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Comment

Disentangling complex emotions with structured neurophysiological models
Comment on "The quartet theory of human emotions: An integrative and neurofunctional model" by S. Koelsch et al.

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Life is complex. Emotions help us to deal with life. So it should not come as a surprise that emotions are also complex. Emotion theories should help us to see through this complex world of emotions. In order to do so, they have to simplify things. However, they should not oversimplify.

Dimensional models have a long tradition in emotion theory [10]. Most dimensional models are based on the three dimensions of arousal, valence, and dominance [3]. The pictures in the International Affective Picture System (IAPS) [4] come with lists of values for these three dimensions. Conceding that dimensional theories do not try to explain the origin or the interactions of emotions, we would at least expect that they give a good description of them. Fig. 1 shows two IAPS pictures that are described by nearly exactly the same triple of dimensional ratings. They will obviously elicit quite different emotions. It would seem that emotions are not fully described by triples of numbers.

Models based on discrete emotions generally offer more emotional richness than dimensional models. However, it is obvious that a limited set of discrete emotions still cannot cover the total range of human emotions. Some researchers think of complex emotions as being composed of a small number of basic constituents. They consider these basic constituents – while different in tendency – to be basically compatible in nature and hence to be consolute, such as water and alcohol. Plutchik postulates a "wheel of emotions" [8] where he arranges eight basic emotions in a circular fashion, implying distances between them. Complex emotions would result from mixtures of these eight basic emotions. Some emotions would not mix, as they are supposed to be the opposite of each other (for instance, sadness and joy).

Plutchik's model seems to be inspired by color theory where a plentitude of colors can be obtained by mixing three basic colors, and where opponent colors do not mix (for example, there is no reddish green). And indeed, it is tempting to think of emotions in terms of a paintbox: Everyday language describes certain complex emotions as "mixed feelings". But everyday language also describes the sun as going down each evening, and we know that it is not the moving sun but the rotation of the earth that results in what we call a sunset.

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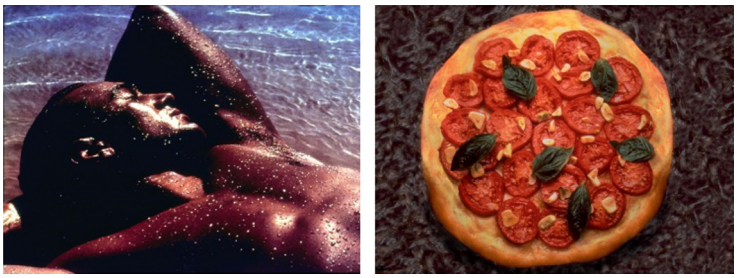

Fig. 1. IAPS pictures 4531 (erotic male) and 7351 (pizza). Both pictures feature average valence ratings of 5.8, average arousal ratings of around 4.25 and average dominance ratings of 5.9 to 6, with standard deviations of 1.7 to 2.3 on the 9-point SAM rating scales [3].

Complex emotions might comprise components that are often considered as opposite to each other. For instance, awe-inspiring stimuli eliciting chills and goosebumps have been shown to stimulate brain regions that are involved in euphoria and reward [2] but at the same time they elicit physiological signs of sadness [1]. It seems that the manikins of the SAM-scale for valence do not like to be stuck to a one-dimensional scale at all times: Sometimes they like to dance, and in this case, they may form unlikely couples, pairing pleasure with sadness.

Structured models of the neurophysiological basis of emotions, such as the Quartet Theory (QT) [5], are more useful in helping to understand complex emotions than simplistic paintbox approaches. Previous approaches of structured neurophysiological models [7] were based on evolutionary speculations that have since been disproven [9]. QT integrates a multitude of well-researched facts on the neurophysiological foundations of emotions into a structured framework and shows how the different parts of this structure are related to each other and how they interact to produce complex emotions.

QT can effectively explain the co-occurrence of seemingly contradictory emotions. For instance, watching a thunderstorm from within a safe shelter, arm in arm with one's beloved, might stimulate brainstem emotions of fear and at the same time allow for tender feelings of joy about witnessing these impressive forces of nature together and without danger. In fact, the differentiation of 'joy' originating in the hippocampus and 'fun' originating in the diencephalon represents an important advance as compared to one-dimensional valence scales that do not specify what type of pleasure is rated high in valence. It might be worth considering whether dynamical properties of emotions could be modeled with a dynamic systems version [6] of QT. Given the rich structure of QT this might appear a promising approach.

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