Building a Resilient Brain:

How to apply the latest neuroscience based brain-changing techniques for better mental health

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Outline

- Part I: Brain Structures
- Part II: Neural Networks and Connections
- Part III: Brain-Changing Interventions
- Part IV: Brain Profiles of Common Disorders
- Part V: Titration and Pendulation
- Part VI: Five Phase Neuropsychotherapy Roadmap

Brain Structures

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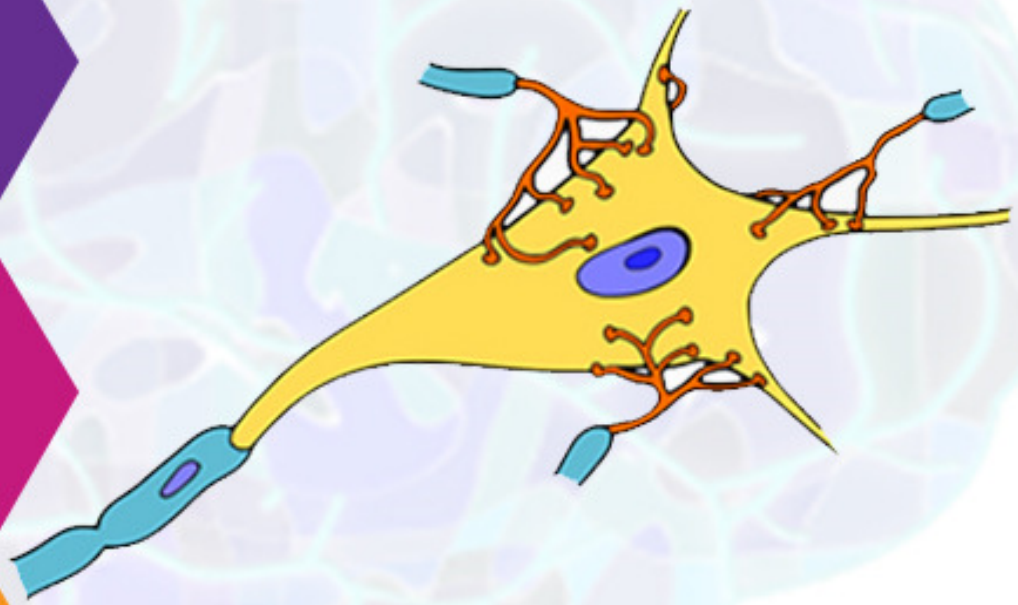
The Nervous Systems

86 BILLION neurons!

Nervous systems exist in the brain AND body

Central Nervous System
= brain and spinal cord
Peripheral Nervous System
= somatic/autonomic systems



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Autonomic nervous system

Sympathetic Nervous System: "Stress Response" or "Fight or Flight"

Characterized by 1,400 biochemical and psychophysiological changes in the body

Dulls/deactivates functioning in cortical areas of the brain

Leads to long-term health consequences when dysregulated

Parasympathetic Nervous System: "Relaxation Response"

The opposite of "stress response," characterized by lowered blood pressure and heart rate, slowed breathing, other indices of relaxation

Meant to be our homeostasis, the state we are in most of the time

Limbic System

Triune Brain

Survival Brain Reptilian
(Lower brain)

Emotional Brain Limbic
(Interior area)

Thinking Brain
(Cerebral cortex)

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Limbic System

Thalamus

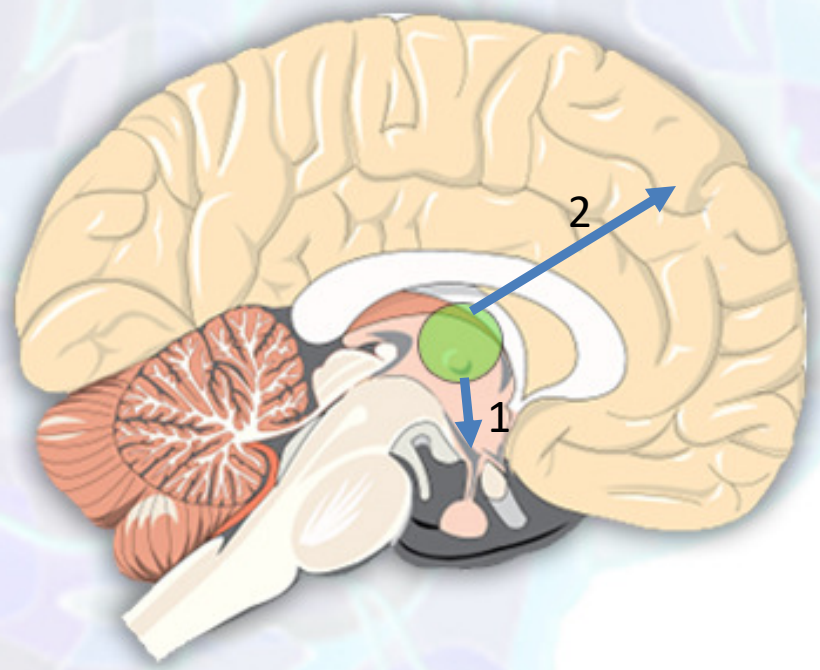
Gateway for sensory information (except smell)

Main objective is to share sensory information with as much of the brain as possible, as fast as possible!

Thalamus: The Two Pathways

1. Fast, short path to the amygdala…

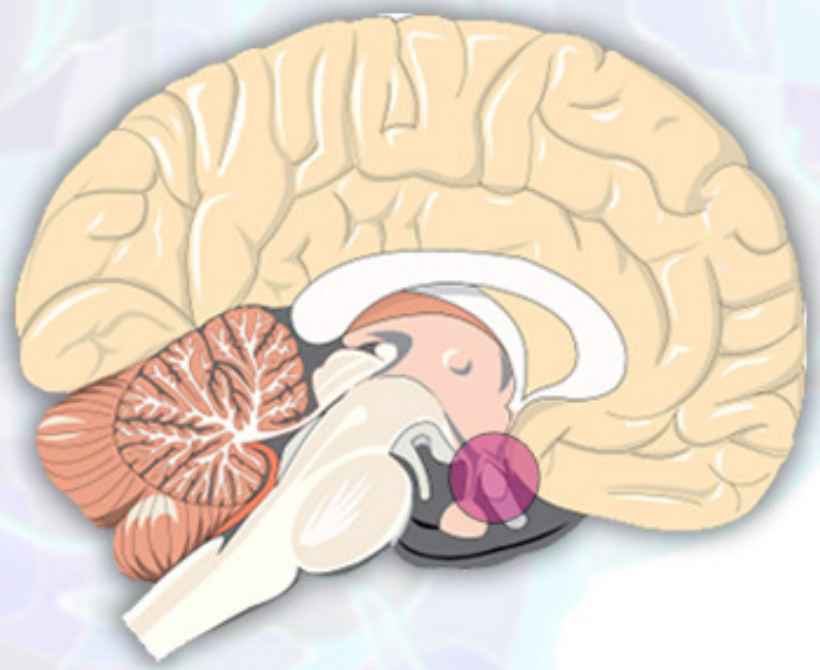
2. Slow, long path to the cortex…



Limbic System

Amygdala

- "Fear brain" or "smoke alarm"
- Can suppress cortical structures
- Involved in fear/threat detection
- Makes final decision about what is dangerous
- Begins stress response through activation of the HPA axis



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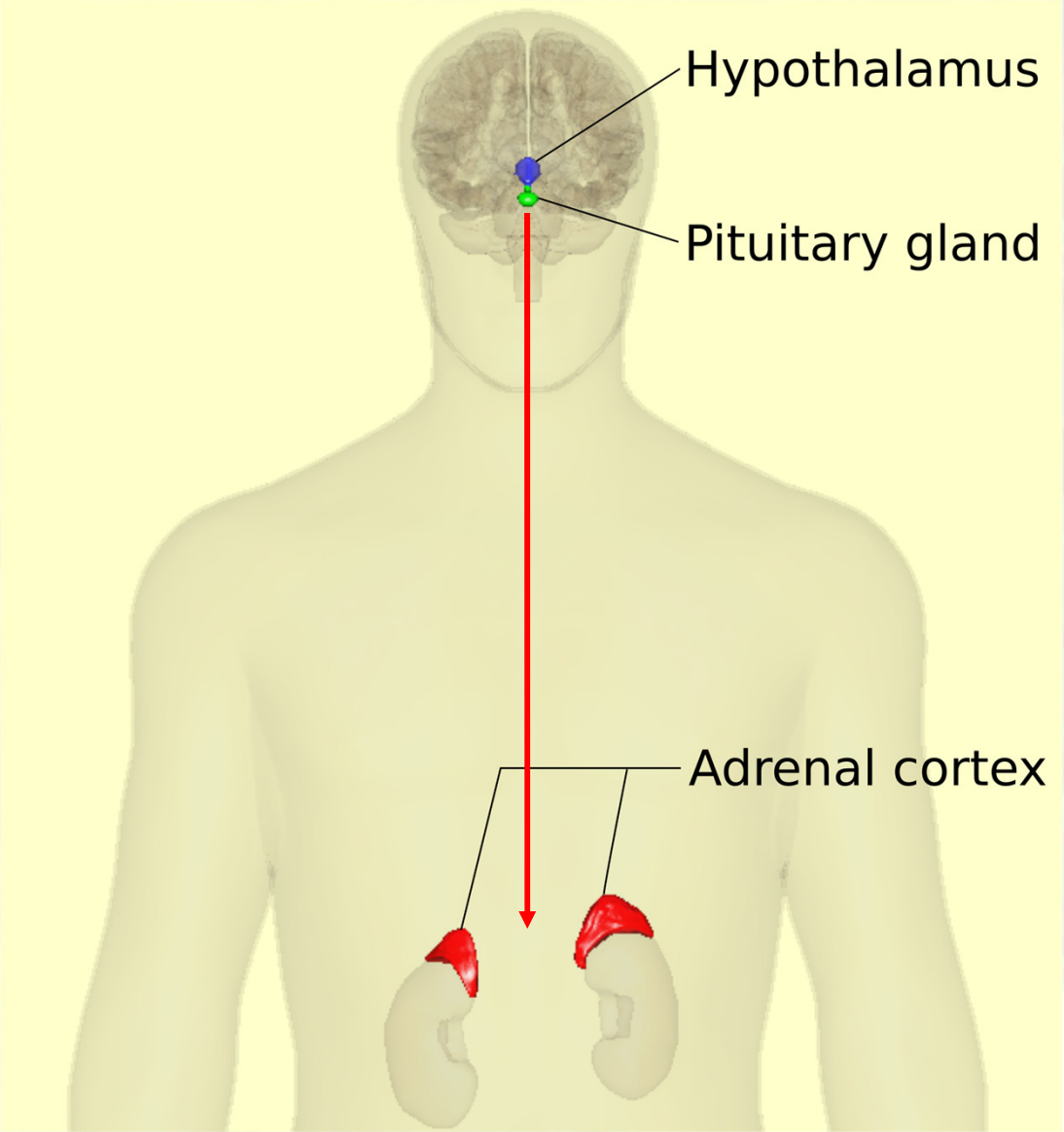
Limbic System

Hypothalamus

- Regulates autonomic functions
- Takes commands from amygdala
- Starting point for the stress pathway in the brain (HPA Axis)

HPA Axis



Limbic System

Hippocampus

- Involved in learning and memory
- Cortisol is toxic to this area
- Explicit, autobiographical, declarative memories

Heal the Hippocampus

- **BDNF promotes neurogenesis in the hippocampus (i.e., Kuipers et a., 2016)**
- BDNF = brain derived neurotrophic factor
  - Consolidates connections between neurons
  - Promotes growth of myelin to make neurons fire more efficiently
  - Acts on stem cells in the hippocampus and PFC to grow into BRAND NEW NEURONS!
- Increase your neurogenesis with…
  - Exercise (Sleiman et al., 2016)
  - Meditation (Cahn et al., 2018)
  - Incorporating Omega-3s into your diet (Agh et al., 2016)
- Decrease your neurogenesis by…
  - Aging (sorry!)
  - Experiencing chronic stress
  - Marijuana use
  - Excessive alcohol use

Limbic System

Insula

- Site of proprioception and interoception
- Helps you feel into the body, for "felt sense"
- Translates sensations into emotions

Limbic System

Nucleus Accumbens

- "Addiction Center"
- Involved in reward, laughter, pleasure , addiction
- Important component of the reward pathways of the brain

Limbic System

Cingulate Cortex

- ”Self-regulation center” – regulates thoughts, emotions, behavior
- Involved in monitoring conflict, emotion regulation, pain expectancy
- Is a limbic and cortical structure (two-in-one)

Triune Brain

Survival Brain Reptilian
(Lower brain)

Emotional Brain Limbic
(Interior area)

Thinking Brain
(Cerebral cortex)

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Frontal Lobe

Prefrontal Cortex:

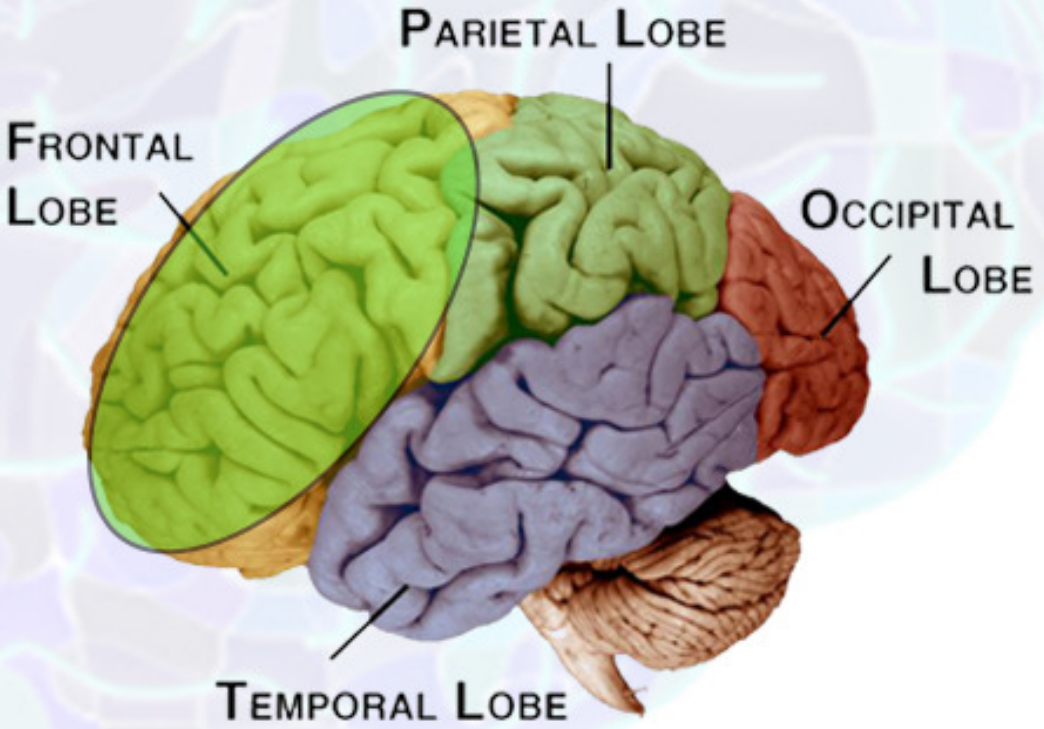
- Rational thought
- Goal-making
- Decision-making
- Sense of others
- Personality
- Sense of self

