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Sense of reality, metacognition and culture in schizophrenic and drug-induced hallucinations: An interdisciplinary approach

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Abstract

Hallucinations possess two main components: (i) a sensory content; and (ii) a sense that the sensory content is real. Influential models of schizophrenic hallucination claim that both the sensory content and the sense of reality can be explained in terms of metacognitive dysfunction. This chapter assesses whether such a claim holds for schizophrenic and drug-induced hallucinations; it further attempts to determine the actual role of metacognition in hallucination and how this role is liable to vary across cultures. It is first argued that the notion of sense of reality is heterogeneous and should therefore be divided into distinct kinds. Next, some monitoring-based models of hallucination are presented. After having briefly distinguished between different levels of metacognitive processing, I show that these monitoring-based models are metacognitive only to a limited extent and that they fail to explain important aspects of the content and sense of reality of hallucinations. I subsequently suggest that the main mechanisms of serotoninergic-hallucinogens are not metacognitive whereas those of anticholinergic-hallucinogens importantly tap into subpersonal metacognitive processes. Looking specifically at the use of ayahuasca across different Amazonian indigenous groups, I put forward the idea that the metacognitive properties of hallucinogenic experiences can be variously exploited or ignored depending on cultural expectations. Finally, I examine how anthropological and linguistic evidence of the ritualized use of hallucinogens supports the existence of multiple metacognitive norms in religion.

Keywords: Amazonia, Anticholinergics, Cognitive Science of Religion, Hallucination, Hallucinogens, Metacognition, Neuroanthropology, Predictive Coding, Psychedelics, Reality Monitoring, Shamanism, Schizophrenia, Sense of Reality

An influential definition proposes that a hallucination is a "sensory perception that has the compelling sense of reality of a true perception but that occurs without external stimulation of the relevant sensory organ" (American Psychiatric Association, 1994, p. 767). To put it a bit more systematically, hallucination can be said to have two main components: (i) a sensory content; and (ii) a sense that the sensory content is real. Monitoring-based models of schizophrenic hallucination claim that both the sensory content and the sense of reality of hallucination can be explained in terms of metacognitive dysfunction. This chapter aims to assess whether such a claim holds for schizophrenic and drug-induced hallucinations. I will argue that the metacognitive dimension of monitoring-based models of hallucination has been somewhat overblown and will attempt to determine the actual role of metacognition in hallucination—especially in drug-induced hallucinations—and how this role is liable to vary across cultures.

The chapter will unfold as follows. I first explore the distinct kinds of phenomenological experiences and neurocognitive mechanisms that underpin the sense of reality. Next, I discuss some of the most influential monitoring-based models of hallucination. Drawing upon the distinction between three levels of metacognitive processing—subpersonal, personal, and supra-personal—, the question is raised whether these models are genuinely metacognitive and whether they explain the major phenomenological aspects of the content of hallucinations and the sense of reality associated to them. Comparing the neurophysiological mechanisms at work in serotoninergic-hallucinogens and anticholinergic-hallucinogens, I suggest that only the latter clearly tap into metacognitive processing. The comparative use of ayahuasca across three different indigenous groups of the Western Amazon is then presented in order to examine whether metacognitive properties of hallucinogenic experiences can be variously exploited or ignored depending on cultural expectations. Finally, in the last section, I examine how

anthropological and linguistic evidence of the ritualized use of hallucinogens supports the existence of multiple metacognitive norms in religion.

The heterogeneity of the sense of reality

Metacognition in a nutshell

This chapter explores the relation between the sense that things are real, metacognition and hallucination. Metacognition is usually defined as "cognition about cognition". What "about" exactly means, in this definition, is still a matter of controversy. For now, a simple example will suffice. Let us imagine that I am being asked what the capital of Honduras is. The process of retrieving the name of the capital is a cognitive process. But many other processes are simultaneously elicited. For instance, before accessing the name of the capital in my memory, I may have the feeling that I will fail—or succeed—in the retrieval task. This feeling is characteristically metacognitive since it informs me about my ability to perform a first-order cognitive task.

Metacognition can take two basic forms: affective and informational (Koriat, Nussirison, Bless, & Shaked, 2008). When I have to take the decision of either further trying to retrieve the name of the capital of Honduras or abandoning the search, I can take this decision on the basis of two distinct inputs. The decision can be first grounded in an affective input. I may decide to keep searching this name because I have the feeling that I am about to retrieve it. Alternatively, the decision can be grounded in an informational input: I keep searching because I have the background belief that I know the geography of Central America. Affective and informational inputs can be used either implicitly or explicitly (Schwarz, 2004), which leads people to interpret their experiences of fluency differently (e.g., McGlone & Tofighbakhsh, 2000).

Finally, it must be noted that some non-human animals are able to use their metacognitive feelings (fluency and disfluency) to assess their confidence in the cognitive task at hand and to take metacognitive decisions accordingly (Smith, Couchman, & Beran, 2014). Although unable to theorize about these feelings as humans do, some animals are able to employ these affective cues in order to monitor and control their cognitive activity.

Homogeneous theories of the sense of reality

An evocative parallel can be drawn between metacognitive feelings and metacognitive judgments, on the one hand, and the sense of reality (SR[1]) and judgments of reality (JR), on the other. The SR is non-reflective and non-propositional. It is what you experience when a car is coming at full throttle while you are crossing the street: you quickly jump on the pavement without even thinking about it. You have a non-reflective sense of the realness of the car.

JRs, on the other hand, are reflective and propositional states[2]. Just as metacognitive judgments can be based either on metacognitive feelings or on propositional pieces of information, JRs can be based on experiences or theoretical considerations. When an animist person reflectively states that dreams are real because they feel so real, she is forming an

[1] All the acronyms used in this chapter are summarized and defined at the end of the text.

[2] It could be argued that judgments can sometimes be made in a non-reflective way. For example, when Marcia Johnson speaks of "heuristic" source monitoring judgments, what she has in mind are "non-reflective judgments" (see subsection: "The reality monitoring model"). However, as I define them here, judgments are required to be reflective. A "non-reflective judgment" is not properly speaking a judgment; it can better be defined as an intuition—and intuitions, unlike judgments, do not consist of propositional contents. Reflective work is required to turn the content of an intuition into a judicative proposition.

experience-based JR; by contrast, when a secular person reflectively states that dreams are unreal because neuroscience tells us so, she is forming an information-based JR.

In the last two decades, several cognitive scientists, philosophers and anthropologists have investigated the origins and mechanisms of the SR (Bentall, 1990; Billon, 2016; Dokic & Martin, 2012, 2015; Farkas, 2013; Frith, 1992; Gallagher, 2009; Johnson & Raye, 1981; Laughlin, 2011; Luhrmann, 2012; Matthen, 2010; Noë, 2012; Pacherie, 2002; Ratcliffe, 2008; Sanchez-Vives & Slater, 2005; Sass, 2014; Seth, 2014; Seth, Suzuki, & Critchley, 2012; Simeon & Abugel, 2006; Slater, Lotto, Arnold, & Sanchez-Vives, 2009). This field of research is mostly based on the study of abnormal cases in which the SR happens to be altered in different ways: derealization syndrome, dreaming, hallucination, neurodegenerative disease, mystical experience, psychosis, virtual reality, etc. A widely shared assumption is that the SR is homogeneous, namely, it seems to be conceived as a well-circumscribed natural kind. Two theses are endorsed by proponents of this view: (1) the SR is underpinned by one single mechanism[3]; (2) a single kind of SR is instantiated or lacking in distinct cases of altered-SR is always the same.

To illustrate how, let us consider the theories of the SR recently put forward respectively by Jérôme Dokic and Jean-Rémy Martin (2012, 2015) and by Anil Seth (2012). They both argue that virtual reality is the symmetrical opposite of derealization. In the first case, subjects wear a head-mounted display which presents them with images. If the properties of these images

[3] It is often acknowledged that this single mechanism can be triggered in different ways. As will be shown later, Dokic and Martin argue that distinct cues are liable to trigger metacognitive feelings of reality. It remains that, in their theory, the SR can be boiled down to one single mechanism: namely, the generation of metacognitive feelings of reality. By the same token, Seth points out that the absence of interoceptive prediction errors can be brought about in different ways. But, here again, the SR is assumed to be reducible to one single mechanism: the accurate prediction of interoceptive states.

fulfill specific criteria, a SR will be induced and the subject will experience the (virtual) world as perfectly actual and real; if the device is not optimally designed, the subject experimenting with it will only see images without having the sense that these images are real (Slater et al., 2009).

