A few questions on the content of the previous lecture

slido

Audience Q&A Session

ⓘ Start presenting to display the audience questions on this slide.

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The visual word form area (VWFA) becomes selective for written words as a result of ....

ⓘ Start presenting to display the poll results on this slide.

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Subitizing refers to our ability to...

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The difficulty acquiring reading skills is called ...., while the difficulty acquiring arithmetic skills is called ....

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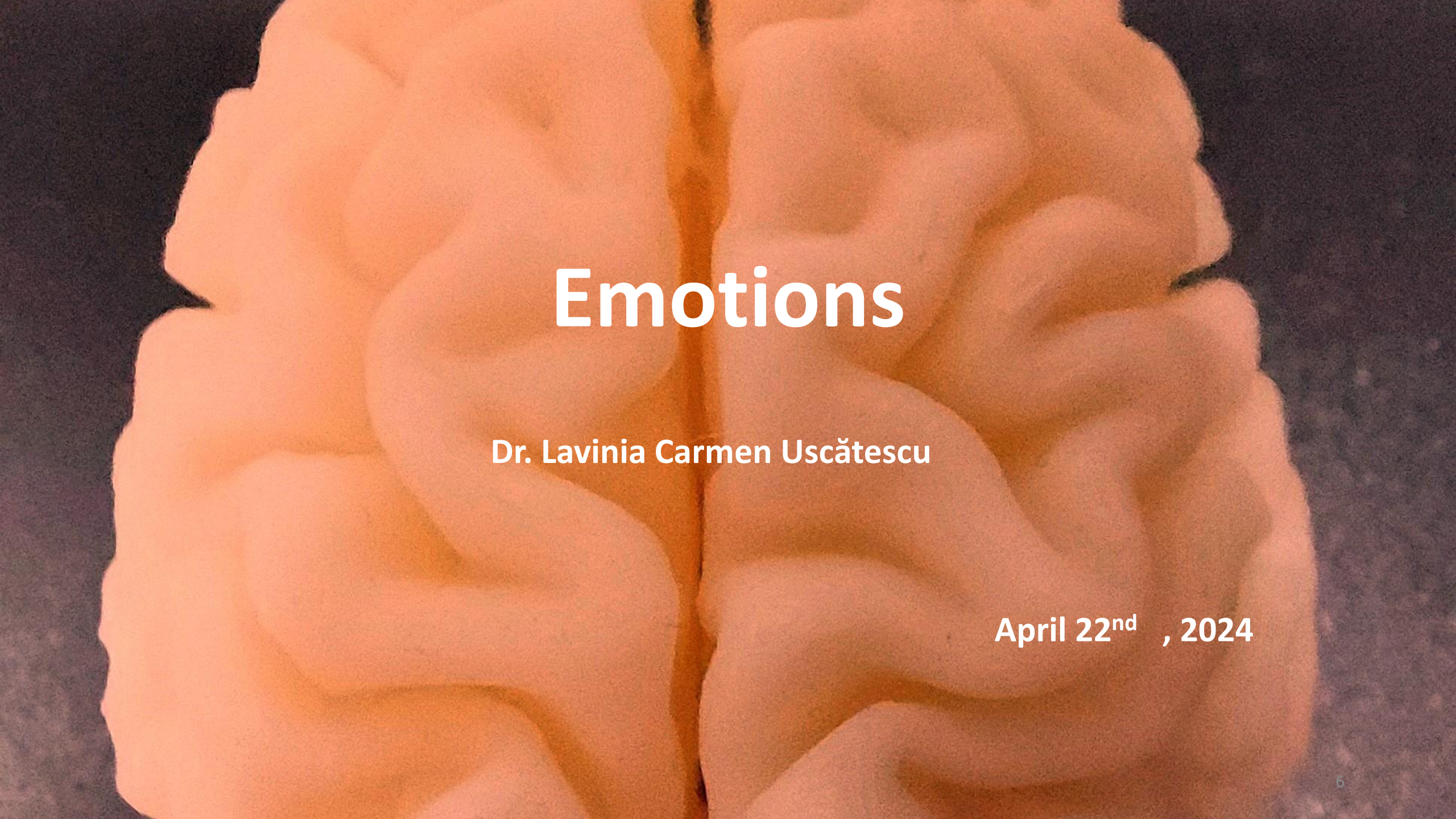


Emotions

Dr. Lavinia Carmen Uscătescu

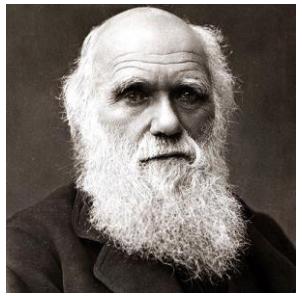
April 22nd , 2024

Outline

1. Theoretical foundations
2. The neural substrates of emotion processing
3. Psychophysiological measures of emotion processing
4. Emotion regulation
5. Alexithymia

Theoretical foundations

Charles Darwin

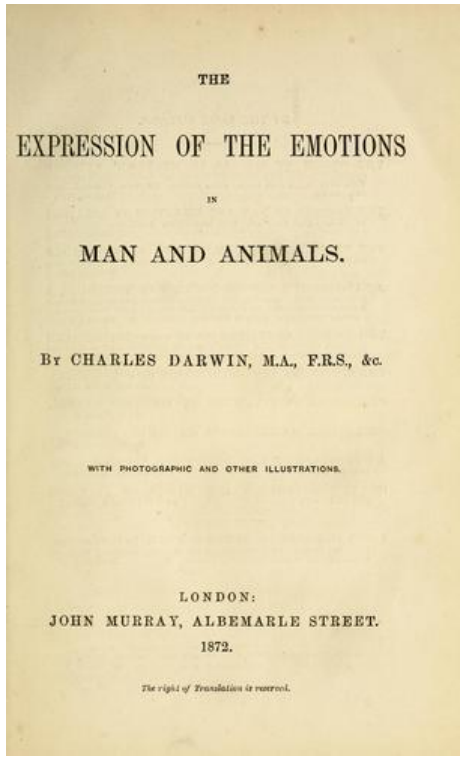


Charles Darwin
(1809 – 1882)

Proposed that **emotional expressions** were **innate** (i.e., instinctual, not learned) and described how many expressions (e.g., anger) are preserved across species.

expressions

external **motor** outcomes in the **face** and **body** associated with **emotional states**



THE

EXPRESSION OF THE EMOTIONS

IN

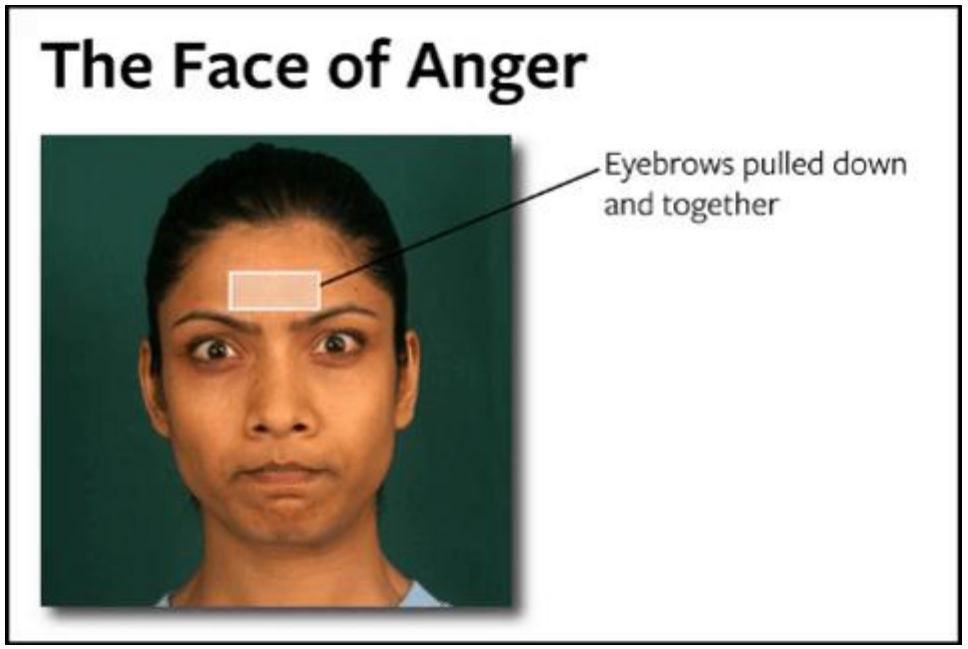
MAN AND ANIMALS.

By CHARLES DARWIN, M.A., F.R.S., &c.

WITH PHOTOGRAPHIC AND OTHER ILLUSTRATIONS.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1872.

He inspired the work of **Paul Ekman** who proposed that there are **6 universal** (cross-cultural) emotional expressions: *fear*, *anger*, *joy*, *sadness*, *disgust*, and *surprise*.



https://www.paulekman.com/

Article | Open access | Published: 12 June 2023

Experiments on real-life emotions challenge Ekman's model

Sara Coppini, Chiara Lucifora, Carmelo M. Vicario & Aldo Gangemi

Sara Coppini[3], Chiara Lucifora[1,3], Carmelo M. Vicario[2] & Aldo Gangemi[1,3]

Ekman's emotions (1992) are defined as universal basic emotions. Over the years, alternative models have emerged (e.g. Greene and Haidt 2002; Barrett 2017) describing emotions as social and linguistic constructions. The variety of models existing today raises the question of whether the abstraction provided by such models is sufficient as a descriptive/predictive tool for representing real-life emotional situations. Our study presents a social inquiry to test whether traditional models are sufficient to capture the complexity of daily life emotions, reported in a textual context. The intent of the study is to establish the human-subject agreement rate in an annotated corpus based on Ekman's theory (Entity-Level Tweets Emotional Analysis) and the human-subject agreement rate when using Ekman's emotions to annotate sentences that don't respect the Ekman's model (The Dictionary of Obscure Sorrows). Furthermore, we investigated how much alexithymia can influence the human ability to detect and categorise emotions. On a total sample of 114 subjects, our results show low within subjects agreement rates for both datasets, particularly for subjects with low levels of alexithymia; low levels of agreement with the original annotations; frequent use of emotions based on Ekman model, particularly negative one, in people with high levels of alexithymia.

https://www.nature.com/articles/s41598-023-36201-5

Review > Psychol Rev. 2020 Jan;127(1):95-113. doi: 10.1037/rev0000174. Epub 2019 Nov 4.

The lexical fallacy in emotion research: Mistaking vernacular words for psychological entities

Alan Page Fiske [1]

Vernacular lexemes appear self-evident, so we unwittingly reify them. But the words and phrases of natural languages comprise a treacherous basis for identifying valid psychological constructs, as I illustrate in emotion research. Like other vernacular lexemes, the emotion labels in natural languages do not have definite, stable, mutually transparent meanings, and any one vernacular word may be used to denote multiple scientifically distinct entities. In addition, the consequential choice of one lexeme to name a scientific construct rather than any of its partial synonyms is often arbitrary. Furthermore, a given vernacular lexeme from any one of the world's 7000 languages rarely maps one-to-one into an exactly corresponding vernacular lexeme in other languages. Words related to *anger* in different languages illustrate this. Since each language constitutes a distinct taxonomy of things in the world, most or all languages must fail to cut nature at its joints. In short, it is pernicious to use one language's dictionary as the source of psychological constructs. So scientists need to coin new technical names for scientifically derived constructs—names precisely defined in terms of the constellation of features or components that characterize the constructs they denote. The development of the kama muta construct illustrates one way to go about this. Kama muta is the emotion evoked by sudden intensification of communal sharing—universally experienced but not isomorphic with any vernacular lexeme such as *heart warming, moving, touching, collective pride, tender, nostalgic, sentimental, Awww—so cute!*.

https://pubmed.ncbi.nlm.nih.gov/31682141/

Context is everything (in emotion research).

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Greenaway, Katharine H. Kalokerinos, Elise K. Williams, Lisa A.

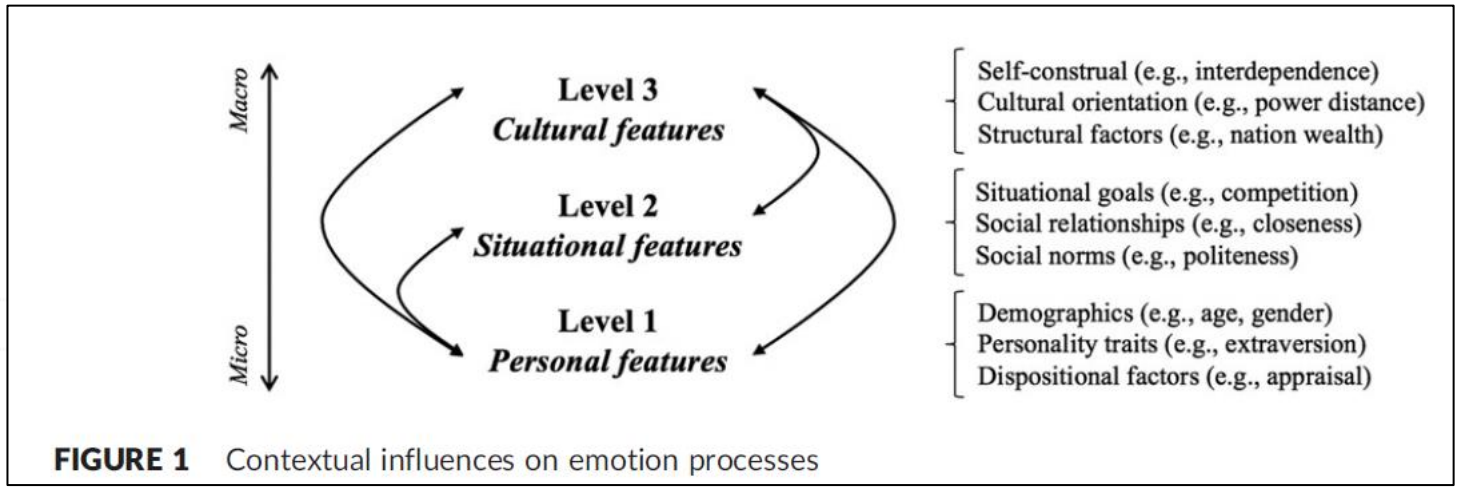


FIGURE 1 Contextual influences on emotion processes

Citation

Greenaway, K. H., Kalokerinos, E. K., & Williams, L. A. (2018). Context is everything (in emotion research). *Social and Personality Psychology Compass, 12*(6), 1–18. https://doi.org/10.1111/spc3.12393

Abstract

As in many areas of psychological inquiry, *context* matters for how emotion is experienced, expressed, perceived, and regulated. While this may sound like a truism, emotion research does not always directly theorize, manipulate, or measure emotion with context in mind. To facilitate this process, we present a framework of contextual features that shape emotion-related processes, and highlight several key factors that have been shown to matter in emotion research. We make four recommendations which we believe will help to better integrate context in emotion science. We argue that a deeper collective understanding, interrogation, and integration of context will propel the field forward theoretically and methodologically, and enhance researchers' ability to probe the mechanisms of human psychological experience. While our focus is on emotion research, we believe that the context framework and associated recommendations will also be useful to other fields of social psychological and personality science. (PsycInfo Database Record (c) 2021 APA, all rights reserved)

https://psycnet.apa.org/record/2018-23811-001

Emotion. 2020 Oct;20(7):1127-1136. doi: 10.1037/emo0000624. Epub 2019 Jul 1.

