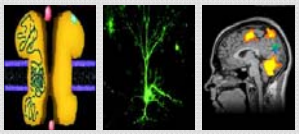

Sensory Processes: From Molecules to Cognition

April 12 - 13, 2016, Veranstaltungszentrum, Ruhr University Bochum

Tuesday April 12, afternoon (13:40 – 16:20)

Session 2 **Neuronal Networks and Circuits**

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How sensory experience and learning change neuronal responses in the visual cortex

Neuronal response properties in the cerebral cortex are not static. They can change during development, after deprivation, and following learning. Even in the adult brain, the structure of neurons is not fixed but can be altered by modifications of sensory input and experience. We study such functional and structural plasticity in the visual cortex, using imaging approaches that allow following the fate of individual neurons over extended periods of time.

In stripe rearing experiments, we found a clear effect of passive exposure of mice to contours of only one orientation. While diverse mechanisms are likely contributing to the observed changes, they are at least partially mediated by an instructive process, by which individual neurons change their orientation preference. We next asked whether orientation tuning also shows plasticity under behaviorally relevant conditions. We trained mice on an operant orientation discrimination learning task and used a genetically encoded calcium indicator to repeatedly measure orientation tuning of individual V1 neurons before and after learning. We found changes in orientation selectivity, tuning width and response amplitude, which correlated with behavioral task performance, suggesting that specific functional changes reflecting visual learning are present as early as V1. Currently, we are expanding these studies to more complex types of visual based learning, such as category learning. To this end, we defined two categories of grating stimuli by introducing a category boundary in a two-dimensional stimulus space consisting of gratings that varied continuously in orientation and spatial frequency. Mice learned to discriminate these two categories in a head-restrained two-choice paradigm. We will now use chronic two-photon calcium imaging in higher areas of the visual cortex to identify neurons representing learned categories, ultimately allowing us to study the synaptic changes underlying category learning.