Primary Motor Cortex

- Movement

Cingulate Cortex

- Self regulation
- Expectation of pain
- Conflict monitoring



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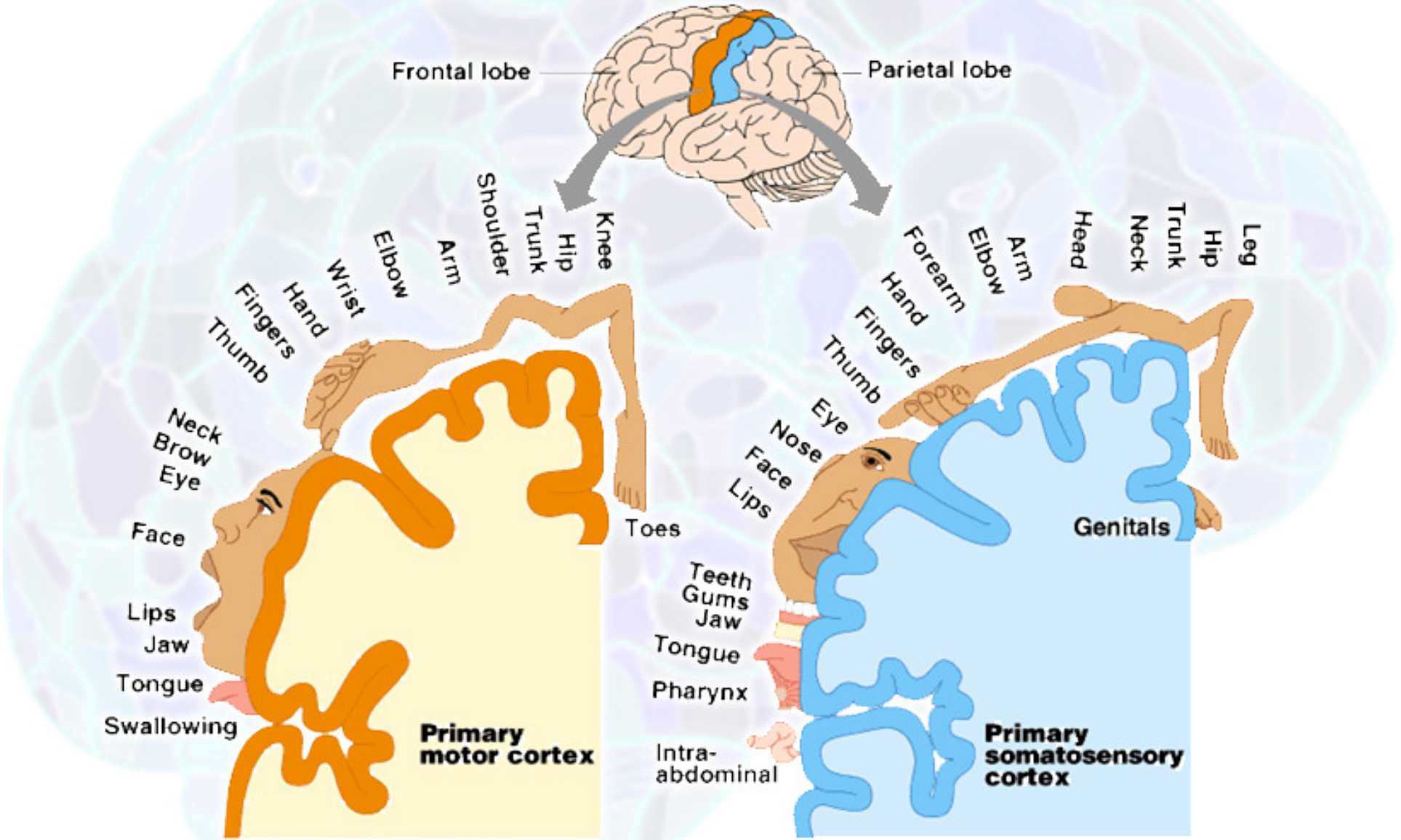
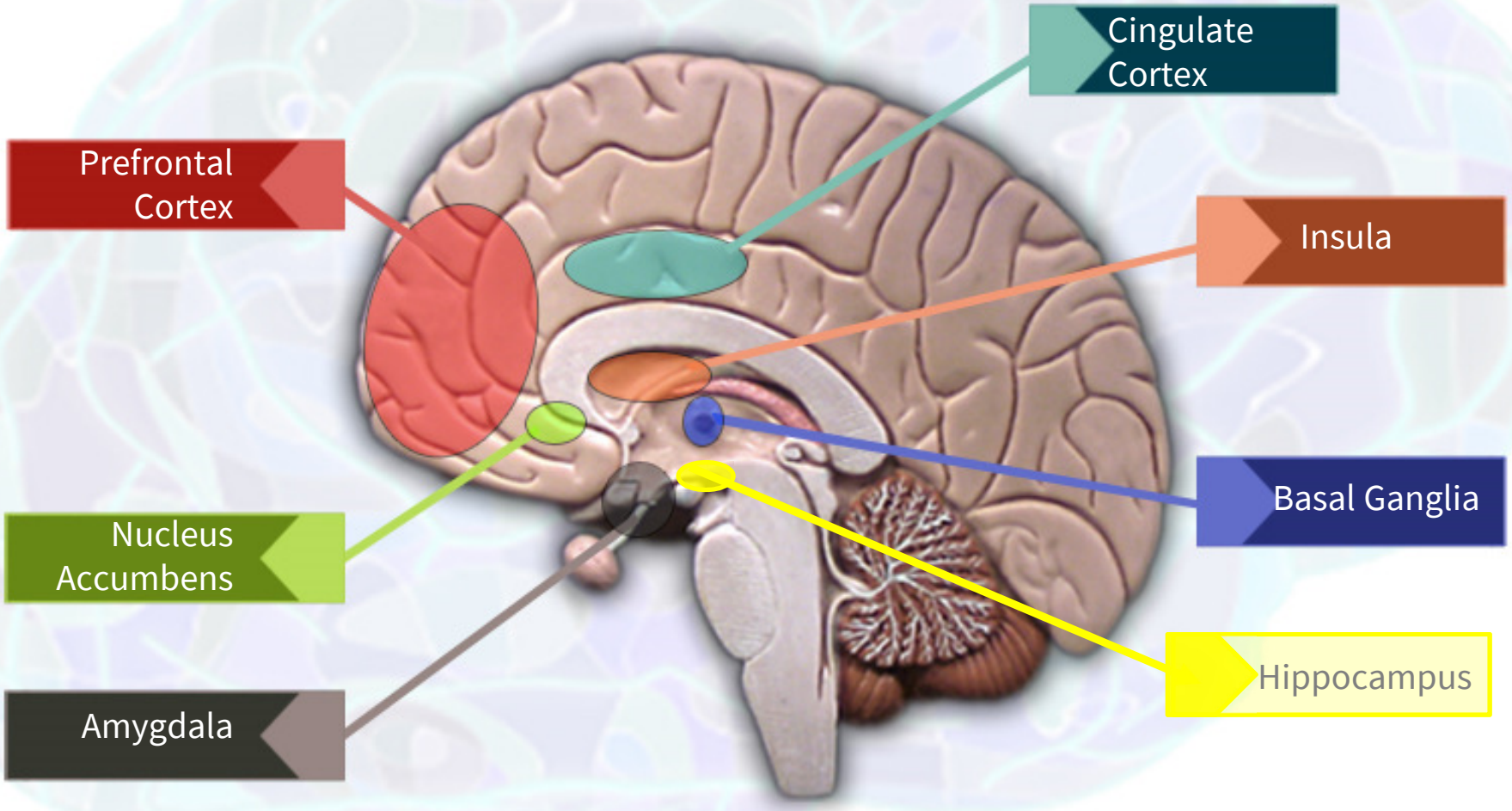
Homunculus on the Sensory Strip



Key structures to know



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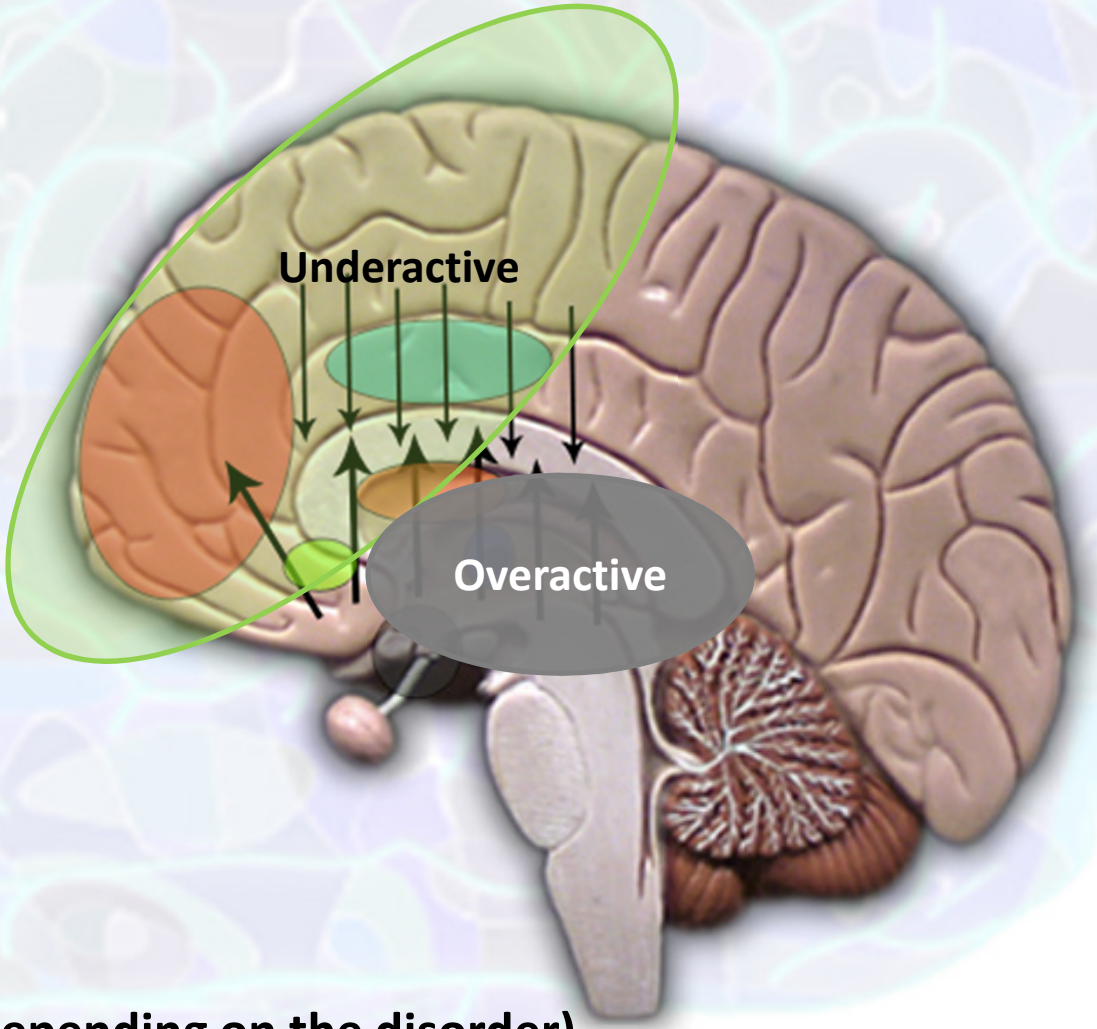
Neuroscience of Mental Illness

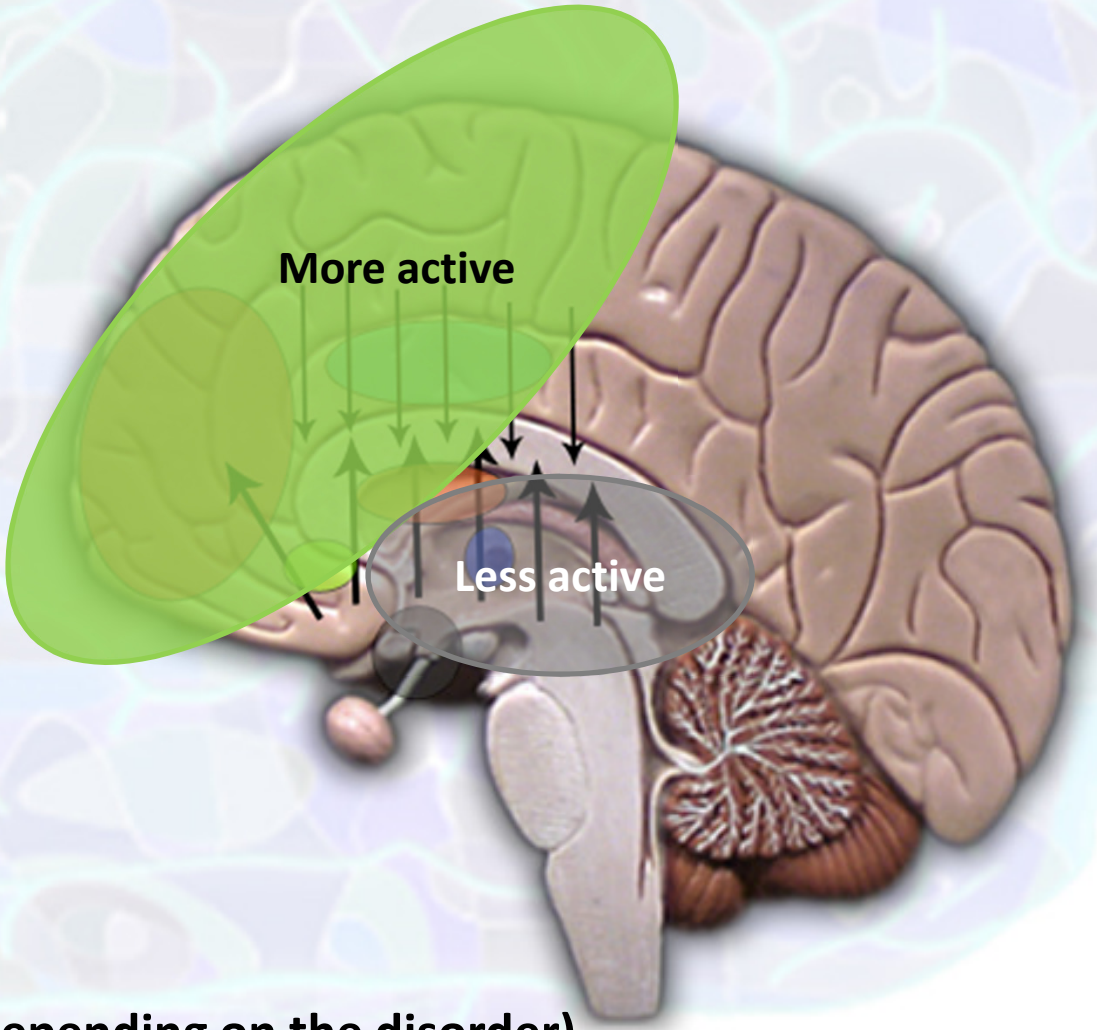


In various ways (depending on the disorder), the brain is "bottom heavy"…

“I’m Triggered.”

