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How Mood and Motivation Regulate Learning: The Neurobiological Perspective

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How Mood And Motivation Regulate Learning: The Neurobiological Perspective

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Objectives

- *Explain the basic neurobiology of emotions, and learning*
- *Explain how emotions and motivation regulate behavior, memory and learning*
- *Discuss evidence-based strategies for maximizing motivation, emotional engagement and learning outcomes*

Emotions and Emotional States

- Emotion:
  - Transient response to specific stimuli in the environment, body, or mind
- Mood/Emotional State
  - A prolonged, persistent emotional response
  - Independent from events that cause response
- Depression is a type of mood disorder

Function of Emotions

- Primary functions:
  - Tool for survival and life preservation
    - Ensure social adjustment and well-being
    - Evaluate experiences/info in terms of risks & gains

(Immordino-Yang & Damasio, 2007)

Function of Emotions

- Emotions regulate the learning process
  - Guide our thinking process
  - Help us connect new information to existing information
  - Direct decision making & goal-building

(Immordino-Yang & Damasio, 2007)

- They connect our inner physiological needs with our intentions

Emotions and Motivation

- Emotions and motivation are intricately interconnected:
  - Emotions constitute the core of one's personality (Squire & Kandel, 2009, 183-189)
  - Motivation determines what goals one needs to pursue and how to pursue them (Shizgal & Hyman, 2013, pp. 1101-1104).

Emotional Learning

- EL involves the unconscious evaluation of experiences, and attaching positive or negative feelings to them
  - These feelings become our likes and dislikes
    - Our likes and dislikes drive our behavior as well as our unconscious processes

(Squire & Kandel, 2009, 183)

Emotional Learning

- Thus, “our likes and dislikes are unconscious recollections of past emotional experiences associated with the object, person or event in question”

(Squire & Kandel, 2009, p.189)

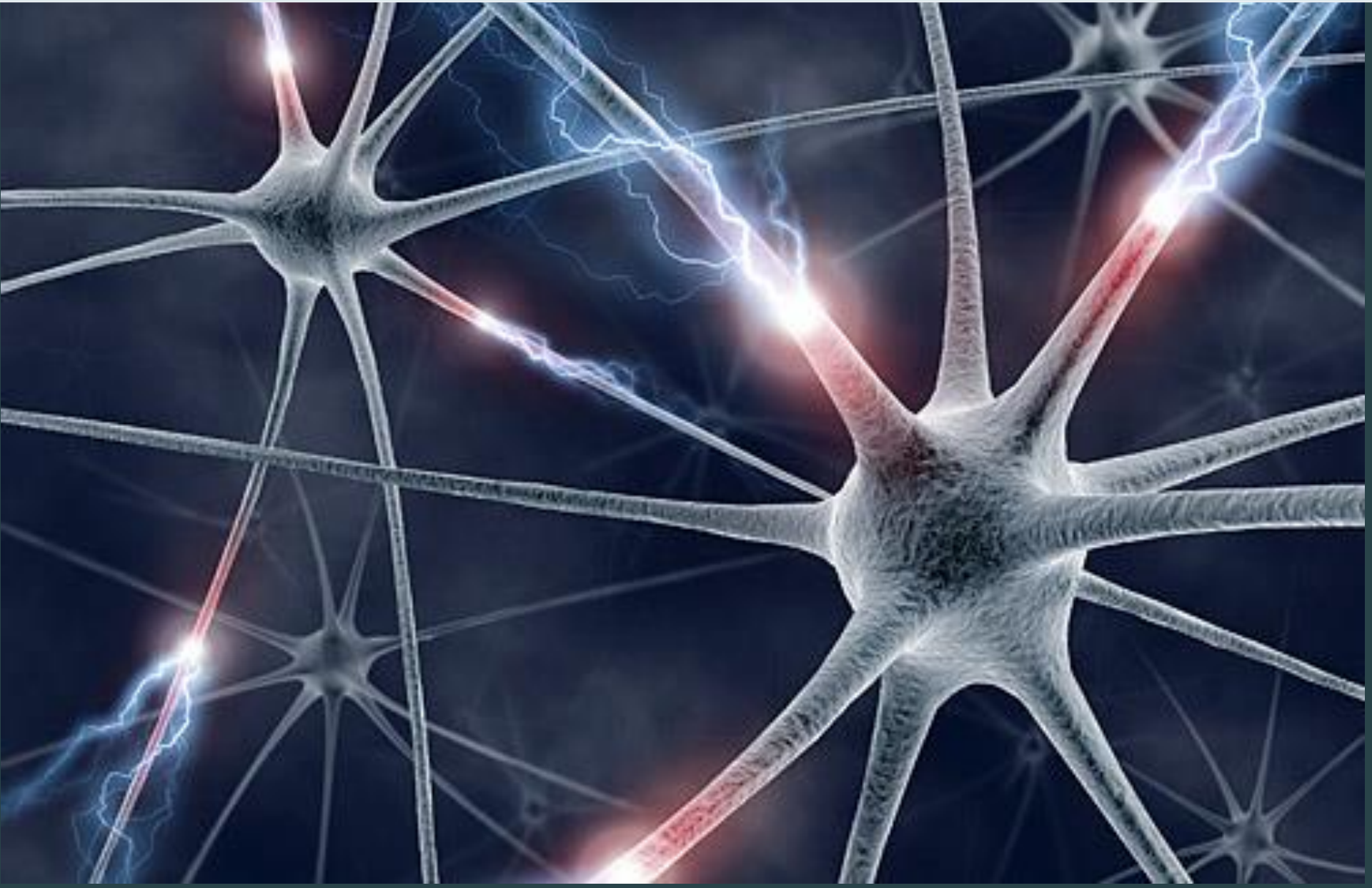
How do we define learning?

