WEEK 3:
THE ANATOMY OF FEELINGS

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A FUNCTIONAL ARCHITECTURE OF THE HUMAN BRAIN: EMERGING INSIGHTS FROM THE SCIENCE OF EMOTION

Lindquist & Barrett (2012)

LINDQUIST & BARRETT

- Faculty psychology approach: mental function as categories that reflect modular 'faculties', such as emotions, cognitions, & perceptions
  - Has dominated research into the mind & its physical correlates
- Constructionist' approach: commonsense mental states (e.g., cognitions, emotions, perceptions) are mental states that are created out of the combination of more basic psychological operations
  - Reminiscent of reading last week: broadly distributed functional networks (composed of basic psychological operations) interact to produce a range of mental states (e.g., anger, sadness, fear, disgust)
  - Assumes that these operations can be mapped to intrinsic networks in the brain

DISCUSSION QUESTIONS

Lindquist & Barrett (2012)

LINDQUIST & BARRETT

- Lindquist and Barrett discuss the faculty psychology and constructionist approaches to the mind.

- They provide an example to promote the idea that the constructionist approach motivates a shift in interpreting how research is interpreted, which can help resolve current limitations.

- Is there current research that integrates faculty psychology and constructionist approaches to explore the brain?

- In the example provided in the article about the anterior insula, it seems helpful to examine the brain structure from both frameworks.

- Could learning from the perspective of both approaches help resolve current limitations in research where one theory can fill in the gaps of the other rather than suggesting that the constructionist approach is superior?

- What are the pros and cons of adopting just one approach for cognitive neuroscience research?

LINDQUIST & BARRETT

- In Lindquist and Barrett (2012), I found myself really compelled by this idea of "common sense" emotional states (e.g., anger, disgust, memory, fear) and how this way of thinking and feeling may actually hinder our ability to understand the way that the human brain actually functions.

- Up to this point, I wonder if human researchers been biased by their own experiences—that is, by personally experiencing the sensations and feelings that make these "common sense" emotional states (for example, having personally felt how salient and unified the concept of "fear" can be).

- Put differently, how limiting are a human's personal emotional experiences when it comes to actually conceiving of biological emotional states that do not qualitatively reflect that lived experience?

- Might people with less commonly and/or clearly defined emotional responses (e.g., people with ASD who typically don't classify emotional states in the "common sense" way) actually be better equipped to conceptualize and study the brain according to a constructionist world view?

LINDQUIST & BARRETT

- I think that the constructionist approach vs psychological faculties approach question is murkier than Lindquist and Barrett (2012) make it out to be.

- They state that "the empirical evidence shows that the mental states people call anger (or sadness, fear, or other emotions) in humans are too variable to hold natural kind status." - meaning that these mental states don't encapsulate a specific, consistent set of phenomena.

- Yet, Nummenmaa and colleagues (2018) found (in a sample of over 1,000 individuals) that while there was some variation, there was a consistency to the sensations and experiences reported in relation to a variety of basic emotions.

- If there is a consistency to the physical experience, why would there not be at least SOME structures in the brain that are responsible for at least part of specific emotions?

- Is it perhaps reasonable to hypothesize that some basic functions arise from specific structures while some other functions (some basic and some more complex) may arise from flexible and more widely distributed networks in the brain?

LINDQUIST & BARRETT

- Lindquist and Barrett (2012) are essentially hypothesizing that neurological processes (emotions included) are emergent.

- Emergentism has been in scientific and philosophical literature since at least John Stuart Mill (if not earlier), and it holds that a given set of processes can interact to produce a new process - basically, a whole has something greater than just the sum of its parts.

- Lindquist and Barrett (2012) suggest that emotions (and other mental processes) emerge as we make "meaning of sensations."

- This brings two questions to mind: What, then, is driving our meaning-making?

- Is it the default network, or is that just a related process with which something else is working to make meaning of our sensory experience?

- Relatedly, what might this constructionist approach potentially mean for the mind-body problem?

