Representation of Self in SWS and REM Dreams

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The aim of this study was to compare the representation of self in REM and SWS dreams. Ninety volunteers slept two non-consecutive nights in the sleep laboratory under electropolygraphic control. They were awakened for one report per night. Awakenings were made, in counterbalanced order, from Slow Wave Sleep and Rapid Eye Movements sleep. Dream reports (90 SWS and 90 REM) were scored by independent judges as regards: a) length (according to temporal units); b) representation of self (according to a nominal eight-point scale). Results showed that: a) REM dream reports were significantly longer than SWS dream reports; b) the representation of Self in REM dream reports is quite similar to the waking experience of Self; c) the representation of Self in SWS dream reports presented a wide variety of characteristics (from a thinking agent or passive observer, to a waking-like Self experience); d) the differences between REM and SWS dream reports in representation of Self persisted independently of report length. Results are discussed referring to a cognitive model of dream production. **(Sleep and Hypnosis 2005;7(2):77-83)**

Key words: cognitive processing, dreaming, REM sleep, Slow Wave Sleep, representation of Self

INTRODUCTION

At present the rigid dichotomy between REM and NREM mental activity has been superseded by empirical evidence that the dreaming occurs continuously throughout sleep (1,2). Many experimental studies have showed oneiric mental production in Sleep Onset (SO), Stage 2 (St.2) and Slow Wave Sleep (SWS), which is not predicted by the REM/NREM sleep dichotomy (3-7). Furthermore experimental data support the hypothesis that cognitive processes involved in dream generation could be the same in the different sleep stages. In fact, from the comparisons between REM and NREM dream reports only one difference emerges constantly: REM dream reports are longer than NREM ones. The most qualitative differences disappeared in length-matched comparison so that qualitative differences between REM and NREM dream reports

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were considered as a mere epiphenomena of quantitative ones (4,5,8-10).

Nevertheless few residual qualitative inter-stage differences persist, as for example the quality of the representation of Self and the presence of emotions. As regards the incidence of the dreamer's Self, Foulkes and Schmidt (8) showed that the presence of Self in the dreams was higher in REM than in SO, in both length-unmatched and length-matched comparison. On the contrary, Bosinelli Cavallero and Cicogna (11), using a different method of scoring, showed a more frequent covert and explicit presence of Self in SO than in REM sleep. The ambiguity regarding experimental data on the representation of Self is due to the different scoring systems, which have detected different aspects of the representation of Self, but also suggests that could it be the quality of the hallucination of Self which differs across sleep stages, not only the rate.

The interest in the study of the representation of Self in dreams has been prompted by three considerations. First, the frequent presence of dreamer's Self that probably plays an important role in organising and structuring the dream narrative. Second the singular variability of this type of experience: the dreamer can be a simple passive observer of the oneiric scene, an active participant, as well he/she can have a double role, an altered presence, or he/she can be embodied in other people or object of the dream, and so on. Third, the representation of Self in dreams corresponds to an experience of the hallucination of Self, and this hallucinatory experience is specially related to the oneiric activity, with the exception of some pathological conditions (12).

As the hallucinatory phenomenon concerns, from a phenomenological point of view, it has been ascribed to the concurrence of two main psychophysiological factors: a) a multisensorial deafferentation, which produces a sort of void or "absence" of external information; b) the psychological endogenous response which produces and externalises images in that sensorial void (13).

It is possible that during sleep the peculiar and different functioning of physiological systems among diverse sleep stages could explain some qualitative differences in the hallucination of Self. At this regard, we are mainly interested in studying different modalities of the hallucination of Self in dream scene, in SWS and REM sleep, which are maximally different in physiologic regulation and in cortical and sub-cortical activation.

The cognitive processing of dream production is assumed to have different levels of engagement, and different availability of memories, depending on conditions of cerebral activation. Such physiological features have been recently underlined by studies using neuroimaging techniques to visualize the different metabolic levels of the cortical-subcortical structures during sleep (14-17). By comparing maps obtained in REM sleep and SWS, it was found that the structures believed to be crucial in elaborating mnemonic traces (hyppocampal cortex, limbic system) are more active in REM sleep: this increased activation could indicate a more spreading activation of mnemonic elements capable of generating more complex and rich oneiric mental constructs. The higher cerebral activation in REM sleep is hence considered a condition facilitating efficiency and engagement of the cognitive dream production, memory processes included (2,5,18).

Our study attempted to analyse in greater details the REM/SWS qualitative differences with special reference to the dream representation of Self. From the above considerations about mnemonic availability, cognitive engagement, proprioceptive deafferentation, we hypothesised that the hallucination of Self can be more similar to the wakefulness perception of Self in REM

than in SWS dreams. On the contrary, we expected more incomplete and bizarre hallucination of Self in SWS than in REM dream reports.

METHOD

One hundred and eighty dreams (90 REM and 90 SWS dream reports) were analyzed, provided by 90 paid university students (45 males and 45 females), aged between 20 and 26, good sleepers and dream recallers (3-4 dreams spontaneously recalled per week). After an adaptation night in the sleep laboratory, participants were studied for two non consecutive nights, under standard electropolygraphic control (two EEG channels, two EOG and one EMG).

