Article

A Novel Concept Introducing the Idea of Continuously Changing Levels of Consciousness

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ABSTRACT

For major advances in the field of consciousness research, it is imperative to propose novel and scientifically useful definitions. As of today, many partially overlapping or opposing concepts about consciousness, self-consciousness, or mindfulness exist, although none is widely accepted. It is problematic particularly for researchers aiming to study objectively a brain function for which no standard neurological correlates and assessment methods have been accepted by most scientists, medical doctors, and philosophers. This short communication briefly presents a unique feature of this new definition proposed recently called *3TC consciousness*. It states that consciousness, in its largest and most inclusive sense, is bound to change its level both continuously and dynamically. The importance of this idea for research is discussed.

Keywords: Self-consciousness, awareness, alertness, mindfulness.

For most people, consciousness and self-consciousness are two relatively different concepts. Being self-conscious, in the general population, generally means to be shy or to worry about what others think of ourself (1,2). For some scientists such as Carruthers and van Gulick, consciousness includes self-consciousness – differences are essentially associated with levels of awareness (3,4). Nearly four centuries ago, Descartes was among the firsts to propose that the mind and the body are separately controlled entities (5-7) – the former (also referred to, then, as the soul or the spirit, would be localized in the brain's pituitary area) being capable of controlling the latter in such a manner that an idea, as an expression of the mind or the soul, arises in the brain, but controls the body. A role for neurons, synapses and multiple brain regions in consciousness was proposed, much later on, by Eccles, Popper, Cottingham and Penfield bringing this area of research into the field of modern neurophysiology (8-11).

Yet, since then, no consensual definition of consciousness was found. In the medical field, to support diagnoses and medical procedures, general practitioners often define consciousness as a level of verbal, motor, and brain activity (12) whereas anesthesiologists care essentially about the loss of alertness for confirming full anesthesia (12,13). For psychiatrists, self-consciousness is particularly important and different from consciousness since schizophrenic patients suffer of a distortion of the reality and of self-representation of themselves (14-16) whereas, for neurologist treating epilepsia, partial seizures are considered to alter the state of consciousness (17-18). For Kabat-Zinn, founder of the Stress Reduction Clinic and developer of the mindfulness-based

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stress-reduction program (MBSR), mindfulness rather than consciousness best describes the idea that concentrating or focusing on the present moment and perceiving, without any judgment or choice, current internal or external impulses, emerging at any given moment in time, enables the reduction of stress (19).

According to his definition, mindfulness allows someone to stay "above" the particular content of thoughts, emotions, or imaginations while remaining aware of the corresponding processes (i.e., 'being aware of being aware'). However, none of those definitions or concepts considered separately can significantly help biomedical researchers and specifically neuroscientists to move this field forward and to provide fundamental insights into consciousness since the relative lack of clarity semantically, epistemologically, mechanistically and neurologically, prevent proper comparisons of studies having considered only one of the definitions as premise for interpreting data (1).

In recent years, several neural mechanisms and brain areas were proposed to underlie the expression of consciousness (or what others may call awareness, spirit, soul, mindfulness, alertness, etc.). Evidences have been found of a role for high-frequency (gamma band) neuronal oscillations, recurrent thalamocortical resonance, NMDA-mediated transient neural assemblies, cortical activation patterns, frontal-limbic and periaqueductal gray somatosensory processes, superior temporal sulcus, temporoparietal junction, perturbational complexity index (PCI), and the 'Greenfield's *brain soup* holistic theory (20-28). However, despite those findings, the specific brain area(s) involved in the expression and/or control of consciousness, if any, remain largely unknown. Since no single definition exists, this largely prevents significant advances in this field of research to be made.

Nonetheless, different approaches (e.g., vagal nerve stimulation, Mindfulness-Based Cognitive Therapy, MBSR, transcendental meditation, etc.), already used therapeutically, were shown to elicit multiple benefits – e.g., improvement of corresponding brain function correlates, restoration of consciousness, enhancement of attention or memory, reduction of cardiovascular risks, and maintenance of normal blood pressure (29-37). Identifying safe and selective drugs capable of increasing benefits on brain functions and health, when using meditative approaches, could thus be of considerable interest specifically for those in need (e.g., elderly) with concentration problems or memory loss (38,39).

As an attempt to further increase our understanding of the neural mechanisms underlying consciousness, a novel inclusive definition (3TC consciousness) was proposed recently that introduces the idea that consciousness depends on multiple factors: *Time*, *Training*, *Task(s)* and *Concentration* (39):

> ***3TC consciousness,* a continuum of states ranging from significant alertness to loss of communication and motor reflexes, enables perception of thoughts, emotions, and sensations without any judgment and at the present moment with limits and continuously changing levels that depend upon time, training, task(s), and concentration as well as on the functional integrity of underlying sensory system elements (i.e., receptors, neurotransmitters, neuronal networks, and pattern of activity) that are yet to be fully characterized.**

Time (age, time of day, season, etc.) generally affects indeed most brain functions – e.g., self-consciousness first emerges at 2 or 3 years of age whereas, for many elderly, memory loss and self-consciousness problems are often progressively found (40-45). Compelling evidence – from Buddhists and scientists – suggests that *Training* is pivotal for those seeking higher consciousness levels (46-52) as well as for benefits on health, as mentioned earlier (29-39). *Tasks* and *concentration* are closely related factors associated with the idea that several tasks performed concomitantly – walking, driving, talking, reading, surfing on internet, listening to music, writing, laughing, or eating – leads generally to errors and slower reaction times cognitively which, in turn, suggests that our brain encounters limits when simultaneously focusing on two or more tasks (53-58). Since concentration or attention has been associated with consciousness or mindfulness (e.g., mindfulness-based attention training or MBAT), multitasking and continuous changes associated with it, in real-life conditions, is bound to be associated also with continuously changing levels of consciousness.

