Kognitionspsychologie II: Session 2

What is an emotion? (continued)

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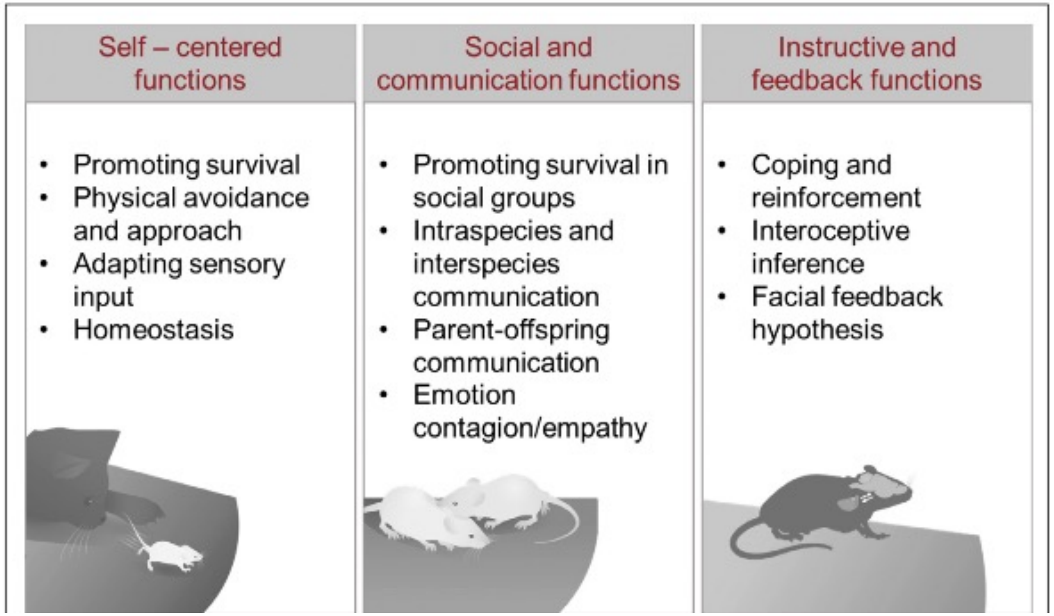
Learning Objectives for this Session

- Further explore the definition and science of emotions by:
- Considering comparative approaches and the discuss the function and description of animal affective experiences and emotions
- Consider alternative formulations to a taxonomy of emotions beyond basic emotions or (simple) dimensional ones (i.e., valence + arousal)

The adaptive value of emotions

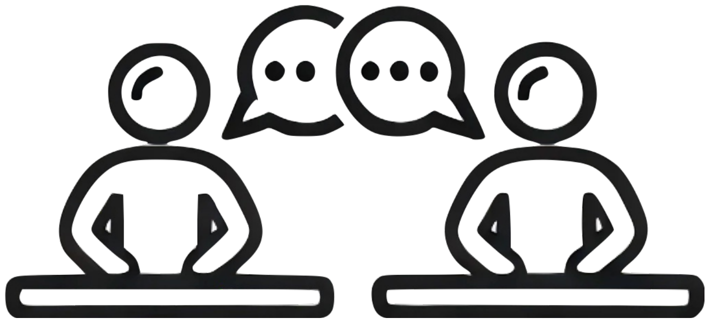


Evolutionary approaches suggest that emotion (expression) serves different functions: **Self-centered functions** promote survival directly (for example, blood flow prepares fight-or-flight responses, facial expressions associated with fear enhance sensory input, disgust reduce it). **Social and communication functions** help maintain survival in social groups by enabling emotional recognition, empathy, and emotion contagion within and across species, influenced by factors such as familiarity, experience, and social dynamics. **Instructive and feedback functions** involve emotional expressions like freezing or heartbeat changes that feedback modulate emotional states and future behavior.

Zych, A. D., & Gogolla, N. (2021). Expressions of emotions across species. *Current Opinion in Neurobiology, 68*, 57–66. https://doi.org/10.1016/j.conb.2021.01.003

DO (NON-HUMAN) ANIMALS EXPERIENCE PAIN?

How would we know and why would this matter?



