Dream recall after Multiple Sleep Latency Test naps with and without REM sleep

Michael Schredl, and Kate Isobel Olbrich

Central Institute of Mental Health, Medical Faculty Mannheim/Heidelberg University, Germany

Summary. The current paper aimed to look into whether Rapid Eye movement (REM) sleep and narcolepsy would have an influence on dream recall frequency after a nap within the Multiple Sleep Latency Test (MSLT) procedure. Overall, 146 patients with a large variety of diagnoses were included. Patients completed a scale measuring dream recall frequency prior to the study and after every MSLT nap an item whether they could recall a dream or not. The findings indicate that REM naps yielded higher dream recall rates than naps without REM and that narcolepsy patients reported higher dream recall than patients with other diagnoses. The results supported the functional state-shift model of dream recall but also provided evidence that models that include physiological as well as psychological variables are most promising for explaining intra-individual and inter-individual differences in dream recall.

Keywords: Dream recall, narcolepsy, REM sleep, Multiple Sleep Latency Test

1. Introduction

The Multiple Sleep Latency Test (MSLT) is used as a diagnostic tool for sleep disorders such as narcolepsy and primary hypersomnia (American Academy of Sleep Medicine, 2014). The typical procedure includes five nap opportunities during the course of the day at two-hours intervals in which the patient is allowed to fall asleep; if the patients stays awake for 20 minutes the test will be stopped, if s/he is falls asleep the nap continues for 15 minutes ending with an awakening (Hirshkowitz & Sharafkhaneh, 2017). The MSLT is necessary for diagnosing narcolepsy because the ICSD-3 criteria require a mean sleep latency of 8 minutes or lower and two sleep onset REM periods (American Academy of Sleep Medicine, 2014). In line with the pathophysiology of an overactive REM sleep system with intrusions of REM sleep at sleep onset (SOREMs) and in the waking state (cataplexies in Narcolepsy Type 1), increased REM density (Christensen et al., 2017) and persisting REM sleep features after waking up called sleep paralysis (Cao & Guilleminault, 2017), patients tend to recall their dreams in general more often but also report more nightmares and lucid dreams (Dodet, Chavez, Leu-Semenescu, Golmard, & Arnulf, 2015; Meaidi, Kupers, Ptito, & Jennum, 2016; Pisko, Pastorek, Buskova, Sonka, & Nevsimalova, 2014; Rak, Beitinger, Steiger, Schredl, & Dresler, 2015; Schredl, 1998; Schredl et al., 2012).

Typically dream recall rates after awakenings from REM sleep are higher compared awakenings from NREM sleep (Nielsen, 2000). Siclari et al. (2017) using high-density EEG recordings of the time period prior to awakenings found a parieto-occipital hot zone as the neural correlate of dream independently of REM and NREM sleep but these favorable conditions occur more often in REM compared to NREM. This fits in the framework of the functional state-shift hypothesis of dream recall (Koukkou & Lehmann, 1983) assuming that small activation differences between two states result in better recall, i.e., the transition between the more active REM sleep to wakefulness is less pronounced that the differences between brain activation in NREM sleep and wakefulness. Whereas the classical functional state-shift model is based a very crude concept of general brain activation, the study of Siclari et al. (2017) showed clearly that higher activity related to increased dream recall is related to very specific brain areas – see also: D'Atri et al. (2019). In contrast to other models of explaining different recall rates after REM sleep and NREM sleep due to more intensive dreaming during REM sleep compared to NREM sleep (see: Nielsen, 2000), the functional state-shift model focuses on the transition between sleep and waking, i.e., how capable is the mind to recall the experiences prior to the shift in functional states after the shift has occurred (Koukkou & Lehmann, 1983). As dreaming experienced more intense by the dreamer is possibly related to increased brain activation, the two theoretical approaches overlap. Based on these findings one would expect that naps during a MSLT with REM sleep (associated with higher brain activation compared to NREM sleep) would be associated with higher dream recall compared to naps without REM sleep. Benbadis, Wolgamuth, Perry, and Dinner (1995) analyzed 167 MSLT naps of 44 patients with excessive daytime sleepiness and found a significant higher dream recall rate of 59% (20/34) after REM naps compared to 37% (49/133) after naps without REM. Two subsequent studies (Pagel, 2008; Schinkelshoek, de Wit, Bruggink, Fronczek, & Lammers, 2018) replicated this differences; Pagel (2008) analyzing 84 patients evaluated for daytime sleepiness reported a dream recall rate of 41.7% (25/60) after REM naps compared to only 9.4% (26/273) of the NREM naps and Schinkelshoek et al. (2018) found that after 73.6% of REM naps patients reported a dreams whereas after NREM naps the figure was 28.0% (based on MSLTs of 247 patients). Given the heightened dream recall

