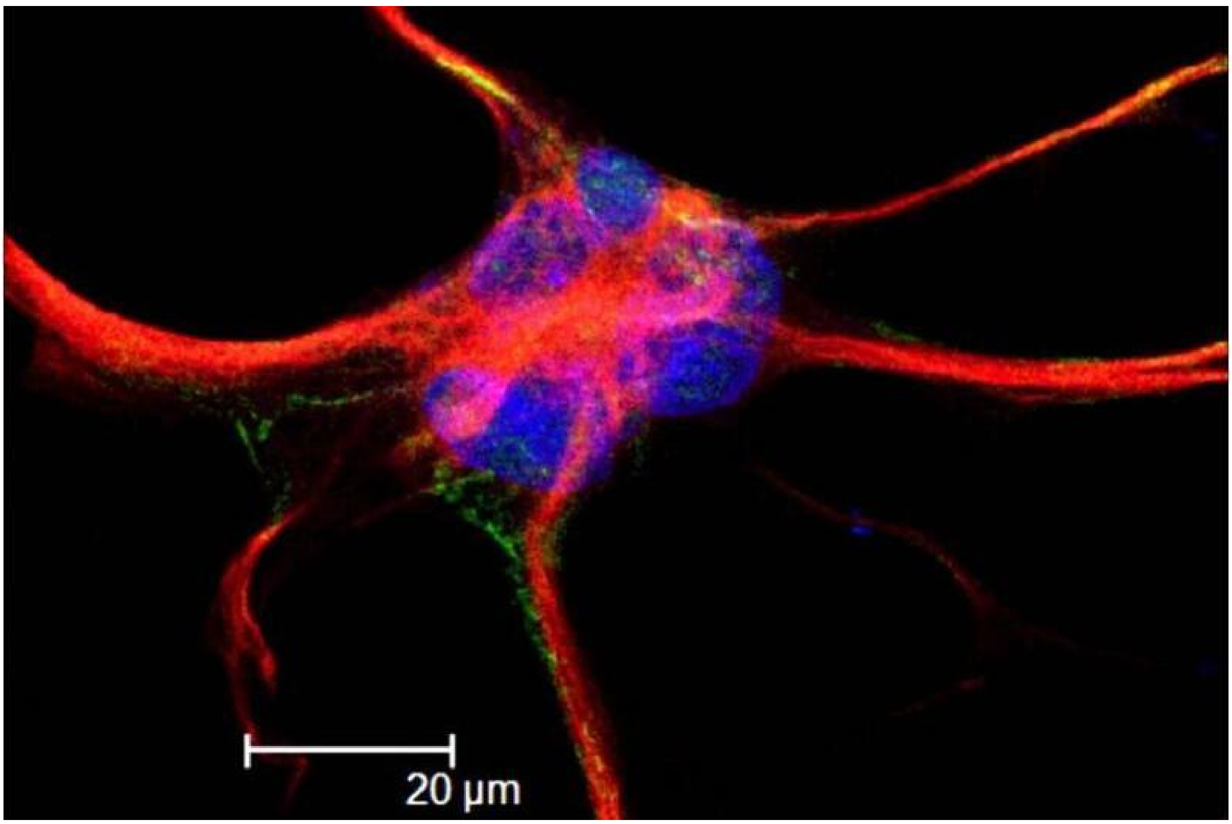
Astrocytes found to play a key role in regulating neural networks

August 14 2015, by Bob Yirka



This is an astrocyte, labeled with GFAP (red), Focal Adhesion Kinase (FAK) green, and nuclear stain To-Pro (blue). Credit: Ivey and MacLean at TNPRC. Via Wikipedia.

(Medical Xpress)—A small team of researchers with members from research centers in Spain and the U.S. has found that astrocyes appear to play a previously unknown key role in regulating neural networks in mouse brains. In their paper published in the journal *Science*, the team describes their study of a type of glial cell in a certain part of the mouse brain, and what they learned about neural networks in doing so. Aryn Gittis and Daniel Brasier with Carnegie Mellon University offer a Perspective piece on the work done by the team and describe possible implications of their findings.

Glial cells exist wherever there are neural cells—they surround neurons providing support for them and also serve as spacers, keeping the neurons apart. They are the most numerous cells in the nervous system. One type of glial cell, the star shaped astrocytes, are known to be active participants in neural communications via the transmission of gliotransmitters. In this new effort, the research team learned more about the role astrocytes play in neural communications and in so doing discovered that under certain circumstances when astrocytes activate one neuron, the responsiveness of another was enhanced. They also found that under other circumstances, the opposite could occur, when one neuron was caused to be excited, another nearby was simultaneously suppressed.

To learn more about the role astrocytes play in neural networks, the researchers used transgenic mouse lines fluorescently to identify communications between them and what are known as medium spiny neurons, located in the striatum—what they really wanted to know though, was whether certain astrocytes couple with certain neurons, or whether there are less specific couplings that occur. A closer look using triple whole-cell electrical recordings from two of the heterotypic neurons and a single astrocyte suggested the former—they apparently only communicate with specific subtypes of adjacent neurons.

As Gittis and Brasier note, the findings by the team suggest that astrocytes likely selectively assist with neural networking in many parts of the brain, which in turn suggests that there are likely groups of them existing and operating in different regions, each helping certain types of neurons communicate in unique ways.

More information: Circuit-specific signaling in astrocyte-neuron networks in basal ganglia pathways, *Science* 14 August 2015: Vol. 349 no. 6249 pp. 730-734. DOI: 10.1126/science.aaa7945

ABSTRACT
Astrocytes are important regulatory elements in brain function. They respond to neurotransmitters and release gliotransmitters that modulate synaptic transmission. However, the cell- and synapse-specificity of the functional relationship between astrocytes and neurons in certain brain circuits remains unknown. In the dorsal striatum, which mainly comprises two intermingled subtypes (striatonigral and striatopallidal) of medium spiny neurons (MSNs) and synapses belonging to two neural circuits (the direct and indirect pathways of the basal ganglia), subpopulations of astrocytes selectively responded to specific MSN subtype activity. These subpopulations of astrocytes released glutamate that selectively activated N-methyl-D-aspartate receptors in homotypic, but not heterotypic, MSNs. Likewise, astrocyte subpopulations selectively regulated homotypic synapses through metabotropic glutamate receptor activation. Therefore, bidirectional astrocyte-neuron signaling selectively occurs between specific subpopulations of astrocytes, neurons, and synapses.