Translating between Human and Animal Emotions

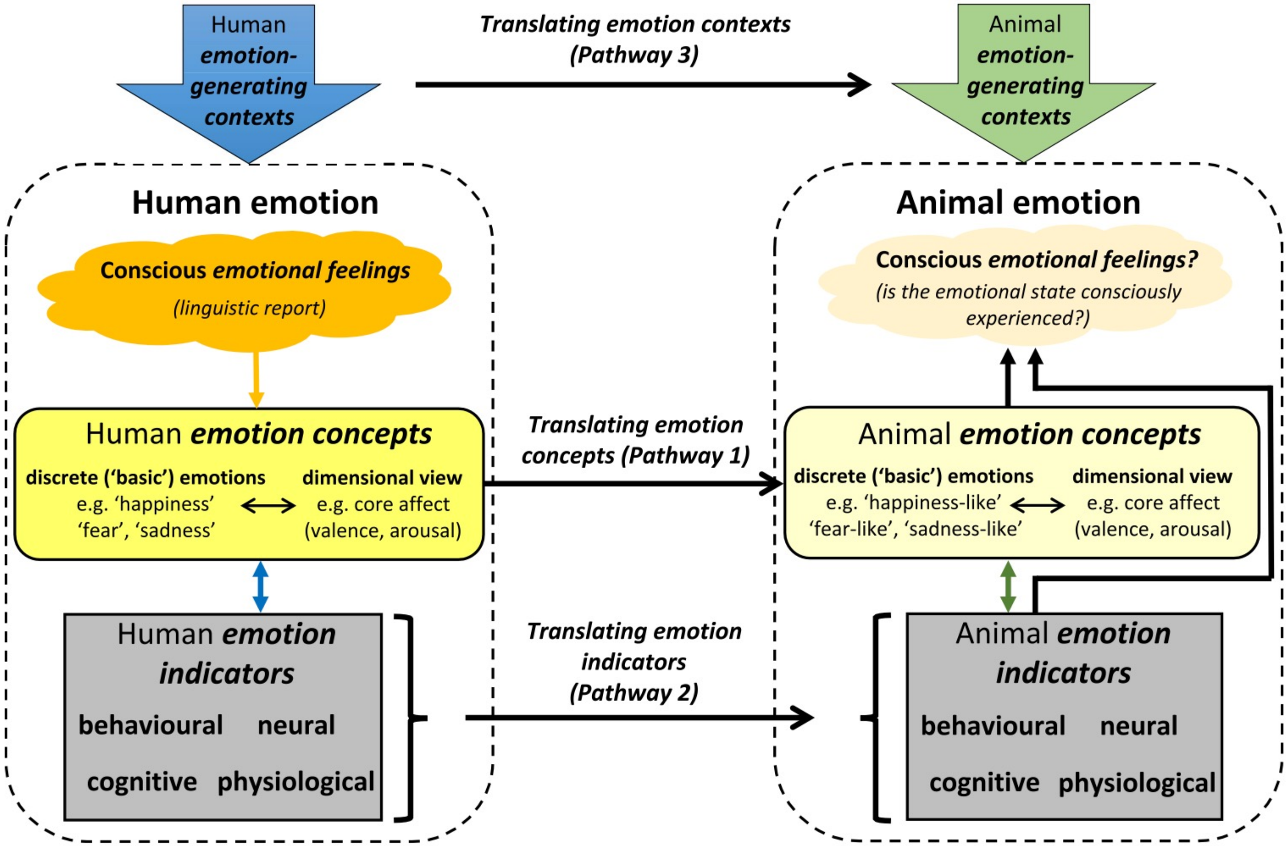
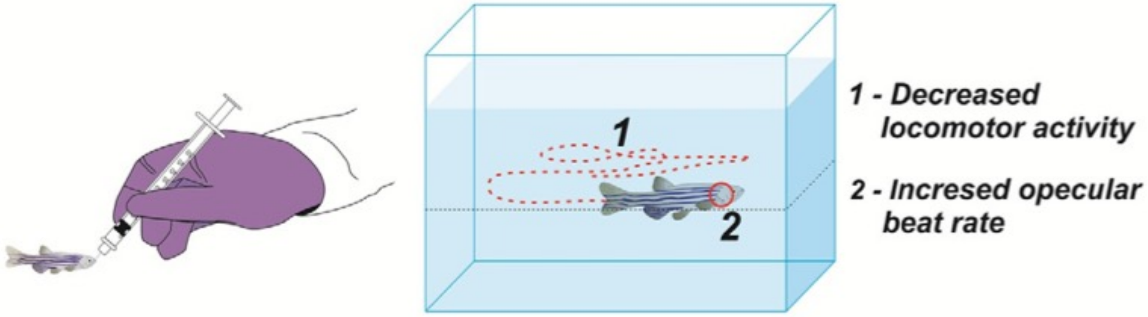
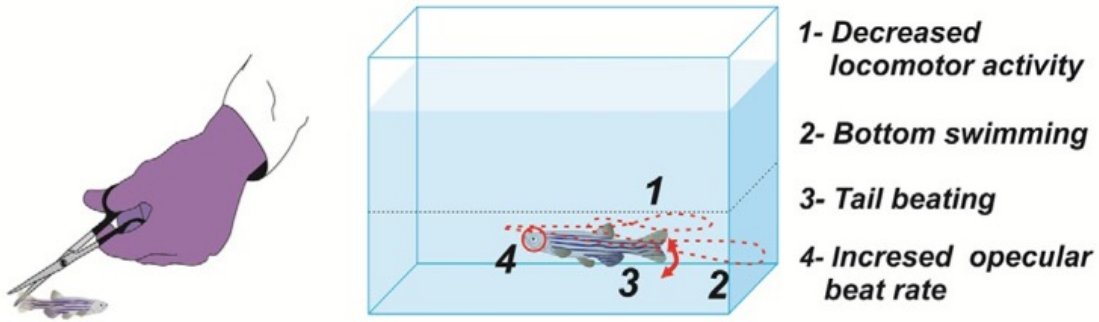


