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NonREM sleep mentation in chronically-treated persons with schizophrenia

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ABSTRACT

This study examined the laboratory dream content reported by 14 patients with schizophrenia and 15 controls, with a focus on reports obtained from NonREM sleep. Both the controls' and patients' frequency of dream recall following awakenings from NonREM and REM sleep were similar to values reported for healthy participants. Patients' NonREM sleep narratives were shorter than those from controls. When compared to their reports from REM sleep, both groups' NonREM sleep reports included significantly fewer words and reportable items. The controls were more likely to report a subjective feeling of bizarreness for their REM sleep reports as compared to their NonREM sleep reports. This difference was not observed in patients with schizophrenia. Taken together, these findings suggest few differences between the NonREM sleep mentation of patients with schizophrenia and of controls and that sleep stage cognitive style is comparable in both groups, with NonREM sleep reports being more thought-like, less elaborate and bizarre than REM sleep reports.

1. Introduction

Empirical studies largely support the continuity hypothesis of dreaming which asserts that dream content reflects various psychological parameters of the dreamer's waking-life (Kramer, Roth, Arand, & Bonnet, 1981; Schredl & Hofmann, 2003). For instance, several aspects of life experiences have been demonstrated to influence dream content such as elements of the pre-sleep situation (De Koninck & Brunette, 1991; Goodenough, Witkin, Koulack, & Cohen, 1975), life events (Cartwright, Lloyd, Knight, & Trenholme, 1984), stress (Breger, Hunter, & Lane, 1971), personality dimensions (Schredl, Schäfer, Hofmann, & Jacob, 1999), and psychological well-being (Pesant & Zadra, 2006). In addition, waking state psychopathological symptoms such as psychotic symptoms have been shown to correlate with corresponding dream content (e.g. bizarre elements) (Schredl & Engelhardt, 2001).

These empirical and clinical observations suggest that continuity should similarly exist between the waking cognitive organization of patients with schizophrenia and their recalled dream content. Much of the laboratory work that attempted to identify dream particularities pathognomonic of schizophrenia was based on experimental awakenings from Rapid Eye

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Movement (REM) sleep, and the results have been both variable and inconsistent with regards to the continuity hypothesis (Kramer, 2000; Kramer & Roth, 1979). Given that NonREM (NREM) sleep dream reports are generally considered as being more thought-like than typical REM sleep dream reports (Foulkes, 1967; Nielsen, 2000), NREM sleep dream reports may be more likely than REM sleep dream reports to directly reflect patients' waking thoughts and concerns. For instance, both Foulkes (1967) and Cartwright and Ratzel (1971) reported that healthy individuals with elevated scores on the schizophrenia scale of the Minnesota Multiphasic Personality Inventory (MMPI) tend to have high dreamlike fantasy scores in their NREM sleep dreams. Moreover, a comparison of REM sleep dream reports and NREM sleep dream reports in drug-naïve schizophrenic patients and control individuals revealed a significant difference in the degree of dream bizarreness between REM sleep and NREM sleep dream reports in controls but not in patients with schizophrenia (Cartwright, 1972). These findings were interpreted as reflecting the fact that, as psychological disturbance increases, qualitative discrimination in cognitive bizarreness between REM sleep dream reports and NREM sleep dream reports becomes reduced. Therefore, it can be suggested that NREM sleep dream reports of patients with schizophrenia may reflect some of their psychopathological features.

We recently showed that, when compared to the laboratory-based REM sleep dream narratives of healthy individuals, the REM sleep dream narratives from chronically treated patients with schizophrenia are shorter, with quantitative differences on several content scales (e.g., fewer familiar characters, more strangers, fewer neutral emotions, a trend for fewer familiar settings) (Lusignan et al., 2009). We also found that patients with schizophrenia spontaneously rated their dream narratives as being less bizarre than did controls despite a similar density of bizarre elements as scored by external judges. These findings were interpreted as reflecting waking neurocognitive processes specific to schizophrenia.

