

Lucid dreaming and associated sleep and dream factors among university students in West Bank Palestine

Firas H. Bazzari¹ and Amjad H. Bazzari²

¹Pharmacy Department, Faculty of Allied Medical Sciences, Arab American University, Palestine

²Faculty of Pharmacy, Al-Quds University, Abu-Dis, Jerusalem, Palestine

Summary. Lucid dreaming is a phenomenon in which the dreamer is aware that he/she is dreaming while the dream is still going on. Many studies investigated the prevalence of lucid dreaming in various populations; however, no study has been conducted in the Arab Middle East region. As age and cultural differences in attitudes towards dreams may influence lucid dreaming, we aimed to investigate lucid dreaming and associated sleep characteristics among university students in West Bank Palestine. This cross-sectional study was conducted through an online questionnaire and a total of 390 students participated. The results revealed a prevalence of 71% and frequency of 0.77 (SD=1.85) lucid dreams/month. The awareness level of lucid dreaming was 38.5% and significantly associated with lucid dreaming incidence. Participant demographics and certain sleep factors such as sleep time, latency, duration and perceived quality did not influence lucid dreaming. However, nocturnal awakening significantly associated with the occurrence of lucid dreams. Dream characteristics including dream frequency, dream recall, day-dreaming and perceived meaningfulness of dreams were all associated with lucid dreaming and positively correlated with its frequency. The results show comparable lucid dreaming patterns to other populations and indicate its dependence on many dream characteristics.

Keywords: Sleep Behavior, Dreams, Undergraduate, Demographic Factors, Psychology

1. Introduction

Lucid Dreaming is a phenomenon in which the dreamer is aware that he/she is dreaming while the dream is going on and may have some control over the dream characteristics (Schredl et al., 2018). Early evidence showed that lucid dreaming primarily occurs during rapid eye movement (REM) sleep and that lucid dreamers are able to signal awareness of being in a dream while continuing to dream (LaBerge et al., 1981). Later studies showed that lucid dreaming is associated with various psychophysiological correlates of consciousness (LaBerge et al., 1986; Holzinger et al., 2006; Dresler et al., 2012) indicative of a hybrid state between sleep and wakefulness (Voss et al., 2009). Accordingly, lucid dreaming could provide the means to explore new aspects of cognition and consciousness and associated psychological connections.

Lucid dreaming has been extensively studied over the past decades and Saunders et al. (2016) reported an estimate global prevalence of 55% yielded from 34 different studies carried out among various populations and subgroups. However, no studies have examined the awareness and prevalence of lucid dreaming in the Arab Middle East

region so far, especially that cultural differences are suggested to influence dreaming aspects and lucid dreaming frequency (Schredl & Bulkeley, 2020). Unlike Western cultures' attitudes towards dreaming, dreams are taken seriously by a large portion of Middle Easterners which may affect their personal life and decision making (Salem et al., 2009).

Despite advancements in the field, lucid dreaming still lacks reliable induction methods, which if present can significantly boost the global prevalence of lucid dreaming (Stumbrys et al., 2012; Bazzari, 2018). Nevertheless, age-related differences were highlighted in previous studies, in which undergraduate university students have a markedly higher incidence of lucid dreaming compared to the general adult population (Schredl & Erlacher, 2004; Erlacher et al., 2008; Vallat et al., 2018). According to the Palestinian Central Bureau of Statistics (PCBS), a total of 5.1 million Palestinians live in the State of Palestine, 3.05 millions of which are in the West Bank (PCBS, 2020). The Palestinian population is generally considered young, where 38% aged (0-14), 30% (15-29) and 4% (above 65) (PCBS, 2017; PCBS, 2020). A total of 75519 undergraduate bachelor students from both genders (61.5% females and 38.5% males) are enrolled in 10 universities in the West Bank, as depicted in the 2019-2020 higher educational statistical yearbook published by the Palestinian ministry of higher education & scientific research (Othman et al., 2021). All combined, there is enough data available regarding this group (i.e. undergraduate students) and multiple studies from different populations that can serve as a point of reference for comparison; therefore, university students in Palestine represent an appealing population to investigate whether cultural factors influence the lucid dreaming phenomenon.

