

A Multimodal Study of Disgust in the Ultimatum Game

F. Rossi¹, V. von Son², I.R. Fasel³, A.G. Sanfey², & M.S. Bartlett^{1,3}

¹ Institute for Neural Computation, University of California, San Diego; ² Donders Institute for Brain, Cognition and Behavior, Radboud University; ³ Emotient, Inc., San Diego.

*Correspondence at: frossi@ucsd.edu

Objective: This study seeks to further our understanding of affective processes in decision-making using a combination of fMRI techniques and FACET (Emotient Inc.) – a state-of-the-art system that automatically decodes emotions from facial expressions [1]. Our goal is to use emotion readings provided by FACET to guide the identification of patterns of brain activity associated with disgust. We test the validity of these patterns using the Ultimatum Game (UG).

Methods: Twenty-four participants were scanned using fMRI. On two functional runs, participants were presented with IAPS pictures [2], which were selected to elicit either positive or negative emotions (especially disgust). In an additional two runs, participants played the role of “Responder” in the UG. During the functional imaging, we recorded video of participants’ faces, and used FACET to determine (frame-by-frame) their level of disgust. The IAPS task was used to create two multi-voxel patterns. One pattern predicts whether a participant was currently viewing a disgusting picture from the fMRI signal (69% accuracy, $p < 0.0001$ – elastic networks, trained with 4-fold cross-validation; p -values estimated using 500 permutations). The other classifier was trained to predict FACET disgust scores from the fMRI signal. The resulting model was then employed to classify picture types (67% accuracy, $p < 0.0001$). We were interested in using the two patterns to predict when participants received either low (€1-€3) or high (€4-€5) offers in the UG.

Results: When applied to the Ultimatum Game (a novel dataset, and a new target), only the face-based disgust detector predicted high/low offers better than chance (65% accuracy; $p < 0.0001$). We benchmarked performance using a classifier trained directly on the fMRI signal from the UG. As expected, accuracy increases to 68%. However it speaks to the generalizability of our model that the difference between models’ accuracy is only marginally significant ($t(23) = 1.75$, $p = 0.0467$).

Conclusions: Previous research has shown that being treated inequitably is strongly related to feelings of disgust [3]. However, this is the first study that operationalizes disgust in terms of patterns of voxels activation, which generalizes across tasks. Notably, a simpler approach based on the assumption that “disgusting picture = feeling of disgust” seems to be task-dependent. We conclude that facial expressions provide a useful basis for a more fine-grained description of disgust in terms of distributed brain activation, which potentially could generalize to other basic emotions. Adding facial expressions to the pool of neuroscientific measurements opens exciting directions for the study of emotions.

References:

- [1] Littlewort G., Whitehill, J., Wu, T., Fasel, I.R., et al. (2011). The Computer Expression Recognition Toolbox (CERT). *Proc. IEEE International Conference on Automatic Face and Gesture Recognition*, 17, pp. 298–305.
- [2] Lang, P.J., Bradley, M.M., & Cuthbert, B.N. (2008). International affective picture system (IAPS): Affective ratings of pictures and instruction manual. *Technical Report A-8*. University of Florida, Gainesville, FL.
- [3] Sanfey, A., Rilling, J., Aronson, J., et al. (2003). The Neural Basis of Economic Decision-Making in the Ultimatum Game. *Science*, 300 (5626), pp. 1755–1758.