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Dream Recall After Night Awakenings From Tonic/Phasic REM Sleep

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ABSTRACT

Eleven healthy subjects, 9 females and 2 males aged 21–23, were submitted to all night polygraphic recording and awoken in REM (Rapid Eye Movements) sleep, randomly upon tonic or phasic REM. Immediately upon awakening subjects were asked about possible dreaming according to the standardized questionnaire. Seventy-seven dreams, i.e. 79% of all 97 REM awakenings, were reported and analyzed. There were no significant differences in reported frequency of dreamings after awakening, mood and dream content due to phasic/tonic REM sleep. Dreams from phasic REM were a bit more colorful. Predictor of morning remembering of dreams was meaninglessness, not meaningfulness of dreams, and, in lesser extent, good mood, colorfulness, dreams with words and phasic REM sleep.

Key words: *dreams, REM sleep, tonic/phasic*

Introduction

Soon after REM (Rapid Eye Movements) sleep had been discovered in 1953¹, it became obvious that dreaming was particularly connected with this stage of sleep². Dreams were reported in about four fifths of awakenings from REM sleep, what is much more than after awakening from non REM (NREM) sleep. Some theoretical models explain physiology of REM sleep and accompanying dream mentation^{3–7}. Results based on awakening subjects from REM sleep support the opinion that dreams are quite common in REM sleep^{8–11}. Nowadays, however, it is apparent that dreaming can also occur beyond REM sleep^{12–15}. NREM dreams have been clearly documented and evaluated^{16–18}, although majority of dreams reported after night awakenings are predominantly associated with REM sleep. During REM sleep, repetitive excitatory bursts of electrical activity originating in pons ascend and stimulate higher brain structures including those associated with control of saccadic eye movements of REMs as well as with associative cortex with its storehouse of traces of memories^{19–21}. So dreams from REM sleep would be a random consequence of forebrain activation by certain REM cells in brain stem and its content would

be more or less edited after awakening^{22–24}. However, no clear distinction in REM mentation content has been found after awakening from phasic or tonic REM sleep, although physiological properties of those two states of REM sleep are apparently different in regard to activation pattern in brain^{25,26}. Different REM dream content often meaningless or bizarre, with more or less visual imagery on one side, and apparently different polygraphic feature with REMs during phasic vs tonic REM sleep, on the other side, still influence further interest and a search of the problem.

The aim of the study was to find possible differences between dreaming in tonic and phasic REM sleep as well as to evaluate remote dream recall of all reported REM dreams.

Material and Methods

We analyzed dream recall in 11 healthy, right-handed young subjects, aged 21–23, 9 females and 2 males (Table 1), undergraduate students of psychology, who willingly

TABLE 1
GENDER, AGE AND FREQUENCY OF AWAKENINGS, REPORTED DREAMS AND REPORTED MORNING REMEMBERING OF DREAMS AFTER AWAKENING IN TONIC AND PHASIC REM SLEEP FOR EVERY SINGLE EXAMINEE

Examinee		1	2	3	4	5	6	7	8	9	10	11	Total
Gender		m	f	m	f	f	f	f	f	f	f	f	
Age		22	21	21	21	22	22	21	21	21	21	23	
Number of awakenings	Phasic REM sleep	3	5	6	6	7	1	8	3	10	3	3	56
	Tonic REM sleep	4	5	5	3	4	4	8	2	3	2	1	41
	Total	7	10	11	9	11	5	16	5	13	5	5	97
Number of reported dreams	Phasic REM sleep	3	4	3	6	7	1	6	3	7	3	4	47
	Tonic REM sleep	1	4	5	3	4	1	7	1	2	1	1	30
	Total	4	8	8	9	11	2	13	4	9	4	5	77
Number of reported morning rememberings	Phasic REM sleep	3	0	0	6	6	0	5	2	2	2	0	26
	Tonic REM sleep	1	0	0	2	4	1	6	0	2	1	1	18
	Total	4	0	0	8	10	1	11	2	4	3	1	44

