Dissecting visual attention

Appendix

Impact paragraph

The present thesis aims to unravel the intricate mechanisms underlying visual attention bias and the effects of alerting and orienting. The impact of this thesis is multi-faceted, extending across the realms of scientific, and clinical impact.

This research significantly contributes to the scientific understanding of visual attention bias and the effects of alerting and orienting. By employing a multifaceted approach that integrates meta-analyses, neuroimaging techniques, computational models, and electrophysiological measures, this work unravels the intricate mechanisms underlying these attentional phenomena. Specifically, the findings in Part I provide insights into the hemispheric asymmetries of attentional control and have implications for a long-standing debate between competing theories of attentional control. The aggregation of TMS studies in two meta-analyses reveals that not all effects reported in the literature are robust and replicable. It demonstrates how conclusions based on small studies can shape a research field even when the evidence at large does not support the same view. The meta-analytic perspective also serves as a strong foundation for further research, expanding our understanding of how hemispheric specialization influences attentional biases and revealing interpretative challenges and knowledge gaps. The impact of Part II has clear implications for the application of brain stimulation in research setting where neuroimaging-guided localization of target areas is the gold standard. By evaluating various TMS target localization methods guided by MRI, our research provides valuable guidance to researchers aiming to precisely target brain regions for intervention. The validation of group-based maps as a reliable approximation of individual task-based targets offers an efficient alternative when individual data is lacking or inconsistent. The Part III uncovers novel insights into attentional mechanisms of cognitive processes. The application of drift diffusion models and EEG signal analysis unveils the mechanisms driving alerting and orienting effects, leading to a more nuanced comprehension of attention dynamics. This comprehensive exploration enriches the existing knowledge base, enhancing our grasp of how attention operates in the human brain.

From a clinical standpoint, the significance of this work lies in its potential to improve the treatment of neglect and attentional diseases. Firstly, the work in Part I challenges an influential theoretical model by Kinsbourne. The model predicts a particular enhancement effect of attention following unilateral disruption of the attention system and has become the basis for brain stimulation-based rehabilitation strategies of spatial neglect. We clearly show that fundamental research in healthy volunteers contradicts this model and this casts doubt on the principles that have guided clinical procedures in stroke patients. A reevaluation of the mechanisms underlying current effect treatment approaches might be called for and our work can serve as a reminder that translational research requires a cautious approach based on strong evidence. Secondly, precise TMS localization is crucial for effective interventions in neurological and psychiatric disorders. The insight of Part II enhances the accuracy of TMS-based interventions, facilitating more effective treatments for individuals with neurological and cognitive disorders. Finally, understanding the cognitive mechanisms underlying alerting and orienting effects is relevant to clinical assessments of attention deficits, potentially informing the design of diagnostic tools and interventions for conditions involving attentional impairments.

In summary, this research leaves a lasting impact across multiple dimensions. It not only advances scientific knowledge, but also informs clinical practices. Through its multifaceted contributions, this work enriches various facets of human life and knowledge.