounios, 2005). Archetypal measures of insight include Duncker’s Candle Problem (Duncker, 1945) and the 9 dot problem (Scheerer, 1963). A useful experimental method that correlates significantly with these classic measures is Mednick’s (1962) Remote Associate Test (Ansburg, 2000; Cunningham, MacGregor, Gibb & Haar, 2009). In this task, a novel word has to be found that forms an associative connective link between three apparently unconnected words. This suggests that insight is not domain specific. If so, forming remote associations may also correlate with the insight that is necessary for lucid dreaming. Frequent lucid dreamers, who show insight during the dream state, may also show superior insight ability in waking life.

In the present study, waking life insight ability was assessed using Compound Remote Associate (CRA) problems (Bowden and Jung-Beeman, 2003) developed from the Remote Associates Test (Mednick, 1962). In this, a word has to be found that can be combined with each of 3 words to form a new compound word or phrase e.g. given the words Age, Mile Sand, the solution word to be found is Stone. Compound remote associates problems provide an easily measurable test of insight ability. They have single solution words and multiple problems can be attempted within a session (Bowden et al., 2005). We expect superior performance on this task to be related to self-reports of lucid dreaming frequency.

Method

Participants

Based on previous studies (Patrick & Durndell 2004, Blagrove et al 2010), sixty-eight participants (52 females, 16 males) were recruited. Participants were from the University of Lincoln, aged between 18 and 25 (*M* = 20.7, *SD* = 1.1), the majority were psychology students, who were not paid for participation, though some were given course credit points. Individuals had to meet the criteria of recalling at least one dream per week to participate. Participants were assigned to one of three groups depending on how often they reported experiencing lucid dreaming. Recruitment continued until there were at least 20 participants per group. Frequent lucid dreamers, experienced lucid dreams more than once a month (17 females, 3 males, mean age = 20.55, SD = 0.99). Occasional lucid dreamers, experienced lucid dreams at least once in their lifetime (20 females, 8 males, mean age = 20.57, SD =

0.84). Non-lucid dreamers never experienced a lucid dream (15 females, 5 males, mean age = 21, SD = 1.49). All recruited participants completed the full study, there was no attrition.

Procedure

Ethical approval was obtained from the School Research Ethics committee. In addition, upon arrival participants were given a consent form to complete. This explained that the experiment was investigating how lucid dreaming is related to problem solving ability. They were told that they would first be asked to complete questions about their dreaming habits, followed by an experiment which would be presented on a computer. They were told that this would consist of a series of compound remote associate problems which assess insight problem solving ability. All participants were tested individually by the same experimenter and completed a form reporting age, sex and questions about the frequency of dream recall and lucid dreaming. Participants were tested individually in a quiet testing room. Testing sessions lasted less than 25 minutes. At the end of their participation a brief explanation of the study was given. Dream recall was measured by the question, "During an average week, how many dreams do you remember? (For example, if I wake up each morning and remember a dream I had that night I would remember 7 dreams)". The definition of a lucid dream used in Blagrove, Bell & Wilkinson (2010) was presented to ensure that participants fully understood the phenomena, prior to lucid dream frequency being assessed. They were told "Lucid dreaming happens when you are having a normal dream, then within the dream you realise that you are dreaming. Instances of waking up immediately on realising that one is dreaming do not count as lucid dreams". Participants were then asked to rate frequency of lucid dreaming on a 7 point scale ("How frequently do you lucid dream?" 0 = never, 1 = less than once a year, 2 = about once a year, 3 = about two to four times a year, 4 = about once a month, 5 = about two to three times a month, 6 = about once a week, 7 = several times a week) as used in Schredl & Erlacher (2004).

Then participants undertook the compound remote associate problem task. 35 problems were selected from the set created by Bowden and Jung-Beeman, (2003). Participants were first given 5 practice compound remote associate problems to solve. This was followed by the presentation of the 30 main compound remote associate problems. Each problem consisted of three words (the problem triad) and a solution word. Each of the three words could be combined with the solution word to create a new compound word or two-word phrase (Bowden et al 2005). The 30 compound remote associate problems used in the main task were selected based on degree of difficulty, comprising 10 easy problems (previously solved by 75% of participants or above within the 30 second time limit, as measured by Bowden & Jung-Beeman, 2003), 10 moderate problems (previously solved by more than 50% but less than 75% of participants) and 10 difficult problems (previously solved by more than 30% but less than 50% of participants). The problems included a mix of homogeneous (where the solution word is either a prefix or suffix for all three words of the problem triad) and heterogeneous (where the solution word is a suffix for at least one of the words of the problem triad and a prefix for the remaining words of the problem triad) solution words. No words were repeated.

Each problem was presented in the centre of a computer screen. The triad of words were simultaneously displayed, at, above and below the centre of the screen, preceded by a 1000ms fixation point. Each compound remote associate problem triad was presented in Times New Roman font, size 40 in black ink on a white background. Participants were instructed that three words would appear on the screen and they must try to think of a fourth word which could be combined with the problem triad to produce a compound word or phrase. Participants were given a 30 second time limit to produce the solution word and were instructed to press any key as soon as they had thought of it. This key press brought up a blank screen and during this blank screen participants were required to write down the solution word on the response sheet provided, or if they were unable to produce a solution to leave a blank space. There was no time limit for the blank screen; participants were instructed to press any key when they were ready to bring up the next problem. If no solution was produced within the 30 second time limit, the problem would disappear from the screen and participants were instructed to press any key to bring up the next problem.

