**Supplementary material for**

**Self-compassion and dorsolateral prefrontal cortex activity during sad self-face recognition in depressed adolescents**

Guanmin Liu1,2, Na Zhang3, Jia Yuan Teoh2, Christine Egan4, Thomas A. Zeffiro5, Richard J. Davidson1,6,7,8, Karina Quevedo2

1 Center for Healthy Minds, University of Wisconsin, Madison, WI 53703, USA

2 Department of Psychiatry, University of Minnesota, Minneapolis, MN 55454, USA

3 Department of Human Development and Family Sciences, University of Connecticut, Stamford, CT 06901, USA

4 Department of Neuroscience, University of Minnesota, Minneapolis, MN 55455, USA

5 University of Maryland School of Medicine, Baltimore, MD 21201, USA

6 Department of Psychology, University of Wisconsin, Madison, WI 53706, USA

7 Waisman Laboratory for Brain Imaging and Behavior, University of Wisconsin, Madison, WI 53705, USA

8 Department of Psychiatry, University of Wisconsin, Madison, WI 53719, USA

Author for correspondence: Karina Quevedo, Email: [queve001@umn.edu](mailto:queve001@umn.edu).

Table of Content

Sample characteristics 1

Stimuli generation of emotional self-other morph-query (ESOM-Q) task 2

Behavioral results on response time and accuracy 4

Additional fMRI analyses and results to happy vs. neutral self-face recognition 5

Additional fMRI analyses and results to sad vs. neutral other-face recognition 6

Supporting references 8

* **Sample characteristics**

**Table S1.** Sample characteristics

|  |  |  |
| --- | --- | --- |
| Variable | Depressed Youth (n=81) | Healthy Controls (n=37) |
| Age: M±SD[Range] | 14.94±1.68 [11.30-17.80] | 14.48±1.54 [12.00-16.90] |
| Sex |  |  |
| Male | 27 (33.33%) | 20 (54.05%) |
| Female | 54 (66.67%) | 17 (45.95%) |
| Race/Ethnicity: |  |  |
| White | 46 (56.79%) | 28 (75.68%) |
| African American | 8 (9.88%) | 1 (2.70%) |
| Hispanic or Latino | 10 (12.35%) | 1 (2.70%) |
| Native American | 2 (2.47%) | 0 |
| Asian | 3 (3.70%) | 3 (8.11%) |
| Multi-racial | 10 (12.35%) | 4 (10.81%) |
| Others  Puberty: Late State/Completed | 2 (2.47%)  71 (87.65%) | 0  29 (78.38%) |
| Annual Household Income: |  |  |
| ＜$24,999 | 20 (24.69%) | 2 (5.41%) |
| $25,000 ~ 49,999 | 21 (25.93%) | 5 (13.51%) |
| $50,000 ~ 99,999 | 20 (24.69%) | 14 (37.84%) |
| $100,000 ~ 149,999  ＞$150,000  Parent Marital Status  Married  Living with Partner  Separated/Divorced  Singer/Never Married  Widowed  Depression Diagnosis  Major Depressive Disorder  Dysthymia  Depressive Disorder-NOS  Comorbid Anxiety  Medication Use: (non-exclusive)  Antidepressant  Antipsychotic  Mood Stabilizing  Stimulant  Anxiolitic  Any Medication | 12 (14.81%)  5 (6.17%)  46 (56.79%)  8 (9.88%)  13 (16.05%)  10 (12.35%)  2 (2.47%)  55 (67.90%)  4 (4.94%)  22 (27.16%)  59 (72.84%)  33 (40.74%)  6 (7.41%)  1 (1.23%)  10 (12.35%)  6 (7.41%)  40 (49.38%) | 12 (32.43%)  4 (10.81%)  30 (81.08%)  2 (5.41%)  3 (8.11%)  2 (5.41%)  0 (0%)  N/A  N/A  N/A  N/A  N/A  N/A  N/A  N/A  N/A  2 (5.41%) |
| Depression severity: M±SD[Range] | 64.00±13.82 [36-93] | 20.27±5.76 [17-44] |
| Self-compassion: M±SD[Range] | 7.00±4.51 [0-16] | 13.11±3.48 [3-16] |