Very few studies investigating this idea directly have been done. This said, dynamic attention states and attention network or default mode network-related activity were recently shown by neuroscientists from Yale and Columbia Universities to constantly undergo transient changes in different conditions including when monotasking and multitasking purposefully or not (59,60). EEG activity recorded by Dennison from experienced Buddhists suggests that default mode network activity often bursts irregularly much like during epilepsia (61).

Now, if we step aside from Science just a second and think about what is known by intuition and observation rather than by experimentation. If one begins purposefully to pay attention to his breathing – as often recommended when initiating a session of meditation –, this relatively easy task becomes much harder when time passes by. How long is it possible for someone to sustain this rather *a priori* simple entry-level step into consciousness (i.e., being conscious of our own body, also known as proprioception)? Most people probably won't succeed at performing this single task more than 30 or 60 seconds.

Indeed, thoughts, ideas and perhaps emotions will come in, disrupting the focussed attention on breathing *per se*. One could start thinking that this task is rather easy, or not. He or she may begin feeling irritated because of not fully understanding what this apparently simple task is all about. Others may radically forget about their respiration because they remembered all of a sudden items of the grocery shopping planned to be done around 17h00 later today. The number of potential scenarios is virtually unlimited. Another observation may be about a man who is asked the same thing but during a whole day in real-life conditions, rather than in a laboratory. Like in the previous case, the man will probably succeed at thinking and being conscious of his respiration. However, most likely, he will forget quite often and all day long because distracted by the plethora of thoughts, emotions and other stimuli (e.g., a car passing by, a baby crying, cravings emerging around mealtime, etc.) exposed to him.

At least a few inferences may be drawn from these simplistic examples. First, *time per se* is constantly changing and hence distracting thoughts, feelings and ideas emerging spontaneously (i.e., unconsciously) are bound to reduce concentration or attention which is the cornerstone of consciousness. Second, beyond the fact that emerging thoughts and ideas will try (even against our will) to emerge constantly, other sensations associated with the external world (vision, hearing, touch, etc.) will routinely, in real-life conditions, be stimulated, becoming sources of distraction. That 'real-life' form of multitasking, generally tested in laboratories, will most

probably also drag the volunteer's attention and concentration away from his entry-level task underlying basic consciousness that is breathing.

Of course, more complex scenarios may be imagined. Can someone realistically achieve steadily maintaining a high level of consciousness which would imperatively require thinking simultaneously (again, much like during multitasking) about his inner body sensation (proprioception – e.g., breathing), sensing external stimuli (vision and audition – e.g., seeing objects moving around him as well as accompanying sounds), emerging thoughts in relation with these stimuli or not (e.g., the sound of this car is annoying; this area smells bad on top of this; Goddam I forgot to brush my teeth, etc.), and emerging thoughts in relation with our memory and acquired knowledge of the world that is imperative for placing things, thoughts and sensations in perspective (e.g., this city is a cool place to be compared with Timbuktu; this said, I am on planet Earth, one of the few places if not the only place of the galaxy where life is possible so… not bad after all, etc.).

If interferences and default mode network activity problems may occur with multitasking experiments in laboratory conditions with only two tasks, let's imagine how attention or concentration must be impaired in real-life conditions. Hence, how long can we realistically expect to express a relatively high level of consciousness? A few seconds, a few minutes? As of today, no one knows with certainty or accuracy. If we think now about the next level in consciousness, as proposed by the father of metaphysics, Spinoza, or some contemporary philosophical leaders such as Kabat-Zinn, Tolle, Krishnamurti or Thich (19, 62-64) – summarized here as 'being aware of being aware'. For instance, let's use one of the examples above, an emerging thought about the 'quality' of the smell that came on our mind as being 'bad'. Being aware that the brain unconsciously chose to give that smell the quality of being 'bad or undesirable' rather than being 'good' or 'neutral' is something someone with high consciousness level should be aware of. That superimposed level of complexity, that is being aware of unconscious choices and judgements our mind makes automatically based on experience, culture, emotion, etc., makes it even harder to maintain consciousness to a high level. Fluctuations or ups and downs are most probably inevitable?

Future investigations are obviously needed to further explore this largely unknown area of neurosciences. It is not unlikely that one day, scientific data capable of demonstrating experimentally these intuitive inferences from observation will be obtained. Nonetheless, for now, one thing is rather clear and obvious only from observation – time, concentration and, the facto, task(s) or multitasking, are important factors that, given their intrinsic dynamic and ever-changing nature, are bound to alter continuously consciousness being expressed at every given moment in time.

In conclusion, a unique and consensual inclusive definition of consciousness may constitute one of the keys to properly study consciousness and its mechanism. Definitions commonly used to describe consciousness, mindfulness, self-consciousness, or awareness often differ significantly from one research group to another making it rather complex for data to be compared. To further understand the underlying neural mechanisms, clearer and scientifically meaningful definitions imperatively need to be established. Most of all, a unique 'one size fits all' definition shall ease data analyses and comparisons among studies from different laboratories. The 3TC consciousness concept is the first to introduce the idea that consciousness level is continuously

changing given that concentration or attention is affected by multitasking and time – factors that are inherently changing continuously.

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