https://www.youtube.com/watch?v=ycu0LSggqvU

Neuroscience of Resilience



In various ways (depending on the disorder), the brain is "bottom heavy"…

Neural Networks and Connections

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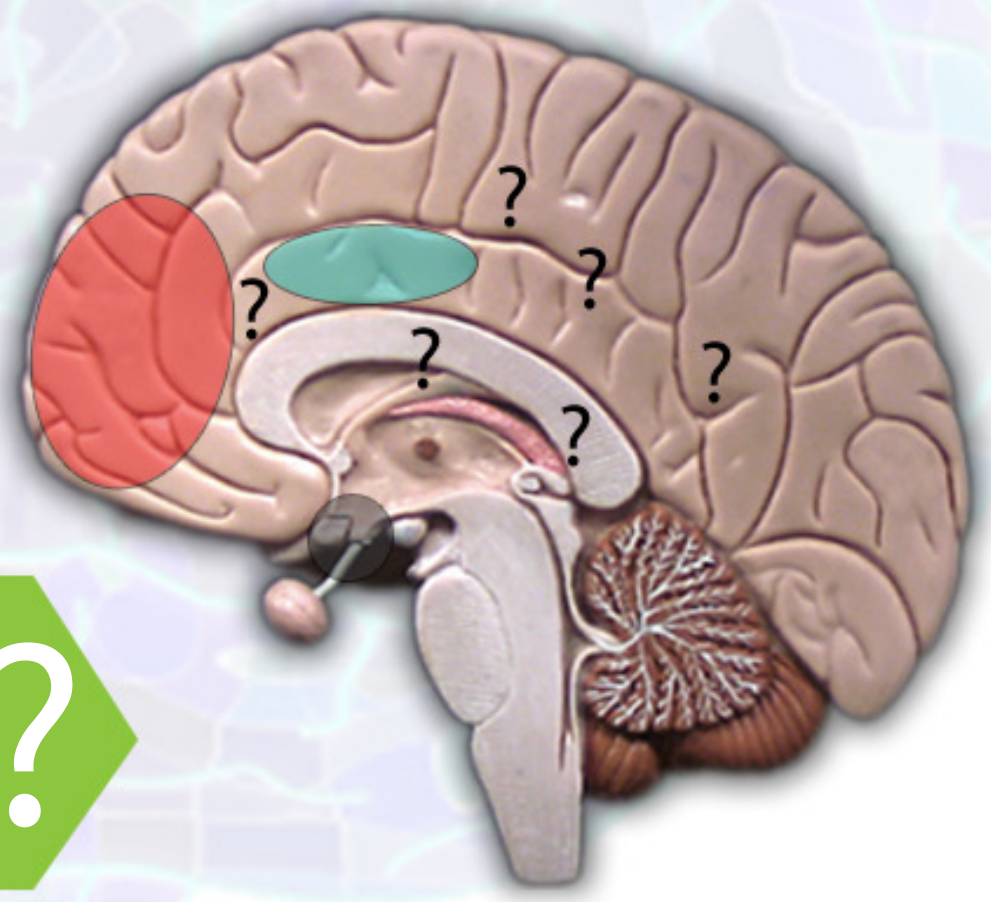
Question:



What do healthy neural connections look like?

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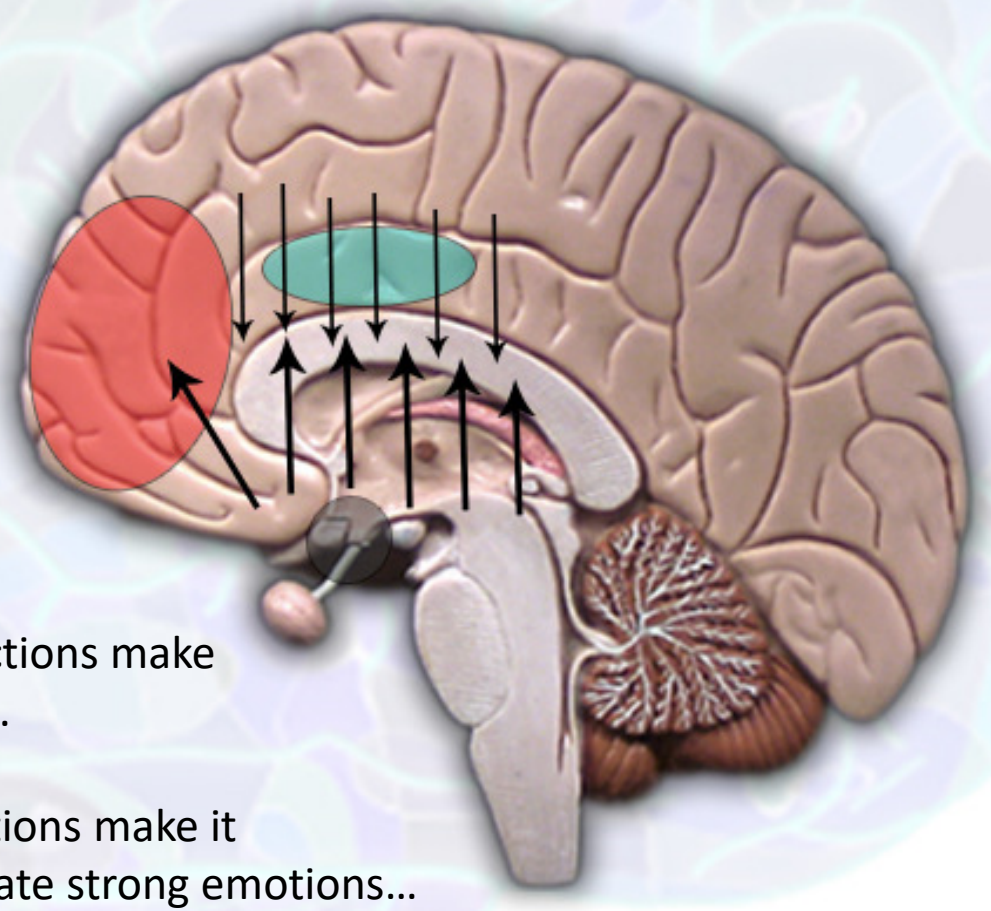
Answer:

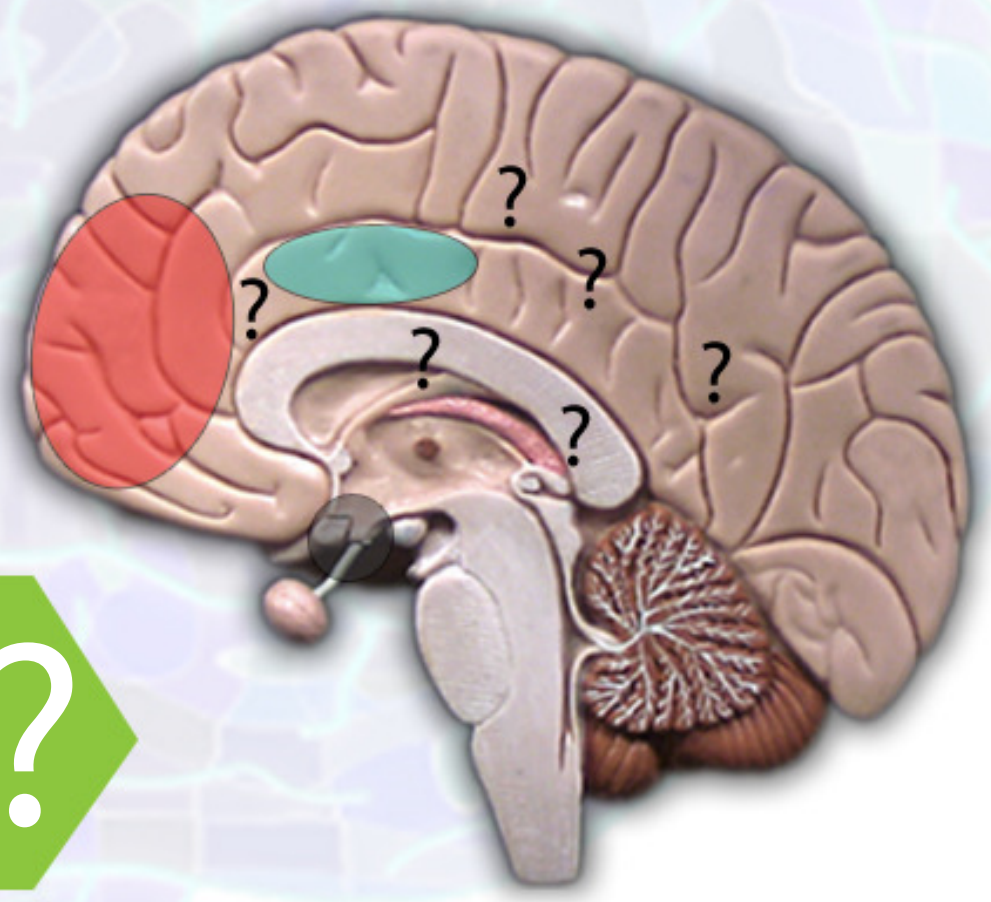
Answer:



Strong afferent connections make us reactive, impulsive…

Weak efferent connections make it difficult to down-regulate strong emotions…

Question:



What do resilient neural connections look like?

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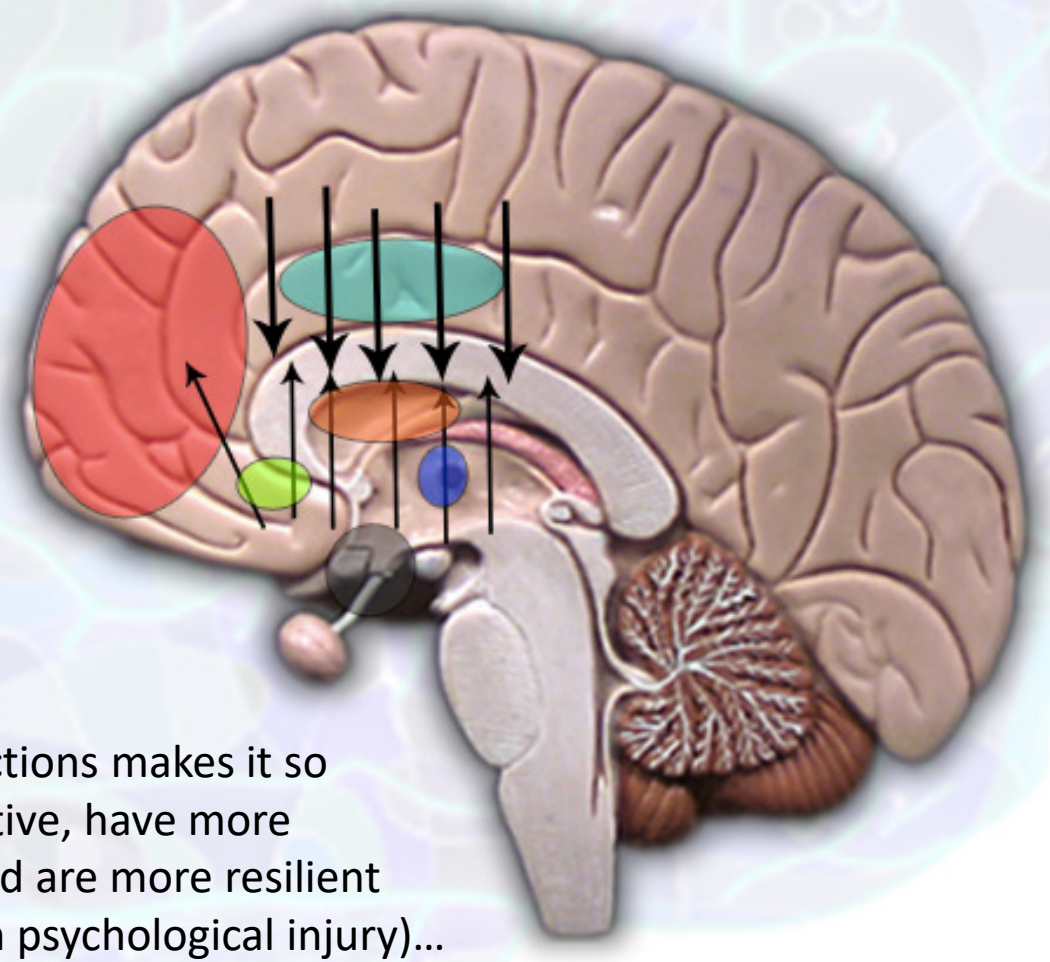
Neuroscience of Resilience



Reversing the connections makes it so that we are less reactive, have more presence of mind, and are more resilient (can better cope with psychological injury)…

Cognitive Control Network

Active during focused attention and cognitive control, such as when we…

- Are engrossed in an activity requiring mental effort
- Are paying attention to the present moment
- Problem-solve
- Set goals
- Make decisions

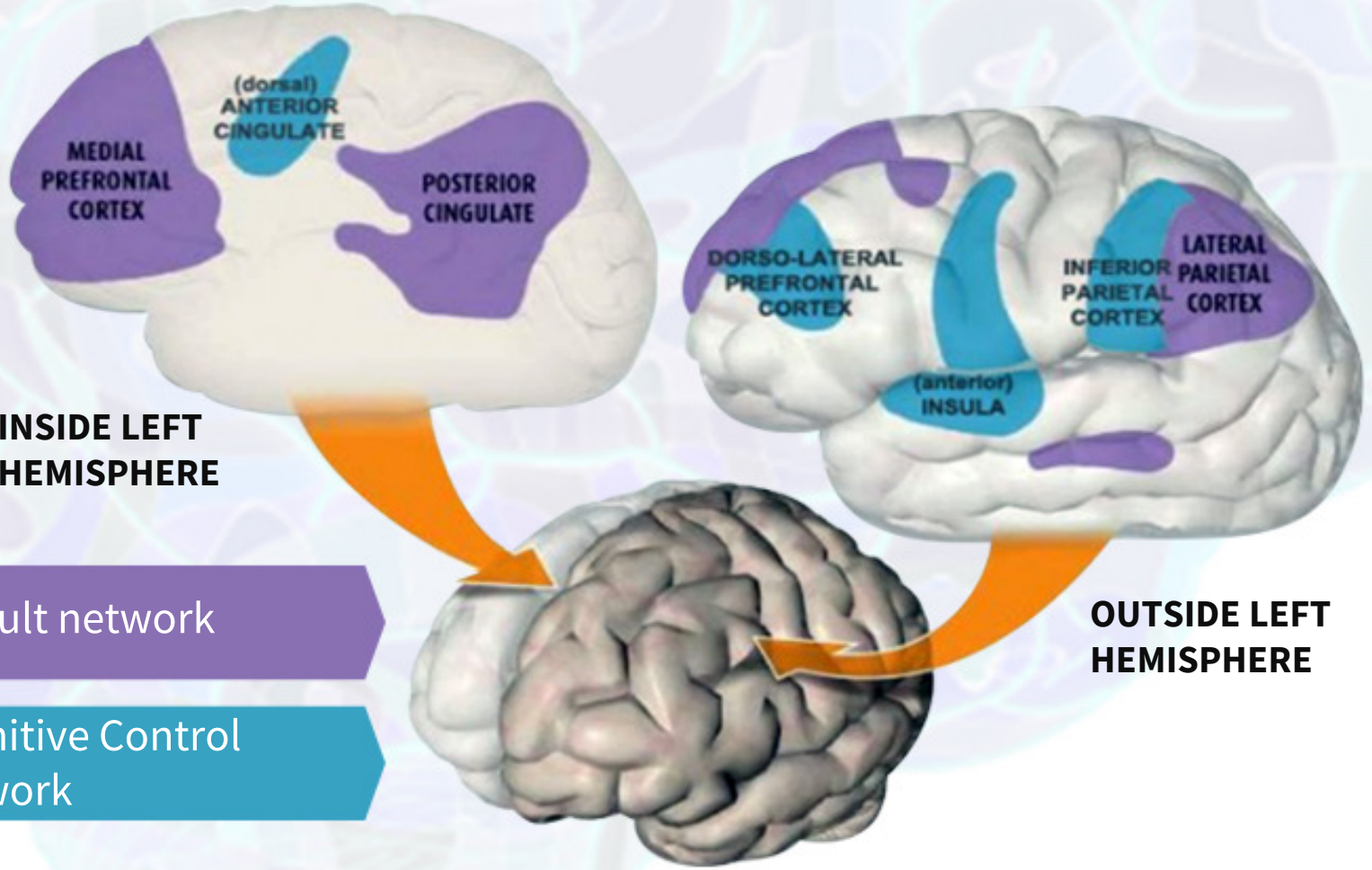
Default Mode Network

Active during times when we are not exerting effortful cognitive control. Our "default state" or "neutral state," such as when we…

- Daydream
- Are between being awake and asleep
- Spontaneously remember things from the past (as opposed to effortful recall)
- Think about ourselves
- Drive mindlessly

Areas of the Networks

When you switch off, a distinct network of brain areas not involved in focused attention bursts into action



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Clinical Relevance of the Networks

Neuroplasticity, or brain change, depends in large part on activating the Cognitive Control Network.