Corresponding address:

Dr. Firas Bazzari, Pharmacy Department, Arab American University, 240 Jenin, 13 Zababdeh.

Email: firmas.bazzari@aaup.edu

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Herein, we aim to determine whether cultural differences, relating to sleep and dream characteristics and attitudes towards dreams, in the Arab Middle East region affect the incidence and prevalence of lucid dreaming compared previously reported findings in other regions. As culture has a major influence on psychology and that a significant number of individuals view dreams as telling and purposeful in this region, it would be expected that aforementioned factors promote lucid dreaming.

2. Method

2.1. Sample

The minimum required representative sample size was determined using the following equation:

$$Sample\ Size = \frac{Z^2 \times p(1-p)}{1 + \left(\frac{Z^2 \times p(1-p)}{e^2 N}\right)}$$

Where, the population size = 75519 (Othman et al., 2021), confidence level (%) = 95% and margin of error (%) = 5%. The calculated sample size was 383 and a total number of 390 responses were received and included in the study.

2.2. Procedure

The online survey was created using Google Forms and written in English, as the official teaching language adopted by the Palestinian universities among the majority of taught undergraduate courses. In addition to the study questions, the survey included a title, a brief description of the study aims and a consent that no personal identifying information will be requested and data will be solely used for scientific research purposes. The link to the survey was shared with the universities' students via online learning portals. The survey was open for responses from 31st December 2020 to 14th March 2021.

Participation was voluntary and participants were not paid. The study strictly adhered to the guidelines of the Palestinian Handbook of Scientific Research Ethics and the Declaration of Helsinki regarding anonymity, voluntary participation and data protection.

2.3. Questionnaire and Research Instrument

2.3.1 Population Demographics

The study involved a total of 390 undergraduate university students studying in the West Bank universities. Data regarding the subjects' demographics; age, gender, marital status, employment, smoking status and physical activity, were collected. Participant demographics are summarized in Table 1.

2.3.2 Sleep Behavior

In order to determine any potential influence of sleep behavior on lucid dreaming incidence and frequency, the questionnaire involved six factors related to participants' sleep behavior, including; (1) sleep time "Q. When do you usually go to sleep?", (2) sleep latency "Q. When in bed, how long does it take you to sleep?", (3) sleep duration "Q. How long do you usually sleep?", (4) sleep quality "Q. How do you describe your sleep quality?", (5) daytime naps "Q. Do you

usually take naps during the day?" and (6) nocturnal awakening "Q. How often do you wake up at night during sleep?". A summary of provided answers and participant responses (counts) are available in supplementary Table S1.

2.3.3 Dream Characteristics and Lucid Dreaming

Five questions regarding dreaming and associated dream characteristics were provided, including; (1) dreaming frequency "Q. How often do you have dreams during sleep?", (2) dream recall "Q. How often do you remember dreams upon waking up?", (3) frequency of nightmares "Q. How often do you have nightmares?", (4) day-dreaming "Q. How often do you have day-dreams?" and (5) dream meaningfulness "Q. Do you believe that dreams have a meaning or something to tell us about the future?". Participant responses are summarized in supplementary Table S1.

To assess the participants' awareness of lucid dreaming, they were asked a yes/no question "Q. Have you ever heard about lucid dreaming?" prior to providing the definition of lucid dreaming. Afterwards, lucid dreaming definition was introduced "A lucid dream is a phenomenon in which the dreamer is aware that he/she is dreaming while the dream is going on" (Schredl et al., 2018), which was followed by a question to determine lucid dreaming prevalence and frequency "Q. How often do you have lucid dreams?". Lastly, to assess the recency of experienced lucid dreams, participants were asked "Q. When was your last lucid dream?".

