POSTER PRESENTATION



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Self-organization of information processing in developing neuronal networks

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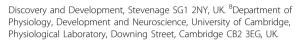
From 24th Annual Computational Neuroscience Meeting: CNS*2015 Prague, Czech Republic. 18-23 July 2015

Human brains possess sophisticated information processing capabilities, which rely on the coordinated interplay of billions of neurons. Despite recent advances in characterizing the collective neuronal dynamics, however, it remains a major challenge to understand the principles of how functional neuronal networks develop and maintain these processing capabilities. A popular hypothesis is that neuronal networks self-organize to a critical state [1-3], because in models, criticality maximizes information processing capacities [4-6]. This predicts that biological networks should develop towards a critical state during maturation, and at the same time processing capabilities should increase. We tested this hypothesis using multi-electrode spike recordings in mouse hippocampal and cortical neurons over the first four weeks in vitro. We showed that developing neuronal networks indeed increased their information processing capacities, as quantified by transfer entropy and active information storage [6-8]. The increase in processing capacity was tightly linked to decreasing the distance to criticality (correlation r = 0.68, p < 10^{-9} ; r = 0.55, p < 10^{-6} for transfer and storage, respectively). Thereby our results for the first time demonstrate experimentally that approaching criticality with maturation goes in hand with increasing processing capabilities.

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Published: 18 December 2015

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doi:10.1186/1471-2202-16-S1-P221

Cite this article as: Priesemann *et al.*: **Self-organization of information processing in developing neuronal networks.** *BMC Neuroscience* 2015 **16**(Suppl 1):P221.

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