m – male, f – female, REM – rapid eye movements

joined the experiment. All subjects slept one night in sleep laboratory where they were awoken every time when REM sleep occurred, but at least three minutes from the beginning of the REM episode. Awakenings from tonic and phasic REM sleep were randomized with only instruction that the subjects should have been awakened from phasic REM rather than from tonic REM if the burst of REMs was quite apparent. Immediately after awakening the subjects were asked standard questions and instructed to give short answers as follows: Have you been dreaming (yes/no)? How do you feel (good/bad/neutral)? Something sexual (yes/no)? Short dream content (free interpretation)? Colorness (colorful/colorless)? Words (yes/no)? Short additional information about previous dream was allowed if soon after awakening it was regarded as important. Soon after spontaneous awakening in the morning, usually between 6.30–7.30, the subjects were asked for short dream recall in previous night. If a single dream was missing it was allowed briefly to remind the subject of the concrete dream as it was written down immediately after night awakening. The dream recalls in the morning were categorized as good remembering, remembering with difficulties (when the subjects should have been reminded), and no remembering. Night sleep recording was done by standard polysomnographic technique using silver electrodes attached with colodion: eleven EEG channels according to 10–20 system including bilateral central and occipital placement of electrodes; EOG using left and right outer cantus, left above and left under eye; one submental EMG channel and one ECG channel. REM sleep identification was in accordance to the Rechtschaffen and Kales criteria.

Results

A dream was reported in 79%, i.e. 77/97 of all REM awakenings, with no significant difference as to tonic (73%, i.e. 30/41) and phasic (84%, i.e. 47/56) (Figure 1).

There was no significant difference in the mood (good/bad/neutral) (Figure 2) and in the content of reported dreams (meaningful/meaningless/bizarre/couldn't recall) (Figure 3) between tonic and phasic REM sleep as well as in colorness (colorful/colorless/couldn't recall) (Figure 4). But, after awakening from phasic REM sleep a diversity

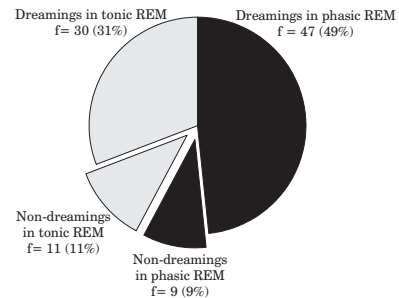


Fig. 1. Frequency (percentage) of dreamings/non-dreamings declared after awakening upon phasic and tonic REM sleep. REM - Rapid Eye Movements. Total of 97 awakenings in 11 examinees, aged 21–23, 9 females and 2 males (77 dreamings = 80%, 20 non-dreamings = 20%).

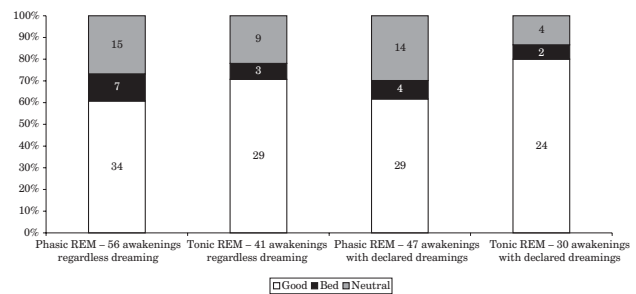


Fig. 2. Mood (good/bad/neutral) after awakenings upon phasic and tonic REM sleep regardless of dreaming (97) vs. declared dreamings (77). REM - Rapid Eye Movements (No statistically significant differences).

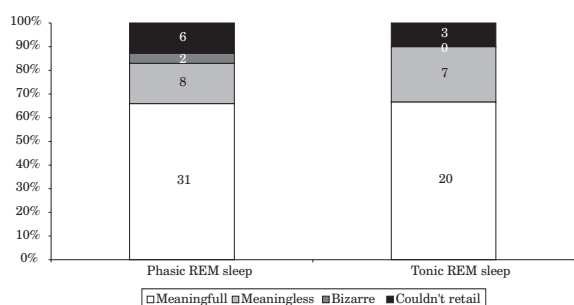


Fig. 3. Differences in dreamings' content between phasic and tonic REM in declared dreamings (n=77). REM – Rapid Eye Movements (No statistically significant differences).