As for derealization syndrome, it often occurs in association with depersonalization; it is characterized by a sense that things are unusually dull, distant, disconnected and bereft of any affective depth (Sierra, 2009; Simeon & Abugel, 2006). As far as we know, the visual system of patients suffering from derealization is not altered in any way. The alteration of reality that they experience is therefore cognitive and affective rather than perceptual.

	optimal virtual reality	non-optimal virtual reality	non-derealized state	derealized state
sense of reality	✅	❌	✅	❌

Table 1. The homogeneous approach to the sense of reality

(Check marks mean that a SR is present while cross marks mean that there is no SR.) As summarized in Table 1, according to Dokic & Martin and Seth, the mechanisms explaining the lack of SR among derealized patients and users of non-optimal virtual reality devices are exactly the same; the reverse mechanisms are purported to explain the presence of SR among non-derealized people and users of optimal virtual reality devices.

Dokic & Martin, and Seth differ in the explanatory mechanisms they are pointing to. While the two first authors propose that feeling-based reality monitoring explains why a SR is present in virtual reality and lacking in derealization (Dokic & Martin, 2012, 2015), the latter maintains that the SR is triggered by the accurate prediction of interoceptive states and is disrupted every time too many prediction errors are generated within the Bayesian interoceptive subsystem (Seth et al., 2012). In spite of these differences, both theories take it for granted that

the SR is a unified kind and that a single neurocognitive mechanism can explain all cases of altered SR[4].

The case against homogeneous theories of the sense of reality

My contention will be that a comparative look at cases of altered SR demonstrates that the SR is not one but many. In other words, folk statements such as "it feels (un)real", "I have the sense it is (un)real", "I experience it as being (un)real", are all prompted by distinct neurophenomenological kinds[5]. If people usually lump them together, it is simply because natural languages and folk concepts are too coarse-grained to avoid such a conflation.

Let us examine the two case studies mentioned by Dokic and Martin, and Seth—namely, derealization and virtual reality. As shown by Table 1, these authors argue that what is missing in derealization is the opposite of what obtains in virtual reality. This claim, however, turns out to be ill-supported. To be sure, roughly speaking, derealized patients say they have the feeling that the world is not real anymore, while subjects experimenting with virtual reality say the opposite. Yet, these two cases are not perfectly symmetrical opposites. What it means for the SR to be lacking in the virtual reality case is very different from what it means for the SR to be

[4] It must be underlined that in their most recent work, Dokic (Forthcoming) and Seth (2015) seem to go beyond their initial homogeneous position and now acknowledge—at least to a certain extent—that different kinds of SR have to be recognized.

[5] By this I imply that the SR consists of distinct neurocognitive mechanisms and distinct corresponding experiences—hence the idea of distinct "neurophenomenological kinds". Although these neurocognitive mechanisms and experiences are distinct and many, they all contribute to the formation of roughly identical JRs. If the heterogeneity of the SR has so far not been duly recognized, it is certainly because of the homogeneity deceivingly conveyed by the everyday linguistic expressions people resort to when they speak of the SR.

lacking in the derealization case. When the SR is lacking because of a non-optimal virtual reality device, the subject does not have the feeling that things around her are real. Immersed in an optimal virtual environment in which the SR is not lacking, the subject will behave in front of a cliff exactly as she would behave in the real world: she will be terribly afraid of jumping from the virtual cliff. Not so when the virtual reality device is non-optimal. To sum up, in the case of virtual reality, the shift from the lack of SR to the presence of SR has distinctive behavioral effects.

In contrast, in the case of derealization, a shift from absent SR to present SR has no behavioral effect whatsoever. Derealized patients report that the world feels unreal to them and yet they behave exactly as before (Sierra, 2009; Simeon & Abugel, 2006). Unlike most Cotard patients, derealized patients are not delusional: if asked to jump from a cliff, they will be as reluctant and terrified as non-derealized people. This suggests that what makes the world of the derealized patient unreal has nothing to do with her sensorimotor system, or the way she navigates and behaves in the world. The unreality of derealization is very different from the unreality of poor virtual reality devices.

Neurophysiological studies of derealization suggest that at least two distinct mechanisms underlie the feeling of unreality that patients report. First, it has been speculated that because of some prefrontal hyperactivity and limbic hypoactivity, the world loses its usual affective depth (Sierra & Berrios, 1998). This limbic deficit could account for the feeling of distance and flatness of the world described by many patients. Consistent with this hypothesis, people suffering from depersonalization and derealization exhibit an abnormal emotional dampening when presented with aversive images (Phillips et al., 2001). Another plausible mechanism accounting for derealization comes from the observation that patients show a deficit in intra-modal and cross-modal integration (Simeon et al., 2000).

Taken together, these remarks support the rejection of homogenous accounts of the SR. Unlike the homogenous theory, the heterogeneous approach to the SR in virtual reality and derealization posits at least three different kinds of SR, as summarized in Table 2.

senses of reality ↓	optimal virtual reality	non-optimal virtual reality	non-derealized state	derealized state
sensorimotor kind	✅	❌	✅	✅
affective kind	✅	✅	✅	❌
integrative kind	✅	✅	✅	❌

Table 2. The heterogeneous approach to the sense of reality

Other cases where the SR is significantly altered will help us to further ramify the heterogeneous taxonomy of the SR. Let us consider the case of psychosis. This condition—especially in its prodromal stage—is characterized by a sense of unreality, surprise, mystery and uncanniness (Jaspers, 1963; Nelson & Sass, 2008; Ratcliffe, 2013). One plausible explanation would be that this condition is associated with an abnormal deficit in the ability to predict world events. This hypothesis is supported by evidence indicating abnormal electrophysiological activity in subjects suffering from schizophrenia or a pharmacologically-induced schizophrenic state[6]: as revealed by experimental paradigms such as the P50 suppression or the mismatch negativity component, the psychotic brain fails to predict easily predictable stimuli and is not surprised by objectively unpredictable stimuli (Clementz, Geyer, & Braff, 1997; Kenemans & Kähkönen, 2011; Umbricht & Krljes, 2005). A fourth kind of SR

[6] To date, glutamatergic NMDA models are among the most accurate and fruitful pharmacological models of psychosis. Ketamine—an NMDA antagonist dissociative anesthetic—is thus widely used by psychiatrists to mimic schizophrenia-like states in healthy volunteers.

could thus be underpinned by the capacity of the brain to predict events of the world. The disruption or disturbance of these predictive mechanisms would result in a sense that the world is unreal[7].

Another instructive comparison is that between mental imagery and perception. Within many spiritual traditions disciples are asked to cultivate their mental imagery (Karnes, 2011; Luhrmann, 2011; Luhrmann, Nusbaum, & Thisted, 2013; Noll, 1985; Ustinova, 2009). This intense cultivation may lead to the enhancement of imagination up to the point where imagined beings become highly sensory-loaded and perception-like. For instance, based on ethnographical and experimental evidence, Tanya Luhrmann (2012; 2013) has shown that American evangelicals' imaginative praying leads to actual sensory experiences: in the beginning, evangelicals are simply pretending that God is talking to them; with time and training, however, their imagination becomes more vivid and autonomous; they eventually have auditory hallucinations of God talking to them. The shift from mere imagination to actual

[7] It could be objected that predictive deficits characterizing psychosis coincide with a sense of "uncanniness", "estrangement" or "unfamiliarity" rather than a sense of "unreality". This is a fair point and I tend to think that a similar concern may prevail as regards derealization: its so-called "unreality" could be better described as a sense of "distance" or "blandness". Arguably, the same worry applies to all qualitative alterations of the SR. I still think there are good reasons to defend a broad and inclusive definition of the SR. First, some authors have somewhat convincingly argued that the qualitative changes at work in psychosis can be accurately characterized as involving a genuine sense of unreality (e.g., Ratcliffe, 2013; Sass, 2014). Second, instead of taking qualitative changes as non-authentic cases of SRs, I propose to include them in the broad class of SRs, but I subsequently distinguish between two subclasses: those which are prototypical cases of SR and which automatically trigger JRs and those which are unclear cases of SR and which require some interpretative effort to trigger JRs (see the next subsection: "From the sense of reality of the judgments of reality").

sensory experience is often described by evangelicals in terms of the emergence of a feeling that God is real and can be experienced as such. A fifth kind of SR might thus be underpinned by the gradual switch from a top-down pattern of connectivity defining imagination to a more bottom-up pattern defining perception (Dentico et al., 2014).

One last comparative case of altered SR is that provided by lucid dreaming as opposed to non-lucid dreaming (especially in REM sleep). In the latter case, everything seems perfectly real. If I am having a non-lucid dream in which I am at the top of a cliff, I will be extremely afraid of jumping because I will experience the entire situation as literally real. By contrast, if I am having a lucid dream, I know from the start that I am in a dream and that I cannot be injured or die "for real". As a consequence, I will not be afraid of jumping from the cliff.

What neurocognitive mechanism could explain this difference? Neuroimaging and electrophysiological studies suggest that the difference is explained by the hypoactivity of the prefrontal cortex (PFC)—and in particular of the dorso-lateral PFC (dlPFC)—in non-lucid dreaming and the relatively normal activity of the same areas in lucid dreaming (Dresler et al., 2012; Hobson, Pace-Schott, & Stickgold, 2000; Voss, Holzmann, Tuin, & Hobson, 2009). This sixth kind of SR would thus be underpinned by a negative mechanism: in order for this kind of SR to obtain in unusual states—such as delusion or dreaming—an absence of critical attitude seems to be required; such critical attitude being apparently underpinned by the dlPFC (Gerrans, 2014, Chapter 5), it follows that the deactivation of this prefrontal component ensures a high SR.