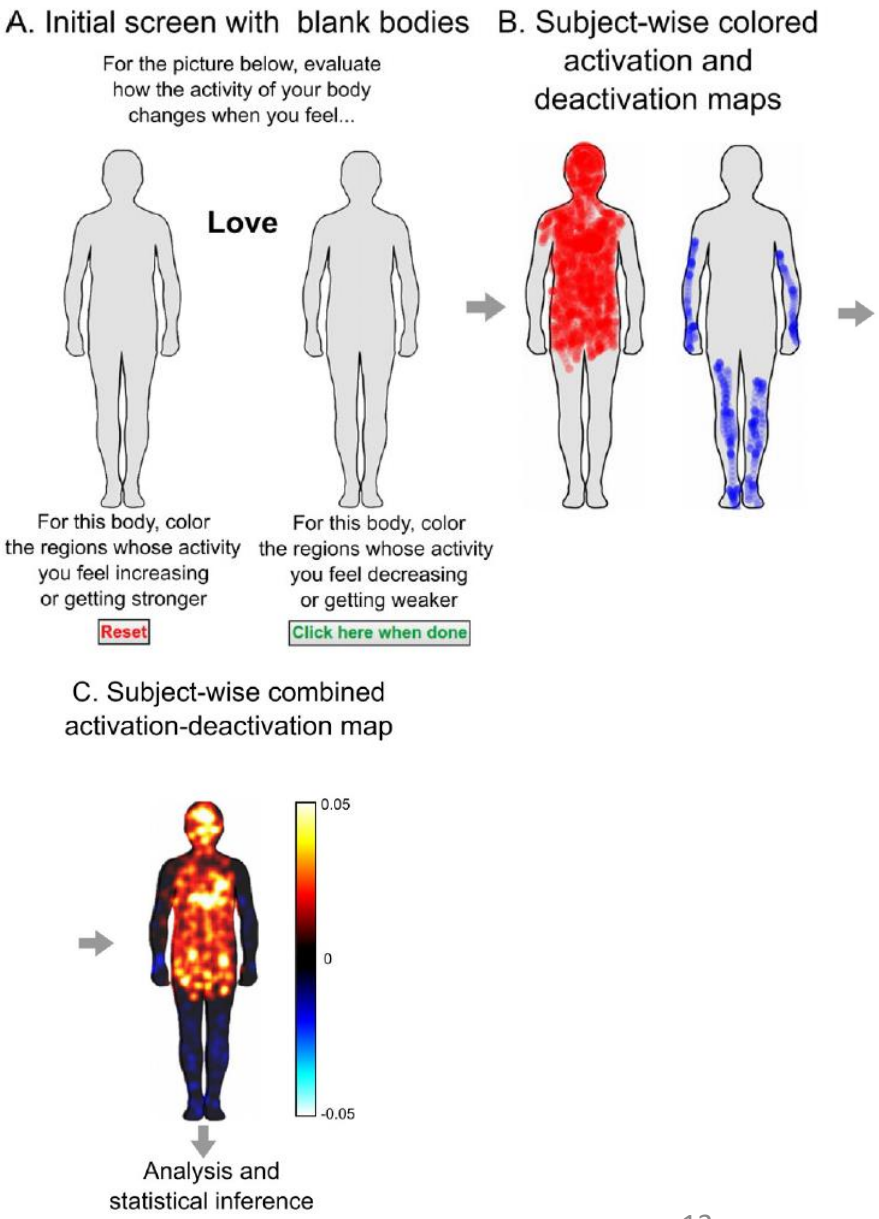
Bodily maps of emotions are culturally universal

Sofia Volynets [1], Enrico Glerean [2], Jari K Hietanen [3], Riitta Hari [4], Lauri Nummenmaa [5]

Abstract

Emotions are often felt in the body, and interoceptive feedback is an important component of conscious emotional experiences. Here, we provide support for cultural universality of bodily sensations associated with 13 emotions in a large international sample (3954 individuals from 101 countries, age range 18–90). Subjects were presented with two silhouettes of bodies alongside with emotional words and asked to color the bodily regions whose activity they felt increasing or decreasing while they experienced each given emotion. We tested the effects of various background factors (age, sex, education, body-mass index, nationality, civilization, and language) on the bodily sensation maps. Bodily sensations associated with emotions were concordant across the tested cultures ($r_s > 0.82$) and across the sexes ($r > 0.80$). Bodily sensations weakened during ageing (mean $r_s = 0.11$ across emotions). We conclude that universality in experiencing emotions in the body is stronger than the differences due to culture or sex.

https://pubmed.ncbi.nlm.nih.gov/31259590/



Lisa Feldman Barrett => dimensional approach (2006) ; **pleasant–unpleasant** and **high–low arousal/activation**

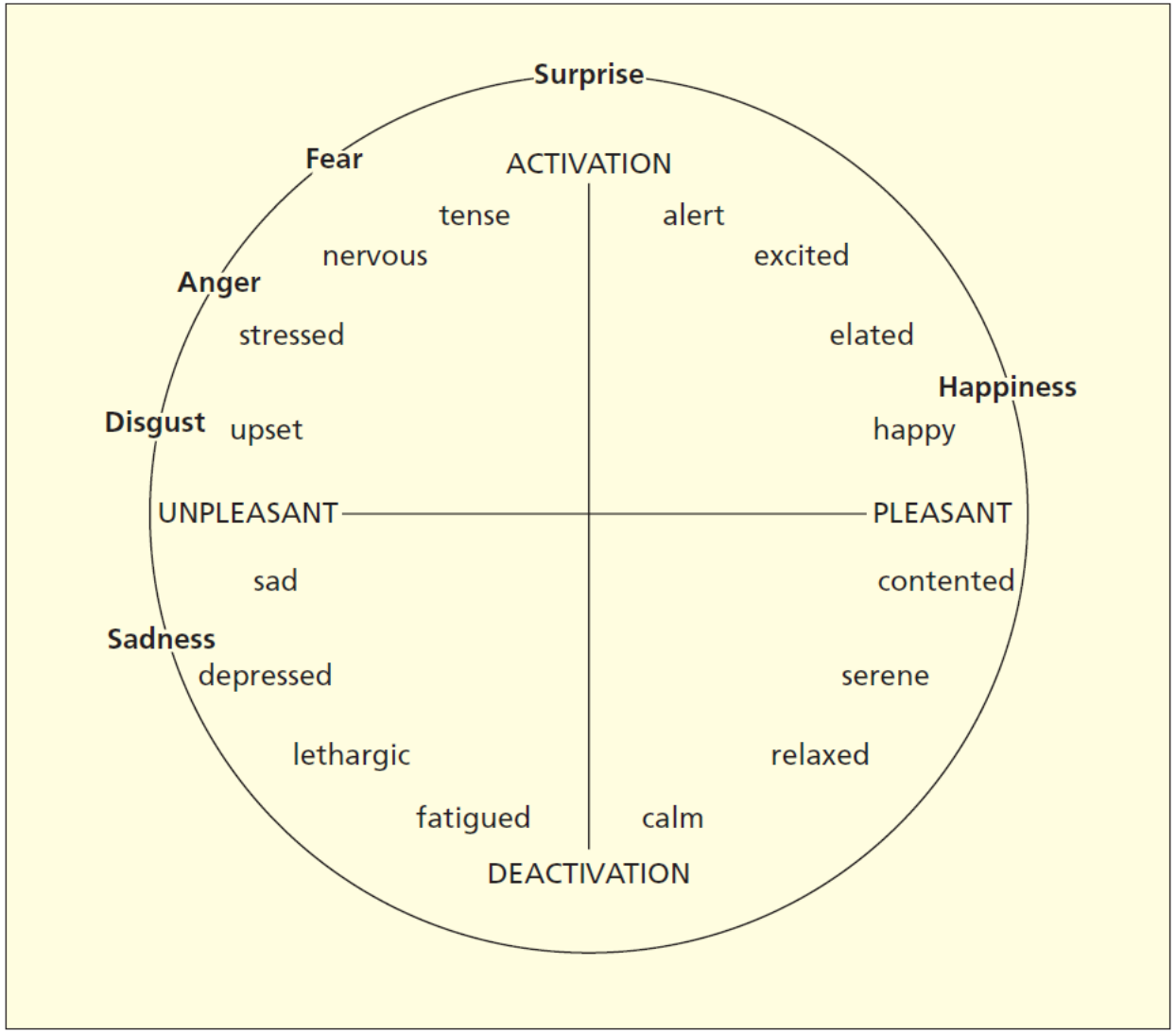


FIGURE 16.4: In the model of Feldman-Barrett, all emotions (and mood) involve a "core affect" system that is organized along two dimensions corresponding to pleasantness and arousal (/activation). Different categories of emotion are points in that space (and linked to associated cognitions—language, memory, perception, theory of mind) but are not afforded a special status.

Ward, (2020), p. 421

arousal

the level of excitement elicited by an emotional experience

valence

the positive or negative aspect of an emotional experience

> Perspect Psychol Sci. 2006 Mar;1(1):28-58. doi: 10.1111/j.1745-6916.2006.00003.x.

Are Emotions Natural Kinds?

Lisa Feldman Barrett [1]

https://pubmed.ncbi.nlm.nih.gov/26151184/

Edmund Rolls (2005) => emotions are elicited by *reinforcers* (i.e., *rewards* and *punishments*)

What Are Emotions, Why Do We Have Emotions, and What Is Their Computational Basis in the Brain?

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Rolls, Edmund T.

Citation

Rolls, E. T. (2005). What Are Emotions, Why Do We Have Emotions, and What Is Their Computational Basis in the Brain? In J.-M. Fellous & M. A. Arbib (Eds.), *Who needs emotions?: The brain meets the robot* (pp. 117–146). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195166194.003.0005

Abstract

Emotions may be defined as states elicited by reinforcers (rewards and punishers). This approach helps with understanding the functions of emotion, and with classifying different emotions; and in understanding what information processing systems in the brain are involved in emotion, and how they are involved. The hypothesis is developed that brains are designed around reward and punishment evaluation systems, because this is the way genes can build a complex system that will produce appropriate but flexible behavior to increase their fitness. By specifying goals rather than particular behavioral patterns of responses, genes are open to a much wider range of behavioral strategies, including strategies that increase their fitness. The primate brain represents the identity of a primary (unlearned) reinforcer first (e.g., for taste in the primary taste cortex) before it decodes the reward or punishment value of the innate reinforcers (in the orbitofrontal cortex, which includes the secondary taste cortex, and the amygdala). Brain regions that represent the identity of objects independently of their reward or punishment value (in the case of vision, the inferior temporal visual cortex) project into the orbitofrontal cortex and amygdala, where neurons learn associations between previously neutral (e.g., visual) stimuli and primary reinforcers (such as taste). This process of stimulus-reinforcement association learning can be very rapid and flexible in the orbitofrontal cortex, and allows appropriate behavioral responses, such as approach to rewarded stimuli or withdrawal from aversive stimuli, to be generated. It is suggested that there are two types of route to action performed in relation to reward or punishment in humans. Examples of such actions include emotional and motivational behavior. The first route is by way of the brain systems that control behavior in relation to previous associations of stimuli with reinforcement, and include the amygdala and, particularly well-developed in primates, the orbitofrontal cortex. The second route in humans involves a computation with many "if. . . then" statements, to implement a plan to obtain a reward. In this case, syntax is required, because the many symbols that are part of the plan must be correctly linked or bound. The issue of emotional feelings is part of the much larger problem of consciousness and I suggest that it is the second route that is related to consciousness.

https://psycnet.apa.org/record/2005-03475-005

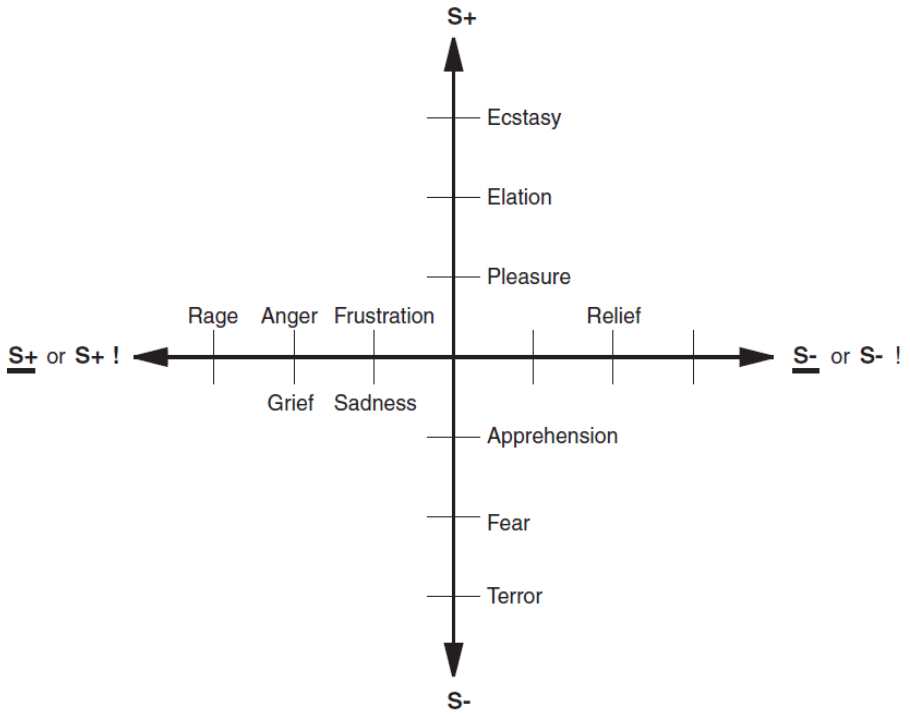
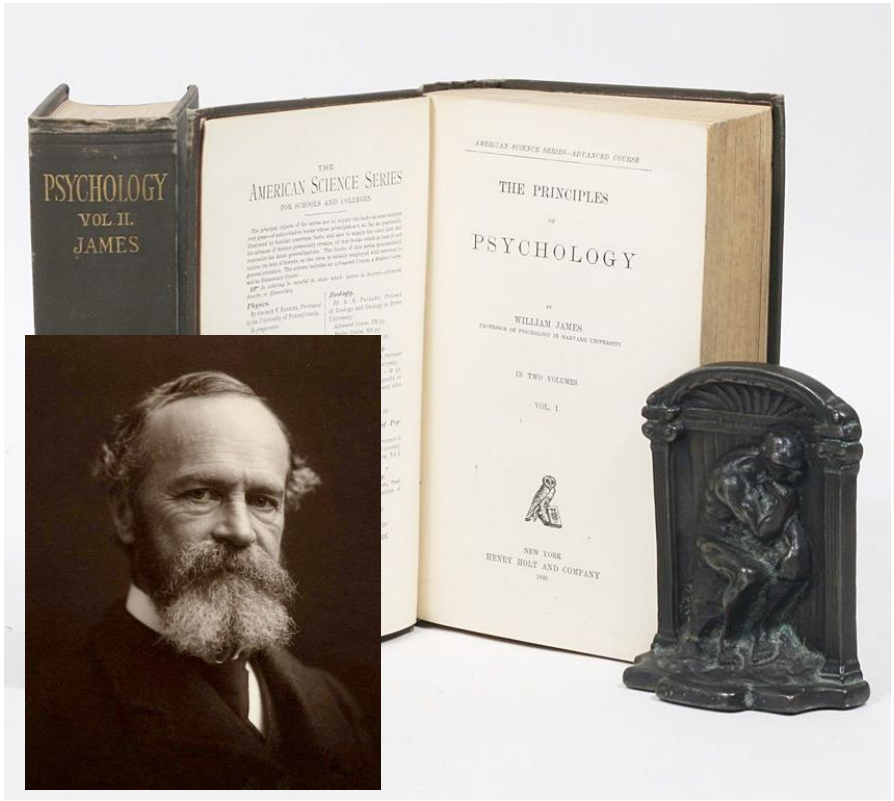


