

Functional and Comparative Neuroanatomy of Interoception

Dr. Henry Evrard

For decades, the brain has been examined mostly as an isolated organ. Yet, the brain is obviously part of a whole organism. Although long dismissed as being of primitive and purely autonomic relevancy, ongoing sensory afferences encoding the physiological state of the body (or interoception) are now known to have a crucial role in shaping emotion and cognition, and in providing a self-referential for self-conscious subjective experiences. A phylogenetically novel and primate specific interoceptive afferent pathway links the body to the brain, providing a neurobiological basis for the central representation of the 'material me', a sine qua non condition for the Emotional Embodiment theory proposed more than one century ago by William James and Carl Lange, and for the Somatic Marker hypothesis of Damasio. Furthermore, a growing wealth of evidence indicates that bodily states impact brain states on an ongoing basis, through an interfacing at several distinct central nodes that can trigger functional network switches based on the detection of homeostatically salient events.

Using neuroanatomy as a gold standard and considering that structure is indissociable from function, this lecture will explore the primate interoceptive pathway from the spinal cord and medulla to cerebral cortex, including the insular cortex (or insula). An overview of the organization of the insula will provide lucid examples of overlaps between architectonics, connections, and functions, all showing that the brain is indeed highly organized, with great implication for our understanding of our interoception shapes brain functions. It will also introduce the notion of cell specificity in the case of the morphologically unique, spindle-shaped von Economo neuron, which occurs primarily in the anterior insula and anterior cingula. Both regions, as well as the von Economo neuron, are targets of neurodegenerations characterized by the subtle loss of self-conscious feelings. While most evidence presented in the lecture comes from non-human primate research, a comparative examination of the insula will help link this evidence to the organization of the human brain.