* **Stimuli generation for the Emotional Self-Other Morph-Query (ESOM-Q) task**

Photographs of the participants’ faces with three expressions (happy, sad and neutral) were obtained during the intake visit under standardized conditions. The researcher would model the face required for each emotional expression (e.g., smiling for the happy face), and/or instruct the participant to recall a memory associated with the emotion prior to taking the photograph. The researcher also elicited expressions by causing the participant to laugh via jokes or instructing the participant to intensify the expression (e.g., turning down the corners of the mouth or furrowing the brow). Any of - or all these strategies were used as necessary. Participant’s photographs were then mirror transposed and non-facial attributes (hair, ears, large scars, or pimples) were removed. Faces were presented against a black background. A non-familiar teen face (from available photographs of previous participants) of similar gender, race, maturity and attractiveness was paired with each participant. Two experimenters agreed in the selection of the appropriate non-familiar face via visual inspection. The individual faces were then manipulated, “morphed,” with their assigned unfamiliar face, (other participants in the sample) in 5% increments using Abrosoft FantaMorph software (Abrosoft, 2011). This resulted in 21 composites that ranged from 0% self and 100% other to 100% self and 0% other. The purpose was to have several novel but easy to recognize pictures of a face to prevent habituation.The potential influence of diagnosis on the emotional intensity of the stimulus faces shown in the scanner, as well as their fit within a unique category of emotion (e.g. neutral, happy or sad expressions) was examined. Ten trained research assistants, blind to diagnosis, scored the face stimuli for the 100% self-face with neutral, happy and sad expressions for emotional category of expression, with higher scores indicating better fit for the sought emotional category. Specifically, they rated how neutral the neutral faces were on a 1 to 5 scale, and how happy or sad the emotionally-valenced faces were. Additionally, they rated physical attractiveness for the participant’s face regardless of emotion on a 1 to 10 scale. A repeated measures ANOVA (3 groups by 4 ratings) showed that diagnostic groups did not differ in emotional intensity or physical attractiveness of pictures, *F*(2, 113) = 0.23, *p*= 0.79.

* **Behavioral results on response time and accuracy**

Mixed repeated-measures ANOVAs with Group (DEP, HC) by Self (self-face, other-face) by Emotion (happy, neutral, sad) were carried out to test whether response time (RT) or accuracy in the ESOM-Q task was different across groups or conditions.

Results of repeated measures ANOVAs showed that Self had a main effect on RT such that participants responded on average slower during self-face recognition compared to other-face recognition: *F*(1, 106) = 8.97, *p* = .003 (self: 897.90±145.06ms; other: 853.19±179.02ms); and an interaction effect between Self and Emotion on RT, *F*(2, 212) = 3.21, *p* = .044. Multiple comparisons showed that the RT for happy self-face recognition (916.60±171.26ms) was slower than that for other-face recognition (847.63±209.93ms), *t*(107) = 3.81, *p*<.001; the RT for neutral self-face recognition (896.19±169.77ms) was slower than that for neutral other-face recognition (855.34±187.25ms): *t*(107) = 2.55, *p* = .012; but no significance difference was found on the RT between sad self-face (880.91±178.08) and sad other-face condition (856.61±210.04). No other significant main effects or interaction effects on RT were found.

Results showed that Emotion had a main effect on accuracy: *F*(2, 216) = 11.56, *p* < .001 (happy: 0.78±0.20; neutral: 0.72±0.17; sad: 0.72±0.18); and an interaction effect between Emotion and Self on accuracy: *F*(2, 216) = 10.08, *p*<.001. Multiple comparisons showed that the accuracy for happy self-face (0.81±0.23) was higher than that for happy other-face (0.76±0.24): *t*(109) = 2.01, *p*=.047; the accuracy for neutral self-face (0.69±0.18) was lower than that for neutral other-face (0.75±0.18): *t*(109) = 4.93, *p*<.001; but no significance difference was found on the accuracy between sad self-face (0.73±0.18) and sad other-face (0.72±0.22). No other significant main effects or interaction effects on accuracy were found.

* **Additional fMRI analyses and results to happy vs. neutral self-face recognition**

***Additional fMRI analyses****.*

Contrasted images of happy self > neutral self were created based on statistical images generated from the first-level analyses described in the main text. The details of the second-level analyses were the same as those described in the main text, the only difference being that contrasted images of happy self > neutral self, instead of sad self > neutral self, were used.