2. Aims and hypotheses

Starting from the hypothesis that NREM sleep dream reports may be more likely than REM sleep dream reports to directly reflect patients' waking thoughts and concerns, and the fact that waking thought patterns of patients with schizophrenia differ from those of healthy controls, we sought to investigate differences in the content of NREM sleep dream reports obtained from patients and controls. We thus investigated their NREM sleep dream content using experimental awakenings from stage 2 NREM sleep recorded in the sleep laboratory. Particular attention was paid to bizarreness in patients' NREM sleep dream reports, a measure presumed to reflect some of the cognitive characteristics associated with schizophrenia. Differences between NREM sleep and REM sleep dream reports were also explored to assess potential sleep stage dependent cognitive styles in schizophrenia as compared to healthy individuals.

As reported in the literature (Cartwright, 1972; Debieve, Bedoret, Meaux, & Fontan, 1977; Okuma, Sunami, Fukuma, Takeo, & Motoike, 1970), we predicted that when compared to controls, the content of laboratory NREM dream reports from patients with schizophrenia would show: (1) a lower word count per dream narrative; (2) fewer reportable items; and (3) a higher level of dream bizarreness. We also predicted that, when compared to controls, patients with schizophrenia would show (4) a lower frequency of dream recall and more "white dreams" (impression of having dreamt without explicit recall) from both REM sleep and NREM sleep awakenings. As shown in laboratory-based awakenings from REM and NREM sleep (Nielsen, 2000), we predicted that when compared to their REM sleep counterparts, NREM sleep dream reports from patients with schizophrenia and controls would include (5) a lower word count per dream narrative, and (6) fewer reportable items. Finally, in accordance with Cartwright (1972), it was predicted that (7) more dream bizarreness and a greater proportion of subjective feeling of bizarreness would characterize control participants' REM sleep dream reports as compared to their NREM sleep dream reports, but these differences were not expected in the patient group.

3. Methods

3.1. Participants

The experimental group was comprised of 14 patients with schizophrenia (13M, 1 F; mean age = 25.5 years, SD = 3.2, range: 20–30; highest level of education obtained = 11.7 ± 0.4) recruited from an ambulatory clinic specializing in schizophrenia within a large urban general hospital. Patients met DSM-IV-TR (American Psychiatric Association, 2000) diagnostic criteria for schizophrenia, as made by the patients' treating psychiatrist. All patients were under atypical antipsychotic medication with one participant taking adjuvant medication. Information on each participant's medication and dosage is presented in Table 1. Exclusion criteria were comprised of suspected drug abuse, the presence of neurological disorders, sleep disorders, or any other psychiatric diagnosis as determined by a psychiatric interview.

The comparison group included 15 healthy controls (12M 3 F; mean = 22.3 years, SD = 4.2, range: 18–31; highest level of education obtained = 12.9 ± 0.4) recruited through advertisements in the community. They completed a questionnaire on past health disorders, medical and psychiatric diagnoses, treatments and hospitalization. Exclusion criteria were a personal history of psychiatric, neurological or sleep disorders, a chronic or current illness, a recent history of shift work, evidence of drug abuse, or current use of CNS-active drugs. The two groups differed by 3.2 years for mean age ($p = 0.03$) and by 1.2 years for education level ($p = 0.049$).

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Table 1
Age and medication of participants with schizophrenia.

Participants	Age (years)	Atypical antipsychotics	Dosage (mg)
1	20	Quetiapine	1200
2	22	Quetiapine	1500
3	23	Olanzapine	10
4	23	Olanzapine	15
5	23	Olanzapine	30
6	24	Olanzapine	15
7	24	Olanzapine	25
8	27	Risperidone	5
9*	27	Olanzapine	2.5
10	27	Clozapine	250
11	28	Quetiapine	800
12	29	Risperidone	3
13	30	Clozapine	500
14	30	Olanzapine	20

* Also took procyclidine 5 mg BID.

3.2. Laboratory sleep measures

Participants were recorded in the sleep laboratory for three consecutive nights. They were permitted to go to bed and rise at their preferred time based on a sleep agenda completed over a two-week period prior to coming to the laboratory. During this period, participants were instructed to maintain their typical sleep-wake schedule and not to deprive themselves of sleep. The first night was intended for adaptation to laboratory conditions and was used to rule out the presence of sleep disorders including sleep apneas (defined as 10 apneas per hour of sleep), the second (baseline) was used for evaluation of sleep architecture and the third night (experimental) for dream collection following awakenings from REM sleep and NREM sleep (see details below).

