THÈSE

Pour obtenir le grade de

DOCTEUR DE L'UNIVERSITÉ GRENOBLE ALPES

École doctorale : ISCE - Ingénierie pour la Santé la Cognition et l'Environnement
Spécialité : PCN - Sciences cognitives, psychologie et neurocognition
Unité de recherche : Laboratoire de Psychologie et Neuro Cognition

Expériences métacognitives spontanées

Spontaneous metacognitive experiences

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Abstract

There has recently been an upsurge of interest in using metacognitive paradigms to experimentally explore consciousness and cognitive processes such as episodic memory. Such laboratory-based research tends to overlook spontaneous experiences, which rather than being provoked by reflective questioning in laboratory settings (e.g. How confident are you that this is the correct response?) arise unexpectedly in daily life. This research examined a range of such spontaneous metacognitive experiences—including déjà vu, jamais vu, tip-of-the-tongue (TOT) states, and error detection—as well as spontaneous thoughts such as involuntary autobiographical memories (IAMs) and zoning out. Employing a multimethod approach, four studies investigated the nature, interrelations, and cognitive processes of these phenomena. In Study 1, (large online survey across, France, Poland and Pakistan; n=860), findings indicated that individuals who frequently experienced one form of spontaneous metacognition were more likely to report others, suggesting shared underlying mechanisms. These experiences exhibited common phenomenological characteristics, including spontaneity, transiency, and lack of intentional control. Cultural variations were observed, with lower reported incidence and frequency of the six phenomena in Pakistan compared to France and Poland. In Study 2, this same large-scale online questionnaire was analysed using both ChatGPT-3.5 and ChatGPT-4, which demonstrated strong performance in classifying descriptions of déjà vu, jamais vu, TOT states, error detection, IAMs, and zoning out. The alignment between AI and human participant classification suggested that these descriptions reliably captured the intended experiences. This method provided a promising tool for analysing large qualitative datasets, with high consistency and reduced experimenter bias.

In Study 3, these six spontaneous phenomena were analysed in patients with epilepsy (n=71) and were compared with control groups (n=96). Results demonstrated that the epilepsy group reported low incidence and frequency of these phenomena, with some patients reporting at least one of the experiences with much higher frequency and unique classification. These findings indicated that while spontaneous cognitive experiences may be shared across populations, their occurrence, subjective interpretation and classification may differ in a meaningful way in individuals with and without epilepsy. In Study 4 (n=96), an experimental replication of the involuntary memory induction paradigm (Schlagman & Kvavilishvali, 2008) demonstrated that low-demand tasks facilitated mind wandering, with environmental cues triggering both IAMs and spontaneous metacognitive experiences such as déjà vu. Taken together, the research contributes to both theoretical and applied domains by providing a comprehensive understanding of the nature, mechanisms, and cross-cultural expression of spontaneous metacognitive and cognitive experiences. This thesis is among the first to examine these experiences collectively within the same participants and across multiple methodological designs, contributing to a more nuanced understanding of how people monitor, interpret, and reflect on their own cognition.

Résumé

L'utilisation de paradigmes métacognitifs pour explorer expérimentalement la conscience et les processus cognitifs tels que la mémoire épisodique a récemment suscité un regain d'intérêt. Ces recherches en laboratoire tendent à négliger les expériences spontanées qui, au lieu d'être provoquées par des questions réfléchies en laboratoire (par exemple, Êtes-vous sûr qu'il s'agit de la bonne réponse ?), surviennent de manière inattendue dans la vie quotidienne. Cette étude a examiné une série d'expériences métacognitives spontanées de ce type, notamment le déjà vu, le jamais vu, mot sur bout de la langue (TOT) et la détection d'erreurs, ainsi que les pensées spontanées telles que les souvenirs autobiographiques involontaires (IAM) et le perdre le fil. En utilisant une approche multiméthode, quatre études ont examiné la nature, les interrelations et les processus cognitifs de ces phénomènes. Dans l'étude 1 (vaste enquête en ligne menée en France, en Pologne et au Pakistan ; n=860), les résultats ont montré que les personnes ayant fréquemment expérimenté une forme de métacognition spontanée étaient plus susceptibles d'en signaler d'autres, ce qui suggère l'existence de mécanismes sous-jacents communs. Ces expériences présentaient des caractéristiques phénoménologiques communes, notamment la spontanéité, le caractère transitoire et l'absence de contrôle intentionnel. Des variations culturelles ont été observées, l'incidence et la fréquence des six phénomènes étant plus faibles au Pakistan qu'en France et en Pologne. Dans l'étude 2, ce même questionnaire en ligne à grande échelle a été analysé à l'aide de ChatGPT-3.5 et ChatGPT-4, qui ont fait preuve d'une grande performance dans la classification des descriptions de déjà vu, de jamais vu, d'états TOT, de détection d'erreurs, d'IAMs et perdre le fil. La concordance entre la classification de l'IA et celle des participants humains a suggéré que ces descriptions capturaient de manière fiable les expériences

prévues. Cette méthode constitue un outil prometteur pour l'analyse de grands ensembles de données qualitatives, avec une grande cohérence et une réduction du biais de l'expérimentateur. Dans l'étude 3, ces six phénomènes spontanés ont été analysés chez des patients épileptiques (n=71) et comparés à des groupes témoins (n=96). Les résultats ont montré que le groupe épileptique rapportait une incidence et une fréquence faibles de ces phénomènes, certains patients rapportant au moins une des expériences avec une fréquence beaucoup plus élevée et une classification unique. Ces résultats indiquent que si les expériences cognitives spontanées peuvent être communes à toutes les populations, leur occurrence, leur interprétation subjective et leur classification peuvent différer de manière significative chez les personnes épileptiques et non épileptiques. Dans l'étude 4 (n=96), une réplication expérimentale du paradigme de l'induction involontaire de la mémoire (Schlagman & Kvavilishvali, 2008) a démontré que les tâches à faible demande facilitaient le vagabondage de l'esprit, les indices environnementaux déclenchant à la fois des IAM et des expériences métacognitives spontanées telles que le déjà-vu. Dans l'ensemble, la recherche contribue aux domaines théoriques et appliqués en apportant une compréhension globale de la nature, des mécanismes et de l'expression interculturelle des expériences métacognitives et cognitives spontanées. Cette thèse est l'une des premières à examiner ces expériences collectivement chez les mêmes participants et à travers de multiples conceptions méthodologiques, contribuant ainsi à une compréhension plus nuancée de la façon dont les gens surveillent, interprètent et réfléchissent à leur propre cognition.

Acknowledgements

I started my PhD journey exactly four years ago. It feels like not too long ago that I moved to France—not just to pursue a PhD, but to live a different kind of life. For me, the PhD was more than an academic venture, it was also an opportunity to experience a new culture. Being away from home, family, and friends, I didn't realize that moving to a different country would mean starting life from scratch. These past four years have been amazing and so unpredictable, and full of growth. I'll try do my best to acknowledge and thank everyone for their kind support.

I consider myself incredibly lucky to have had supportive friends and a kind, brilliant supervisor. I neither have enough words to express my gratitude to Chris, nor this section is sufficient. If you hadn't accepted me as your PhD student, I don't know whether my dream of studying and living abroad would have ever come true. It takes courage and dedication to mentor someone with little relevant background, and having such a kind and encouraging supervisor has made all the difference. Chris, you have always been patient, enthusiastic, and supportive of both my academic progress and personal well-being. You didn't just teach me science, you also taught me life values. You constantly encouraged me to take on new challenges and regularly checked in to ensure I was managing well. Our meetings have always been inspiring and motivating. Even when I couldn't express myself and when my speech would jumble up, you would know the answers. Whether it was academic or administrative problems, you have always been available and willing to help. You are my mentor and friend too. I'm so grateful for everything.

Céline, though I didn't have as many frequent interactions with you as with Chris, I truly admire you. I appreciated every meeting we had, formal or informal. You are an amazing researcher and a kind person. I've been fortunate to have both of you as supervisors, I got the best of both worlds: British and French, and I'm very happy about that.

Moving to a different country to start a new life and pursue a PhD is not as easy as it may seem, and we often don't realize this until we actually do it. Throughout my PhD, whenever I needed help, whether in my studies or otherwise, I had a support of my friends and my supervisor's. Perhaps this is why adjusting to a new country, even with a language barrier, was a bit easier. I learned so much from my office mates, both

current and former. Cynthia, Adeline, Sarah, Léa, and Ellie, thank you for being so kind and supportive. Cynthia, you always encourage me to try new things and join activities, which really helped relieve PhD stress, and you have always been so supportive in every matter, so thank you so much for that. I want to thank Quentin, Clara, Eva, and David. I've bothered you all so many times, for translating my questionnaires, testing my experiments, helping with analyses, and you've always been helpful and never complained. Gio, I'll always cherish our summer in the library. Your witty humour always cheers me up even on the saddest days.

To all current and former members of the Moulin-Souchay team, it's been a pleasure sharing ideas and intellectual conversations with you. The lab environment has always been supportive and friendly. All the PhD students, post-docs and other members have been amazing.

I am also grateful to Muntaha and Hammad for helping me deal with so many administrative 'things' that come with being an international student. You made those experiences bearable. Muntaha, I miss our silly times in France. Your sense of humour is unmatched. You've always been there to listen when I needed to rant, and your motivation—even from Budapest—always worked.

I also want to thank Ayanna for hosting me in her lab. Though I felt that the time was a bit short, it was incredibly inspiring. The work in your lab and interaction with your team; it was an incredible experience, both academically and personally. I made good friends and learned a lot. Special thanks to McKinzey, you made Chapter 2 of my thesis appealing with your fancy analyses and inspired me to finally learn R (which I had avoided until then!). I'm so glad we're friends and I look forward to collaborating more in the future.

During this journey, I had the chance to collaborate with brilliant researchers like Akira and Krystian. Krystian, I don't even know where to begin. You're a brilliant, enthusiastic researcher and one of the kindest people I've met. It's been a pleasure working with and learning from you. I hope our collaboration continues to grow. I'm also grateful to the jury members of my PhD for their support, time, and engagement. I am grateful to Farzana and Amna for their help regarding data collection in Pakistan.

Finally, to my parents and sisters—thank you for all of love and support.

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List of Abbreviations

ACC	Anterior Cingulate Cortex
aPFC	Anterior Prefrontal Cortex
BF	The Bayes Factor
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CRT	Cathode Ray Tube
DMN	Default Mode Network
DPFC	Dorsolateral Prefrontal Cortex
DRM	Deese, 1959; Roediger & Mcdermott, 1995
EEG	Electroencephalogram
eHRAF	Electronic Human Relations Area Files
ERN	Error-Related Negativity
ERP	Event-Related Potential
ESP	Extra Sensory Perception
fMRI	Functional Magnetic Resonance Imaging
FOK	Feeling-Of-Knowing
GPT	Generative Pre-Trained Transformer
IAMs	Involuntary Autobiographical Memories
JOL	Judgments of Learning
LLMs	Large Language Models
mPFC	Medial Prefrontal Cortex
MRT	Metronome Response Tasks
MTLE	Medial Temporal Lobe Epilepsy
PFC	Prefrontal Cortex
RCJs	Retrospective Confidence Judgments
RLPFC	Rostrolateral Prefrontal Cortex
RMSEA	Root Mean Square Error of Approximation
RWI	Recognition Without Identification
SART	Sustained-Attention-To-Response Task
SDT	Signal Detection Theory
SRMR	Standardized Root Mean Square

TOT Tip-Of-The-Tongue

TUITs Task-Unrelated Images and Thoughts’

Chapter 1

Spontaneous Metacognitive Experiences

Imagine that you are presenting one of your research papers for the very first time at an international conference in London. At various points leading up to the big moment, you wonder whether you know the material well enough. Such an assessment might prompt further revision of the slides and verbal practice, until those uncertainties are diminished and you feel confident in being able to answer possible questions. Later, after your presentation session is over, you think about the answer to peoples' questions, reflecting whether the presentation went well or could have gone better. These forms of self-evaluation are some examples of metacognition about memory, or metamemory. In simple words, the ability to reflect on, evaluate and control one's own cognitive process is known as metacognition (Fleming, 2023) and "people's knowledge of, monitoring of, and control of their own learning and memory processes" is known as metamemory (Dunlosky & Bjork, 2008, p.11).

This chapter provides an overview of metacognition, elucidating various definitions found within the existing literature of metamemory research, while distinguishing between facets of metacognition (metacognitive judgments from metacognitive feelings) and explore the role of spontaneous metacognitive feelings in cognitive processes. However, sometimes some of this metacognitive processing will be spontaneous and not sought-for. Consider an example: *You arrive in Boston for the first time on a research visit. While unpacking in your apartment room, you look out the window, see tall buildings and are suddenly struck by an eerie feeling of familiarity. It feels like you have experienced this exact moment before. Although, at the same time you know that this feeling of familiarity is erroneous and this is actually your first time being in this room and visiting the city*. This dissociative experience is known as déjà

vu and a perfect example of one's ability of self-evaluation in the form of spontaneous metacognition. The central aim of this chapter is to address the important question: What is spontaneous metacognition, and what are its significant characteristics? In this regard, Chapter 1 will provide definitions, a comprehensive literature surrounding spontaneous metacognition, and their connection to the phenomena central to this thesis, which includes déjà vu, jamais vu, tip-of-the-tongue, and error detection, as well as spontaneous thoughts like involuntary autobiographical memories and zoning out. Although such spontaneous experiences are common, fundamental questions remain: Why do these phenomena arise? Do they share underlying features? How do people perceive and classify these experiences in their daily life? and why do some people experience them more frequently than others? Moreover, how might factors such as age and cultural background influences such experiences?

1.1. Defining Metacognition

Metacognition is a broad construct and its definitions differ depending on the field of research, including psychology, cognitive neuroscience, philosophy and other disciplines. The term emerged from metamemory originally described as "knowledge and cognition about cognitive phenomena" (Flavell, 1979, p. 906). For decades aspects of metacognition have been studied under many different names, including "vigorous thinking" (Gray, 1925); the feeling-of-knowing (FOK) experience (Hart & Kuhlen, 1965) and tip-of-the-tongue (TOT) state (Brown & McNeill, 1966) in memory research. However, the concept dates back to early philosophical discussions, for instance, Plato and Aristotle introduced ideas about self-awareness in cognition (Georghiades, 2004), and later theorists such as Piaget (1950) and Vygotsky (1962) emphasized reflective thinking in cognitive development (Steinbach, 2008; Tsai, 2001). Since then, numerous studies have explored its various components and mechanisms

and different definitions are available in the literature defining metacognition (see Table 1.1 for different definitions in the literature).

Table 1.1

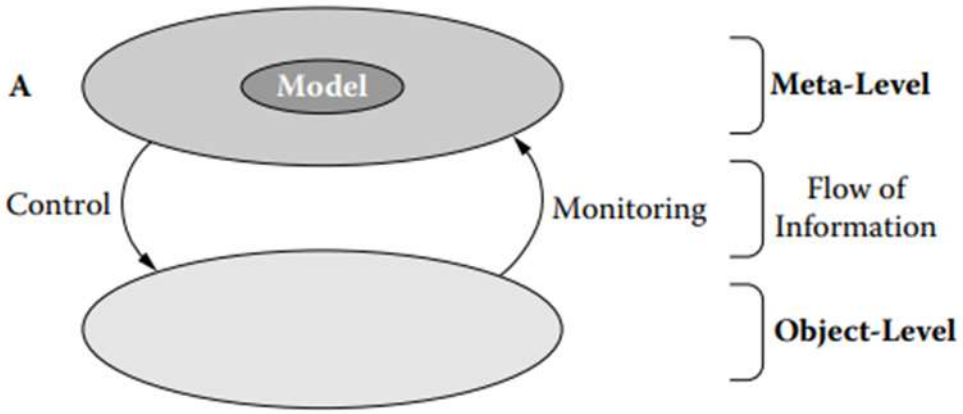
Different definitions of metacognition by different theorists

Flavell (1976)	"one's knowledge concerning one's own cognitive processes and products or anything related to them, e.g. the learning-relevant properties of information and data" (p. 232)
Cross & Paris (1988)	"The knowledge and control children have over their own thinking and learning activities" (p. 131)
Livingston (2003)	"Metacognition refers to higher order thinking which involves active control over the cognitive processes engaged in learning" (p. 2)
Koriat (2004)	"Metacognition, narrowly defined, concerns people's cognitions and feelings about their cognitive states and cognitive processes." (p. 261)
Fleming (2023)	"the capacity to reflect on, evaluate, and control mental function in a variety of useful ways" (p. 242)
Fleming & Lau (2014)	"The ability to recognize one's own successful cognitive processing, in e.g., perceptual or memory tasks, is often referred to as metacognition" (p.1)
Kuhn & Dean, (2004)	"Awareness and management of one's own thought" (p. 270)
Martinez (2006)	"The monitoring and control of thought" (p. 696)
Dunlosky & Bjork (2008)	"Metacognition can be defined as the awareness, experience, and control of our cognitive processes". (p. 355)
Perfect & Schwartz (2004)	Metacognition is traditionally defined as the experiences and knowledge we have about our own cognitive processes" (p.1)
Baker & Brown (1984)	"an awareness of what skills, strategies, and resources are needed to perform a task effectively; and the ability to use self-regulatory mechanisms to ensure successful completion of a task" (p. 345)

Hennessey (1999)	"Awareness of one's own thinking, awareness of the content of one's conceptions, an active monitoring of one's cognitive processes, an attempt to regulate one's cognitive processes in relationship to further learning, and an application of a set of heuristics as an effective device for helping people organize their methods of attack on problems in general" (p. 3)

Nelson and Narens (1990; 1994) developed a cognitive model that brought metacognition into the modern era. According their model, metacognition can be described as the interchange between two levels of information processing — an object level and a metalevel (as shown in Figure 1.1 below). Object-level processing focuses on specific components of cognitive function, such as object recognition, phonological coding, spatial representation, and semantic processing. Whereas the metalevel monitors and evaluates object level activations, initiating feedback control to regulate these ongoing cognitive activities. This model highlights the dynamic and interactive nature of metacognition, where continuous monitoring and regulation enhance cognitive efficiency (Dunlosky & Bjork, 2008; Koriat, 2019).

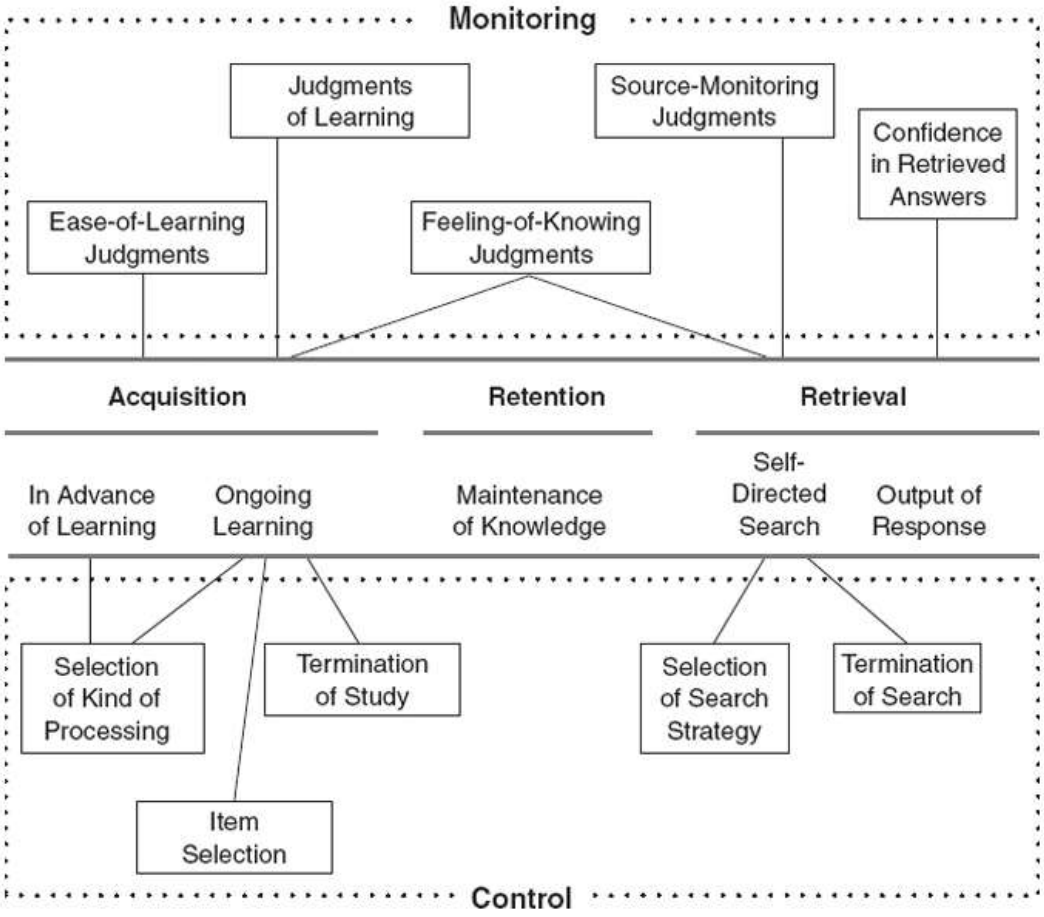
Figure 1.1



Note. Nelson and Narens (1990) model of monitoring and control. (Adapted from Nelson & Narens, 1990, as adapted by Dunlosky, Serra, and Baker, 2007, in Dunlosky and Bjork, 2008, p. 356)

Based on Nelson and Narens's cognitive model, metacognition is essential for the supervision of our perceptions, thoughts, memories, and actions and involves two high-order metacognitive processes, that is metacognitive monitoring and metacognitive control (Koriat, 2019). Metacognitive monitoring assesses or evaluates the current state of particular cognitive activity (Dunlosky & Metcalfe, 2009), for instance, as illustrated in the example earlier in this chapter, one might ask: *How familiar am I with this topic to confidently answer questions?* Similarly, when reflecting on a presentation or talk, one might consider: *To what extent will I be able to remember everything I have prepared?* Metacognitive control, on the other hand, regulates our ongoing cognitive processes (Dunlosky et al., 2007), such as deciding to rehearse material more before the presentation to improve the recall - making it smoother and stumble free. These two processes operate in tandem, ensuring effective self-regulation of cognition (see Figure 1.2).

Figure 1.2



Note. Monitoring judgments and control processes, and their relationships to the three stages of learning. (Adapted from Nelson, T. O., and Narens, L. (1990). Metamemory: a theoretical framework and new findings. In G. H. Bower (Ed.), The psychology of learning and motivation (Vol. 26, pp. 125–173). New York: Academic Press.In Dunlosky and Metcalfe (2009), p. 55.

Figure 1.2 illustrates how metacognitive monitoring processes, such as Judgment of Learning and Feeling of Knowing guide control processes across acquisition, retention and retrieval stages. It represents the variety of metacognitive judgments and control decisions typically measured in traditional laboratory memory tasks. The current thesis seeks to go beyond these controlled paradigms by examining spontaneous metacognitive experiences in daily life.

In everyday life, we constantly engage in metacognition while doing any activity, such as speaking, problem-solving, or making decisions and so on. We continuously assess, judge, and even attempt to influence our cognitive processes, often without deliberate effort. The extent to which metacognitive control is needed depends on the outcome of metacognitive monitoring (Norman et al., 2019). Some researchers argue that metacognitive control involves both conscious and unconscious decision-making, influencing tasks such as error correction or adjusting responses based on implicit feedback (Schwartz & Perfect, 2004). For example, returning to the earlier scenario of preparing for a conference presentation, one might consciously monitor the readiness by rehearsing the slides. However, some forms of the monitoring occur unconsciously, such as, noticing that slides are mis-numbered (without deliberate checking). This illustrates how spontaneous error detection can occur at an implicit level, prompting corrective action (Lyons & Zelazo, 2011; Moulin et al., 2002). This distinction between intentional and unintentional metacognitive processes is critical for understanding spontaneous experiences such as déjà vu, jamais vu, TOT and error detection, where automatic detection of conflict brings an experience into conscious awareness (see Section 2 below).

In addition to introspection and self-regulatory mechanisms, metacognition covers wide range of phenomena, so it is important to distinguish between subcomponents of metacognition like metacognitive knowledge and metacognitive experiences (Efklides,2008; Flavell, 1979). Metacognitive knowledge is the person's factual knowledge and understanding of their own and other people's cognitive abilities and strategies (Flavell, 1979), for example, repeating your new cell phone number multiple times to increase the likelihood of future recall when giving it to your friends or filling out forms. Whereas, metacognitive experience is the conscious awareness of

one's own feelings, task related progress and goals within cognitive processing (Efklides, 2008) and it can be in the form of metacognitive feelings (feeling of knowing, feeling of familiarity, feeling difficulty or feeling of confidence) and / or metacognitive judgments (judgment of learning or judgment of effort time spent on a task) (Efklides, 2009).

It has been proposed that metacognitive feelings are generated by nonconscious and nonanalytical inferential processes, and that once they arise in conscious state, they provide basis for analytic judgement, estimates or control decisions (Koriat & Levy-Sadot, 1999). As a result, metacognition often involves both judgments and feelings, occurring during a cognitive task, reflecting aspects of the current task, for example, feeling being close to or far from solving the current puzzle. Some of these thoughts and evaluations are deliberate reflections based on ongoing cognitive task, for example considering the scenario mentioned at the beginning of the chapter, after the talk at the conference, you might deliberately ask yourself: *Did I answer the audience's questions clearly and confidently?* However, sometimes some of these metacognitive processing occurs spontaneously and unintentionally and it can be in the form of feelings of fluency, certainty and difficulty. For example, during the experience of déjà vu, described at the beginning of this chapter, the feeling of familiarity has been proposed to emerge unintentionally, potentially highlighting how nonconscious monitoring process can surface into awareness unexpectedly.

The brain areas associated with metacognition are distinct from other cognitive processes including episodic memory, perception, decision making and reasoning (Norman et al., 2019). The neural basis of metacognition has been obtained from the studies of neuropsychological cases (Shimamura, 2000) and with the help of functional magnetic resonance imaging (fMRI) and neuroimaging researches. The prefrontal

cortex (PFC) is considered to play critical role in most aspects of metacognition (see Pannu & Kaszniak, 2005, for a review). Brain imaging in healthy participants show that prospective judgments (e.g., JOL) are associated with rostrolateral and dorsolateral PFC whereas retrospective judgments (e.g., FOK) are associated with rostromedial PFC (Fleming et al., 2012).

Neuroimaging studies of JOLs indicate that left ventromedial, lateral, and dorsomedial PFC regions are involved in prospective metacognitive judgments and successful recall (Kao et al., 2005). FOKs, on the other hand, are associated with the left PFC (Jing et al., 2004; Kikyo et al., 2002) and additional activity in the inferior frontal gyrus and parietal lobe (Brodmann area 7) (Maril et al., 2003). Similarly, regions including the left ventromedial PFC (Schnyer et al., 2005), left inferior PFC (Jing et al., 2004), and bilateral PFC and temporal lobe (Kikyo & Miyashita, 2004) have been found to be acitivated in FOK judgments (Schwartz & Bacon, 2008). The lateral PFC is linked to retrospective confidence judgments (RCJs), where individuals evaluate their past performance. Moreover, damage to the dorsal anterior cingulate cortex (ACC) has been associated with deficits in FOK accuracy, suggesting its role in metacognitive monitoring.

1.2. Metacognitive Experiences and Spontaneous Metacognition

Reflecting on one's own thinking allows individuals to regulate their cognitive activities. Our metacognitive system enables us to recognize what we know, even in moments of temporary retrieval failure, or mistakenly believe we have experienced something when we have not (Schwartz & Cleary, 2016). These metacognitive experiences arise as subjective awareness and feelings during problem-solving situations. According to Efklides (2008), cognitive monitoring and control can operate at the object level, even without full conscious awareness. However, when automatic regulation fails, such as

in cases of errors, conflicts, or novel situations, the information becomes available to conscious awareness in the form of subjective experiences (e.g., feelings and judgments). These experiences are referred to as metacognitive experiences or metamemory awareness and includes feeling of knowing (FOK), feeling of difficulty, feeling of familiarity, tip-of-the-tongue, judgment of learning, confidence and so on (Dunlosky et al., 2016).

People rely on their metacognitive experiences as a source of information regarding the errors they have made. The relationship between metamemory errors and metacognitive process offers insight into the nature of these subjective experience. While such errors can be frustrating, they serve an adaptive function by highlighting our knowledge limitations (Schwartz & Cleary, 2016). This thesis focuses on exploring the everyday occurrence of such errors in everyday life, emphasizing their role in healthy cognitive functioning. There are a number of ways in which metacognition could be described as spontaneous, but here we would like to draw a distinction between feelings and reflections which are prompted by explicit questioning, and by experiences which arrive into consciousness without being sought and without prompts. One of the goals of this thesis is to draw apart metacognitive judgements from metacognitive feelings and, in particular, explore the role of spontaneous metacognitive feelings in cognitive processing. A number of authors have discussed the differences between metacognitive experiences and metacognitive judgements (e.g. Moulin & Souchay, 2014). Here it is proposed that this distinction maps onto decision-making processes which are controlled, deliberate and sought-for (judgements) and more automatic, but nonetheless epistemically motivated feelings or experiences.

It is suggested that such experiences are spontaneous, for example, we cannot 'decide' to have a déjà vu experience or a tip-of-the-tongue experience, but we can make conscious evaluations of performance, or report retrospective confidence judgments when asked to. For instance, when introducing a colleague, one might occasionally feel uncertain about their name (a spontaneous feeling), but it is unnecessary to consciously evaluate the names of all our colleagues (in the form of a confidence judgement - when we introduce them) even though we could if we wanted to. This distinction is crucial because most metacognitive research relies on explicit introspective paradigms, whereas everyday cognition often involves spontaneous, unintentional metacognitive experiences.

A particular claim, therefore, is that metacognitive experiences are not sought for but they grab our attention, and perhaps a good example of this is when things go wrong in cognitive processing. In order to bring a change in an individual's current knowledge and behaviour, it is important that a person consciously perceives these states. According to Whittlesea and Leboe, (2003), spontaneous metacognitive awareness occurs when something unexpected happens, or when something goes wrong. The discrepancy between what was expected and what actually happened leads to a surprise and that causes the spontaneous feeling of familiarity. This feeling of familiarity is basically a reaction to the perception that something went wrong in current event processing. This can occur in multiple contexts, for example, when the previously known answer does not come smoothly to mind, or do not know if the given answer is right or wrong, when there is some kind of discrepancy; when cognitive knowledge state and feeling state do not match. Thus, conflict imposes itself on consciousness as metacognitive phenomenology and causes a change in action. Otherwise, control is not needed, and the system continues in a usual manner. So, if

one were riding a bike along the path smoothly, or reading a text with full comprehension, or effortlessly retrieving from memory, these processes could continue to occur without any kind of metacognitive awareness or intervention (Metcalfe & Schwartz, 2016).

Nonetheless, when discrepancies occur, conscious metacognitive states are proposed to arise spontaneously, and examples of these spontaneous metacognitive states include tip-of-the-tongue (TOT) states, noticing that one's mind is wandering, and states such as déjà vu (Dunlosky & Tauber, 2016). Thus, it is important to form a distinction between metacognitive knowledge and metacognitive experiences because certain spontaneous metacognitive states are accompanied by distinctive and recognizable conscious feelings and experiences rather than knowledge. The unsettling feeling, we undergo when we experience déjà vu comprises another spontaneous metacognitive state. The nagging TOT state that we endure when retrieval does not smoothly produce the answer we seek provides another well-known and universally experienced example of a spontaneous metacognitive experience (Schwartz, 2006).

This thesis focuses on spontaneous metacognitive experiences (see Table 1.2 for the definitions), such as, déjà vu, jamais vu, TOT and error detection along with spontaneous thoughts including involuntary autobiographical memories, and zoning out. We propose that spontaneous metacognitive experiences are spontaneous cognitive phenomena that are part of our metacognitive processes, arising automatically to guide our cognitive process and are related to each other, that is, if the person experiences one, they are also like to experience others (Chapter 2).

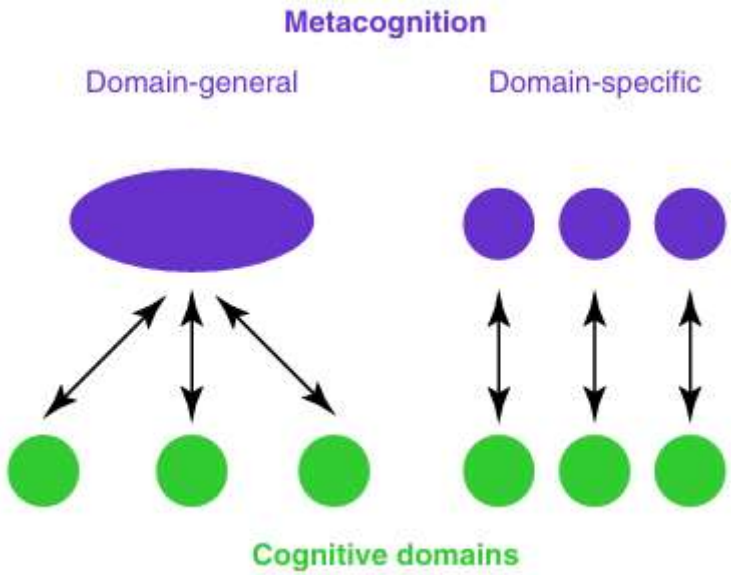
My starting point for claiming these are all related stems from previous research - albeit with rather limited sample sizes – which has shown correlations between some types of these seemingly different experiences. For example, in a study by Moulin and his colleagues (2022) the frequency of déjà vu in daily life correlated with frequency of jamais vu experiences, similarly another study reported a borderline correlation between the self-reported incidence of déjà vu and jamais vu, r (203) = 0.129, p = 0.066 (O'Connor & Moulin, 2013). Likewise, empirical evidence from Moulin et al., (2014) suggests correlations between déjà vu and other spontaneous experiences. Specifically, they found that the frequency of tip-of-the-tongue positively correlated with the frequency of déjà vu (r (306) = .19, p=.001), indicating that people who experience tip-of-the-tongue state more frequently also report having more frequent déjà vu experiences. They further found a significant positive correlation between déjà vu and involuntary memories in older adults (r (44) =.723, p<.001), such that higher levels of déjà vu reported were associated with more frequent involuntary memories. Thus, the empirical literature asserts that the incidence of déjà vu, jamais vu and TOT are associated with each other across individuals.

One major question in the cognitive research is whether cognition is domain-general or domain specific. A domain-specific metacognition proposes that different metacognitive processes operate independently within each cognitive domain. In contrast, a domain-general metacognition proposes that individuals use a common resource to monitor their memory, perception and other cognitive tasks (see Figure 1.3) (Mazancieux et al., 2018; Rouault et al., 2018). While previous research has identified correlations among some of these spontaneous experiences, current debates on the domain-generality of metacognition provides a more robust foundation for exploring the association between these phenomena. Domain-general idea suggest

that different domains share resources and should include similar brain networks and areas (Miller, 2000). As Frensch and Buchner (1999) propose that debate about domain generality is essentially about how broadly a theoretical principle or empirical finding can be applied across different cognitive domains.

Behavioral studies have found that individual's metacognitive sensitivity tends to correlate across different cognitive tasks (e.g., memory, perception and reasoning) (Gardelle & Mamassian, 2014; Song et al., 2011). Mazancieux et al., (2020) found that individual differences in metacognitive sensitivity, measured by retrospective confidence judgments, were significantly correlated between episodic and semantic memory tasks, supporting a domain-general component for confidence-based evaluations. Further neuroimaging research suggests that metacognitive abilities for different type of tasks partly depend on shared neural regions (McCurdy et al., 2013). Allen et al., (2016) found that metacognitive monitoring and memory performance are linked through shared neurological mechanisms, such as right anterior prefrontal cortex (aPFC) and hippocampus. However, these evidences are mixed, as correlations can vary depending on the type of metacognitive measure used, and some imaging studies have failed to find common neural structures across domains (Baird et al., 2013).

Figure 1.3



Note. "It remains debated whether metacognition operates as a domain-general resource applied over cognitive domains (left) and/or whether metacognition itself relies on domain-specific components that operate over corresponding cognitive domains". (Adapted from Rouault et al., 2018 p.2)

While research on domain-general metacognition has mostly focused on explicit metacognitive judgments (such as confidence ratings), this is particularly interesting and one can wonder if this principle could also extend to spontaneous metacognitive experiences. Metacognitive experiences such as déjà vu and TOT are conceptualized as epistemic feelings, that is, subjective, consciously accessible states that signal monitoring of internal cognitive activity (Moulin & Souchay, 2014). These feelings, though non-conceptual, provide fast-acting cues about the accuracy or fluency of cognitive processes, arising without deliberate introspection. According to de Sousa (2009), epistemic feelings serve as heuristic signals for epistemic monitoring and control, functioning similarly to perceptual cues about cognitive states.

Metcalfe and Schwartz (2016) propose that metacognitive experience like déjà vu and TOT arise spontaneously in response to cognitive conflict, such as, an unexpected sensation of familiarity or retrieval failure. Recent theoretical accounts further characterize déjà vu akin to fact-checking mechanism (metacognitive monitoring) within memory system, signalling a mismatch between an eerie feeling of familiarity and conscious recognition that situation is novel (Urquhart et al., 2022; Aitken et al., 2023). Neuroimaging research suggests that spontaneous metacognitive experiences, such as déjà vu and TOT involve overlapping neural systems. Specifically, activity in the anterior cingulate cortex (ACC) has been consistently observed during cognitive conflict, expectation violation, and error detection, all of which characterize these metacognitive experiences (Bush & Posner, 2000; McGuire & Botvinick, 2010; Posner & DiGirolamo, 1998). Additionally, the medial prefrontal cortex (mPFC, particularly Brodmann area 10) is active during self-referential metacognitive reflection (Chua et al., 2014). Together, these findings suggest that diverse spontaneous metacognitive experiences may draw on a common, relevant system centred around the ACC and mPFC (Schwartz & Metcalfe, 2016; see Table 1.3). This supports the idea that metacognitive feelings may not be entirely domain-specific but could instead rely on shared, domain-general neural mechanisms.

This thesis builds on such theoretical framework and explore extending the notion of domain-generality from explicit metacognitive judgments to spontaneous metacognitive experiences. If metacognition is domain-general, then we might think that across individuals, who are prone to one type of spontaneous metacognitive experience might be more prone to the other types. The thesis further explores the extent to which this domain-general characterisation can be extended to other types of spontaneous cognitive phenomena and cognitive domains. Here we propose that

spontaneous metacognitive experiences share key characteristics, such as, they arise automatically without deliberate intention, reflect internal detection of cognitive conflict or mismatch and are associated with activity in frontally mediated brain regions such as anterior cingulate cortex (ACC) and areas of prefrontal cortex (PFC). In the following section we provide theoretical foundations of each phenomena and evaluate these features across different spontaneous experiences, while Chapter 5 details experimental methodologies. We explore to what extent this domain-general characterization can be extended to diverse spontaneous cognitive phenomena.

1.2.1. Déjà Vu

One of our considerations for the study of spontaneous metacognitive experiences is déjà vu. Déjà vu can be described as a false feeling of familiarity of being somewhere before or done something before, despite the fact that the situation is new (Perrin et al., 2023; Cleary et al., 2009). It is characterized by an intense subjective eerie feeling of familiarity combined with the awareness that this feeling is false and inappropriate (Moulin, 2018; O'Connor & Moulin, 2010). Approximately, 80-90% of the population experience déjà vu at least once a year (see Brown, 2003).

Historically, the term "déjà vu" was broadly used to refer to any feeling of familiarity, regardless of its accuracy, leading early researchers to note significant ambiguities in its usage (e.g. Arnaud, 1896; translated by Bertrand et al., 2017). Some early researchers even included precognition into their definition, describing the sense that one is likely to be able to predict what will happen next (Cleary & Brown, 2022; Carrington, 1931; Jensen, 1868; Myers, 1895; Titchener, 1928; Ward, 1918). Over time, especially in parapsychological literature, déjà vu became more narrowly defines as a false sense of familiarity and the meaning became more specific. Later, Neppe (1983, p. 3) proposed a clearer and widely accepted definition, describing it as "any

subjectively inappropriate impression of familiarity of a present experience with an undefined past". This further refined the concept of "dreamy states" used to refer to déjà vu experience in early researches on epilepsy (O'Connor et al., 2021; see Chapter 4 for déjà vu in epilepsy). Various subtypes of déjà vu have been proposed, including déjà arrivé (already happened), déjà rêvé (already dreamed), déjà connu (already known), déjà gôuté: (already tasted), déjà vécu (already lived) and so on (see Moulin, 2018 and Neppe 2010). While the term déjà vu literally translates from French meaning "already seen", its modern usage encompasses broader spectrum of experiences, that is, "already experienced" related to familiarity (Cleary & Brown, 2022).

In the literature, déjà vu has been described as an illusion (Roediger, 1996; Jacoby & Whitehouse, 1989; Penfield & Perot, 1963); a misattribution (Schacter, 2002); and a cognitive or 'epistemic' feeling (da Sousa, 2009; Moulin & Souchay, 2014). O'Connor et al., (2021) propose that déjà vu is a dissociative metacognitive experience arising from a metacognitive evaluation of 'the familiarity' (lower level memory process). They argue that such phenomenon is dissociative because the feeling or experiences dissociate from the cognitive process that normally generates it. This dissociation indicates that metacognitive evaluations are operating independently from ongoing cognitive processes. This idea of being aware and recognising the falseness of the current situation makes déjà vu a metacognitive or metamemory error and distinguishes it from false memory. Thus, defining characteristic of déjà vu includes conflictual, erroneous interpretations of cognitive processing.

Survey data suggests that déjà vu is more likely to occur for familiar places, scenes, people, scenes, and conversations (Moulin, 2018), asserting that it may have a unique visual trigger, however, no real patterns has been observed and even people

who are blind have reported experiencing déjà vu (O'Connor & Moulin, 2006). The current conceptualization is that the déjà vu experience is spontaneous and not deliberately sought. It arises from a high order interpretation of retrieval process triggered by inappropriate activation of familiarity and is not directly related to the ongoing conscious processing (Barzykowski & Moulin, 2022). Déjà vu thus fits the idea of spontaneous metacognitive conflict, where contradictory evaluations of memory and perception result in a subjective eerie feeling (e.g. Urquhart et al., 2021). As illustrated in our research visit example earlier in the chapter, one might enter a room and experience an overwhelming feeling of familiarity, despite knowing it is their first time in that space.

Several theorists attempt to explain the occurrence of déjà vu. The decoupled familiarity hypothesis suggests that déjà vu arises from false familiarity generated by top-down cognitive or neurological processes (Illman et al., (2012), asserting that déjà vu is infrequent or random experience caused by neurophysiological anomalies. However, gestalt familiarity hypothesis, posits that déjà vu occurs when the current experience shares similar configuration to a personal past but forgotten situation (Cleary & Claxton, 2018; Cleary & Brown, 2022). This suggests that déjà vu might occur when a person recognizes similar spatial arrangements or environmental cues but fail to retrieve the original memory source. In our research visit example, a visitor might unknowingly recognize the configuration of apartment room (the arrangement of windows, furniture and lighting), as a resembling past experience, leading to a feeling of familiarity without explicit recollection. The gestalt familiarity hypothesis aligns with bottom-up processing theories which suggest that simple everyday perceptual similarities may trigger feeling of having encountered something before, even if you have not (e.g., Chapman & Mensh, 1951; MacCurdy, 1924; Myers, 1895). Empirical

studies (see Brown & Marsh, 2008; Cleary et al., 2012; Cleary et al., 2009) support this view, showing that perceptual resemblance, even in the absence of explicit memory retrieval, can induce feeling of familiarity. Thus déjà vu occurs when what we feel and what we consciously assess do not align, generating a cognitive conflict (Moulin, 2018).

Despite the progress in defining déjà vu, it remains a complex and elusive phenomenon. Most researches rely on retrospective self-report methods, including short surveys enquiring the incidence of déjà vu (e.g., Have you ever had a déjà vu experience? or How often do you have a déjà vu experience?) (Brown, 2003; Gallup & Newport, 1991; van Paesschen et al., 2001). Other studies use long questionnaires assessing different dimensions of the experience and some use multi-point scales to assess the déjà vu frequency (Adachi et al., 2008; Fortier & Moulin, 2015; Shaw et al., 2016). Neppe (1983) developed both a quantitative (frequency, duration) and a qualitative (emotional intensity, clarity of experience) questionnaire to be administered in an interview format, later refined by Sno et al., (1994). These tools assess potential déjà vu triggers, frequency, associated emotions and external factors such as fatigue, stress or intoxication (Brown, 2003). However, researchers have shown concern associated with retrospective evaluation emphasizing that our long-term memory is prone to reconstruction and biasness, and this self-report data on déjà vu might be flawed (Aitken & O'Connor, 2020). Since Brown's (2003) influential review article on déjà vu experience, a number of laboratory investigations of déjà vu emerged in the scientific literature (see Chapter 5 for detail).

Déjà vu has been associated with hippocampus,a region traditionally involved in memory and novelty detection (Nyberg, 2005). Case study have shown that despite reduced hippocampal volume, an individual can still experience déjà vu, indicating that parahippocampal structures may also contribute to the experience (Curot et al., 2021).

A research involving patient with mesio-temporal epilepsy has found that entorhinal cortex disruption was linked to déjà vecu, a form of déjà vu in which the experience is of recollection of a prior event rather than familiarity. The findings suggested that parahippocampal disruption leads to déjà vu, while more substantial memory deficits (e.g., recollective disruption) may lead to déjà vecu (Brandt., 2021; Illman et al., 2012). Urquhart et al. (2021) in their fMRI study found that déjà vu experiences activate the frontal midline and parietal brain regions, areas typically associated with conflict detection and resolution. Supporting the idea that déjà vu arises from a mismatch between feeling of familiarity and the conscious realization that this feeling should not be experienced. Déjà vu has also been observed in patients with epilepsy. Studies assert that epilepsy patients experience déjà vu as ictal phenomena either spontaneously due to discharge in temporal cortex or artificially in response to electric stimulation (Adachi et al., 2010). Further, Critchley (1989) proposed that both déjà vu and jamais vu result from temporary malfunctions in familiarity processing in the temporal lobe. Indicating that both phenomena are associated with medial temporal lobe epilepsy (MTLE) and occurs in pre-seizure auras (Burwell & Templer, 2017; Cho et al., 2011; Contardi et al., 2007).

In sum, déjà vu arises when a subjective feeling of familiarity is judged to be inappropriate to the current context, creating a cognitive conflict (O'Connor & Moulin, 2013; Urquhart & O'Connor, 2014). This mismatch between familiarity and novelty can be viewed as an internal fact-checking process, signalling a failure in memory attribution (Brown, 2004). It is considered both spontaneous, as it occurs unintentionally, and metacognitive, as it involves conscious awareness of discrepancy between implicit memory signal and explicit recognition. For these reasons, déjà vu

plays a central role in the thesis as well-established example of spontaneous metacognitive experience involving conflict detection.

1.2.2. Jamais Vu

Jamais vu is another metamemory phenomenon that is related to, yet opposite to, déjà vu. While déjà vu is characterized as a false feeling of familiarity with a novel situation, jamais vu can be described as the subjective experience of unfamiliarity for a stimulus that is known to be familiar (Moulin, 2018). The term jamais vu, comes from French meaning “never seen”. Despite its historical link to déjà vu, defining jamais vu has been long debated, with many scholars attempting to describe its nature and association with other cognitive anomalies (Adachi et al., 2003; Ardila et al., 1993; Bancaud et al., 1994; Sno, 1994, 2000; Sno & Draaisma, 1993; Sno & Linszen, 1990). Like déjà vu, the subjective experience of jamais vu is difficult to describe and has been referred to in a various different way such as, “illusion” (Roediger, 1996), “feeling of strangeness” (Morgan, 1936; Woodworth, 1948) and “alienation” (Stern, 1938; Hunter, 1957).

Yager and Gitlin (1995) defined jamais vu as the sensation of never having encountered something that, in reality, has been known previously, while Neppe (1983) defined it as an “any subjectively inappropriate impression of non-familiarity of a present experience with an undefined past” (p.343 in Sno, 2000). Reed (1979) characterized it as an incidence of recall without recognition, where an individual fails to recognize frequently experienced stimuli. Devereux (1967) called it “fausse non-reconnaissance”, arguing that it triggers from an immediate misidentification of reality. Silbermann (1963) referred to jamais vu as ‘jamais phenomenon’ describing it as erroneous reaction in which something that should be familiar seems unfamiliar. Silbermann further suggested that such experience may vary in intensity, that is, from

just a brief moment where one temporarily fails to recognize something familiar (a fleeting misperception), to an intense experience where one strongly believes that something previously experienced feels like completely new or never been experienced (a fixed conviction).

From a psychoanalytic perspective, some researchers (Silbermann, 1963; Devereux, 1967) describe jamais vu experience as a defence mechanism, a way for the mind to distance itself from an unpleasant or fragmented aspect of experiences. They suggest that this distancing is similar to depersonalization, where individuals feels detached from themselves or their surroundings, and mind shield itself from distressing aspect of reality by inducing a jamais vu experience (also see Boesky, 1969; Myers & Grant, 1972). However, Neppe (1983) argues that while jamais vu and depersonalization may share some similarities, they are two distinct phenomena, particularly in the context of neurological conditions such as complex partial seizures. Neppe suggests that in depersonalization the emphasis is on the person itself, whereas in jamais vu, the experience is linked to situation or places – generating a fleeting feeling that a familiar situation or environment is entirely new, even though it is not. Moulin et al., (2021) proposes that jamais should be conceptualized as an epistemic feeling signalling a dissociation in the cognitive system, that is, a metacognitive evaluation assessing the current situation against our expectancies and goal processing. This view aligns with broader theories of cognitive conflict, where expectations about familiarity fail to align with actual recognition processes.

Unlike déjà vu, which has been extensively studied with an emerging theoretical framework, scientific literature on jamais vu is very limited and fragmented with no common definition (Moulin et al., 2021). However, in the literature, jamais vu is considered to be related to two phenomena, that is, word alienation and semantic

satiation (Brown, 2003; Cleary & Brown, 2022). Word alienation or 'loss of meaning of words' (Reed, 1974) occurs when an ordinary word suddenly appears unfamiliar or strange (Sno & Draaisma, 1993). This can be induced experimentally by having participants stare at a specific word for about one minute (Reed, 1974). Heymans (1904, 1906) in his studies observed that 78% of people experienced word alienation at least once in their lives and among these, 10% experienced it more often, while 68% experienced it rarely. Similarly, Brown and Marsh (2010) in their survey study on college students found that 60% of students reported experiencing word alienation and occurred more often in males and older students, typically at least every few months.

While in word alienation a familiar word temporarily loses its meaning upon visual fixation, in semantic satiation repeated verbalization of a word leads to perceptual fragmentation (Amster, 1964; Kounios et al., 2000). Smith and Klein (1990) describe semantic satiation as perceptual distortion caused by excessive processing of a stimulus, leading to temporary fragmentation (Balota & Black, 1997; Lewis & Ellis, 2000). Both semantic satiation and word alienation includes sense of conflict, that is, the word should feel familiar but it does not (Cleary & Brown, 2022). The principal idea is that if you constantly stare at a specific word for too long, you may experience the fleeting sensation that there is something strange about the word or spellings are wrong (see Severance & Washburn, 1907 'loss of associative power'). Similarly, repeating a word aloud, e.g., "bowl", over and over again, can cause a temporary loss of meaning rendering it perceptually fragmented (see Titchener, cited in Smith & Klein, 1990).

In our everyday life, jamais vu is not limited to words, it can also occur for familiar places and faces. People may suddenly experience a temporary sense of complete loss of fluency while performing a procedural or repetitive act, such as, driving a car or

playing a musical instrument, (Moulin et al., 2021). However, the etiology of jamais vu remains largely unknown. Although jamais vu is much rarer than déjà vu (Sno, 2000), early research by Heymans (1904, 1906) suggests that these two phenomena may stem from disruptions in recognition processes (Brown, 2003). Others suggest that even minor undetected alteration in a familiar environment may induce a sense of unfamiliarity, which then overgeneralizes to the entire experience (Findler, 1998; Hunter, 1957). Similarly, seeing a familiar person in a different context can also trigger jamais vu (Searleman & Herrmann, 1994). Similar to déjà vu, some propose that jamais vu may result from recognition failure due to memory distortion, where repeated retrievals subtly alters memory representations, causing failure to recognize previously familiar stimuli (Cleary & Brown, 2022).

Furthermore, evidence suggests factors such as fatigue, substance abuse, other psychopathological states (Sno 2000; Silbermann, 1963; Chari, 1964; Yager & Gitlin, 1995) may also induce jamais vu like experience. Jamais vu have also been associated with neurological disturbances like complex partial seizures (particularly medial temporal lobe epilepsy similar to déjà vu), and migraine (e.g., Bigal et al., 2003; see Chapter 4 for jamais vu in epilepsy). Due to infrequency and subjective nature of the phenomenon, studies mostly rely on retrospective questionnaire to determine the incidence and frequency of jamais vu. Researchers emphasize that as a dissociative experience where something familiar feels unfamiliar, jamais vu is conceptually linked to déjà vu (Moulin et al., 2021), and even though both occur in similar pathologies, their correlation in healthy individuals remains unclear (Brown, 2004).

Although empirical and neurological studies on jamais vu are very scare, less in known about the associated brain areas. However, jamais vu has been observed in MTLE along with déjà vu. Studies propose that both déjà vu and jamais vu occur due

to temporary malfunctions in familiarity processing in temporal lobe (Critchley, 1989), and linked to pre-seizure auras (Burwell & Templer, 2017; Cho et al., 2011; Contardi et al., 2007).

In sum, jamais vu is considered a spontaneous metacognitive experience, occurring without deliberate intention and involving cognitive conflict. Like déjà vu, it signals a mismatch between internal expectation and perception, but in the opposite direction, a false feeling of unfamiliarity towards familiar object or situation. Both, déjà vu and jamais vu have been associated with medial temporal lobe (Critchley, 1989) and described as forms of depersonalization (Myers & Grant, 1972). Penfield (1955) consider both as “interpretive” illusions of opposite nature, and several studies have noted that, like déjà vu, jamais vu is also more likely to occur under conditions of stress or fatigue (Burnham, 1903; Conklin, 1935; Fukao et al., 2005; Reed, 1979; Tiffin et al., 1946). Given its theoretical similarity to déjà vu and its relevance to theories of conflict detection and memory monitoring, jamais vu is included in this thesis as one of the six key phenomena under investigation. Studying jamais vu alongside déjà vu and other spontaneous cognitive phenomena will deepen our understanding of spontaneous metacognitive experiences and its potential domain-generality.

