

# Neuron-glia communication upon cell-selective activation of Ca<sup>2+</sup> dependent pathways

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## Summary

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*The nervous system consists of multiple cell types with distinct physiological specializations and gene expression patterns. Specialized nervous system cell types are broadly divided into neurons and glial cells. Understanding of the roles glia fulfil in normal and pathophysiological states of the nervous system has vastly improved in recent years. The aim of this project is to study the molecular mechanisms of communicating activity states between neurons and glial cells.*

Research field:	Biomedicine and health technology
Supervisors:	Prof. Dr. Tönis Timmusk Prof. Dr. Indrek Koppel
Availability:	This position is available.
Offered by:	School of Science Department of Chemistry and Biotechnology
Application deadline:	Applications are accepted between June 01, 2023 00:00 and June 30, 2023 23:59 (Europe/Zurich)

## Description

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The central nervous system (CNS) consists of multiple structurally intertwined cell types – neurons, glial and vascular cells. While these cell types act together as a physiologically indivisible and interdependent unit, neurons have historically received the largest share of researchers' attention. In the past decades this focus has shifted to include other cell types in rethinking CNS physiology and disorders. For example astrocytes, accounting for 20-40% of CNS glia, were once considered metabolically and structurally supportive cells to neurons but a growing body of evidence now suggests a central role for astrocytes in development, homeostasis, and multiple disorders of the CNS.

The aim of this project is to study how GPCR(Gq)-dependent activation of intracellular Ca<sup>2+</sup> release in neurons or astrocytes changes gene expression not in the cells where Ca<sup>2+</sup> is primarily released, but how this activation state is communicated to other cell types in proximity. This is a fundamental study with broad implications for understanding CNS function and developing therapeutic strategies for many common CNS pathologies such as Alzheimer's disease and major depressive disorder. We use an experimental system of co-cultured primary rat brain cells. For cell-specific activation of Ca<sup>2+</sup>-dependent signaling pathways in neurons and astrocytes we shall use a chemogenetics strategy that has been recently validated in our lab. Cell-specific transcriptome changes will be studied using different approaches, including translating ribosome affinity purification, single-cell RNA-seq and *in situ* hybridization. Cell-specific proteome changes will be studied using a puromycin labeling-based tool developed by our group (publication currently under revision). Using these approaches for analysis, we shall probe gene expression signatures in neuron-astrocyte communication and determine the molecular transmitters (proteins? small molecule transmitters?) that form the basis of this communication.

### Supervisors:

Main supervisor: Prof. Dr. Indrek Koppel

Co-supervisor: Prof. Dr. Tönis Timmusk

### Applicants should fulfil the following requirements:

- MSc degree in life sciences (preferably biology or gene technology)
- Solid expertise in cell and molecular biology techniques. Additional expertise in animal work, cultures of primary neurons and glia, and in microscopy techniques will be advantageous.
- Good command of English in oral and written communication
- Good teamworking and organizational skills



**We offer:**

- Exciting fundamental research project in molecular neuroscience
- Interdisciplinary research environment in life sciences
- State-of-the-art research infrastructure including a microscopy core facility, small laboratory animal facility, mass spectrometry and HPLC analysis resources.

**About the department**

The Department of Chemistry and Biotechnology comprises three divisions – Chemistry, Gene Technology and Biomedicine, and Food and Biotechnology – and 23 research groups working on a broad scope of fundamental and applied research topics.

**Additional information**

For additional information, please contact Dr. Indrek Koppel [indrek.koppel@taltech.ee](mailto:indrek.koppel@taltech.ee)



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