Corresponding address:
Michael Schredl, Sleep laboratory, Central Institute of Mental Health, PO Box 12 21 20, 68072 Mannheim, Germany.
Email: Michael.Schredl@zi-mannheim.de

Submitted for publication: August 2019
Accepted for publication: September 2019

in patients with narcolepsy who also have more naps with REM sleep (see diagnostic criteria above), the reported figures might be confounded. I.e., it would be desirable to differentiate between narcolepsy patients and patients with other diagnoses.

The current study set out to investigate whether or not rapid eye movement (REM) during a MSLT nap is associated with heightened dream recall. The second hypothesis of the study proposed that narcolepsy patients will have a higher dream recall compared to patients with other diagnosis, i.e., without the over-active REM sleep system.

2. Method

2.1. Participants

Overall, 146 consecutive patients (69 males, 77 females) with a mean age of 33.79 yrs. (SD=14.08) undergoing diagnostic procedures in the sleep laboratory of the Central Institute of Mental Health, Mannheim, Germany were included.

Participants were grouped regarding their diagnoses (see Table 1). Mental disorders included patients with depression, eating disorder, anxiety disorder, bipolar disorder, borderline personality disorder, attention deficit hyperactivity syndrome, and obsessive-compulsive disorders.

2.2. Materials

Dream recall frequency was measured with an item of the Mannheim Dream questionnaire (Schredl, Berres, Klingauf, Schellhaas, & Göritz, 2014). For the question "How often have you recalled your dreams recently (in the past several months)?" seven response options were presented: 0 = never, 1 = less than once a month, 2 = about once a month, 3 = 2-3 times a month, 4 = around once a week, 5 = a few times a week and 7 = almost every morning. The retest reliability of this item was high (r = .756; Schredl et al., 2014).

The Multiple Sleep Latency Test carried out at this sleep center included 5 nap opportunities scheduled at 09:00, 11:00, 13:00, 15:00 and 17:00. Patients are told that they are allowed to fall asleep. If the patients fell asleep they would be woken up after 15 minutes. If the patients did not manage to fall asleep after 20 minutes the test was stopped.

Within a newly developed MSLT questionnaire the same question "Did you have the impression that you dreamed?" was presented after each nap period. The categories were: 0 = No and 1 = yes. The percentage of naps with successful recall was computed per participant – over all naps in which the participant fell asleep. The MSLT questionnaire also encompassed visual analogue scales measuring tiredness prior and after the nap and an item eliciting the subjective estimated sleep latency; variables not included in the present analyses.

2.3. Procedure

Patients were studied in the sleep lab over two consecutive nights in which a polysomnography was conducted. Before the first night patients were asked to fill out the MADRE questionnaire including the dream recall frequency item. The MSLT is carried out between the two polysomnography nights. After each nap the patients were woken up (if necessary) by the experimenter and completed afterwards the dream recall item of the MSLT questionnaire on their own. i.e., the patients were not questioned about their dream recall immediately after awakening. After these diagnostic procedures, the patients received a diagnosis which is based on the results from the polysomnography, the MSLT and the patients' sleep history.

