Kognitionspsychologie II: Session 5
Emotion

Loreen Tisdall, FS 2024

Version: March 26, 2024

Learning Objectives

- Discuss the possible **adaptive significance** of emotions
- Learn how **comparative approaches** give some support to the idea of basic emotions
- Learn about **developmental patterns** in the maturation of the neural architecture of emotional experience and regulation
- Learn about **neural model**(s) of basic (and not so basic) emotions

Affect, Mood, and Emotion

“What do you believe is the difference between an emotion and a mood?”

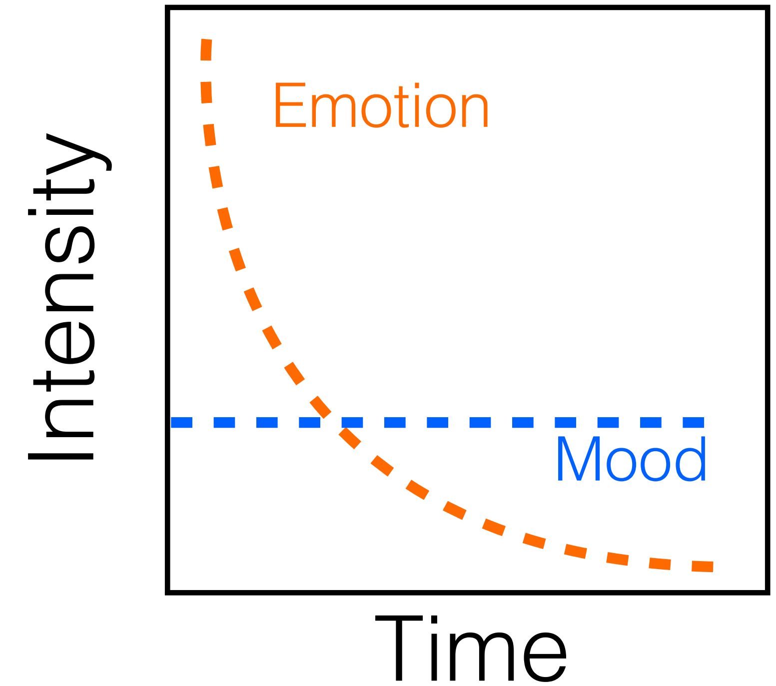
(a) “There is no right or wrong answer, please simply write down your personal view”;
(b) ”Please do not ask friends or colleagues for their opinion to assist you in deciding your answer”;
(c) “Please do not use any form of reference text to help you answer the question (e.g., dictionaries, textbooks, internet, etc.)”;
(d) “Please feel free to use any examples or experiences you may have to illustrate your answer”;
(e) “Make your answer as short or as long as you like”;
(f) “The question asks for the difference between two types of human feeling. If you do not think that there is a difference, please simply state that opinion”

Beedie, C., Terry, P., & Lane, A. (2005). Distinctions between emotion and mood. ***Cognition & Emotion, 19***(6), 847–878. doi:10.1080/02699930541000057

Affect, Mood, and Emotion

Summary of distinctions between emotion and mood

Criterion	*Emotion*	*Mood*
Anatomy	Related to the heart	Related to the mind
Awareness of cause	Individual is aware of cause	Individual may be unaware of cause
Cause	Caused by a specific event or object	Cause is less well defined
Clarity	Clearly defined	Nebulous
Consequences	Largely behavioural and expressive	Largely cognitive
Control	Not controllable	Controllable
Display	Displayed	Not displayed
Duration	Brief	Enduring
Experience	Felt	Thought
Intensity	Intense	Mild
Intentionality	About something	Not about anything in particular
Physiology	Distinct physiological patterning	No distinct physiological patterning
Stability	Fleeting and volatile	Stable
Timing	Rises and dissipates quickly	Rises and dissipates slowly



Affect is typically used as general term to refer to mental states consisting of emotions and moods; **emotions** have episodic nature, are triggered by specific (internal or external) stimuli - hence, have intentionality (i.e., are about something) and have high(er) intensity and more limited temporal course relative to **moods**.

Beedie, C., Terry, P., & Lane, A. (2005). Distinctions between emotion and mood. ***Cognition & Emotion, 19***(6), 847–878. doi:10.1080/02699930541000057

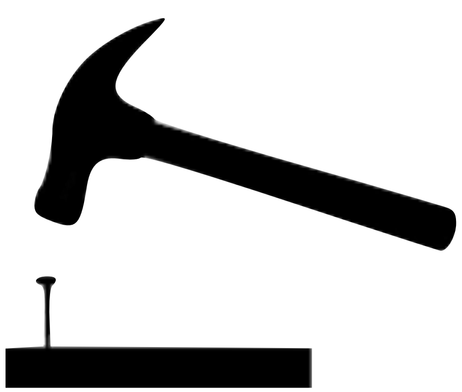
What is emotion?

Image created with AI (Bing), January 31, 2024

"It is widely agreed that emotion refers to a collection of psychological states that include subjective experience, expressive behavior (e.g., facial, bodily, verbal), and peripheral physiological responses (e.g., heart rate, respiration). It is also widely agreed that emotions are a central feature in any psychological model of the human mind. Beyond these two points of agreement, however, almost everything else seems to be subject to debate."

Gross, J.J, & Barrett, L.F. (2011). Emotion generation and emotion regulation: One or two depends on your point of view. *Emotion Review, 3*, 8–16.

Emotion

Ontogeny	Mechanism
Phylogeny	 Adaptive Significance

Why emotion(s)?

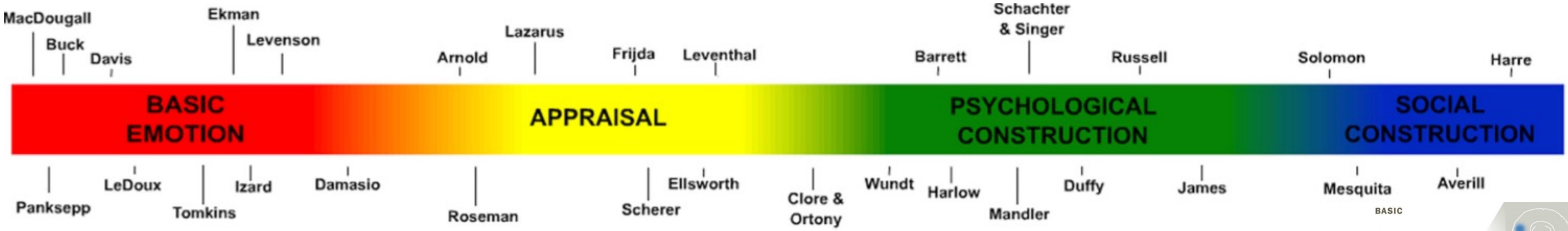
Images created with AI (Bing), February 14, 2024

The woman without fear

"WHEN SHE WAS 42 YEARS OLD, S.M. couldn't remember actually having felt scared since she was 10. This is not because she has not been in frightening circumstances since then; she has been in plenty. She has been held at both knife- and gunpoint, physically accosted by a woman twice her size, and nearly killed in a domestic-violence attack, among multiple other frightening experiences. […] She even stated that she "hated" snakes and spiders and tried to avoid them. Yet, contrary to her declarations, when taken to an exotic pet store, she spontaneously went to the snakes and readily held one, rubbed its scales, and touched its tongue, commenting, "This is so cool!"

Gazzaniga, M.S., Ivry, R.B., & Mangun, G.R. (Eds.). (2019). Social Cognition. In Gazzaniga, M.S., Ivry, R.B., & Mangun, G.R. (Eds.), *Cognitive Neuroscience. The biology of the mind* (5th ed., pp. 566-617). W.W. Norton & Company.

Four perspectives on emotion



Basic Emotion: emotion words such as "anger," sadness," and "fear" each name a unique mechanism that causes a unique mental state with unique measurable outcomes.

Appraisal: emotion words name privileged mental states that are unique in form, function, and cause from other mental states, but "anger," "sadness," "fear," and other emotion words do not name distinct, dedicated mental mechanisms per se. Instead, emotions are linked to appraisals which in turn trigger biologically basic emotional responses characterised either by stereotyped outputs or by a strong and almost inescapable tendency to interact with the world in a particular way (both fear and surprise are linked to the appraisals of uncertainty).

Psychological Construction: all mental states are seen as emerging from an ongoing, continually modified constructive process that involves more basic ingredients that are not specific to emotion.

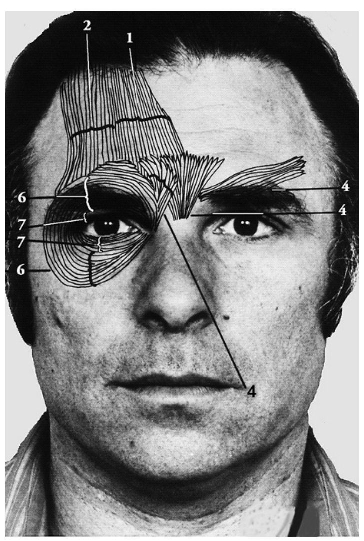
Social Construction: Emotions are viewed as social artifacts or culturally-prescribed performances that are constituted by sociocultural factors, and constrained by participant roles and social context.

Gross, J.J, & Barrett, L.F. (2011). Emotion generation and emotion regulation: One or two depends on your point of view. *Emotion Review, 3*, 8–16.

Basic Emotions

"Emotions are viewed as having evolved through their adaptive value in dealing with fundamental life-tasks. Each **emotion has unique features: signal, physiology, and antecedent events**. Each emotion also has characteristics in common with other emotions: rapid onset, short duration, unbidden occurrence, automatic appraisal, and coherence among responses. These **shared and unique characteristics are the product of our evolution**, and distinguish emotions from other affective phenomena."

"Most of my presentation will describe <u>nine characteristics</u> of the emotions of **anger, fear, sadness, enjoyment, disgust, and surprise**. I will also raise the possibility that contempt, shame, guilt, embarrassment, and awe may also be found to share these nine characteristics."



Ekman's proposal of micro expressions

Characteristics which Distinguish Basic Emotions from One Another and from Other Affective Phenomena

	Basic with regard to:	
	Distinctive States	*Biological Contribution*
1. Distinctive universal signals	x*	x
2. Presence in other primates		x
3. Distinctive physiology	x*	x
4. Distinctive universals in antecedent events	x*	x
5. Coherence among emotional response		x
6. Quick onset		x
7. Brief duration		x
8. Automatic appraisal		x
9. Unbidden occurrence		x

** Distinguish one emotion from another*

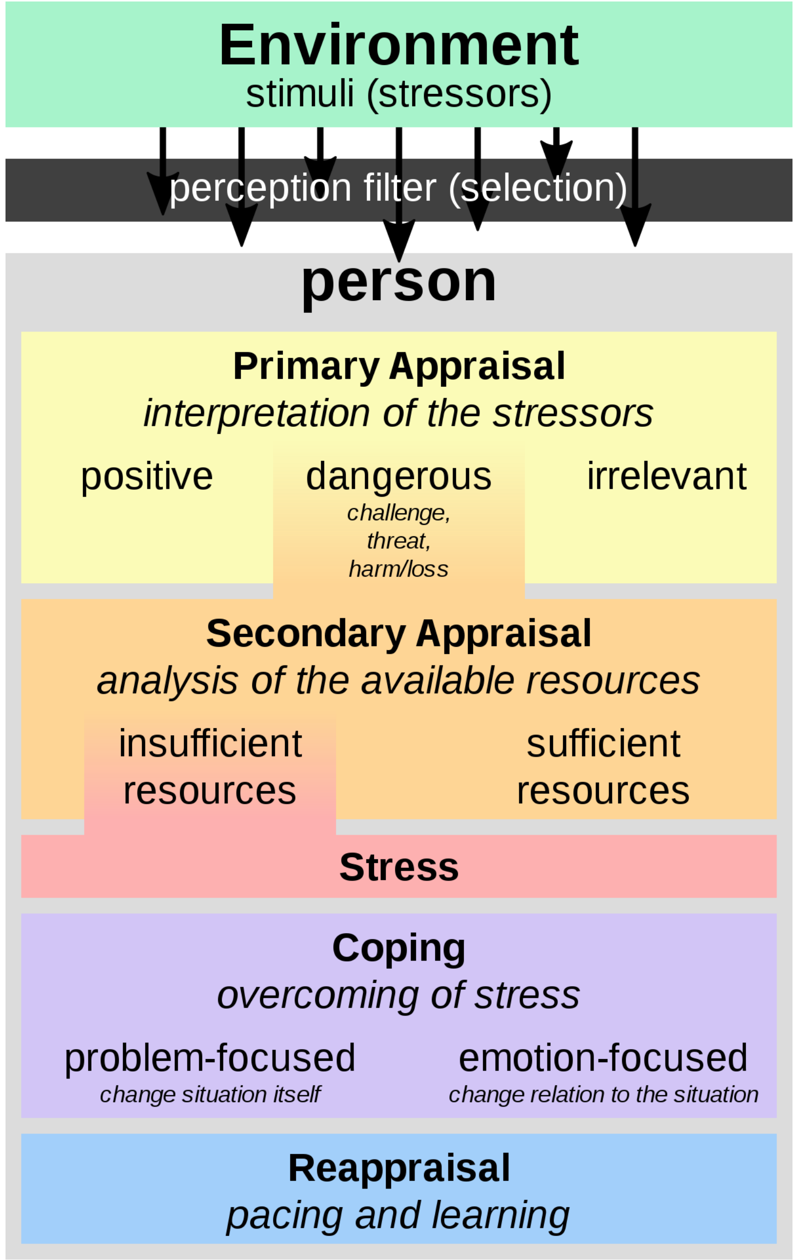
Ekman, P. (1992). An argument for basic emotions. ***Cognition & Emotion, 6***(3/4), 169-200. doi:10.1080/02699939208411068

