**Supplementary Materials**

**Cultural variation in neural responses to social but not monetary reward outcomes**

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**Section 1: Smiling and Angry Faces in the SID Task**

We created different faces (775 x 775 pixels) in FaceGen Modeller and framed them in an oval keyhole (Park et al., 2016). Faces varied by race (White, Asian), sex (male, female), and emotional expression (high intensity [“excited”] smile, moderate intensity [“moderate”] smile, low intensity [“calm”] smile, neutral, low intensity [“low”] anger, moderate intensity [“moderate”] anger, high intensity [“high”] anger). Example faces are depicted in Figure S1 and FaceGen parameters are available in Table S1.

**Figure S1**

*Examples of facial stimuli, which varied by emotional expression (smile, anger), race (White, Asian), and sex (male, female).*

A picture containing graphical user interface

Description automatically generated

**Table S1**

*FaceGen Parameters for Smiling and Angry Facial Stimuli*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Emotional Expression (Smile)** | | | |
| **Parameter** | **Neutral** | **Calm Smile** | **Moderate Smile** | **Excited Smile** |
| Expression: SmileClosed | 0 | 0.50 | 0.55 | 0.60 |
| Expression: SmileOpen | 0 | 0 | 0.50 | 1.00 |
| Modifier: EyeSquint Left | 0 | 0 | 0.10 | 0.20 |
| Modifier: EyeSquint Right | 0 | 0 | 0.10 | 0.20 |
| Phoneme: aah | 0 | 0 | 0.30 | 0.50 |
| Phoneme: big aah | 0 | 0 | 0 | 0.10 |
| Phoneme: D, S, T | 0 | 0 | 0.30 | 0.50 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Emotional Expression (Anger)** | | | |
| **Parameter** | **Neutral** | **Low Anger** | **Moderate Anger** | **High Anger** |
| Expression: Anger | 0 | 0.25 | 0.50 | 0.80 |
| Modifier: BrowDown Left | 0 | 1.00 | 1.00 | 1.00 |
| Modifier: BrowDown Right | 0 | 1.00 | 1.00 | 1.00 |
| Phoneme: B, M, P | 0 | 1.00 | 0 | 0 |
| Phoneme: ee | 0 | 0 | 0 | 0.30 |
| Phoneme: F, V | 0 | 0 | 0 | 0 |
| Shape: Mouth – Lips puckered | 0 | +3.16 | - | - |

*Note*. Parameters for smiling faces are the same as reported in Park et al. (2016).

**Section 2: SID Task Description**

We developed a revised SID task to address limitations of the paradigm developed by Spreckelmeyer et al. (2009). First, in the Spreckelmeyer et al. (2009) paradigm, the same circle cues were used to signal the potential to view a smiling face (social incentive) in the SID task as were used to signal the potential to gain money (monetary incentive) in the MID task. While the order of the tasks was counterbalanced across participants, it is unclear whether neural activity in response to these cues represents the anticipation of receiving a social incentive, a monetary incentive, or perhaps both types of incentives. Second, the smiling facial stimuli were posed images of White male and female actors and were not carefully controlled or standardized. Third, scrambled images were presented on trials where participants missed the target as well as on “non-gain” trials. However, these scrambled images were not “social,” like the facial stimuli, and therefore, there was no social feedback on missed and “no gain” trials. Finally, the paradigm lacked a comparable loss condition where participants had the potential to receive negative social feedback, making it difficult to control for effects due to valence. To address these limitations, in our revised version of the SID task, we: (1) used clover cues to signal the potential to view a smiling face, and circle cues to signal the potential to gain money, (2) used neutral faces on trials where participants missed the target and on “non-gain” and “non-loss” trials, and (3) included a loss condition where participants had the potential to avoid viewing an angry face.

**Section 3: Reaction Times and Success Rates in the SID and MID Tasks**

We calculated the mean reaction time in milliseconds on trials in which participants hit the target, responding with a button press before it disappeared, as well as the mean success rate percentage within each culture for each trial type. Means and standard deviations for the SID and MID tasks are presented in Tables S2 and S3, respectively. As described in the main manuscript, the target presentation time was adaptive, such that participants hit the target on approximately 66% of trials for each type in each task (e.g., excited smile gain, $1 loss), which ensured comparable performance across the different trial types.

**Table S2**

*Reaction Times and Success Rates in the Social Incentive Delay (SID) Task*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **European Americans (N = 26)** | | | | **Chinese (N = 27)** | | | |
|  | Hit Reaction Time (ms) | | Success Rate  (%) | | Hit Reaction Time (ms) | | Success Rate  (%) | |
|  | Mean | *SD* | Mean | *SD* | Mean | *SD* | Mean | *SD* |
| **Emotional Expression (Smile)** |  |  |  |  |  |  |  |  |
| Neutral | 237.66 | 29.00 | 53.85 | 16.87 | 241.99 | 31.36 | 58.33 | 10.96 |
| Calm | 229.69 | 29.06 | 52.40 | 16.21 | 238.05 | 24.86 | 57.87 | 11.58 |
| Moderate | 228.50 | 32.02 | 58.17 | 16.93 | 234.54 | 30.33 | 60.19 | 12.52 |
| Excited | 230.00 | 24.59 | 56.25 | 14.25 | 229.53 | 26.40 | 55.56 | 8.72 |
| **Emotional Expression (Anger)** |  |  |  |  |  |  |  |  |
| Neutral | 236.13 | 22.74 | 59.13 | 13.49 | 232.54 | 27.81 | 57.41 | 12.14 |
| Low | 234.57 | 25.94 | 55.77 | 10.14 | 228.97 | 22.38 | 56.02 | 11.69 |
| Moderate | 227.26 | 23.72 | 56.25 | 14.68 | 230.28 | 23.47 | 57.41 | 11.10 |
| High | 233.89 | 20.34 | 59.62 | 12.40 | 227.88 | 29.53 | 56.94 | 11.67 |

