Abstract

General cognitive capacity, also referred to as intelligence, varies widely across individuals. The foundations of interindividual intelligence differences are likely to result from variation in the structural and functional properties of the brain. Over the last decades, the identification of such neural correlates has been substantially propelled through the use of neuroscientific methods, especially magnetic resonance imaging (MRI). In this dissertation, I utilized MRI in order to investigate both structural and functional brain properties potentially underpinning different realms of human intelligence differences. In the first study, I examined measures of brain volume and brain network connectivity and related them to fluid intelligence and general knowledge, an indicator of crystallized intelligence. I found that an individual’s level of general knowledge is associated with structural connectivity independent of any effects exerted by age or sex. Moreover, I observed fluid intelligence to be best predicted by cortex volume in males and functional connectivity in females. In the second study, I utilized neurite orientation dispersion and density imaging to demonstrate that fluid intelligence is inversely correlated with dendritic density and arborization in the cortex. Also, I was able to replicate respective findings in an independent sample provided by the Human Connectome Project. In the third study, I utilized functional MRI in order to investigate the association between fluid intelligence and functional brain connectivity at rest. Here, I found relevant functional connections to be predominantly constituted by brain regions included in the Parieto-Frontal Integration Theory of intelligence. Overall, the dissertation at hand provides new insights into the neurobiology of intelligence. It reveals neural correlates of fluid intelligence from both micro- and macroscopic realms (cortex microstructure and brain network connectivity) and sheds light on the vastly unknown brain properties underpinning general knowledge.