

# Dream Recall Frequency, Lucid Dream Frequency, and Personality During the Covid-19 Pandemic

Imagination, Cognition and  
Personality: Consciousness in  
Theory, Research, and Clinical  
Practice

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## Abstract

Dream recall frequency and lucid dream frequency showed large inter-individual differences that are partly related to personality dimensions. However, as dream research is a small field, independent studies are necessary to build a solid empirical foundation. The present online survey included 1,537 participants (1,150 women, 387 men) with a mean age of  $35.1 \pm 15.8$  years. Whereas the relationship between openness to experience and dream recall frequency was in line with previous research – supporting the life-style hypothesis of dream recall, the associations between the Big Five personality factors and lucid dream frequency are less homogenous; for example, the negative relationship between neuroticism and lucid dream frequency. Even though the effect sizes of these associations are small, the findings can help in identifying links between waking and dreaming. Moreover, it was found that lucid dream frequency was related to Covid-19-related worries, whereas dream recall frequency was not.

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Two publication pattern analyses (Nielsen, 2011; Nielsen & Germain, 1998) based on the databases PsycINFO and Index Medicus/PubMed clearly indicated that dream research is a very small field. Dreaming defined as subjective experiences during sleep that can be recalled upon awakening (Schredl, 2018) falls within the broader field of psychology. A keyword search in PsycINFO (American Psychological Association) carried out on March 9, 2022, resulted in 4,820 hits for the keyword dreaming, whereas sleep (32,492 hits), memory (92,461 hits), and personality (50,159 hits) produced much more publications (all search terms were introduced in 1967 into the PsycINFO database). Given the broad spectrum of dream research topics ranging from dream recall, dream content, and nightmares to clinical uses of dreams, it seems inevitable that the number of empirical findings regarding a specific research question is small. These small numbers of research studies reinforce the so-called replication crisis postulated in psychology, as carefully carried out replications studies could not confirm the findings in a considerably large percentage of publications (up to two thirds) (Lewandowsky & Oberauer, 2020). To deal with this problem, meta-analyses can be considered as they are based on a number of independently carried out studies. (Sharpe & Poets, 2020); thus, replication studies are important. In this paper, for two topics (1) dream recall frequency and big five personality factors and (2) lucid dream frequency and big five personality factors we present a review of the empirical studies and replication studies that have been carried out so far.

Dream recall is considered successful if the person can remember some content of the subjective experiences that had occurred during sleep. (Schredl, 2018). In representative studies (Schredl, 2008, 2009), the mean dream recall is once per week. A wide variety of factors affect intra-individual fluctuations, and inter-individual differences in dream recall, for example, sleep duration (Schredl & Fulda, 2005), nocturnal awakenings (Schredl et al., 1998), default mode network connectivity (Vallat et al., 2022), personality dimensions such as absorption (Beaulieu-Prevost & Zadra, 2007), boundary thinness (Hartmann, 1989), and openness to experience (Schredl & Göritz, 2017). Even though comprehensive models of dream recall have been proposed (Schredl, 2018), Schonbar (1965) has put forward a very specific theoretical framework, the so-called “life-style hypothesis of dream recall”, to explain stable inter-individual differences in dream recall frequency, that is, persons with high introspection, who are interested in psychological topics, vivid imagination tend to recall dreams more often. This hypothesis is supported by research showing that interest in dreams, for

example keeping a dream diary, increases dream recall (Schredl, 2018). The dream recall studies using a Big Five personality measure (see Table 1) would support this “life-style hypothesis” as openness to experience is consistently related to dream recall frequency across the studies, with only one exception (Schredl, 2002a). Two studies (Aumann et al., 2012; Schredl & Göritz, 2017) found a small but substantial correlation between neuroticism and dream recall frequency: However, Schredl and Göritz (2017) demonstrated that this is due to the increased frequency of nightmares, in other words, dream recall in persons with high neuroticism scores are increased because they experience more nightmares (Levin & Nielsen, 2007). Correlations between the other three Big Five factors (extraversion, agreeableness, conscientiousness) and dream recall frequency have only been found once (see Table 1) and, thus, have not been corroborated by independent studies. Although the pattern regarding openness to experience and dream recall seems consistent, the association of the other Big Five factors with dream recall is less clear and warrants further studies.