**Table S3**

*Reaction Times and Success Rates in the Monetary Incentive Delay (MID) Task*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **European Americans (N = 26)** | | | | **Chinese (N = 27)** | | | |
|  | Hit Reaction Time (ms) | | Success Rate  (%) | | Hit Reaction Time (ms) | | Success Rate  (%) | |
|  | Mean | *SD* | Mean | *SD* | Mean | *SD* | Mean | *SD* |
| **Monetary Amount**  **(Gain)** |  |  |  |  |  |  |  |  |
| $0 | 234.04 | 26.63 | 54.81 | 17.35 | 229.01 | 24.50 | 55.09 | 13.98 |
| $1 | 210.70 | 23.90 | 62.98 | 11.45 | 215.69 | 16.63 | 64.35 | 10.80 |
| $3 | 211.10 | 25.07 | 67.31 | 11.77 | 212.67 | 22.35 | 66.20 | 11.40 |
| $5 | 207.18 | 23.37 | 64.90 | 12.26 | 209.12 | 14.10 | 65.28 | 10.59 |
| **Monetary Amount (Loss)** |  |  |  |  |  |  |  |  |
| $0 | 224.05 | 26.58 | 54.81 | 19.39 | 224.93 | 30.64 | 54.17 | 14.29 |
| $1 | 222.56 | 26.35 | 60.10 | 9.37 | 215.45 | 27.48 | 59.72 | 10.59 |
| $3 | 212.64 | 19.76 | 64.42 | 9.81 | 215.18 | 21.34 | 63.89 | 9.39 |
| $5 | 214.38 | 17.64 | 63.46 | 10.56 | 213.34 | 17.68 | 61.11 | 8.72 |

*SID Task*

To examine cultural differences in behavior on the SID task, we conducted separate linear mixed effects regressions on mean log-transformed reaction time and success rate for smiling and angry expressions. We entered Culture (European American [0], Chinese [1]), Emotional Expression (linear contrast) and their interaction as fixed effects, and individual participants as random intercepts. While moderate intensity expressions were not included in the final analyses reported in the main manuscript, we report them below for completion.

*Smiling expressions*. For log-transformed reaction time, there was no significant effect of Culture, Emotional Expression, or Culture X Emotional Expression interaction (*ps* > .18). For success rate, there was no significant effect of Culture, Emotional Expression, or Culture X Emotional Expression interaction (*ps* > .08).

*Angry expressions*. For log-transformed reaction time, there was no significant effect of Culture, Emotional Expression, or Culture X Emotional Expression interaction (*ps* > .30). For success rate, there was no significant effect of Culture, Emotional Expression, or Culture X Emotional Expression (*ps* > .76).

In summary, in the SID task, European Americans and Chinese had similar reaction times and success rates across the different trial types.

*MID Task*

To examine cultural differences in the MID task, we conducted separate linear mixed effects regressions on mean log-transformed reaction time and success rate for gains and losses. We included Culture (European American [0], Chinese [1]), Monetary Amount (linear contrast) and their interaction as fixed effects, and individual participants as random intercepts. As described previously, moderate monetary amounts ($3) were not included in the manuscript, but we report them below.

*Monetary gains*. For log-transformed reaction time, there was a significant effect of Monetary Amount, suggesting that participants were faster on trials with increasing monetary gains (simple effect for European Americans: *B* = -.04, *SE* = .01, *t*(152.65) = -6.04, *p* < .001; Chinese: *B* = -.03, *SE* = .01, *t*(152.14) = -3.86, *p* < .001). There was no significant effect of Culture or Culture X Monetary Amount interaction (*ps* > .10). For success rate, there was a significant effect of Monetary Amount, such that participants were more successful on trials with increasing monetary gains (simple effect for European Americans: *B* = 7.74, *SE* = 2.26, *t*(153.00) = 3.43, *p* < .001; Chinese: *B* = 7.25, *SE* = 2.21, *t*(153.00) = 3.27, *p* = .001). There was no significant effect of Culture or Culture X Monetary Amount interaction (*ps* > .88).

*Monetary losses*. For log-transformed reaction time, there were no significant effect of Monetary Amount, Culture, or Culture X Monetary Amount interaction (*ps* > .33). However, for success rate, there was a significant effect of Monetary Amount, suggesting that participants were more successful on trials with increasing monetary losses (simple effect for European Americans: *B* = 6.78, *SE* = 2.21, *t*(153.00) = 3.06, *p* = .003; Chinese: *B* = 5.59, *SE* = 2.17, *t*(153.00) = 2.57, *p* = .01). There was no significant effect of Culture or Culture X Monetary Amount interaction (*ps* > .61).

In summary, in the MID task, both European Americans and Chinese were faster at responding and had higher success rates on trials where they could receive higher monetary incentives, which is consistent with previous research (e.g., Rademacher et al., 2010). European Americans and Chinese also had higher success rates on trials where they could avoid greater monetary losses. Importantly, however, these differences in reaction times and success rates were comparable across cultural groups.

**Section 4: Cue Ratings in the SID and MID Tasks**

We calculated positive and negative arousal scores for the cues based on valence and arousal ratings, as in previous work (Genevsky et al., 2013). First, we mean-deviated valence and arousal ratings to control for individual differences in response style. Second, to map these ratings onto the high arousal positive and high arousal negative quadrants of the affective circumplex (i.e., rotate the ratings 45 degrees), we divided each mean-deviated valence and arousal rating by the square root of two. Finally, for positive arousal scores, we took the sum (), and for negative arousal scores, we took the difference ().

Means and standard deviations for cues in the SID and MID task are shown in Tables S4 and S5, respectively. As described previously in Section 3, moderate trials were excluded from the main manuscript, but we report them below for completion.

**Table S4**

*Ratings of Clover and Shield in the Social Incentive Delay (SID) Task*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **European Americans (N = 26)** | | **Chinese (N = 27)** | |
|  | Mean | *SD* | Mean | *SD* |
| **Clover Cue** | Positive Arousal | | | |
| No line | -0.28 | 0.75 | -0.19 | 1.22 |
| Bottom line | 0.29 | 0.91 | 0.09 | 0.79 |
| Middle line | 0.75 | 0.71 | 0.51 | 1.01 |
| Top line | 1.65 | 1.45 | 2.48 | 1.39 |
| **Shield Cue** | Negative Arousal | | | |
| No line | 0.25 | 0.70 | -0.25 | 1.29 |
| Bottom line | 0.61 | 0.87 | 0.72 | 1.17 |
| Middle line | 1.21 | 0.91 | 0.80 | 1.01 |
| Top line | 1.86 | 1.56 | 1.43 | 1.81 |