PESSOA

- Cortical–subcortical 'functionally integrated systems' as a model of the emotional brain

  - Based on large-scale networks & their interactions

  - Aimed at understanding the brain basis of emotion & interactions between emotion & perception, cognition, motivation, & action

- Principle 1: Massive Combinatorial Anatomical Connectivity

  - Both cortical & subcortical brain regions are densely interconnected

PESSOA

- Principle 2: Cortical–Subcortical Anatomical Connectional Systems
  - Large-scale cortical–subcortical anatomical connectional systems involve the basal ganglia & additional subcortical forebrain structures
  - Cortical signaling must be understood in terms of an expanded framework in which cortical & subcortical mechanisms are intimately interrelated

PESSOA

- Principle 3: High Distributed Functional Connectivity
  - Functional connectivity: the extent of coherence between signals of two regions, often indexed by correlating the associated signal time series (i.e., how their signals co-vary)
  - Both the anatomical location of a region & its position in a space of functional relationships to other regions are important
  - Takeaway: understanding brain circuits requires moving beyond structural connectivity and considering functional relationships

PESSOA

- Principle 4: Overlapping Brain Networks
  - Anatomical & functional networks have widespread connectivity
  - Best to describe the brain based on networks (thus highlighting their relative independence), but allow regions to belong to multiple networks simultaneously

- Principle 5: Dynamic Brain Networks
  - Brain networks are not static but evolve temporally
  - Functional connections vary as a function of context, & are altered by cognitive, emotional, & motivational variables
  - Thus, network organization = dynamic

PESSOA

- Takeaways
  - The brain basis of emotion involves large-scale cortical–subcortical networks that are distributed and sensitive to body signals
  - The high degree of signal distribution & integration provides a nexus for the intermixing of information related to perception, cognition, emotion, motivation, & action
  - The functional architecture consists of multiple overlapping networks that are highly dynamic & context-sensitive

PESSOA

- Takeaways (continued)
  - Thus, how a given brain region affiliates with a specific network shifts as a function of task demands and brain state
  - Cortical–subcortical connectional systems (principle 2) & functionally integrated systems provide a unifying framework to understand the emotional brain, & how emotion is interlocked with perception, cognition, motivation, and action
- TL; DR: Emotion is a large-scale network property of brain function

DISCUSSION QUESTIONS

Pessoa (2017)

PESSOA

- Pessoa (2017) explains that the experience of any one "emotion" is, in fact, the product of the combination of multiple "basic" neurological functions that form a myriad of networks.

- Additionally, the author writes, "importantly, the functional architecture consists of multiple overlapping networks that are highly dynamic and context-sensitive," (p. 357).

- This raises the question of how much of the activity of these networks can be explained by context and how much can be explained by individual differences - explained by both past experiences and genetic input?

PESSOA

- Pessoa (2017) described that "brain networks are not static but evolve over time." Do these brain networks evolve over time due to experiences?

- If this is the case, do certain people have more dynamic (or evolved) brain networks due to exposure to more experiences?

- For example, does living in one place, working the same job, living the same lifestyle without any changes throughout your whole life limit your ability to adequately develop your dynamic brain networks?

- Individuals from rural communities often live in the same place their whole lives.

- Does this mean their brain networks have not evolved as effectively as those from urban areas or people who have moved for work/college/other life circumstances?

- Could it possibly be extrapolated that this might play a role in their lower socioeconomic status as well, or is that too far of a stretch?

NEURAL CORRELATES OF EMOTION–COGNITION INTERACTIONS: A REVIEW OF EVIDENCE FROM BRAIN IMAGING INVESTIGATIONS

Dolcos, Iordan, & Dolcos (2011)

DOLCOS, IORDAN, & DOLCOS

- The impact of emotion on cognition
  - Emotion can:
    - produce both enhancing & impairing effects on cognition
    - have both immediate & long-term effects that may impact lower level (e.g., perceptual) & higher level (e.g., mnemonic) cognitive processes
- The impact of cognition on emotion
  - Capacity to use cognitive control to resist momentary emotional distraction & the ability to cope with longer lasting emotions & feelings

DOLCOS, IORDAN, & DOLCOS

- The role of individual differences in emotion-cognition interactions
  - Personality-related differences
    - Personality traits (e.g., extraversion & neuroticism) influence the neural correlates of emotion processing across a range of emotional processes
      - Including experience, perception, attention, and memory

DOLCOS, IORDAN, & DOLCOS

- Sex-related differences
  - Women are more emotionally reactive & expressive, display more extensive knowledge of emotional experience, & recall more emotional autobiographical memories
  - During a task involving emotion regulation females mainly recruited brain regions associated with emotion processing, while males mainly recruited brain regions typically involved in cognitive processing, thus…
    - Men may be able to use cognitive regulation with less effort than women
    - Women may use positive affect in the service of down-regulating negative affect to a greater extent than men