Fig. 2 Schematic representation of some of the pathways of inference that are traversed when moving from the source of our interest in animal emotions—human emotional feelings—to what we study in animals—measurable indicators of their emotional states. Concepts of human emotion are ultimately derived from linguistic report as indicated in Fig. 1 and the left-hand side of this figure, and provide the basis for our general concepts of animal emotion (Pathway 1). Behavioral, physiological, neural and cognitive markers that change in reliable ways when people report particular emotional feelings can be used as markers of these states in humans and may also be translated for use as markers of related states in other species (Pathway 2). Reported human feelings are often associated with specific contexts (large 'emotion-generating contexts' arrow on left of figure). Likewise, specific contexts can be inferred to induce particular emotional states in animals (Pathway 3). However, whether animal emotional states identified in these ways are consciously experienced (right-hand 'Conscious emotional feelings?' bubble) remains the focus of intense research and debate. The assumptions and uncertainties inherent in navigating these pathways are discussed in the text

Mendl, M., Neville, V., & Paul, E. S. (2022). Bridging the gap: Human emotions and animal emotions. *Affective Science, 3*(4), 703–712. https://doi.org/10.1007/s42761-022-00125-6

Comparative approaches in the study of pain





Costa, F. V., Rosa, L. V., Kalueff, A. V., & Rosemberg, D. B. (2022). Nociception-related behavioral phenotypes in adult zebrafish. In The Neurobiology, Physiology, and Psychology of Pain (pp. 387–393). Elsevier. https://doi.org/10.1016/B978-0-12-820589-1.00034-8

Comparative approaches in the study of pain

Key Principles	Criteria
1. Whole animal responses that differ from innocuous stimulation	• Evidence of central processing of nociception involving brain areas that regulate motivated behaviour (including learning and fear) • Nociceptive processing sensitive to endogenous modulators (e.g. opioids in vertebrates) • Nociception activates physiological responses (change in respiration, heart rate, or hormonal levels, e.g., cortisol in some vertebrates) • Evidence that responses are not just a nociceptive reflex (i.e., not simply moving away) • Alterations in behaviour over longer term that reduce encounters with the stimulus • Protective behaviour such as wound guarding, limping, rubbing, or licking • All of the above reduced by analgesia or local anaesthetics
2. Change in motivation	• Self-administration of analgesia • Pay a cost to access analgesia • Selective attention whereby the response to the noxious stimulus has high priority over other stimuli; the animal does not respond appropriately to concurrent events (e.g., presentation of predator; reduced performance in learning and memory tasks) • Altered behaviour after noxious stimulation where changes can be observed in conditioned place avoidance and avoidance learning paradigms • Relief learning • Long-lasting change in a suite of responses, especially those relating to avoidance of repeat noxious stimulation • Avoidance of the noxious stimulus modified by other motivational requirements as in trade-offs • Evidence of paying a cost to avoid the noxious stimulus

Sneddon, L. U., Elwood, R. W., Adamo, S. A., & Leach, M. C. (2014). Defining and assessing animal pain. *Animal Behaviour, 97*, 201–212. https://doi.org/10.1016/j.anbehav.2014.09.007

Comparative approaches in the study of pain

Table 2
Criteria for pain perception

Vertebrates	Mammalia	Aves	Amphibia/Reptilia	Agnatha/Osteichthyes	Cephalopoda	Decapods	Insecta
Nociceptors	√	√	√	√	√	√	√
Pathways to CNS	√	√	√	√	√	√	√
Central processing in brain	√	√	√	√	√	√	√
Receptors for analgesic drugs	√	√	√	√	√	√	?[a]
Physiological responses	√	√	√	√	√	√	?
Movement away from noxious stimuli	√	√	√	√	√	√	√
Behavioural changes from norm	√	√	√	√	√	√	√
Protective behaviour	√	√	√	√	√	√	No
Responses reduced by analgesic drugs	√	√	√	√	√	√	√[a]
Self-administration of analgesia	√	√	?	√	?	?	?
Responses with high priority over other stimuli	√	√/?[b]	?	√	√	√	No
Pay cost to access analgesia	√	?	?	√	?	?	?
Altered behavioural choices/preferences	√	√	?	√	√	√	√
Relief learning	√	?	?	?	?	?	√
Rubbing, limping or guarding	√	√	?	√	√	√	?
Paying a cost to avoid stimulus	√	√	?	√	?	√	?
Trade-offs with other requirements	√	√	?	√	?	√	?