Sleep was recorded with a Grass Neurodata Model 15 Acquisition System assisted by Harmonie software (Stellate, Montréal, Canada). A 22-electrodes montage was used (Fp1, Fp2, F3, F4, F7, F8, Fz, C3, C4, Cp5, Cp6, T3, T4, Tp7, Tp8, P3, P4, P7, P8, Pz, O1, and O2) according to the American Electroencephalographic Society (1994). EEG electrodes were referenced to linked earlobes (A1 + A2), and each reference electrode had a serial 10-kΩ resistor for impedance equilibrium purposes (Pivik et al., 1993). Sleep stages were scored blind relative to group membership according to standard criteria (Rechtschaffen & Kales, 1968) using 20-s epochs. Sleep onset latency (SOL) was defined as the first occurrence of either 10 consecutive minutes of stage 1 sleep or the first epoch of any other sleep stage. Oronasal airflow, thoracic and abdominal respiratory effort, oximetry and anterior tibialis EMG were monitored during nights one and two. All subjects received a financial compensation for their participation. The study was approved by the ethics committee of the Rivière-des-Prairies hospital and carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). Written informed consent was obtained from each participant.

3.3. Laboratory dream collection

On night three, each participant was awakened during stage 2 NREM sleep and REM sleep and interviewed for dream content. A maximum of two awakenings were enforced during stage 2 NREM sleep: after 15 min into the first sleep cycle and after 10 min into the third sleep cycle. A maximum of four awakenings were enforced during REM sleep: after at least 10 min of REM sleep into the second and third sleep cycle and after 15 min in any subsequent sleep cycle (see Lusignan et al., 2009). Participants were allowed to return to sleep after the dream reporting was completed.

A male experimenter conducted the laboratory recordings and collected all dream reports. Participants were informed that they would be awakened by a knock on the sleep chamber's door during the night and that the experimenter would enter the room and question them about what had been going through their mind (e.g., images, thoughts, or feelings) just prior to their awakening. The word "dream" was not used unless a participant specifically did so. Participants were instructed to confirm that they were awake by a simple verbal response, to remain lying down with their eyes closed, and to start describing any material recalled with no particular attempt to be logical, sequential, or interpretative. When a participant did not spontaneously start reporting within 10–15 s, the experimenter asked whether they had been seeing, hearing, or thinking about something just prior to being awakened; upon a negative reply, the participant was asked whether they thought something had been going through their mind but could not be remembered (white dream) or if it was a total absence of sleep mentation. Whenever a pause of 10–15 s occurred during the verbal report, the experimenter inquired if there was additional material. At the end of a report, the experimenter asked a few short questions to ensure that the material recounted had been correctly understood. Questions typically concerned actions, locations, characters and feelings or thoughts associated with the dream. All verbal reports were tape-recorded and subsequently transcribed.

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3.4. Scoring of dream content

Dream content was coded and analyzed independently by two extensively trained judges according to the objective coding system of Hall and Van de Castle (H/V; 1966). All dream reports were independently scored by two raters and inter-rater agreement ranged from 76% to 91% across all of the content categories. The following basic categories were used: (1) *Characters,* consisting of people, animal or mythical figures, classified under each of the following four headings: number, gender, identity and age; (2) *Social interactions,* consisting of relations between individual characters or groups that can be scored under three subscales: aggression, friendliness and sexuality; (3) *Activities*, i.e., actions performed by dream characters, classified under eight categories: physical, movement, location change, verbal, expressive communication, visual, auditory and thinking; (4) *Emotions*, representing affective states of characters divided into positive, negative and neutral emotions; (5) *Achievement outcome*, including success and failure, i.e., a successful handling of some difficulty encountered by a character or an incapacity of the character to achieve his or her desired goal because of personal limitations and inadequacies; (6) *Objects*, i.e., items that are contained in the physical surroundings, classified under 12 categories: architecture, household, food, implements, travel, streets, regions, nature, body parts, clothing, communication and money; (7) *Descriptive elements*, describing attributes and qualities of objects, people, actions and emotional states such as color, size, age, density, thermal, velocity, linearity, intensity and evaluation.