1.2.3. Tip-of-the-tongue

A tip-of-the-tongue (TOT) state refers to a conscious feeling that a word or the piece of information is available in the memory but it is temporarily inaccessible (Schwartz & Metcalfe, 2014). Defining TOT precisely is important because, like other spontaneous metacognitive experiences examined in this thesis, it relies on subjective introspection to be identified and studied. Early research debated whether TOTs should be classified as a ‘cognitive state’ (temporary retrieval failure) or as a ‘metacognitive experience’ (an awareness and feeling of temporary inaccessibility) (Schwartz, 2006). Nelson (2000)

distinguished TOTs as cognitive states involving partial phonological or semantic information contrasting them with Felling of Knowing (FOK), which are future oriented judgment about recognizability.

Some researchers (e.g., Hamberger & Seidel, 2003; Kikyo, Ohki, & Sekihara, 2001; Kohn et al., 1987; Vigliocco, Antonini, & Garrett, 1997) operationalised TOT states solely in terms of mnemonic performance, ignoring the metamemory aspect. However, most contemporary research view TOT as a subjective metacognitive experience that inform retrieval monitoring and control (see Brown, 1991; Schwartz, 1999; Smith, 1994 for reviews). TOTs have been characterized as experiences where recall feels imminent even though retrieval fails temporarily (Brown & McNeil, 1966; Schwartz & Brown, 2014). Unlike FOK judgments that predict future recognition, TOT states involve immediate conscious conflict, that is individual is simultaneously confident in knowing the information and aware of the retrieval failure (Schwartz et al., 2000; Schwartz, 2008). This conflict signals an active metacognitive monitoring process rather than simple retrieval difficulty.

Metcalfe and Schwartz (2016) propose that phenomenologically TOTs arise from conflict detection, that is, the conflict between the lack of retrieval and the confidence that retrieval is imminent. This conflict is a metacognitive experience alerting us of this mismatch. Being aware of this conflict prompts adjustments to retrieval behaviour. This view resonates with the central theoretical stance of this thesis, proposing that spontaneous metacognitive experiences occur to detect and signal conflict in cognitive processing.

Theories of TOT generation can be broadly divided into two accounts: the direct-access view and the heuristic metacognitive view. The direct-access view propose that TOTs occur because the memory trace is partially activated by the target word but not

enough for full recall (Brown 2012). The person tries to recall target word, but something interferes with, block or prevent the recall (Perfect & Hanley, 1992). In contrast, the heuristic metacognitive view argues that TOTs occur from inferential judgments based on cue familiarity and partial retrieval information. This perspective aligns TOTs more closely with broader metacognitive theories, emphasizing metacognitive monitoring and evaluation (Schwartz & Metcalfe, 2011, 2014). Recent research supports the heuristic view, recognising TOT as epistemic feeling based on subjective monitoring cues (Schwartz & Cleary, 2016).

Additionally, TOTs are linked to increased cognitive effort (Schwartz, 2001), guiding our retrieval behaviour (Ryan et al., 1982; Schwartz, 2008). While metacognitive researchers consider partial and related information as a key factor inducing TOTs (Schwartz & Metcalfe, 2011), language researchers argue that such partial information is not the cause of TOT, but instead, it is the part of same process that causes retrieval failure in the first place (see Brown, 2012; Warriner & Humphreys, 2008). Both direct-access and heuristic metacognitive approaches, emphasize the metacognitive processes in word retrieval, differing in whether the TOT is a direct product of the memory trace or an inferential judgment based on available cues (Schwartz & Cleary, 2016).

Survey studies highlight the universality of TOT experiences across languages and culture. Nearly 90% of world languages, contain a metaphorical reference to ‘tongue’ when describing a TOT state (Schwartz, 1999). A cross-cultural study by Bernnan et al., (2007) in Guatemala found that Q’eqchi’ language lacks a specific term for TOTs, but still reported experiencing it when the concept was explained, with rates comparable to those in western languages. Similar findings have been observed across different populations, including monolinguals and bilinguals (Gollan & Acenas,

2004), ASL speakers (Thompson et al., 2005) and synesthetes (Simner & Ward, 2006). TOTs are experienced by children (Hanly & Vandenberg, 2010), college-age students (Schwartz, 2006), and older adults (Brown & Nix, 1996; Schwartz & Frazier, 2005). TOTs have also been reported in neurological conditions, such as Alzheimer's disease, anomic aphasia, and temporal-lobe epilepsy (Brown, 2011). Further, diary studies have shown that real-world TOTs are quite common and occur as often as at least once a day for older adults (Brown, 2012). This contrasts TOTs with other spontaneous metacognitive experiences, such as déjà vu, which may occur only once or twice in a lifetime (Brown, 2004). The literature on TOT is considerably more extensive compared to other spontaneous cognitive phenomena in this thesis. This rich body of research provides a firm foundation for understanding metacognitive experiences and allows for more informed comparison a across different cultures and cognitive domains.

Neurological studies on TOTs provides strong evidence that TOTs engage conflict detection mechanisms in the brain. Studies have shown that right prefrontal brain regions, including the ACC, right dorsolateral PFC, and right inferior PFC are strongly activated during a TOT state but not strongly active during the situations where individual either know or don't know a response, suggesting TOTs involves distinct neural conflict mechanism (Maril et al., 2001, 2005; Kikyo et al., 2001; Metcalfe et al., 2012). This aligns with the view that TOTs represent a conflict detection mechanism, where the ACC signals a mismatch between confidence in knowledge and retrieval failure, prompting continued search efforts. Furthermore, the frontal aslant pathway, a white-matter tract connecting Broca's area to the ACC, may contribute to TOT-related frustration, particularly in anomic aphasia, where patients feel confident in knowing a word but struggle to retrieve it (Catani et al., 2013).

Studies also distinguish TOT states from FOKs. While both involve a sense of partial accessibility to knowledge, TOTs reflect an immediate conflict between strong confidence in knowing a word and the inability to retrieve it, whereas FOKs involve a prediction of future recall (Schwartz, 2006, 2008). Maril and colleagues (2005) in their study found that TOTs are associated with ACC, right dorsolateral PFC, and right inferior PFC whereas FOKs are associated with left ventromedial cortex, asserting that both are distinct metacognitive experiences. Unlike TOTs, FOKs do not consistently activate the ACC, suggesting they do not involve the same conflict-driven metacognitive monitoring (Chua et al., 2014). Instead, FOKs rely on inferential judgments about whether information will be recognizable in the future. Overall, these findings suggest that TOTs are driven by a real-time retrieval failure conflict (right-lateralized, ACC-involved), while FOKs rely on predictive assessments of recognizability (left-lateralized, ACC-independent). This distinction highlights how metacognitive experiences differ not just in phenomenology but also in their underlying neural processes.

The methodological development for studying TOTs is also relatively advanced compared to the other spontaneous metacognitive phenomena. Retrospective self-reports ask individuals to recall past TOT experiences, while diary studies track real-time occurrences over extended periods (Brown & McNeill, 1966). However, since diary studies capture only naturally occurring TOTs, laboratory methods have been developed to artificially elicit TOTs (Brown & McNeill, 1966; see Chapter 5 for details).

To summarize, TOTs represent one of the crucial metacognitive state due to their universality, high frequency in everyday life and ease of observability in the laboratory. They arise automatically and involve real-time conflict between confidence and retrieval failure. Jersakova et al., (2016) proposes that both TOT and déjà vu are

subjective experiences of a temporary malfunction in the cognitive system. Both are thought to arise from unsuccessful or partial retrieval alongside a metacognitive awareness that something is wrong with the retrieval process. Specifically, TOT involves inability to recall a piece of information despite an awareness that it should be accessible, whereas déjà vu involves feeling of familiarity coupled with the awareness that this familiarity is false and the situation is novel. Further studies suggest that both déjà vu and TOT function as "epistemic feelings", subjective signals about cognitive processing (Arango-Muñoz, 2010; O'connor and Moulin, 2013). Examining them alongside each other and other experiences will help in determining the potential domain-generality of spontaneous metacognitive monitoring processes.

1.2.4. Error Detection

Imagine waking up one morning, preparing for your early university class, worried you might be late. You grab your bag and rush out the door, only to realize, as the main door slams behind you, that you've locked yourself out with keys inside your home. You immediately realise the error you have just made and think about the trouble it is going to cost you. Errors are ubiquitous part of human behaviour (Rabbit, 1966; Norman, 1981) and just like in this example, we all are prone to occasional errors as we engage in our daily activities. While errors can sometimes lead to unfavourable or frustrating consequences, they are an important source of information in the regulation of our cognitive processes (Nick et al., 2004). Within metacognition, the ability to detect an error is one of the fundamental components of cognitive control (Logan & Crump, 2010). Specifically, error detection refers to the process of identifying a discrepancy between expected outcomes and actual performance (Winograd & Johnston, 1982).

Whenever we are acquiring new skills, the learning process is based on trial and error, however, even when the skills become automatic and more fluent, errors still

prevail in our task performance. Detecting and correcting these errors is essential for executive control at high level performance (Holroyd & Coles, 2002; Yeung et al., 2004). Multiple cognitive functions contribute to error detection and correction, ranging from simple attention and perceptual processing to high-order executive functioning like problem solving and self-monitoring (Dams-O'Connor & Suman-Parestsky, 2018). Studies assert that two types of self-monitoring are related to metacognition, such as, explicit self-monitoring, which is slow, deliberate and includes awareness and implicit self-monitoring, which is fast, automatic and occurs without awareness (Firth, 2012). Reaction time task studies, focusing on monitoring (detecting errors) and control (changing the behaviour after an error has occurred) assert that after making an error, people often slow down, adopting a more cautious strategy. Whereas, other studies show that changes in strategy can happen automatically, even without explicit error detection (Yeung & Summerfield, 2012). This notion supports the idea that metacognitive processes not only help in detecting our errors but also help in adjusting our behaviours and are important in understanding how we monitor and control our cognitions (Firth, 2012).

Different theories and models provide useful framework in the conceptualization of how error detection works. However, researchers often consider these theories as mutually exclusive, designing experiments to determine which one is correct (Logan & Crump, 2010). Some theories within error monitoring framework emphasize that awareness is essential for error detection and correction in metacognitive regulation, proposing that errors are identified through a comparison between intended and actual response. When a mismatch is detected, an error signal is triggered (Gehring et al., 1993). Supporting this view, studies by Rabbitt (1967, 1968, 2002) show that people detect 80-95% of their errors, sometimes with false alarms and adjust their behaviour

accordingly and often slowing down after detecting an error. Further evidence from behavioural studies (Dehaene et al., 1994; Gehring et al., 1993) show that neural markers of error detection, such as error-related negativity (ERN) in event-related potential (ERP), only occur when a person is aware of making an error, leading to post-error slowing response. This suggests that error detection plays a crucial role in adaptive human behaviour, allowing for both immediate corrections, such as, responding more cautiously to avoid further errors, and longer-term learning of appropriate stimulus-response contingencies.

In contrast, other theories argue that error detection does not require deliberate comparison. Instead, the models propose that simply having a competing response generates a conflict sufficient to signal an error emphasizing that conflict monitoring is a key mechanism for error detection (Yeung et al., 2004; also see Holroyd et al., 2005). Yeung and colleagues (2004) propose neural network model positing that error detection is influenced by monitoring for the conflict that occurs after a response. According to this model, the error-related negativity (ERN) signal recorded via electroencephalogram (EEG), reflects post-response conflict, meaning that error correction can occur automatically before the error is consciously detected. They further argue that this conflict monitoring mechanism is likely to be an adaptive feature of human cognition, influencing compensatory strategies and guiding our future responses. However, Steinhauser et al., (2008) tested both conflict-monitoring and response monitoring in error signalling task. The results showed that model fit favoured the response monitoring theory, which suggested that error detection is mediated by the internal error correction. This means that, when an error occurs, rather than relying on conscious comparison of conflict, the correct response is initiated often before we are even aware of our error, and this internal corrective process serve as a signal that

an error was made. An important question in metacognitive research concern whether metacognitive conflict occurs at conscious level (top-down) or whether it arises automatically (bottom-up). Although different models propose different mechanisms, they converge on the broader view that spontaneous metacognitive experiences often involve rapid and automatic detection of cognitive mismatch, without deliberate introspection (Yeung et al., 2004; Firth, 2012).

Additionally, Crosson et al., (1989) proposed a hierarchical pyramid model of awareness, highlighting three levels of awareness in adults with traumatic brain injury, expanding the scope of awareness to include metacognitive sills, such as, self-monitoring and performance anticipation. The foundational level, intellectual awareness, involves recognizing that cognitive functioning is impaired. The next level, emergent awareness, refers to the ability to recognize the problem when it occurs. Together, these levels form the basis for the anticipatory awareness, that allows a person to realize that a problem is likely to occur due to a deficit. According to their view, both intellectual and emergent awareness are essential in error recognition and correction. In contrast, Toglia and Kirk (2002) proposed dynamic model of awareness that differentiates between stored metacognitive knowledge (what we know about our own cognitive abilities) and task specific (online) awareness. Their model suggests that awareness functions as a dynamic process rather than a series of hierarchical levels, emphasizing that awareness of task difficulty and potential failure generates self-monitoring and strategy adjustment, which further facilitates error detection and correction.

The role of awareness in error detection has also been studied in aging and neurological conditions. Research on older adults and people with traumatic brain injury assert that diminished awareness, specifically for emergent awareness, is

associated with reduced error monitoring (Harty et al., 2013; Dockree et al., 2015). A very small number of studies (using approaches other than electrophysiological methods) indicate that older adults tend to show decreased ability to monitor and evaluate their performance (Bruce et al., 1982; Graham et al., 2005; Rabbitt, 1990; Suchy et al., 2011) suggest that older adults show diminished performance monitoring abilities. In contrast, other studies provide contradictory evidence that older adults may still retain or even improve their ability to monitor their performance (Clare et al., 2010; Lovelace & Marsh, 1985; Rabbitt, 2002; Siobhán et al., 2013).

Neurological studies on error detection has shown that ACC plays a crucial role in performance monitoring and error detection. Studies on error-related negativity (ERN), a neural response following errors, suggest that the ACC detects competition or conflict during information processing (Yeung et al., 2004). Research has shown that the frontal and prefrontal regions, particularly the dorsal ACC, are crucial for monitoring errors and initiating performance adjustments (Bettcher & Giovannetti, 2009; Carter et al., 1998). Awareness of errors is necessary for effective correction, as indicated by event-related potential (ERP) studies linking error recognition to anterior cingulate and medial prefrontal activity (Dehaene et al., 1994; Gehring et al., 1993). Deficits in error monitoring are observed in individuals with traumatic brain injury (TBI) and aging-related cognitive decline (Dockree et al., 2015; Harty et al., 2013). Behavioural studies commonly use simple choice reaction time and signal detection tasks to study error detection and the underlying mechanisms (Fleming et al., 2012). In this thesis, we discuss the methodologies used in such studies in detail in Chapter 5.

To summarize, error detection qualifies as a spontaneous metacognitive experience, as it often occurs automatically, without deliberate intention, and arises

from a mismatch between actual and expected outcomes. This aligns with other spontaneous metacognitive experiences explored in this thesis, such as déjà vu, jamais vu and TOT, which are also characterized by the emergence of conflict signals that prompts awareness. Error detection involves both implicit and explicit self-monitoring (Firth, 2012) and activates brain regions implicated in other spontaneous metacognitive experiences, particularly ACC, known for its role in conflict monitoring and cognitive control (Yeung et al., 2004). Studying error detection within this framework allows us to explore whether such diverse experiences share common metacognitive mechanisms. Notably, metacognitive phenomena examined in this thesis are typically studied using a wide variety of methodologies, for instance, some are more reliant on questionnaire-based approaches (e.g., déjà vu and jamais vu), some rely on cross-cultural and age comparisons (e.g., TOT) and others are more reliant on neurological studies (e.g., déjà vu and error detection). One of the cores aims of this thesis is to apply a unified theoretical and methodological approach to these otherwise different cognitive domains, something that has not been done before in metacognition research. This approach offers a novel lens on the domain-generality of metacognitive monitoring by examining multiple spontaneous cognitive experiences within the same individuals using a consistent methodological framework.

1.2.5. Involuntary Autobiographical Memories

"*I was waiting at the bus-stop, thinking that it was a bit of a gloomy place to be standing all by myself. Some strange sounds were coming from the neighbouring factory. In the street, the cars are passing me. A car with unusually sharp headlights is approaching me. I suddenly remember my younger brother's eight years birthday. He got a toy robot that could shine with its eyes and was able to walk*" (Berntsen & Hall, 2004 p. 789).

Involuntary autobiographical memories (IAMs), refers to memories of a specific personal past event that pop into our mind unintentionally or with no preceding attempt at retrieval (Berntsen, 1996). These memories often emerge unexpectedly in daily life, triggered by environmental cues or internal thoughts (Berntsen, 2009), as illustrated in the above example. Diary studies indicate that IAMs are frequent aspect of our everyday life occurring several times a day (Berntsen, 2001). IAMs represent a form of spontaneous cognition that provides insight into how memory retrieval can be triggered without our deliberate effort, aligning with the broader framework of spontaneous experiences explored in this thesis.

Involuntary Memories versus Mind Wandering. Although both IAMs and mind wandering can be classified as instances of spontaneous thought, several theoretical distinctions set them apart. IAMs differ from mind wandering in term of its trigger, cognitive mechanisms and executive control involvement (Berntsen, 2021). Some researcher argues that IAMs are essentially cue-dependent and triggered by external stimuli (such as sounds, smells, or other visual stimuli) as well as internal cues (such as thoughts, feelings or bodily sensations). This suggest that IAMs are stimulus driven rather than free-floating thoughts (Berntsen, 2009). In contrast, mind wandering is mostly stimulus-independent, triggered when our attention drifts from an ongoing task to internal stream of thoughts as opposed to being directed at external environmental demands (Maillet et al., 2017). This view is in line with Singer's (1974) theory of daydreaming, which was influenced by William James' (1890) notion of stream consciousness (Berntsen, 2009). Furthermore, Smallwood and Schooler (2006) operationalised mind wandering as task-unrelated thought, in which executive attention shifts away from the primary task, leading performance failure and superficial

engagement with external stimuli. However, IAMs are not necessarily task-independent and can be triggered by ongoing tasks (Schlagman & Kvavilashvili, 2008).

Additionally, Christoff and colleagues (2016) view mind wandering as unconstrained thought, meaning it is not strongly influenced by external context. While IAMs are highly-context based, triggered by external situational constraints and emerge automatically in response to relevant cue. Researchers argue that IAMs align with Type 1 processes, which are fast and automatic, requiring no executive control (Berntsen, 2009). Whereas, 'mind wandering should be conceived as an instance of Type 2 cognition, because it involves 'perceptual decoupling' to suppress or inhibit the constraints of the ongoing situation and because the regulation of mind wandering relies on executive control' (Berntsen, 2021 p.6). Mind wandering has also been linked to the recruitment of a frontal-parietal control network (Smallwood et al., 2012). IAMs, on the other hand, occurs without recruiting brain areas linked to strategic retrieval (Hall et al., 2014). Further studies indicate that the prevalence of mind wandering decreases with age, whereas no clear age-related decline has been seen for IAMs (Berntsen et al., 2015; Berntsen et al., 2017).

While this view emphasizes a categorical distinction between mind wandering and IAMs, other researchers argue for a continuum between the two based on shared phenomenological features and cognitive triggers. IAMs are often described as spontaneous, a view supported by neuroimaging findings showing reduced cognitive control during their retrieval. From this perspective, IAMs may be considered as part of category of 'stimulus unrelated thoughts' such as mind wandering, which also involves thoughts decoupled from current perceptual inputs (Barzykowski & Moulin, 2022; Mills et al., 2021; Schooler et al., 2011). Several studies highlight the similarities between the two (e.g., see Cole & Kvavilashvili, 2019; Plimpton et al., 2015), noting

that both tend to occur under similar conditions, such as, low cognitive load, and may share underlying mechanism and mood effects. Barzykowski et al. (2018) further propose that IAMs can occur as the content of mind wandering episodes, suggesting that IAMs and future-oriented thoughts are spontaneous manifestations of mind wandering.

Voluntary versus Involuntary Memories. A further distinction is made between voluntary and involuntary retrieval of autobiographical memories (e.g., Brewin et al., 2010; Mace, 2007; Rubin, 2006; Schlagman & Kvavilashvili, 2008; Uzer et al., 2012). Ebbinghaus (1885/1964) was the first to highlight the important theoretical distinction between them, stating that in voluntarily memories “we can call back into consciousness by an exertion of the will directed to this purpose” (p. 1) whereas involuntarily memories “are mental states once present in consciousness return to it with apparent spontaneity and without any act of the will” (p. 2). Voluntary memory retrieval can be direct, quick and effortless or sometimes it can be generative, requiring more cognitive effort (Conway & Pleydell-Pearce, 2000). Studies suggest that voluntary memories involve a top-down strategic retrieval process, reflecting a goal-directed search (Rasmussen & Berntsen, 2011). Whereas involuntary memories are cue-driven, unintentional, require no conscious search and are usually experienced as fast and effortless (Barzykowski et al., 2019; Barzykowski & Staugaard, 2018). Further studies assert that involuntary memories tend to be recent, related to specific time in the personal past, and occur when a person is in relax state. These general characteristics of involuntary memories and their retrieval contexts suggest that the memories and their underlying retrieval mechanisms are different from those of other types of retrievals (Ball, 2007).

Different theoretical frameworks have been proposed to explain IAMs. Some theorists propose that IAMs are more likely to occur during diffused state of attention, that is, while the person is engaged in fairly routine, automatic activities requiring minimum attention, such as, brushing teeth or making a cup of tea or washing dishes (Berntsen, 1998; Kvavilashvili & Mandler, 2004; Schlagman et al., 2007). Kvavilashvili and Mandler (2004) suggest that in such state people are more likely to notice external cues that could prompt involuntary memories. The diffused attentional state allows for the wider and faster activation of memory networks, making retrieval more likely and this retrieval is related to specific past event (Ball & Little, 2006; Berntsen & Hall, 2004; Schlagman et al., 2007). Conway and Pleydell-Pearce (2000) while agreeing that IAMs are more likely during low attention focus, they provide an alternative explanation for its cause. They propose a hierarchical network model for autobiographical memory retrieval, suggesting that voluntary memories are a result of top-down metacognitive search process, while involuntary memories occur spontaneously, without deliberate control. They argue that executive control system, that generally regulates which autobiographical memory to enter consciousness, is less vigilant during diffused attention state, allowing unexpected memories to surface.

However, not all theorists assume that IAMs are the result of low attention focus. For instance, Wegner's (1994) model of unwanted thoughts suggests that two attentional systems operate in parallel, one focused on the current goals and the other automatically suppresses unrelated thoughts. According to his model, when cognitive load overwhelms the attention capacity, the secondary suppression system fails, allowing previously inhibited memories to enter our consciousness. This process is similar to how mind wandering occurs.

Spontaneous thoughts, including mind wandering, occupies a significant portion of our waking hours (30–50%) and has been linked to medial PFC, posterior cingulate/precuneus, and posterior temporoparietal cortex, regions that form the core of the default mode network (DMN; Christoff et al., 2014). Fox and Christoff (2014) argue that mind wandering also activates metacognitive regions like rostrolateral prefrontal cortex (RLPFC) and dorsolateral prefrontal cortex (DPFC), indicating that the functioning extends beyond the DMN suggesting multiple neural substrates contribute to spontaneous cognition, demanding broader investigation. Across these cognitive phenomena, the medial temporal lobe (MTL), anterior cingulate cortex (ACC), prefrontal cortex (PFC), and default mode network (DMN) are commonly involved. These regions are crucial for memory retrieval, spontaneous thought processes, conflict monitoring, and metacognitive regulation). Functional connectivity studies suggest that mind wandering involves memory-related medial temporal lobe (MTL) structures and parietal regions (Andrews-Hanna, 2012). In early study, Andreasen et al., (1995) revealed that during "rest", when asked what had been going through participants' minds, they regularly reported autobiographical memory retrieval, overlapping with planning for the future, and other thoughts, leading to the identification of the default mode network.

Hall et al., (2008) examined IAMs in their study, by pairing pictures with descriptive words during encoding. During recall on seeing the word, participants judged whether an item could be worn, alternating between involuntary retrieval (no instruction to recall the picture) and voluntary retrieval (explicit instruction to recall the picture). Results showed that both voluntary and involuntary memories activated PFC regions. In another study, Kompus et al., (2011) used event-related fMRI and EEG to compare involuntary and voluntary memory. In the study participants responded if a

word triggered a spontaneous memory. Findings suggested voluntary memories relied more on dorsolateral PFC, whereas successful memory recall, in both voluntary and involuntary condition, showed general overlapping neural recruitment. Similarly, in a study by Hall et al., (2014) investigating neural differences between voluntary and involuntary episodic memory retrieval. Results showed that voluntary memories activated dorsal frontal regions, reflecting greater strategic retrieval, while both memory types engaged medial-temporal, ventral occipitotemporal, and ventral parietal regions similarly, suggesting that involuntary memories share core neural components with voluntary memory systems.

Early research on IAMs largely relied on diary and questionnaire methods asking participants to describe their involuntary memories in as much details as possible highlighting its content, the retrieval context, triggering cues and other characteristics (Berntsen, 1998, 2001; Berntsen & Hall, 2004; Berntsen & Rubin, 2002; Kvavilashvili & Mandler, 2004; Ball & Little, 2006; see Chapter 5 for empirical studies). Over the past few years, there has been a notable shift toward laboratory based experimental approaches (e.g., Vannucci et al., 2019; Barzykowski & Niedźwieńska, 2017; 2016; Plimpton et al., 2015; Barzykowski et al., 2019; Wright-Wilson et al., 2024) allowing researchers to elicit and examine IAMs under controlled conditions, facilitating more rigorous investigation of their underlying cognitive and neural mechanisms. In sum, IAMs are spontaneous and frequently occurring phenomenon, studying it in association with other spontaneous cognitive phenomena could offer better understanding of our memory, cognitive systems and their potential underlying mechanisms.

IAMs qualify as a spontaneous cognitive phenomenon due to their unintentional and effortless emergence into consciousness. While they lack immediate conflict

signals as observed in experiences like déjà vu, jamais vu, TOT and error detection, IAMs involve internal monitoring processes that guide the surfacing of personal memories. Recent theoretical development proposes that both IAMs and déjà vu may reflect different points along a continuum of spontaneous memory experiences, differing in the accessibility of retrieved content and subjective experience of familiarity (Barzykowski & Moulin, 2023). Barzykowski and Moulin (2023) offer a detailed continuum model in which IAMs and déjà vu are theorized to arise from shared involuntary memory retrieval mechanisms. IAMs provide accessible autobiographical content, while déjà vu is marked by a sense of familiarity without access to episodic details. Critically, they argue that distinguishing between IAMs and déjà vu relies on a metacognitive evaluation of the plausibility and contextual fit of the retrieved experience, IAMs are plausible and relevant to one's past, but déjà vu is recognized as an erroneous familiarity. Both can be triggered by environmental cues, but differ in the degree of retrieved detail and subjective confidence. Studying IAMs alongside déjà vu and other metacognitive experiences enable us to explore whether a domain-general metacognitive monitoring system underpins different forms of spontaneous cognitive conflict and subjective experience. In this way, IAM serve as an essential part of the broader theoretical framework of this thesis, aiming to determine potential shared mechanisms across diverse spontaneous cognitive phenomena.

1.2.6. Zoning Out

"As you begin this chapter, you are probably paying at least some attention to the words you are reading. After a page or two, however, there is a real possibility if not likelihood, that your attention may wander. Should that happen, your eyes may continue moving across the page, the phonology of the words may continue sounding in your head, yet your mind will be elsewhere. This phenomenon of "zoning out" while

reading is ubiquitous" (Schooler et al., 2004, p.203). An episode of mind wandering without awareness is known as zoning out (Smallwood et al., 2008).

Zoning Out versus Mind Wandering. Zoning out could be confused with the concept mind wandering, however, researchers have drawn distinctions between these two phenomena. As noted in the IAM section, mind wandering occurs when our attention shifts away from an ongoing task towards self-generated thoughts about different place and time, often without meta-awareness (Maillet & Schacter, 2016). Mind-wandering can be either intentional or unintentional (see for review Seli et al., 2015; Seli et al., 2016; Seli et al., 2015). Intentional mind wandering occurs when individual deliberately initiates or continue mind wandering episode and has meta-cognitive awareness of its occurrence, at least at some point during the episode. In contrast, unintentional mind wandering lacks conscious initiation and occurs spontaneously, without metacognitive awareness that the mind is wandering (Seli et al., 2016).

Smallwood (2013) further provides a nuanced theoretical view of mind wandering by considering the 'ignition point' and the 'continuation of the episode, suggesting that intentionality and meta-awareness can function independently. There is a possibility that a person may intentionally initiate mind wandering and has meta-awareness, yet the person become so absorbed that eventually loses awareness. Conversely, a person may unintentionally initiate mind wandering, but later become aware of it as the episode continues. Seli et al., (2016) further argue that intentional and unintentional mind wandering are conceptually similar to mind wandering with and without awareness (for review see Smallwood et al., 2007), with their onset point determining if the mind wandering was intentional or unintentional.

This distinction aligns with research categorizing mind wandering into two distinct types, tuning out and zoning out, reflecting mind wandering with and without meta-awareness (see Schooler et al., 2011; Smallwood and Schooler, 2015; Smallwood et al., 2007). Tuning out refers to mind wandering with awareness, in which people recognize their distraction and are able to control their train of thoughts at least to some degree. Whereas, zoning out occurs without awareness, people are completely unaware that their mind is wandering – it is unintentional and lack meta-awareness. However, people recognize that they were mind-wandering when they come to the end of the mind-wandering episode and are able to report its phenomenal content retrospectively (Seli et al., 2017).

Compared to tuning out, zoning out is more strongly associated with response-inhibition failures and reading-comprehension deficits (Smallwood et al.,2008). Moreover, neuroimaging studies, show different brain activity pattern for tuning out and zoning out, implying differences in task performance and neurocognitive activity (reflecting unique cognitive processes) (Seli et al., 2017). For instance, Christoff et al. (2009) in their fMRI study found that zoning out, compared to tuning out, recruits a number of traditional metacognitive regions, including rostrolateral prefrontal cortex and rostromedial prefrontal cortex. They further found that dorsal ACC and anterior PFC were more active during mind wandering without meta-awareness (which some refer to as zoning out). Anterior PFC which is known for being involved in mind wandering with meta-awareness (tune out) was more active when people were unaware that they were mind wandering. Whereas when people were aware that they were mind wandering, their brain activity did not show extra activation beyond what was already happening when they were unaware. This suggests that executive

functions might process internal conflicts within thoughts without realizing you are mind wandering.

Conceptualization of Zoning Out. Research on zoning out while reading asserts that people can fundamentally lack an awareness of the contents of their consciousness. The disssociation between zoning out experience while reading and the realization that one has been zoning out highlights the importance of distinction between experiential or basic consciousness (referring to the contents of experience) and “metaconsciousness” or “meta-awareness” (referring to explicit awareness of contents of consciousness) (Schooler, 2001, 2002; Schooler et al., 2003). When people zone out, they are experientially conscious whatever has distracted them, but lack metaconsciousness of their fact that they have been zoned out. However, eventually, they suddenly become metaconscious that they were zoned out and have not been paying attention to the current task. This suggests that zoning out serves as an indicator of propensity for distraction and the capacity for a high-order form of monitoring (meta-awareness) during which people realize that their mind has wandered (Sayette et al., 2010).

Despite being a common phenomenon, zoning out has received limited direct research attention. The phenomenon has been indirectly explored through two related lines of research: (1) ‘task-unrelated images and thoughts’ (TUITs; Giambra 1995,) focusing on mind-wandering while performing the task and (2) research on ‘comprehension monitoring’ (Brown, 1980) or ‘self-regulated comprehension’ in reading (Hacker, 1998). However, these studies primarily focus on metacognitive monitoring strategies for reading efficiency while overlooking the possibility that readers may fail to realize that they are not attending to the text at all. Empirical study by Schooler and colleagues (2004) provides a more comprehensive understanding of

the zoning out while reading (see chapter 5 for more details). The researchers argue that while research on metacognition in reading has long examined comprehension monitoring, it has largely ignored the phenomenon of zoning out. They further note that 'The experience of suddenly realizing that one has been zoning out certainly represents a metacognitive experience in Flavell's use of the term. Nevertheless, the notion of metacognition in general, and the specific distinction between metacognitive knowledge and metacognitive experience fails to adequately capture the zoning-out phenomenon' (p.219). They suggest that metaconsciousness plays a crucial role in identifying zoning out lapse, and its absence allows mind wandering to continue unnoticed.

Schooler (2002) proposed that while conscious experience and implicit cognitive monitoring occur continuously, explicit attention to assess the content of thought happens only occasionally. Within this framework, Schooler et al., (2004) argue that zoning out occurs when automatic monitoring fails to detect a lapse in attention, delaying correction until meta-awareness intervenes. Realizing the fact that one has been zoned out require a high-order form of monitoring (i.e. meta-awareness) in which one consciously evaluates whether their thoughts align with the current task goals. If a discrepancy detected, then attention is redirected. However, since metaconscious reflection is cognitively demanding, it is brief, leading to repeated zoning-out episodes. This idea suggests that implicit monitoring alone is insufficient to detect the zone out lapses and requires periodic conscious intervention.

Research suggest that zoning out episode is caught when consciousness reflects upon itself. Meta-awareness may be triggered by explicit reminders, periodic self-monitoring, or implicit cues like pauses in thought. External factors, such as text breaks, page turns, or environmental sounds, can also prompt metaconscious

reflection, enabling individuals catch their zoning out episode. Given the challenge of objectively identifying zoning out episode, studies typically rely on self-report measures, verbal reports or thought probes (asking participants to describe immediate content of their awareness) (Schooler et al., 2004). The phenomenon of zoning out is not metacognitive in itself, but like other spontaneous cognitive phenomena discussed in thesis, it occurs unintentionally. Zoning out reflects a lapse in attention and highlights the limitations of implicit cognitive regulation and emphasize the crucial role of meta-awareness in self-monitoring and attentional control. Thus, by studying zoning out in association with other spontaneous cognitive phenomena and examining its underlying mechanisms, can help in the understanding of attentional lapses and metacognitive monitoring. Having discussed the nature and characteristics of these experiences, in the next section we briefly review how metacognition has traditionally been measured in laboratory settings, and how these approaches differ from the focus of the present thesis.

Table 1.2

Definitions/quotes of all six phenomena by different theorists

Phenomena	Respective definitions/quotes
Déjà vu	"Déjà vu is the subjective experience of familiarity combined with the knowledge that this experience is false" (Moulin, 2018, p. 1). "The strange feeling of having been somewhere or done something before - even though there is evidence to the contrary - is called déjà vu" (Cleary et al., 2009, p. 1082). "déjà vu can be described as a dissociative experience, resulting from a metacognitive evaluation (the certainty) of a lower-level memory process (the familiarity)" (O'Connor, 2021, p. 835). "Déjà vu is typically a transitory mental state in which a novel experience feels highly familiar" (Wells et al, 2012, p. 1).

	"Déjà vu is the striking sense that the present situation feels familiar, alongside the realization that it has to be new" (Cleary et al., 2012, p.969).
Jamais vu	"A subjective experience of unreality or unfamiliarity for a stimulus known to be familiar" (O'Connor et al., 2021, p. 835).
	"A jamais vu experience involves encountering an objectively familiar situation that momentarily feels unfamiliar, such as walking into your bedroom and momentarily having no sense of familiarity associated with this setting" (Cleary & Brown, 2022, p. 192).
	"Jamais vu can be considered the opposite of déjà vu in that it involves encountering an objectively familiar stimulus that momentarily feels unfamiliar" (Brown, 2003, p. 402).
	"familiar places or people are somehow not familiar or the way they should be" (Ardila et al., 1993, p. 138).
	"the intense feeling that the current circumstances are novel and strange, while objectively realizing that they have, indeed, been previously experienced. (Burwell & Templer, 2017, p. 1194)
Tip-of-the-tongue (TOT)	"The tip-of-the-tongue state (TOT) is a conscious feeling that occurs when an item that a person is trying to retrieve is temporarily inaccessible" (Schwartz & Metcalfe, 2014, p. 373).
	"The tip-of-the-tongue state (henceforth, TOT) is typically defined as the feeling that a known word will be recalled even though it is not accessible immediately" (Schwartz, 2006, p. 1).
	"the conscious feeling that accompanies or reflects upon the cognitive process of retrieval when an item that a person is trying to retrieve is temporarily inaccessible (Schwartz & Metcalfe, 2011 p. 737)".
	"A TOT is a conscious feeling that a word is in memory even though it is temporarily inaccessible to the person" (Schwartz & Cleary, 2016, p. 96).
	"The "tip of the tongue" (TOT) phenomenon is a state in which one cannot quite recall a familiar word but can recall words of similar form and meaning." (Brown & McNeill, 1966, p. 325)
Error Detection	"Error detection results when there is enough of a mismatch between input and the selected schemata to induce the subjective feelings of confusion" (Winograd & Johnston, 1982 p.63).

	"Error recognition refers to the ability to recognize or detect the presence of an error; recognition may happen as the error is being made or after it has occurred" (Dams-O'Connor & Shuman-Paretsky, 2018, p. 1327).
	"some monitoring processes, such as those associated with the evaluation of one's own performance, may conceivably be sufficiently automatized to be deployed non-consciously" (Charles et al., 2013, p. 80).
	"a mismatch or a conflict between the executed response and the intended correct response indicates the presence of an error" (Maier et al., 2008, p. 263).
	"Error monitoring is the metacognitive process by which we are able to detect and signal our errors as soon as a response has been made." (Yeung & Summerfield, 2012, p. 1313)
Involuntary autobiographical memory (IAM)	"Recollections of personal events that come to mind without any conscious attempt at retrieval" (Barzykowski & Moulin, 2023, p. 3).
	"memories from the past that come to mind spontaneously, without any deliberate attempt to retrieve them (i.e., past memories that simply "pop" into one's mind)" (Schlagman et al., 2006, p. 64).
	"Memories for personal events that come to mind spontaneously with no preceding conscious attempt at retrieval, such as a particular location triggering a memory of a past event associated with this location" (Berntsen, 2021, p. 1).
	"Involuntary autobiographical memories are memories of personally experienced events that come to mind spontaneously– that is with no preceding attempts at retrieval" (Rasmussen & Berntsen, 2009, p. 1137).
	"Involuntary autobiographical memories (IAMs) are memories of past events that come to mind without deliberate retrieval attempts." (Vannucci et al., 2019, p. 117)
Zoning out	Zoning out is referred to as "mind wandering without awareness" (Smallwood et al., 2008 p. 1144).
	"When your mind wanders, but you don't realize this until you catch it" (Smallwood et al., 2007 p. 533).
	"tune-outs and zone outs, which reflect mind wandering with and without meta-awareness" (Seli et al., 2017, p. 1809).

> "At some point during reading, you realize that you have no idea what you just read" (Reichle et al., 2010, p. 1302).
>
> "unaware mind-wandering episodes (termed zoning out) and aware episodes (termed tuning out)" (Schooler et al., 2011, p. 323).

1.3. Measuring Metacognition

For decades research in metacognition has extensively focused on the relationship between subjective prediction and objective performance, including how individuals evaluate their learning, knowledge, memory, and responses to environmental stimuli (e.g., Dunlosky et al., 2005; Hertzog & Dixon, 1994; Koriat, 1993; Sikström & Jönsson, 2005). In laboratory settings, researchers typically assess metacognition by asking participants prospective (before task performance) and retrospective (after task completion) judgments about some aspects of their cognition or memory. In metamemory research, prospective judgments include Judgments of Learning (JOL), where individuals predict how well they will recall information later, and Feelings of Knowing (FOK), where people indicate whether they feel that they know an answer even if they cannot recall it immediately (see Figure 1.2). Retrospective measurements, on the other hand, involve assessing confidence levels after completing a task (Fleming & Dolan, 2012).

To evaluate the accuracy of these metacognitive judgments, researchers compare them against objective performance measures. One approach involves correlating JOLs or FOKs with actual recall or recognition outcomes, providing a quantitative measure of metacognitive accuracy (Nelson, 1984). Similarly, another common measure is Signal Detection Theory (SDT) to separate metacognitive sensitivity (the ability to distinguish correct from incorrect responses) from response bias, offering a more refined analysis of how well subjective confidence corresponds with actual

performance (Maniscalco & Lau, 2012). Together, these methods provide a comprehensive view of both the processes behind metacognitive monitoring and their effectiveness in guiding learning and decision-making (Fleming & Dolan, 2012).

While such measures have been central to traditional metamemory research, particularly in studies of JOLs, FOKs and even TOT states, they are less directly relevant to the study of spontaneous metacognitive experiences such as déjà vu, jamais vu and error detection. In these cases, the focus is not on the accuracy of a future oriented judgment but on the subjective phenomenology of spontaneous cognitive feelings. Thus, although the classical framework of metacognitive accuracy provides important context, the present thesis extends metacognitive research by exploring phenomena where predictive accuracy is not the primary concern.

Table 1.3

Brain regions associated with six spontaneous cognitive experiences

Phenomena	Associated brain region
Déjà vu	Hippocampus, parahippocampal structure, frontal midline, parietal brain region, medial temporal lobe
Jamais vu	Medial temporal lobe
Tip-of-the-tongue (TOT)	Right PFC, ACC, dorsolateral PFC, right inferior PFC
Error Detection	ACC, dorsal ACC, frontal and prefrontal regions
Involuntary autobiographical memory (IAM)	DMN, medial PFC, posterior cingulate cortex, precuneus, medial temporal lobe
Zoning out	Dorsal ACC, anterior PFC

Note: ACC = Anterior cingulate cortex; DMN = Default mode network; PFC = Prefrontal cortex

1.2. Summary

Metacognition broadly refers to our ability to reflect on and regulate one's own cognitive processes. While traditional metacognition research has largely focused on deliberate and effortful forms of monitoring (e.g., confidence judgements), this chapter reviewed literature highlighting that some of the metacognitive processes also occur spontaneously, that is, automatically and without deliberate cognitive effort. These spontaneous metacognitive experiences include phenomena like déjà vu, jamais vu, TOT and error detection. This chapter provides theoretical overview of each experience, exploring their general characteristics and neural underpinnings. Each of these experiences share key characteristics, that is, they are unintentional, signal conflict or cognitive mismatch, and often trigger further cognitive evaluation or behavioural adjustment. Additionally, this thesis also considers two non-metacognitive experiences like IAMs and zoning out. While these do not necessarily involve conflict signalling, they occur unintentionally and are associated with internal monitoring and awareness processes. IAMs reflect the spontaneous emergence of personal memories, often guided by internal or environmental cues. Zoning out highlights the role of meta-awareness in identifying attentional lapses. Their inclusion allows us to explore whether broader metacognitive monitoring processes also underpin other types of spontaneous cognitive events.

A central theoretical question explored in this chapter is whether such spontaneous metacognitive experiences may reflect a domain-general approach and can be extended to other types of spontaneous cognitive phenomena and cognitive domains. That is, rather than operating independently, might use a broader and integrative system for different cognitive tasks. If metacognition is domain-general, then we might think that individuals who are prone to one type of spontaneous metacognitive

experience might also be more likely to experience others. This view is theoretically supported by proposed overlapping cognitive characteristics and by converging neural evidence. For instance, these experiences involve overlapping neural circuits (see Table 1.3), such as, the medial temporal lobe (MTL), anterior cingulate cortex (ACC), prefrontal cortex (PFC), and default mode network (DMN). These regions are crucial for memory retrieval, spontaneous thought processes, conflict monitoring, and metacognitive regulation.

Despite their shared features, these experiences are typically studied within separate theoretical framework and different methodologies. This thesis brings them together for the first time under a unified conceptual and empirical approach. By identifying their shared characteristics and comparing them systematically, this thesis explores whether spontaneous metacognitive experiences may reflect domain-general mechanisms of cognitive monitoring.

1.4. Thesis Aims

This thesis aims to examine spontaneous metacognitive experiences as a potentially unified class of cognitive phenomena. We propose that these spontaneous metacognitive experiences are part of our metacognitive system, and arise automatically in order to guide cognitive processing. The overarching goal of this thesis is to investigate the incidence and frequency of six spontaneous cognitive experiences (déjà vu, jamais vu, TOT, error detection, IAMs and zoning out) in daily life. We aim to determine the potential association between them and test if these experiences reflect domain general metacognitive monitoring system and if we can extend that to other spontaneous cognitive experiences, that is, individuals who frequently experience one experience may also likely to experience others. Additionally, we explore their cross-cultural variations, association with religious and/or spiritual aspects and verify their

definitions (see Chapter 2). We further examine if these spontaneous cognitive experiences share some common characteristics, so that they can be meaningfully grouped together reflecting on our cognitive systems. Chapter 3 investigates how people classify and categorize these spontaneous cognitive experiences, and if we can get consensus on subjective descriptions of the experiences. In Chapter 4 we explore theses phenomena in patients with epilepsy. We examine if there are group difference in the occurrence and phenomenological characteristics of these six phenomena. In Chapter 5, we discuss the empirical methods in literature studying these phenomena and propose a paradigm that could be useful to study metacognitive experiences along with spontaneous thoughts in a laboratory setting. Finally, Chapter 6, integrate them into the existing knowledge. In this thesis we investigate following questions:

- Are the six spontaneous cognitive phenomena associated with one another?
- How frequently do people experience these phenomena in daily life?
- Do these experiences share common phenomenological characteristics?
- Are there cultural differences in the experience or reporting of these phenomena?
- Is there a relationship between spontaneous cognitive experiences and religious or spiritual beliefs?
- Do people with epilepsy report more spontaneous metacognitive experiences compared to people without epilepsy?
- How do people describe these experiences?
- Can we use experimental design that generates IAM in lab to provoke spontaneous metacognitive experiences and spontaneous thoughts?

Furthermore, this thesis has an Open Science approach, that we think is crucial for transparency in research. Thus, we systematically pre-registered all of our studies on OSF website.

Chapter 2

The Natural History of Spontaneous Cognitive Phenomena in Pakistan, Poland and France

In Chapter 1, we provided the theoretical framework for the six spontaneous cognitive experiences, including their phenomenology and neural mechanisms. We discussed that metacognitive experiences like déjà vu, jamais vu, TOT and error detection arise automatically from disruption or uncertainty in ongoing cognitive processes. These experiences reflect metacognitive conflict whether as a mismatch between expectation and outcome (e.g., déjà vu, jamais vu and error detection) or as a conflict between retrieval failure and subjective access (e.g., TOT). Whereas, cognitive experiences like IAMs and zoning out are not overtly metacognitive but still arise without deliberate effort and accessible through retrospective introspection. We further highlighted the empirical evidence of correlations between them (e.g., déjà vu and jamais vu, Moulin et al., (2022); déjà vu and TOT, déjà vu and involuntary memories in older adults, Moulin et al., (2014)), suggesting that these phenomena, although seemingly distinct, may co-occur and reflect underlying commonalities in cognitive processing.

Furthermore, while these experiences vary in their specific mechanisms and levels of awareness, neurocognitive evidence points to partial overlap in the brain regions involved across these experiences, such as the medial temporal lobe (MTL), anterior cingulate cortex (ACC), prefrontal cortex (PFC), and the default mode network (DMN) (e.g., Christoff et al., 2009; Fox & Christoff, 2014; Yeung et al., 2004; Maril et al., 2005), which are associated with spontaneous cognition, memory monitoring, and metacognitive control. These patterns support the idea that spontaneous metacognitive and spontaneous thoughts might stem from partially shared neural and cognitive processes. The current chapter builds on that theoretical framework to

investigate the incidence, frequency and potential associations among spontaneous metacognitive experiences and spontaneous thoughts.

2.1. Introduction

Due to the infrequent and subjective nature of these spontaneous cognitive experiences, it is difficult to get an exact estimate of the actual frequency, so researchers have to consider their relative frequency (Berntsen, 2021) and mostly rely on retrospective surveys (see Chapter 5 for laboratory research into these phenomena). Many researchers in literature have attempted to provide an estimate of frequency of these infrequent experiences, for example, people experience roughly 20 involuntary memories in a day (Rasmussen & Berntsen, 2011), TOT state once a week (Schwartz & Metcalfe, 2011), déjà vu about once a year (Brown, 2003), jamais vu which is much rarer than déjà vu, with five people experiencing jamais vu once a week, whereas 13 people experience déjà vu once a week (Ardila et al., 1993; see Cleary & Brown, 2022 pp. 194, for more details). In line with previous approach, we used a retrospective questionnaire to explore how frequent people experience these phenomena and how they relate to one another. While previous researches have studied these phenomena separately or in pairs, for the first time we are trying to explore their occurrences and relationship between these phenomena, and include them in same large-scale survey using consistent definitions.

In addition to assessing the incidence and frequency of the six cognitive phenomena, we explored cultural differences and association with religious and spiritual aspects. We draw on phenomena like déjà vu and TOT as ‘reference’ experiences, as they have a more developed empirical literature, especially in relation to age, education and culture. For instance, déjà vu has consistently been shown to decline with age (Brown, 2003; Adachi et al., 2001; Adachi et al., 2003; Moulin et al.,

2014; Moulin et al., 2020). Furthermore, some studies have found modest but consistent positive correlation between déjà vu and years of education. Several studies (e.g., Chapman & Mensh, 1951; NORC surveys 1984-1989) report small but statistically significant correlations (ranging between 0.10 to 0.20), indicating that people with more education are likely to report more frequent déjà vu. However, some studies did not find any significant association (e.g., see Adachi et al., 2008; Kohr, 1980). For TOT, studies have shown increase in the TOT states with age (see Brown, 2011 for a review). Dahlgren (1998) in her study found that although adults initially appeared to experience more TOT states, when controlled for the knowledge the age effect diminished. This indicated that level of knowledge, and not age, contributed to the frequency of TOTs experienced, suggesting that the higher the knowledge level, the more TOTs participants experienced.

In contrast, to our knowledge, phenomena like jamais vu, error detection, IAMs and zoning out have not been studied in terms of large-scale self-report to assess demographic patterns and cultural differences. Jamais vu, often mentioned alongside déjà vu, have scarce empirical studies, with some studies reporting low frequency and inconsistent age effects (Ardila et al., 1993; Labate et al., 2018; Moulin et al., 2020). Similarly, while error detection is extensively studies in laboratory settings, it is typically examined through task-based reaction time paradigm (see Chapter 5) and not as a spontaneous subjective experience in daily life. Involuntary memories, although common in daily life, have not been broadly studied in relation to metacognition or demographic variation. Zoning out, often considered as a subtype of mind-wandering without meta-awareness (Schooler et al., 2004), remains unexplored in relation to demographic variables and other spontaneous experiences.

The current study investigates whether the patterns observed in reference experiences (déjà vu and TOT) also extend to these less explored phenomena, particularly in relation to age, education, culture, religiosity and spirituality. This allows us to test the hypothesis that these phenomena, despite surface-level differences, may reflect shared underlying processes related to spontaneous cognition and metacognition. For age, we can make a strong prediction of a decline in experiences as has been shown previously in the literature (at least for déjà vu) but for gender differences, this have never been systematically explored in a large sample, and the studies that have compared déjà vu incidence in male and female participants, did not find any consistent gender difference (Brown, 2003), so we are not making any hypotheses about gender differences.

A growing body of research emphasizes the importance of context and culture in understanding cognitive processing (for details see Proust & Fortier, 2022). Cognitive abilities such as attention, memory, decision making and judgment and so on, which are universal principles of cognition are shaped by the shared tradition and cultural practices. By understanding the cultural and contextual elements, we are better able to identify the shared principles and its influence on our cognitive functioning (Thomas, 2023). Metacognitive experiences like déjà vu and TOTs have been studied from a cultural perspective in number of non-English speaking countries. Using translated version of Sno et al.'s (1994) Inventory of Déjà vu Experience Assessment (IDEA), many studies have evaluated déjà vu in countries like Italy (Labate et al., 2019; Mumoli et al., 2017), France (Curot et al., 2019; Fortier & Moulin, 2015), the Czech Republic (Lacinová et al., 2016), Japan (Adachi et al., 2007; Kusumi, 2006), Argentina (Parra, 2015a), Egypt (Zahran, 2018), and Taiwan (Shiah et al., 2014).

As déjà vu is a French term, Fortier and Moulin (2015) in their on-line survey examined if there is a difference regarding the interpretation and frequency of déjà vu experience between French and English speakers. Researchers did not find differences in the incidence of déjà vu between groups. However, they did find that French-speaking participants experienced déjà vu more frequently and interpreted it as disturbing rather than pleasant, compared to English-speaking participants. Cleary and Brown (2021) argue that anecdotal evidence suggests familiarity with the déjà vu experience in non-Western cultures, such as China, but the labelling (language/terminology) may differ, that is, there may not be a well-established or commonly used Mandarin word for déjà vu. Additionally, analysis of the eHRAF (electronic Human Relations Area Files) World Cultures database found no formal systematic evidence on déjà vu experiences across global cultures. They further argue that although déjà vu is being studied in more countries, it remains unclear whether it is a truly universal phenomenon. TOTs, on the other hand, have been shown to be culturally universal, with comparable self-reports across languages and groups, including Q'eqchi' speakers in Guatemala, ASL users, and bilinguals (Schwartz & Metcalfe, 2011; see Chapter 1 for detailed review). Given its strong cross-cultural validation, TOT serves as a robust reference experience for the comparative assessment. Déjà vu, while theoretically important and widely reported, has somewhat more variable cross-cultural evidence. Nevertheless, both déjà vu and TOT provide valuable reference points for assessing other spontaneous cognitive experiences.

