**Self processing in relation to emotion and reward processing in depression: Supplementary Materials**

Statistical Models

*Associative Learning Task*

In all analyses, tasks (e.g. self, reward and emotion) were modelled separately.

We first examined whether task performance differed according to condition using mixed-effects linear regression models. Accuracy (%) and reaction times (ms) were entered outcomes in separate models, and condition entered as a categorical predictor. Subject was included as a random effect to account for the within-subject effect of condition.

We then examined whether task performance (accuracy and reaction times) was associated with depression severity using linear regression models. In each model task outcomes were entered as predictors in wide format according to each condition (e.g. for the self task average accuracy/reaction times in the self, friend and stranger condition were entered as separate predictors). PHQ-9 or BDI-II total scores were used as continuous outcomes in separate models.

*Go/No-Go Self-Esteem Task*

We first examined whether task performance differed according to condition using mixed-effects linear regression models. Discriminative accuracy was entered as the outcome, and referential-emotion condition was entered as the predictor. Subject was included as a random effect to account for the within-subject effect of condition.

To explore whether depression was associated with discriminative accuracy when categorising positive and negative words with the self and others we used linear regression models with PHQ-9 and BDI-II scores as a continuous outcomes in individual models. Discriminative accuracy in each referential-valence combination (self-positive, self-negative, other-positive, other-negative) were entered as predictors.

As we excluded a high proportion of participants (25%) due to non-compliance in our main analysis, we repeated this model including all participants as a sensitivity analysis.

*Social Evaluation Learning Task*

We first examined whether task performance differed according to condition using mixed-effects linear regression models. As this task was completed over two sessions we included session as a categorical predictor in all models. We accounted for within-subject effects by including subject as a random effect. Our first model used bias scores as a continuous outcome and referential condition as a categorical predictor. Our second model used errors to criterion as a continuous outcome, and referential condition, rule and an interaction between referential condition and rule as predictors. Our third model used the same predictors, with global ratings as a continuous outcome.

We then used a mixed-effects linear regression model to estimate the relationship between biased learning and depression severity. PHQ-9 or BDI-II scores were entered as a continuous outcome and bias scores (like-dislike) in each referential condition were entered as predictors in wide format. To account for the within-subject design across testing sessions, session was entered as a fixed effect and subject was entered as a random effect.

To examine whether the relationship between self bias scores and depression symptoms was consistent across sessions we conducted an exploratory analysis using mixed-effects linear regression. Again PHQ-9 and BDI-II scores were used as outcomes in separate models. Bias scores in the self condition, session and an interaction between these terms were used as predictors.

To understand the relative contribution of learning the ‘like’ versus ‘dislike’ rules on overall biased learning we conducted another mixed-effects linear regression model. PHQ-9 and BDI-II scores were entered as a continuous outcomes in separate models, and errors to criterion in each referential condition – rule combination were entered as predictors in wide format. To account for the multiple testing sessions, session was entered as a fixed effect and subject was entered as a random effect. We also repeated this model with global ratings for each referential-condition-rule combination as predictors, to assess the consistency of deliberative versus automatic learning.

Finally, we assessed whether these our findings regarding the association between depression and performance on this task were maintained when social anxiety was taken into account by repeating these models with BFNE scores entered as an additional predictor.

*Primary Diagnosis of Major Depressive Episode*

To examine whether our findings were valid for participants meeting clinical diagnostic criteria for depression, we repeated the primary analyses examining the association between task performance and depression for each task using logistic regression models with a binary variable of meeting diagnostic criteria as a primary diagnosis of Major Depressive Episode on the CIS-R as the outcome. Not meeting diagnostic criteria for a primary MDE was used as the reference category in all analyses. As the CIS-R was only completed at session 1, for tasks with multiple sessions only data from session 1 was used.

*Adjusting for Age and Gender*

We repeated the analyses for each task examining the association between task performance and depression with age (continuous) and gender (categorical) included as additional predictors.

Table S1

*Mean (SD) accuracy (%) and reaction times for the Associative Learning Tasks*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Self | | | Reward | | | Emotion | | |
|  | Self | Friend | Stranger | £9 | £3 | £1 | Happy | Neutral | Sad |
| Accuracy (%) | 88.01 (10.34) | 83.55 (11.67) | 80.77 (13.09) | 79.67 (15.39) | 75.23 (15.61) | 74.98 (17.04) | 80.06 (15.49) | 69.28 (16.07) | 64.64 (16.26) |
| Reaction Times, (ms) | 676 (70) | 706 (80) | 712 (77) | 681 (91) | 712 (98) | 700 (101) | 710 (114) | 750 (121) | 748 (121) |