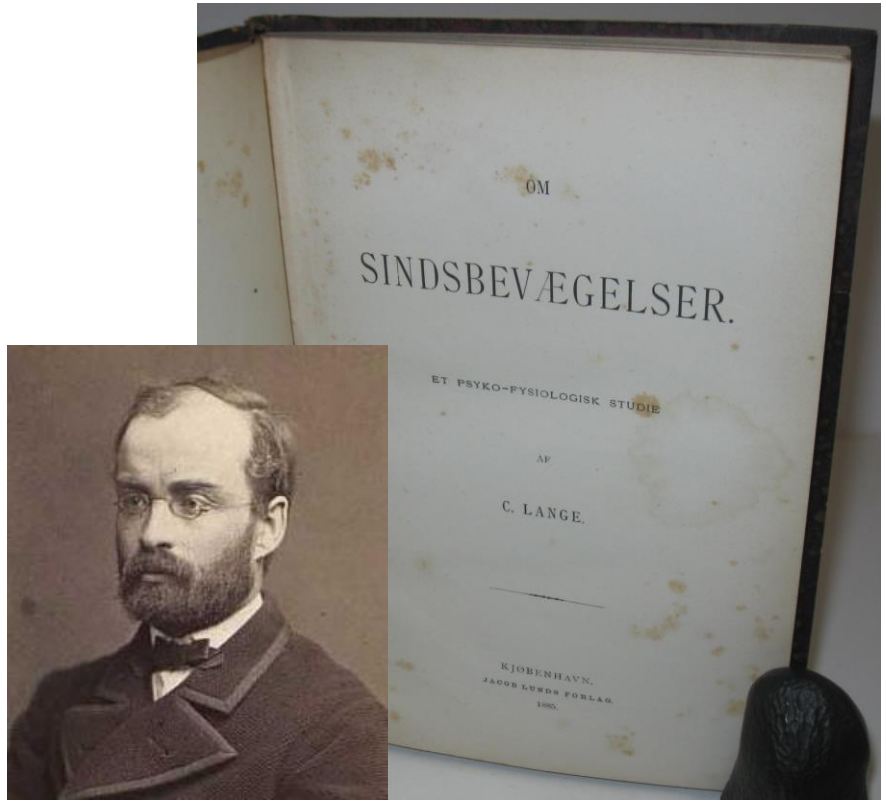
Figure 5.1. Some of the emotions associated with different reinforcement contingencies are indicated. Intensity increases away from the center of the diagram on a continuous scale. The classification scheme created by the different reinforcement contingencies consists of (1) the presentation of a positive reinforcer (S+), (2) the presentation of a negative reinforcer (S–), (3) the omission of a positive reinforcer (S+) or the termination of a positive reinforcer (S+!), and (4) the omission of a negative reinforcer (S–) or the termination of a negative reinforcer (S–!). (From Rolls, 1999a, Fig. 3.1.)

James-Lange Theory Of Emotion

Posits that **bodily states precede** the **conscious experience of emotions**, e.g., we feel sad *because* we cry, not vice-versa; in other words, it was the **physiological response to stimuli** that elicited subjective feelings.



William James
(1842 – 1910)



Carl Georg Lange
(1934 – 1900)

1890

Published "*The Principles of Psychology",*

in which he laid out his theory of emotions

1885

Published "*Emotions*"

(above in original, in Danish)

What is an Emotion?
Author(s): William James
Source: *Mind*, Apr., 1884, Vol. 9, No. 34 (Apr., 1884), pp. 188-205
Published by: Oxford University Press on behalf of the Mind Association

"My thesis on the contrary is that the bodily changes follow directly the Perception of the exciting fact, and that our feeling of the same changes as they occur IS the emotion. Common sense says, we lose our fortune, are sorry, and weep; we meet a bear, are frightened and run; we are insulted by a rival, are angry and strike.

The hypothesis here to be defended says that this order of sequence is incorrect, that the one mental state is not immediately induced by the other, that the bodily manifestation must first be interposed between, and that the more rational statement is that ***we feel sorry because we cry, angry because we strike, afraid because we tremble, and not that we cry, strike, or tremble because we are sorry, angry, or fearful*** *as the case may be.*

Without the bodily states following on the perception the latter would be purely cognitive in form, pale, colourless, destitute of emotional warmth*. We might then see the bear and judge it best to run, receive the insult and deem it right to strike, but we would not actually feel afraid or angry."*

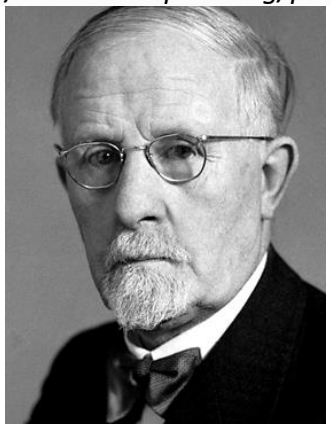
https://www.jstor.org/stable/2246769?seq=1

Cannon-Bard Theory Of Emotion

Philip Bard
(1898–1977)
doctoral student of Walter Cannon

The Nobel Prize in Physiology or Medicine 1949 was divided equally between Walter Rudolf Hess "for his discovery of the functional organization of the interbrain as a coordinator of the activities of the internal organs" and António Caetano de Abreu Freire Egas Moniz "for his discovery of the therapeutic value of leucotomy in certain psychoses"

https://www.nobelprize.org/prizes/medicine/1949/summary/



Walter Hess
(1881 – 1973)

The James-Lange Theory of Emotions: A Critical Examination and an Alternative Theory

Walter B. Cannon

The American Journal of Psychology, Vol. 100, No. 3/4, Special Centennial Issue (Autumn - Winter, 1987), pp. 567-586 (20 pages)

https://doi.org/10.2307/1422695 · https://www.jstor.org/stable/1422695

Walter Cannon
(1871 – 1945)

1928

Induced "sham rage" in cats following brain lesions => **caudal hypothalamus** essential for eliciting this rage response in lesioned cats.

1949

Elicited rage in cats by electrically stimulating their **hypothalamus**.

1987

Published a critique to the James-Lange theory. Also coined the term "*homeostasis*" and described the "*fight or flight*" response.

Cannon-Bard Theory Of Emotion => contradicts the *James-Lange theory* and posits that **bodily sensations** occur **after** the conscious **emotional** experience.

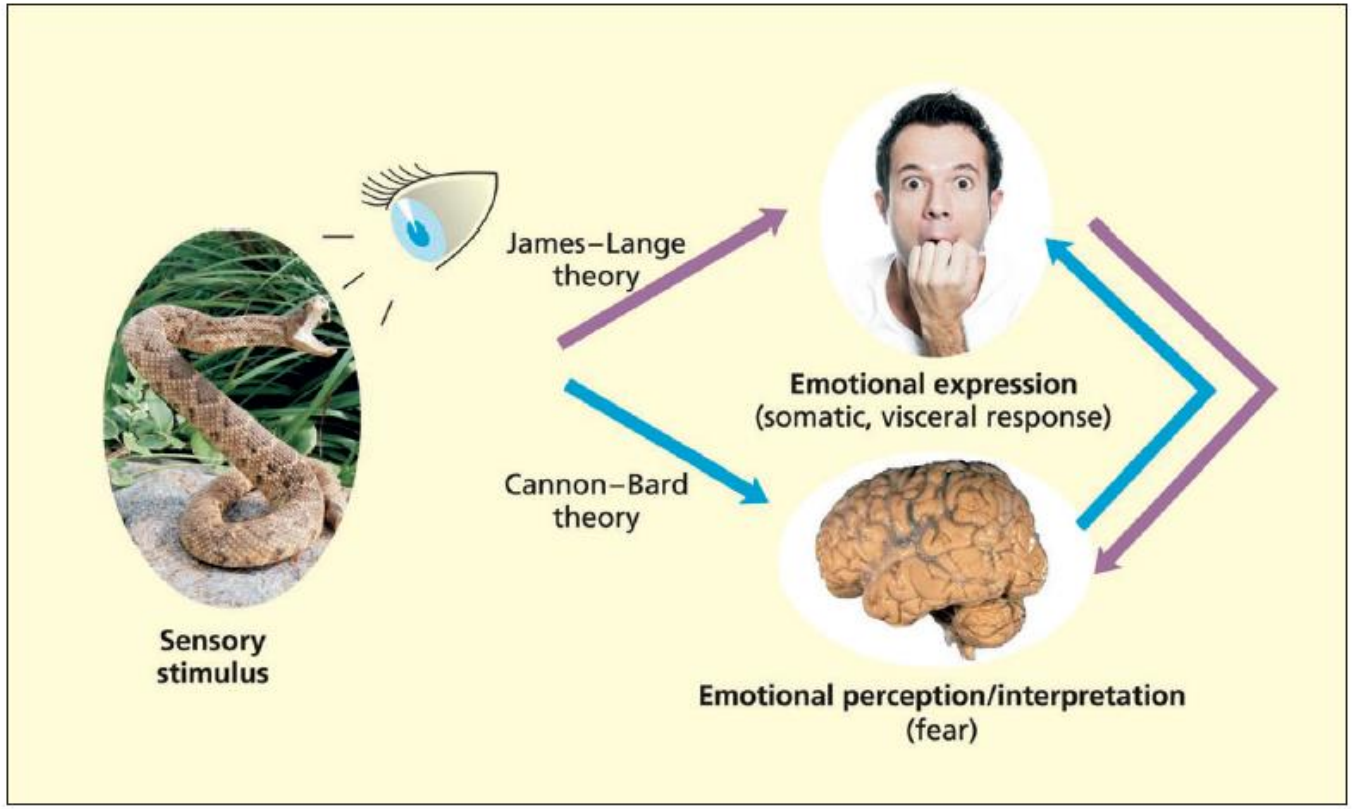


FIGURE 16.2: According to the James–Lange theory, bodily reactions occur first and emotional processing occurs after (as the perception/interpretation of those reactions). According to the Cannon–Bard theory, the emotional perception/interpretation occurs first and the bodily reaction occurs after.

From Ward, 2012, p. 75.

Ward, (2020), p. 418

Stanley Schachter & **Jerome Singer** (1962) => the Two-factor theory of emotion

Cognitive, social, and physiological determinants of emotional state.

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Schachter, Stanley Singer, Jerome

Citation

Schachter, S., & Singer, J. (1962). Cognitive, social, and physiological determinants of emotional state. *Psychological Review, 69*(5), 379–399. https://doi.org/10.1037/h0046234

Abstract

"It is suggested that emotional states may be considered a function of a state of physiological arousal and of a cognition appropriate to this state of arousal. From this follows these propositions: (a) Given a state of physiological arousal for which an individual has no immediate explanation, he will label this state and describe his feelings in terms of the cognitions available to him… . (b) Given a state of physiological arousal for which an individual has a completely appropriate explanation, no evaluative needs will arise and the individual is unlikely to label his feelings in terms of the alternative cognitions available. (c) Given the same cognitive circumstances, the individual will react emotionally or describe his feelings as emotions only to the extent that he experiences a state of physiological arousal. An experiment is described which, together with the results of other studies, supports these propositions." (PsycINFO Database Record (c) 2016 APA, all rights reserved)

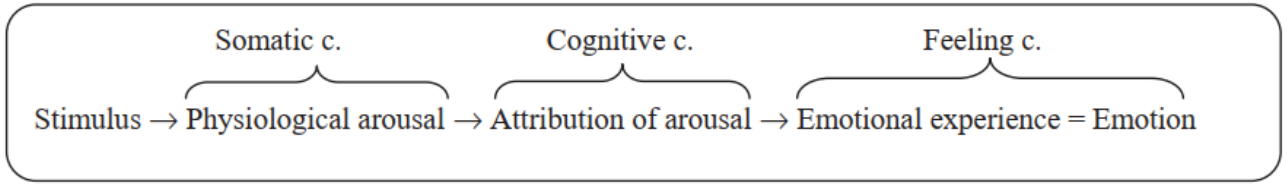


Figure 2. Order of components in Schachter's theory.

Moors, (2009)
https://psycnet.apa.org/record/2009-11142-001

Step 1: a stimulus elicits an **undifferentiated** state of arousal => emotional **intensity**;

Step 2: the arousal is **interpreted** => **type** of emotional experience.

Antoine Bechara & **Antonio Damasio** (2005) => The somatic marker hypothesis

ELSEVIER

Games and Economic Behavior

Volume 52, Issue 2, August 2005, Pages 336-372

The somatic marker hypothesis: A neural theory of economic decision

Antoine Bechara , Antonio R. Damasio

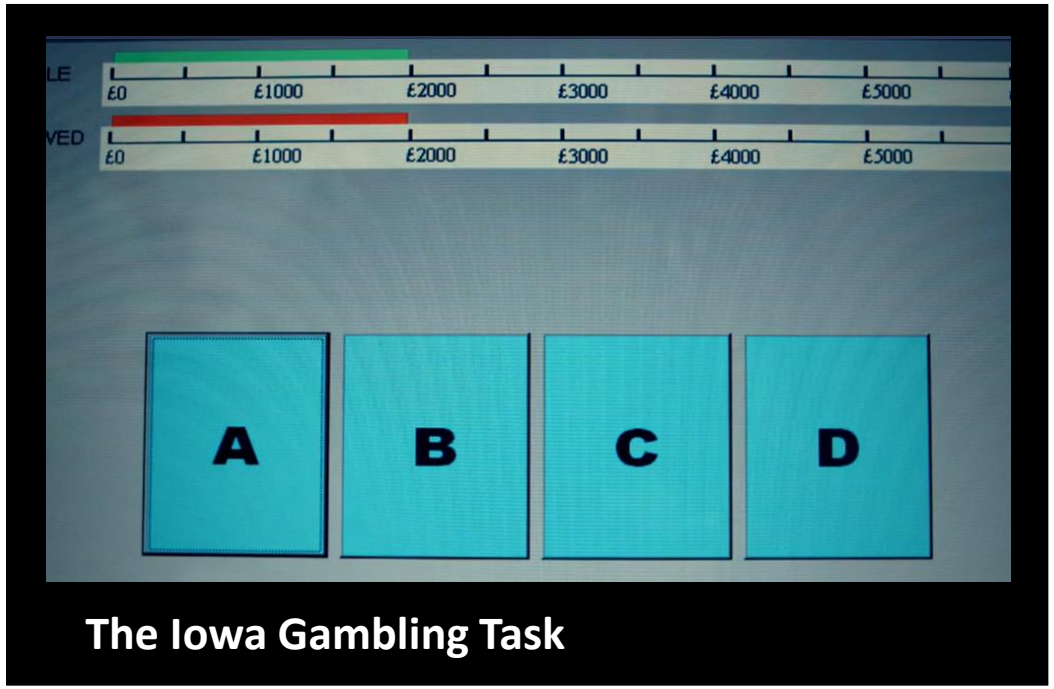
https://www.sciencedirect.com/science/article/pii/S0899825604001034

somatic markers

bodily sensations that are **associated with emotions** (e.g., the association of rapid heartbeat with anxiety or of nausea with disgust)

Posits that **bodily sensations** elicited by emotions **inform** our **decision-making** process.

