**Obsessive-compulsive disorder and its compulsions**

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Obsessive-compulsive disorder (OCD) can be linked with multiple brain systems, and multiple structures are central parts within this disorder. The reason for this is the many different symptoms, which makes it difficult to fully understand OCD in all its forms. In this paper, we will focus on the compulsion's OCD patients have, and the reason why OCD patients can't seem to stop these compulsions. Is it simply the inability to act against the compulsion or do they not want to act against the compulsion?

Firstly, we will discuss whether people with OCD simply do not want to act against the compulsion. This might be explained using the reward system. The compulsive behaviour in patients with OCD following obsessive thoughts can be described as rewarding (Koch et al., 2018). However, there is little hard evidence about the role of the reward system in OCD, mainly because of the different contradicting results of research. Therefore, the first part contains mostly presumptions. Nonetheless, these presumptions are still worth discussing. In the second part, we will discuss the inability to act against the compulsions as reason for the compulsions. This might be explained using the inhibitory control system.

*The reward system*

The reward system consists of multiple brain areas including the striatum, the nucleus accumbens and the prefrontal cortex (Arias-Carrión, Stamelou, Murillo-Rodríguez, Menéndez-González, & Pöppel, 2010). Tobler and colleagues have found the lateral prefrontal cortex to be one of the central points in the reward system (Tobler et al., 2009). The lateral prefrontal cortex integrates reward values and risk by incorporating input from the orbitofrontal cortex (OFC), the amygdala, the inferior temporal cortex and the cingulate cortex (Tobler et al., 2009). The lateral prefrontal cortex sends this input to the dorsolateral prefrontal cortex and premotor regions, which might influence behavioural output (Tobler et al., 2009).

In a study performed by Figee and colleagues (2011), the neural basis of the reward system in OCD patients was examined. Figee and colleagues compared brain activation during a monetary incentive task of OCD patients and healthy controls. They found a reduced activation of the nucleus accumbens (Figee et al., 2011). Based on this finding, Figee et al. (2011) suggest that less activation of the nucleus accumbens in the reward system may imply that people with OCD are less able to choose beneficially in reward anticipation. Therefore, it would be the inability to anticipate correctly to a reward which results in the repetitive behaviour.

Jung et al. (2013) found dysfunctional connectivity between the amygdala and the striatum as well as between the striatum and the orbitofrontal cortex, which are all structures involved in the reward processing system. Different parts of the orbitofrontal cortex are thought to play different roles in the rewarding system. The lateral orbitofrontal cortex may be involved in processing punishments and the medial orbitofrontal cortex may be involved in processing rewards. They found a positive correlation between the medial orbitofrontal cortex and the nucleus accumbens and a negative correlation between the lateral orbitofrontal cortex (Jung et al., 2013). This positive correlation between the medial orbitofrontal cortex and the nucleus accumbens might signify that the medial orbitofrontal cortex is less activated as well. This reduced activation in turn might explain a reduced ability to process rewards within OCD patients.

*The inhibitory control system*

According to Evans, Lewis and Iobst (2004) the compulsions OCD patients perform are not rewarding but "senseless and troubling", even though the patient feels obligated to carry out the compulsion. In this case, the reason for the compulsions might be found in the inhibitory control system.

A study by Koch and colleagues (2018) examined activation and functional connectivity during a monetary reward task within patients with OCD and healthy controls. They found an increase in the default mode network, which is involved in internal mental states, and consists of the ventromedial prefrontal cortex and posterior cingulate as central parts (Koch et al., 2018). This increased focus on internal mental states, which is explained by an increased functional connectivity between the ventromedial prefrontal cortex and the posterior cingulate, could explain an inability to inhibit the compulsions OCD patients feel (Koch et al., 2018).

Penades et al. (2006) have found impaired inhibitory process in motor and cognitive mechanisms. They link this outcome to possible impairment of the mediation of inhibitory controls by frontostratial circuitries. Eyal Kalanthroff (2017) found similar results and even found a correlation between the severity of the symptoms and the impaired task control. They also suggest the impaired task control in people with OCD is the effect of the inability to inhibit compulsions.

The orbitofrontal cortex seems to be involved in the inhibitory abilities. In several studies, hyperactivity in the orbitofrontal cortex has been found compared to healthy people (Tamm, Menon, & Reiss, 2002) which implies the inhibition of responses (Bokura, Yamaguchi, & Kobayashi, 2001). Bokura et al. (2001) found that specifically the lateral and anterior part of the orbitofrontal cortex is involved in the inhibition of behaviour and responses.

Concerning the motor system of brain, the orbitofrontal cortex is connected to several other brain parts like the anterior cingulate cortex for executive functions, the caudate nucleus for the coordination of motor activity and the thalamus for the modulation of motivation and action (Evans, Lewis & Iobst, 2004).

Evans, Lewis and Iobst (2004) state that the orbitofrontal cortex, the caudate nucleus and the anterior cingulate cortex are key in the (unsuitable) response inhibition system and the selection of behaviour. former studies, an increasing amount of the metabolism of glucose has been found in these brain regions in people with OCD (Schwartz, Stoessel, Baxter, Martin &

Phelps, 1996). When OCD patients were successfully treated and showed a decrease in the symptoms, a decline in the glucose metabolism was reported (Saxena et al., 1999). These findings suggest that the metabolism of glucose is involved in symptoms of OCD.

It can be said that the explanation of compulsive behaviours should primarily be found in the inhibitory control system. Structures such as the orbitofrontal cortex, caudate nucleus and anterior cingulate cortex are key in understanding how this compulsive behaviour comes about. However, the reward system shouldn't be written off entirely. It does have an influence on the compulsions, but the way it influences the compulsive behaviour needs to be researched further.

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