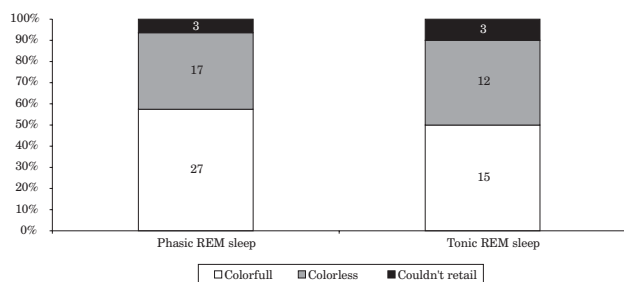


Fig. 4. Differences in dreamings' colourness between phasic and tonic REM sleep in declared dreamings. REM-Rapid Eye Movements (No statistically significant differences).

of colors in the dreams was spontaneously reported more often, mostly orange, yellow, and green (Table 2). Sexual arousal after REM awakening was reported very sporadically, unrelated to dream content and tonic/phasic. There was no difference in dreamings' words remembering (wordful/wordless/couldn't retell) after awakening from tonic or phasic REM sleep (Figure 5) and in a number of dreams remembered in the morning between phasic and tonic REM sleep as well (Figure 6). But there were differences in dreamings' content across dreamings colourness in declared dreamings ($\chi^2=29.269$; DF=6; $p=0.001$; Fisher Exact Test $p<0.001$) (Figure 7). Major contribution to the difference is caused by larger participation of meaningless content in colorless than in colorful dreams and larger participation of meaningful content in colorful than in colorless dreams. There were no meaningful dreams if the examinee couldn't remember regardless if these dreams were in color or not. The two dreams with bizarre content were in the group of colorful dreams. In all dreams, regardless of whether originating from tonic or phasic REM sleep, there were differences in the content of the reported dreams immediately after night awakening (meaningful/meaningless/bizarre/couldn't recall) across remembering words in the dreams (yes/no/couldn't recall) ($\chi^2=17.631$, DF=6, $p=0.007$, Fisher Exact Test (2-tail) $p=0.005$) (Figure 8). Major contribution

TABLE 2
NUMBER OF DREAMINGS WITH RECOGNIZED PARTICULAR COLOR IN PHASIC AND TONIC REM SLEEP

Colour	Phasic REM	Tonic REM
White	1	1
Rose	1	1
Red	2	0
Orange	3	0
Yellow	3	1
Green	4	2
Blue	3	2
Violet	1	0
Grey	1	2
Black	2	0

REM – rapid eye movements

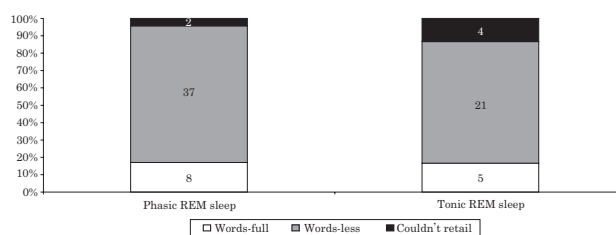


Fig. 5. Differences in dreamings' words remembering between phasic and tonic REM sleep in declared dreamings. REM- Rapid Eye Movements (No statistically significant differences).

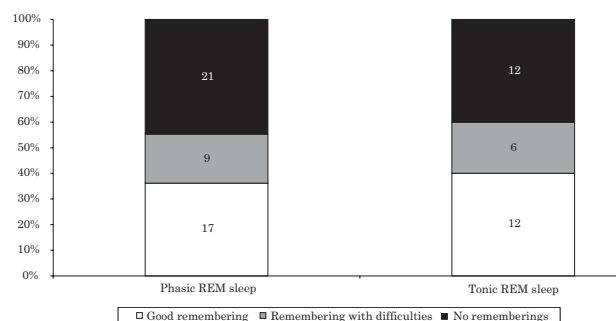


Fig. 6. Differences in dreamings' morning remembering between phasic and tonic REM sleep in declared dreamings. REM – Rapid Eye Movements

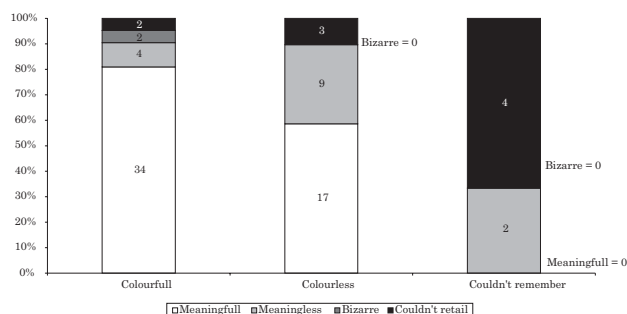


Fig. 7. Dreamings' content across dreamings colourness in declared dreamings (n=77) ($\chi^2=29.269$; df=6; $p=0.001$: Fisher' Exact Test $p<0.001$). (No statistically significant differences).