The Process of Learning

"Learning is the process in which *neurons that fire together* to produce a particular experience are altered so that they have a tendency to fire together again. The subsequent combined firing of the neurons reconstructs the original experience, producing a 'recollection' of it. The act of recollecting makes the neurons involved even more likely to fire again in the future."

(Carter, et al 2009, 154)

* Neurons that fire together wire together
* Learning is an experience-dependent process

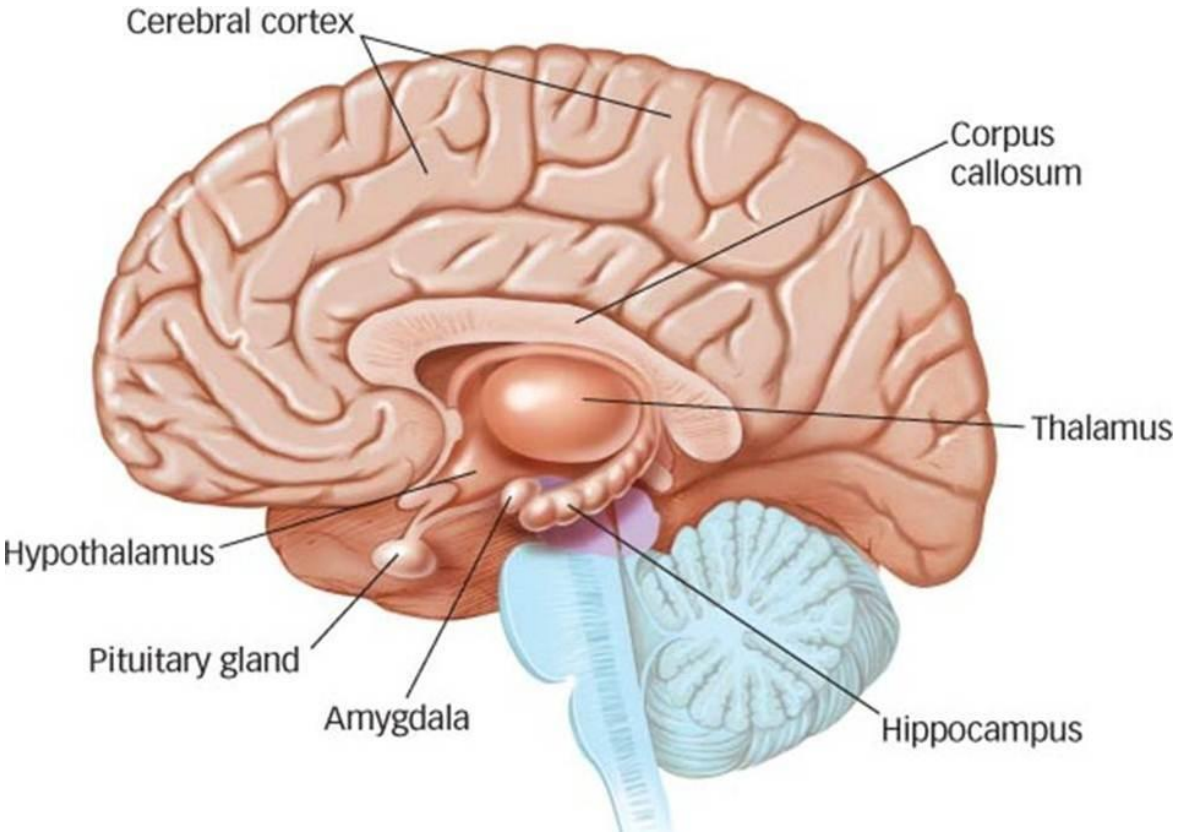


Primary Phases of Learning

- Initial processes:
  - Perceptual Registering
  - Activation of pre-attentive mechanisms
  - Activation of memory systems dedicated to new information

