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Comment

Levels of analysis in neuroscientific studies of emotion: Comment on "The quartet theory of human emotions: an integrative and neurofunctional model" by S. Koelsch et al.

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In the conduct of neuroscience research, methodological choices and theoretical claims often reveal underlying metamethodological and ontological commitments. Koelsch et al. [1] accentuate such commitments in their description of four "neuroanatomically distinct systems," each the substrate of "a specific class of affects" (p. 1). Explication of those classes of affect require *theoretical* integration across *methodologically* diverse disciplines, including "psychology, neurobiology, sociology, anthropology, and psycholinguistics" (p. 3). (Philosophy is noticeably missing from this list, but several aspects of the authors' stance indicate that it is not ignored.)

From our perspective, the experiential heartbeat of this model [1] is in the proposal that (1) the integrated activity of four basic affect systems "generates" (p. 29) emotion percepts; (2) emotion percepts can be "reconfigured" (p. 31) through expressive and communicative language use; and (3) reconfigured emotion percepts have distinctively "moral" (p. 41) repercussions.

Emotion percepts: unverbalized subjective feeling

The authors propose that a ("pre-verbal") [1] (p. 28) or "unverbalized" (p. 44) subjective feeling includes: (1) an *affective component* based on projections from the affect systems to insular and somatosensory cortices; (2) a *sensory-interoceptive component* based on synthesis of the physiological condition of the body in the insular cortex; (3) a *motor component* based on action tendencies that originate in the basal-ganglia and orbitofrontal cortex; and (4) a *cognitive component* involving conscious cognitive appraisal. The first and second of these components are straightforwardly sensory, involving the integration of intero-, extero-, and proprioceptive information in the secondary somatosensory cortex (p. 30–31). However, the third component, the James–Lange aspect of this proposal, requires clarification: how

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do "action tendencies" become manifest as aspects of subjective feeling? Are the processes mediated by the basal ganglia and orbitofrontal cortex separable from "conceptual-semantic language functions"?

There is evidence that the basal ganglia mediate some forms of category learning. In particular, basal ganglia activation occurs during probabilistic category learning, i.e., learning that incrementally provides the "felt sense" of a category (coarsely, a "gut feeling") even before the basis for categorization can be stated [2]. In the perceptual-motor and perceptual-cognitive tasks used in implicit category learning research, increments in category learning are not verbally articulable; instead increments in learning become evident as a "sense" of the capacity to act. The learned category becomes accessible as a sensed "I can," as Husserl put it (cf. [3]), enabling an embodied and preverbal sense of "the same" perceptual object over time even while its sensory presentation changes. Thus, this sense of "sameness" entails a categorial semantics that exceeds sensation even while remaining embodied and preverbal. The basal ganglia plausibly mediate a similar grasp of "sameness" in emotion percepts—despite shifting somato*sensory* and *sensory*-interoceptive content—although to our knowledge this hypothesis has not been examined in relation to subjective emotion.

Also, there is evidence that the orbitofrontal cortex mediates "intuitive" perceptual judgments. For example, activation of the orbitofrontal cortex occurs during judgments that a fragmented object is nameable even before it can be explicitly named [4–6]. Stated differently, activation of the orbitofrontal cortex mediates emergence of a "felt sense" of a perceptual object that precedes articulation of the "nameable" category to which it belongs. The perceptual-cognitive stimuli used in this research remain preverbal, but the implicit recognition of category fit (a "felt sense" of familiarity) even before the object can be named may be the origin of efforts toward what Husserl [7] called "horizon explication":

> . . .every experience refers to the. . .capacity of. . .explicating, step by step, the thing which has been given in a first view, in conformity with what is really self-given thereby, but also of obtaining. . .new determinations of the same thing. (p. 32)

Although not all "intuitive" judgment tasks (e.g., anticipation of a common association to three words in a remote associates task) are mediated by the periorbital cortex [8], the detection of *imminent* coherence (its "sense") before such coherence can be "named" warrants attention in studies of the emergence of emotion percepts.

In sum, the emergence of emotion percepts is *not* tidily preverbal or preconceptual, although its occurrence also exceeds the sensory particulars of an emotion category (whether basic or moral). Plausibly, then, an implicitly naming and categorizing felt sense may already be "at work" within the covert semantics of gesture, movement, and vocalization of emotion percepts. The William James behind the James–Lange theory of emotion similarly resisted reduction of an emotion percept to its sensory qualia; in a manner that anticipates (and that influenced) Husserl's more fully developed account, he described "a residual conscious affection, a sense of the direction from which an impression is about to come, although no positive impression is yet there" [9] (p. 251). It is important to not convert the James–Lange hypothesis into a sensation-centered alternative to a rich and, more recently, empirically warranted phenomenological account.

