Empowering Treatments through a Neuroscience Model of Emotion
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LEARNING OBJECTIVES: After this workshop, participants will be able to:

1. Outline the latest neuroscience understandings of what happens in the anxious brain.
2. Describe how to help people understand their often confusing and overwhelming experiences.
3. Utilize modeling in the therapeutic relationship to teach new emotional skills.
4. Develop more effective self-talk to guide client’s efforts to establish new responses.
5. Explain how to improve exposure techniques by focusing on increasing the safety signal rather than reducing the anxiety signal.

INTRODUCTION

Treatments for anxiety have largely been based on CBT models

Practical techniques usually have limited neuroscience explanations

Have a highest level cognitive processing brain that makes decisions (“mind”)  
Have a lowest level physiological processing brain (“body”)  
Somewhere in between lies emotional processing

Based on top-down model of brain functioning: thoughts cause/control feelings

Ex: Judith Beck’s explanation of emotional reasoning as: “You think something must be true because you “feel” (actually believe) it so strongly, ignoring or discounting evidence to the contrary

Emotion is a poorly conceptualized secondary process

Neuroscience advances change explanations of these processes

Emotion becomes a more clearly conceptualized primary process
Anxiety is more often a bottom-up process of feelings causing/controlling thinking
Enable us to explain what is happening in anxiety to clients

Incorporating these explanations will empower the treatment of anxiety

Basic techniques still are useful but they are explained & implemented differently

Will be illustrating how to do this in four basic areas:

Psychoeducation: how to explain to clients what is happening to them
Therapeutic relationship: how to use mirroring & modeling to increase therapist impact
Self-talk skills: how to explain and correct self-talk more effectively
Exposure: how to change focus during the process to make it more effective

Overview of Trilevel Emotional Responding Model (TER)

Based on my own synthesis of the neuroscience literature

Basic foundation derived from MacLean’s & Spiegel’s triune brain models
Differ in its conceptualization of limbic or emotional levels
Assumes a **hierarchical** model of brain functioning  *(See Diagram 1)*

Each level inputs data, makes decisions, and executes responses by its own methods

Each level sends information up to the next higher level to influence its functioning
and receives higher level feedback that influences the lower level functioning

Three higher level decision making parts of the brain:

- **Neocortex:** “Human” brain which makes decisions by **Thinking**
- **Paleocortex:** “Mammalian” brain which makes decisions by **Emoting**
- **Brain nuclei:** “Reptilian” brain which makes decisions by **Reacting**

Three lower level body regulating and activating parts of the brain

- **Brain stem nuclei:** Regulates basic homeostatic physiological life processes
- **Spinal cord:**
- **Peripheral nerves:**

Basic hierarchical principles:

- Lower levels are phylogenetically earlier developments having simpler circuits
  that are more genetically hard wired and are excitatory
- Higher levels are phylogenetically later developments having more complex circuits
  that are more wired by learning and are inhibitory

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**NEUROSCIENCE EXPLANATION OF PANIC**

**Brain Nuclei Level: Amygdala Functioning**

**Description:** *(See Diagrams 2, 3, 4)*

Amygdala is a small almond shaped nuclei that is embedded in the temporal lobe
close to the front of the brain stem where it can easily receive all sensory inputs

It functions like the sentry for the brain monitoring input and regulating attention
and arousal

Amygdala is fully myelinated one month prior to birth

**Input:**

Amygdala receives the **gist** of input from 2 systems at a subconscious level

- **External senses** (smell, sight, sound)
- **Internal physiological processes** (heart rate, breathing, gastrointestinal upset, etc.)

It provides very fast appraisal of possible (unusual, novel, uncertain) dangers

Good analogy: Burglar alarm

**Decision making:**

- If it detects possible danger, then it automatically triggers its unconscious, instinctive
  reflexive reactions (all-or-none response with no thinking)
- It is only an **on switch** – it does not determine whether the danger is false
- It is turned off by:
  - absence of the triggering stimulus
  - a higher level **off signal** that the stimulus is not a danger

Certain triggers are hard wired: pain, loud noises, angry or frightened human face

Certain inputs are easily learned: snakes, insects,

Only stimulus triggers can be learned (classical or Pavlovian conditioning)

implicitly learned without conscious awareness or processing
Intense arousal can produce one-time or flash-bulb learning where the strength of the arousal is taken an indicator of the validity of the danger. This learning is rapid and enables the amygdala to quickly react to the generalized gist of a learned danger in the future that is resistant to extinction. If the amygdala is lesioned, then fear conditioning and autonomic arousal will not take place in response to a danger though the higher level will know it is dangerous.

**Responding:**

It provides very fast reaction to possible dangers in 3 major response systems:

- **Biological / body reactions** through the autonomic nervous system
  - Sympathetic autonomic arousal = increased heart rate & blood pressure, rapid breathing, sweating, digestive slowing, sexual inhibition

- **Brain reactions** = increase activating neurotransmitters dopamine & norepinephrine

- **Behavioral reactions** = freeze, flight, fight emergency survival reactions, and facial expression of fear

Amygdala activation reaction is also sent up to the next level where it becomes its signal can be translated into emotions for further processing.

