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Neurobiological correlates of avatar identification processing and emotional inhibitory control in internet gaming disorder

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Internet gaming disorder (IGD) is the most prevalent subcategory of internet addiction. It has been associated with self-concept deficits and related characteristics such as emotional as well as social competence deficits, increased social anxiety and a stronger identification with the own avatar (i.e. a graphical agent that often seems to be constructed according to gamers' ideal). In addition, IGD seems to be linked with inhibitory control deficits, definable as impairments in the inhibition of reactions to irrelevant stimuli during the pursuit of cognitively represented goals. However, the neurobiological correlates of avatar compared to self and ideal-related identification processing as well as emotional inhibitory control in (socially) anxious contexts as potentially important factors in IGD development have not been explored yet.

The brain region of the left angular gyrus (AG) has been associated with self-identification from a third-person perspective in healthy controls and showed avatar-related hyperactivation in long-term online gamers during a task on self and avatar reflection in functional magnetic resonance imaging (fMRI). The dorsal anterior cingulate cortex (dACC) seems to be involved in the integration of negative affect and cognitive control. Based on these observations, internet gaming addicts were neurobiologically examined by means of fMRI with a focus on the left AG as well as the dACC while completing specific tasks and compared to non-addicted controls as well as social media addicts. Hereby, participants' concepts of self, ideal and avatar were assessed with a reflection task asking for the evaluation of characteristics regarding the self, ideal and own avatar. Emotional inhibitory control in a socially anxious context was neurobiologically explored by means of an emotional Stroop task (EST) assessing the inhibition on socially anxious words compared to positive, negative and neutral word stimuli under parallel reaction time recording. In addition, the emotional inhibitory control at anxious stimuli was examined neuropsychologically by means of an affective Go/No-Go task (AGN). Besides, psychometric questionnaires assessing impulsivity, emotional competence and social anxiety were applied.

Internet gaming addicts showed significantly higher levels of impulsivity, social anxiety and emotional competence deficits relative to non-addicted controls in psychometric measures.

Neurobiologically, internet gaming addicts exhibited left AG hyperactivations during the reflection on their own avatar relative to self and ideal reflection within their group as well as compared to non-addicted controls. In the EST, internet gaming addicts had longer reaction times during the inhibition on socially anxious compared to positive and negative words as well as compared to positive, negative and neutral words together. During the latter comparison, internet gaming addicts neurobiologically showed significant hypoactivations in the left middle and superior temporal gyrus (MTG and STG), which was also significantly lower relative to social media addicts. Functional alterations in the dACC were not observed. Neuropsychologically, no significant differences in emotional inhibitory control at anxious stimuli between internet gaming addicts and non-addicted controls were detected by means of the AGN.

In summary, the virtually concretized avatar might replace the rather abstract ideal in IGD as a construct to identify with. The need for such a construct might arise from the urge to compensate dissatisfaction with the own person as a facet of self-concept deficits. The MTG and STG have previously been associated with the retrieval of words or expressions during communication, social perception and emotion regulation (based on a study in social anxiety disorder). The present finding of these regions' hypoactivation in relation to socially anxious stimuli might indicate that 1) socially anxious words are less retrievable from the semantic storage of internet gaming addicts than positive, negative or neutral words, 2) in IGD, emotional inhibitory control in the socially anxious context is

represented by brain regions involved in the processing of social information (such as the MTG and STG) and that 3) internet gaming addicts have deficiencies in the cognitive regulation of emotions as well as in the processing of social information, with the MTG and STG hypoactivation during socially anxious word blocks possibly serving as a neurobiological correlate of IGD-related social and emotional competence deficits as facets of self-concept impairments.