sher Exact Test $p<0.001$) (Figure 7). Major contribution to the difference is caused by larger participation of meaningless content in colorless than in colorful dreams and larger participation of meaningful content in colorful than in colorless dreams. There were no meaningful dreams if the examinee couldn't remember regardless if these dreams were in color or not. The two dreams with bizarre content were in the group of colorful dreams. In all dreams, regardless of whether originating from tonic or phasic REM sleep, there were differences in the content of the reported dreams immediately after night awakening (meaningful/meaningless/bizarre/couldn't recall) across remembering words in the dreams (yes/no/couldn't recall) ($\chi^2=17.631$, DF=6, $p=0.007$, Fisher Exact Test (2-tail) $p=0.005$) (Figure 8). Major contribution

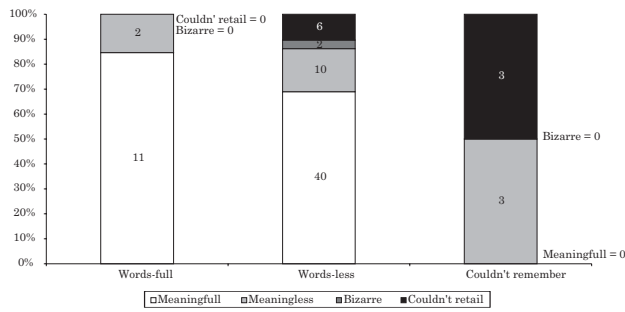


Fig. 8. Dreamings' content across dreamings words remembering in declared dreamings (n=77), ($\chi^2=17.631$; df = 6; p = 0.007; Fisher Exact Test p=0.005).

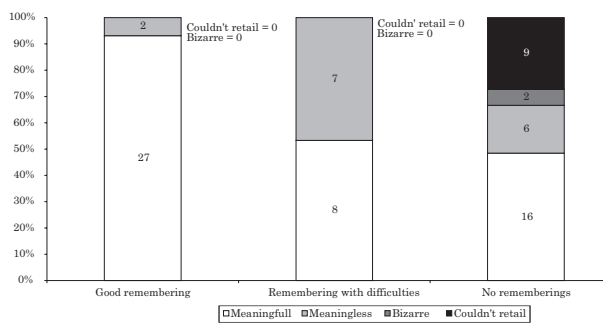


Fig. 9. Dreamings' content across dreamings morning remembering in declared dreamings (n=77), ($\chi^2=27.851$; df=6; p = 0.001; Fisher Exact Test p < 0.001).

to the difference was the absence of meaningful dreams in the group where examinees couldn't remember if their dreams were with or without words. In the group of dreams with words there were no dreams the content of which examinees couldn't recall. The significant difference in distribution of all dream contents after night awakenings (meaningful/meaningless/bizarre/couldn't recall) was found between different morning remembering of dreams (good remembering/remembering with difficulties/no remembering) ($\chi^2=27.851$, DF=6, p=0.001, Fisher Exact Test (2-tail) p<0.001) (Figure 9). The Odds Ratios in Logistic Regression Analysis indicate that better morning remembering of dreams reported after night

awakenings from REM sleep was connected with meaningless content, and in lesser extent also with good mood, colorful dreams, as well as with phasic REM sleep (Table 3).

Discussion

Our results show that REM sleep is associated with high density of dreaming regardless of whether phasic and tonic. Night dreaming was reported in 79% of all REM awakenings, more often in phasic (84%) than in tonic (73%) REM, with no significant difference as to phasic/tonic. Mood after awakening from REM is mostly good or neutral, regardless of the dream content or whether awakening was from phasic or tonic REM. Colors are present significantly more than words in all dreams from REM, which means that majority of the dreams from REM are picturesque rather than narrative. Diversity of colors was more evident in phasic REM, but with no statistic significance vs tonic REM. All dreams from REM are more often meaningful than meaningless, but it is possible that meaningfulness is the consequence of »editing« the dream after awakening, which can be concluded from the fact that the predictor of morning remembering is meaningfulness and not meaningfulness of the dreams.