Amygdala’s signal unconsciously biases these higher level appraisals.

When a higher level needs to produce autonomic arousal, it sends a signal down to the amygdala since it controls the activation of the sympathetic system.

**Integration with other levels:**

Because the amygdala both monitors the lower level physiological processes and also activates these processes, it can easily set up an escalating feedback process. If it detects increased heart rate, it triggers sympathetic arousal which will further accelerate the heart rate which will create the physical symptoms of a panic attack.

If a person does not know what is happening and cannot activate a safety signal, then the uncertainty will further amplify the panic feeling.

Consequently the amygdala can learn to fear physiological symptoms.

Amygdala activation signal serves as the basis for the fear response at higher levels.

Amygdala cannot “reason” itself off; this regulation has to come from a higher level.

**Paleocortical Level:**

**Description:**

Sensory & motor cortex (Diagram 5), cingulate & parahippocampal gyri (Diagram 4), ventral, medial, orbital prefrontal cortex, insula (Diagram 6, 7)

**Input:**

- Receives external sensory input & constructs detailed sensory maps of outer world
- Receives lower level physiological input & constructs a body map
- Receives output from emotional facilitation nuclei & translates into emotions
  - Amygdala info translates into fear; accumbens info translates into pleasure, reward
- Emotion = metainformation created to assess how important (valuated) something is
Decision making:
Mammalian brain can learn how to value experiences & use valuation to choose between 2 competing responses (strongest emotional response wins, executes)
   A hungry mammal seeking food in a dangerous situation can weigh whether it is more important to pursue food or safety depending on its internal states
Emotional brain can learn more than just sensory triggers
   It can learn more detailed sensory maps with complicated emotional contingencies
   It can learn novel motor responses through conditioning and mirrored modeling
   It can learn emotions including the conditioning of emotions to emotions (fear of fear)
Learning is implicit (happens automatically at subcortical level) and tends to create a habitual response that can execute almost as fast as innate reflex
   Once learned response will automatically execute (pops into action in a blink)
   Will automatically project past memory into situation as present experience

Responding:
Mammalian infants do not have innate safety signal to turn off the amygdala alarm but they all emit a distress vocalization that calls for parental protection
   Mother's presence is initial safety signal that starts process of learning others
   It responds to all 3 major response systems of the lower level:
   **Biological / body reactions** through the autonomic nervous system
      Parasympathetic activation will turn off the arousal symptoms of fear
      Safety signal comes from ventromedial prefrontal cortex
   **Brain reactions** = can use emotional feedback to turn on lower neurotransmitter systems in addition to new neurotransmitters like oxytocin
   **Behavioral reactions** = experiences an urge to act that is used to motivate behavior
      Can learn novel ways to flee, fight, hide, or avoid situations
      Avoidance behaviors are easily learned because of the emotional relief they provide
   Add new type of response unique to mammals
   **Social communication** by using the **language of emotions**

Integration with other levels:
Because select brain nuclei signals become the basis of emotions
   this level quickly takes over most lower level reactions
   so the two levels are often seen as one – ex: limbic system
   If there is no calming protective relationship, this level further amplifies the lower and adds an emotional experience that motivates additional ways of avoiding fear

Neocortical Level:
   **Description:** *(See Diagram 8)*
   Dorsolateral prefrontal cortex = multimodal decision making association area
   Parietal-occipital-temporal cortex = multimodal sensory association area
   Vastly expanded parts of neocortex = 3 times as large as chimpanzee
Input:
Receives no new sensory input
However it adds verbal thoughts to the lower level sensory input
It can label and interpret the fear experience
Ex: My strongly beating heart translates into “I am having a heart attack”
It can also add explicit memories from the past to the experience
Can consciously retrieve and think about in working memory
Ex: This reminds me of “the time that I was stuck in an elevator”

Decision making:
It makes conscious decisions by thinking about:
explicit memories from related past experiences
learned analytic processes of using logic and rational problem solving
imagined future outcomes created by its envisioning capacities
It can learn by verbal instructions, reasoning, and envisioned possibilities
Digital learning which depends on symbolic representation instead of
analogic learning which depends on experiential conditioning / modeling
Creates very efficient and rapid form of learning not available to mammals
Based on reasoning alone it can decide “don’t be afraid, there is nothing to fear”

Responding:
It can give instructions to the lower motor circuits on what actions to take
It has meta control, while the paleocortex has direct control
If lower level is unsure about what to do, then this level can provide direction
It can try to override a habit that automatically executes at the lower level
but whether it succeeds depends on whether its instruction has sufficient valuation
to the weighing of valuation of each option
What it typically fails to realize is that the lower levels do not “hear” thoughts
Amygdala receives not direct input from the neocortex, only paleocortical messages
Paleocortex only responds to the emotional or experiential part of the message
Ex: Saying “its only thunder, don’t be afraid” in a harsh, critical way will actually amplify fear reaction
while saying the same words in a calm, soothing way may succeed in reducing the fear reaction