Lucid dreams are a special form of dreams in which the dreamer is aware that she or he is dreaming while dreaming (LaBerge, 1985). About 50% of the population has experienced one lucid dream during one’s lifetime (Saunders et al., 2016; Schredl & Erlacher, 2011). Frequent lucid dreamers exist, but are quite rare (Saunders et al., 2016). A variety of factors have been associated with lucid dream frequency, for example, meditation practice (Baird et al., 2018), mindfulness (Stumbrys & Erlacher, 2017), need for cognition (Blagrove & Hartnell, 2000), and openness to experience (Hess et al., 2017). The empirically validated effects of lucid dream induction techniques, like reality checks (Stumbrys et al., 2012), support the idea that persons who actively reflect on their state of consciousness while being awake experience lucid dreams more often. Nevertheless, the most important factor in explaining inter-individual differences in lucid dream frequency is overall dream recall frequency (Hess et al., 2017); therefore, it is important to control dream recall frequency when studying the relationship between lucid dream frequency and personality. The six empirical studies summarized in Table 2 indicated that the pattern between lucid dream frequency and the Big Five personality measures is – in contrast to the dream recall frequency findings (see Table 1) – less consistent. Three studies (Hess et al., 2017; Schredl et al., 2016b; Watson, 2001) found the expected association between openness to experience and lucid dream frequency; however, one study (Watson, 2001) did not control for dream recall frequency. These findings would fit in the above-mentioned theory that being open to inner processes in waking life is associated with a higher frequency of lucid dreams. Three studies (Hess et al., 2017; Watson, 2001) found a relationship between agreeableness and lucid dream frequency. One idea might be that as lucid dreams are often characterized by wish-fulfilment (gratifying one’s own needs) (Stumbrys et al., 2014) that persons with frequent lucid dreams tend to be less orientated toward the needs and perspective of other persons – a key concept in agreeableness (Shirayev, 2017). In addition the relationship between lucid dream frequency and conscientiousness reported by three studies (Schredl et al.,

**Table 1.** Dream Recall Frequency and the Big Five Personality Dimensions.

Big Five Factors	Hill et al. (1997)	Schredl (2002a)	Watson (2003)	Schredl (2004c)	Aumann et al. (2012)	Schredl et al. (2016a)	Schredl et al. (2016a)	Schredl and Göritz (2017)	Schredl & Rauthmann (2022)
Sample size	336	108	169	437	1,958	745	551	2,492	819
Sample type	Students	Students	Students	Students	Mainly students	Adolescents	Adults	Adults	Mainly students
Statistical analysis	Correlations	Correlations	Correlations	Regression	Correlations	Regression	Regression	Regression	Regression
Neuroticism	-.09	.104	.05	-.0056	.079***	.0012	.0667	.1826***	.0354
Extraversion	.08	-.068	.02	-.0646	.087***	.0585	.0002	-.0043	.0109
Openness to experience	.23***	-.090	.22**	.1705***	.154***	.0856*	.1959***	.2219***	.1919***
Agreeableness	.00	-.048	.07	-.0958	.00	-.0110	.1008*	.0322	.0591
Conscientiousness	.09	.003	-.07	.0353	.01	-.0198	-.0341	.1063***	-.0104

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

**Table 2.** Lucid Dream Frequency and the Big Five Personality Dimensions.

Big Five Factors	Watson (2001) Sample 1	Watson (2001) Sample 2	Schredl and Erlacher (2004)	Schredl et al. (2016b)	Hess et al. (2017)	Shafiei (2019)
Sample size	471	457	439	1,210	2,491	234
Sample type	Students	Students	Students	Adolescents/ Adults	Adults	Adults
Statistical analysis	Correlations	Correlations	Correlations	Regression	Regression	Regression
Controlled for DRF	No	No	No	Yes	Yes	Yes
Neuroticism	.02	.03	.002	-.0158	.0608*	-.016
Extraversion	.01	.13**	.034	.0601	.0167	-.036
Openness to experience	.14**	.08	.058	.2528***	.1244***	.031
Agreeableness	-.11*	-.09*	-.032	.0177	-.0833***	-.020
Conscientiousness	-.10*	-.15**	.015	-.1031**	-.0234	.006

\* p < .05, \*\* p < .01, \*\*\* p < .001, DRF = Dream recall frequency.