From the senses of reality to the judgments of reality

Thorough examination of cases in which the SR is significantly altered demonstrates that there is no such a thing as a unified SR but that distinct kinds of SR must be recognized. So far, six distinct kinds of SR have been distinguished: sensorimotor (present in derealization),

affective (lacking in derealization), integrative (lacking in derealization), predictive (lacking in psychosis), sensory (enhanced in some spiritual traditions) and the last one that we could dub apodictic (present in non-lucid dreaming and lacking in lucid dreaming). This list is not exhaustive. Additional kinds of SR could be identified. Other potential candidates include SRs underpinned by the sense of mineness (Billon, Forthcoming), objectual reification (Lutz, Jha, Dunne, & Saron, 2015), and metaphysical and mystical insights (D'Aquili & Newberg, 1999).

A serious worry is that by recognizing the existence of too many kinds of SR, we are running the risk of dissolving the very concept of SR. Let us address this problem. A dispositionalist definition of the SR would read as follows: *any experience disposing people to form JRs qualifies as an instance of SR*. One may wonder whether this definition does not vindicate the homogeneous theory of the SR. Indeed, what all kinds of SR seem to have in common is that they dispose people to judge that things they experience are real. However, there are at least two reasons why the homogenous account does not hold water.

First, although all SRs dispose people to form JRs, they arguably do so in very different ways. Consider the distinction proposed by philosophers of psychiatry between the endorsement model and the explicationist model of delusion (Bayne & Pacherie, 2004). The two models have it that experience plays a key role in the formation of delusion. However, the endorsement model states that the content of the experience is already conceptually-rich and that the delusional belief simply endorses the conceptual content of the unusual experience, whereas the explicationist model maintains that the content of experience is conceptually poor and that the delusional belief substantially contributes to the delusional content by explaining the unusual experience. Interestingly, this distinction largely overlaps with the distinction, in the field of religious studies, between intrinsic and extrinsic theories of mystical experiences (Taves, 2009).

Applied to the SR, this conceptual distinction suggests that SRs might fall under two distinct categories: conceptually rich SRs already contain in themselves the concept of reality featured in JRs; conceptually poor SRs evoke the formation of the concept of reality in JRs but which do not intrinsically contain it. For instance, it seems that "qualitative" SRs—i.e., SRs depending on affective load and accurate prediction—are not conceptual rich. Indeed, when derealized or psychotic patients report the unreality of the world, their judgment of unreality seems to require some inferential leap, as arguably their experience intrinsically contain the concept of unfamiliarity or surprise or strangeness but does not intrinsically contain the concept of non-reality. On the contrary, it seems that "functional" SRs—i.e., SRs depending on the sensorimotor function and the dlPFC-related reality-testing function—are conceptually richer. Indeed, when people immersed in virtual reality exploit affordances of the environment or when non-lucid dreamers navigate in their oneiric world, their experiences seem to intrinsically contain some concept of reality.

This distinction can be meaningfully reformulated within the framework of cultural attraction (Claidière, Scott-Phillips, & Sperber, 2014; Sperber, 1996). According to this theory, each mental representation is not equally likely to be successful and to spread across individuals and cultures. Some representations prove universally very catchy while others are much less so. As a consequence, through cultural transmission, some representations become prominent whereas others swiftly vanish. Experience being an important factor in cultural attraction—specific experiences foster and underpin equally specific beliefs—it is arguable that altered states of consciousness play the role of cultural attractors for a specific class of supernatural beliefs. It could subsequently be said the first class of experiences—conceptually rich SRs—is a stronger cultural attractor for JRs than the second class of experiences—conceptually poor SRs. In the long run, across individuals and cultures, rich SRs will trigger more JRs than poor SRs.

The other reason why the dispositionalist definition of the SR does not vindicate the homogenous theory is that there is no deterministic relationship between SRs and JRs. Although SRs—especially conceptually rich SRs—offer solid ground to make JRs, some cultures may be reluctant to ground JRs in specific SRs. For example, evangelicals see sensory vividness as a sign of reality whereas Buddhist practitioners see it as mere illusion (Beyer, 1973). It will be later shown that each culture prioritizes specific SRs over others (see "The enculturation of metacognition"). In sum, although SRs appear to be natural anchors for JRs, cultural learning can still undermine the disposition of SRs to ground JRs. As predicted by the theory of cultural attraction, however, through history and cultures, some SRs prove to ground JRs more predictably and consistently than others.

A worry which has not yet been addressed is that experiences which have little in common with SRs can nonetheless occasionally ground JRs. This is well illustrated by a study in which questionnaires measuring SR were administrated to one group of participants who had navigated into a virtual office and another group who had navigated into a real office (Usoh, Catena, Arman, & Slater, 2000). The researchers reasoned that participants would report having a stronger SR in the real rather than in the virtual environment. This prediction failed to be borne out. Very often, people reported having a stronger SR in the simulated office. When they looked closer at the results, researchers realized that when the real office failed to display prototypical features (furniture, smell, sounds, etc.), participants rated the office as not being real. In other words, in this case, "real" simply meant "prototypical". The office they were presented with was obviously real and participants seemingly interpreted the experimenters' questionnaire and motivation for conducting this study as bearing on the prototypical quality of the office.

The crucial lesson to be drawn from this study is that JRs are fundamentally comparative and context-dependent. Judging that something is real only makes sense within a specific

linguistic, social, and cultural context (Austin, 1962; Goffman, 1974; Schütz, 1945; Wittgenstein, 1969). Even if "real" is often used in a strong sense, it can also be used in a deflationary way to simply mean that something is "prototypical". This point also sheds light on a paradox we are facing regarding the status of sensory-SR: on the one hand, studies on Charles Bonnet hallucinations show that some people can experience a vivid sensory content and yet not experience it as real (ffytche, 2005, 2013); on the other hand, Luhrmann (2012) adduces convincing evidence to the effect that experiencing something as sensorially vivid amounts to experiencing it as real. The apparent paradox can easily be solved by combining the heterogeneous approach with a form of contextualism. When the patient suffering from Charles Bonnet syndrome is talking with his physician she is playing a different language game from the one in which evangelicals are embedded; as a result, something different is meant when they use the adjective "real".

The previous remarks should not be understood as suggesting that all experiences can equally well qualify as an instance of SR, which would contradict our account of SRs and JRs in terms of cultural attraction. It is worth emphasizing that the experience of prototypicality leads to a JR *only* in cases in which experimenters ask people to answer unusual questions. By contrast, the experience of affective dampening or the experience of having the dlPFC deactivated almost always alters JRs. The definition of SR, then, should be revised accordingly: any experience disposing people to form JRs, *and doing so in a consistent manner and across very different contexts*, qualifies as an instance of SR. In other words, it only makes sense to speak of SR when the experience at hand proves to be a strong attractor for JRs. In this respect, the total number of unusual experiences which qualify as SRs does not probably exceed a dozen.

So far, it has been assumed that the concept of JR is the same in every culture. This assumption could be disputed. For example, it might be that some cultures have a more qualitative understanding of reality and others a more functional one. In one culture, affective

alterations of experience could evoke JRs whereas functional alterations would fail to do so. In another culture, only experiences leading to a significant change in behavior would consistently trigger JRs while simple qualitative alterations would fail to do so. Furthermore, the concept of reality might be shaped by experience. In the subculture of derealized patients, for instance, the qualitative experience of unreality might lead people to form a more qualitative concept of reality. All these hypotheses can only be adjudicated by empirical inquiry, but they must be borne in mind. For now, let me simply stress that the proposal that some SRs better attract JRs than others only holds to the extent that the concept of reality is the same everywhere. If the concept of reality is shaped by experience, then, in a culture in which a specific set of experiential practices is encountered and a qualitative concept of reality has developed, the kinds of SRs which will turn out to attract JRs will be different from those encountered in a culture in which reality is defined in behavioral terms.

Metacognitive models of hallucination and reality

The reality monitoring model

Given the above definition of SR and JR, let us turn to the cognitive processes generating them. Over the last three decades, reality monitoring (RM) models of hallucination have been widely developed in order to explain both the content of hallucinations—their sensory character—and their mode—the fact that they appear to be real. The distinction between perception and imagination is pivotal. Philosophers have paved the way for present controversies. Hume (1978 [1739]), for example, held that imagination and perception are fundamentally identical, and differ only in their respective vividness whereas Reid (2000 [1764]) considered that imagination and perception have distinct structural properties.