Integration with other levels:
The more comprehensive and wise decision making possible at this level makes it possible to see solutions that lower levels cannot envision
which can help people break out of lower level escalating feedback loops
However, if this level naively thinks that its instructions will automatically be heard and followed, then it can set up a new escalating feedback loop
First error is assuming that lower levels make wise decisions
which leads to blindly interpreting amygdala’s alarm as an actual reality
which creates thoughts that further amplify the emotional arousal
Ex: Since heart beating rapidly, I must be having a panic attack
Second error is assuming that its instructions will automatically control lower level responses which leads to failure and frustration
which then causes a further escalation of the negative emotional cycles
Ex: When telling self to “not be afraid” doesn’t stop fear, then actually become more afraid
Integration between Levels:

**Good way to conceptualize: Family system analogy**
Captures essential characteristics of each level in easy to remember way
- Neocortical = adult = last to develop, able to think
- Paleocortical = child = emotionally solves
- Amygdala = infant = first to develop, just reacts

Can understand anxiety problems as dysfunctional interactions between levels
- Poor communication due to failure to translate language of lower level
- Faulty understanding of how to influence lower level

**Most anxiety problems are escalating feedback loops**
Usually most problems are due to bottom-up processes
- Amygdala with its emotional power creates a runaway process
Easiest to intervene at highest level first
- Cognitive expectations more easily changed by logical analysis
- Emotional expectations take experiential conditioning
Differences in where loops are explains some disorder differences
- Panic = physiological trigger = avoidance of arousal symptoms
- Phobia = external sensory trigger = avoidance of specific situation
- OCD = obsession is verbal trigger = compulsion is pseudo safety signal

**THERAPEUTIC ADVANTAGES OF NEUROSCIENCE MODEL**

**Psychoeducation Advantages**
- Explains why symptoms happen – normalizes the experience
  - Takes some of shame / blame out of old response making it easier to release
- Explains why naïve cognitive solutions don’t work
  - Amygdala doesn’t listen to verbalizations just the emotions accompanying them
  - Getting frustrated and trying to turn off will actually turn on and up the response
- Makes it easier to explain why it is necessary to “accept the anxiety”
- Makes it easier to “externalize the problem” as amygdala so can decide to not let it control one’s life
- Helps explain why old techniques like “focusing on the solution” work which makes it easier to get clients to accept them

**Therapeutic Relationship Advantages**
- Emotional responses are relationally not cognitively learned by mirroring the modeling of “good parents”
- Therapist “loans emotional confidence” to people by noticing and affirming small evidences of the desired strength in the client
- Therapist encourages people to talk to their internal experiences with the empathic attitude that reflects what the person desires (& therapist models)
- As client acts on own confidence, therapist steps back and reflects their strength
- Clients are taught to assess their confidence and then wisely borrow from others only as much as they need to bolster their own efforts
Self-Talk Advantages

Don't just search for automatic thoughts; search for emotional urges
Translate emotional expectations into cognitive thoughts to allow analysis
Explain expectations not as cognitive errors but as naïve translation of emotional solutions into naïve cognitive interpretations
In additional to usual cognitive challenges, ask which level of brain they want to be making their decisions -- naïve amygdala reaction or wise neocortical thinking
Cognitive validation helps new adaptive self-talk become reasonable choice, but to make it effective in overriding old paleocortical response it has to become more strongly emotionally valuated than old response
Emotional empowerment is crucial

Exposure Advantages

Exposure is about learning a new higher level response (safety, tolerance, mastery) that overrides an old response (it does not diminish or replace it)
"White-knuckled" repetitions of facing the fear will not necessarily extinguish
The higher level off-signal must be paired with the experience of the lower level anxiety signal or extinction will not take place
Must face the anxiety; if turn off with meds or no sense of threat, then no extinction
Goal is **not to turn off the on-signal** (not focus on reducing anxiety)
but to **turn on the off-signal** (focus on increasing sense of safety / mastery)

REFERENCES

Diagrams for the Neuroscience Model of Emotion

1. Trilevel Emotional Responding Model

Neocortical Brain Thinking
Paleocortical Brain Emoting
Brain Nuclei Reacting
Physiological Functioning

2. Emotional Facilitation Nuclei

Septal nuclei
Hypothalamic nuclei
Amygdala

Looking at front of brain stem and basal ganglia

3. Limbic Nuclei

Sensory-motor areas are older parts of cortex

4. Limbic System Gyri

5. Paleocortical Anatomy

Neocortex is mainly two large multimodal association areas

6. Limbic Sensory Cortex

7. Limbic Motor Cortex

8. Neocortical Anatomy

Human neocortex is 3 times larger than chimpanzee

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