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Supplementary Materials for

Universal facial expressions uncovered in art of the ancient Americas: A computational approach

Alan S. Cowen* and Dacher Keltner

*Corresponding author. Email: alan.cowen@berkeley.edu

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The PDF file includes:

Other Supplementary Material for this manuscript includes the following:

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Supplementary Material

Table S1. Emotion category and affective feature questions

Emotion Category Questions	**Sculpture facial configuration survey.** Select the emotions this person feels. **Context description survey.** <Someone playing an instrument, A prisoner of war, Someone being tortured, Someone carrying a heavy load, Someone who is about to get in a fight, Someone playing a sport, Someone holding a baby, OR Someone embracing a loved one> might feel… (select all that apply) **Options.** Amusement (humor), Anger, Awe (amazement), Concentration, Confusion, Contempt (resentment), Contentment (comfort), Contemplation, Determination, Desire (e.g., for food/sex), Disappointment, Disgust, Distress (anxiety), Doubt (suspicion), Ecstasy (bliss), Elation (joy), Embarrassment, Fear, Interest, Love (romance, adoration), Pain, Pride, Realization (epiphany), Relief, Sadness, Shame, Strain, Surprise, Sympathy, Triumph (achievement)
Affective Feature Questions	**Sculpture facial configuration survey.** To what extent does the portrayed individual feel (1…9) **Context description survey.** To what extent would <someone playing an instrument, a prisoner of war, someone being tortured, someone carrying a heavy load, someone who is about to get in a fight, someone playing a sport, someone holding a baby, OR someone embracing a loved one> feel:
approach	…Like this is something you would want to approach? (desire to avoid…desire to approach)
arousal	…Stimulated? (more subdued…more stimulated)
attention	…Focused? (more unfocused…more focused)
certainty	...Certain? (very uncertain…very certain)
commitment	...A sense of commitment to an individual or creature? (lack of commitment to an individual/creature…strong commitment to an individual/creature)
control	…Like things are under control? (things seem out of control…things seem under control)
dominance	…Dominant? (more submissive…more dominant)
fairness	…Like things are fair? (sense of unfairness…sense of fairness)
identity	…Like you identify with a group of people? (lack of group identity…strong group identity)
improvement	…His/her situation has improved? (situation has worsened…situation has improved)
obstruction	…Like you're obstructed by something? (very unobstructed…very obstructed)
safety	…A sense of safety? (very unsafe…very safe)
valence	…Pleasant? (very unpleasant…very pleasant)