(√) in selected taxa indicates that at least one species within an animal class fulfils the criterion, while (?) denotes that more evidence is needed or that it is inconclusive. The more criteria an individual species satisfies, the more likely it is that the species experiences pain as defined in this review.

[a] Pharmacological evidence that opioids work as analgesics in cockroaches, *Periplaneta americana* (Gritsai, Dubynin, Pilipenko, & Petrov, 2004).

[b] Some studies show pain is imperative whereas others demonstrate reduced pain behaviour when birds are starved or placed in novel circumstances.

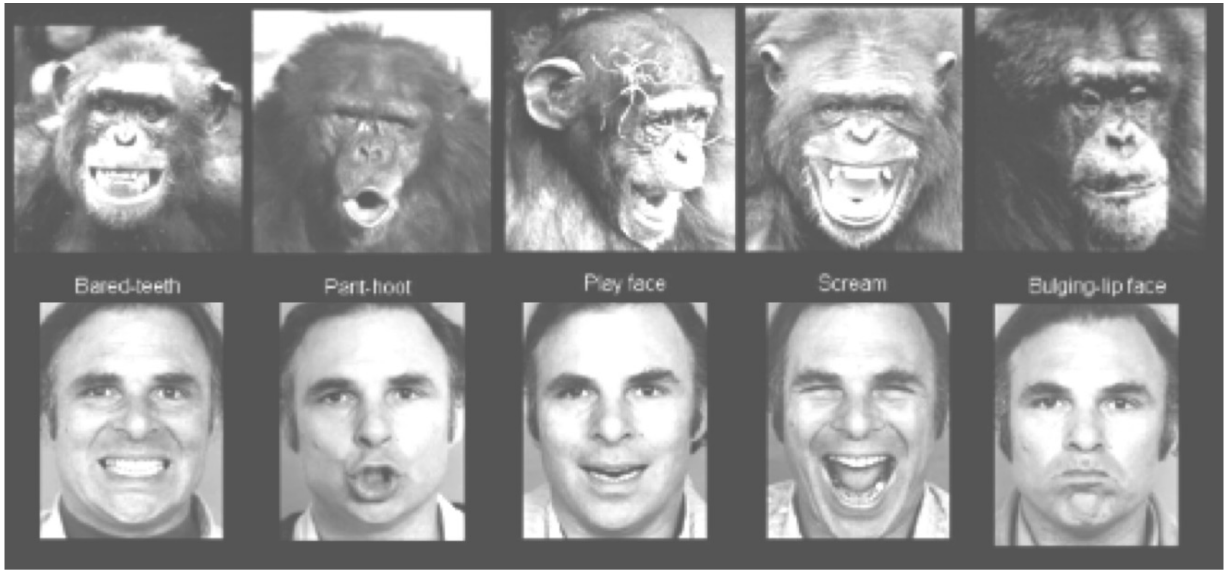
Sneddon, L. U., Elwood, R. W., Adamo, S. A., & Leach, M. C. (2014). Defining and assessing animal pain. *Animal Behaviour, 97*, 201–212. https://doi.org/10.1016/j.anbehav.2014.09.007

Definitions of Nociception, Pain, and Emotion

- Nociception is the neurophysiological process of encoding noxious stimuli that produce actual or potential tissue injury. It involves peripheral neurophysiological pathways in the sensory nervous system that encode objective information about physical stimuli and relay it from the body to the spinal cord. Nociception generates biological signals that mediate between external events and an organism's internal environment, leading to reflexive behavior to protect the organism.
- Pain is a more "reflective" process that often, but not always, results from perceiving nociceptive information. When the brain processes this information, the stimulus can be consciously experienced as painful, with consideration given to its location, intensity, sensory and emotional qualities. Pain is a contextualized, multidimensional construct resulting from interactions of peripheral and central nervous systems with potential external factors, but it cannot be reduced to peripheral activity in sensory pathways. Pain is defined as an unpleasant subjective experience with sensory and emotional components.
- Emotion is different from both pain and nociception, though the constructs are substantially overlapping conceptually and functionally. Emotional experiences are outcomes of interactions between somato-visceral patterns mediated by the peripheral nervous system, as well as cognitive processes and meta-cognitive attributions mediated by the central nervous system (CNS). Emotions can be evoked by physiological states, events in the environment, and cognitive processes, making them functionally adaptive to various stressors. Unlike pain, there do not seem to be dedicated peripheral pathways for specific emotions.