**Table S5**

*Ratings of Circle and Square Cues in the Monetary Incentive Delay (MID) Task*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **European Americans (N = 26)** | | **Chinese (N = 27)** | |
|  | Mean | *SD* | Mean | *SD* |
| **Circle Cue** | Positive Arousal | | | |
| No line | -1.29 | 0.77 | -1.47 | 1.08 |
| Bottom line | 0.58 | 0.64 | 0.45 | 0.85 |
| Middle line | 1.35 | 1.01 | 1.36 | 0.91 |
| Top line | 2.90 | 0.84 | 3.09 | 1.03 |
| **Square Cue** | Negative Arousal | | | |
| No line | -1.32 | 1.21 | -1.45 | 1.10 |
| Bottom line | 0.83 | 0.89 | 0.44 | 0.71 |
| Middle line | 1.73 | 0.77 | 1.56 | 1.07 |
| Top line | 2.73 | 1.16 | 3.06 | 1.30 |

*SID Task Cue Ratings*

We conducted separate linear mixed effects regressions on positive arousal ratings of clover cues and negative arousal ratings of shield cues. We entered Culture (European American [0], Chinese [1]), Emotional Expression (linear contrast) and their interaction as fixed effects, and individual participants as random intercepts. If the model returned a singular fit warning, we removed the random intercept and ran a linear model.

*Positive Arousal*. Emotional Expression was significant, suggesting that positive arousal increased as participants rated clover cues signaling greater intensity smiles (simple effect for European Americans: *B* = 1.40, *SE* = .21, *t*(153) = 6.74, *p* < .001; Chinese: *B* = 1.89, *SE* = .20, *t*(153) = 9.26, *p* < .001). There was no significant effect of Culture (*p* = .42) and no Culture X Emotional Expression interaction (*p* = .10).

*Negative Arousal*. Emotional Expression was significant: negative arousal increased as participants rated shield cues signaling greater intensity anger expressions (simple effect for European Americans: *B* = 1.21, *SE* = .24, *t*(204) = 5.06, *p* < .001; Chinese: *B* = 1.14, *SE* = .23, *t*(204) = 4.87, *p* < .001). There was no significant effect of Culture (*p* = .07) and no Culture X Emotional Expression interaction (*p* = .84).

*MID Task Cue Ratings*

We conducted separate linear regressions on positive arousal ratings of circle cues and negative arousal ratings of square cues. As above, we entered Culture (European American [0], Chinese [1]), Monetary Amount (linear contrast) and their interaction as fixed effects, and individual participants as random intercepts. As described above, if the model returned a singular fit warning, we removed the random intercept and ran a linear model.

*Positive Arousal*. Monetary Amount was significant, suggesting that positive arousal increased as participants rated circle cues signaling greater monetary gains (simple effect for European Americans: *B* = 2.98, *SE* = .18, *t*(204) = 16.83, *p* < .001; Chinese: *B* = 3.26, *SE* = .17, *t*(204) = 18.78, *p* < .001). There was no significant effect of Culture (*p* = .83) and no Culture X Monetary Amount interaction (*p* = .26).

*Negative Arousal*. Monetary Amount was significant, such that negative arousal increased as participants rated shield cues signaling greater monetary losses (simple effect for European Americans: *B* = 2.92, *SE* = .21, *t*(204) = 14.22, *p* < .001; Chinese: *B* = 3.27, *SE* = .20, *t*(204) = 16.25, *p* < .001). There was no significant effect of Culture (*p* = .54) and no Culture X Monetary Amount interaction (*p* = .22).

Across both SID and MID tasks, European Americans and Chinese differentiated among the cues in positive and negative arousal ratings, and there were no significant cultural differences.

**Section 5: Whole Brain Analysis**

We conducted a priori volume of interest (VOI) analyses in the Nucleus Accumbens (NAcc) to test our predictions based on previous research (Park et al., 2016; Rademacher et al., 2010; Knutson et al., 2001a, 2001b). While we report the VOI analyses in the main manuscript, we also conducted a post hoc exploratory whole brain analysis for the SID task.

The whole brain analysis included four orthogonal regressors of interest. The first regressor contrasted smiling vs. neutral faces during “anticipation” (excited smile = +2, moderate smile = +1, calm smile = 0, neutral = -3). The second regressor contrasted angry vs. neutral faces during “anticipation” (high intensity anger = +2, moderate intensity anger = +1, low intensity anger = 0, neutral = -3). The third regressor contrasted hits vs. misses for smiling faces during the “outcome” (excited smile, hit = +3, miss = -3; moderate smile, hit = +2, miss = -2; calm smile, hit = +1, miss = -1; neutral, hit = 0, miss = 0). The fourth regressor contrasted hits vs. misses for angry faces during the “outcome” (high intensity anger, hit = +3, miss = -3; moderate intensity anger, hit = +2, miss = -2; low intensity anger, hit = +1, miss = -1; neutral, hit = 0, miss = 0). Additionally, we included one regressor each to mark the “anticipation” and “outcome” periods, as well as six regressors modeling head movement as covariates. The regressors were then convolved with a gamma variate hemodynamic response kernel.

To compare findings within and across cultures, we averaged and extracted coefficient maps for the regressors of interest for European Americans and Chinese and conducted *t*-tests using 3dtest++ in AFNI. We also implemented 3dClustSim with a gray matter mask to determine our cluster-threshold. At a voxelwise threshold of *p* < .005, clusters of nine or more voxels with faces touching (nearest neighbor = 1) were significant at *p* < .05, corrected. Results are shown below in Table S6 and Figure S2. Additionally, unthresholded maps are available on NeuroVault.