Change occurs when the brain is alert and engaged. This state releases in the brain the neurochemicals needed for brain change.

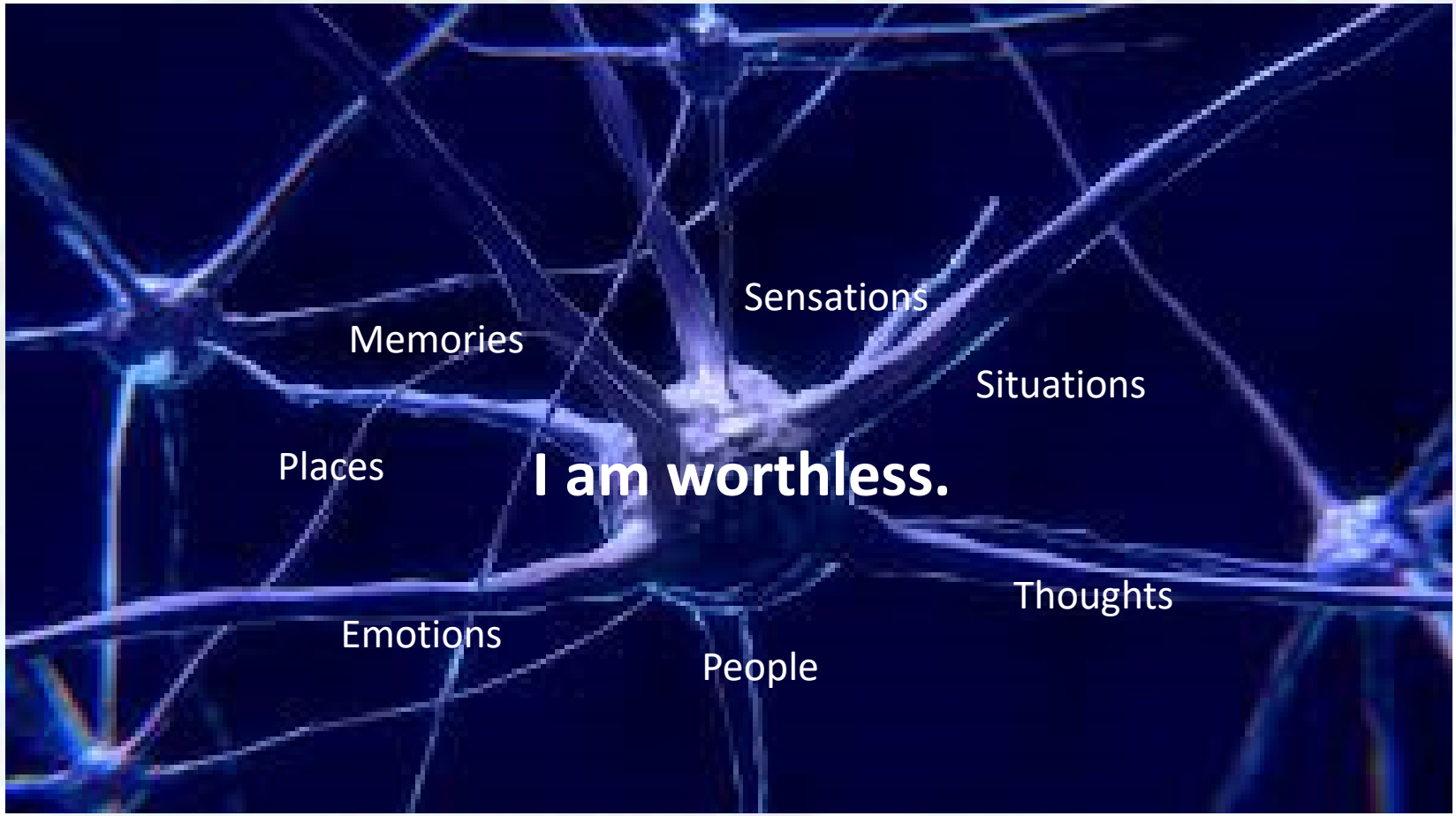
When disengaged or inattentive, or doing something without thinking, your neuroplastic switches will turn off.

The more engaged you are in a task and the harder you are trying, the more brain change occurs.

This means that, for therapy purposes, we want clients to be in the Cognitive Control Network

Neural Networks

Neural Networks



Rules of Neuroplasticity

1. Neurons that fire together wire together (Hebb's Rule, 1949)
2. Use it or lose it.
3. You have to activate a network to change it.
4. Your attention is the network you're in.
5. State to Trait: Repetition and effort promotes brain change.
6. Brain change is active, not passive.

What does therapy aim to change?

- **Activations**
  - Increase some…
  - Decrease others…
- **Connections and pathways**
  - Strengthen some…
  - Weaken others…
- **Networks**
  - Activate/de-activate
  - Shift them…
  - Loosen them…
  - Integrate them…

Brain-Changing Interventions

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Three Types of Interventions

1. **Bottom-up interventions:**
   Working with the body/going through the body to change the brain

2. **Top-down processing:**
   Working with the mind/going through the mind to change the brain

3. **Horizontal processing:**
   Working across hemispheres or across sensory modalities

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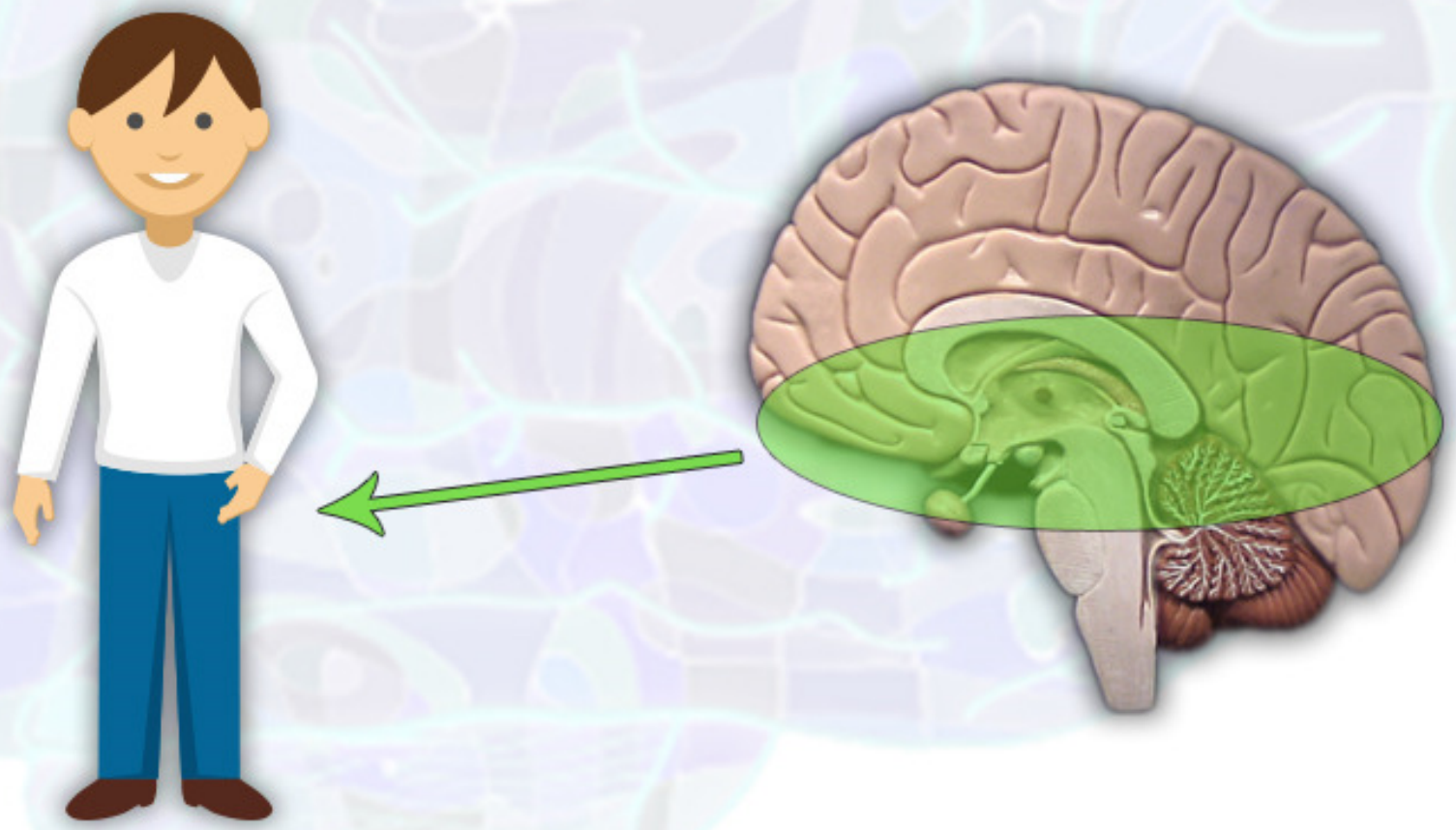
Bottom-up Interventions

Going through the body/senses to change the brain (especially the lower parts of the brain)



Bottom-up Interventions

01 Sensory awareness or exposure techniques

02 Interoceptive awareness or exposure techniques

03 Proprioceptive awareness or exposure techniques

04 Yoga

05 Qigong

06 Diaphragmatic breathing

07 Body scan

08 Progressive muscle relaxation

09 Autogenic training (both bottom-up and top-down)

10 Exercise

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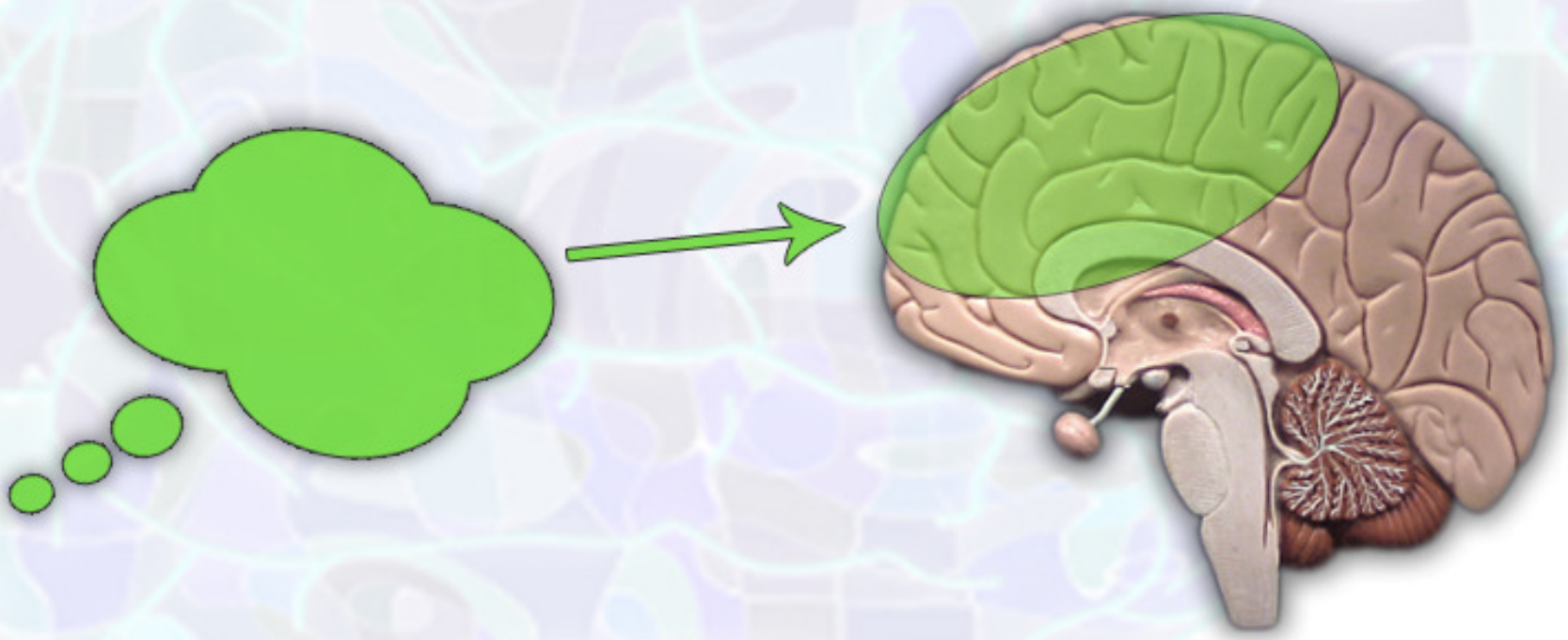
Top-down Interventions

Using the mind (thoughts) to change the brain (usually the upper parts of the brain)



Top-down Interventions

- Cognitive restructuring/ reappraisal
- Autogenic training (both bottom-up and top-down)
- Acceptance and Commitment Therapy cognitive exercises
- Talk therapy
- Open monitoring meditations
- Assertiveness training, communication techniques
- Focus/concentration meditations
- Many evidence-based interventions

Horizontal Interventions

1. Processing across modalities or hemispheres
2. Art and music therapies
3. Sensory Integration
4. EMDR

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Question:

Part I:

When do you think horizontal interventions might be most helpful to a client?

