

**DOCTORAL THESIS OF LYON UNIVERSITY**

**Delivered by**

University Claude Bernard Lyon 1

**Doctoral school:**

Neurosciences and Cognitive Sciences (ED476)

**PhD specialty**:

Neurosciences

Publicly defended on the XXXXX, by

**Raphaël Vallat**

The cerebral correlates of dream recall

**Jury**

Dr. Sophie Schwartz Reviewer

Pr. Michael Schredl Reviewer

Pr. Yves Rossetti Examiner

Dr. Perrine Ruby PhD director

*À Isabelle et Alain*

*« J’ai rêvé tant et plus, mais je n’y entends note. »*

François Rabelais*, Pantagruel,* 1532

*« Je croyais entendre,*

*Une vague harmonie enchanter mon sommeil,*

*Et près de moi s'épandre un murmure pareil,*

*Aux chants entrecoupés d'une voix triste et tendre. »*

Charles Brugnot, *Les Deux Génies*, 1833

RÉSUMÉ

ABSTRACT

Since the dawn of time, men and women have been fascinated by their dreams, and have sought to understand their nature and meaning. However, despite millennia of philosophical speculation and more than a century of scientific exploration, several questions regarding dreams remain pending.

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**Peer-reviewed publications**

**Submitted or under review**

**In preparation**

**\*** The authors contributed equally to this work

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FIGURES AND TABLES

ACKNOWLEDGMENTS

GENERAL INTRODUCTION



Jean-Jacques Grandville. *Second rêve –Une promenade dans le ciel*, 1847

1. Sleep & Dreams

« Dream science holds an intermediate position between history and biology. It is a science of observation, because observation is an essential part of it, but it is also an historical science in the sense that the elapsed dream can never be reenacted and is therefore investigated, not directly, but through memory. »

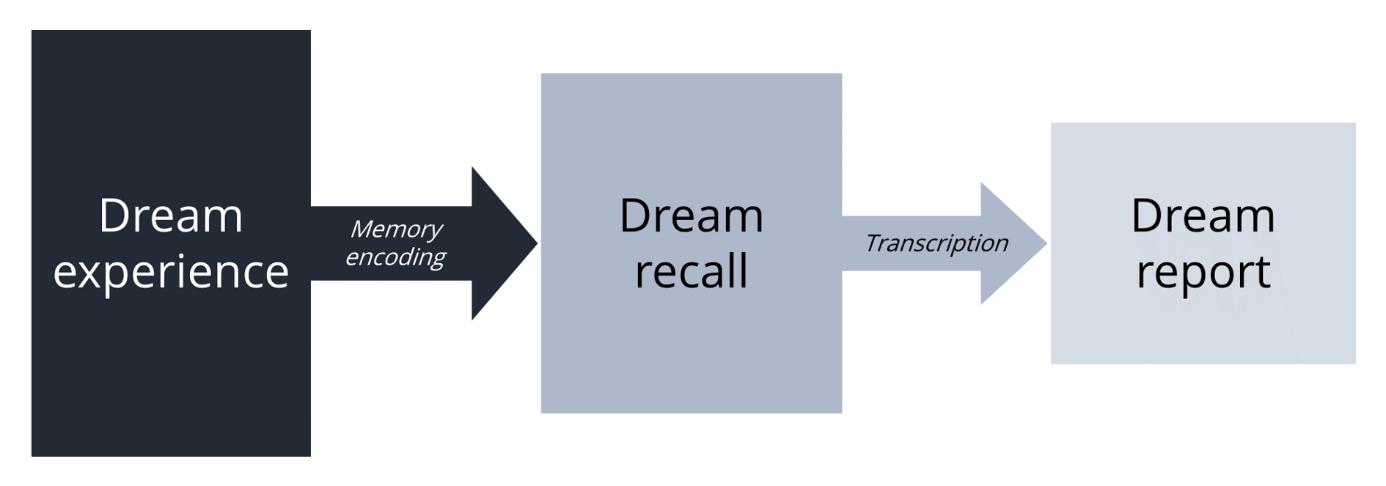
Yves Delage. Le rêve. Etude psychologique, philosophique et littéraire. 1920