2.4. Statistical Analysis

Data analysis was conducted using JASP software (Version 0.14.1, www.jasp-stats.org). The frequency of lucid dreaming was calculated for each participant subgroup as the number of lucid dreams per month (reported as mean ± standard deviation). This was done using class means of participant responses ("Never had a lucid dream" = 0, "Once per year or less" = 0.0833, "Two to four times per year" = 0.25, "Once per month" = 1, "Two to three times per month" = 2.5, "Once per week" = 4 and "Multiple times per week" = 14). Similarly, the frequency of dreams was converted based on response class means ("Once per month or less" = 1, "Two to three times per month" = 2.5, "Once per week" = 4, "Multiple times per week" = 14, "Everyday" = 30). Dependence of lucid dreaming incidence on partici-

Table 1. Participant demographics.

Variable	Count (%)	Variable	Count (%)
Age		Physical Activity	
<18	12 (3.1%)	Inactive	86 (22.0%)
18-25	370 (94.9%)	Moderate	235 (60.3%)
>25	8 (2.0%)	High	69 (17.7%)
Gender		Working Status	
Male	114 (29.2%)	Studying Only	289 (74.1%)
Female	276 (70.8%)	Studying and Working	101 (25.9%)
Marital Status		Smoking Status	
Single	356 (91.3%)	Non-Smoker	318 (81.5%)
Married	15 (3.8%)	Smoker	72 (18.5%)
Other	19 (4.9%)		

Table 2. Frequency of lucid dreaming.

Response	Class Mean (Lucid dreams/month)	Frequency (Number of Participants)	%
Never had a lucid dream	0	113	29
Once per year or less	0.0833	96	24.6
Two to four times per year	0.25	82	21
Once per month	1	48	12.3
Two to three times per month	2.5	21	5.4
Once per week	4	25	6.4
Multiple times per week	14	5	1.3

participant demographics was assessed using Chi-square test. To evaluate the impact of sleep behavior and dreaming characteristics, participant responses were coded into ordinal values for non-parametric testing, supplementary Table S1. These included sleep time, latency, duration, quality, daytime naps, nocturnal awakening, frequency of dreaming, dream recall, frequency of nightmares, dream meaningfulness and day-dreaming. Shapiro-Wilk Test of bivariate and multivariate normality was significant ($P < 0.001$) for all above variables indicating deviation from normal distribution. Differences between participant groups in relation to lucid dreaming incidence and frequency ranks were assessed using Mann-Whitney (MW) test or Kruskal-Wallis (KW) test with Post-hoc Dunn test (P values were adjusted using Holm-Bonferroni method, P_{holm}). Spearman's Rank Correlation was used to determine the existence of correlation between sleep and dreaming characteristics and the frequency of lucid dreaming. Significance was determined at 95% confidence level ($P < 0.05$).

3. Results

3.1. Awareness and Prevalence of Lucid Dreaming

The sample participants had an overall lucid dreaming prevalence of 71% ($n=277$) and an overall frequency of 0.77 ($SD=1.85$, $n=390$) lucid dreams/month, Table 2. The percentage of participants who are considered frequent lucid dreamers, i.e. reporting a frequency of one lucid dream per month or more (Snyder & Gackenbach, 1988), was 25.4% ($n=99$) compared to 74.6% infrequent lucid dreamers. Out

Table 4. Lucid dreaming and sleep behavior.

Lucid Dreaming Sleep Variable	Incidence		Frequency		Correlation	
	χ^2 Statistic	P-value	H Statistic	P-value	ρ Statistic	P-value
Time	3.614	0.306	2.093	0.553	0.060	0.240
Latency	3.689	0.450	3.746	0.441	0.091	0.072
Duration	6.174	0.187	6.804	0.147	-0.074	0.142
Quality	6.404	0.171	4.664	0.323	-0.017	0.737
Daytime Naps	5.999	0.050	1.462	0.481	-0.061	0.228
Night Awakening	13.784	0.008**	15.603	0.004**	0.174	<0.001**

** $P < 0.01$

Table 3. Lucid dreaming and participant demographics.

