First and foremost, I want to thank the professor Rossetti, president of the jury, as well as, Professor Schwartz and Professor Schredl, members of the jury, for the interest you have shown in my work and for allowing me to defend this doctoral thesis today. I also want to thank doctor Perrine Ruby, my thesis advisor, for her great help over the past 4 years, and without whom none of the present work would have been possible. Finally, I also wish to thank everyone in this room for being here.

I will start my presentation by introducing some of the main issues related to dreaming. In the second and most substantial section of my talk, I will detail several studies that we have conducted in the aim of improving our knowledge of the mechanism of dream recall frequency. In the third section, I will detail a study which aimed at characterizing the link 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 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 function? And why is there such variability in dream recall? Or, to be more precise, why is there such variability, both among and between individuals, in the frequency of dream recall?

Regarding the first question, I will use during this presentation the working model and framework proposed by Fabian Guénolé which 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 forms, 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 forgot, depending on whether one is able to encode the dream experience into long term 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, and 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. A normal night of sleep consists of a repetition of four or five 90-minutes long cycles in which sleep stages follow each other. The identification of sleep stages across time results in a hypnogram that represents the succession of sleep stages across the night. On this figure, you can see an example hypnogram from one individual, with the five main sleep stages on the vertical axis, and the time of the night on the horizontal axis.

In order to obtain such hypnogram, one must first identify the sleep stages using polysomnography, which refers to the simultaneous recording of brain activity (EEG or electroencephalography), eye movements (EOG or electrooculography) and muscle activity (EMG or electromyography). 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.

Back to our question of when does dreaming occur during the sleep. First and foremost, it is important to say that dreaming is not specific to REM sleep, as researchers believed for several decades. Instead, it is now well admitted that dreaming can in fact occur in any sleep stages. As there is no neurophysiological marker of dreaming, it is impossible to know for 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 relates to the fundamental issue of whether dreaming has a function or not. Numerous assumptions have been made over the centuries. For example, in ancient times dreams were believed to be omens or messages from deities, while 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 hypothesis, 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: “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.”