We hypothesized that cultural variation will depend in part on conceptual familiarity and labelling. The principal idea is that, spontaneous metacognitive experiences are part of the metacognitive system, and arise automatically in order to guide cognitive processing. People experience these spontaneous experiences, at

some point in their life, but may not realize it and this might be because of the unfamiliarity with the phenomena or terminology. For instance, a person may have had a jamais vu-like experience but due to lack of culturally or linguistically specific label to describe it, they will not be able to share their experience. Our hypothesis is that the rates of experiencing these infrequent spontaneous experiences will be related to how familiar people are with the concepts and their definition: rates of experiencing these phenomena, and replying 'I don't know' will differ amongst cultures when no definition is provided, but will be more consistent when the definition is provided.

To improve our understanding of the six spontaneous cognitive phenomena, we further explored if the frequency of six phenomena is associated with some religious and spiritual aspects. Religiosity is usually referred to the formal, institutional and outward expression of faith and often measured by variables such as importance of religion, belief in God, frequency of prayer and frequency of attending religious services (Hill & Pargament, 2008). Spirituality, on the other hand, reflects a more internal, personal and emotional connection to the sacred and is often assessed by feelings of spiritual well-being, inner peace and coping (Miller & Thoresen, 2003; Cotton et al., 2006).

Research into déjà vu and spirituality has often been biased both in survey design and interpretation. Surveys frequently included déjà vu among paranormal items (Gow et al., 2009; Parra, 2015a, 2015b; Palmer, 1979), framing it as mystical rather than normal cognitive experience. While some earlier studies linked déjà vu with paranormal beliefs, empirical findings have generally shown only weak or nonsignificant correlations (Gaynard, 1992; Adachi et al., 2008; Fox, 1992; Sen & Yesilyurt, 2014). Studies reporting stronger associations, often included survey

designs that biased respondents by grouping déjà vu alongside paranormal phenomena (Kohr, 1980; McClenon, 1994).

Similarly, the interpretation of déjà vu itself has been associated with mysterious and unempirical concepts such as reincarnation and extra sensory perception (ESP) (Funkhouser, 1983). Even William James categorised déjà vu as a form of religious experience (James, 1982). Others have suggested that in eastern religion the common idea of reincarnation may be based in part on the déjà vu experience (Carmichael, 1957). Additionally, empirical research investigating relationship between religiosity and déjà vu did not find any significant association between formal religious affiliation and déjà vu incidence (McClenon, 1994; Palmer, 1979). Likewise, analysis of the NORC database (1984, 1988, 1989) did not show significant difference in déjà vu incidence between Protestants and Catholics (cf. Fox, 1992). However, individuals identifying as fundamentalist reported significantly fewer déjà vu experiences than those identifying as moderate or liberal in their religious beliefs (Cleary & Brown, 2021). In this study we proposed that people who are religious and/or spiritual are likely to experience spontaneous cognitive phenomena more often. To measure religiosity and spirituality in our survey, we selected items based on a systematic review by Cotton et al., (2010). They identified the most commonly used and developmentally appropriate measures in adolescent health research. Specifically, we included questions assessing belief in God, frequency of prayer and related behaviours (see method section for details).

In addition to assessing cultural differences and link with religiosity and spirituality, we also explored the subjective phenomenology of six cognitive phenomena focusing on duration, control, onset, pleasantness/unpleasantness and perceived significance. Based on the proposed idea that these experiences are

spontaneous, we hypothesized that participants would generally report sudden onset and low control over their occurrence. Drawing on the concept of epistemic feelings, which signal conflict or uncertainty in cognitive processing (Moulin & Souchay 2014), we also expected participants to perceive these experiences as significant rather than random or meaningless. Studies propose that experiences like déjà vu and jamais vu are fleeting or typically brief (Moulin et al., 2021), for example, Brown et al. (1994) found that most participants reported déjà vu experience lasting only a few seconds. Accordingly, we expected that participants would classify these experiences as brief. Although we did not have specific hypothesis regarding pleasantness/unpleasantness, we included these dimensions to further characterize the subjective quality of the experiences in an exploratory manner. By evaluating these phenomenological characteristics, we aim to determine whether the six spontaneous experiences share consistent subjective features, further supporting the idea that they may be meaningfully grouped together based on certain characteristics.

As mentioned earlier (and discussed in Chapter 1), cognitive experiences such as déjà vu, jamais vu, TOT and error detection are conceptualised as spontaneous metacognitive experiences, involving internal monitoring of cognitive states. In contrast, involuntary memories and zoning out represent non-metacognitive spontaneous experiences, occurring without such reflective monitoring. In the present study, we tested both, a single factor model and a two-factor model to explore whether the associations between these six spontaneous phenomena are better represented by loading all experiences onto one factor (i.e., spontaneous experiences) or by separating them into metacognitive and non-metacognitive categories.

2.2. Method

2.2.1. Participants

There were 1200 Participants (262 respondents to the French questionnaire, 402 for the Polish questionnaire and 536 from Pakistan sample). Participants were mostly psychology undergraduate students who completed the questionnaire for course credit, however because the questionnaire was freely available online, there were also respondents from outside this group. Demographic characteristics of the final sample are given in Table 2.1. Ethical approval for the study was granted by the Ethical Research Committee, Institute of Psychology, Jagiellonian University, Kraków, Poland and Department of Humanities, COMSATS University, Lahore Campus, Pakistan.

Table 2.1

Demographic Information of The Participants

Demographic variable	Frequency	Percentages %
N	860	
Age *M*(SD)	22.342(5.93)	
Gender		
Female	637	73.89
Male	199	23.09
Non-binary/third gender	11	1.28
Other	2	0.23
Nationality		
France	178	20.65
Pakistan	370	42.92
Poland	312	36.19

2.2.1. Design and Materials

An online survey was designed on Qualtrics to collect data. The questionnaire was originally developed in English language and was subsequently translated into French, Polish and Urdu language to ensure the accessibility and good understanding for participants from diverse linguistic background. The translations were reviewed by the

native-speaking expert psychology researchers to ensure the conceptual equivalence across the translations. The questionnaire has different sections (see Annex III for specimen of questionnaire). In the first section, participants were presented only with the label of the phenomena (names of spontaneous experiences, e.g. 'jamais vu') and asked to report the if they have ever had the experience. For instance, "have you ever experienced déjà vu?". Participants responded with either *yes*, *no*, or *I don't know*. In the second section, participants were again presented with the label of the phenomena but this time, a definition of the experience was also included (see Table 2.2 for the definitions of experienced provided in the questionnaire). Participants again reported their incidence with either "yes" or "no" response (don't know was not an option). Only those participants who reported having ever experienced the phenomena were then asked to report their frequency over the past week and year by selecting one of the ranges in the options: 0, 1-2, 3-5, 6-10, 11-20, 21- 50, 51-100 or more than 100. They also had the option, if willing, to share a few lines about their experience related to the phenomenon. Following the incidence reporting, participants were asked to provide their agreement with the definition in the questionnaire using a 6-point Likert scale (6 being 'extremely agree' and 1 being 'extremely disagree').

In a third section, we requested participants to evaluate the six experiences using dichotomies to determine the duration, control, onset, pleasantness/unpleasantness, and significance of the experiences. For example, participants were requested to select from the following dichotomies: - It's a brief sensation/it's a long sensation/I don't know - It's something I have control over/it's something I have no control over/I don't know - It's a pleasant experience/it's an unpleasant experience/I don't know - It comes suddenly/it comes gradually over the time/ I don't know - It's a random event/it's a meaningful event/ I don't know. Before

moving on to the next section participants were requested (if they are willing) to provide additional information about their own experiences.

In the fourth section, we assessed the religious and spiritual factor among the participants. Items assessing religiosity and spirituality were adapted from those identified in a systematic review by Cotton et al., (2010). This review evaluated 100 studies (published between 1999 and 2009) examining religiosity and spirituality constructs in adolescent health outcomes and summarized commonly used items. Based on their findings, we included items on beliefs in high power/God, reading religious content or participation in any religious activity or going to religious gatherings and so on. We used a rating scale (from 0 to 100 or not applicable; 0 = not at all, 100 = to great extent) to assess the religiosity and spirituality among participants.

In the fifth section, participants were asked if they have had any psychiatric issues or any other medical problems such as epilepsy, schizophrenia, drug addiction, depression, anxiety, or any serious head injury. Additionally, at the end of this section, participants were requested (if willing) to share their personal experience related to the phenomena under study. In the sixth and final section, we included some post-survey questions, enquiring the use of internet during survey to learn more about the spontaneous phenomena (e.g., “During the study, did you search the Internet for answers or information related to spontaneous metacognitive experiences?”). This was intended to see if participants’ responses might have been influenced by the external sources. We also requested participants to provide feedback related to the questionnaire difficulty to assess the accessibility and comprehension of the questionnaire across diverse culture. However, responses to these questions were too low for further analysis.

Table 2.2

Definitions of six experiences used in the large online survey questionnaire

Experiences	Definitions with examples
Déjà vu	*"The sensation that you feel you have encountered something before (a place, a conversation, etc) whilst knowing this to be false (i.e. You know that you have never been to a given place before)."*
Jamais vu	*"The feeling that you find something strange or unfamiliar (e.g. the spelling of a word looks wrong), even though you know it to be correct and it is known to you."*
Tip-of-the-tongue	*"The feeling that you know a piece of information (like an actor's name) but that you cannot get the word/name out."*
Error detection	*"When you realise after having done something (like sending the text message) that you made a mistake that you weren't aware of at the time of committing this error (i.e., sending it to the wrong person)."*
Involuntary autobiographical memory	*"When you have a memory from a past event (like a place on your holidays) pop into your head without having thought about it."*
Zoning out	*"When you are concentrating on one thing (e.g. reading a book), but you then realise that you have been thinking about something else."*

2.2.2. Procedure

Participants of 18 years or above were invited to take part in the survey and were provided with a brief overview of the study. The participants first completed a consent form and were asked to provide demographic information such as age, gender, nationality, educational status, language and their association with religion (if any). The questions (i.e. phenomenon by phenomenon) within the different sections were in random order for all the participants and to ensure careful participation, some additional "attentional checks" were used throughout the survey. For example, "Have you ever, choose answer 'I don't Know', experienced the feeling of flying in a bowl?", participants chose among '*It is very pleasant, I do not know, or That is not true'*. The questionnaire was publicised in three countries through links with universities, that is,

France, Poland and Pakistan. However, the survey was open (in four languages i.e. English, French, Polish and Urdu), so people from other countries also completed the survey.

2.3. Results

We collected a total of 1200 responses (262 from France, 402 for Poland and 536 from Pakistan). Firstly, we removed incomplete responses. Questionnaires without a complete section 2 (definition of terminologies) were excluded from the data analysis. Second, the data from participants with nationalities other than French, Poland and Pakistan were removed to minimise differences in use of the labels or familiarity with the terminologies within each of the three versions. This resulted in 860 responses for our final analysis.

2.3.1. Incidence of Spontaneous Experiences (Whole Sample)

Our first question was to answer yes, no or 'don't know' to report if at any point in their lives people had had the given experience. To answer this question, we first considered the proportion of people who did not know how to respond (who we can imagine were not sure if they understood the phenomenon or could not identify whether they had ever had the experience). Table 2.3 shows the proportion of people who responded *don't know*. Deja vu, TOT, and zoning out received the lowest proportions of don't know responses, whereas, for jamais vu and error detection the proportion of people who did not know how to respond approached being half of the sample.

We then calculated the incidence of the phenomenon as a proportion only of those who replied yes or no to this question (i.e. not taking into account those who did not know how to respond). These data are in the second column of Table 2.3. The incidence was highest for TOT, with 91% of the population having said they had

experienced the phenomenon. It was lowest for jamais vu, at 45% of the population. The incidence of 84% for déjà vu, without having provided a definition, is similar to the rates of incidence we see reported in the literature**.** This is in accordance to a study by Cleary and Reyes (2009) in which they found that 87% of participants (33 of 38) reported at least one incidence of déjà vu.

Table 2.3

Incidence of The Spontaneous Experiences

Experiences	Proportion who replied "don't know"	Proportion who have had the experience (before definition)	Proportion who have had the experience (after definition)
Déjà vu	.13	.84	.79
Jamais vu	.45	.45	.67
TOT	.13	.91	.88
Error detection	.41	.78	.85
Involuntary memory	.32	.76	.79
Zoning out	.13.	.84	.89

Note: Table showing proportion of 'don't know' responses for incidence of spontaneous experiences and estimates of the incidence of the experience before and after being given a definition of the experience. TOT = tip-of-the-tongue

2.3.2. Incidence of Spontaneous Experiences (After Definitions)

To produce a better estimate of the incidence of the spontaneous experiences, we now took the proportion of people who reported having had the experience at least once in their life following having been given a definition, shown in the rightmost column of Table 2.3. Notably, the major change was observed for the jamais vu phenomenon: reported incidence rose from 45% to 67%. This suggest that participants were initially unsure how to respond, perhaps due to unfamiliarity with the term 'jamais vu', however, after reading the definition, many recognised that had indeed experienced it but only

identified it retrospectively. In contrast, the reported incidence of experiences like déjà vu and TOT slightly decreased after reading the definition. It is possible that initially participants thought that they had experienced these phenomena, but after reading the definition, they realised that their prior understanding was not consistent with the provided description. This pattern highlights the complexity of self-reporting subjective cognitive experiences, especially when conceptual labels and familiarity vary across individuals.

A final stringent analysis of the incidence of these phenomena is to take only those people who ‘agreed’ or ‘strongly agreed’ with our definition. This final sample is described in Table 2.4. The first thing to note is that the level of agreement with our definitions in the sample is high. Secondly, this has the effect of increasing the estimates of incidence of the experience. We might conclude that when provided with a definition of the experience and when agreeing with the definition, we have the most ‘consensual’ and accurate estimate of these experiences. Those people who say they have never had the experience also tend not to agree with our definition of it. Naturally, this is a bit circular - if we have never experienced jamais vu, for instance, we might find it difficult to agree with a definition of it. The fact that estimates of the incidence increase having been provided with a definition, however, means that people are able to process the definition when given it in relation to their own previous experiences.

Table 2.4

Estimates for Incidence of Spontaneous Phenomenon Only for those Who Agree with the Provided Definition of the Experience

Experiences	N (those who agreed or strongly agreed with our definition)	Proportion who have had the experience
Déjà vu	631 (73.37%)	.88
Jamais vu	572 (66.51%)	.78
TOT	689 (80.11%)	.95
Error detection	651 (75.69%)	.90
Involuntary memory	643 (74.77%)	.86
Zoning out	687 (79.88%)	.96

Note: TOT = tip-of-the-tongue.

2.3.3. Frequency of Spontaneous Experiences

We calculated the mean weekly and yearly frequencies for the 6 phenomena (see Table 2.5). Participants gave their responses as a range (e.g. from 3-5 experiences per year), so we recoded their responses as the midpoint of the range (e.g. 4 times a year). In Table 2.5, we present the frequency for the whole sample, which includes all of the responses given by participants after having been presented the definition. If they responded that they had never had the experience, they were entered as having a yearly frequency of 0. In a more stringent analysis of only those people who had ever had the experience "Experiencers", we excluded people who had not had the experience in calculating the frequency, as their zero counts could influence the frequency reporting and underestimate the true occurrence rate among the experiencers.

Table 2.5

Frequency of Spontaneous Experiences

Experiences	Weekly Frequency		Yearly Frequency	
	Whole Sample	Experiencers	Whole Sample	Experiencers
Déjà vu	1.58 (7.48)	2.03 (8.42)	12.22 (20.82)	15.68 (22.39)
Jamais vu	2.17 (8.63)	3.30 (10.47)	11.64 (22.09)	17.68 (25.18)
TOT	3.99 (10.66)	4.54 (11.26)	30.58 (34.06)	34.73 (34.25)
Error detection	2.84 (10.05)	3.37 (10.86)	16.90 (26.07)	19.99 (27.24)
Involuntary memory	4.95 (13.73)	6.29 (15.21)	23.43 (33.09)	29.97 (34.72)
Zoning out	8.65 (16.92)	9.77 (17.67)	45.13 (39.46)	50.95 (38.22)

Note: TOT = tip-of-the-tongue.

To explore whether there were differences in frequency across these experiences, we conducted an ANOVA, and to do so, we only took people who reported having had all six experiences, which meant the sample was reduced to 348 people. Firstly, for yearly frequency, a Greenhouse-Geisser corrected ANOVA showed a significant difference across experiences, $F (4.52, 1568.71) = 121.36$, $p<.001$, partial eta squared = .26. Bonferonni corrected post-hoc tests compared the experiences with each other. Zoning out was the most frequent experience, which was significantly more frequent than the TOT ($p<.001$), which in turn was significantly more frequent than involuntary memories ($p=.018$), which was significantly more frequent than error detection ($p<.001$), which was not significantly more frequent than jamais vu, which was not more significant than déjà vu. In sum, the three less frequent experiences, déjà vu, jamais vu and error detection do not differ from each other in frequency, but they are less frequent than zoning out, TOT and IAM experiences.

We did the similar analysis for weekly frequency, with the sample of 342 people. A Greenhouse-Geisser corrected ANOVA showed a significant difference across experiences, $F(3.13, 1067.85) = 33.49$, $p<.001$, partial eta squared = .08. Bonferonni corrected post-hoc tests compared the experiences with each other. Zoning out was the most frequent experience, which was significantly more frequent than the involuntary memories ($p<.001$), which was not significantly more frequent than TOT, which was not significantly more frequent than jamais vu. In sum, the experiences like TOT, jamais vu, error detection and déjà vu do not differ from each other in weekly frequency, but they are less frequent than zoning out and IAM experiences.

2.3.4. Correlations of Frequency

The extent to which these experiences draw upon shared mechanisms would be consistent with finding correlations amongst the frequency of the experiences, something which has already been shown in prior studies. We used R studio (version 4.3.2) and ran non-parametric Spearman correlations between the experiences in two separate analyses (see Table 2.6), both of which were Bonferroni corrected (such that the p value threshold was .005). For the yearly frequencies all phenomena significantly correlated with each other (r values ranging from .28 to .58), such that the more the participants experienced any one phenomenon, the more they experienced the others. For the weekly frequencies, we found the same pattern (r values in this case ranged from .16 to .40).

Table 2.6

Spearman's Correlations Between the Six Types of Experience for Yearly and Weekly Frequencies

Experiences	Déjà vu	Jamais vu	TOT	Error detection	Involuntary memories	Zoning out
Jamais vu						
Yearly frequency	0.35***					
Weekly frequency	0.24***					
TOT						
Yearly frequency	0.44***	0.34***				
Weekly frequency	0.25***	0.24***				
Error detection						
Yearly frequency	0.31***	0.30***	0.45***			
Weekly frequency	0.16***	0.26***	0.33***			
Involuntary memories						
Yearly frequency	0.31***	0.28***	0.43***	0.42***		
Weekly frequency	0.18***	0.19***	0.2900***	0.23***		
Zoning out						
Yearly frequency	0.41***	0.32***	0.58***	0.47***	0.48***	
Weekly frequency	0.21***	0.22***	0.40***	0.28***	0.38***	

Note: ****p* < .001*;* TOT= tip-of-the-tongue.

2.3.5. Relationships with Participant Characteristics

To look at correlations between frequency of experience of these phenomena, we focussed on the number of experiences in the last year only, since we imagine that is the most stable estimate of the frequency of the phenomenon. Thus, we ran non-parametric Spearman correlations (Bonferroni corrected) between the yearly frequency of six phenomena, age, religiosity and spirituality. Age did not correlate with yearly frequency for any of the six experiences (all *ps >.05)*. Religiosity significantly

correlated with yearly frequency of déjà vu (rho = -0.27, *p*<.001), TOT (rho = -0.30, *p*<.001), error detection (rho = -0.15, *p*=.004), and zoning out (rho = -0.24, *p*<.001), such that the more religious people are, the less they experienced these phenomena. For spirituality, we found similar pattern for déjà vu (rho = -0.19, *p*<.001), TOT (rho = -0.21, *p*<.001), error detection (rho = -0.14, *p*=.015) and zoning out (rho = -0.15, *p*=.006), such that the more spiritual people are, the less they experienced these phenomena.

2.3.6. Cultural Differences

To explore whether there were cultural differences in frequency of these experiences, across nationality groups and religion, we again conducted repeated measure ANOVAs, adding a between subjects' factor for group. There was a significant main effect of nationality group on yearly frequency, F (2, 747) = 44.72, *p*<.001, partial eta squared = .11, with the Pakistani group reporting lower overall frequencies (mean frequency with standard error in parentheses) (France, 3.46 (0.09); Pakistan, 2.41 (0.09); Poland, 3.37(0.09)). Importantly, there was also a significant interaction between experience type and nationality groups, Greenhouse-Geisser corrected F (9.54, 3563.92) = 21.54, *p*<.001, partial eta squared = .06; such that there were differences in how frequently the three groups reported their experiences. Table 2.7 shows yearly frequency of the six experiences reported by nationality groups.

Similar to the analysis above where we need not add group as a factor, the marginal means (and standard error) across these six experiences suggest that in a year generally people had equal frequency of déjà vu (2.42(0.08)) and jamais vu (2.09(0.08)), 3 to 5 experiences; TOT (3.73(0.08)) 6 to 10 experiences; error detection (2.72(0.08)) and IAM (2.97(0.08)) 3 to 5 experiences; and zoning out (4.45(0.08)) 11 to 20 experiences.

Table 2.7

Cultural Differences in the Yearly Frequency of the Six Experiences

Variables	Déjà vu M(SD)	Jamais vu M(SD)	TOT M(SD)	Error detection M(SD)	IAM M(SD)	Zoning out M(SD)
Nationality						
France	3.23 (1.64)	2.57(1.92)	4.46(1.64)	2.82(1.90)	2.98(2.27)	5.06(1.70)
Pakistan	1.70(1.95)	2.03(2.17)	2.58(2.24)	2.43(2.12)	2.62(2.31)	3.47(2.58)
Poland	2.53(1.74)	1.85(1.88)	4.51(1.78)	3.09(1.82)	3.50(2.32)	5.13(1.91)
Religion						
Christianity	2.65(1.74)	1.83(1.84)	4.40(1.80)	2.95(1.86)	3.153(2.31)	4.99(1.84)
Islam	1.72(1.94)	2.04(2.16)	2.63(2.25)	2.44(2.14)	2.66(2.32)	3.52(2.58)
Others	2.84(1.78)	2.36(2.08)	4.40(1.76)	3.37(1.76)	3.48(2.39)	5.23(1.65)
Prefer not to say	2.88(1.73)	2.19(1.86)	4.61(1.69)	2.74(1.88)	3.33(2.28)	5.05(2.03)

Note: TOT = tip-of-the-tongue; IAM= involuntary autobiographical memory.

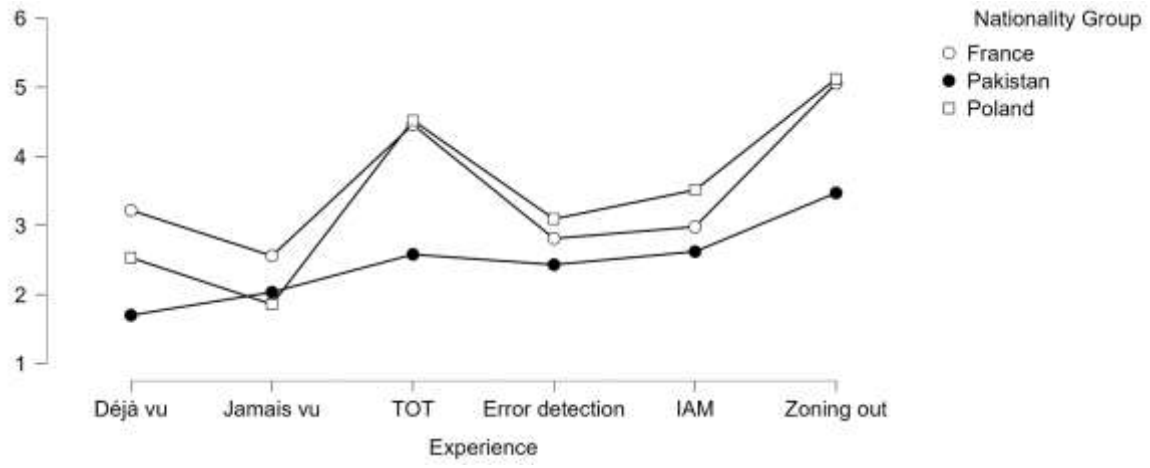
To look at the religious aspects and its association with the spontaneous metacognitive experiences, in our questionnaire we asked participants about their association with any specific religion by selecting one option from the following list: Christianity, Islam, Hinduism, Buddhism, Judaism, Sikhism, other or prefer not to say. To explore the religious group differences for yearly frequency of the six experiences, we excluded cases that were not enough in number to compare with other religious groups. Out of 860 participants, 368 associated with Islam, 186 with Christianity, 134 with Other and 87 participants chose ‘prefer not to say’. Only 3 participants associated

with Buddhism and 1 with Judaism, so we excluded those cases. 81 cases were missing, we assumed that they are among those who do not prefer to disclose their religion, so we included them in the category of “prefer not to say”. A repeated measures ANOVA showed significant main effect of types of religious group, F (3, 742) = 28.07, p<.001, partial eta squared = .10. A Greenhouse-Geisser corrected ANOVA showed significant interaction, F (14.19, 3508.99) = 10.89, p<.001, partial eta squared = .04; such that there were differences in how frequently the people with different religions experienced these phenomena. The frequency of experiences is given in Table 2.7. The marginal means showed that the Muslims reported fewer mean (and standard error) experiences in general (Christians, 3.18 (0.11); Muslims, 2.35 (0.09); Others, 3.47(0.12); those who preferred not to associate with any religion, 3.32(0.11)).

For more stringent analysis, we conducted another frequentist and Bayesian Repeated Measure ANOVA in JASP (80.18.3.0) to explore whether nationality or religion influence the yearly frequency of the six phenomena independently. In this larger model with more factors, nationality, showed a significant main effect (F (2, 740) = 3.57, p = .029, partial eta squared = .01), as well as significant interaction (F (9.53, 3525.71) = 6.39, p<.001, partial eta squared = .02; extreme evidence BF_{10}= $3.184x10^{+249}$). Whereas for religious group, results neither showed a significant main effect (F (3, 740) = 0.96, p = .411, partial eta squared = .004), nor a significant interaction (F (14.291, 3525.71) = 1.14, p = .314, partial eta squared = .005; extreme evidence BF_{10}= $3.655x10^{+235}$). This suggests that despite the high Bayes factor (BF), the effect size is extremely small, implying that the cultural differences are more likely to be due to nationality than religion, or at least it is difficult to disentangle the two.

Figure 2.1

Nationality Group differences in Experiencing the Six Spontaneous Cognitive Phenomena



Note: Experience values ranging from 0 to 7 (e.g. 0 = 0, 1 = 1-2, 2 =3-5, 3 = 6-10, 4 = 11-20, 5 = 21-50, 6 = 51-100 and 7 = more than 100)

2.3.7. Classification of Spontaneous Experiences

In our questionnaire, we asked participants to classify the six experiences in terms of duration, control, predictability, pleasantness/unpleasantness, and significance (see design and material above for details). We conducted binomial tests separately for all six phenomenon and set the test value to > 0.5 to see whether the specific proportion of participants was significantly greater than 50%. For more stringent analysis we only included the responses of participants who reported experiencing the respective phenomena. Table 2.8 presents the significant proportions of participants classifying the six experiences.

Table 2.8

Phenomenological Classification of The Six Experiences

Variables	Duration	Control	Onset	Pleasantness	Significance
Déjà vu	Brief 81%	No control 77%	Sudden 85%	-	Random 70%
Jamais vu	-	No control 64%	Sudden 61%	-	Random 58%
TOT	-	No control 73%	Sudden 67%	Unpleasant 86%	Random 67%
Error detection	Brief 68%	-	Sudden 68%	Unpleasant 64%	-
IAM	-	No control 62%	Sudden 62%	-	-
Zoning out	Long 65%	-	Gradual 56%	-	-

Note. TOT= tip-of-the-tongue; IAM= involuntary autobiographical memory.

The majority of participants (81%) classified déjà vu as a brief experience; without control (77% of participants); having sudden onset (85% participants); and being a random event (70% participants). For jamais vu, participants (64%) commonly described it as without control over; having sudden onset (61% participants); and being a random event (58% participants). For TOT, participants (64%) categorized it without

control; having sudden onset (67% participants); being an unpleasant experience (86% participants); and being a random event (67% participants).

For error detection, participants (68%) described it as a brief experience; having a sudden onset (68% participants); and as being an unpleasant experience (64% participants). For IAMs, participants (62%) categorized it as without control and having a sudden onset (62% participants). Finally, for zoning out, participants (65%) categorized it as a long sensation and with a gradual onset (56% participants).

2.3.8. Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) was used to explore the relationships between the yearly frequency of the six spontaneous experiences across spontaneous experience types. We specifically explored and compared two structures of interest. The first is a single factor explanation, where the yearly frequency of all the six spontaneous experiences all load onto a single factor of spontaneous thoughts. This factor structure would suggest that all the types of spontaneous experiences are related to each other in how frequently they occur. The second model tested was a two-factor explanation, where spontaneous experiences loaded onto metacognitive or non-metacognitive forms of spontaneous experiences. If this factor structure fits the data better, this would suggest that the frequency of spontaneous experiences is better represented when separating metacognitive and non-metacognitive forms of spontaneous experience. Thus, the frequency of one type of spontaneous experience is better represented in the context of its own type (e.g., metacognitive) compared to as a whole genre (e.g., overall spontaneous experiences). The same 860 participants used in prior analyses were used in this confirmatory factor analysis.

Analysis Plan. We conducted the analyses in three steps. First, we preformed preliminary data analysis, which included examination of distributional properties and univariate outliers of each item, multivariate outliers and bivariate relations. Second, we estimated two CFAs. We used Full Information Maximum Likelihood estimation with robust standard errors (Huber-White) to account for missing data and slightly non-normal distributions of the items. Third, we evaluated which model fit our data better and then used that model to perform measurement invariance testing to compare the fit of our factor structure across nationalities. This final analysis indicates if the relationships between all the six spontaneous experiences are similar across cultures.

We conducted a holistic evaluation and comparison of the models based on fit indices, factor loadings, and consistency with theory informed expectations. The following guidelines were used as indicators of good model fit to the data: root mean square error of approximation (RMSEA) below .06; standardized root mean square (SRMR) below 0.8; and comparative fit index (CFI) above .95 (Hu & Bentler, 1999; Kline, 2011).

We further conducted measurement invariance testing to test if the measurement model fit similarly (i.e., was invariant) based on participants' nationality. Testing for measurement equivalence involved examining three levels of invariance by adding constraints at each step (van de Schoot et al., 2012; Vandenberg & Lance, 2000). Configural invariance refers to whether the same structure (i.e., items loading onto factors) fits well for each group. Metric invariance refers to whether the corresponding factor loadings for an item on a factor are similar across groups (e.g., the item of jamais vu loads similarly onto a factor across nationality groups). Lastly, scalar invariance refers to whether the corresponding items intercepts (e.g., jamais vu) are similar across groups. At each step, we evaluated the change in the model fit by

examining if the CFI value of a model changed ≤ |.01| (Cheung & Rensvold, 2002; Putnick & Bornstein, 2016). If the change was less than the critical number, we determined that the model "passed" the test of invariance because the model with constraints fit similarly to the model without them.

Preliminary Analysis. Univariate analysis of yearly frequency (Table 2.9), including the evaluation of histograms and P-P plots, indicated if items were approximately normally distributed (skew < |1| and kurtosis < |3|; Fields, 2018). Four items have a skew greater than |1| and three items has a kurtosis greater than |3|. Three out of the four items with a skew greater than |1| also have extreme outliers (z-score > |3|), while the other items had no extreme outliers. Bivariate analyses (Table 2.6) showed all the items were linearly and positively correlated. Relationships were weakly to moderately correlated. No items were too highly correlated with each other. Investigation of outliers via Mahalanobis distances identified 37 participants that were considered extreme multivariate outliers (χ^2 = 15.09, df = 5, p = .01). Based on these data screening steps, we retained all items and responses.

Table 2.9

Items included in the Confirmatory Factor Analyses

Item	**Type of Spontaneous Experiences**	*N*	*M (SD)*	Skew	K
1	Déjà vu	825	12.22 (20.81)	2.68	7.01
2	Jamais vu	826	11.64 (22.08)	2.67	6.54
3	Tip-of-the-tongue	812	30.58 (34.06)	0.98	-0.52
4	Error Detection	833	16.90 (26.07)	2.05	3.17
5	Involuntary Autobiographical Memories	806	23.43 (33.09)	1.45	0.57
6	Zoning Out	814	45.13 (39.46)	0.28	-1.59

Evaluation of the Single Factor CFA. The single factor model fit the data well: RMSEA = 0.04 CI [.03,.06], SRMR = .03, CFI = 0.97. All factor loadings were statistically significant (Table 2.10). When evaluating potential local misfit in the model, there was a single standardized residual > |3|, suggesting that there was misfit in the model specifically in the estimation of the relationship of jamais vu and déjà vu. Furthermore, there were no suggested modification indices that were large enough (i.e., above 10) to meaningfully improve model fit.

Table 2.10

Factor Loadings from the single factor Confirmatory Factor Analysis

Factor	Item	Factor Loading	R^2
Spontaneous experiences	Déjà vu	0.45***	.20
	Jamais vu	0.45***	.20
	Tip-of-the-tongue	0.70***	.49
	Error detection	0.56***	.31
	Involuntary memories	0.58***	.34
	Zoning out	0.70***	.49

Note. ****p* < .001, [1]Factor loadings are standardized with respect to the observed item scores (std.all in R).

Evaluation of the Two Factor CFA. The two-factor model fit the data well: RMSEA = 0.03 CI [.02,.05], SRMR = .02, CFI = 0.98. All factor loadings were statistically significant (Table 2.11). When evaluating potential local misfit in the model, there was a single standardized residual > |3|, suggesting that there was misfit in the model specifically in the estimation of the relationship of jamais vu and déjà vu. There were once again no suggested modification indices that were large enough (i.e., above 10) to meaningfully improve model fit.

Table 2.11

Factor Loadings from the two factor Confirmatory Factor Analysis

Factor	Item	Factor Loading	R^2
Metacognitive	Déjà vu	0.46***	.21
	Jamais vu	0.46***	.22
	Tip-of-the-tongue	0.72***	.51
	Error detection	0.56***	.32
Non-Metacognitive	Involuntary memories	0.60***	.36
	Zoning out	0.75***	.55

Note. ***$p < .001$, [1]Factor loadings are standardized with respect to the observed item scores (std.all in R).

Model Comparison. We decided to retain the two-factor model given that the global model fit statistics indicated better fit in the two-factor model compared to the one facto model. Furthermore, when comparing the difference in chi-square statistics across the two models (Table 2.12), there is a significant difference between the models, suggesting that the fit of the two-factor model is significantly different from the fit of the one-factor model. When comparing the local fit between the two models, there seems to be no meaningful differences between the two. Thus, we opted to continue on with the two-factor model for evaluating measurement invariance.

Measurement Invariance Testing*.* Model fit indices from the tests of measurement invariance are shown in Table 2.12. The initial multigroup CFA fit the data well. The CFI value changed > |.01| when adding the first constraint. Accordingly, we concluded that the factor loadings between the groups were not similar to each other. This suggests that while the metacognitive and non-metacognitive factor structure fit the data of each nationality well, that there are differences between nationalities in the strengths of the individual items to the factors of spontaneous

metacognitive and non-metacognitive experiences. In the context of spontaneous experience frequency, this may suggest that the frequency of different metacognitive or non-metacognitive experiences differ across cultures.

Table 2.12

Model Fit for Measurement Invariance Tests by Nationality

Measurement Invariance by Nationality					
	Model Fit Statistics				
Model	X^2 (*df*)	CFI	ΔCFI	RMSEA	SRMR
Configural	26.01 (24)	.996		.02	.03
Metric	43.378 (32)	.979	.017	.04	.06

2.4. Discussion

In this large online survey study, we attempted to explore the understanding of people about the spontaneous metacognitive experiences and how frequently they experience these phenomena. We wanted to examine people's understanding of the terminologies and how that effects their experience and for this we looked for the differences in the experience incidence between "no definition" and "definition section". We proposed that without the definition if people are less sure about the studied phenomena then they will be more sure about them once they have the definition.

Results show that, without definition, almost half of the participants did not know how to respond to the incidence of jamais vu and error detection. We assume that this is because they did not understand the phenomena, hence could not report if they ever have had the experience. However, when participants received the definition of phenomena, noticeably incidence of the jamais vu and error detection increased, while proportion of participants reporting déjà vu and TOT slightly decreased. This is likely because people understood these metacognitive phenomena better with the definitions

and were more certain if they have ever experienced it. We assume that the pattern is complex with some people thinking that they have had experienced the phenomena only to find out that their experiences does not align with the provided definitions and other people who have had the experience but only realised it retrospectively once they learned the definitions.

Further results indicated that, the incidence of TOT, error detection and zoning out were high, each experienced by more than 85% people. Whereas 79% people reported experiencing déjà vu and IAMs and 67% reported jamais vu. These findings suggest that while some of the metacognitive phenomena are widely recognized and experienced, others may be less familiar and more challenging to identify. Further, spontaneous phenomena like TOT, error detection and zoning out are more common than déjà vu and IAMs, and jamais vu is more rare than all the other five experiences. This is in line with the previous literature asserting that TOT is more common than déjà vu (Schwartz & Metcalfe, 2011) and jamais vu is less common than déjà vu (Brown, 2004).

To estimate the frequency of spontaneous experiences in everyday life is challenging as they occur unpredictably and vary between individuals. Since it is difficult to get an exact count, researchers rely on estimating their relative frequency (Berntsen, 2021). For the yearly frequency of the experiences, results indicated that people experience zoning out, TOT and IAM experiences more frequently and each differ in occurrence. In a year, people tend to have 50 experiences of zoning out, 34 experiences of TOT state and 29 experiences of involuntary memories on average. Whereas, experiences like déjà v, jamais vu and error detection are less frequent than these three, with people experiencing between 15 to 19 experiences on average in a year. Similarly, in a week, people tend have zoning out experience and involuntary

memories more frequently than other experiences and both phenomena differ in occurrence. People experience 9 experiences of zoning out and 6 experiences of Involuntary memories on average in a week.

People experience déjà v, jamais vu, TOT and error detection less frequently, occurring between 2 to 4 experiences a week. The general pattern of these findings is consistent with previous research in terms of relative frequency, showing that IAMs and zoning out occur more frequently than déjà vu, jamais vu, TOTs and error detection. For example, previous research has estimated that people report 20 IAMs a day (Rasmussen & Berntsen, 2011), déjà vu about once a year (Brown, 2003), TOT approximately once a week (Schwartz & Metcalfe, 2011) and jamais vu about once a week (as reported by five people in a study) (Ardila et al., 1993).

In our study we proposed that the frequency of six spontaneous cognitive experiences is related to each other, that is, the more frequently you experience one, the more frequently you will experience others as well. Results showed that if a person experience spontaneous metacognitive experiences like déjà vu, jamais vu, TOT and error detection, the person is also likely to experience spontaneous thoughts like IAM and zoning out. This is in line with the literature and a number of these correlations have been attempted in previous research, and so we replicated those findings. Research has shown previously an association between some of these different types of these seemingly different experiences such as between jamais vu and déjà vu (Moulin et al., 2022), déjà vu and tip-of-the-tongue and even déjà vu and involuntary memories in older adults (Moulin et al., 2014).

Moreover, studies have shown that with age, experiences like déjà vu decreases (Aitken et al., 2023; Fortier and Moulin, 2015; Wells et al., 2021) and TOT increases (Salthouse & Mandell, 2013). However, in this study, we did not find an

association between age and the six spontaneous phenomena. One possible reason for not finding age related differences could be the nature of our sample, which consisted of young adults (university students). This relatively homogenous and age restricted group may not provide sufficient variability to identify age related trends. Thus, it is important to take this limitation into consideration when interpreting the results, and future studies should aim to include diverse age range to explore age pattern in such experiences more thoroughly. Additionally, we wanted to explore any associated religious and/or spiritual aspects with six cognitive phenomena. We hypothesized that individuals who are more religious and/or spiritual would experience these phenomena more frequently. However, our results indicated that the more religious or spiritual a person is, the less they are likely to experience metacognitive experiences (like déjà vu, TOT and error detection) and spontaneous thoughts (like zoning out). This aligns with the previous findings showing that while formal religious affiliation is not strongly associated with déjà vu frequency (McClenon, 1994; Palmer, 1979; Fox, 1992), individuals identifying as religious fundamentalists tend to report fewer déjà vu experiences than those with moderate or liberal beliefs (Cleary & Brown, 2022).

Another aim of the study was to determine how people classify and describe these six spontaneous cognitive experiences. We proposed that even though not all the phenomena are metacognitive, however, all the six experiences should be somewhat automatic, surprising and short-lived, capturing a common form of reflection on the cognitive system and that they may be grouped together meaningfully. People classified five of the cognitive experiences, that is, déjà vu, jamais vu, TOT, error detection and involuntary memories, as having sudden onset. This suggests that these experiences are spontaneous and one cannot predict the probability of experiencing

them in any particular situation. Similarly, people classified déjà vu, jamais vu, TOT and involuntary memories as having no control over it, meaning one cannot decide to have or avoid them intentionally. Further, people described déjà vu, jamais vu, and TOT as a random experience in life. Déjà vu and error detection were described as brief experiences, suggesting these types of metacognitive experiences are short-lived. TOT and error detection were deemed unpleasant. People described zoning out as long sensation with gradual onset. In sum, these cognitive experiences indeed seem to share common characteristics and people consider them as unintentional and spontaneous. This is in line with the literature asserting that phenomena like déjà vu, jamais vu, TOT, and IAM occur spontaneously in daily life (see Metcalfe & Schwartz, 2016; Moulin et al., 2022; Barzykowski & Moulin, 2023).

In our data (and literature) these metacognitive experiences and spontaneous thoughts correlate with each other and share certain similar characteristics such as spontaneity, short duration and lack control. We were further interested to explore if the relationship between these six spontaneous experiences is better represented by grouping together all experiences under one “spontaneous experiences” factor (a single factor model) or by separating them into metacognitive and non-metacognitive experiences (two-factor model). Confirmatory factorial analysis (CFA) indicated that both models fit the data well, however, two-factor model, with experiences loading onto either a metacognitive or non-metacognitive factor, demonstrated a significantly better fit (RMSEA = 0.03, SRMR = .02, CFI = 0.98) compared to the one-factor model (RMSEA = 0.04, SRMR = .03, CFI = 0.97). This suggests that the frequency with which people experience these spontaneous cognitive phenomena is better represented by categorizing these experiences as metacognitive and non-metacognitive experiences.

The categorization of experiences provides more accurate representation of data, reflecting distinct, yet interrelated, types of spontaneous experiences.

Further we found that there are cultural differences in experiencing these phenomena. Participants from Pakistan are less likely to experience these six phenomena than France and Poland. Pakistan reported low incidence (see Annex I for detailed chai square analyses) and frequency of these phenomena. Moreover, measurement invariance testing showed differences in factor loading across the nationalities, indicating that while the overall factor structure is generally consistent across the groups, the strength of association of certain experiences (metacognitive and non-metacognitive) differs culturally. In other words, the frequency of spontaneous metacognitive experiences and spontaneous thoughts differ across the culture. This suggests that cultural background may influence how people experience and perceive metacognitive experiences and spontaneous thoughts.

To determine if the cultural differences observed in the current study are due to nationalities or religion, we conducted frequentist and Bayesian Repeated Measure ANOVA. The results showed that nationality seems to have more influence than religion and although Pakistan experience these phenomena less frequently and differently than France and Poland (see Figure 2.1), there were no differences in the pattern of experiencing. The Bayes Factor was high for all the interactions (for both nationality and religion) but the effect size was extremely small to determine the true differences.

In order to understand our cognitive processes more deeply, it is important to consider how cultural context shapes our cognitive functioning (Thomas, 2023). Moulin et al., (2014) argue that decline in déjà vu reporting over the lifespan could also reflect shifts in conceptual familiarity or cultural framing, rather than solely cognitive changes.

It is possible that fewer déjà vu experiences reported by older adults are not because the experience itself diminishes, but because they are less familiar with, or less comfortable with the concept itself. Cleary and Brown (2022) further argue, even when spontaneous metacognitive experiences such as déjà vu occur, a lack of conceptual familiarity or an established cultural label may influence whether people notice, recall or accurately report it. While these phenomena are theorised to be universal, due to conceptual unfamiliarity, people may overlook or misinterpret their own experiences. Naturally, if a person is not familiar with certain phenomena, they cannot keep a tally of one's infrequent mental experiences. So, if it's truly due to the unfamiliarity with phenomena, then future studies could explore this difference by conducting longitudinal research across different cultures perhaps. Where participants can learn the definition and weeks or months later can be asked to report the frequency of the experiences.

The data for this study were collected from France, Pakistan and Poland, with the majority of Muslim participants from Pakistan, while France and Poland comprised the other religious groups. It seems that overall pattern is driven by the Pakistani Muslim group and it largely contributed in influencing differences of experiencing the phenomena. This might explain why Muslims experience these phenomena less frequently than Christians and people of other religions. Even though questionnaire research (Fortier & Moulin, 2015) has shown differences in déjà vu between French speaking and English-speaking respondents; likely to be due to how people interpret the definition of the experience. This group imbalance in our study precluded an exploration of language-based differences in experiences.

To identify the cultural differences due to religion and/or language, in experiencing these metacognitive phenomena, future research should aim for the

balanced samples of religious and language groups across cultures. Nevertheless, our results do indicate significant cultural differences. Chi-square tests showed that overall Pakistan reported lower incidence of these experiences even after knowing the definitions of phenomena. As expected, there were not many differences in the incidence and frequency of these phenomena in cultures like France and Poland.

As discussed earlier, studies emphasize that cultural background shape how we perceive and categorize information, and also influence whether we rely on top-down (use of prior knowledge) or bottom-up (sensory knowledge) processing. For instance, Masuda and Nisbett (2001) suggest that western cultures often emphasize individual objects and their attributes, while eastern cultures use holistic approach, focusing more on the context and its relationship. This difference is also evident in categorization, with western cultures preferring taxonomic categories (grouping by shared characteristics) and eastern cultures emphasizing on functional relationships (Ji et al., 2004). In other words, some cultures (such as eastern) focuse on a holistic approach, considering background, whereas other cultures (such as western) focuses more on analytical approach, separating objects from their context (Ji et al., 2001). Thus exploring cultural differences in cognition by considering top-down and bottom-up process could provide a useful framework to examine varying life experiences across different cultures and also identify the types of cognitive process that can be shaped by culture and the level at which cultural differences might emerge in terms of processes and brain systems (Gutchess & Gilliam, 2022).

Building on these cultural cognitive frameworks, we can assume that individuals from holistic culture may experience and describe their spontaneous metacognitive experiences embedded within broader contextual awareness. On the other hand, individuals from analytical cultural traditions may isolate such experiences without

connecting it to broader or emotional context. Moreover, cultures emphasizing top-down processing may interpret such experiences through established beliefs (e.g., spiritual interpretation of déjà vu), while bottom up cultures may experience such phenomena as surprising or anomalous without immediate interpretation. There is a possibility that these differences in cognitive style could influence not only the frequency with which spontaneous phenomena are recognised and reported but also the qualitative nature of how they are described. Studies emphasize that although metacognitive feelings such as feeling of familiarity and tip-of-the-tongue experience appear universal, cultural patterns and shared exposure can influence their occurrences and interpretation. For instance, different cultures foster feelings of fluency through common rituals, objects, and beliefs, which may shape how metacognitive phenomena are subjectively experienced and socially shared (Reber & Norenzayan, 2012; Schwarz, 2018; Proust & Fortier, 2022)

Another goal of this study was to verify the definitions of six spontaneous cognitive experiences and it's understanding in our questionnaire. Research on spontaneous metacognition is challenged by the need for consensual definitions of nuanced experiences, enabling accurate comparisons of the phenomena across different cultures, age groups, and languages (Thomas, 2023). To ensure the understanding and agreement with the definition of six experiences provided in our questionnaire, we asked participants to indicate their agreement level with the definitions. People agreeing to great extent with the definition of experiences provided in the questionnaire offers most consensual and accurate estimate of these experiences. Moreover, in our questionnaire we asked participants' own descriptions of these experiences in daily life. Summarising such descriptive qualitative data is often

complex and prone to experimenter bias, therefore we used large language model to analyse this data and validate definitions (see Chapter 3 for details).

2.5. Conclusion

Our findings reveal that spontaneous metacognitive experiences, like déjà vu, jamais vu, TOT, error detection, are associated with spontaneous thoughts, like involuntary memories and zoning out. The more person experiences one phenomenon, the higher are the chances to experience others as well. Furthermore, these cognitive experiences share common characteristics including spontaneity, brief duration and lack of control. We further found cultural differences in experiencing these phenomena and culture like Pakistan experiences low incidence and frequency of these six phenomena compared to France and Poland. Additionally, how people described and reported these experiences varied across different linguistic and cultural groups, notably the incidence reporting of jamais vu increased when participants received the definition. Therefore, we propose that future research should use consensus definitions of these subjective experiences. Cognitive researchers should also explore the cultural factors that may contribute in shaping such experiences. Considering both cultural and methodological variability is essential for a comprehensive understanding of spontaneous cognitive phenomena and the cognitive processes that underlie them, particularly those related to metacognition.

Chapter 3

What Does AI Make of Spontaneous Metacognition? Talking to ChatGPT About Jamais Vu

In large-online survey we collected descriptions of the six phenomena from a reasonably large sample (n=860) across three countries (Poland, France, and Pakistan – see Chapter 2). In the survey we requested participants to share their experiences related to the phenomena. Participants were not obliged to give a written example of the experience, and not everyone chose to do so. In this Chapter we tested if AI models like ChatGPT could be useful in analysing a large qualitative dataset, particularly classifying subjective metacognitive experiences.

3.1. Introduction

ChatGPT, released by Open-AI in November 2022, is based on "generative pre-trained transformer" (GPT) language model technology (Kirmani, 2022) - a specific structure of neural networks. This model is trained on 175 billion parameters to generate responses closely similar to human language (MacNeil et al., 2022). It also integrates human feedback into its system, by responding to user questions and conversations without the need of specific prompts (Andrews et al., 2023). Its abilities extend from addressing simple inquiries to facilitating complex discussions in near-human language (Liu et al., 2021). As ChatGPT is capable of producing response text that is nearly indistinguishable from natural human language (Dale, 2021), in this Chapter we aimed to investigate its potential to analyse subjective human experiences, specifically spontaneous metacognitive experiences. One outcome of it being used successfully in this way would be to incorporate it into an automated, labour-saving, qualitative analysis workflow for the exploration of metacognitive experiences (for examples of qualitative analysis carried out by ChatGPT see Siiman, 2023; Jalali & Akhavan, 2024).

Our reasoning was that ChatGPT's extensive training renders it useful to researchers for classifying and verifying subjective reports based on a synthesis of extant knowledge and language use. Recent studies have explored ChatGPT's proficiency in various domains, including medical, and neuropsychology. For instance, Balas and Ing (2023) conducted a study comparing the provisional and differential diagnosis accuracy of ChatGPT and ISABEL (Pro Differential Diagnosis Generator – a successful and well-known electronic diagnostic support tool for both adult and pediatric conditions since 2006). They found that conversational AI models like ChatGPT have the potential to assist frontline healthcare workers by providing timely and accurate diagnoses.

Another study by Loconte et al. (2023) tested if ChatGPT could mimic human intelligence. They conducted a neuropsychological evaluation of ChatGPT's behavioural performance by administering standard tests used to evaluate cognitive functioning in humans. Results showed that ChatGPT excelled in generative linguistic tasks, however, its performance varied significantly in prefrontal tests, particularly in tasks related to planning, recognising semantic incongruities and understanding the intentions and mental states of others. While LLMs have demonstrated high accuracy in medical diagnostic studies (Hirosawa et al., 2023; Delsoz et al., 2023; Johnson et al., 2023), few recent studies have highlighted that their performance in intelligence-related tasks (including planning; Valmeekam et al., 2022; common-sense reasoning; Klein & Nabi, 2019; metaphor understanding; Prystawski et al., 2022) is less accurate. For a cognitive researcher looking at subjective experiences, it is interesting that ChatGPT has weaknesses in responding to questions about the mental states of others, which we might expect is related to the fact that it does not have its own mental state. One view of metacognition is that it is achieved by directing the sorts of

processing concerning others' mental states inward to consider our own mental state (Proust, 2012). This is evident in neuropsychological populations in which the relationship between metacognition and understanding mental states has been explored (e.g., Jiang et al., 2022; Carruthers, 2009).

Unlike the above research which evaluates the utility or functioning of ChatGPT, our study focused on how it responds to and categorises accounts of experiences gathered from human participants. The goal was to establish a more objective and replicable view of the description and categorisation of the six phenomena with the help of ChatGPT. In other words, we intended to investigate how ChatGPT categorises these phenomena and gain insight into people's general perceptions and qualitative descriptions of these six phenomena. If ChatGPT were able to use the descriptions given by participants in response to given experience labels such as 'déjà vu' and recover the initial term used, it would tell us that the subjective description of the experience produced in our questionnaire and the total of human experience captured in ChatGPT converged on the same concept.

There is a growing literature on ChatGPT's use in qualitative data analysis. Researches have shown that ChatGPT can analyse and interpret interview-based datasets, generate codes, identify themes and categories (Sen et al., 2023). Meaningful results can be achieved with proper prompts (Morgan, 2023; Mesec, 2023). For example, Morgan (2023) re-analysed a dataset from 24 undergraduates taking part in exchanges in six focus groups discussing their experience of university and compared the results from ChatGPT to a standard qualitative analysis (Reflexive Thematic Analysis; Braun & Clarke, 2022). Morgan concluded that ChatGPT performed 'reasonably well' and noted that it was less capable of identifying subtle, interpretive themes but that it was more successful at reproducing concrete,

descriptive themes. Other research describing human and ChatGPT analyses of the same qualitative dataset with the same conclusion is provided by Wachinger et al., (2024).