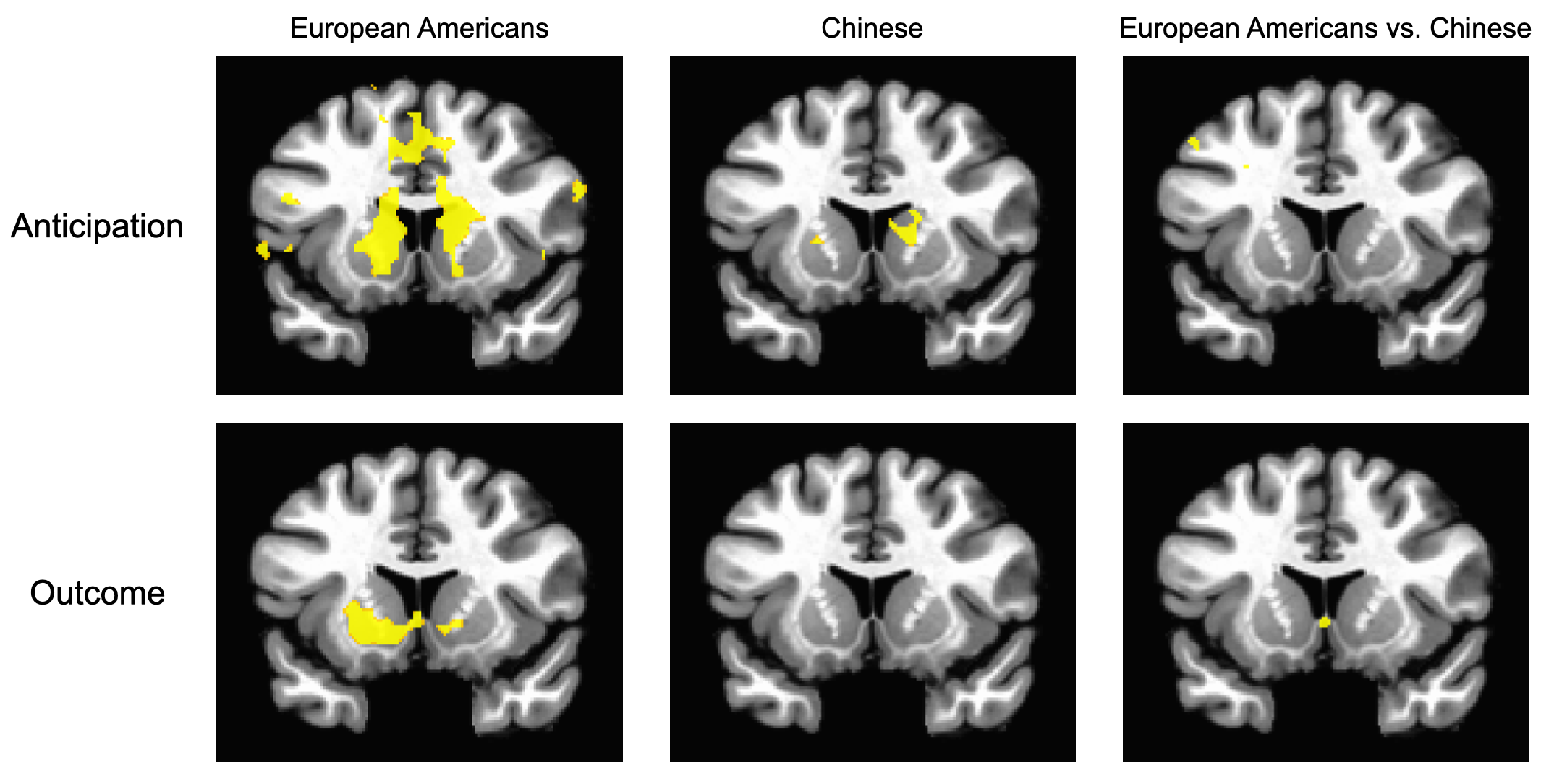
**Table S6**

Whole Brain Contrasts

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Region** | ***x*** | ***y*** | ***z*** | **Peak Z** | **Voxels** |
| **Anticipation of smiling vs. neutral faces** | | | | | |
| *European Americans* |  |  |  |  |  |
| L Caudate (+ Nucleus Accumbens) | -10 | 10 | 8 | 4.793 | 2210 |
| R Culmen/R Fusiform Gyrus | 42 | -51 | -20 | 4.341 | 373 |
| R Precentral Gyrus | 51 | -8 | 46 | 4.576 | 321 |
| L Superior Frontal Gyrus | -13 | 65 | 6 | 4.182 | 154 |
| L Inferior Frontal Gyrus | -39 | 27 | -18 | 4.639 | 67 |
| L Inferior Frontal Gyrus | -48 | 21 | -6 | 3.904 | 65 |
| R Precuneus | 22 | -66 | 38 | 4.069 | 55 |
| R Cuneus | 30 | -83 | 32 | 3.418 | 49 |
| R Red Nucleus | 1 | -19 | -9 | 3.586 | 41 |
| R Superior Temporal Gyrus | 45 | -37 | 6 | 4.067 | 40 |
| L Inferior Occipital Gyrus | -42 | -80 | -3 | 3.970 | 36 |
| L Postcentral Gyrus | -22 | -34 | 55 | 3.507 | 30 |
| L Middle Temporal Gyrus | -48 | -60 | 14 | 4.090 | 24 |
| R Cingulate Gyrus | 19 | -40 | 29 | 4.216 | 23 |
| R Postcentral Gyrus | 22 | -28 | 52 | 3.256 | 23 |
| L Cingulate Gyrus | -7 | -14 | 35 | 3.644 | 22 |
| L Lingual Gyrus | -22 | -98 | -3 | 3.757 | 19 |
| R Paracentral Lobule | 1 | -14 | 46 | 3.172 | 18 |
| L Inferior Semi-Lunar Lobule | -25 | -77 | -35 | 3.741 | 17 |
| L Paracentral Lobule | -4 | -31 | 49 | 3.632 | 17 |
| R Declive | 10 | -77 | -20 | 3.211 | 15 |
| R Middle Occipital Gyrus | 36 | -83 | 0 | 3.734 | 15 |
| L Fusiform Gyrus | -45 | -51 | -18 | 3.248 | 13 |
| L Inferior Frontal Gyrus | -51 | 7 | 20 | 3.337 | 13 |
| L Middle Frontal Gyrus | -28 | 50 | -6 | 3.614 | 12 |
| R Thalamus | 1 | -8 | -6 | 3.042 | 11 |
| R Insula | 45 | -101 | 43 | 4.024 | 11 |
| L Superior Frontal Gyrus | -30 | 42 | 26 | 3.420 | 10 |
| L Putamen | -30 | -14 | -3 | 3.429 | 9 |
| L Cingulate | -13 | 27 | 26 | 3.248 | 9 |
| R Middle Frontal Gyrus | 25 | 24 | 32 | 3.529 | 9 |
| L Precuneus | -22 | -60 | 32 | 3.616 | 9 |
| L Medial Frontal Gyrus | -16 | 7 | 49 | 3.263 | 9 |
| *Chinese* | | | | | |
| R Anterior Cingulate | 1 | 39 | 20 | 4.685 | 178 |
| R Putamen | 25 | 1 | 17 | 3.978 | 123 |
| L Caudate (+ Nucleus Accumbens) | -16 | 18 | 8 | 3.607 | 42 |
| L Postcentral Gyrus | -51 | -25 | 20 | 3.398 | 29 |
| R Cingulate Gyrus | 68 | 68 | -15 | -4.385 | 18 |
| R Superior Frontal Gyrus | 16 | 39 | 40 | 3.469 | 16 |
| L Medial Frontal Gyrus | -4 | 44 | 38 | 3.382 | 12 |
| L Superior Frontal Gyrus | -16 | 27 | 49 | 3.428 | 10 |
| R Thalamus | 1 | -5 | 6 | 3.751 | 9 |
| R Thalamus | 1 | -16 | 6 | 3.494 | 9 |
| *European Americans vs. Chinese* | | | | | |
| *no significant cultural differences* |  |  |  |  |  |
| **Anticipation of angry vs. neutral faces** | | | | | |
| *European Americans* |  |  |  |  |  |
| R Superior Frontal Gyrus | 19 | 21 | 49 | -3.962 | 58 |
| R Superior Temporal Gyrus | 54 | -57 | 17 | -3.929 | 50 |
| R Middle Frontal Gyrus | 45 | 76 | -3 | 4.926 | 44 |
| L Inferior Occipital Gyrus | -22 | -89 | -9 | 3.216 | 15 |
| R Precuneus | 10 | -51 | 32 | -3.746 | 15 |
| L Middle Occipital Gyrus | -25 | -77 | 8 | 3.471 | 12 |
| R Superior Temporal Gyrus | 56 | -19 | 12 | -3.235 | 10 |
| *Chinese* |  |  |  |  |  |
| R Precuneus | 19 | -66 | 49 | 4.550 | 86 |
| R Middle Frontal Gyrus | 19 | -14 | 58 | 3.939 | 62 |
| L Insula | -33 | 10 | 12 | 3.788 | 12 |
| L Middle Temporal Gyrus | -30 | -63 | 23 | 3.522 | 10 |
| *European Americans vs. Chinese* |  |  |  |  |  |
| R Superior Frontal Gyrus | 22 | 24 | 52 | -3.857 | 19 |
| L Postcentral Gyrus | -60 | -8 | 14 | -3.481 | 11 |
| **Outcome of hits vs. misses for smiling faces** | | | | | |
| *European Americans* |  |  |  |  |  |
| L Putamen | -19 | 7 | 0 | 4.416 | 360 |
| L Cuneus | -22 | -92 | 0 | 4.749 | 241 |
| R Middle Occipital Gyrus | 30 | -80 | 3 | 4.932 | 188 |
| R Putamen | 30 | -11 | 0 | 3.885 | 46 |
| L Anterior Cingulate | -2 | 33 | 14 | 3.567 | 39 |
| L Cerebellum | -4 | -54 | -32 | 3.955 | 34 |
| L Superior Frontal Gyrus | -28 | 42 | 38 | 3.570 | 31 |
| L Culmen | -30 | -40 | -23 | 3.632 | 25 |
| L Thalamus | -19 | -28 | 0 | 4.082 | 22 |
| R Superior Temporal Gyrus | 39 | -31 | 6 | 4.175 | 21 |
| L Precentral Gyrus | -28 | -11 | 61 | -3.624 | 21 |