Question:

Part I:

Should we start with top-down approaches or bottom-up approaches with our clients? ….. And why?

?

Answer:

1. **Bottom-up** for most disorders, since most disorders contain a stress component. When stress is involved the amygdala becomes overactive, and it then suppresses activation of the “thinking area” of the brain.

2. When the PFC is underactive it becomes extremely difficult to engage in top-down interventions (such as cognitive therapy) with success.

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Five-Phase Neuropsychotherapy Treatment Roadmap

1. Develop therapeutic alliance (bottom-up)
2. Develop “felt sense”(bottom-up)
3. Reduce subcortical activations (bottom-up/top-down)
4. Increase cortical activations (top-down)
5. Alter brain connectivity (bottom-up/top-down)

Brain Profiles of Common Disorders

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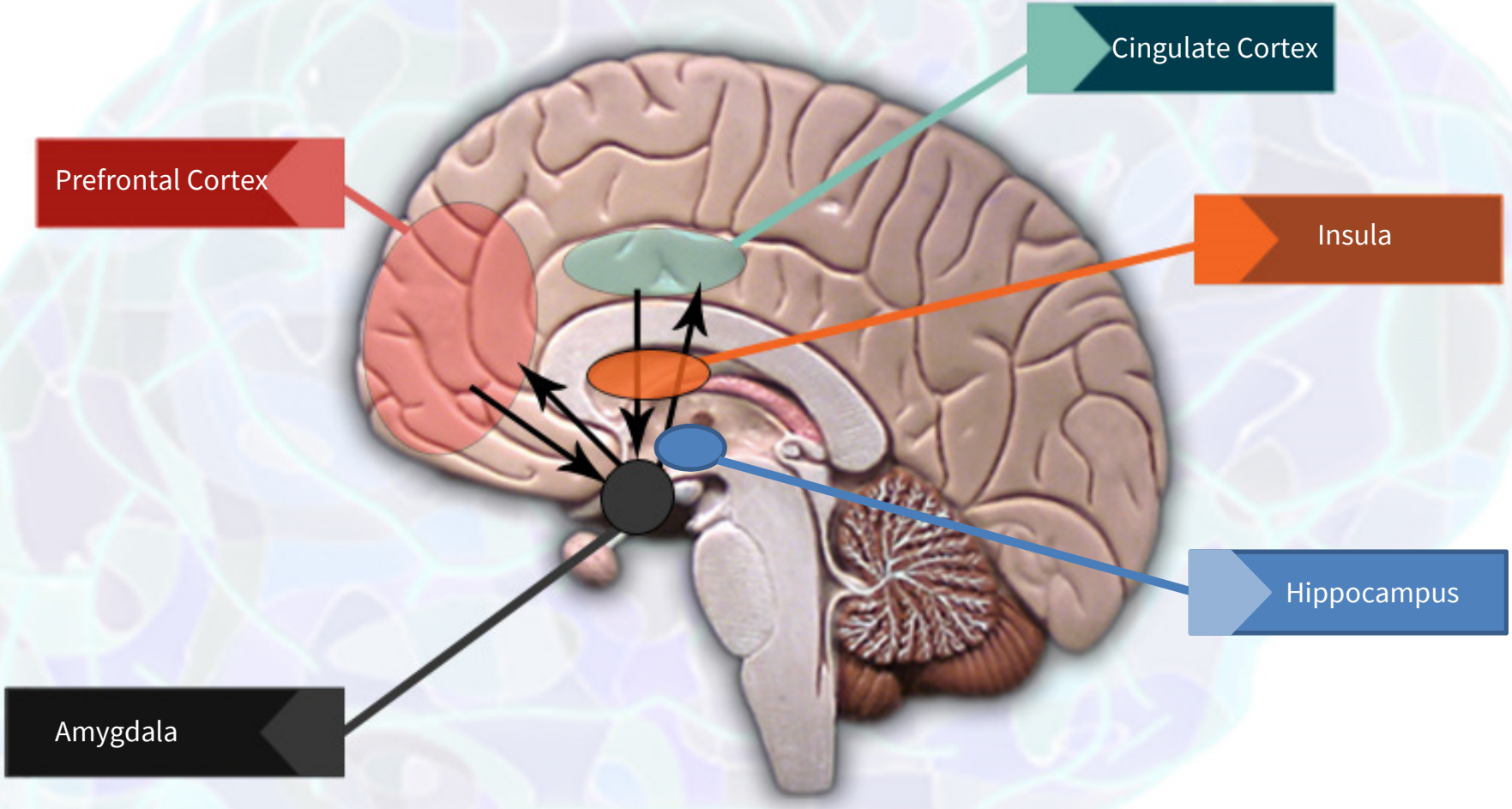
The Neuroscience of Anxiety and Trauma



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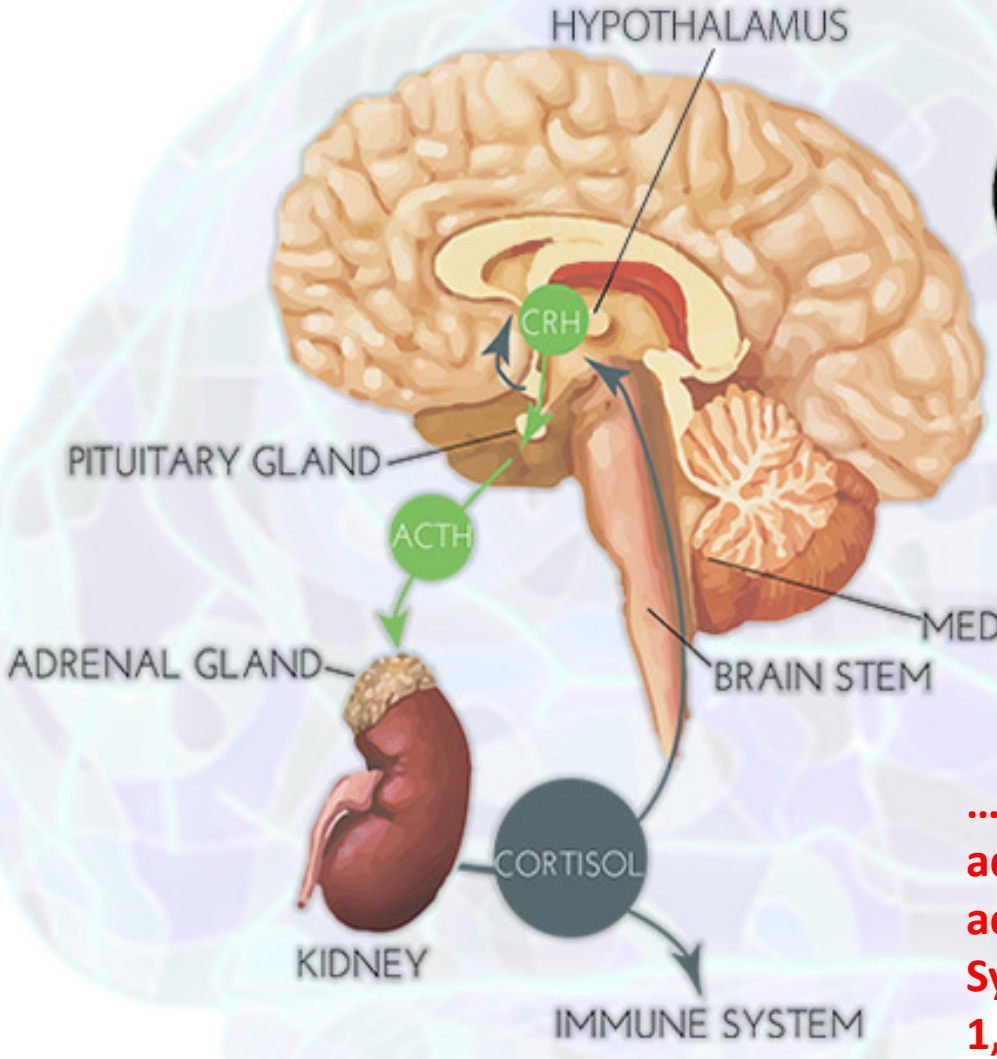
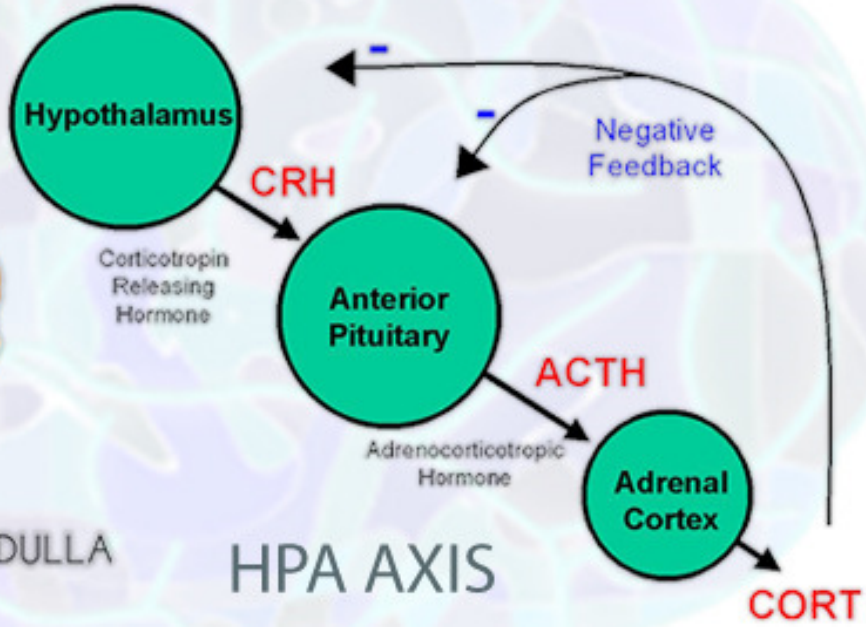
Stress Response System

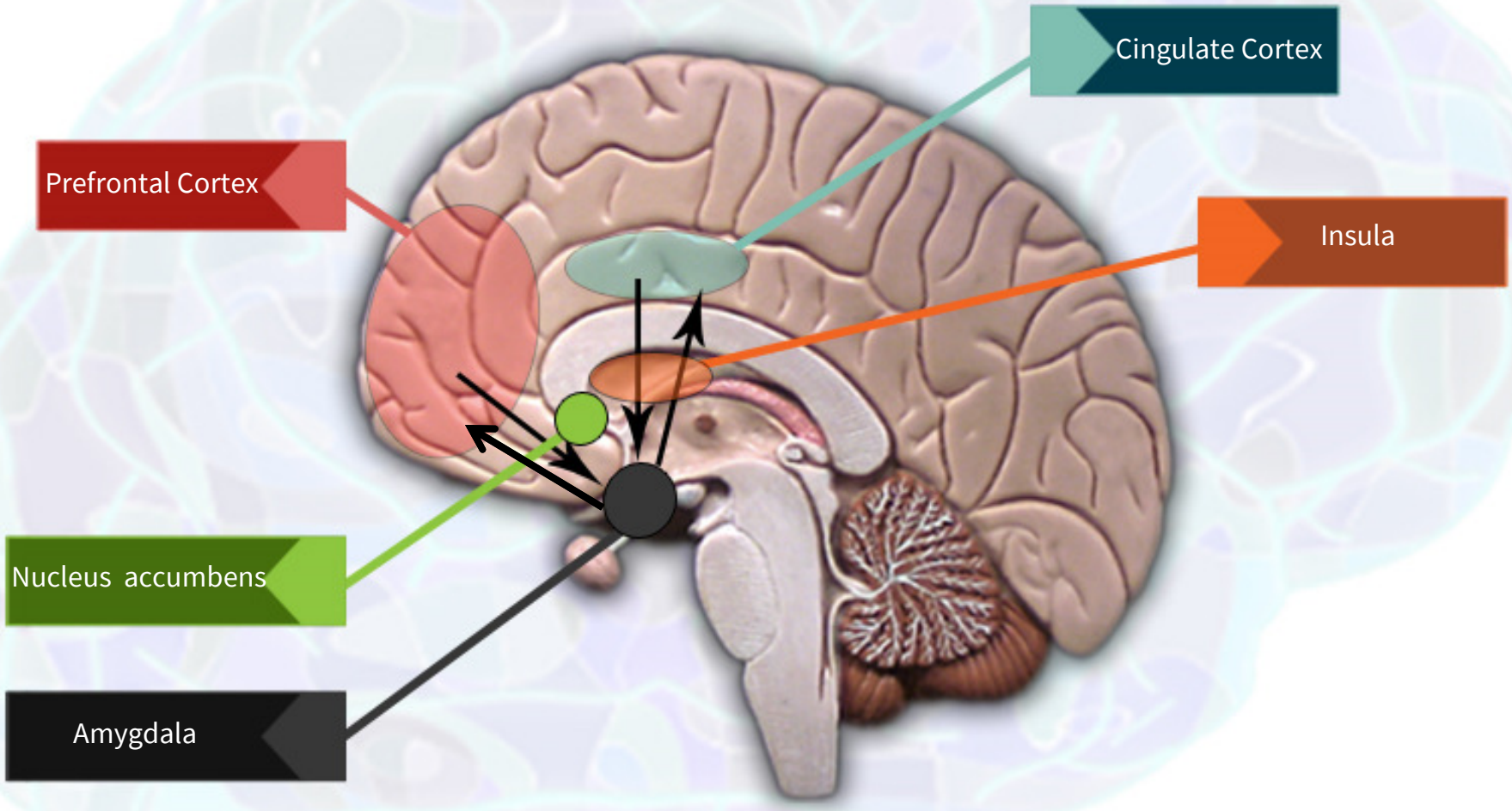
…Amygdala tells hypothalamus to start the Stress Response System (HPA Axis)…





…Hypothalamus activates pituitary, then adrenals… At this point the body activates the Sympathetic Nervous System (see next slide), resulting in 1,400 chemical reactions!