Appraisals

Richard S. Lazarus

Susan Folkman

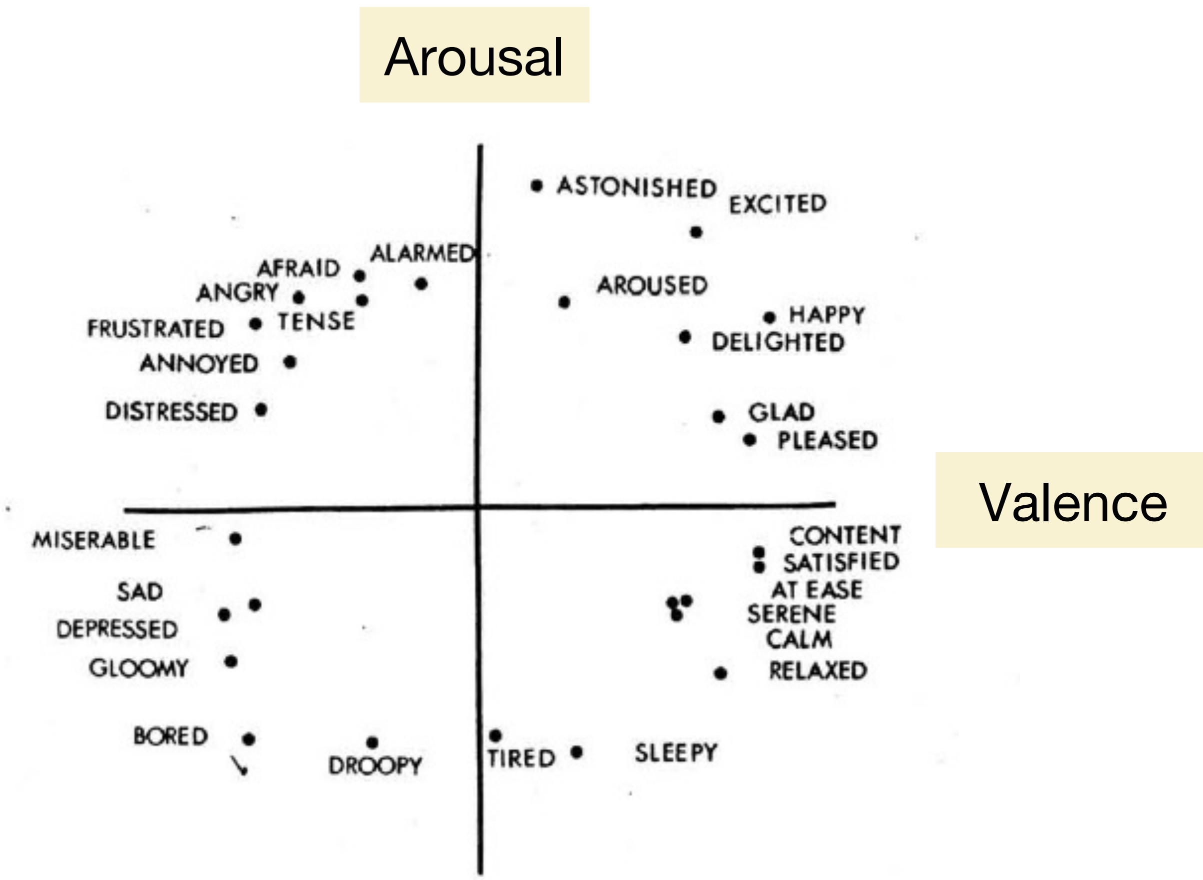
Lazarus and Folkman (1984) conducted a number of experiments in which they used movies to produce emotional reactions and stress (e.g., genital mutilation). A number of **manipulations were used to change cognitive interpretation** (e.g., narrator comments). Lazarus and Folkman found that participants' interpretations had a crucial role in the emotional experience and behaviour leading Lazarus and Folkman to propose a theory of "cognitive appraisal" which is based on the **importance of individuals' appraisals (cognitive interpretations of the environment)**. This theory has had many uses in clinical and educational practice, particularly in the form of **reappraisal interventions** (*see figure on the right*).



According to such approaches, **appraisals are cognitive phenomena** (i.e., "part of the cloud of associates that each perceived or thought of informational element stirs") and **respective "action tendencies" may have adaptive/maladaptive character** depending on either **universal** (anger -> fight) or **individually learned patterns**.

Lazarus, R.S., & Folkman, S. (1984). *Stress, appraisal and coping*. New York: Springer.

Psychological Construction



The circumplex model of affect proposes that all affective states arise from cognitive interpretations of core neural sensations that are the product of two independent (neurophysiological) systems. This model stands in contrast to theories of basic emotions, which posit that a discrete and independent (neural) system subserves every emotion.

"At the heart of emotion, mood, and any other emotionally charged event are states experienced as simply feeling good or bad, energized or enervated. These states—called core affect—influence reflexes, perception, cognition, and behavior and are influenced by many causes internal and external, but people have no direct access to these causal connections. Core affect can therefore be experienced as free-floating (mood) or can be attributed to some cause (and thereby begin an emotional episode). These basic processes spawn a broad framework that includes perception of the core-affect-altering properties of stimuli, motives, empathy, emotional meta-experience, and affect versus emotion regulation; it accounts for prototypical emotional episodes, such as fear and anger, as core affect attributed to something plus various nonemotional processes."

Russell, J.A. (1980). A circumplex model of affect. ***Journal of Personality and Social Psychology, 39***, 1161–1178.

Social Construction

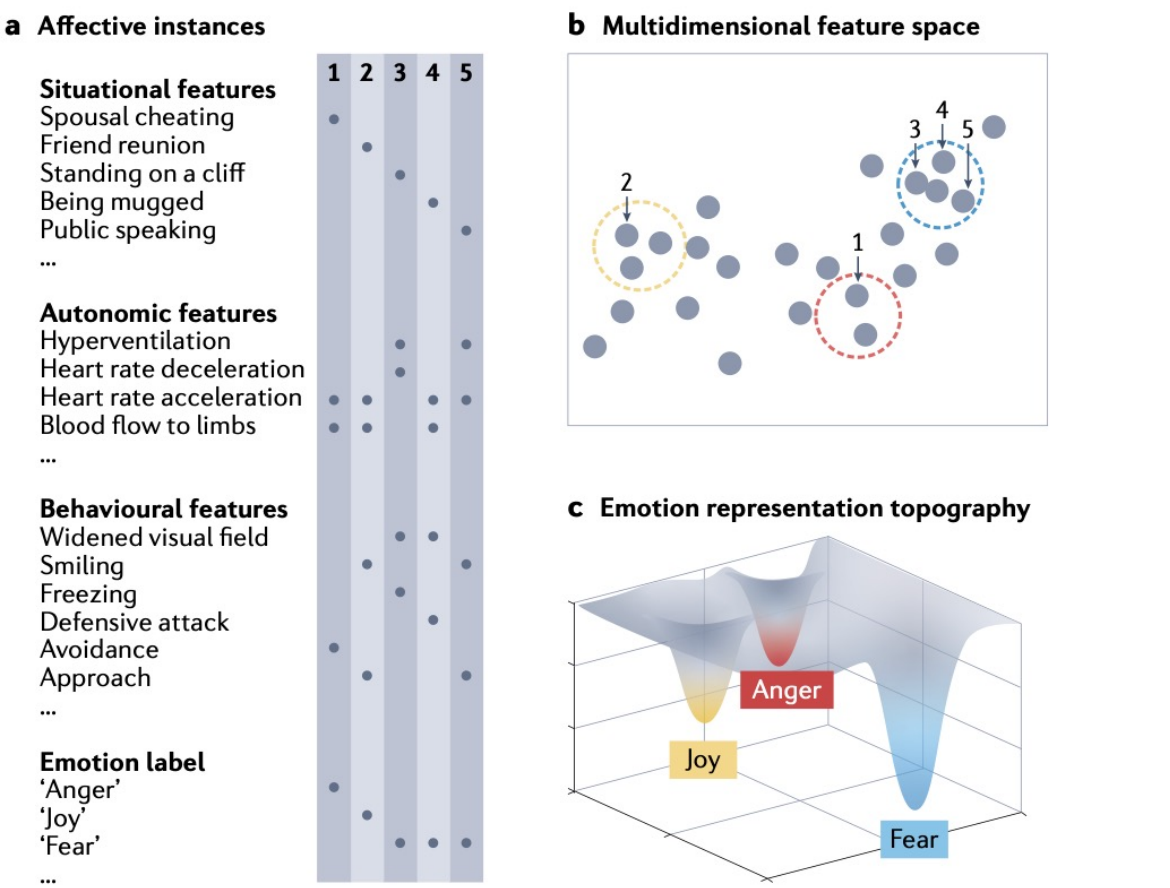


Fig. 1 | **A constructionist framework of emotion representation. a** | Emotion categories name populations of situated instances with features that vary between categories (anger, joy and fear) and within categories (different instances of fear). For example, an instance of anger at spousal cheating (column 1) shares some features with joy at a reunion with a friend (column 2) and fear while being mugged (column 3). Instances of fear evoked by different situations also differ in their features (columns 3, 4 and 5). **b** | Emotions emerge from multidimensional feature space, and the similarity between emotional instances can be represented as the distance between grey circles in that feature space. **c** | Emotion feature space is warped by experience and concept use. Experience of many similar instances and socially learned categories creates a mnemonic category, which are visualized as shaded attractor-basins. Attractor-basins guide how people interpret future situated instances and warps people's perceptions of similarity between these instances.

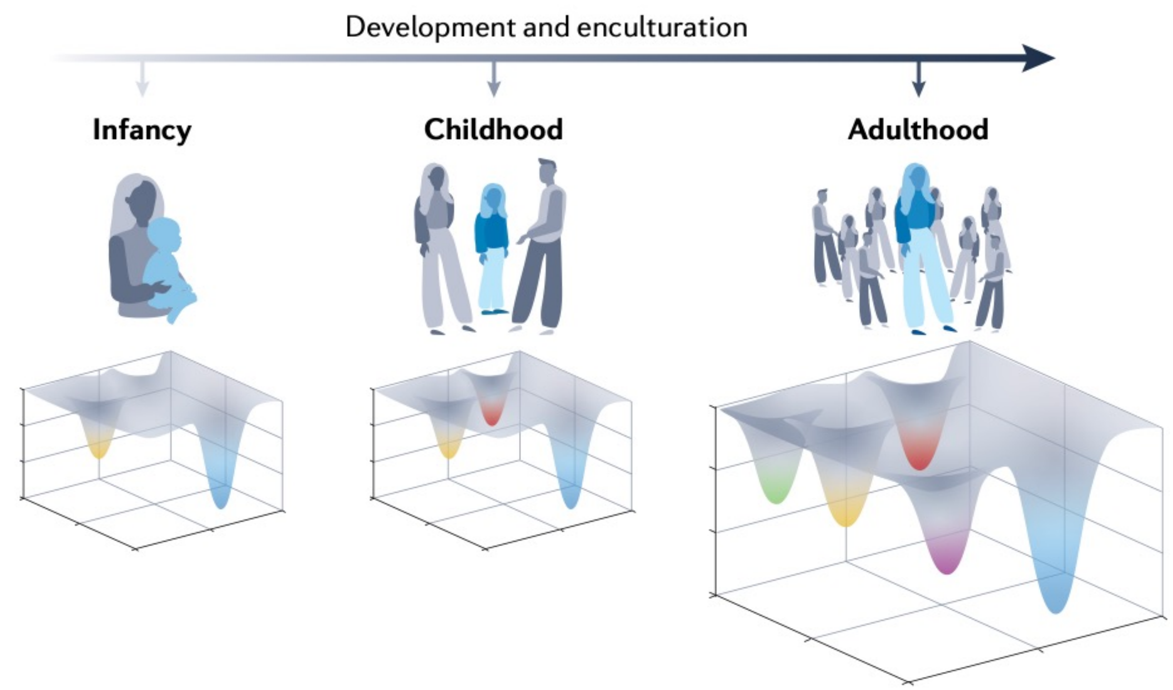
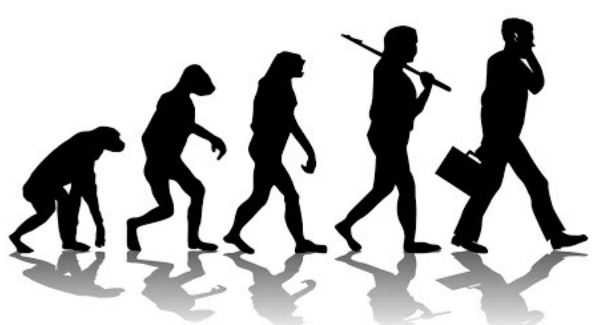


Fig. 2 | **The impact of social learning on emotion across development.** Across development, social learning opportunities influence people's exposure to situated instances and the social categories that people use to make meaning of and communicate these instances. The figure depicts representations of valence in infancy (where the source of social learning is the primary caregivers), the development of emotion concepts in early childhood (when sources of social learning might expand to multiple caregivers, teachers and peers), and an adult emotion concept topography which varies by individual (where sources of social learning are the many other adults in one's own and other cultural groups).