In sum, one challenge in researching spontaneous metacognition is to have consensual definitions of hard-to-describe experiences which can permit sensible comparisons of the phenomena across different cultures, age groups, and languages (Thomas, 2023). To address this, we often ask participants to generate descriptions of their experiences in daily life, but summarising such descriptive qualitative data is laborious and prone to experimenter bias. One promising solution would be to use large language models to exploit this data, which is something we report here. In this study, we examined spontaneous metacognitive experiences (including déjà vu, jamais vu, TOT and error detection), as well as spontaneous thoughts (such as IAMs and zoning out), based on the subjective description of each phenomenon. See Table 1.1, in Chapter 1, for definitions of the phenomena which are the topic of study of this study from the scientific literature.

In this study, the descriptions we used were our raw data for all the experimental trials (for examples see Table 3.1). We begin by presenting an example proof of concept analysis of the déjà vu and jamais vu experiences as described in these data (Experiment 1). Because this analysis raised questions about how well ChatGPT is able to categorise jamais vu, we were motivated to design an experiment to examine exactly this. Experiment 2 reports a preliminary experiment where we laboriously entered information into the ChatGPT as if we were questioning a human participant, and in Experiment 3 we ran multiple classifications of the experiences uploaded as a batch into ChatGPT and compared the responses to a sample of data from human participants.

Table 3.1

Few Examples of Raw French and English Data/Description of Six Phenomena

Phenomena	Raw Descriptions
Déjà vu	*"Il m'arrive parfois d'avoir l'impression d'avoir déjà connus certains lieux ou personnes, mais c'est très rare. C'est une sensation très particulière ! comme si on avait été dans une autre dimension par le passé"* *"I was talking with my friend about going to cafe i thought i went their before but when we reach cafe i came to know that it was only my own thoughts I never went to that place before."*
Jamais vu	*"Cela m'arrive lorsque je porte particulière attention à l'orthographe de certains mots que j'écris normalement automatiquement. Alors cet orthographe me paraît bizarre et je le remets en question"* *"I saw my friend writing a word during lecture i thought she was spelling it wrong but it was correct that's how i experienced that."*
Tip-of-the-tongue (TOT)	*"On parlait de l'étude des minéraux et je ne retrouvais plus le terme "géologie", ça m'a beaucoup frustré parce que je pouvais quasiment mes rappeler de tous les cours que j'ai eu là dessus mais pas du mot.."* *"It happens so many times I knew about things but I forgot an appropriate word to call them. And it happens most of the days."*
Error Detection	*"C'est quelque chose de très stressant car nous prenons conscience de cette erreur que trop tard et que la personne ayant reçu le SMS ou autre l'ait sûrement déjà lu, rejoute encore plus de stresse puisque c'est quelque chose qui ne lui était pas destiné."* *"I was suppose to send a message to my brother to help one of my friend but I accidentally sent the message to the same friend which I was asking help for. It made me feel ashamed, quite low and embarrassed."*

Involuntary autobiographical memory (IAM)	*“ça m'arrive rarement mais c'est en général souvent un souvenir que j'avais oublié, ou du moins auquel je n'avais plus pensé depuis longtemps, et sur le coup ça me fait bizarre”* *“I was sitting to study. Suddenly I remember my college days and friends. I was not remembering it but it was just a sudden thought come into my mind.”*
Zoning out	*“Cela arrive très souvent par exemple lors de la relecture de cours j'ai comme l'impression d'avoir des absences puis vient le moment de lucidité ou je sursaute et me rend compte que je n'étais plus concentrée”* *“It feels like you're thinking about a lot of things all at once but when you try to track your thoughts, they all disappear like you weren't thinking of anything at all.”*

3.2. Experiment 1 (ChatGPT 4.0)

3.2.1. ChatGPT Analysis of Descriptions of Déjà Vu and Jamais Vu

In the first phase, we asked ChatGPT (4.0) to describe the experiences of 121 qualitative descriptions of déjà vu from the French-speaking respondents of our questionnaire. We fed the raw data of the déjà vu experiences in the French, all at once, into ChatGPT and asked it to describe what the participants were experiencing (note that in participants’ descriptions, many of the responses would have included the word déjà vu). ChatGPT, as expected, identified the experience as déjà vu and added an appropriate definition: “*This phenomenon is characterized by the eerie and confusing feeling that one has lived through the present situation before. People often describe it as an overwhelming sense of familiarity with something that shouldn't be familiar at all, such as a conversation, a place, or an event. They often struggle to determine whether they have actually experienced the situation before or if it's a trick of the mind, possibly related to dreams or fleeting memories. This sense of déjà vu can occur spontaneously and is typically brief, but it can leave a strong impression of*

having "already seen" or "already lived through" the situation, even when logic says otherwise."

When asked if there were any statements which did not seem like déjà vu, it identified three types of experiences where the descriptions differed from typical reports of déjà vu: “Dream-like experiences and lucid dreams”, “Premonitory feelings or predictions” and “Extended or complex experiences”. Respectively, ChatGPT reported that these experiences were mentioned 15%, 10% and 5% of the time, with 70% of the experiences thus being typical déjà vu.

In our original questionnaire (see Chapter 2), we asked participants to describe their metacognitive experiences on a series of dichotomies (for instance reporting whether it was a brief or a long sensation), and we asked ChatGPT to carry out a similar classification, where it categorized the experiences based on the same dichotomies. Human participants (and ChatGPT in parenthesis) described déjà vu accordingly as a brief sensation 81% of the time (ChatGPT 80%); as having no control over it 77% of the time (90%); as being a pleasant experience 41% of the time (40%); as having a sudden onset 85% of the time (85%) and it being a random event 70% of the time (70%). Note that this is not a circular argument: we never presented this aspect of the data to ChatGPT, nor is this data yet in the public domain. The level of correspondence between ChatGPT and human classification was strikingly high. The ChatGPT’s responses are based on a combination of specific description in the prompt and a small, experientially relevant proportion of the vast data on which it has been trained. The ability of ChatGPT to classify these experiences, identify notable subcategories (such as prescience; Cleary et al., 2021; dream-like states; Curot et al. 2021) and to report similar classifications as the human participants based on an analysis of the text in the example descriptions is reassuring and confirms that

participants, ChatGPT and researchers of this study operationalise classification of déjà vu in similar ways. Future research should explore more closely the relationship between prescience and déjà vu for example (Curot et al., 2021).

A more stringent test would be to try the same thing but without having the circularity of the descriptions sometimes including the name of the experience that the person is describing. Thus, in a second phase, we gave ChatGPT 4.0 a subset of 58 of the same descriptions to describe what the experience was, but in this phase, the descriptions didn't include the word déjà vu. ChatGPT was still able to describe and define the experiences as déjà vu. In the third phase, we conducted the same analysis using a sample of 130 descriptions collected in English with the same prompts, and ChatGPT again classified the experiences as déjà vu.

Less is known about the experience of jamais vu, hence, we were motivated to carry out the same analysis with the examples of jamais vu statements. From our questionnaire, we had 87 statements in French that described jamais vu experiences. ChatGPT summarised these experiences as follows: "*The experiences described by various individuals in the document you've shown are generally related to the phenomenon of "jamais vu." This is a psychological phenomenon in which familiar things feel suddenly strange or unfamiliar. It contrasts with "déjà vu," where new situations feel unnervingly familiar."*

"*In the statements, people reported moments when words (often ones they regularly use) appeared strange or felt as if they were spelled incorrectly, even though they were correct. This often led to a sense of doubt and confusion. Some individuals felt this particularly strongly with names or common words, describing a sudden estrangement from the words' meanings and spellings.*" To our question asking whether any experiences described were not jamais vu, ChatGPT listed three specific

examples. It identified these cases because they were not the typical linguistic forms of jamais vu seen in most examples, but it did not make conceptual categories as it did in the earlier déjà vu analysis. For example, for the very typical experience of jamais vu given in the quote, "*À force de répéter un mot, ou à force de voir un visage, j'ai l'impression que ce mot/visage devient bizarre, comme s'il n'existait pas*," ChatGPT described the experience as '*an aspect of jamais vu (with the word) but also extends to a visual perception involving a face, which might indicate a broader perceptual or existential questioning beyond language*'. ChatGPT stated that approximately 85% of the experiences described are 'primarily linguistic, focusing on words and names' with 15% of the cases involving non-linguistic elements, such as places or faces. Naturally, this would be something to follow up on in future research, to consider the differences between linguistic and non-linguistic jamais vu.

With 134 statements in English, ChatGPT again identified the descriptions as jamais vu (note that only in one instance someone used the phrase 'jamais vu' in their description), but it did not spontaneously identify any differences between linguistic and non-linguistic forms, instead, it said that some of the statements were merely referring to forgetting: ""*I am a student and lives in hostel and went home after 3-4 months. My sister showed me a thing that I already knew we had at home but I didn't remember although I knew so I felt that it was jamias vu* [sic]*" - While this mentions a form of forgetfulness, it seems more related to simply not remembering an item, which might not fit the typical definition of jamais vu*."

The human participants (and ChatGPT in parentheses) described jamais vu accordingly as a brief sensation 56% of the time (ChatGPT 90%); as having no control over it 64% of the time (95%); as being a pleasant experience 11% of the time (20%); as having a sudden onset 61% of the time (95%) and it being a random event 58% of

the time (90%). The similarity between the human and ChatGPT responses is less impressive than in the déjà vu example above. Additionally, ChatGPT seems to have a restricted view of jamais vu as being primarily a linguistic concept. This motivated us to examine how well ChatGPT could classify jamais vu specifically. We hypothesise that due to a lack of developed scientific literature, it struggles to classify and describe these experiences, and to this end, we gave ChatGPT a series of questionnaires which we developed in parallel to be conducted by a modest sample of human participants. Our primary aim was to develop an idea of the extent to which ChatGPT can be relied on as an analytic tool for the classification of spontaneous cognitive experiences.

Table 3.2

Categorisation of Metacognitive experiences by Human Participants and ChatGPT

Variables	Brief duration	No control	Sudden onset	Pleasant experience	Random experience
Déjà vu					
Human participants (Chapter 1)	81%	77%	85%	41%	70%
ChatGPT 4.0	80%	90%	85%	40%	70%
Jamais vu					
Human participants (Chapter 1)	56%	64%	61%	11%	58%
ChatGPT 4.0	90%	95%	95%	20%	90%

3.3. Experiment 2 (ChatGPT 3.5)

In this experiment, ChatGPT was tested twice using a procedure we developed to test the reliability of the qualitative statements, that we had tested on human participants (see experiment 3 below). In this task, the qualitative descriptions of spontaneous cognitive experiences were presented to participants and then, they were asked to classify them as one of the six original experiences. The idea was to test ChatGPT exactly as we would a human participant on the entirety of our procedure. If ChatGPT (or human participants) identified correctly the experience being described then we should see some form of consensus in the 'back classification' of the descriptions: an experience described within the context of questions about déjà vu in the original experiment, should be defined as déjà vu by ChatGPT (or a human participant).

3.4. Method

3.4.1. Participants and Materials

ChatGPT version 3.5, tested in June 2023. A total of 632 qualitative descriptions were received from French-speaking respondents (121 déjà vu, 87 jamais vu, 122 TOT, 98 error detection, 81 IAM and 123 zoning out) and 952 descriptions from English-speaking respondents (130 déjà vu, 134 jamais vu, 163 TOT, 186 error detection, 164 IAM and 175 zoning out). 60 descriptions each in French and English, were selected from the original questionnaire. Raw descriptions related to these six phenomena were examined individually. Statements containing keywords, such as déjà vu, jamais vu, tip-of-the-tongue, error detection, involuntary autobiographical memory and zoning out, were excluded from the analysis to avoid providing obvious cues for classification. Similarly, English language responses to French prompts were also excluded (there were no French language responses to English prompts). Once we had twenty statements (excluding the mentioned keywords) efforts were made to choose ten for

each of the six experiences, by aiming for an equal word count in each case. The mean word count of French statements for all six experiences was similar, with values as follows: déjà vu (233.8), TOT (240.1), jamais vu (237.1), IAM (236.3), error detection (241.8), and zoning out (240.6). Similarly, the mean word count of English statements was as follows: déjà vu (183.1), TOT (182.4), jamais vu (182), IAM (181), error detection (183.4), and zoning out (180.7). Note that only French participants were tested with French data. The purpose of this procedure was to objectively obtain ten descriptions of each six phenomena for classification analysis. These descriptions were used for all of the following tasks, including our online questionnaire with human participants (see experiment 3 below).

3.4.2. General Procedure

For each trial with ChatGPT, a new chat was created, the task was exactly similar to what we carried out with human participants. In experiment 2, ChatGPT was tested in French, and each question and description of experiences was entered at a new prompt. The task began with providing the definition and an example of each phenomenon and in turn, ChatGPT was questioned on its potential experiences and the related frequencies of six spontaneous phenomena. Note that participants in the large online questionnaire (Chapter 1) often based their descriptions on the examples provided within each definition of the experiences. To avoid this kind of bias response and reduce the obvious cues, we slightly modified the examples in the definitions used for all the experiments and testing in this chapter (see Annex IV for precise examples and definitions used in French). LLMs like ChatGPT cannot experiences these phenomena, we still asked ChatGPT about them to understand how it processes its training data and generates relevant responses. Thus, if ChatGPT reported having

ever experienced one of the phenomena, it was asked about the frequency with which it experienced the phenomenon in the last year (see Box 1 for details and examples).

After that, we fed 60 descriptions of six phenomena, with ten for each phenomenon and ten additional control statements to ChatGPT (see Annex IV for all 70 French descriptions and 70 English descriptions). ChatGPT was instructed to read these 70 descriptions and to classify them as either déjà vu, jamais vu, TOT, error detection, IAM, zoning out or other. Lastly, ChatGPT was asked to evaluate all six phenomena in terms of control, spontaneity, awareness and reliability, using a Likert-type scale ranging from 0 to 4 (0 being “not at all” and 4 being “completely”). For example, (i) “In your opinion, how much control do you have over these phenomena (e.g. triggering them, stopping them, maintaining them, etc.)?”, (ii) “In your opinion, how spontaneous (unintentional) are these phenomena?”, (iii) “In your opinion, during these phenomena, to what extent are you aware of your own thought processes?”, and (iv) “How reliable do you consider your own thought processes to be during these phenomena?”.

Due to an experimental oversight, unlike with the human participants where the statements were presented in a pseudorandom order, in one testing the statements were presented in a blocked design, grouping together each phenomenon. We were concerned that the blocked nature of the presentation of items may have helped ChatGPT classify the experiences, or even add a bias for certain experiences. Therefore, we conducted another test with ChatGPT, randomised the order of 70 descriptions and again asked ChatGPT to classify them.

3.4.3. Results and Discussion

For incidence and frequency section of the questionnaire, ChatGPT said yes to experiencing jamais vu, TOT, error detection, IAM and zoning out and also provided the frequencies of the experiencing phenomena in the past year. In a year, ChatGPT reported 3 to 5 experiences of jamais vu, 6 to 10 experiences of TOT states, 3 to 5 experiences of error detection, 11 to 20 experiences of IAMs and 11 to 20 experiences of zoning out. The frequency provided by the ChatGPT in this testing corresponded to some extent to the frequencies reported by the French participants in Experiment 3 (see the result and discussion section of Experiment 3). As LLM, ChatGPT should lack subjective experiences, of course it does not actually experience these phenomena and does not experience “a year” either. It seems that ChatGPT’s response was based on its understanding of the provided information. This is evident in the later testing where ChatGPT said no to experiencing any of the six phenomena and further stated that as an AI language model, it lacks personal sensations or experiences, rendering it incapable of experiencing such phenomenon.

For the classification of subjective descriptions, we fed 70 descriptions to ChatGPT once in a blocked order and once in a random order. ChatGPT was asked to categorise those descriptions by choosing one option from the list of seven experiences, i.e., déjà vu, jamais vu, TOT, error detection, IAM, zoning out or other. Figure 3.1 shows that ChatGPT correctly classified all the TOT-related descriptions (with an accuracy rate of 100%). It was mostly good at classifying descriptions of déjà vu (with 85% accuracy) and error detection (with 75% accuracy), however, it inaccurately classified a few of those statements as jamais vu and zoning out. Similarly, ChatGPT classified IAM and zoning out statements with 78% accuracy but confused some IAM descriptions with déjà vu and zoning out. Subsequently, ChatGPT

mislabelled some zoning out statements as déjà vu and other. Furthermore, ChatGPT failed to recover the correct label for jamais vu descriptions (with only 5% accuracy) and control statements (with only 15% accuracy) and confused them with other experiences.

We used signal detection theory to analyse the data and evaluate ChatGPT's performance in classifying the descriptions. The detailed analysis is shown in Table 3.5, the *d'* value represents the sensitivity, high value indicates better performance in recovering original labels. The *c* value represents the signal detection parameter of response bias. Positive values refer to conservative bias, negative values indicate a liberal bias and zero is unbiased. As described above, ChatGPT seems to show high accuracy in the categorization of TOT statements (with *d'*=4.35) but is also likely to have liberal response bias (with *c*=-0.91), indicating that ChatGPT has a high false alarm rate for TOTs, that is, ChatGPT is more likely to categorize no-TOT descriptions as TOT descriptions. Subsequently, ChatGPT showed the lowest accuracy in the categorization of jamais vu (with *d'*=0.47) and control statements (with *d'*=1.35) and exhibited conservative response bias, indicating a greater tendency towards missing jamais vu (with *c*=1.88) and control statements (with *c*=1.71), meaning that ChatGPT is less likely to recover correct labels for jamais vu or control statements.

In several instances (4.3% of the time), despite repeated attempts to prompt ChatGPT to choose only one from the provided list, it selected multiple options. For example, a jamais vu description in the quote "*Hearing the word 'wheelbarrow', repeating it to myself and then the more I repeat it to myself, the more the word seems wrong. It makes you feel strange, you wonder if it really exists, if you've got the wrong letter or sound inside the word",* ChatGPT classified it as "error detection" or "TOT" and provided the following explanation: *"The experience you describe is often associated*

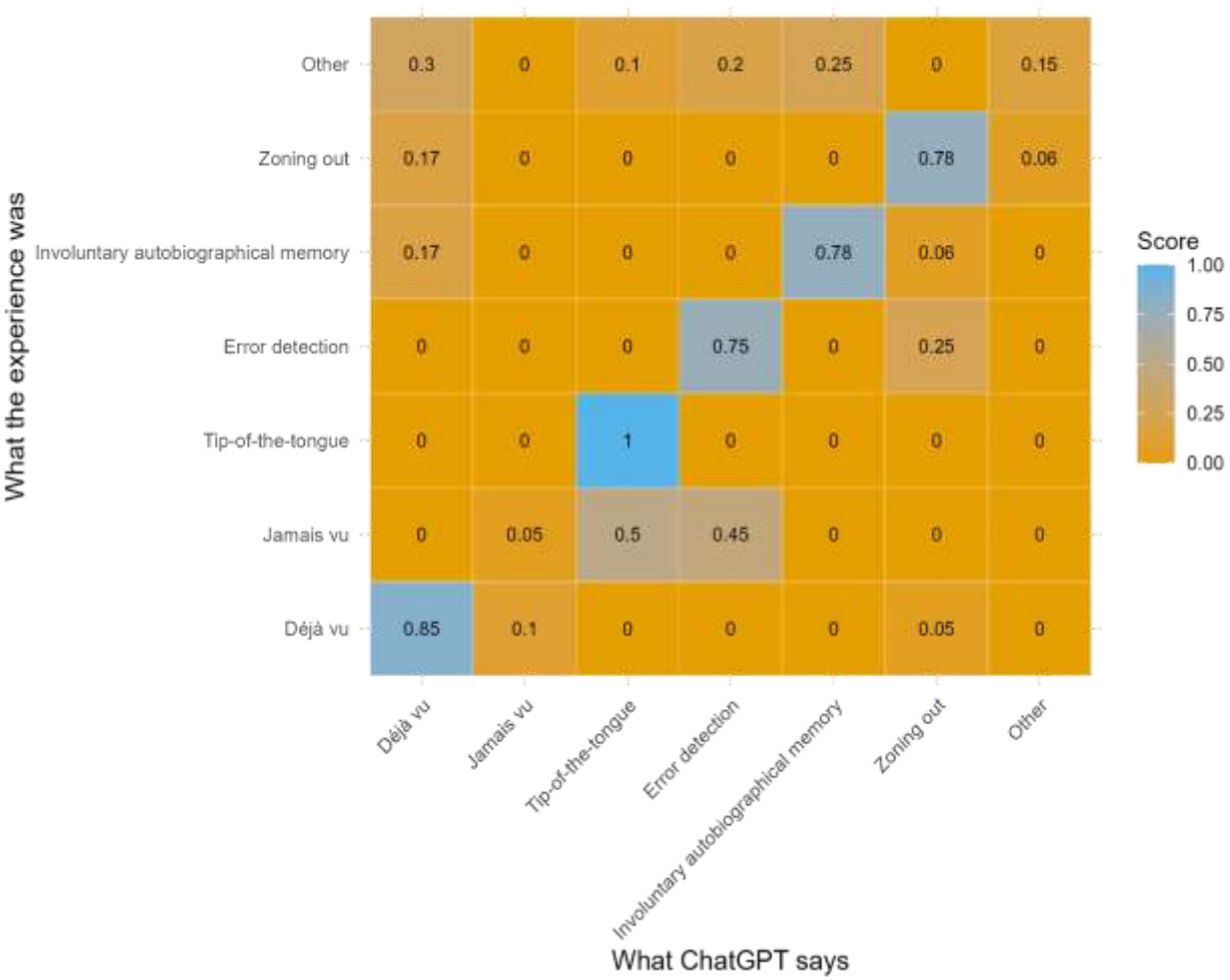
with the sensation of "error detection". In this case, you hear the word "wheelbarrow" and, as you repeat it, you begin to doubt its validity. You wonder about the word's accuracy, questioning the letters or sounds that make it up. This feeling of strangeness and doubt can occur when you focus on a specific word repeatedly. However, it's also possible that this experience can be described as a variant of the "tip-of-the-tongue", where the word itself seems stranger and stranger the more you try to remember it" (translated in English here). Further, for some descriptions, instead of selecting from the list of experiences, ChatGPT (3.5 % of the time) responded at first that the given description did not exactly match any of the options proposed and for some other descriptions, it (3.5 % of the time) responded with the explanation that reported experience may affect one's life in different ways, for example, *"In this situation, it seems that you're experiencing a loss of confidence in yourself and your ability to write correctly, despite your instincts telling you that you're right. This may be linked to a lack of certainty and a questioning of your skills in the moment. This can be a frustrating and unsettling experience, but it's important to remember that doubts and uncertainties can occur from time to time, and this doesn't call into question your overall skills. Taking a step back, trusting yourself and remembering your knowledge and experience can help you overcome this situation"* (translated in English). In these instances, we insisted that ChatGPT select one option from the list.

Moreover, in some cases (2.9 % of the time), ChatGPT used the labels not included in the options to categorise particular statements. For example, ChatGPT used labels such as “désir de partage” (desire to share) and “rêverie” (daydream) to classify a few of IAM descriptions and “détachement de l’attention (detachment of attention) ou dérive de l’attention (drift of attention)”, “rêverie ou distraction mentale (daydreaming or mental distraction)” to classify a few of zoning out statements. In such

cases, if, on the second attempt, ChatGPT still failed to choose from the provided options, this second attempt was considered the final response. In general, the performance of ChatGPT for the correct classification of descriptions seemed to be above average with 62% accuracy.

Figure 3.1

ChatGPT's Classification of Spontaneous Subjective Experiences in Experiment 2



Note: This classification matrix represents the proportion of prompts classified as one of the seven experiences.

Similar to French human participants, we asked ChatGPT to evaluate the six experiences on control, spontaneity, awareness and reliability. It repeatedly emphasised that as an AI language model, it has no personal awareness or experience related to these phenomena: "*As an artificial intelligence, I don't have the capacity to*

evaluate or feel phenomena such as déjà vu, jamais vu, tip-of-the-tongue, involuntary autobiographical memory, error detection or zoning out. These are subjective experiences specific to each individual. So I can't provide a personal assessment of them" (here translated into English). However, with some persistence ChatGPT provided general perspective based on the dataset it has (see Table 3.3).

In general, ChatGPT characterised all the six experiences as spontaneous and reliable and with awareness, meaning these types of experiences occur suddenly, without deliberate intent and to some extent people trust their thought processes and are attentive during the experiences. Experiences like déjà vu, jamais vu, occur without control, whereas experiences like TOT, error detection, IAM and zoning out can be controlled to some extent, meaning people may be able to control when to have these experiences or when not to. ChatGPT's characterisation of some of the phenomena differed slightly during one testing, for instance, it said that jamais vu can be controlled totally, whereas IAM cannot be controlled at all and zoning out is unreliable. Even though, the prompts and model version were same, this variation in response could be attributed to training of ChatGPT on vast data providing different answers derived from different proportion of that training data.

Table 3.3

ChatGPT's Evaluation of the Six Phenomena in Experiment 2

Experiences	Characteristics			
	Control	Spontaneity	Awareness	Reliability
Déjà vu	Little or no	Moderate	Moderate	Moderate
Jamais vu	Not at all **/ Total**	Moderate	Moderate	Moderate
TOT	Little to moderate	Moderate	Moderate	Moderate
Error detection	Little to moderate	**Somewhat**/ A little	**High** / Moderate	**High**/ Moderate
IAM	**Not at all** / Little to moderate	Moderate	Moderate	Moderate
Zoning out	Little to moderate	**Somewhat**/ Moderate	**Somewhat**/ Moderate	**Unreliable**/ Moderate

Note: TOT= tip-of-the-tongue. IAM= involuntary autobiographical memory. The key differences in ChatGPT's responses across two tests are highlighted in bold.

3.5. Experiment 3

In the final experiment, we sought to compare ChatGPT's ability to classify the experiences with human participants'. The human participants were tested (in French, on the French materials) using an online questionnaire as described above. For ChatGPT, we conducted multiple tests where it classified each experience by inputting all 70 descriptions into a single prompt at a time, testing it in both French and English.

3.6. Method

3.6.1. Participants

ChatGPT was tested between April and May 2024. Each test was opened in a new chat. There was a total of fourteen tests, seven in ChatGPT 3.5 and seven in 4.0 using French and English data. The human sample included 23 French-speaking adults from France. They were invited to take part in an online survey voluntarily, their ages ranged from 18 to 58 years (*M* =31.17, *SD* = 11.89) and included 7 males, 13 females and 3 non-binaries.

3.6.2. Procedure

Human participants completed an online questionnaire and the procedure was similar to the one described in experiment 2. Only those participants who reported having experienced the phenomena were asked to report their frequency over the last year by selecting one of the ranges in the options: 0, 1-2, 3-5, 6-10, 11-20, 21- 50, 51-100 or more than 100. Then participants received 60 descriptions of six phenomena, with ten for each phenomenon and ten additional control statements (total 70 descriptions in a random order) and they had to classify them by choosing only one from the list of seven experiences (i.e. déjà vu, jamais vu, TOT, error detection, IAM, zoning out or other). Lastly, participants evaluated all six phenomena in terms of control, spontaneity, awareness and reliability, using a Likert-type scale ranging from 0 to 4 (0 being “not at all” and 5 being “completely”). In this experiment, ChatGPT was not tested as a participant was but asked to classify the whole set of 70 (randomly ordered) descriptions at the same time. Each time ChatGPT was asked for a classification, a new chat was started.

3.7. Results and Discussion

In this experiment, we are better able to quantify ChatGPT's experiences, and also to provide a comparison with human data. Our participants gave their responses as a range (e.g. from 6-10 experiences per year). We calculated the mean yearly frequencies for the 6 phenomena (see Table 3.4). Human participants reported 3 to 5 experiences of déjà vu, 1 to 2 experiences of jamais vu, 11-20 experiences of TOTs and zoning out, 6 to 10 experiences of error detection and IAMs in a year

Table 3.4

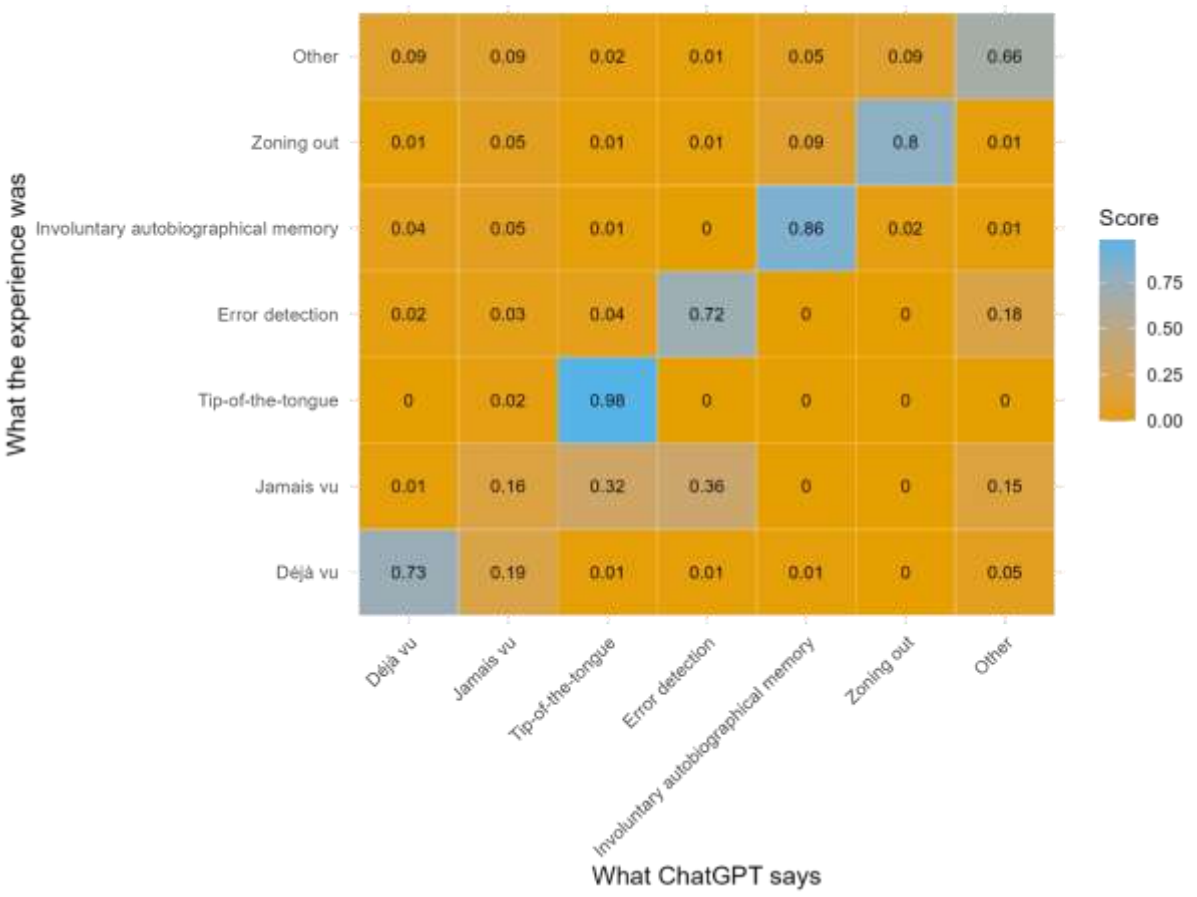
Frequency of spontaneous experiences by Human Participants

Experiences	Yearly frequencies M(SD)
Déjà vu	2.17 (1.19)
Jamais vu	1.9 (1.37)
TOT	4.57 (1.59)
Error detection	3.48 (1.76)
IAM	3.09 (2.20)
Zoning out	4.57 (1.67)

Note: TOT= tip-of-the-tongue. IAM= involuntary autobiographical memory

Figure 3.2

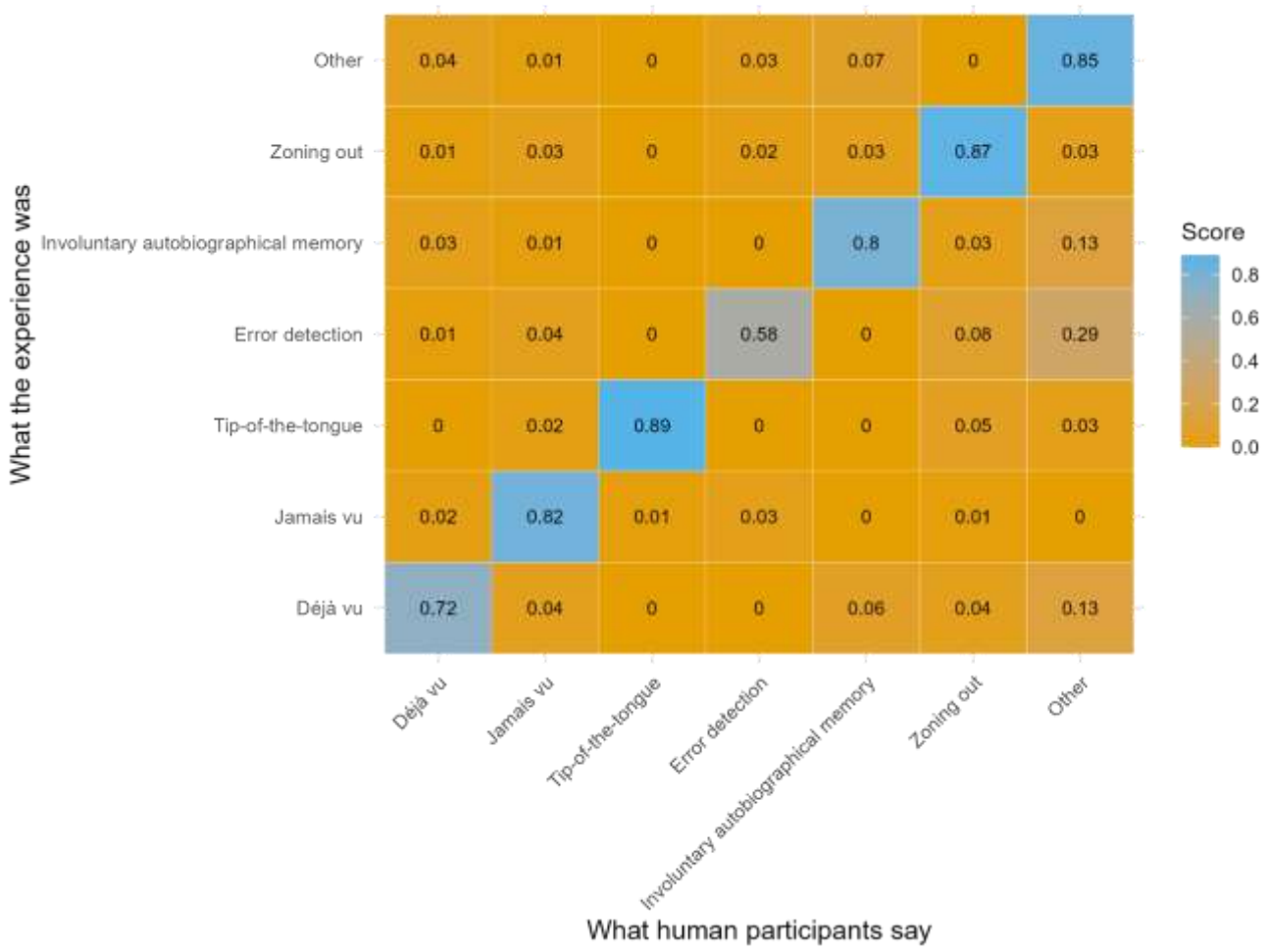
Classification of Spontaneous Subjective Experiences in ChatGPT 3.5 and 4.0



Note: This classification matrix represents ChatGPT's classification of seven experiences on French (6 trials) and English (8 trials) data.

Figure 3.3

Classification of Spontaneous Subjective Experiences Acquired from Human Participants (n=23)



Note: This figure represents the responses of human participants in classifying the experiences based on their understanding.

This experiment with ChatGPT aimed to validate these experiences by cross-referencing them with responses from human participants and exploring ChatGPT's performance in analysing and categorising these subjective experiences. The results show that the overall performance of ChatGPT (with 71% accuracy) in recovering

correct labels of the descriptions was almost similar to human participants (with 79% accuracy). While ChatGPT performed well in identifying déjà vu, TOT, error detection, IAM and zoning out, it struggled in identifying jamais vu and control questions across all experiments. As shown in Table 3.5, ChatGPT's performance was exceptional in identifying TOT-related statements (with *d'*=3.50) as compared to other experiences, meaning that it was easier for ChatGPT to identify TOT (linguistic) statements as it matched closely to the general description in the literature. However, ChatGPT was extremely poor in categorising statements related to jamais vu (with *d'*=.46), and it also had difficulty in identifying control questions (with *d'*=1.92). Additionally, like in Experiment 2, ChatGPT seems to have a liberal response bias for TOT descriptions (with *c*=-0.28) and conservative response bias for jamais vu descriptions (with *c*=1.23). This could mean that the presented descriptions of jamais vu were not clear enough for ChatGPT to analyse carefully and control questions were also a bit confusing for it. Consequently, as shown in Figure 3.2, ChatGPT labelled most of the jamais vu statements as TOT and/or error detection. Moreover, some descriptions provided to ChatGPT, included emphasis on focus or words or remembering an information. It seems that ChatGPT identified those descriptions as memory retrieval problems or situations where someone is detecting some issue.

Nonetheless, ChatGPT's performance in classifying other experiences is good, asserting that the subjective descriptions presented to ChatGPT were close enough to the general descriptions available in the dataset it has. Furthermore, if we compare the performance of ChatGPT with French participants, Figures 3.2 and 3.3 show that both were almost similar in identifying experiences like déjà vu, IAM and zoning out, but ChatGPT was better in identifying statements related to TOT, and error detection. However, French participants were much better than ChatGPT in identifying and

classifying descriptions related to jamais vu (with *d'*= 2.87) and control questions (with *d'*=2.20), presumably because human beings experience spontaneous metacognitive experiences and these experiences are part of daily life, hence they are better in identifying such subjective experiences.

Table 3.5

Classification Sensitivity and Bias on Each Experience

Experiences	Experiment 2 ChatGPT 3.5		Experiment 3 Human Participants		Experiment 3 ChatGPT 3.5,4.0	
	d'	*c*	*d'*	*c*	*d'*	*c*
Déjà vu	2.30	0.11	2.65	0.74	2.53	0.66
Jamais vu	0.47	1.88	2.87	0.53	0.46	1.23
TOT	4.35	0.91	3.99	0.76	3.50	-0.28
Error detection	1.89	0.27	2.42	1.01	2.13	0.46
IAM	2.49	0.48	2.73	0.54	3.06	0.43
Zoning out	2.33	0.40	2.92	0.32	3.01	0.60
Other	1.35	1.71	2.20	0.08	1.92	0.54

Note: d' = sensitivity; *c* = response bias; TOT= tip-of-the-tongue; IAM= involuntary autobiographical memory.

In questionnaire, we asked human participants to evaluate spontaneous experiences using Likert-type scale, for instance, rating to which extent these experiences are spontaneous (see Table 3.6). Participants (87%) described déjà vu as having no control over it at all; completely spontaneous (73% participants); as being extremely aware of experiences (34% participants) and from somewhat to not at all relying on one's thought process (43% participants). They described jamais vu as having no control over it at all (45% participants) of the time; completely spontaneous (42% participants); as being extremely aware of experiences (40% participants) and from somewhat relying on one's thought process (50% participants). They described TOT as having a little control over it (41% participants); completely spontaneous (46% participants); as being extremely aware of experiences (48% participants) and moderately relying on one's thought process (48% participants).

For error detection, participants (30%) described it as having a little control over it; moderately spontaneous (43% participants); as being highly aware of experiences (30% participants) and extremely relying on one's thought process (48% participants). Participants (38%) described IAM as having high to little control over it; completely spontaneous (55% participants); as being a little aware of experiences (32% participants) and highly reliable (50% participants). They described zoning out as having moderate control over it (44% participants); moderately spontaneous (64% participants); as being moderately aware of experiences (39% participants) and moderately relying on one's thought process (43% participants). The evaluation of these six experiences by human participants and ChatGPT is similar they both described experiences like déjà vu and jamais vu as without control, completely spontaneous, being extremely aware of one's own experience.

Table 3.6

Human participants' Evaluation of the Six Phenomena

Experiences	Characteristics			
	Control	Spontaneity	Awareness	Reliability
Déjà vu	Not at all	Complete	Extreme	Some to not at all
	87%	73%	34%	43%
Jamais vu	Not at all	Complete	Extreme	Some
	45%	42%	40%	50%
TOT	A little	Complete	Extreme	Moderate 48%
	41%	46%	48%	
Error detection	A little	Moderate	High	Extreme 48%
	30%	43%	30%	
IAM	High to little	Complete	A little	High
	36%	55%	32%	50%
Zoning out	Moderate	Moderate	Moderate	Moderate 43%
	44%	64%	39%	

Note: TOT= tip-of-the-tongue; IAM= involuntary autobiographical memory.

3.8. General Discussion

In this chapter we provide comprehensive evaluation and comparison of ChatGPT as a qualitative analysis tool with human participants to better understand and classify infrequent subjective experiences like déjà vu, jamais vu, TOT, error detection, IAM and zoning out. One of the overarching goals of the thesis is to better understand and classify spontaneous metacognitive experiences. LLMs such as ChatGPT offer a synthesis of the extant knowledge and generates human-like responses in real time (Dale, 2021) and variety of scientific fields, including psychological research have shown interest in them (Ziem et al., 2023). In this study wanted to test the extent to which certain experiences can be classified and differentiated. In turn, we proposed human participants should be able to correctly classify the descriptions based on our definitions and ChatGPT should be able to classify and recover correct labels of subjective descriptions using its existent knowledge.

We did series of testing with ChatGPT (4.0 and 3.5) in French and English language and compared the findings with human participants. Both, ChatGPT and human participants classified descriptions of metacognitive experiences (déjà vu, TOT and error detection) and spontaneous thoughts (IAM and zoning out) with good accuracy rate (as shown in Figure 3.1,3.2 and 3.3; Table 3.3). For jamais vu descriptions and control question, human participants showed high accuracy rate. Whereas, ChatGPT consistently struggled in the correct classification of jamais vu descriptions and control statements and had conservative bias ($c = 1.88$) for jamais vu descriptions. This discrepancy could be due to the subjective and complex nature of these experiences, and as human participants have direct personal insights into such phenomena they seem to have better classification accuracy, while ChatGPT relies solely on pre-existing data. Moreover, it could be possible that due to lack of sufficient

training data and even lack of coherent definition in the literature, ChatGPT lacks complete understanding of more nuanced cognitive phenomena like jamais vu which led to frequent misclassification of it as TOT and/or error detection.

Additionally, ChatGPT showed liberal response bias (c = -.91) for TOT descriptions, indicating that it has the tendency to categorize non-TOT descriptions as TOT. This bias could be attributed to ChatGPT's reliance on patterns in linguistic data, that aligns with the general description of TOT available in the scientific literature. Researches argue that closed-source LLMs like GPT models may introduce bias in classification and annotation of the data (Ollion et al., 2023), and even though ChatGPT is trained on multilingual data, researches question its ability to handle the data in languages other than English (Lai et al., 2023).

In one of our testing ChatGPT (3.5) responded with experiencing the phenomena and provided the yearly frequency as well, whereas in other testing we slightly modified instruction to reduce any ambiguity, and it responded that it lacks cognitive experiences (note no other modifications were made in any question or procedure). Studies assert that, the data structure, language, type of analysis and the prompt could affect the generation of output (Ziem et al., 2023) and sometimes LLM models even with identical input can generate contrasting results (Reiss, 2023). AI tools like ChatGPT cannot experience metacognition or personal sensations and certainly cannot experience time or years. It seems that in our testing based on prompts, ChatGPT generated frequencies of the phenomena from the training dataset. Similarly, ChatGPT showed slight variability in evaluating the experiences on control, spontaneity, awareness and reliability, even though we used the same version (3.5) and prompt. This variability could be due to the underlying architecture and training processes. As mentioned earlier, it is possible that LLMs like ChatGPT may generate

different outcomes for the same prompts because they are trained on vast, diverse datasets containing inconsistent and sometimes contradictory information. Nevertheless, the evaluation of six phenomena generated by ChatGPT matches the evaluation provided by the human participants.

Both ChatGPT and human participants, categorized experiences like déjà vu and jamais vu as without control. Subsequently, both categorised all the six experiences as spontaneous. This is in line with the existing literature suggesting that phenomena like déjà vu, jamais vu, TOT, and IAM occur spontaneously in daily life without conscious control (see Metcalfe & Schwartz, 2016; Moulin et al., 2020; Barzykwski & Moulin, 2022). This is also evident in our large survey data (see results of Chapter 2) in which participants categorised experiences likes déjà vu, jamais vu, TOT and IAMs as without control and spontaneous. Error detection also arising spontaneously.

Overall, ChatGPT's classification and evaluation aligns with the human participants, asserting that it effectively analysed the subjective descriptions that closely resembled its training data set. The comparison of ChatGPT' analyses with French human participants' data, provided a consensus view regarding the general perceptions and descriptions of these phenomena. It shows that the subjective description of the experience gathered in our questionnaire and the extensive training data and experience captured in ChatGPT converged on the same concept, suggesting that these descriptions are a good/accurate representation of these six phenomena. This provides a general assumption about these phenomena and how the society perceives these experiences based on the large dataset ChatGPT has. Moreover, ChatGPT's validation for the majority of phenomena suggests that these descriptions effectively represent those metacognitive experiences and can be used in

the research questionnaire to delve further into these intriguing experiences. However, ChatGPT's struggle with experiences like jamais vu suggest that such experiences are with more variability.

3.9. Conclusion

In conclusion, ChatGPT offered a useful means of summarizing a large qualitative dataset, an exciting possibility for cognitive psychologists. To rely more fully on AI models like ChatGPT as an analytical tool for analysing large qualitative data, particularly classifying subjective (meta)cognitive experiences, requires further development and improvement in the training dataset, something which is shown in its classification of jamais vu experiences

Chapter 4

Déjà Vu and Other Spontaneous Experiences in Epilepsy

4.1. Introduction

Recently, spontaneous cognitive experiences have received increasing interest in cognitive research such as mind wandering and involuntary memories (for reviews see Christoff et al., 2011; O'Callaghan et al., 2015; Kvavilashvili & Schlagman, 2008; Andrews-Hanna et al., 2010). However, it has largely overlooked spontaneous metacognitive experiences, which refers to everyday experiences that raise to conscious thoughts and feelings related to ongoing cognitive processing (see Chapter 1 for an overview.) This thesis addresses that gap. Research highlight that experiences such as déjà vu and TOT are spontaneous metacognitive experiences that arise without deliberate intention when something "goes wrong" cognitively (Metcalfe & Schwartz, 2016). For instance, while solving a puzzle, one might feel either close or far from the correct solution, generating metacognitive signal (Norman et al., 2019). These experiences reflect real-time monitoring of ongoing cognitive processes, where mismatch between expectations and actual outcome may give rise to conscious metacognitive state spontaneously, such as déjà vu or TOT state (Whittlesea & Leboe, 2003; Metcalfe & Schwartz, 2016).

Research on such phenomena, in healthy and clinical groups, has been limited, largely because these experiences are infrequent, subjective, and spontaneous. Most researchers rely on questionnaires requesting participants to retrospectively assess their past experiences. However, a review of theoretical and methodological approaches to these phenomena can be found in Cleary and Schwartz (2020) (also see Cleary & Brown, 2021; O'Connor et al., 2021, for laboratory-based studies). One way of gaining further insight into these subjective and infrequent phenomena is to

harness neurological populations, with the aim of identifying whether there are patterns in experiences of these phenomena. Building on this, in the current project we used retrospective questionnaire to examine the occurrence of spontaneous metacognitive experiences, like déjà vu, jamais vu, TOT, error detection, as well as spontaneous thoughts such as involuntary autobiographical memory (IAM) and zoning out in both epilepsy patients and healthy controls.

Research into spontaneous metacognitive experiences like déjà vu and jamais vu share a long history with some forms of epilepsy (Brown, 2004; Cleary & Brown, 2022). Hughling-Jackson (1888) coined the term “dreamy states” to refer to the nebulous mental states, such as déjà vu, déjà vécu, memory reminiscence and so on, that often accompany epileptic seizures (Zeman, 2012). While the exact relationship between déjà vu and these dreamy states remains unclear, Johanson et al. (2008) surveyed subjective experiences during partial epileptic seizures and found that 18% of participants reported déjà vu or other memory-related phenomena. Déjà vu in epilepsy has often been linked to abnormal activity in temporal lobe regions involved in recognition memory (O’Connor & Moulin, 2008), however, it is important to note that déjà vu is more than just a memory issue—it is a metacognitive experience, a mental state where familiarity and memory processing clashes (Illman et al., 2012). While epileptic and non-epileptic déjà vu share some phenomenological similarities, important differences have also been noted, such as greater emotional intensity, longer duration, associated autonomic responses (sweating, depersonalization), abnormal EEG (linked to rhinal cortex, amygdala, hippocampus) in epilepsy (Warren-Gash & Zeman, 2014; Cleary et al., 2021).

In addition, jamais vu, which is the opposite of déjà vu and referred to as a lack of familiarity with a familiar stimulus, often has been observed in the pre-seizure aura

of temporal lobe epilepsy (TLE) patients (Warren-Gash & Zeman, 2013; Wolfradt, 2000). As compared to déjà vu, jamais vu has significantly lower incidence and frequency (Neppe, 1983), and despite the shared neural origin of both phenomena in TLE, data on jamais vu remains limited and makes it difficult to draw any conclusion regarding its incidence, significance and association with déjà vu (Brown, 2004).

A much more frequently researched spontaneous metacognitive phenomenon is the tip-of-the-tongue (TOT) state, a subjective feeling of knowing for the currently unretrievable information (O'Connor et al., 2021), which has also been observed in neurological conditions like Alzheimer's disease, anomic aphasia and even TLE (Brown, 2011). Studies have shown that people with TLE report higher rates of TOT compared to non-epileptic controls. For instance, Thompson and Corcoran (1992) found that TOTs were the most frequent memory problem in epilepsy patients, with 43% of patients reporting daily experiences, in contrast to only 14% of control participants. Similarly, other studies have explored TOT experiences in different forms of epilepsy by examining word-finding difficulties in patients (Lomlomdijan et al., 2011) and suggest that TLE affecting the cerebral hemisphere dominant for language tends to have lexical access impairment, thus reporting a high frequency of TOTs in patients (Condret-Santi et al., 2014; Hamberger, 2015).

A relatively frequently explored spontaneous phenomenon is involuntary autobiographical memory (IAM - unintentional recall of personal past events). Barzykowski and Moulin (2023) propose that both déjà vu and IAM are forms of subjective spontaneous cognition, arising automatically and sharing similar cognitive processes. While déjà vu delivers a sense of familiarity without clear retrieval, IAM provides access to actual memory content. According to their continuum hypothesis, individuals with TLE who experience frequent déjà vu should also report a high

frequency of IAMs. They argue that testing TLE patients on tasks that evoke IAMs could provide insights into the relationship between bottom-up and top-down processes in memory retrieval.

The empirical literature shows an association in the frequency between these spontaneous cognitions in daily life, for instance, déjà vu and jamais vu (Moulin et al., 2022; O'Connor & Moulin, 2013), or déjà vu, involuntary memories and TOT (Moulin et al., 2014). In line with these findings, our large survey study (Chapter 2) revealed significant correlations across all the six phenomena, suggesting the more you experience one phenomenon, the higher the chances to experience other phenomena too. In this study, we examine the incidence and frequency of these six phenomena in patients with epilepsy compared to a non-clinical group. We also examine whether six phenomena share common characteristics, such as being spontaneous, automatic and brief. We explore these characteristics in the dichotomy section of our survey, where participants classify each experience. We propose that these spontaneous experiences may share certain phenomenological characteristics and can be grouped meaningfully to guide our cognitive processes.

Based on limited literature on epilepsy and findings of our large survey study (in Chapter 2), we hypothesize that participants who report higher frequency of one phenomenon will also report higher frequency of others. However, due to the exploratory nature of this study, we cannot be sure that all phenomena will relate to each other. We further propose that the epilepsy group is likely to report a high frequency of these six spontaneous experiences. This hypothesis is based on small literature asserting that the epilepsy population in some cases reports a high frequency of déjà vu and related experiences compared to the control group (see Neppe, 1983; Warren-Gash & Zeman, 2014), though this has not always been the case with some

reporting lower rates of déjà vu in epilepsy patients than in control groups (Adachi et al., 2010).

While there has been extensive research on déjà vu in epilepsy, the literature on jamais vu, TOT and IAMs in this context is limited. Spontaneous experiences like error detection and zoning out have not been explored in epilepsy to the best of our knowledge. Hence, this research aims to address these gaps and extend the study of spontaneous cognition in clinical populations. Examining these experiences collectively in epilepsy patients can help understand how these experiences relate to one another and how epilepsy influences their occurrence. If these experiences are indeed related through shared mechanisms, then we would expect them to be correlated with comparable frequencies. On the other hand, if epilepsy only affects certain kinds of experiences, they would not necessarily be correlated. This follows a broader theoretical question in metacognition research, that is, whether these subjective experiences reflect domain-specific phenomena or arise from a domain-general metacognitive system.

4.2. Method

4.2.1. Participants

We collected 175 responses (76 patients with epilepsy, and 99 non-clinical participants). Data were collected on a questionnaire, between November 2022 and September 2023. Patients already diagnosed with epilepsy were approached in an outpatient clinic of the Neurology Department, during their follow-up visits at Central Park Teaching Hospital. The non-clinical participants included medical college students and family members of patients in the neurology clinic. Medical students interviewed the participants, administered the questionnaire and were available to assist with filling in the form if there were any concepts that were not clear. The

Institutional Review Board (IRB) of Central Park Medical College, Lahore Pakistan approved the study.

Firstly, we removed responses from participants under 18 years old. We also removed responses in which participants reported conditions such as depression, stroke, ADHD, OCD or reported medication of antidepressants/anti-anxiety. This resulted in a total of 167 responses for our final analysis. The age across both groups ranged between 18 to 80 years (*M*=31.76, *SD*=13.76) and 57.47% of participants were males. We tested for group differences in age, gender and education to ensure that both groups are comparable. A Bayesian Independent Sample t-test provided anecdotal evidence for no difference in age (BF_{10}=.17) and moderate evidence for no difference in education (BF_{10}=.33). A chi square test showed no significant difference in gender between groups, $X^2(1, N=167) = .79$, $p = .373$.

