Supplementary Material for:

Beautiful friendship: Social sharing of emotions improves subjective feelings and activates the neural reward circuitry

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Supplementary Results

Arousal

Although our hypothesis referred to the valence dimension of emotion, we also obtained after each picture subjective ratings of arousal as the second primary emotion dimension commonly assessed in emotion research (Lang et al., 2005). Regarding arousal ratings, we did not observe any social sharing effects overall (emotional: M=-0.035, SEM=0.078; t(57)=-0.451, p=0.654; including neutral: M=0.032, SEM=0.072; t(57)=0.456, p=0.650) or when considering positive, negative, and neutral pictures separately (positive: M=-0.060, SEM=0.111; t(57)=-0.548, p=0.586; negative: M=-0.010, SEM=0.079; t(57)=-0.126, p=0.90; neutral: M=0.169, SEM=0.103; t(57)=1.638, p=0.107). (See Supplementary Table S2 for all raw data on subjective ratings of valence and arousal).

Supplementary Tables

(Supplementary Tables S1, S2, S3)

Table S1. Stimulus details. Valence ratings, difference to midpoint of valence scale, and arousal ratings from (Lang et al., 2005). Scales ranging from 1 to 9.

| | | Valence | Arousal |
|--------------------|-------------|------------------------|-------------|
| | | Difference to midpoint | |
| | Mean (SD) | Mean (SD) | Mean (SD) |
| | | | |
| negative face | 1.67 (1.19) | 3.33 (0.08) | 6.1 (2.4) |
| negative nonface | 2.5 (1.55) | 2.5 (0.34) | 5.74 (2.16) |
| negative inanimate | 2.7 (1.58) | 2.3 (0.53) | 5.5 (2.2) |
| negative total | 2.29 (1.44) | 2.71 (0.32) | 5.78 (2.26) |
| | | | |
| neutral face | 5 (1.28) | 0 (0.11) | 3.28 (1.94) |
| neutral nonface | 4.98 (1.5) | -0.02 (0.5) | 4.29 (2.09) |
| neutral inanimate | 5 (1.01) | 0 (0.05) | 2.79 (1.91) |
| neutral total | 4.99 (1.26) | -0.01 (0.22) | 3.45 (1.98) |
| | | | |
| positive face | 8.32 (1.16) | 3.32 (0.17) | 4.74 (2.58) |
| positive nonface | 7.56 (1.47) | 2.56 (0.55) | 5.67 (2.31) |
| positive inanimate | 7.37 (1.59) | 2.37 (0.21) | 4.41 (2.41) |
| positive total | 7.75 (1.41) | 2.75 (0.31) | 4.94 (2.44) |
| | | | |

| | V | alence Mean (SEI | VI) | |
|-------------------------|---------------|------------------|----------------|----------------|
| | | | raw sharing | sharing effect |
| | shared | unshared | effect | corrected |
| negative | 3.457 (0.146) | 3.288 (0.155) | 0.168 (0.063) | 0.088 (0.056) |
| positive | 8.015 (0.134) | 7.921 (0.136) | 0.093 (0.071) | 0.136 (0.073) |
| emotional (neg and pos) | 5.736 (0.059) | 5.604 (0.074) | 0.131 (0.045)* | 0.112 (0.045)* |
| neutral | 6.196 (0.086) | 6.119 (0.082) | 0.076 (0.066) | 0.064 (0.068) |
| all | 5.888 (0.060) | 5.776 (0.069) | 0.112 (0.035)* | 0.095 (0.037)* |

| Table ell Cablecare rainge er falenee and areaear (eeare rainge er ill) | Table S2. Sub | jective ratings c | of valence and arousal | (scale range 0 -12 | 2). |
|---|---------------|-------------------|------------------------|--------------------|-----|
|---|---------------|-------------------|------------------------|--------------------|-----|