Reconfiguring emotion percepts

An emotion percept is *not* a self-enclosed outcome simply waiting for linguistic "expression," "translation," "transformation," or, in the authors' [1] preferred term, "reconfiguration." Justification for their terminological choice is tempered—but negatively framed. First, they suggest that Wittgenstein has "shown" that language games surrounding emotion percepts function in a "different mode than the grammar of words and *things*" (p. 32, italics ours). However, they do not offer a contrasting grammar of words and *emotion percepts*. Second, the authors suggest that direct "translation" will not suffice (p. 42), although the (metaphoric?) process they reject is not clearly described. Third, the term "expression" might seem most relevant, but the authors use that term sometimes for the peripheral manifestation of physiological and motoric processes (p. 3) and sometimes for linguistic communication about emotion percepts (p. 31).

Even so, the term "expression" seems especially apt for the process through which selected linguistic forms (including preverbal gesture, posture, and vocalization) progressively explicate the vaguely felt sense of an emotion percept. The gap between a felt sense and an articulated impression is already evident in the judgments that generate an emotion percept (see above). Collingwood [10] provides an accessible (and popular) account of this process, but

explicative expression is addressed more precisely by James and Husserl (see above) and others (e.g., Ingarden, Ricoeur) in the phenomenological tradition. There have been preliminary attempts to describe explicative expression in relation to its neurocognitive substrate (e.g., [11,12]) but, as the authors affirm, the neural aspects of such reflective activity are "not yet known" [1] (p. 32).

Empirical prospects

At times the authors' [1] portrayal of what Wittgenstein purportedly "shows" seems to foreclose empirical examination of emotion percepts—especially their expressive explication. In their words:

> . . .an individual cannot *guarantee* [that] the use of words referring to his or her own feeling state (i.e., to an emotion percept) corresponds to the same feeling state in different situations, and an individual cannot *guarantee* that the use of words referring to his or her feeling state corresponds to the same feeling state of another individual even if the other individual uses the same words. (p. 32; italics ours)

The authors acknowledge that, even without such guarantees, a naturalized conception of Wittgensteinian language games is within empirical reach (see also [13]). But how might such empirical work address the *expressive* activities that plausibly generate an emotion percept?

The authors emphasize "cross-validation" of verbally reported emotion percepts with "objective measures." However, their position is potentially a velvet-gloved critique of emotion research that crosses disciplinary boundaries. It may be useful to revisit the now conventional multi-trait, multi-method orientation toward construct validation (cf. [14]). In this approach, two or more distinct traits (e.g., sadness, fear) are measured using two or more distinct methods (e.g., rating scales, content analysis). And yet, it is possible to generalize this approach to include also multiple *levels of analysis*. For example, (1) the hierarchical structure of narratives enables assessment of emotion indicators at the level of discourse structure (e.g., lexical items, declarative sentences, event structures); (2) the hierarchical structure of neural affect systems enables assessment of emotion indicators at the level of neuroanatomical structure (e.g., hippocampal or orbitofrontal BOLD indices); and (3) multi-leveled emotion constructs motivate assessment of emotion indicators across levels of analysis (e.g., discourse measures, neural affect measures).

Ideally this multi-trait, multi-method approach would require fully-crossed measurement: each of several traits would be assessed using each of several methods across two or more levels of analysis. And yet, such comprehensive efforts are never realized in practice. Instead construct validation is usually sought within one level of analysis (e.g., sadness and fear across lexical items and declarative sentences) or across levels of analysis within only one trait (e.g., fear across declarative sentences and orbitofrontal BOLD indices). Considerable integrative effort—with careful argument—is required to evaluate construct validity independently of fully-crossed research designs.

Another desideratum in construct validation research is precise articulation of the nomological (theoretical) net [14] that guides construction of the relevant multi-trait, multi-method matrices. With that in mind, it remains useful to consider closely constructs developed in moral or aesthetic disciplines (e.g., literary or musical aesthetics) that do not currently have viable neuroscience correlates. For example, how are the facets of "sublime feeling" identified in recent psychometric efforts [15] related to patterns of activation in the orbitofrontal cortex? Is each of them (wonder, transcendence, tenderness, nostalgia, peace) simply "shaped by social and cultural norms" or is there—for any or all of them—sufficient coherence across levels of analysis to warrant their consideration as a "natural" kind? These remain pivotal questions, worthy of examination at all relevant levels of analysis. Especially when extended to "moral" emotions, nuanced theory articulation remains a challenge for psychologists, neurobiologists, sociologists, anthropologists, psycholinguists, philosophers—and anyone who crosses disciplinary boundaries in their study of emotional life.

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