INSTITUTO CAJAL

SEMINARIO PRESENCIAL

Viernes, 26 de Mayo de 2023
12:30 h. Instituto Cajal (CSIC) Madrid

Dra. CELIA HERRERA-RINCÓN

Investigadora del Programa Ramón y Cajal. Universidad Complutense de Madrid

FROM MICROBES TO MINDS: USING A BRAIN-BACTERIA INTERFACE TO DISCOVER A UNIVERSAL CODE FOR INFORMATION-PROCESSING ACROSS SCALES OF BIOLOGICAL ORGANIZATION

Abstract

While it is clear that bacteria in the gut and neurons in brain communicate (the brain-gut- microbiota axis), many of the fundamental questions in this field are wide-open. Nowadays, the scientific community has focused on indirect pathways of connection between (gut) bacteria and (brain) neurons, which are executed through metabolites and signals, but much better understanding is still required before therapeutic tools can be developed for these pathologies. There is a need to reveal the actual mechanisms of action, which may go beyond what is already known, and can only be derived from radically new methodologies and a multi-integrative “top-down” scientific approach that provide a holistic understanding of the bidirectional communication between neurons and bacteria. Our group seeks to develop the first integrated electrical-optical Brain-Bacteria Interface (BBI), a multi-site stimulation and recording platform specifically suited to extract information in real-time across highly diverse biological entities. Here, we show real-time information transfer in co-culture of neurons and bacteria, both optically, through fluorescent genetically-encoded ion reporters, and electrically, through customized micro-electrode-array on microfluidic chambers. The extraction of information content from signaling between neurons and pathogens, and the establishment of a novel interface between neuroscience, synthetic biology, biophysics, information science, and molecular physiology will produce new knowledge of both basic and applied impact, bridge a capabilities gap that establishes a new direction for the field, and serve as an enabling technology which will allow others to research scientific questions that are fundamental relevance to practical current barriers in biomedicine, evolution, and unconventional computation.

Affiliation and short bio

Dr. Herrera-Rincon is a nonconformal neuroscientist, mainly interested in fundamental topics like emergence and the nature of the mind::matter relation. Celia received her Ph.D. in Neuroscience, from the Complutense University of Madrid (Madrid, Spain) in 2014. In 2015, she moved to the USA and started her post-doctoral research at Tufts and Harvard Universities (Boston, MA) under the supervision of Prof. Michael Levin. During her postdoc studies, she began to uncover the bioelectric language by which cells coordinate their activity and she developed two ground-breaking preparations (Xenopus embryo development without a brain or the brainless model, and wearable bioreactor for regeneration). After two years working as a postdoc, Dr. Herrera-Rincon became an Independent Researcher at Tufts in December 2017 after awarding a grant from the Templeton World Charity Foundation Inc., which funds 2-3 high risk/high-reward projects each year from promising researchers at early stages of the career across the globe. She was awarded a Ramón y Cajal Fellowship in 2020 and she joined the Complutense University of Madrid, where she is leading a team to understand the deepest aspects of the brain-bacteria communication, using a unique methodology: the Brain-Bacteria Interface (BBI). BBI is the first integrated platform optimized to extract Information during live communication between bacteria and neurons.

Instituto Cajal. CSIC
Avda. Doctor Arce, 37. 28002. Madrid. Tel. 91 585 4750
www.cajal.csic.es

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Related publications with the topic

Herrera-Rincon, C., Pai, V.P., Moran, K.M., Lemire, J.M., and Levin, M., (2017), The brain is required for normal muscle and nerve patterning during early Xenopus development, Nature Communications, 8 (1): 587

Herrera-Rincon, C., Pare, J.F., Martyniuk, C.J., Harrison, C., Fischer, A., and Levin, M., (2020), An in vivo brain-bacteria interface: the developing brain as a key regulator of innate immunity, npj Nature Regenerative Medicine, 5:2.

Herrera-Rincon, C., Murciano-Brea, J. and Geuna, S., (Sep 2022). Can we promote neural regeneration through microbiota-targeted strategies? Introducing the new concept of Neurobiotics, Neural Regeneration Research, 17(9):1965-1966

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