| Arousal Mean (SEM) | | | | | | | |
|----------------------------|---------------|---------------|-----------------------|-----------------------------|--|--|--|
| | shared | unshared | raw sharing effect | sharing effect corrected | | | |
| negative | 6.817 (0.242) | 6.865 (0.245) | -0.048 (0.087) | -0.010 (0.079) | | | |
| positive | 5.545 (0.236) | 5.500 (0.216) | 0.044 (0.094) | -0.060 (0.111) | | | |
| emotional (neg and pos) | 6.181 (0.210) | 6.183 (0.203) | -0.001 (0.072) | -0.035 (0.078) | | | |
| neutral | 4.080 (0.242) | 3.989 (0.223) | 0.090 (0.114) | 0.169 (0.103) | | | |
| all | 5.481 (0.208) | 5.451 (0.192) | 0.029 (0.073) | 0.032 (0.072) | | | |

* significant effect of social sharing (p<0.05) . The corrected sharing effect takes into account that standard ratings for picture sets used in shared vs. unshared experimental conditions cannot be totally matched within subjects and therefore corrects the raw sharing effect of each participant accordingly (see Methods). Overall statistical patterns are the same for raw sharing effects.

| Region | Hem. | Hem. BA Coordinates peak voxel | | T-value Cluster size | | | | |
|--|---------------|--------------------------------|-------------------|-------------------------|-----------------|----------------------|-----------------|---|
| | | | Х | У | Z | | | _ |
| unshared_emo > shared_er | no | | | | | | | |
| Lingual gyus | R L | 18 18 | 12 -9 | -76 -82 | -5 -8 | 4.03 3.8 | 40 27 | |
| unshared_neu > shared_ne | u | | | | | | | |
| Lingual gyrus | R R R | 18 18 18 | 12 9 12 | -57 -61 -76 | 1 -5 -5 | 3.97 3.85 3.68 | 231 | |
| emo > neu | | | | | | | | |
| Frontopolar cortex | L L | 10 10 10 | -3 0 -9 | 62 56 65 | -2 16 25 | 3.87 3.8 3.58 | 13 30 | |
| Anterior cingulate gyrus Lingual gyrus Middle temporal gyrus | L/R R R | 32 18 37 | 0 18 54 | 38 -91 -70 | 7 -5 13 | 3.73 3.36 5.95 | 17 13 377 | |
| Amygdala | R L R | 37 | 54 -21 21 | -58 -4 -4 | 4 -14 -14 | 4.34 4.39 3.94 | 157 | |
| Fusiform gyrus | R R | 37 37 23 | 42 30 | -43 -73 -52 | -14 -5 31 | 3.79 3.56 | 19 21 167 | |
| Lingual gyrus /Cuneus | R L | 18 | 3 -12 | -32 -49 -94 | 13 -2 | 3.92 3.88 | 31 | |
| Middle occipital gyrus Superior occipital gyrus | R L R | 18 19 19 | 18 -48 39 | -91 -76 -82 | -5 16 31 | 3.36 5.47 3.53 | 13 234 | |
| Midbrain | R | | 3 | -16 | -14 | 3.7 | 11 | |
| neg > pos | | | | | | | | |
| Inferior/medial frontal gyrus | R R R | 48 44 46 | 51 39 57 | 23 5 29 | 16 31 16 | 6.34 6.2 6.16 | 2365 | |
| | L L L | 6 44 48 | -48 -54 -45 | 2 14 11 | 31 37 19 | 4.73 4.01 3.18 | 95 | |
| Superior frontal gyrus | R R | 10 10 | 12 15 | 65 68 | 28 19 | 5.76 5.35 | 45 | |

Table S3. Regional activation during picture phase. Peak voxels in MNI space, p<0.001 uncorr., k>10.