RM models stress that the reality status of an inner experience—the discrimination between imagination and perception—is not self-evident. As Marcia Johnson and her

colleagues remark, "reality is not given directly in perceptual and memory representations but is a product of judgment processes" (Johnson, Hashtroudi, & Lindsay, 1993, p. 14). The challenge is then to understand how people usually determine the reality status of mental representations. Going beyond the recently revived Humean view (Aleman, Böcker, Hijman, de Haan, & Kahn, 2003; Mintz & Alpert, 1972) according to which the ascription of reality depends only on content-related properties—e.g., on sensory vividness—, as well as beyond the view that only structural properties matter (see Frith's and Dokic & Martin's models discussed below), proponents of RM models consider that both content-related and structural properties contribute to defining the reality status of mental representations.

A few terminological distinctions are in order. Strictly speaking, *RM* can be defined as "the processes by which a person attributes a memory to an external or an internal source" (Johnson & Raye, 1981, p. 67). The related notion of *source monitoring* has to do with discriminating one's source of information, whether internal (dreaming vs. imagining) or external (e.g., seeing vs. being told). Finally, both *RM* and *source monitoring*, which designate offline discrimination between stored—rather than currently entertained—representations, differ from *reality testing* which specifically concerns *online* discrimination between what is real and not real.

RM models are largely based on Marcia Johnson's groundbreaking studies, demonstrating that externally-generated memories are characterized by having more spatial and temporal contextual attributes, more numerous semantically detailed and affectively loaded sensory attributes, and less cognitive operations than internal-generated memories (Johnson et al., 1993; Johnson & Raye, 1981; Mitchell & Johnson, 2009). People have been shown to use these features to identify what the source of a given mental representation is. For instance, "a memory with, say, a great deal of visual and spatial detail and very little cognitive operations [will] be judged to have been externally derived" (Johnson et al., 1993, p. 4). Source monitoring

models usually posit that the process through which the source of a representation is identified can be either reflective—i.e., deliberation-based—or non-reflective—i.e., heuristics-based. By default, people tend to resort to non-reflective "heuristic source monitoring", but in some contexts, "systematic source monitoring" proves more appropriate (Johnson et al., 1993, p. 5).

Building on the findings of the source monitoring research program, Richard Bentall and others have used Johnson's list of features to explain hallucination, in a model meant to identify the mechanisms discriminating between internally- and externally-generated representations. The proposal is that the list of attributes identified and studied by Johnson can explain the reality status ascribed to representations. This is supported by evidence showing, for example, that schizophrenic patients tend to interpret recordings of their own voice as being the recording of someone else's voice; likewise, they tend to interpret words that they have imagined as words that they have heard (for a review, see: Bentall, 2003, Chapter 14; Bentall & Varese, 2013; for neuroscientific evidence in favor of this hypothesis, see: Mitchell & Johnson, 2009, p. 659 et sq.). The SR and the content of schizophrenic hallucination could therefore be understood as a tagging error: representations that should be tagged as internally-generated are being tagged as externally-generated.

To the extent that the ascription of a reality is considered to be the result of a constructive process including heuristic and analytic decisions, culture is often assumed to shape RM. This model is said to explain the high prevalence of hallucination in non-Western cultures (Bentall, 1990, p. 90) and it has been applied to specific ethnographic cases (Beyer, 2009, Chapter 24; Luhrmann, 2012, Chapter 7).

The self-monitoring model

The self-monitoring (SM) model differs from the RM model of hallucination in two important respects: while the latter is concerned with memories—that is, with offline

monitoring—, the former is concerned with currently entertained representations; besides, while the latter model takes content-related attributes —e.g., sensory vividness—to play a role in the monitoring process, the former model is not committed to such a claim.

Although the basic idea of SM had been adumbrated in earlier works (Feinberg, 1978; von Helmholtz, 1948 [1866]), it was Christopher Frith (1992) who developed it in its most complete version. According to this model, monitoring discriminates between self- and other-generated representations. Before explaining how SM might account for hallucination, it will be useful to focus on agency. When a bodily action is intentionally produced, both a motor signal and an efference copy—or corollary discharge—of the original signal are generated. The function of this copy is to predict the consequence of the bodily action. Once this action has been performed, a comparator monitors the discrepancy between the effects produced by the action and those predicted by the efference copy. If there is no discrepancy, the brain will then infer that the action was self-generated; if there is a discrepancy, the brain will infer that the action was other-generated. The underlying hypothesis is that sensorimotor information registered by the nervous system will be accurately predicted only if it is self-generated.

The schizophrenic positive symptom of passivity—i.e., experiencing one's own actions as being controlled by an external entity—can be explained within this framework. The comparator in charge of discriminating between self-generated and other-generated actions happens to be impaired among schizophrenic patients (Farrer & Franck, 2007; Frith, 2005, 2012). The comparator detects discrepancy between expected and actual sensory information, and abnormal discrepancy results in the feeling of passivity.

The self-monitoring model has been proposed to explain not only delusions of passivity, but also thought insertion (Feinberg, 1978; Frith, 1992) and hallucination (Frith, 1992; Jones & Fernyhough, 2007; Seal, Aleman, & McGuire, 2004). In the case of hallucination, for example,

the impairment of the comparator in schizophrenia would explain why patients experience their self-generated inner speech as being other-generated.

The online reality monitoring model

In contrast with the classic offline RM model, the online reality monitoring (ORM) model (i) is concerned with representations that are currently entertained rather than stored in memory, and (ii) it assumes that the ascription of reality is not content-dependent. In this regard, the ORM model is quite similar to the SM model; the two models simply differ from one another concerning the role they ascribe to the sense of agency in the constitution of the SR. While the SM model equates lack of agency with reality, the ORM model holds that the two concepts are conceptually distinct.

The ORM model has been recently put forward by Jérôme Dokic and Jean-Rémy Martin (2012, 2015). The authors claim that the SR is produced by metacognitive feelings—first and foremost by feelings of fluency, which can be experienced in distinct domains. For example, the content of a representation is arguably processed more fluently when one is perceiving than when one is imagining. Similarly, good virtual environments succeed in triggering sensorimotor feelings of fluency whereas poor virtual environments fail to do so. A key claim of the ORM model is that sensory or imagery contents are tagged by metacognitive feelings; this affective tagging accounts for the SR. Such a model fits particularly well with cases in which there is no sensory content, but there is still a sense that some entity is present and real (Chan & Rossor, 2002; Fénelon, Soulas, Cleret de Langavant, Trinkler, & Bachoud-Lévi, 2011).

A critical assessment of monitoring models of hallucination

The heterogeneity of metacognition: subpersonal, personal and supra-personal levels

We are now in a position to assess whether the "metacognitive" models of hallucination introduced in the previous section are indeed metacognitive, as assumed in the literature (e.g., Aleman & Larøi, 2008, Chapter 5). To do so, it is useful to adopt a minimalist functional definition of metacognition which reads as follows: "Metacognition is the set of capacities through which an operating cognitive subsystem is evaluated or represented by another subsystem in a context-sensitive way" (Proust, 2013, p. 4). Given that a subsystem can be evaluated or represented by another subsystem in many ways, I propose to distinguish between three distinct metacognitive levels: subpersonal, personal, and supra-personal (Fortier, In preparation).

Subpersonal metacognition. First, metacognition can take place at the subpersonal level. According to predictive coding, perception is the result of bidirectional processing (Friston, 2010; Hohwy, 2013). Based on prior experience and expectation, the brain predicts—in a top-down fashion—what will be perceived next. Sensory information collected by the senses—i.e., bottom-up processing—only shapes perception if top-down predictions are at odds with sensory evidence. Predicting coding models include an additional mechanism through which prediction errors are more or less weighted (Clark, 2013; Feldman & Friston, 2010; Hohwy, 2012). The more precise the prediction errors, the more extensive the revision of prior expectations. Precision weighting, which can be defined as the inverse of variance, allows a predictive hierarchy to enhance prediction errors when data are very reliable and to undermine them when data are unreliable. For instance, in a noisy or dark environment, sensory information registered by the retina will not receive much weight; by contrast, in a bright environment, and especially if attention is directed at a specific object, the sensory data will be highly reliable and will therefore be highly weighted (Hohwy, 2012). All these weighting mechanisms are subpersonal—i.e., they cannot be consciously accessed. Nonetheless, it seems quite intuitive to consider them metacognitive. While prediction errors correspond to first-order cognitive

processing, the mechanisms through which the reliability of sensory data is being evaluated correspond to second-order metacognitive processing (Shea et al., 2014).

Personal metacognition. This type of metacognition refers to the metacognitive processes that can take place at the conscious level. Personal metacognition includes both affective-based and information-based metacognition (on this distinction see subsection "Metacognition in a nutshell").

Supra-personal metacognition. Although metacognition is often used by individuals for their own private monitoring and control, at times, they communicate their metacognitive judgments to others. Communicating metacognitive information can considerably improve collective decision-making (see Bahrami, this volume), but it can also be used strategically and deceivingly (see Le Guen, this volume). Supra-personal metacognition must be distinguished from the personal and subpersonal levels (Shea et al., 2014).

