

# "Astrocytes: The Shining Stars in the Brain for Cognition and Sociality"

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Brain is composed of not only neurons but also glia. So far, the most of brain functions, especially cognitive functions, have been attributed to neurons, and the role of glia has been believed to be limited to nutritional and sanitary functions. However, the landscape has been changing recently and the role of glia in cognition remains as one of the hottest topics in the field of brain science. Among the various glial cell types, astrocytes are the star-shaped cells in the brain and they are the most numerous cell type in the human brain consisting of about 60% of total brain cell population. Our research group has been focusing on the ability of astrocytes to contribute to cognitive processes by releasing various transmitters and hormones such as glutamate, d-serine, ATP, GABA, proBDNF, etc, which directly or indirectly influence the brain plasticity and cognition. In addition to conventional  $\text{Ca}^{2+}$ -dependent release, astrocytes can release those transmitters in  $\text{Ca}^{2+}$ -independent fashion as well as in volume-dependent fashion. The most striking difference between astrocytes and neurons is that unlike neurons that utilize vesicular release machinery at presynaptic terminals, astrocytes utilize unique ion channels such as Best1 to allow channel-mediated, tonic release of major transmitters such as glutamate, d-serine, and GABA. The released "gliotransmitters" strongly influence neuronal firing activity and plasticity, resulting in control of learning and memory, motor coordination, and brain plasticity. Furthermore, the dynamic changes in cellular properties of astrocytes under pathological conditions underlie various neurological disease states, including schizophrenia, depression, epilepsy, Alzheimer's disease, Parkinson's disease, and traumatic brain injury. Over the past 10~15 years, we have accumulated enough lines of evidence to support that astrocytes are not just passive bystanders, but active players in controlling and modulating brain plasticity and behaviors. The novel insights and tools that we have developed over the years are currently being translated into various psychiatric, social, and neurodegenerative diseases in human. To sum up, astrocytes are the true shining stars in the brain.