| | L | 32 | -6 | 50 | 25 | 4.8 | 75 |
|----------------------------|---|----|-----|-----|-----|------|------|
| | L | 9 | -6 | 56 | 40 | 4.17 | |
| | L | 8 | -6 | 41 | 55 | 3.3 | |
| | L | 10 | -12 | 62 | 31 | 4.26 | 11 |
| Inferior temporal / | L | 37 | -42 | -58 | -8 | 8.92 | 6107 |
| inferior occipital gyrus | R | 37 | 45 | -67 | -8 | 8.8 | |
| | L | 18 | -36 | -88 | 4 | 8.16 | |
| cluster also including: | _ | | | | | | |
| Amygdala | R | | 21 | -4 | -11 | 5.16 | |
| | L | | -21 | -4 | -14 | 4.3 | |
| Hippocampus | L | | -27 | -10 | -11 | 4.83 | |
| Temporal pole | R | 38 | 48 | 14 | -26 | 3.74 | |
| Middle temporal gyrus | R | 21 | 51 | -4 | -17 | 4.23 | 61 |
| Brainstem | | | 0 | -37 | -35 | 3.93 | 34 |
| | | | | | | | |
| pos > neg | | | | | | | |
| Medial orbitofrontal gyrus | R | 11 | 9 | 56 | -5 | 4.77 | 24 |
| | R | 47 | 39 | 50 | -5 | 3.79 | |
| | R | 46 | 39 | 47 | 7 | 3.71 | |
| Anterior cingulate gyrus | L | 25 | -6 | 35 | 4 | 4.98 | 476 |
| | L | 11 | -15 | 44 | -2 | 4.89 | |
| Cingulate gyrus | R | 23 | 9 | -13 | 31 | 4 | 59 |
| Hippocampus | R | | 21 | -34 | 7 | 4.08 | |
| Precuneus | R | 7 | 9 | -73 | 37 | 5.26 | 387 |
| | L | 7 | -9 | -67 | 31 | 4.71 | |
| Paracentral lobule | L | 4 | -6 | -19 | 67 | 4 | 153 |
| | R | 4 | 3 | -19 | 67 | 3.92 | |
| Posterior cingulate gyrus | L | 23 | -6 | -31 | 25 | 3.97 | |
| Angular gyrus | R | 39 | 42 | -64 | 43 | 3.68 | 10 |
| | | | | | | | |

| Source | x | у | Z | atlas- type |
|--|-----|-----|-----|----------------|
| (Rothkirch, Schmack, Schlagenhauf, & Sterzer, 2012) | 0 | 26 | -14 | MNI |
| | 30 | 38 | -14 | MNI |
| (Schlagenhauf et al., 2009) | 0 | 45 | -12 | MNI |
| | -3 | 42 | -18 | MNI |
| | -6 | 45 | -18 | MNI |
| (Walter et al., 2010) | 39 | 21 | -15 | MNI |
| | 33 | 30 | -9 | MNI |
| (Diaconescu et al., 2011) | 20 | 20 | -24 | MNI |
| (Bunzeck, Dayan, Dolan, & Duzel, 2010) | 10 | -24 | -18 | MNI |
| (Bunzeck, Doeller, Dolan, & Duzel, 2012) | 6 | 48 | -20 | MNI |
| | 0 | 46 | -26 | MNI |
| | -4 | 36 | -26 | MNI |
| | 4 | 40 | -28 | MNI |
| (Liu, Hairston, Schrier, & Fan, 2011) | -46 | 42 | -4 | MNI |
| | -42 | 52 | -6 | MNI |
| (Wagner, Boswell, Kelley, & Heatherton, 2012) | -27 | 36 | -12 | MNI |
| (Diekhof, Falkai, & Gruber, 2011) | 21 | 21 | -21 | MNI |
| | -24 | 27 | -21 | MNI |
| | 15 | 18 | -18 | MNI |
| | -21 | 39 | -18 | MNI |
| (Bermpohl et al., 2010) | -30 | 42 | -9 | MNI |
| (O'Doherty, Critchley, Deichmann, & Dolan, 2003) | -39 | 42 | -15 | MNI |
| (O'Doherty, Kringelbach, Rolls, Hornak, & Andrews, 2001) | 6 | 42 | -24 | Tal |
| | -10 | 40 | -22 | Tal |
| | -4 | 28 | -18 | Tal |
| | 36 | 58 | -12 | Tal |

Table S4. Activation peaks in OFC used for ROI creation.

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