**SUPPLEMENTAL MATERIAL**

**Negative emotions towards others**

**are diminished in remitted major depression**

Roland Zahn1,2, Karen E. Lythe2, Jennifer A. Gethin2, Sophie Green2,

 John F. William Deakin3, Clifford Workman3,2, Jorge Moll4

*1Institute of Psychiatry at King’s College London, Department of Psychological Medicine, Centre for Affective Disorders, London, SE5 8AZ, UK*

*2The University of Manchester & Manchester Academic Health Sciences Centre, School of Psychological Sciences, Neuroscience and Aphasia Research Unit, Manchester, M13 9PL, UK*

*3The University of Manchester & Manchester Academic Health Sciences Centre, Institute of Brain, Behaviour and Mental Health, Neuroscience & Psychiatry Unit, Manchester, M13 9PL, UK*

*4Cognitive and Behavioral Neuroscience Unit, D’Or Institute for Research and Education (IDOR), 22280-080 - Rio de Janeiro, RJ, Brazil*

**Supplemental methods**

***Participants***

Initial suitability was assessed with a phone pre-screening interview of 707 volunteers (for exclusion reasons see Table 1), which included questions about personal history of major physical illnesses, substance abuse, axis-I disorders, psychological and pharmacological treatment, as well as family history of psychiatric disorders (a copy of the updated version of a previously described [[1](#_ENREF_1)] screening interview can be obtained at http://www.translational-cognitive-neuroscience.org/start/test-materials). *Inclusion criteria for both groups were*: right handedness, English as first language and aged 18-65 years old. Additional inclusion criteria for the history of depression group were at least one past major depressive episode according to the Diagnostic Statistical Manual (DSM-IV-TR, [[2](#_ENREF_2)]), that was a moderate to severe depressive episode according to the International Classification of Diseases (ICD-10, World Health Organization) with at least a 2 month duration requiring treatment and remission of symptoms for at least 6 months.

*Exclusion criteria for both groups were*: centrally active medications other than hormonal contraceptives, residual symptoms of or manifest axis-I disorders [[2](#_ENREF_2)], significant psychosocial impairment as an indicator of a clinically relevant personality disorder or incomplete remission, a Montgomery Åsberg Depression Rating Scale (MADRS, [[3](#_ENREF_3)]) score >10 (=cut-off for depression [[4](#_ENREF_4)]), current self-harming behaviour, a history of alcohol or substance abuse, schizophrenia, schizo-affective disorder, bipolar disorder, developmental disorders, learning disabilities, neurological illnesses or physical illnesses that significantly impair psychosocial functioning or brain function. *Additional exclusion criteria for the remitted MDD group were:* depressive episodes secondary to another psychiatric disorder. *Additional exclusion criteria for the healthy control group were:* a history of medication with antidepressants or antipsychotics, or a first degree relative with a diagnosed major depression, bipolar disorder or schizophrenia, or a personal history of any axis-I disorder [[2](#_ENREF_2)] with a corresponding category in ICD-10.

Suitable participants according to the phone pre-screening (see Table 1) were invited for a clinical interview by a senior psychiatrist (RZ) and a structured assessment by either KL or JG after having been extensively trained in joint assessments and achieving high inter-rater reliability (KL, JG, RZ had completed the recommended SCID-I-training and inter-rater reliability was very good: κ=0.64 [KL&RZ] and κ=1 [KL&JG] for past MDD; κ=.60 [KL&RZ] and κ=1 [KL&JG] for past MDD including melancholic and atypical specifiers). The following instruments were administered: the Structured Clinical Interview for DSM-IV (SCID-I, [[5](#_ENREF_5)]), which was modified to allow lifetime diagnoses of MDD subtypes and was used as a standardized measure to verify diagnosis of MDD [[2](#_ENREF_2)], and a shortened version of the Weissman Family History Screen [[6](#_ENREF_6)], which was used to assess the psychiatric history of first degree family members.

