The role of astrocytes in complex cognitive processing

ABSTRACT:

Background
The importance of glial cells in the brain is rising due to emerging data supporting dynamic neuron-glia interactions, in which astrocyte signaling complements and modulates the communication between pre- and post-synaptic neurons.

Aims
The main research objective of this project was to assess how astrocyte signaling and calcium-dependent mechanisms underlie cognitive processing in the brain, and to control these pathways to modulate cognitive function.

Method
We tested the dnSNARE model that lacks astrocyte signaling via exocytosis and the IP3R2KO model that lacks calcium-dependent signaling in astrocytes. To assess the influence of these mechanisms to cognitive function, we used complementary state-of-the-art techniques such as in vivo electrophysiology, innovative behavior, structural and molecular analysis, to characterize, monitor and rescue cognitive function.

Results
Our results show that neuronal synchrony between the prefrontal cortex and the dorsal hippocampus is dependent on astrocyte signaling. This synchrony supports correct cognitive computation and may be rescued by supplementation of D-serine, a known modulator of glutamatergic excitatory transmission, which is released by astrocytes. We showed also that astrocytic calcium-dependent mechanisms are relevant for cognitive computation in different life stages and may be used to modulate cognitive performance.

Conclusions
This grant allowed us to explore the potential of astrocyte modulation in brain cells and circuits to allow correct cognitive computation. The results obtained in this project have widened our understanding of astrocyte-specific mechanisms that might mediate cognitive performance.

Keywords

Astrocyte, Gliotransmission, Learning, Prefrontal cortex

Published Work:

Guerra-Gomes, S., Sousa, N., Pinto, L., & Oliveira, J. F. (2018). Functional roles of astrocyte calcium elevations: From synapses to behavior. *Frontiers in Cellular Neuroscience, 11*: 427. doi: 10.3389/fncel.2017.00427

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