# Dreams

## Modern definition

According to the Cambridge Dictionary, a dream is a *“series of events or images that happen in the mind when one is sleeping”*. This vague definition illustrates quite clearly how little we know about dreams, despite more than a century of experimental research and millennia of religious and philosophical speculation on their nature and meaning. The main reason for this lack of a clear and consensual definition (Pagel et al. 2001) is due to the fact that dreaming is, by nature, elusive, or, to say it in other words, *“a phenomenon that we can observe only during its absence”* (Paul Valery, *Analecta*, 1926). Indeed, we still do not know precisely when does dreaming occur during sleep, and therefore, the study of dreaming must rely on the introspective recall of the dreamer.

This observation led Guénolé to distinguish three successive forms of the dreaming phenomenon, intertwined like nesting dolls (Guénolé 2009). The primordial state is the dream-experience, which occurs during sleep, and of which very little is known because the dreamer has no means to communicate in real-time his or her oneiric travels to the external world. With the notable exception of lucid dreaming, the dream-experience is unobservable to the waking consciousness, be it that of an external observer, but also that of the dreamer him- or herself. The second form is the memory of the dream-experience as we recall it after awakening. Like other memory data, dream recall is mediated by introspection, or rather *“retrospection”* (Schwartz et al. 2005), and is therefore likely to be influenced by several mechanisms such as forgetting, reconstruction, verbal description difficulties and censorships. The last and third form is the verbal report of the dream memory using words or pictures. The dream report is the only one that can actually be communicated to others and therefore the only one eligible to empirical investigation. It is critical to emphasize that the dream recall and dream reports can only be experienced during wakefulness, while the dream-experience occurs only during sleep.

Figure 1: The three forms of dreams (Guénolé, 2009)

\*\*\*\*\*\*\*\*\*

Several questions remain pending: do we dream every nights? For how long? Why do we sometimes recall our dreams and sometimes not? Are dream reports accurate and exhaustive transcriptions of the dream experience? What is, or what are, the function(s) of dreaming?

From an historical standpoint, dreams were seen in many ancient civilizations as omens or messages from deities and were interpreted to predict the future.

# Sleep

## Definition

## Sleep stages

## Sleep architecture

## Methodology: EEG and ERP

# Link between dreaming and sleep stages

## The REM sleep hypothesis of dreaming

## The new hypothesis: dreaming occurs in all sleep stages

# Neurophysiological correlates of dreaming

## A scientific deadlock

## Brain activity during REM sleep

## Brain activity in the minutes preceding awakening

## Dreaming and the default mode network

## Methodology; fMRI and functional connectivity

1. Cerebral correlates of dream recall

« We must also inquire what the dream is, and from what cause sleepers sometimes dream, and sometimes do not; or whether the truth is that sleepers always dream but do not always remember (their dream); and if this occurs, what its explanation is. »

Aristotle. On dreams. 350 B.C.

# Dream recall frequency

## Inter- and intra-individuals variability in DRF

## Group comparisons of high and low dream recallers

# Parameters correlated with DRF

## Psychological factors

## Physiological parameters

## Sleep parameters

# Brain activity associated with a high or low DRF

## EEG studies

## PET study

## Remaining questions

1. Dream content and dream function

“I often think that the night is more alive and more richly colored than the day”.

Vincent van Gogh, 1888

# Dream content

## Methodology: basic principles of dream content analysis

## Experimental results

## The memory sources of dreams

# The function(s) of dreams

## Historical perspective

Voir bouquin De Koninck

Plato: dreams express hidden desires and are dominated by negative emotions (in tune with Freud, see De Koninck).

Aristotle

## Emotional regulation

## Memory processing

## Others hypotheses

1. Hypothesis and objectives

# Unresolved issues

## Differences between HR and LR at awakening

## Differences in the micro-structure of HR and LR

## What are the memory sources of dreaming?

EXPERIMENTAL RESULTS

METHODOLOGICAL DEVELOPMENT

GENERAL DISCUSSION

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