**Supplemental results**

***Agency-congruent emotions in the independent sample***

**Our main analysis of differential effects of moral emotions focussed on the pooled sample in order to achieve satisfactory statistical power. Here, we present an exploratory analysis of the results in our independently recruited sample. A repeated measures ANOVA for the six moral emotion measures (guilt, shame, contempt/disgust towards self, indignation/anger towards self, contempt/disgust towards others, indignation/anger towards others) in our independent sample (*n*=81 MDD, *n*=42 control participants) revealed a moral emotion by group interaction (*F*[5,120]=2.8, *p*=.02). This was driven by trends of increased self-contempt/disgust (*B*=4.1, standard error=2.1, *t*=1.9, *p*=.06) and increased shame (*B*=3.5, standard error=1.7, *t*=2.1, *p*=.04) in the MDD compared to the control group with no effects of group on any other moral emotion (*t*<1.3, *P*>.22). These results were unchanged for self-contempt/disgust after excluding outlying values (effect of MDD on self-contempt/disgust: *t*=1.9, *p*=.06), but the effects on shame weakened after excluding outliers (*t*=1.6, *p*=.11).**

***Agency-incongruent emotions***

**Although our primary hypotheses were restricted to agency-congruent emotions, we also explored the role of agency-incongruent emotions (i.e. guilt, shame, self-contempt and self-indignation in the other-agency condition, and contempt towards others or indignation towards others in the self-agency condition). As expected, agency-incongruent emotions were infrequent overall. The MDD group, however, showed higher agency-incongruent guilt, self-contempt/disgust and shame compared with the control group (see Supplemental Table 4).**

**Supplemental References**

[1] Green S, Lambon Ralph MA, Moll J, Deakin JF, Zahn R. Guilt-selective functional disconnection of anterior temporal and subgenual cortices in major depressive disorder. Arch Gen Psychiatry. 2012;69:1014-21.

[2] American-Psychiatric-Association. Diagnostic and statistical manual of mental disorders, 4th edition, Text Revision, 34. Washington DC: American Psychiatric Association; 2000.

[3] Montgomery SA, Åsberg M. A new depression scale designed to be sensitive to change. British Journal of Psychiatry. 1979;134:382-9.

[4] Zimmerman M, Posternak MA, Chelminski I. Derivation of a definition of remission on the Montgomery–Asberg depression rating scale corresponding to the definition of remission on the Hamilton rating scale for depression. Journal of Psychiatric Research. 2004;38:577-82.

[5] First MB, Spitzer RL, Gibbon M, Williams JBW. Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version, Patient Edition. (SCID-I/P) New York: Biometrics Research, New York State Psychiatric Institute; 2002.

[6] Weissman MM, Wickramaratne P, Adams P, Wolk S, Verdeli H, Olfson M. Brief screening for family psychiatric history - The family history screen. Arch Gen Psychiatry. 2000;57:675-82.

 **Supplemental Table 3** Between-group comparisons on agency-congruent emotions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Response | Remitted MDD | Control | Statistics |  |
|  | mean | sd | mean | sd | *t*-value | *p*-value |
| Self-agency: Guilt (%)  | 26.9 | 13.9 | 27.2 | 12.9 | -.19 | .85 |
| Self-agency: Shame (%)  | 13.6 | 9.8 | 12.6 | 10.4 | .60 | .55 |
| Self-agency: Indignation/anger towards self (%) | 7.1 | 7.0 | 9.2 | 8.3 | -1.8 | .08 |
| Self-agency: Self-contempt/disgust (%) | 15.0 | 11.8 | 13.0 | 10.6 | 1.2 | .25 |
| Other-agency: Indignation/anger towards other (%) | 23.9 | 14.3 | 28.7 | 15.4 | -2.1 | .04\* |
| Other-agency: Contempt/disgust towards other (%) | 8.8 | 8.7 | 12.1 | 11.6 | -2.0 | .05\* |

\*=significant at p=.05, 2-sided. Total sample of *n*=70 Control and *n*=101 MDD in all comparisons.

**Supplemental Table 4** Between-group comparisons on agency-incongruent emotions

|  |  |  |  |
| --- | --- | --- | --- |
| Response | Remitted MDD | Control | Statistics |
|  | mean | sd | mean | sd | *t*-value | *p*-value |
| Other-agency: Guilt (%)  | 3.4 | 3.6 | 2.1 | 3.2 | 2.4 | .02\* |
| Other-agency: Shame (%)  | 4.0 | 5.8 | 2.3 | 3.7 | 2.3 | .02\* |
| Other-agency: Indignation/anger towards self (%) | 1.1 | 1.7 | 1.1 | 1.9 | -.2 | .87 |
| Other-agency: Self-contempt/disgust (%) | 4.2 | 5.6 | 2.5 | 4.7 | 2.3 | .03\* |
| Self-agency: Indignation/anger towards other (%) | .9 | 2.0 | .7 | 1.0 | .9 | .35 |
| Self-agency: Contempt/disgust towards other (%) | .4 | 1.0 | .4 | .8 | -.4 | .67 |

\*=significant at *p*=.05, 2-sided. Total sample of *n*=70 Control and *n*=101 MDD in all comparisons.