The Neuroscience of Addiction



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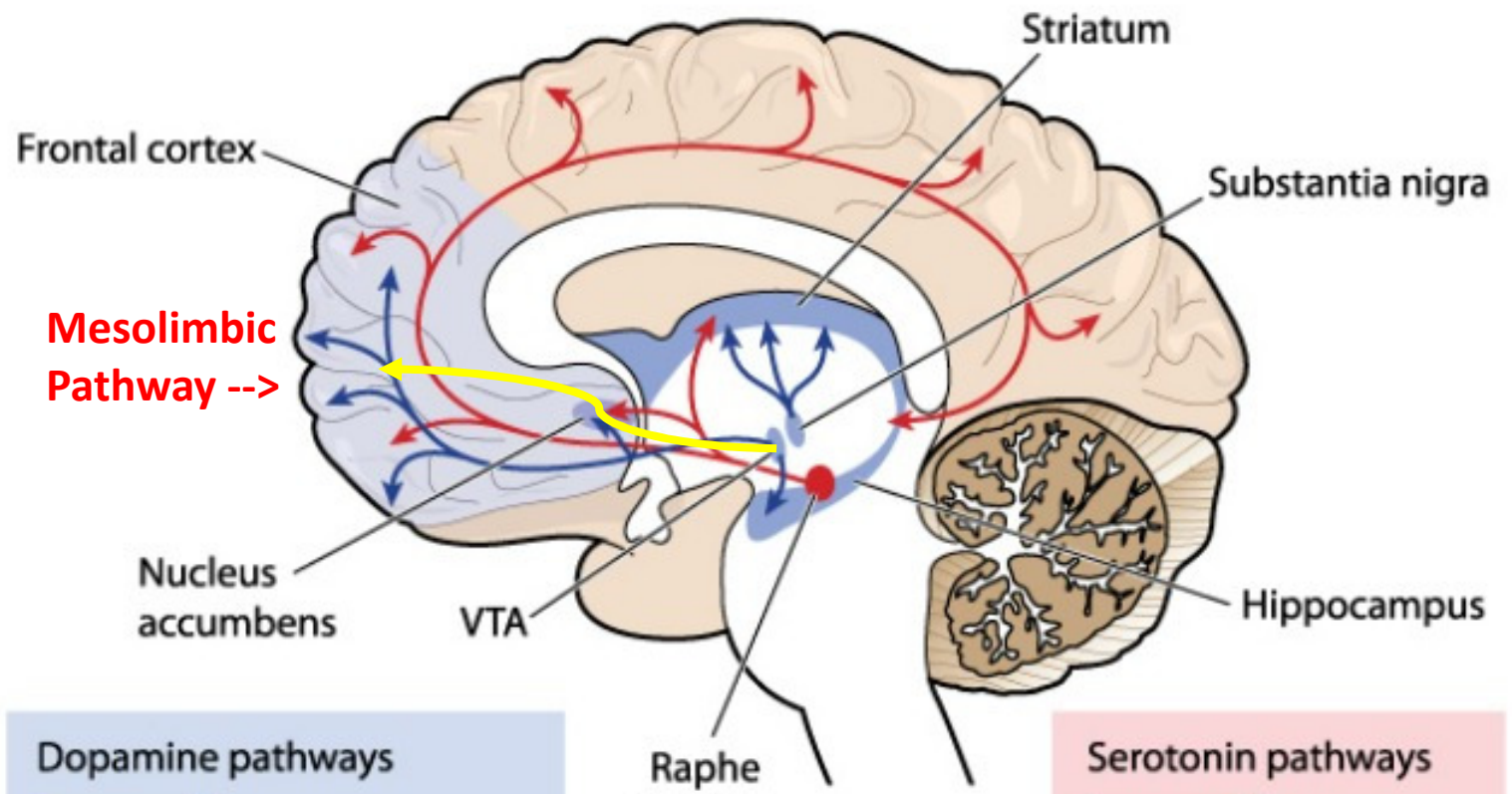
Reward System



Dopamine pathways

Functions

- Reward (motivation)
- Pleasure, euphoria
- Motor function (fine tuning)
- Compulsion
- Perseveration

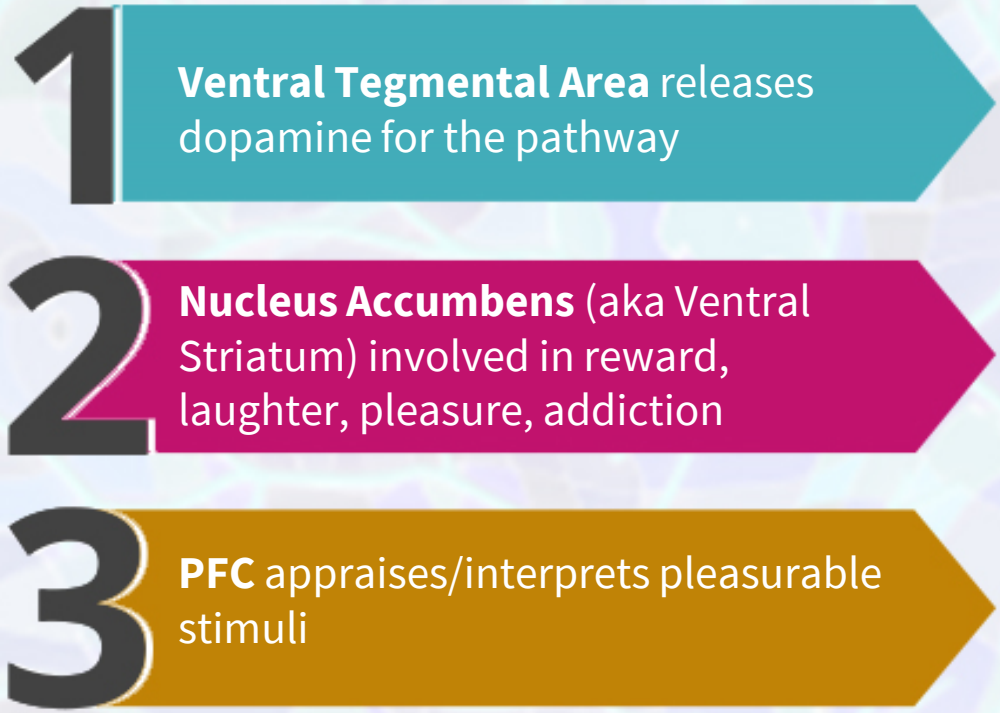
Serotonin pathways

Functions

- Mood
- Memory processing
- Sleep
- Cognition

Reward Pathway

Mesolimbic Pathway (Dopaminergic Pathway): Involved in reward, pleasure, addiction. Three areas:



Other reward circuits are also involved in reward and pleasure, but also habit formation and motivation.

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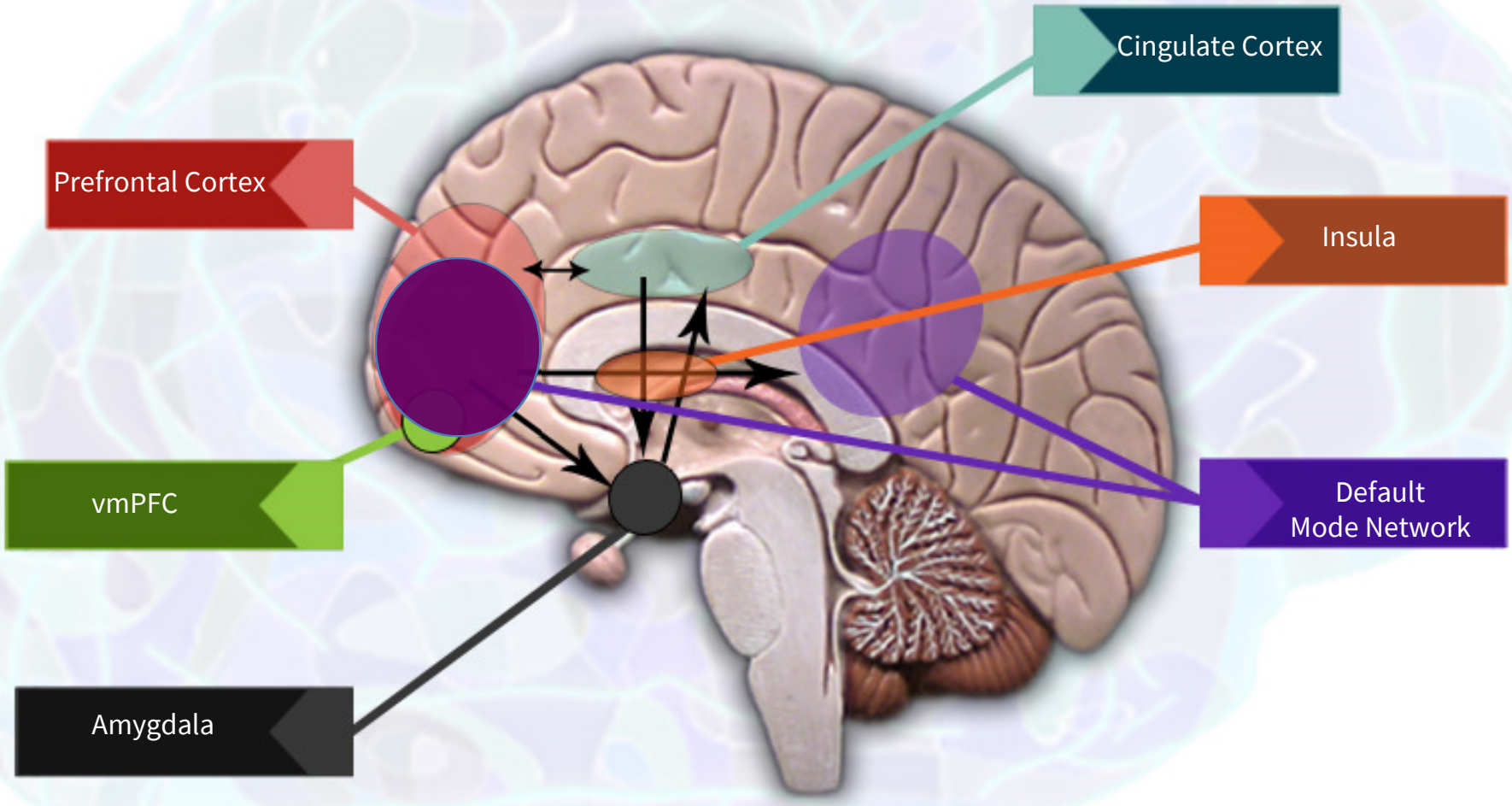
The Neuroscience of Depression



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Titration and Pendulation

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What does therapy aim to change?

- **Activations**
  - Increase some…
  - Decrease others…
- **Connections and pathways**
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- **Networks**
  - Activate/de-activate them…
  - Shift them…
  - Loosen them…
  - Integrate them…

And how do we do it??...

How to change?

Intentional dysregulation and re-regulation!

(But too much too fast can be counterproductive.)

Incorporating Pendulation and Titration

- Emotion induction is a “pendulation” strategy which builds emotion-regulation skills.
- Pendulation is the movement between regulation and dysregulation. The client is helped to move to a state where he or she is dysregulated, and then iteratively helped to return to a state of regulation.
- “Titration” allows the client to experience small amounts of the event's distress at a time in order to release the stored energy and allow their nervous system to return to balance.

Science of Pendulation

1. Slightly increase amygdalar activation (titration/pendulation)
2. Help client re-regulate. Ex: Working through the body (utilizing the breath), send signals up to the amygdala to calm down….

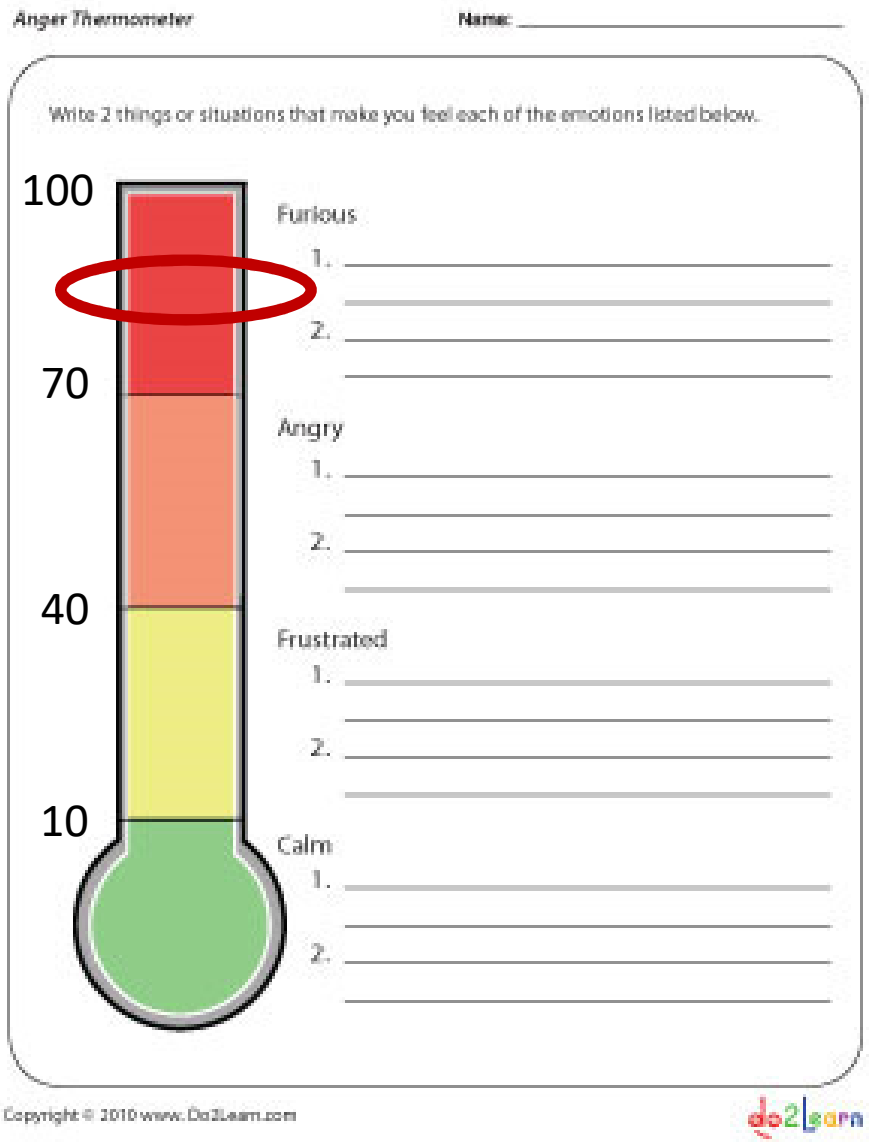
- The breathing/body activates the parasympathetic nervous system and disarms the amygdala.
- When you are able to reduce amydalar activation after a stressor, you have successfully regulated emotion and reversed the stress response.
- You feel more in control, and able to manage overwhelming emotions.

