Comment

On the role of language from basic to cultural modulation of affect Comment on "The quartet theory of human emotions: An integrative and neurofunctional model" by S. Koelsch et al.

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Koelsch et al. [1] propose the following two emotion-relevant functions of language: "(a) With regard to subjective feelings, language is an important means to express as well as communicate emotions (and, therefore, also to elicit emotions in other individuals). (b) With regard to conscious appraisal, language is an important means to regulate emotions" – assuming that "activity of affect systems and effector systems is synthesized into an emotion percept (pre-verbal subjective feeling), which can be transformed (or reconfigured) into a symbolic code such as language".

But language may modulate emotion in maybe even more basic ways:

Recent neuroscience studies reveal brain activity correlates of emotional language content even within the (un-conscious) affect system of the model of Koelsch et al. [1] (who generally suggest language to modulate emotion rather at conscious processing levels).

Even during reading, – while processing symbolic language units (words) represented by other symbols (print; letters) – highly emotional text triggers e.g., hippocampus, insula and amygdala activation [2,3] – brain areas usually understood to encode basic emotional characteristics of more elementary stimuli.

Such – maybe surprising – findings are compatible with the neural re-use hypothesis [4]: as evolution had no time to develop new brain structures responding to the rapidly changing modern environment, comparably old brain structures like the limbic system keep involved in the processing of emotional content also when presented in symbolic ways [5]. An implicit goal of language designed to emotionally capture the reader may, accordingly, be to activate these "ancient" brain regions that normally respond to stimuli of immediate or basic emotional relevance [6]. For instance, subjective immersion into reading descriptions of fearful events in "Harry Potter" books correlated with activity in brain areas associated with pain empathy [7]. Reading about fictional emotions can apparently create corresponding "real" emotions in the reader.

Most research on the emotion-cognition coupling uses affective ratings for an increasing number of words in different languages [8,9]. Event-related potentials (ERP) revealed that affective dimensions of word content trigger increased attention allocation and elaborate semantic evaluation in the following temporal order: first arousal, then

valence [10] – matching general principles of influential emotion models [11] where initial alternation of physiological states (arousal) becomes object of cognitive appraisal processes (valence).

Very early ERP effects [12] may reflect that emotion-laden words represent the emotion potential of a concept in iconic ways or such known from classic conditioning: the word itself has become the emotional stimulus (see [13] for an elaborate comment). Words' semantics are also object to variation: Words may develop some kind of affective "own life" due to emotional connotations acquired in different contexts we encountered them before: Single words' affective connotations, accordingly, modulated activity in emotion related brain areas (including insula and amygdala) independent from how readers rated the overall emotional content of sentences these words were embedded in [3].

But besides serving as a *vehicle* for communication of emotion, language also *influence*s emotion percepts: Since Sapir Whorf [14] or Slobin's "thinking for speaking" [15], language has been proposed to determine many of our cognitive processes. "Linguistic relativity" refers to how the necessity to verbally express most of our thoughts may modulate the way we think or perceive our environment depending on the specific language we use for thinking.

Accordingly, language may influence our emotion percepts in ways that are all but conscious.

"Reconfigurations of emotion percepts through language" [1] depend on the availability of appropriate linguistic labels that, in turn, depend on a given language. "Jealousy", for instance might be a useful label helping to sort out our emotion percepts in, e.g., a situation where we feel the strong urge to either run away, burst out in tears or kill somebody, because we just saw our partner in an intimate situation with somebody else. Now, ratings of the concept "jealousy" are less negative in English compared to German and Spanish translations [9] – we can only speculate to which degree this may determine the readiness of somebody from either cultural background to experience "jealousy".

In a comparative study [9] we showed that cross-language differences in affective evaluations are not limited to single concepts but rather extend to the general structure of the affective space: increasingly positive valence associates with increasing arousal in American and Spanish, but not in German and Portuguese rating data – potentially reflecting cultural frame shifts concerning intro- vs. extraversion.

Language shift, accordingly, provides a sufficient trigger for changes of emotional state in bilingual participants; both Spanish–German and German–Spanish bilinguals displayed their own personality as more extroverted, more neurotic and less conscientious when filling out the same personality inventory in Spanish vs. German language [16].

The cultural context in which we experience emotion through language seems to modify even our most basic emotional brain responses:

Native *Spanish* speakers displayed strongest electrophysiological correlates of attention allocation to words of *positive* valence, whereas the same held for *negative* words and *German* participants [17]. Descriptions of fearful moments in another cross-language [2] study elicited comparable emotional brain responses in both native and second language, while only native reading of happy passages triggered amygdala responses.

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