Good morning everyone,

Before starting my presentation, I would like to thank all of you for being here, and particularly the professors Sophie Schwartz, Michael Schredl and Yves Rossetti for accepting to be members of my PhD jury.

This is the general outline of my presentation. First I will introduce dreaming and some of the main issues related to its scientific study. In the second and most substantial section of my presentation, I will detail several studies that we have conducted in the aim of improving our knowledge of the mechanism of dream recall. In the third section, I will describe a study which aimed at characterizing the relationship between waking-life and dream content, in order to better understand the possible function of dreaming. In the fourth section, I will briefly describe an open-source software that I co-developed and which aims at providing a comprehensive and free graphical interface for the visualization and analysis of sleep data. Finally, I will end with some general conclusions and future perspectives.

To begin with, I would like to start by stating some open questions related to dreaming that I will use as a support for introducing this vast phenomenon. These questions are: what is dreaming? When does it occur during sleep? Does it have a functional effect? And why is there such variability in dream recall?

There are many ways to answer the first question of what is dreaming, or in other words, what is a definition of dreaming. In this presentation, I will use the definition and framework proposed notably by Fabian Guénolé which simply states that “dreaming is a mental experience during sleep which can be recalled and reported at wake”. In this model, the dreaming phenomenon is separated in three successive steps, namely the dream experience, the dream recall and finally the dream report. The dream experience takes place during sleep and refers to the dream as it is originally experienced. Upon awakening, the dream experience can be recalled, or forgotten, depending on whether one is able to encode the dream experience into memory or not. Finally, the dream can be reported using either words or pictures. Importantly, there is a loss of information between each of these three steps, in part because of forgetting, reconstruction mechanisms, censorship and description difficulties.

The second question was when does dreaming occur during sleep. Before answering that question, I would like first to introduce some basic notions of sleep and the methods to study it. Sleep is not a passive and homogenous state but rather an evolving process during which the brain pass through several distinct states, or sleep stages. The gold standard for the identification of sleep stages is polysomnography, which refers to the simultaneous recording of brain activity (EEG or electroencephalography), eye movements (EOG or electrooculography) and muscle activity (EMG or electromyography). Using those information the identification of sleep stages is then performed visually by inspecting consecutive segments of polysomnographic recordings. The five sleep stages are Wakefulness, N1 sleep, N2 sleep, N3 sleep and REM sleep. They all have distinctive electrophysiological properties. For instance, resting wakefulness is characterized by a predominance of the alpha rhythm and a high muscular activity, whereas N3 sleep, sometimes called deep sleep is characterized by large amplitude slow waves.

A normal night of sleep consists of a repetition of four or five ninety minutes long cycle in which sleep stages follow each other in a specific order. On this figure, you can see a hypnogram, which represents in one person the succession of sleep stages across time.

Back to our question of when does dreaming occur during the sleep. I want to say first that, contrarily to what was believed for several decades, we know today is not specific to REM sleep, but can rather occur during any sleep stages. Consequently, there is not an electrophysiological signature of dreaming, and this represents a fundamental impediment to the study of the cerebral correlates of dreaming because one can never be sure whether someone asleep is dreaming or not unless awakening him or her. And even after asking the sleeper, we cannot be sure that failure to recall a dream means that the sleeper was not dreaming before.

The third question was “does dreaming have a functional effect”. On this point, numerous assumptions have been made over the centuries. For example, in ancient times dreams were believed to be omens or messages from deities. Freud believed in the beginning of the twentieth century that they were the guardians of sleep. More recently, dreams have been proposed to play a role in psychological individualism, emotional regulation, memory consolidation, threat or social simulation. However, there are still few evidences either supporting or refuting these hypotheses, and therefore future research is needed to better understand the possible function of dreaming.

Finally, a question which will take up a great deal of our attention relates to why there is such variability in dream recall. To introduce this point I would like to borrow the words of Aristotle who wrote more than two thousand years ago in his famous treatise on sleep: “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.”

Indeed, Aristotle was right to point out that there is a large variability in the dream recall frequency (or DRF, an acronym that I will use a lot throughout this presentation), both among a single person, but, above all, and it will be the focus of the present thesis, between individuals. One method to find an explanation for this variability is to compare psychological, sleep and neurophysiological parameters between individuals who recall their dreams every day, or High recallers, and individuals who almost never recall a dream, or Low recallers.

Doing so, several decades of research have shown that several factors are positively associated with dream recall frequency. For instance, women recall their dreams better than men, and young people better than older people. People with specific personality traits, such as increased openness to experience or anxiety, recall their dreams more often than others. People with higher creative-thinking abilities recall their dreams more often.

I am now going to talk about study number 5, which was recently published in the journal Plos One with the title “Characteristics of the memory sources of dreams: a new version of the content-matching paradigm to take mundane and remote memories into account.”.

We know that dream content is somehow related to the waking-life of the dreamer. However, the factors that mediate the incorporation of waking-life experiences into dream content are still poorly known.

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