Gilam, G., Gross, J. J., Wager, T. D., Keefe, F. J., & Mackey, S. C. (2020). What is the relationship between pain and emotion? Bridging constructs and communities. *Neuron, 107*(1), 17–21. https://doi.org/10.1016/j.neuron.2020.05.024

Comparative approaches beyond pain: Basic emotions



"In collaboration with other researchers, we have now developed a similar system for chimpanzees (ChimpFACS) and, in the process, have made exciting new discoveries regarding chimpanzees' perception and categorization of emotional facial expressions, similarities in the facial anatomy of chimpanzees and humans, and we have identified homologous facial movements in the two species."

Ekman saw this type of research as showing that chimpanzees and humans share similar facial movements, supporting the idea that (basic) emotional expressions and experiences are evolutionarily conserved across species.

Parr, L., Waller, B.M., & Vick, S.J., (2007). New developments in understanding emotional facial signals in chimpanzees. Current Directions in Psychological Science, 16, 117-122.

Comparative approaches beyond pain: Anger

Experiments show that monkeys react negatively to unfair treatment, suggesting a sense of fairness and emotional responses like anger. Monkeys rejecting unequal rewards shows that emotions like anger may have evolutionary roots tied to social fairness and cooperation, which are crucial for group survival.

Brosnan, S. F., & De Waal, F. B. M. (2003). Monkeys reject unequal pay. Nature, 425(6955), 297–299. https://doi.org/10.1038/nature01963

Comparative approaches beyond pain: Love

Animals exhibit behaviors associated with bonding and affection, suggesting experiences similar to human love and attachment. There is some debate about whether love should be seen as a basic emotion (adaptive function, universal, specific neural basis) or a complex emotion/syndrome (i.e., not a single emotion or a simple feeling but a complex, dynamic system composed of various emotional, cognitive, and behavioral elements that interact with one another over time).

Comparative approaches to the study of emotions

Figure 7. A tree of emotions, which shows the resources (upright font) and situations (capitals) that emotions (italics) are about, while tracing possible phylogenetic connections between them. Drawing by and courtesy of Randolph Nesse.[117]

From an evolutionary perspective, emotions have adaptive value, aiding survival through different functions – which may be similar across species.

"Even with regards to the most complex human emotions, animal parallels cannot be ruled out. Human shame, for example, typically stems from the violation of social norms and is characterized by a desire for invisibility. It is expressed in a shrinking body posture and downcast gaze, which brings it morphologically close to the submission displays of primates and other animals. Due to its self-conscious nature, human shame appears cognitively more complex than submission, but the associated emotions may not be so different."

De Waal, F. B. M. (2011). What is an animal emotion? Annals of the New York Academy of Sciences, 1224(1), 191–206. https://doi.org/10.1111/j.1749-6632.2010.05912.x