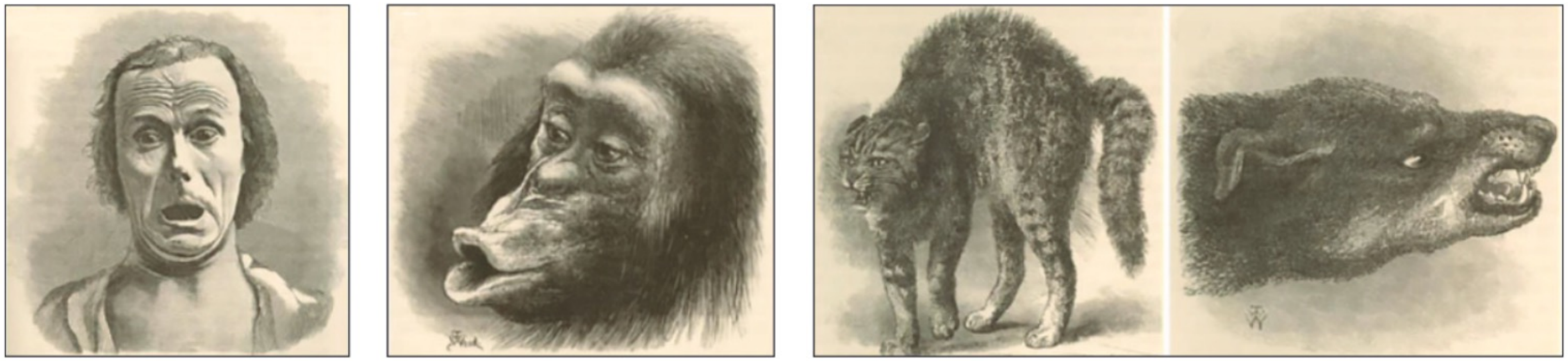
The social construction view on emotion posits that **emotions are cultural artifacts** that are transmitted through social learning within and between cultural groups. This view suggests that emotions emerge from the **confluence of biology and culture**, and that they can be modeled as **psychological phenomena that build on basic human abilities but evolve under local cultural and ecological pressures**.

Lindquist, K.A., Jackson, J.C., Leshin, J., Satpute, A.B. & Gendron, M. (2022). The cultural evolution of emotion. *Nature Reviews Psychology, 1*, 669–681 (2022). https://doi.org/10.1038/s44159-022-00105-4

Emotion

Ontogeny	Mechanism
 Phylogeny	Adaptive Significance

Universal (basic) emotions



a b c

FIGURE 10.5 Examples of emotional expressions given by Charles Darwin.
(a) Terror in a human. **(b)** Disappointment in a chimpanzee. **(c)** Hostility in a cat and a dog.

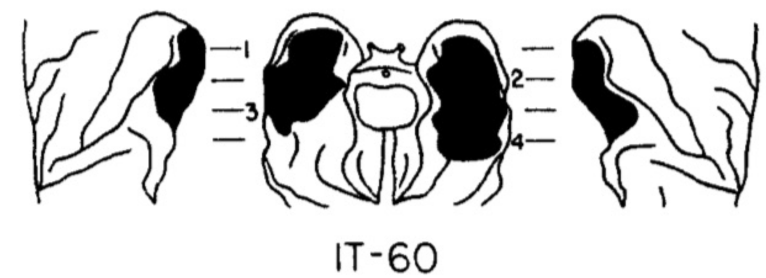
- Jaak Panksseep pioneered the experimental study of affect in non-human animals
- Affect = "ancient brain processes for encoding value—that is, as heuristics that the brain uses for making snap judgments about what will enhance or detract from survival"
- Assumption: feelings are not just captured using subjective reports but are accompanied by objectively measurable states
- Stimulation of specific subcortical brain circuitry produced very specific emotional behavioral patterns (approach/avoidance) → suggested 7 primary-process emotional systems, or core emotional systems, produced by ancient subcortical (unchanged by cognition) neural circuits common to all higher animals (*SEEKING*/desire, *RAGE*/anger, *FEAR*/anxiety, *LUST*/sex, *CARE*/maternal nurturance, *GRIEF*/separation distress, and *PLAY*/physical social engagement)

Gazzaniga, M.S., Ivry, R.B., & Mangun, G.R. (Eds.). (2019). Emotion. In Gazzaniga, M.S., Ivry, R.B., & Mangun, G.R. (Eds.), *Cognitive Neuroscience. The biology of the mind* (5th ed., pp. 427-473). W.W. Norton & Company.

Emotion specificity: Fear

amygdala lesion

inferior temporal lesion



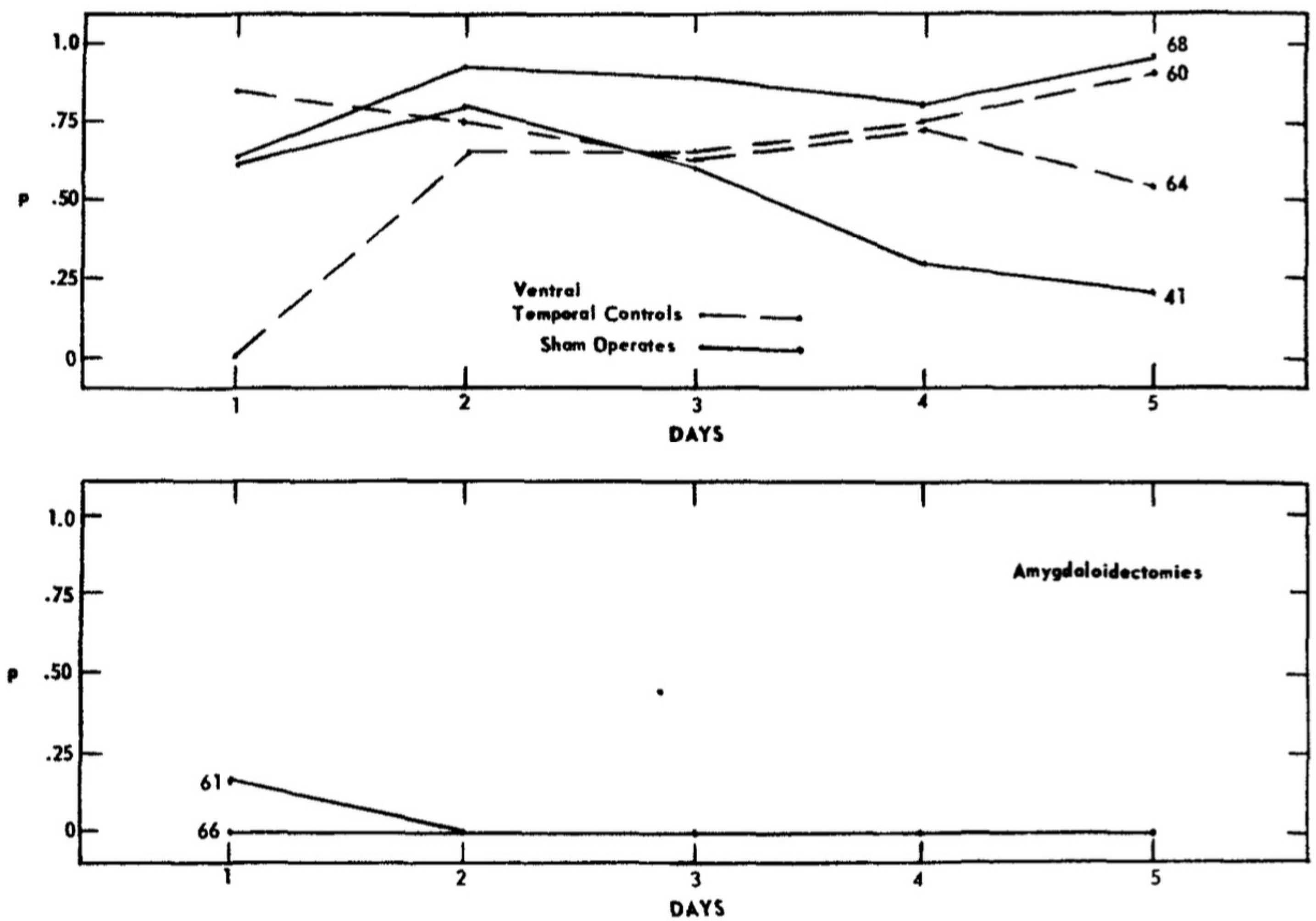


FIG. 5. Proportions of avoidance responses to experimenter.

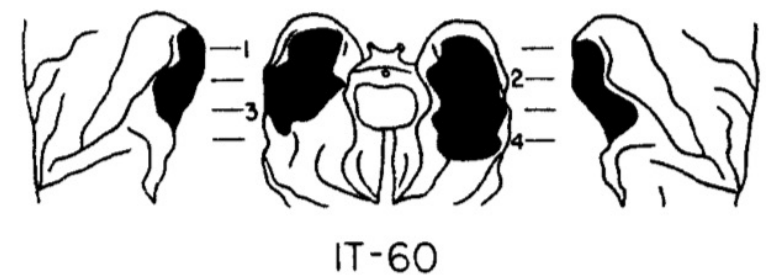
"In gross behavior, a marked increase in tameness and a weakening or disappearance of fear responses to previously aversive stimuli by amygdala animals."

Weiskrantz, L. (1956) Behavioral changes associated with ablation of the amygdaloid complex in monkeys. *Journal of Comparative Physiology and Psychology, 49*, 381–391.