The following scales were also used to explore additional features in the typewritten dream reports: (1) *Physical sensations*, including tactile, pain and visceral sensations, as well as smell and taste sensations. This in house scale uses the absolute total number of mentions of any physical sensation in the dream report; (2) *Involvement*, i.e., the degree of dreamer's behavioral participation in the dream (i.e., observer or participant). This is an in house categorical scale; (3) *Subjective feeling of bizarreness* (i.e., spontaneous reported feeling of bizarreness); this is also an in house scale and is based on the spontaneous mention by the dreamer that the dream was bizarre. The degree of bizarreness in dream reports was also scored by two independent judges using the Bizarreness Scale of Williams, Merritt, Rittenhouse, and Hobson (1992). This scale includes three categories of bizarreness: discontinuities, incongruities and uncertainties. Each of these three levels can be detailed according to four different categories: (1) characters/actions/places/objects/time; (2) thoughts of dreamer or dream characters; (3) emotions, feelings and physical sensations; (4) Ad hoc explanations (i.e., explanations that refer to a previously noted bizarreness and that offer some sort of explanation to this bizarreness).

Dream report length was determined by computing the number of words in each dream report. The number of words not specifically related to the dream content was also calculated.

3.5. Statistical analysis

When more than one NREM sleep or REM sleep dream report was collected from the same participant, dream content scores were first averaged across all reports from the same participant within each group. Comparisons between NREM and REM sleep reports within each group (controls and participants with schizophrenia) were performed using non-parametric Wilcoxon matched pairs test since the variance of many variables was found to be different between the two data sets. Between group statistical comparisons were also performed using non-parametric Mann–Whitney U-tests. Chi-square tests and Fisher's Exact test were used to analyze categorical data. A criterion for significance was set at 0.05 for the primary analyses. A more stringent alpha level ($p = 0.05$ divided by the number of comparisons computed) was used for the secondary analyses.

4. Results

4.1. Laboratory sleep measures

Standard polysomnographic variables, including NREM and REM sleep latency, obtained during baseline recording (night 2) for patients with schizophrenia and controls are presented in Table 2. One patient's value for NREM sleep latency was excluded as it was more than three standard deviations above the mean. Mann–Whitney U-tests revealed no significant group differences on any of the sleep parameters.

4.2. Laboratory dream recall

There were a total of 55 awakenings from NREM sleep (SCZ = 28, CTL = 27), which resulted in 34 dream reports (SCZ = 17, CTL = 17). There was no significant difference between the two groups in the number of dream reports with reportable content (SCZ = 12 vs. CTL = 10; $p = 0.7$, Fisher's exact test) nor in the number of white dreams (SCZ = 5 vs. CTL = 7; $p = 0.5$). Participants with schizophrenia and controls reported between one to two dreams each. Four participants in each group reported a single dream, while four participants with schizophrenia and three controls reported two dreams each. The remaining 15 participants (8 controls and 7 patients) reported either white dreams or no dream recall.

A total of 41 awakenings from REM sleep were conducted in control participants, which resulted in 36 dream reports. Individual subjects reported between one to three dreams each. Two participants reported a single dream, five reported

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Table 2
Sleep variables (mean ± SEM) recorded at baseline in control participants and patients with schizophrenia.

Sleep parameters	Controls (n = 15)	Schizophrenia (n = 14)	p Value[a]
Total sleep duration	467.7 ± 7.3	483.7 ± 19.3	0.1
Sleep efficiency (%)	94.4 ± 1.1	95.8 ± 0.8	0.4
Total number of arousals	24.3 ± 0.9	23.1 ± 2.9	0.09
NonREM sleep latency (min)	11.8 ± 1.8	27.4 ± 6.3	0.1
REM sleep latency (min)	82.3 ± 9.8	99.4 ± 15.4	0.3
Stage 1 sleep (%)	6.3 ± 0.6	5.8 ± 0.7	0.3
Stage 2 sleep (%)	63.6 ± 1.5	67.6 ± 2.4	0.1
Stage 3 sleep (%)	6.9 ± 0.7	5.9 ± 1.3	0.2
Stage 4 sleep (%)	3.4 ± 1.1	1.4 ± 0.5	0.1
REM sleep (%)	19.7 ± 1.1	19.3 ± 1.6	0.6
Wakefulness (%)	5.6 ± 1.1	4.2 ± 0.8	0.4

[a] Mann–Witney U-test.

two dreams, and eight reported as many as three dreams. There was a significantly higher incidence of dream recall from REM sleep awakenings (87.8%) compared to NREM sleep awakenings (37.0%) (p = 0.0001, Fisher's exact test), with a higher proportion of white dreams in NREM sleep (25.9%) compared to REM sleep (7.32%) (p = 0.03).