Results

As shown in Figure 1, the three groups (non-lucid dreaming, occasional lucid dreaming and frequent lucid dreamers) differed in the number of correct compound remote associate problem solutions produced, $F(2, 65) = 4.53$, $p = .014$. Bonferroni corrected comparisons showed that the number solved differed significantly between the ‘non-lucid’ and the ‘frequent lucid’ dreaming groups ($p = .011$) but not between ‘frequent’ and ‘occasional’ ($p = .28$) or ‘occasional’ and ‘non-lucid dreamers’ ($p = .38$). In addition, the difficulty of the remote associate problem affected the number solved, $F(2,130) = 91.86$, $p < .001$. There was no interaction between the factors, $F(4, 130) = 0.62$, ns. Mean results are shown in Table 1.

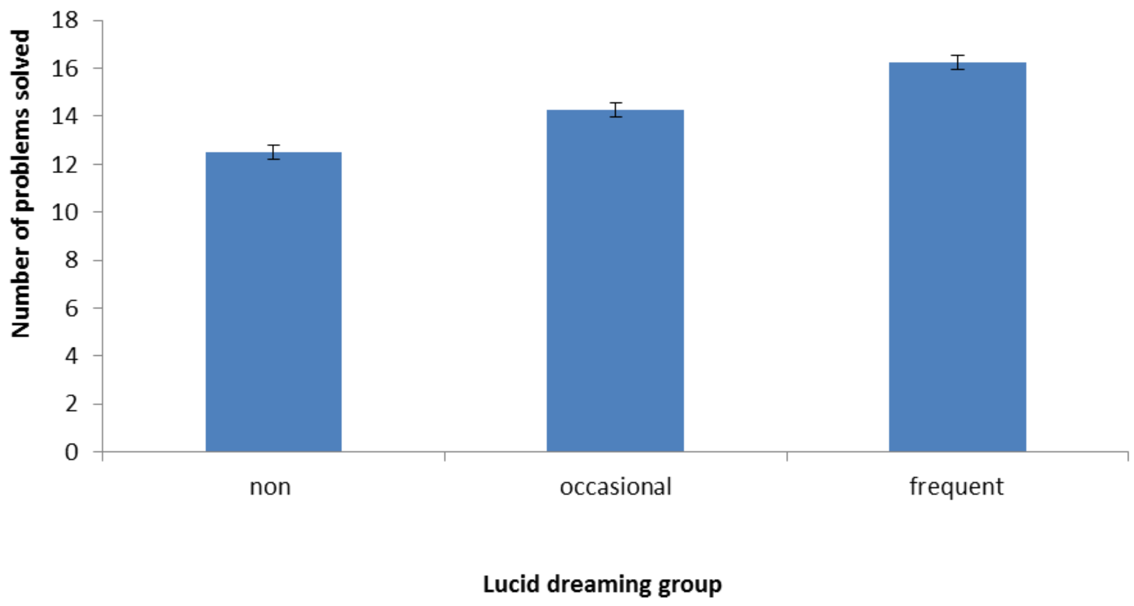

Figure 1. Number of compound remote associate problems solved out of 30 by the different lucid dreaming groups. Error bars show +/- 1 SE.

Table 1

Means and standard errors of 10 compound remote associative problems solved by Lucid dreaming groups, shown by problem difficulty.

	Easy	Medium	Difficult
Non Lucid (N=20)	6.00 (.40)	4.35 (.46)	2.15 (.33)
Occasional lucid (N=28)	6.32 (.34)	5.18 (.39)	2.79 (.28)
Frequent lucid (N=20)	6.95 (.40)	5.45 (.46)	3.85 (.33)

Discussion

It was hypothesised that a key feature of gaining lucidity whilst in the dream state is insight – an ability that may exist while dreaming as it does in waking life. Here we investigated this relationship. Insight was measured using a compound remote associate task (Bowden & Jung-Beeman, 2003) where participants had to find the link between three apparently unconnected words. As predicted, frequent lucid dreamers showed superior performance on solving these insight problems compared to non-lucid dreamers..

It is known that insight as measured by 'remote associate' tasks correlates well with other classic measures of insight (Cunningham et al., 2009). Here remote associate problem solving is further found to relate to the ability to realise that one is dreaming while within the dream state. This suggests common underling cognition in the two phenomena. Chu and MacGregor (2011), propose that solving such insight problems requires ignoring the first, typically unsuccessful word and searching for more distant solutions. More broadly it has been suggested that those who are particularly successful on compound remote associate problems are those who show high levels of divergent thinking and the ability to overcome fixation on habitual associations (Zhong, Dijksterhuis, & Galinsky, 2008, Ostafin & Kaasman, 2012). Similar cognitive skills can be argued to be necessary to obtain lucidity while dreaming. Here, dreamers must overcome the deep-seated tendency to accept the dream world as reality.