2016b; Watson, 2001) is very interesting; high conscientiousness including elements like, for example, strive for achievement and less spontaneity (Shiraev, 2017), is associated with lower frequencies of lucid dreams. Considering that only one study reported a relationship between neuroticism and lucid dream frequency, one might hypothesize that persons with high neuroticism scores and, thus, those who have more nightmares, may use lucid dreaming as a way of coping with them (Zadra & Pihl, 1997). Overall, the pattern between lucid dream frequency and the Big Five personality factors is very inhomogeneous and, therefore, more independent studies are required to understand this pattern.

The main objective of the present study was to investigate the relationship between the Big Five personality factors, dream recall frequency, and lucid dream frequency in a new and independent sample. However, as the survey was carried out during the Covid-19 pandemic, we had the opportunity to explore whether the presence and intensity of Covid-19-related anxiety is related to dream recall frequency and/or lucid dream frequency as a substantial number of studies (Fränkl et al., 2021; Guerrero-Gomez et al., 2021; Schredl & Bulkeley, 2020; Solomonova et al., 2021) reported an increased dream recall frequency due to the pandemic in a substantial percentage of the population. For focusing on the main objective of the study, we included this COVID-19 related variable in the regression analysis in order to control for possible confounding effects.

## **Methods**

### *Participants*

Overall, 1,537 participants (1150 women, 387 men) were recruited and completed the online survey between June 2020 and June 2021. The mean age was  $35.1 \pm 15.8$  years (range: 15 to 88 years). Most of the population (66.49%) identified as Caucasian, the other participants were grouped into “Non-white” (33.51%) with Asian (13.73%), Black/African (8.07%), Indigenous (4.16%), and others (7.55%). Participants were asked to name any mental health diagnosis received from a doctor or health care professional. Participants chose one or more of the 19 diagnoses listed. The most common current diagnoses were mood disorders ( $N = 226$ , 14.70%) and anxiety disorders ( $N = 202$ , 13.14%). Other diagnoses were reported by 82 participants (5.34%).

### *Research Instruments*

For eliciting dream-related variables, the English version of the Mannheim Dream questionnaire (MADRE) was used (Schredl et al., 2014). Dream recall frequency was measured with a seven-point scale (coded as 0 = never, 1 = less than once a month, 2 = about once a month, 3 = about 2 to 3 times a month, 4 = about once a week, 5 = several times a week, 6 = almost every morning). The scale has a high

retest reliability (mean interval about 8 weeks) with  $r = 0.85$  (Schredl, 2004b). An eight-point rating scale measuring lucid dream frequency was presented (“How often do you experience so-called lucid dreams?”) 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 = two to three times a month, 6 = about once a week, 7 = several times a week). To ensure a correct understanding of the phenomenon of lucid dreaming, the following definition was included: “In a lucid dream, one is aware that one is dreaming during the dream. Thus, it is possible to wake up deliberately, or to influence the action of the dream actively, or to observe the course of the dream passively.” The retest reliability (four-week interval) of this scale was  $r = .89$  (Stumbrys et al., 2013). A similar eight-point scale was presented for measuring nightmare frequency, also including a definition to ensure proper understanding of the nature of nightmares: “Nightmares are dreams with strong negative emotions that result in awakening from the dreams. The dream plot can be recalled very vividly upon awakening. (Schredl et al., 2014)”. The retest reliability of this scale was  $r = .75$  (Stumbrys et al., 2013).

The Big Five personality factors (neuroticism, conscientiousness, extraversion, agreeableness, and openness) were measured with a 10-item version of the Big Five Personality Questionnaire BFI-10 (Rammstedt & John, 2007). The findings of Rammstedt and John (2007) and others, e.g., Kunnel John et al. (2019), indicated that the BFI-10 scales retain significant levels of reliability and validity, comparable to the BFI-44 with 44 Items with adequate reliability coefficients (Cronbach’s alpha) ranging from .79 to .88 for the five subscales (Benet-Martínez & John, 1998).