Table S2

Results from a mixed-effects linear regression model examining differences in task performance (accuracy and reaction times; outcomes) according to stimuli in self, reward and emotion associative learning tasks (predictors)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Accuracy (%)** | | | | | **Reaction Times (ms)** | | | | |
|  | ***b*** | ***b* 95% CI** | **β** | **β 95% CI** | **p** | ***b*** | ***b* 95% CI** | **β** | **β 95% CI** | **p** |
| Self |  |  |  |  |  |  |  |  |  |  |
| Self (reference) | 88.01 | 86.09, 89.94 | 0.32 | 0.16, 0.48 | < .001 | 676.20 | 663.79, 688.60 | -0.28 | -0.44, -0.12 | < .001 |
| Friend | -4.46 | -7.19, -1.74 | -0.37 | -0.51, -0.23 | 0.001 | 29.29 | 11.75, 46.83 | 0.38 | 0.29, 0.47 | 0.001 |
| Stranger | -7.24 | -9.97, -4.52 | -0.60 | -0.74, -0.46 | < .001 | 36.21 | 18.67, 53.75 | 0.47 | 0.38, 0.56 | < .001 |
| Reward |  |  |  |  |  |  |  |  |  |  |
| High (£9) (reference) | 79.67 | 77.05, 82.30 | 0.19 | 0.03, 0.35 | < .001 | 680.72 | 664.91, 696.52 | -0.17 | -0.33, -0.01 | < .001 |
| Medium (£3) | -4.45 | -8.16, -0.73 | -0.28 | -0.41, -0.14 | 0.019 | 31.25 | 53.60, 2.75 | 0.32 | 0.24, 0.40 | 0.006 |
| Low (£1) | -4.69 | -8.41, -- 0.98 | -0.29 | -0.43, -0.15 | 0.013 | 19.07 | -3.28, 41.42 | 0.20 | 0.11, 0.28 | 0.094 |
| Emotion |  |  |  |  |  |  |  |  |  |  |
| Happy (reference) | 80.06 | 77.45, 82.67 | 0.51 | 0.36, 0.66 | < .001 | 709.46 | 690.05, 728.87 | -0.22 | -0.38, -0.06 | < .001 |
| Neutral | -10.78 | -14.47, -7.08 | -0.63 | -0.76, -0.49 | < .001 | 40.03 | 12.58, 67.48 | 0.33 | 0.26, 0.41 | 0.004 |
| Sad | -15.41 | -19.11, -11.72 | -0.90 | -1.03, -0.76 | < .001 | 38.01 | 10.56, 65.46 | 0.32 | 0.25, 0.39 | 0.007 |

*b* = unstandardised regression coefficients, β = standardised regression coefficients

Note: Accuracy and reaction times were entered as outcomes in separate models, and tasks were analysed separately.

Table S3

Results from a mixed-effects linear regression model examining differences in discriminative accuracy (outcome) according to referential condition (self/other) and emotion (positive/negative) (predictors)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | *b* | *b* 95% CI | β | β 95% CI | p |
| Intercept | 1.40 | 1.30, 1.50 | 0.56 | 0.38, 0.73 | < .001 |
| Referential Condition | -0.69 | -0.81, -0.56 | -1.14 | -1.36, -0.93 | < .001 |
| Emotion | -0.38 | -0.50, -0.25 | -0.63 | -0.84, -0.41 | < .001 |
| Condition\*Emotion | 0.79 | 0.61, 0.97 | 1.31 | 1.01, 1.61 | < .001 |

*b* = unstandardised regression coefficients, β = standardised regression coefficients

Note: Self was the reference category for the condition variable, positive was the reference category for the emotion variable

Table S4

Results from linear regression models examining the association between discriminative accuracy in each referential-emotion condition (predictors) with PHQ-9 and BDI-II Scores (outcomes) in participants demonstrating task compliance according to a priori criteria (n = 108) and all participants (n = 144)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PHQ-9 | | | | | BDI-II | | | | |
|  | *b* | *b* 95% CI | β | β 95% CI | p | β | 95% CI | *b* | *b* 95% CI | p |
| **Task Compliant (n = 108)** |  |  |  |  |  |  |  |  |  |  |
| Intercept | 12.08 | 8.81, 15.35 | 0.00 | -0.17, 0.17 | < .001 | 20.84 | 13.87, 27.82 | 0.00 | -0.18, 0.18 | <.001 |
| Self-Positive | -2.47 | -4.54, -0.39 | -0.24 | -0.44, -0.04 | 0.020 | -3.20 | -7.62, 1.23 | -0.15 | -0.36, 0.06 | 0.155 |
| Self-Negative | -0.59 | -2.57, 1.39 | -0.05 | -0.24, 0.13 | 0.553 | -0.81 | -5.03, 3.41 | -0.04 | -0.22, 0.15 | 0.704 |
| Other-Positive | 3.51 | 1.24, 5.79 | 0.30 | 0.10, 0.49 | 0.003 | 6.78 | 1.93, 11.64 | 0.28 | 0.08, 0.47 | 0.007 |
| Other-Negative | -2.46 | -4.24, -0.68 | -0.27 | -0.46, -0.07 | 0.007 | -5.13 | -8.92, -1.34 | -0.27 | -0.46, -0.07 | 0.008 |
| **All participants (n = 144)** |  |  |  |  |  |  |  |  |  |  |
| Intercept | 9.84 | 7.83, 11.85 | 0.00 | -0.16, 0.16 | < .001 | 16.92 | 12.72, 21.11 | 0.00 | -0.16, 0.16 | < .001 |
| Self-Positive | -2.10 | -3.78, -0.42 | -0.24 | -0.44, -0.05 | 0.015 | -2.39 | -5.89, 1.12 | -0.13 | -0.33, 0.06 | 0.181 |
| Self-Negative | 0.05 | -1.56, 1.66 | 0.00 | -0.17, 0.18 | 0.949 | 0.32 | -3.04, 3.68 | 0.02 | -0.16, 0.20 | 0.850 |
| Other-Positive | 2.81 | 0.97, 4.66 | 0.28 | 0.10, 0.46 | 0.003 | 5.17 | 1.31, 9.02 | 0.25 | 0.006, 0.44 | 0.009 |
| Other-Negative | -1.35 | -2.82, 0.11 | -0.17 | -0.35, 0.01 | 0.070 | -3.24 | -6.30, -0.18 | -0.20 | -0.38, -0.01 | 0.038 |

*b* = unstandardised regression coefficients, β = standardised regression coefficients

Note: A priori criteria for non-compliance was discrimination scores lower than 5 and/or bias scores less than 12 or greater than 36. Separate analyses were conducted including task compliant participants (n = 108) and all participants (n = 144).