***Additional fMRI results.***

***Neural correlates of self-compassion during happy vs. neutral self-face recognition in the total sample.*** No suprathreshold clusters were found related to self-compassion, diagnostic group or the interaction between them during happy vs. neutral self-face recognition in the total sample.

***Neural correlates of self-compassion during happy vs. neutral self-face recognition in the HC sub-sample.*** No suprathreshold clusters were found related to self-compassion during happy vs. neutral self-face recognition in the HC sub-sample.

***Neural correlates of self-compassion during happy vs. neutral self-face recognition in the DEP sub-sample.*** No suprathreshold clusters were found related to self-compassion during happy vs. neutral self-face recognition in the DEP sub-sample.

* **Additional fMRI analyses and results to sad vs. neutral other-face recognition**

***Additional fMRI analyses****.*

Contrasted images of sad other > neutral other were created based on statistical images generated from the first-level analyses described in the main text. The details of the second-level analyses were the same as those described in the main text, the only difference being that contrasted images of sad other > neutral other, instead of sad self > neutral self, were used.

***Additional fMRI results.***

***Neural correlates of self-compassion during sad vs. neutral other-face recognition in the total sample.*** No suprathreshold clusters were found related to self-compassion or diagnostic group during sad vs. neutral other-face recognition in the total sample, but the self-compassion by diagnostic group interaction showed an association with activity in the left inferior parietal lobule (IPL) extending to postcentral gyrus and superior parietal lobule (Table S2). Specifically, self-compassion related positively to activity in the left IPL (*r* = 0.53, *p* = .001) in the HC sub-sample but not significantly in the DEP sub-sample (*r* = -0.09, *p* = .44). However, IPL activity did not significantly relate to depression severity in either sub-sample (HC: *r* = -0.10, *p* = .55; DEP: *r* = 0.14, *p* = .22).

***Neural correlates of self-compassion during sad vs. neutral other-face recognition in the HC sub-sample.*** Whole-brain analysis showed that self-compassion related positively to activity in the left postcentral gyrus extending to precentral and supramarginal gyrus (*r* = 0.66, *p* < .001), the left insula extending to lateral orbitofrontal gyrus (*r* = 0.59, *p* < .001) and the right postcentral gyrus (*r* = 0.59, *p* < .001) during sad vs. neutral other-face recognition in the HC sub-sample (Table S2). However, activity in none of these regions related significantly to depression severity (left postcentral gyrus: *r* = -0.07, *p* = .69; left insula: *r* = -0.09, *p* = .61; right postcentral gyrus: *r* = 0.06, *p* = .74).

***Neural correlates of self-compassion during sad vs. neutral other-face recognition in the DEP sub-sample.*** No suprathreshold clusters were found related to self-compassion during sad vs. neutral other-face recognition in the DEP sub-sample.

**Table S2.** Neural activity correlates during sad vs. neutral other-face recognition (*puncorr* < 0.001 at voxel level, cluster-level *pFWE* < 0.05)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Covariate of Interest | Region | | Cluster Size (K) | Hemisphere | MNI coordinates | | | *T* |
| x | y | z |
| **Total sample** |  | |  |  |  |  |  |  |
| Self-compassion | | No suprathreshold clusters |  |  |  |  |  |  |
| Diagnostic group | | No suprathreshold clusters |  |  |  |  |  |  |
| Self-compassion by diagnostic group interaction | | Inferior parietal lobule/postcentral gyrus/ superior parietal lobule, BA40 | 125 | Left | -32 | -44 | 52 | 4.24 |
| **HC sub-sample** | |  |  |  |  |  |  |  |
| Self-compassion (+) | | Post-/precentral gyrus/supramarginal gyrus, BA6/4/3 | 277 | Left | -60 | -16 | 40 | 5.93 |
| Insula/lateral orbitofrontal cortex, BA47/13 | 107 | Left | -40 | 18 | -6 | 4.69 |
| Postcentral gyrus, BA3/4/1/6 | 94 | Right | 52 | -16 | 52 | 4.40 |
| **DEP sub-sample** | |  |  |  |  |  |  |  |
| Self-compassion | | No suprathreshold clusters |  |  |  |  |  |  |

**Supporting references**

Abrosoft. (2011). Abrosoft FantaMorph. [*http://www.fantamorph.com/index.html*](http://www.fantamorph.com/index.html)*.*