

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/395014881>

# Editorial overview: Consciousness on the borders of life and death

Article in *Current Opinion in Behavioral Sciences* · August 2025

DOI: 10.1016/j.cobeha.2025.101594

CITATIONS

0

READS

33

5 authors, including:



**Gerry Leisman**

University of Haifa

464 PUBLICATIONS 4,227 CITATIONS

[SEE PROFILE](#)



**Olivia Gosseries**

University of Liège

431 PUBLICATIONS 16,682 CITATIONS

[SEE PROFILE](#)



**Calixto Machado**

Institute of Neurology and Neurosurgery Havana Cuba

659 PUBLICATIONS 4,575 CITATIONS

[SEE PROFILE](#)



**Charlotte Martial**

University of Liège

146 PUBLICATIONS 3,583 CITATIONS

[SEE PROFILE](#)

# Editorial overview: Consciousness on the borders of life and death

Gerry Leisman, Olivia Gosseries, Calixto Machado, Charlotte Martial and Amedeo D'Angiulli



Current Opinion in Behavioral Sciences 2025, 66:101594

Available online xxxx

<https://doi.org/10.1016/j.cobeha.2025.101594>

2352–1546/© 2025 Elsevier Ltd. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

## Gerry Leisman<sup>1,2</sup>



<sup>1</sup> Movement and Cognition Laboratory, Department of Physical Therapy, University of Haifa, Israel

<sup>2</sup> Resonance Therapeutics Laboratory, Department of Neurology, Universidad de Ciencias Médicas de la Habana, Havana, Cuba  
e-mail: [g.leisman@alumni.manchester.ac.uk](mailto:g.leisman@alumni.manchester.ac.uk)

**Gerry Leisman** is a full professor and research fellow at Haifa University and professor of restorative neurology at the University of Medical Sciences, Havana. He studies the movement and cognition developmentally, examining mechanisms of self-organizing systems in the brain applied to fetal, neonatal, infant, and child development and developmental disabilities.

Our ability to adequately define life and death and other states in between has resulted in many controversies philosophically and empirically, with arguments supporting or detracting from issues such as the harvesting of organs for transplantation, the right to life, sentience, consciousness during fetal development, altered states of consciousness, locked-in syndrome, and life itself. According to a generally accepted view, life can be described as a quality that differentiates entities possessing physiological activities such as self-sustenance, growth, communication, and replication from those that do not. Entities that have concluded (expired) or those that never possessed such functions, we classify as nonliving or inanimate. Biology is the science concerned with the study of life. Unfortunately, there exists no consensus regarding life's definition. This is partly because life is a progression complicated by a lack of a complete understanding of the characteristics of living things. Death is the permanent termination of all biological processes sustaining an organism, and as such, it is the end of its life, offering a boundary to life. However, mental life and consciousness may end earlier than the moment at which all biological processes cease. This themed issue provides multidisciplinary perspectives for a better understanding of life, death, living behavior, adaptive function, and consciousness-supporting behavior of organisms.

This special issue includes 19 reviews, both on theoretical work and experimental findings, that address the development of consciousness from fetus to the changes occurring throughout life, up to the very edge of death, in both humans and nonhumans. Mudrik and colleagues [1] review different theories of consciousness and examine the conditions under which conscious experience contributes to a life being considered worth living, highlighting the ethical implications of consciousness across species and states. On the other hand, Buchman [2] describes a new framework for categorizing life along its measurable continuum, with the aim of harmonizing our normative perspectives with the rapid advancements in medical innovation.

## Olivia Gosseries<sup>3,4</sup>



<sup>3</sup> Coma Science Group, GIGA-Consciousness, GIGA Institute, University of Liège, Liège, Belgium

<sup>4</sup> NeuroRehab & Consciousness Clinic, Neurology Department, University Hospital of Liège, Liège, Belgium

Dr. **Olivia Gosseries** is Director of the Coma Science Group, research associate at FNRS-FRS and associate professor. As a neuropsychologist, her early work focused on diagnosis and prognosis in patients with disorders of consciousness recovering from coma using non-invasive brain stimulation and electrophysiology. In recent years, she has worked more extensively on therapeutic options for this challenging patients' population.