Although there are no significant differences in the analyzed characteristics of dreams from tonic and phasic REM, it is striking that spontaneous reporting of particular color is significantly more frequent after phasic REM, which gives some importance to the »scanning« hypothesis of rapid eye movements in dreaming in REM²⁷ or to the fact that REM phasic arousal correlated with primary visual experience²⁵. Interesting are the predictors of morning remembering of dreams which were reported during night awakenings from REM. Meaningless dreams seem to be better remembered, or the shape in which the meaningful dreams were »arranged« immediately after awakening might be forgotten in the morning, and in fact the dreams were meaningless but not recalled as such either in the native or in arranged form. Good mood after awakening from REM with dreams is also a predictor of morning remembering as well as the

TABLE 3
RESULTS OF LOGISTIC REGRESSION

Variable	Dependent variable = morning remembering of dreams (Yes vs. No)				
	Odds Ratio	95% Confidence limits		Chi-Square (DF=1)	p
		Lower	Upper		
CONTENT (meaningless vs. meaningful)	5.46	1.66	17.93	7.816	0.005
MOOD (good vs. bad)	2.22	0.70	7.03	0.369	0.543
COLORNESS (colorful vs. colorless)	1.82	0.26	12.629	1.836	0.175
WORDS (yes vs. no)	2.10	0.46	9.54	0.915	0.338
REM SLEEP (phasic vs. tonic)	1.20	0.44	3.31	0.128	0.719

Overall fit Change in -2 log Likelihood = 12.217 (5 df) p=0.032, REM – rapid eye movements

colorfulness of the dream and dreams from phasic REM but in a lesser extent than meaningless dreams. Perhaps just colorfulness of dreams is associated with somewhat greater likelihood for morning remembering of the dreams from phasic REM, when the richness of colors is most prominent. Sexual arousal is rare and not associated with the dream content. Sexual contents of the dreams were not reported at all. Dream contents associated with the real (experimental) situation were extremely rare. It can be said that, according to the obtained results, dreams are not mentally controlled phenomenon, although this fact does not exclude possible psychological importance of dreaming. Particular scales developed to measure self-participation in sleep claim to be able to discriminate phasic from tonic REM with suspension of reflective self-representation during phasic events of REM sleep⁵. It might be connected with the results which show that burst of rapid eye movements are associated with vividness and emotionality^{10,28} and less conceptual dreaming²⁹.

REM sleep should be regarded as complex phenomenon with documented regional activation of different brain areas from pontine tegmental area to the left thalamus, both amygdaloid complexes, anterior cingulate cortex, right parietal operculum²¹. It seems apparent that dreams are mostly randomized consequence of particular brain activation. But it still remains vague whether it is related with the memory processes in sleep or not.

In conclusion, the obtained results indicate that the only difference between dreaming in tonic and phasic REM sleep might be enriched colorfulness of dreams originating from phasic REM. This observation was apparent, but not statistically proved. On the other hand, although not apparent, statistically was proved that prediction for better morning remembering of dreams after night awakenings from REM sleep was connected with meaningless content, and in lesser extent also with good mood, colorful dreams, as well as with phasic REM sleep.

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PRISJEĆANJE SNOVA NAKON NOĆNOG BUĐENJA IZ TONIČNOG/FAZIČNOG REM SPAVANJA

SAŽETAK

Jedanaest zdravih ispitanika, 9 žena i 2 muškarca u dobi 21–23 godine, podvrgnuti su cjelonoćnom polisomnografskom snimanju i probuđeni iz REM spavanja, nasumično iz toničkog ili fazičkog REM-a. Odmah nakon buđenja ispitanici su upitani o mogućem sanjanju u skladu sa standardiziranim upitnikom. Analizirano je 77 snova koji su navedeni nakon pojedinačnih buđenja, što je bilo 79% od svih 97 buđenja iz REM-a. Nije bilo značajnih razlika u čestoti sanjanja nakon buđenja iz fazičkog ili toničkog REM spavanja, kao niti u raspoloženju i sadržaju snova. Snovi iz fazičkog REM-a su bili nešto slikovitiji. Prediktor jutarnjeg prisjećanja bila je besmislenost, a ne smislenost snova, a u manjoj mjeri dobro raspoloženje, slikovitost i fazički REM.