Participants with schizophrenia were awakened 35 times from REM sleep for dream content, which resulted in 33 dream reports. Individual subjects reported between one to three dreams each. Two participants reported a single dream, five reported two dreams, and seven reported as many as three dreams. There was a higher incidence of dream recall from REM sleep awakenings (94.3%) compared to NREM sleep awakenings (42.9%) (p = 0.0001, Fisher's exact test), with white dreams reported more frequently in NREM sleep (17.9%) compared to REM sleep (2.9%) (p = 0.04).

Due to the lower levels of dream recall obtained in response to NREM sleep awakenings, only 7 of the 15 controls (47%) reported one or more dreams from both REM (n = 17 reports) and NREM sleep (n = 10 reports). Similarly, only 8 of the 14 patients (57%) reported one or more dreams from both REM (n = 18 reports) and NREM sleep (n = 12 reports). Results on the content of NREM sleep dream reports as well as on REM sleep versus NREM sleep comparisons were thus based on the reduced number of controls and patients who also reported dream content from NREM sleep.

4.3. Laboratory dream content

4.3.1. Between group comparison on NREM sleep dream content measures

Table 3 presents differences in NREM sleep dream reports between patients with schizophrenia and controls. Between group comparisons on several primary and exploratory dream content variables could not be computed (e.g., characters, dream bizarreness, social interactions, emotions, achievement outcome, physical sensations) as they appeared too infrequently or not at all in dream reports collected from the two groups' NREM sleep. Only variables that were amenable to statistical analyses are thus presented here and in the accompanying tables. Table 3 shows that NREM sleep dream reports from the patient group contained fewer words than did those from controls, and this despite a greater number of verbal interventions from the experimenter (EVI). Both groups of participants reported an equivalent proportion of words that were not specifically related to dream content. There were no significant group differences on any of the exploratory dream content variables.

Table 3
Dream-related variables for laboratory NREM (stage 2) sleep reports (mean ± SEM) from control participants and participants with schizophrenia.

Dream report parameter	CTL (n = 7)	SCZ (n = 8)	p Value
Primary analyses[c]			
Number of words[a]	54.2 ± 10.2	20.3 ± 4.7	0.002*
Additional words[a] (not related to dream content)	11.4 ± 8.01	7.1 ± 3.3	0.8
Number of reportable items[a]	4.8 ± 2.1	2.7 ± 0.5	0.7
Experimenter's verbal intervention[a]	4.1 ± 0.5	6.4 ± 0.8	0.04*
Secondary analyses[d]			
Objects[a]	1.0 ± 0.5	0.9 ± 0.2	n/a
Activities[a]	1.2 ± 0.3	0.6 ± 0.2	0.09
Personal involvement[b] (% of active participation in the dream)	80.0%	33.3%	0.04

CTL = control group; SCZ = schizophrenia group; n/a = not applicable.
[a] Mann–Whitney U-test.
[b] Chi-square (Fisher exact, two-tailed).
[c] Alpha level = 0.05.
[d] Alpha level = 0.008.
* Statistically significant.

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Table 4
Differences in dream content variables (mean ± SEM) between NREM (stage 2) and REM sleep reports from control participants.

Dream report parameters	NonREM reports	REM reports	*p* Value
Primary analyses[c]			
Number of words[a]	54.2 ± 10.2	298.1 ± 59.7	0.04*
Additional words[a] (not related to dream content)	11.4 ± 8.01	42.0 ± 11.2	0.03*
Number of reportable items[a]	4.8 ± 2.1	26.1 ± 4.8	0.03*
Experimenter's verbal intervention[a]	4.1 ± 0.5	9.2 ± 1.0	0.01*
Secondary analyses[d]			
Objects[a]	1.0 ± 0.5	7.4 ± 1.4	n/a
Activities[a]	1.2 ± 0.3	7.5 ± 1.8	0.01
Personal involvement[b] (% of active participation in the dream)	80.0%	80.6%	0.6

n/a = not applicable.
[a] Wilcoxon matched pairs test.
[b] Chi-square (Fisher exact, two-tailed).
[c] *p* Value = 0.05.
[d] *p* Value = 0.008.
* Statistically significant.