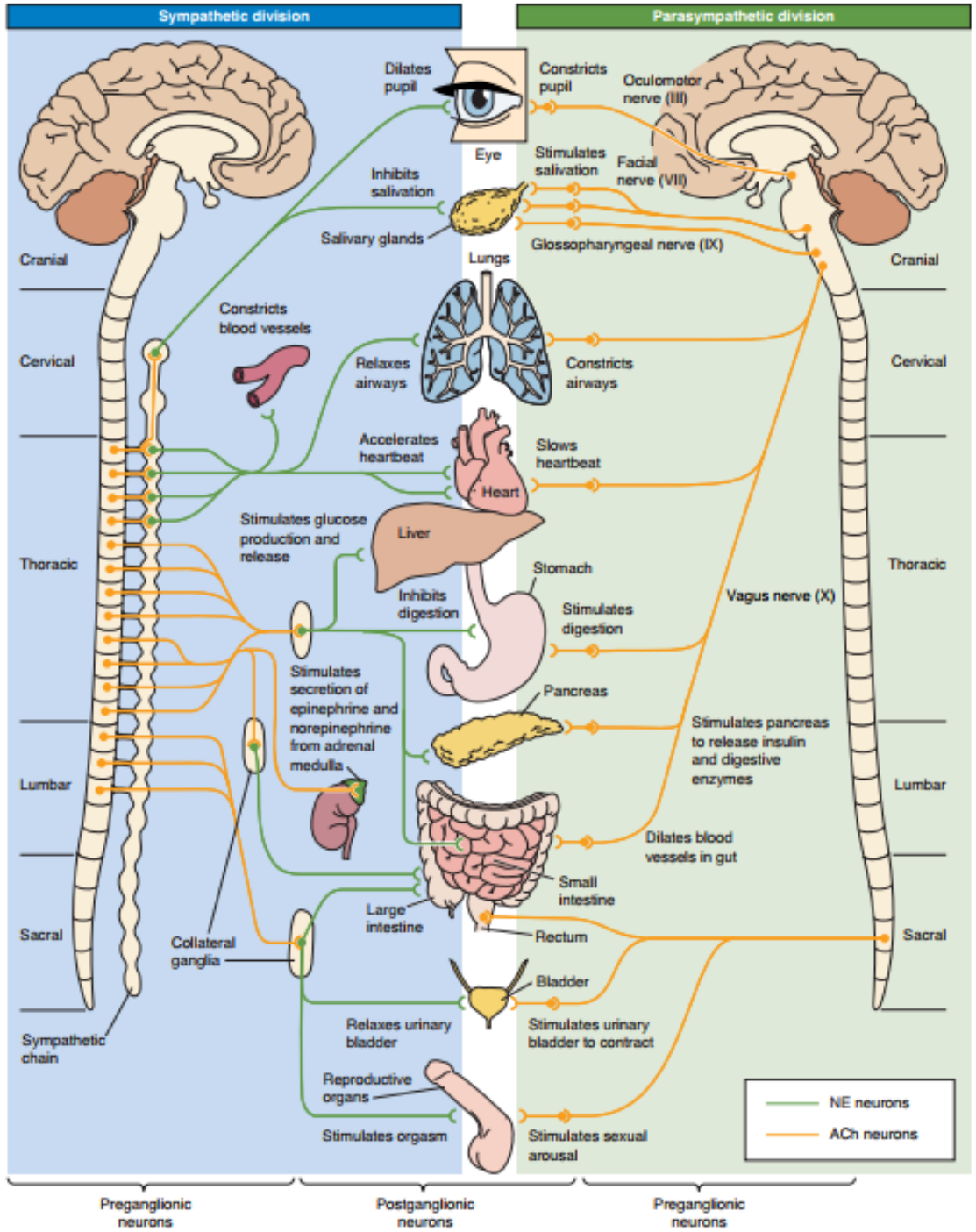
Within the brain, somatic markers are thought to be processed in the *ventromedial prefrontal cortex* and the *amygdala*.



The Iowa Gambling Task

https://www.pbs.org/video/brain-david-eagleman-episode-4-clip-4/

The neural substrates of emotion processing



The autonomic nervous system (ANS)

The ANS innervates three types of tissue: glands, smooth muscle, and cardiac muscle. Thus, almost every part of the body is a target of the ANS, as shown in Figure 15.9. The ANS:

- Innervates the secretory glands (salivary, sweat, tear, and various mucus-producing glands).
- Innervates the heart and blood vessels to control blood pressure and flow.
- Innervates the bronchi of the lungs to meet the oxygen demands of the body.
- Regulates the digestive and metabolic functions of the liver, gastrointestinal tract, and pancreas.
- Regulates the functions of the kidney, urinary bladder, large intestine, and rectum.
- Is essential to the sexual responses of the genitals and reproductive organs.
- Interacts with the body's immune system.

The physiological influences of the sympathetic and parasympathetic divisions generally oppose each other. The sympathetic division tends to be most active during a crisis, real or perceived. The behaviors related to it are summarized in the puerile (but effective) mnemonic used by medical students, called the four Fs: fight, flight, fright, and sex. The parasympathetic division facilitates various non–four-F processes, such as digestion, growth, immune responses, and energy storage

Bear et al., (2016), pp. 533 - 534

The **Papez circuit** and the limbic brain

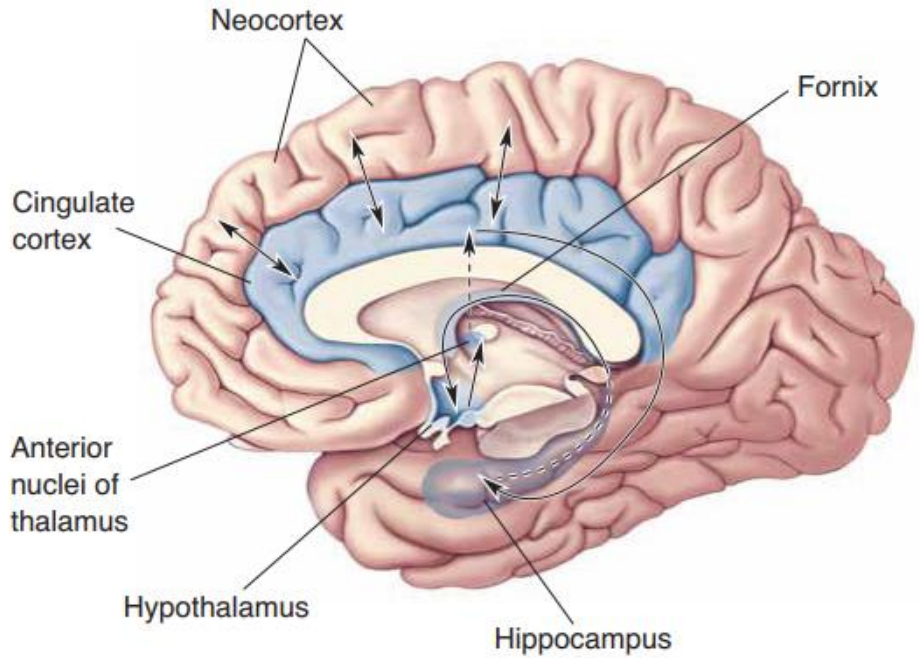
James Papez
(1883 – 1958)

A Proposed Mechanism for Emotion. *Arch Neurol Psych.* 1937;38:725-743

JAMES W. PAPEZ, M.D.
ITHACA, N. Y.

The work of Cannon,[1] Bard,[2] Penfield,[3] Ranson [4] and others has greatly advanced knowledge of the functions of the hypothalamus. In the light of these researches the connections of the hypothalamus to the medial wall of the cerebral cortex gain a new significance. The following discussion presents some anatomic, clinical and experimental data dealing with the hypothalamus, the gyrus cinguli, the hippocampus and their interconnections. Taken as a whole, this ensemble of structures is proposed as representing theoretically the anatomic basis of the emotions.

https://tinyurl.com/3vrdfjpr



▲ FIGURE 18.5
The Papez circuit. Papez believed that the experience of emotion was determined by activity in the cingulate cortex and, less directly, other cortical areas. Emotional expression was thought to be governed by the hypothalamus. The cingulate cortex projects to the hippocampus, and the hippocampus projects to the hypothalamus by way of the bundle of axons called the fornix. Hypothalamic effects reach the cortex via a relay in the anterior thalamic nuclei.

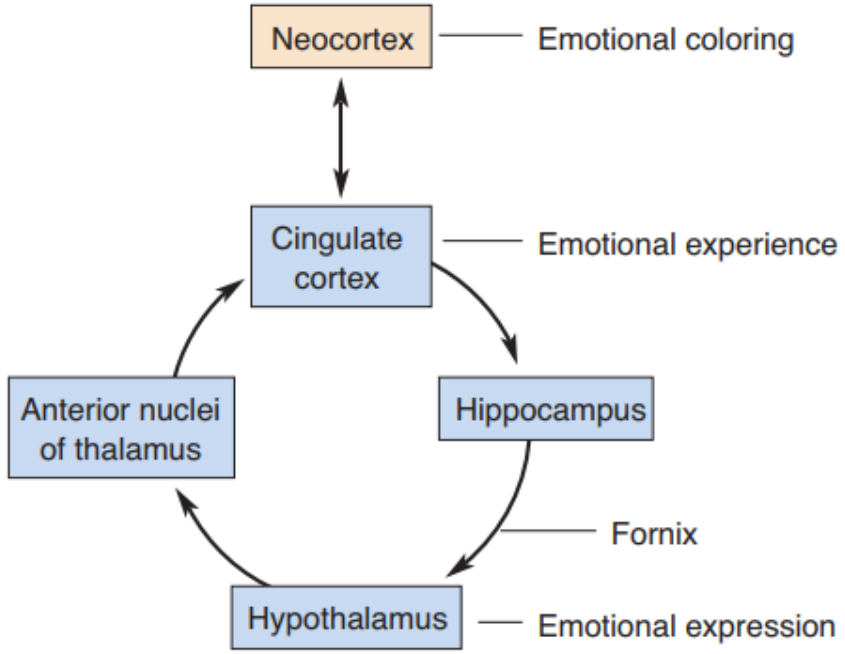
Bear et al., (2016), p. 623

In the Papez circuit, the **hypothalamus** governs the behavioural expression of emotion.

The hypothalamus and neocortex are arranged so that each can influence the other, thus linking the expression and experience of emotion.

In the circuit, the **cingulate cortex affects the hypothalamus** via **the hippocampus and fornix** (the large bundle of axons leaving the hippocampus), whereas **the hypothalamus affects the cingulate cortex** via **the anterior thalamus**.

The fact that **communication between the cortex and hypothalamus is bidirectional** means that the Papez circuit is compatible with both the James–Lange and the Cannon–Bard theories of emotion.

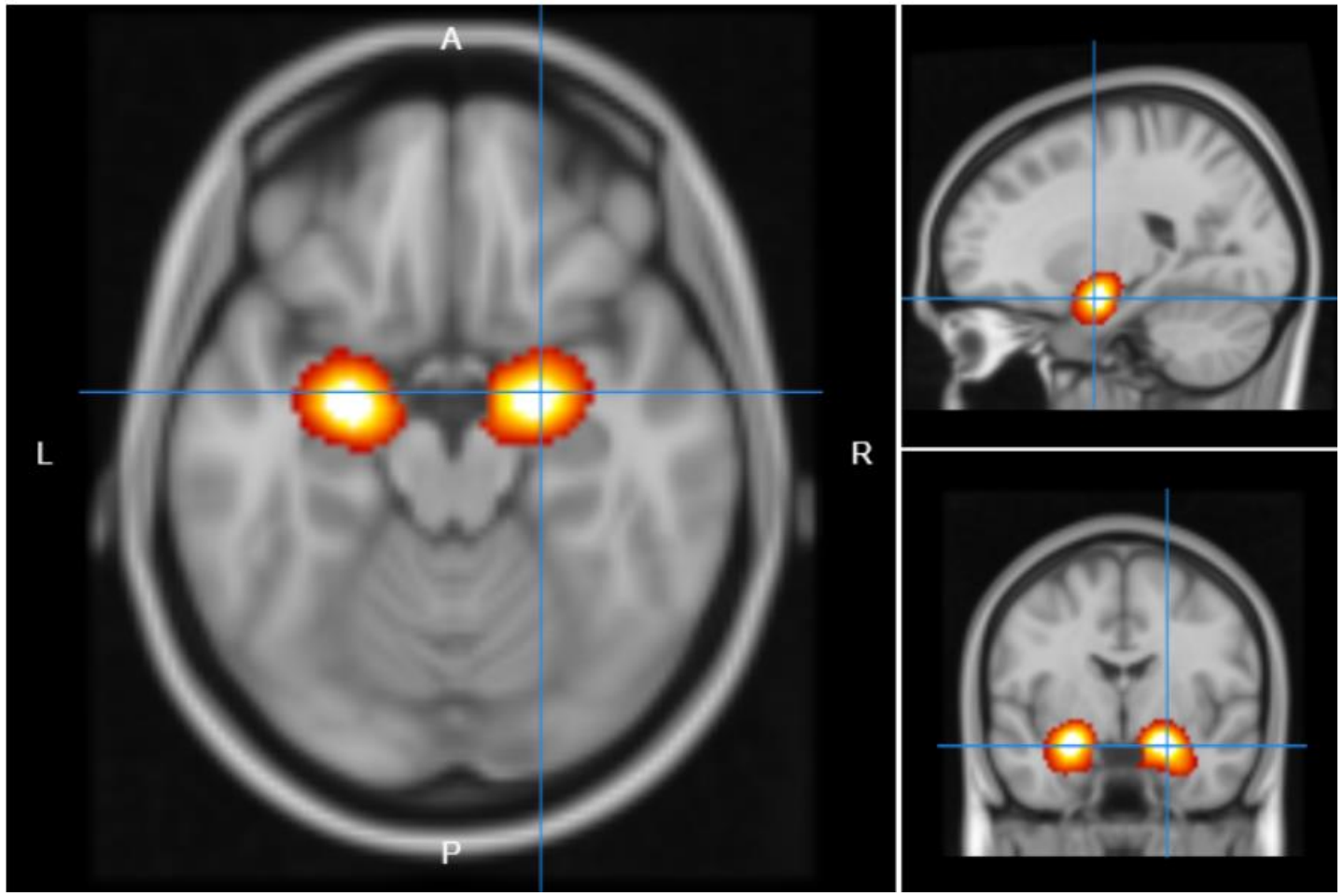


Bear et al., (2016), p. 623

It was **Paul Broca** who, in the 1850s, used the name **limbic lobe** to refer to the **cingulate gyrus** and the **parahippocampal gyrus**. He thought however that these were involved in *olfaction*. Papez later identified the role of these structures in *emotion processing*. Later, **Paul MacLean** (1949) extended this idea to incorporate regions such as the **amygdala** and the **orbitofrontal cortex**, which he termed the **limbic brain**.

More on the conceptual evolution of the limbic brain here: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4591172/

The amygdala: fear (and more)



In monkeys, bilateral lesions of the amygdala

=> **Kluver–Bucy syndrome** (Kluver & Bucy, 1939; Weiskrantz, 1956):

- **oral exploration** of objects;
- **lack** of appropriate **fear** and **anger** response;
- **inappropriate** sexual behaviour.

More on Kluver-Bucy in humans:

https://www.ncbi.nlm.nih.gov/books/NBK544221/

https://www.e-arm.org/journal/view.php?number=713

Patient S.M., bilateral amygdala lesions and impaired fear response

Published: 15 December 1994

Impaired recognition of emotion in facial expressions following bilateral damage to the human amygdala

R. Adolphs, D. Tranel, H. Damasio & A. Damasio

Nature **372**, 669–672 (1994) | Cite this article

Abstract

STUDIES in animals have shown that the amygdala receives highly processed visual input[1,2], contains neurons that respond selectively to faces[3], and that it participates in emotion[4,5] and social behaviour[6]. Although studies in epileptic patients support its role in emotion[7], determination of the amygdala's function in humans has been hampered by the rarity of patients with selective amygdala lesions[8]. Here, with the help of one such rare patient, we report findings that suggest the human amygdala may be indispensable to: (1) recognize fear in facial expressions; (2) recognize multiple emotions in a single facial expression; but (3) is not required to recognize personal identity from faces. These results suggest that damage restricted to the amygdala causes very specific recognition impairments, and thus constrains the broad notion that the amygdala is involved in emotion.