Table S5

*Results from mixed-effects linear regression models examining differences in measures of performance on the Social Evaluation Learning task (outcome) according to referential condition and rule (predictors)*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ***b*** | ***b* 95% CI** | **β** | **β 95% CI** | **p** |
| **Bias Scores** |  |  |  |  |  |
| Intercept | -1.26 | -2.55, 0.04 | 0.14 | 0.02, 0.27 | 0.057 |
| Referential Condition |  |  |  |  | < .001 |
| Self (reference) |  |  |  |  |  |
| Friend | -2.07 | -2.93, -1.21 | -0.35 | -0.49, - 0.20 | < .001 |
| Stranger | -0.44 | -1.31, 0.42 | -0.07 | -0.22, 0.07 | 0.318 |
| Session | -0.13 | -0.83, 0.58 | -0.01 | -0.07, 0.05 | 0.726 |
|  |  |  |  |  |  |
| **Errors to Criterion** |  |  |  |  |  |
| Intercept | 6.19 | 5.46, 6.92 | -0.17 | -0.29, -0.05 | < .001 |
| Referential Condition |  |  |  |  | < .001 |
| Self (reference) |  |  |  |  |  |
| Friend | -1.12 | -1.75, -0.50 | -0.27 | -0.41, -0.12 | < .001 |
| Stranger | -0.16 | -0.78, 0.46 | -0.04 | -0.19, 0.11 | 0.615 |
| Rule |  |  |  |  | < .001 |
| Positive (reference) | |  |  |  |  |
| Negative | 1.45 | 0.82, 2.07 | 0.34 | 0.19. 0.49 | < .001 |
| Session | 0.21 | -0.15, 0.57 | 0.02 | -0.02, 0.07 | 0.254 |
| Condition\*Rule |  |  |  |  | < .001 |
| Self (reference) |  |  |  |  |  |
| Friend | 2.07 | 1.19, 2.95 | 0.49 | 0.28, 0.70 | < .001 |
| Stranger | 0.44 | -0.44, 1.32 | 0.10 | -0.10, 0.31 | 0.328 |
|  |  |  |  |  |  |
| **Global Ratings** |  |  |  |  |  |
| Intercept | 5.61 | 5.39, 5.83 | 0.66 | 0.58, 0.75 | < .001 |
| Referential Condition |  |  |  |  | < .001 |
| Self (reference) |  |  |  |  |  |
| Friend | 0.32 | 0.14, 0.50 | 0.17 | 0.07, 0.27 | 0.001 |
| Stranger | 0.09 | -0.10, 0.27 | 0.05 | -0.05, 0.15 | 0.354 |
| Rule |  |  |  |  | < .001 |
| Positive (reference) |  |  |  |  |  |
| Negative | -2.67 | -2.85, -2.49 | -1.47 | -1.57, -1.37 | < .001 |
| Session | 0.22 | 0.12, 0.33 | 0.06 | 0.03, 0.09 | < .001 |
| Condition\*Rule |  |  |  |  | 0.985 |
| Self (reference) |  |  |  |  |  |
| Friend | 0.01 | -0.25, 0.26 | 0.00 | -0.14, 0.15 | 0.947 |
| Stranger | -0.01 | -0.27, 0.24 | -0.01 | -0.15, 0.13 | 0.915 |

*b* = unstandardised regression coefficients, β = standardised regression coefficients

