Classification of discrete emotional states from brain activity patterns


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**Introduction**

- Categorical emotional models posit six basic emotions (anger, fear, disgust, happiness, sadness and surprise) that are evolutionary scripts with distinct neural and physiological bases.
- Recent meta-analyses (e.g., Kober et al., 2008; Lindquist et al., 2012) have questioned the anatomical specificity of basic emotions by showing that the same brain regions are active during multiple emotional states.
- However, it is possible that spatially overlapping yet different patterns of brain activity in a shared circuitry could underlie different emotional states. We tested this hypothesis by using multi-voxel pattern analysis (MVPA; see e.g. Mur et al., 2009).

**Methods**

- Participants’ haemodynamic brain activity was measured with functional magnetic resonance imaging (fMRI) while emotional experiences were elicited with two different techniques.
- In Study 1, 20 participants viewed 10-s long emotional movies representing four emotion categories (disgust, fear, happiness, sadness) and a neutral state. Self-reports of the discrete emotional feelings experienced during the scanning were collected afterwards.
- In Study 2, 14 participants viewed adjectives from six emotion categories (disgust, fear, happiness, sadness, surprise, anger) and were instructed to imagine a situation where they would feel the corresponding emotion. Pairwise similarity ratings between emotion words were collected afterwards.
- Both fMRI datasets were analyzed using MVPA, where brain activity patterns were used to classify the participants’ current emotional state. MVPA was implemented using a backpropagation neural network classifier in the Princeton MVPA toolbox (http://code.google.com/p/princeton-mvpa-toolbox/).

**Results**

Behavioral results demonstrated the discrete nature of basic emotions.

**Conclusions**

- Discrete activation patterns of widespread brain networks underlie basic emotional states.
- Emotion-wise activation of midline structures was similar when emotions were induced by both movies and guided mental imagery, suggesting that these regions support discrete emotions in an induction-independent fashion.
- Since midline structures are linked to self-referential processing (e.g., Buckner & Carroll, 2007), we propose that our results reflect the discrete nature of consciously experienced emotional feelings.

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References