Distress Thermometer

- Staying stabilized, within “degrees of freedom” (DoF) is critical.
- Leaving DoF leads to dissociation or “losing your mind” (amygdalar hijacking)
- Distress thermometer = 1-100, where 1 is no distress and 100 is the worst possible distress
- Want to identify approximate upper and lower limits of distress thermometer (“boiling point” and “freezing point” if applicable)
- Checking in with “temperature” increases “dual awareness,” which is when the client can both experience and observe a phenomenon at the same time.
- **Dual awareness can reduce feelings of guilt, blame, and shame.**

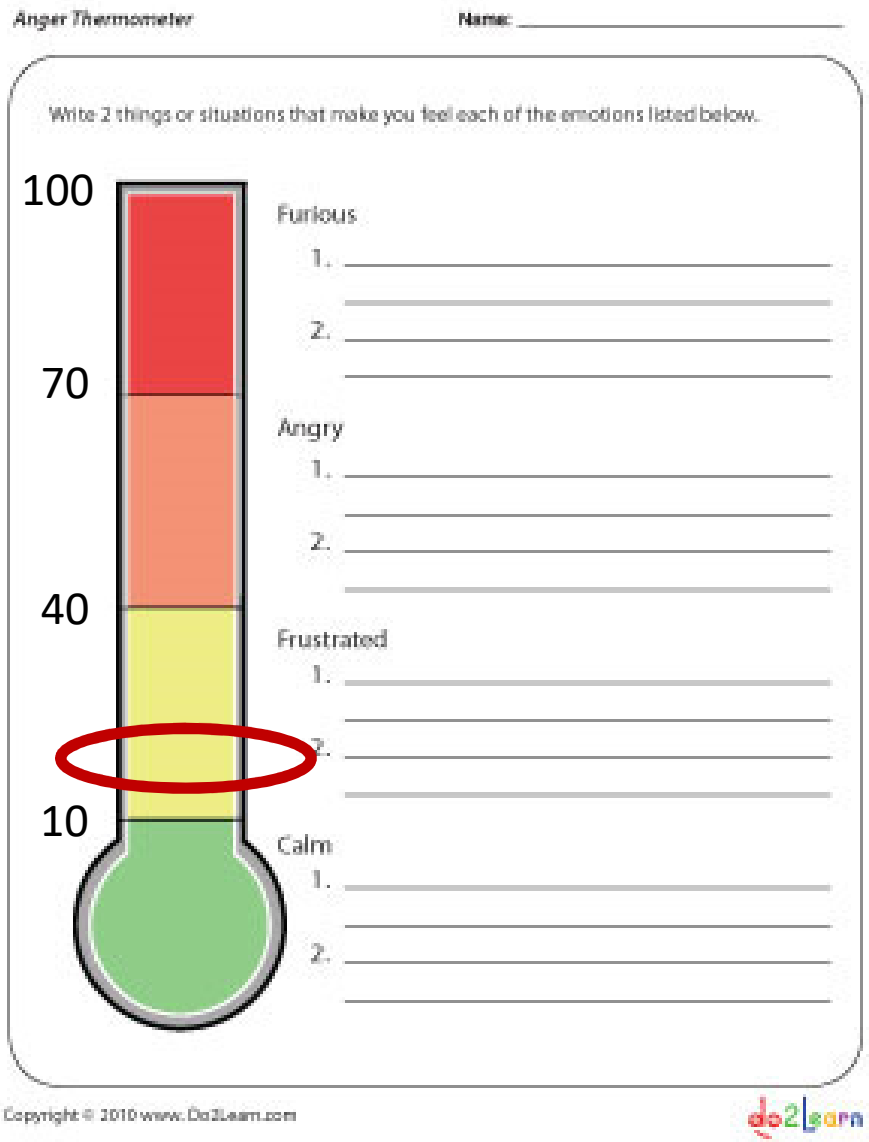
Distress Thermometer

- Ask, *"Do you have a sense of where your own 'boiling point' is, the point at which you feel overwhelmed or out of control?"*
- *Define the upward "anchor" as an example of this.*



Distress Thermometer

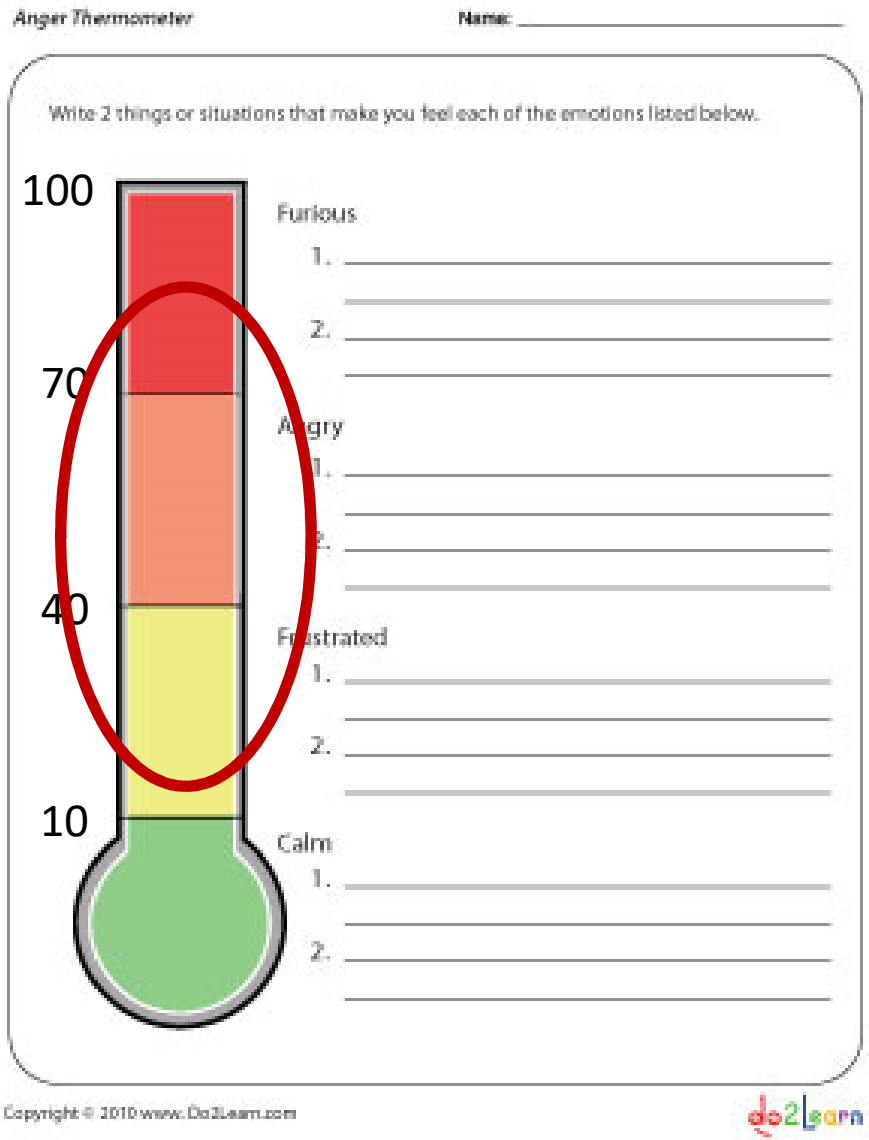
- Ask, *"Do you have a sense of where your own 'freezing point' is, the point at which you feel disconnected, dissociated, or frozen?"*
- *Define the downward "anchor" as an example of this.*



Distress Thermometer

– Between these points is your “Degrees of Freedom”

- *This is where therapy is done!*
- ***Resourcing is needed when the boiling or freezing points are approached.***



Phase I: Develop Therapeutic Alliance

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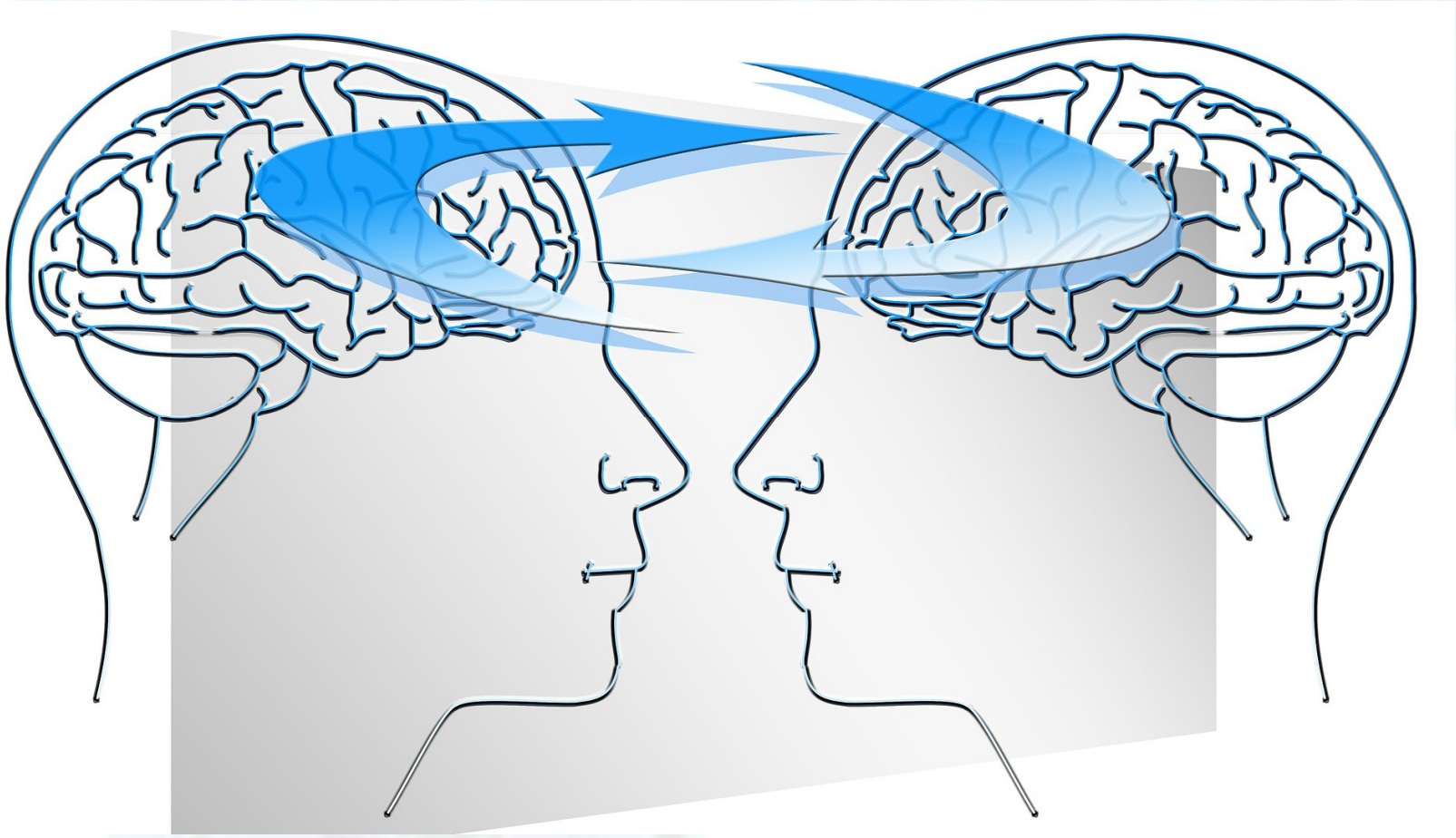
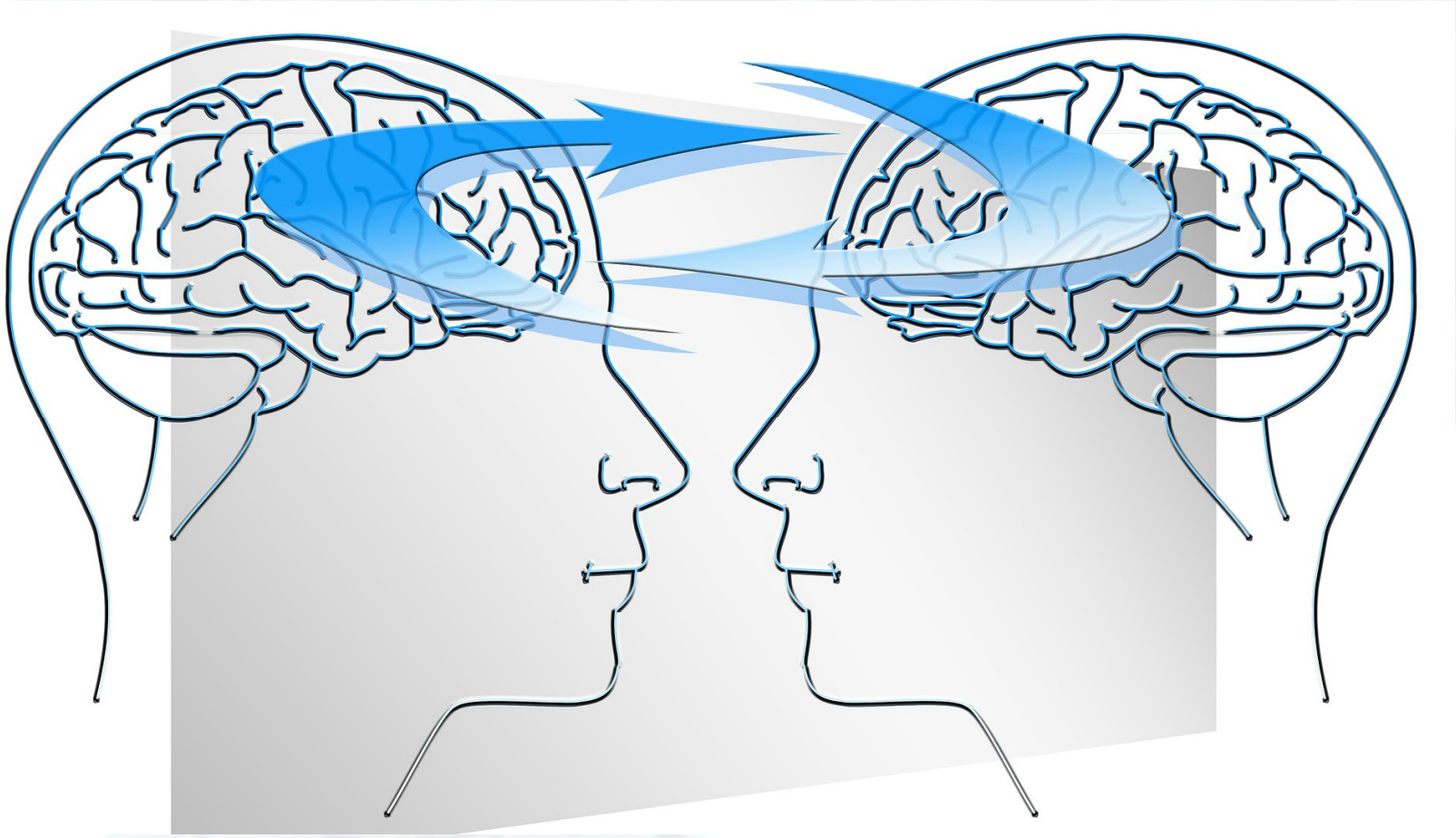
Phase I: Develop Alliance

- Therapeutic alliance = Bottom-up approach to therapy
- The therapeutic alliance accounts for between 15-50% of the outcome variance (depending on which studies you believe).
- Various bodies of research indicate that *brains can interact with and influence other brains*…
  - Brain waves align when people make eye contact and "attune"
  - Mothers can soothe infants and reduce their cortisol by focusing on them using their PFC (through eye contact and touch)

What is the mechanism?



What is the mechanism? MIRROR NEURONS!



Discovery of Mirror Neurons

- Mirror Neuron Hypothesis: There is a link between particular neurons in our own brain and other people's actions.
- Dual action: Brain contains a system of neurons that fire in response to the intentional actions of others, and when we perform those actions (Gallese, Fadiga, Fogassi, & Rizzolatti, 1996).
- Emotional centers also have mirror-like qualities (Singer et al., 2004)

Implications of Mirror Neurons

- Mirror neurons are the neural mechanism of the therapeutic alliance.
- They allow clients to have a different, (hopefully) reparative *experience* in therapy.
- Clients can, through this alliance, re-learn and heal attachment.
- **The therapeutic alliance remains the MOST important "approach" or "technique" you will use with a client.**

Mirror Neurons

- Activate mirror neurons
  - Eye contact/listening
  - Mirroring
  - Following
- Monitor Transference/Countertransference
  - Somatic and cognitive/emotional countertransference
- Recalibrate Boundaries
  - Too rigid = not enough merging
  - Too loose = too much merging

Social Medicine is Real!