Participants completed a 21-item version of the Depression Anxiety Stress Scale (DASS-21), a shortened version of the 42-item DASS (Antony et al., 1998). This shortened version of the DASS scale is comparable to the 42-item DASS with high Cronbach’s alpha for the subscales for depression ( $\alpha = .94$ ), anxiety ( $\alpha = .87$  for, and stress ( $\alpha = .91$ ) (Antony et al., 1998). In the present sample, the inter-correlations between the three factors were high (range:  $r = .686$  to  $r = .771$ ,  $N = 1,537$ ) and the Cronbach’s alphas were high: for the DASS-21 total score  $r = .949$ , for the depression subscale  $r = .925$ , for the anxiety subscale  $r = 0.87$ , and for the stress subscale  $r = 0.871$ .

The Pandemic Anxiety Scale (PAS) containing 7-item was completed by participants to measure their Covid-19-related worries (McElroy et al., 2020). Five-point Likert scales ranging from 0 (“strongly disagree”) to 4 (“strongly agree”) was used, e.g., “I am worried that I will catch Covid-19.” or “I am worried about missing school or work.” Cronbach’s alpha values for the two subscales ranged from 0.78 to 0.60 (McElroy et al., 2020). In the present sample, Cronbach’s alpha for all seven items was  $r = .787$  ( $N = 1,537$ ).

## Procedure

Participants were recruited by promoting the study through partner organizations, charities, health authorities, clinics, hospitals, posters, social media (e.g., Instagram,

Twitter, and Facebook) and via Dalhousie University's experimental participation system (SONA). The study was entitled "PROSIT-Covid19" with Predicting Risks and Outcomes of Social InTeractions (PROSIT) being a research project located at Dalhousie University and the IWK Health Centre. There were no exclusion criteria, e.g., persons with or without a diagnosis of a mental disorder or illness could participate. Participants received a link to register for the study, where they could provide fully informed consent for participation in the study. REDCap, a secure web-based platform, was utilized to create and deliver the online dream questionnaire. Participants who completed the survey received financial compensation (\$10) or university academic bonus points (0.5 SONA points). The study protocol was approved by the local ethics committee in accordance with the Declaration of Helsinki.

### **Data Analysis**

Statistical procedures were performed using the R statistical computing platform version 4.1.0 (R Core Team, 2021). For this paper, the sample with complete data regarding dream recall frequency, DASS-21, Big Five personality factors, and Covid-19-related anxiety were included. Very few missing values were present in the other two dream-related variables (lucid dream frequency and nightmare frequency). As dream recall frequency and lucid dream frequency were measured on ordinal scales, ordinal regressions were used to analyze the effects of different predictors (the Big five personality factors, DASS-21 and Covid-related anxiety) on dream recall frequency and lucid dream frequency, controlling for age, sex, ethnicity, and current mental health diagnoses. The regression coefficients of the ordinal regression are "standardized estimates". In addition, effect sizes (Cohen's *d*) based on the regression coefficients were computed.

### **Results**

The means and standard deviations of the Big Five personality factors, the Depression Anxiety Stress Scale (21 Items), and the Covid-related anxiety (Pandemic Anxiety Scale) are depicted in Table 3. The distribution of the dream recall frequency scale is shown in Table 4, highlighting that only a small proportion never recalled dreams, about 40% of the participants recalled their dreams once a week or more often. More than 60% of the participants reported having at least one lucid dream (see Table 5), and more than 20% stated that they had lucid dreams at least a month. Lucid dream frequency was correlated to dream recall frequency:  $r = .343$  (Spearman correlation,  $p < .0001$ ,  $N = 1,528$ ). Slightly more than 20% of the participants reported not having nightmares; however, about 14% experienced nightmares once a week or more often (see Table 5). Nightmare frequency was related to dream recall frequency ( $r = .488$ , Spearman correlation,  $p < .0001$ ,  $N = 1,531$ ) and lucid dream frequency ( $r = .360$ , Spearman correlation,  $p < .0001$ ,  $N = 1,524$ ). The



**Table 3.** Means and Standard Deviation the Big Five Personality Factors, the DASS-21, and the Covid-Related Anxiety Scale (N = 1,537).