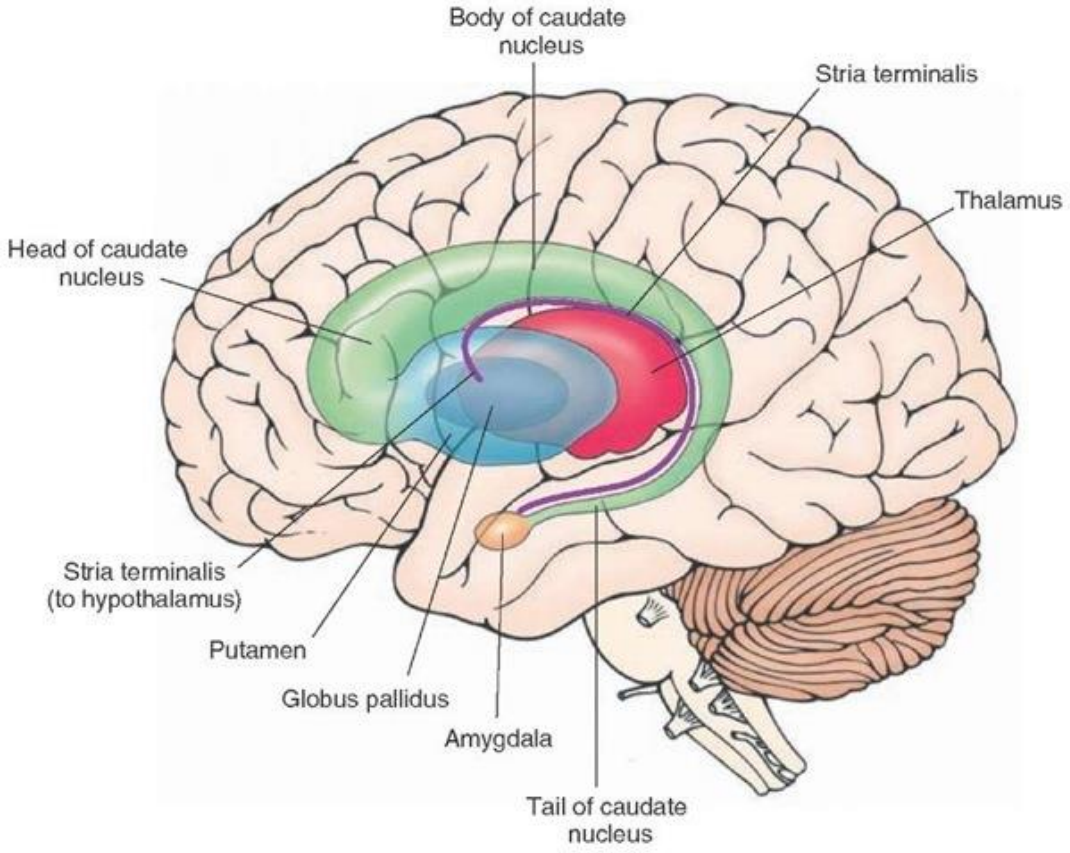
Primary Phases of Learning

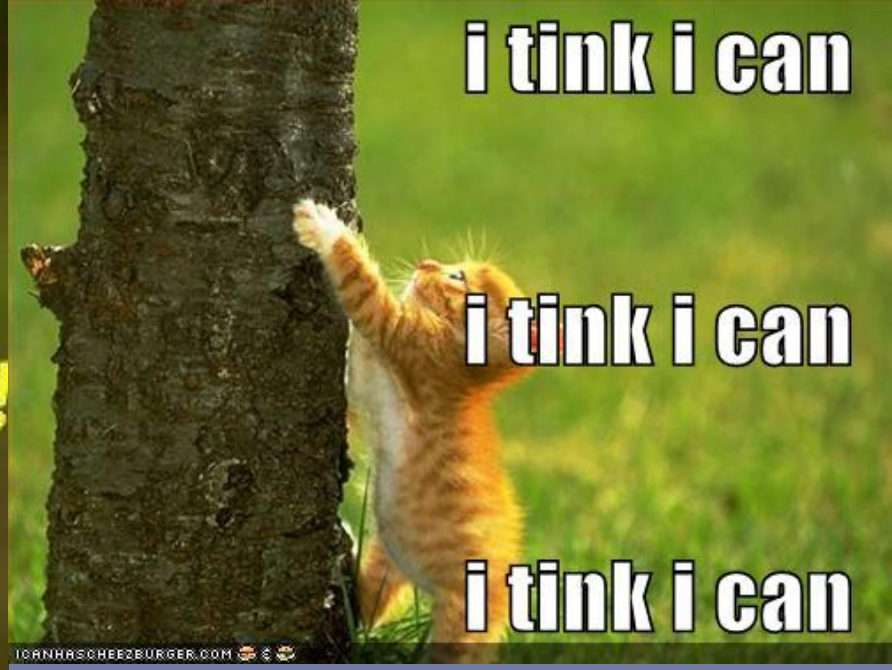
- Major Processes
  - Encoding
  - Transfer
  - Imprinting
  - Retrieval
  - consolidation



Primary Centers of Emotional Processing & Learning

- Amygdala
- Prefrontal cortex
- Anterior cingulate
- Anterior insula
- Hippocampus
- Striatum





Motivational States

Emotions: Launching Pad for Motivation

- The emotional system is intricately connected with autonomic and voluntary body physiology
- It provides minute-by-minute broadcasts of the body's internal states and its reactions to environmental experience
  - The prefrontal cortex uses the information to develop motivation
    - The motivation creates the urge to act or respond
      - The PFC regulates the action to make it appropriate for context

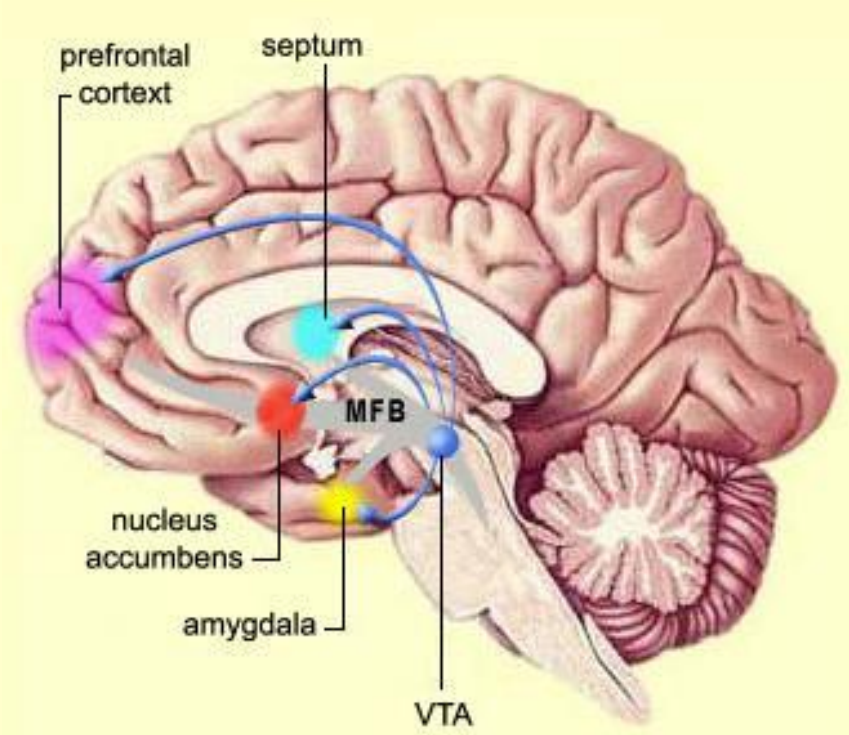
Motivation

- Motivation is “the set of processes through which organisms regulate the probability, proximity and availability of stimuli”