Emotion specificity: Fear

amygdala lesion

inferior temporal lesion



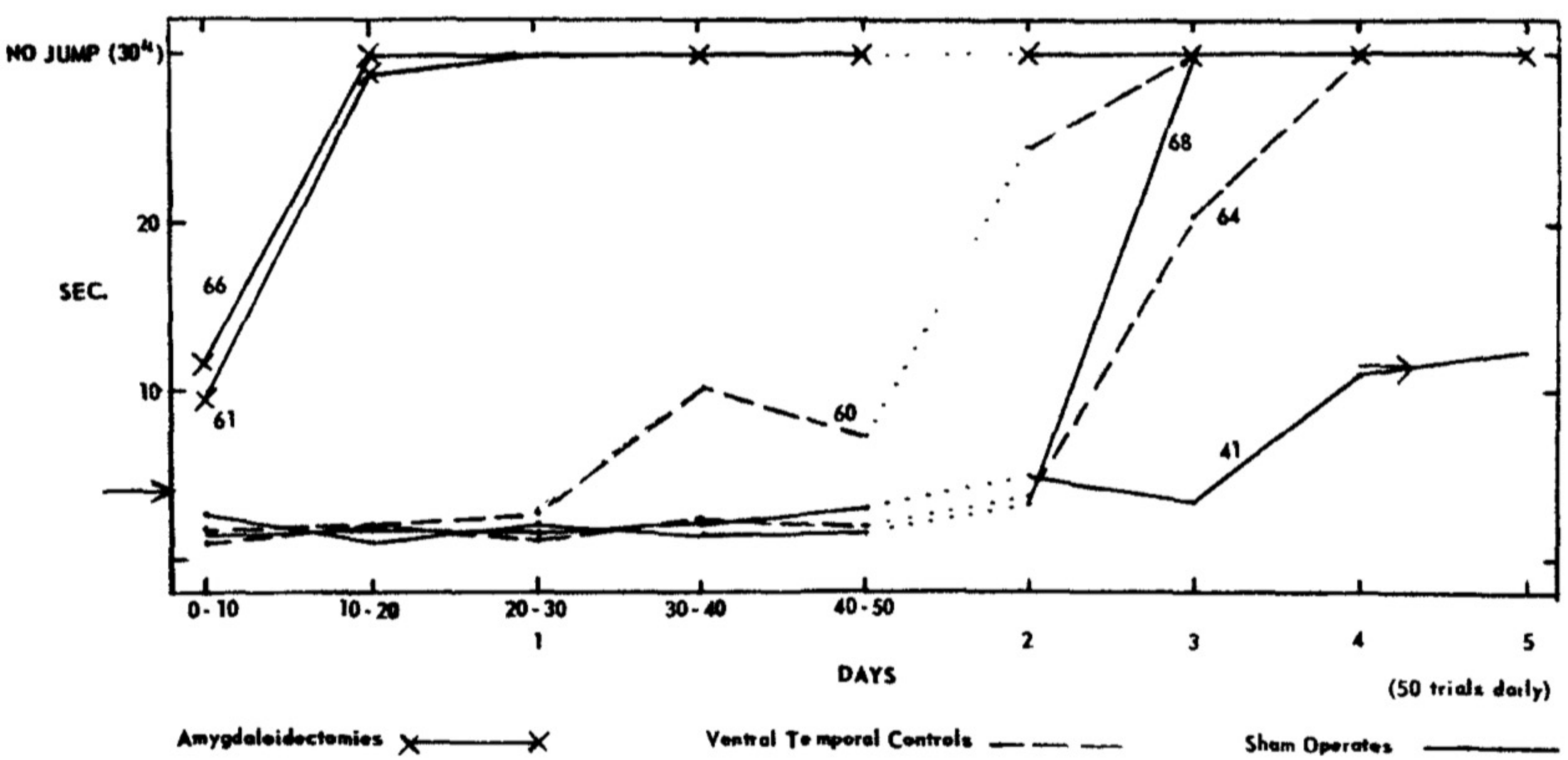
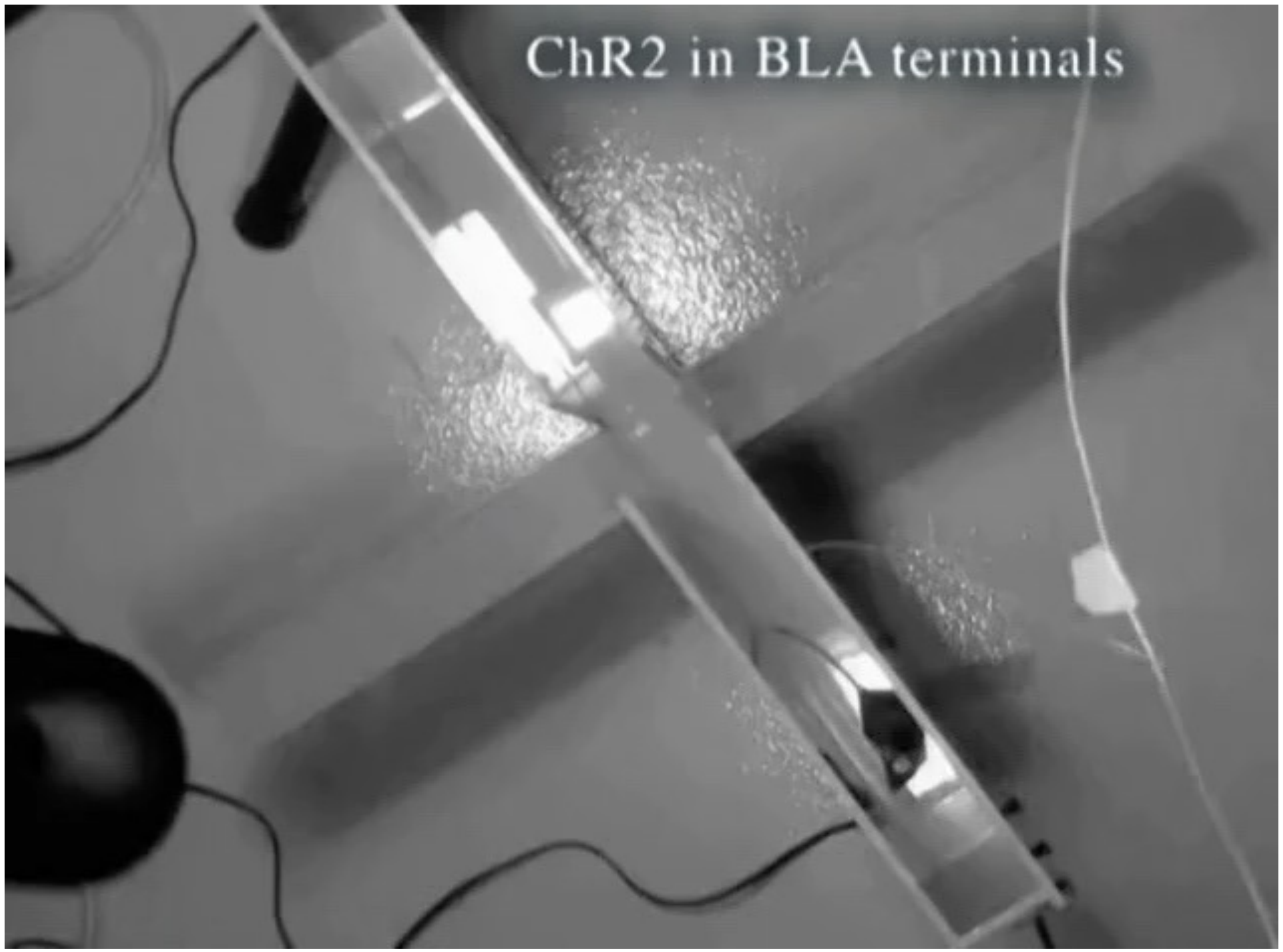


FIG. 3. Extinction of conditioned avoidance.

"More rapid extinction by amygdala animals of conditioned avoidance and conditioned depression, when these behaviors had been established preoperatively."

Weiskrantz, L. (1956) Behavioral changes associated with ablation of the amygdaloid complex in monkeys. *Journal of Comparative Physiology and Psychology, 49*, 381–391.

Emotion specificity in neural responses: Fear

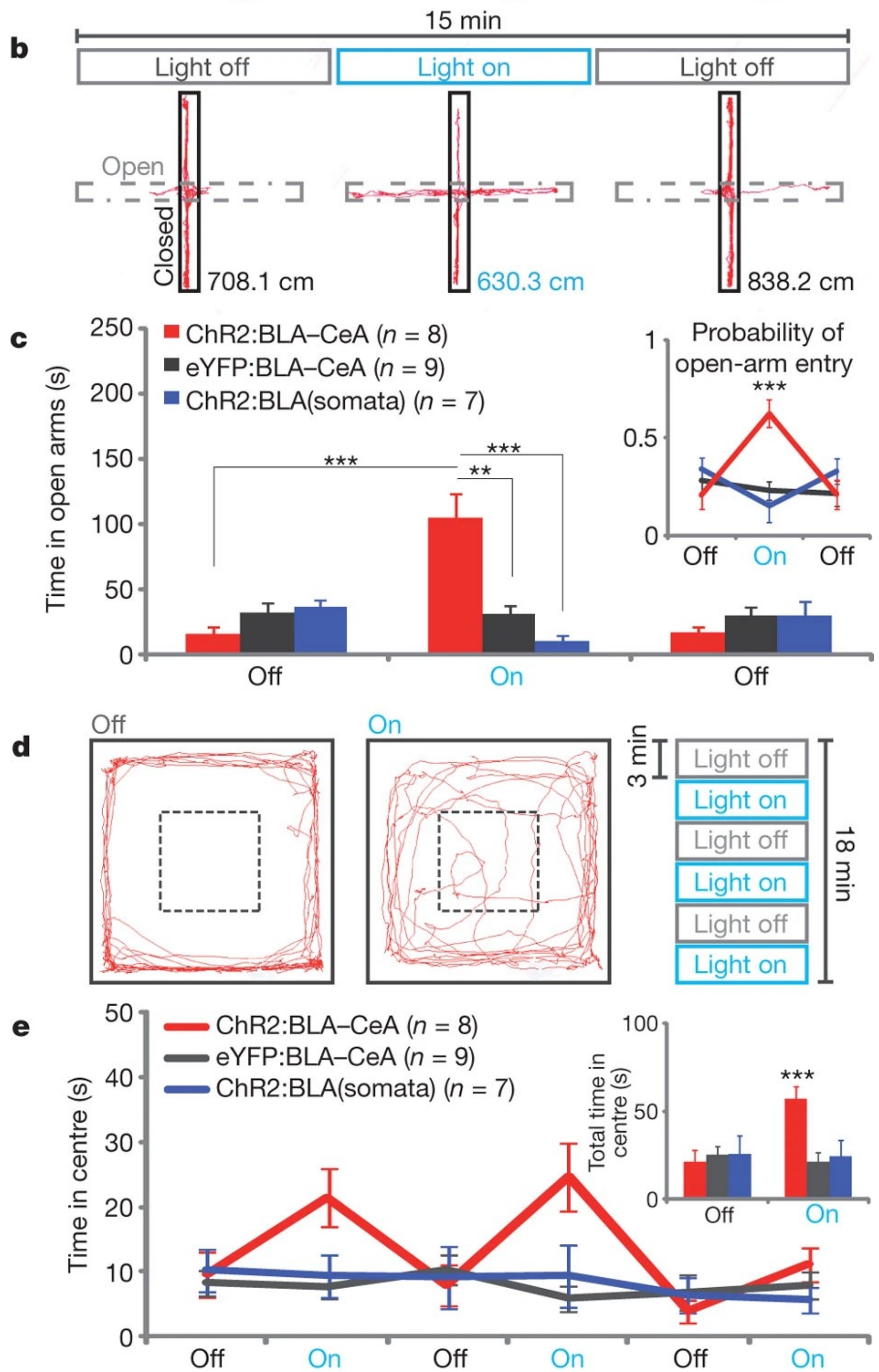


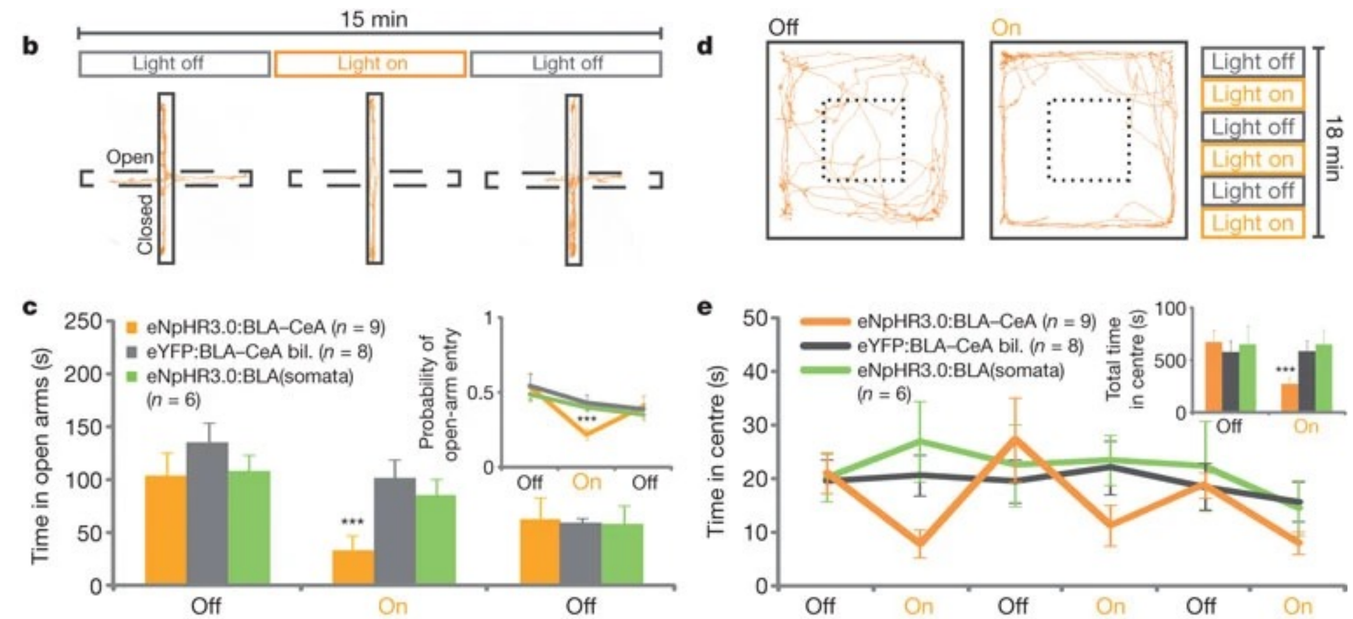
Optogenetics
a biological technique which involves the use of light to control cells in living tissue, typically neurons, that have been genetically modified to express light-sensitive ion channels. It is a neuromodulation method that uses a combination of techniques from optics and genetics to control and monitor the activities of individual neurons in living tissue—even within freely-moving animals—and to precisely measure these manipulation effects in real-time.

"With the capability of optogenetics to control not only cell types but also specific connections between cells, we observed that temporally precise optogenetic stimulation of basolateral amygdala (BLA) terminals in the central nucleus of the amygdala […] exerted an acute, reversible anxiolytic effect."

Tye, K. M., Prakash, R., Kim, S. Y., Fenno, L. E., Grosenick, L., Zarabi, H., ... & Deisseroth, K. (2011). Amygdala circuitry mediating reversible and bidirectional control of anxiety. ***Nature, 471*** (7338), 358-362.