## Calixto Machado<sup>5</sup>



<sup>5</sup> Laboratory of Clinical Neurophysiology, Department of Neurology, Institute for Neurology and Neurosurgery, Havana, Cuba

**Calixto Machado** currently works at the Department of Clinical Neurophysiology, Institute of Neurology and Neurosurgery, Havana, Cuba. Dr. Machado is a Senior Professor and Researcher in neurology and clinical neurophysiology. Dr. Machado's current projects are disorders of consciousness, brain death, autism, and heart rate variability in autonomic function assessments in different neurological diseases.

Leisman and colleagues [3] describe current evidence from experimental, clinical, and animal research about the level and content of cognition and consciousness in the fetus. From convergent observations of behavior, they demonstrate that the building of functional connectivities and integration of complex brain functions typically associated with minimal human consciousness may start early *in utero*. They also suggest that consciousness is not an all-or-none process but rather a continuum of increasingly complex and emergent interactions within multiple neural networks. Next, Delafield-Butt and Ciaunica [4] examined the genesis of a prereflective self-consciousness *in utero* in humans. These authors suggest that a state of self-generated anticipatory perceptual awareness is observable in the fetus, first evident in the prospective sensorimotor organization of bodily movements during the second trimester, revealing an early adaptive awareness that establishes the foundation for the abstract, reflective, and conceptually backed conscious experience in adults.

Terlouw and Le Neindre [5] address in their review the question of whether farm animals may experience forms of consciousness similar to those observed in humans. While modern slaughter practices are designed to minimize suffering, the scientific literature remains limited on the subjective experiences of animals during this process. The evidence reviewed highlights increasing support for the presence of emotions and consciousness in animals, though much remains to be understood. The authors review key brain regions involved in conscious processing and describe commonly used stunning techniques (mechanical, electrical, gaseous) to induce unconsciousness by disrupting these neural networks in different ways. This important line of inquiry raises ethical and scientific challenges, calling for more research into the neurobiology of consciousness to inform both animal welfare practices and our broader understanding of sentient experience.

Bosl and Shenkar [6] note that human consciousness emerges over time. At least from conception, neurodevelopment generates and supports a neuroelectric field that can be quantified by computational methods from dynamic systems theory. In the early embryonic stages, genetically driven cellular processes are mediated by endogenous electromagnetic fields and intrinsic electrical fields produced by migrating neurons. In the ambient cellular environment, these interactions influence each other, impacting neural migration. The emergence of Theory of Mind is accompanied by increasing neural connectivity, neuroelectric field complexity, and more integrated information processing. Neurodegeneration in old age and the often-associated decline in conscious awareness correlate closely with changes in the dynamical complexity of the neuroelectric fields. Monitoring trajectories of the neuroelectric field and its complexity changes through the lifespan presents a developmental perspective and empirical correlation for studying the emergence and decline of human consciousness and, resultingly, cognition.

Ben-Soussan and Paoletti [7] have examined the notion of vitality electrophysiologically. They have connected life, consciousness, neuronal synchronization, and death. In addition, the state of self in relation to biophotons provides a better understanding of the life–death continuum and its relation to consciousness. In attempting to gain a better understanding of the potential contributors to the notion of consciousness, Binder [8] reflects on the notion of temporality in consciousness and reviews leading theories and hypotheses that attempt to address this enduring paradox.

### Charlotte Martial<sup>3,4</sup>



<sup>3</sup> Coma Science Group, GIGA-Consciousness, GIGA Institute, University of Liège, Liège, Belgium

<sup>4</sup> NeuroRehab & Consciousness Clinic, Neurology Department, University Hospital of Liège, Liège, Belgium

**Charlotte Martial** is a researcher at Coma Science Group (GIGA-Consciousness, Université de Liège, Belgium). Within this team, she leads studies on the phenomenon of near-death experiences. Her field of interest encompasses episodes of "disconnected" consciousness, characterized by the living of a subjective mental experience without the perception of the external environment.

