The Neural Mechanisms Underlying Problem-Focused Rumination in Depression

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Aims & Background

Aim. To examine neural correlates and mechanisms underlying autobiographical problem-solving deficits (APS) in major depressive disorder (MDD) that drive rumination.

Background

MDD is marked by rumination, defined as repetitively focusing on one’s emotions and problems with the adaptive intent of understanding them and identifying possible solutions. However, this process does not lead to the generation of solutions and may instead perpetuate ruminative processing.

We hypothesized that APS deficits may be driven by difficulties engaging the dorsomedial prefrontal cortex (DMPFC), which is thought to facilitate mental simulation of possible solutions to personal problems. We predicted that failure occurs due to individuals with MDD failing to represent their problems in concrete terms.

In addition, we hypothesized that this failure would result in MDD individuals becoming stuck elaborating on aspects of their problems, reflected in greater concreteness of the problems and experiencing increased negative emotion, supported by the amygdala and right anterior insula.

Methods (cont.)

think of each problem, and (2) how sad and anxious they felt while thinking about each problem in the scanner.

Recall of thoughts were coded using a consensus approach to determine (1) problem severity, (2) stage of problem-solving achieved, (3) the degree of abstractness, and (4) solution effectiveness.

Data Analysis

The effect of APS was estimated according to the GLM. Single-subject data were modeled using a box-car function convolved with the canonical hemodynamic response function (HRF). The function contained appropriately placed masks of the HRF, the time course with fixation being modeled as the baseline, with the rating and inter-trial interval censored from analysis. A conjunction analysis was conducted to identify brain regions jointly correlated with experimenter-rated solution effectiveness and subject-rated successful solution generation. A search was used to examine group differences in the extracted ROI. A whole-brain analysis was conducted to examine group differences in APS related activity.

Results

Does the MDD group become stuck repetitively, and abstractly, thinking about their problems and emotions?

As shown in fig. 1, the MDD group reported engaging in more frequent, abstract, processing of more severe problems that were associated with more negative and less positive emotion relative to controls. The MDD group also generated more abstract and less effective solutions to their personal problems and became stuck during the early stage of problem-solving.

Does the MDD group demonstrate decreased activity in brain regions underlying effective solution generation?

As shown in fig. 2, the MDD group demonstrated decreased activity in the DMPFC, which in turn was associated with a greater percentage of solutions generated.

Does the observed solution generation in the MDD group relative to controls explained by increased abstract processing inhibiting DMPFC?

As shown in fig. 4, the MDD group demonstrated more abstract processing of problems relative to controls and a greater engagement in autobiographical information and increased emotion processing.

Conclusions

Individuals with MDD fail to generate effective solutions during APS because they do not engage the DMPFC to simulate potential outcomes of generated solutions. This failure appears to occur due to the abstractness of their thoughts which may serve to protect individuals with MDD by allowing them to avoid the more intense emotional experiences that arise when problems are directly faced.