

Cogsys Principia — Emotions

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Two old opposing textbook theories:

James–Lange theory

Physiological change precedes emotion and affects emotion: physiological arousal causes emotion.

Carl Lange “Om Sindsbevægelse, en psyko-fysiologisk Studie” (1885):

“We have in every emotion as certain and manifest factors: (1) a cause, — a sense impression, which acts as a rule by the aid of memory, or of an associated idea; — and thereafter (2) an effect, namely, the previously discussed vasomotor changes, and further, issuing from them, the changes in the bodily and mental functions.” — <http://psychclassics.yorku.ca/Lange/>

Hypothesis: somatic muscle activity should modulate emotional feelings (Friedman, 2010).

Cannon-Bard theory

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and one more (not so old) text book theories

Schachter-Singer theory

emotion \leftarrow bodily response + cognitive interpretation.

For example a beating heart and a situation with a tiger chasing you and the look of a lover.

The interpretation of the situation together with the bodily response gives the 'emotion'.

Experiment (“exquisitely bad”) with subjects received an injection of epinephrine and a confederate posing either euphoric or angry (Friedman, 2010).

Frijda's "Laws of emotion"

Nine Putative "empirical regularities" (Frijda, 1988).

Situational meaning: Emotions arise in response to the meaning structures of given situations; different emotions arise in response to different meaning structures.

Concern: emotions arise in response to events that are important to the individual's goals, motives or concerns.

Apparent reality: emotions are elicited by events appraised as real, and their intensity corresponds to the degree to which this is the case.

Change, habituation and comparative feeling: emotions are elicited not so much by the presence of favorable or unfavorable conditions, but by actual or expected changes in favorable or unfavorable conditions

Hedonic asymmetry: Pleasure is always contingent upon changes and disappears with continuous satisfaction. Pain may persist under persisting adverse conditions.

Conservation of emotional momentum: Emotional events retain their power to elicit emotions indefinitely, unless counteracted by repetitive exposures that permit extinction or habituation, to the extent that these are possible.

Closure: Emotions tend to be closed to judgments of relativity of impact and to the requirements of goals other than their own.

Care for consequence: Every emotional impulse elicits a secondary impulse that tends to modify it in view of its possible consequences.

Lightest load and the greatest gain: Whenever a situation can be viewed in alternative ways, a tendency exists to view it in a way that minimizes negative emotional load.

Examples

Apparent reality: “A photograph of one distressed child in Vietnam had more effect than reports about thousands killed.”

Hedonic asymmetry: “The grief upon one’s partner’s being gone is much, much more poignant and enduring than the joy caused by his or her presence a month before or the joy after his or her return one month later.”

Closure: “Verbal expressions of emotions tend to reflect this absoluteness in quality and time: ‘I could kill him’ or ‘I cannot live without her’.”

Care for consequences: “. . . tendency toward moderation or inhibition of response . . . is evident in those rare instances when control power fails . . . under toxic influences like those of alcohol”

Categories of emotions

Ekman's "basic emotions" vs. Lisa Feldman Barrett: "Conceptual act model of emotion": "the experience of emotion is an act of categorization, guided by embodied knowledge about emotion" ([Barrett, 2006](#))

	Natural-kind view	Categorization View
How many kinds of emotion?	There are a few privileged emotion kinds (at a minimum, anger, sadness, fear, disgust, and happiness).	There are no natural kinds of emotion. A person parses core affect into categories based on the concepts that he or she has learned
Brain mechanism	Specific kinds of emotion are produced by distinct, dedicated neural circuits	There are two distributed neural systems of concern—one for computing valuation and the other for implementing conceptual knowledge about emotion
...

Nine characteristics of “basic emotions”