Beyond basic and simple dimensional approaches

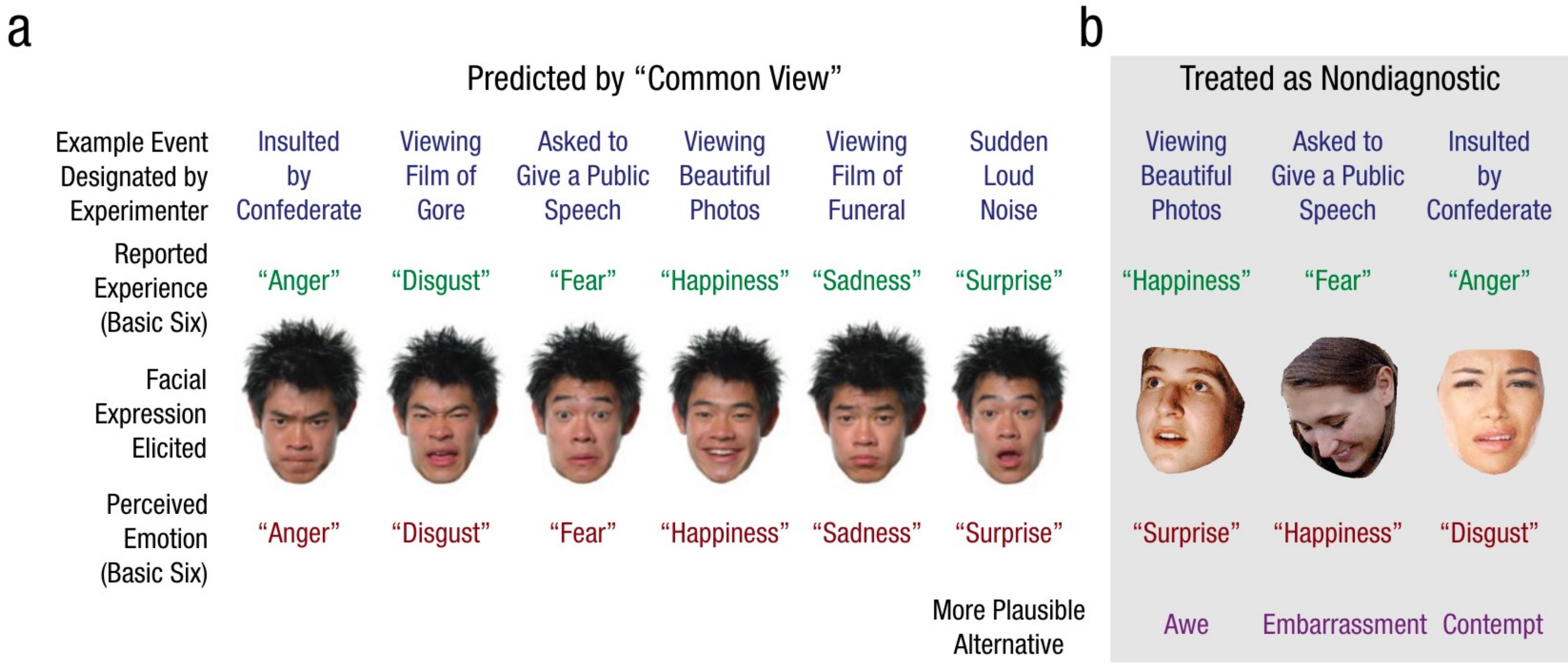


Fig. 1. Barrett and colleagues' portrayal of the "common view" of emotion and example violations of a "common view" model of emotion. In Barrett and colleagues' portrayal of lay and scientific views on emotion, particular emotion antecedents consistently elicit experiences that are captured by six coarse, mutually exclusive categories—"anger," "disgust," "fear," "happiness," "sadness," and "surprise" (a). These experiences in turn give rise to prototypical facial configurations. Example antecedents that have been used experimentally to elicit each of the basic six emotion categories are shown to the left, along with the prototypical facial configurations that they are expected to evoke. In their review, Barrett and colleagues assume that any violations of this model can serve as evidence against the diagnostic value of facial expression more generally. We illustrate some counterexamples to this tenet in (b). Plausible responses to some of the antecedents that have been used to elicit the basic six also include the three expressions presented here, which are reliably recognized as signals of "awe," "embarrassment," and "contempt" (Cordaro et al., in press; Cowen & Keltner, in press; Keltner, 1995; Shiota, Campos, & Keltner, 2003). Compared with the basic six prototypes in terms of facial muscle activation, they most closely resemble "surprise," "happiness," and "disgust," respectively, categories that notably contrast with the emotions people readily perceive in these expressions. In fact, emotional expressions convey a wide variety of states, including blends of emotion, that cannot be accounted for by the basic six.

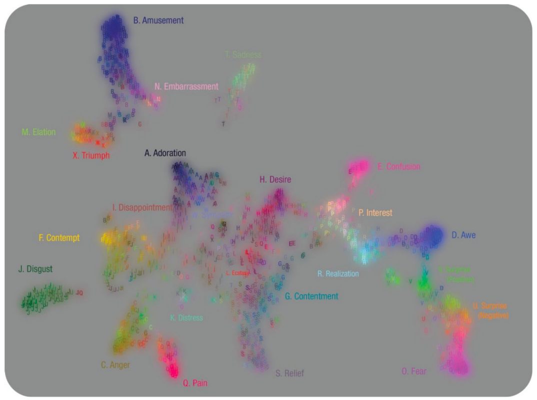
Cowen, A., Sauter, D., Tracy, J. L., & Keltner, D. (2019). Mapping the passions: Toward a high-dimensional taxonomy of emotional experience and expression. *Psychological Science in the Public Interest, 20*(1), 69–90. https://doi.org/10.1177/1529100619850176

Beyond basic and simple dimensional approaches

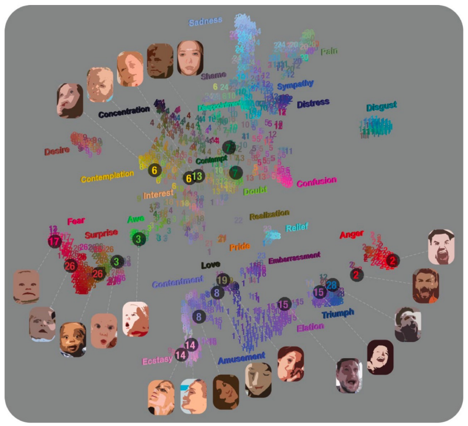
Words

Movies

Vocal bursts



Facial/bodily expressions



"(…) we offer an alternative conceptual and methodological approach that reveals a richer taxonomy of emotion. Dozens of distinct varieties of emotion are reliably distinguished by language, evoked in distinct circumstances, and perceived in distinct expressions of the face, body, and voice. Traditional models—both the basic six and affective-circumplex model (valence and arousal)—capture a fraction of the systematic variability in emotional response. In contrast, emotion related responses (…) can be explained by richer models of emotion."