Statistical analyses were performed with SAS 9.4 for Windows. The mixed model that accounts for the statistical dependency in the data (multiple observations per participant) was based on the glimmix procedure within SAS.

3. Results

An ordinal regression for dream recall frequency (item of the MADRE questionnaire) with the factors age, gender and narcolepsy diagnosis vs. all other diagnoses was computed. Age (standardized estimate: -.0061, X^2= 0.0, p = .9434) and gender (standardized estimate: .1136 X^2= 1.8, p = .1798) were not significantly related to dream recall frequency whereas narcolepsy patients recalled their dreams slightly more often than the patients with other diagnoses (3.81 ± 1.60 (N = 21) vs. 3.08 ± 1.94; SE: .1323, X^2= 2.5, p = .0586, one tailed).

In total, 611 nap periods with sleep were recorded. 30 of these nap periods had missing data (questionnaire item was not completed) and were not included in analysis. Out of these 581 nap periods 497 did not include any REM sleep whereas 114 of these nap periods did include REM sleep. Dream recall after a nap with REM sleep was higher compared with naps without REM sleep (see Table 2).

For the subgroup of 22 patients with narcolepsy, dream recall after a nap with REM sleep was higher compared to

Table 1. Demographics and dream recall frequency (Questionnaire) for the different diagnostic groups

Diagnosis	Total	Men	Women	Age (M ± SD)	Dream recall frequency[1]
Narcolepsy	22	12	10	30.68 ± 13.55 yrs.	3.81 ± 1.60 (21)
Primary Hypersomnia	29	13	16	28.34 ± 9.58 yrs.	2.70 ± 2.07 (27)
Insomnia and Restless legs syndrome	27	12	15	40.22 ± 15.63 yrs.	3.67 ± 1.76 (24)
Insufficient sleep syndrome	24	14	10	33.75 ± 13.26 yrs.	2.67 ± 1.81 (24)
Mental Disorders	23	7	16	35.48 ± 14.45 yrs.	3.74 ± 1.79 (23)
Sleep apnea, Obstructive snoring	11	6	5	42.00 ± 11.00 yrs.	1.70 ± 1.95 (10)
Parasomnia	9	4	5	42.11 ± 18.10 yrs.	3.44 ± 1.88 (9)
No Diagnosis	1	1	0	30 yrs.	4.0 (1)

[1]Means and standard deviations of the seven-point questionnaire scale

Table 2. Dream recall for naps with and without REM sleep

	Naps with REM	Naps without REM
Total sample	46.30% (50/108)	22.41% (106/473)
Narcolepsy patients	58.06% (36/62)	25.64% (10/39)
Patients with other diagnoses	30.43% (14/46)	22.12% (96/434)

dream recall after a nap without any REM sleep. For the rest of the participants, dream recall after a nap with REM sleep was also higher than dream recall after a nap without any REM sleep.

In a mixed model analysis with the dependent variable of dream recall (Yes/No) the effects of the independent variables REM sleep (present/not present) and the diagnosis of narcolepsy vs. other patients were analyzed. The naps with REM sleep yielded a significant higher rate of dream recall ($t = 2.5$, $p = .0061$, one-tailed) and patients with narcolepsy had higher dream recall after naps compared to the patients with other diagnoses ($t = 1.8$, $p = .0359$, one-tailed).

There was a significant positive relationship between the dream recall after the MSLT naps (percentage of naps with successful dream recall) and the dream recall frequency measured by the MADRE questionnaire for the total sample ($r = .246$, $N = 136$, $p < .001$, one tailed). This was also valid for the subgroup of narcolepsy patients ($r = .558$, $N = 21$, $p < .005$, one tailed) and marginally significant for the patients with other diagnoses ($r = .148$, $N = 115$, $p = .0568$, one tailed).

