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Peter Somogyi is Professor of Neurobiology at the Department of Pharmacology, University of Oxford, UK. He graduated in biology and received his PhD in cell biology at the Eötvös Loránd University, Budapest, Hungary. He is a Fellow of the Royal Society, the British Academy of Medical Sciences, the Hungarian, the German and the European Academies. He is the recipient of The Brain Prize in 2011. He was Associate Director then Director of the Medical research Council Anatomical Neuropharmacology Unit at Oxford from 1985 to 2015. He established the Stephen Kuffler Research Foundation www.kuffler.org in 2012 to support exceptional talent in Central Europe, and the Ramon y Cajal summer Scholarship competition in 2005 for high school pupils.

Somogyi contributed to the identification of cell types in the cerebral cortex and for the localization of signalling molecules in identified synapses of microcircuits in the brain. He pioneered the high-resolutions synaptic dissection of connections in the cerebral cortex defining synaptic links and their temporal dynamics. His vision that explanations of normal and pathological events in the brain can only come from the rigorous spatio-temporal definition of the neuronal circuits that underlie these events has led to the discoveries of novel cell types, rules of neuronal connections, their molecular constituents and temporal dynamics. His work has demonstrated how co-operative interactions in time and space between distinct identified neurons and receptors underlie the processing power of the cortex that he calls the chronocircuit. He has educated and mentored many students and postdoctoral scientists, who are now professors and scientific leaders throughout the world.

links:

www.mrcbndu.ox.ac.uk/groups/somogyi-group

Temporal and spatial specialisations of rhythmic subcortical GABAergic neurons coordinating network activity of the hippocampal formation

What circuit mechanisms couple and uncouple activity amongst functionally related cortical areas? Subcortical projections innervating multiple areas are potential contributors. The entire cortical mantle is innervated by subcortical basal forebrain cholinergic, GABAergic and glutamatergic neurons, but their branching and termination patterns are largely unknown.

Rhythmically discharging GABAergic neurons in the medial septum and the diagonal band nuclei (MSDB) innervate the hippocampus and/or related cortical areas and contribute to the coordination of network activity such as theta rhythmicity and high frequency ripple oscillations (SWR). Some of them exclusively innervate local cortical GABAergic interneurons. Individual MSDB neurons show a wide range of activity patterns, which may be related to their termination in different cortical areas and/or forming synapses with different target interneuron types. We test this hypothesis by recording and labelling single GABAergic neurons in vivo in the medial septum of rats and mice and follow their axons to their terminations. Individual neurons display diverse and pronounced theta phase selectivity in their firing and terminate in restricted parts of one or a limited number of hippocampal or cortical areas. For example, in rats one group of neurons fire phase-coupled to the descending phase of the CA1 theta cycle, are silent during SWRs and sustain their firing rate between theta and non-theta epochs. In contrast, neurons that preferentially fire at the ascending phase of theta cycle are active during SWRs and significantly increase their firing during theta oscillations compared to non-theta epochs. Individual medial septal GABAergic axons targeted only a restricted range of GABAergic interneuron types in the hippocampus, as established on the basis of molecular cell type markers. In turn, distinct types of interneuron show specific theta phase preference in their firing and subdivide the surface of target pyramidal cells through subcellular domain specific termination rules. The results are consistent with a circuit scheme of discrete types of MSDB GABAergic neurons each targeting only restricted cortical areas, and via specific local GABAergic interneuron types modulating the activity of pyramidal cell assemblies. The restricted termination of GABAergic MSDB axons with phase shifted rhythmic discharge and discrete termination zones along the septo-temporal and medio-lateral axes of the hippocampus may also contribute to the travelling wave nature of theta oscillations. I propose that highly selective subcortical MSDB GABAergic neurons are key players in coordinating cortical activity through parallel, area and target cell type selective projections.

Somogyi, P., Katona, L., Klausberger, T., Lasztóczy, B. & Viney, T. (2014) Temporal redistribution of inhibition over neuronal subcellular domains underlies state-dependent rhythmic change of excitability in the hippocampus. *Phil. Trans. R. Soc. B.* 369, 20120518.