Metacognition in monitoring models of hallucination

With this plural taxonomy of metacognition in mind, let us now ask whether the processes described by the monitoring models of hallucinations are genuinely metacognitive? The right answer seems to be a nuanced one: some processes involved in RM are metacognitive and others are not. The RM model posits that cues used to recognize mental representations as internally- or externally-generated include spatial and temporal attributes. These attributes are clearly not metacognitive. Yet, other cues involved in RM seem metacognitive. For instance, RM has been shown to be partially tapping into the cue of cognitive effort (or disfluency) (Bentall, Baker, & Havers, 1991; Larøi, Van der Linden, & Marczewski, 2004). One of the reasons why RM is impaired among schizophrenic patients is precisely that they are unable to use cognitive effort as a heuristic. It appears, then, that (personal) metacognition is partially involved in the RM model, along with other non-metacognitive processes.

The Signal Detection Theory (SDT)-based version of the RM model advocated by Bentall is also often deemed metacognitive. This claim is questionable as metacognition is usually associated with Type 2—rather than Type 1—SDT. Type 1 SDT consists in presenting subjects with more or less intense and noisy stimuli and subsequently asking them to decide whether the stimulus is present or absent. Now, subjects can be additionally asked to rate the certainty they have in the accuracy of their first-order task. For example, a subject can judge that no stimulus was presented (Type 1 SDT) and be very uncertain—or alternatively very certain—about the first-order decision (Type 2 SDT) (Fleming & Lau, 2014; Maniscalco & Lau, 2014). Second-order SDT is undeniably metacognitive. But first-order SDT performance can hardly be considered metacognitive. It is thus questionable that Bentall's ORM model has anything to do with metacognition.

According to Dokic and Martin's ORM model, only metacognitive feelings (such the feeling of fluency) contribute to the SR. Whether this model can successfully account for the SR of hallucination is a matter of debate, but if it does, it will imply that hallucination is indeed largely underpinned by metacognitive mechanisms.

The limits of monitoring models of hallucination

The previous subsection examined whether influential psychiatric models of hallucination are metacognitive. It has been suggested that some of them are so only to a certain extent. It now remains to be established whether these models can effectively account for the content and SR of hallucinations.

Let us first consider the RM model of hallucination. What is puzzling in this model is that hallucination—i.e., an online process—is interpreted in terms of a memory deficit—i.e., in terms of an offline deficit. It remains to be elucidated why the inability to distinguish between stored representations could give us any clue as to how representations that are currently

entertained may be dysfunctional. In this regard, SM and ORM models are more convincing because they point to the impairment of online cognitive processes and not offline ones.

Proponents of the RM model still contend that offline monitoring deficit is a good predictor of online deficit. Not being able to remember that a memory was acquired from imagination would somehow result in a higher tendency to hallucinate. As Johnson and her colleagues put it, "hallucinations can be analyzed according to many of the same factors that have been shown to influence reality monitoring in normal individuals" (Johnson et al., 1993, p. 15). By the same token, Bentall asserts that "if hallucinators are poor at judging the difference between real and imaginary events, it might also be expected that they would be deficient in the related skill of reality monitoring" (Bentall, 1990, p. 89). Indeed, some studies support the claim that RM impairment is linked to hallucination (e.g., Brébion et al., 2000).

Such a line of evidence fails to convincingly vindicate the RM model of hallucination, though. Several studies demonstrate that there is in fact no straightforward association between RM impairment and hallucination. For example, poor self-speech recognition turns out to be linked to acute psychosis in general and not specifically to hallucination (Johns, Gregg, Allen, & McGuire, 2006). Moreover, patients currently suffering from hallucinations and patients who had suffered from hallucinations in the past but who are not any more performed equally poorly in RM tasks (Varese, Barkus, & Bentall, 2012). If RM was directly associated with hallucination, non-hallucinating patients should obtain better scores than currently hallucinating ones.

More generally, findings are inconsistent as to whether hallucinations—especially auditory verbal hallucinations—are simply resulting from an impairment of RM or SM. For example, the claim that psychotic patients' hallucinations result from impaired self-speech recognition could not be replicated (Versmissen et al., 2007). Admittedly, some neurophysiological data demonstrate that hallucinations are associated with an increased

activity in Broca's area (McGuire, Shah, & Murray, 1993); such a finding nicely supports the RM, SM and ORM models and the view that hallucinations result from misattributed inner speech. Yet, it remains that, by and large, neurophysiological data are still quite inconsistent (Allen, Aleman, & McGuire, 2007; Shergill, Bullmore, Simmons, Murray, & McGuire, 2000; Silbersweig et al., 1995).

As said above, the SM and the ORM models conceive of the monitoring deficit explaining hallucination as an *online* deficit. The SM model was first developed as a model explaining delusion of passivity in motor actions, and in this specific domain the SM model is supported by compelling evidence (Farrer & Franck, 2007; Frith, 2005, 2012). The question, however, is whether this model can explain thought insertion and hallucination as easily as it can explain delusion of passivity. For example, the contextual information integration deficit model (Uhlhaas & Silverstein, 2005) can arguably better explain though insertion than the SM model (Martin & Pacherie, 2013). Similarly, the Bayesian account of the phenomenology of hallucinations seems rather promising (Corlett, 2015; Wilkinson, 2014) whereas the SM model has a very limited explanatory power.

As for the ORM model, Dokic and Martin's proposal solves the problem that offline RM models are facing. But it does so somewhat speculatively: so far, no specific experimental evidence supports the metacognitive feeling-based model of the SR that they are advocating.

Furthermore, it can be argued that a general limit of the three monitoring models is that they remain rather silent about the *content* of hallucinations. They explain how people misattribute external features to internally-generated representations, how self-produced representations are misattributed to other agents, and how some contents can be erroneously tagged as real while they are imaginary. But these mechanisms do not explain why, for example, auditory verbal hallucinations possess many phenomenological features that inner voices do not have (Cho & Wu, 2013), or why one may hallucinate many voices speaking at the same

time (Jones, 2010). If hallucination is nothing but a mistagged inner voice, the phenomenological features just mentioned then prove quite puzzling and incomprehensible.

Last but not least, monitoring models posit that hallucinating patients take the imaginary for the real. This would imply that they make no distinction between *ordinary reality* and *hallucinatory reality*. Things would be recognized as either real or non-real. As Leudar and Thomas (2000) rightly observe, however, patients often take their hallucinations for real, even though they are perfectly able to discriminate between the ordinary world, the hallucinatory world and the world of imagination. This discriminatory ability clearly challenges monitoring accounts of the SR. By the same token, the phenomenon of double bookkeeping (Bleuler, 1950 [1911]; Bortolotti, 2011; Bortolotti & Broome, 2012; Sass, 1994, 2014) suggests that although hallucinations feel very real they do so differently than the ordinary world. These phenomenological niceties can easily be accommodated by the heterogeneous account of the SR adumbrated above; by contrast, the homogenous conception of the SR endorsed by monitoring models seems ill-equipped to make sense of these complexities.

Schizophrenic and psychedelic double bookkeeping vs. deliriant single bookkeeping

Louis Sass defines double bookkeeping as "the phenomenon whereby the patient who seems to be convinced of her delusion nevertheless acts or reacts as if the delusion were either untrue or irrelevant" (2014, p. 128). More specifically, patients suffering from double bookkeeping

> will frequently demonstrate a degree or kind of certitude, and their delusions a sort of "incorrigibility", that goes beyond any possibility of doubt. "Well, that is how it is; I have no doubts about it," says the patient. "I know it is so". Yet at the same time the patient does not, at least in the typical case, act on what he (seemingly) so confidently asserts, as if the belief, or pseudo-belief, pertained to some other realm. (Sass, 2014, pp. 127–128)

As Bortolotti and Broome (2012, p. 188) remark, not every schizophrenic patient indulges in such a double registration. For some patients, delusions or hallucinations fit well with the classical single registration picture. Yet, many patients exhibit various inconsistencies between what they believe, what they experience and what they do. For these patients, things can be real in very distinct ways (Gallagher, 2009; Sass, 2014).

Drug-induced hallucinations provide interesting cases to better understand the neurobiological mechanisms underpinning double and single bookkeeping. Indeed, some hallucinogens—the so-called "psychedelics"—perfectly illustrate the double registration phenomenon whereas other hallucinogens—the so-called "deliriants"—are characterized by single registration. The first category of hallucinogens includes psilocybin mushrooms, plants such as ayahuasca, peyote, and morning glory as well as various synthetic compounds (DMT, 5-MeO-DMT, LSD, mescaline, etc.). These psychedelic hallucinogens have mainly an agonist activity on serotoninergic receptors (Dos Santos, Osório, Crippa, & Hallak, 2016; Nichols, 2004). The second category of hallucinogens includes plants such as datura, brugmansia, mandrake, henbane, belladonna, duboisia, as well as various synthetic compounds (Ditran, 3-Quinuclidinyl benzilate, JB-336, etc.). In contrast to psychedelic hallucinogens, deliriants mainly have an antagonistic activity on muscarinic acetylcholine receptors (Gyermek, 1998).