Category	Mean ± SD
Neuroticism	6.64 ± 2.28
Extraversion	5.98 ± 2.22
Openness to experience	7.05 ± 1.94
Agreeableness	7.14 ± 1.92
Conscientiousness	7.59 ± 1.90
DASS-21	39.27 ± 14.04
Covid-related anxiety (PAS)	26.83 ± 6.46

DASS-21 = Depression Anxiety Stress Scale (21 Items), Pandemic Anxiety Scale (PAS).

**Table 4.** Dream Recall Frequency Distribution (N = 1,537).

Category	Frequency	Percentage
Almost every morning	159	10.34%
Several times a week	371	24.14%
About once a week	247	16.07%
About 2 to 3 times a month	268	17.44%
About once a month	156	10.15%
Less than once a month	207	13.47%
Never	129	8.39%

correlation coefficient for the relationship between nightmare frequency and lucid dream frequency was reduced ( $r = .235$ , Spearman partial correlation), but still significant ( $p < .0001$ ) if dream recall frequency was accounted for.

The ordinal regression for dream recall frequency (Table 6, Analysis 1) indicated that openness to experience was, as expected, related to dream recall frequency (small effect size). The relationship between conscientiousness and dream recall was significant but very small. Dream recall frequency was lower in older persons, and persons with non-white ethnicity recalled their dreams less often the persons with Caucasian descent (see Table 6, Analysis 1). Interestingly, there were no gender differences in dream recall frequency. Whereas Covid-related anxiety was not related to dream recall frequency, the Depression Anxiety Stress Scale (DASS-21) total score was related (see Table 6, Analysis 1). In order to test whether this relationship might be due to nightmare frequency, that is persons with high DASS-21 scores experience more nightmares and, therefore, have higher overall dream recall, we conducted a second analysis including nightmare frequency as an additional predictor (see Table 6, Analysis 2). In addition, the DASS-21 score was, indeed, no longer related

**Table 5.** Lucid Dream Frequency and Nightmare Frequency Distributions.

Category	Lucid dream frequency (N = 1,528)		Nightmare frequency (N = 1,531)	
	Frequency	Percentage	Frequency	Percentage
Several times a week	64	4.16%	108	7.03%
About once a week	66	4.29%	113	7.35%
two or three times a month	121	7.87%	205	13.34%
About once a month	141	9.17%	215	14.00%
About two or four times a year	231	15.03%	326	21.21%
About once a year	111	7.22%	94	6.12%
Less than once a year	201	13.08%	140	9.11%
Never	593	38.58%	330	21.47%

to dream recall frequency, whereas the relationship between openness to experience and dream recall frequency remained unchanged.

The ordinal regression for lucid dream frequency was controlled for dream recall frequency that is the strongest factor related to lucid dream frequency (see Table 7, Analysis 1). Despite controlling for dream recall frequency (which is related to openness to experience), lucid dream frequency was also related to openness to experience (see Table 7, Analysis 1). Neuroticism showed a negative association with lucid dream frequency. Older persons were more likely to report higher lucid dream frequency; also men tended to estimate their lucid dream frequency higher compared to women (see Table 7, Analysis 1). Both scales, the DASS-21 and the Covid-related anxiety scale were related positively to lucid dream frequency. As lucid dream frequency is related to nightmare frequency (see above), we repeated the ordinal regression analysis including nightmare frequency as an additional variable (see Table 7, Analysis 2). Even though, the effects were smaller, the DASS-21 total score and the Covid-related anxiety scale were still related to lucid dream frequency. The overall pattern (age, gender, neuroticism, openness to experience) was not changed by introducing nightmare frequency into the regression analysis (see Table 7, Analysis 2).