Emotion specificity in neural responses: Fear

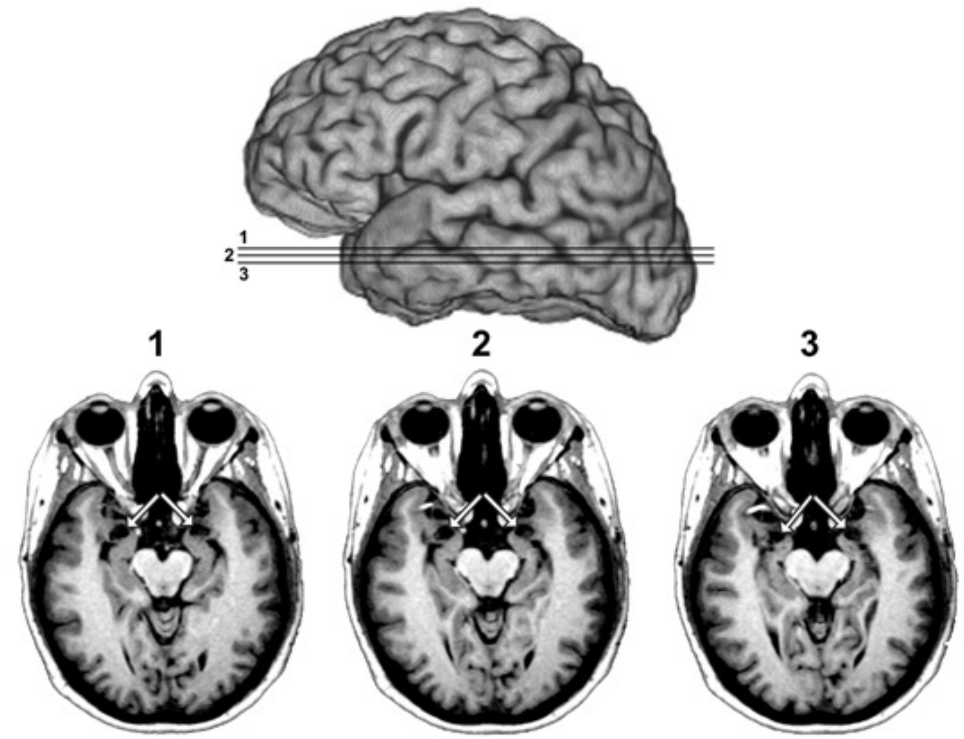




"Conversely, selective optogenetic inhibition of the same projection [...] increased anxiety-related behaviors"

Tye, K. M., Prakash, R., Kim, S. Y., Fenno, L. E., Grosenick, L., Zarabi, H., ... & Deisseroth, K. (2011). Amygdala circuitry mediating reversible and bidirectional control of anxiety. *Nature, 471* (7338), 358-362.

Emotion specificity in neural responses: Fear



The woman without fear

Adolphs et al. report the case of an individual (SM) with a rare genetic condition, Urbach-Wiethe disease, which caused parts of her brain to harden, destroying her amygdala. SM reportedly had trouble recognising fear in other people and could not tell what fearful facial expressions mean, but was capable of discerning other emotions. SM did not show fear responses to typically frightening stimuli (e.g., snakes, horror movies).

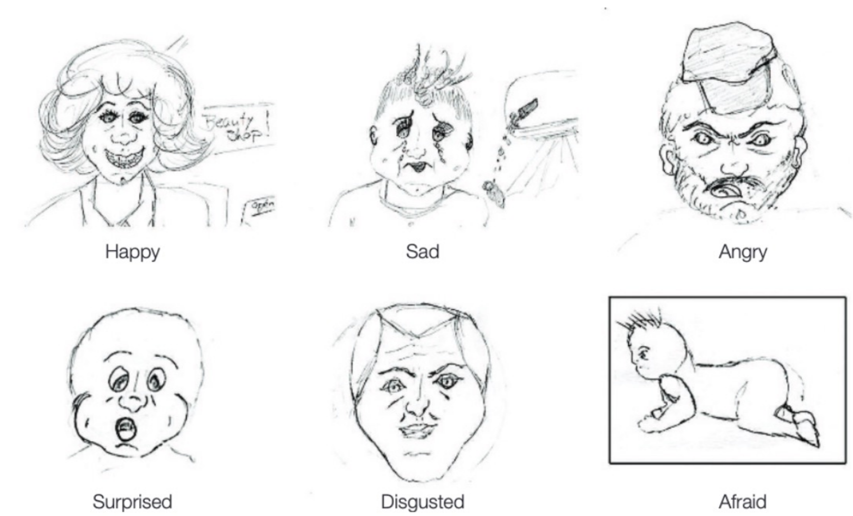
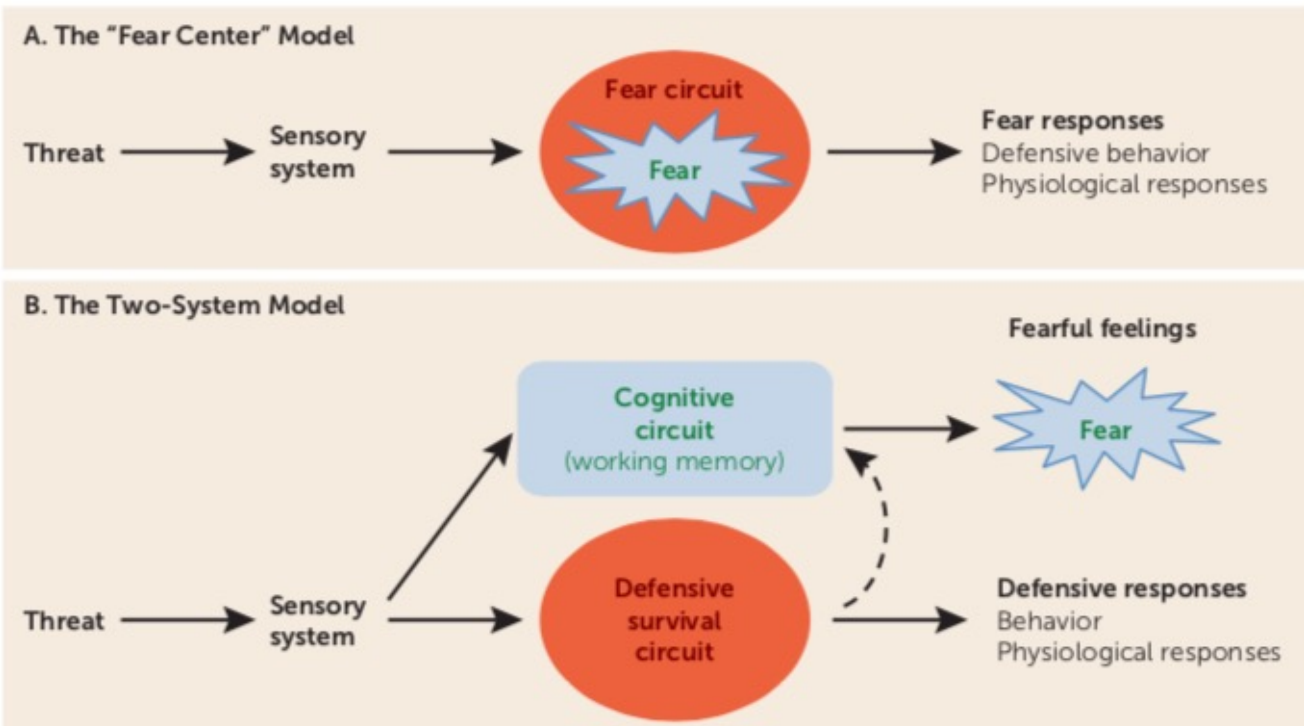


FIGURE 10.1 S.M.'s deficit in comprehending fear is also observed on a production task.
S.M. was asked to draw faces that depicted basic emotions. When prompted to draw a person who was afraid, she hesitated and then produced a picture of a baby. She was, however, not happy with her drawing of "afraid."

Adolphs R, Tranel D, Damasio H, Damasio A (1994). Impaired recognition of emotion in facial expressions following bilateral damage to the human amygdala. *Nature*. **372** (6507): 669–72. doi:10.1038/372669a0

Emotion specificity in neural responses: Fear

FIGURE 1. The Traditional "Fear Center" View Versus the "Two-System" View of "Fear"[a]



[a] In the traditional "fear center" model, the subjective experience of "fear" in the presence of a threat is innately programmed in subcortical circuits that also control defensive behaviors and physiological responses. The two-system framework views "fear" as a product of cortical circuits that underlie cognitive functions such as working memory; subcortical circuits control defensive behaviors and physiological responses and only indirectly contribute to conscious "fear." The traditional view thus requires different mechanisms of consciousness in the brain for emotional and nonemotional states, whereas in the two-system framework, both emotional and nonemotional states of consciousness are treated as products of the same system. In the two-system framework, what distinguishes an emotional from a nonemotional state of consciousness, and what distinguishes different kinds of emotional states of consciousness, are the input processes by the cortical consciousness networks (see Figure 3).

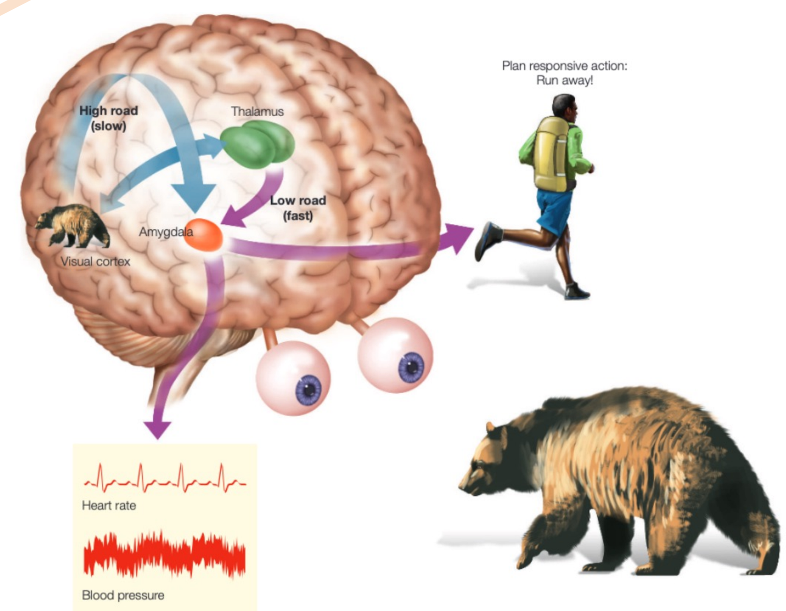


FIGURE 10.12 The amygdala receives sensory input along two pathways. When a hiker chances upon a bear, the sensory input activates affective memories through the cortical "high road" and subcortical "low road" projections to the amygdala. Even before these memories reach consciousness, however, they produce autonomic changes such as increased heart rate, raised blood pressure, and a startle response like jumping back. These memories also can influence subsequent actions through the projections to the frontal cortex. The hiker will use this emotion-laden information in choosing his next action: Turn and run, slowly back up, or shout at the bear?

Modern theories of fear posit an important role for the amygdala in behavioural fear responses (cf. defensive survival circuit in the figure above) while proposing a central cognitive contribution to the conscious perception of "fear".

LeDoux, J. E., & Pine, D. S. (2016). Using Neuroscience to Help Understand Fear and Anxiety: A Two-System Framework. *The American Journal of Psychiatry*, *173*(11), 1083–1093.

Emotion

Ontogeny 	Mechanism
Phylogeny	Adaptive Significance

Emotional experience across the adult lifespan

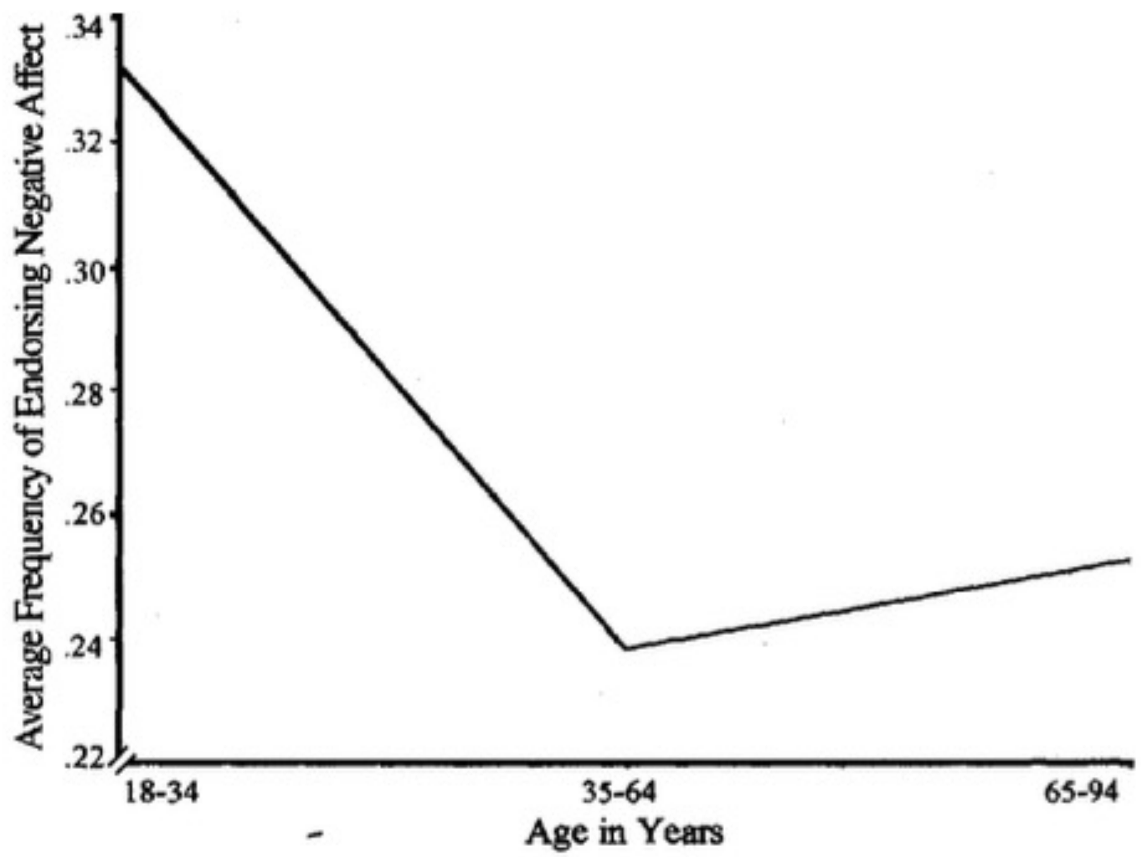


Figure 1. Frequency of negative affect across the life span.