| L Inferior Frontal Gyrus | -39 | 27 | 12 | 3.249 | 18 |
| L Culmen | -16 | -48 | -20 | 3.266 | 16 |
| R Thalamus | 16 | -28 | 3 | 3.293 | 14 |
| R Cingulate Gyrus | 4 | -5 | 32 | 3.876 | 14 |
| L Postcentral Gyrus | -60 | -22 | 17 | 3.564 | 10 |
| *Chinese* |  |  |  |  |  |
| R Lingual Gyrus | 22 | -95 | -3 | 4.023 | 86 |
| L Cuneus | -22 | -98 | 0 | 4.152 | 78 |
| R Parahippocampal Gyrus | 22 | -5 | -15 | 4.297 | 43 |
| R Anterior Cingulate | 4 | 30 | 14 | 3.501 | 40 |
| L Cingulate Gyrus | -2 | -8 | 26 | 3.656 | 13 |
| R Cerebellum | 1 | -43 | -12 | -3.511 | 13 |
| R Anterior Cingulate | 4 | 42 | 3 | 3.467 | 10 |
| R Cerebellum | 42 | -66 | -23 | -3.459 | 10 |
| R Middle Frontal Gyrus | 54 | 1 | 40 | 3.331 | 9 |
| *European Americans vs. Chinese* |  |  |  |  |  |
| L Culmen | -13 | -54 | -15 | 3.700 | 45 |
| L Middle Frontal Gyrus | -30 | 42 | 35 | 3.769 | 38 |
| R Caudate | 1 | 12 | 0 | 3.533 | 15 |
| L Culmen | -30 | -40 | -23 | 3.672 | 9 |
| L Culmen | -10 | -37 | -20 | 3.152 | 9 |
| L Postcentral Gyrus | -60 | -22 | 17 | 3.770 | 9 |
| **Outcome of hits vs. misses for angry faces** | | | | | |
| *European Americans* |  |  |  |  |  |
| R Precentral Gyrus | 30 | -28 | 61 | 5.053 | 1780 |
| R Putamen | 30 | 1 | 6 | 5.075 | 458 |
| L Putamen | -25 | -14 | 3 | 4.737 | 377 |
| R Culmen | 25 | -43 | -23 | 4.558 | 242 |
| R Superior Temporal Gyrus | 59 | -16 | 6 | 4.407 | 183 |
| R Inferior Parietal Lobule | 42 | -22 | 26 | 3.946 | 40 |
| R Precentral Gyrus | 54 | -5 | 23 | 4.174 | 36 |
| L Culmen | -19 | -40 | -20 | 4.210 | 35 |
| L Transverse Temporal Gyrus | -54 | -16 | 12 | 4.136 | 30 |
| R Superior Frontal Gyrus | 33 | 21 | 49 | 3.485 | 29 |
| L Cerebellar Tonsil | -25 | -40 | -29 | 3.534 | 25 |
| L Superior Temporal Gyrus | -54 | -28 | 17 | 3.580 | 16 |
| L Insula | -39 | -37 | 20 | 3.410 | 16 |
| R Superior Frontal Gyrus | 25 | 50 | 14 | 3.396 | 14 |
| R Cingulate Gyrus | 4 | 30 | 26 | -4.185 | 13 |
| R Inferior Frontal Gyrus | 39 | 50 | 0 | 3.469 | 12 |
| R Medial Frontal Gyrus | 25 | 42 | 3 | 3.384 | 12 |
| L Superior Temporal Gyrus | -45 | -31 | 12 | 3.642 | 9 |
| *Chinese* |  |  |  |  |  |
| R Superior Temporal Gyrus | 54 | -11 | 8 | 4.585 | 357 |
| L Superior Frontal Gyrus | -4 | 24 | 55 | -4.155 | 112 |
| L Postcentral Gyrus | -51 | -22 | 14 | 4.254 | 89 |
| L Insula | -28 | 4 | 23 | 4.773 | 81 |
| R Paracentral Lobule | 7 | -19 | 46 | 4.213 | 72 |
| R Precentral Gyrus | 22 | -16 | 52 | 3.995 | 64 |
| R Thalamus | 22 | -16 | 20 | 4.240 | 50 |
| R Middle Occipital Gyrus | 19 | -86 | 17 | 3.570 | 49 |
| R Putamen | 22 | 4 | 17 | 3.665 | 47 |
| R Superior Temporal Gyrus | 30 | -46 | 20 | 3.757 | 46 |
| L Insula | -39 | 15 | 12 | -3.962 | 30 |
| L Culmen | -4 | -31 | -6 | -4.423 | 26 |
| R Precuneus | 19 | -74 | 52 | 3.541 | 23 |
| L Inferior Frontal Gyrus | -25 | 18 | -9 | -4.062 | 22 |
| L Insula | -45 | -34 | 20 | 3.449 | 21 |
| R Caudate | 22 | 15 | 17 | 3.775 | 20 |
| L Medial Frontal Gyrus | -4 | 39 | 38 | -3.454 | 19 |
| L Postcentral Gyrus | -36 | -19 | 29 | 3.628 | 18 |
| L Declive | -19 | -63 | -18 | 3.439 | 16 |
| R Postcentral Gyrus | 51 | -11 | 46 | 3.474 | 14 |
| L Insula | -33 | -34 | 17 | 3.559 | 13 |
| R Claustrum | 28 | 21 | 0 | -3.704 | 13 |
| R Medial Frontal Gyrus | 10 | 27 | 38 | -3.421 | 13 |
| R Postcentral Gyrus | 28 | -34 | 43 | 3.689 | 11 |
| R Postcentral Gyrus | 45 | -16 | 52 | 3.325 | 11 |
| R Cerebellum | 25 | -54 | -35 | 3.772 | 10 |
| L Middle Occipital Gyrus | -10 | -89 | 17 | 3.416 | 10 |
| R Postcentral Gyrus | 7 | -54 | 70 | 3.535 | 10 |
| L Precentral Gyrus | -39 | -16 | 38 | 3.311 | 9 |
| L Parahippocampal Gyrus | -13 | -2 | -9 | -3.548 | 9 |
| R Parahippocampal Gyrus | 13 | -19 | -9 | -3.587 | 9 |
| Right Thalamus | 4 | -5 | -0 | -3.544 | 9 |
| *European Americans vs. Chinese* |  |  |  |  |  |
| L Cingulate Gyrus | -22 | 7 | 46 | 3.346 | 14 |
| L Inferior Parietal Lobule | -45 | -37 | 52 | 3.463 | 12 |
| R Subcallosal Gyrus | 25 | 4 | -9 | 3.292 | 11 |
| L Thalamus | -22 | -22 | 14 | 3.677 | 11 |
| L Putamen | -19 | 10 | -9 | 3.382 | 9 |
| R Putamen | 16 | 10 | -3 | 3.965 | 9 |
| R Putamen | 10 | -22 | 8 | 3.499 | 9 |
| R Thalamus | 30 | 1 | 6 | 3.194 | 9 |
| L Paracentral Lobule | -10 | -34 | 58 | 3.480 | 9 |