Serotoninergic hallucinogens (psychedelics) are remarkable in that they induce hallucinations which can readily be distinguished from the ordinary world; in other words, lucidity and insight are perfectly preserved under the action of the drug (Fortier, In Press; Heim & Wasson, 1958, Chapter 8; Perry, 2002; Rolland et al., 2014). However, unlike some Charles Bonnet hallucinations which can be extremely vivid and yet devoid of any SR, psychedelic hallucinations seem highly real (Shanon, 2002). The psychonaut experimenting with serotoninergic hallucinogens does not conflate the hallucinatory world with the ordinary world but she nonetheless experiences her hallucinations to be genuinely real. In front of a psychedelic

vision, the psychonaut generally behaves differently than she would in front of the same vision in the everyday world, but this does not mean she ascribes less reality to psychedelic experiences. Simply, the kind of actions that one undertakes in front of an ordinary entity is very different from the kind of actions that one undertakes in front of a psychedelic entity (e.g., Heim & Wasson, 1958, p. 209 et sq.).

Anticholinergic hallucinogens (deliriants) greatly differ from serotoninergic hallucinogens in that, under their effect, psychonauts lose any lucidity and insight and fall into a complete state of delusion (Ashton, 2002; Fortier, In Press; Itil & Fink, 1966; Ketchum, Sidell, Crowell, Aghajanian, & Hayes, 1973; Perry, 2002). The psychologist and psychonaut Benny Shanon (2002, pp. 81–82) reports that when he took ayahuasca, he never had a hallucination that he could not discriminate from the ordinary world; he only lost his ability to distinguish between hallucinatory and everyday objects when he took *toé* (a potent anticholinergic plant). Most of the time, under the effect of anticholinergic intoxication psychonauts forget that they have taken a hallucinogenic drug. They take everything they see at face value. This is also why in front of deliriant hallucinations people behave exactly as they would in front of the corresponding non-hallucinatory object.

The comparison of schizophrenic, psychedelics-induced and deliriants-induced hallucinations reveals two important points. First, if we draw a continuum spanning between single bookkeeping and double bookkeeping, anticholinergic hallucinogens would be located at the single bookkeeping side and serotoninergic hallucinogens at the double bookkeeping side. Although the phenomenon of double bookkeeping has mainly been discussed in relation to schizophrenia, psychedelics seem to be the best epitome of double registration. Some schizophrenic patients—but certainly not all of them—exhibit a double bookkeeping pattern; as a consequence, it would be accurate to categorize schizophrenic hallucinations in the middle of the continuum.

Double bookkeeping poses a serious problem for monitoring models of hallucination. These models wrongly assume that hallucinations have a homogenous SR and that this SR is the same as the one people entertain in their everyday life. Admittedly, monitoring models can to a certain extent accommodate the single bookkeeping type of hallucinations that one encounters in deliriant states. But the study of schizophrenic hallucinations—and a fortiori the study of psychedelic hallucinations—shows that that *two things can be considered real but real in two very distinct ways*. Only a heterogeneous theory of the SR going beyond monitoring models of hallucination seems to be able to account for these phenomenological features.

The role of metacognition in hallucinogenic experiences

Metacognition and serotoninergic hallucinogens

We are now in position to build upon previous sections in order to answer two important questions: Does the content of hallucinogenic experience stem from metacognitive processes? Does the heterogeneous SR of hallucinogenic experience stem from metacognitive processes?

As explained above, in addition to top-down and bottom-up processes, Bayesian models also include a third type of process through which prediction errors are more or less weighted: subpersonal metacognition. Is subpersonal metacognition involved in the generation of hallucinogenic processes? At the neuropharmacological level, top-down processes are presumed to be mediated by glutamatergic NMDA receptors while bottom-up processes are posited to be mediated by glutamatergic AMPA receptors (Corlett, Frith, & Fletcher, 2009). Unlike ketamine—a potent NMDA receptor antagonist—serotoninergic agonists do not dampen NMDA activity: under the effect of psychedelics top-down processes are largely preserved. By contrast, serotoninergic hallucinogens have been shown to indirectly impact AMPA receptors and thereby evoke bottom-up hyper-signaling (Aghajanian & Marek, 2000). Within a Bayesian framework, the content of serotoninergic hallucinations can thus be

understood as resulting from excessive bottom-up signaling coupled with preserved top-down predictions. Metacognition does not seem to be involved.

As for the SR of psychedelic experiences, here again, metacognition does not play any significant role. The heterogeneous SR characterizing these experiences can be accounted for by non-metacognitive factors: an increased limbic activity (Riba et al., 2006) which contrasts with the derealized patient's limbic hypoactivity; an intermodal hyperconnectivity (Brogaard, 2013; Carhart-Harris et al., 2016; Luke & Terhune, 2013; Roseman, Leech, Feilding, Nutt, & Carhart-Harris, 2014; Tagliazucchi, Carhart-Harris, Leech, Nutt, & Chialvo, 2014) which also contrasts with the hypoconnectivity of derealization; a decreased capacity to predict events of the world (Riba, Rodríguez-Fornells, & Barbanoj, 2002; Vollenweider, Csomor, Knappe, Geyer, & Quednow, 2007); and an enhanced sensory load (Carhart-Harris et al., 2016; de Araujo et al., 2012; Roseman et al., 2016). All these factors underlie the complex blending of hypo-reality and hyper-reality that one experiences under the effect of psychedelics.

Although in psychedelic experiences the content of hallucination and the SR are not directly underpinned by metacognitive processes, it remains that metacognition as such happens to be somewhat altered by the hyperactivity of the serotoninergic system. The most notable consequence is a change in connectivity within the default mode network (Carhart-Harris et al., 2012; Palhano-Fontes et al., 2015) affecting *inter alia* areas—e.g., the anterior cingulate cortex—known to play a significant role in metacognition (for a review of areas involved in metamemory, see: Chua, Pergolizzi, & Weintraub, 2014, p. 271).

Metacognition and anticholinergic hallucinogens

Neuromodulators are assumed to be centrally involved in subpersonal metacognition. In particular, Yu and Dayan (2005) have demonstrated that acetylcholine and norepinephrine play an important role in precision weighting: while the latter specifically signals unexpected

uncertainty, the former signals expected uncertainty. Increase in acetylcholine activity results in an enhanced weighting of bottom-up prediction errors; by contrast, cholinergic deficits result in a diminished weighting. In sum, acetylcholine proves to be a key ingredient of subpersonal metacognition.

Anticholinergic hallucinogens exert an antagonist activity on muscarinic receptors leading to cholinergic depletion and to dampened precision weighting. In other words, low level of acetylcholine leads subpersonal metacognition to evaluate bottom-up information as unreliable. A recent model of complex hallucinations induced by cholinergic deficits proposes that hallucinations occur at the middle of the visual hierarchy: unlike psychedelic hallucinations, they do not concern the processing of primary visual features (de Araujo et al., 2012; Roseman et al., 2016) nor the processing of high-level categories, but somewhere in-between, the processing of proto-objects (Collerton, Perry, & McKeith, 2005).

The lack of cholinergic activity—and subsequently the lack of precision of bottom-up processes—results in an increased imposition of prior models of the world. This is quite consistent with the stability and the recurrence of hallucinations produced by antimuscarinic agents. Conversely, increase in AMPA activity—and subsequently the stronger bottom-up signaling—induced by serotoninergic hallucinogens is quite consistent with repeated revisions of priors and the experience of unstable hallucinations. It thus appears that metacognition—and more specifically subpersonal metacognition—plays an important role in the genesis of hallucinations.

As for the SR in deliriant experiences, it seems to be partly explained by non-metacognitive factors. As explained above, impaired intermodal connectivity has been shown to be involved in the altered SR of derealization; psychedelics exhibit the opposite pattern with enhanced intermodal connectivity; experiences resulting from a cholinergic deficit appear to be characterized by a diminished—rather than enhanced—degree of brain connectivity (Delbeuck,

Collette, & Van der Linden, 2007). Unlike the SR of psychedelic experiences, which is only determined by cognitive factors, the SR of deliriant experiences is arguably partly dependent upon at least one well-known metacognitive area: the dlPFC. The SRs of non-lucid dreaming and anticholinergic intoxication have several features in common. Both are characterized by a lack of insight: everything that is experienced in this state is taken at face value. The lack of critical evaluation of experience underpins the strong and continuous SR reported by both non-lucid dreamers and psychonauts having ingested a deliriant hallucinogen. Incongruities usually foster the sense that things are not real; however, in situations in which the dlPFC is impaired, this does not seem to be the case anymore (Fletcher et al., 2001; Fugelsang & Dunbar, 2005; Parris, Kuhn, Mizon, Benattayallah, & Hodgson, 2009). As noted earlier, an important neurophysiological difference between the SR of non-lucid dreaming and the lack of SR of lucid dreaming lies in the degree of activity of prefrontal regions such as the dlPFC. Interestingly, electrophysiological studies show large overlapping between the non-lucid dreaming and the deliriant states (Itil, 1970; Itil & Fink, 1966), and some evidence supports the proposal that the dlPFC shows abnormally low activity under the effect of anticholinergic drugs (Major, Vijayraghavan, & Everling, 2015). Note that the kind of metacognitive activity we are here pointing to is a relatively high-level one, as the detection of incongruities in one's experience is carried out at a personal and arguably explicit level.