Demographic Factor	Lucid Dreaming Incidence		Lucid Dreaming Frequency	
	χ^2 Statistic	P-value	Statistic	P-value
Age	1.189	0.552	H 0.555	0.758
Gender	0.248	0.618	U 15772.5	0.968
Marital Status	0.969	0.616	H 0.884	0.643
Working Status	0.692	0.406	U 13921.5	0.479
Smoking Status	0.107	0.743	U 11482.5	0.968
Physical Activity	0.065	0.968	H 0.470	0.790

of all 390 participants, 150 (38.5%) were "aware" of lucid dreaming before receiving the definition (answered "yes" to "have you ever heard about lucid dreaming?" question). Of these participants, 124 (82.7%) reported having a lucid dream before compared to 63.8% (153 out of 240) of participants who were not aware of lucid dreaming. Accordingly, awareness and incidence of lucid dreaming were deemed dependent variables ($\chi^2 = 16.1$, $P < 0.001$). Indeed, participants who were aware of lucid dreaming (mean 0.923 ± 1.59 lucid dreams/month, $n=150$) had 2.71-fold higher odds (OR 2.71, 95% CI 1.65 – 4.46, $P < 0.001$) of experiencing a lucid dream than unaware participants (mean 0.67 ± 1.79 , $n=240$, $U=14578$, $P < 0.01$). The overall frequency of dreams in the sample was 11.6 ($SD=10.7$) dreams/month; therefore, the estimated percentage of lucid dreams from all experienced dreams is 6.64%.

3.2. Lucid Dreaming is Independent from Participant Demographics

The occurrence of lucid dreaming was independent from participant demographic variables including age group, gender, marital status, working status, smoking status and physical activity. Additionally, the distribution of lucid dreaming frequency variable (based on ranks) was not statistically different among these demographic groups, as assessed using KW and MW tests, Table 3.

3.3. Sleep Behavior and Lucid Dreaming Frequency

In relation to sleep behavior, the frequency of nocturnal (night) awakenings during sleep was related to lucid dream-

Table 5. Lucid dreaming and dream characteristics.

Lucid Dreaming	Incidence		Frequency		Correlation	
Sleep Variable	χ^2 Statistic	P-value	H Statistic	P-value	ρ Statistic	P-value
Frequency	11.47	0.022*	18.11	0.001**	0.204	<0.001**
Recall	8.675	0.034*	16.68	<0.001**	0.182	<0.001**
Nightmares	18.72	<0.001**	12.44	0.014*	0.068	0.183
Day-Dreaming	10.96	0.027*	17.46	0.002**	0.191	<0.001**
Meaningfulness	9.274	0.01*	9.971	0.007**	0.127	0.012*

* P<0.05, **P<0.01

ing incidence ($\chi^2 = 13.8, P<0.01$), significantly affected lucid dreaming frequency distribution ($H = 15.6, P<0.01$) and correlated with lucid dreaming frequency ($\rho = 0.174, P<0.001$). For instance, participants reporting an average of two awakenings per night (mean 1.10 ± 2.05 lucid dreams/month) had more frequent distribution of lucid dreams ($P_{\text{holm}}<0.001$) than participants reporting no night awakenings (mean 0.59 ± 1.79 , Effect size $d = 0.27$). In contrast, all other assessed factors including sleep time, sleep latency, sleep duration, quality of sleep and frequency of daytime naps were independent from and did not correlate with lucid dreaming incidence and frequency, respectively, Table 4. However, a positive correlation (one-tailed) was observed between lucid dreaming frequency and sleep latency ($P=0.036$).

3.4. Dream Characteristics Impact Lucid Dreaming Frequency

All investigated dream characteristics in the sample including dreaming frequency, dream recall, nightmare frequency,

day-dreaming and the belief of dream meaningfulness were significantly related to lucid dreaming incidence and frequency distribution. Additionally, the aforementioned dream characteristics showed a statistically significant correlation with the frequency of lucid dreaming with the exception of nightmare frequency. The statistical analysis results are summarized in Table 5.