## Discussion

Overall, the findings of the current study are in line with previous research showing that openness to experience is the only Big Five personality factor consistently related to dream recall frequency (see studies in Table 1). However, the picture is less clear for lucid dream frequency that was related to high openness to experiences (controlling statistically for the effect of dream recall frequency) and low neuroticism, partly in line with previous findings (see Table 2). In addition, dream recall was not related to Covid-19-related worries, but lucid dream frequency was. Despite the small effect

**Table 6.** Ordinal Regression Analyses for the Dream Recall Frequency.

Variable	Analysis 1 (N = 1,537)				Analysis 2 (N = 1,531)			
	Coefficient	t	p	Effect size	Coefficient	t	p	Effect size
Age	-.2992	-6.1	<.0001	-0.165	-.1837	-3.7	.0002	-0.101
Gender (0 = f, 1 = m)	-.0416	-0.9	.3787	-0.023	-.0777	-1.6	.1026	-0.043
Ethnicity (0 = white, 1 = non-white)	-.1505	-3.2	.0015	-0.083	-.1360	-2.9	.0043	-0.075
Anxiety Disorder	.0206	0.1	.7398	0.011	.0348	0.6	.5729	0.019
Mood Disorder	.0704	1.1	.2550	0.039	.0172	0.3	.7849	0.009
Other diagnoses	-.0067	-0.1	.8955	-0.004	-.0096	-0.2	.8550	-0.005
Neuroticism	-.0568	-1.0	.3328	-0.031	-.0587	-1.0	.3218	-0.032
Extraversion	.0538	1.1	.2567	0.030	.0369	0.7	.4394	0.020
Openness to experience	.1667	3.6	<.0001 <sup>1</sup>	0.092	.1306	2.8	.0023 <sup>1</sup>	0.072
Agreeableness	-.0246	-0.5	.6172	-0.014	.0033	0.1	.9471	0.002
Conscientiousness	.1081	2.2	.0268	0.060	-.0015	0.0	.9766	0.020
DASS-21	.2099	3.6	.0004	0.115	-.0916	-1.5	.1337	-0.051
Covid-related anxiety (PAS)	.0379	0.8	.4427	0.021	-.0814	-1.6	.1075	-0.045
Nightmare frequency					1.0695	18.8	<.0001	0.590

Coefficient = Standardized estimates (equivalent to standardized regression coefficients), <sup>1</sup> one-tailed, DASS-21 = Depression Anxiety Stress Scale (21 items), Pandemic Anxiety Scale (PAS).

**Table 7.** Ordinal Regression Analyses for the Lucid Dream Frequency.

Variable	Analysis 1 (N = 1,528)				Analysis 2 (N = 1,524)			
	Coefficient	t	p	Effect size	Coefficient	t	p	Effect size
Age	.1722	3.4	.0007	0.095	.2147	4.2	<.0001	0.118
Gender (0 = f, 1 = m)	.1866	3.8	.0001	0.103	.1741	3.6	.0003	0.096
Ethnicity (0 = white, 1 = non-white)	.0165	0.3	.7389	0.009	.0288	0.6	.5630	0.016
Anxiety Disorder	.0009	0.0	.9884	0.001	-.0022	-0.0	.9723	0.001
Mood Disorder	.0618	1.0	.3385	0.034	.0342	0.5	.5972	0.019
Other diagnoses	-.0237	-0.4	.6692	-0.013	-.0203	-0.4	.7164	-0.011
Neuroticism	-.2064	-3.4	.0008	-0.114	-.2186	-3.5	.0004	-0.121
Extraversion	-.0766	-1.5	.1232	-0.042	-.0787	-1.6	.1168	-0.043
Openness to experience	.1401	2.9	.0019 <sup>1</sup>	0.077	.1258	2.6	.0050 <sup>1</sup>	0.069
Agreeableness	.0974	1.9	.0579	0.054	.1086	2.1	.0351	0.060
Conscientiousness	.0098	0.2	.8489	0.005	.0518	-0.6	.5311	-0.018
DASS-21	.2786	4.6	<.0001	0.154	.1550	2.5	.0120	0.085
Covid-related anxiety (PAS)	.1821	3.6	.0003	0.100	.1264	2.5	.0140	0.070
Dream recall frequency	.6886	13.1	<.0001	0.380	.4739	8.2	<.0001	0.261
Nightmare frequency					.5290	8.5	<.0001	0.292

Coefficient = Standardized estimates (equivalent to standardized regression coefficients), <sup>1</sup> one-tailed, DASS-21 = Depression Anxiety Stress Scale (21 items), Pandemic Anxiety Scale (PAS).

sizes between dream measures and personality measures, these findings might help to identify possible pathways how these variables might be linked.

