



# Means and Metrics *for* Detecting and Measuring Consciousness

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International Forum  
on Consciousness

## ABSTRACTS

### Who's Really in Control? Quantifying the Influence of the Unconscious Brain

Heather Berlin

Do you really have control over your decisions and behaviors? And if so, which parts of your brain constitutes the “you” and which parts submit themselves to “your” will? According to recent findings, complex cognitive and emotional processing at the unconscious level significantly affects how humans behave, think and feel. Scientists are now beginning to understand how this occurs at the neural level. Research taking advantage of advances in neuroimaging has led to a revival and re-conceptualization of some of the key concepts of psychoanalytic theory. And investigating what an artists’ brain looks like during an improvised performance (i.e. spontaneous creativity) is giving us unique insights into the neural basis of unconscious processes. Understanding these mechanisms also lets us influence the brain in more direct ways. So finally, I will discuss what is currently achievable with brain/computer interfaces and the ways we are learning to change ourselves with the push of a button via neural prosthetics, causing us to ponder: who’s really in control anyway?

### Quantifying Consciousness from First Principles: Integrated Information Theory

Melanie Boly

#### Quantifying consciousness

Behavioral reports have traditionally been the gold standard for evaluating the presence of consciousness. However, it is becoming clear that consciousness can be present even in the absence of overt behavior and in unresponsive subjects. I will present neurophysiological evidence supporting the presence of consciousness in dissociated states from several domains. Measures of cortical integration and differentiation have recently proven to be the most reliable marker of consciousness irrespective of behavior and have been validated in a large number of different conditions. The most common dissociation between consciousness and behavior

occurs every night during dreaming sleep. Recent work using both within-state, no-task paradigms and TMS-EEG shows that consciousness can be present during non REM sleep when the front of the brain shows high amplitude slow waves, as long as a posterior cortical hot zone is activated. Studies using different anesthetics have also shown that fully unresponsive subjects anesthetized with ketamine (as compared to propofol or xenon) retrospectively report intense dreams, which are again associated with high complexity responses to TMS, despite the occurrence of slow waves. High complexity responses can also be observed in about 20% of patients in a vegetative state suggesting, in line with previous findings using active paradigms, that a number of completely unresponsive patients may retain consciousness. Finally, a number of studies in healthy awake volunteers have emphasized frequent dissociations between consciousness and task-related cognitive functions. Overall, recent findings show that the anatomical neural correlates of consciousness are primarily localized to a posterior cortical hot zone that includes sensory areas, rather than to a fronto-parietal network involved in task monitoring and reporting. I will end by discussing promising theoretical approaches and avenues of future research.

### **Challenges and Opportunities for Consciousness Research:**

#### ***Perspectives from Buddhist Thought and Meditative Practice***

**Thupten Jinpa**

With increasing sophistication in brain imaging techniques and growing refinement in measurements of specific facets of consciousness – perception, attention, meta-awareness, memory, etc. – today neuroscience represents an important discipline within the scientific study of consciousness. An exciting part of this new science of consciousness is the willingness to look at the interaction between the mind and the brain, exploring the question of how conscious mental processes, such as disciplined meditative practice, might affect the brain in measurable ways. Studies of long-term Buddhist meditators hold the promise of expanding our current understanding of the human mind’s capacities and open new ways to understand the mechanisms of mind-to-brain effects. My presentation will focus on two questions: 1) What specific contemplative practices from the Buddhist tradition can offer opportunities for exploring the difficult question of mind-to-body effects (I will provide few examples of such practices)?; and 2) what might we learn from Buddhist theorizing on consciousness with respect to identifying what could be called the core features of consciousness? Other questions I shall raise include, “Does the pan-Indian concept of “mental consciousness” (manas) suggest a crucial gap contemporary Western conceptualization on consciousness?” “What does the Buddhist equation of mind (citta) as a repository of dispositions, mental faculty (manas) as the organ of cognition, and consciousness (vijnana) as the instrument of cognition suggest about the essential character of consciousness?” “What questions does the Buddhist notion of concept-free consciousness and meditative state of content-free pure consciousness pose to contemporary concept of consciousness?” These questions will be raised to enrich our growing crosscultural dialogue on the difficult problem of consciousness.