The results show that increased dreaming frequency is associated with more frequent distribution of lucid dreams. Indeed, participants who experience almost daily dreams had higher frequency of lucid dreams (mean 1.05 ± 1.97 lucid dreams/month) than participants reporting once weekly ($0.59 \pm 1.07, P_{\text{holm}}<0.05$) or once monthly dreams ($0.35 \pm 0.87, P_{\text{holm}}<0.001$). Similarly, a higher dream recall of almost all dreams (mean 1.39 ± 2.98) was related to higher lucid dreaming frequency than a recall of few ($0.63 \pm 1.48, P_{\text{holm}}<0.05$) or almost no dreams ($0.18 \pm 0.53, P_{\text{holm}}<0.001$).

A positive correlation for lucid dreaming was also observed with day-dreaming and the belief of dream-meaning-

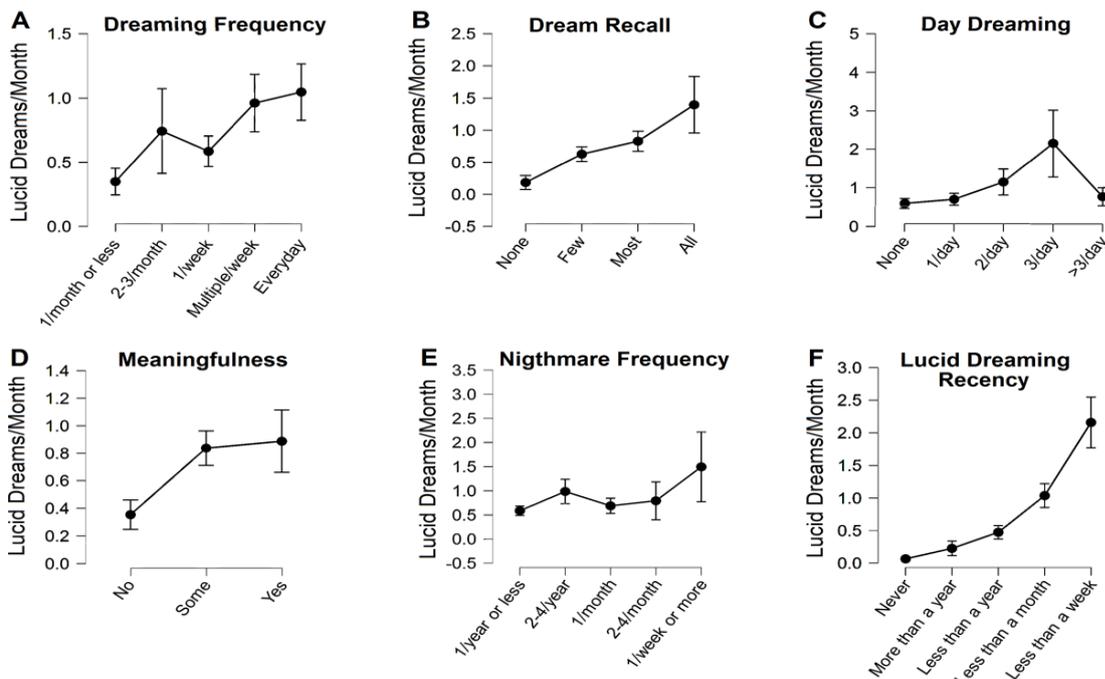


Figure 1. Lucid dreaming frequency and dreaming characteristics. The results are plotted as (mean \pm SEM) lucid dreams/month for the different participant groups based on A) dreaming frequency, B) recall, C) day-dreaming, D) belief of dream meaningfulness, E) nightmare frequency and F) how recent the last experienced lucid dream was.

fulness. Participants reporting a daily average of two day-dreaming episodes (mean 1.15 ± 2.32) had more frequent lucid dreams than participants experiencing no day-dreams (0.59 ± 1.68 , $P_{\text{holm}} < 0.01$). Despite that an average of three day-dreams displayed the highest lucid dreaming frequency (mean 2.15 ± 3.47 , $n=16$), the differences in ranks with other groups were not significant ($P_{\text{holm}} > 0.05$). Interestingly, participants who believe that all (mean 0.89 ± 1.96 , $n=74$) or some (0.84 ± 2.0 , $n=251$) dreams have a meaning had higher lucid dreaming frequency distribution than participants who do not (0.35 ± 0.86 , $n=65$, $P_{\text{holm}} < 0.01$). Lastly, a significant correlation was observed between lucid dreaming frequency and how recent the last experienced lucid dream was ($P < 0.001$). The results are plotted based on dream characteristics for the different participants' groups in Figure 1.

