NEURODEVELOPMENT, PLASTICITY AND CRITICAL PERIODS
Prof. Takao Hensch
Center for Brain Science, Harvard University
and Division of Neuroscience, Children's Hospital Boston, Harvard Medical School

PROGRAM

Monday June 25th
• 9h-12h
Experience-dependent brain development
Core concepts of experience-based brain development, surveying a range of well-documented critical period effects across species.
Learning objectives: introduce synaptic plasticity as a result of neuronal activity, including structural consequences of competition; concept of map formation and timing/duration of critical periods; barn owl audio-visual integration, birdsong learning, whisker barrel reorganization, orientation and ocular dominance plasticity (amblyopia), human cognitive development.
• 13h-16h
Discussion of selected papers by students

Tuesday June 26th
• 9h-12h
From functional plasticity to structural consolidation
A detailed analysis of critical period mechanism in the visual cortex. The induction, expression and consolidation of plasticity will be explored at a cellular/molecular level. Learning objectives: traditional views of NMDA receptor-mediated synaptic plasticity as a model; novel insights of GABA function as a critical period trigger; homeostatic plasticity and the balance of excitation-inhibition; structural re-wiring via extracellular proteases, protein synthesis and growth factors.
• 13h-16h
Discussion of selected papers by students

Wednesday 27.6
• 9h-12h
Critical period manipulation and social impact
Considers the potential for increased understanding and modifiability of critical period brain plasticity and its social implications.
Learning objectives: consolidation of structural changes by active inhibitors of neurite growth (nets, myelin) or epigenetic changes; both invasive and non-invasive methods for reactivating brain plasticity; therapeutic approaches to developmental disorders, strategies for lifelong learning, education policy and neuroethics.
• 13h-16h
Discussion of selected papers by students

Inscriptions by e-mail to Sonia.Bolea@unil.ch

Credits: 2
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Research:

Much of our adult behavior reflects the neural circuits sculpted by experience in infancy and early childhood. At no other time in life does the surrounding environment so potently shape brain function – from basic motor skills, sensation or sleep to higher cognitive processes like language. Understanding how this plasticity waxes and wanes with age carries an impact far beyond neuroscience, including education policy, therapeutic approaches to developmental disorders or strategies for recovery from brain injury in adulthood.

Our laboratory explores the mechanisms underlying critical periods of brain development. Research is aimed at the interface between cell biology and neuroscience - applying cellular/molecular techniques to elucidate complex neural systems. We have achieved the first direct control over critical period timing in the visual system (Hensch 2005). By manipulating inhibitory transmission in the neocortex, amblyopic effects of deprivation are delayed (by gene-targeted reduction of GABA synthesis) or accelerated (by cortical infusion of a positive GABA receptor modulator, diazepam).

A major goal now is to establish the generality of this principle of excitatory-inhibitory balance across brain regions and systems. Remarkably, a specific, local inhibitory circuit may drive critical period onset in visual cortex. Downstream of this trigger lies an extracellular proteolytic cascade and structural reorganizations, which ultimately consolidate plasticity. Imaging efforts at the Center for Brain Science will visualize the dynamic re-wiring of connections in mouse models to provide further insight for translational research into disorders of critical period development at Children’s Hospital Boston.

Selected Publications:


