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Supplementary Information for

The neural representation of facial emotion categories reflects conceptual structure

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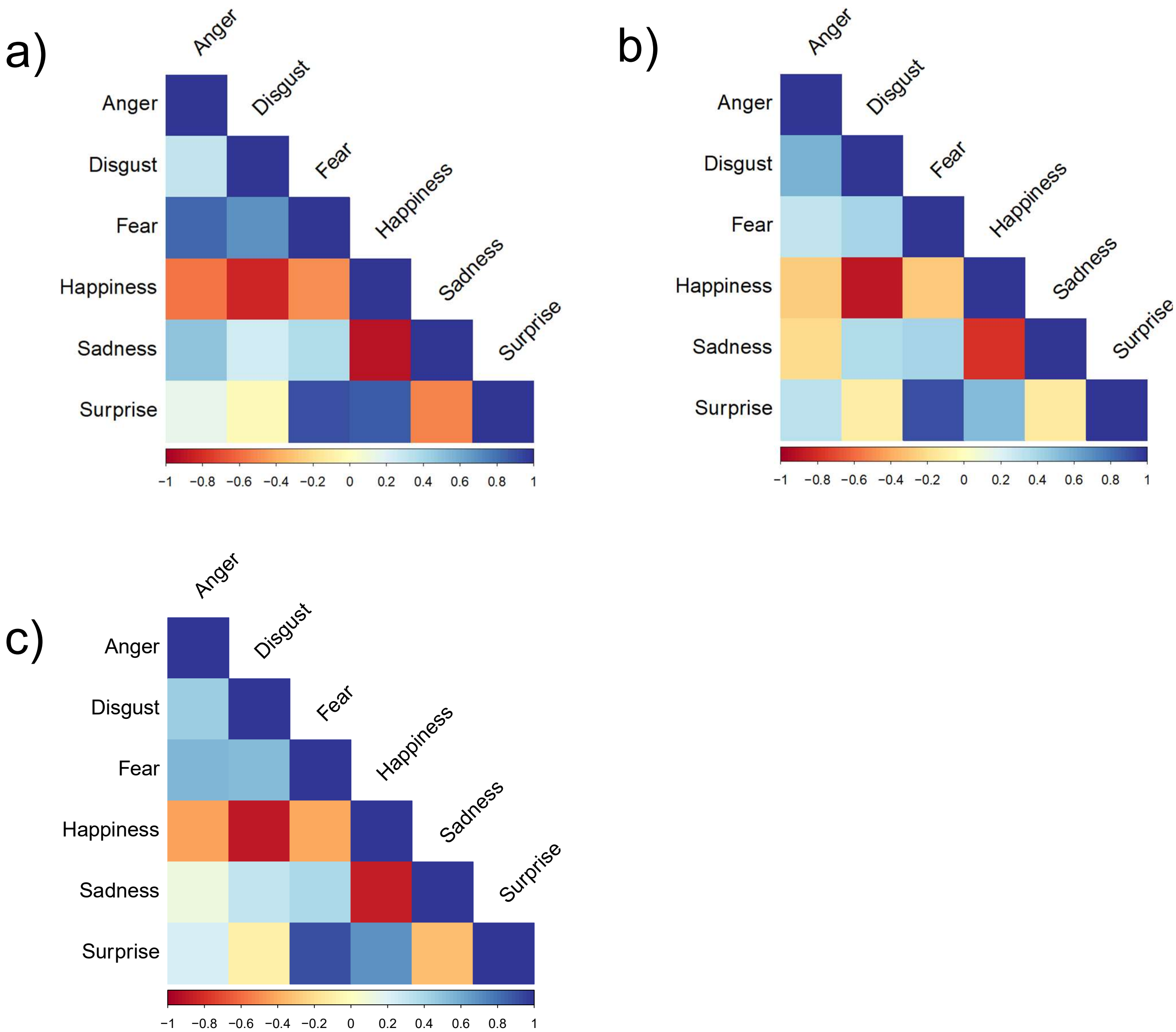

Fig. S1. Average conceptual dissimilarity matrices (DMs) derived from the conceptual ratings data.
Conceptual similarity was measured as the Pearson correlation distance ($1 - r$) between vectors of ratings made for each emotion category on its relationship with a large set of traits including thoughts, bodily feelings, and associated actions. Average conceptual DMs are depicted for a) American participants (n = 20), b) Japanese participants (n = 20), and c) the whole sample (N = 40). Cooler colors indicate high conceptual similarity and warmer colors indicate high conceptual dissimilarity.

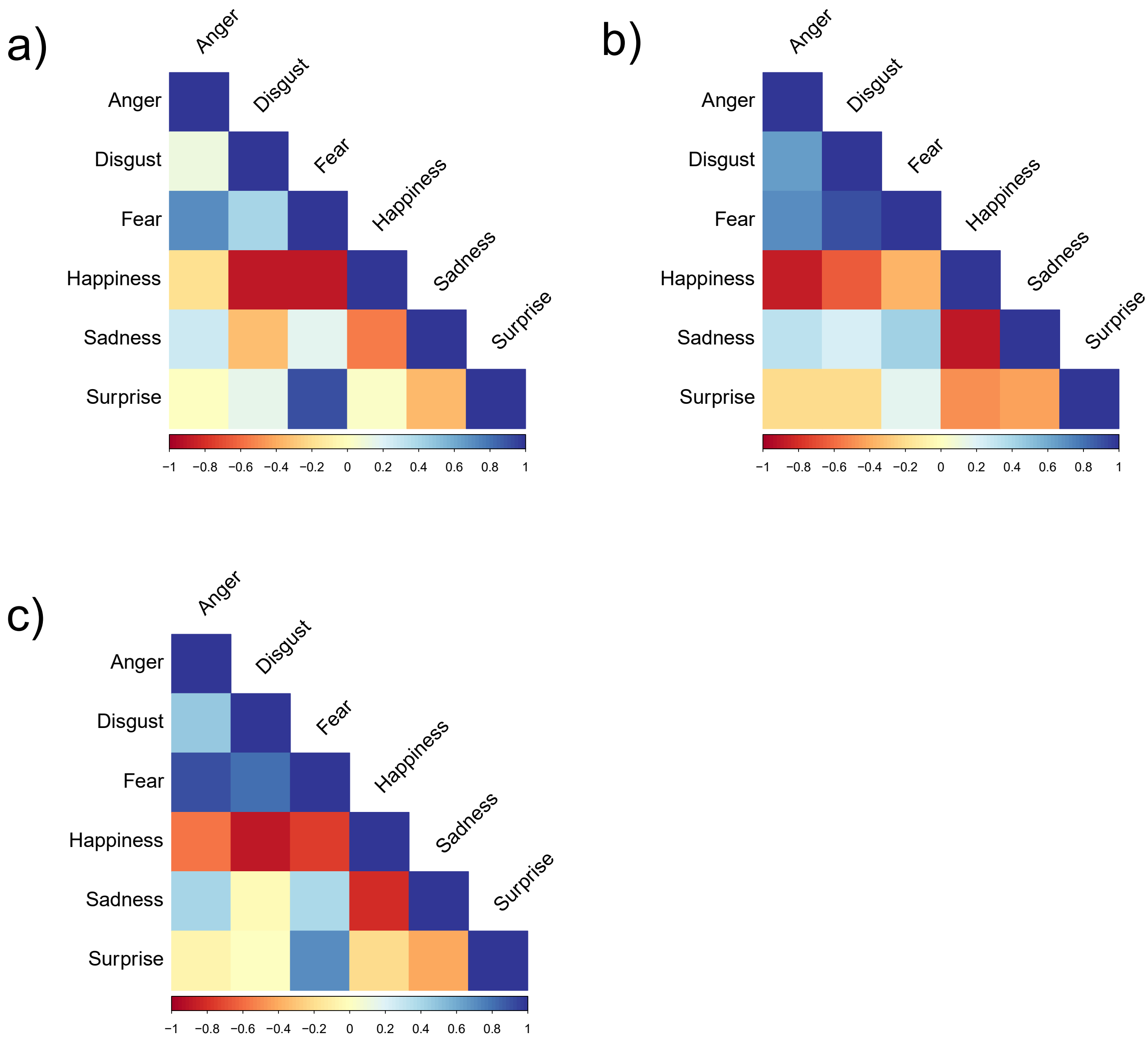

Fig. S2. Average perceptual dissimilarity matrices (DMs) derived from the mouse-tracking data.
Perceptual similarity was measured as average deviation toward the unselected category response on mouse-tracking trials with the two categories in question as response options (e.g. Angry-Disgusted). Average perceptual DMs are depicted for a) American participants ($n = 20$), b) Japanese participants ($n = 20$), and c) the whole sample ($N = 40$). Cooler colors indicate high perceptual similarity and warmer colors indicate high perceptual dissimilarity.