**Figure S2**

*Neural Activity in Response to Smiling Faces of Increasing Intensity During Anticipation (top) and Outcome (bottom) for European Americans Only (left), and Chinese Only (middle), and European Americans versus Chinese (right)*



*Note*. Voxels were thresholded at *p* < .005 (uncorrected) and cluster thresholded based on AFNI’s 3dClustSim at 9 or more contiguous voxels (*p* < .05, corrected).

**Section 6: Cultural Differences in Ideal Affect with Ideal LAP**

We administered the Affect Valuation Index (AVI; Tsai, Knutson, & Fung, 2006) to assess actual and ideal affect. In the main manuscript, we report findings for actual and ideal high arousal positive (HAP) aggregates. However, we also averaged how much participants reported actually feeling and ideally wanting to feel “calm,” “peaceful,” “relaxed,” and “serene” to create actual and ideal low arousal positive (LAP) aggregates, respectively. Actual and ideal aggregates had high internal consistency for both cultural groups (Cronbach’s α for European Americans: actual LAP = .82, ideal LAP = .89; Chinese: actual LAP = .74, ideal LAP = .76).

As described in the main manuscript, we also ipsatized LAP ratings to control for cultural differences in scale response styles (Chen, Lee, & Stevenson, 1995). For each participant, we calculated their overall mean and standard deviation across all 39 ideal affect ratings, and then, for each ideal affect rating, we subtracted their mean and divided by their standard deviation. We aggregated the four ipsatized ideal and actual affect ratings described above to create ipsatized ideal and actual LAP aggregates, respectively.

To test for cultural differences, we conducted a 2 (Culture [European American, Chinese]) X 2 (Ipsatized Ideal Affect [HAP, LAP]) repeated-measures analysis of variance (ANOVA), covarying for actual HAP and LAP. Culture was a between-subjects factor, and ipsatized ideal affect was a within-subjects factor. The Culture X Ideal Affect interaction was not statistically significant (*p* = .27). Based on prior work (Tsai, Knutson, & Fung, 2006), to further probe for cultural differences, we ran a separate one-way analysis of covariance (ANCOVA) on ideal HAP and ideal LAP, covarying for actual HAP and LAP, respectively. As reported in the main manuscript, European Americans (*M* = .71, *SE* = .08) ideally wanted to feel HAP states more than Chinese (*M* = .46, *SE* = .07), *F*(1, 50) = 5.68, *p* = .02, partial η2 = .10. However, there were no significant cultural differences in ideal LAP, *p* = .72 (European American: *M* = 1.02, *SE* = .08; Chinese: *M* = 1.06, *SE* = .08).

