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Punishment Sensitivity in Patients with Anorexia Nervosa
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Introduction

Despite an increased interest in the abnormalities of the reward system in patients with Anorexia nervosa (AN) a comprehensive understanding of the underlying mechanisms is still lacking. Why are patients with acute AN ready to endure hunger, exhaustion from excessive exercise or cold? In order to shed light on the motivational aspects driving such unusual behavior, punishment sensitivity has to be considered. Punishment sensitivity reflects the inhibition of behavior under potentially punishing conditions . So far punishment sensitivity has been less of a focus in eating disorder research.

Aims

To gain insight on the hypothesis of altered punishment sensitivity and aversive processing in AN.

Methods

We have conducted several experiments. For experiment 1 we focused on decision making. Participants decide whether they accept a small monetary loss with a high probability or a larger monetary loss with a rather low probability (Green et al., 2014). More specifically, in this task the participants choose between a small, relatively certain loss and a larger but uncertain loss. The same procedure was applied in a separate task during which participants had to choose between a relatively certain small win and a larger but uncertain win. We compared the behavior of acute and recovered AN patients with healthy controls. In addition the effect of the appetite-stimulating hormone ghrelin on decision making was investigated (blood samples). In the experiment 2 and 3 we measured punishment-related behavioral adaptation using two tasks: A learning task (2) and flanker task which both included punishments (3). In the latter task punishment can be avoided by responding fast. Using the learning task fMRI data were obtained in acute and recovered AN patients as well as healthy controls.

Results & Conclusions

Regarding experiment 1 we found no group differences in decision making regarding losses and no relationships with ghrelin. However in the alternative task offering monetary gains recovered AN individuals choose more often the safer option and thus may be more risk averse towards probabilistic wins. This might be a possible trait promoting recovery. The results were submitted to a peer-reviewed research journal (under review).

Analyzing choice behavior during the learning task (experiment 2), we found a statistical trend for increased behavioral adaptation after negative feedback in acute AN which is in line with our initial hypothesis of increased punishment sensitivity. However, the effect size of this difference was small and additional analyses that compare reaction times on trials immediately following negative feedback vs. neutral trials did not indicate any group differences. Main effects of feedback during the punishment-related learning task on the level of brain were found in the ventro-medial prefrontal cortex, ventral striatum and anterior cingulate cortex (ACC). Patients had increased ACC responses during behavioral adaptations. This finding may be suggestive of increased monitoring for the need to adjust performance strategies and be related to increased punishment sensitivity.

The main outcome metric of the flanker task (experiment 3) is based on the so-called Gratton effect (Gratton et al., 1992) which is the finding of a lower interference effect (reaction time differences) after an incongruent trial compared to the effect after a congruent trial. That means, after a congruent trial an incongruent stimulus will lead to an increase in conflict which is manifested by an increase in reaction time and usually also ACC activity (Barch et al., 2001). If this incongruent trial is followed by another incongruent trial, there will be less interference. We found an attenuated Gratton effect in patients, which was independent of punishment (manuscript in preparation). The lack of conflict adaptation during a modified Flanker task in AN seems remarkable and may indicate increased proactive (tonic) control (and subsequently less reactive control) (Braver, 2012). Our recent paper on delay discounting in AN, which is a project closely related and partially overlapping with the ones we report on here, also found increased proactive (tonic) control in AN (King et al., 2016).

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