URL

https://s3-us-west-1.amazonaws.com/emotionwords/map49.html
https://s3-us-west-1.amazonaws.com/emogifs/map.html
https://s3-us-west-1.amazonaws.com/vocs/map.html
https://s3-us-west-1.amazonaws.com/face28/map.html

Cowen, A., Sauter, D., Tracy, J. L., & Keltner, D. (2019). Mapping the passions: Toward a high-dimensional taxonomy of emotional experience and expression. *Psychological Science in the Public Interest, 20*(1), 69–90. https://doi.org/10.1177/1529100619850176

From basic to complex emotions

«The "common view" model of emotion portrayed in Figure 1a is incomplete in essential ways. Events or stimuli do not elicit single emotions; instead, they elicit a wide array of emotions and emotional blends, mediated by appraisals. Emotional experience does not reduce to six emotions but rather to a complex space of 25 or so kinds of emotional experience and emotion blends (e.g., Fig. 3). Emotional experience does not manifest itself in prototypical facial-muscle configurations alone but rather in multimodal expressions involving the voice, touch, posture, gaze, head movements, the body, and varieties of expressions within a given modality (e.g., Cordaro, Keltner, et al., 2016, in press; Cowen et al., 2018, 2019; Cowen & Keltner, in press; Figs. 4 and 5). Social observers do not necessarily label expressions with single emotion words but instead use a richer conceptual language of inferred causes and appraisals, ascribed intentions, and inferred relationships between the expresser and their environment, including the observer. The realm of emotion is a complex, high-dimensional space.»

Cowen, A., Sauter, D., Tracy, J. L., & Keltner, D. (2019). Mapping the passions: Toward a high-dimensional taxonomy of emotional experience and expression. *Psychological Science in the Public Interest, 20*(1), 69–90. https://doi.org/10.1177/1529100619850176

Beyond basic and simple dimensional approaches

Table 1. Separate Consideration of the Dimensionality, Distribution, and Conceptualization of Emotion Clarifies Past Methodological Limitations