### Amedeo D'Angiulli<sup>6,7</sup>



<sup>6</sup> Department of Neuroscience, Carleton University, Ottawa, Canada

<sup>7</sup> Children's Hospital of Eastern Ontario Research Institute, Ottawa, Canada

Dr. **Amedeo D'Angiulli** is Professor of Developmental Social and Cognitive Neuroscience at the Department of Neuroscience, and Director of the Neuroscience of Imagination, Cognition and Emotion Research (NICER) Lab at Carleton University, Ottawa, Canada. He is also Lead Research Scientist at Children's Hospital of Eastern Ontario Research Institute and visiting professor at the International Telematic University Uninettuno, Rome, Italy.

Cecconi et al. [9] examine how consciousness can become detached from external sensory inputs, as observed in states like anesthesia, sleep, and mind-wandering. They review experimental methods used to investigate this sensory disconnection, contributing to a deeper understanding of the neural mechanisms underlying conscious awareness. Within the specific domain of disconnected consciousness, Gosseries et al. [10] reviewed trance states that range from shamanic ancestral practices to modern adaptations, and describe the phenomenological characteristics, underlying neural mechanisms, and potential clinical applications of such peculiar states. Taking manipulations of consciousness states clinically, Boulakis and Demertzi [11] describe 'mind-blanking' as a relatively unexplored mental state, and examine its relation to thought content and dynamics. They note that mental blanking is associated with variations in cortical and physiological arousal levels and propose that mind blanking is unrelated to any type of content, represented as a moment during content transitioning or as a failure to transition across contents. They also suggest that mind blanking may aid in isolating the neural correlates of cognition.

Ursino and Pirazzini [12] explore the role of cross-frequency coupling between theta and gamma oscillations as a fundamental mechanism underlying cognitive functions and consciousness. They emphasize how this neural dynamic supports the encoding and retrieval of information, suggesting that it may serve as a core process across diverse conscious states. Additionally, Meiron [13] described the functioning of consciousness and cognition among individuals with schizophrenia in the context of self-awareness electrophysiologically as reflected in the reduced connectivity within the anterior default mode network, which seems to underlie excessive resting frontal alpha power and is consistently linked to compromised prefrontal cortex region activity and to disruptions in regulating the storage of sensory information. Increased power within slow and fast wave oscillations in schizophrenia was reported to be associated with distorted perceptions of self-agency.

One of the more difficult problems to resolve is, like life, the description of death. Díaz-Cobacho and Molina-Pérez [14] focus on those who advocate allowing people to choose their definition and criteria for death within a range of reasonable alternatives. The authors outline the main proposals and their rationales and provide a current overview of the state of the controversy. Fritz and colleagues [15] examine the phenomenon of near-death experience, focusing particularly on their overlap with drug-induced states, and review emerging evidence that the latter may model the former in controlled settings.

Finally, van Hoorn and colleagues [16] discuss the importance of incorporating neurophysiological monitoring to evaluate consciousness levels in terminally ill patients undergoing continuous sedation. They suggest that such monitoring can enhance patient care by ensuring sedation effectively alleviates suffering without unnecessarily diminishing consciousness. In parallel, Spivey [17] explores the possibility of an organism's cognition extended out into the environment, namely, a contiguous manifold of cognitive activity that might allow some of that cognition to persist after its death. At the antipodes of death, D'Angiulli and Roy [18] review topics linked to the role of imagination in life beyond the generation of visual mental imagery. That is, as a dimension of self-consciousness and an aspect of generativity and natural selection in evolution, imagination or

*imaginative generativity* can be framed as one of the primary mechanisms for survival, on the basis of transdisciplinary research and literature synthesis.

In conclusion, this special issue invites a rethinking of consciousness as a graded, dynamic phenomenon rather than a binary state. Spanning developmental, clinical, and comparative perspectives, the contributions underscore that consciousness can emerge, fluctuate, and decline in ways that challenge traditional boundaries between life and death. These findings carry significant ethical and clinical implications, especially in contexts like fetal development, end-of-life care, and nonhuman sentience. As scientific understanding deepens, so must our frameworks for interpreting and acting upon these insights — calling for greater precision, interdisciplinary dialogue, and ethical responsibility in how we define and engage with conscious life.