The enculturation of metacognition: ayahuasca rituals in three Amazonian cultures

Ayahuasca ritual among the Cashinahua: dampening emotional arousal

The last section mostly concerned the relationship between hallucinogens and *subpersonal metacognition*. Let us now examine the role *personal metacognition* plays in hallucinogenic experiences. The focus will be on ayahuasca, a hallucinogenic brew extensively

used in indigenous shamanism of the Amazon (Brabec de Mori, 2011; Labate & Cavnar, 2014). In addition to differences between Westerners and Indigenous people in the way the brew is used, many differences between indigenous groups themselves are to be pointed out. More specifically, in some Amazonian groups, the use of ayahuasca taps into and exploits some metacognitive processes while in others only cognitive properties of hallucinogenic experiences are looked for and paid attention to.

The case of the Cashinahua, an Ameridian group straddling Peru and Brazil, is particularly interesting. When they are hunting, Cashinahua try to evoke "*date*" ("surprise", "terror") in the prey they are chasing (Deshayes, 2013). It is believed that doing so helps expel the animal's soul outside of its body and thereby making it more innocuous and ready to be killed, cooked and eaten. When the hunter is tracking the animal, he endeavors to be as discreet as possible and to remain unnoticed from the prey. To do so, he will typically produce non-human sounds and wear enticing vegetal perfume. In the last stage of the chase, when the hunter jumps out from a shrub and shoots the prey, the latter is bewildered and terrified as it realizes too late that it has been fatally tricked by the hunter.

A powerful Cashinahua hunter will ideally be able to evoke *date* in other beings but will not be affected by other beings' attempts to evoke *date* in himself. Being surprised in the forest because a jaguar or a spirit is suddenly jumping out from a bush could potentially be fatal: it could result in being de-souled. In Cashinahua culture, the position of the prey is defined as the patient in which *date* is being evoked, whereas the predator is defined as the agent evoking *date* in others. It is critical for hunters, then, to make sure that in front of an unexpected event no fear or surprise will be experienced (Deshayes, 2002, 2013).

Ayahuasca has in this regard interesting properties because, among other things, it often induces frightening, terrifying, and baffling visions. It is hence no surprise that Cashinahua hunters traditionally use the hallucinogenic brew to train themselves to keep composure in front

of surprising and terrifying visions (Deshayes, 2002)[8]. Emotional arousal must be kept as low as possible because being emotionally aroused, moved and surprised amounts to being turned into a prey. As it were, ayahuasca is used as a virtual reality device to learn emotional control and it thereby shapes personal metacognitive processes[9].

Ayahuasca ritual among the Shipibo: the search for fluency

The use of ayahuasca is quite widespread among the Cashinahua; by contrast, among the Shipibo, usually only the shaman (*onaya* or *meraya*) drinks the brew. In Shipibo culture, ayahuasca is mainly used to meet the spirits, receive teachings and powers from them and diagnose people's ailments. Before starting my fieldwork with Shipibo shamans of the Middle Ucayali, I was bearing in mind Deshayes' caveat to the effect that Cashinahua—and possibly all Amazonian indigenous people—are less interested in the visual contents of ayahuasca than in its affective effects. To my great surprise, this was not the case for the Shipibo (see also: Gebhart-Sayer, 1986).

When shamans talk about their visions and offer advice as to how novices should cope with the ayahuasca experience, they are always speaking of visions. Feelings of terror, awe or surprise are not much discussed. Shamans are rather paying attention to and searching for visual fluency in their hallucinogenic experiences rather than any specific visual contents.

Shamans use a plethora of techniques—such as magical songs (*icaros*) and perfumes—to shape their hallucinations. When facing a dangerous and spiteful spirit, shamans typically

[8] It is worth noting that in addition to paying attention to the affective effects of ayahuasca, Cashinahua also pay attention to some of the visual contents induced by the hallucinogenic brew (Keifenheim, 1999; Kensinger, 1973; Lagrou, 2012).

[9] Regulation of emotional arousal has already been studied cross-culturally and has been shown to have important metacognitive consequences (Murata, Moser, & Kitayama, 2013).

grasp their bottle of perfume, put some perfume in their mouth without swallowing it and then spray it on the bad spirit which will immediately disappear. A similar technique to dissolve a hallucination consists in blowing a lot of tobacco smoke on a hallucination. From a neurocognitive standpoint such techniques make total sense: psychedelic experiences are known to be highly synesthetic (Brogaard, 2013; Luke & Terhune, 2013) it is hence natural that sudden change in auditory input (when singing *icaros*) or olfactory input (when spraying perfume) can affect vision.

What is the kind of visual contents, then, that Shipibo shamans try to evoke or dispel? What makes visions desirable is not their content but rather their ease of processing. Good visions worth being searched are bright, clear and distinct, while bad visions to be dispelled are dark and confused. These characteristics clearly fit with those that students of metacognition call fluency (Reber, Schwarz, & Winkielman, 2004). Hence, among the Shipibo, a main norm governing ayahuasca ritual is that of fluency.

Ayahuasca ritual among the Jivaro: the search for specific visual contents

Unlike Cashinahua and Shipibo ayahuasca rituals, the Jivaro ritual does not typically involve metacognition. Among Jivaro groups (Achuar, Aguaruna, Huambisa, Shuar, etc.) ayahuasca is mainly used for vision quests (Baud, 2011; Brown, 1986; Fericgla, 1997; Harner, 1973; Rubenstein, 2012; Surrallés, 2003; Taylor, 1993). Ayahuasca drinking is not confined to the circle of ritual experts but is widely distributed among the entire population. However, people only drink ayahuasca a few times in a lifetime. This is usually done in key periods of one's existence (before becoming an adult, before becoming a father, after having killed someone, etc.).

These vision quests are known as *arutam* quests. The ritual often unfolds as follows: the quester goes into the forest in order to be isolated; he may be occasionally accompanied by a

friend taking care of him; ayahuasca is then ingested and the *arutam* spirit is invoked; it sometimes takes several days for *arutam* to manifest itself; when the spirit appears, the quester is expected to touch it and make it subsequently disappear; some time later the spirit comes back and unveils a personal oracular message to the quester which will endow him with some extraordinary physical and mental powers. *Arutam* quests can be induced by the intake of ayahuasca, but also by other hallucinogenic compounds—such as the anticholinergic plant locally known as *toé*—or simply by fasting and social deprivation.

While the Cashinahua ritual involves the shaping of metacognitive feelings and the Shipibo ritual the search for fluency, the Jivaro ayahuasca ritual does not include any significant metacognitive dimension. It is rather mainly based on the search for specific high-level content-related visual properties: namely, those of the *arutam* spirit.

Hallucinations and religious metacognition: epistemic status of the supernatural in Amazonian shamanism

Opaque religious traditions: supernatural thinking and the norm of deference

Personal metacognition is based on the use of metacognitive feelings but also on the use of epistemic norms. Let us now turn to this examination of the role of the latter—i.e., of analytic metacognition—within Amazonian shamanism. An important question of religious metacognition is that of knowing what the metacognitive norms governing the acceptance or rejection of propositions are (Proust, 2013, Chapters 8, 14). When doing mathematics, the metacognitive norm implicitly applied is that of accuracy. By contrast, when debating politics in a family dinner, a wise policy may be to use the metacognitive norm of consensus rather than that of accuracy. If one wants to make sure that the dinner does not turn into a fistfight, it is judicious to apply the norm of consensus—namely, to express ideas with which interlocutors can concur. Metacognitive norms include relevance—which is particularly useful in everyday

conversation—, coherence—needed when writing realistic fiction—, fluency—the main norm of classical poetry—, etc.

What are the central epistemic norms governing religious thinking? In the last two decades a consensus has emerged within the field of cognitive science according to which opacity and deference play a central role in supernatural thinking (Atran, 2002; Bloch, 2004; Sperber, 1975, 1996). The claim is twofold. Religious rituals and religious beliefs are quite opaque. Seeing someone pouring water in a glass is transparent and straightforward; it is not as easy to understand what is going on when seeing someone carrying out a magical ritual. By the same token, the ordinary assertion that "the cat is sitting on the mat" is transparent, not the supernatural one: "God is three and one". Being opaque, supernatural beliefs can only be endorsed deferentially. They are not fully understood and do not have first-hand evidence justifying them, but are nonetheless accepted by deference to religious authorities. When the priest, bishop or pope says that God is three and one, he must have very good reasons to believe so; it is fair to trust him and believe what he says. Accordingly, the consensus view in the cognitive science of religion is that supernatural thinking is mainly governed by the epistemic norm of deference.

