OSCILLATIONS

A dynamic role for astrocytes

The once-prominent idea that astrocytes exist primarily to provide metabolic and structural support to neurons has gradually been overturned by our growing awareness of their direct contribution to many aspects of brain function. A new study by Lee *et al.* uncovers another role for these cells — astrocytes are here shown to be involved in the maintenance of 'fast' synchronous activity (oscillations) in the mouse brain.

Neural oscillations in the gamma frequency range (25–80 Hz) have been linked to multiple aspects of cognitive function, but little is known about how gamma oscillations are generated and maintained. To investigate the underlying cellular mechanisms, Lee *et al.* performed calcium imaging in mouse hippocampal brain slices in which oscillations (detected by recording extracellular field potentials) were induced by application of carbachol. They discovered a temporal correlation between increases in intracellular calcium levels in astrocytes and oscillatory activity, which suggested that astrocytic calcium dynamics might contribute to neural oscillations.

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Increases in intracellular calcium levels in astrocytes can trigger the release of vesicular 'gliotransmitters', such as glutamate, which modulate neuronal activity. To determine whether this mechanism contributes to normal oscillatory activity, the authors used an engineered lentiviral vector to express tetanus toxin (TeNT) — which blocks calcium-dependent vesicular release — in astrocytes in hippocampal slices. TeNT expression did not block the induction of gamma oscillations by carbachol but reduced their duration. Application of a glutamate receptor agonist to the slices reversed the effects of TeNT expression, suggesting that astrocytic glutamate release is important for the maintenance of gamma oscillations in the hippocampus.

To examine the contribution of astrocytes to oscillatory activity *in vivo*, the authors generated a transgenic mouse in which TeNT expression could be reversibly induced in astrocytes at a specific time and recorded the electroencephalogram (EEG) in freely moving animals over a 24-hour period. They observed a marked reduction in EEG power in the low gamma range in animals that were awake, confirming the importance of astrocytic vesicular release for the maintenance of gamma oscillatory activity.

The authors examined the TeNT-expressing mice using a battery of behavioural tests to determine whether the changes in gamma oscillatory activity had any cognitive effects. Although the mice behaved normally in most tests, the authors observed a specific impairment in novel object recognition, suggesting that gamma oscillations have a crucial role in this particular aspect of cognitive function.

Previous work has demonstrated that astrocytic gliotransmitter release can regulate slow cortical oscillations. The discovery that astrocytes also contribute to fast oscillatory activity in the brain is further proof of the crucial role for these glia in the control of network activity. Furthermore, this work provides additional evidence of the link between gamma oscillatory activity and cognitive function.

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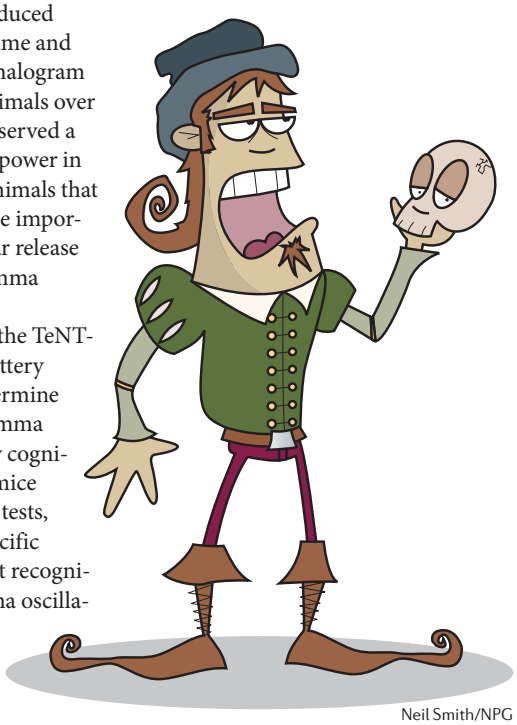
ORIGINAL RESEARCH PAPER Lee, H. S. *et al.* Astrocytes contribute to gamma oscillations and recognition memory. *Proc. Natl Acad. Sci. USA* http://dx.doi.org/10.1073/pnas.1410893111 (2014)



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