At first blush, these findings might seem inconsistent with those of Park et al. (2016), in which European Americans valued HAP more and LAP less than Chinese, but the group differences in ideal HAP were not significant. Fortunately, these two studies exist in a larger context of two decades of research on ideal affect. Based on 125 datasets of ideal affect, European Americans consistently value HAP more than East Asians, including Chinese (Tsai et al., 2023). Thus, the findings in the present study are consistent with the larger body of research, whereas Park et al. (2016) is an outlier. As we discussed in Park et al. (2016), we think it may have been due to our specific fMRI sample. Many Chinese told us they were afraid of the scanner, and therefore, we believe that the Chinese who did participate valued HAP more than those in the survey studies. Therefore, in the present study, we provided more information about the safety of the scanner during participant recruitment, and as a result, we believe we were able to recruit a sample that was more consistent with our survey studies.

These two decades of research on ideal affect has also revealed changes in ideal LAP over time, with European Americans valuing LAP more than previously, although the behavioral consequences of these changes are unclear (Tsai et al., 2023). As a result, recent studies have either found no cultural differences in ideal LAP or have found that European Americans value LAP more than East Asians. In the present study, we found no significant cultural differences in ideal LAP, which is consistent with these patterns.

**Section 7: NAcc Activity Timecourses Including Moderate Smiles**

In the main manuscript, we report activity in the Nucleus Accumbens (NAcc) in response to viewing excited smiling faces, calm smiling faces, and neutral faces. Because our hypotheses contrasted NAcc activity differences to excited vs. calm smiling expressions, and NAcc activity to moderate smiling expressions did not follow a linear trend (Figure S3), we excluded moderate smiling expressions from the final analyses, but we report them here for interested readers. We speculate that the moderate expressions looked odd because they were in between excited and calm smiles.

**Figure S3**

*Cultural Differences in Nucleus Accumbens (NAcc) Activity in Response to Smiling Faces in the SID TaskChart, histogram

Description automatically generated*

**Section 8: Post Hoc Power Analysis**

We conducted a post hoc power analysis based on the Culture X Emotional Expression interaction we observed for NAcc activity during the outcome of the SID task. To do so, we used the “powerSim” function (part of the “simr” package in RStudio) to run 1,000 simulations of our linear mixed effects model. Based on the results when alpha = .05, we achieved approximately 55.50% power, 95% CI = [52.36, 58.61]. We also examined pairwise comparisons across cultures for each emotional expression, and as reported in the main manuscript, European Americans (*M* = .19, *SE* = .07) showed greater average NAcc activity when they viewed excited faces than did Chinese (*M* = .10, *SE* = .07), *t*(39.06) = 2.47, *p* = .01, 95% CI = [.02, .16], Cohen’s *d* = .68. We also conducted a post hoc power analysis for this *t*-test in G\*Power, which revealed that we achieved approximately 78.72% power.

**Section 9: Mediation Model**

We hypothesized that cultural differences in NAcc activity to viewing smiles would be mediated by ideal HAP. As described in the main manuscript, the mediation model was marginal. For completion, we report the details below.

We conducted a series of three linear regressions. In the first regression, we entered Culture (0 = Chinese, +1 = European American) as the independent variable and average NAcc responses to excited smiles during the outcome (i.e., volumes 6-7) as the dependent variable. As reported in the Results in the manuscript, European Americans showed greater NAcc activation to excited smiles than did Chinese, *B* = .09, *SE* = .04, *t* = 2.49, *p* = .02. In the second regression, we entered Culture as the independent variable and self-reported raw ideal HAP as the dependent variable. European Americans wanted to feel HAP states more than Chinese, *B* = .48, *SE* = .20, *t* = 2.36, *p* = .02. Finally, in the third regression, we entered Culture and ideal HAP as the independent variables and average NAcc responses to excited smiles as the dependent variable. Culture predicted NAcc responses, *B* = .09, *SE* = .04, *t* = 2.27, *p* = .03. Ideal HAP, however, was not significant (*p* = .81), and a one-sided Sobel test revealed a marginal indirect effect (*p* = .06).

**Section 10: Anterior Insula Activity in Response to Angry Expressions**

We examined whether there were cultural differences in NAcc responses to viewing angry faces to rule out the possibility that the cultural differences we observed in NAcc responses to excited smiles reflected a more general response to other higher intensity emotional expressions. However, we also examined whether there were cultural differences in anterior insula activity, which has been associated with the outcome of a social loss (see Martins et al., 2021 for a recent meta-analysis). We centered spherical Volumes-of-Interest (VOIs) with an 8 mm diameter in the bilateral anterior insula (Talairach coordinates, ±34, 24, –4) (Genevsky et al., 2013). As in the main manuscript, we averaged the percentage signal change within the VOI, extracted activity timecourses, and averaged activity separately for misses for each trial type. Here we focused on the “outcome” (i.e., volumes 6-7) after participants successfully missed the target. Activity was lagged by 4 s to account for the hemodynamic response.

*Angry expressions.* We entered Culture (European American [0], Chinese [1]), Emotional Expression (linear contrast: high anger [1], low anger [0], neutral [-1]), and their interaction as fixed effects, and individual participants and volume as random intercepts as described in the main manuscript. Emotional Expression was not significant for European Americans or Chinese (simple effect *ps* > .11), and there was no significant Culture X Emotional Expression interaction, (*p* = .85). In other words, anterior insula activity did not increase linearly as participants viewed faces with greater intensity anger expressions.

**Section 11: NAcc Activity in Response to Monetary Incentives During Volume 6 and 7**

We found an unexpected Culture X Monetary Amount interaction in NAcc activity during the “outcome” of the MID task (i.e., volumes 6-7). As reported in the manuscript, Monetary Amount was significant for Chinese (*B* = .06, *SE* = .02, *t*(255.10) = 2.74, *p* = .01) but not for European Americans (*p* = .57). This interaction, however, was driven by differences in NAcc activity specifically during volume 7. When conducting the same analysis on activity during volume 6 only, the linear effect of Monetary Amount was significant, suggesting that NAcc activity increased as participants anticipated greater monetary gains (simple effect for European Americans: *B* = .07, *SE* = .03, *t*(100.84) = 2.14, *p* = .04; Chinese: *B* = .11, *SE* = .03, *t*(99.69) = 3.67, *p* < .001), and there was no Culture X Monetary Amount interaction (*p* = .31).