(Salmone and Correa, 2012)

Motivation

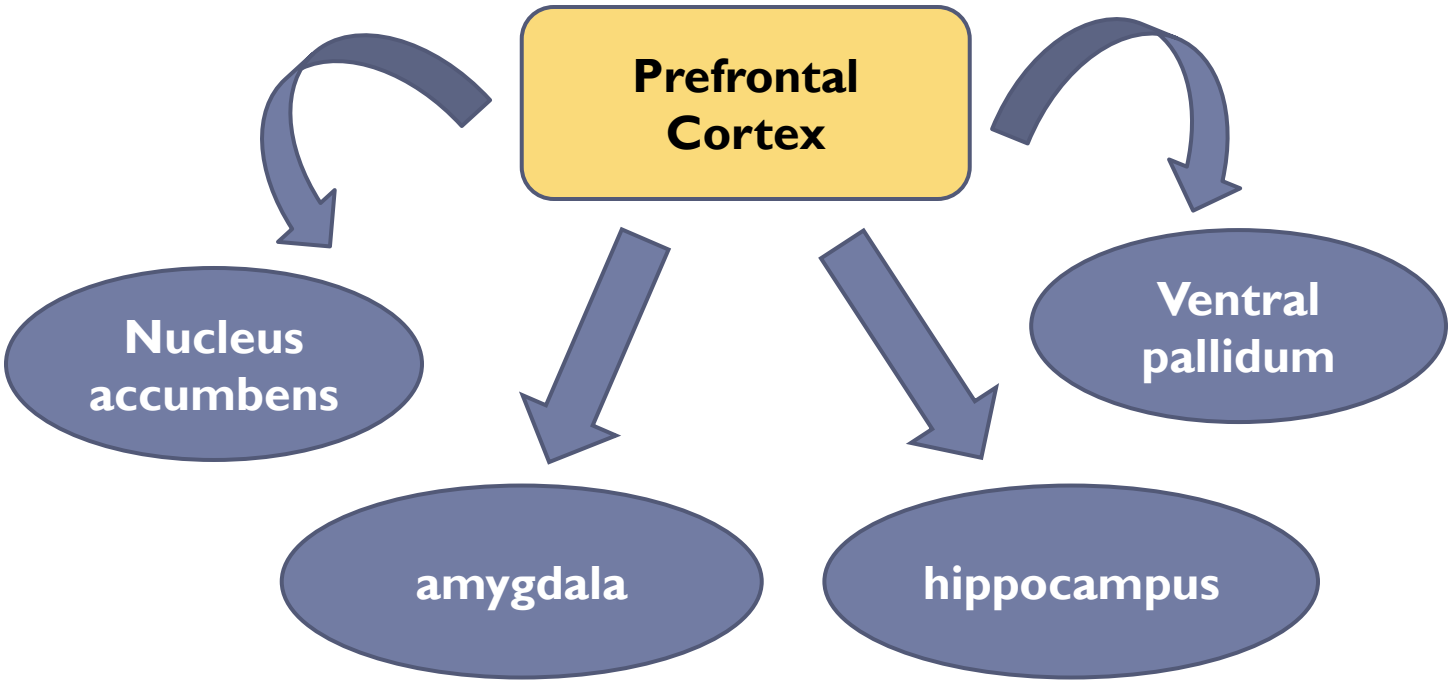
- Motivational circuitry comprises a vast network of interconnected regions
  - “The ventrotegmental area (VTA) and its widespread projections to cortical and limbic regions form the foundation of the motivational circuitry” (Love, 2014)



Motivation

- The VTA dopaminergic neurons project to
  - The nucleus accumbens
  - Hippocampus
  - Amygdala
  - Ventral pallidum
  - Prefrontal cortex
  - Other areas
- These projections form the mesocorticolimbic pathway (Love, 2014, pp. 50-51)

Mesocorticolimbic/Motivational Pathway

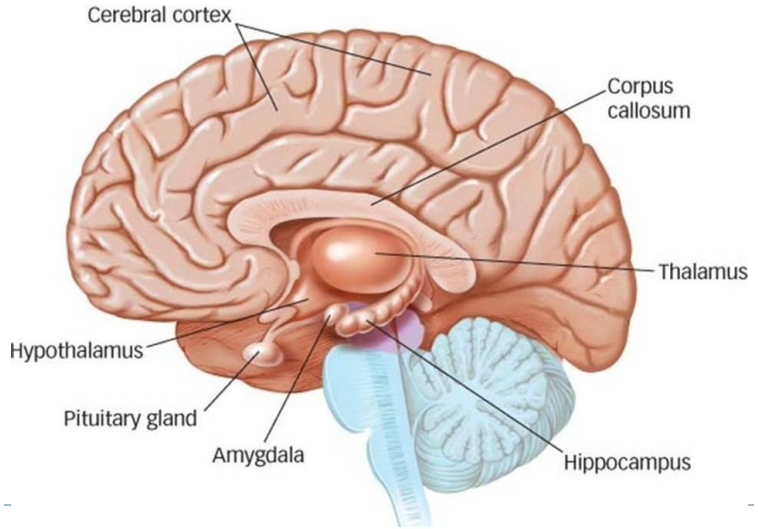


The PFC sends down glutamatergic projections to various MCL regions , thus exerting top-down control over voluntary behavior

This Presenter-designed diagram is based on Love (2014)

