Meet the NOCI Twente PhD candidates

Development of a microbiome-gut-brain-axis on a microfluidic chip

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The gastrointestinal tract is connected to the brain through bi-directional signaling pathways which are partly regulated by the composition of the microbiota. This is called the microbiome-gut-brain axis (MGBA)[1]. Disturbance of this communication system is linked to a number of neurodegenerative diseases and conditions like depression, anxiety, stress, autism, Alzheimer's disease and Parkinson's disease[2]. Until now, most research carried out to study the MGBA involved animal models. However, these models lack transferability of the results to the human physiology. Moreover, i*n vitro* models often focus unilaterally on one organ and fail to integrate all components of the pathway between our gut microbiome and brain, and thus provide limited insight into molecular mechanisms of the interaction[3].

To study the complex relationship between the gut microbiome and brain health, we are translating the microbiome-gut-brain axis to a microfluidic chip. We are using pluripotent stem cell-derived organoids to recapitulate the intestinal epithelium with a functional mucus layer, a directional neuron serving as the vagus nerve and a brain. Small intestine-specific bacteria will be introduced to this poly-culture as well. Combined with relevant on-chip readouts, we can model the impact of the microbiota on neuronal functioning, and *vice versa*.

Literature:

1. Dinan, Timothy G., and John F. Cryan. "The impact of gut microbiota on brain and behaviour: implications for psychiatry." *Current Opinion in Clinical Nutrition & Metabolic Care* 18.6 (2015): 552-558.
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3. Cryan, John F., and S. M. O'mahony. "The microbiome-gut-brain axis: from bowel to behavior." *Neurogastroenterology & Motility* 23.3 (2011): 187-192.