Lifting the veil of opacity: supernatural thinking and the norm of accuracy

The theory of religious cognition previously sketched fits relatively well with the Christian tradition (but see: Christian, 1996; Claverie, 2003; Luhrmann, 2012). On the other hand, this theory is at odds with Amazonian shamanism. Admittedly, just like other supernatural systems, Amazonian shamanism includes opaque statements. All the more so as, in many traditions, shamans speak and sing in a profoundly esoteric language (e.g., Townsley, 1993). Yet, in many shamanic traditions, opacity and deference only characterize the first stage of a longer initiatory process. The widespread use of hallucinogens, as well as other

procedures—such as fasting and social deprivation—evoking altered states of consciousness, enable shamans, and to a certain extent non-expert folks, to experientially explore the realm of the supernatural. Through experience, mysterious supernatural entities and mysterious statements describing these entities lose their opaque character and become as obvious and transparent as ordinary objects.

In his detailed monograph dedicated to Sharanahua[10] shamanism, Pierre Déléage (2009) has neatly demonstrated that an epistemic shift occurs during shamanic training: while non-shamans and novices endorse propositions about supernatural entities only deferentially, initiated shamans who have experienced the hallucinatory world of ayahuasca have now first-hand evidence supporting their supernatural beliefs[11]. The norm which subsequently governs their acceptance of supernatural statements is a norm of accuracy rather than deference.

The contrast between "opaque" traditions and "experiential" ones is also illustrated by the property of psychedelics to increase creativity, facilitate problem solving and induce "aha experiences" (Stafford & Golightly, 1967). In addition to visual and auditory information provided by hallucinations, serotoninergic hallucinogens also provide insights leading people to process religious discourse not as opaque and abstruse propositions but as what seems to be crystal-clear truth (Huxley, 1954). As far as personal metacognition is concerned, it thus

[10] The indigenous group studied by Déléage lives in the Purus region of the Peruvian Amazon, near the Brazilian border. Along with the Shipibo and the Cashinahua, the Sharanahua belong to the Pano language family.

[11] Saying that shamans have first-hand evidence of the existence of supernatural beings and that their metacognitive norm is that of accuracy does not amount to saying that these supernatural beings exist in the objective world! Being a naturalist, I assume that such beings exist only in people's minds. One can very well apply a norm of accuracy and nonetheless produce false statements—this is what happens every time one makes a mistake while solving a mathematical equation.

appears that the use of hallucinogens—especially those of the serotoninergic family—makes an important difference: while the default metacognitive norm of supernatural thinking might very well be that of deference (Atran, 2002; Bloch, 2004; Sperber, 1975, 1996), after having taken a hallucinogen, people tend to switch to the norm of accuracy.

Supra-personal metacognition: the epistemic status of supernatural beings in Amazonian shamanism

Let us finally explore how culture and drug-induced hallucinations interact together at the level of supra-personal metacognition. As we have seen, this level is specifically concerned with the transmission of metacognitive information to others (Shea et al., 2014). Although some studies have explored the influence of culture on supra-personal metacognition (see Barhami, this volume; Le Guen, this volume; Nuckolls & Swanson, this volume), to my knowledge very, little has been said about supra-personal metacognition within the context of religion.

In a classical essay, Robin Horton (1967) proposed that supernatural entities were, like scientific entities, invisible and posited to explain visible phenomena. In spite of these striking similarities, it can still be questioned whether supernatural and scientific entities are ascribed exactly the same ontological status. In order to answer this question, Paul Harris and his colleagues conducted three experiments in which the certainty with which children believe in supernatural and scientific entities and their respective inferential powers were tested. Each of the three experiments was conducted in a specific cultural context: with American children in a relatively secular context (Harris, Pasquini, Duke, Asscher, & Pons, 2006), with Spanish children in a deeply Catholic context (Guerrero, Enesco, & Harris, 2010), and finally with Mayan children in a traditional animistic context (Harris, Abarbanell, Pasquini, & Duke, 2007).

The findings were quite consistent across the three cultures: in each case children were more certain about the existence of scientific entities rather than supernatural ones, and in each

case scientific entities permitted more inferential generalizations than supernatural ones. The upshot of these studies, then, qualifies Horton's claim: although both types of entities have much in common, it remains that scientific entities do not have the same ontological status as supernatural ones. Harris proposes to explain this pattern of answer in terms of supra-personal metacognition: "in all three communities it is plausible that special beings are not talked about in the same way that scientific entities are discussed. Even if people sometimes presuppose the existence of both, children may notice various subtle attestations of faith, doubt, or uncertainty regarding special beings" (2012, p. 149). Indeed, a quick look at how people talk about scientific and supernatural entities in everyday life suggests that metacognitive cues conveyed about scientific entities differ from those conveyed about supernatural entities (Harris, 2012, p. 148 et sq.).

It is particularly interesting to examine Harris' hypothesis in the context of Amazonian shamanism, as many of the local languages possess markers of evidentiality (Dixon & Aikhenvald, 1999; Nuckolls & Swanson, this volume). While they are speaking, people are forced to express the metacognitive status of their sentences. For instance, if I communicate information about a spirit, evidential markers of my sentence will specify whether *I have been told* or *it is generally said* that there are spirits or whether *I have myself experienced* these spirits.

In his monograph on Sharanahua shamanism, Déléage (2009) has thoroughly studied the linguistic structure of songs and reports of the shamans. His main finding is that while novices mainly speak of the spirits using deferential evidentials, initiated shamans speak of the spirits using experiential or ostensive evidentials. As a consequence, it seems reasonable to surmise that in societies in which the supernatural world can be experienced—because notably of hallucinogenic use—and in which evidentiality is systematically marked, metacognitive information about supernatural entities will be highly variable—e.g., children growing in a

family replete with shamans will associate spirits with experiential evidentials whereas children growing in a family with no shaman will associate spirits with deferential evidentials. The ontological status of supernatural entities as compared to scientific entities should consequently be divergent. The coexistence of hallucinogenic use and linguistic evidential systems seems to be a factor of diversity in supra-personal metacognition in general and in religious metacognition in particular.

Conclusion

Let us take stock. Throughout the chapter, it has been suggested that metacognition and the sense of reality are two heterogeneous concepts. The question whether hallucinations and their characteristic SR result from metacognitive processes can therefore only be answered in multiple ways. The role of metacognition in hallucination is not as prominent as monitoring models of hallucination suggest, but it still plays an important role, especially in anticholinergics-induced hallucinations.

Consistent with the view that culture should not be confined to high-level symbolism (Roepstorff, Niewöhner, & Beck, 2010; Smail, 2008), the influence of culture on metacognition and SR has been explored at different levels. Hallucinogen intake is a cultural matter: hallucinogenic substances are available in many places on earth and yet used only in some of them (La Barre, 1980, Chapter 2). Thus, one obvious way to culturally modulate metacognitive mechanisms leading to hallucination and altered SR is to resort to hallucinogens, and especially anticholinergic ones, which have long been employed in initiation rituals of various Amerindian groups (Furst, 1976, Chapter 12; Safford, 1922).

Differences are also a matter of interindividual expertise. In a groundbreaking study Fleming and colleagues (2010) showed that metacognitive performances of subjects were predicted by individual brain structure (by gray matter volume in anterior prefrontal cortex). A

fascinating question which remains unaddressed is whether interindividual diversity in gray matter volume stems from genetic predispositions or training and expertise. In the same vein, Elisa Filevich and her colleagues (2015) established a link between gray matter volume in frontopolar cortex, metacognitive function and the ability to experience lucid dreaming. Given that lucid dreaming can be trained (Hurd & Bulkeley, 2014), it is likely that these neuroanatomical differences are simply the result of expertise. Transferring such studies within cultures in which lucid dreaming is widely cultivated (e.g., Jokic, 2015, Chapter 5) could crucially help determining the respective contribution of genetics and expertise in such interindividual differences.

Expertise in ayahuasca intake seems to exert an effect on the dlPFC and thereby on metacognitive processes mediated by this area. Whereas in novices, use of ayahuasca tends to impair executive function and working memory, it enhances them in expert users (Bouso, Fábregas, Antonijoan, Rodríguez-Fornells, & Riba, 2013). Ayahuasca experts thus have an enhanced (high-level) metacognition as well as a decreased (apodictic) SR.

Going up into the hierarchy of metacognition, at the supra-personal level, hallucinogens still play an important role. Relations between hallucinogens, religion and mysticism have been extensively studied. As shown, hallucinogen intake has noteworthy consequences on religious metacognition and on the confidence people have towards the existence of supernatural entities.

Acronyms used in this chapter (by alphabetical order)

dlPFC: Dorsolateral prefrontal cortex

JR: Judgment of reality

ORM model: Online reality monitoring model

PFC: Prefrontal cortex

RM model: Reality monitoring model

SM model: Self-monitoring model

SDT: Signal detection theory

SR: Sense of reality

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