Regulatory Role of the PFC

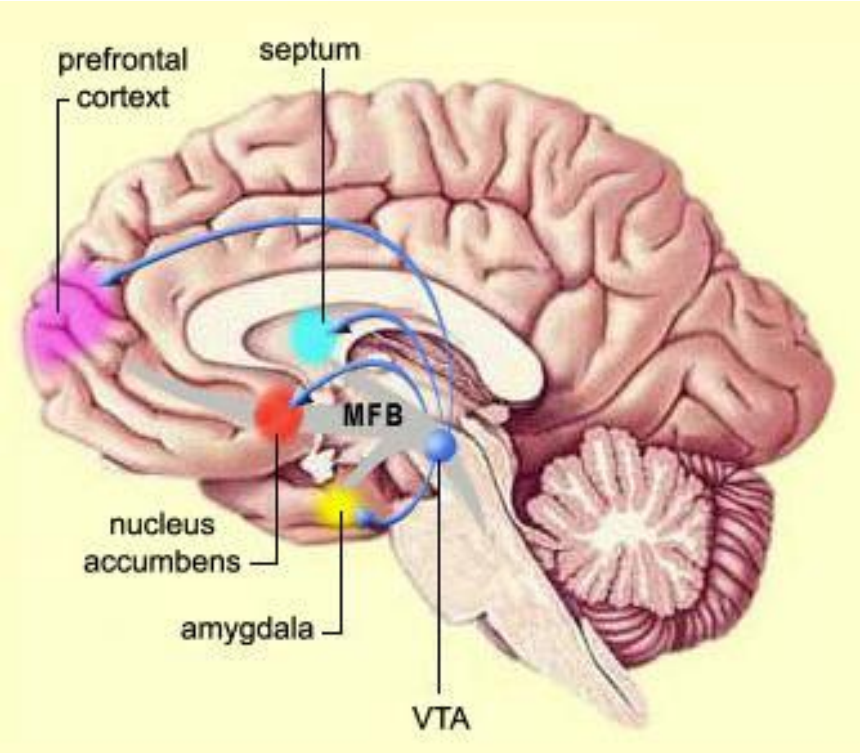
- Regulates self-directed behavior
- Contributes to:
  - Processing and evaluation of rewards
  - Formation of cognitive representations of reward value
  - Association of actions with rewards and level of effort



(Rushworth, et al, 2011)

Amygdala

- Responds directly to auditory, visual, gustatory, and olfactory sensory channels
- Central to:
  - Emotional processing
  - Motivation
  - Memory
  - Learning



(Kandel, et. al, 2013; Davis and Whalen, 2001)

Amygdala

- Its activation contributes to association between the reward and the behavior

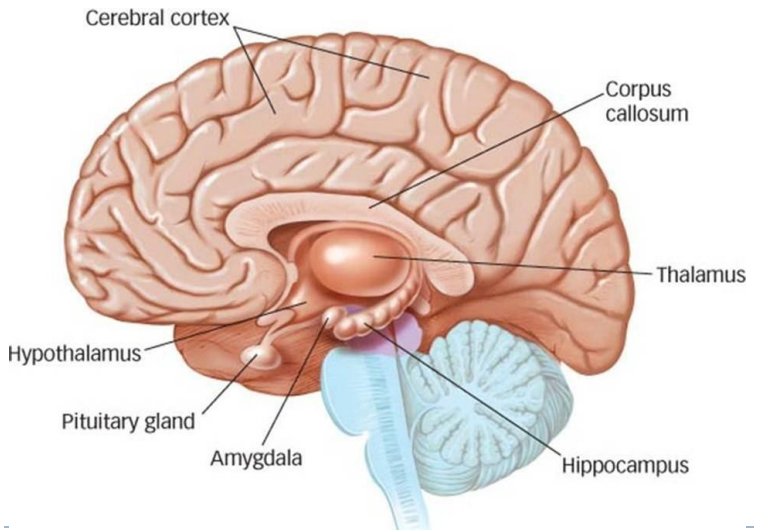
  (Bermudez, and Shultz, 2010)

- It triggers activation of attention mechanisms to increase vigilance and maximize processing of incoming sensory information; thus preparing individual for response

  (Kandel, et. al, 2013; Davis and Whalen, 2001)

Hippocampus

- Primary memory center
- Processes location and context of reward
- Detects novelty
- Its dopaminergic projections stimulate the VTA pathway (Love, 2014, p. 51)



Major Emotional Regulators

- Stress hormones
  - Dopamine, Norepinephrine, ACH, cortisol
- Learning & social bonding neurotransmitters
  - Serotonin
  - Oxytocin
  - Dopamine
    - Assigns motivational value/salience to reward
    - Increases the drive toward the reward

