



Review

Epileptic qualia and self-awareness: A third dimension for consciousness

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ABSTRACT

Over the last few decades, there has been increasing awareness among epileptologists about the need to refine our understanding and assessment of ictal consciousness, focusing on both subjective and behavioral aspects of seizures. Specifically, there have been suggestions that both the internal and external milieu – the former related to the phenomenal qualia of experience, the latter related to behavior – must be taken into account for a better understanding of altered states of consciousness in epilepsy. It has been proposed that clinical and experimental data from patients experiencing alterations of consciousness during epileptic seizures could be better understood within a bidimensional model, in which any manifestation of conscious experience can be plotted according to the level and contents of consciousness. The ‘level’ axis measures the degree of alertness/arousal, whereas the ‘contents’ axis measures the vividness of specific experiential phenomena reported by the patient. We argue that certain seizure types might require more rigorous conceptual models for their characterization, and we highlight the potential usefulness of a more refined framework which includes a further dimension related to the ‘self’, in addition to those of ‘level’ and ‘contents’. This model could be visualized in a three-dimensional space to allow fine-grained distinctions between epileptic seizures.

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1. Introduction

Epilepsy can arguably be defined as a quintessential pathology of consciousness [1]. A number of key symptoms reported by patients with epilepsy are, in fact, associated with altered states of consciousness, so that the assessment of these alterations is fundamental for the diagnosis and categorization of epileptic seizures. In fact, the clinical evaluation of the consciousness impairment – defined as “the inability to respond normally to exogenous stimuli due to altered awareness and/or responsiveness” [2] – allowed the traditional distinction between simple partial seizures (without loss of consciousness) and complex partial seizures (with the alteration of consciousness) [2,3].

However, ‘consciousness’ is a very general term whose meaning refers to a constellation of uses, so that it is almost impossible to univocally define it. In fact, both the neuroscientific [4–7] and philosophical [8–12] literatures include a wide range of definitions of consciousness. This intrinsic ambiguity inevitably reflects on the accuracy of the clinical

use of this concept, especially in epileptology where the assessment of patients’ consciousness plays a crucial role. Therefore, for practical scopes, the application of a two-dimensional model of consciousness has been proposed, built on two axes that describe a quantitative dimension and a qualitative dimension, respectively [13,14]. The ‘arousal’ axis evaluates the ‘level’ of consciousness and measures the alertness of the patient during the seizure, whereas the ‘awareness’ axis evaluates the ‘contents’ of consciousness or subjective experience during the seizure, focusing on the vividness of sensations, emotions, memories, thoughts, and feelings, as well as altered perceptions and hallucinations [15].

Philosophers describe these subjective aspects of experience as *qualia* (plural of *quale*), a Latin term that has also entered the vocabulary of neuroscience. With regard to the study of epilepsy, this term has been used in expressions like ‘phenomenal qualia’, ‘emotional qualia’, and ‘epileptic qualia’ to identify subjective mental content during seizures [16–19]. In other words, the term ‘qualia’ indicates the phenomenal aspects of consciousness and, therefore, appears to be the essential trait that characterizes the qualitative dimension of being conscious.

Although it is theoretically possible to locate every physiological or pathological change of consciousness in the two-dimensional operative space, this model still remains a coarse-grained framework. In fact, epileptic seizures can be only classified according to both the increase or

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decrease of the level of alertness/arousal and the presence or absence of specific experiential contents [17,20]. Thus, there is no possibility to evaluate differences between qualia, for instance, with regard to their self-referencing features and relevant properties (e.g., having autobiographical or memory components). It can be argued that the bidimensional model falls short of assessing whether the connection between consciousness and other key cognitive functions of the self (i.e., attention, sense of agency, authorship, etc.) is adequately preserved [21]. Thus, a fine-grained framework could prove useful not only for the development of the classification of seizures affecting consciousness but also for a better understanding of the nature of consciousness. Moreover, a more accurate theoretical framework could be of help in interpreting clinical data, given that, often, the qualitative degree of the alterations of consciousness and the emotional feature of epileptic qualia can significantly affect the quality of life of patients [22].

In the next sections, we shall discuss a few issues concerning the categorization of seizures with altered states of consciousness and the assessment of ictal consciousness. We shall also propose a new conceptual framework characterized by a multidimensional approach.

2. Altered conscious states and epileptic qualia during seizures

The catalog of ictal alterations of consciousness reported in the scientific literature is large [23,24]. However, there is currently no real consensus on the best psychometric tools to provide a detailed phenomenological description of epileptic consciousness states. As we have highlighted, this lack of agreement can have relevant consequences to clinical practice since the same symptoms occurring as part of an epileptic seizure can be described in different ways. The recent proposal by the International League Against Epilepsy (ILAE) still classifies focal seizures into two categories: those ‘without impairment of consciousness or awareness’ (which roughly correspond to the concept of ‘simple partial seizures’) and those ‘with impairment of consciousness or awareness’ (which roughly correspond to the concept of ‘complex partial seizures’) [25]. Therefore, the impaired level of consciousness remains a core distinguishing feature of focal seizures. In line with this approach, Blumenfeld and Jackson have recently suggested two categorizations compatible with both the old and the new classification report, namely ‘focal aware conscious seizures’ (FACS) and ‘focal impaired consciousness seizures’ (FICS) [26]. Of note, the term ‘dyscognitive’ had also been proposed in order to further characterize this last type of seizures [2].