Just one mental experience was solicited, per night, in one of two conditions: REM and SWS.

Slow Wave Sleep condition. Participants were awakened after ten minutes of continuous delta sleep, stage 3-4 or stage 4 (according to the criteria of Rechtschaffen and Kales (19)), provided at least 30 minutes from initial sleep onset had elapsed.

Rapid Eye Movement sleep condition. Participants were awakened during the second REM period, ten minutes after the appearance of the first clear burst of rapid eye movements.

The order of the awakenings was counterbalanced across participants.

Upon awakening (executed via an acoustic signal) a report of mental experience was solicited, via intercom, with the standard question: "Please tell me everything you can remember of what was going through your mind immediately before I woke you up", and after the end of the subject's spontaneous report, "Can you remember anything else?".

Immediately after the dream report the subject, previously trained, was invited to describe his own representation of Self in the related dream sequence. In particular subjects were asked how they felt inside the dream scene and their level of participation (e.g. no participation, simple observer, active as in real life).

In order to obtain two reports per subject, whenever an awakening in a certain condition failed to produce a content report, additional nights were scheduled until a report was produced.

Dream reports were submitted to five independents judges.

The report length was scored in Temporal Units, according to Foulkes' criteria (7): a temporal unit being defined as whatever activities could have occurred synchronously and were not described as having occurred successively. According to length, reports were then classified in two categories: single-unit reports (a single scene or action), and multi-unit reports (an organized narrative sequence) (20). Agreement percentage in the length scoring was >80%. Judges corrected any scoring discrepancies and the reconciled version was used in the data analysis.

Characteristics of the representation of Self were scored by a nominal eight-point scale (12):

I– No representation. Absence of representation of Self either as physical presence or thinking subjectivity (for example in the typical hypnagogic hallucination).
Ex. 1: "a kind of white submarine bearing the letters A and C".

II– Awareness of one's own thoughts or presence of Self as pure thinking agent (the Self image is totally absent).
Ex. 2: "I was thinking of problems about my examination... I had the image of the open book...nothing else".

III- Static representation of oneself, total or partial Self body image, more or less associated to proprioceptive, kinestetic, agreeable or painful sensations. This representation is more complete than a simple noncorporealized thinking presence.

Ex. 3: "I was seeing my body lying on the bed, and it was completely white, better beige. I was able to see myself lying on that bed, I had to fall asleep.... I saw neither the room nor the bed, only my body and the beige as a colour".

IV- Representation of oneself as a passive observer of the dream events. The dreamer is inside the scene, but totally a passive observer and no taking part in the oneiric scene.
Ex. 4: "I was at a gasoline station and I was observing this scene: a child was mounting an inflatable horse which had a motor inside. When the signal rang the horse bumped against a pole. The child was my nephew".

V- Precise awareness of oneself, both mental and physical, analogous to wakefulness. The dreamer actively participates in the event with a pluri-sensorial hallucination of Self, like the Self-awareness one experiences upon waking.
Ex. 5: "I was in the country and I was talking with a friend; My girlfriend was there and we were talking about a building...I felt ill at ease because I was involved in a discussion I didn't like...I was feeling as if I were in the real life".

VI- Awareness of oneself through identification with other characters in the dream. The dreamlike experience of Self is sui generis, expressed either by way of embodiment in or identification with other characters or even with objects.
Ex. 6: "A lot of beautiful actresses....I'm transformed and become a famous actor".
Ex. 7: "I was inside a gigantic photocopying machine. I knew I was inside, as an abstract entity, as a mind, I was the machine, so I couldn't see myself".

VII- Double representation of Self, in the sense of two distinct and relatively active roles: e.g. when the dreamer plays both the role of the chief character and that of observer or else plays roles of different protagonist.
Ex. 8: "I was in a South-American country, I was riding a horse, other people were with me...we were pursuing a man, who was also myself, because he (I) had some money".

VIII- This category includes the lucid dream in which the dreamer is aware of the dreamlike quality of his/her experience.
Ex. 9: "I remember a soccer match in which I was playing. I was in my bed and I was able to see myself playing soccer. I was aware it was my imagination".

Agreement percentage in the Self scale scoring was >84%. Judges corrected any scoring discrepancies and the reconciled version was used in the data analysis.

RESULTS

Average dream recall rates were 94.74% in REM and 67.16% in SWS (χ^2 = 42.65; p<.0001).

The REM reports were significantly longer (5.34±4.25) than SWS ones (2.08±1.72) (t89=7.45 - p<.0001). Furthermore REM phase presents more multi-unit reports (N=79/90; 87.78%) than SWS (N=47/90; 52.22%), χ^2 = 27.09; p<.00001).

The Self-analysis results are shown in Table 1. Since not a single lucid dream

Table 1. Percentage of every point of the self scale for REM and SWS dream reports.