Table S6

*Results from mixed-effects linear regression models examining the effect of Social Evaluation Learning task outcomes according to referential condition and rule on depression severity after adjusting for social anxiety (BFNE scores)*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PHQ-9 | | | | | BDI-II | | | | |
|  | *b* | *b* 95% CI | β | β 95% CI | p | β | 95% CI | *b* | *b* 95% CI | p |
| **Bias Scores** |  |  |  |  |  |  |  |  |  |  |
| Intercept | 3.44 | 0.91, 5.97 | 0.00 | -0.14, 0.14 | 0.008 | 4.88 | 0.00, 9.77 | 0.00 | -0.14, 0.14 | 0.051 |
| Self | 0.10 | 0.04, 0.16 | 0.11 | 0.04, 0.19 | 0.002 | 0.21 | 0.10, 0.32 | 0.12 | 0.06, 0.18 | < .001 |
| Friend | -0.03 | -0.09, 0.03 | -0.03 | -0.10, 0.03 | 0.292 | 0.01 | -0.10, 0.11 | 0.00 | -0.05, 0.06 | 0.895 |
| Stranger | 0.01 | -0.06, 0.07 | 0.01 | -0.06, 0.07 | 0.859 | 0.03 | -0.09, 0.14 | 0.01 | -0.04, 0.07 | 0.678 |
| Session | -0.75 | -1.18, -0.32 | -0.07 | -0.11, -0.03 | 0.001 | -0.46 | -1.23, 0.31 | -0.02 | -0.05, 0.01 | 0.244 |
| BFNE | 0.13 | 0.07, 0.19 | 0.24 | 0.13, 0.35 | < .001 | 0.26 | 0.15, 0.37 | 0.23 | 0.13, 0.33 | < .001 |
| **Errors to Criterion** |  |  |  |  |  |  |  |  |  |  |
| Intercept | 2.55 | -0.11, 5.20 | 0.00 | -0.14, 0.14 | 0.061 | 4.06 | -1.10, 9.23 | 0.00 | -0.14, 0.14 | 0.124 |
| Self-Positive | 0.15 | 0.06, 0.24 | 0.12 | 0.05, 0.19 | 0.001 | 0.28 | 0.11, 0.44 | 0.10 | 0.04, 0.16 | 0.001 |
| Self-Negative | -0.04 | -0.13, 0.04 | -0.03 | -0.10, 0.03 | 0.317 | -0.16 | -0.32, -0.01 | -0.06 | -0.12, 0.00 | 0.038 |
| Friend-Positive | 0.04 | -0.05, 0.12 | 0.03 | -0.03, 0.08 | 0.387 | 0.02 | -0.13, 0.18 | 0.01 | -0.04, 0.06 | 0.794 |
| Friend-Negative | 0.09 | 0.01, 0.16 | 0.07 | 0.01, 0.13 | 0.031 | 0.00 | -0.14, 0.14 | 0.00 | -0.05, 0.05 | 0.999 |
| Stranger-Positive | -0.04 | -0.13, 0.05 | -0.03 | -0.09, 0.03 | 0.380 | 0.02 | -0.14, 0.18 | 0.01 | -0.05, 0.06 | 0.788 |
| Stranger-Negative | -0.06 | -0.16, 0.03 | -0.05 | -0.11, 0.02 | 0.179 | -0.02 | -0.19, 0.15 | -0.01 | -0.07, 0.05 | 0.804 |
| Session | -0.74 | -1.17, -0.31 | -0.07 | -0.11, -0.03 | 0.001 | -0.45 | -1.24, 0.33 | -0.02 | -0.05, 0.01 | 0.260 |
| BFNE | 0.13 | 0.07, 0.19 | 0.24 | 0.13, 0.35 | < .001 | 0.25 | 0.14, 0.37 | 0.23 | 0.13, 0.33 | < .001 |
| **Global Ratings** |  |  |  |  |  |  |  |  |  |  |
| Intercept | 4.37 | 0.81, 7.94 | 0.00 | -0.14, 0.14 | 0.017 | 7.61 | 0.77, 14.45 | 0.00 | -0.14, 0.14 | 0.030 |
| Self-Positive | -0.52 | -0.82, -0.21 | -0.12 | -0.19, -0.05 | 0.001 | -0.75 | -1.32, -0.18 | -0.08 | -0.15, -0.02 | 0.010 |
| Self-Negative | 0.11 | -0.20, 0.42 | 0.03 | -0.05, 0.10 | 0.479 | -0.01 | -0.59, 0.57 | 0.00 | -0.07, 0.06 | 0.976 |
| Friend-Positive | -0.09 | -0.40, 0.24 | -0.02 | -0.08, 0.05 | 0.632 | -0.01 | -0.60, 0.59 | 0.00 | -0.06, 0.06 | 0.987 |
| Friend-Negative | 0.23 | -0.05, 0.50 | 0.05 | -0.01, 0.12 | 0.103 | 0.34 | -0.17, 0.86 | 0.04 | -0.02, 0.09 | 0.196 |
| Stranger-Positive | 0.31 | 0.01, 0.60 | 0.07 | 0.00, 0.13 | 0.046 | -0.17 | -0.74, 0.39 | -0.02 | -0.08, 0.04 | 0.543 |
| Stranger-Negative | -0.17 | -0.46, 0.12 | -0.04 | -0.10, 0.03 | 0.251 | 0.18 | -0.36, 0.73 | 0.02 | -0.04, 0.08 | 0.502 |
| Session | -0.76 | -1.19, = 0.32 | -0.07 | -0.11, -0.03 | 0.001 | -0.46 | -1.27, 0.35 | -0.02 | -0.06, 0.02 | 0.267 |
| BFNE | 0.13 | 0.07, 0.19 | 0.24 | 0.14, 0.35 | < .001 | 0.27 | 0.16, 0.38 | 0.24 | 0.14, 0.34 | < .001 |

*b* = unstandardised regression coefficients, β = standardised regression coefficients, BFNE = Brief Fear of Negative Evaluation

*Reliability of findings with clinical diagnosis of a Major Depressive Episode*

To examine whether our findings applied to participants meeting diagnostic criteria for depression we repeated our analyses, examining the odds of meeting diagnostic criteria for a primary Major Depressive Episode (MDE) associated with task outcomes.

For the associative learning tasks, we again observed little evidence of a relationship between task performance and depression (supplementary table 7). There was weak evidence of increased reaction times when pairing shapes with the stranger being associated with an increased odds of a MDE (OR: 1.02, 95% CI: 1.00, 1.03, p = 0.034). However, this was not observed for PHQ-9 or BDI-II scores, suggesting an unreliable association.

