

Neural correlates of states of consciousness: lessons from deep sleep and meditation

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The state of deep sleep (Slow Wave Sleep – SWS) is electrophysiologically characterized by the periodical alternation between periods of depolarized neural activity and periods of electrical silence related to deep neural hyperpolarization (i.e. Slow Oscillation). The latter phase induces a widespread disruption of large-scale integration of information, periodically quenching the continuum of information processing which is typically observed in wakefulness. This may represent one, if not the most important, mechanism subtending sleep unconsciousness. Similar phases of hyperpolarization are observed also in other condition of unconsciousness, such as deep anesthesia and vegetative states. One of the EEG hallmarks of this bistable behavior in humans is the spontaneous or evoked Sleep Slow Oscillation (SSO and K Complex, respectively). While the site of emergence of K Complexes is sensory modality dependent, the SSO origins preferentially in frontal areas sweeping the cortex with an antero-posterior directionality.

It is worth noting that the mechanical stimulation of the nasal vault epithelium at frequencies of typical eastern contemplative practices (Pranayama) induces a non-ordinary state of consciousness which is associated with the same antero-posterior directionality of information of slow EEG activities. Meditative breathing-related states show a paradoxical neural behavior characterized by EEG hallmarks of SWS (delta and theta activities and an antero-posterior flow of information) on the one side and a phenomenological state of wakefulness on the other side. The mismatch between neural correlates typical of unconsciousness and the subjective experience of consciousness during breathing-related meditative states support the notion that sleep and wakefulness are two extreme, and sometimes intermingled, points of the continuum of consciousness.

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Brief biography

Angelo Gemignani, Ph.D., M.D., Is a psychiatrist, doctor in psychology and currently full professor of Biological Psychology and Psychophysiology at the University of Pisa, Italy.

He is the current director of the University Department of “Surgical, Medical and Molecular Pathology, and Critical Care Medicine” of the University of Pisa, and the director of the Clinical Psychology branch at the Pisa University Hospital. Angelo Gemignani is also a founding member, and current director of the 1st level master’s degree course in “Neuroscience, Mindfulness, and Contemplative Practices”, in collaboration with the Buddhist Institute “Lama Tzong Khapa” of Pomaia, Italy. Angelo Gemignani is member of the Academic Senate of the University of Pisa.

Gemignani's research is mainly oriented to the study of the psychophysiological mechanisms of sleep, consciousness, acute and chronic distress, and distressing emotional states. He has authored more than 140 papers in international academic journals and PI of several national and international projects. His current scientific attention is mainly devoted to the study of psychobiological bases of meditative techniques and their effects on different levels of consciousness. Thanks to his publications and research experiences, Prof. Gemignani can be considered a specialist in sleep, consciousness, stress, and emotion.