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Dissertation: The neural basis of human aggression

Abstract

Aggression is a basic form of human social behavior, serving important purposes as securing mates, territory or food. It is defined by its goal to harm or injure somebody, who is motivated to avoid such treatment. The present thesis is devoted to the understanding of the cognitive, emotional and motivational processes underlying aggressive behavior, by tapping into its neural underpinnings in healthy humans. The thesis followed a multi-method approach, using functional magnetic resonance imaging (fMRI), event-related potentials (ERPs), task-induced oscillations, a psychopharmacological manipulation and genetic data.

In the first chapter, a review of the relevant empirical and theoretical literature on human aggression is given, stemming both from the fields of neuropsychology and psychiatry and of social psychology. The experiments of chapter 2 to 4 used a well established paradigm from social psychology, the Taylor Aggression Paradigm, to clarify the neural correlates of reactive aggression. The first fMRI experiment (chapter 2) could disentangle the neural processes related to the decision-making and to social feedback within an aggressive interaction. The second study (chapter 3) used ERPs and task-induced oscillations to delineate the impact of trait aggressiveness on cognitive and motivational processes during a social interaction. We found evidence for pronounced inhibitory processes, instigated by prefrontal areas, in those high trait aggressive individuals, who could refrain from aggressive retaliation. In a second fMRI study (chapter 4), the effects of altered serotonin levels on behavioral and neurophysiological correlates of reactive aggression were examined. The results demonstrated a diminishing effect of lowered serotonin levels on reactive aggression, in low trait aggressive individuals at least. Effects on the neural level hinted at an altered emotional evaluation of the opponent's behavior within the social interaction.

The last part (chapter 5) aimed at clarifying the influence of different polymorphisms in the serotonergic and dopaminergic system on trait aggression and at tapping into the relationship between executive functions and aggressiveness. Interindividual variance in trait anger could be explained with differences in the DRD4 exon III polymorphism. Moreover, high trait aggressive participants showed more impulsive and thoughtless behavior in the Tower of London task, but did not present a general impairment in executive functions. The results are discussed with respect to the existing empirical and theoretical literature of the field, and are used to extend current models on the neural basis of human aggression.