"Although any and all claims about age change based on cross-sectional designs must be tempered accordingly, our findings contribute to a remarkably reliable pattern of findings in the literature that suggest that emotional functioning remains vital in the second half of life. The entire array of emotions are experienced in the later years, but negative emotions are experienced less frequently and are better controlled, and emotional experience is more complex. More so than younger adults, older adults also appear to experience complex mixes of emotions, and positive and negative experiences are less independent in older adults."

Carstensen, L. L., Pasupathi, M., Mayr, U., & Nesselroade, J. R. (2000). Emotional experience in everyday life across the adult life span. *Journal of Personality and Social Psychology, 79*(4), 644.

Emotional experience across the adult lifespan

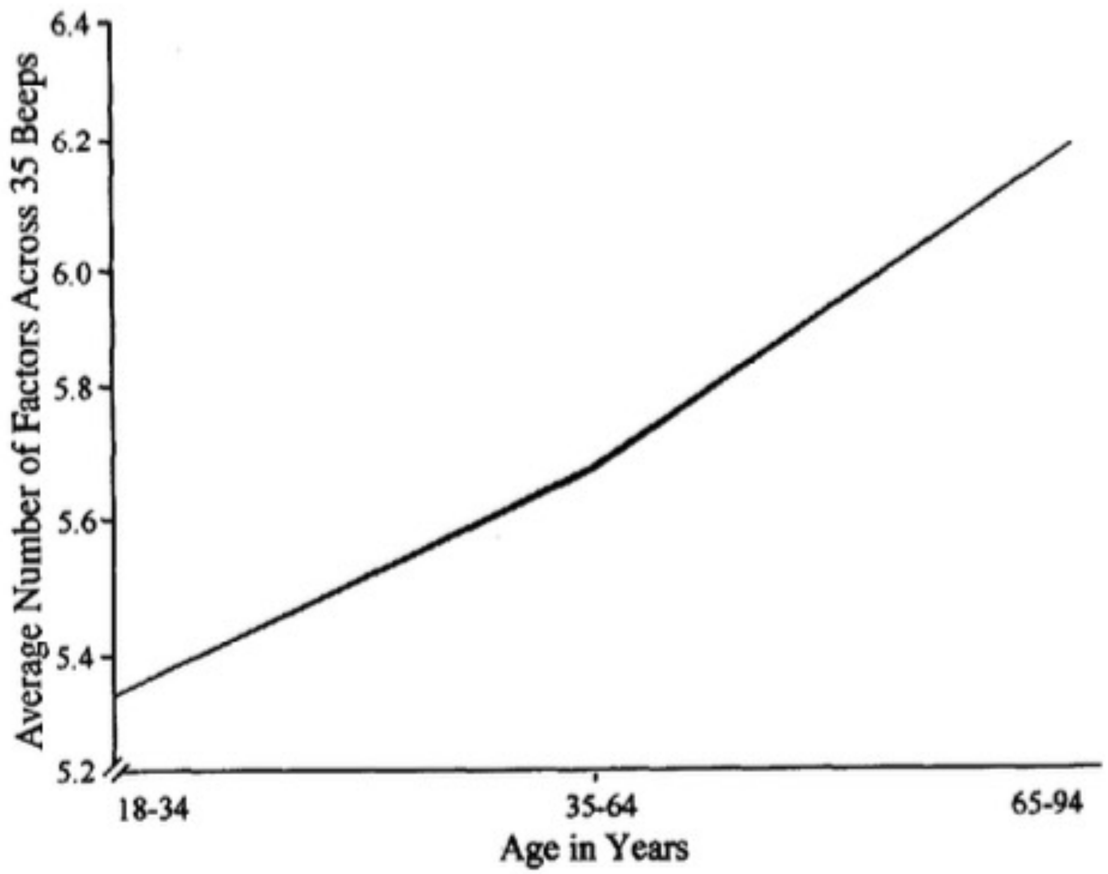


Figure 2. Differentiation of emotional experience over time.

"Although any and all claims about age change based on cross-sectional designs must be tempered accordingly, our findings contribute to a remarkably reliable pattern of findings in the literature that suggest that emotional functioning remains vital in the second half of life. The entire array of emotions are experienced in the later years, but negative emotions are experienced less frequently and are better controlled, and emotional experience is more complex. More so than younger adults, older adults also appear to experience complex mixes of emotions, and positive and negative experiences are less independent in older adults."

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Emotional experience across the adult lifespan

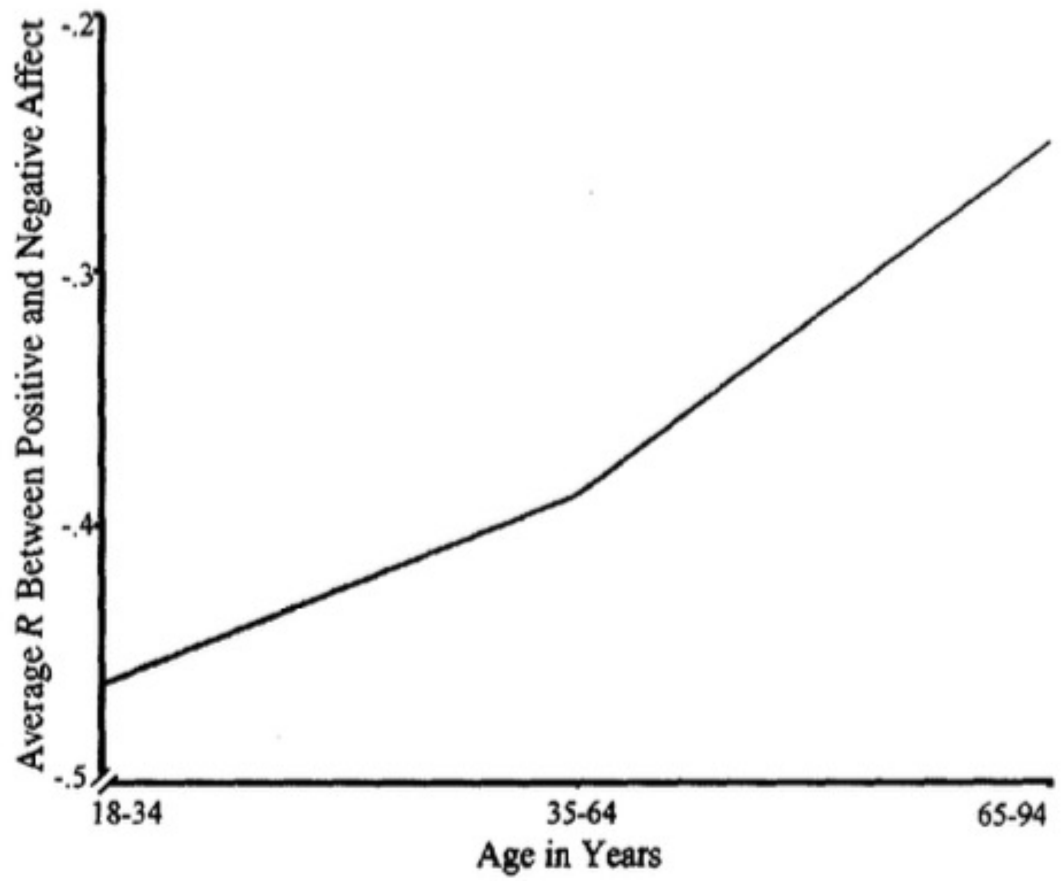

Figure 3. Poignancy with age: The correlation between positive and negative affect across the life span.

"Although any and all claims about age change based on cross-sectional designs must be tempered accordingly, our findings contribute to a remarkably reliable pattern of findings in the literature that suggest that emotional functioning remains vital in the second half of life. The entire array of emotions are experienced in the later years, but negative emotions are experienced less frequently and are better controlled, and emotional experience is more complex. More so than younger adults, older adults also appear to experience complex mixes of emotions, and positive and negative experiences are less independent in older adults."

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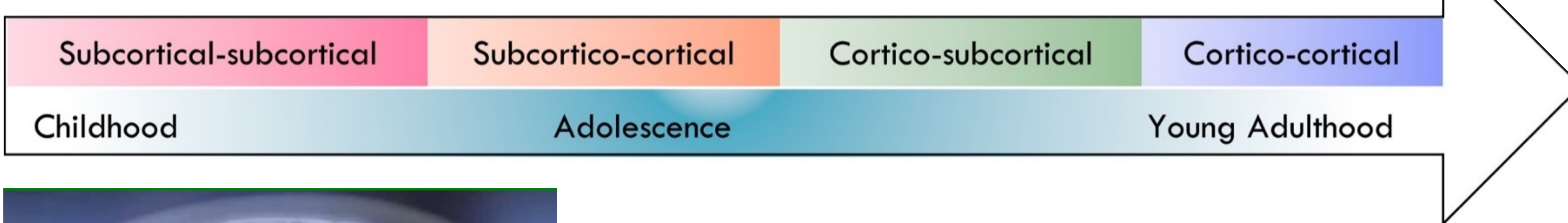
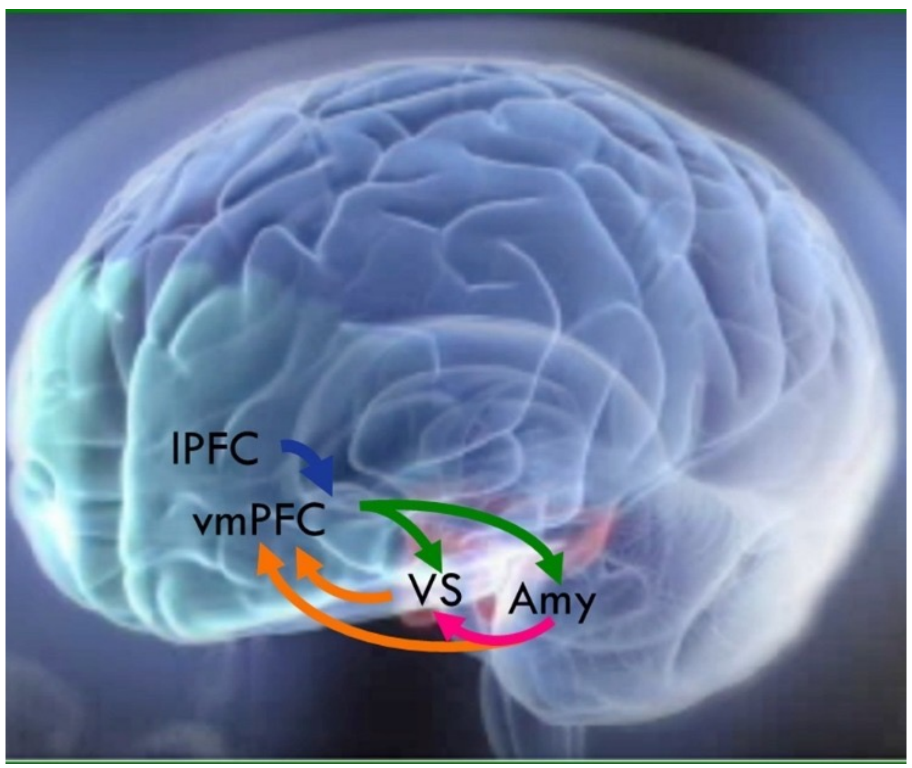
Emotional development

Schematic representation of hierarchical fine-tuning involving different neural structures hypothesized to take place between childhood and adulthood





The ventral striatum (VS) is implicated in learning and prediction of positive outcomes and receives inputs from the basolateral amygdala (Amy). The amygdala is important in learning the emotional significance of cues in the environment, and can facilitate ventral striatum activity through its direct inputs from the basolateral nucleus, leading to motivated action. The ventromedial prefrontal cortex (vmPFC) has been implicated in fear and emotion regulation. This region has dense projections to the (inhibitory) cells in the amygdala and to the ventral striatum (VS) that modulate emotive behaviors. Cortico-cortical connections include pathways between lateral prefrontal cortex (lPFC), implicated in higher cognitive functions, and medial prefrontal regions, involved in emotion and social interactions. These connections may serve as an interface between cognitive and emotional processes.