Although the Mann-Whitney test indicated weak but statistically significant differences in age between groups (W= 2678.00, p=.033, rB= -.195), however, Bayes factor provided moderate evidence in favour of the null hypothesis (BF10= .174). This suggests that despite the statistical significance observed, the effect size is extremely small and Bayes evidence is not substantial enough to confidently reject the null hypothesis, implying that the group differences in age may not be as robust as the p-value alone would suggest. Collectively, these analyses indicated that both groups were comparable across demographic variables.

Table 4.1

Characteristics of Participants

Characteristics	Epilepsy Group n=71	Nonclinical Group n=96
Age *M(SD)*	31.14(11.15)	30.67(14.79)
Gender %		
Males	53.52	60.42
Females	46.48	39.58
Education *M(SD)*	12.94(3.51)	13.53(2.62)
Age at which epilepsy was diagnosed *M(SD)*	25.35(6.24)	-
Epilepsy duration (in months) *M(SD)*	59.44 (56.00)	-

4.2.2. Design and Material

Data were collected using a questionnaire with different sections. The questionnaire used in this study was adopted from the large online questionnaire used in Chapter 2. The original questionnaire included questions about the frequency of six phenomena over the past week, and agreement level with the provided definitions. However, in piloting, for the patients with epilepsy, the questionnaire was lengthy and time-consuming. Hence, to enhance response quality and maintain participants' interest, these questions were excluded from the questionnaire version used in this study.

In the first section, after written informed consent, participants provided demographic information such as age, gender, total years of education completed, parental consanguinity, medical/psychiatric/psychological issues and medication (if any). The patients with epilepsy were further requested to determine their age at the

time of diagnosis, duration of illness, epileptic focus and surgical status (if any). The demographic characteristics of both groups are given in Table 4.1. Patients with epilepsy did not know their epileptic focus so this information is not included in the table.

In the second section, participants were presented with terminologies of the phenomena followed by their definitions and then asked to report their incidence (see Annex V for the questionnaire). For instance, after reading the definition of déjà vu, participants were asked if they had *ever* experienced it. Only those participants who reported having ever experienced the phenomena were asked to report their frequency over the past year by selecting one of the ranges in the options: 0, 1-2, 3-5, 6-10, 11-20, 21- 50, 51-100 or more than 100.

In the third section, we requested participants to evaluate the six experiences using dichotomies to determine the duration, control, pleasantness/unpleasantness, and significance of the experiences. For example, participants were requested to select from the following dichotomies: - It's a brief sensation/it's a long sensation/I don't know - It's something I have control over/it's something I have no control over/I don't know - It's a pleasant experience/it's an unpleasant experience/I don't know - It comes suddenly/it comes gradually over the time/ I don't know - It's a random event/it's a meaningful event/ I don't know. At the end of the survey, we included an open-ended question inviting participants to share details or express their thoughts about these phenomena. However, we did not receive a sufficient number of responses to this question.

4.3. Results

4.3.1. Incidence of Spontaneous Experiences

In addition to frequency comparisons, we also assessed whether epilepsy and non-clinical groups differed in incidence reporting of the experiences. Participants in both groups respond with either “yes” or “no” when asked if they had ever had the given experience at any point in their lives. Table 4.2 shows the proportion of responses of both groups and whether the groups were significantly different or not. The 2x2 chi-square test indicated that the overall non-clinical group is significantly more likely to report having experienced jamais vu (76%; X^2 (165) =9.31, p = .002), error detection (85%; X^2 (167) =12.11, p < .001) and IAM (90%; X^2 (166) =8.66, p = .003) compared to epilepsy group. However, we found that although the proportion of the non-clinical group was numerically high in reporting déjà vu (82%), TOT (84%) and zoning out (92%), the X^2 did not indicate any significant group differences (all ps >.05).

Table 4.2

Incidences of six experiences in patients with Epilepsy and Non-clinical sample. Figure represents percentage of the population who report ever having had the experience in their lifetime.

Experiences	Epilepsy (%)	Non-clinical (%)
Déjà vu	70.42	82.11
Jamais vu	54.29	76.84
TOT	80.28	84.38
Error detection	61.97	85.42
IAM	73.24	90.53
Zoning out	90.14	92.71

Note: TOT= tip-of-the-tongue; IAM= involuntary autobiographical memory.

4.3.2. Frequency of Spontaneous Experiences

Participants who have had the given experience at some point in their lives also reported how often it occurred in the last year. Participants gave their responses as a range (e.g. from 6-10 experiences per year), but we recoded them as values ranging from 0 to 7 (e.g. 0 = 0, 1 = 1-2, 2 =3-5, 3 = 6-10, 4 = 11-20, 5 = 21-50, 6 = 51-100 and 7 = more than 100) for our analyses. We performed frequentist and Bayesian (Mann-Whitney and Bayesian tests) analyses in JASP (80.18.3.0) to compare the group differences for the yearly frequency of all six phenomena. The frequency of the experiences is given in Table 4.3.

We found significant group differences for the yearly frequency of déjà vu (W= 4024.50, p=.030, r_B= .193; anecdotal evidence BF_{10}= 1.66), jamais vu (W= 4492.00, p<.001, r_B= .318; extreme evidence BF_{10}= 115.34), error detection (W= 4278.500, p=.004, r_B= .255; moderate evidence BF_{10}= 9.143) and IAM (W= 4211.00, p=.008, r_B= .236; strong evidence BF_{10}= 11.18) with the control group experiencing it more often than the epilepsy group. The Bayes Factor (BF) provided anecdotal to extreme evidence for meaningful group differences in these four experiences. The posterior distribution of the mean differences between both groups in Table 4.3 showed that the non-clinical sample reported a higher frequency of zoning out (11 to 20 experiences), IAM (6 to 10 experiences), jamais vu and error detection (3 to 5 experiences) in a year.

The Mann-Whitney test was non-significant for the group differences in TOT (W= 3542.00, p=.661, r_B= .039; BF_{10}= .209) and zoning out (W= 3691.50, p=.351, r_B= .083; BF_{10}= .283) and the Bayes factor also supported the null hypothesis suggesting that the groups are not meaningfully different from each other.

Table 4.3

Summary of Yearly Frequency of all Six Phenomena (recoded values; means (and standard deviations)

Experiences	Non-clinical group	Epilepsy Group
Déjà vu	2.61 (1.82)	2.00 (1.63)
TOT	2.91 (2.02)	2.70 (1.71)
Jamais vu	2.34 (1.86)	1.35 (1.55)
Error detection	2.55 (1.67)	1.76 (1.75)
IAM	3.42 (1.79)	2.54 (1.93)
Zoning out	4.02 (1.94)	3.70 (1.89)

Note: All Ns = 96 (non-clinical) and 71 (epilepsy) - except for déjà vu frequency where there were 95 controls.

4.3.3. Classification of Spontaneous Experiences

In our questionnaire, we asked both groups to classify six phenomena in terms of duration, control, onset, pleasantness/unpleasantness, and significance (see design and material above for details). We ran binomial tests separately for each group and set the test value to > 0.5 to see whether the specific proportion of participants was significantly greater than 50%. Additionally, we ran 2x3 the chi-square test to compare epilepsy and non-clinical group differences in classification and to see if there is a significant association between groups and the category choice (e.g. “déjà vu is a brief sensation”, “déjà is a long sensation”, “I don’t know”). Both the Binomial and X^2 tests were conducted separately for all six phenomena, and for more stringent analysis we only included the responses of participants who reported experiencing the respective phenomena.

Table 4.4 presents the significant proportions of participants classifying the six experiences. The X^2 indicated significant group differences only in the classification of some experiences. Déjà vu was classified as a brief and sudden experience by both groups. In the epilepsy group, 86% rated it as brief and 84% as sudden, compared to 74% and 71% respectively in the non-clinical group. Chi-square tests showed that the epilepsy group was significantly more likely to classify déjà vu as brief (p = .028) and sudden (p = .042). Whereas, the non-clinical group was significantly more likely to classify déjà vu as a meaningful experience (66%; p < .001).

When classifying jamais vu, 71% of the epilepsy group rated it as brief and 66% as without control, but these proportions were not significantly different from the non-clinical group (p = .163 and p = .117). However, the non-clinical group was significantly more likely to classify jamais vu as a sudden event (69%; p = .012). For emotional valence, the epilepsy group most frequently chose “I don’t know” (68%), whereas the non-clinical group showed no clear preference. A majority of both groups classified jamais vu as a random experience (epilepsy: 65%, non-clinical: 70%), with no significant group difference (p = .079).

TOT was generally categorized as lacking control and occurring suddenly. In the epilepsy group, 72% described TOT as being without control, and 67% as sudden, in the non-clinical group, the figures were 63% and 76%, respectively. While the group difference in control ratings was not significant (p = .326), the non-clinical group was significantly more likely to classify TOT as sudden (p < .001). Additionally, 86% of the non-clinical group considered TOT to be a random experience, significantly more than in the epilepsy group (75%; p = .047). Non-clinical group was significantly more likely to classify TOT as an unpleasant experience (81%; p <.001).

Table 4.4

Phenomenological classification of six experiences in Epilepsy and non-clinical group

Variables	Duration	Control	Onset	Pleasantness	Significance
Déjà vu					
Epilepsy	Brief 86%	-	Sudden 84%	-	-
Non-Clinical	Brief 66%	-	Sudden 81%	-	Meaningful 66%
X^2	p = .028		p = .048		p < .001
Jamais vu					
Epilepsy	Brief 71%	No control 66%	Sudden 65%	I don't know 68%	Random 65%
Non-clinical	-	-	Sudden 69%	-	Random 70%
X^2	p = .163	p = .117	p = .012	p = < .001	p = .079
TOT					
Epilepsy	-	No control 72%	Sudden 67%	-	Random 75%
Non-Clinical	-	No control 63%	Sudden 76%	Unpleasant 81%	Random 86%
X^2		p = .326	p < .001	p < .001	p = .047
Error detection					
Epilepsy	Brief 77%	No control 75%	-	Unpleasant 75%	Random 74%
Non-Clinical	-	-	Sudden 68%	Unpleasant 83%	Random 75%
X^2	p < .001	p = .030	p < .001	p = .176	p = .041
IAM					
Epilepsy	-	-	Sudden 77%	Pleasant 66%	Meaningful 71%

Non-Clinical	-	-	Sudden 71%	-	-
X^2			p = .261	p = .004	p = .006
Zoning out					
Epilepsy	-	No control 65%	Suddenly 67%	-	-
Non-Clinical	Long 69%	No control 65%	Suddenly 65%	-	-
X^2	p = .011	p = .547	p < .001		

Note: X^2 = Represents p values of the chi-square test for group differences in the classification of six phenomena; TOT= tip-of-the-tongue; IAM= involuntary autobiographical memory.

The epilepsy group was significantly more likely to classify error detection as brief (77%; p < .001) and without control (75%; p = .030), compared to the non-clinical group. In contrast, the non-clinical group was significantly more likely to classify it as a sudden (68%; p < .001) and random experience (75%; p = .041). Finally, 75% of the epilepsy group and 83% of the non-clinical group classified error detection as an unpleasant experience, but the groups did not differ (p = .176).

A significantly greater proportion of the epilepsy group classified IAM as pleasant (66%; p = .004) and meaningful (71%; p = .006). While both groups considered it a sudden experience (77% epilepsy vs. 71% non-clinical), this difference was not statistically significant (p = .261).

The epilepsy group was significantly more likely to classify zoning out as having sudden onset (67%; p < .001), while the non-clinical group was more likely to describe it as having a long duration (69%; p = .011). Both groups equally described zoning out as lacking control (65% in each group) but there were no significant group differences (p = .547)

4.3.4. Frequency Correlations

To analyse the association between the yearly frequencies of all six phenomena, we ran non-parametric Spearman correlation analyses, separately for each group in R studio (version 4.3.2). We applied the Holm correction for multiple comparisons (Holm, 1979). Table 4.5 shows the Spearman rho correlation for the yearly frequency of different experiences in epilepsy and non-clinical groups post-Holm correction.

In the epilepsy group, only zoning out was significantly associated with TOT (p = .022) and IAM (p = .0003), suggesting that if the person experienced zoning out frequently, the person is also likely to experience TOTs and IAMs. All the other associations were non-significant (all ps >.118). In the non-clinical sample, we found significant correlation between the yearly frequencies of all six phenomena (rhos > .34 and all ps <.05) suggesting that the more the participants experienced any one phenomenon, the higher the chances they experienced the others too. No significant correlations were found between age or education level and the frequency of any of the six experiences (all ps > .311).

Table 4.5

Spearman's correlations between the six types of experience for yearly frequencies

Experiences	Déjà vu	Jamais vu	TOT	ED	IAM	ZO
Jamais vu						
Epilepsy	0.33		-			
Nonclinical	0.39**		-			
TOT						
Epilepsy	0.28	0.16	-			
Nonclinical	0.42***	0.42***	-			
Error detection						
Epilepsy	0.16	0.33	0.17		-	
Nonclinical	0.46***	0.48***	0.41***		-	
IAM						
Epilepsy	0.09	-0.06	0.31	0.09	-	
Nonclinical	0.39**	0.46***	0.34*	0.42***	-	
Zoning out						
Epilepsy	0.32	0.10	0.39*	0.140	.49***	-
Nonclinical	0.49***	0.52***	0.50***	0.49***	0.53***	-

Note: *$p < .05$, **$p < .01$, ***$p < .001$; TOT= tip-of-the-tongue; IAM= involuntary autobiographical memory.

4.3.5. Unique Cases in Epilepsy

To further explore the variability, descriptive patterns and perhaps potential clinical relevance of spontaneous cognitive experiences in epilepsy, we examined the subset of participants reporting exceptionally high frequencies of one or more spontaneous phenomena, that is either 51 to 100 experiences or more than 100 experiences within the past year. Table 4.6 gives an overview of 13 unique cases of patients with epilepsy. This case-level analysis was conducted to better understand the phenomenological characteristics associated with frequent occurrences and to assess whether any patterns emerged across individuals or phenomena. This exploratory approach allowed us to go beyond and capture the diversity of experiences within our epilepsy sample.

Patient A reported experiencing 51 to 100 experiences of déjà vu in a year. In line with other respondents (see Table 4.4), she described déjà vu as a sudden and short-lived experience. However, unlike most participants, she reported being able to exert control over déjà vu experiences. This notion contradicts to the existing literature, characterizing déjà vu as a spontaneous state (Metcalfe & Schwartz, 2016; Aitken et al., 2023).

Similarly, Patient B reported experiencing more than 100 TOTs, and 51 to 100 experiences of zoning out in the year. Her description of TOT as spontaneous and random corresponds with the description presented in Table 4.4. However, unlike most patients she reported ‘don’t know’ regarding onset of TOT. Her description of zoning out as spontaneous with sudden onset matches the reporting of other patients. Additionally, Patient C reported 51 to 100 experiences of IAMs in the year. His description of IAM as spontaneous, pleasant and meaningful aligns with the majority of clinical cases in Table 4.4.

Patient I reported 51 to 100 experiences of TOTs and zoning out. Her description of TOT as spontaneous, unpredictable and random experience aligns with the other patients. Further, she classified zoning out as being spontaneous and with sudden onset similar to other patients. Additionally, 9 patients with epilepsy reported 51 to 100 experiences of zoning out within a year. Their descriptions of zoning out correspond with the characteristics listed in Table 4.4, that is, zoning out is a spontaneous/without one’s control and having sudden onset.

However, some descriptions in Table 4.6 deviated from the common experiences provided by the patients in Table 4.4. For instance, unlike majority of the patients, Patient D reported that zoning out experience occurs gradually rather than suddenly.

Similarly, Patient F reported ‘don’t know’ about whether one has a control over zoning out or not. Lastly, three patients reported that their zoning out experience occurs with control, suggesting that some patients do not perceive zoning out experiences as a spontaneous phenomenon.

Table 4.6

Summary table of epilepsy patients reporting exceptionally high frequency and distinctive phenomenological characteristics of six spontaneous cognitive experiences.

Patient ID	Demographics	Diagnosis age	Déjà vu	TOT	Jamais vu	Error detection	IAM	Zoning out
			Yearly frequency & classification	Yearly frequency & classification	Yearly frequency & classification	Yearly frequency & classification	Yearly frequency & classification	Yearly frequency & classification
Patient A	Female, 33 years old	31	51-100 A brief sensation with control. It's a meaningful experience that comes suddenly. But don't know if it's pleasant/ unpleasant	No experience	No experience	3-5 A long sensation without control. It's a random experience that comes suddenly. But don't know if it's pleasant/ unpleasant	No experience	21-50 A brief sensation with control that comes suddenly. It's a pleasant and meaningful experience
Patient B	Female, 23 years old	20	6-10 A brief sensation, that comes suddenly. It is an unpleasant and random experience, but do not know if it is with or without control	More than 100 A brief sensation without control. It is an unpleasant and random experience but don't know if it's predictable	6-10 A brief sensation without control. It comes suddenly and is a random experience. But do not know if it's	11-20 A brief sensation with control and is a random event. But do not know if it's pleasant/ unpleasant or predictable	21-50 A long sensation without control. It is a pleasant and meaningful experience that comes suddenly	51-100 A long sensation without control. It is an unpleasant and a random experience that comes suddenly

					pleasant/ unpleasant			
Patient C	Male, 19 years old	Unknown	6-10 A brief sensation with control. It is an unpleasant and a random experience that comes suddenly	11-20 A brief sensation with control. It is a pleasant experience that comes gradually	3-5 A long sensation without control. It is a pleasant experience that comes suddenly. But don't know its significance	11-20 A brief sensation without control. It is a random experience that comes suddenly but don't know if it's pleasant/ unpleasant	51-100 A long sensation, without control. It is a pleasant and meaningful experience that comes suddenly	1-2 A brief sensation with control. It is a meaningful experience that comes suddenly but don't know if it's pleasant/ unpleasant
Patient D	Male, 21 years old	Unknown	6-10 A brief sensation with control. It is an unpleasant and random experience that comes suddenly	21-50 A brief sensation with control. It is an unpleasant and random experience that comes suddenly	6-10 A brief sensation with control. It is an unpleasant experience that comes suddenly. But don't know its significance	3-5 A brief sensation with control. It's a pleasant and random experience	21-50 A brief sensation without control. It is an unpleasant but meaningful experience that comes suddenly	51-100 A long sensation without control. It is an unpleasant but meaningful experience that comes gradually
Patient E	Male, 24 years old	Unknown	1-2 A brief sensation without control. It's a pleasant and random	6-10 A brief sensation with control. It's an unpleasant and	11-20 I do not know the duration, control, pleasantness/	21-50 A brief sensation without control. It's an unpleasant and random	11-20 A long sensation without control. It's a pleasant and meaningful	51-100 A long sensation without control. It's a pleasant and meaningful

			experience that comes suddenly	random experience that comes suddenly	unpleasantness, predictability or significance of the experience	experience that comes suddenly	experience that comes suddenly	experience that comes suddenly
Patient F	Female, 57 years old	38	6-10 A brief sensation with control. It's a Pleasant and meaningful experience that comes suddenly	21-50 A long sensation without control. It's a random experience that comes suddenly but don't know if it's pleasant/ unpleasant	No experience	No experience	21-50 A long sensation without control. It's a pleasant and meaningful experience that comes suddenly	51-100 A long sensation that comes suddenly. But don't know if it's with control, pleasant/ unpleasant or significant
Patient G	Male, 27 years old	22	No experience	No experience	No experience	3-5 A brief sensation with control. It's an unpleasant and random experience but do not its predictability	21-50 A long sensation with control. It's a pleasant and meaningful experience that comes suddenly	51-100 A long sensation without control. It's a meaningful experience that comes suddenly but do not know if it's pleasant/ unpleasant
Patient H	Female, 31 years old	27	6-10 A long sensation with control. It's an Unpleasant but meaningful experience that comes gradually	11-20 A long sensation without control. It is an unpleasant and a random experience that comes suddenly	No experience	No experience	21-50 A long sensation without control. It's an unpleasant but meaningful experience that comes suddenly	51-100 A long sensation with control and is meaningful. But don't know if its pleasant/ unpleasant or predictable

Patient I	Female, 39 years old	33	6-10 A brief sensation, with control but do not know if it's a pleasant/ unpleasant experience, predictable or significant	51-100 A long sensation without control. It is an unpleasant and random experience that comes suddenly	21-50 A brief sensation with control and comes suddenly. But don't know if it is pleasant/ unpleasant or significant	11-20 A long sensation without control that comes suddenly and is a random experience. But don't know if it's pleasant/ unpleasant	21-50 A long sensation without control. It's a pleasant and meaningful experience that comes suddenly	51-100 A brief sensation with control. It's a pleasant and meaningful experience that comes suddenly
Patient J	Female, 25 years old	22	11-20 A long sensation without control. It's an unpleasant experience that comes suddenly. But don't know its significance	6-10 A long sensation without control. It's an unpleasant and random experience that comes suddenly	11-20 A brief sensation with control but don't know if it's pleasant/ unpleasant, predictable or significant	11-20 A brief sensation with control. It's an unpleasant and random experience that comes suddenly	21-50 A long sensation without control that comes suddenly. But don't know if it's pleasant/ unpleasant or significant	51-100 A long sensation without control. It's an Unpleasant but meaningful experience that comes suddenly
Patient K	Male, 29 years old	22	6-10 A brief sensation with control. It's a meaningful experience that comes suddenly. But don't know if it's pleasant/ unpleasant	6-10 A long sensation without control. It's an unpleasant and random experience that comes suddenly	6-10 A long sensation without control. It's a random experience that comes suddenly but don't know if it's pleasant/ unpleasant	6-10 A brief sensation with control. It's an unpleasant and random experience that comes suddenly	11-20 A brief sensation with control. It's a Pleasant and meaningful experience that comes suddenly	51-100 A long sensation without control, that comes suddenly and is a meaningful experience. But don't know if it's pleasant/ unpleasant

Patient L	Female, 32 years old	30	No experience	11-20 A long sensation without control. It's an unpleasant and random experience that comes suddenly	No experience	No experience	21-50 A brief sensation with control. It's a pleasant and meaningful experience that comes suddenly	51-100 A long sensation with control. It's a pleasant and meaningful experience that comes suddenly
Patient M	Male, 44 years old	37	3-5 A brief sensation without control. It's an unpleasant and random experience that comes suddenly	21-50 A long sensation without control. It's an unpleasant experience but don't know its predictability or significance	No experience	21-50 A long sensation without control. It's an unpleasant and random experience that comes suddenly	3-5 A brief sensation with control. It's a Pleasant and random experience that come suddenly	51-100 A long sensation without control. It's an Unpleasant but meaningful experience that comes suddenly

Note: TOT= tip-of-the-tongue; IAM= involuntary autobiographical memory.

4.4. Discussion

If and how déjà vu and other related nebulous mental experiences in epilepsy differ from healthy people has held importance for researchers and clinicians for years (Cleary et al., 2021). Unlike most previous research that investigates these experiences separately, our approach offers a comprehensive, comparative view of how these experiences occur across groups providing novel insights. In our data, we examined the differences in the incidence, frequency and phenomenological characteristics of six spontaneous experiences between epilepsy and non-clinical groups. Previous research has shown that subjective cognitive experiences, such as déjà vu, have different and striking phenomenological characteristics when they occur as part of seizure activity (Illman et al., 2011). Furthermore, factors such as epilepsy onset age, duration, and affected brain area form unique cognitive profiles (Khalife, 2022; Adachi et al., 2003). These considerations are crucial in understanding the occurrence of spontaneous experiences in patients with epilepsy.

In line with previous literature (see Adachi et al., 2010; Brown, 2004), our results showed that overall the non-clinical group reported high incidence and frequency of these phenomena. The non-clinical group was significantly more likely to experience phenomena like déjà vu, jamais vu, error detection and IAM. As an example, the epilepsy group reported 1-2 experiences of jamais vu and error detection in a year, whereas the non-clinical group reported 3-5 experiences. Similarly, for IAM, the epilepsy group reported 3-5 experiences per year, while the non-clinical group reported 6-10 experiences.

The first issue to address is why a group with epilepsy might report having fewer spontaneous experiences than healthy controls. One potential explanation for the lower reporting of these phenomena in the epilepsy group could be attributed to

memory. Memory difficulties are among the most common cognitive complaints in epilepsy patients, especially in TLE (Butler & Zeman, 2008). Studies have shown that seizure frequency, early onset age, and lifetime number of seizures are significantly associated with memory impairment (Lespinet et al., 2002; Hendriks et al., 2004; Oyegbile et al., 2004). These factors could affect the hippocampus and related memory networks, leading to difficulties in retaining and recalling personal experiences (Butler & Zeman, 2008), which may explain why epilepsy group in our data reported fewer occurrences of spontaneous cognitive experiences. Further, déjà vu and jamais vu has been reported as a symptom of temporal lobe epilepsy and are often accompanied by fear and discomfort (Bigal et al., 2003; Fukao et al., 2005), there is a possibility is that patients with epilepsy might be hesitant to report these experiences, due to the fear of perceiving the occurrence of these phenomena as a pathology symptom or the need to adjust medication.

Despite the statistical significance of group differences in our data, the effect sizes were small (ranging from .193 to .318) indicating that the magnitude of this difference is small and could have limited practical or clinical significance. Interestingly, although both groups reported a similar frequency of déjà vu (3 to 5 experiences yearly), the anecdotal yet significant evidence suggests differences in the nature or pattern of these experiences. The Bayes factor and Mann-Whitney test did not reveal significant group differences for TOT and zoning out experiences, with both groups reporting similar frequencies of TOT (i.e., 3 to 5 experiences in a year). However, the non-clinical group reported zoning out more frequently (11 to 20 experiences in a year) compared to the epilepsy group (6 to 10 experiences in a year).

Additionally, the Bayes factor supporting the null hypothesis suggests that these group differences are likely attributed to epilepsy rather than age or education. This

suggests that while patients with epilepsy may experience these phenomena less frequently, they experience them differently or having epilepsy could make these experiences different. The nebulous mental experiences such as déjà vu and jamais vu are part of normal brain activity, patients with cognitive dysfunction may experience low frequency and different forms of déjà vu and other related phenomena (Adachi et al., 2003; Adachi et al., 2010). Some even suggest that physiological and epileptic déjà vu are similar, however, differ in frequency and associated features - the 'company it keeps' (Warren-Gash & Zeman, 2014).

Another goal of this study was to determine how the non-clinical and epilepsy groups classify and describe these six spontaneous phenomena and if there are significant group differences in those classifications. One of the most important findings of the current study was that non-clinical group consistently classified all the six experiences as unpredictable and having a sudden onset. This suggest that despite their conceptual and contextual differences, these experiences are perceived as arising spontaneously and without deliberate effort. This categorization diverges notably from more deliberate and effortful process typically associated with metacognitive processes and suggest that some metacognitive experiences like déjà vu, jamais vu, TOT and error detection arise automatically and involuntarily yet still reflect self-relevant cognitive monitoring or awareness. Moreover, while IAMs and zoning out are not traditionally metacognitive experiences, however, their shared phenomenological characteristics with spontaneous metacognitive experiences suggest that they may arise from common triggering conditions or underlying cognitive dynamics.

Further, non-clinical group described experiences like jamais vu, TOT and error detection as random, while they classified déjà vu experience as a brief experience

with some significance in life. They classified TOT and zoning out as unintentional and beyond one's control, with zoning out described as lasting longer in duration. TOT and error detection were reported as unpleasant experiences.

The epilepsy group showed both notable differences and some similarities in how certain experiences are classified and perceived. The majority of patients with epilepsy classified déjà vu, jamais vu and error detection as a brief, meaning that such experiences are perceived as short-lived. In terms of onset, experiences like déjà vu, TOT, jamais vu, IAM and zoning out were described as having a sudden onset, indicating that these are spontaneous experiences and one cannot predict the likelihood of experiencing such phenomena in certain circumstances. Further, jamais vu, error detection, TOT and zoning out were classified as without control asserting that these are unintentional and occur without deliberation. Additionally, epilepsy group described TOT, jamais vu, and error detection as random events with no specific significance in one's life. Whereas, IAMs were categorised as meaningful and pleasant experience. Error detection was described as an unpleasant experience, while responses to jamais vu were mixed, with majority reporting uncertainty about whether it was a pleasant or an unpleasant experience.

There are indeed group differences in experiencing and classifying these phenomena but in general, both groups classify phenomena like déjà vu, jamais vu, TOT, IAM and zoning out as sudden and unpredictable. Experiences like TOT, jamais vu and error detection were considered random (without any significance) by both groups. Both groups classified TOT and zoning out as an unintentional experience, déjà vu as brief and error detection as unpleasant experience. This suggests that these spontaneous experiences seem to share common characteristics. This was also evident in our large survey data (Chapter 2) and study 2 (Chapter 3), where participants

consistently described experiences like déjà vu, jamais vu, TOT and IAM as without anyone's control and spontaneous. These findings also align with the previous literature asserting that phenomena like déjà vu, jamais vu, TOT, and IAM occur spontaneously in daily life (see Metcalfe & Schwartz, 2016; Moulin et al., 2022; Barzykwoski & Moulin, 2023). In support of this, Fukao et al., (2005) found that both the epilepsy and healthy group reported experiencing déjà vu and jamais vu as brief experience typically lasting from several to tens of seconds. Similarly, research has shown that error detection often occurs through implicit self-monitoring which is fast, automatic and without awareness (Firth, 2012). Zoning out has also been characterized as unintentional lapse in attention, marked by lack of control over one's thoughts (Smallwood and Schooler, 2015).

In addition to this, we noticed some unique cases in our epilepsy data (see Table 4.6) showing that some patients with epilepsy experience a high frequency of at least one phenomenon as compared to other phenomena and their description or characteristics of those experiences are somewhat different than the other patients. For instance, one patient reported 51 to 100 experiences of déjà vu within a year, whereas 3 to 5 experience of error detection, 21 to 50 experiences of zoning, but never experiencing TOT, jamais vu or IAM in their life. Some patients even reported that they could control these experiences. As mentioned earlier, these variations in frequency and description are likely to be influenced by several factors, such as individual differences, epilepsy foci, and frequency or severity of seizures (Khalife, 2022; Adachi et al., 2003). These factors may help explain why some patients report certain phenomena such as déjà vu, TOT, IAM or zoning out more frequenctly and with different characteristics than others.

In our non-clinical data, we found that experiencing one spontaneous phenomenon increases the likelihood of experiencing others too. Suggesting that if a person experiences spontaneous metacognitive experiences like déjà vu, jamais vu, TOT or error detection, the person is also likely to experience spontaneous experiences like IAM or zoning out. This is in line with the literature and the findings of our large survey study (in Chapter 2). Researches, though with smaller sample size, has shown association between different types of these seemingly different experiences (jamais vu and déjà vu, Moulin et al., 2022; déjà vu and tip of the tongue, and even déjà vu and involuntary memories (in older adults), Moulin et al., 2014).

Patients with epilepsy often report déjà vu and jamais vu as a part of an epileptic seizure or as an aura of temporal lobe epilepsy (Sengoku et al., 1997; Fukao et al., 2005; Warren-Gash & Zeman, 2013; Aitken & O'Connor, 2020). Moreover, Barzykowski and Moulin (2023) propose that people with temporal lobe epilepsy reporting a high frequency of déjà vu are also likely to report a higher frequency of involuntary memories. With this proposition, we hypothesised that if patients with epilepsy report spontaneous metacognitive phenomena (déjà vu, jamais vu, TOT and error detection) they are also likely to report spontaneous thoughts (IAM and zoning out). However, our data did not show significant correlations among these six phenomena, except for the TOT and zoning out (p = .0226) and zoning out with IAM (p = .0003). Moreover, studies have shown that with age, experiences like déjà vu decreases (Aitken et al., 2023; Fortier and Moulin, 2015; Wells et al., 2021) and TOT increases (Salthouse & Mandell, 2013). However, in this study, we didn't find an association between age and the six spontaneous phenomena.

4.5. Conclusion

Exploring spontaneous cognition, like déjà vu, jamais vu, TOT, error detection, IAM and zoning out, collectively provides valuable insight into the cognitive process involved in epilepsy. In our study, we found group differences in experiences of the six spontaneous phenomena and the epilepsy group reported low incidence and frequency of these phenomena. Some patients experienced at least one of the experiences with much higher frequency than the other experiences and their classification of these experiences differed from those of other patients. However, due to a lack of information about the seizure frequency or epileptic foci in our data, we are unable to draw specific conclusions about how different types of epilepsy might influence the occurrence of these spontaneous experiences. This is something future research could focus on as this could help to gain deeper understanding of how epilepsy could influence spontaneous cognition.

Chapter 5

Unveiling Spontaneous Cognitive Phenomena: An Experimental Paradigm for Studying Déjà Vu, Involuntary Memories and Beyond

In chapter 2, we explored the incidence and frequencies of spontaneous metacognitive experiences (like déjà vu, jamais vu, tip-of-the-tongue and error detection) along with spontaneous thoughts (like involuntary autobiographical memory and zoning out) across three countries, examining their occurrences in daily life and possible cultural differences. In this chapter we review experimental paradigms available in literature for inducing these six spontaneous experiences in a laboratory setting (Table 5.1 gives an overview of published empirical researches using different methodologies to generate these spontaneous experiences). Furthermore, we present an experimental paradigm that could be effective in investigating these naturally occurring spontaneous experiences in the laboratory. Findings from the previous chapters demonstrated that the frequencies of these six spontaneous experiences correlate with each other and the definitions of phenomena used in our studies work well. Building on that, this chapter aims to experimentally provoke these real-life experiences using a paradigm previously shown successful in inducing involuntary autobiographical memories.

5.1. Introduction

Due to their infrequency, subjectivity and spontaneity, for a long time, the metacognitive experiences like déjà vu, jamais vu and TOT have been researched through retrospective surveys (often including single yes/no questions asking if the respondents has ever experienced the phenomena), prospective surveys and sometimes case studies. However, in recent years, there has been a proliferation of tasks developed to produce these sensations in the laboratory based on theoretical

statements about how they are caused (see Chapter 1). This experimental approach is well exemplified by research into déjà vu.

Table 5.1

Example methodologies in empirical studies successfully generating spontaneous cognitive experiences in the laboratory

Phenomena	Methodology
Déjà vu	
Brown & Marsh (2009)	Priming methodology similar to Jacoby & Whitehouse (1989)
Cleary et al. (2009); Cleary et al., (2012)	Recognition without identification (RWI) paradigm
Urquhart & O'Connor (2014)	DRM inspired recognition task (Deese, 1959; Roediger & McDermott, 1995)
Jamais vu	
Severance & Washburn (1907); Titchener (1919)	'Loss of associative power' in words
Balota & Black (1997)	Semantic satiation using a semantic memory paradigm
Moulin et al. (2022)	Repeated writing
Tip-of-the-tongue	
Brown & McNeil (1966); Schwartz (2010)	Word definitions
Metcalfe et al. (1993)	Cue familiarity using word pair association task
Schwartz & Smith (1997)	Cue-to-target using fictional animal pictures
Cleary & Specker (2007); Cleary & Reyes (2009)	Recognition without identification (RWI) paradigm
Error detection	
Charles et al. (2013)	Masking paradigm
Rabbitt (1978); Rabbitt & Vyas 1981	Target identification task
Yeung et al. (2004)	Conflict monitoring using Eriksen-flanker task
Involuntary memories	

Mace (2006)	Word-cue method prompting the retrieval
Ball (2007)	Free association paradigm
Watkins et al. (2005)	30-min think-aloud task
Schlagman &Kvavilashvili (2008) ; Barzykowski et al. (2021)	Vigilance task detecting infrequent targets
Zoning out	
Seli et al. (2016)	Version of sustained-attention-to-response tasks (SART; Robertson et al., 1997)
Schooler et al. (2004)	Reading task
Smallwood et al. (2007)	Go-no-go task
Seli et al. (2013)	Metronome Response Tasks (MRT)

5.1.1. Déjà vu

Déjà vu, a brief experience accompanied by erroneous feeling of familiarity whilst knowing that the familiarity is false, is more likely to occur for familiar places and people, scenes, and conversations. Following the publication of influential review by Brown (2003), there has been upsurge in the experiments inducing déjà vu and related experiences in laboratory settings (Moulin, 2018).

The experimental studies inducing déjà vu in laboratory draw on methodologies that focuses on studying cognitive processes. These methodologies integrate theories of déjà vu into a broader cognitive framework (Cleary & Brown, 2022) to produce déjà vu and offer empirical evidence for cognitive theories of déjà vu (Moulin, 2018). The basic conceptualization is that, inappropriate activation of familiarity leads to déjà vu experience, creating the subjective impression of memory retrieval, even though there is no such representation from the personal past is accessible (Brown, 2004). This idea that déjà vu might occurs when the relevant memory cannot be retrieved has inspired

experimental paradigms aimed at inducing déjà vu or something akin to it in a laboratory.

In early experiments, Brown and Marsh (2008) used an episodic memory recognition test design and explored how briefly exposing participants to stimuli (like images or scenes, without their conscious focus) could subtly change their beliefs about whether they had previously encountered that information to produce déjà vu - like experiences (Barzykowski & Moulin, 2023). In the encoding phase, Brown and Marsh (2008) presented undergraduate students pictures of various campus scenes, some from never-visited college campuses (unique campus photos), while others from their 'home' campus scenes. These pictures were presented for such a brief duration that participants could only catch a glimpse of them while focusing on another task requiring only superficial processing. A week later, participants were presented with pictures of scenes and asked to judge the likelihood of having visited each location before. Participants were more likely to say that they had visited a pictured location from a different campus if they had glanced at it prior week, compared to the pictured scenes that they had not seen before. Although Brown and Marsh's experiment did not explicitly tested déjà vu induction, the mechanisms implicated were clearly inspired by theories of déjà vu (Moulin, 2018). Their experiment evoked false beliefs about autobiographical memories. Notably, in the open-ended responses where participants volunteered whether they experienced a sense of confusion about whether they had visited the target location, nearly half of the participants reported experiencing déjà vu or something akin to it.

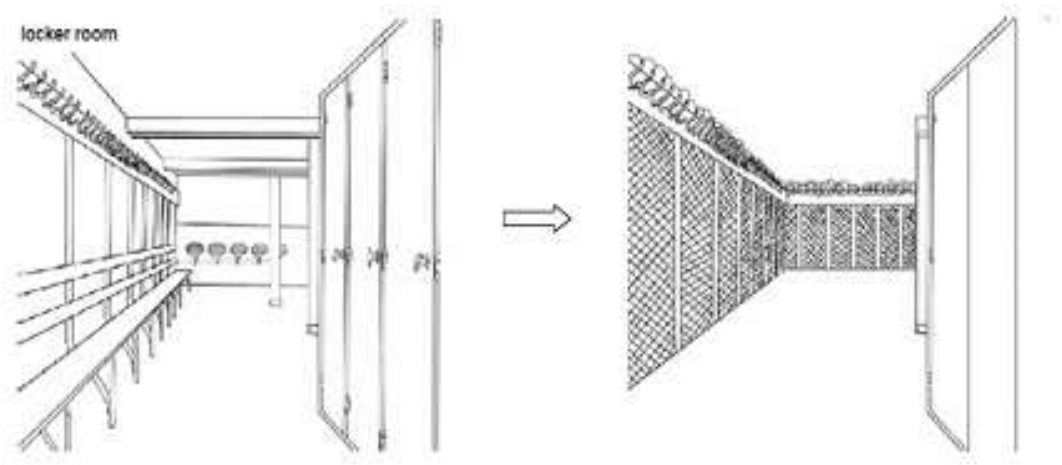
In a follow-up experiment, Brown and Marsh (2009) used a priming methodology with symbols, similar to Jacoby and Whitehouse (1989). They operationalised déjà vu as an experience occurring from the subliminal exposure to the identical stimulus

before being asked about its previous exposure. Twenty-four undergraduates participated in the study. The experiment did not have any study phase and participants were presented with either previously known (high and low familiarity symbols, for instance wheelchair symbol or the divide symbol being familiar) or novel symbols. Participants were primed with either different or identical or no symbol for 35ms. They asked participants if they had 'encountered' the symbols prior to participating in the study. Critically, they also asked the participants if they experienced déjà vu in response to symbols during the experiment. Fifty percent of the participants reported experiencing déjà vu at some point during the study. These experimental paradigms represent the cognitive 'double take' notion to provoke déjà vu like experience, that is, quickly glancing at a stimulus and subsequently processing the full information.

Cleary and colleagues (2009) propose that déjà vu experience occurs from the configural overlap in perception, rather than unattended processing of an identical stimulus. Based on Gestalt similarity hypothesis, the basic idea is that feeling of familiarity is generated by the certain configural similarity for the environment that specifically relates to one's personal past event though it is known that this feeling of familiarity is false. Cleary et al., (2009) used recognition without identification (RWI) paradigm to induce déjà vu in participants. RWI refers to a phenomenon where an individual recognizes a familiar stimulus without being able to identify specific details (Brown et al., 2013). In their experiment, undergraduate students studied black-and-white line scenes of room or a street with its labels, for instance landing strip (with an airplane in the air above the runway). These scenes were configurally similar to 'test' scenes (e.g. in Figure 5.1 the ceiling beams and rows of hooks in the picture of a locker room on left side corresponds to the barbed wire and horizontal support bars in the fenced area in the left picture, preserving the similar angled lines and spatial layout).

Although the specific elements differed in each scene, they shared large perceptual similarity. In the experiment participants were asked whether they had a déjà vu experience when they indicated that the scene was similar but were unable to recall the original. Results showed that participants were more likely to reported déjà vu when they identified a similar new scene as familiar (17 %) compared to when they identified an unrelated new scene as familiar (13 %).

Figure 5.1



Note: "*Example of possible named study scene (left column) and their corresponding configurally similar novel test scene (right column)"* (Cleary et al., 2009, p. 1084).

Subsequently, Cleary et al., (2012) produced déjà vu in the participants by using 3D virtual reality version of conceptually the same method. These virtual reality scenes were visually different (for example, an alley versus hallway) while sharing similar spatial structure, such as the arrangements of elements on a grid. Results showed that participants were more likely to report déjà vu for old scenes incorrectly identified as new (51%), 33% participants reported déjà vu for the perceptually similar scenes correctly identified as new and only 18% participants reported déjà vu for the new

scenes recognized as new. These studies used visual similarity between experimental scenes and previously encountered scenes to induce déjà vu in their participants.

Similarly, Urquhart and O'Connor (2014) directly manipulated familiarity and fluency processing of stimulus to generate déjà vu in undergraduate participants. In the experiment, they used a DRM inspired recognition task (Deese, 1959; Roediger & McDermott, 1995), to generate erroneous familiarity for critical words. In the study phase, participants studied list of words (e.g., rest, bed and blanket) which were semantically linked to an unpresented word (sleep) referred to as the critical lure (generating a sense of subjective familiarity). In their experiment, the DRM task was paired with an additional task of monitoring studied word for a feature present only in the critical lure (e.g., the starting letters 'sle') making participants to realise that some of these erroneous familiar words are in fact novel. Results showed that 60% of the participants reported déjà vu at least once in the experiment. Déjà vu reports were more frequent for high novelty critical words (25% of the time) than low novelty critical words (10% of the time). Conflict between information from the encoding phase and familiarity of stimulus generated déjà vu experience in the participants.

The literature suggests that déjà vu occurs more frequently for places and physical settings (Cleary & Brown, 2022) and also for situations configurally similar to our past experiences (Cleary et al., 2012). In the current experiment, we used pictures of Grenoble city (familiar) and cities in Pakistan (novel) to provoke déjà vu experiences. Additionally, we included French words (familiar) and French non-words (pseudowords) as stimuli. The use of multiple stimuli was intended to increase the likelihood of provoking déjà vu and other spontaneous cognitive experiences. Similar to Brown and Marsh's (2008) 'cognitive double take' methodology, in our experiment participants briefly viewed stimuli twice while engaged in a vigilance task. This dual

presentation of familiar and unfamiliar stimuli is expected to create a conflict between subjective familiarity and objective novelty, thereby maximizing the likelihood of déjà vu reports particularly for the novel Pakistan pictures. While we did not make hypothesis for déjà vu experience associated with word-related stimulus, we hypothesized that participants would more likely to report jamais vu for French words.

5.1.2. Jamais Vu

Jamais vu is a lack of familiarity with the familiar stimulus and often discussed alongside déjà vu but remains less frequently studied experimentally. Jamais vu typically arise for places and faces, occurring as a brief sensation that a familiar environment is unfamiliar or that a well-known person appears different. In some cases, it arises during procedural or repetitive tasks, such as sudden loss of fluency (Moulin et al., 2022). In the literature, the jamais vu experience has been conceptually linked to phenomena like 'word alienation' (e.g, spellings of words seem strange or wrong (Reed, 1974)) and 'semantic satiation' (repeating an oral pronunciation of a word until it loses its connotative meaning temporarily (Breese, 1921; Amster, 1964; Kounios et al., 2000; Cleary & Brown, 2022). Although its incidence and frequency in real life is significantly lower than déjà vu (Neppe, 1983; Brown, 2004), it is relatively easy to induce in the laboratory using repeated presentation or a 'dissociative staring' paradigm (Moulin et al., 2022; see below). However, based on the notion of word alienation and semantic satiation, some researchers have tried to generate these sensations in laboratory settings, aiming to produce jamais vu or similar experiences.

In early experiments, Severance and Washburn (1907) studied the 'loss of associative power' in words. In their experiment, all participants had 'a fair amount of introspection training' (p. 182) and were instructed to stare at the words printed on a white paper for three minutes and report all the changes associated with appearance

of the word. They noted how the words lost their meaning, became strange and perceptually fragmented over time. Similarly, Titchener (1919) reflected upon the similar phenomena but in spoken form. He proposed that saying a word out loud repeatedly, like “house”, the word would start to lose its meaning and sound strange, as if the word has become unfamiliar regardless of its familiarity.

Repeated checking has been linked to semantic satiation (Giele et al., 2013; Brown, 2004), which occurs when a word loses its meaning after being repeated or inspected excessively. This phenomenon, often studied in controlled experiments, reflects the brain’s habituation to excessive processing. Balota and Black (1997) studied semantic satiation in younger and older adults using a semantic memory paradigm. In their experiment participants repeatedly saw a word (e.g. dog) twice, 12 or 22 times, and then they were asked to judge whether pairs of words (e.g., dog–cat or dog-chair) were semantically related or not. Results showed that younger adults took longer (well-documented decrease in reaction time) to respond when a word has been repeated excessively suggesting semantic satiation. Whereas older adults did not show similar effect. Moreover, in their following experiment, Balota and Black investigated similar satiation effect using phonologically related words (e.g., same-claim, same-dime) but did not find any effect. While researchers haven’t observed semantic satiation for phonological representation, it has been found for face processing (Lewis & Ellis, 2000; Moulin, 2018).

Most recently, Moulin et al. (2022) conducted experiment building upon previous studies on semantic satiation (e.g., Amster, 1964; Kounios et al., 2000; Reed, 1974). In their experiment, participants wrote repeatedly one word for up to 120 times and later on they answered questions related to their subjective experience of the task. Participants were instructed to stop writing if the word began feeling ‘peculiar’. The trial

was classified as jamais vu experience, if participants stopped copying the word before 120 repetitions, and indicated that the 'word felt peculiar' and described it feeling unreal. Researchers tested this sensation using the words that varied in how frequently they are used in the language. They hypothesised that high frequency words are more likely to induce jamais vu because they are more familiar and creates stronger conflict when satiated by repetition. The findings confirmed that participants reported experiencing jamais vu more for the high frequency words than low frequency (less familiar) words during the word copying task. Moulin et al. suggest that an experimental paradigm successfully producing semantic satiation might also be useful for studying jamais vu experience and could also help in understanding its mechanism. While the current experiment does not use semantic satiation approach, it draws on the observed phenomenological and correlational similarities between déjà vu and jamais vu. These experiences often co-occur and are theorized to share similar metacognitive processes (conflict signalling) (see Chapter 1 and Chapter 2). Hence, we hypothesized that the conditions which provoke spontaneous feeling of familiarity (as in déjà vu) may also provoke its inverse (as in jamais vu).

5.1.3. Tip-of-the-tongue

In our experiment we also aimed to provoke tip-of-the-tongue (TOT) experience for word stimuli. TOT state is a subjective feeling of knowing for currently unretrievable information (O'Connor et al., 2021). In a typical TOT induction experiment, participants study a list of general questions or word definitions and then indicate whether they are experiencing a TOT state for each item. The TOT state was first studied empirically by Brown and McNeil (1966). In their experiment, participants studied the definitions of rare words and were instructed to generate the target word (for instance, ambergris, apse and so on). When participants could not recall the target word, they indicated

whether they were experiencing a TOT state. Later on, participants were provided with target words and asked if that was the word for which they experienced a TOT. Brown and McNeil found that participants often had parts of target words, even when they failed to come up with the whole word. These findings inspired the later experimental studies on TOTs.

Over the years, a variety of linguistic and non-linguistic (including pictures, sounds, faces and odors) cues has been used to study TOTs in the laboratory (for a review see Brown (2012)). Some of these empirical studies use target related words either prior to or following the definition with the aim of influencing the rate of TOTs or resolution probability by facilitating or blocking access to target word (Brown, 2012). Schwartz (2010) used definition cue to induce TOTs and study its association with emotions. Thirty university students participated in the study and answered list of general information questions. Participants were instructed to take their time and refrain from guessing. Questions were displayed on the computer screen, and participants proceeded to the next question on successful recall. However, if unsuccessful, they were asked to indicate whether they were experiencing a TOT. Incorrect answers were not followed by TOT judgment. Participants then rated the emotional intensity and frustration associated with TOT states. Finally, participants took a recognition test for the same questions. Overall, participants reported 30% TOT rate in the study. Results further indicated that more TOTs (38%) were reported for question following emotional arousal compared to the neutral ones, suggesting that emotional cues increase the likelihood of TOTs. However, Jersakova et al. (2015) failed to replicate the similar findings in their experiment, demonstrating that emotions do not impact semantic TOT reports.

Metcalfe et al. (1993) conducted an experiment to study how cue familiarity influences TOTs and feeling of knowing judgements using word pair association task. Participants studied word pairs (like, “captain – carbon”). In one condition, both the cue (“captain”) and target (“carbon”) were shown together twice (A-B, A-B). In the second condition, the cue was shown again, but with an unrelated target (A-B, A-D). In the third condition, neither the cue nor the target was repeated (A-B, C-D). After the study phase, participants attempted to recall the target word when provided with the cue word. On unsuccessful recall, participants reported whether they experienced a TOT. Results indicated higher TOT rates in the A-B, A-D (lowest recall) conditions, suggesting that people rely on cue familiarity rather than direct access to the target when experiencing a TOT state.

Schwartz and Smith (1997) induced TOTs in a laboratory setting using pictures of fictional animals, known as TOTimals. The experiment consisted of three phases, that is, target learning, recall and recognition. During learning phase, participants studied the animal names, their countries and additional information under three conditions: minimal (name – country pair only), medium (name – country pair with a drawing of the animal), and maximum (name – country pair, drawing and biographical details, such as, size, diet, etc). In the recall phase, participants were given the country name (e.g., Panama) and asked to recall the target name (e.g., *yelkey*), reporting TOTs if unable to recall. In the recognition phase, they were given the country name and four potential answers (one correct and three distractors). Participants made recognition judgement for all the items, regardless of prior recall accuracy. Results showed high TOT rates in the medium and maximum information conditions (19%) compared to minimum information condition (11%) suggesting that a TOT state is often influenced

by the amount of information you can retrieve and not necessarily how well the target word has been memorized (also see Koriat, 1993, 1995).

Additionally, TOT states have been studied in the laboratory using the "recognition without identification" (RWI) paradigm, which has also been used in the generation of déjà vu (as above). Cleary and Specker (2007) used this paradigm to investigate TOTs in undergraduate students. During the encoding phase, participants studied the names of celebrities. In the recognition phase, participants saw pictures of celebrity faces, half of which corresponded to previously studied names and half to unstudied names. During the recognition test, participants attempted to name the celebrity picture presented. On successful identification, participants rated the likelihood that the name had been studied. However, if they could not identify the face on the first attempt, they reported whether they experienced a TOT state and were given a second chance to identify the face or asked to take a guess if they still do not know the name. Results indicated that the mean proportion of unidentified celebrity faces eliciting TOT states was similar for both studied (31%) and unstudied (33%) names, suggesting that face familiarity, rather than prior exposure to the name, influenced the TOT state.

Cleary and Reyes (2009) further extended this approach to famous scenes, landmarks and buildings (e.g., Taj Mahal, Eiffel Tower, Fallingwater). Their findings showed overall 9% of TOT rates in experiment 1 and 11% in experiment 2, and participants reported higher recognition for the non-studied item when experiencing a TOT state, supporting the role of stimulus familiarity in eliciting TOTs (Brown 2012). In the current study, we are using repetitive verbal and non-verbal stimuli, however, there is neither a study phase nor a recognition test, hence we are not sure if participants will report TOTs, insofar as we are not asking to retrieve any information. As such, the

participants will not be assessing the success of their retrieval or trying to recall information related to the image. In this experiment we are simply exploring the possibility of provoking TOT state using multiple stimuli.

5.1.4. Error Detection

In metacognition, detecting and correcting errors are important components of monitoring and self-regulation. Error detection, one of the ciritical aspect of cognitive control (Logan & Crump, 2010), includes identification of a mismatch between inputs and the established mental framework or expectation, often triggering subjective feelings of confusion (Winograd & Johnston, 1982). Errors are an inherent part of human behaviour (Rabbitt, 1966; Norman, 1981) and their consequences can sometimes cause annoyance. While error detection often includes conscious deliberation, especially in complex scenarios, sometimes it can also be automatic and unconscious (Charles et al., 2017) and can occur either during or after an error has been made (Dams-O'Connor & Shuman-Paretsky, 2018).