We extend our gratitude to all contributors for their insightful work and to the reviewers for their critical evaluations. It is our hope that this collection stimulates further inquiry and dialogue into the enigmatic nature of consciousness at life's boundaries.

### Declaration of Competing Interest

None.

### Acknowledgements

O.G. is a research associate at F.R.S.-FNRS.

### References

- Mudrik L, Mylopoulos M, Negro N, Schurger A: **Theories of consciousness and a life worth living**. *Curr Opin Behav Sci* 2023, **53**:101299.
- Buchman AS: **Untangling a taxonomy of living from the science of the continuum of life**. *Curr Opin Behav Sci* 2024, **55**:101345.
- Leisman G, Alfasi R, D'Angiulli A: **From sensory motor and perceptual development to primary consciousness in the fetus: converging neural, behavioral, and imaging correlates of cognition-mediated emergent transitions**. *Curr Opin Behav Sci* 2024, **60**:101455.
- Delafield-Butt J, Ciaunica A: **Sensorimotor foundations of self-consciousness in utero**. *Curr Opin Behav Sci* 2024, **59**:101428.
- Terlouw EC, Le Neindre P: **Consciousness in farm animals and the 'how' and 'why' of slaughter techniques**. *Curr Opin Behav Sci* 2024, **56**:101358.
- Bosl WJ, Shenkar JRC: **Dynamical measures of developing neuroelectric fields in emerging consciousness**. *Curr Opin Behav Sci* 2025, **61**:101480.
- Ben-Soussan TD, Paoletti P: **Life in light of the Sphere Model of Consciousness: a bio-electrophysiological perspective on (well-) being and the embodied self**. *Curr Opin Behav Sci* 2024, **55**:101344.
- Binder M: **Is the time's flow an illusion? — the issue of the temporality of the conscious experience**. *Curr Opin Behav Sci* 2024, **57**:101387.
- Cecconi B, Bonhomme V, Laureys S, Gosseries O, Boly M, Annen J: **Experimental approaches to study sensory disconnection in humans during sleep and anesthesia**. *Curr Opin Behav Sci* 2025, **63**:101505.
- Gosseries O, Marie N, Lafon Y, Bicego A, Grégoire C, Oswald V, Vanhaudenhuyse A: **Exploration of trance states: phenomenology, brain correlates, and clinical applications**. *Curr Opin Behav Sci* 2024, **58**:101400.
- Boulakis PA, Demertzi A: **Relating mind-blanking to the content and dynamics of spontaneous thinking**. *Curr Opin Behav Sci* 2025, **61**:101481.
- Ursino M, Pirazzini G: **Theta-gamma coupling as a ubiquitous brain mechanism: Implications for memory, attention, dreaming, imagination, and consciousness**. *Curr Opin Behav Sci* 2024, **59**:101433.
- Meiron O: **Self-awareness in schizophrenia: identifying common neural oscillatory parameters underlying altered sense of self-agency and reduced prefrontal cortex excitability**. *Curr Opin Behav Sci* 2024, **58**:101398.
- Díaz-Cobacho G, Molina-Pérez A: **Pluralism in the determination of death**. *Curr Opin Behav Sci* 2024, **57**:101373.
- Fritz P, Lejeune N, Cardone P, Gosseries O, Martial C: **Bridging the gap:(A) typical psychedelic and near-death experience insights**. *Curr Opin Behav Sci* 2024, **55**:101349.
- van Hoor A, Jonckheer J, Laureys S, Six S: **Why neurophysiological monitoring should be included to assess patient comfort during continuous sedation until death**. *Curr Opin Behav Sci* 2025, **62**:101485.
- Spivey MJ: **Extended cognition and life after death**. *Curr Opin Behav Sci* 2023, **54**:101325.
- D'Angiulli A, Roy R: **The frog-manikin holding the blue parasol umbrella: imaginative generativity in evolution, life, and consciousness**. *Curr Opin Behav Sci* 2024, **58**:101397.