4.3.2. Between stage comparison on dream content measures

Table 4 presents the differences in dream content between NREM sleep and REM sleep dream narratives reported by control participants while Table 5 shows the equivalent data for patients with schizophrenia. Differences observed in both data sets were in the expected direction for the following variables: number of words, number of reportable items and experimenter's verbal intervention. Each of these variables occurred less frequently in association with NREM sleep reports as compared to those from REM sleep. As shown in Table 4, control participants also reported significantly fewer additional words not related to their dream content from NREM sleep as compared to REM sleep. A similar albeit non-significant difference was also noted in the patient group (see Table 5). With regards to the exploratory dream content variables amenable to analyses, Tables 4 and 5 show that although objects, activities and personal involvement occurred more frequently in both groups' REM dream reports than in those from NREM sleep, these differences did not meet the more stringent alpha level set for these additional comparisons.

Statistical comparisons between each group's NREM sleep and REM sleep dream reports on measures of bizarreness could not be computed given the low incidence of bizarreness across reports and the fact that only 15 of the 29 participants (7 controls and 8 patients) provided dream reports from both REM and NREM sleep. However, given the empirical and theoretical importance of these measures, we examined at a descriptive level the available data from these 15 participants by tabulating the proportion of participants describing a bizarre element or a subjective feeling of bizarreness at least once in their NREM sleep dream reports as compared to their REM dream reports. Both groups' REM sleep dream reports were more likely to contain a bizarre element, but this difference was particularly salient in the patients with schizophrenia. Specifically, whereas bizarre elements were present in at least one of the REM sleep reports from each of the 8 patients (100%) compared to 5/7 (71.4%) in controls, they were found in the NREM sleep dream reports of only one of the patients (12.5%) compared to 2/7 (28,6%) in controls. In addition, control participants were more likely to report a subjective feeling of bizarreness at least once in association to their REM dream reports (5/7 participants) as compared to their NREM sleep

Table 5
Differences in dream content variables (mean ± SEM) between NREM (stage 2) and REM sleep reports from participants with schizophrenia.

Dream reports parameters	NonREM reports	REM reports	*p* Value
Primary analyses[c]			
Number of words[a]	20.3 ± 4.7	123.0 ± 28.5	0.04*
Additional words[a] (not related to dream content)	7.1 ± 3.3	15.8 ± 4.6	0.07
Number of reportable items[a]	2.7 ± 0.5	14.7 ± 2.4	0.005*
Experimenter's verbal intervention[a]	6.4 ± 0.8	10.4 ± 1.3	0.03*
Secondary analyses[d]			
Objects[a]	0.9 ± 0.2	4.2 ± 0.9	0.03
Activities[a]	0.6 ± 0.2	4.2 ± 0.8	n/a
Personal involvement[b] (% of active participation in the dream)	33.3%	72.7%	0.03

n/a = not applicable.
[a] Wilcoxon matched pairs test.
[b] Chi-square tests (Fisher exact, two-tailed).
[c] *p* Value = 0.05.
[d] *p* Value = 0.008.
* Statistically significant.

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dream reports (1/7 participants). There were no comparable differences in participants with schizophrenia as only one patient reported a subjective feeling of bizarreness in association with dream reports from either NREM sleep or REM sleep.

5. Discussion

The aim of the study was to investigate differences in the content of NREM sleep dream reports obtained from adults with schizophrenia and healthy control participants. To summarize the main findings of the present study: (1) Patients with schizophrenia obtained levels of dream recall following experimental awakenings from both Stage 2 and REM sleep that are consistent with what is reported in the literature for healthy controls; (2) Group comparisons of NREM sleep dream reports revealed that the patients' reports were shorter despite a greater number of verbal interventions from the experimenter; (3) When compared to their REM sleep dream counterparts, both groups' NREM sleep dream reports included significantly fewer words and reportable items; (4) Statistical comparisons on several content measures, including bizarreness, could not be computed given limited number of dream reports obtained and the rare occurrence of these content indicators across reports; (5) Analyses of exploratory dream content variables revealed no significant differences between groups or between NREM and REM sleep dream reports. These findings are discussed in turn.