The main methodological limitation that should be noted is the sample selection, as it was a convenience sample obtained in the vicinity of a university and a psychiatric hospital. This selection bias was accounted for by including age, gender, ethnicity, clinical diagnoses, and psychopathology into the regression analyses to control for possible confounding effects. For example, much more women than men participated in the study (which is typical, for example, when studying psychology students, e.g., Schredl et al. (2003)). However, by including gender into the regression analyses, the main findings, the associations between personality factors and dream recall frequency respective lucid dream frequency are not affected. For interpreting the association between COVID-19-related anxiety and dream parameters, the knowledge whether the participants had experienced a COVID-19 infection might have helped. On the other hand, one might speculate that persons who experienced very mild COVID-19 infections show low anxiety levels regarding COVID-19 and, thus, the effect is indirectly present in the findings. Because of the sample selection issue, interpreting the effects of socio-demographic variables on the dream variables is quite difficult, e.g., that men more often reported lucid dreams than women. Possible associations with socio-demographic variable and dream-related variables can only be studied in a valid manner in representative samples. The two dream measures were of retrospective nature, showing high retest reliabilities (Schredl, 2004a; Stumbrys et al., 2013) and, thus, indicate that stable inter-individual difference in dream recall frequency and lucid dream frequency have been measured reliably. There is, however, the discussion whether retrospective measures might overestimate or underestimate the real frequency (due to memory biases), for example, if measured with sleep logs (Aspy et al., 2015). On the other hand, keeping a dream diary can increase dream recall frequency dramatically, especially in low dream recallers (Schredl, 2002b) and, thus, affect the variable under study. Despite these methodological issues, correlations between diary measures of dream recall and retrospective scales are high (Schredl, 2018), indicating that correlational patterns (in this case to personality dimensions) should not strongly be affected by this methodological issue. For lucid dream frequency, as being relatively low in many persons, the problem is that obtaining reliable log measures would require long study periods that is typically not feasible in large samples.

The present study offered additional support to the current literature (see Table 1) that openness to experience is the main Big Five factor associated with dream recall frequency and, thus, is in line with the life-style hypothesis of Schonbar (1965). This link might be explained by behavioral factors, e.g., as persons with higher openness to experience scores tend to read more likely magazine articles about dreams and dream interpretation (Schredl, 2011; Schredl & Göritz, 2020), share dreams more often (Graf et al., 2021; Schredl et al., 2016a) and, thus, are more focused on the topic; which increases dream recall (Schredl, 2018). On the other hand, there might be also neurophysiological links as the personality trait of openness to experience is related to increased default mode network connectivity

(Beaty et al., 2016) as is dream recall frequency (Vallat et al., 2022). It would be interesting to study these possible links in future studies by combining neurophysiological measures and psychological measures within one sample.

The negative association between age and dream recall frequency was reported in several other large-scaled studies (Schredl et al., 2014; Schredl & Bulkeley, 2019; Schredl & Piel, 2003) and possibly reflects cohort effects, i.e., older persons were socialized in a time period in which dreams were not as valued as today (Schredl, 2007). Although Schredl and Bulkeley (2019) reported a slightly lower dream recall frequency in US citizens with African heritage compared to Caucasian US citizens, there are no theoretical explanation why non-Caucasian participants reported a slightly lower dream recall frequency than Caucasians in this sample. That is, a possible relationship between dream recall and ethnicity is still an open question.