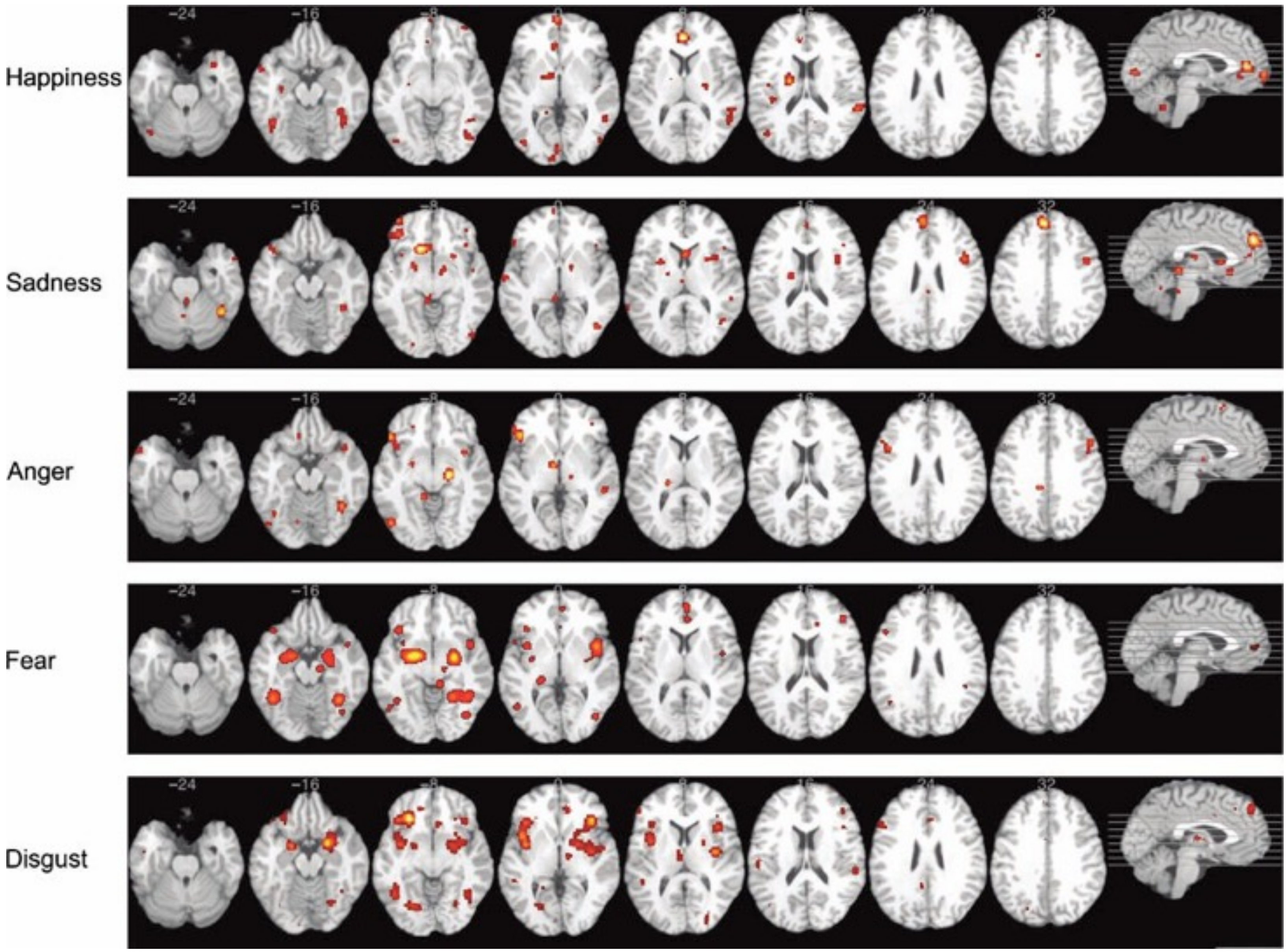
Current developmental models propose that there is a **hierarchical fine-tuning** that takes place across childhood and adolescence as a function of **biological maturation and experience**; this process represents a potential mechanism for the observed changes in emotional reactivity and regulation across childhood and adolescence (e.g., patterns of self-control and risk taking).

Casey, B. J., Heller, A. S., Gee, D. G., & Cohen, A. O. (2019). Development of the emotional brain. ***Neuroscience Letters, 693***, 29–34. http://doi.org/10.1016/j.neulet.2017.11.055

Emotion

Ontogeny	Mechanism 
Phylogeny	Adaptive Significance

The emotional brain: Emotional states



STG, ACC

caudate head

IFG

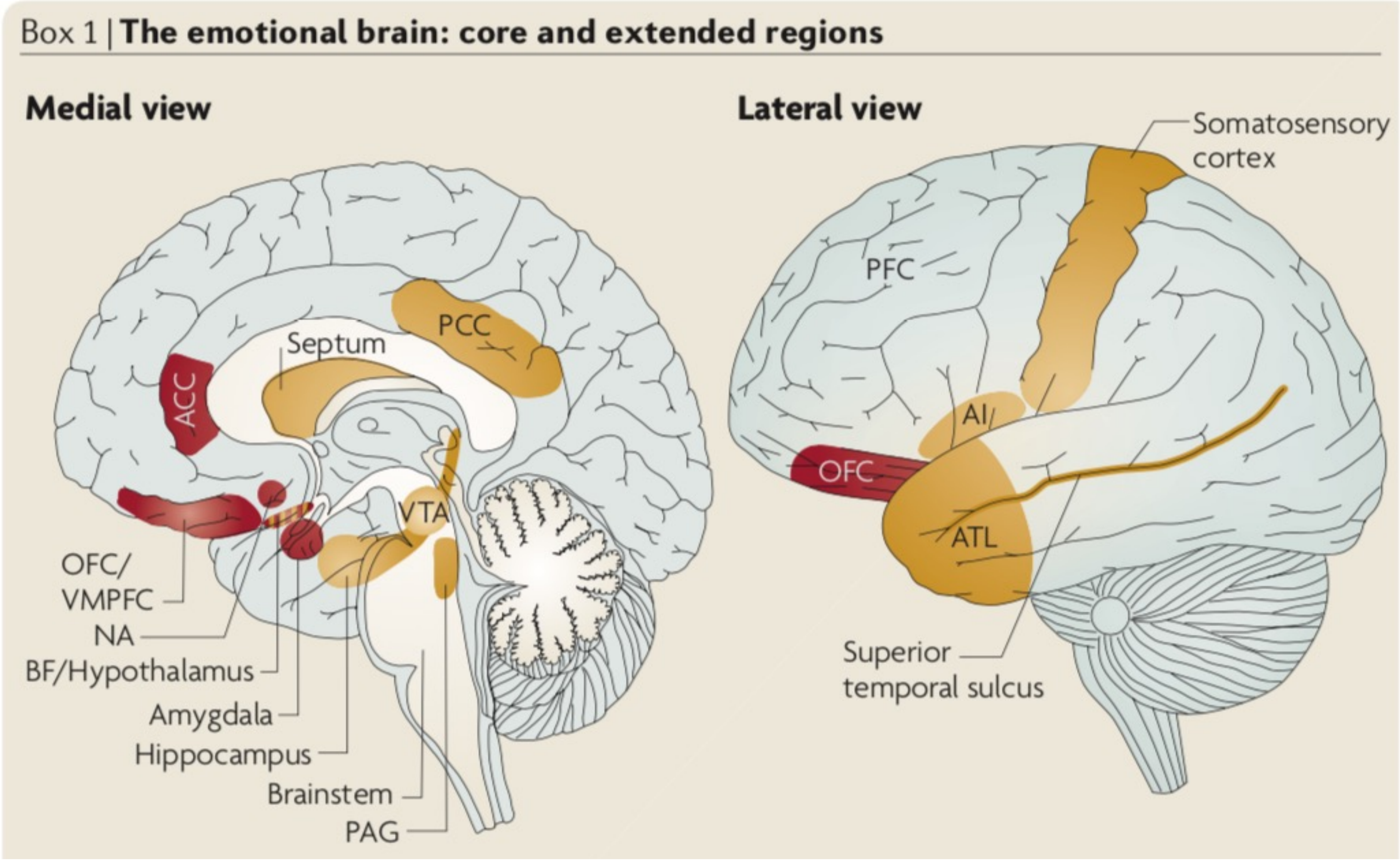
Amygdala

Insula

Activation likelihood maps representing activity consistently associated with each basic emotion state in experiments involving emotional stimuli (e.g., pictures, faces). Rather than representing magnitude of activation, the color gradient represents the degree of overlap (i.e., activation likelihood or **consistency**) among the activation coordinates across studies that contributed to the analysis. Additional analysis (not shown here) suggest some neural **discriminability** between the specific emotional states considered.

Vytal, K. & Hamann, S. (2010). Neuroimaging support for discrete neural correlates of basic emotions: A voxel-based meta-analysis. *Journal of Cognitive Neuroscience, 22*, 2864-85

The emotional brain

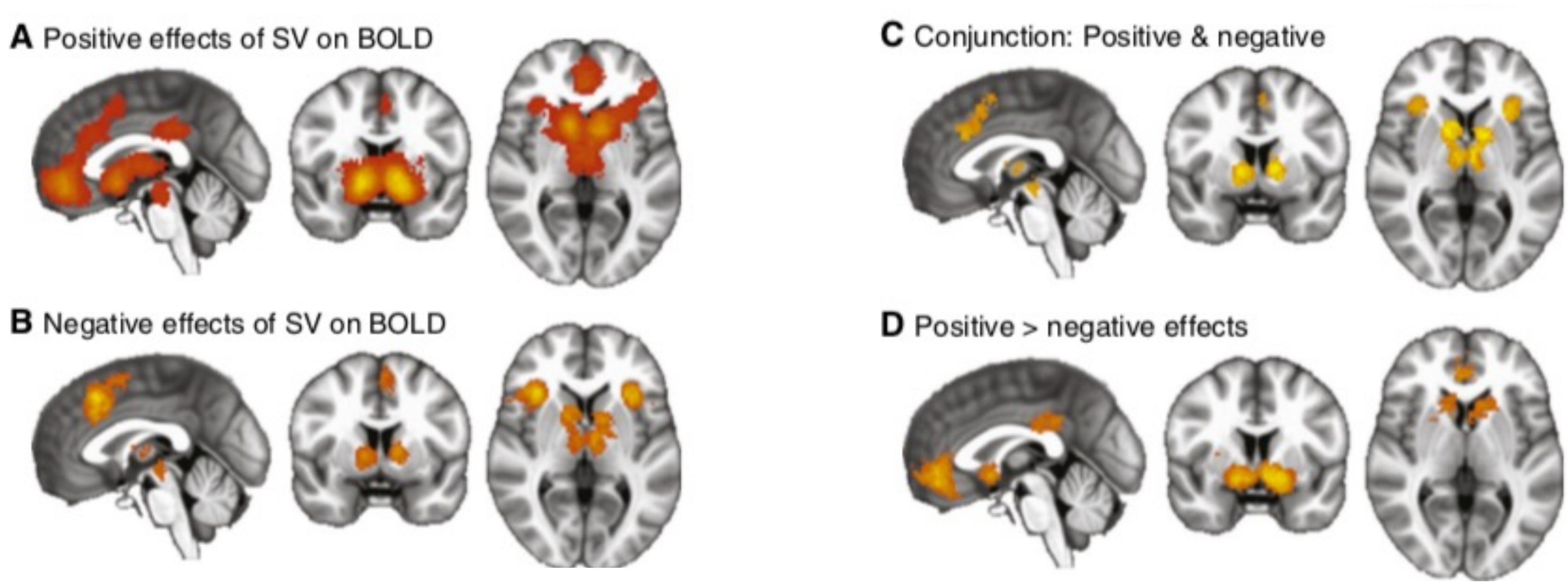


Core emotional regions (dark red areas) include, subcortically, the amygdala, the nucleus accumbens (NA) and the hypothalamus, and cortically, the orbitofrontal cortex (OFC), the anterior cingulate cortex (ACC) (especially the rostral part) and the ventromedial prefrontal cortex (VMPFC). Extended regions (brown areas) include, subcortically, the brain stem, the ventral tegmental area (VTA) (and associated mesolimbic dopamine system), the hippocampus, the periaqueductal gray (PAG), the septum and the basal forebrain (BF); and cortically, the anterior insula (AI), the prefrontal cortex (PFC), the anterior temporal lobe (ATL), the posterior cingulate cortex (PCC), superior temporal sulcus, and somatosensory cortex.

