

# A network approach to response inhibition and aggression : combining functional imaging and non-invasive brain stimulation in the study of impulse control

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## Valorization



## RELEVANCE

The empirical work presented in this thesis entitled 'A network approach to response inhibition and aggression: Combining functional imaging and Non-Invasive Brain Stimulation in the study of impulse control' is relevant for a variety of societal questions.

Each year, over 180.000 registered 'violent crimes' (including murder, manslaughter, rape, sexual coercion, robberies, dangerous and serious bodily injury, and slight bodily injury with intent) are registered e.g. by German authorities (Polizeiliche Kriminalstatistik PKS / Bundeskriminalamt BKA, 2013). In the United States, violent crimes amount to over one million per year (Uniform Crime Report UCR / Federal Bureau of Investigation FBI, 2013). The prevalence of aggressive behaviour is one of the main challenges our modern civilization has to face. It leads to the experience of unsafety in all of us and poses enormous costs to our social systems. Therefore, it is crucial to provide the public, forensic professionals, and workers dealing with aggressive individuals (in schools, hospitals, and the social sector) with scientific evidence on 1) possible etiological models and 2) potential interventions able to decrease impulsivity and aggression. The empirical work presented in this thesis does both: Employing functional imaging it is providing evidence on the neural correlates of successful as well as failed impulse control and aggression. This leads to a better understanding of the underlying neural mechanisms. Furthermore, by employing Non-Invasive Brain Stimulation it provides evidence on how impulse control can be manipulated and thus opens up possibilities towards directly brain-based interventions.

Besides its general societal relevance, impulsivity and aggression are crucial components of various clinical disorders such as attention deficit hyperactivity and conduct disorder, obsessive compulsive disorders, certain expressions of schizophrenia, borderline and antisocial personality disorder, as well as psychopathy. Our health care systems are responsible for treating children, adolescents, adult patients, and criminal offenders displaying these pathologies. Such treatment poses enormous costs. It is necessary to increase the quality of life of the concerned individuals and their environment as well as to ensure their (re)integration into society. To constantly better understand these pathologies and the mechanisms underlying their inhibitory deficits is the foundation of advanced treatment options. Thereby, deficits in impulse control have to be understood on behavioural and biological level. Furthermore, by not only identifying but also finding ways to manipulate the underlying mechanisms on behavioural and biological level, the corner stone for clinical interventions is set. The empirical work presented in this thesis contributes to a better understanding of neural mechanisms underlying impulsivity and aggression, and furthermore makes a first step towards manipulating these mechanisms in order to ultimately decrease impulsivity and aggression.

## TARGET GROUP

The results presented in this thesis are of interest to several occupational groups. First and foremost, professions dealing with highly impulsive or aggressive individuals in a clinical, forensic, or developmental context can profit from our work. Therefore, we published in scientific journals relevant to these professions and presented our results on various national and international conferences.

We believe that the results presented in this thesis are also of relevance to the general public and, thus, gave interviews resulting in several newspaper articles.

## ACTIVITIES / PRODUCTS

Ultimately, the results presented in our thesis could lead to the development of direct brain-based interventions in order to improve impulse control and decrease aggression. However, in order to reach this goal many steps have to be taken before. First, our results have to be replicated in healthy and clinical samples. Second, they have to be validated on single subject level.

## INNOVATION

Our results are innovative, because they directly address the question in how far response inhibition and aggression are related on brain level. In our work we use a multi-method approach combining functional imaging in order to identify relevant neural networks and various forms of Non-Invasive Brain Stimulation to modify impulse control by manipulating the underlying neural mechanisms. This approach enables an overarching look on response inhibition and aggression.

## SCHEDULE AND IMPLEMENTATION

Future plans include translating our findings on response inhibition to more naturally valid forms of inhibition. Furthermore, we plan to replicate the findings presented in chapter 7 and to test the (in part) successful brain stimulation protocol in a clinical context including highly impulsive individuals. Depending on the outcome, we will work on further combining a potential brain stimulation intervention with inhibition training and develop new treatment options in order to improve impulse control and decrease aggressive behaviour.