Studies on understanding of error detection in humans use experimental paradigms that range from simple tasks such as pressing a button to more complex designs. These studies often rely on behavioural, subjective and neural measures to study the underlying mechanisms of error detection (Logan & Crump, 2010). One of the most studied neural markers of error detection in laboratory is error-related negativity (ERN), an event-related potential (ERP) observed in electroencephalography (EEG). ERN typically peaks at fronto-central electrodes approximately 100 ms after an erroneous response (Dehaene et al., 1994; Falkenstein et al., 2000; Gehring et al., 1993). Error detection is associated with activity in the anterior cingulate cortex, a region linked to conflict monitoring and cognitive control (and implicated in metacognition more generally and déjà vu, see Chapter 1). By tracking ERN, researchers can study error

processing in real-time and relate it to behavioral and subjective measures of metacognitive monitoring (Charles et al., 2013).

Experimental paradigms study error detection, by inducing errors and measuring participants' ability to detect them. For instance, Charles et al. (2013) used a masking paradigm to study error detection during a number comparison task. Participants briefly saw target digits (1,4,6, or 9) for 16 ms on a computer screen with a white background followed by a masking stimulus (four letters; two E's and two M's for 250 ms). The timing between the target and the mask varied across the trials (16-100 ms) influencing the visibility of the target, and in some trials, participants only saw the mask and no target (mask-only condition). Participants indicated if the target number was smaller or larger than 5 using a button press.

In Charles et al.'s first experiment, to induce errors, participants were instructed to respond within 550ms to avoid a penalty sound, generating time pressure. However, in their second experiment, there was no time pressure or penalties, allowing for comparison across conditions. After each trial, participants reported whether they saw the target (visibility task) and whether they thought they had made an error (performance evaluation task). The results showed that under time pressure, participants detected their errors better than chance even when unaware of their mistakes. However, under reduced time pressure, both task performance and error detection improved suggesting that people can detect their errors even without being fully aware of their mistakes and benefit from more time processing.

Rabbitt and colleagues (Rabbitt, 1978; Rabbitt & Vyas, 1981) used two behavioral measures to study error detection. In one experiment (Rabbitt, 1978), participants identified the target letters from the letter displays on a cathode ray tube (CRT) screen, which contained either 5 or 9 letters, some including a target letter. Participants viewed

the displays for 2 ms, with a 50 ms interval between displays. In another experiment (Rabbitt & Vyas, 1981), participants performed a tone discrimination task, recognising one of two tones differing by 200 Hz ("Easy" condition) or 25 Hz ("Difficult" condition). In both experiments, participants had to either indicate an error detection by pressing a neutral key or all response keys (error signaling response; ESR) or correct errors instantly with correct response (error correction response; ECR). The duration of error responses was measured as the time elapsed between the erroneous response and the respective detection response.

An alternative approach to study error detection is conflict monitoring using Eriksen-flanker task. In an Eriksen-flanker task (Eriksen & Eriksen, 1974), a target stimulus is flanked by several similar non-target stimulus. The participants have to press a button corresponding to the target stimuli. A trial is congruent if the distractors are identical to the central target stimulus, whereas the trial is incongruent if the distractors differ from the target stimulus (also see Botvinick et al., 1999; Scheffers & Coles, 2000; Steinhauser et al., 2008). Yeung and colleagues (2004) used the flanker task to study error detection and its underlying mechanism. In this experiment undergraduates performed a flanker task where they responded to the direction of a central arrow flanked by congruent (e.g., >>>>) or incongruent stimuli (e.g., >><>>). Stimuli were presented briefly (100 ms), followed by a blank screen (500 ms) during a random intertrial interval (1,000–1,100 ms). Participants completed practice and data-collection blocks, with feedback on reaction time and error rate provided after each block. They were instructed to adjust their speed or accuracy based on their error rate and minimize movement and blinking during the task. Behavioral and ERP data revealed that errors are detected by recognizing the mental conflict that arises after an

error has been made, supporting the idea that conflict monitoring is a key mechanism for error detection.

5.1.5. Involuntary Autobiographical Memories

Despite their prevalence in daily life, IAMs have received relatively less attention in empirical studies, and has predominantly relied on diary and questionnaire methods (e.g., Berntsen & Hall, 2004; Berntsen, 1996, 1998, 2001; Kvavilashvili & Mandler, 2004; Mace, 2004, 2005, 2006; Berntsen & Rubin, 2002). Results from initial diary studies indicates that most IAMs are triggered by the external or environmental cues (e.g., objects, scenes, themes and so on) as opposed to internal cues (e.g., bodily sensation and emotional state) (Ball & Little, 2006; Berntsen, 1998; Kvavilashvili & Mandler, 2004; Mace, 2004; Schlagman et al., 2007).

Different methodologies have been used to produce IAMs in laboratory. For instance, Mace (2006) elicited involuntary memories using word-cue method to prompt the retrieval. Participants received 20 phrase cues (e.g., “being at the movies, sitting in class, being at a picnic, etc”). They were instructed to recall a personal memory from their high school years in response to each cue and report any involuntary memories triggered by these voluntary memories (so-called memory chaining) and the second memory could come from any time period. Participants also identified possible triggers of these involuntary memories. After completing their task, participants reviewed all their memories, categorizing them as either specific or summary memory and also indicated whether memory clusters were from same general event. The results showed that nearly half the time (in 46% cases) the recall of a voluntary memory was followed by the recall of an involuntary memory.

Conversely, Ball (2007) used a free association paradigm to generate IAMs in the laboratory. Participants were given high frequency semantic cues (e.g., ‘rain’,

'coffee', 'dog') and were instructed to generate continuous free associations to word cues for 20-30 seconds per word until stopped by the experimenter while being tape-recorded. After completing the three trials, participants listened to their recorded responses and then examined the types of memories that they produced. The results showed that participants reported involuntary memories during 86% of trials. Additionally, Watkins et al., (2005) elicited autobiographical memories in participants by using 30-min think-aloud task while simultaneously presenting a range of stimuli (such as pictures, music and scents). Participants were instructed to report any thoughts considered to be autobiographical memories. At the end of the session, participants verified the memories and indicated if those memories came to mind voluntarily or involuntarily.

Studies emphasize that IAMs are more likely to occur in diffused attentional state (Ball 2007; Bernsten, 2009). Giambra (1989, 1995) showed that undemanding vigilance tasks reliably induce task-unrelated thoughts or mind wandering, which are characteristic of many everyday habitual activities, such as washing up or brushing one's teeth (Smallwood & Schooler, 2006). Building on that, Schlagman and Kvavilashvili (2008) developed a method that attempts to simulate the conditions in which IAMs occur in everyday life (i.e., being engaged in low cognitive demanding task and being surrounded by stimuli that can act as incidental triggers). In their experiment, participants were required to detect 15 infrequent target slides with vertical lines in stream of 785 nontarget slides with horizontal lines (each presented for 1.5 seconds). In addition to lines, participants saw cue words in the centre of each slide (e.g. 'missed opportunity,' 'a wonderful oppurtunity' or 'crossing the road') and were told to ignore them. Their task was to detect slides with vertical lines, and additionally to report any involuntary autobiographical memory that had come to mind at any point during the

task. Results showed that, participants reported on average approximately 6 involuntary memories during the 800 slide long presentations (ranging from 1 to 24), and the most of the IAMs reported were triggered by irrelevant cue words presented on the slides.

Recently Barzykowski et al., (2021) conducted an experiment using the paradigm designed by Schlagman and Kvavilashvili (2008), however, with slight modification. In their experiment participants completed the vigilant task of detecting patterns of vertical lines (7 target slides) in a stream of 393 non-target slides with horizontal lines (each presented for 2 seconds) containing short verbal phrases in the centre of each slide (e.g., 'driving a bike', 'romantic dinner' etc). Participants were instructed to write down and rate each time an involuntary thought occurred during the vigilance task. Results indicated that participants generated a mean of 5.51 (6.55) IAMs (ranging from 0 to 31) during the experiment. In our experimental study, we used a similar paradigm with an attempt to provoke IAM and other spontaneous cognitive experiences.

5.1.6. Zoning Out

Interestingly, such vigilance tasks (e.g. Schlagman & Kvavilashvili, 2008) has also been used to study mind wandering (see Pelagatti et al., 2020 for details) and zoning out (for an explanation of the difference of the two, see Chapter 1). Studies assert that mind wandering involves controlled processing that can occur without intention or even awareness (Schooler, 2002). This distinction is central to studies on intentional and unintentional mind wandering (Seli et al., 2016; Seli et al.,2015; Forster & Lavie, 2009). For instance, Seli et al., (2016) examined the intentional and unintentional mind wandering during an easy and difficult version of sustained-attention-to-response task (SART; Robertson et al., 1997). In their experiment, 113 undergraduates completed

one of the two versions of the task and responded to thought probes measuring intentional and unintentional mind wandering. In the difficult task version, participants saw digits (1-9) for 250 milliseconds on a screen in a random order, followed by a mask ("x") for 900 milliseconds. There were 900 trials in which each block had nine trials with different type sizes (48 to 120 points). Participants were instructed to press the space bar for all digits except 3 (no-go digit). In the easy version (sequential SART) the task was the same as the difficult version, however, digits were shown in a sequential order. Throughout the task, participants were randomly interrupted by thought probes after every 45 trials, and were asked to classify their mental state as task-focused, intentional or unintentional mind wandering. Results showed increased rates of unintentional mind wandering in the difficult task comparative to the easy task. They argue that intentional and unintentional mind wandering are conceptually similar to mind wandering with and without awareness (Smallwood et al., 2007), with their onset point determining if the mind wandering was intentional or unintentional.

Expanding on this idea, researchers have futher categorized mind wandering into two distinct types, tuning out and zoning out (see Schooler et al., 2011; Smallwood and Schooler, 2015) offering a nuanced framework for understanding the role of awareness and intention during the episode of mind wandering. In tuning out, people can be aware that their mind is wandering and, to some extent they are able to control their train of thoughts. Whereas, in zoning out, person is unaware that their mind is wandering – it is unintentional and lacks meta-awareness. However, people recognize that they were mind-wandering when they come to the end of the mind-wandering episode and are able to report its phenomenal content retrospectively (Seli et al., 2017). In our study, we focus on the occurrence and self-reporting of zoning out during

the long monotonous vigilance task and hypothesized that participants are likely to zone out frequently and report it the moment they realize their lapse in attention.

Researchers have investigated mind wandering and metacognition together (e.g., see Fox & Christoff, 2014; Preiss et al., 2016; Preiss et al., 2019; Schooler et al., 2011) however, empirical studies examining zoning out particularly in a laboratory setting are scant and often referred as mind wandering without awareness (e.g., see Seli et al., 2013; Smallwood et al., 2007; Smallwood & Schooler, 2015). Nevertheless, researches studying zoning out in laboratory setting have used approaches such as 'comprehension monitoring' (e.g., Brown, 1980), or 'metacomprehension' (e.g., Hacker, 1998) assessing reader's metacognitive strategies influencing monitoring and comprehension performance during reading tasks. Similalry, some studies use 'task-unrelated images and thoughts' methodology (TUITs; see Giambra, 1995; Singer, 1993, for reviews), in which participants perform a 'dull' vigilance task and report every time they have a task unrelated thought. For instance, in Giambra and Grodsky's (1989) experiment, participants read multiple passages that differed in terms of interest and difficulty. Each time participants had an intentional or unintentional TUIT, they pressed a response key to report it. They found that attentional demands were not related to TUIT reporting frequency, asserting that both difficult as well as easy text was same in generating TUITs, however boring text generated more TUITs than the easy text.

Schooler et al., (2004) investigated zoning out by asking participants read dull passages of text on their computer screen for 45 minutes while monitoring their mental states. Participants self-reported each time they caught themselves zoning out by keypress and intermittently answered "thought probes" enquiring whether they experienced mind wandering just before the presentation of the probes. Findings

revealed that participants often caught themselves zoned out on an average of 5.4 times while reading, but they were also caught zoned out by probes 13.2% of the time, often without prior awareness (approximately 67% of episodes). These zoning out episodes were found to be correlated with poor comprehension, suggesting that sometimes people mind-wander without complete awareness.

In another study, Smallwood et al., (2007) examined instances of zoning out in a simple go-no-go task. In their experiment participants saw words (from Jacoby, 1998) on their screen and pressed space bar in response. However, they were instructed to withhold their response when presented with target stimulus (XXXXX), which was randomly embedded in the stimuli list. During the task participants intermittently responded to thought probes enquiring if they experienced mind wandering with awareness (i.e., tuning-out) or without awareness (i.e., zoning out). Findings revealed that when participants were zoned out, their response times to go/no-go task were significantly fast than when they were tuned-out. This suggest that during zoning out, participants were more likely to function automatically or without actively processing the task, whereas tuning out involved a degree of self-awareness that slowed their response times. Similarly, other approache to study zoning out in laboratory includes Metronome Response Tasks (MRT) (Seli et al., 2013) in which participants monitor the passage of time to press a response key synchronously with a steady stream of aural beat (Seli et al., 2017) and respond to random thought probes inquiring the experience of zoning out.

Barzykowski and Moulin (2023) in their recent paper propose that spontaneous cognitive experiences like déjà vu and involuntary memories share similar cognitive process in a continuum – favouring an interaction between them. Both, déjà vu and IAM are subjective and spontaneous experiences, with déjà vu delivering a sense of

false familiarity and IAM delivering actual memory content. They hypothesized that experimental paradigm triggering IAMs should also trigger déjà vu experiences. They emphasize that as déjà vu is a spontaneous mental experience occurring without intention, it is not directly related to current goals of conscious processing, however, the environmental cues generating IAMs can also trigger déjà vu experience. Barzykowski and Moulin further argue that as IAMs and déjà vu are spontaneous phenomena and are independent of ongoing conscious processing, one may ask about their relationship with mind wandering. Mind wandering which occurs when instead of focusing on our surroundings, we drift away in thoughts (Zedelius et al., 2015) and since it is often unrelated to current context, it is possible that people might experience IAMs or déjà vu during typical mind wandering episodes. Hence, based on their continuum hypothesis, we proposed that in undemanding task during current experiment, in addition to reporting spontaneous thoughts like IAMs and zoning out, participants are also likely to report déjà vu and possibly other spontaneous metacognitive experiences like jamais vu, tip-of-the-tongue and error detection.

5.2. Probe versus Self-caught

One of the challenges in studying spontaneous metacognitive experiences, like déjà vu and TOT, is the lack of an objective and diagnostic measure of such experiences. As a result, researchers have to mostly rely on self-report methods, either in the form of retrospective questions or trial-by-trail prompting methods, where participants are asked at regular intervals to report their specific cognitive state (Cleary, 2014). While trail-by-trial probing is a common approach, particularly in TOT research and often in déjà vu, O'Connor and Moulin (2010) point out that prompting on every trial may enhance the frequency reporting of the experiences. Jersakova et al. (2016) suggest that free reporting is a better method than trial-by-trial probing. Jersakova and

colleagues demonstrated across series of experiments that trial-by-trial prompting led to significantly high reporting of déjà vu and TOT experiences compared to free reporting (self-caught) methods. They argue that probing method may introduce response bias, as participants may infer that they are expected to experience and respond accordingly. However, Cleary et al. (2020) suggest that free reporting methods may lead to underreporting, not because the experiences are absent, but because self-monitoring divides the attention between the primary task and the need to detect and report one's cognitive state. In our study we employed a self-caught (free reporting) method, in which participants were instructed to press a key whenever they have a thought or experience. While, this may increase the monitoring demands, we used this approach to reduce the response bias. Moreover, self-caught method has been successfully used in the study of other spontaneous cognitive phenomena, including error detection (Charles et al., 2013), IAMs (Barzykowski et al., 2021) and even zoning out (Schooler et al., 2004).

5.3. The Current Study

The experimental paradigm we used in the current study included engaging participants in monotonous vigilance task requiring little attention. Participants were required to detect infrequent target vertical lines in the long boring stream of non-target slides with horizontal lines, while exposed to irrelevant stimulus. We proposed that during the boring vigilance task, participants are likely to report error detection when they forget their primary task, that is, to press "v" button on seeing vertical lines on the screen. In our experiment, participants were further instructed to report any spontaneous thought occurred during the vigilance task. Such study paradigm is usually used to produce involuntary autobiographical memories which are personal past memory that automatically pops into our mind without the intention of retrieving it.

Such memories do not require any conscious search and occur fast and effortless during activities requiring minimal cognition, for example, washing dishes, or ironing etc (Barzykowski et al., 2019; Moulin et al., 2022).

Across the range of experimental paradigm reviewed in introduction section, eliciting spontaneous metacognitive experiences (déjà vu, jamais vu, TOT, error detection) and spontaneous thoughts (IAMs and zoning out), a pattern emerges. These paradigms reflect key features of established experimental tasks, they consistently rely on repetition, low cognitive demand, superficial processing, and subtle stimulus exposure. For instance, déjà vu has often been induced using brief or subliminal exposure to stimuli and relying on the 'cognitive double-take' effect (e.g., Cleary et al., 2009; Brown & Marsh, 2008, 2009). While jamais vu has been induced using repetitive overexposure to familiar stimuli, leading to semantic satiation (e.g., Moulin et al., 2022). Our study mirrors these approaches by engaging participants in a repetitive, low-effort vigilance task with brief dual exposures to both familiar and unfamiliar visual and verbal stimuli, conditions known to trigger both a sense of false familiarity and unfamiliarity. Although, our paradigm did not induce errors through time pressure or complex stimuli, it enabled spontaneous error detection, with participants occasionally realizing they had forgotten task instructions or missed a response (e.g., Charles et al., 2013; Rabbitt, 1978). The dull and monotonous vigilance task reliably trigger mind wandering in the form of IAMs and zoning out (e.g., Schlagman & Kvavilashvili, 2008; Smallwood et al., 2007).

While TOT has not previously studied in low-level repetitive vigilance tasks, there is precedent for conceptual overlap in the literature. Both déjà vu and TOT have also been successfully induced using the recognition without identification (RWI) paradigm (e.g., Cleary et al., 2009; Cleary & Specker, 2007), in which stimuli feels

familiar even in the absence of full recognition. Although our task does not replicate this structure, it shares some conceptual similarities, like the presence of brief, potentially familiar stimuli not requiring full retrieval, which raises the question if it is possible that similar mechanisms might be involved.

As emphasized in the literature and proposed by Barzykowski and Moulin (2023), indulging in a task requiring low cognitive demand can generate an episode of mind wandering, and based on their hypothesis, environmental cues generating IAMs should also generate metacognitive experiences like déjà vu. Thus, the overall goal of the present study was to replicate the experimental methodology that previously has been successful in generating IAMs in laboratory settings and explore the possibility of provoking other spontaneous cognitive experiences like déjà vu, jamais vu, TOTs, error detection and zoning out. This is an exploratory experimental study using different stimulus to provoke six spontaneous phenomena, hence we cannot be sure that all phenomena will relate to each other or will be experienced by the participants during the experiment. Additionally, we aimed to explore the phenomenology characteristics of six experiences, that is, if the experienced reported in the experiment are different from the real-life experiences in term of spontaneity and strength and also their focus on the task. Furthermore, we assessed the subjective judgment of intensity and frequency for both their real-life and experimentally provoked experiences.

5.4. Method

5.4.1. Participants

A total of 103 French-speaking psychology undergraduates' (91 females, Age Mean (SD) = 20.24 (3.08)) participated in this study in return for course points. They gave their written consent for participation prior to data collection. Four participants had a very high count of false alerts (135, 386, 48 and 158 button presses) and three

participants did not report any thoughts or experiences so they were excluded from the analyses. The final sample therefore consisted of 96 participants (84 females, Age Mean (SD) = 20.25 (3.17)).

5.4.2. Design and Material

The experiment was built on “psychopy” (2022.1.1 Builder). The experimental study paradigm was inspired by an experimental study carried out by Barzykowski et al. (2021) to investigate potential efforts for voluntary and involuntary memory retrieval. Similar to their experiment, participants were informed that the experiment consists of a vigilance task of detecting patterns of vertical lines (8 targeted slides) in a stream of 392 non-targeted slides with horizontal lines with random sizes and positions. In this experiment the stimuli were presented twice in repetitive manner, we used (repetitive) 50 street pictures of Grenoble, 50 street pictures of Pakistan, 50 French words (e.g., *geste*; *soupe*) and 50 French pseudowords (e.g., *turoge*; *bilude*) in picture format. The words used in the experiment were derived from an online website “lexique.org” (Lexique, n.d.) and words were selected based on specific criteria such as the word should be of low frequency, consisting of 5-7 letters. The stimuli/pictures were presented for 4 seconds on the computer screen. The horizontal and vertical lines appeared on these stimuli/pictures. We generated different random sequence of pictures and vertical and horizontal lines for each participant.

Participants were provided with written instructions and definitions of the six cognitive experiences as derived from the study in Chapter 2 to make sure participants understand the instructions and experience that they might experience during the vigilance task. During the experiment, participants recorded the details related to their thoughts in a response section. The response section had questions like, (i) Was your thought related to the image or the word you saw in the experiment? Would you like to

share the thought that came to mind? (Participants typed their response in the response box), (ii) Which of the following experiences did you have during the task? (Choose from the options provided by clicking on them) – Déjà vu/ jamais vu/tip-of-the-tongue/IAM/error detection/zoning out/other. (iii) How spontaneous did you feel the experience was? - Using a rating scale participant chose between “0” being not at all to “1” being completely spontaneous. (iv) How would you describe the strength of the experience? - Using a rating scale participant will choose between “0” being extremely weak experience to “1” being extremely strong experience. (v) How focused do you think you were on the task? - Using a rating scale participant chose between “0” not at all focused to “1” completely focused. The rating scales used in the response section were with fine scale granularity and all arithmetical points on this scale were possible between 0 and 1.

At the end of the experiment, participants filled out a short questionnaire on which they reported the frequency of six phenomena in the last year by choosing one option from 0,1-2, 3-5, 6-10,11-20,21-50,51-100 or more than 100. For example, “How many times have you experienced déjà vu in the last year?” and so on. Participants also reported the frequency of experiences during the experiment using a scale from 0 to (more than) 10. Additionally, participants reported intensity of the real world and experimental phenomena using a Likert-type scale. For example, “How intense was the experience of déjà vu during the experiment”, and “How intense is the experience of déjà vu in everyday life?” with 1 being very weak and 4 being very strong.

5.4.3. Procedure

Participants were tested individually. Each experiment session lasted between 40 to 60 minutes. Participants were told that they were taking part in vigilance task of detecting infrequent vertical lines. Participants were instructed to press “v” on their

keyboard each time they detect targeted stimuli. Additionally, participants were informed that they would also see pictures and words, but they were instructed to ignore those. Participants were further explained that because the task is repetitive and quite monotonous, they could have some thoughts, which could be related or unrelated to the task and is quite normal. In particular, participants were informed that we are interested in six experiences listed in the instructions. They were instructed to report any thought that comes to the mind by pressing “spacebar” on their keyboard, which would pause the vigilance task and record the thought. After reading the written instructions, participants were given brief, example/practice slides on the computer screen so that the participants get an idea of what the experiment looks like and what is their task to avoid any confusion.

Once the experimenter was certain that the instructions were understood, the participants started the task. Whenever participants pressed “spacebar” to record the thought they had, it would pause the experiment and take them to the response section for unlimited time interval. After answering these questions participants would return to the experiment by pressing the “continue” on the keyboard.

5.5. Results

Participants completed the vigilance task of detecting target slides with vertical lines by correctly pressing the “v” button. On average, participants detected 6.95 target slides out of 8 (*SD* = 1.20).

5.5.1. Thought Button Presses

On average, participants pressed the space bar approximately 29.80 times during the experiment to report a thought or experience (i.e. approximately 7% of all trials). Before proceeding with further data analyses, we reviewed the qualitative data to ensure that

the reported experiences corresponded to the descriptions of the experiences/thoughts reported by the participants during the task.

The vast majority of trials (93%) did not yield any particular experience; the trial ended without the participant pressing the space bar. There were a total of 2852 space button presses across all participants. On the majority of occasions, the participant volunteered a text response indicating if there was any particular trigger for the thought or experience, and a brief description of it. The number of statements given, the initial classification and the final classifications after verification are given in Table 5.2.

Table 5.2

Classifications of subjective experiences following space button press

Experience	Original Experiences Classified by Participants	Classifications without descriptions	Experiences reclassified by experimenters according to descriptions	Final classifications - number of experiences (%)
Déjà vu	847	169	160	692 (24%)
Jamais vu	427	18	29	401 (14%)
TOT	70	5	12	58 (2%)
Error detection	232	26	21	212(7%)
IAM	578	35	38	639 (22%)
Zoning out	307	55	103	204 (7%)
Other	371	32	15	646 (23%)
Not classified	23	-	23	-

Note: TOT = tip-of-the-tongue; IAM = involuntary autobiographical memory.

The research team verified the classifications according to the example text proposed by the participant as a justification. Of the 678 experiences classified as déjà vu by the participant and where a description had been left, 160 (23%) were recoded. 66 of these 160 experiences (41%) were recoded as IAMs (e.g. "*Childhood vacation in Spain*"; "*I remembered the first time I went to this amphitheater, Louis Veil*"). The remaining responses were all recoded as 'other'. These included descriptions of identifications of the image without any other content, e.g. "*University*", perceptual

descriptions "*the steps remind me of the big stairs of temples*", and reflections on the experiment: "*I know I've seen these images, but I want it to end*". Examples of statements from the remaining 518 déjà vu experiences in the experiment are given in Table 5.3.

Of the 409 experiences classified as jamais vu where the participant had offered a description, 29 experiences were recoded. Majority of these recoded responses (7%) were changed to 'other'. Most of these statements described the similarity between a nonword and a real word (e.g. "*resembles the word "laundry*""; "*unknown word but reminds me of "pill*""). There were three responses recoded as IAMs (e.g. *"I was thinking of a road trip with my friends"*) and three instances of déjà vu (e.g. *"no, impression of having been there but probably a false idea"*). Because the experiment included both real words and nonwords, it is sometimes difficult to interpret whether the described response is a false impression of unreality or mis-spelling of a real word, or it refers to the identification of a nonword. Table 5.3 clearly shows a few instances of unfamiliarity and unreality for words and pictures, and notably shows that people press the space bar for a trial which is after the one which has triggered the experience.

Of the 206 experiences classified as error detection with descriptions given by the participants, 21 (10%) were recoded. Participants described 4 experiences (19% of recoded statements) which could be classified as IAMs (e.g. "*I got lost in my thought*, *I saw myself eating an ice cream on the beach*") and 17 which were classified as other, with descriptions of the stimuli (e.g. "*an abandoned building*"), or reflections about the stimuli ("*why is there a picnic table in the middle of a pedestrian path?*"). Of the remaining 185 statements, it was clear that the participants were able to describe instances of spontaneous error detection, although in the statements given it is sometimes difficult to evaluate whether participant is reporting a subjective experience

of an error, or their objective evaluation of an error in the experiment: "*related to the word, I focused on the mistake in the word*". Yet other examples were similar to jamais vu descriptions: "*related to the word, doubting if it's spelled correctly*".

Of the 540 experiences classified as Involuntary autobiographical memories where the participant had left a description, 38 experiences were recoded (7%). Again, these were mostly recoded as 'other' (94%) with the statement describing or identifying the image rather than clearly evoking a spontaneous experience or thought e.g. "*image, (my girlfriend lives over there)"; "I recognized the campus*". Two experiences were recoded as déjà vu: *"I have already been here"* and *"Image, Feeling of having already visited the place"*, although a three of the IAM descriptions also made reference to déjà vu, they were not recoded (e.g. "*I also felt déjà vu*"). Examples of the comments are given in Table 5.3.

Of the 252 experiences classified as zoning out by the participant and where a description was left, 103 (41%) were reclassified. The zoning out category did include metacognitive experiences of being aware of having zoned out (see Table 5.3), but it also contained a lot of descriptions which described the contents of their mind wandering, including future intentions, plans or reminders for the near future (e.g. "*none, I was thinking about what I'll do tonight*";" *did I start the washing machine?*"; *I thought about what I'll do this weekend, and when I saw the photo, I imagined a fashion show*); metacognitive reflections on the task ("*I wondered where the vertical lines are*"; "*the previous word lasted longer than the others*"); descriptions of the stimuli ("*there's snow on the ground*"; *"image, I wonder where this photo was taken*"); and emotional and physiological states ("*can't wait for it to end*"). As such, of the reclassified experiences, 90% were changed to 'other', consistent with the classification for 'other' experiences (above). There were also descriptions (9%) for which the experience was

reclassified as an IAM (e.g. *"linked to the image, the sign saying "early childhood" made me think of my brothers when they were babies*"; "*my house move*") and there was one experience reclassified as jamais vu ("*I'm thinking about not knowing this word and wondering if it's because it doesn't exist*").

Of the 339 times the participants pressed the space bar and classified their experience as 'other' and left a description of the experience, 15 (4%) of the statements were recoded as other experiences. The majority (87%) of these 15 were recoded as IAMs (e.g. "*Memory of this morning's shower*"; "*No, I was remembering a conversation I had during a carpool ride"*). The statements in the 'other' category (see Table 5.3) often featured future intentions, plans or reminders for the near future; metacognitive reflections on the task; descriptions of the stimuli; and emotional and physiological states (boredom, hunger, tiredness).

Table 5.3

Some examples of descriptions of experiences in the experiment. Translations performed in ChatGPT 4o

Experience	Example Description
Déjà vu	*déjà vu, feeling of having been there even though I haven't;* *already seen, but I have no memory of ever going there;* *I feel like I know the place in the image but I can't recognize it;* *the image is related, I feel like I've already seen it even though I think it's not the case in reality;* *the last three words gave me the impression of having already seen them, but I'm not sure;* *recognize a building in the background and therefore think I recognize the street even though I've never seen it before;*
Jamais vu	*at first glance, I thought the spelling was wrong, but after several readings, I don't think so anymore;* *does this word really exist? I feel like it's fake, it's funny;* *doubt about the word's spelling;* *same as previously, strange lighting, seems unreal/photoshopped;* *Image. Feels like it was taken from a slightly shifted angle;* *The word "union" didn't seem familiar to me;*

	correct spelling seemed wrong; *not this word but the previous one ("bottle"), I no longer recognized the word*
TOT	*with the word "rensse," it reminds me of another word I know, but I can't remember it;* *Searching for an old friend's nickname that resembled the displayed word "Baneau";* *it reminded me of a word, but I couldn't remember which one;* *I was looking for the meaning of this word because I feel like I know it;* *it made me think of a song, but I don't remember the title;*
Error detection	*pressed the space bar instead of "v" to detect vertical bars;* *of the word, I realized after a second reading that I had misunderstood the word;* *I feel like I missed something;* *oops, I made a mistake;* *unrelated to the image, I forgot to send an SMS*
Involuntary memories	*after my workday, one evening it was foggy and raining;* *involuntary autobiographical memory: street I often take to go to university with friends, hence memories of the times spent with them;* *memory linked to the word "shower" about a situation when I arrived in Grenoble for my studies;* *holiday memories related to the slide, memory of a specific place and event there;* *memory of a funfair where I ate caramelized peanuts*
Zoning out	*To a word: I thought about how many times it appeared, and I ended up disconnecting from the experiment;* *abstraction of everything except a small fixed point;* *neither of the two, I lost my train of thought! I wanted to press the other key and got it wrong, I wasn't paying attention;* *slide, I wondered what I was doing in this booth, it even made me smile;* *slide, I just lost my concentration for at least 13 slides, I hope I didn't miss any vertical lines, I was thinking about everything and nothing, replaying my choices and actions over the week;* *image and word, I drifted off in my thoughts again, but I don't even remember what I was thinking about, all I know is that I lost track;* *I feel like an automaton;* *No. Aware that I got distracted*
Other	*wanting to sleep and thinking about tonight's bed;* *it's not related to the image. I was thinking about my exam I'm going to take right after the experiment;* *slide, I was thinking about the fact that I'll eat soon, but I still don't know what, and also that I need to finish mopping at home;* *I forgot my water bottle;* *I have a song stuck in my head;* *I'm starting to get bored;*

	I'm thinking about the censorship of Baudelaire's works; *the word "cabinet" reminded me to make a dentist appointment;* *linked to the image, the cloud is shaped like a face;* *my thought wasn't linked to the image or word. I was wondering if the task would end soon;* *No. Is it really possible to have no intrusive thoughts with each presented image/word?;* *No. Thought that I can't seem to detect the vertical bars and need to make more effort to concentrate;* *not really related, I feel like I sometimes forget the task, and I think this will take a while;* *landscape resembling the United States, reminded me of movies;* *a thought about: where exactly was my finger on the "v" key*

Note: TOT = tip-of-the-tongue.

There were 23 instances of trials where the participant pressed the space bar, left a description but did not classify the experience. It was possible to classify these based on their description (e.g. "*a field where we used to play soccer with friends years ago*"; "*my thought isn't linked to the image*, *I find this experiment boring*").

The extent to which thought button presses (reporting the experiences) are reliable depends on how clearly and consistently participants described their experiences. For some phenomena, like déjà vu, error detection and IAMs, descriptions were detailed and aligned closely with theoretical perspective, supporting confidence in their accuracy. However, reports of jamais vu and TOT experiences were more ambiguous, and zoning out responses, though rich, often described the content of thought rather than attentional lapse, raising concern regarding their validity. However, the overall quality of the descriptions suggests that majority of the participants engaged thoughtfully with the task.

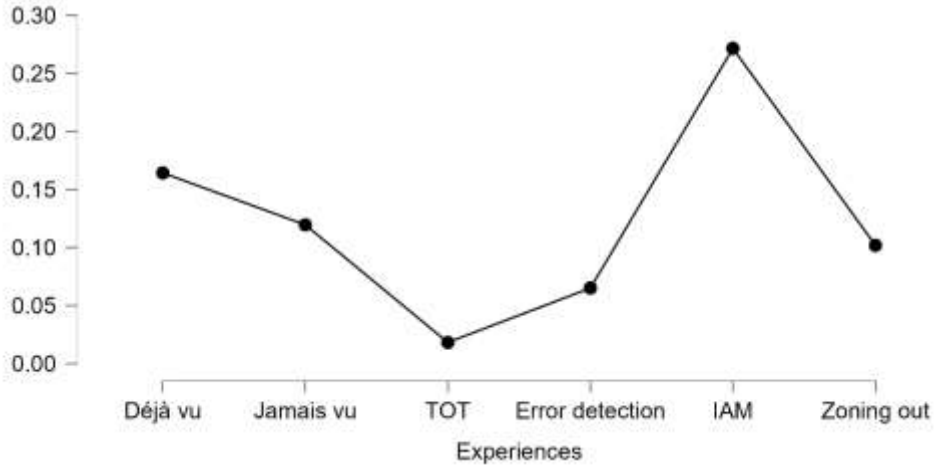
5.5.2. Experience Reporting

In the experiment each time a participant had a thought or an experience, they pressed the space bar to report it. We calculated the mean proportion of the six

experiences reported and the mean proportion of the participants reporting those experiences (see Table 5.4). Déjà vu made up 16% of button presses, experienced by 74% of participants. Jamais vu made up 12% of button presses, experienced by 57% of participants and TOT was least reported (2% average rate, 31% of participants). Similarly, error detection accounted for an average of 6% button presses, experienced by 53% of participants, whereas, IAMs were most frequently experienced, for a mean of 27% of participant's button presses, with 90% of the sample reporting at least one experience. Zoning out made up 10% of button presses, experienced by 66% of participants.

To examine whether there were differences in frequency across these experiences, we conducted an ANOVA. For experimental frequency, ANOVA showed a significant difference across experiences, F (5, 475) = 31.64, *p*=.000, partial eta squared = .25. IAMs were the most frequent experience, which were significantly more frequent than déjà vu (p<.001), which in turn was significantly more than jamais vu (p=.045), which was not significantly more frequent than zoning out (p=.041), which was not significantly more frequent than error detection (p=.097). TOTs were the least frequent experience. In sum, zoning out and error detection do not differ from each other in frequency but they were less frequent than IAMs, déjà vu and jamais vu but more frequent than TOTs (see Figure 5.2).

Figure 5.2



Note: TOT = tip-of-the-tongue; IAM = Involuntary autobiographical memory

Table 5.4

Participants Reporting Spontaneous Experiences

Experiences	Button presses %	Participants Reporting %
Déjà vu	16	74
Jamais vu	12	57
Tip-of-the-tongue	2	31
Error detection	6	53
Involuntary memories	27	90
Zoning out	10	66

5.5.3. Frequency of Experiences Across Picture and Word Stimuli

We did series of ANOVA analyses to examine the differences in experimental frequency of phenomena across different stimuli. ANOVA indicated significant differences across the stimuli, F (3, 285) = 9.38, p<.001, partial eta squared = .09. Participants responded significantly more often to French non-word stimuli, and least to Pakistan pictures. Responses to Grenoble pictures and French words were

significantly more than responses to Pakistan pictures (see Figure 5.3 and Annex VII for the overall mean for frequency of six experiences across different stimulus type).

For Grenoble pictures, ANOVA showed significant difference across experiences, F (5, 490) = 45.76, $p<.001$. IAMs were the most reported experience, which was significantly more frequent than déjà vu ($p<.001$), which in turn was significantly more frequent than zoning out, which was significantly more frequent than jamais vu ($p=.001$), which was not significantly more than TOTs, which was not more significant than error detection. Jamais vu, TOTs and error detection were the least reported experiences in response to Grenoble pictures, and did not differ from each other in frequency.

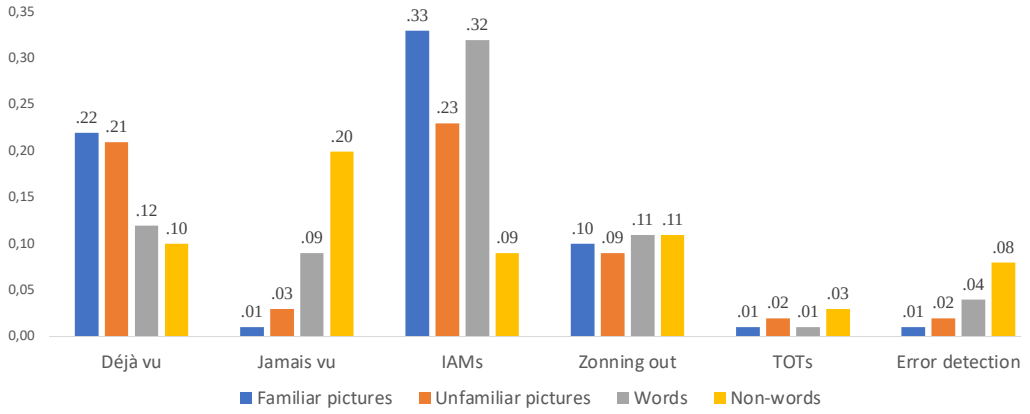
For Pakistan pictures, ANOVA showed significant difference across experiences, F (5, 475) = 20.55, $p<.001$. IAMs were the most reported experience, which was not significantly more frequent than déjà vu ($p=.55$). Déjà vu was significantly more frequent than zoning out ($p<.001$), which in turn was not significantly more frequent than jamais vu. Experiences like jamais vu, TOTs and error detection were the least frequent and did not differ from each other. Similarly, jamais vu and zoning out did not differ from each other in frequency in response to Pakistan pictures.

For French words, ANOVA showed significant difference across experiences, F (5, 475) = 23.44, $p<.001$. IAMs were the most frequently reported experience, which in turn was significantly more frequent than déjà vu ($p<.001$). Déjà vu did not differ from zoning out, which was significantly more than error detection ($p=.041$). TOT and error detection were the least reported experiences and did not differ from each other. Similarly, jamais vu did not differ from error detection and zoning out.

For French non-words, ANOVA showed significant difference across experiences, F (5, 475) = 6.48, p<.001. Jamais vu was the most frequent experience, which in turn was significantly more than zoning out (p=.017), which in turn was more frequent than TOTs (p=.003). Error detection was significantly more frequent than TOTs (p<.001). Déjà vu frequency in response to French non-word stimuli did not differ from error detection, IAMs and zoning out. Error detection did not differ from jamais vu. Additionally, TOT, error detection and IAM did not differ from each other.

Overall the results show that our experimental design successfully provoked range of cognitive experiences. As expected, IAMs were the most commonly reported phenomenon, however, we were able to provoke other experiences as well, including déjà vu, zoning out and even jamais vu and error detection. This shows that while the task was designed for involuntary memory retrievals, it was sensitive enough to capture broad range of experiences. Moreover, we did not include an analysis comparing first-time versus second time reports, preliminary analysis showed no meaningful differences, so given the primary goal, which was examining the distribution and frequency of different experiences and to maintain the clarity and focus, we did not include those results here.

Figure 5.3



Note: Overall mean ratings for frequency of each type of thought across stimulus type. *TOT = tip-of-the-tongue; IAM = Involuntary autobiographical memory*

5.5.4. Frequency Judgment of Experiences

At the end of the experiment, participants retrospectively reported the frequency of six experiences over the past year and during the experiment. For yearly frequencies of the phenomena, participants gave their responses as a range (e.g. from 6-10 experiences per year), so we recoded their responses as the midpoint of the range (e.g. 8 times a year). For frequencies of the experiences during the experiment, participants gave response between 0 to 10 during the experiment. We calculated the mean yearly and experimental frequencies for the 6 phenomena (see Table 5.5).

Table 5.5

Frequency of Spontaneous Experiences

Experiences	Yearly Frequency M(SD)	Experimental Frequency M(SD)
Déjà vu	21.31 (26.53)	3.81 (3.75)
Jamais vu	15.87 (24.63)	3.23 (3.56)
TOT	36.81 (34.94)	.77 (1.66)
Error detection	25.51 (30.13)	2.08 (2.84)

Involuntary memory	69.12 (38.5)	5.31 (3.34)
Zoning out	67.59 (36.81)	4.83 (3.54)

Note: TOT = tip-of-the-tongue.

Overall, the yearly mean frequency of these experiences (Table 5.5) indicates that IAMs and zoning out were by far the most commonly experienced phenomena, followed by TOT and error detection. Déjà vu was less frequent, however, jamais vu was the least frequent experienced phenomenon. In the experimental frequency reporting, IAMs and zoning again were the most frequently reported phenomena. However, experimental frequency reporting of déjà vu and jamais vu was more than error detection and TOT was the least frequent experience.

Further, we also analysed yearly estimations using a repeated-measures ANOVA with experience type as the within-subject factor (see Annex VII for detailed repeated-measure ANOVA analyses). Participants reported that IAMs and zoning out were the most frequently experienced, while déjà vu and jamais vu were the least frequent, with jamais vu being the rarest. The TOT experience was estimated to occur more often than déjà vu, jamais vu, and error detection but less frequently than IAMs and zoning out. We then repeated this analysis for participants' estimations of the frequency of these experiences during the experiment. Again, IAMs and zoning out were reported as occurring with similar frequency, while TOT was estimated as the least frequent, followed by error detection, déjà vu, and jamais vu.

5.5.5. Intensity Rating of the Experiences

To examine the differences in the intensity of the six experiences between real-life and during the experiment, we conducted series of paired sample t-test using Wil Wilcoxon's signed-rank. The results showed no significant difference in the intensity of

déjà vu experience between real life and the experiment (W=1109.00, p=.326, r_B= -.132). However, the experiences like jamais vu (W=326.50, p<.001, r_B = -.676), TOT (W=855.00, p<.001, r_B = -.521) and error detection (W=454.00, p<.001, r_B = -.601) were significantly more intense during the experiment compared to real life. Whereas IAMs were found to be significantly more intense in real life (W=922.00, p=.001, r_B = .505). Finally, no significant difference was observed in the intensity of zoning out in real life and during the experiment (W=730.00, p=.522, r_B = .101).

5.5.6. Phenomenological Characteristics

To explore whether there were differences in the phenomenological characteristics of these phenomena, we conducted a series of ANOVAs. We analysed spontaneity, strength and focus on the task for each experience across four stimuli. Results did not show any significant differences in the phenomenology of these experiences. All experiences during the experiment were reported equally spontaneous and strong with participants exhibiting a similar level of focus across all stimuli. For more stringent analysis, jamais vu and TOT were excluded due to insufficient responses. For IAMs, spontaneity and strength were consistent across all stimuli, however, focus was significantly higher for the Grenoble pictures compared to Pakistan pictures and French words (F (3, 39) = 2.95, p=.044). Whereas, for zoning out, the overall focus on the task was significantly lower compared to déjà vu, error detection and IAMs (F (3, 72) = 17.45, p<.001).

5.5.7. Correlation of Frequency

The extent to which these experiences rely on similar cognitive mechanisms would be consistent with finding correlations amongst the frequency of the experiences. We used R studio (version 4.3.2) and ran series of non-parametric Spearman correlations between the experiences for yearly and experimental frequencies of these

phenomena, all of which were Bonferroni corrected. For the yearly frequencies déjà vu, jamais vu, TOT and error detection significantly correlated with each other (r values ranging from .30 to .48; $p<.05$), such that the more the participants experienced any one phenomenon, the more they experienced the others. The yearly frequency of IAMs significantly correlated with yearly frequency of déjà vu (rho = .35, $p=.006$), TOTs (rho = .44, $p=.000$), error detection (rho = .33, $p=.013$), and zoning out (rho = .47, $p=.000$). The yearly frequency of zoning out was found to be significantly associated with yearly frequency of TOTs (rho = .36, $p=.004$), For the experimental frequencies, déjà vu significantly correlated with jamais vu (rho = .41, $p=.000$), TOTs (rho = .31, $p=.037$), and IAMs (rho = .35, $p=.007$), no other correlations were significant.

We examined whether the frequency of reported experiences in the experiment correlated with participants' real-life experiences. The Spearman correlations indicated significant correlation between real-life and experimental déjà vu (rho = .39, $p=.004$); error detection (rho = .42, $p=.001$); and IAM (rho = .38, $p=.008$). This suggests that the experiment may have successfully provoked experiences that participants also encounter in their daily lives. However, we did not find significant correlations between real-life and experimental frequency of jamais vu, TOTs and zoning out (all ps >.05).

5.6. Discussion

In this exploratory experimental study, we tested using the IAM generating paradigm to provoke six spontaneous cognitive experiences. Specifically, the study aimed to examine spontaneous metacognitive experiences (déjà vu, jamais vu, TOT and error detection) in relation to spontaneous thoughts (IAMs and zoning out) in a laboratory setting. Based on the Barzykowski and Moulin's (2023) continuum hypothesis, in addition to IAMs and zoning out, we attempted to also provoke spontaneous

metacognitive experiences using a paradigm that typically generates IAMs. In short, the experiment successfully provoked such ‘spontaneous’ experiences.

In the current experiment participants pressed ‘thought button’ each time they had an experience or a thought during a vigilance task and volunteered a text response indicating any particular triggers along with a brief description. These experience classifications were verified and reclassified based on their descriptions (Table 5.1). Participants pressed the thought button approximately 30 times, with all participants reporting at least one experience of at least one of the six experiences. IAMs were the most frequently reported phenomenon, reported by the highest proportion of participants (90%) and accounting for the highest button press (see Table 5.4). Déjà vu followed a similar pattern, reported by 74% participants and occurring. Interestingly, jamais vu (with 12% button press) was experienced by 57% participants, while zoning out accounted for only 10% of button press but was experienced by higher proportion of participants (66%). Notably higher proportion of jamais vu button press suggests that it might be the more frequent phenomenon experienced by the participants within the task than zoning out. Whereas zoning out which was reported by more participants, this suggests that it might be easier to provoke and more common across participants. In contrast, Error detection (6% average rate) and TOTs (2% average rate) were the least reported experiences.

In this study, we analysed the retrospective judgement of the participants regarding the frequency of these experiences in real life and during the experiment. This analysis helped in determining whether the task was successful in provoking experiences that participants recognize from real-life. Participants who reported more frequent experiences in real-life also tended to report more frequently in the laboratory setting, suggesting that task successfully captured the natural occurring cognitive phenomena.

Specifically, real-life and experimental frequency of déjà vu, error detection and IAM correlated with each other. Yearly frequency of déjà vu, jamais vu, TOT and error detection correlated with each other. Yearly frequency of IAM correlated with déjà vu, error detection and zoning out. Yearly frequency of zoning out correlated with TOTs. For experimental frequency, déjà vu significantly correlated with jamais vu, and IAMs. This pattern suggests that experiencing one spontaneous phenomenon enhances the chances of experiencing others as well. For instances, if a person experiences spontaneous metacognitive experience like déjà vu or jamais vu, the person is also likely to experiences spontaneous thoughts like IAMs and zoning out. This is also supported by the findings in literature showing similar associations between these spontaneous cognitive experiences (e.g., jamais vu and déjà vu, Moulin et al., 2021; déjà vu and TOT, and even déjà vu and involuntary memories (in older adults), Moulin et al., 2014).

While reporting the experiences during the experiment, participants also rated them on spontaneity, strength and task focus. Findings indicated no significant differences in phenomenological characteristics across the six experiences. All were rated equally spontaneous and strong across all the stimuli, with participants maintaining consistent focus on the task while reporting these phenomena. This aligns with existing literature indicating that phenomena like déjà vu, jamais vu, TOT, and IAMs arise spontaneously in daily life without conscious control (Metcalfe & Schwartz, 2016; Moulin et al., 2022; Barzykowski & Moulin, 2023). In our data (Chapter 2 and 4; and literature) these metacognitive experiences and spontaneous thoughts were also found to share certain similar characteristics such as being spontaneous, short-lived and without control and also correlated with each other.

In the current experiment we had city picture and word stimuli (pictures of Grenoble and Pakistan and French words and French non-words). We conducted series of ANOVA analyses to examine the difference between reporting of six experiences across these stimuli. We hypothesized that picture stimuli would likely to provoke déjà vu experience as it is often linked to places and visual stimuli, while word stimuli would likely to provoke IAMs and experiences like jamais vu and TOTs. Zoning out was expected to arise from the monotonous nature of the task. Rather than discussing stimuli categories separately, we now consider them in relation to each experience to understand how these phenomena occurred in our experiment.

Findings showed that in general participants reported experiences more frequently in response to Grenoble picture compared to Pakistan pictures and word stimuli. IAMs were reported more frequently in response to picture stimuli (both Grenoble and Pakistan) and French words than other experiences. This suggest that picture cues and French word stimuli provoked IAMs more frequently than the other experiences. This aligns with previous studies generating IAMs with verbal phrases (Barzykowski et al., 2021; Mace, 2006) and emphasizing that IAMs are related to personal past event, coming to mind relatively quickly and without any deliberate effort (Schlagman & Kvavilashvili, 2008).

In the experiment, participants reported déjà vu experience equally often in response to both Grenoble and Pakistan pictures. This is in line with the previous literature suggesting that déjà vu can be triggered by novel scenes that are configurally similar to our personal past experiences (Cleary et al., 2012). Furthermore, in Brown and Marsh ‘s (2008) study participants were more likely to report false familiarity for mundane scenes from an unfamiliar campus as if they had seen the images before, demonstrating how novelty combined with subtle familiarity cues can provoke déjà vu.

There is a possibility that while Pakistan pictures, although novel, may have shared configural similarity with Grenoble pictures, contributing to reporting of déjà vu experience across familiar and unfamiliar stimuli.

Jamais vu, on the other hand, was more frequently reported in response to French non-words. This is not in line with the previous studies which emphasizes the occurrence of jamais vu with familiar stimuli in the form of 'semantic satiation' (Moulin et al., 2022). Provoking a jamais vu sensation typically requires excessive processing of a familiar stimulus (Moulin, 2018). However, in this experiment jamais vu in response to French non-words (unfamiliar stimuli) suggests that duration of stimuli presentation might not have been sufficient to provoke the jamais vu sensation for familiar stimuli and participants might have mistaken the French non-words for real French words with unusual spellings and thus reported jamais vu for French non-words.

Further, error detection and TOTs were the least reported across all stimuli. Low reporting of TOT is consistent with the nature of the task. TOTs are usually provoked during effortful lexical retrieval or question-answer formats (Metcalfe & Schwartz, 2016), Zoning out occurred infrequently but was distributed evenly across stimuli, likely reflecting general reduced attentional focus or mind-wandering due to the repetitive or monotonous nature of the task, aligning with the previous literature (e.g., Schooler et al., 2004)

Taken as a whole, these findings demonstrate that IAM generating paradigm is also effective in provoking déjà vu, zoning out and other spontaneous cognitive experiences. The principle idea is that when attention defuses the mind starts to wander and as proposed by Barzykowski and Moulin (2023) the environmental cues

that generate IAMs may also trigger other spontaneous experiences like déjà vu, jamais vu, error detection and zoning out.

Previous experimental studies have mostly focused on the content of the thoughts or experiences, however, this study examined the frequency of spontaneous cognitive phenomena in association with each other, while exploring their phenomenological characteristics. Although the paradigm effectively provoked spontaneous cognitive experiences, future studies should aim to refine the paradigm. In our study we employed self-caught method to reduce the response bias. Free reporting, while is considered to be more conservative and possibly accurate estimate (Jersakova et al., 2016) and has been successfully used in the study of both spontaneous metacognitive phenomena and spontaneous thoughts (e.g., Déjà vu and TOT, Jersakova et al., 2016; error detection, Charles et al., 2013; IAMs Barzykowski et al., 2021; zoning out, Schooler et al., 2004) may increase the monitoring demands and may lead to underreporting of the experiences (Cleary et al., 2020). Moreover, it is possible that the self-caught reporting method expectations and indicative of a normative experience related to the task could influence participants' reporting and what they should be experiencing independent of what participants are actually experiencing (Jersakova et al. 2016).

Similarly, experimental methods may exaggerate the rate of experience generation, and participants might confuse certain experiences due to overlapping phenomenological characteristics (Jersakova et al., 2016). To address this, we provided clear definitions of each phenomenon before the task, and encouraged participants to describe their experiences in their own words. While qualitative descriptions in our data were mostly reassuring, however, some descriptions suggested that some participants might not fully understand these phenomena. For

example, one participant reported jamais vu with the description "*unknown word but reminds me of "pill"*", which was reclassified as other. This aligns with Jersakova et al.'s (2016) recommendation to corroborate self-reports through descriptive elaboration. Despite these efforts, it is possible that some participants may still have inferred what experiences were expected of them, particularly for less familiar phenomena like jamais vu. Thus, while our method followed recommended practices to reduce demand characteristics, future work could further improve accuracy by combining self-caught and probe-based methods.