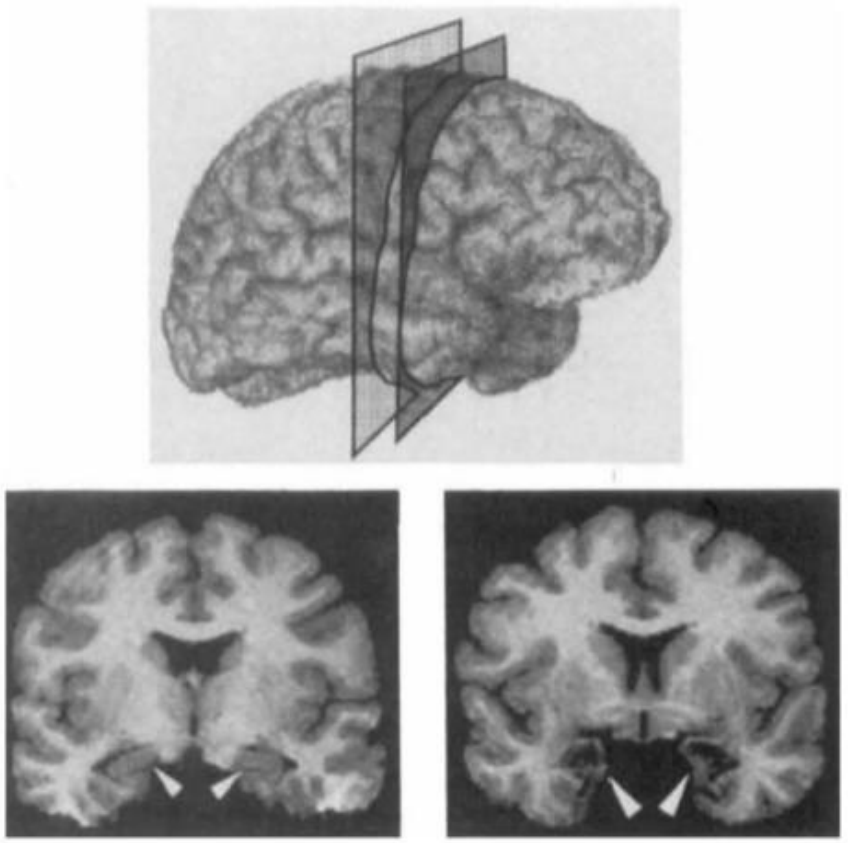


FIG. 1 t_1-weighted MR images of S.M.'s brain. Planes of section are shown at the top, on a three-dimensional reconstruction[26] of S.M.'s brain. There is extensive bilateral amygdala damage (lower right image, large arrowheads) with sparing of neocortex and hippocampus (lower left image, small arrowheads). The tissue of the amygdala has been replaced by mineral deposits as a result of Urbach–Wiethe disease[11].

https://www.nature.com/articles/372669a0

Curr Biol. Author manuscript; available in PMC 2012 Jan 11.
Published in final edited form as:
Curr Biol. 2011 Jan 11; 21(1): 34–38.
Published online 2010 Dec 16. doi: 10.1016/j.cub.2010.11.042

PMCID: PMC3030206
NIHMSID: NIHMS254004
PMID: 21167712

The human amygdala and the induction and experience of fear

Justin S. Feinstein,[1,*] Ralph Adolphs,[2] Antonio R. Damasio,[3] and Daniel Tranel[1]

Associated Data

▸ **Supplementary Materials**

Summary

Go to: ▸

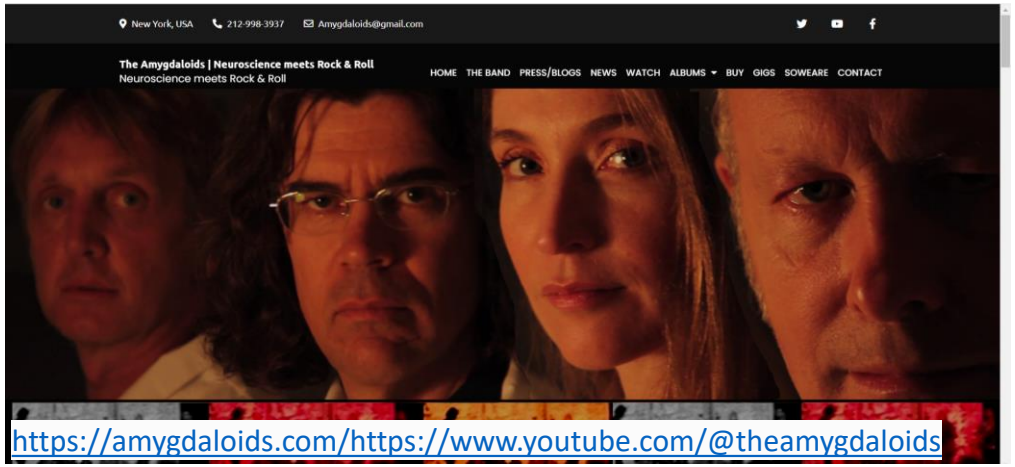
Although clinical observations suggest that humans with amygdala damage have abnormal fear reactions and a reduced experience of fear [1–3], these impressions have not been systematically investigated. To address this gap, we conducted a new study in a rare human patient, SM, who has focal bilateral amygdala lesions [4]. To provoke fear in SM, we exposed her to live snakes and spiders, took her on a tour of a haunted house, and showed her emotionally evocative films. On no occasion did SM exhibit fear and she never endorsed feeling more than minimal levels of fear. Likewise, across a large battery of self-report questionnaires, three months of real-life experience sampling, and a life history replete with traumatic events, SM repeatedly demonstrated an absence of overt fear manifestations and an overall impoverished experience of fear. Despite her lack of fear, SM is able to exhibit other basic emotions and experience the respective feelings. The findings support the conclusion that the human amygdala plays a pivotal role in triggering a state of fear, and that the absence of such a state precludes the experience of fear itself.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3030206/#R4

The case of SM, the fearless woman

https://www.youtube.com/watch?v=2Hi3JO1rqYw

Joseph LeDoux and the study of the amygdala's response to fear



https://amygdaloids.com/https://www.youtube.com/@theamygdaloids

Reviews and Overviews

Using Neuroscience to Help Understand Fear and Anxiety: A Two-System Framework

Joseph E. LeDoux, Ph.D., Daniel S. Pine, M.D.

Published Online: 9 Sep 2016 | https://doi.org/10.1176/appi.ajp.2016.16030353

Abstract

Tremendous progress has been made in basic neuroscience in recent decades. One area that has been especially successful is research on how the brain detects and responds to threats. Such studies have demonstrated comparable patterns of brain-behavior relationships underlying threat processing across a range of mammalian species, including humans. This would seem to be an ideal body of information for advancing our understanding of disorders in which altered threat processing is a key factor, namely, fear and anxiety disorders. But research on threat processing has not led to significant improvements in clinical practice. The authors propose that in order to take advantage of this progress for clinical gain, a conceptual reframing is needed. Key to this conceptual change is recognition of a distinction between circuits underlying two classes of responses elicited by threats: 1) behavioral responses and accompanying physiological changes in the brain and body and 2) conscious feeling states reflected in self-reports of fear and anxiety. This distinction leads to a "two systems" view of fear and anxiety. The authors argue that failure to recognize and consistently emphasize this distinction has impeded progress in understanding fear and anxiety disorders and hindered attempts to develop more effective pharmaceutical and psychological treatments. The two-system view suggests a new way forward.

https://ajp.psychiatryonline.org/doi/full/10.1176/appi.ajp.2016.16030353

Two routes via which a stimulus reaches the amygdala

"quick and dirty" route/"low road"

Stimuli reach the amygdala **fast**, via the thalamus.

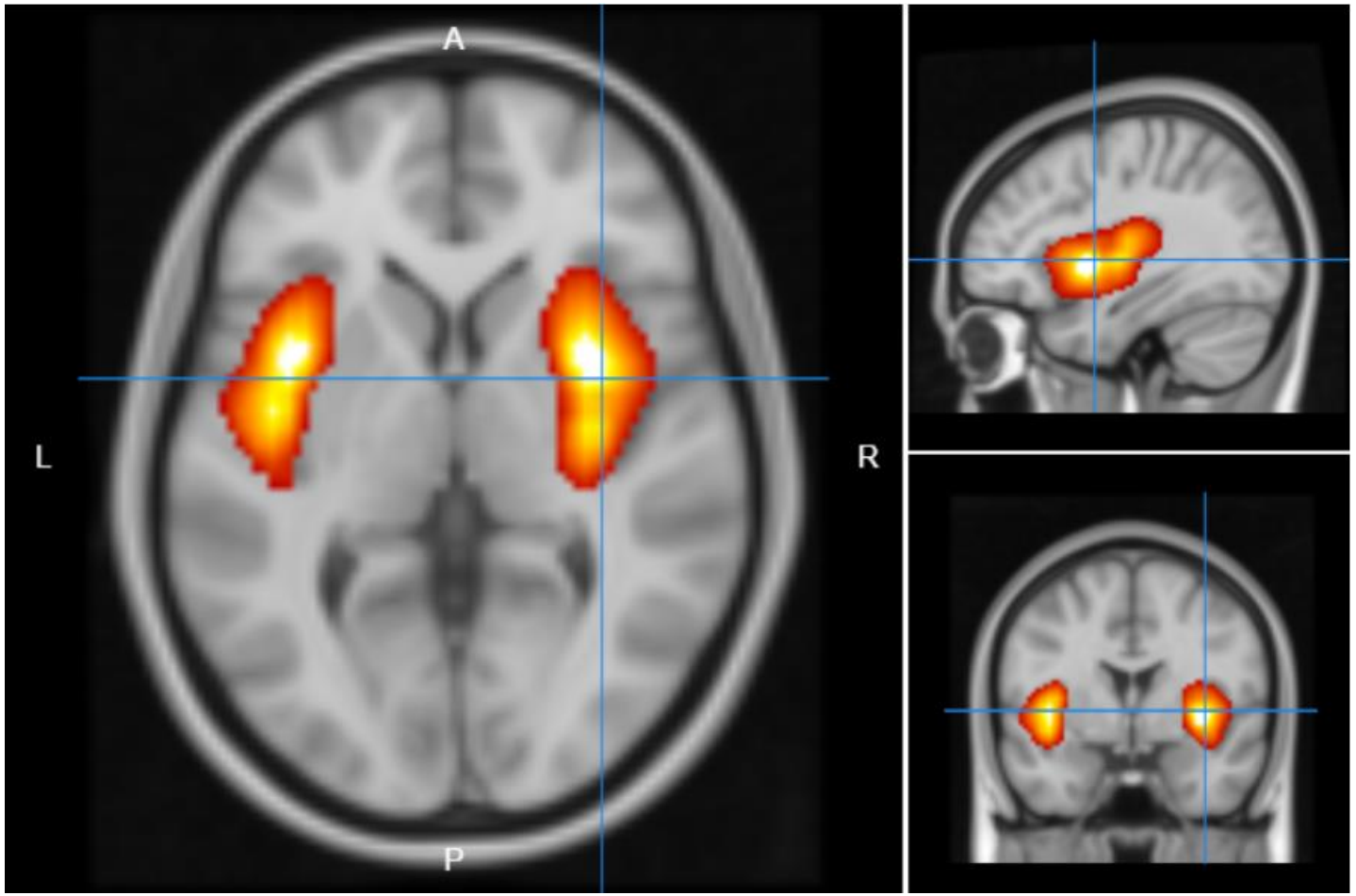
Enables **rapid** and unconscious **responses**.

"high road"

Information from the thalamus is **not directly** passed onto the amygdala, but first goes to the cortex.

Slower, but carries **more information** about the stimulus and enables conscious awareness and assessment.

The insula: disgust and interoception



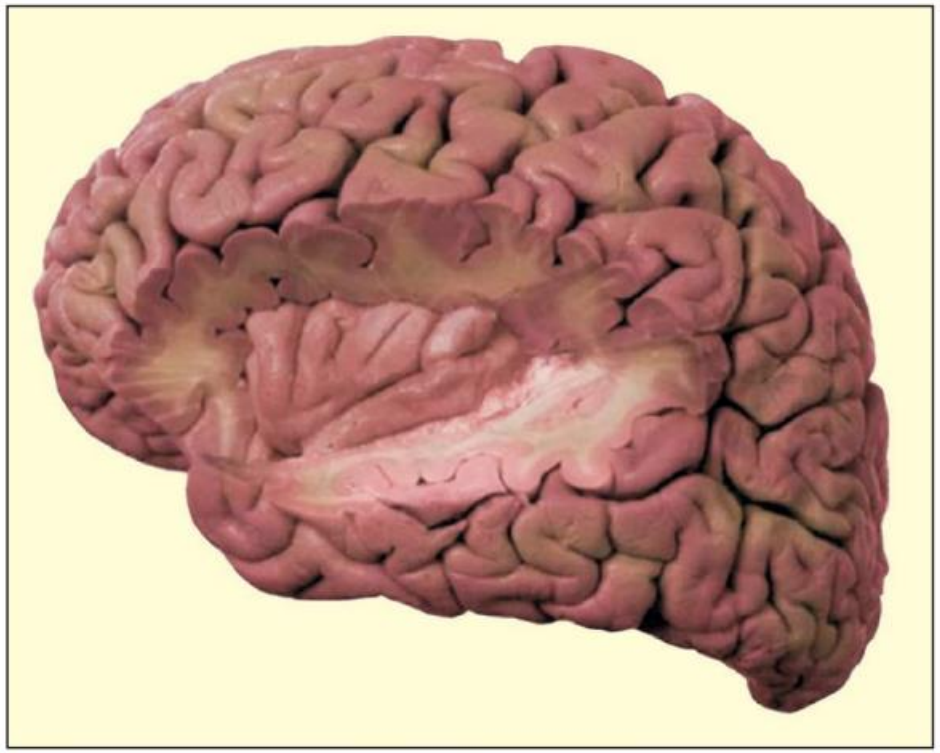


FIGURE 16.12: *The **insula** is an island of cortex lying, bilaterally, **underneath the temporal lobes**. It is implicated in the creation of bodily feelings associated with emotions, and in the **perception of disgust** in particular.*

Ward, (2020), p. 429

J Cogn Neurosci. 2007 Jul;19(7):1206-17. doi: 10.1162/jocn.2007.19.7.1206.