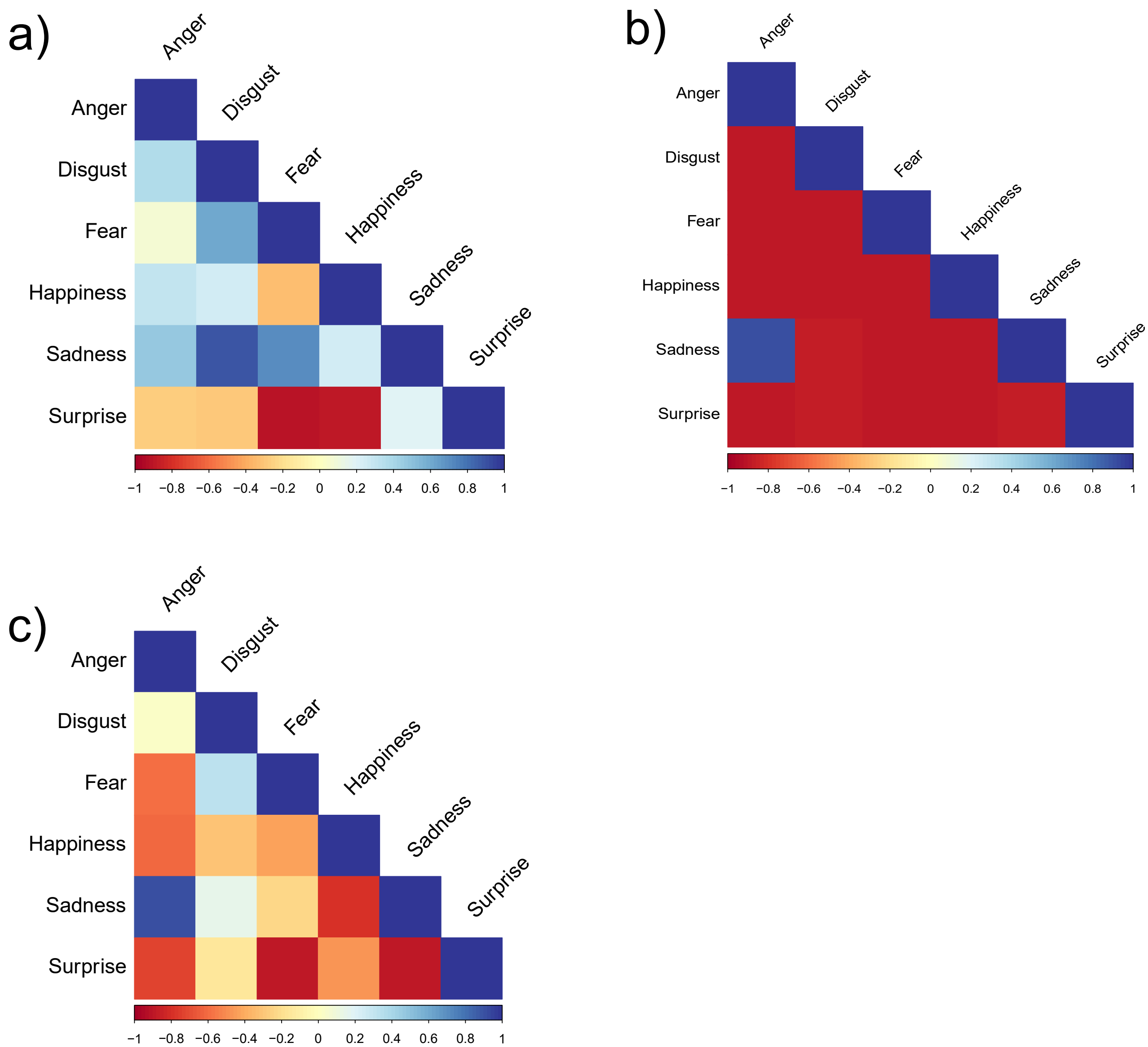

Fig. S3. Visual DMs for the face stimuli used in all tasks.
All tasks ($N = 40$) used the JACFEE face stimulus database. To account for any physical resemblance between the stimuli in each category, we included three visual control DMs in our regression models. The visual DMs were based on the overlap (Pearson correlation distance) between stimuli from each category (e.g. Anger and Disgust) in a) pixel intensity, b) retinotopic outlining, and c) representations in the C2 layer of the HMAX computational model of ventral temporal processing. Cooler colors indicate high visual similarity and warmer colors indicate high visual dissimilarity.