For the Go/No-Go task, as we observed for the PHQ-9 and BDI-II, depression was predominantly associated with discriminative accuracy in the other condition. Increased discriminative accuracy when associating positive words with others was associated with an increased odds of experiencing an MDE (OR: 4.82, 95% CI: 1.51, 15.35, p = 0.008). Increased discriminative accuracy when associating negative words with others was associated with a reduced odds of experiencing an MDE, although effects overlapped with the null (OR: 0.43, 95% CI: 0.18, 1.01, p = 0.052). There was little evidence of an association between discriminative accuracy when associating words with the self with MDE (supplementary table 8).

Finally, we observed highly similar findings for the association between performance on the social reinforcement learning task with odds of experiencing a primary MDE to those we observed for the PHQ-9 and BDI-II (supplementary table 9). Reduced positive biases when learning about the self, driven by a greater number of errors when learning the positive rule, was associated with a greater odds of experiencing a primary MDE (self bias scores; OR: 1.16, 95% CI: 1.08, 1.25, p < .001, self-positive errors to criterion; OR: 1.23, 95% CI: 1.10, 1.38, p < .001). Increased global perceptions of being liked by the computer were associated with a reduced odds of experiencing depression (OR: 0.49, 95% CI: 0.32, 0.74, p < .001).

Table S7

*Results from logistic regression models examining the association between accuracy and reaction times in the Associative Learning tasks and odds of meeting diagnostic criteria for a primary major depressive episode*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Task | Stimuli | Accuracy (% correct) | | | Reaction Times (ms) | | |
| OR | 95% CI | p | OR | 95% CI | p |
| Self | Self | 0.99 | 0.94, 1.05 | 0.794 | 0.99 | 0.98, 1.00 | 0.122 |
|  | Friend | 1.02 | 0.97, 1.07 | 0.464 | 0.99 | 0.98, 1.00 | 0.197 |
|  | Stranger | 1.02 | 0.98, 1.07 | 0.383 | 1.02 | 1.00, 1.03 | 0.034 |
| Reward | High (£9) | 0.99 | 0.95, 1.03 | 0.558 | 1.00 | 0.99, 1.01 | 0.669 |
|  | Medium (£3) | 1.04 | 1.00, 1.09 | 0.066 | 1.00 | 0.99, 1.01 | 0.904 |
|  | Low (£1) | 1.01 | 0.98, 1.04 | 0.498 | 1.00 | 0.99, 1.01 | 0.930 |
| Emotion | Happy | 0.99 | 0.96, 1.03 | 0.753 | 1.00 | 0.99, 1.01 | 0.719 |
|  | Neutral | 1.00 | 0.97, 1.04 | 0.857 | 1.01 | 1.00, 1.01 | 0.293 |
|  | Sad | 1.03 | 0.99, 1.06 | 0.138 | 0.99 | 0.98, 1.00 | 0.234 |

OR = Odds Ratio

Table S8

*Results from a logistic regression model examining the association between discriminative accuracy in the Go/No-Go Task and odds of meeting diagnostic criteria for a primary major depressive episode*

|  |  |  |  |
| --- | --- | --- | --- |
|  | OR | 95% CI | p |
| Self Positive | 0.71 | 0.28, 1.84 | 0.482 |
| Self Negative | 0.71 | 0.29, 1.78 | 0.471 |
| Other Positive | 4.82 | 1.51, 15.35 | 0.008 |
| Other Negative | 0.43 | 0.18, 1.01 | 0.052 |

OR = Odds Ratio

Table S9

*Results from logistic regression models examining the association between social reinforcement learning task outcomes and odds of meeting diagnostic criteria for a primary major depressive episode*

|  |  |  |  |
| --- | --- | --- | --- |
|  | OR | 95% CI | p |
| **Bias Scores** |  |  |  |
| Self | 1.16 | 1.08, 1.25 | < .001 |
| Friend | 0.99 | 0.92, 1.06 | 0.725 |
| Stranger | 0.95 | 0.88, 1.03 | 0.253 |
| **Errors to Criterion** |  |  |  |
| Self-Positive | 1.23 | 1.10, 1.38 | < .001 |
| Self-Negative | 0.90 | 0.80, 1.01 | 0.069 |
| Friend-Positive | 1.00 | 0.88, 1.14 | 0.992 |
| Friend-Negative | 1.03 | 0.92, 1.16 | 0.594 |
| Stranger-Positive | 0.98 | 0.86, 1.11 | 0.720 |
| Stranger-Negative | 1.07 | 0.95, 1.21 | 0.236 |
| **Global Ratings** |  |  |  |
| Self-Positive | 0.49 | 0.32, 0.74 | < .001 |
| Self-Negative | 1.16 | 0.76, 1.76 | 0.496 |
| Friend-Positive | 1.12 | 0.76, 1.66 | 0.567 |
| Friend-Negative | 0.68 | 0.43, 1.07 | 0.097 |
| Stranger-Positive | 1.08 | 0.73, 1.59 | 0.691 |
| Stranger-Negative | 1.23 | 0.80, 1.90 | 0.340 |

OR = Odds Ratio

Chart, box and whisker chart

Description automatically generated

Figure S1

Results from a logistic regression model examining the association between discriminative accuracy in the self-esteem go/no-go task according to referential-emotion condition and odds of meeting criteria for a major depressive episode as a primary diagnosis.