'Insight' can be seen to be related to other demonstrated cognitive correlates of lucidity in dreaming. The tendency towards 'field independence' for example allows people to 'step back' from perceived reality, reflect on it and evaluate the perceptual evidence. For the insight that leads to lucidity, people also seem able to step-back from the obvious interpretation and consider a remote and at the time implausible option – that it is all a dream. A similar argument is made by Blagrove and Hartnell (2000) and Gruber et al (1995) with regard to internal locus of control. Internal locus of control, it is argued, produces a tendency to self-reflection and volitional control that can lead to lucidity. Generally, it is the ability to separate oneself from the current reality and in some sense observe it, that seems to be a common element that leads to the insight that one is dreaming. This is the case both for those who are field independent and have a high internal locus of control but also for those who engage in intense interactive ‘gaming’ or meditation. In these, people learn to engage with, while remaining separate from, alternative virtual realities (Gackenbach et al 1986a, Gackenbach 2009).

Additional support for the notion that similar cognition may be involved in waking and dreaming insight comes from the cognitive neuroscience of the two tasks. A brain area consistently implicated in insight is the dorsolateral prefrontal cortex. Qiu et al., (2010) report activation here and from the precuneus when solving insight problems. Indeed, solving compound remote associate problems have also been explicitly linked to the activation of the dorsolateral prefrontal area (Cerruti & Schlaug, 2009, Metuki et al., 2012). Similarly, the meta-cognitive awareness that is the hallmark of lucid dreaming has also been linked to activation in the dorsolateral prefrontal cortex and parietal cortex (Dresler et al., 2012, Voss, Holzmann, Tuin & Hobson, 2009). Interestingly in the context of the Idaho gambling task whose successful performance also correlates with lucid dreaming frequency, this area along with ventromedial cortex are the key regions activated. In the context of the Idaho task these areas have been linked to, inhibiting impulsive responses so allowing the representation of a dilemma, maintain and organise working memory and evaluating solutions (Brevers, Bechara, Cleeremans & Noël 2013) - activities not unrelated to lucid dreaming.

While the link between lucid dreaming and insight appears well supported and plausible it is worth noting that some compound remote associate problems can be solved by non-insight means (Bowden et al., 2005, Sawyer, 2011). A further issue not fully resolved by the current study is the specificity of the link between lucidity and insight. Frequent lucid dreamers may also show superior general problem solving ability and be linked to this rather than insight problem solving specifically.

In this study it was found that those who report a high frequency of lucid dreams also are more successful at solving insight problems. Specifically, they showed the ability to see the connections needed to solve compound remote associate problems. It seems likely that this correlation arises from common underlying cognitive abilities that precede insight in both cases. This is the first empirical support demonstrating the relationship between lucid dreaming and insight.

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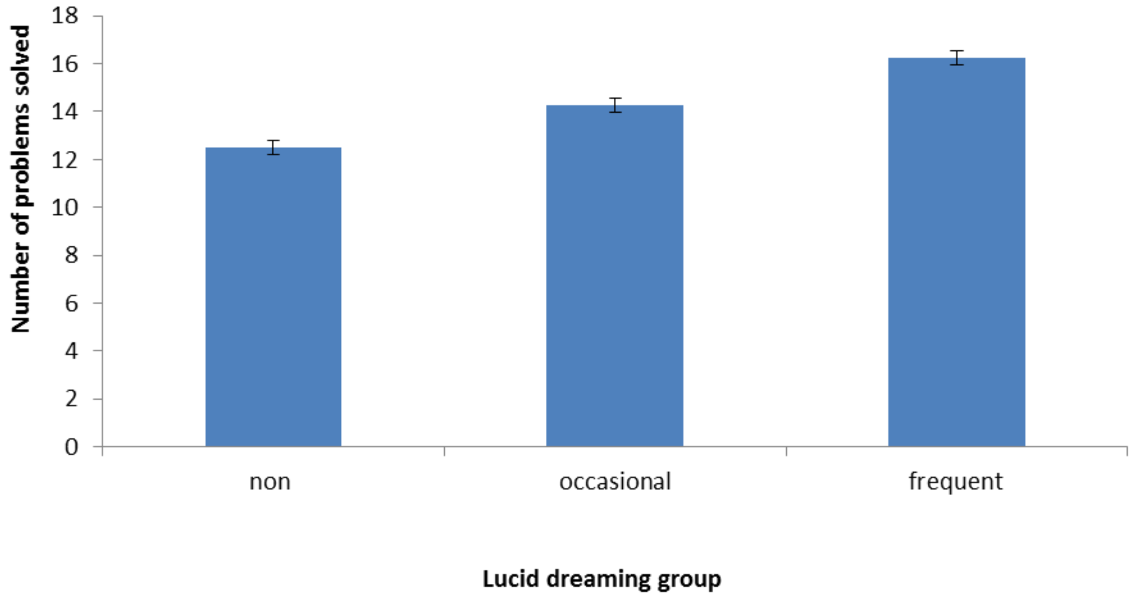

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