Disgust and happiness recognition correlate with anteroventral insula and amygdala volume respectively in preclinical Huntington's disease

C M Kipps [1], A J Duggins, E A McCusker, A J Calder

Affiliations + expand

PMID: 17583995 DOI: 10.1162/jocn.2007.19.7.1206

Abstract

Patients with Huntington's disease (HD) can show disproportionate impairments in recognizing facial signals of disgust, but the neural basis of this deficit remains unclear. Functional imaging studies have implicated the anterior insula in the ability to recognize disgust, but have identified other structures as well, including the basal ganglia. In view of variable insula and basal ganglia volume changes in HD, we used voxel-based morphometry to map regional variations in gray matter (GM) volume in participants carrying the mutation for HD, and correlated this with their performance on a test of facial emotion recognition for six basic emotions (disgust, fear, anger, happiness, sadness, surprise). The volume of the anteroventral insula was strongly correlated with performance on the disgust recognition task. The amygdala volume (bilaterally) correlated with the ability to recognize happy facial expressions. There was marked specificity of the regional correlations for the emotion involved. Recognition of other emotion expressions, or more general cognitive or motor performance as measured by a standardized rating scale, did not correlate with regional brain volume in this group. Control participants showed no effect for any measure. The strong linear correlations for disgust and happiness recognition imply direct involvement of the anterior insula in disgust appreciation, and a similar role for the amygdala in recognizing happy facial expressions. The absence of a significant correlation with the basal ganglia suggests a less critical role for these structures in disgust recognition than has previously been suggested. The findings also highlight the role of neurodegenerative diseases combined with statistical imaging techniques in elucidating the brain basis of behavior and cognition.

https://pubmed.ncbi.nlm.nih.gov/17583995/

Cortex, Insula, and Interoception

Maryam Rahmani & Farzaneh Rahmani

Chapter | First Online: 27 April 2019

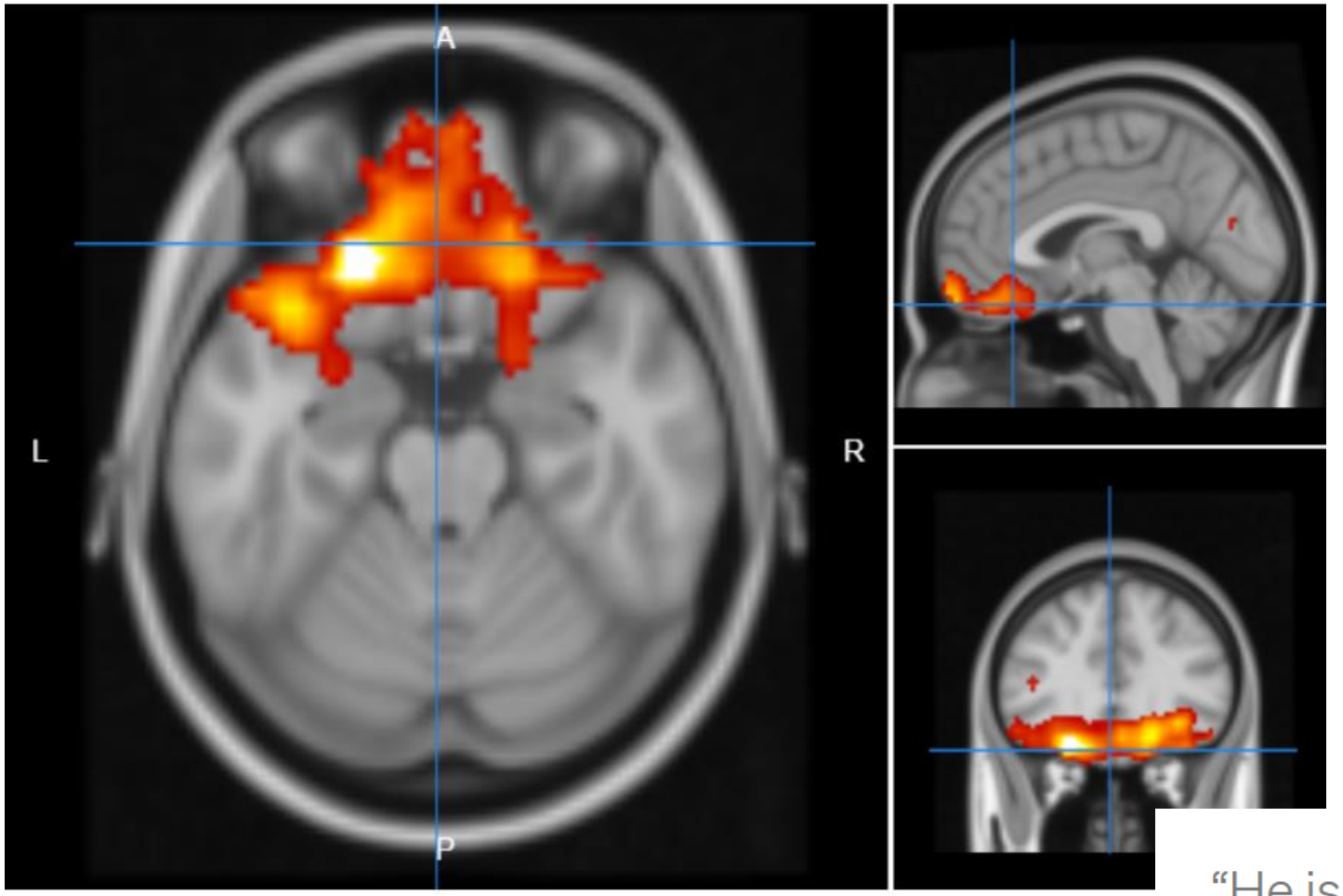
828 Accesses

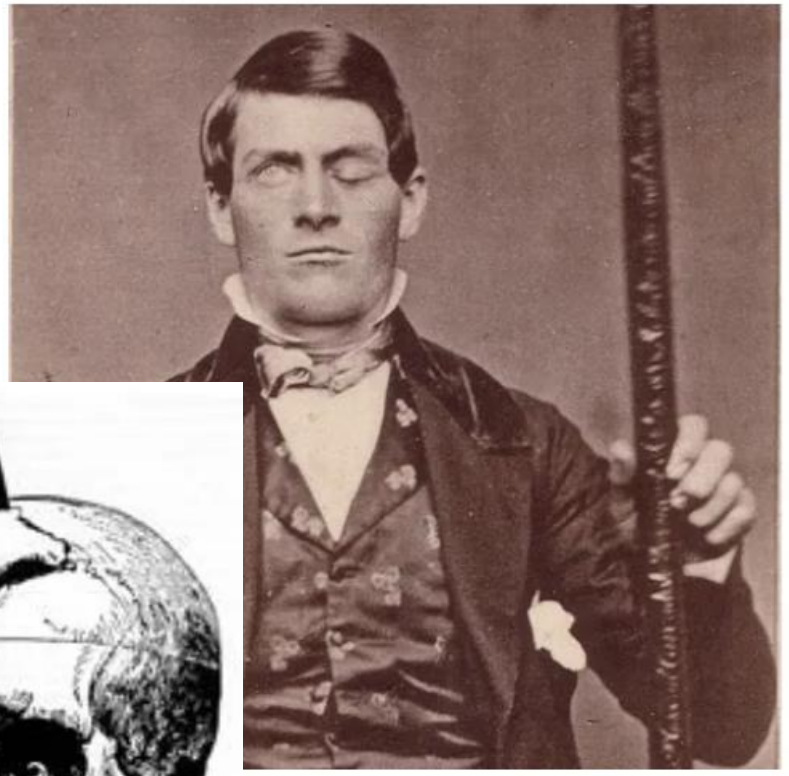
Abstract

Interoception as the ability of human beings to sense their internal body feelings is far beyond visceral sensations and comprises a variety of sensory modalities, including metabolic, immunologic, and autonomic status. The key area onto which interoceptive sensations project is the insular cortex in the brain. Owing to this ability, the posterior portion of the insula makes functional connections to the thalamocortical hubs as well as areas within the limbic system and the amygdala, which is historically known for its role in the perception of anger and fear. The prefrontal gyrus, anterior cingulate cortex, and several other neocortical areas add cognitive input to interoceptive perception. Granular cortices are core modulating units of interoception, while agranular cortices are directly responsible to drive perception and the resulting action that is derived from interoceptive decision making. These cortical outbound communications synchronize the activity of amygdalo-insular region with other cognitive networks and inform the rest of the brain about the interoceptive predictions and sensations, all to produce an integrated representation of internal and external body feelings and a unique form of consciousness. The granular interoceptive cortices are less prone to predictive errors, meaning a more precise interoception and factual interpretation of internal body feelings in relation to sensory input. Affective parts of our consciousness, or what we commonly call an internal sensation, enroot from predictions within the interoceptive system that might or might not be true predictions, but are congruent with overall exteroceptive and interoceptive mood of the body.

https://link.springer.com/chapter/10.1007/978-3-030-10620-1_4

The orbitofrontal cortex: contextualized emotions



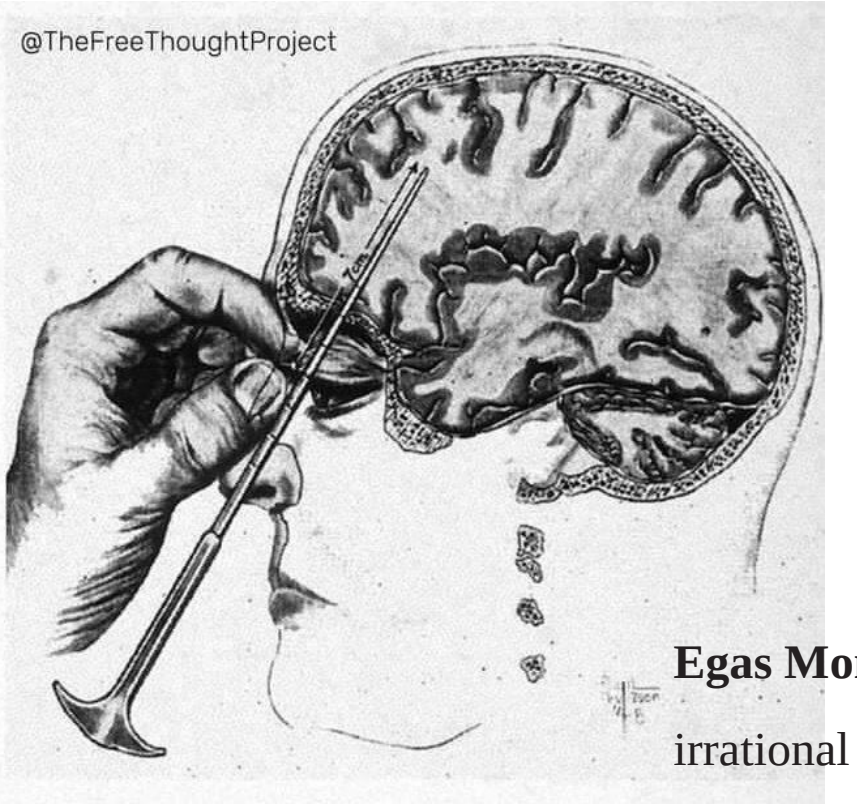


"He is fitful, irreverent, indulging at times in the grossest profanity, which was not previously his custom," — Dr. Harlow (1848)

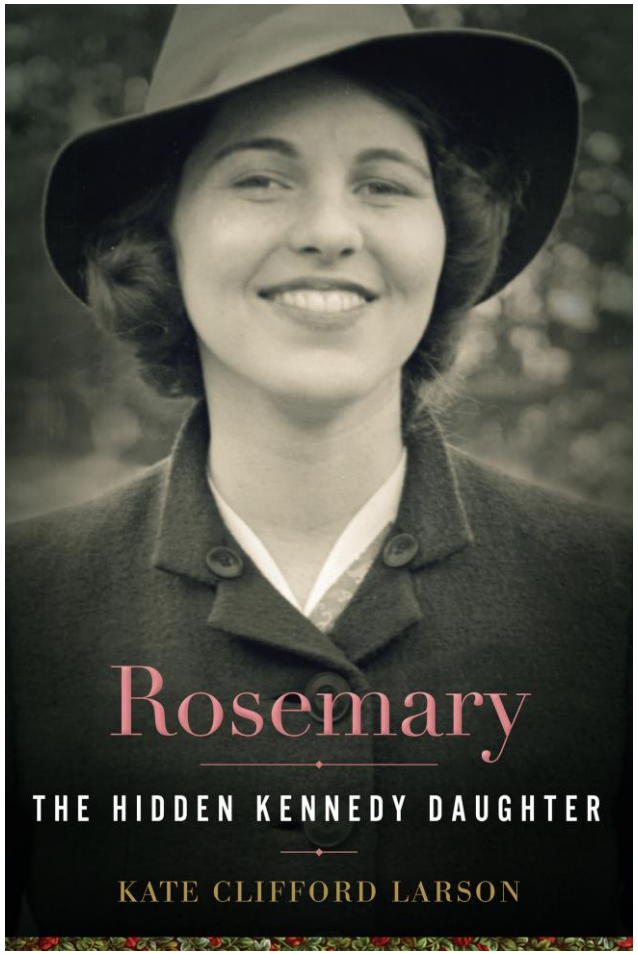
Jacobsen, C. F. (1936). Studies of cerebral function in primates. I. The functions of the frontal association areas in monkeys. *Comparative Psychology Monographs, 13, 3,* 1–60.

Some animals became calmer and showed less frustration when reward was not given

https://psycnet.apa.org/record/1937-02587-001



Egas Moniz
(1874 – 1955)



Egas Moniz concluded that perhaps anxiety, irrational fears, and emotional hyperexcitability in humans might be treated by damage to the frontal lobes. He created the lobotomy/leucotomy procedure.

Nat Neurosci. Author manuscript; available in PMC 2017 Aug 3.
Published in final edited form as:
Nat Neurosci. 2015 May; 18(5): 620–627.
doi: 10.1038/nn.3982

PMCID: PMC5541252
NIHMSID: NIHMS880692
PMID: 25919962

What the orbitofrontal cortex does not do

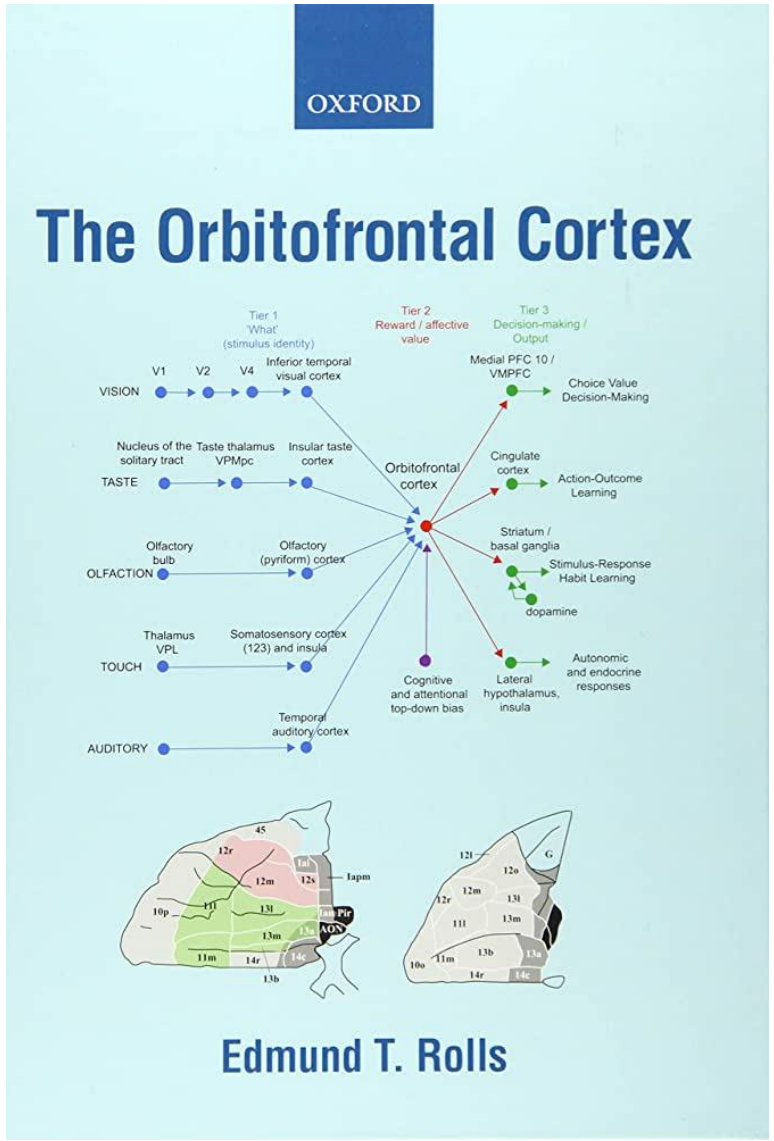
Thomas A Stalnaker, Nisha K Cooch, and Geoffrey Schoenbaum

