**Supplemental Materials for**

**Associations between mental wellbeing and fMRI neural bases underlying responses to positive emotion in a twin sample**

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Supplementary Methods

*S1 Psychometric measures.*

COMPAS-W is a 26-item composite scale of wellbeing that measures both subjective and psychological wellbeing across six components (composure during stress, own-worth, mastery over environment, positivity, achievement and goal orientation, satisfaction with physical, psychological health and social relationships). It has shown moderate to strong internal consistency, test-retest reliability, and validity, and provides a reliable and valid index of mental health (Gatt et al., 2014). The DASS-42 is a 42-item measure of depression, anxiety, and stress symptoms, consisting of three subscales (DASS-Depression, DASS-Anxiety, DASS-Stress) that are based on the tripartite model of anxiety and depression (low positive affect, physiological hyperarousal, and negative affect; Clark & Watson, 1991). In this current study, these are labelled collectively as negative mood symptoms. Good construct validity, excellent internal consistency, reliability and concurrent validity have been reported (Brown, Chorpita, Korotitsch, & Barlow, 1997; Lovibond & Lovibond, 1995).

*S2 Univariate twin analysis.*

It is assumed that MZ twins share 100% of additive genetic variance and common environmental variance, while DZ twins only share 50% of additive genetic variance and 100% common environmental variance. Depending on the intra-class correlation values calculated for the MZ and DZ twins, either an ACE or an ADE model is tested. If the MZ correlation is greater than twice the DZ correlation, an ADE model would be appropriate due to non-additive genetic effects; otherwise, an ACE model would be chosen.

Supplementary Results



*Figure S1.* Voxel-wise activation of the three negative emotion contrasts (Angry > Neutral; Fear > Neutral; Sad > Neutral) showing significant clusters in the frontal and temporal regions. There were no significant regions for the Disgust > Neutral contrast. These clusters were not taken to univariate and multivariate modelling as they did not show significant associations with wellbeing in the linear mixed models.

Table S1

*Full Width at Half Maximum (FWHM) of the Gaussian kernel and Resel values for the five emotion contrasts.*

|  |  |  |
| --- | --- | --- |
| Contrast | FWHM (voxels) | Resels |
| 1. Happy > Neutral
 | 11.2 11.5 7.5 | 180.7 |
| 1. Angry > Neutral
 | 11.3 11.5 7.5 | 177.1 |
| 1. Fear > Neutral
 | 12.4 12.6 8.4 | 133.5 |
| 1. Disgust > Neutral
 | 11.9 12.1 7.9 | 153.7 |
| 1. Sad > Neutral
 | 13.5 14.0 8.9 | 104.4 |

Table S2

*Univariate heritability estimates for the COMPAS-W scores indexing wellbeing levels.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | ICC |  | Model fit |  | Parameter estimates |
| MZ | DZ |  | Comparison | -2LL | AIC | df | Δχ2 | *p* |  | A [CI] | D [CI] | E [CI] |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ADE | .447 | .106 | vs. saturated | 639.82 | 191.82 | 224 | .05 | - | 0 | .420[0, .57] | .580[.43, .77] |
|  |
| **AE** |  |  | **vs. ADE** | **640.45** | **190.45** | **225** | **.63** | **0.426** | **.406****[.22, .56]** | **0** | **.594** **[.44, .78]** |
| E |  |  | vs. AE | 656.25 | 204.25 | 230 | 15.80 | <0.001 |  |  | 1 |

*Note.* ICC = intra-class correlation; MZ = monozygotic twins; DZ = dizygotic twins; -2LL = minus twice the log likelihood; df = degrees of freedom; AIC = Akaike’s information criterion; CI = 95% confidence intervals. The variance was decomposed into additive (A), non-additive (D), and unique environmental (E) factors. The AE model (in bold) was selected as the best-fitting model based on parsimony and lowest AIC value.

References

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