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Astrocytes Potentiate Synaptic Transmission SUHITA NADKARNI, PETER JUNG, Department of Physics and Astronomy and Quantitative Biology Instiute, Ohio University — A recent experimental study shows that astrocytes, a subtype of glia, are able to influence the spontaneous activity in the brain via calcium dependent glutamate release. We model the coupling mechanism between an astrocyte and a neuron based on experimental data. This coupling is dynamic and bi-directional, such that the modulations in intracellular calcium concentrations in astrocytes affect neuronal excitability and vice versa via a glutamatergic pathway. We demonstrate through simple neural-glial circuits that increases in the intracellular calcium concentration in astrocytes nearby can enhance spontaneous activity in a neuron, a significant mechanism said to be involved in plasticity and learning. The pattern of this marked increase in spontaneous firing rate in our model quantitatively follows that observed in the experiment. Further, depending on the type of synaptic connections diverging from the neuron, it can either inhibit or excite the ensuing dynamics and potentiate synaptic transmission, thus reinstating the integral role played by astrocytes in normal neuronal dynamics.

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