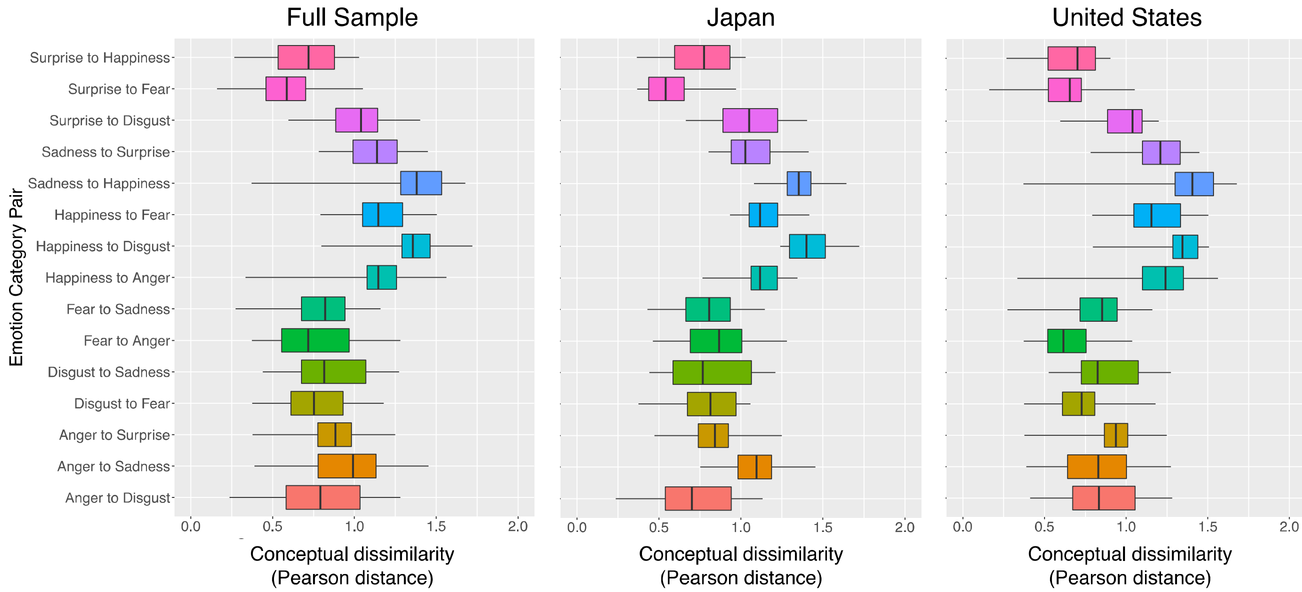

Fig. S4. Distributions of conceptual similarity values for each emotion category-pair. Box plots are depicted for conceptual similarity, showing inter-subject variability in conceptual knowledge (center line, median; box limits, upper and lower quartiles; whiskers, remaining data range). Conceptual similarity was measured as the Pearson correlation distance (1 - *r*) between vectors of ratings made for each emotion category on its relationship with a large set of traits including thoughts, bodily feelings, and associated actions. Distributions are depicted separately for the full sample ($N = 40$), the Japanese sample ($n = 20$), and the American sample ($n = 20$).