Furthermore, future studies should aim to validate these measurements in diverse populations, such as older adults, who report fewer spontaneous metacognitive experiences (for déjà vu, Brown, 2003; Aitken et al., 2023) and patients with epilepsy, who often report déjà vu and jamais vu as a part of an epileptic seizure with striking phenomenological characteristics (Fukao et al., 2005; Warren-Gash & Zeman, 2013; Illman et al., 2011) and to study the phenomenological characteristics of the experiences and also compare experimental experiences with real life instances.

Another important question is to determine the relationship between these real-life and experimentally provoked subjective experiences. Studies have found that experiences like déjà vu and TOT are more intense and emotional when experienced in real-life (Jersakova et al., 2016), and real-life déjà vu tends to last longer and are more comprehensive (Urquhart & O'Connor, 2014). Similarly, research comparing naturally occurring and experimentally generated TOTs has shown moderate relationship between real-life and experimental TOTs in younger adults (but not for older adults) (Burke et al., 1991). While, in another study participants rated their experimental TOTs as similar to real-life TOTs (Ryan et al., 1982). In this experimental study, participants judged the intensity of these experiences in both the experiment

and real-life. Experiences like jamais vu, TOTs and error detection were reported as more intense during the experiment, while IAMs were reported as more intense in real-life. No significant differences were found for the déjà vu and zoning out. These results suggest that while experimental paradigms can evoke similar subjective states, future research should further assess how closely these reflect the depth and complexity of real-life experiences

5.7. Conclusion

Exploring spontaneous metacognitive experiences in relation to spontaneous thoughts in a laboratory setting provides valuable insight into our cognitive processes and its underlying mechanisms. In our study we found that when engaged in low demanding task our mind wanders and the environmental cues generating IAMs could also provoke spontaneous metacognitive experiences like déjà vu. Findings further revealed that spontaneous metacognitive experiences are associated with spontaneous thoughts, that is, the more person experiences one phenomenon, the higher are the chances to experience others as well. Future studies should focus on validating these measurements in diverse population and compare the experimental phenomenological characteristics of these phenomena with real-life.

Chapter 6

General Discussion

This thesis set out to investigate a set of similar phenomena which occur infrequently in daily life, are striking when they do occur and which can be thought of as feelings which serve to guide cognitive processing (Moulin & Souchay, 2014). For the first time, these phenomena have been researched side-by-side in the same participants, partly motivated by recent research which proposes certain domain-general metacognitive processes (see Chapter 1). Following this idea, this thesis investigates whether spontaneous metacognitive experiences, such as déjà vu, jamais vu, TOT and error detection, might reflect a common metacognitive monitoring system. If metacognition is indeed domain-general (e.g., see Mazancieux et al., 2020; Ruby et al., 2017; Morales et al., 2018), then a person experiencing one type of spontaneous metacognitive phenomena (e.g., déjà vu) may also be likely to experience others (e.g., TOT and error detection). This idea is central to the current thesis, which proposes that spontaneous metacognitive experiences are interconnected signals of the cognitive system, arising automatically to guide our processes. Notably the detection of conflict (e.g. between familiarity and the knowledge that this is false) has been proposed as a something underpinning these experiences (Schwartz & Metcalfe, 2014; Metcalfe & Schwartz, 2016). In addition, this thesis extended to (non-metacognitive) spontaneous thoughts such as involuntary memories and zoning out. We proposed that people experiencing spontaneous metacognitive experiences frequently are also likely to experience spontaneous thoughts. Moreover, particularly in involuntary memory, there are paradigms and theoretical statements which might help us better understand spontaneous metacognitive phenomena (Barzykowski & Moulin, 2023).

This general discussion concentrates on the empirical evidence across four studies to support these propositions. Chapter 2 highlights cultural differences in experiencing six spontaneous phenomena. Chapter 3 investigates whether large language models can provide consensus on subjective descriptions of the experiences. Chapter 4 reveals group differences in experiencing these phenomena between non-clinical and epilepsy groups. Finally, Chapter 5 shows that an experimental task designed to generate IAMs can also provoke spontaneous metacognitive experiences such as déjà vu. Together, these findings indicate that, despite their surface differences, these six spontaneous phenomena, share certain common characteristics.

6.1. Conceptual Familiarity

In this thesis, we examined how conceptual understanding and familiarity with terminology could affect the self-reporting of the experiences. Results indicated (Chapter 2) that understanding and familiarity of the terminology could affect incidence reporting. In the large online survey, participants were asked whether they had experienced each phenomenon first without receiving their definitions and then again after receiving the definitions. The results showed notable shifts in the incidence rates. For instance, before the definition, nearly half of the participants were uncertain about whether they had experienced jamais vu and error detection, however, once they were given the definitions the incidence reporting of these experiences increased substantially. Conversely, the incidence reporting of more familiar experiences like déjà vu and TOT slightly decreased after receiving the definitions. This suggests that when participants understood the phenomena, they were better able to identify and report whether they had experienced them. Hence, clear and accurate definitions are

critical when assessing the occurrence of such spontaneous phenomena. Annex II we give these definitions in English, French and Polish and suggest that these be used in future research.

6.2. Incidence and Frequency

One of the important aims of this thesis was to determine how common and frequent are these six spontaneous cognitive experiences. Across different studies, we examined both the lifetime occurrences (incidence) and frequency (yearly and experimental) of these phenomena. Across these studies, certain phenomena were consistently reported as more common than the others (see Table 6.1 for summary of incidence results). In Chapter 2, TOTs, error detection and zoning out were reported as more common than déjà vu experience and IAM, while jamais vu was the least commonly reported experience. Similarly, in Chapter 4, we assessed the lifetime incidence of all the six phenomena in both non-clinical and epilepsy groups. The non-clinical group reported IAMs, zoning out, error detection, TOTs and déjà vu as more common than jamais vu. Likewise, the epilepsy group, reported high incidence of zoning out, TOTs, IAMs and déjà vu than error detection and jamais vu (group differences are discussed in the neurological perspective section below). Thus, these results indicate that experiences like déjà vu, TOTs, error detection, IAMs and zoning out are commonly recognised and reported, while jamais vu appear to be less frequent. While lower reporting of jamais vu could be partially attributed to reduced familiarity as suggested in the earlier chapters. Jamais vu remained least frequent and least widely reported experience even when we provided the clear definition and tried to provoke these experiences. This suggest that, beyond the issues of familiarity or recognition, jamais vu may in fact occur less often than other spontaneous cognitive experiences.

This is evident in the literature as well, showing that TOT is more common than déjà vu (Schwartz & Metcalfe, 2011) and jamais vu is less common than déjà vu (Brown, 2004; O'Connor & Moulin, 2013).

Table 6.1

Results Summary of Incidence Reporting of all Six Phenomena (recoded percentage) across different studies.

Experiences	Chapter 2 (n =860)	Chapter 4		Chapter 5 (n= 96)
		Non-clinical group (n=96)	Epilepsy group (n=71)	
Déjà vu	88	82.11	70.42	74
Jamais vu	78	76.84	54.29	57
TOT	95	84.38	80.28	31
Error detection	90	85.42	61.97	53
IAM	86	90.53	73.24	90
Zoning out	96	92.71	90.14	66

Note: TOT= tip-of-the-tongue; IAM= involuntary autobiographical memory. The Table represents the proportion of participants reporting life time incidence of the six phenomena.

In addition to lifetime incidence we also assessed the frequency of these phenomena in daily life (yearly). Chapter 2, showed that zoning out, TOTs and IAMs occur more frequently than the experiences like déjà vu, jamais vu and error detection (see Table 6.2 for frequency result summary). Chapter 3, showed that experiences like TOT and zoning out occur more frequently, while, déjà vu and jamais vu were the least frequent, with jamais vu being the rarest. Experiences like error detection and involuntary memories were more frequent than déjà vu experience. In Chapter 4, non-clinical group reported experiencing zoning out and IAMs more frequently than déjà

vu, jamais vu, TOTs and error detection. The epilepsy group also showed somewhat similar pattern with patients reporting zoning out more frequently than all the other phenomena. Patients reported experiencing déjà vu, involuntary memories and TOT state more frequently than jamais vu and error detection (the least frequently occurring phenomena).

Table 6.2

Results Summary of Retrospective Yearly Frequency of all Six Phenomena (recoded values; means (and standard deviations) across different studies.

Experiences	Chapter 2 (n =860)	Chapter 4		Chapter 5 (n= 96)
		Non-clinical group (n=96)	Epilepsy group (n=71)	
Déjà vu	15.68 (22.39)	2.61 (1.82)	2.00 (1.63)	21.31 (26.53)
Jamais vu	17.68 (25.18)	2.91 (2.02)	2.70 (1.71)	15.87 (24.63)
TOT	34.73 (34.25)	2.34 (1.86)	1.35 (1.55)	36.81 (34.94)
Error detection	19.99 (27.24)	2.55 (1.67)	1.76 (1.75)	25.51 (30.13)
IAM	50.95 (38.22)	3.42 (1.79)	2.54 (1.93)	69.12 (38.5)
Zoning out	29.97 (34.72)	4.02 (1.94)	3.70 (1.89)	67.59 (36.81)

Note: TOT= tip-of-the-tongue; IAM= involuntary autobiographical memory

In our experimental study (Chapter 5), participants made retrospective yearly judgment and reported real-time experiences by pressing the ‘spacebar’ on the keyboard. Based on retrospective judgment, Involuntary memories and zoning out were the most frequently experienced phenomena, while déjà vu and jamais vu were the least frequent, with jamais vu being the rarest. The TOT experience was reported more often than déjà vu, jamais vu, and error detection but less frequently than involuntary memories and zoning out. In contrast, in the real-time task-based reports,

IAMs were again the most frequently reported experiences, as one might expect when using a methodology developed to induce IAMs, while TOTs were the least frequently experiences than the other phenomena. Déjà vu and jamais vu were more frequent than zoning out and error detection. Error detection and zoning out were equally frequent (Table 5.4, Chapter 5).

These findings across four studies provide converging evidence that certain spontaneous cognitive experiences are more common and consistently reported than others, regardless of the method used. Involuntary memories and zoning out consistently emerged as the most common and frequently occurring phenomena, both in retrospective self-reporting and real-time experimental task. This suggests that such experiences are embedded in our daily cognition and are relatively easy for participants to recognize and report supporting previous research that suggests IAMs occurs about 20 times per day (Rasmussen & Berntsen, 2011).

However, other experiences, such as TOT and error detection, were reported relatively frequently in retrospective assessments but occurred far less often during the experimental task. For TOT, this discrepancy is possibly due to the fact that our experimental paradigm was not designed to elicit any retrieval failures, as it lacked structured recall or recognition phases typically used in TOT experiments. Notably, the déjà vu experience was reported more frequently in the real-time task than in retrospective judgment, suggesting that some experiences are perhaps more accessible or recognizable when experienced in the moment but difficult to recall or estimate retrospectively. Moreover, it is perhaps easier in the laboratory to induce the kind of metacognitive conflict at the heart of déjà vu than it is common in daily life, where it might rely on such factors as how frequently we travel far from our home

(Brown, 2003). Jamais vu, on the other hand, consistently emerged as the least frequent experience across all studies. This finding aligns with previous estimates that indicate that jamais vu is rarer than déjà vu (Neppe, 1983; Ardila et al., 1993; see Cleary & Brown, 2022 pp.194, for more details). Overall, these findings contribute to our understanding of how these spontaneous phenomena are experienced daily life and which phenomena remain more elusive or difficult to recognise likely due to their subjectivity and infrequency. It further highlights the importance of methods used to measure the occurrences of these phenomena. Factors such as, conceptual clarity, recognisability and salience play an important role in the reporting of these experiences, especially in the self-reporting methods (Barzykowski & Moulin, 2023).

In the thesis, we hypothesized that the six spontaneous cognitive experiences would be related, such that experiencing one phenomenon frequently would correlate with experiencing others as well. Across multiple studies, we found consistent patterns of correlation supporting this idea. In Chapter 2, the yearly frequency of all six spontaneous experiences positively correlated with each other, indicating that if a person experiences spontaneous metacognitive experiences like déjà vu, jamais vu, TOT and error detection, the person is also likely to experience spontaneous thoughts like IAM and zoning out. Chapter 4 replicated these findings in the non-clinical group but not in the epilepsy group, suggesting that certain neurological factors could influence these associations (differences are discussed in the neurological section below). Chapter 5 further provided more detailed insight, showing positive correlations among yearly frequency of déjà vu, jamais vu, TOT and error detection. Yearly frequency of IAM correlated with déjà vu, error detection and zoning out, while zoning out frequency correlated specifically with TOT frequency. Moreover, experimental

frequency of déjà vu significantly correlated with jamais vu, and IAMs. These findings replicate and extend previous research showing similar correlations in smaller samples (e.g., jamais vu and déjà vu, Moulin et al., 2022; déjà vu and tip-of-the-tongue, Moulin et al., 2014; and even déjà vu and involuntary memories in older adults, Moulin et al., 2014). Overall these findings suggest a shared underlying cognitive mechanism linking the occurrence of these spontaneous experiences, while the absence of similar correlations in the epilepsy group indicates that neurological differences may disrupt these underlying associations.

6.3. Cultural Differences

One aim of this thesis was to explore how spontaneous cognitive experiences may vary across cultures particularly in terms of incidence and frequency. In Chapter 2, data were collected across three countries (France, Poland, and Pakistan) allowing for a comparison of how these experiences are reported and perceived across cultural groups. Simple chi-square tests and a complex modelling approach consistently showed cultural group differences. Participants from Pakistan reported significantly lower incidence and frequency of six experiences compared to participants from France and Poland. Chi-square tests showed that even after providing definitions, participants from Pakistan still reported significantly lower rates of six phenomena, whereas France and Poland showed almost similar patterns. Measurement invariance testing further confirmed cultural differences. Differences in factor loadings indicated that the strength of association between specific experiences and their underlying factors varied by group. This suggests that although the general structure of these experiences may be universal, the way individuals perceive them may be shaped by culture. This observation aligns idea suggesting that variation in how people interpret

and relate to certain cognitive phenomena may stem from cultural exposure and conceptual familiarity (Fortier & Moulin, 2015).

To identify whether these differences were due to religion or nationality, the Bayesian analysis revealed high Bayes Factors for interactions involving both variables, however, effect sizes were extremely small, limiting the strength of interpretation. The overall pattern suggested that differences in experiencing these phenomena were largely driven by the Pakistani Muslim group in our sample. These findings support the notion that while spontaneous cognitive phenomena may be considered universal cognitive processes, their recognition and reporting are be shaped by cultural context. This also aligns with the literature highlighting that cognitive processes, such as attention, memory, and categorisation, are shaped by cultural traditions and practices (Proust & Fortier, 2022; Thomas, 2023). For instance, cross-cultural research has shown that Western cultures often adopt a more analytical, object-focused style of processing, whereas Eastern cultures tend to engage in holistic thinking, giving greater attention to context (Masuda & Nisbett, 2001; Ji et al., 2004). Thus, the cultural context may influence not only the perception of spontaneous cognitive events but also the likelihood of recognising or reporting them introspectively. Such things have been shown in the context of generational differences between younger and older participants (Moulin et al., 2014).

In sum, there seem to be culture differences for the frequency, reporting and even the understanding of the definitions of these phenomena, even if there clearly seems to be some common experiences across the diverse populations we used in this thesis. Whether these differences are due to language, culture or religion is difficult to say, since there was not enough control of these covarying factors. Perhaps most

critically, even when a definition of these experiences is presented, differences in frequency and incidence are maintained (as Moulin et al., 2014 also showed for age groups), meaning that one cannot overlook cultural factors in the reported occurrence of spontaneous metacognitive experiences in retrospective questionnaires, and that depending on the methodology used, experiences such as déjà vu and jamais vu are possibly not purely cognitive phenomena.

6.4. Qualitative Descriptions

Spontaneous metacognitive experiences like déjà vu and jamais vu are inherently more nebulous and often difficult to define and describe (Aitken & O'Connor, 2020; Moulin et al., 2022). One important aim of this thesis was to gain more comprehensive understanding of such phenomena, not only through incidence and frequency measures, but also by examining how individuals perceive and describe them in their own words. In a large online survey (Study 1 – Chapter 2) participants were invited to voluntarily share their experiences related to the phenomena. While not all participants chose to do so, the qualitative data gathered offered rich contextual insight that could not be obtained by quantitative data alone. However, analysing and classifying such descriptive data is often complex and prone to experimenter bias. To address this, we explored the use of large language model, like ChatGPT, as a tool for analysing these descriptions. While prior research has examined the ChatGPT's ability to analyse interview-based datasets (e.g., Sen et al., 2023; Morgan, 2023), our approach focused specifically on whether ChatGPT could categorise subjective cognitive experiences and correctly recover their original labels. Our goal was not to evaluate ChatGPT itself, but to explore whether it can be used as tool to help classify subjective descriptions of

metacognitive experiences and whether its output aligned with human classification, offering a more objective method for analysing such data.

Using both GPT-3.5 and GPT-4, we tested ChatGPT's performance on English and French descriptions. Across multiple experiments, ChatGPT performed well in classifying experiences such as déjà vu, TOT states, error detection, IAMs and zoning out, showing relatively good alignment with human participants. However, ChatGPT consistently struggled in the correct classification of jamais vu descriptions and control statements. It showed conservative bias for jamais vu descriptions and frequently misclassified them as TOT or error detection. This likely could be due to the subjective and complex nature of such phenomenon. In contrast, human participants were more accurate, likely due to their ability to draw on personal experiences. Since ChatGPT relies on pre-existing data, it is possible that due to insufficient training data and inadequate literature on jamais vu, it could not classify jamais vu descriptions accurately. This of course is similar to the empirical data on human subjects where jamais vu was consistently experienced less frequently and was less well known than the other phenomena. This highlights the broader need for clearer definitions and more robust empirical research on such phenomenon.

Notably, both ChatGPT and human participants evaluated all six experiences as spontaneous and categorised déjà vu and jamais vu as lacking control. This convergence provides a consensus view about how people perceive and describe these cognitive phenomena, which is explored in more detail in the next section. This methodological approach not only enhances our understanding of the phenomenological classification used in the questionnaire but also raises broader theoretical questions. Specifically, the shared subjective qualities across different

phenomena, such as sudden onset, lack of control and fleeting nature, does this mean that these spontaneous metacognitive experiences fundamentally connected by a shared mechanism? Or are they distinct cognitive processes that only feel similar because we have limited categories for describing these experiences. this suggest the possibility of a common underlying mechanisms. These questions are central to the understanding of spontaneous cognitive phenomena and their underlying mechanisms

Nevertheless, ChatGPT's validation for the majority of phenomena suggests that these descriptions effectively represent those metacognitive experiences and can be used in the research questionnaire to delve further into these intriguing experiences. This approach offers a promising methodology for analysing large qualitative datasets with good consistency and reduced experimenter bias.

Table 6.3

Example Summary of Subjective Descriptions of Six Phenomena (recorded across different studies).

Experiences	Chapter 3	Chapter 5
Déjà vu	*"I'm living in a moment and in my head I feel like I've already heard what people are saying, already felt those sensations...Even though I know it can't be true"* *"Sometimes I feel as if I've been to a certain place or person before, but it's very rare. It's a very special feeling! It's like being in another dimension in the past"*	*"I feel like I've already seen it even though I think it's not the case in reality"* *"feeling of having already been to this place even though I haven't"*

Jamais vu	"*I wrote a word in a paragraph, which I then reread to correct any mistakes and after going over it several times I wondered why it was spelled like that, I found its spelling strange even though I knew it was right"* "*This happens to me when I pay particular attention to the spelling of certain words that I normally write automatically. The spelling then seems odd and I question it."*	"*does this word really exist?"* *"I feel like I know this word but I think it doesn't exist"*
TOT	*"I was looking for the name of a bar in my town (which I'd been to before and which I'd known for several years) but couldn't remember. I knew the word started with a "c". It's extremely frustrating and challenging at the same time"* *"I can't remember the word, but I think about it for a good five minutes before giving up. It usually comes back when I'm doing something unrelated like taking a shower. It's very frustrating and annoying not to remember"*	*"it reminded me of a word, but I couldn't remember which one"* *"I was looking for the meaning of this word because I feel like I know it"*
Error detection	*"I was telling my sister that it was 40km from my parents' house to Valence, and when I sent the message I thought straight away "ah bah not at all no it's 20". I felt a bit stupid, I told myself I knew the "right answer""* *"I sent a photo of a joke to my brother instead of my girlfriends. At the time I felt ashamed, but very quickly I remembered that it was just a funny photo and that it wasn't serious to have made this mistake."*	"*forgot to press "v"; I realized after the image had passed that there were vertical lines"* *"I realized after a second reading that I had misunderstood the word"*
IAM	*"It happens to me sometimes. It's often when I'm talking to my friends or family and they say a particular word that a memory spontaneously comes back to me. So I'm quick to recount the memory, which is often pleasant or funny"* *"Sometimes they appear as flashes, we didn't even know they were still in us, but they come back suddenly and the*	*"it reminded me of a delicious praline brioche I ate a few weeks ago"* *"waterfall, I thought of a waterfall I visited with friends"*

	representation we have of them is very precise and seems almost recent."	
Zoning out	"*This happens when I'm really concentrating on a book and a sentence or an idea makes me think of something else; or when I'm listening to someone but can't get interested any more, my own thoughts become "louder" than the conversation"* *"I was reading but after a few seconds I realized I was in my thoughts even though my eyes continued to follow the lines of the book. I realized that I didn't know what the last lines I read were about"*	*"focused on looking at the images, but my mind was no longer really focused, I was half asleep"* *"I can't focus anymore; it's too long"*

Note: TOT= tip-of-the-tongue; IAM= involuntary autobiographical memory. The Table represents the subjective descriptions provided by the participants in different studies.

6.5. Phenomenological Characteristics

A further goal of this thesis was to understand how people perceive and classify spontaneous experiences. To achieve this goal, participants classified the experiences (Chapter 2 and Chapter 4) in terms of duration, onset, control, pleasant/unpleasantness and their significance. Participants also rated each phenomenon (Chapter 3 and Chapter 5) along different phenomenological dimensions, including spontaneity, awareness, control, reliability and strength. These measures allowed us to understand how people perceive these experiences, thereby contributing to a nuanced phenomenological characteristic of spontaneous metacognitive experiences and spontaneous thoughts. We proposed that, although not all the six phenomena are metacognitive, however, they are characterised by certain common features capturing a shared form of reflection on the cognitive system and provide a basis for grouping these phenomena together in a theoretically meaningful way.

Results showed sudden onset and spontaneity are the dominant characteristics of these spontaneous cognitive phenomena. The majority of the experiences were consistently classified as having sudden onset. In Chapter 2, participants classified déjà vu, jamais vu, TOT, error detection and IAMs as with sudden onset, while zoning out was uniquely perceived as arising gradually. Likewise, in Chapter 4, where the non-clinical group classified all the six phenomena as having sudden onset, the epilepsy group showed slight distinction by not categorising error detection as such. For spontaneity, in Chapter 3, participants rated all the experiences as occurring spontaneously, and similar pattern was observed in the results of Chapter 5, where all the phenomena were rated as equally spontaneous in an experimental context. This consistency across the studies (survey and experimental) supports the conclusion that, although there are some specific variations, spontaneity and sudden onset is a are a common and possibly defining feature of most spontaneous cognitive experiences. This aligns with the literature emphasising that experiences like déjà vu, jamais vu, TOT and involuntary memories occur spontaneously (Barzykoswki & Moulin, 2023; Metcalfe & Schwartz, 2016).

For duration of the experiences, in Chapter 2, participants classified déjà vu, and error detection as short-lived. These findings were extended in Chapter 4, with non-clinical group classifying déjà vu as having short duration, while the epilepsy group categorised déjà vu, jamais vu and error detection as having short duration and zoning out as having longer duration. These patterns support the idea that spontaneous metacognitive experiences like déjà vu and jamais vu are brief and fleeting experiences (Moulin et al., 2022; Aitken & O'Connor, 2020).

Lack of control merged as another defining feature of these spontaneous phenomena. In Chapter 2 participants categorized déjà vu, jamais vu, TOT and IAM as lacking control. Similarly, in Chapter 3, participants rated déjà vu and jamais vu as having no control. In Chapter 4, the non-clinical group categorised TOTs and zoning out occurring without control, while the epilepsy group classified zoning out and error detection as lacking control. These findings are in line with the literature and highlight the unintentional and involuntary nature of experiences déjà vu, jamais vu, TOT and involuntary memories and zoning out (Barzykoswki & Moulin, 2023; Metcalfe & Schwartz, 2016; Seli et al., 2016; Schooler et al., 2004).

The emotional valance of experiences in terms of pleasant and unpleasant varied across the phenomena and studies. In Chapter 2, participants classified TOT and error detection as unpleasant. A similar pattern was observed in Chapter 4, where the non-clinical group described TOT and error detection as unpleasant. The epilepsy group provided more nuanced description, they reported that they do not know whether jamais vu is pleasant or unpleasant, but classified error detection as unpleasant and IAM as a pleasant experience.

In the terms of level of awareness associated with each experience, in Chapter 3, participants rated déjà vu, jamais vu, TOT and zoning out as involving extreme to moderate awareness, error detection high awareness, while IAM involving little awareness. This aligns with Efklides' (2008) idea suggesting that metacognitive experiences arise in to our conscious awareness particularly when there is a cognitive conflict or novelty (bottom-up processes). While zoning out is not a traditional metacognitive experience, it begins with a bottom-up attentional lapse, and the

moment when one becomes aware that they have zoned out reflects a high-order form of monitoring (meta-awareness) (Schooler et al., 2004; Sayette et al., 2010).

Our metacognitive hypothesis requires that rather than just being meaningless experiences, the experient is in some way motivated to act on the feeling, or that it has some kind of significance to them. We probed this idea with a question about significance, which the person could reply as being 'random' or 'meaningful'. In Chapter 2, déjà vu, jamais vu and TOT were classified as "random" experiences. In Chapter 4, the non-clinical group categorised jamais vu, TOT and error detection as random experiences, while déjà vu was classified as a meaningful experience. Likewise, the epilepsy group described jamais vu, TOT and error detection as random but IAM as a meaningful experience. These findings suggest that although many spontaneous experiences are perceived as arising without pattern or cause, some (like IAM and déjà vu) may carry subjective significance depending on the individual or group. We proposed that spontaneous metacognitive experiences are not entirely random or meaningless. Experiences like déjà vu and TOT are automatic, fast-acting epistemic feelings, occurring under specific conditions, such as conflict monitoring or retrieval failure (Moulin & Souchay, 2014). They are infrequent and represent complex and sensitive nature of human cognitive system, requiring comprehensive understanding in association with each other. However, we only do not have unequivocal support for this idea in our questionnaire studies which required participants to describe the experiences with a series of dichotomies. This could be because the notion of 'significance' or 'meaningfulness' was interpreted as a more metaphysical, selfhood form of significance (as is often measured in autobiographical memory research as 'personal significance' (e.g., Alea & Bluck, 2007) rather than the more anodyne

metacognitive ‘significance’ such that the experience is relevant for the current goals of cognitive processing.

Overall, the pattern observed across these studies not only highlights the phenomenological aspects of spontaneous cognitive phenomena but also raises important questions regarding how such phenomena are conceptualised within broader cognitive and metacognitive framework. The findings converge on a set of core phenomenological characteristics such as spontaneity, lack of control and suddenness. These characteristics thus successfully distinguish such phenomena from a more deliberate reflective form of metacognition. These shared features provide basis for grouping them together in a theoretically meaningful way. At the same time, the divergence observed in perceived awareness, emotional valance and significance, especially between epilepsy and non-clinical groups, suggest that these phenomena are not always experienced in the same way, and their metacognitive nature needs further support from future studies. These experiences thus may be shaped by the individual, contextual and possibly neurological factors. These findings contribute to a broader perspective on how certain spontaneous cognitive experiences may fit within or extend current understanding of metacognition. Whilst at an individual level, as reported in retrospective questionnaires, we receive little support for the metacognitive nature of these experiences, this is perhaps due to the failings of our questions: prior experimental and retrospective questionnaire studies (e.g. Schwartz, 2006) propose that the TOT is a metacognitive experience and yet we failed to capture that in our questions. However, in our later studies (see Chapter 3), where participants and ChatGPT classified the TOT experience solely based on the subjective descriptions obtained in our large questionnaire (Chapter 1), there was a consistency. Here are

some example descriptions received in English, one of the TOT descriptions read, *“I find it annoying, I persist and do everything I can to remember it in the moment. However, if I still can't remember the word in question, I put it aside because I know that the solution will come naturally to me later*.” Similarly, déjà vu description read, “*This thing confuses my mind. Earlier today I felt that I have had the same conversation with my colleague at a place. But we were neither there before nor had same topic of conversation*”; jamais vu: “*I saw my friend writing a word during lecture i thought she was spelling it wrong but it was correct that's how i experienced that”*; error detection: “*One day I wanted to message my friend that send me your assignment. I sent this message to my teacher and I was very ashamed that time. Why did I send this message to madam?”.* These descriptions reflect awareness of mental states and internal conflict, key components of metacognitive experience. Further, both human participants and ChatGPT consistently categorised TOT, déjà vu, jamais vu and error detection as involving awareness. This alignment across human participants and AI model suggests that participants do perceive these experiences as metacognitive.

6.6. Neurological Aspects

One experiment in this thesis explored whether spontaneous cognitive phenomena differ between control and neurological population, inspired by the large neuropsychological literature on metacognition, and in particular the insights into déjà vu in epileptic samples. In Chapter 4 we compared the incidence, frequency and classification of the six phenomena between non-clinical and epilepsy groups. Our approach was novel in that it tested six spontaneous experiences in an epilepsy group and compared them with control group, rather than, for example, concentrating on déjà

vu. This allowed us to examine and identify more nuanced patterns of such experiences from a neurological perspective.

In our data, the epilepsy group reported overall lower incidence and frequency of all six spontaneous cognitive experiences compared to the non-clinical group. These findings align with earlier research suggesting that individuals with epilepsy do not necessarily report more déjà vu experiences than the general population (Brown, 2004; Silberman et al., 1985). Additionally, we found group differences in the classification of phenomena. Both groups perceived déjà vu as a brief experience, but the epilepsy group additionally classified jamais vu and error detection as a brief phenomenon. Both groups categorised déjà vu, jamais vu, TOT, IAM and zoning out as having sudden onset. While, the non-clinical group categorised error detection also as having a sudden onset. Regarding control, both groups agreed that zoning out experience and TOT states lack control, whereas epilepsy group also classified jamais vu and error detection occurring without control. In terms of perceived significance, both groups considered jamais vu, TOT, and error detection to be random and lacking personal meaning. However, the non-clinical group considered déjà vu to have significance, while the epilepsy group considered involuntary memories have some significance. For emotional valance, non-clinical group classified TOT and error detection as unpleasant. The epilepsy group described error detection as unpleasant but IAMs as pleasant experience, and reported that they do not know whether jamais vu was pleasant or unpleasant.

While these findings reflect general patterns, we also observed notable individual differences within the epilepsy group (table 4.6 Chapter 4). In a few unique cases, some patients reported very high frequencies for specific phenomena. For

instance, one participant reported 51 to 100 experiences of déjà vu in a year, while reporting no lifetime experience of TOT, jamais vu, or IAMs. Some patients also reported feeling that they could control their experiences, for example experiences like TOT, jamais vu and déjà vu, which is in contrast to the typically involuntary nature of these phenomena (Barzykoswki & Moulin, 2023; Metcalfe & Schwartz, 2016). These variations in frequency and description could be due to factors like individual differences, epilepsy foci, and seizures frequency or severity. Previous research suggests that experiences like déjà vu can have different phenomenological qualities when associated with seizure activity (Illman et al., 2011), and that age of onset and epilepsy duration may also contribute to variation (Adachi et al., 2003; Khalife, 2022).

Furthermore, we found differences in the pattern of associations between the phenomena across groups. In the non-clinical group, all the six experiences were positively correlated with each other, as found clearly across this thesis, suggesting that there might be a possibility of shared or connected aspect of cognitive functioning. In contrast, the epilepsy group did not show consistent correlations between the experiences, which could indicate a more fragmented experiential pattern. These differences suggest that spontaneous metacognitive experiences may be processed differently in individuals with epilepsy.

Overall, our findings indicate that while spontaneous cognitive experiences may be shared across populations, their occurrence, subjective interpretation and classification may differ in a meaningful way in individuals with and without epilepsy and maybe shaped by underlying neurological factors. Notably, a few unique cases showed categorisation pattern that differed from the broader perspective. It would have been more informative if we had access to more detailed neuropsychological profiling

for these individuals. Perhaps using a mixed method, combining qualitative interviews with experimental tasks, might have provided deeper insight into how people with epilepsy interpret and report these experiences. Additionally, integrating physiological measures like EEG could offer more objective understanding into neural correlates of these spontaneous phenomena in such clinical population.

6.7. Experimental Experiences

For a long time, metacognitive experiences, such as déjà vu, jamais vu and TOT have primarily been researched through retrospective and prospective surveys, sometimes case studies, due to their infrequent, subjective and spontaneous nature. However, recent years have seen the development of laboratory-based tasks designed to generate these experiences drawing on theoretical explanations of their cognitive mechanisms (Chapter 1). In this thesis we introduce an experimental paradigm to study spontaneous metacognitive experiences, like déjà vu, jamais vu, TOT and error detection, along with spontaneous thoughts, such as involuntary memories and zoning out, as they naturally occur in real time. Based on Barzykowski and Moulin's (2023) continuum hypothesis, we adapted a paradigm that typically generates IAMs, in an effort to also provoke spontaneous metacognitive experiences under similar conditions.

Unlike retrospective surveys, which rely on participants' memory, this approach allowed for real time detection and reporting of spontaneous phenomena, offering an insight into how these experiences may emerge and what might be the possible triggers. In Chapter 5, we discussed how our paradigm reflects key features of established experimental tasks, such as repetition, low cognitive demand, superficial engagement and subtle stimulus exposure (for details see Brown & Marsh, 2008;

Cleary et al., 2009; Moulin et al., 2022; Schlagman & Kvavilishvali, 2008; Smallwood et al., 2007; Seli et al., 2016; Charles et al., 2013; Rabbitt, 1978). Our monotonous vigilance task involved detecting 8 targeted slides (with verticals lines) in the stream of 392 non-targeted slides (with horizontal lines) while exposed to irrelevant stimuli (repetitive verbal and non-verbal). This setup was designed to foster mind-wandering and provoke spontaneous cognitive phenomena.

Participants were instructed to press the 'space bar' on keyboard, to report any experience or thought they had during the task. Upon pressing the button, participants selected the type of experience from the provided list (e.g., déjà vu, jamais vu, TOT etc) and wrote a brief description of their experience and perceived trigger. Our experimental paradigm effectively provoked spontaneous cognitive experiences. On average, participants pressed the space bar approximately 30 times, with all participants reporting at least one experience of at least one phenomenon. Involuntary memories were the most frequently reported phenomenon, followed by déjà vu. Zoning out was also common across participants. Error detection and TOTs were the least reported experiences. Importantly, the experimental frequency of déjà vu and involuntary memory correlated with participants' retrospective reports of real-life frequency, supporting the validity of experimental paradigm. These results suggest that certain experiences like déjà vu and IAMs might be easier for people to notice and report in real time. In contrast, other experiences, like jamais vu maybe hard to recognise and report.

Previous experimental studies have tended to focus on the content of spontaneous thoughts. Whereas our study investigated the frequency of various spontaneous cognitive phenomena relative to one another, while also exploring their

phenomenological characteristics (as discussed above). As discussed earlier in the phenomenological section, that people describe these phenomena as being spontaneous and experiences like déjà vu, jamais vu, TOT and error detection were perceived as involving awareness of one's own cognitive state, establishing their metacognitive nature. This was also supported by our, Confirmatory Factorial Analysis in Chapter 2, which showed that frequency with which people experience these spontaneous experiences is better represented when separating metacognitive (like déjà vu, jamais vu, TOT and error detection) from non-metacognitive experiences (like IAMs and zoning out). These metacognitive experiences grouped together, likely reflecting shared mechanisms of self-monitoring and cognitive conflict. Together, these findings suggest that the subjective and structural dimensions of these phenomena align, providing a more coherent and accurate framework for understanding their place in spontaneous cognition.

6.8. Limitations and Future Direction

This thesis provides a first appreciation of spontaneous metacognitive experiences through survey, neurological and experimental perspectives. While these studies contribute novel insights, we acknowledge certain limitations, which can guide future research. One of the limitations in the thesis concerns the inclusion of relatively homogenous university student sample. In Chapter 2, although the dataset was large and cross-cultural, this may limit the generalisability of the findings to broader populations, especially given that age and life experience might influence both the frequency and interpretation of spontaneous phenomena. For example, studies have shown that déjà vu decreases with age while TOT increases with age (Brown, 2003). Hence, future research should include more demographically diverse groups,

particularly older adults, to examine the occurrence of these phenomena across the lifespan.

In the thesis, we found cultural differences in the incidence and frequency of spontaneous cognitive phenomena. Although Pakistan showed lower frequency than France and Poland (see Figure 2.1 -Chapter 2), we did not find differences in the pattern of experiencing these phenomena. Furthermore, to determine if these cultural differences were due to religion or language, the sample dataset was imbalance in terms of religion and language, with Pakistani sample predominantly Muslims. Future research should aim for balanced sampling across both linguistic and religious groups to better identify the cultural and contextual effects on spontaneous phenomena.

Certain cognitive phenomena studied in this thesis, especially jamais vu, are inherently difficult to define and maybe less familiar. While we provided clear definitions in each study, there is a possibility that unfamiliarity with these experiences could still have influenced participants' ability to accurately recall or report them. Future longitudinal research might examine if familiarity over time leads to more reliable reporting of such phenomena. A key methodological recommendation from this thesis is to provide clear and concise definitions when asking participants to report such subjective phenomena and this should be incorporated as a standard practice in future research on spontaneous metacognitive experiences and spontaneous thoughts. A further innovation would be to provide the person with a definition, ask them to monitor their experiences prospectively, and after 6 months ask them about their experiences.

In the thesis, across different studies, yearly frequency of the six experiences was assessed using categorical ranges (e.g., 3 to 5 experiences, 6 to 10 experiences

and so on) which were then recoded into ordinal values (from 0 to 7). While this approach allowed for the easy data handling and comparison, it may have influenced individual variability, especially at the upper end of the scale. For example, if multiple participants reporting more than 100 experiences in a year, they all would have the same recoded value. Future studies could consider employing alternative approach, such as open-ended frequency or continues measure, for more accurate frequency reporting, particularly in clinical populations where certain experiences may occur more frequently.

In our experimental study (Chapter 5) participants rated all the six phenomena as equally spontaneous and strong with same level of focus on the task. While, this might reflect genuine phenomenological similarity, it could also indicate response bias or measurement insensitivity. A block-by-block presentation of the stimulus might allow for the precise assessment of not only phenomenological differences. Furthermore, in our experiment, there is a possibility that some experiences may have gone unreported because participants did not recognise them or felt uncertain about the classification. Similarly, the possibility of demand characteristics cannot be ruled out. Future research should aim to refine the paradigm and validate the findings across diverse groups, including older adults or clinical population (such as epilepsy), to determine how these experiences differ across people.

In Chapter 3, we explored the use of large language model (ChatGPT versions 3.5 and 4.0) for classifying subjective descriptions of the six phenomena obtained from the human participants. While the AI model performed well for the most phenomena, it consistently misclassified jamais vu and control statements. This reflects limitations in the model's training dataset for such subjective metacognitive experiences.

Additionally, we observed inconsistencies in its responses when using the same prompts across different sessions, reflecting limitations of LLM stability as highlighted by the other researches (e.g., Reiss, 2023). Future research could explore other language models that which have real time access to updated literature, alongside prompt optimisation and compare the results with human participants for the validation to further advance research on spontaneous metacognition.

In Chapter 4, while we observed group differences in experiencing these six experiences between epilepsy and non-clinical participants, we lacked clinical data such as seizure frequency, epilepsy type, or specific neurological foci. Future studies should include detailed clinical histories to determine the possible factors influencing the occurrence and frequency of these spontaneous cognitive phenomena. Moreover, while jamais vu has also been observed as a part of an epileptic seizure or as an aura of temporal lobe epilepsy (Sengoku et al., 1997), very little is known regarding its neural underpinnings. Similarly, lexical access impairment and elevated TOT frequency have been observed in patients with language-dominant TLE (Condret-Santi et al., 2014; Miozzo & Hamberger, 2015), and recent research propose that frequent déjà vu may co-occur with frequent involuntary memories (Barzykowski & Moulin, 2023). Thus, future experimental studies should focus on exploring the relationship between these phenomena, particularly in epilepsy patients to gain insight into the neurological link between them.

The results of this thesis show that spontaneous metacognitive experiences correlate with spontaneous thoughts, suggesting possible shared mechanisms. Building on the theoretical framework presented in Chapter 1, we identified overlapping neural correlates across these six phenomena (including regions like medial temporal

lobe, prefrontal cortex, anterior cingulate cortex and default mode network). Future studies should design experiments utilising neuroimaging and electrophysical methods to examine different phenomena in parallel to identify commonalities and distinctions in the neural circuits underlying each phenomenon.

Another important consideration in researching spontaneous metacognitive cognitive phenomena is the reliability of retrospective self-report methods. As noted in recent literature (e.g., Urquhart et al., 2014; O'Connor & Moulin, 2021), déjà vu and related phenomena are fleeting and infrequent, often recalled long after the experience. This delay introduces reconstructive biases and underreporting, particularly when participants are asked to estimate frequency over wide intervals (e.g., annually) (Aitken & O'Connor, 2020). Other strategies, such as counting remembered instances to estimate frequency have also shown to be unreliable (Lugtig et al., 2016). Similarly, researchers argue that task demand can inflate reporting of such experiences (Jersakova et al., 2016). To improve accuracy and reduce reporting bias, future studies should consider using prospective methods (e.g., diary studies or real-time reporting), and ideally combine subjective descriptions with physiological or contextual measures, as was successfully demonstrated in classic studies involving clinical populations (Aitken & O'Connor, 2020). In agreement with Cleary and Brown (2021), we propose the development of a mobile application to study spontaneous metacognitive experiences and spontaneous thoughts. This could allow people to report their experiences as they naturally occur in real time providing details regarding time of the day, geolocation, activity level, phenomenological characteristics along with subjective descriptions.

6.9. Conclusion

This thesis provides a multi-perspective examination of spontaneous metacognitive experiences (déjà vu, jamais vu, TOT and error detection) and spontaneous thoughts (involuntary memories and zoning out). Importantly, this thesis is among the first to examine these experiences collectively within the same participants and across multiple methodological designs. Chapter 1 provided an overview of literature highlighting theoretical perspective and overlapping brain regions associated with these experiences (including anterior cingulate cortex, prefrontal cortex, medial temporal lobe and default mode network) involved in conflict monitoring, cognitive control; memory retrieval and mind wandering. Building on this foundation, empirical studies presented here suggest that while these experiences differed in their content, they may reflect shared cognitive mechanisms.

One possible mechanism is metacognitive conflict detection, as theoretical perspective has indicated in experiences like déjà vu, jamais vu, TOT and error detection, where individual is aware of the mismatch between subjective feeling and objective evaluation. This aligns with Metcalfe & Schwartz's (2016) theoretical framework for TOT, which argues that such states are metacognitive feelings (involving signalling conflict) that arise from monitoring potential knowledge and induce further retrieval efforts. The TOT experience reflects connection between conscious feelings and conflict monitoring. They further suggest that the ACC (brain area associated with conflict monitoring) is active during the TOT state.

For incidence and frequency, findings across different studies indicated that IAMs and zoning out are the most common spontaneous cognitive experiences, followed by TOTs and error detection, with déjà vu and especially jamais vu being less

frequent. The thesis also highlighted the fact that participants' familiarity with the terminology could significantly influence self-report accuracy, emphasising the importance of providing clear definitions when assessing such experiences. However, across studies we also observed that the less frequent experiences (e.g., jamais vu) remained less common even when clear definitions were provided, suggesting that the rarity of such experiences is not merely a result of misunderstanding, but may reflect genuine differences in their underlying frequency. The integration of qualitative data and exploratory AI-assisted analysis further enriched our understanding of how people perceive and describe these elusive experiences.

These phenomena, while vary in their occurrences, share core phenomenological characteristics, such as spontaneity, lack of control and sudden onset. Similarly, the correlational pattern observed was consistent across retrospective and experimental studies, supporting the idea that spontaneous metacognitive experiences and spontaneous thoughts are closely related. This suggests that there is a possibility that these experiences arise from similar metacognitive monitoring processes, such as conflict detection or partial memory retrieval. For instance, déjà vu, jamais vu, TOT, and error detection all involve a mismatch between expectation and reality, implicating systems like the ACC or frontal regions responsible for conflict resolution. Similarly, the default mode network, known to support spontaneous thought and memory retrieval, may underpin experiences such as IAMs, zoning out, and even déjà vu. Barzykoswki and Moulin (2023) argue that déjà vu and IAM lie on the continuum, favouring an interaction between shared neural and cognitive processes. Both may engage in overlapping mechanisms like default mode network or prefrontal cortex but differ in the retrieval success and metacognitive interpretation. However,

differences observed between the non-clinical and epilepsy groups regarding the classification and frequency of certain experiences, suggests that neurological conditions may shape how these phenomena are perceived and reported. The important theoretical question remains, whether is it only their certain phenomenological characteristics that links them, or is there a deeper mechanism? Or do they just appear to operate on shared mechanism and involve distinct processes.

The experimental study presented in Chapter 5 marked an important methodological contribution. Unlike traditional approaches that rely on memory-based reporting, this paradigm allowed participants to report their experiences in real time. The results supported the validity of this method, particularly for phenomena like IAMs and déjà vu. This thesis contributes to a more nuanced understanding of how spontaneous cognition unfolds and demonstrates that spontaneous metacognitive experiences are not random, they are meaningful mental events that reveal how people monitor, interpret, and reflect on their own cognition. Notably, in Chapter 3, both human participants and ChatGPT consistently categorised déjà vu, jamais vu, TOT and error detection as involving awareness, a key component of metacognition. Nevertheless, future research should examine how consistently people recognise this metacognitive component across different contexts and whether this awareness varies across cultures or clinical populations. Further, there were certain limitations that we acknowledge and provide directions for the future researches

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Annex I

Cultural difference in incidence reporting of the six phenomena (Study 1; Chapter 2)

We hypothesized that the incidence of experiencing these infrequent spontaneous experiences will be related to how familiar people are with the concepts and their definition, that is, rates of experiencing these phenomena, and 'I don't know' response should differ amongst cultures when no definition is provided, but should be more equal when the definition is provided. For "no definition" section, we ran 2x3 chi-square test (X^2) and for "definition" section we conducted 2x2 chi-square test to see if there are significant cultural group differences, between France, Pakistan and Poland, for phenomena incidence. Both X^2 tests were conducted separately for all six phenomena.

Table I

Cultural differences for the incidence of experiences in "no definition" & "definition" section of the survey

Experiences	Don't Knows (with no definition) %	Yes Responses (with no definition) %	Yes Responses (with definition) %
Déjà vu			
France	3.96	94.35	96.59
Pakistan	26.99	44.35	59.61
Poland	2.24	93.26	90.00
No definition x^2 (852) = 255.889, $p < .001$			
Definition x^2 (845) = 134.5147, $p < .001$			
Jamais Vu			
France	32.18	54.59	80
Pakistan	43.01	18.36	59.95
Poland	55.13	15.71	67.09
No definition x^2 (851) = 118.029, $p < .001$			
Definition x^2 (847) = 21.398, $p < .001$			
TOT			
France	0.56	97.19	100
Pakistan	18.11	67.03	73.37
Poland	14.10	83.65	99.02
No definition x^2 (860) = 87.557, $p < .001$			
Definition x^2 (837) = 134.872, $p < .001$			
Error Detection			
France	59.89	29.38	89.27
Pakistan	18.73	62.53	77.32
Poland	55.12	37.17	91.26
No definition x^2 (852) = 128.937, $p < .001$			
Definition x^2 (852) = 28.716, $p < .001$			

IAM			
France	48.88	41.01	79.65
Pakistan	25.40	45.95	72
Poland	31.09	64.10	86.08
No definition x^2 (860) = 100.959, p < .001			
Definition x^2 (831) = 19.590, p < .001			
Zoning out			
France	8.43	87.64	97.18
Pakistan	23.04	47.43	76.35
Poland	2.24	96.47	98.39
No definition x^2 (859) = 235.736, p < .001			
Definition x^2 (838) = 96.569, p < .001			

Note: TOT= tip-of-the-tongue; IAM= involuntary autobiographical memory.

The principal idea is that people experience spontaneous metacognitive phenomena, at some point in their life, but may not realize it and this might be because of the unfamiliarity with the phenomena. The results are consistent with our hypothesis, changes in “yes” responses between “no definition” and “definition” section. Results show that for every experience there was a significant increase in the incidence reporting in all three groups after providing the definition (see Table x). Results further indicated cultural differences in experiencing these spontaneous metacognitive experiences, even after providing the definition of the phenomena and notably, Pakistan reported significantly lower incidence of these phenomena.

Annex II

Definitions used in Study 1 (Chapter 2) large survey questionnaire (France, Poland and Pakistan)

Déjà vu	The sensation that you feel you have encountered something before (a place, a conversation, etc) whilst knowing this to be false (i.e. You know that you have never been to a given place before), is known as "déjà vu"
Jamais vu	The feeling that you find something strange or unfamiliar (e.g. the spelling of a word looks wrong), even though you know it to be correct and it is known to you, is called “jamais vu”
Tip-of-the-tongue	The feeling that you know a piece of information (like an actor’s name) but that you cannot get the word/name out, is known as “tip-of-the-tongue”
Error detection	When you realise after having done something (like sending the text message) that you made a mistake that you weren’t aware of at the time of committing this error (i.e. Sending it to the wrong person), this is known as “error detection”
Involuntary autobiographical memory	When you have a memory from a past event (like a place on your holidays) pop into your head without having thought about it, this is called “involuntary autobiographical memory”
Zoning out	when you are concentrating on one thing (e.g. reading a book), but you then realise that you have been thinking about something else, this is known as “Zoning out”.

French Version

Déjà vu	La sensation d'avoir déjà rencontré quelque chose auparavant (un lieu, une conversation, etc.) tout en sachant que c'est faux (c'est-à-dire que vous savez que vous n'êtes pourtant jamais allé à cet endroit avant), est connue sous le nom de "Déjà vu”
Jamais vu	Le sentiment que vous trouvez quelque chose d'étrange ou d'inconnu (par exemple, l'orthographe d'un mot vous semble fausse), même si vous savez qu'il est correct et que vous le connaissez, est appelé "Jamais vu".

Mot sur bout de la langue	Le sentiment que vous connaissez une information (comme le nom d'un acteur) mais que vous n’arrivez pas à retrouver le mot ou le nom, est connu sous le nom de "mot sur bout de la langue".
Détection d'erreur	Lorsque vous vous rendez compte après avoir fait quelque chose (comme envoyer un SMS) que vous avez fait une erreur dont vous n'étiez pas conscient au moment de commettre cette erreur (c'est-à-dire l'envoyer à la mauvaise personne), on parle d’une "détection d'erreur".
Souvenir autobiographique involontaire	Lorsque le souvenir d'un événement passé (comme un lieu de vacances) vous revient en mémoire sans que vous y ayez pensé, on parle de "souvenir autobiographique involontaire".
Perdre le fil	Lorsque vous vous concentrez sur une chose (par exemple, lire un livre), mais que vous vous rendez compte que vous pensiez à autre chose, on parle de "Perdre le fil".

Polish version

Déjà vu	Déjà Vu" to poczucie, kiedy wydaje Ci się, że spotkałaś/łeś się już z czymś wcześniej (miejsce, rozmowa itp.), a jednocześnie wiesz, że to nieprawda (np. bo wiesz, że nigdy w danym miejscu nie byłaś/byłeś).
Jamais vu	Uczucie, że coś wydaje Ci się dziwne lub nieznane (np. pisownia jakiegoś słowa wydaje się być błędna), mimo że wiesz, że jest to Ci znane i poprawne, nazywamy zjawiskiem "Jamais Vu"
Końca języka	Poczucie, że znasz jakąś informację (np. jakieś słowo, nazwisko aktora/aktorki), ale nie potrafisz przypomnieć sobie tego słowa/nazwiska, nazywamy zjawiskiem "końca języka"
Wykrywania błędów	Kiedy po wykonaniu jakiejś czynności (np. wysłaniu wiadomości tekstowej) zdajesz sobie sprawę, że popełniłaś/łeś błąd, którego nie byłaś/łeś świadoma/y w momencie jego popełniania (np. zorientowałaś/łeś się, że wysłałaś ją do niewłaściwej osoby), jest to znane jako zjawisko "Wykrywania błędów"

mimowolnym wspomnieniem autobiograficznym	Zjawisko, Kiedy wspomnienie jakiegoś wydarzenia (np. miejsca z wakacji) wyskakuje Ci w myślach bez wcześniejszej próby myślenia o nim, nazywamy "mimowolnym wspomnieniem autobiograficznym".
Wyłączanie się myślami/gubienie wątku	Kiedy koncentrujesz się na jednej rzeczy (np. czytaniu książki), ale potem zdajesz sobie sprawę, że myślałaś/łeś o czymś zupełnie innym, jest znane jako "Wyłączanie się myślami/gubienie wątku".

Annex III

Specimen of large online survey In English (Study 1; Chapter 2)



English

Consent Form

Consent for the Participation in the Study

PARTICIPATION

We would like to invite you to participate in an online survey on "Spontaneous MetaCognitive Experiences". This is a PhD thesis research project being conducted in the Laboratory of Psychology and NeuroCognition at University of Grenoble Alpes, France. The survey will take approximately ten to fifteen minutes to complete. It is organised into four quick sections, first asking about metacognitive experiences, and then about yourself.

Your participation in this survey is voluntary. In order to participate you need to be 18 or older. You may refuse to take part in the research or exit the survey at any time. You are free to decline to answer any particular question you do not wish to answer for any reason.

BENEFITS & RISKS

There are no right or wrong answers, but your responses will help us learn more about metacognitive experiences in different cultures. There are no apparent risks involved in participating in this study. However the survey may ask questions about your life events or personal memories, but you are not required to provide any details, and you should not share with us anything you consider too personal.