	I*	II	III*	IV**	V**	VI	VII
REM	1.11%	1.11%	1.11%	6.67%	83.33%	-	6.67%
SWS	8.89%	5.56%	8.89%	24.44%	47.78%	2.22%	2.22%

* = p<.05
**= p<.001

occurred in either of the sleep conditions examined (REM and SWS), point VIII of the scale was not taken into account.

The distribution of participation of Self was significantly different between the two sleep conditions considered ($\chi^2 6 = 35.38$; $p<.0001$). In particular while in REM sleep there was a greater incidence of point V (waking-like representation of Self), in SWS the distribution was wider spread.

Comparing the two sleep conditions for each category of the Self nominal scale significant differences were found: in category I - no participation ($\chi^2 = 5,73$; $p<.05$ - SWS>REM), in category III - static representation of oneself ($\chi^2 = 5,73$; $p<.05$ - SWS>REM), in category IV - representation of oneself as passive observer of the dream scene ($\chi^2 = 10,83$; $p<.001$ - SWS>REM), in category V - precise awareness of oneself, both mental and physical, analogous to wakefulness ($\chi^2 = 32,74$; $p<.001$ - REM>SWS).

Taking into account the dream reports length we performed the same analysis compared single-unit vs. multi-unit reports for each sleep condition (Table 2). No significant differences were found.

and can be explained with a different efficiency of the memory processes (storage and/or retrieval) consistent with a different activation of cortical-subcortical memory pathway during sleep (14-17).

As regards qualitative analysis significant differences were found between REM and SWS dreams with regard to the pluriperceptive representation of Self in dream scene. The representation of Self in REM dreams resulted frequently similar to the perception of Self in wakefulness (complete hallucination of Self) (point V in our nominal scale). On the contrary, in SWS dream reports we observed a polymorphous representation of Self.

Generally the quantitative differences between REM and SWS are inferred from the difference in reports length (5,6). Nevertheless, in the present study, the representation of Self kept the same characteristics in both sleep conditions irrespective of length. In fact, within each sleep condition the comparison between single- versus multi-unit reports did not show different representation of Self in any case.

It is known that the construction of representation of Self comes about through

Table 2. Percentage of every point of self scale for single-unit and multi-units for REM, SWS dream reports.

	I	II	III	IV	V	VI	VII
				REM			
Single-unit	-	-	-	18.18%	81.82%	-	-
Multi-units	1.27%	1.27%	1.27%	5.06%	83.54%	-	7.59%
				SWS			
Single-unit	13.95%	9.30%	2.33%	25.58%	46.51%	-	2.33%
Multi-units	4.26%	2.13%	14.89%	23.40%	48.94%	4.26%	2.13%

DISCUSSION

REM sleep was characterised by an average mentation recall significantly higher than SWS. As regards the length, REM dream reports resulted longer and with a higher number of multi-units reports in comparison to SWS ones. Both these quantitative results are consistent with previous studies (5,6)

the elaboration of experiences accumulated over one's life and which are then integrated in the different mnemonic systems (perceptive representation of Self, episodic Self, semantic Self-knowledge) (21-23).

By comparing PET maps obtained in SWS and REM sleep, it was found that the structures, believed to be crucial in memory storage (hyppocampal cortex, limbic

system), are more active in REM. This increased activation could indicate a more spreading activation of mnemonic elements, capable of generating more rich oneiric mental constructs (14,16). Furthermore the particular neurophysiological activation of cerebral areas involved in mnemonic traces processing may well facilitate the integration of information coming from the different memory systems. That might explain why the representation of Self in REM dreams can be frequently similar to the perception of Self in wakefulness. While, in SWS, in light of the hypoactivation of the cortical areas responsible for mnemonic activity, it may be harder for the cognitive system to bring back the Self-referred information from different memory systems and to process it so as to produce a complete symbolic representation of Self. This physiological state might well explained the polymorphous or partial or poor representation of Self observed in SWS dream reports.

We should conclude that the length of dream reports, as quantitative index, cannot explain the difference in representation of Self between the sleep stages. Different physiological regulation of sleep stages instead could affect the quality of hallucination of Self.

In the introduction we claimed that hallucinatory process profits by the sensorial absence of internal and external information. In REM the absence of external environmental input, could enhance the probability of complete hallucination of Self, which has the characteristics of perception of Self in wakefulness (11).

Let us add a suggestive note: the hallucination of Self similar to the wakefulness Self experience solely happens in dreams, while the incomplete hallucination of Self overall observed in SWS dream reports is present also in some particular altered states of consciousness in wakefulness, named autoscopic hallucination (out of body experience, mind-body dissociation, double Self phenomenon and so on) (12,24). In these pathologies too, patients partially maintain the proprioceptive perception referred to their bodies hic et nunc as in SWS condition (that is, the sensorial void is only partial), only the parts of Self are hallucinated, in a similar way to points II, III, IV and VII of our scale, and the waking-like hallucination of Self is never present.

Further research should investigate hallucination of Self in the other sleep stages, eventually comparing it with other Self experiences in particular states of consciousness.

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