4. Discussion

The present study showed that presence of REM sleep during a nap within the Multiple Sleep Latency Test (MSLT) protocol was associated with higher dream recall compared with naps without REM sleep. Dream recall prior to the study and after MSLT naps was higher in narcolepsy patients compared to patients with other diagnoses.

One methodological issue is that the patients were not questioned directly after awakening from a nap but completed the questionnaire after they got up on their own; this might explain why dream recall rates are lower compared to awakening studies (Nielsen, 2000), with only 46.3% of participants who experienced REM sleep reported dream recall compared to 80% in Nielsen's overview of over-night studies. This methodological difference (being asked directly after awakening vs. completing the questionnaire later) might also explain the lower dream recall rates after REM sleep naps in the present study compared to the studies of Benbadis et al. (1995) with a recall rate of 59% and of Schinkelshoek et al. (2018) with a recall rate of 73.6%. However, these differences might also be confounded with the diagnosis of narcolepsy as previous studies did not present the percentage of narcolepsy patients in their samples.

The difference in dream recall after naps with REM sleep compared to naps without REM sleep is in line with previous research (Benbadis et al., 1995; Pagel, 2008; Schinkelshoek et al., 2018), supporting indirectly the functional state-shift model of dream recall (Koukkou & Lehmann, 1983). The present study did not focus on the awakening process directly, e.g., determine the last sleep stage with its specific activation pattern and EEG activation after awakening. As the naps were at maximum of 15 minutes duration, the probability that REM sleep occurred quite close to the awakening is relatively high. As mentioned above, this model should be updated based on findings using high density EEG (D'Atri et al., 2019; Siclari et al., 2017), evoked-potentials (Eichenlaub, Bertrand, Morlet, & Ruby, 2014) or functional magnetic resonance imaging (Vallat, Meunier, Nicolas, & Ruby, 2017) to obtain more precise indices of brain activation and, not done yet, also include brain activation patters measured after awakening – as the functional state-shift hypothesis focuses on the differences in functional states before and after awakening (Koukkou & Lehmann, 1983).

The significant difference in dream recall after naps, especially after REM sleep naps, between narcolepsy patients and patients with other disorders confirm previous findings of heightened dream recall in narcolepsy (Rak et al., 2015; Schredl, 1998; Schredl et al., 2012) but also emphasize the importance of differentiating clinical samples of patients undergoing diagnostic procedures due to complaints of excessive daytime sleepiness. The overactive REM sleep system in narcolepsy (Cao & Guilleminault, 2017) is obviously related to higher dream recall in general. Interestingly, home dream recall frequency is correlated with dream recall rates after the MSLT naps; a finding that lends support to the so-called life-style hypothesis of dreaming (Schonbar, 1965), i.e., recalling dreams as a part of a more general life style including creativity, openness to experiences and so on (Schredl, 2018). From a theoretical viewpoint, the present study would favor models explaining dream recall that include physiological variables like brain activation, sleep inertia as well as psychological variables like personality or interferences during the awaking process (Schredl, 2018).

To summarize, the current study showed that dream recall after MSLT naps are affected by the presence or absence of REM sleep and the presence or absence of a narcolepsy diagnosis. Future research can expand the present findings exploring the emotional tone, intensity, and content of nap dreams and whether these characteristics have an impact upon recalling the dream successfully.

References

American Academy of Sleep Medicine. (2014). The international classification of sleep disorders. (ICSD-3). Darien, IL: AASM.

Benbadis, S. R., Wolgamuth, B. R., Perry, M. C., & Dinner, D. S. (1995). Dreams and rapid eye movement sleep in the multiple sleep latency test. Sleep, 18, 105-108.

Cao, M. T., & Guilleminault, C. (2017). Narcolepsy: Diagnosis and management. In M. Kryger, T. Roth & W. C. Dement (Eds.), Principles and practice of sleep medicine (6th edition) (pp. 873-882). Philidelphia: Elsevier.

Christensen, J. A. E., Kempfner, L., Leonthin, H. L., Hvidtfelt, M., Nikolic, M., Kornum, B. R., & Jennum, P. (2017). Novel method for evaluation of eye movements in patients with narcolepsy. Sleep Medicine, 33, 171-180.