5.1. Dream recall

The results from the present study show that the level of dream recall frequency obtained in both groups following experimental awakenings from REM and NREM sleep (REM sleep: SCZ = 94.3%, CTL = 87.8%; NREM sleep: SCZ = 42.9%, CTL = 37.0%) approximates the values generally observed in studies of REM and NREM sleep mentation in healthy adults (REM sleep = 81.9% ± 9.0; NREM sleep = 43.0% ± 20.8 (see Nielsen (2000) for a review). The normative level of dream recall reported by our patient group contrasts with older laboratory findings of lowered dream recall frequency in schizophrenia compared to controls (Dement, 1955; Jus et al., 1973; Kramer, Whitman, Baldridge, & Ornstein, 1970; Okuma et al., 1970). This discrepancy might be attributable to variations in the experimental protocols, including method of awakening (e.g., sounding a buzzer, calling out the sleeper's name, knocking on the chamber's door), duration of the sleep stage prior to planned awakenings, inclusion or not of an adaptation night, and number of nights investigated. Discrepancies in dream recall may also reflect varying patient characteristics and treatment modalities (e.g., age of participants, illness duration, type of antipsychotic medications, presence of adjuvant medication, presence or not of withdrawal period, psychiatric comorbidity). That being said, our results suggest that dream recall in patients with schizophrenia is comparable to that of healthy individuals across both REM and NREM sleep.

5.2. Group comparisons on NREM dream content measures

While comparing the dream content of both groups of participants, we found that NREM sleep dream narratives from patients with schizophrenia contained fewer words than those of control participants, corroborating other laboratory findings in patients with schizophrenia following both NREM (Cartwright, 1972) and REM sleep awakenings (Cartwright, 1972; Chang, 1964; Debieve et al., 1977; Hall, 1966; Lusignan et al., 2009; Okuma et al., 1970). Moreover, in spite of a greater number of EVIs, our patients did not provide more details about their dreams, suggesting that their dream reports are in fact simpler, or more poorly recalled, than those provided by healthy controls.

Abnormalities associated with language production in schizophrenia might be partially responsible for their altered or impoverished dream narratives. Although these kinds of deficits have been proposed to account for the briefness of dream reports in schizophrenia (Chang, 1964; Okuma et al., 1970), we found that patients' difficulty in reporting dream content did not appear to affect their overall speech productivity. Indeed, even though our patient group used fewer words than controls to describe their dream experiences, they used an equivalent number of words to describe elements not directly related to the dream content. Given the widespread cognitive disorders in schizophrenia, other neuropsychological dysfunctions could potentially explain the constriction of dream narratives by patients with schizophrenia, such as deficits affecting differentially dream production, dream encoding into memory, or its retrieval.

An alternative explanation would relate the briefness of dream reports in schizophrenia to sleep inertia following NREM sleep awakenings. Findings demonstrate an endogenous circadian rhythm in sleep inertia of cognitive performance, with worst impairment upon awakening during the biological night (Scheer, Shea, Hilton, & Shea, 2008) and greater effects of sleep inertia on cognitive performance when subjects are awakened from NREM sleep than from REM sleep (Silva & Duffy, 2008). It is possible that the known sedative effects of some antipsychotic agents (Kane & Sharif, 2008) might give rise to greater sleep inertia in patients with schizophrenia. However, in the present study, the observation that participants with schizophrenia used the same number of words to describe elements not directly related to the dream content suggest comparable levels of alertness when reporting dream content. Although not directly measured in the present study, sleep inertia effects in participants with schizophrenia may be expressed through a greater initiation time before reporting dream content. Given that dream memory is vulnerable to the passage of time, a greater time delay before providing dream reports may affect dream recall in schizophrenia. This possibility could be tested by evaluating the correlations between time delays

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before providing a verbal report and the length of both NREM and REM dream reports in patients with schizophrenia and in healthy controls.