Chart, box and whisker chart

Description automatically generated

Figure S2

Results from a logistic regression model examining the association between bias scores in the social evaluation learning task according to referential condition and odds of meeting criteria for a major depressive episode as a primary diagnosis.

Table S10

*Results from linear regression models examining the association between task performance outcomes with depression (PHQ-9/BDI-II) adjusting for gender and age.*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Associative Learning** |  |  |  |  |  |  |  |  |  |  |
|  | PHQ-9 | | | | | BDI-II | | | | |
|  | *b* | *b* 95% CI | β | β 95% CI | p | *b* | *b* 95% CI | β | β 95% CI | p |
| **Accuracy (% correct)** |  |  |  |  |  |  |  |  |  |  |
| *Self* |  |  |  |  |  |  |  |  |  |  |
| Intercept | 15.10 | 6.00, 24.21 | -0.14 | -0.51, 0.22 | 0.001 | 19.50 | -0.09, 39.09 | -0.03 | -0.63, 0.11 | 0.051 |
| Self | -0.06 | -0.17, 0.06 | -0.11 | -0.33, 0.11 | 0.334 | -0.14 | -0.39, 0.11 | -0.12 | -0.34, 0.10 | 0.270 |
| Friend | -0.06 | -0.17, 0.05 | -0.12 | -0.36, 0.11 | 0.288 | -0.01 | -0.24, 0.22 | -0.01 | -0.24, 0.22 | 0.922 |
| Stranger | 0.05 | -0.05, 0.15 | 0.12 | -0.12, 0.35 | 0.337 | 0.12 | -0.10, 0.33 | 0.13 | -0.11, 0.37 | 0.281 |
| Gender |  |  |  |  |  |  |  |  |  |  |
| Male (reference) |  |  |  |  |  |  |  |  |  |  |
| Female | 1.02 | -1.22, 3.26 | 0.19 | -0.22, 0.60 | 0.369 | 3.80 | -1.01, 8.62 | 0.33 | -0.09, 0.74 | 0.121 |
| Other | -2.32 | -13.20, 8.56 | -0.43 | -2.44, 1.58 | 0.674 | 4.88 | -18.51, 28.27 | 0.42 | -1.60, 2.44 | 0.680 |
| Age (years) | -0.15 | -0.28-0.01 | -0.18 | -0.35, -0.01 | 0.034 | -0.25 | -0.54, 0.05 | -0.14 | -0.31, 0.03 | 0.099 |
| *Reward* |  |  |  |  |  |  |  |  |  |  |
| Intercept | 8.88 | 1.51, 16.25 | -0.08 | -0.44, 0.28 | 0.019 | 9.77 | -5.90, 25.43 | -0.25 | -0.61, 0.11 | 0.220 |
| High (£9) | -0.06 | -0.15, 0.03 | -0.18 | -0.43, 0.08 | 0.171 | -0.17 | -0.36, 0.02 | -0.23 | -0.48, 0.03 | 0.078 |
| Medium (£3) | 0.09 | 0.00, 0.18 | 0.26 | 0.00, 0.53 | 0.053 | 0.21 | 0.02, 0.41 | 0.28 | 0.02, 0.55 | 0.034 |
| Low (£1) | -0.03 | -0.09, 0.04 | -0.08 | -0.30, 0.13 | 0.432 | 0.03 | -0.11, 0.17 | 0.04 | -0.17, 0.25 | 0.686 |
| Gender |  |  |  |  |  |  |  |  |  |  |
| Male (reference) |  |  |  |  |  |  |  |  |  |  |
| Female | 0.60 | -1.64, 2.83 | 0.11 | -0.30, 0.52 | 0.600 | 3.70 | -1.05, 8.45 | 0.32 | -0.09, 0.73 | 0.125 |
| Other | -4.49 | -15.36, 6.38 | -0.83 | -2.84, 1.18 | 0.415 | 0.32 | -22.77, 23.42 | 0.03 | -1.96, 2.02 | 0.978 |
| Age (years) | -0.11 | -0.25, 0.03 | -0.14 | -0.32, 0.04 | 0.117 | -0.18 | -0.48, 0.12 | -0.10 | -0.28, 0.07 | 0.244 |
| *Emotion* |  |  |  |  |  |  |  |  |  |  |
| Intercept | 9.80 | 2.95, 16.65 | -0.12 | -0.49, 0.24 | 0.005 | 15.98 | 1.34, 30.61 | -0.27 | -0.63, 0.09 | 0.033 |
| Happy | -0.03 | -0.11, 0.04 | -0.10 | -0.31, 0.12 | 0.372 | -0.08 | -0.23, 0.08 | -0.11 | -0.32, 0.11 | 0.324 |
| Neutral | 0.03 | -0.05, 0.11 | 0.08 | -0.16, 0.31 | 0.521 | 0.06 | -0.11, 0.22 | 0.08 | -0.16, 0.31 | 0.514 |