The association between openness to experience and lucid dream frequency found in the present study is in line with previous research (Hess et al., 2017; Schredl et al., 2016b). This relation cannot solely be explained by the relationship between dream recall frequency and openness to experience (as lucid dream frequency is related to dream recall frequency), as dream recall frequency – by including this variable into the regression analyses – was statistically controlled for. One might speculate whether persons with high openness to experience scores might be also more interested into learning more about lucid dreaming and more likely to apply lucid dream inductions methods (Stumbrys et al., 2012) to increase their lucid dream frequency. A recent survey (Neuhäusler et al., 2018) showed that lucid dream induction techniques, e.g., reality checks, have been applied by a substantial number of persons. To study this line of thinking, it would be necessary to measure the frequency of spontaneously occurring lucid dreams and the frequency of induced lucid dreams (occurring while applying a lucid dream induction method) separately – which was not done in the present study. Given the neurophysiological background of the openness to experience dimension (Beaty et al., 2016), it would be interesting to study whether frequency default mode network connectivity is higher in frequent lucid dreamers.

The small effect sizes for the age effect (higher lucid dream frequency in older persons) and gender effect (higher lucid frequency in men compared to women) have not been reported previously (Hess et al., 2017; Schredl et al., 2016b). Interestingly, a representative study (Schredl & Erlacher, 2011) reported the same gender difference (men reporting more frequent lucid dreams); a finding that is still open to discussion as one survey indicated the women know more about lucid dreaming and lucid dreaming induction techniques than men (Neuhäusler et al., 2018). More detailed studies are necessary to explain the age and gender effects – if replicated by future surveys – reported in this study.

Even though the finding that lucid dream frequency is related to low neuroticism scores have not been reported before (see Table 2), it does make sense as lucid dreams are associated with positive daytime mood in the morning (Stocks et al., 2020). Furthermore, having lucid dreams and use them to conquer nightmares (Zadra & Pihl, 1997) can also

enhance self-efficacy and decrease neuroticism scores which are associated with depressive mood and anxiety (Shirayev, 2017). This finding also indicates that articles claiming possible negative effects of lucid dreaming (Soffer-Dudek, 2020; Vallat & Ruby, 2019) should be viewed with caution until a more solid empirical database is available. To study beneficial effects of practicing lucid dreaming on psychopathology and emotional stability, longitudinal studies are necessary.

As Covid-19-related worries were not related to dream recall frequency, it is very likely that the subjectively reported increases in dream recall frequency due to the pandemic (Fränkl et al., 2021; Guerrero-Gomez et al., 2021; Schredl & Bulkeley, 2020; Solomonova et al., 2021) might not be explained by direct effects of the pandemic itself on dream life but by indirect effects, for example, changes in sleep behavior due to lock-downs (Gorgoni et al., 2021; Scarpelli et al., 2021), e.g., home schooling and home office increased sleep duration in some parts of the population (Bottary et al., 2020) whereas, on the other hand, sleep problems including more frequent nocturnal awakenings were also reported more often during the pandemic (Dal Santo et al., 2021). That is, longer sleep duration (Schredl & Fulda, 2005), on the one hand, and insomnia and frequent nocturnal awakenings (Schredl et al., 1998), on the other hand, are related with higher dream recall frequency. However, psychopathology and Covid-19-related worries were associated with lucid dream frequency. This cannot be explained solely by nightmare frequency that is positively related to lucid dream frequency as nightmare frequency was statistically controlled for. As lucid dream frequency is associated with high sensory processing sensitivity (Schredl et al., 2022), one might speculate whether highly sensitive persons who recall lucid dreams more often are also more prone to Covid-19-related worries (and worries in general). From a clinical viewpoint, it would be interesting whether using the lucid dream therapy technique developed for nightmares in general (Augedal et al., 2013) may also be helpful in coping with Covid-19-related fears by addressing and coping with these fears within the dream.

To summarize, dream recall frequency and lucid dream frequency were associated with the Big Five personality factors; thus, inter-individual differences in the dream measures are partly explained by personality. Whereas the openness to experience-dream recall relationship replicated previous findings nicely, the relationship between lucid dream frequency and the other Big Five personality factors warrants further empirical studies. Although the effects sizes of these associations are small, these relationships can help to formulate models explaining dream recall and/or lucid dreaming, e.g., effects of waking-life behavior (focusing on dreams) or neurophysiological factors like default mode network connectivity.

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