CONFIDENTIALITY

This online survey does not collect identifying information such as your name, email address, or IP address. Therefore, your participation and responses will remain anonymous and confidential. The responses collected through this survey will only be used for research purposes. In any eventual publication, quotes may be used, but they will always be anonymous.

Releasing material and data to other parties

Your answers are merged with the answers of the other participants in a large database; your answers cannot be traced back to you. This database may be uploaded to a public repository and might be shared with other researchers, which is recommended best practice in any psychological research.

Information about the outcome of the study

You are entitled to receive information about the outcome/result of the study. Please contact the research team to do so.

CONTACT

If you have questions at any time about the study or survey, you may contact the researchers on the following email addresses.

Gull zareen < gull.zareen@univ-grenoble-alpes.fr > Research Student

Chris Moulin < christopher.moulin@univ-grenoble-alpes.fr> Research Supervisor

I have read and agree with the terms above

- ○ Yes, I agree to participate
- ○ No, I don't agree to participate

Demographics

Specify your gender please.

- ○ Male
- ○ Female
- ○ Non-binary / third gender
- ○ Other
- ○ Prefer not to say

What is your age?

What is your nationality?

If you have more than one nationality, write down the other one below please.

Do you speak any of these languages?

- [ ] English
- [ ] French
- [ ] Polish
- [ ] Urdu

How many years of education have you completed?

Which religion do you belong to?

Questionnaire

In this research we are interested in finding out about the experience of people's errors in their personal mental life that happen to us on an every-day basis. These errors are perfectly normal, and part of healthy thinking processes. In this study we want to investigate how often they occur in daily life. Thus we humbly request you to spare few minutes, read the questionnaire carefully and try to answer all the items to the best of your knowledge please.

Metacognitive experiences refer to awareness and feelings that you have in a problem-solving situation. People rely on their metacognitve experiences as a source of information regarding the errors they have made.

Block 23

Sometimes we will ask you additional questions to make sure you are doing the survey with care. **For example**, you may see a question like: "To what extent (....)", in which you will also find a request to answer in specific way, such as:
"Choose answer two". A question of this type might look as follows: "To what extent, choose answer two, positively".

In the example above, you are simply asked to "choose answer two", regardless of the rest of the question. When you see a question of this type, always choose the answer as instructed.

Survey

SECTION 1

In this part you will be presented with different spontaneous experiences that you may or may not have experienced in your life. If you have had these spontaneous experiences, you are requested to provide further information. So read each item carefully and answer the following questions please.

Block D

Have you ever experienced "**Déjà vu**"?

- ○ YES
- ○ NO
- ○ I don't know

Block T

Have you ever experienced a "Tip of the Tongue"?

- ○ YES
- ○ NO
- ○ I don't know

Block J

Have you ever experienced "Jamais Vu"?

- ○ YES
- ○ NO
- ○ I don't Know

Have you ever, choose answer 'I don't know', experienced the feeling of flying in a bowl?

- It is very pleasant
- I do not know
- That is not true

Block I

Have you ever experienced an "Involuntary Autobiographical Memory"?

- YES
- NO
- I don't know

Block E

Have you ever experienced "Error Detection"?

- YES
- NO
- I don't Know

Block Z

Have you ever experienced "Zoning out"?

- YES
- NO
- I don't Know

Block 20

SECTION 2

In this part you will be presented with definition and terminology of different spontaneous experiences that you may or may not have experienced in your life. Read each item carefully and answer the following questions please.

The sensation that you feel you have encountered something before (a place, a conversation, etc) whilst knowing this to be false (i.e. You know that you have never been to a given place before), is known as "Déjà Vu". Have you ever had this experience?
You don't need to give the same answer as the last time we asked

- ○ YES
- ○ NO

How many times in the last year?

How many times in the last week?

Would you like to describe your experience in a few lines?
We are interested in knowing how it feels.

To what extent do you agree with this definition of the experience?

	Extremely Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Extremely Agree
The sensation that you feel you have encountered something before (a place, a conversation, etc) whilst knowing this to be false (i.e. You know that you have never been to a given place before), is known as "Déjà Vu".	○	○	○	○	○	○

The feeling that you know a piece of information (like an actor's name) but that you cannot get the word/name out, is known as "Tip of the Tongue". Have you ever had this experience?
You don't need to give the same answer as the last time we asked

- ○ YES
- ○ NO

How many times in the last year?

[ ]

How many times in the last week?

[ ]

Would you like to describe your experience in a few lines?
We are interested in knowing how it feels.

[ ]

To what extent do you agree with this definition of the experience?

	Extremely Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Extremely Agree
The feeling that you know a piece of information (like an actor's name) but that you cannot get the word/name out, is known as "Tip of the Tongue".	○	○	○	○	○	○

Block J2

The feeling that you find something strange or unfamiliar (e.g. the spelling of a word looks wrong), even though you know it to be correct and it is known to you, is called "Jamais Vu". Have you ever had this experience?
You don't need to give the same answer as the last time we asked

- ○ YES

○ NO

How many times in the last year?

How many times in the last week?

Would you like to describe your experience in a few lines?
We are interested in knowing how it feels.

To what extent do you agree with this definition of the experience?

	Extremely Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Extremely Agree
The feeling that you find something strange or unfamiliar (e.g. the spelling of a word looks wrong), even though you know it to be correct and it is known to you, is called "Jamais Vu".	○	○	○	○	○	○

Block 25

To what extent, choose answer "strongly disagree", is positive?

- ○ It is wrong
- ○ Not sure
- ○ Strongly disagree

Block I2

When you have a memory from a past event (like a place on your holidays) pop into your head without having thought about it, this is called "Involuntary Autobiographical Memory". Have you ever had this experience?

You don't need to give the same answer as the last time we asked

- ○ YES
- ○ NO

How many times in the last year?

[ ]

How many times in the last week?

[ ]

Would you like to describe your experience in a few lines?
We are interested in knowing how it feels.

[ ]

To what extent do you agree with this definition of the experience?

	Extremely Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Extremely Agree
When you have a memory from a past event (like a place on your holidays) pop into your head without having thought about it, this is called "Involuntary Autobiographical Memory".	○	○	○	○	○	○

Block E2

When you realise after having done something (like sending the text message) that you made a mistake that you weren't aware of at the time of committing this error (i.e. Sending it to the wrong person), this is known as "Error Detection". Have you ever had this experience?
You don't need to give the same answer as the last time we asked

- ○ YES
- ○ NO

How many times in the last year?

How many times in the last week?

Would you like to describe your experience in a few lines?
We are interested in knowing how it feels.

To what extent do you agree with this definition of the experience?

	Extremely Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Extremely Agree
When you realise after having done something (like sending the text message to the wrong person) that you made a mistake that you weren't aware of at the time, this is known as "Error Detection".	○	○	○	○	○	○

Block Z2

when you are concentrating on one thing (e.g. reading a book), but you then realise that you have been thinking about something else, this is known as "Zoning Out". Have you ever had this experience?
You don't need to give the same answer as the last time we asked

○ YES
○ NO

How many times in the last year?

How many times in the last week?

Would you like to describe your experience in a few lines?
We are interested in knowing how it feels.

To what extent do you agree with this definition of the experience?

	Extremely Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Extremely Agree
when you are concentrating on one thing (e.g. reading a book), but you then realise that you have been thinking about something else, this is known as "Zoning Out".	○	○	○	○	○	○

Dichotomies For Describing the Experiences

SECTION 3

How would you describe your experience of the following phenomena?
Using the drop down menu, please select the relevant option. If you have never never experienced the phenomenon, answer according to the best of your knowledge.

	Duration	Control	Pleasant
Déjà vu			
Tip of the Tongue			
Jamais Vu			
Involuntary Autobiographical Memory			
Error Detection			

	Duration	Control	Pleasant
Zoning Out			

Is there anything else that comes to your mind when thinking of these types of mental/cognitive phenomena? This could be interesting for our study.

Block 21

SECTION 4

In this section we would like to ask about you, your religious/spiritual views and medical health. If you feel comfortable, answer the following questions please.

Religious and Spiritual Beliefs

Please answer these questions about your religious and spiritual beliefs

	Not at all 0 10 20 30 40 50 60 70 80 90 100 To great extent	Not Applicable	
Do you believe in God/ a Higher Power?		☐	
How often do you read religious books, magazines, or stories?		☐	
How often do you pray?		☐	
How often do you attend to religious services? (such as Mosque/Church/Temple etc)		☐	
How often do you thank God for the things that happen in your life?		☐	
How often do you ask God for help with problems?		☐	

Answer the following questions as honestly as possible please.

During the study, did you search the Internet for answers or information related to spontaneous metacognitive experiences?

- ○ Yes
- ○ No

During which part of the study did you look for additional information?

What did you check? Be as specific as possible.

Answer the question below please

	Very difficult	Somewhat difficult	Difficult	Neutral	Easy	Somewhat easy	Very easy
How difficult did you find this survey to complete?	○	○	○	○	○	○	○

Annex IV

Six phenomena with definitions and examples In French used in Study 2 (Chapter 3)

Déjà vu	La sensation d'avoir déjà rencontré quelque chose auparavant (un lieu, un visage, etc.) tout en sachant que c'est faux (c'est-à-dire que vous savez que vous n'avez pourtant jamais eu cette rencontre auparavant), est connue sous le nom de "déjà vu"
Mot sur bout de la langue	Le sentiment que vous connaissez une information (comme le titre d'une chanson) mais que vous n'arrivez pas à retrouver le mot ou le nom, est connu sous le nom de "mot sur bout de la langue"
Jaimas vu	Le sentiment que vous trouvez quelque chose d'étrange ou d'inconnu (par exemple, un mot semble avoir perdu son sens.), même si vous savez qu'il est correct et que vous le connaissez, est appelé "jamais vu"
Souvenir autobiographique involontaire	Lorsque le souvenir d'un événement passé (par example, un événement familial particulier) vous revient en mémoire sans que vous y ayez pensé, on parle de "souvenir autobiographique involontaire"
Détection d'erreur	Lorsque vous réalisez soudainement que vous avez oublié quelque chose d'important après avoir quitté la maison (comme oublier votre portefeuille), on parle d'une "détection d'erreur"
Perdre le fil	Lorsque vous vous concentrez sur une chose (par exemple, écouter un ami), mais que vous vous rendez compte que vous pensiez à autre chose, on parle de "Perdre le fil"

French qualitative descriptions of all six phenomena used for all the experiments in Chapter 3

Déjà vu

1. J'adore cette sensation, mais en même temps c'est très étrange. C'est comme une sensation de revivre le moment une deuxième fois, et de même prévoir ce qu'il va se passer ensuite, et avoir juste raison sur le scénario futur. J'ai l'impression d'être comme une voyante avec des super pouvoirs.

2. Cela m'arrivait souvent avant, depuis une dizaine d'années je dors mieux et ce type d'expérience est devenue rare. Je me souviens que je ne le vivais pas bien car j'avais l'impression de devenir un peu folle, ou en tous cas une nette sensation de déréalisation
3. C'est comme si je savais ce qu'il allait se passer à l'avance, et que ça se passait effectivement. Je me fais parfois la réflexion " la dernière fois j'avais dit/fait ça" et je reproduit spontanément l'action que je pensais avoir déjà faite par le passé
4. Je ne sais pas vraiment ce que je ressens mais j'ai vraiment l'impression d'avoir été dans cette situation et je quand on me dit que non, j'essaie de tout remettre en ordre en me disant que j'ai confondu avec autre chose mais c'est très difficile
5. Cela m'arrive parfois. Généralement j'apprécie ce sentiment mais cela peut aussi me perturber. Lorsque ça m'arrive je reste concentrée sur ce sentiment quelques secondes avant de réussir à me reconcentrer sur ce que je faisais avant.
6. Cela m'arrive assez souvent et je reste souvent très perplexe sur le moment. Que ce soit pendant des moments avec mes proches ou toute seule. J'essaie de chercher d'où pourrait provenir ce phénomène mais je ne sais pas trop.
7. C'était en TD, nous étions en groupe et j'avais l'impression de revivre pour la deuxième fois quelque chose, c'est comme si j'aurais presque pu deviner la suite des événements tellement cela me paraissait s'être déjà produit.
8. Il m'arrive parfois d'avoir l'impression d'avoir déjà connus certains lieux ou personnes, mais c'est très rare. C'est une sensation très particulière ! Comme si on avait été dans une autre dimension par le passé.
9. C'était une situation banale au restaurant universitaire en attendant de m'assoir avec mes amis. J'ai eu l'impression d'avoir déjà exactement vécu ce moment. Je me suis sentie bizarre mais c'était passager.
10. Je vis un moment et dans ma tête j'ai l'impression d'avoir déjà entendu ce que les personnes sont en train de dire, déjà ressenti ces sensations…Alors que je sais que cela ne peut pas être vrai.

Mot sur bout de la langue

11. Il m'arrive de vouloir parler de quelque chose à quelqu'un, d'attendre pour ne pas lui couper la parole et quand viens mon tour, de ne plus me rappeler de ce que je voulais dire et d'avoir la sensation d'avoir l'information proche mais sans pouvoir l'atteindre.
12. Je cherchais le nom d'un bar de ma ville (dans lequel je suis déjà allée et que je connais depuis plusieurs années) mais impossible de m'en souvenir. Je savais que le mot commençait par un "c". C'est extrêmement frustrant et challengeant à la fois.

13. Je cherchais le nom d'un acteur. C'est énervant. Dans ces situations je tente de trouver le mot en empruntant d'autres "chemins d'idées", par exemple en évoquant d'autres images ou mots ou expressions ou souvenirs associés.

14. Je trouve ça agaçant, je persiste et fais tout pour m'en souvenir dans l'instant T. Cependant si je n'arrive toujours pas à me souvenir du mot en question, je mets cette idée de côté car je sais que la solution me viendra naturellement plus tard.

15. J'étais en train d'écrire avec ma sœur, et à plusieurs reprises nous cherchions des mots pour décrire au mieux la situation mais nous étions incapables de trouver le mot que nous avions en tête, tout en sachant qu'il correspondait parfaitement.

16. Je ne me rappelle plus du mot, j'y réfléchit pendant cinq bonnes minutes avant d'abandonner. Généralement il me revient quand je fais quelque chose qui n'a rien à voir comme prendre une douche. C'est très frustrant et énervant de ne pas s'en rappeler.

17. je dirais que ça m'arrive au moins une fois par semaine. J'aime bien utiliser des mots précis, parfois un peu rares, et ça peut m'arriver de "bloquer" sur un mot que je ne retrouve pas. En général j'utilise des mots équivalents dans ce cas.

18. Souvent c'est le nom de personnes que "j'oublie". C'est assez frustrant et ça peut me préoccuper plusieurs jours jusqu'à ce que retrouve son nom. Ça devient une obsession tellement le fait d'oublier quelque chose d'aussi simple parait bête.

19. Je cherche à trouver le nom de telle ou telle personne et j'ai l'impression que je suis proche de le trouver alors que je n'y arrive pas. Généralement cela me revient à un autre moment, lorsque je ne cherche plus à trouver ce nom.

20. Je veux dire un mot mais il ne sort pas est c'est très énervant car je cherche mais je ne le retrouve pas et un moment après il ressort d'un coup comme si mon cerveau cherche encore alors que inconsciemment je pensais ne plus y penser.

Jamais vu

21. J'ai écrit un mot dans un paragraphe, que j'ai ensuite relu pour corriger les éventuelles erreurs et après être passée plusieurs fois dessus je me suis demandée pourquoi il s'écrivait comme ça, je trouvais son orthographe étrange bien que je savais qu'elle était juste.

22. Par exemple, en partiel, quand je ne me souviens plus de l'orthographe d'un mot je l'écris sur mon brouillon de plusieurs façons. Au final, j'ai l'impression de perdre le sens du mot et je choisis l'orthographe qui me parait le plus juste. Cette sensation est perturbante.

23. En écrivant un mot (souvent un nom), je suis pris d'une sensation d'étrangeté en voyant ce mot qui en apparence ne veut plus rien dire pendant un bref

instant. C'est comme si toute la sémantique derrière le mot était momentanément coupée du stimulus.

24. Entendre le mot "brouette", se le répéter puis plus je me le répète, plus le mot me semble faux. Cela entraine un sentiment d'étrangeté, on se demande s'il existe réellement, si on ne se trompe finalement pas de lettre ou de son à l'intérieur du mot.

25. C'est une sensation étrange, de doute et de frustration puisque nous savons que le mot est correctement orthographié mais notre cerveau nous dit le contraire ce qui nous contraint à vérifier son orthographe sur internet ou dans un dictionnaire.

26. Mon correcteur orthographique m'a corrigé mais je trouvais le mot "moche" avec cette orthographe alors je suis allée vérifier sur internet pour être certaine que cela s'écrivait comme ça mais j'avais toujours l'impression que c'était mal écrit.

27. Cela fait bizarre, mais (en reprenant l'exemple du mot), je l'ai écrit plusieurs fois pour m'assurer de l'orthographe et j'ai essayé de me rappeler la dernière fois que je l'avais vu écrit, pour me souvenir de l'orthographe.

28. C'était sur l'orthographe d'un mot. Je savais qu'il s'écrivait de cette manière mais ça me paraissait tout à fait étrange. Puis, à force de me questionner sur ce mot je trouvais qu'il avait de moins en moins de sens.

29. Je perds souvent confiance en moi dans ces moments en me disant que je ne sais pas écrire de toute manière et je ne sais pas si je peux me fier à mon « instinct » qui me dit que c'est juste même si ça n'en a pas l'air.

30. Cela m'arrive lorsque je porte une attention particulière à l'orthographe de certains mots que j'écris normalement automatiquement. Cette orthographe me paraît alors bizarre et je la remets en question.

Souvenir autobiographique involontaire

31. Je suis concentrée sur une tâche cognitive, et un flash-back d'un lieu avec détails du contexte : couleurs, environnement, situation. C'est un instant de la scène d'environ une seconde. L'expérience est furtive et n'occasionne pas de conséquences (pensées, émotions) particulières.

32. Il ne s'agit pas d'une expérience très nette/forte, mais plutôt l'évocation 'inattendue' d'un souvenir en lien avec un lieu (PS: je n'ai pas compté les fois où j'ai vécu cette expérience lors de rêves, mais cela me semble au moins aussi fréquent que lorsque je suis éveillée).

33. Cela m'arrive parfois. C'est souvent lors de discussions avec mes amis ou ma famille et qu'ils vont prononcer un mot particulier qu'un souvenir va me revenir spontanément. Alors je m'empresse de raconter ce souvenir qui est souvent agréable ou marrant.

34. Certains souvenirs étaient agréables, d'autres l'étaient moins... Donc les sentiments ressentis étaient très différents d'une expérience à l'autre. Par

contre j’avais toujours envie d'en parler avec les personnes concernées par le souvenir.

35. Parfois se sont des souvenirs joyeux, donc je suis heureuse face à ses souvenirs, et parfois se sont des souvenirs moins joyeux, mais je n'éprouve pas tellement de la tristesse, plutôt de la reconnaissance, de la fierté et de la nostalgie.

36. Un souvenir ancien est revécu sans qu'on l'ai recherché dans sa mémoire, il apparait spontanément. Généralement cela m'arrive sans que quelque chose de précis m'y fasse penser, où alors je n'arrive pas à identifier ce que c'est…

37. Je passe mon temps à me laisser entraîner dans des rêveries et je trouve ça très agréable. Même lorsque les souvenirs ne le sont pas forcément c'est toujours intéressant d'accepter de se replonger en arrière je trouve.

38. Le souvenir d'être à un endroit précis me revient d'un coup, alors que je n'ai pas réactivé ce souvenir depuis longtemps, et que rien (ou en apparence) n'a semblé activer ce souvenir dans mon environnement.

39. De manière général ce sont toujours des bons souvenirs qui reviennent en mémoire donc c'est une sensation agréable. J'aime bien essayer de comprendre pourquoi cet évènement en particulier me revient à l'esprit.

40. Des fois ça apparait comme des flashs, on ne savait même pas que ces souvenirs étaient encore en nous mais ils reviennent brusquement et la représentation qu'on en a est très précise et semble presque récente.

Détection d'erreur

41. C’est assez perturbant de ne pas se souvenir de ce qu’on a réellement fait. Je me sens un peu bête selon l’erreur. Ca peut aussi être délicat de l’expliquer à l’autre, je peux en avoir honte ou juste rire de ma propre bêtise.

42. Généralement ça arrive quand on fait quelque chose en pensant à une autre chose, c'est assez déconcertant car on le fait naturellement, presque inconsciemment, et lorsqu'on revient à notre activité de base, avec une nouvelle attention on se rend compte de l'erreur.

43. C'est une expérience assez désagréable qui me donne un sentiment de honte, il m'arrive que lorsque je suis envahie par des émotions négatives comme quand je suis stressée et énervée, et que je dois me dépêcher (donc pas le temps de réfléchir, pas concentrée à 100%).

44. C'est quelque chose de très stressant car nous prenons conscience de cette erreur que trop tard et que la personne ayant reçu le SMS (ou autre) l'ait sûrement déjà lu, rajoute encore plus de stress puisque c'est quelque chose qui ne lui était pas destiné.

45. Je disais à ma sœur que de chez mes parents à Valence il y avait 40km, et quand j'ai envoyé le message je me suis dit directement "ah bah pas du tout

non il y en a 20". Je me suis sentie un peu bête, je me suis dit que je savais la "bonne réponse".

46. J'ai envoyé une photo d'une blague à mon frère à la place de mes copines. Sur le coup j'ai ressenti de la honte mais très rapidement je me suis souvenu que c'était juste une photo marrante et que ce n'était pas grave d'avoir fait cette erreur.

47. Cela dépend de la nature du message, mais souvent m'en rendre compte bien après l'avoir envoyé en ayant la réponse de la personne qui ne devait pas recevoir ce message et qui ne comprend donc pas ce qu'on est en train de lui dire.

48. Sentiment de gêne, car le mauvais destinataire n'a peut être rien à voir ou tout à voir avec le message, et nous ne voulons pas forcément qu'il ait l'information... On se sent bête car c'est quelque chose de facilement évitable.

49. Cela m'arrive parfois également. Plus souvent lorsque que je suis fatiguée, stressée ou déconcentrée. Souvent je fais des fautes d'orthographe que je n'ai pas l'habitude de faire et lorsque je m'en rends compte j'ai un peu honte.

50. J'ai beaucoup de détresse et de colère contre moi. Gros trouble de l'attention et c'est beaucoup plus douloureux qu'une simple erreur et si ca peut parfois faire rire moi ca me fait pleurer je me déteste dans ces moments-là.

Perdre le fil

51. Quand je suis en train de faire quelque chose, par exemple : lire un livre, la vaisselle ou que je suis en classe, je me surprends parfois à partir dans mes pensées. C'est comme s'il était impossible pour moi de me concentrer ou que mes pensées prenaient le dessus.

52. Cela arrive quand je suis très concentrée sur un livre et qu'une phrase ou une idée me fait penser à autre chose; soit quand j'écoute quelqu'un mais que je n'arrive plus à m'y intéresser, mes propres pensées deviennent plus "sonores" que la conversation.

53. C'est typiquement ce qu'il se passe quand on lit et qu'on relit la même phrase plusieurs fois d'affilé, sans la comprendre, ou quand au milieu d'une conversation on se rend compte qu'on n'écoutait plus rien. C'est plus fréquent lorsque je suis fatigué.

54. Comme si je partais dans mes pensées, je vois les images auxquelles je pense devant mes yeux alors que je suis dans une autre situation dans la réalité et quand j'ai terminé, je reviens à la réalité et les images deviennent floues et s'effacent.

55. Je lisais mais après quelques secondes je me suis rendu compte que j'étais dans mes pensées même si mes yeux ont continué de suivre les lignes du livre. Je me suis rendu compte que je ne savais pas de quoi parlaient les dernières lignes lues.

56. Perturbé, transporté complètement dans l'univers auquel on pense tout en continuant l'activité de manière mécanique. Dans l'exemple de la lecture, cela est parfois gênant car on est obligé de relire les passages vu qu'on était étourdi.

57. C'est assez frustrant quand on relie volontairement plusieurs fois la même ligne ou qu'on demande de faire répéter quelqu'un parce qu'on pensait à autre chose, tout en sachant qu'il fallait lire attentivement ou alors comprendre l'autre.

58. Je voyais les mots défiler devant mes yeux mais je n'arrivais pas à y mettre du sens, c'était pour moi juste une suite de lettres, mon esprit était littéralement ailleurs, j'ai dû relire le passage en me concentrant vraiment dessus.

59. C'est dur à décrire car je ne m'en rends pas compte. Je réalise ce qui vient de se passer seulement quand je reviens sur ma tâche. C'est un peu bête, car on perd du temps, mais j'aime bien la sensation d'être dans ses pensées!

60. Il m'arrive très fréquemment de lire en étant concentrée au début, puis de penser à autre chose par association ou simplement par manque de concentration tout en continuant à lire, mais de manière déconnectée et passive.

Control Questions

61. Cela m'arrive de temps en temps, et je pense que mes amis l'ont eu aussi. Quand je mange un aliment très froid, comme une glace, ou que je bois une boisson fraiche, j'ai mal aux dents. Certaines personnes disent qu'elles l'ont quand elles se nettoient les dents, mais moi je me souviens de l'avoir quand j'ai escaladé la Bastille. Il faisait très chaud, et j'ai pris une tasse de café et puis une glace tout de suite.

62. La dernière fois que j'ai vécu cette expérience, j'étais à l'extérieur de chez moi. Je pliais le linge et j'ai vu un de mes t-shirts préférés et ça m'a fait sourire. Je n'aime généralement pas laver mes vêtements.

63. Parfois, quand je suis très fatigué et qu'il est tôt le matin, je regarde par la fenêtre pour voir quel temps il fait. J'aime savoir quel temps il fera pendant la journée.

64. C'est une situation frustrante, je pense avoir un animal de compagnie, mais les gens avec qui je vis ne pensent pas que ce soit une bonne idée.

65. Je pense souvent à des choses qui m'intéressent et je n'en discute pas avec d'autres personnes. Par exemple, quand j'étais au supermarché l'autre jour, je me demandais pourquoi la tomate est un fruit et non un légume. Parfois, je cherche la réponse sur Google, car je peux alors en parler à mes amis.

66. C'est une expérience intéressante. Par exemple, j'étais invitée à l'anniversaire de Pierre, et y voir Carole parler avec Pierre m'a bouleversé. Il m'avait invité mais je ne voulais pas voir Carole. Ces choses nous arrivent à tous.

67. J'ai voyagé en Asie l'année dernière pendant mes vacances d'été, et quand j'y étais, j'ai appris que Tokyo était la capitale du Japon, mais que l'empereur vivait à Kyoto. J'ai trouvé cela très intéressant

68. Mon chat s'est enfui hier, alors j'ai mis des dépliants pour demander aux gens s'ils l'avaient vu. J'espère la trouver. Elle s'est déjà enfuie, mais c'est la première fois qu'elle s'échappe de cet appartement.

69. Cela m'arrive parfois. J'aime faire les mots croisés dans le journal, mais la semaine dernière, quand je suis allé faire les mots croisés, j'ai découvert que mon colocataire avait déjà rempli les mots croisés.

70. Parfois, quand il fait noir, j'utilise la torche de mon téléphone portable pour voir où je vais. Cela m'aide à voir dans le noir, mais je n'aime pas utiliser ma batterie. Une fois j'avais oublié mon téléphone et je n'aimais pas me promener dans le noir.

English qualitative descriptions of all six phenomena used for all the experiments with AI model in Chapter 3 Déjà vu

1. It feels this has happened before, the event or conversation or a certain action, but I am unable to recall what happens next. Even by trying to recall and put some thought into it, still cannot determine how it ends.

2. I'm typing a text to someone I get this feeling it has happened before, I was sitting here and writing this. The feeling is strange but I don't know why I like whenever it happens, it’s pleasant.

3. I once was in a family gathering and suddenly the discussions and the situation seemed very familiar like I have been in this situation before. The only feeling was I wanted to tell everyone about this.

4. This thing confuses my mind. Earlier today I felt that I have had the same conversation with my colleague at a place. But we were neither there before nor had same topic of conversation.

5. It feels very strange to me. As I had never visited a place before. But suddenly I remember that somehow, I had visited that place before. Or I had seen that moment before this.

6. I was talking to my friend about going to the cafe. I thought I went there before but when we reached cafe, I came to know that it was only my own thoughts I never went to that place before.

7. I visited a park once there I experienced that a part of that park was similar to a place I visited before but couldn't recognize that. It was quite confused situation.

8. I went to Makkah for the first time in my life for umrah and there was a place that i saw and felt like i have been there before although it was my 1st time

9. I'm sitting somewhere and people are busy doing what they are doing and instantly, out of nowhere, I feel like this has happened before and I've seen it

10. I see many people and when I talk to them sometimes I feel like this conversation has happened before but that never happened.

Tip of the tongue

11. I once met a friend who was asking about another friend but she didn't know her name. I was just telling her who is she. But her name was also not coming to me. It was just circulating in my mind. How funny moment that was.

12. I felt it today when I was having a political conversation with my acquaintances and I wanted to call out the term used for Russian power and I completely got stuck in words and couldn't make that terminology to appear in my mind.

13. There was a time when I wanted to tell something, and I knew I know it, but couldn't say it. This was very irritating and embarrassing at the same time for claiming something to know but cannot say it.

14. It feels very nervous when you know something but you can't speak it out. Sometimes you need to describe it to your friend, so that he can help you to remember that particular thing or name.

15. I was trying to remember an actor's name from the movie Gladiator. I could remember his face but couldn't recall his name. It felt like I am growing old now, can't remember small things.

16. It's a very confusing feeling like you're trying to complete your sentence and you can't because you can't get it out what you have in your mind and it gets very weird.

17. I like a song and heard it many times but whenever I try to remember it I forget its name and then I have to take some time to remember it or ask a friend.

18. It's very disturbing. when you want to give an information but you are unable to pronounce the exact word or even become incapable to explaining it.

19. It feels like your brain knows the words but is censoring that particular word and is playing a joke on you and then you get embarrassed in public.

20. I feel restless until I remember that name. Then I google it, ask my friends about it and when I remember what that was, finally I can rest.

Jamais vu

21. Sometimes when I read my notes I feel how is it possible the word is right, it may be wrong but in actuality the written word is right but I feel it is wrong. I mostly feel those words that I saw or read in my past, especially childhood. It's a very anonymous feeling.

22. Last week, while solving my assignment. I had the solution of questions in front of me but I was ambiguous about those, though, I knew that those were the right solutions suggested by instructor but I confirmed those from 3 people and then wrote them.

23. When I focus on one word or keep spelling/looking/saying a specific word it starts to look wrong as if it wasn't like this from the beginning, like somehow the spelling is wrong etc.

24. It happens to me almost in my every exam I write wrong word and then I remember it would be like this. In this way I make my paper so ugly by cutting. So, it is quite hateful.

25. While writing in my exams, I write a word correctly like Appetite but I keep looking at the word over and over again because I have second thoughts that it might be wrong.

26. When you are writing something in paper, you get sometime nervous then you even got so anxious that you doubt about the spellings of the word you are familiar with.

27. I saw my friend writing a word during lecture i thought she was spelling it wrong but it was correct that's how i experienced that.

28. It feels like looking at something you know really well but somewhere at the back of your mind, your mind refuses to recognize it.

29. I often felt myself confused regarding spelling correction. Last time I was confused in spelling of "expectations".

30. Improving skills is a good way to become better from Good. Spelling mistakes are often done by me. But at the same time, I realize that I had made a certain blunder. So, I correct it.

Involuntary autobiographical memory

31. I feel like I totally forgot that part of my life and now I don't know how it came to my mind but that feels good and I compare that event with my now condition to know whether I'm grown up now or still doing the same things.

32. It happens a lot of time, I don't even want to remember a past event but then something like an event or a cue or any words take my mind towards a certain memory associated to someone or something (event).

33. Last week I was trying to sleep but out of nowhere the memories of my ex-girlfriend poped up in my mind which brought back the moments we spent together and all those memories shattered my heart.

34. When you finally relax yourself and then your brain continuously turns on the most embarrassing memories of your past and you just wish you had never become relaxed in the first place.

35. It feels good when a memory pops up in mind which is good. And if that memory is bad one then I feel bad that why this comes to my mind I don't want to remember this anymore.

36. It’s about my dreams like I often see dreams and forget it then after some days I go through a situation or a place that appeared in my dream that reminds me of same dream.

37. Certain things just immediately remind you of something like it just takes you back in time. If I listen to a song it takes me to the time I discovered it and stuff.

38. I was sitting to study. Suddenly I remember my college days and friends. I was not remembering it but it was just a sudden thought come into my mind.

39. Getting thoughts about the past is not pleasant for me. The memories I try to run away from keep popping up and it makes me feel sad and depressed.

40. I was doing my quiz and some sort of family holiday popped up in my mind even I was literally not thinking about it, and I was like why now?

Error detection

41. I don't take it seriously because I think that sometimes it happens by fault. This situation occurs in sending messages but when I do some work after doing it, it is strange because after doing it I feel bad as I can't do this work.

42. I was supposed to send a message to my brother to help one of my friends but I accidentally sent the message to the same friend for whom I was asking help. It made me feel ashamed, quite low and embarrassed.

43. I was talking to my friend and suddenly I felt assertive and behaved like an outsider and said these things which I didn't want to. But later I realized that I should not do this.

44. Just a few hours ago I was going to text my FYP partner about our project but I accidentally texted my other friend which I realized after sending the text. So, I quickly deleted it.

45. It is anxiety provoking because you realize that it shouldn't have happened. It also happens when you have to do something in a certain way and it doesn't, you realize afterwards.

46. One day I wanted to message my friend that send me your assignment. I sent this message to my teacher and I was very ashamed that time. Why did I send this message to madam?

47. It's like at the time of doing that thing I was unaware of the circumstances but afterwards I realized my mistake and thought that I shouldn't have done that.

48. After doing such mistake I just feel uncomfortable as if I have made a huge mistake and the whole world is going to kill me and perceive me as ashamed person.

49. Recently just sent message in official group while was replying to my friend. Though I deleted abruptly but you know very well, teachers never ignore it.

50. It is sometimes when I try to text my friend and after texting him I realise I might have made a mistake and he will get offended maybe.

Zoning out

51. Sitting in classroom and listening to the instructor, often seems fruitless because at the end of the lecture I understood nothing about the lecture but the fact is I was thinking about someone else and couldn't focus on what teacher was speaking. This is truly quite often.

52. I am a novel reader, and almost every night I read a book. A day when I am mentally disturbed or something happens to me wrong I during reading slowly moves toward that incident and start thinking about that.

53. Few days ago when I sat to prepare my exam my focus was on studies but I was thinking about my results and paper. That what kind of paper is expected, what kind of questions can come?

54. It feels like you're thinking about a lot of things all at once but when you try to track your thoughts, they all disappear like you weren't thinking of anything at all.

55. It’s like a person being on a place while not being in that place. It’s like you get cut off from the present state of environment and mind, it takes you to your unconscious.

56. I start studying something then I remember something and I connect the chains and go far away from the topic. Then I realize, I was studying and I should focus on it.

57. It's like I'm afraid of something and I don't want to remember it but whenever I'm doing something else, I remember that bad thought and I get totally distracted.

58. During my study time, I'm actually making notes but my mind is elsewhere and I can't listen if someone's calling my name, similar with lecture during the class.

59. It always remain a problem. I cannot concentrate on my existing task but to think about coming events like traveling schedules, domestic deeds etc.

60. While reading, unconsciously, I'm thinking about other things such as mobile, doing something else. It's just because reading is my least priority.

Control questions

61. It happens to me from time to time, and I think my friends have had it too. When I eat something very cold, like an ice cream, or drink a cold drink, I get a toothache. Some people say they get it when they clean their teeth, but I remember getting it when I climbed the Bastille. It was very hot, and I had a cup of coffee and then an ice cream straight away.

62. The last time I had this experience, I was outside my house. I was folding laundry and saw one of my favourite t-shirts and it made me smile. I generally don't like washing my clothes.

63. Sometimes, when I'm really tired and it's early in the morning, I look out the window to see what the weather's like. I like to know what the weather will be like during the day.

64. It's a frustrating situation, I think about having a pet, but the people I live with don't think it's a good idea.

65. I often think about things that interest me and don't discuss them with other people. For example, when I was in the supermarket the other day, I was wondering why tomatoes are a fruit and not a vegetable. Sometimes I Google the answer, because then I can talk to my friends about it.

66. It's an interesting experience. For example, I was invited to Pierre's birthday party, and seeing Carole talking to Pierre upset me. He had invited me but I didn't want to see Carole. These things happen to all of us.

67. I travelled to Asia last year during my summer vacations, and when I was there I learned that Tokyo was the capital of Japan, but that the emperor lived in Kyoto. I found this very interesting.

68. My cat ran away yesterday, so I put up flyers to ask people if they'd seen it. I hope to find her. She's run away before, but this is the first time she's escaped from this apartment.

69. It happens to me sometimes. I like to do the crossword in the newspaper, but last week when I went to do the crossword, I discovered that my flatmate had already filled in the crossword.

70. Sometimes, when it's dark, I use the torch on my cell phone to see where I'm going. It helps me see in the dark, but I don't like using up my battery. Once I forgot my phone and I didn't like walking in the dark.

Annex V

Questionnaire used for study 3 (with epilepsy patients) in Chapter 4

Déjà vu and Other Spontaneous Metacognitive Experiences

CONSENT FOR THE PARTICIPATION IN THE STUDY

Participation - We would like to invite you to participate in this study on "Spontaneous MetaCognitive Experiences". This is a PhD thesis research project being conducted in the Laboratory of Psychology and NeuroCognition at University of Grenoble Alpes, France. The survey will take approximately ten to fifteen minutes to complete. It is organized into 3 different small sections, asking about metacognitive experiences.
Your participation in this survey is voluntary. In order to participate you need to be 18 or older. You may refuse to take part in the research or stop at any time. You are free to decline to answer any particular question you do not wish to answer for any reason.

Benefits & Risks - There are no right or wrong answers, but your responses will help us learn more about metacognitive experiences. There are no apparent risks involved in participating in this study. However, the survey may ask questions about your life events or personal memories, but you are not required to provide any details, and you should not share with us anything you consider too personal.

Confidentiality - This questionnaire does not collect identifying information such as your name etc. Therefore, your participation and responses will remain anonymous and confidential. The responses collected through this survey will only be used for research purposes. In any eventual publication, quotes may be used, but they will always be anonymous.

Releasing material and data to other parties - Your answers are merged with the answers of the other participants in a large database; your answers cannot be traced back to you. This database may be uploaded to a public repository and might be shared with other researchers, which is recommended best practice in any psychological research.

Information about the outcome of the study - You are entitled to receive information about the outcome/result of the study. Please contact the research team to do so.

CONTACT

If you have questions at any time about the study or survey, you may contact the researchers on the following email addresses. Gull Zareen < gull.zareen@univ-grenoble-alpes.fr > Research Student
Chris Moulin < christopher.moulin@univ-grenoble-alpes.fr> Research Supervisor
Amna Liquat < amina.liaquat.pk@gmail.com > Research Team Member

I have read and agree with the terms above

○ Yes, I agree to participate

○ No, I don't agree to participate

SECTION 1

In this research we are interested in finding out about the experience of people's errors in their personal mental life that happen to us on an every-day basis. These errors are perfectly normal, and part of healthy thinking processes. In this study we want to investigate how often they occur in daily life.

We will introduce you to the definition and terminology of different spontaneous experiences that you may or may not have had in your life. Please read each item carefully and answer the following questions.

You may circle the answer or write it down.

Demographic Information

Q1. I am :

Male / Female / Non-binary / Third gender / Other / Prefer not to say

Q2. Age: _____

Q3. Years of education of completed: _____

Q4. Indicate your parental consanguinity:

First cousin marriage / second cousin marriage / not related

Q5. Your age at the time of diagnosis: _____

Q6. Indicate the duration of your Illness: _____

Q7. Indicate your epileptic focus: _____ / unknown

Q8. Indicate your surgical status (if any): _____

post-surgical / pre-surgical

Q9. Other medical or psychiatric/psychological issues (if any): _____

Q10. Are you taking any medication?

Yes / No

If yes specify the duration and purpose: _____

SECTION 2

DÉJÀ VU. The sensation that you feel you have encountered something before (a place, a conversation, etc) whilst knowing this to be false (i.e. You know that you have never been to a given place before), is known as "**déjà vu**". Have you ever had this experience?

Yes / No

If yes:

How many times in the last year?

- o 0
- o 1-2
- o 3-5
- o 6-10
- o 11-20
- o 21-50
- o 51-100
- o More than 100

TIP OF THE TONGUE. The feeling that you know a piece of information (like an actor's name) but that you cannot get the word/name out, is known as "**tip of the tongue**". Have you ever had this experience?

Yes / No

If yes:

How many times in the last year?

- o 0
- o 1-2
- o 3-5
- o 6-10
- o 11-20
- o 21-50
- o 51-100
- o More than 100

JAMAIS VU. The feeling that you find something strange or unfamiliar (e.g. the spelling of a word looks wrong), even though you know it to be correct and it is known to you, is called "**jamais vu**". Have you ever had this experience?

Yes / No

If yes:

How many times in the last year?

- o 0
- o 1-2
- o 3-5
- o 6-10
- o 11-20
- o 21-50
- o 51-100
- o More than 100

INVOLUNTARY AUTOBIOGRAPHICAL MEMORY. When you have a memory from a past event (like a place on your holidays) pop into your head without having thought about it, this is called "**involuntary autobiographical memory**". Have you ever had this experience?

Yes / No

If yes:

How many times in the last year?

- o 0
- o 1-2
- o 3-5
- o 6-10
- o 11-20
- o 21-50
- o 51-100
- o More than 100

ERROR DETECTION. When you realise after having done something (like sending the text message) that you made a mistake that you weren't aware of at the time of committing this error (i.e. Sending it to the wrong person), this is known as "**error detection**". Have you ever had this experience?

Yes / No

If yes:

How many times in the last year?

- 0
- 1-2
- 3-5
- 6-10
- 11-20
- 21-50
- 51-100
- More than 100

ZONING OUT. When you are concentrating on one thing (e.g. reading a book), but you then realise that you have been thinking about something else, this is known as "**zoning out**". Have you ever had this experience?

Yes / No

If yes:

How many times in the last year?

- 0
- 1-2
- 3-5
- 6-10
- 11-20
- 21-50
- 51-100
- More than 100

SECTION 3

How would you describe your experience of the following phenomena? Please circle one of the relevant options available in each column and row. If you have never experienced the phenomenon, answer according to the best of your knowledge.

	Duration	**Control**	**Pleasant/Unpleasant**	**Predictability**	**Significance of the event**
Déjà vu	- It's a brief sensation - it's a long sensation - I don't know	- It's something I have control over - It's something I have no control over - I don't know	- It's a pleasant experience - It's unpleasant experience -I don't know	- It comes suddenly - It comes gradually over the time -I don't know	- It's a random event - It's a meaningful event -I don't know
Tip of the Tongue	- It's a brief sensation - it's a long sensation - I don't know	- It's something I have control over - It's something I have no control over - I don't know	- It's a pleasant experience - It's unpleasant experience -I don't know	- It comes suddenly - It comes gradually over the time -I don't know	- It's a random event - It's a meaningful event -I don't know
Jamais Vu	- It's a brief sensation - it's a long sensation - I don't know	- It's something I have control over - It's something I have no control over - I don't know	- It's a pleasant experience - It's unpleasant experience -I don't know	- It comes suddenly - It comes gradually over the time -I don't know	- It's a random event - It's a meaningful event -I don't know
Involuntary Autobiographical Memory	- It's a brief sensation - it's a long sensation - I don't know	- It's something I have control over - It's something I have no control over - I don't know	- It's a pleasant experience - It's unpleasant experience -I don't know	- It comes suddenly - It comes gradually over the time -I don't know	- It's a random event - It's a meaningful event -I don't know
Error Detection	- It's a brief sensation - it's a long sensation - I don't know	- It's something I have control over - It's something I have no control over - I don't know	- It's a pleasant experience - It's unpleasant experience -I don't know	- It comes suddenly - It comes gradually over the time -I don't know	- It's a random event - It's a meaningful event -I don't know
Zoning Out	- It's a brief sensation - it's a long sensation - I don't know	- It's something I have control over - It's something I have no control over - I don't know	- It's a pleasant experience - It's unpleasant experience -I don't know	- It comes suddenly - It comes gradually over the time -I don't know	- It's a random event - It's a meaningful event -I don't know

Q: Is there anything else that comes to your mind when thinking of these types of mental/cognitive phenomena? Would you like to describe your experience in a few lines? We are interested in knowing how it feels. This could be interesting for our study.

Annex VI

Questionnaire used post-experimental task (Study 4; Chapter 5)

Souvenir Autobiographique Involontaire et des Expériences Métacognitives Spontanées

Vous pouvez entourer la réponse ou l'écrire.

Informations démographiques

Q1. Je suis:

Homme / Femme /Autre / Je préfère ne pas le dire

Q2. Veuillez indiquer votre âge:_____

Q3. Le niveau d'éducation actuel:_____

Q4. Années de vie à grenoble:: _____

Lisez attentivement les questions et répondez à l'aide du menu déroulant pour chacun des phénomènes suivants.

	combien de fois en avez-vous fait l'expérience au cours de l'année écouée ?	**combien de fois l'avez-vous ressenti au cours de l'expérience ?**	**Quelle est l'intensité de ce phénomène dans la vie réelle ?**	**Quelle a été l'intensité ce phénomène au cours de l'expérience ?**
Déjà vu	0 1-2 3-5 6-10 11-20 21-50 51-100 Plus de 100	0 1 2 3 4 5 6 7 8 9 10	None/ Très faible / Faible Forte / Très forte	Très faible / Faible Forte / Très forte / Je ne l'ai pas ressentie pendant l'expérience
Jamais vu	0 1-2 3-5 6-10 11-20 21-50 51-100 Plus de 100	0 1 2 3 4 5 6 7 8 9 10	None/ Très faible / Faible Forte / Très forte	Très faible / Faible Forte / Très forte / Je ne l'ai pas ressentie pendant l'expérience
Mot sur bout de la langue	0 1-2 3-5 6-10 11-20 21-50 51-100 Plus de 100	0 1 2 3 4 5 6 7 8 9 10	None/ Très faible / Faible Forte / Très forte	Très faible / Faible Forte / Très forte / Je ne l'ai pas ressentie pendant l'expérience
Détection d'erreur	0 1-2 3-5 6-10 11-20 21-50 51-100 Plus de 100	0 1 2 3 4 5 6 7 8 9 10	None/ Très faible / Faible Forte / Très forte	Très faible / Faible Forte / Très forte / Je ne l'ai pas ressentie pendant l'expérience
Souvenir autobiographique involontaire	0 1-2 3-5 6-10 11-20 21-50 51-100 Plus de 100	0 1 2 3 4 5 6 7 8 9 10	None/ Très faible / Faible Forte / Très forte	Très faible / Faible Forte / Très forte/ Je ne l'ai pas ressentie pendant l'expérience
Perdre le fil	0 1-2 3-5 6-10 11-20 21-50 51-100 Plus de 100	0 1 2 3 4 5 6 7 8 9 10	None/ Très faible / Faible Forte / Très forte	Très faible / Faible Forte / Très forte / Je ne l'ai pas ressentie pendant l'expérience

Merci beaucoup d'avoir participé à cette étude de doctorat. Vos réponses ont été enregistrées. Si vous avez des questions concernant l'étude ou l'enquête, vous pouvez contacter les chercheurs à l'adresse électronique suivante ou sur Twitter.

Gull Zareen < gull.zareen@univ-grenoble-alpes.fr > (@Gull_Zareen) https://twitter.com/Gull_Zareen

Annex VII

Table VII. Overall mean ratings for characteristics of each type of thought.

	Déjà vu		Jamais vu		Involuntary autobiographical memories		Zooning out		Tip-of-the-tongue		Error detection		
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*Test*
Stimulus Type: Combined Across All Categories													
Density index	.16[1,2,3,4,5]	.19	.12[1,6,7,8]	.15	.27[2,6,9,10,11]	.19	.10[3,9,12]	.13	.02[4,7,10,12,13]	.04	.07[5,8,11,13]	.01	*F* (5, 475) = 31.64, *p = .001, $\eta 2$ =.25
Spontaneity	.77	.14	.72	.17	.83	.11	.68	.26	.80	.20	.77	.13	*F*(5, 30) = .90 , p = .493 , $\eta 2$ =.13
Strength of experience	.62	.25	.57	.26	.70	.21	.59	.28	.66	.33	.63	.21	*F*(5, 30) = .83 , p = .539 , $\eta 2$ =.12
Focusing on the task	.60	.14	.62	.24	.62	.07	.36	.29	.58	.28	.54	.26	*F*(5, 30) = 1.63 , p = .181 , $\eta 2$ =.21
Retrospectively estimated yearly everyday frequency	3.45[1,2,3,4]	1.66	2.74[1,5,6,7,8]	1.87	5.71[2,5,9,10]	1.79	5.73[3,6,11,12]	1.61	4.32[4,7,9,11,13]	1.85	3.47[8,10,12,13]	1.99	*F*(5, 470) = 69.77, *p = 0.001; $\eta 2$=.43
Retrospectively estimated frequency during the vigilance task	3.89[1,2,3,4]	3.78	3.16[5,6,7,8]	3.52	5.32[1,5,,9,10]	3.35	4.85[2,6,11,12]	3.58	.77[3,7,9,11,13]	1.66	2.12[4,8,10,12,13]	2.85	*F*(5, 460) = 32.16, *p = 0.001; $\eta 2$=.26
Stimulus Type: Familiar picture stimuli													
Density index	.22[1,2,3,4,5,A,B]	.28	.01[1,6,7,A,B]	.05	.33[2,6,8,9,10,A]	.30	.10[3,7,8,11,12]	.18	.01[4,9,11,A]	.03	.01[5,10,12,A]	.05	*F*(5, 475) = 46.42 , *p = .001 , $\eta 2$ =.33
Spontaneity	.71	.20			.75	.14	.71	.22					*F*(2, 24) = .18 , p = .833 , $\eta 2$ =.02
Strength of experience	.58	.19			.66	.16	.60	.24					*F*(2, 24) = .67 , p = .523 , $\eta 2$ =.05
Focusing on the task	.55[1]	.18			.65[2]	.17	.34[1,2]	.29					*F*(2, 24) = 12.37 , *p = .001 , $\eta 2$ =.51

Stimulus Type: Unfamiliar picture stimuli												
Density index	.21[1,2,3,4,C,D]	.31	.03[2,5,C,D]	.13	.23[5,6,7,8,A,B,C]	.29	.09[3,6,9,10]	.20	.02[4,7,9,]	.08	.02[5,8,10,B]	.09	*F*(5, 475) = 20.56 , *p = .001 , *η2* =.18
Spontaneity	.77	.14			.70	.26	.54	.37					*F*(2, 6) = 2.83 , *p* = .136 , *η2* =.47
Strength of experience	.66	.23			.53	.23	.56	.30					*F*(2, 6) = 1.42 , *p* = .313 , *η2* =.32
Focusing on the task	.47[1]	.15			.50[2]	.30	.11[1,2]	.12					*F*(2, 6) = 8.24 , *p = .019 , *η2* =.73
Stimulus Type: Words												
Density index	.12[1,2,3,A,C]	.25	.09[4,5,A,C]	.19	.32[1,4,6,7,8,B,D]	.33	.11[6,9,10]	.19	.01[2,5,7,9]	.05	.04[3,8,10,C]	.11	*F*(5, 475) = 23.47 , *p = .001 , *η2* =.20
Spontaneity	.79	.18			.78	.27	.71	.14					*F*(2, 8) = .382 , *p* = .694 , *η2* =.09
Strength of experience	.70	.17			.66	.13	.50	.24					*F*(2, 8) = 1.27 , *p* = .331 , *η2* =.24
Focusing on the task	.58	.21			.53	.15	.42	.32					*F*(2, 8) = 2.28 , *p* = .165 , *η2* =.36
Stimulus Type: Non-words												
Density index	.10[1,2,B,D]	.19	.20[1,3,4,5,B,D]	.30	.09[3,C,D]	.19	.11[4,6]	.21	.03[2,5,6,7,A]	.08	.15[7,A,B,C]	.26	*F*(5, 475) = 6.48 , *p = .001 , *η2* =.06
Spontaneity	.80	.17			.72	.30	.72	.28					*F*(2, 10) = .32 , *p* = .736 , *η2* =.06
Strength of experience	.71	.16			.64	.14	.65	.23					*F*(2, 10) = .52 , *p* = .613 , *η2* =.09
Focusing on the task	.56[1]	.21			.54[2]	.16	.25[1,2]	.20					*F*(2, 10) = 4.70 , *p = .036 , *η2* =.48

* $p < .05$. While means with the same numerical subscripts (e.g.,[1-1,2-2]) are significantly different between columns (indicating differences between types of thoughts), means with the same literal subscripts (e.g. [A-A, B-B]) are significantly different between rows (indicating differences within the same type of thought across stimulus type).

For example, in the first row (Density Index, Stimulus Type: Combined across all categories), the density index for déjà vu (.16) was significantly different than that for each of the following: (1–1) jamais vu, (2–2) IAMs, (3–3) zoning out, (4–4) TOTs, and (5–5) error detection. At the same

time, looking at the literal subscripts, the density index of déjà vu in response to familiar pictures was significantly different from that reported in response to: (A–A) words and (B–B) non-words.

The phenomenological characteristics were rated on a scale from 0 (e.g., extremely weak) to 1 (e.g., extremely strong). The rating scales had fine granularity, allowing participants to select any value between 0 and 1.

Density index was the proportion of each type of thought relative to the total number of reported mental contents for each participant. It reflects the relative frequency of a specific type of thought within an individual's overall cognitive activity. For example, an IAMs index of 0.27 indicates that on average 27% of all reported mental contents were IAMs. Notably, two participants may have the same IAMs index despite reporting a different absolute number of IAMs, as the index accounts for the total volume of mental content reported. This approach is consistent with previous work (e.g., Barzykowski & Niedźwieńska, 2018; Barzykowski, Riess, Hajdas et al., 2019) and minimizes the risk of biasing the results due to individual differences.