| Sad | 0.01 | -0.07, 0.08 | 0.02 | -0.22, 0.25 | 0.879 | 0.04 | -0.13, 0.21 | 0.06 | -0.18, 0.29 | 0.638 |
| Gender |  |  |  |  |  |  |  |  |  |  |
| Male (reference) |  |  |  |  |  |  |  |  |  |  |
| Female | 0.88 | -1.34, 3.10 | 0.16 | -0.25, 0.57 | 0.435 | 3.99 | -0.75, 8.72 | 0.34 | -0.06, 0.75 | 0.098 |
| Other | -3.44 | -14.39, 7.51 | -0.63 | -2.66, 1.39 | 0.536 | 2.60 | -20.79, 25.99 | 0.22 | -1.79, 2.24 | 0.826 |
| Age (years) | -0.14 | -0.28, 0.00 | -0.18 | -0.35, 0.00 | 0.045 | -0.26 | -0.55, 0.04 | -0.15 | -0.32, 0.02 | 0.091 |
| **Reaction Times (ms)** |  |  |  |  |  |  |  |  |  |  |
| *Self* |  |  |  |  |  |  |  |  |  |  |
| Intercept | 11.00 | 1.67, 20.32 | -0.11 | -0.47, 0.26 | 0.021 | 21.27 | 1.37, 41.17 | -0.25 | -0.62, 0.11 | 0.036 |
| Self | 0.00 | -0.02, 0.03 | 0.03 | -0.29, 0.36 | 0.848 | 0.00 | -0.06, 0.05 | -0.01 | -0.33, 0.32 | 0.962 |
| Friend | -0.01 | -0.04, 0.01 | -0.18 | -0.58, 0.21 | 0.357 | 0.00 | -0.09, 0.02 | -0.23 | -0.63, 0.16 | 0.242 |
| Stranger | 0.01 | -0.02, 0.04 | 0.10 | -0.34, 0.54 | 0.648 | 0.03 | -0.04, 0.09 | 0.18 | -0.26, 0.62 | 0.423 |
| Gender |  |  |  |  |  |  |  |  |  |  |
| Male (reference) |  |  |  |  |  |  |  |  |  |  |
| Female | 0.765 | -1.46, 2.99 | 0.14 | -0.27, 0.55 | 0.498 | 3.71 | -1.04, 8.45 | 0.32 | -0.09, 0.73 | 0.125 |
| Other | -3.10 | -14.05, 7.84 | -0.57 | -2.59, 1.45 | 0.576 | 4.07 | -19.29, 27.43 | 0.35 | -1.66, 2.37 | 0.731 |
| Age (years) | -0.13 | -0.27, 0.02 | -0.15 | -0.33, 0.02 | 0.087 | -0.23 | -0.53, 0.08 | -0.13 | -0.31, 0.04 | 0.143 |
| *Reward* |  |  |  |  |  |  |  |  |  |  |
| Intercept | 6.40 | -1.23, 14.02 | -0.10 | -0.47, 0.26 | 0.099 | 8.71 | -7.56, 24.98 | -0.26 | -0.62, 0.10 | 0.292 |
| High (£9) | 0.01 | -0.01, 0.04 | 0.22 | -0.15, 0.59 | 0.234 | 0.03 | -0.02, 0.08 | 0.25 | -0.12, 0.61 | 0.189 |
| Medium (£3) | -0.01 | -0.04, 0.02 | -0.18 | -0.64, 0.28 | 0.446 | -0.01 | -0.06, 0.05 | -0.05 | -0.51, 0.40 | 0.813 |
| Low (£1) | 0.00 | -0.02, 0.02 | 0.02 | -0.36, 0.40 | 0.911 | -0.01 | -0.06, 0.03 | -0.12 | -0.49, 0.26 | 0.545 |
| Gender |  |  |  |  |  |  |  |  |  |  |
| Male (reference) |  |  |  |  |  |  |  |  |  |  |
| Female | 0.76 | -1.47, 2.98 | 0.14 | -0.27, 0.55 | 0.504 | 3.79 | -1.00, 8.54 | 0.33 | -0.08, 0.74 | 0.117 |
| Other | -3.54 | -14.43, 7.34 | -0.65 | -2.66, 1.36 | 0.521 | 2.89 | -20.34, 26.12 | 0.25 | -1.75, 2.25 | 0.806 |
| Age (years) | -0.14 | -0.28, -0.01 | -0.18 | -0.34, -0.01 | 0.039 | -0.26 | -0.55, 0.02 | -0.15 | -0.32, 0.01 | 0.072 |
| *Emotion* |  |  |  |  |  |  |  |  |  |  |
| Intercept | 10.05 | 3.22, 16.88 | -0.11 | -0.48, 0.25 | 0.004 | 17.40 | 2,77, 32.03 | -0.26 | -0.62, 0.10 | 0.020 |
| Happy | 0.00 | -0.01, 0.02 | 0.08 | -0.30, 0.46 | 0.667 | 0.00 | -0.04, 0.04 | 0.02 | -0.36, 0.40 | 0.914 |
| Neutral | 0.00 | -0.03, 0.02 | -0.10 | -0.60, 0.40 | 0.699 | -0.01 | -0.05, 0.04 | -0.06 | -0.56, 0.44 | 0.821 |
| Sad | 0.00 | -0.02, 0.02 | -0.01 | -0.51, 0.49 | 0.967 | 0.00 | -0.05, 0.05 | 0.02 | -0.49, 0.52 | 0.943 |