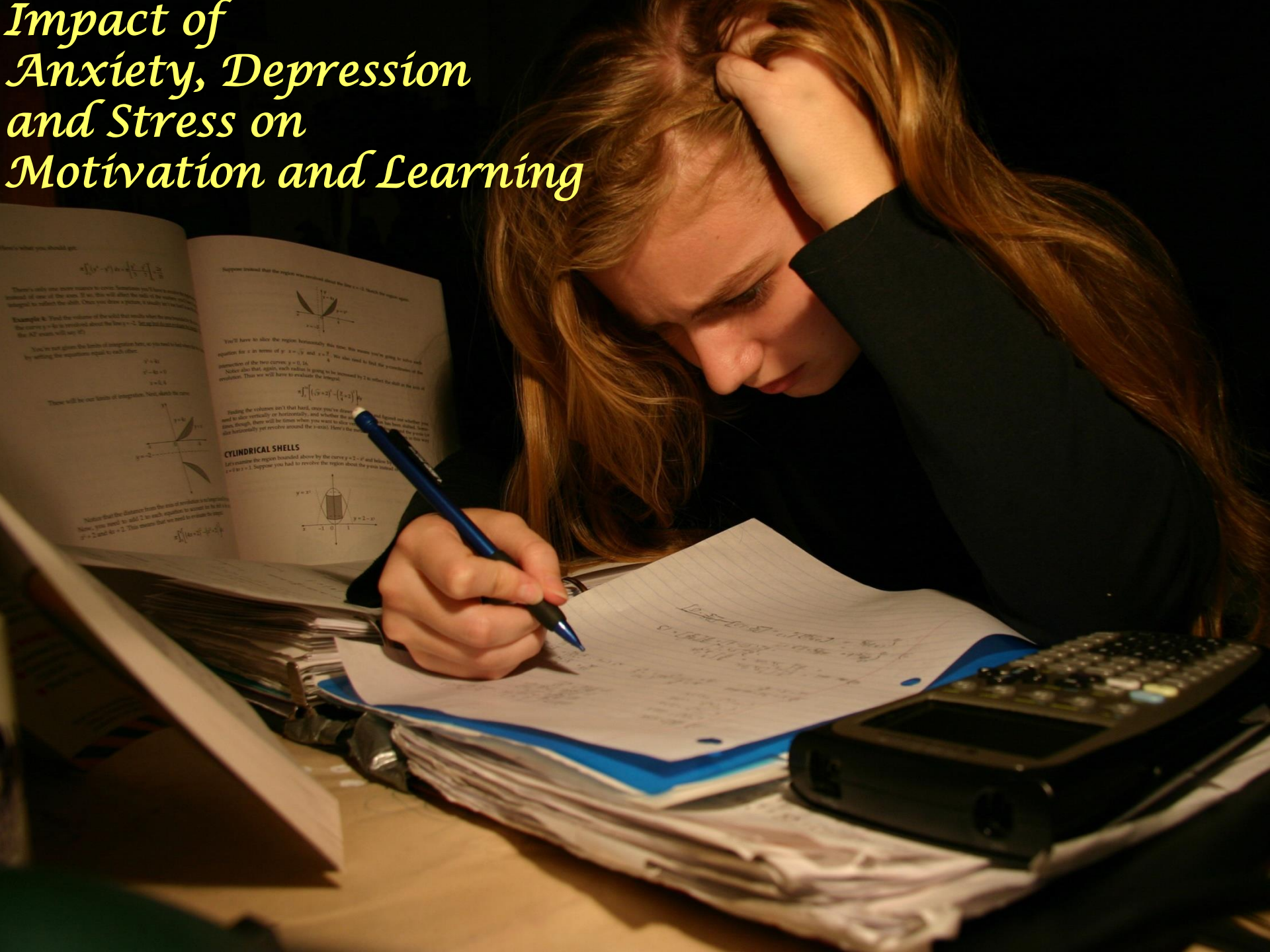
Oxytocin and DA act on the pathway together to "shape social motivation and influence expression of affiliative behavior"

(Love, 2014, p. 51)

Dopamine

- Repeated activation of dopaminergic pathways creates memories of activation patterns and makes them tied to the learning system

Impact of Anxiety, Depression and Stress on Motivation and Learning



Impact of Anxiety

- Anxiety tends to have a greater impact on activation of pre-attentive mechanisms and working memory than on L-T memory
  - This causes a breakdown in self-regulation systems
    - Which will directly impact the encoding process
      - This causes fragmentary comprehension during listening and reading

Impact of Anxiety

- Impact on attention:
  - High level of arousal narrows the scope of attention
    - Diverts attention from peripheral details
  - Hard tasks induce anxiety and decrease attentional capacity

(Baddeley, 2007, 260)

Impact of Depression

- Depression has a greater impact on LT memory than on attention and WM
  - Level of retrieval is correlated with severity of depression
    - Patient is preoccupied with depressive thoughts
    - Tends to lack motivation & avoid risk
    - The negative mood impacts interpretation of events that have happened
      - Blames self for failure (Baddeley, 2007, 283)

Effects of Prolonged Stress

- Causes numerous physical neurocognitive conditions, including Stroke
  - Heart disease
  - Cancer
  - Risk for major depression
  - Insomnia
  - Impotence
  - Chronic fatigue

(Kandel et al, 2013)

Effects of Prolonged Stress

- Puberty and Adolescence are periods of high vulnerability to the effect of complex stressors
  - Due to significant spurt in neuroplasticity
  - Undergoing development of cortical and limbic system regions in the brain.

(Holder & Blaustein, 2013; Dahl & Gunnar, 2009; Parron & Viner, 2007)

Effects of Prolonged Stress

- In pubertal/adolescents complex stressors cause:
  - Increased stress reactivity
  - Vulnerability to anxiety and depression
  - Decreased cognitive performance in adulthood

(Holder & Blaustein, 2013)

Impact of Stress

- Intense responses elevate cortisol levels
  - Impairs attention, self-regulation, and encoding
  - Cognitive effects are reversible following acute episodes
  - May become irreversible when stress is chronic