5.3. Between stage comparison on dream content measures

Consistent with previous studies, we found that when compared to their REM sleep dream reports, both groups' NREM sleep dream reports included significantly fewer reportable items. Such quantitative differences are in line with the suggestion that NREM sleep dream reports lack the dreamlike quality that characterizes most REM sleep dream reports, i.e., that NREM sleep dreams are more thought-like, less elaborate, visual, kinesthetic, affective, and bizarre (Foulkes, 1967; Nielsen, 2000). We also found that the NREM sleep dream narratives from both groups were significantly shorter in terms of word count when compared to their REM sleep dream reports. However, only control participants reported fewer additional words not related to dream content from NREM sleep in comparison to their REM sleep reports. This result may be attributable to a floor effect since the actual number of additional words used was relatively low in association with both REM and NREM sleep dream reports. That being said, given the fact that both groups' NREM sleep dream reports showed a decrease in the number of reportable items compared to their REM counterparts, our findings suggest that cognitive style associated with REM and NREM sleep in schizophrenia is similar to what is observed in healthy individuals.

5.4. Dream bizarreness

Our main predictions concerning dream bizarreness could not be tested. The relatively small number of dream reports collected and the low incidence bizarreness across reports (especially from NREM sleep) rendered impossible any parametric or non-parametric statistical comparisons. This was also true for other dream content variables of interest (e.g., social interactions, characters, physical sensations). Although challenging, future comparative studies of laboratory-based dream content in patients with schizophrenia should aim for larger group sizes combined with more experimental awakenings, especially from NREM sleep.

That being said, the descriptive examination of the data obtained from the 8 patients and 7 controls that contributed dream reports from both their REM and NREM sleep suggests that REM dream reports are more likely than NREM reports to contain bizarre elements and that this difference may be more pronounced in patients with schizophrenia. Our preliminary findings also suggest that the main difference between patients with schizophrenia and control individuals in terms of dream bizarreness lies in participants' self-ratings of bizarreness of their own dreams. While both of our groups' REM sleep dream reports contained more objectively scored bizarreness than their NREM sleep dream reports, only control participants were more likely to report a subjective feeling of bizarreness regarding their REM dream reports compared to their NREM sleep dream reports. Two possibilities may partially account for these results. First, patients with schizophrenia may be accustomed to a higher degree of strangeness in their thoughts and consequently potentially bizarre elements are not perceived as being particularly salient or unusual for them, even when they occur in their dreams. Alternatively, healthy controls may simply have a greater capacity for insight and critical thinking and thus better appreciate the apparent strangeness of their dream experiences. It would be interesting to examine the relation between objective and subjective measures of bizarre elements in dreams and waking thought samples from the same participants as well as in relation to measures of cognitive insight in schizophrenia (Warman, Lysaker, & Martin, 2007).

5.5. Limitations of the study and future directions

The methodological constraints of the present study, namely, the small size of the sample, the limited number of dream reports per participant, and the unequal distribution across gender all suggest caution in interpreting the findings. For instance, as detailed by Domhoff (1996), it is unlikely that repeatable and robust results can be obtained with dream reports much shorter than 50 words, especially when using Hall/Van de Castle content categories. Similarly, although everyday dream recall is relatively stable over time (Robert & Zadra, 2008; Schredl & Fulda, 2005), several dream content variables appear infrequently in dream reports and show large intra-individual fluctuations. Further analyses, with multiple dream reports from larger and more diversified populations, are required to investigate potential gender effects as well as patterns of dream content in patient groups with predominantly negative or positive symptomatology or those in the acute phase of the illness versus patients with chronic histories. The fact that our schizophrenia patients were all medicated may also be considered as a limiting factor, preventing a purer assessment of their dream experiences. Finally, no measure of waking cognitive bizarreness was taken from our participants. This would have permitted a more direct comparison of waking cognitions between our two groups rather than assuming that participants with schizophrenia necessarily experience more bizarre thoughts than do controls.

6. Conclusion

General similarities exist in the recall and content of REM and NREM dreams of patients with schizophrenia in comparison to that of healthy controls. Our results suggest that sleep stage cognitive style in schizophrenia is comparable to that

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observed in healthy individuals, with NREM sleep dream reports being more thought-like, less elaborate and less bizarre than REM sleep dream reports.

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