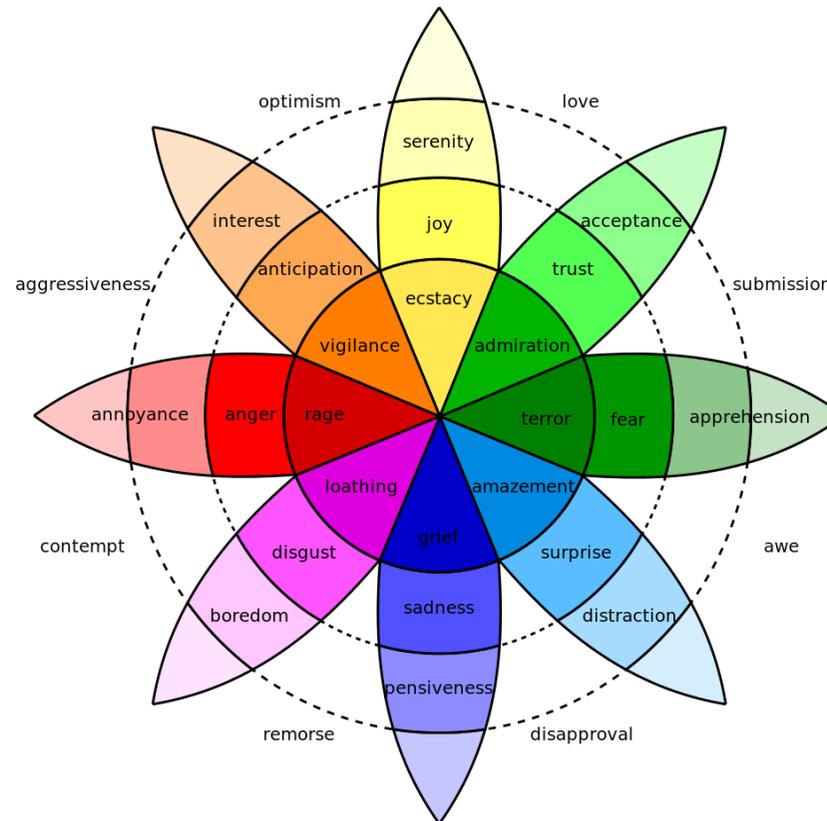
Basic emotions: surprise, anger, happiness, disgust, fear and sadness (Ekman, 1992):

1. Distinctive universal signals. Facial expressions of anger, fear, enjoyment, sadness and disgust across cultures.
2. Presence in other primates. “There is some evidence for similar facial expressions in other primates for fear and anger, possibly also for sadness and happiness”
3. Distinctive physiology. “distinctive patterns for autonomic nervous system (ANS) activity for anger, fear, and disgust, and it appears that there may also be a distinctive pattern for sadness”. “. . . blood goes to the hands in anger”

4. Distinctive universal in antecedent events. Minimal “training” can give rise to common emotions, e.g., limited exposure for establishing snake fear in monkeys.
5. Coherence among emotional response. Facial expression and ANS should have coherence with emotions.
6. Quick onset. “facial expressions can begin in a matter of milliseconds after an emotion-provoking stimulus”
7. Brief duration. “My proposal that emotions are typically a matter of seconds. . . .”
8. Automatic appraisal. “Often the appraisal is not only quick but it happens without awareness,”

9. Unbidden Occurrence. "...emotions as happening to, not chosen by us."

Robert Plutchik's Wheel of Emotions



“Three” dimensions (intensity, eight primary emotions as four pairs of opposites) (Plutchik, 2001).

Core affect

“Core affect and the psychological construction of emotion” (Russell, 2003):

Two “basic” dimensions: valence (pleasure vs. displeasure) and arousal (activation vs deactivation).

“Core affect per se is not about anything”, i.e., is not necessarily directed towards an object.

Core affect with appraisal is following by “social construction of emotional experience from prototypes” (Oatley and Johnson-Laird, 2014).

English Wikipedia

Affection Anger Angst Anguish Annoyance Anxiety Apathy Arousal Awe
Boredom Confidence Contempt Contentment Courage Curiosity Depres-
sion Desire Despair Disappointment Disgust Distrust Dread Ecstasy Em-
barrassment Envy Euphoria Excitement Fear Frustration Gratitude Grief
Guilt Happiness Hatred Hope Horror Hostility Hurt Hysteria Indifference
Interest Jealousy Joy Loathing Loneliness Love Lust Outrage Panic Pas-
sion Pity Pleasure Pride Rage Regret Relief Remorse Sadness Satisfaction
Schadenfreude Self-confidence Shame Shock Shyness Sorrow Suffering
Surprise Trust Wonder Worry Zeal Zest

. . . and

The emotional brain ([LeDoux, 1998](#)):

. . . the proper level of analysis of a psychological function is the level at which that function is represented in the brain. This leads to a conclusion that clearly falls into the realm of the bizarre at first—that the word “emotion” does not refer to something that the mind or brain really has or does.

Emotion expression

Darwin-Ekman et al. evolutionary explanation of emotion expression

Physiological regulation, e.g., fear “... elicits a cascade of responses including heavier breathing, the redistribution of blood in preparation for rapid movement, and a marshaling of attentive resources to promote hypervigilance” (Shariff and Tracy, 2011).