4. Discussion

The results indicate similar lucid dreaming prevalence and frequency patterns to other populations, suggesting that cultural difference in the tested population sample do not significantly influence lucid dreaming incidence and prevalence. However, as the main hypothesized culture affecter of lucid dreaming is the attitude towards dreams, the result indeed show that a belief of dream meaningfulness is significantly associated with higher incidence and frequency of lucid dreams.

The results revealed an overall lucid dreaming prevalence of 71% with a percentage of 25.4% frequent lucid dreamers, which is comparable to previous findings reporting a prevalence range of 47-90% and a percentage range of 17-38% of frequent lucid dreamers for university student samples from different populations (Palmer, 1979; Blackmore, 1982; Schredl & Erlacher, 2004; Erlacher et al., 2008; Yu, 2008). Consistent with previous evidence, no significant influence was observed for participant demographics on lucid dreaming incidence and frequency (Gackenbach, 1988; Snyder & Gackenbach, 1988; Schredl & Erlacher, 2004; Schredl & Erlacher, 2011; Erlacher, et al., 2012; Zink & Pietrowsky, 2013; Bulkeley, 2014). However, some studies reported that females have an earlier age of onset and different phenomenology of lucid dreaming compared to males (Stumbrys et al., 2014; Hess et al., 2017).

Apart from nocturnal awakenings, all other assessed sleep characteristics in this sample were independent from and did not correlate with lucid dreaming occurrence and frequency, respectively. The positive correlation observed between nocturnal awakenings and frequency of lucid dreams is consistent with previous reports (Smith & Blagrove, 2015). Accordingly, recent studies showed an association between lucid dreaming and sleep fragmentation and narcolepsy-associated sleep alterations (Dodet et al., 2015; Rak et al., 2015; Gott et al., 2020). Additionally, a proposed technique of lucid dreaming induction is known as the "wake-back-to-bed" method (LaBerge et al., 1994; Stumbrys et al., 2012). As lucid dreaming is hypothesized to represent a state between sleep and wakefulness (LaBerge et al., 1986; LaBerge, 1990; Voss et al., 2009), evidence suggests a role for lucid dreaming in the study and potential treatment of insomnia (Knab & Engel, 1988; Ellis et al., 2021). These findings further support the one-tailed positive correlation between lucid dreaming frequency and sleep latency observed in this sample.

In relation to dream characteristics, the current findings show that lucid dreaming is significantly dependent on

multiple dream variables. Dream characteristics such as frequency and recall are hypothesized to depend on certain personality factors including creativity and attitudes towards dreams (Wolcott & Strapp, 2002; Aumann et al., 2012; Schredl & Göritz, 2017), which also associate with lucid dreaming (Gackenbach, 1988; Gruber et al., 1995; Patrick & Durdell, 2004; Zink & Pietrowsky, 2013; Hess et al., 2017; Schredl et al., 2019). In addition, day-dreaming frequency in this sample is found to positively correlate with lucid dreaming frequency. Similarly, day-dreaming is associated with positive attitudes and creativity; thus, considered personality-dependent (Gold & Cundiff, 1980; Zhiyan & Singer, 1997; Blouin-Hudon & Zelenski, 2016; Zedelius et al., 2020). These results indicate that dream characteristics reflect personality factors that influence lucid dreaming and could represent a waking and sleeping personality continuum (Gruber et al., 1995; Schredl & Erlacher, 2004). Indeed, the general dream structure differs between lucid and non-lucid dreamers as shown by Zink & Pietrowsky (2013) who also reported that lucid dreams have higher personal significance and reflect on experienced daytime events. This is consistent with the current finding that belief of dream meaningfulness is significantly associated with lucid dreaming in this sample. Lastly, another interesting finding of the current study is the significant association between lucid dreaming awareness and frequency.

