Research Summary

The goal of our activity is to understand the mechanisms underlying plastic changes in the human central nervous system (CNS) and to develop novel therapeutic approaches for recovery of function based on these advances. Our work has focused on the human motor system and on plastic changes taking place across sensory modalities for example in blind individuals (crossmodal plasticity). We have studied cortical reorganization in patients with CNS lesions in particular stroke and traumatic brain injury. In healthy volunteers, we studied cortical plasticity associated with deafferentation and motor skill learning.

We utilize different techniques in the context of well defined hypothesis-driven investigations including transcranial magnetic (TMS, video) and DC (tDCS) stimulation, fMRI, TMS in combination with fMRI, MR spectroscopy, diffusion tensor imaging (DTI), PET scanning and magnetoencephalography (MEG). We are interested in the development of these techniques to help us to understand mechanisms of human plasticity and to modulate human brain processes. Our research protocols in healthy volunteers are geared to identify mechanisms of human neuroplasticity and to develop interventional approaches to enhance them when they play a beneficial role and down-regulate them when they are maladaptive. Advances in this understanding in healthy volunteers are subsequently applied to patients with neurological conditions like stroke in attempts to enhance neurorehabilitative processes. In blind individuals, we seek to understand the mechanisms underlying the remarkable compensatory processes involved in crossmodal plasticity, and to facilitate them using noninvasive techniques.

Our future goals are to improve our understanding of mechanisms underlying plasticity of function in humans. On the basis of these insights, we are engaged in translational efforts to develop rational rehabilitative interventions to improve motor disability after stroke in particular using peripheral nerve stimulation, TMS and tDCS. In patients with severe hand paralysis, we use an MEG-based brain computer interface to control grasping motions of an orthosis attached to the paralyzed hand.

Recent Publications:

   Current Biology 14;20(17):1545-9. See Dispatch on this article (Current Biology 2010 20(17) pp. R709 - R710)