### **Consciousness and its Place in Nature**

**Christof Koch**

Human and non-human animals not only act in the world but are capable of conscious experience. That is, it feels like something to have a brain and be cold, angry or see red. I will discuss the empirical progress that has been achieved over the past several decades in locating the footprints of consciousness to the posterior part of cortex, in the back of the brain.

I will introduce Integrated Information Theory. IIT explains in a principled manner which physical systems are capable of conscious, subjective experience. The theory explains many biological and medical facts about consciousness and has been used to build a consciousness-meter to assess the presence of consciousness in neurological patients. IIT also predicts that consciousness is much more widespread in biology than conventionally assumed, that a silent cortex may give rise to experience and that digital computers cannot be conscious, even if they were to perfectly simulate a human brain. Consciousness does not arise as a form of computation but as a causal power.

### **Hidden Cognition in the Severely Injured Brain: How to Identify It and Where Do We Go from There?**

**Nicholas Schiff**

Severely brain-injured patients who harbor high-level cognitive function and are misidentified as unconscious or minimally conscious represent a vastly underserved population that is uniquely vulnerable to neglect and lack of therapeutic engagement. This lecture will review a wide range of studies aimed at identifying such hidden cognitive capacity and consider the possible underlying mechanisms producing cognitive motor dissociation (CMD). CMD patients have sustained both marked injury to the motor systems as well as injuries within the corticothalamic pathways but can nonetheless demonstrate at least evidence for command following capacities on functional magnetic resonance imaging (fMRI) or electroencephalography (EEG). In ongoing research we have identified and tracked spontaneous recovery of communication capacity in some CMD patients. In this lecture we will give special consideration to the unique challenges that brain injuries producing CMD bring to reestablishing communication systems. Evidence will be presented supporting the view that many CMD patients can be expected to harbor the capacity to recover and establish reliable communication with the surrounding world. That such transformative outcomes may be possible should motivate a broad rethinking our overall approach to the severely brain injured patient.

### **Within and without Self: Teachings from Psychedelics**

**Franz Vollenweider**

Recent years have seen a burgeoning scientific interest in the phenomenology and underlying neurobiology of altered states of consciousness (ASC) induced by psychedelic drugs such as psilocybin and LSD, also driven by growing evidence of their beneficial effects on physical and mental well-being. At the core of the psychedelic experience is the dissolution of the phenomenological self or ego concomitant with a feeling of oneness or unity with all that exists, and a sense that one's everyday identity has dissolved into a timeless ultimate reality. This peculiar state of selflessness arises sequentially and unfolds to along with profound changes in perception and mood to culminate in a blissful state of content-free pure consciousness, also referred to as peak or mystical-type experience according to the literature on the philosophy of spirituality. In this presentation I will discuss recent research strategies with psychedelics and advances to identify molecular, cellular, and system-based correlates of psychedelic-induced alterations of the sense of self, emotion processing, imagery and social interactions. In this presentation I will discuss recent research strategies with psychedelics and advances to identify molecular, cellular, and system-based correlates of psychedelic-induced alterations of the sense of self, emotion processing, imagery, and social interactions. Furthermore, I will discuss some recent advances in the clinical applications of psychedelics drugs in psychiatric disorders such as depression.

## **Experiential Opportunities, Friday 8:15-9:00am**

### **(1) Feynman Winter Garden: Yamuna Foot Wakers & Yoga with Laura Flanagan**

Learn how important the feet are as your foundation. Participants will have an opportunity to massage and train their feet on unique tools called Yamuna Foot Wakers. These little half magical spheres not only massage reflexology points in the feet, but they also strengthen the over 100 muscles in the feet – helping to take you out of patterns which extend into the knees, hips, spine and shoulders. Participants will also learn and experience ways to immediately release and keep tension out of the body through simple yoga exercises that can be done at work, standing in line at the grocery store, or even sitting at a stoplight in traffic.

### **(2) Auditorium: The Shape (Shifting) of Consciousness: A Sonic Odyssey with Lisa O'Connor**

Engage in conversation with presence, through malleable wave patterns & geometric frequencies that will expand the shape of your awareness, in dimensions, at first more felt than heard. Intervals of song & sound will excite conscious coherence in your memory, meditation, being & becoming. Through the use of voice, high resonance sounding tools, and a kaleidoscope of global instrumentation, Lisa creates sonic spaces wherein the listener can come to meet all of who they are, to let go of inhibitions, to yield to basic trust & inspiration, so one's full potential can be realized & embodied for the way forward.