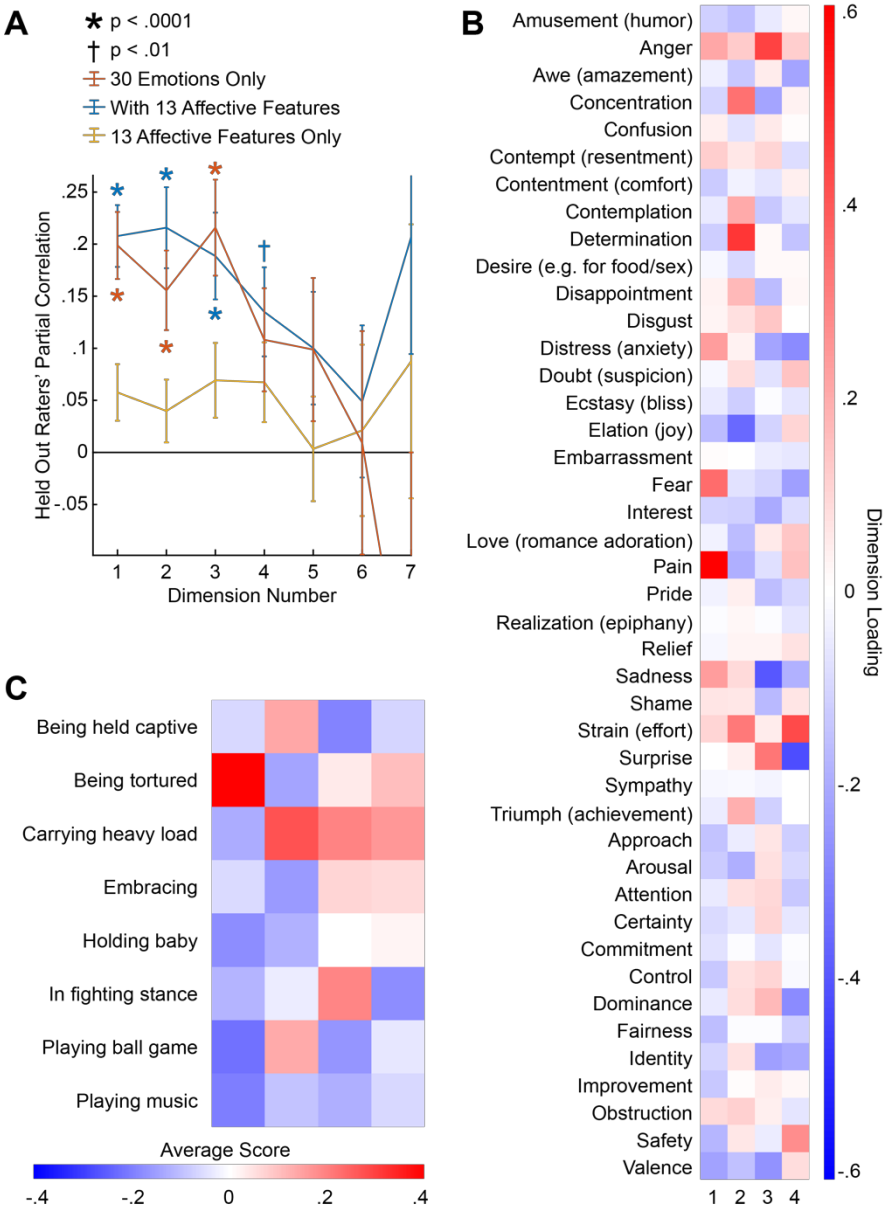

Fig. S1. Inclusion of affective features reveals one additional, difficult-to-interpret dimension. Same as Fig. 3A-C but includes affective features in the analysis and represents negative dimension scores/loadings in blue. Category and affective feature judgments were normalized such that they were weighed equally by PPCA and concatenated. **A.** To extract dimensions of perceived facial expression that accord with Western expectations for the emotions that might unfold in the 8 portrayed contexts, we again applied PPCA in a leave-one-subject-out fashion. There were four significant dimensions ($p \leq .0035$) and held out correlations were similar to those using the categories alone (Fig. 3A). **B.** Positive and negative loadings of perceived emotions in the face on each PPCA dimension. Unlike in Fig. 3B we do not separate the positive and direction dimension loadings, given that negative loadings on affective features have different meanings (e.g., a negative loading on "dominance" could equally signify "submissive" in the positive direction). The first three dimensions are similar to those captured using the categories alone (Fig. 3B). The fourth dimension seems to represent "strain" and heavy lifting in the positive direction, similar to the second dimension, but with "surprise" and "dominance" and combat in the negative direction. **C.** Average ratings from each context onto each dimension, largely similar to Fig. 3C. Note: To make measurements commensurate, both average emotion intensities and average affective features ratings were normalized by subtracting the overall minimum average rating and dividing by the maximum. Additionally, given that separate sets of subjects participated in emotion and affective feature surveys, subjects were randomly paired across surveys so that held out data for each iteration included both emotion and affective feature ratings.

Movie S1. Illustrating why principal component analysis (PCA) or factor analytic methods are not designed to account for the reliability of judgments of individual features. Each scatterplot represents hypothetical ratings from two sets of raters, with one set of ratings represented in blue and the other in orange. Each dot represents a hypothetical stimulus. Its position represents its average rating in terms of two hypothetical features. In the scatterplots on the left, there is no consistency in ratings across the two sets of raters (blue and orange). In the middle, the consistency in ratings can be captured by one dimension, with ratings orthogonal to this dimension being inconsistent across the two sets of raters. On the right, both dimensions are required to explain the consistency in ratings across the two sets of raters, given that the dots are stable in position along both axes. The dimensions extracted by PCA and factor analytic methods (first row) account only for the distribution of ratings –concatenated or averaged across datasets – and extract the same dimensions regardless of the reliability of judgments of each feature. Thus, PCA is not equipped to identify when an individual category, like fear, is reliably distinguished from every other rated category. By contrast, dimensions extracted by PPCA (second row) are designed to account for the reliability of ratings of each individual feature.