

## Comment

# From neuro-functional to neuro-computational models

## Comment on “The quartet theory of human emotions: An integrative and neurofunctional model” by S. Koelsch et al.

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Historically, there has been a strong opposition between psychological theories of human emotion that suggest a limited number of distinct functional categories, such as anger, fear, happiness and so forth (e.g. [1]), and theories that suggest processing along affective dimensions, such as valence and arousal (e.g. [2]). Only few current models acknowledge that both of these perspectives seem to be legitimate [3], and at their core, even fewer models connect these insights with knowledge about neurophysiology [4]. In this regard, the Quartet Theory of Human Emotions (QTHE) [5] makes a very important and useful contribution to the field of emotion research – but in my opinion, there is still at least one more step to go.

In many ways, the QTHE seems to be overlapping with the hierarchical theory of emotion proposed by Panksepp [4]. One of the obvious differences between the two is that the three level hierarchy suggested by Panksepp [4] is complemented by a fourth level within the QTHE, which is achieved by separating Panksepp's primary level into the brainstem oriented affect system and the diencephalon centered affect system. Future research that specifically targets this difference will hopefully show whether it is indeed justified by functional means, as suggested by the literature reviewed in [5]. The QTHE, secondly, puts specific emphasis on the role of language. While Panksepp [6] has also emphasized the crucial role of (mainly spoken) language and prosody, with recent language processing studies supporting at least the separation of the secondary and tertiary level of his theory [7,8], he never explicitly integrated language processes into his model. His focus has been on the primary emotion level, where the QTHE presents a more balanced description of all four affect systems, thus integrating basal affective processes with language, prosody and also music. At every system, the QTHE also emphasizes a more elaborated view on positive and negative valence than most dimensional models [2], as has been empirically suggested [9].

The one point where the QTHE misses a chance, in my opinion, is to finally make the step from neuro-functional models that map specific psychological functions to anatomical brain regions, thus providing little more than a function-to-structure-mapping based on already published studies, to a real neuro-computational model of affect that actually is able to predict new effects. The fundament, I think, is already there. It has been shown recently, for example, that it is possible to predict the affective value of words, at least in parts, in an algorithmic way [10]. Moreover, it

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is known that affective responses are dependent on familiarity [11], which can be calculated algorithmically [12] and has been assumed to be one of the fundamentals of emotion and motivation [13]. Unfortunately, the QTHE does not incorporate any of these computational elements.

Just to be clear, I am confident that the QTHE will significantly contribute to future emotion research and will probably inspire further interesting hypotheses concerning the interaction between emotion and language, among others. But given that no model of human emotion that I know of effectively combines the psychological with the neurophysiological domain within a single computational model, I think this is the way to go for the QTHE. As far as I know, the closest thing to a neuro-computational model of emotion we have right now is the neuro-functional model proposed by Panksepp [4], which strongly (but not completely) overlaps with the Zurich model of social motivation suggested by Bischof [13], which is built upon systems theory (for an English introduction to the Bischof model, see [14]). Thus, the QTHE has the chance to become the first available neuro-computational model of human emotion. In my opinion, this is the direction to go.

## References

- [1] Ekman P. An argument for basic emotions. *Cogn Emot* 1992;6:169–200.
- [2] Russell JA. Core affect and the psychological construction of emotion. *Psychol Rev* 2003;110(1):145–72.
- [3] Russell JA. Emotion in human consciousness is built on core affect. *J Conscious Stud* 2005;12(8–10):26–42.
- [4] Panksepp J. What is an emotional feeling? Lessons about affective origins from cross-species neuroscience. *Motiv Emot* 2012;36(1):4–15.
- [5] Koelsch S, Jacobs A, Menninghaus W, Liebal K, Klann-Delius G, von Scheve C, et al. The quartet theory of human emotions: an integrative and neurofunctional model. *Phys Life Rev* 2015;13:1–27 [in this issue].
- [6] Panksepp J. The power of the word may reside in the power of affect. *Integr Physiol Behav Sci* 2008;42(1):47–55.
- [7] Briesemeister BB, Kuchinke L, Jacobs AM, Braun M. Emotions in reading: dissociation of happiness and positivity. *Cogn Affect Behav Neurosci* 2014. <http://dx.doi.org/10.3758/s13415-014-0327-2>.
- [8] Briesemeister BB, Kuchinke L, Jacobs AM. Emotion word recognition: discrete information first, continuous later? *Brain Res* 2014;1564:62–71.
- [9] Briesemeister BB, Kuchinke L, Jacobs AM. Emotional valence: a bipolar continuum or two independent dimensions? *SAGE Open* 2012;2(4):2158244012466558.
- [10] Westbury C, Keith J, Briesemeister BB, Hofmann MJ, Jacobs AM. Avoid violence, rioting, and outrage, approach celebration, delight, and strength: using large text corpora to compute valence, arousal, and the basic emotions. *Q J Exp Psychol* 2014. <http://dx.doi.org/10.1080/17470218.2014.970204>.
- [11] Kuchinke L, Krause B, Fritsch N, Briesemeister BB. A familiar font drives early emotional effects in word recognition. *Brain Lang* 2014;137:142–7.
- [12] Bogacz R, Brown MW, Giraud-Carrier C. Model of familiarity discrimination in the perirhinal cortex. *J Comput Neurosci* 2001;10(1):5–23.
- [13] Bischof N. Das Rätsel Ödipus. Die biologischen Wurzeln des Urkonflikts von Intimität und Autonomie [The riddle of Oedipus. The biological roots of the core conflict between intimacy and autonomy]. Munich: Piper; 1985.
- [14] Schönbrodt FD, Unkelbach SR, Spinath FM. Broad motives in short scales: a questionnaire for the Zurich model of social motivation. *Eur J Psychol Assess* 2009;25(3):141–9.