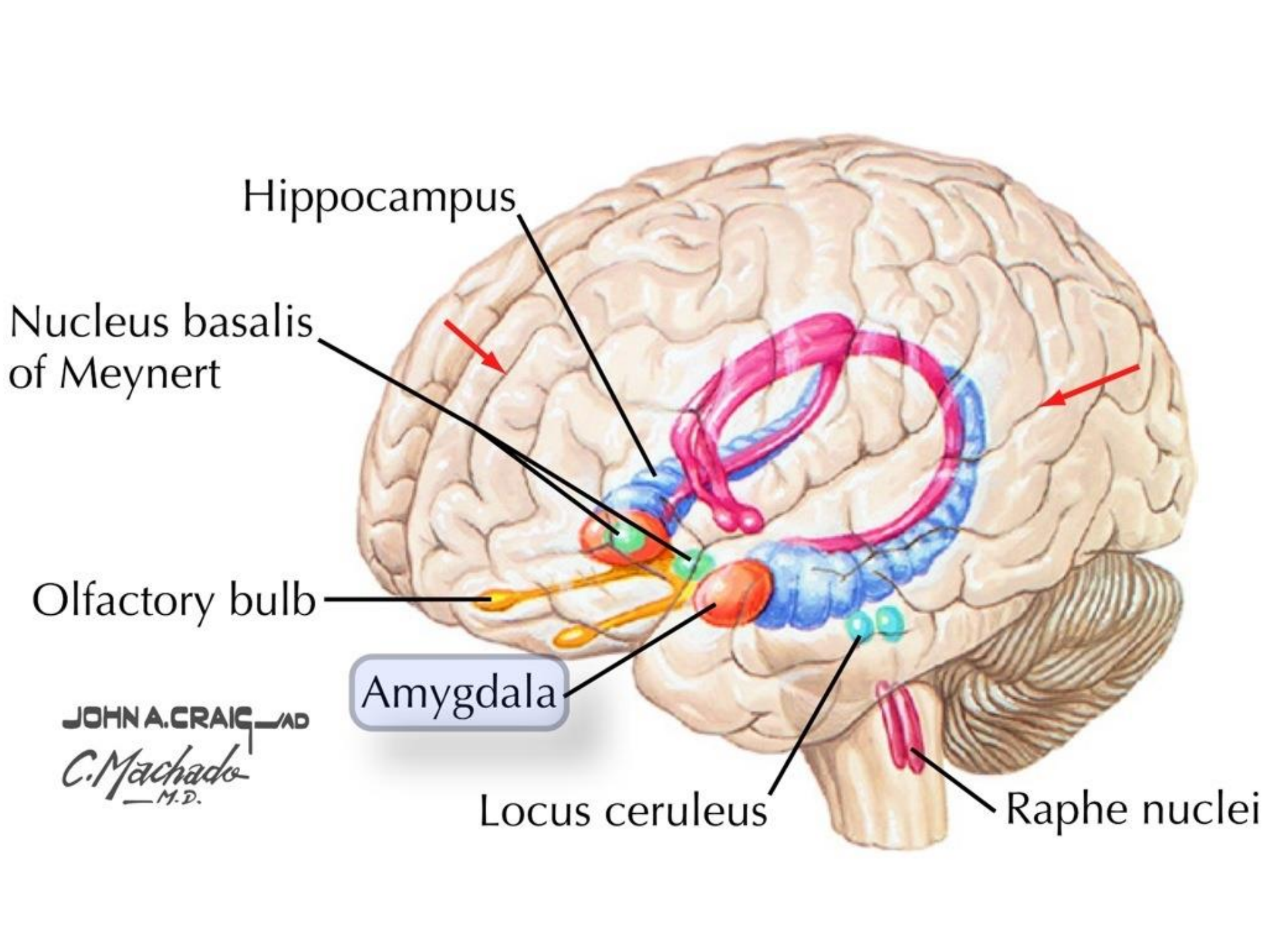
Depression & Chronic Stress

- The elevated stress hormones (esp. cortisol) levels reach toxic limits
  - This compromises the immune system
    - Causes significant physical damage to memory centers
      - Short & long term memory impairments

Depression & Chronic Stress

- Elevated HPA axis activity hits at the very core of memory, attention and self-regulation systems
  - Suppresses normal rates of neurogenesis in hippocampus, thus causing it to atrophy.
  - Failure of self-regulatory functions in the frontal lobe causes disruption of the encoding process

(Kandel, et al., 2013, 1409)


Hippocampus
Nucleus basalis of Meynert
Olfactory bulb
Amygdala
Locus ceruleus
Raphe nuclei
JOHN A. CRAIG — AD
C. Machado — M.D.

How to Raise a Motivated Student

Teacher-Student Relationship

- Positive nonverbal therapist-patient interactions can lead to "lasting changes in behavior by increasing the patient's range of strategies for doing, being, and interacting with others"

(Squire & Kandel, 2009, 191)

- Know your students by name and show them that you really care

Teacher-Student Relationship

- Essential for student motivation (Zainun, et al. 2015)
  - Positive student-teacher relationship promotes positive student emotional response
    - Being friendly, helpful and accessible/approachable
      - Teacher approachability mediates "students' learning, goal orientation and enjoyment" (Urhahne, 2015, p. 79)
    - This promotes student motivation
      - Motivation increases attention
        - Maximizes learning

(Misbah, et al, 2015; Urhahne, 2015; Brekelmans & Wubbels, 1991)

Teacher-Student Relationship

- Why teachers must care about their emotions:
  - For their own well-being
  - To maximize their students' motivation and engagement
  - "Teachers need to acknowledge the power of their emotions and that teaching involves more than just instructional behavior"

Becker, Goetz, Morger, & Ranellucci, 2014, pp. 24-25)

Teacher-Student Relationship

- Direct relationship between *teacher judgment and expectations* and *student motivation and performance*
  - Effect shows in IQ testing as well as achievement testing
  - Students adapt to inaccurate teacher judgment
    - Over-estimates scenario
    - Underestimated scenario

(Urhahne, 2015, p. 73)