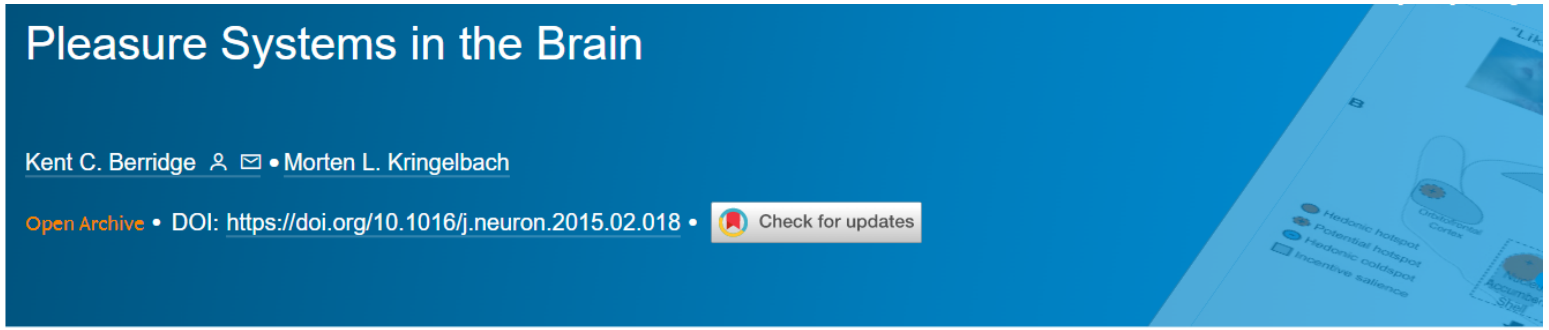
Abstract

Go to: ▸

The number of papers about the orbitofrontal cortex (OFC) has grown from 1 per month in 1987 to a current rate of over 50 per month. This publication stream has implicated the OFC in nearly every function known to cognitive neuroscience and in most neuropsychiatric diseases. However, new ideas about OFC function are typically based on limited data sets and often ignore or minimize competing ideas or contradictory findings. Yet true progress in our understanding of an area's function comes as much from invalidating existing ideas as proposing new ones. Here we consider the proposed roles for OFC, critically examining the level of support for these claims and highlighting the data that call them into question.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5541252/





Pleasure is mediated by well-developed mesocorticolimbic circuitry and serves adaptive functions. In affective disorders, *anhedonia* (lack of pleasure) or *dysphoria* (negative affect) can result from breakdowns of that hedonic system. Human neuroimaging studies indicate that surprisingly similar circuitry is activated by quite diverse pleasures, suggesting a common neural currency shared by all. Wanting for reward is generated by a large and distributed brain system. Liking, or pleasure itself, is generated by a smaller set of hedonic hot spots within limbic circuitry. Those hot spots also can be embedded in broader anatomical patterns of valence organization, such as in a keyboard pattern of nucleus accumbens generators for desire versus dread. In contrast, some of the best known textbook candidates for pleasure generators, including classic pleasure electrodes and the mesolimbic dopamine system, may not generate pleasure after all. These emerging insights into brain pleasure mechanisms may eventually facilitate better treatments for affective disorders.

https://pubmed.ncbi.nlm.nih.gov/25950633/

Brain. 2001 Sep;124(Pt 9):1720-33. doi: 10.1093/brain/124.9.1720.

Changes in brain activity related to eating chocolate: from pleasure to aversion

D M Small [1], R J Zatorre, A Dagher, A C Evans, M Jones-Gotman

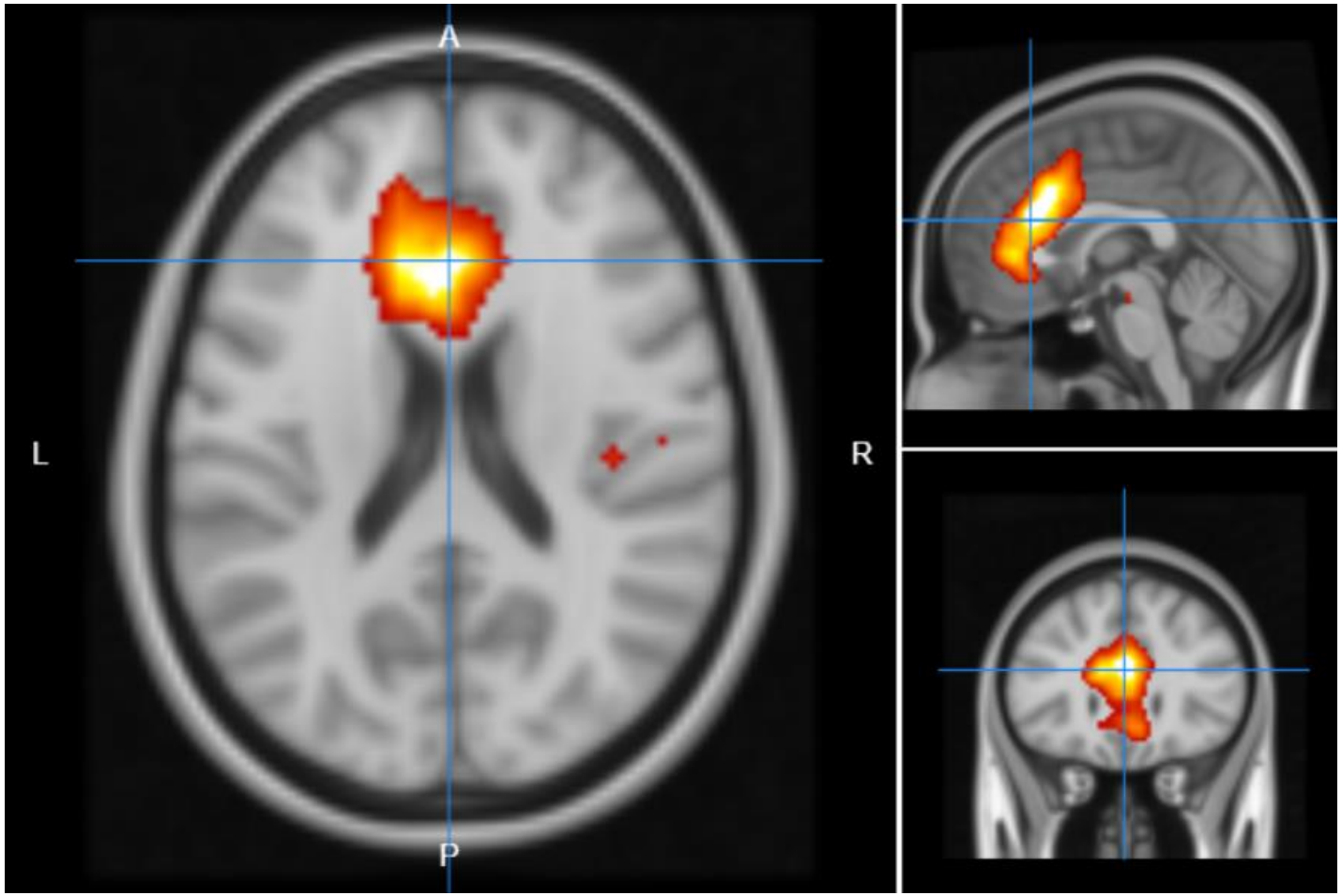
https://pubmed.ncbi.nlm.nih.gov/11522575/

The OFC => **assessing the rewarding value** of a stimulus & monitoring whether the outcome of an action is met.

For example, Small et al. (2001) asked participants to eat chocolate in between scans, and noticed that with **satiety**, participants self-reported pleasure for eating the chocolate decreased and at the same time there was a shift in activity **from the medial to the lateral parts of the OFC.**

The OFC also seems to be involved in **hedonic** experiences. This has implications for affective disorders.

The anterior cingulate

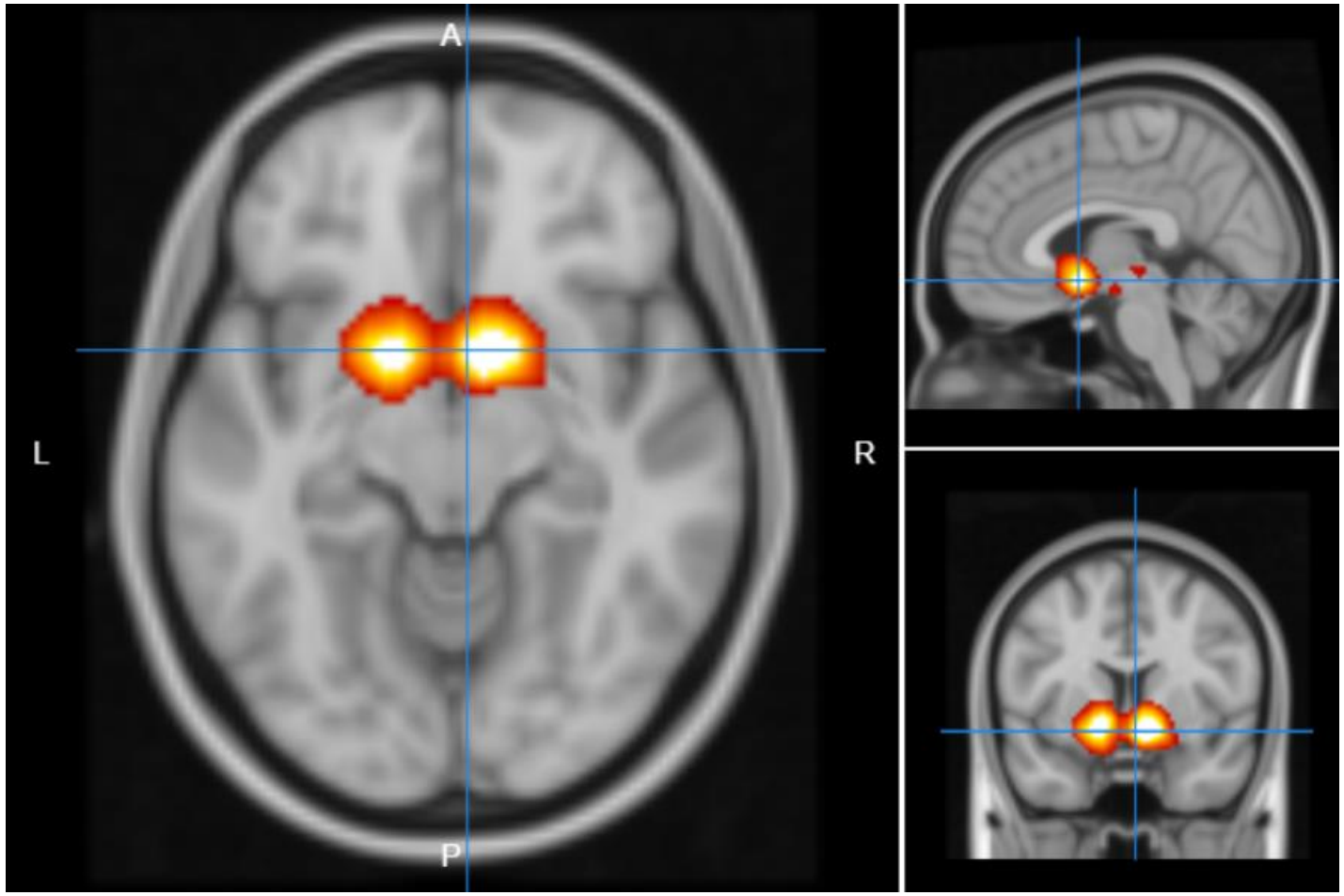


Also involved in perception of pain and empathy to observed pain.

The anterior cingulate cortex, like the insula, is involved in **processing bodily signals that characterize emotions** but, whereas the insula is more concerned with the input (and awareness) of these signals, **the anterior cingulate is more concerned with the output of bodily responses**. Lesions in this area disrupt the **skin conductance response** (Tranel & Damasio, 1995) and changes in **heart rate and blood pressure** (Critchley et al., 2003) to emotional stimuli.

Ward, (2020), p. 431

The ventral striatum and reward



Innervated with **dopaminergic** neurons, involved in tracking the **reward value** of stimuli and **encoding prediction errors**.

Crucial for **affective anticipation**, showing increased activity when individuals anticipate either rewarding and aversive experiences (Jensen et al., 2003).

Densely interconnected with the **amygdala** and the ventromedial prefrontal cortex, thus contributing to **fear learning and extinction**.

The cerebellum and emotional memories

Human cerebellum and corticocerebellar connections involved in emotional memory enhancement

Matthias Fastenrath, Klara Spalek, David Coynel, +7, and Dominique J.-F. de Quervain Authors Info & Affiliations

Edited by James McGaugh, University of California Irvine, Irvine, CA; received March 21, 2022; accepted August 9, 2022

October 3, 2022 | 119 (41) e2204900119 | https://doi.org/10.1073/pnas.2204900119

Emotional information is better remembered than neutral information. Extensive evidence indicates that the amygdala and its interactions with other cerebral regions play an important role in the memory-enhancing effect of emotional arousal. While the cerebellum has been found to be involved in fear conditioning, its role in emotional enhancement of episodic memory is less clear. To address this issue, we used a whole-brain functional MRI approach in 1,418 healthy participants. First, we identified clusters significantly activated during enhanced memory encoding of negative and positive emotional pictures. In addition to the well-known emotional memory–related cerebral regions, we identified a cluster in the cerebellum. We then used dynamic causal modeling and identified several cerebellar connections with increased connection strength corresponding to enhanced emotional memory, including one to a cluster covering the amygdala and hippocampus, and bidirectional connections with a cluster covering the anterior cingulate cortex. The present findings indicate that the cerebellum is an integral part of a network involved in emotional enhancement of episodic memory.

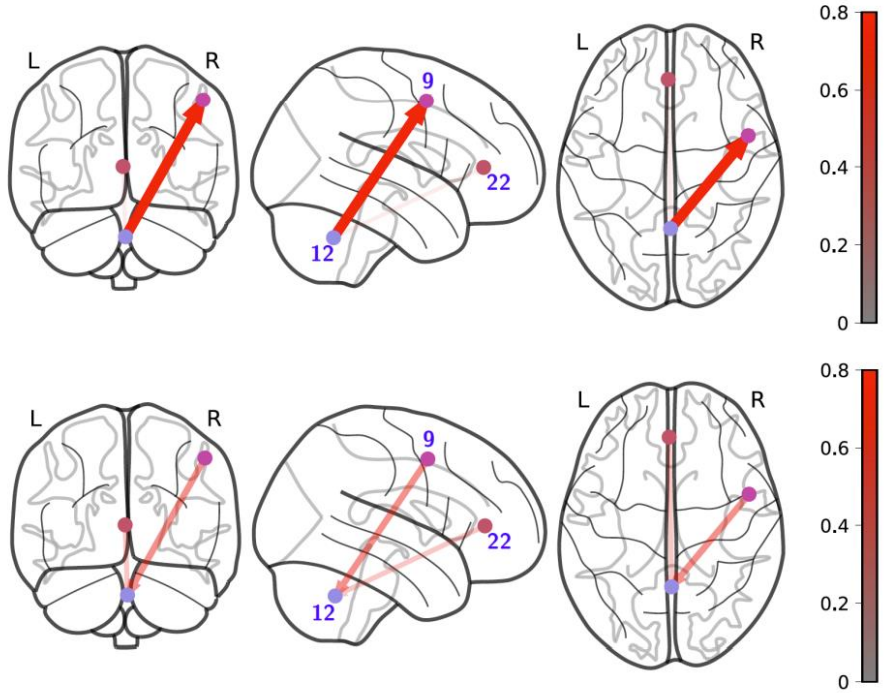


Figure S8. Bidirectional increase in the strength of cerebello-cortical connections during enhanced emotional memory encoding. The width and color of the arrows correspond to the strength of increase in connectivity in the replication sample.

https://www.pnas.org/doi/full/10.1073/pnas.2204900119

Take-home messages

1. Important insight into the function of various brain areas comes from neuropsychology (i.e., the study of brain lesions);

2. Brain areas rarely play distinct and unique functions in isolation (e.g., the orbitofrontal cortex); it is the interconnectedness between them that gives rise to the rich palette that is the human affective experience;

3. The study of complex functions, such as emotions, requires multimodal research approaches (e.g., lesions, neuroimaging, psychophysiological measures, self-report);

4. Emotion processing does not exist in isolation but intersects with other areas of cognitive processing (e.g., decision making).