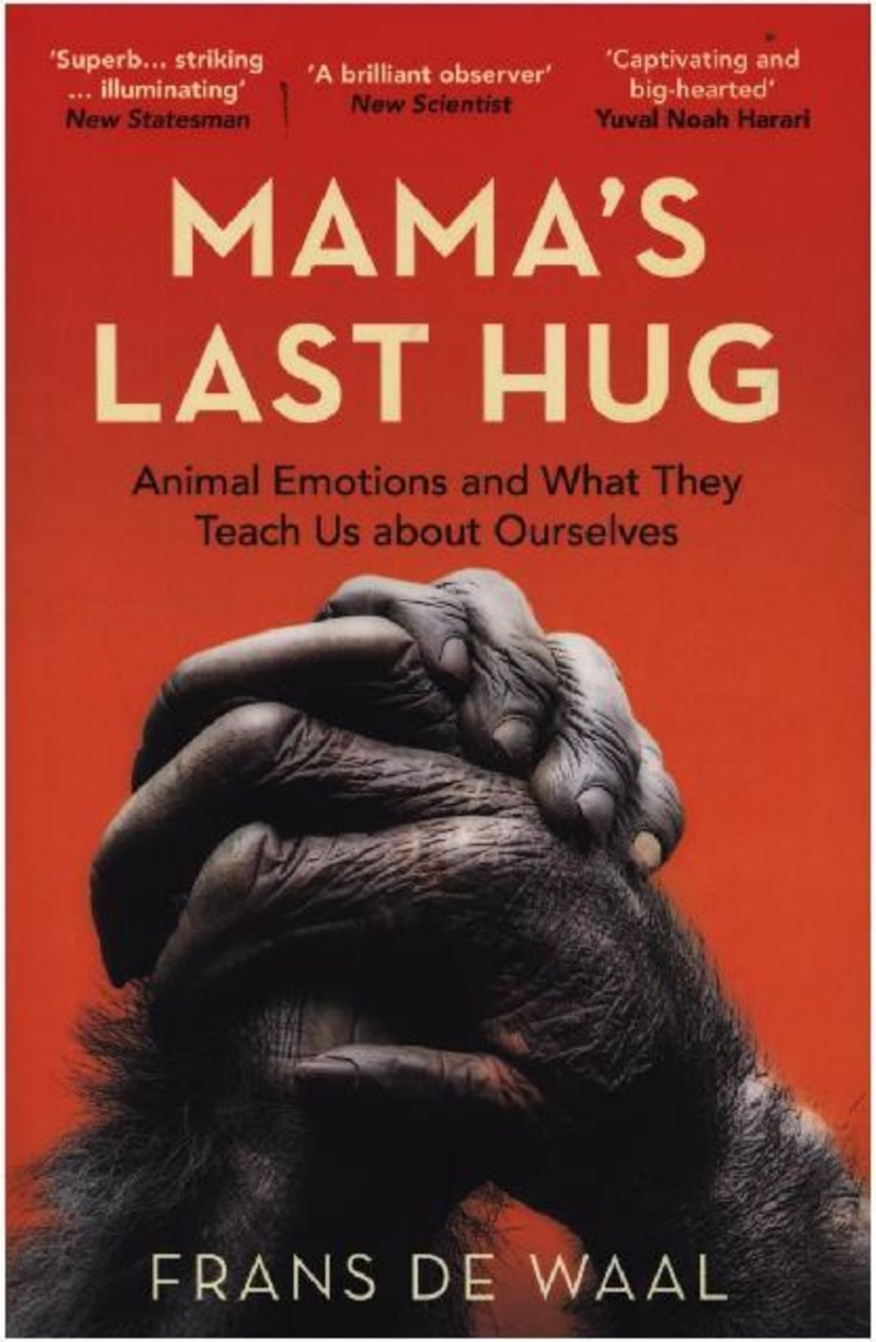
Focus	Methodological feature of study	Approach of most studies reviewed by Barrett et al.	Approach necessary to derive semantic space of emotion
Studying the dimensionality, or number of varieties, of emotion	Range of emotions studied	Focus on basic six	Open-ended exploration of a rich variety of states and emotional blends
	Source of emotional states to study	Scientists' assumptions	Empirical evidence, including ethnological and free response data
	Measurement of expressive behavior	Facial-muscle movements sorted into basic six	Multimodal expressions involving the face, body, gaze, voice, hands, and visible autonomic response measured
	Statistical methods	Recognition accuracy	Multidimensional reliability analysis
Studying the distribution of emotion, or how emotions are structured along dimensions (e.g., whether emotion-related responses fall into discrete categories or form continuous gradients)	Stimuli used in experiments	Small set of prototypical elicitors and expressions	Numerous naturalistic variations in elicitors and behavior
	Statistical methods	Recognition accuracy; confusion patterns	Large-scale data-visualization tools and closer study of variations at the boundaries between emotion categories
Studying the conceptualization of emotion, including whether emotions are more accurately conceptualized in terms of emotion concepts or more general features	Labeling of expression	Choice of discrete emotion in matching paradigms	Wide range of emotion categories, affective features from appraisal theories, and free-response data
	Statistical methods	Confirmatory analysis of assumed one-to-one mapping of stimuli to discrete emotion concepts	Inductive derivation of mapping from stimuli to emotion concepts using statistical modeling
		Qualitative examination of whether emotion-related responses seem like they could be accounted for by valence and/or arousal; sorting paradigms, factor analysis, and other heuristic-based approaches	Statistical modeling of the extent to which the reliable recognition of expression and elicitation of emotional experience can be accounted for by valence, arousal, and other broad concepts

Emphasis on elicitation and analytic methods!

Cowen, A., Sauter, D., Tracy, J. L., & Keltner, D. (2019). Mapping the passions: Toward a high-dimensional taxonomy of emotional experience and expression. *Psychological Science in the Public Interest, 20*(1), 69–90. https://doi.org/10.1177/1529100619850176

Summary

- **Adaptive views on emotions** see these as benefiting survival through self-centered, social, and behavioral regulation functions.
- **Comparative approaches** suggest that different non-human animals have affect experiences — pain. However, distinctions between nociception, pain, and emotion suggest caution in equating the affective experience of humans with that of other animals – and consensus on criteria (behavioral, neural) is lacking.
- **Comparative approaches more generally** suggest that other animals can also experience both basic (e.g., anger) and perhaps more complex emotions (e.g., love); these views, challenge the notion that complex emotions are uniquely human, put into question the role of language and culture in the origins of these emotions, and strengthen the idea of biologically determined affective experience that fulfills adaptive functions.
- **Modern views** on emotion understanding and expression in humans suggest a complex taxonomic structure that involves blends of emotions expressed through multiple channels (e.g., language, facial expressions, voice, posture). Whether this taxonomy is universal and the extent to which it can be compared across species remains unclear.


'Superb... striking ... illuminating'
New Statesman
'A brilliant observer'
New Scientist
'Captivating and big-hearted'
Yuval Noah Harari
MAMA'S LAST HUG
Animal Emotions and What They Teach Us about Ourselves
FRANS DE WAAL