Two limitations may be argued to affect result interpretation. Firstly, the age range of sample participants is relatively young, which may suggest lower cultural awareness compared to elder persons. Nonetheless, the cultural attitudes toward dream meaningfulness did correlate with lucid dreaming frequency suggesting that the potential effect of age is minor. Secondly, participant responses to some of the assessed sleep and dream characteristics, which may undergo variations overtime, could have been based on the most recent patterns. This might be argued to be a source of variation; however, the effect would have been minimized by the employed sample size.

5. Conclusions and Future Directions

The current findings, particularly the association between lucid dreaming awareness and perceived dream value with lucid dreaming frequency, suggest that attitudes towards dreaming may influence psychological barriers controlling lucid dreaming. This follows the general consensus that multiple psychological aspects impact the cognitive ability and self-awareness during lucid dreaming. Accordingly, subsequent studies in a wider population shall examine whether familiarization with lucid dreaming would have a causal role in experiencing lucid dreams. In addition, to assess the differential effect, or lack thereof, between anticipated positive and negative lucid dreaming experiences. At last, the molecular mechanisms underlying lucid dreaming are largely unknown; nevertheless, further research focusing on the psychology of lucid dreaming may provide key insights into the cognitive physiology of the sleep-wake cycle and the dream lucidity phenomenon as a dissociative mental state of consciousness.

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SUPPLEMENTARY

Table S1. Participant sleep behavior and dream characteristic groups and responses.

Sleep Variable	Count (%)	Coding	Dream Variable	Count (%)	Coding
Latency			Frequency		
< 15 minutes	101 (25.9%)	0	1/month or less	70 (18%)	0
15 – 30 minutes	129 (33.1%)	1	2-3 times/month	45 (11.5%)	1
30 – 60 minutes	80 (20.5%)	2	1/week	80 (20.5%)	2
1 – 2 hours	61 (15.6%)	3	Multiple times/week	114 (29.2%)	3
> 2 hours	19 (4.9%)	4	Everyday	81 (20.8%)	4
Time			Recall		
Before 8 pm	7 (1.8%)	0	None	24 (6.2%)	0
8 – 10 pm	35 (9%)	1	Few dreams	173 (44.3%)	1
10 pm – 12 am	153 (39.2%)	2	Most dreams	147 (37.7%)	2
After 12 am	195 (50%)	3	Every dream	46 (11.8%)	3
Duration			Nightmares		
< 6 hours	29 (7.5%)	0	1/year or less	140 (35.9%)	0
6 – 7 hours	105 (26.9%)	1	2-4 times/year	84 (21.5%)	1
7 – 8 hours	128 (32.8%)	2	1/month	109 (28%)	2
8 – 9 hours	84 (21.5%)	3	2-4 times/month	37 (9.5%)	3
> 9 hours	44 (11.3%)	4	Multiple times/week	20 (5.1%)	4
Quality*			Day-Dreaming		
Very Bad	42 (10.8%)	0	None	182 (46.7%)	0
Low	45 (11.5%)	1	1/day	114 (29.2%)	1
Moderate	106 (27.2%)	2	2/day	47 (12.1%)	2
Good	161 (41.3%)	3	3/day	16 (4.1%)	3
Excellent	36 (9.2%)	4	> 3/day	31 (7.9%)	4
Daytime Naps			Meaningfulness		
None	282 (72.3%)	0	None	65 (16.7%)	0
Once per day	102 (26.2%)	1	Some dreams	251 (64.3%)	1
Two or more times	6 (1.5%)	2	All dreams	74 (19%)	2
Nocturnal Awakening					
None	150 (38.4%)	0			
1 per night	124 (31.8%)	1			
2 times	63 (16.2%)	2			
3 times	41 (10.5%)	3			
> 3 times	12 (3.1%)	4			

* Participant perceived quality: "Very bad" was defined as to wake up very tired, sleepy and poorly rested, "Excellent" was defined as to wake up refreshed and well rested.