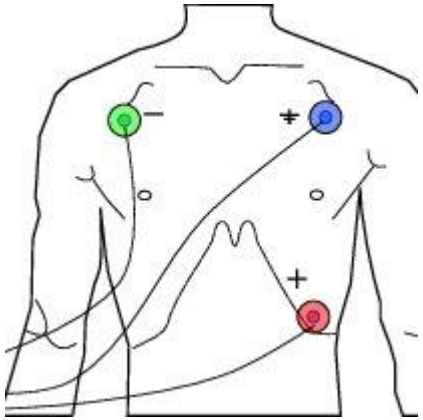
Psychophysiological measures of emotion processing

Skin conductance response (SCR)

An **indirect** measure of **sympathetic autonomic activity** that is associated with both **emotion** and **attention**. In humans, the amplitude of SCRs is related to the **level of arousal** elicited by visual stimuli, **irrespective of emotional valence**.

Laine et al., (2009);
https://pubmed.ncbi.nlm.nih.gov/19144740/

Heart rate



High heart rate variability (**HRV**) is associated with **higher emotional well-being**, lower levels of worry and rumination, **lower anxiety**, and generally **better emotion regulation**.

Mather & Thayer, (2018);
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5761738/

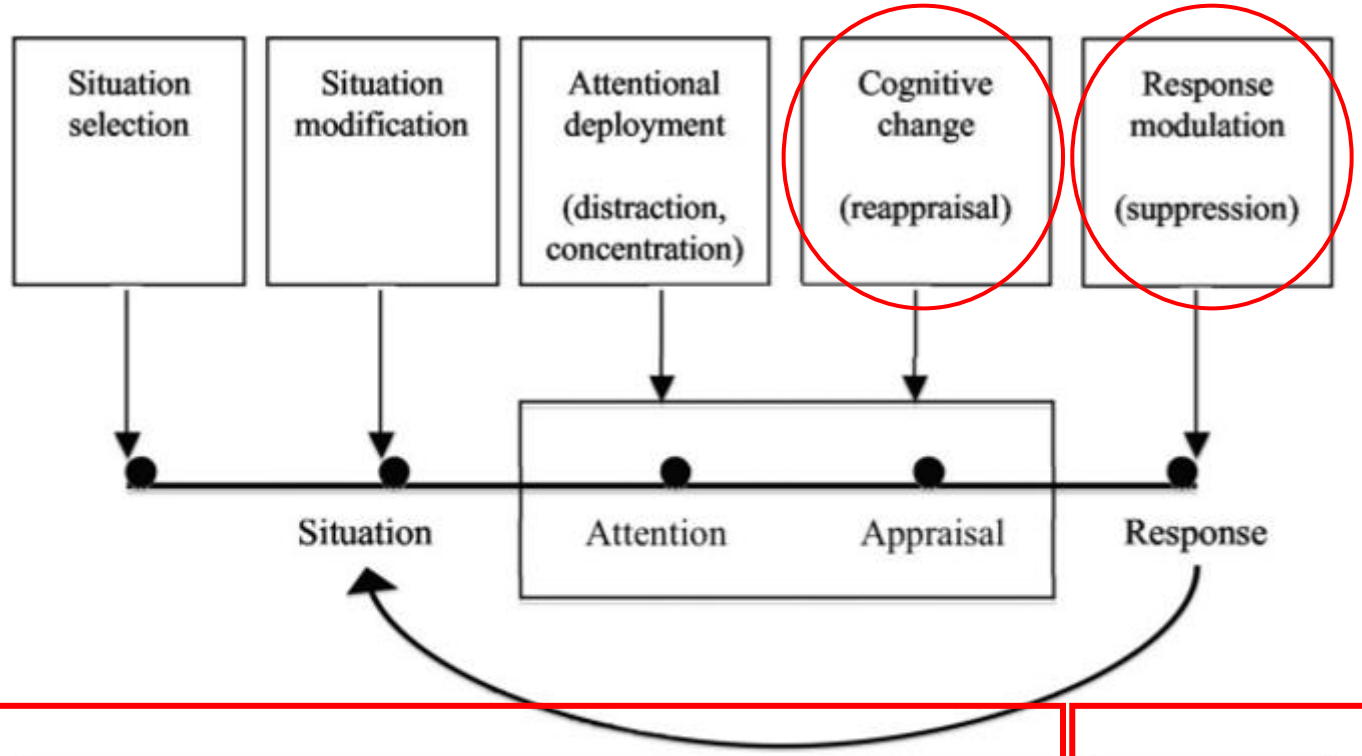
Respiration rate

More intense responses to **negative emotions** (e.g., fear, anger, anxiety) result in **shallower, rapid breathing.**

Jerath & Beveridge, (2020);
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7457013/)

Emotion regulation

James Gross (1998; 2002) => The process model of emotion regulation



before the emotion is fully experienced, or during the emotion experience

after the emotion has completely developed

Reproduced from "Emotion Regulation: Conceptual Foundations," by J.J. Gross and R.A. Thompson, 2007, in J.J. Gross (Ed.), Handbook of Emotion Regulation, p. 10, Guilford Press. Copyright 2007 by Guilford Press.

https://psu.pb.unizin.org/psych425/

CONTENTS ▲

PSYCHOLOGY OF HUMAN EMOTION: AN OPEN ACCESS TEXTBOOK

eword

ction

Emotion is one of my favorite psychology courses to teach. After teaching this course for years, and fluctuating between assigning textbook and journal article readings to my stu- decided to jump in and write my own textbook for the course. My goals in writing this text- ere to:

re my fascination for human emotion with other students and faculty.
vide every student equal access and opportunity to learn about human emotion.
ate an interactive textbook that helps students to test their knowledge and apply concepts

https://psu.pb.unizin.org/psych425/front-matter/introduction/

Alexithymia

Review > Handb Clin Neurol. 2021;183:47-62. doi: 10.1016/B978-0-12-822290-4.00004-9.

Alexithymia

Jeremy Hogeveen [1], Jordan Grafman [2]

Affiliations + expand

PMID: 34389125 PMCID: PMC8456171 DOI: 10.1016/B978-0-12-822290-4.00004-9

Free PMC article

Abstract

Humans are highly adept at differentiating, regulating, and responding to their emotions. At the core of all these functions is emotional awareness: the conscious feeling states that are central to human mental life. Disrupted emotional awareness-a subclinical construct commonly referred to as alexithymia-is present in a range of psychiatric and neurological disorders and can have a deleterious impact on functional outcomes and treatment response. This chapter is a selective review of the current state of the science on alexithymia. We focus on two separate but related issues: (i) the functional deficits associated with alexithymia and what they reveal about the importance of emotional awareness for shaping normative human functioning, and (ii) the neural correlates of alexithymia and what they can inform us about the biological bases of emotional awareness. Lastly, we outline challenges and opportunities for alexithymia research, focusing on measurement issues and the potential utility of formal computational models of emotional awareness for advancing the fields of clinical and affective science.

Keywords: Alexithymia; Emotional awareness; Emotional communication; Emotions; Interoception; Neurological disorders.

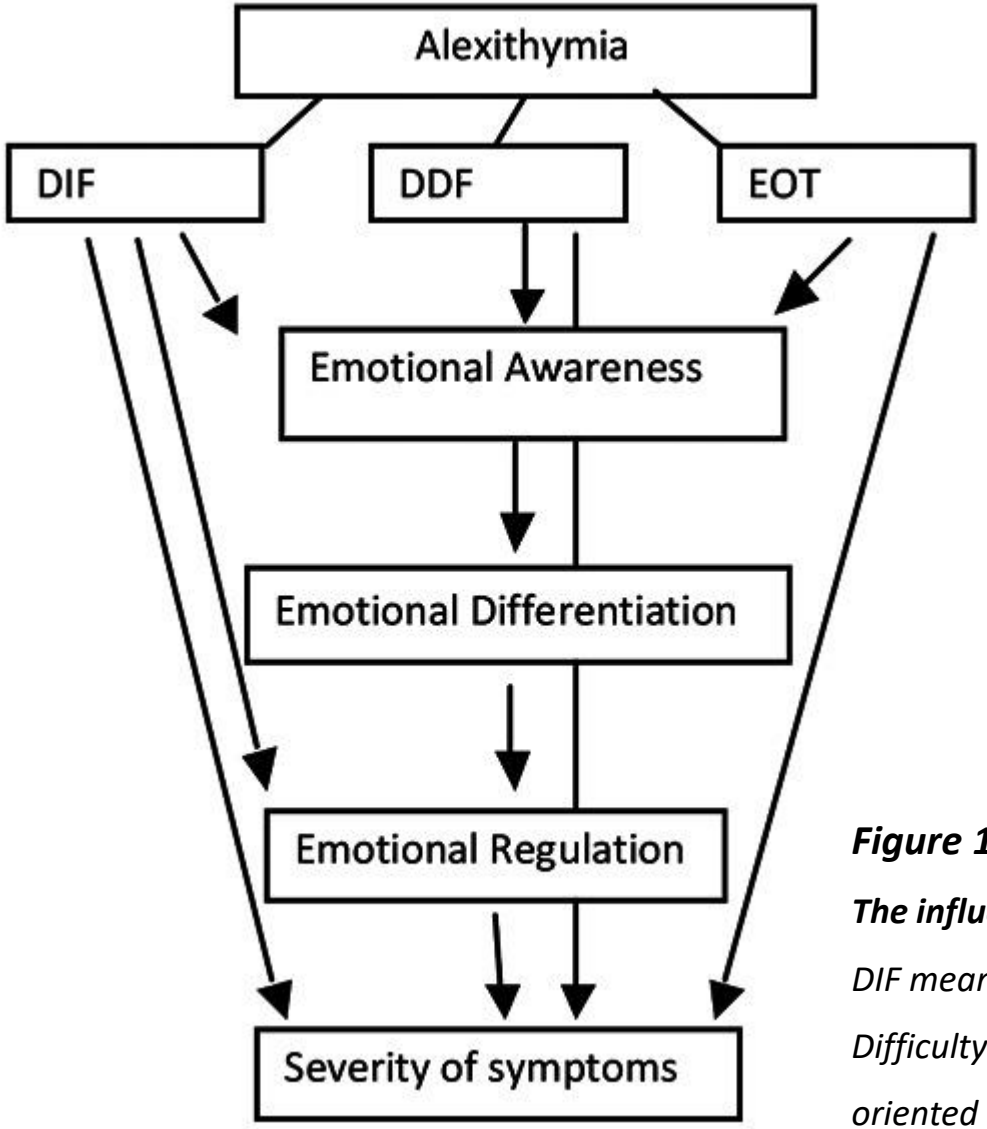
https://pubmed.ncbi.nlm.nih.gov/34389125/

Sub-clinical construct first described in the 1970s, defined by **disrupted emotional awareness**, evidenced by difficulties in **understanding** and **expressing** emotions.

High levels of alexithymia are frequently found in populations with e.g., **psychoses**, **eating disorders**, **substance abuse disorders** and **autism**. It can also develop as a result of traumatic brain injury or degeneration (see Hogeveen & Grafman, 2021).

Closely linked to **emotion dysregulation** and higher levels of **emotional distress**.

Current measures are largely self-report – conceptual and measurement challenges still need to be addressed!



Res Psychother. 2018 Apr 12; 21(1): 292.
Published online 2018 Apr 12. doi: 10.4081/ripppo.2018.292

Alexithymia and emotional processing: a longitudinal mixed methods research

Ana Nunes da Silva,[1] António Branco Vasco,[1] and Jeanne C. Watson[2]

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7451369/

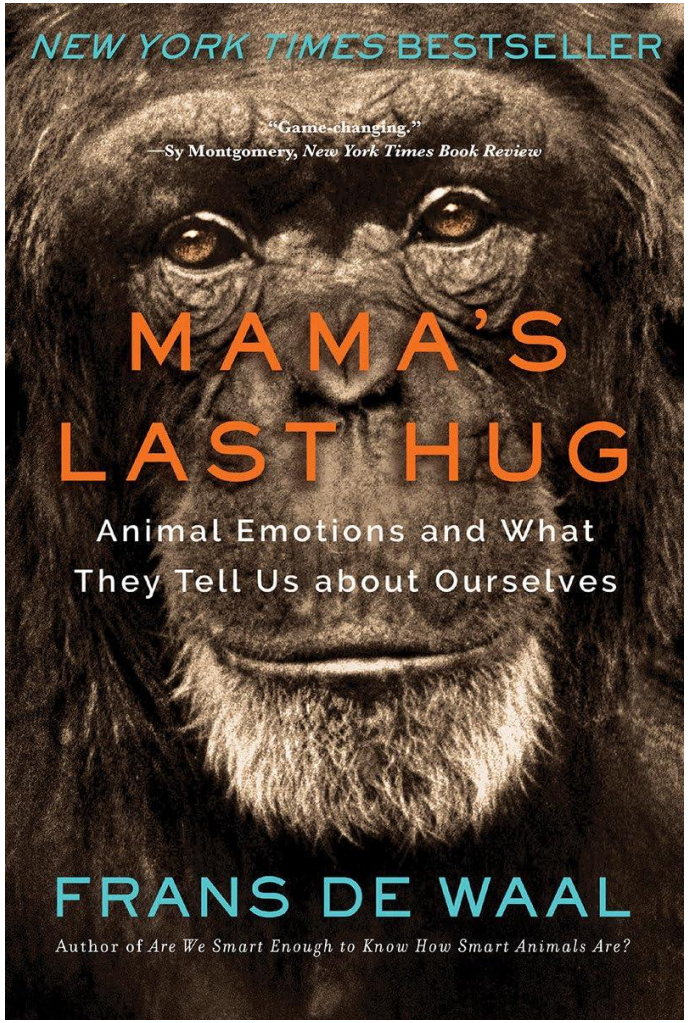
One of the things that most impressed me is being able to identify what causes me to have an emotional breakdown. Identify both the external and the internal patterns and knowing my own patterns; what I do to cause this. Formerly, maybe I would only blame the others (...) Choose, know how to choose, know that I have options and make rational ones, thinking, writing, which...if I do this what will happen? (...) Then I remember a few phrases of the questionnaire 'I know clearly identify the external and internal factor'...' At first 'What?! I didn't know' Maybe I choose 'no, never, rarely' and now I am fine, and that was one of the items that I was there a long time thinking...

Figure 1.

The influence of alexithymia on emotional processing.

DIF means Difficulty identifying feelings, DDF means Difficulty describing feelings and EOT means Externally oriented thinking.

Further resources



in memoriam

Frans de Waal
(1948 – 2024)

Emory University primatologist Frans de Waal — who pioneered studies of animal cognition while also writing best-selling books that helped popularize the field around the globe — passed away March 14, 2024, from stomach cancer.

https://news.emory.edu/features/2024/03/er_frans_de_waal_16-03-2024/index.html