DOLCOS, IORDAN, & DOLCOS

- Age-related differences
  - Negative affect decreases & positive affect increases or remains stable throughout the life span
  - Enhanced ability to control emotions & a tendency to increase positive emotions & attenuate negative emotions with age
  - Relative preservation of the mechanisms responsible for emotional processing with age
- Clinical Application: Unbalanced emotion-cognition interactions may lead to, for example, mood & anxiety disorders

DISCUSSION QUESTIONS

Dolcos, Iordan, & Dolcos (2011)

DOLCOS, IORDAN, & DOLCOS

- Dolcos, Iordan, and Dolcos (2011) discuss the neuroanatomical and functional network basis for the amplification of emotionally-rich memories.

- The authors mention that the intensity, rather than the valence, of the experience determines the strength of the memory.

- Could this explain why when recalling a distressing event, we sometimes try to find the humor in the situation?

- This seems to be a method of reappraising the memory with an equal emotional intensity but with the opposite valence.

DOLCOS, IORDAN, & DOLCOS

- In the section on emotion and aging, Dolcos, Iordan, & Dolcos (2011) brought up an interesting point where the heightened PFC and lowered medial temporal lobe (MTL) activation seems to co-occur with a lowered negative emotion in older adults.

- The change in the activation pattern is thought to compensate for the loss of neurons in the MTL region, basically to combat neural degradation.

- However, somehow, it looks like the bright side of the degradation is the improvement on the emotional regulation.

- How do scientists make sense of the phenomenon?

DOLCOS, IORDAN, & DOLCOS

- Dolcos, Iordan, Dolcos (2011) describe that emotional stimuli capture our attention more easily than non-emotional stimuli. Thus, emotional stimuli can benefit cognitive processes (e.g., better memory for emotional events).

- In regards to sleep, does this impact dreams, nightmares, and our subsequent memories of them the next morning?

- Are emotion-provoking dreams remembered more easily than those that elicit minimal emotion?

- Is this why individuals with PTSD often complain of more vivid dreams or nightmares due to their experience with severely emotional traumatic events?

- Furthermore, it was stated that "the amygdala is shown to detect and process emotional stimuli with increased efficacy".

- Since military personnel tend to use the amygdala more often than civilians during times of training and war, is it possible that military personnel experience few nightmares during deployments due to their increased levels of cortical control surrounding emotion, but then experience more nightmares when they return to civilian life?

DOLCOS, IORDAN, & DOLCOS

- Dolcos discusses emotion-cognition interactions and their effects on behavior.

- Cognitive behavioral therapy is based on the relationship between emotions, cognitions, and behaviors and the impact that they all have on one another.

- How can brain imaging investigative research benefit CBT to influence treatment with therapy clients?

- Are brain imaging studies often considered in the clinical world in terms of further developing therapeutic approaches?

DOLCOS, IORDAN, & DOLCOS

- Dolcos, Lordan, and Dolcos (2011) discuss the role of individual differences, such as age, sex, and personality traits, in emotion-cognition interactions.

- In particular, they mention that responses to emotional challenges may depend on an individual's "cognitive behavioral profile".

- I'm wondering if we could use such profiles in clinical work as a tool for selecting the best treatment for an individual with an affective disorder.

- For example, if I'm treating a client with depression, could I use their gender, age, and personality traits (in addition to any other information I've learned about them) to better inform which types of emotion regulation strategies the client is most likely to respond to and therefore which type of therapy might best address their needs?

CLINICAL APPLICATION

- Learning about the anatomical networks of emotion
- Implications:
  - Increased understanding of underlying brain disorders
  - Development of new therapeutic strategies
    - E.g., psychiatric medications, electrical brain stimulation, Dialectical Behavioral Therapy (DBT)

CLINICAL APPLICATION

- TED Talk: The science of emotions
  - Jaak Panksepp coined the term 'Affective Neuroscience' in 1990
  - Studying emotions & affective states of animals may lead to more rapid understanding of human emotions
  - https://www.youtube.com/watch?v=65e2qScV_K8
- Emotion Regulation
  - Changes brain structure & function
  - https://www.youtube.com/watch?v=YUPIhzHa-68