In addition to these overlapping conceptual tools, the assessment of the level and the content of consciousness relies heavily on the skills of the clinician, who has to take a plurality of factors into consideration. For example, clinical manifestations such as ictal aphasia, forced attention, or disturbances in sensory processes and memory can further complicate the assessment of epileptic seizures affecting consciousness. The development of more refined and unequivocal concepts would, therefore, improve clinicians’ accuracy in the evaluation of the subjective features of seizures.

Since the early observations of Hughlings-Jackson, it is well known that a local epileptic activity arising from the temporal lobe often brings about subjective experiences in the patient’s mind. Hughlings-Jackson described these phenomenal contents as “psychical states which are much more elaborate than crude sensations” [27]. Wilder Penfield was then able to show that in patients with epilepsy undergoing surgical procedures, these mental states or ‘epileptic qualia’ could be replicated by electrically stimulating the temporal lobe [28]. Penfield was also able to note that these phenomenal experiences had a saliency that was sometimes more gripping than the patient’s personal reminiscences. Further studies following these pioneering observations suggested that these subjective symptoms are more frequently elicited by the stimulation of the limbic components of the medial temporal lobe (especially the amygdala) and that these regions are also responsible for the emotional flavor of phenomenal experiences [29–31].

Several tools have been developed for the assessment of ictal consciousness. For instance, the method of inviting patients to think out loud has been used during electrical brain stimulation, often in combination with interview techniques [32]. The psychometric instruments for the assessment of ictal subjective experiences include the Phenomenology of Consciousness Inventory (PCI) [33], which has also been widely used in healthy populations; the Ictal Consciousness Inventory (ICI) [34], which has been specifically developed for the assessment of ictal conscious states of patients with epilepsy; and the Responsiveness in Epilepsy Scale (RES) [35], which is a standardized evaluation battery that measures responsiveness during seizures and has been specifically designed to be administered to patients undergoing continuous video-EEG monitoring. Other tools for collecting relevant data include retrospective structured [36] and semistructured interviews [37,38].

Therefore, over the last few decades, considerable progress has been made in the scientific study of the phenomenal aspects of epileptic seizures. In fact, there is general agreement that both the internal (i.e., phenomenal qualia) and external (i.e., behavior) perspectives must be taken into consideration when studying ictal consciousness. However, our understanding and interpretation of neuroscientific data would highly benefit from the development of better conceptual frameworks which could enable researchers to establish more rigorous relationships between subjective and objective perspectives. A theoretical model with more refined conceptual categories could prove useful in capturing a more comprehensive picture of the phenomenal and private dimensions of epileptic qualia on the one hand and the behavioral manifestations of altered states of consciousness on the other.

3. A three-dimensional conceptual framework

One of the proposed theoretical approaches to understand alterations of consciousness during seizures is a bidimensional model, based on the measurement of the level of alertness and the contents of conscious experience [17,20]. In general, disturbances of the level of alertness tend to correlate with the involvement of subcortical structures, mainly the brainstem activating system, basal forebrain, and thalamus [24]. This, in turn, drives the complete loss of consciousness through the transient disruption of frontoparietal and midline (precuneus/posterior cingulate cortex) associative networks, which have been proposed to be an organized baseline state of neural activity, according to the ‘default mode network’ (DMN) model of brain function [15,17,24,39].

The DMN is a widespread network that includes the posterior cingulate cortex (PCC) and precuneus in the posteromedial parietal cortex, the temporoparietal junction, the medial prefrontal cortex, the parahippocampal gyri, the superior frontal sulci, and the nonspecific nuclei of the thalamus [40–45]. Converging evidence suggests that DMN activity could be altered or disrupted in neuropsychiatric disorders characterized by disturbances in specific cognitive processes, such as self-reflection and self-awareness [46–51]. These findings have led Northoff and other authors to consider preserved DMN activity as a *conditio sine qua non* for the maintenance of consciousness and self-oriented cognition [51–53].

Therefore, both the level and the content axes of the bidimensional model seem to be related to another dimension, which roughly refers to self-awareness and self-oriented cognition. Arguably, without the reference to a third dimension involving the concept of self, the bidimensional model does not fully account for the subjective aspects of seizures (such as limbic status, psychomotor automatisms, states with forced attention) in which the relationship with the sense of agency and self-identity is altered or disrupted. In these cases, the bidimensional model outlines a picture in which the level of consciousness is maintained, but the content is severely restricted [17], with no possibility of further distinctions between epileptic qualia with automatic features and those in which a sense of self is wholly or partially preserved. These observations can, therefore, be visualized as a three-

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