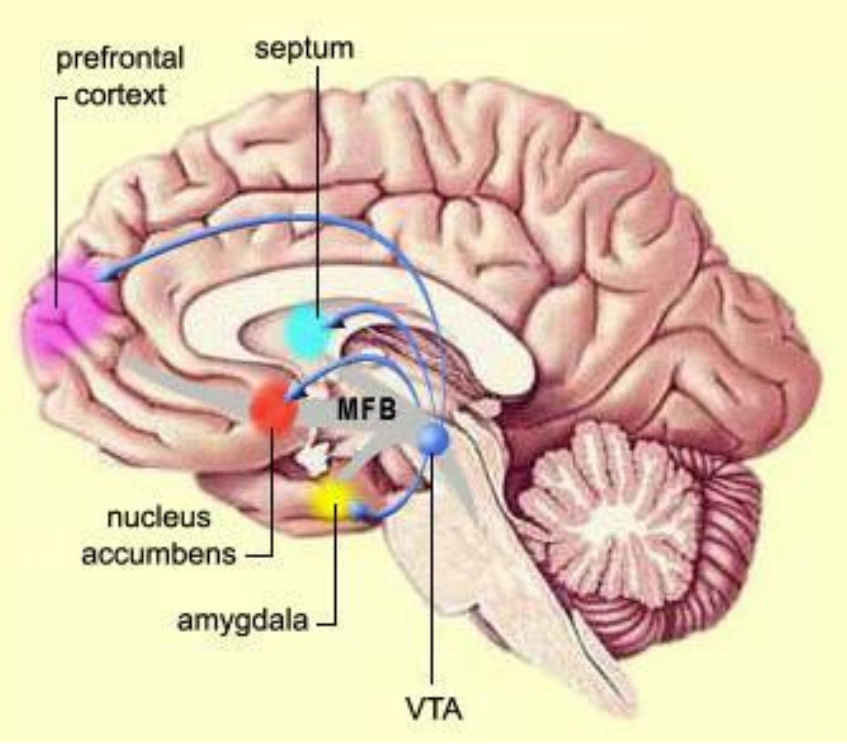
Teacher-Student Relationship

- Charismatic computer trainer behavior
  - Positive interactions
  - Individual attention
  - Intellectual stimulation
- Produced positive trainee affectivity
- Increased recall 1 week post training
- Increased transfer of knowledge 1 week post training

(Towler, Arman, Quesnell, & Hoffman, 2014)

Maximizing Motivation

- Regulatory Role of Amygdala
  - The amygdala induces neuroplastic modifications in a large-scale neural network by physically modifying network properties through its control over norepinephrine and stress hormones (Kandel et al, 2013)



Maximizing Motivation

- “When the amygdala becomes active, anatomical connections from the *amygdala* to the *cortex* may facilitate the processing of whatever stimuli are present. In addition, anatomical connections from the *amygdala* to the hippocampus could influence declarative memory directly”

(Squire & Kandel, 2009, 189)

Maximizing Motivation

- Amygdala Activators
  - Personalize information
    - Examples from life (your life/client's life)
    - Provide inspirational stories
  - Provide opportunities for
    - Debates
    - Enacting stories
    - Role play/Acting

Maximizing Motivation

- According to Molins-Ruana, et. al (2014), Students' motivation increases when they use educational interdisciplinary *videogames*
  - The approach is based on team collaboration

Maximizing Motivation

- Stimulate curiosity
- Encourage students ask questions
- Make student part of the decision
- Provide meaningful feedback

Motivational Strategies

- The older a person is, the more knowledge they have about motivation-promoting and maintaining strategies
- Five major motivational strategies:
  - Modification of the environment
  - Self-administered rewards
  - goal-oriented self-talk
  - Transforming tedious tasks into game activities

(Cooper & Corpus, 2009, 9. 525)

Maximizing Student Engagement

- Increase familiarity
  - Topic forecasts
  - Introduce brief overviews of what will be covered in future weeks
- Remind student of learning objectives prior to and throughout instruction
  - Connect goals to real-life experiences
  - Enable student visualize self at end of goal

Maximizing Student Motivation

- To translate motivation into tangible outcomes the individual must possess functional self-regulation abilities
  - Use Cognitive Restructuring techniques
    - E.g.: Let's examine the way you have been studying
    - What did you do differently?
    - How can you keep doing the same thing and expect different results?!!
    - Tell me about the things you intend to change between now and the next exam
  - National association of CBT
    - http://www.abct.org/Home/

The Student

- Buhrau & Sujan (2015) identify 2 categories of individuals, based on self-regulation skills:
  - Those with high consideration for future consequences (CFC)
    - Develop motivation to self-regulate when presented with distant benefits
  - Those with low CFC
    - Develop motivation to self-regulate when immediate benefits are expected

Dysfunctional Self-Regulation

- A core deficit of ADHD is decreased self-regulation
- The dysfunction is more severe in Autism
- Also found in many psychiatric disorders
- Can be acquired due to frontal brain damage
  - Trauma
  - Alcoholism and drug addiction

Dysfunctional Self-Regulation

- “Complaining to individuals “about their lack of motivation (laziness), drive, willpower, or self-discipline will not suffice to correct the problem.”
  - Pulling back will be even worse

(Barkley, 2012, p. 203)

- So what to do?

Dysfunctional Self-Regulation

- We must understand that:
  - “1. internalized, self-generated forms of motivation are weak at initiating and sustaining goal-directed behavior;
  - 2. externalized sources of motivation, often artificial, must be arranged within the context at the point of performance; and
  - 3. these compensatory, prosthetic forms of motivation must be sustained for long periods”

(Barkley, 2012)

Intervention: Physiological

- Student needs to regulate sleep
  - Facilitates more efficient rationalization and resolution of interpersonal conflicts, moral reasoning, decision making, emotional expression, and processing of emotional faces.
    (Pace-Schott et al 2011)
  - There are overlapping neural networks regulating sleep and mood (Kandel 2013, 1405)

Intervention: Physiological

- Increased Physical Activity
  - Directly modifies brain structure by
    - stimulating 3 major processes:
      - Brain derived growth factors
      - Neurogenesis
      - Brain connectivity
    - Increasing levels of serotonin, norepinephrine, dopamine
    - These neurotransmitters are essential for emotional stability, attention, memory, and learning

(Ratey, 2009)

Take Home Message

- Emotional processing is the gateway to learning
- Motivational states are mediated by an intricate network that works to connect our inner physiology with our conscious self-regulatory processes
- Stress, anxiety and depression alter brain chemistry, and can devastate our motivational systems and the entire learning process
- There is a lot that we can do to maximize student motivation, engagement and learning outcomes

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