| Gender |  |  |  |  |  |  |  |  |  |  |
| Male (reference) |  |  |  |  |  |  |  |  |  |  |
| Female | 0.80 | -1.42, 3.02 | 0.15 | -0.26, 0.56 | 0.477 | 3.79 | -0.96, 8.54 | 0.33 | -0.08, 0.74 | 0.117 |
| Other | -2.80 | -13.85, 8.25 | -0.52 | -2.56, 1.52 | 0.617 | 3.80 | -19.86, 27.46 | 0.33 | -1.71, 2.37 | 0.751 |
| Age (years) | -0.14 | -0.28, 0.00 | -0.17 | -0.34, 0.00 | 0.044 | -0.26 | -0.55, 0.03 | -0.15 | -0.32, 0.02 | 0.082 |
| **Self-Esteem GNAT** |  |  |  |  |  |  |  |  |  |  |
|  | PHQ-9 | | | | | BDI-II | | | | |
|  | *b* | *b* 95% CI | β | β 95% CI | p | *b* | *b* 95% CI | β | β 95% CI | p |
| **d’** |  |  |  |  |  |  |  |  |  |  |
| Intercept | 14.60 | 9.83, 1.937 | -0.08 | -0.55, 0.39 | < .001 | 24.07 | 13.87, 34.27 | -0.20 | -0.68, 0.28 | < .001 |
| Self Positive | -2.52 | -4.61, -0.43 | -0.25 | -0.45, -0.04 | 0.019 | -3.52 | -7.98, 0.95 | -0.17 | -0.38, 0.04 | 0.122 |
| Self Negative | -0.53 | -2.55, 1.49 | -0.05 | -0.23, 0.14 | 0.605 | -0.95 | -5.26, 3.37 | -0.04 | -0.23, 0.15 | 0.664 |
| Other Positive | 3.85 | 1.53, 6.18 | 0.32 | 0.13, 0.52 | 0.001 | 7.55 | 2.59, 12.51 | 0.31 | 0.10, 0.51 | 0.003 |
| Other Negative | -2.49 | -4.28, -0.69 | -0.27 | -0.46, -0.07 | 0.007 | -5.09 | -8.93, -1.25 | -0.27 | -0.47, -0.07 | 0.010 |
| Gender |  |  |  |  |  |  |  |  |  |  |
| Male (reference) |  |  |  |  |  |  |  |  |  |  |
| Female | 0.54 | -2.39, 3.46 | 0.09 | -0.42, 0.60 | 0.718 | 2.70 | -3.55, 8.96 | 0.23 | -0.30, 0.75 | 0.393 |
| Other | 1.52 | -9.34, 12.37 | 0.26 | -1.63, 2.16 | 0.782 | 7.41 | 15.80, 30.62 | 0.62 | -1.33, 2.58 | 0.528 |
| Age (years) | -0.14 | -0.28, 0.00 | -0.18 | -0.36, 0.00 | 0.044 | -0.25 | -0.54, 0.05 | -0.15 | -0.34, 0.03 | 0.099 |
| **Social Evaluation Learning** | | | | | | | | | | |
|  | PHQ-9 | | | | | BDI-II | | | | |
|  | *b* | *b* 95% CI | β | β 95% CI | p | *b* | *b* 95% CI | β | β 95% CI | p |
| **Bias Scores** |  |  |  |  |  |  |  |  |  |  |
| Intercept | 10.46 | 7.15, 13.77 | -0.07 | -0.41, 0.26 | < .001 | 17.09 | 10.18, 23.99 | -0.22 | -0.56, 0.12 | < .001 |
| Self | 0.10 | 0.04, 0.19 | 0.12 | 0.05, 0.19 | 0.001 | 0.23 | 0.12, 0.34 | 0.12 | 0.06, 0.19 | < .001 |
| Friend | -0.03 | -0.09, 0.02 | -0.03 | -0.09, 0.03 | 0.272 | 0.01 | -0.09, 0.12 | 0.01 | -0.05, 0.06 | 0.792 |
| Stranger | -0.01 | -0.07, 0.06 | -0.01 | -0.07, 0.06 | 0.814 | 0.00 | -0.12, 0.11 | 0.00 | -0.06, 0.05 | 0.947 |
| Session | -0.88 | -1.30, -0.46 | -0.08 | -0.12, -0.04 | < .001 | -0.72 | -1.46, 0.03 | -0.03 | -0.06, 0.00 | 0.062 |
| Gender |  |  |  |  |  |  |  |  |  |  |
| Male (reference) |  |  |  |  |  |  |  |  |  |  |
| Female | 0.55 | -1.52, 2.61 | 0.10 | -0.28, 0.48 | 0.605 | 3.17 | -1.15, 7.51 | 0.28 | -0.10, 0.66 | 0.153 |
| Other | -2.19 | -12.33, 7.95 | -0.40 | -2.26, 1.46 | 0.673 | 3.43 | -17.86, 24.71 | 0.30 | -1.57, 2.17 | 0.753 |
| Age (years) | -0.10 | -0.23, 0.02 | -0.12 | -0.27, 0.03 | 0.108 | -0.20 | -0.46, 0.07 | -0.11 | -0.26, 0.04 | 0.147 |

*b* = unstandardised regression coefficients, β = standardised regression coefficients