



## Seewiesen Colloquia

Speaker invited by: Dept. Gahr

Thursday, 14 January 2016, 13:00 h, in House 4, Lecture Room

## Learning to hear: development and plasticity in the deaf brain

**Prof. Dr. Andrej Kral**

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Postnatal development includes progressive and regressive brain changes, some of them dependent on experience. Using a natural model of congenital deafness, the deaf white cat, our team has focused on effects of sensory experience on the structure and function of the auditory system. We use cochlear implant to test auditory function in deaf animals. Further, we provide deaf animals with a portable signal processor and a cochlear implant and induce hearing experience at different ages. We could demonstrate a delayed and altered cortical synaptic development in congenital deafness. Chronic electrical stimulation prevented many of the maturational deficits, provided stimulation was initiated within early sensitive periods. To investigate the reasons for sensitive periods, we studied visual function of the cortical auditory areas. We could demonstrate an areal-specific crossmodal reorganization in deafness. Although in the reorganized areas the auditory responsive neurons were not reduced in number, recruitment of even a limited number of neurons for visual tasks will reduce the computational capacity in the given area. Reduced feature sensitivity, as we have further shown, complicates the starting point for learning after restoration of hearing. Finally, corticocortical connections were studied both anatomically and functionally. Based on our layer-specific recordings in primary auditory cortex we previously suggested a corticocortical decoupling in deafness. Using tracer experiments and functional studies we find reduced bottom-up and top-down cortical information transfer in deafness. Such compromised top-down processing in the auditory cortex is likely participating on the closure of sensitive periods.

### Who is Andrej Kral?

- 1993 MD, School of Medicine, Comenius University, SK
- 1998 PhD, School of Medicine, Comenius University, SK
- 2002 Associate Professor of Physiology (Priv.-Doz.), School of Medicine, J.W.Goethe University, Germany
- 2004 Professor of Neurophysiology, University Clinics Hamburg–Eppendorf & Adjunct Professor, The University of Texas
- 2009 Chair and Professor of Auditory Neuroscience, Medical University Hannover, Germany

### Selected publications (details on [www.neuroprostheses.com](http://www.neuroprostheses.com)):

- Hubka P et al., (2015): Auditory feedback modulates development of kitten vocalizations. *Cell Tissue Res* 361: 279-294
- Gordon K et al., (2015): Asymmetric hearing during development: The aural preference syndrome and treatment options. *Pediatrics* 136(1): 141-153.
- Kral A (2013): Auditory critical periods: a review from system's perspective. *Neuroscience* 247: 117-133.
- Kral A et al., (2013): Single-sided deafness leads to unilateral aural preference within an early sensitive period. *Brain* 136:180-193.
- Kral A, Sharma A (2012): Developmental neuroplasticity after cochlear implantation. *Trends Neurosci* 35(2): 111-122.
- Reimer A et al., (2011): Fast propagating waves in the rodent auditory cortex. *Cereb Cortex* 21:166-177.
- Kral A, O'Donoghue GM (2010): Profound Deafness in Childhood. *New England J Med* 363:1438-50.
- Tillein J et al., (2010): Cortical representation of interaural time differences in congenital deafness. *Cereb Cortex* 20: 492-506.
- Lomber SG et al., (2010): Crossmodal plasticity in specific auditory cortices underlies visual compensations in the deaf. *Nat Neurosci* 13(11): 1421-1427.