Although one could attempt to link the core and extended regions to specific affective functions, such an attempt would be largely problematic because **none of the regions is best viewed as 'purely affective'.**

Pessoa, L. (2008). On the relationship between emotion and cognition. ***Nature Reviews Neuroscience, 9(***2), 148–158. http://doi.org/10.1038/nrn2317

The emotional brain: Reward and punishment



Meta-analysis of different studies involving outcomes consisting of either rewards or penalties (e.g., monetary payoffs, consumable liquids, arousing pictures, social feedback):

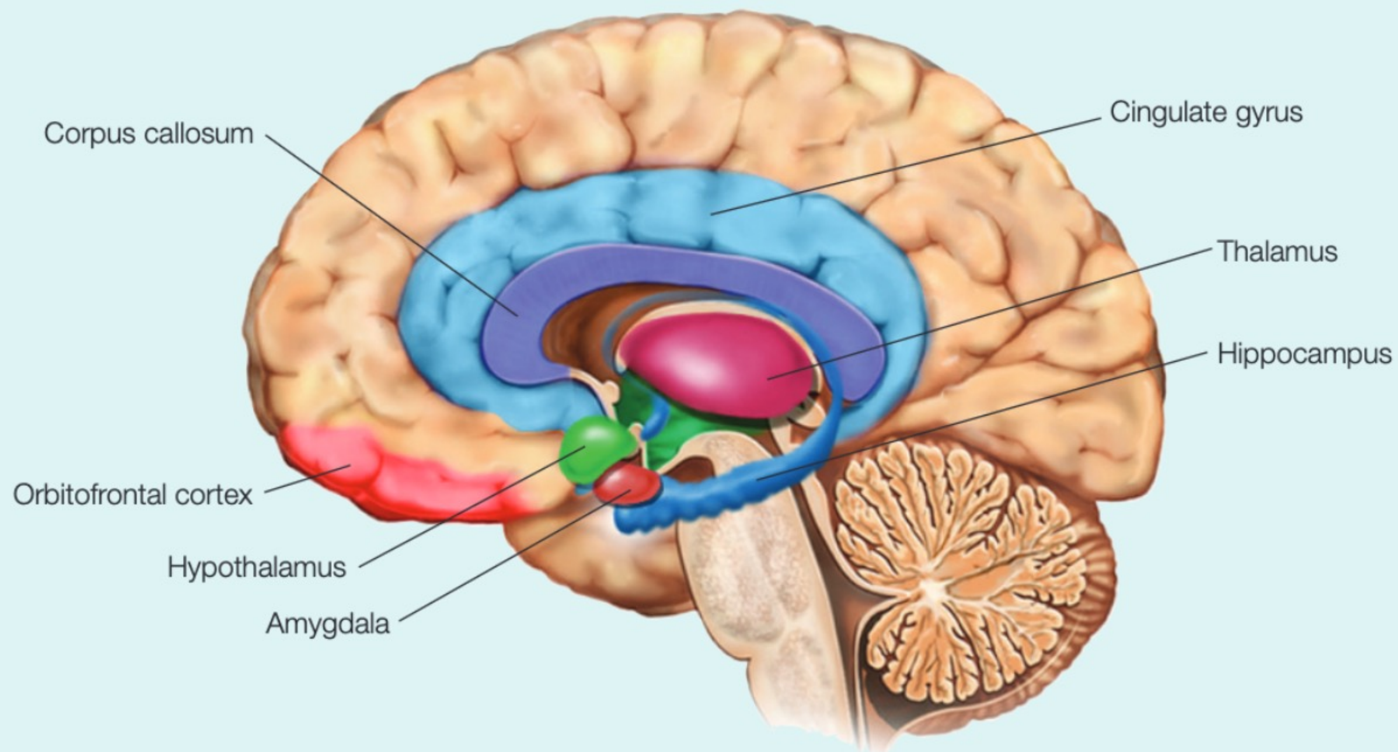
"In one set of regions, both positive and negative effects of subjective value (SV) on BOLD are reported at above-chance rates (…). Areas exhibiting this pattern include anterior insula, dorsomedial prefrontal cortex, dorsal and posterior striatum, and thalamus. The mixture of positive and negative effects potentially reflects an underlying U-shaped function, indicative of signal related to arousal or salience. In a second set of areas, including ventromedial prefrontal cortex and anterior ventral striatum, positive effects predominate. Positive effects in the latter regions are seen both when a decision is confronted and when an outcome is delivered, as well as for both monetary and primary rewards. These regions appear to constitute a "valuation system," carrying a domain-general subjective value signal and potentially contributing to value-based decision making."

Bartra, O., McGuire, J. T., & Kable, J. W. (2013). The valuation system: a coordinate-based meta-analysis of BOLD fMRI experiments examining neural correlates of subjective value. ***NeuroImage***, ***76***, 412–427.

The emotional brain

ANATOMICAL ORIENTATION

Anatomy of Emotion

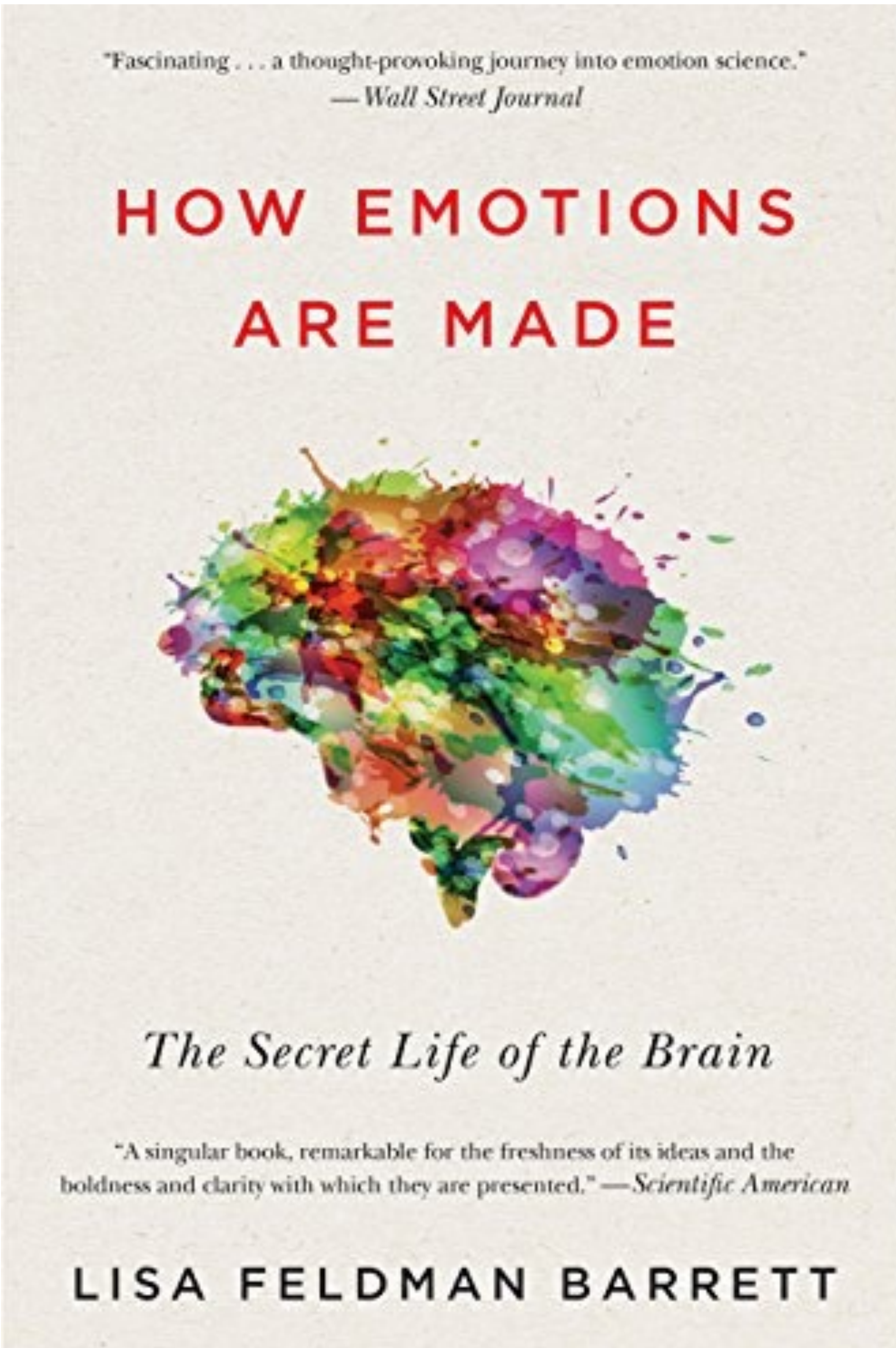


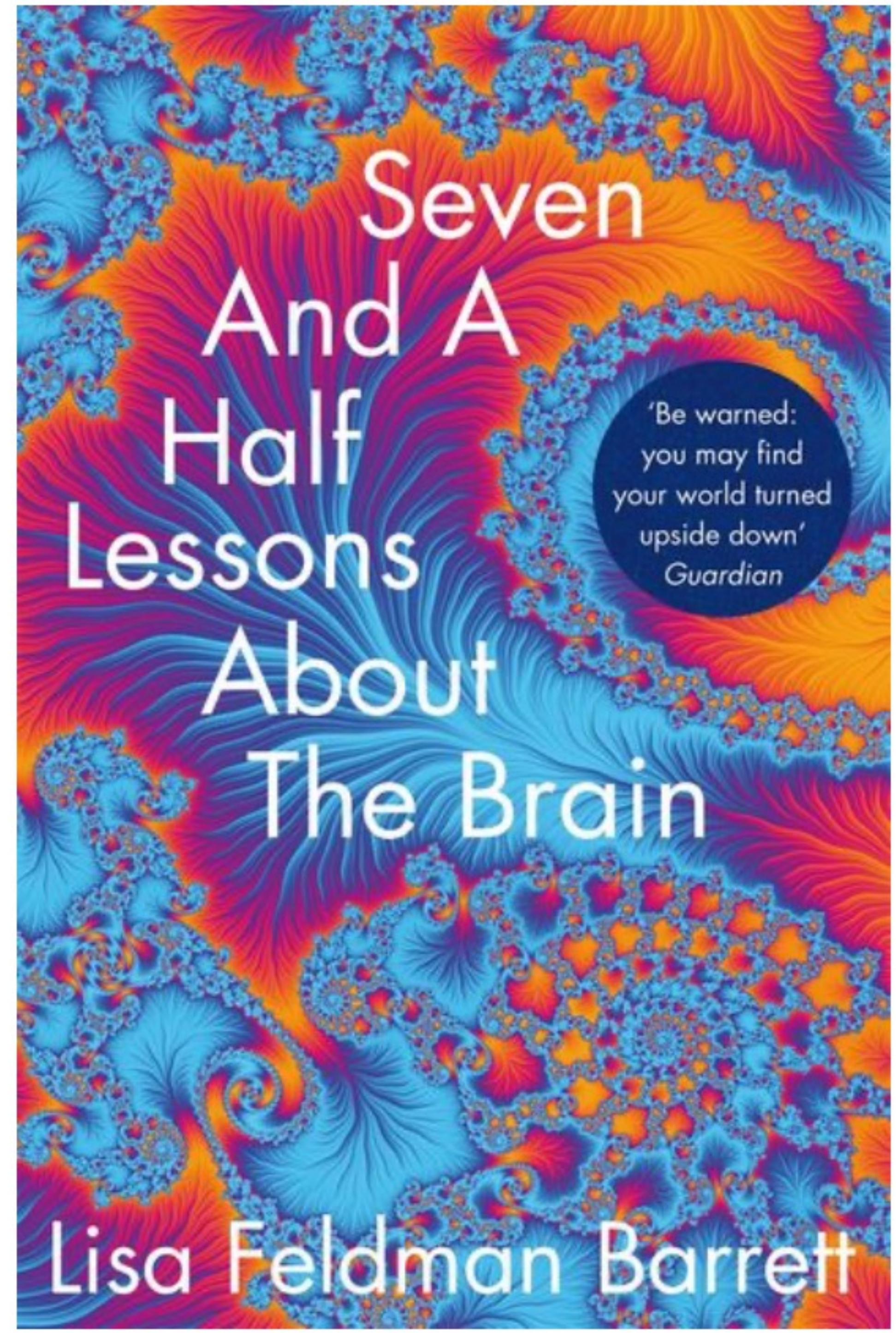
The limbic system, whose primary structures are identified here, contains complex neural circuits that Paul MacLean posited were involved in the processing of emotion.

Gazzaniga, M.S., Ivry, R.B., & Mangun, G.R. (Eds.). (2019). Emotion. In Gazzaniga, M.S., Ivry, R.B., & Mangun, G.R. (Eds.), *Cognitive Neuroscience. The biology of the mind* (5th ed., pp. 427-473). W.W. Norton & Company.

Summary

- **Adaptive significance**: Different perspectives on affect and emotion put emphasis on specific vs. general adaptive functions by either assigning a specific mapping between emotional experience and a biological substrate (i.e basic emotions) or, alternatively, emphasising context and development (i.e., constructivist approach).
- **Comparative approaches:** animal models have provided evidence for biological specificity of specific behavioural syndromes/emotional states (e.g., amygdala - fear); this mapping is simplistic and modern theories of human emotion see emotional states as involving interplay of various neural/cognitive processes.
- **Development:** Developmental patterns in the experience and regulation of emotion suggest a progressive development of the neural circuits (subcortical to cortical) that are responsible for both coding different aspects of the world (e.g., reward, punishment) and their integration/regulation.
- **Neural basis:** current models of emotional experience and regulation encompass a number of neural structures with only a few being core emotional regions and most being associated with other aspects of cognitive processing (e.g., memory, decision-making) – this stance makes clear the somewhat arbitrary distinction between emotional and cognitive processing (cognition is not value free!).


"Fascinating . . . a thought-provoking journey into emotion science."
—Wall Street Journal
HOW EMOTIONS
ARE MADE
The Secret Life of the Brain
"A singular book, remarkable for the freshness of its ideas and the boldness and clarity with which they are presented." —Scientific American
LISA FELDMAN BARRETT


Seven
And A
Half
Lessons
About
The Brain
'Be warned:
you may find
your world turned
upside down'
Guardian
Lisa Feldman Barrett

No lecture next week, see you in 2 weeks (April 9)!