When conducting the analysis on volume 7 only, the Culture X Monetary Amount interaction was significant, *B* = .09, *SE* = .04, *t*(100.41) = 2.65, *p* = .01. Monetary Amount was significant for European Americans in the negative direction (simple effect for European Americans: *B* = -.09, *SE* = .03, *t*(101.03) = -3.54, *p* < .001), but not for Chinese (*p* = .88). More specifically, this effect for European Americans was driven by greater NAcc responses to $0 gains than to $1 or $5 gains. In previous work, Knutson and colleagues have observed the magnitude of NAcc responses to $0 gains to decrease during anticipation then increase during the outcome, which we observed for the Chinese in this study (Knutson et al., 2003). However, for the European Americans, NAcc responses to $0 gains increased such that they were greater than responses to $1 and $5 gains. Since this interaction was not predicted and has not been previously observed, we do not discuss it further.

**Section 12: NAcc Activity During Anticipation of Angry Expressions**

**and Monetary Incentives**

To rule out the possibility that cultural differences in NAcc responses to viewing excited smiles reflected a more general response to other higher intensity emotional expressions or to other rewards, we examined whether there were cultural differences in response to viewing angry faces and receiving monetary rewards during the outcome. However, since NAcc is more commonly reported during anticipation (see Oldham et al., 2018 for meta-analysis), we also conducted separate linear mixed effects regressions on average NAcc activity while participants anticipated (i.e., volumes 3-4) angry faces and monetary incentives.

*Angry expressions.* We entered Culture (European American [0], Chinese [1]), Emotional Expression (linear contrast: high anger [1], low anger [0], neutral [-1]), and their interaction as fixed effects, and individual participants and volume as random intercepts. While the Culture X Emotional Expression interaction was significant, *B* = -.03, *SE* = .02, *t*(260.00) = -2.04, *p* = .04, the simple effect of Emotional Expression was not significant for European Americans or Chinese (*ps* > 07). To decompose the interaction, we conducted post hoc *t*-tests between cultures for each expression. European Americans showed less average NAcc activity when they anticipated neutral faces than Chinese, *t*(50.85) = -2.43, *p* = .02 (European American: *M* = -.09, *SE* = .03; Chinese: *M* = -.01, *SE* = .03). However, no significant cultural differences emerged when participants anticipated low or high intensity anger expressions, *ps* > .18.

*Monetary incentives.* We entered Culture (European American [0], Chinese [1]), Monetary Amount (linear contrast: gain $5 [1], gain $1 [0], gain $0 [-1)], and their interaction as fixed effects, and individual participants and volume as random intercepts. The Culture X Monetary Amount interaction was not significant (*p* = .77). Within cultures, Monetary Amount was significant for European Americans and Chinese (simple effect for European American: *B* = .14, *SE* = .02, *t*(260.00) = 8.64, *p* < .001; Chinese: *B* = .14, *SE* = .02, *t*(260.00) = 9.23, *p* < .001). Consistent with prior work (Knutson et al., 2001a, 2001b), both European Americans and Chinese showed greater NAcc activity as they anticipated gaining increasing amounts of money.

**Section 13: Social Media Platforms and Closeness with Friends**

*Social media platforms*. To examine whether differences in the NAcc response to excited smiling faces correlated with the intensity of friends’ smiles on social media, participants indicated whether they had a social media account, and if so, which platform they used (i.e., Facebook, Instagram, WeChat). Out of our final sample of 26 European Americans and 27 Chinese, 25 European Americans and 27 Chinese had a social media account; of those, European Americans used Instagram (N = 18), Facebook (N = 6), and Twitter (N = 1) as their social media platform, while Chinese used WeChat (N = 24), Facebook (N = 2), and Instagram (N = 1).

*Friends on social media*. To capture a range of friends, we asked participants to identify three of their “closest” friends and three “new” friends. Participants navigated to each friend’s profile, indicated whether they could see their friend’s face, and rated their emotional expression. European Americans had more friends on average whose faces they could see and rate compared to Chinese, *t*(49.84) = 4.74, *p* < .001, 95% CI = [1.26, 3.11], Cohen’s *d* = 1.32 (European American: *M* = 5.04; Chinese: *M* = 2.85).

To demonstrate validity and ensure there were no cultural differences in how close participants felt toward their close and new friends, we also administered a self-report measure of how close participants felt to each friend using an adapted Inclusion of Other in the Self Scale (IOS; Aron, Aron, Tudor, & Nelson, 1991). Participants were given seven pairs of circles that represented their “self” and their “friend,” which ranged in degree of overlap from not at all (1) to mostly overlapping (7). Participants were instructed to select the pair of circles that best represents how close they are with each of the six friends, with greater overlap signifying greater closeness.

We calculated average closeness ratings separately for close friends and new friends. Means and standard deviations are reported below in Table S7. We then conducted a linear regression with Culture (European American [0], Chinese [1]), Friend Type (new [0], close [1]), and their interaction as independent variables, and average closeness as the dependent variable. As expected, there was an effect of Friend Type (simple effect for European Americans: *B* = 2.54, *SE* = .29, *t* = 8.62, *p* < .001; Chinese: *B* = 2.60, *SE* = .28, *t* = 9.26, *p* < .001), but no Culture X Friend Type interaction (*p* = .89). In other words, across cultures, participants reported feeling closer to their close friends than to their new friends. Thus, we were confident that we captured a range of friendships for each of the cultural groups.

**Table S7**

*Ratings of Closeness for Close and New Friends*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **European Americans (N = 25)** | | **Chinese (N = 27)** | |
|  | Mean | *SD* | Mean | *SD* |
| Close Friends | 4.94 | 1.02 | 4.66 | 1.12 |
| New Friends | 2.40 | 1.06 | 2.06 | 0.88 |

We collapsed across average expression ratings for close and new friends in the main manuscript. However, we conducted a linear regression with peak NAcc activity to excited smiles as the independent variable and the average intensity of friends’ expressions as the dependent variable, including average closeness ratings across friends as a covariate. As predicted, participants who showed a greater NAcc response to excited smiles had friends who showed higher intensity, excited smiles in their profile photos, *B* = 1.31, *SE* = .60, *t* = 2.21, *p* = .03. Closeness ratings were not significantly associated with the intensity of friends’ smiles (*p* = .38).

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