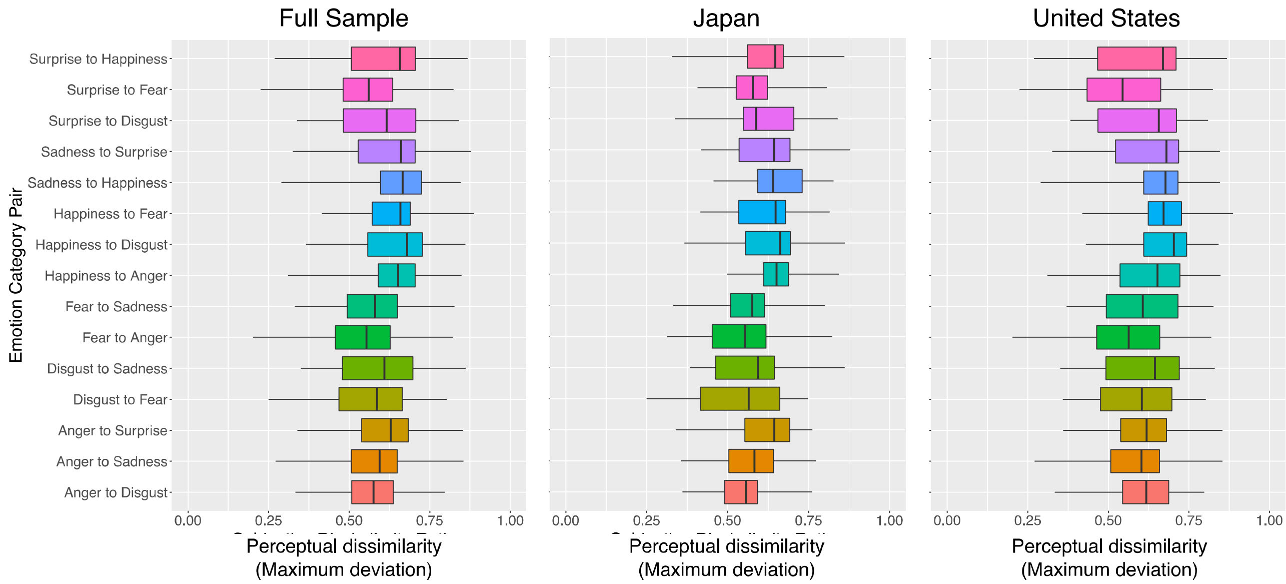

Fig. S5. Distributions of mouse-tracking perceptual similarity values for each emotion category-pair.

Box plots are depicted for perceptual similarity, showing inter-subject variability in conceptual knowledge (center line, median; box limits, upper and lower quartiles; whiskers, remaining data range). Perceptual similarity was measured as average deviation toward the unselected category response on mouse-tracking trials with the two categories in question as response options (e.g. Angry-Disgusted). Distributions are depicted separately for the full sample ($N = 40$), the Japanese sample ($n = 20$), and the American sample ($n = 20$).