Social communication

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For example: disgust “Constricted Orifices Reduce Inhalation of Possible Contaminants” (physiological function) and then “Warns About Aversive Foods, as Well as Distasteful Ideas and Behaviors” (communicative function) (Shariff and Tracy, 2011).

Computers and emotions

“Affective computing” et al.

Sentiment analysis: Determine sentiment/emotion/opinion in a text.

Emotion recognition:

- Speech emotion recognition
- Face expression recognition, image-based, facial electromyography
- Gestures
- Movements
- Music emotion recognition
- Physiology: Galvanic skin response, cardiac and respiration.

Sentiment analysis

Valence: Positive-negative, e.g., AFINN (Nielsen, 2011)

Valence, arousal, dominance, e.g., ANEW (Bradley and Lang, 1999)

“Linguistic Inquiry and Word Count”: Aggression (Swear words: damn, piss, fuck), Affective processes (happy, cried, abandon), Anxiety (worried, nervous), Anger (hate, kill, annoyed), Sadness (crying, grief, sad), Positive emotion (love, nice, sweet), Negative emotion (ugly, nasty) (Tausczik and Pennebaker, 2010)

NRC: anger, anticipation, disgust, fear, joy, sadness, surprise, trust. (Plutchik’s eight) (Mohammad and Turney, 2013). Others: (Bann and Bryson, 2012)

Happy, funny, sexy, romantic, . . . , melancholy, sad (Petersen et al., 2009)

Speech emotion recognition

“Survey on speech emotion recognition: Features, classification schemes, and databases” ([El Ayadi et al., 2011](#)).

For example: A database of German emotional speech: Anger, joy, sadness, fear, disgust, boredom, neutral.

Face expression recognition

Example:

Kaggle competition: “[Challenges in Representation Learning: Facial Expression Recognition Challenge](#)”, 48x48 pixel grayscale images of faces; angry, disgust, fear, happy, sad, surprise, neutral.

Physiology signals emotion recognition

“An affective computing approach to physiological emotion specificity: Toward subject-independent and stimulus-independent classification of film-induced emotions” ([Kolodyazhniy et al., 2011](#))

Channels: Electrocardiography, impedance cardiography, blood pressure monitor, electrodermal activity, respiratory inductive plethysmography, capnography, temperature sensor, piezo-electric sensor, eyeblink EMG, facial expression EMG, facial expression EMG.

Three classes classification: fear, sadness, neutral.

Emotion expression

WE-4R robot expressing 6 different emotions + neutral with its two 9 DOF arms and 47 DOF face (Miwa et al., 2004). “...has the ability to express emotions and to communicate with humans in a human-like manner” with the Ekman six: surprise, anger, happiness, disgust, fear and sadness as well as neutral.

Pepper robot touted to have emotions: **What makes you angry?** and **Is there anything that bothers you?**

Emotional intelligence

the capacity to reason about emotions, and of emotions to enhance thinking. It includes the abilities to accurately receive emotions, to access and generate emotions so as to assist thought, to understand emotions and emotional knowledge, and to reflectively regulate emotion so as to promote emotional and intellectual growth. — (Mayer et al., 2004)

Popular claim: “Best predictor of success in life” .

EI correlates with academic performance and inversely with deviant behavior.

Four areas of emotional intelligence

(Mayer et al., 2004)

1. Perceive emotion. Recognize emotion in facial or postural expressions
2. Use emotion to facilitate thought. “Some types of problem solving are specifically facilitated by some emotions”
3. Understand emotions.
4. Manage emotion. “count to 10”

“Outstanding questions”

From (Oatley and Johnson-Laird, 2014):

“What is the basis of emotional experience? Is it positive-versus-negative valence, a small number of basic emotions, or a larger number of states of action readiness?”

“Are emotional terms in natural languages coherent and can theories of emotion explain them?”

“Can a cognitive theory of emotion be implemented in a computer model that can infer emotions from stories”

Further questions

Why should robots have emotions and/or expression of emotions?

- 1) To communicate with humans,
- 2) Because it is an advantage itself?

Leftover theories

Opponent-Process Theory. “hedonic habituation”

Action-readiness theory of emotion. “ur-emotions” states of readiness for certain kinds of action.

Communicative theory of emotions ([Oatley and Johnson-Laird, 2014](#))

Belief-desire theory of emotion, also with computational modeling ([Reisenzein, 2009](#)).

References

Bann, E. Y. and Bryson, J. J. (2012). The conceptualisation of emotion qualia: semantic clustering of emotional tweets. In *Proceedings of the 13th Neural Computation and Psychology Workshop*.

