Dipl.Psych. Ruth Marie Krebs
Abstract to the thesis “Task-dependent modulation of reward and novelty processing within human ventral striatum and midbrain”

Abstract

Computational models of how reward and novelty are coded in the human brain and motivate behavior suggest that there is a close functional relationship between the processing of reward and novelty. One possibility is that stimulus novelty signals an exploration bonus motivating the individual to explore an environment for rewards. However, data as to how reward and novelty functionally interact in the human brain are still missing. The goal of this thesis is to investigate this interaction with an anatomical emphasis on the mesolimbic dopaminergic circuitry, including the substantia nigra / ventral tegmental area complex (SN/VTA) and nucleus accumbens (NAcc). Experiments 1 and 2 investigate the functional interaction between reward and novelty in the mesolimbic system and the influence of related personality traits using functional magnetic resonance imaging (fMRI). The findings are compatible with the notion that novelty serves as an exploration bonus for rewards under conditions where attention is explicitly directed towards reward. This interaction is furthermore depending on personality traits in a way that novelty-seekers were more responsive to novel cues in the absence of reward and needed less reward to boost their memory for novel cues. These observations strongly suggest that novelty seeking is not necessarily based on actual reward-predicting stimulus properties. Experiment 3 investigates how mesolimbic fMRI signals are correlated with actual dopamine (DA) release as measured by positron emission tomography (PET). The results of experiment 3 confirmed that mesolimbic fMRI signals were correlated with DA release within ventral striatum – a notion that has been implied in many studies but has not been demonstrated yet. This latter finding supports the inference that the mesolimbic interactions between novelty and reward signal functional properties of dopaminergic circuitry. The findings of this thesis confirm that novelty and reward processing indeed interact regarding behavioral motivation, and that the mesolimbic responses can be functionally distinguished depending on individual differences in the tendency to seek either for reward or novelty – indicating that both properties are not interchangeable.