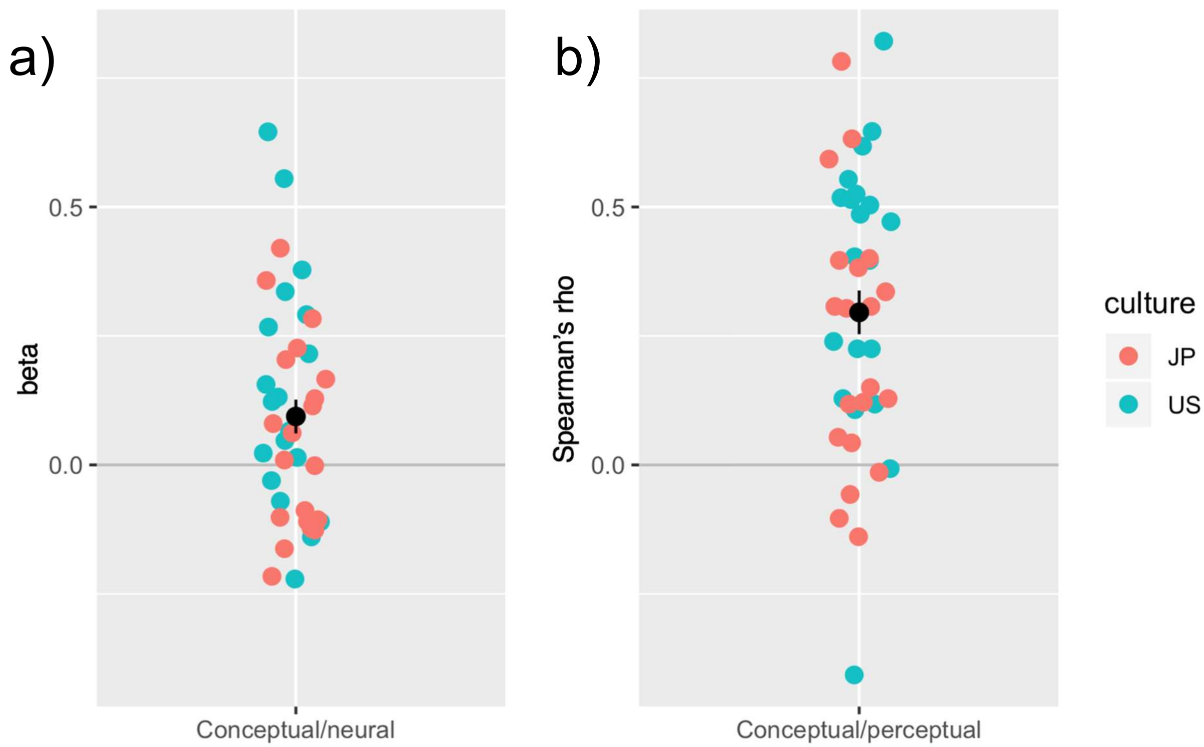

Fig. S6. Representational similarity analysis results.
Dot plots depict each subject's relationship between conceptual similarity and neural pattern similarity (a); and conceptual similarity and perceptual similarity derived from mouse-tracking (b); Japanese are shown in pink and Americans shown in blue. In a), each subject's beta value extracted from the rFG ROI (obtained using a leave-one-out procedure) is plotted. Note that three visual model DMs are included as covariates in the model. In b), for illustrative purposes only, Spearman correlation coefficients between conceptual and perceptual DMs are plotted. As the actual analysis conducted was a GEE multi-level regression that precludes obtaining subject-specific regression coefficients, an estimate of each subject's zero-order relationship is provided through Spearman correlation (thus, unlike the actual multi-level model used, these estimates do not account for the three visual DMs). Black dots indicate whole-sample mean; error bars depict standard error of the mean.

Table S1. Measures of functional MRI signal quality at each scanning site.
Japanese and American subjects were scanned using identical scanner protocols, but in separate locations with different equipment. Here we provide estimates of the signal quality of the functional data collected at each site to show that the data are comparable in terms of signal quality, signal consistency, and motion. Image quality metrics were computed using MRIQC version 0.10.1 (Esteban et al., 2017). Means and standard deviations (in parentheses) are shown for each site for the following metrics: signal to noise ratio; temporal signal to noise ratio; global correlation, the average brain-wide correlation between voxel time-series; framewise displacement (mean), the average displacement in volumes that showed instantaneous head motion, averages across runs; framewise displacement (number), the average number of volumes per run that showed displacement more than 0.20mm; AFNI's outlier ratio, number of outliers in a 4D dataset divided by total number of timepoints; and AFNI's quality index, an index of how much individual runs deviated from the norm for a given subject (with smaller values indicating less deviation from the norm).

Measure	Japan	United States
Signal to noise ratio (SNR)	4.617 (0.339)	4.408 (0.296)
Temporal signal to noise ratio (tSNR)	42.43 (8.598)	38.45 (8.239)
Global correlation (gcor)	0.035 (0.068)	0.018 (0.009)
Framewise displacement (mean)	0.195 (0.066)	0.207 (0.079)
Framewise displacement (number)	108.920 (55.861)	115.606 (72.583)
AFNI's outlier ratio (aor)	0.005 (0.014)	0.004 (0.003)
AFNI's quality index (aqi)	0.019 (0.017)	0.019 (0.011)

Table S2. Word and phrase stimuli used to calculate conceptual similarity.
The top 40 words and phrases from a pre-test in which participants were asked to "list the top 5 thoughts, bodily feelings, and actions" associated with each emotion category are shown in a). These were used to calculate measures of conceptual similarity for each subject. The full set of features were also subdivided into face-related features (b), and non-face-related features (c).

a) Emotion features	b) Face-related features	c) Non face-related features
Anxious	Crying	Anxious
Avoidance	Frowning	Avoidance
Calm	Gagging	Calm
Clenching Fists	Gasping	Clenching Fists
Crying	Jaw grinding	Depression
Depression	Laughing	Excitement
Excitement	Screaming	Frustration
Frowning	Smiling	Gross
Frustration	Turning away	Headache
Gagging	Vomiting	Heart racing
Gasping	Wide Eyes	Heat
Gross	Yelling	Hiding
Headache		Jumping
Heart racing		Lethargic
Heat		Lonely
Hiding		Loving
Jaw grinding		Nausea
Jumping		Pain
Laughing		Punching
Lethargic		Rage
Lonely		Shaking
Loving		Shock
Nausea		Sickness
Pain		Slumping over
Punching		Sweating
Rage		Tense
Screaming		Upset
Shaking		Warmth
Shock		
Sickness		
Slumping over		
Smiling		
Sweating		
Tense		
Turning away		
Upset		
Vomiting		
Warmth		
Wide Eyes		
Yelling		