Barrett, L. F. (2006). Solving the emotion paradox: categorization and the experience of emotion. *Personality and Social Psychology Review*, 10(1):20–46.

Bradley, M. M. and Lang, P. J. (1999). Affective norms for English words (ANEW): Instruction manual and affective ratings. Technical Report C-1, The Center for Research in Psychophysiology, University of Florida.

Cannon, W. B. (1987). The James-Lange theory of emotions: a critical examination and an alternative theory. *The American Journal of Psychology*, 100(3-4):567–566.

Ekman, P. (1992). **An argument for basic emotions**. *Cognition and Emotion*, 6(3/4):169–200.

El Ayadi, M., Kamal, M. S., and Karray, F. (2011). Survey on speech emotion recognition: Features, classification schemes, and databases. *Pattern Recognition*, 44(3):572–587. DOI: [10.1016/j.patcog.2010.09.020](https://doi.org/10.1016/j.patcog.2010.09.020).

Friedman, B. H. (2010). Feelings and the body: the Jamesian perspective on autonomic specificity of emotion. *Biological psychology*, 84(3):383–383. DOI: [10.1016/j.biopsycho.2009.10.006](https://doi.org/10.1016/j.biopsycho.2009.10.006).

Frijda, N. H. (1988). The laws of emotion. *American Psychologist*, 43(5):349–358. DOI: [10.1037/0003-066X.43.5.349](https://doi.org/10.1037/0003-066X.43.5.349).

Kolodyazhniy, V., Kreibig, S. D., Gross, J. J., Roth, W. T., and Wilhelm, F. H. (2011). An affective computing approach to physiological emotion specificity: toward subject-independent and stimulus-independent classification of film-induced emotions. *Psychophysiology*, 48:908–922. DOI: [10.1111/j.1469-8986.2010.01170.x](https://doi.org/10.1111/j.1469-8986.2010.01170.x).

LeDoux, J. (1998). *The emotional brain*. Touchstone, New York, New York, USA.

- Mayer, J. D., Salovey, P., and Caruso, D. R. (2004). Emotional intelligence: theory, findings, and implications. *Psychological Inquiry*, 15(3):197–215.
- Miwa, M., Itoh, K., Ito, D., Takanubu, H., and Takanishi, A. (2004). Design and control of 9-DOFs emotion expression humanoid. In *Proceedings of the 2004 IEEE International Conference on Robotics & Automation*, pages 128–133. IEEE.
- Mohammad, S. M. and Turney, P. D. (2013). NRC Emotion Lexicon. Technical report, National Research Council Canada.
- Nielsen, F. Å. (2011). [A new ANEW: evaluation of a word list for sentiment analysis in microblogs](#). In Rowe, M., Stankovic, M., Dadzie, A.-S., and Hardey, M., editors, *Proceedings of the ESWC2011 Workshop on 'Making Sense of Microposts': Big things come in small packages*, volume 718 of *CEUR Workshop Proceedings*, pages 93–98.
- Oatley, K. and Johnson-Laird, P. N. (2014). Cognitive approaches to emotions. *Trends in Cognitive Sciences*, 18(3):134–140. DOI: [10.1016/j.tics.2013.12.004](https://doi.org/10.1016/j.tics.2013.12.004).
- Petersen, M. K., Mørup, M., and Hansen, L. K. (2009). Sparse but emotional decomposition of lyrics. In Baumann, S., Burred, J. J., Nürnberger, A., and Stober, S., editors, *3rd International Workshop on Learning Semantics of Audio Signals: Proceedings*, pages 31–43.
- Plutchik, R. (2001). The nature of emotions. *American Scientist*, 89:344–350.
- Reisenzein, R. (2009). Emotional experience in the computational belief-desire theory of emotion. *Emotion Review*, 1(3):214–222. DOI: [10.1177/1754073909103589](https://doi.org/10.1177/1754073909103589).
- Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological Review*, 110(1):145–172. DOI: [10.1037/0033-295X.110.1.145](https://doi.org/10.1037/0033-295X.110.1.145).
- Shariff, A. F. and Tracy, J. L. (2011). [What are emotion expressions for](#). *Current Directions in Psychological Science*, 20(6):395–399. DOI: [10.1177/0963721411424739](https://doi.org/10.1177/0963721411424739).
- Tausczik, Y. R. and Pennebaker, J. W. (2010). The psychological meaning of words: LIWC and computerized text analysis methods. *Journal of Language and Social Psychology*, 29(1):24–54. DOI: [10.1177/0261927X09351676](https://doi.org/10.1177/0261927X09351676).