Plasticity of visual field representations

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CHAPTER 8

Summary

Unravelling the organization of the visual cortex is fundamental to understanding the degree to which the adult visual cortex has the capability to adapt its function and structure. The research in this thesis aimed to: 1) understand how the visual field representations present in the adult visual cortex are shaped by visual experience, predictive mechanisms, damage due to visual field defects or developmental disorders, and 2) develop advanced techniques and paradigms to characterize receptive fields (RFs) and their connections using neurocomputational models. To do so, I combined the neuroimaging technique functional magnetic resonance imaging (fMRI) with biologically-driven neurocomputational models to investigate whether neurons – at the population or subpopulation level – have the capacity to modify their receptive field properties following damage (artificial and natural) to the adult visual system or following changes in the stimulus. The main project outcomes are: 1) the development of a new a versatile brain mapping technique that captures the activity of neuronal subpopulations with minimal prior assumptions and high resolution, which we call micro probing (MP); 2) the design of alternative visual mapping stimuli, with which we have shown that the recruitment of neural resources depends on the task and/or stimulus; 3) the development of a novel approach to map the visual field and that enables the evaluation of vision loss and provides important information about the function of the visual cortex and 4) the finding that in response to an artificial scotoma (mimicking a lesion to the visual system), there is a system-wide reconfiguration of cortical connectivity and RFs which may underlie the predictive masking of scotomas. These novel techniques and findings increase our understanding of the neuroplastic properties of the visual cortex and may be applied in the evaluation of pre- and post-treatment strategies that aim for vision restoration and rehabilitation.