D'Atri, A., Scarpelli, S., Schiappa, C., Pizza, F., Vandi, S., Ferrara, M., Cipolli, C., Plazzi, G., & De Gennaro, L. (2019). Cortical activation during sleep predicts dream experience in narcolepsy. Annals of Clinical and Translational Neurology, 6(3), 445-455.

Dodet, P., Chavez, M., Leu-Semenescu, S., Golmard, J.-L., & Arnulf, I. (2015). Lucid dreaming in narcolepsy. Sleep, 38(3), 487-497.

Eichenlaub, J.-B., Bertrand, O., Morlet, D., & Ruby, P. (2014). Brain reactivity differentiates subjects with high and low dream recall frequencies during both sleep and wakefulness. Cerebral Cortex, 24(5), 1206-1215.

Hirshkowitz, M., & Sharafkhaneh, A. (2017). Evaluating sleepiness. In M. Kryger, T. Roth & W. C. Dement (Eds.), Principles and practice of sleep medicine (6th edition) (pp. 1651-1658). Philidelphia: Elsevier.

Koukkou, M., & Lehmann, D. (1983). Dreaming: the functional state-shift hypothesis. British Journal of Psychiatry, 142, 221-231.

Meaidi, A., Kupers, R., Ptito, M., & Jennum, P. (2016). Dreams in narcoleptic patients with and without cataplexy. Journal of Sleep Research, 25(Suppl 1), 245.

Nielsen, T. A. (2000). A review of mentation in REM and NREM sleep: "covert" REM sleep as a possible reconciliation of two opposing models. Behavioral and Brain Sciences, 23, 851-866.

Pagel, J. F. (2008). Sleep stage associated changes in dream recall across the day on awakening from MSLT naps. Sleep Supplement, 31, A373.

Pisko, J., Pastorek, L., Buskova, J., Sonka, K., & Nevsimalova, S. (2014). Nightmares in narcolepsy: underinvestigated symptom? Sleep Medicine, 15(8), 967-972.

Rak, M., Beitinger, P., Steiger, A., Schredl, M., & Dresler, M. (2015). Increased lucid dreaming frequency in narcolepsy. Sleep, 38(5), 787-792.

Schinkelshoek, M., de Wit, K., Bruggink, V., Fronczek, R., & Lammers, G. J. (2018). Sleep-state and dream perception in sleep disorders. Journal of Sleep Research, 27(Suppl 1), 296.

Schonbar, R. A. (1965). Differential dream recall frequency as a component of "life style". Journal of Consulting Psychology, 29, 468-474.

Schredl, M. (1998). Dream content in patients with narcolepsy: preliminary findings. Dreaming, 8, 103-107.

Schredl, M. (2018). Researching Dreams: The Fundamentals. Cham: Palgrave Macmillan.

Schredl, M., Berres, S., Klingauf, A., Schellhaas, S., & Göritz, A. S. (2014). The Mannheim Dream questionnaire (MADRE): Retest reliability, age and gender effects. International Journal of Dream Research, 7, 141-147.

Schredl, M., Binder, R., Feldmann, S., Göder, R., Hoppe, J., Schmitt, J., Schweitzer, M., Specht, M., & Steinig, J. (2012). Dreaming in patients with sleep disorders: A multicenter study. Somnologie, 16, 32-42.

Siclari, F., Baird, B., Perogamvros, L., Bernardi, G., LaRocque, J. J., Riedner, B., Boly, M., Postle, B. R., & Tononi, G. (2017). The neural correlates of dreaming. Nature Neuroscience, 20, 872–878

Vallat, R., Meunier, D., Nicolas, A., & Ruby, P. (2017). Sleep inertia and functional connectivity between brain regions at awakening: An EEG-fMRI study. International Journal of Dream Research, 10(Suppl 1), S59.