- Connection with others – "social medicine":
  - Reduces cardiovascular reactivity (Lepore, et al, 1993)
  - Reduces blood pressure (Spitzer, et al, 1992)
  - Reduces vulnerability to catching a cold (Cohen, et al, 2003)
  - Reduces anxiety (Cohen, 2004)
  - Slows cognitive decline (Bassuk, et al 1999)
  - Improves sleep (Cohen, 2004)
  - Improves depression (Russell & Cutrona, 1991)
  - Reduces cortisol levels (Kiecolt-Glaser, et al, 1984)

The chemical side…

Oxytocin vs. Cortisol

https://www.ted.com/talks/kelly_mcgonigal_how_to_make_stress_your_friend/transcript?language=en

"Your biological stress response is nudging you to tell someone how you feel, instead of bottling it up."

Mirroring Exercise

Rethinking transference and countertransference

- Transference, countertransference, projective identification – these contain useful clinical information!
- Goal is therapeutic mirror neuron activation/merging, through boundary calibration and recalibration.

Phase II: Develop “Felt Sense”

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Five-Phase Neuropsychotherapy Treatment Roadmap

1. Develop therapeutic alliance (bottom-up)
2. Develop "felt sense"(bottom-up)
3. Reduce subcortical activations (bottom-up/top-down)
4. Increase cortical activations (top-down)
5. Alter brain connectivity (bottom-up/top-down)

Anchoring Into the Present (Outside-In)

Connect with three surfaces and notice how they feel different from one another. Notice temperature, texture, etc. Can be done with touch, smell, sound, taste, sight.

Grounding exercises
Sensory awareness techniques
Interoceptive exposure

Research Support

1. Improved cognitive control and pain management (Gard et al., 2012).
2. Improved attention and concentration (Malinowski, 2013).
3. Increased insula and dACC activation (Critchley, Wiens, Rotshtein, Ohman, & Dolan, 2004).

Distress in the Body (Inside-In)

Slowly, safely connect with the body; can start with a body scan for this and identify “safe” or “strong areas (for resourcing)

Inquire about distress in the body, both at “baseline” and when stressed. See handout for example questions!

Interoceptive Exposure (Inside-In)

Evidence-informed technique that helps traumatized individuals build interoceptive awareness by connecting external movement and sensations with internal experiences.

This is primarily done by physically connecting with the breath and heartbeat using the hands.

Research Support

1. Improved self-regulation and sense of well-being (Herbert & Pollatos, 2012; Gu & Fitzgerald, 2014).
2. Improved emotional balance (Seth, 2013).
3. Increased ability to be in the present moment and to focus (Seth et al., 2011).
4. Improved ability to sustain attention (Bishop, Lau, Shapiro, Carlson, Anderson, Carmody, et al., 2004).
5. Increased dACC and insula activation (Critchley, Wiens, Rotshtein, Ohman, and Dolan, 2004).

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Phase III: Reduce Subcortical Activation

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Mindful Breathing: Diaphragmatic Breathing

"Mindful breathing is a technique whereby individuals direct their awareness and attention to their breath, and to any sensations that arise (Kabat-Zinn, 1990)."

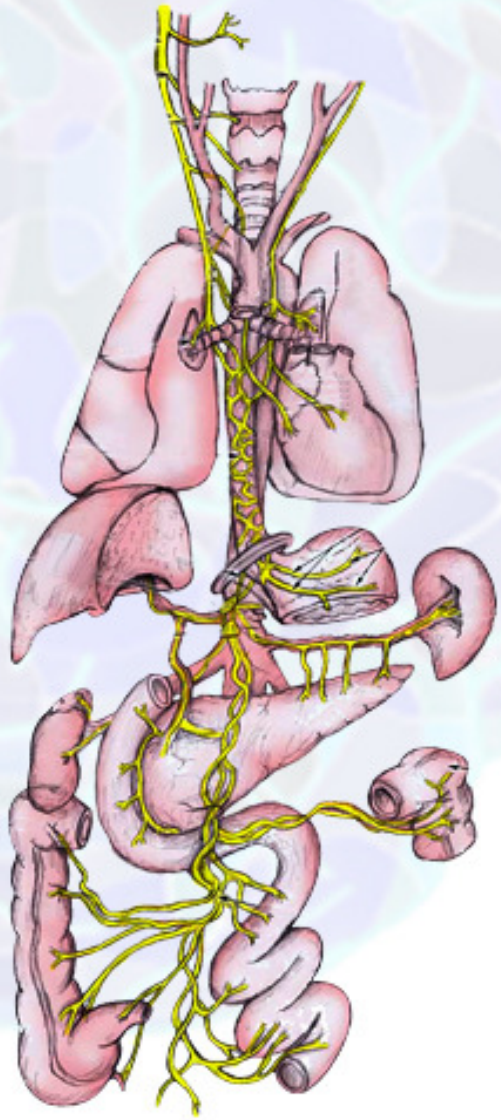
Breathing techniques are recommended for anxiety management (Davis et al., 2008) due to their ability to reduce autonomic arousal and amygdalar activity.

Techniques can be open or closed, and are largely bottom-up.

BUT, for breathing exercises to work we need to breathe through our diaphragm!

Mindful Breathing: Vagus Nerve

1. 10th cranial nerve
2. Activates the PNS
3. Depends on acetylcholine to function
4. Relaxes you and reduces inflammation
5. Stimulated through diaphragmatic breathing!



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Mindful Breathing: Vagus Nerve

1. Wonder woman pose
2. La-Z-Boy pose
3. Sit on your hands
4. Halasana (and other yoga poses)

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5-5-8-2 Breath

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Research Support

Focused Breathing Exercises…

1. Reduce sympathetic nervous system arousal (“fight or flight”; Hazlett-Stevens & Craske, 2009) and stress (Christakis et al., 2012)
2. Reduce anxiety in athletes (Omoluabi, 1994), panic disorder (Haxlett-Stevens & Craske, 2009), etc.
3. Improve emotion regulation (Arch & Craske, 2006).
4. Thicken/strengthen the PFC (Lazar et al., 2005)
5. Increases heart rate variability (Ma et al., 2017; Kulur et al., 2009)
6. Reduce insular reactivity (Paul et al., 2002)

Tense and Release

Progressive Muscle Relaxation (PMR) is a concentration, bottom-up mindfulness technique whereby individuals tense and release major muscle groups, one at a time (McCallie, Blum, & Hood, 2008).

The goal is to learn to identify, regulate, and release muscle tension, in addition to psychological tension (Manzoni et al., 2008).

Tense muscle groups at approx 40% intensity for 7 seconds, then relax for 10 seconds.

Follow this practice with Conditioned Relaxation, wherein muscle groups are assigned numbers and the participant counts backward, systematically relaxing the muscles that correspond to each number.

Research Support

1. Increases HRV, reduces cardiovascular indices of stress (Green, 2011)
2. Normalizes cortisol levels (Dolbier & Rush, 2012)
3. Reduces depression (Lolack et al., 2008), anxiety (Chen et al., 2009)
4. Medium/large effect sizes for generalized anxiety and panic (Manzoni et al., 2008).
5. Reduces headaches (Sanjiv & Apurva, 2014)

Autogenic Training

Mindfulness technique where person focuses on selected sensations (Gonzalez de Riviera, 1997) in order to achieve psychophysiological relaxation (Stetter & Kupper, 2002).

Autogenic training improves self-regulatory capacities and trains individuals to modify the functioning of their autonomic nervous system by repeating a sequence of statements about warm and heavy sensations felt throughout the body.

Redirects blood flow to promote relaxation, instead of tension/anxiety.

Research Support

1. Increases heart rate variability and improves vagal heart control (Lim & Kim, 2014; Miu, Heilman, & Miclea, 2009), thereby reducing individuals' level of stress and anxiety
2. Reduces anxiety and insomnia (e.g., Bowden, Lorenc, & Robinson, 2012; Dhiman & Harneet, 2010)
3. Improves self-monitoring and self-regulation (e.g., Shinozaki et al., 2010;Yagi & Sakairi, 2009)
4. Increases insula activation and self-awareness (Schlamann, Naglatzki, de Greiff, Forsting, and Gizewski, 2010)

Phase IV: Activate Cortical Structures

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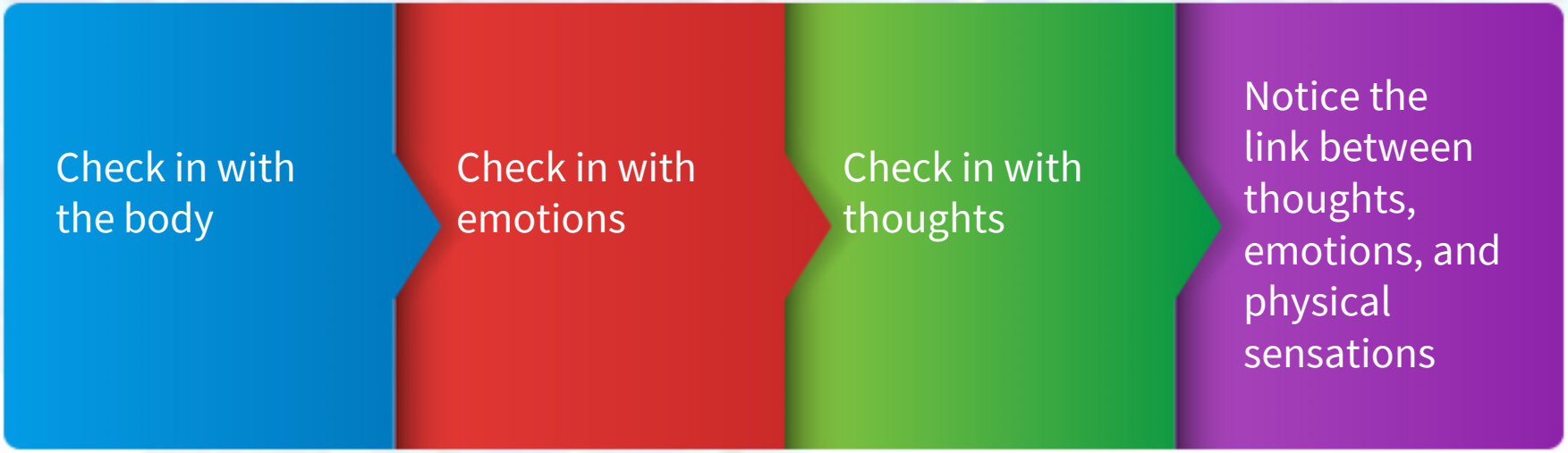
Integrated Systems Check

- An open awareness, bottom-up AND top down meditation in which the person "checks in" with their thoughts, emotions, body, and breath
- Can be done in 3 minutes, or 30 minutes

Four steps:



Resource Meditation

Locate an area of the body that feels “resourced” (strong, safe, etc.)

Maintain focus on this area, noticing its sensations, with eyes closed or open and focusing on some static object.

Alternate this focus with attention to the breath.

Research Support

Meditations…

1. Enhance cognitive abilities (Xion & Doraiswamy, 2009)
2. Improve empathy (Fulton, 2005; Zha- piro & Izett, 2008).
3. Reduce stress and anxiety (Chiesa & Seretti, 2009; Hofmann et al., 2010)
4. Increased activation of PFC and ACC (Fox et al., 2014)
5. Reduces amygdalar activation (Taren, Creswell, & Gianaros, 2013)

Remembering Your Past Self

Describe a recent disappointing or distressing event that you feel anxious or upset about.

Note emotions related to this event, and what the mind tells you about how you will be impacted by it.

Now, recall your life 5 years ago, and stressors you had at that time. Are they still part of your daily life? Did they resolve?

Third Person Perspective

Brief, 21-minute cognitive reappraisal (writing) intervention developed as an emotion regulation strategy

The individual “reappraises” an event or conflict that has elicited negative emotions

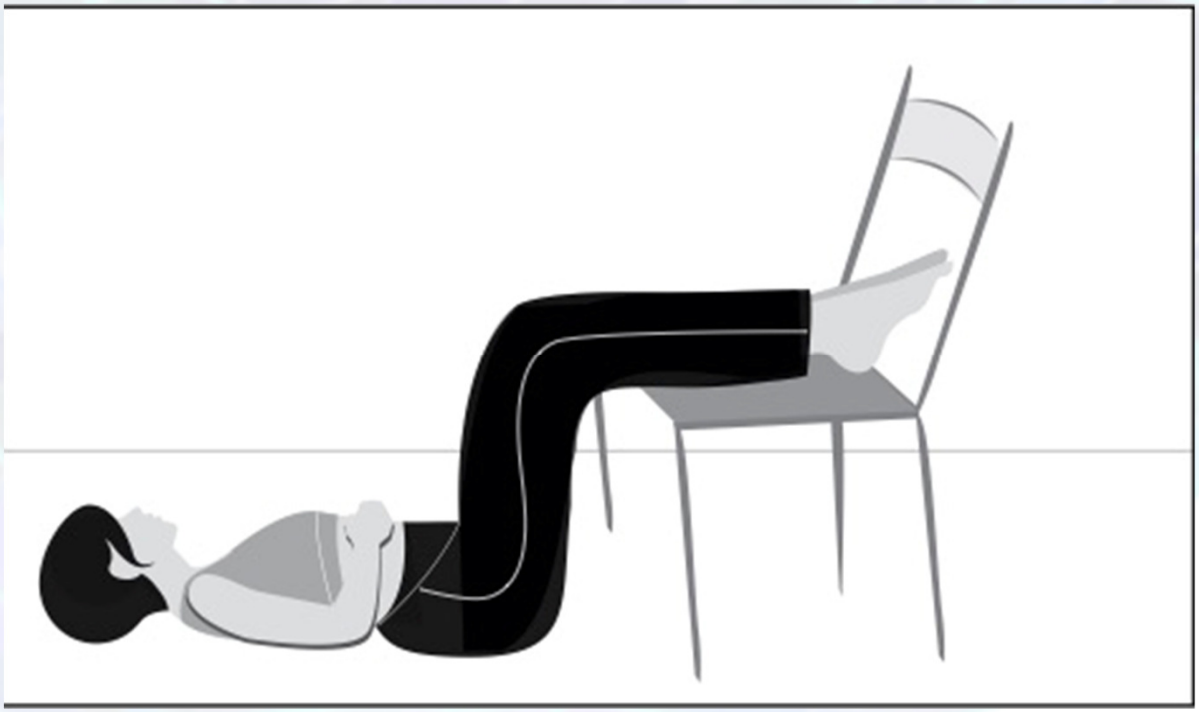
Reappraised conflict can be one that occurred in a romantic relationship, but can also be applied to other contexts

Reappraisal interventions…

- Improve marital quality, reduce conflict distress (Finkel et al., 2013)
- Activate areas of PFC implicated in emotion regulation (Bastiaansen et a., 2018; Ruby & Decety, 2004)
- Activate dorsal ACC, which is implicated in emotion regulation and managing response tendencies (Ochsner & Feldman Barrett, 2001; Zilverstand et a., 2017)
- Elicit activation of both ACC/PFC, which work together to facilitate self-regulation: ACC determines level of response conflict and need for control, while PFC executes regulation process (Botvinick et al., 2001)

Getting Creative – Combining Bottom-Up and Top-Down

Psoas Relaxation:



Phase V: Alter Brain Connectivity

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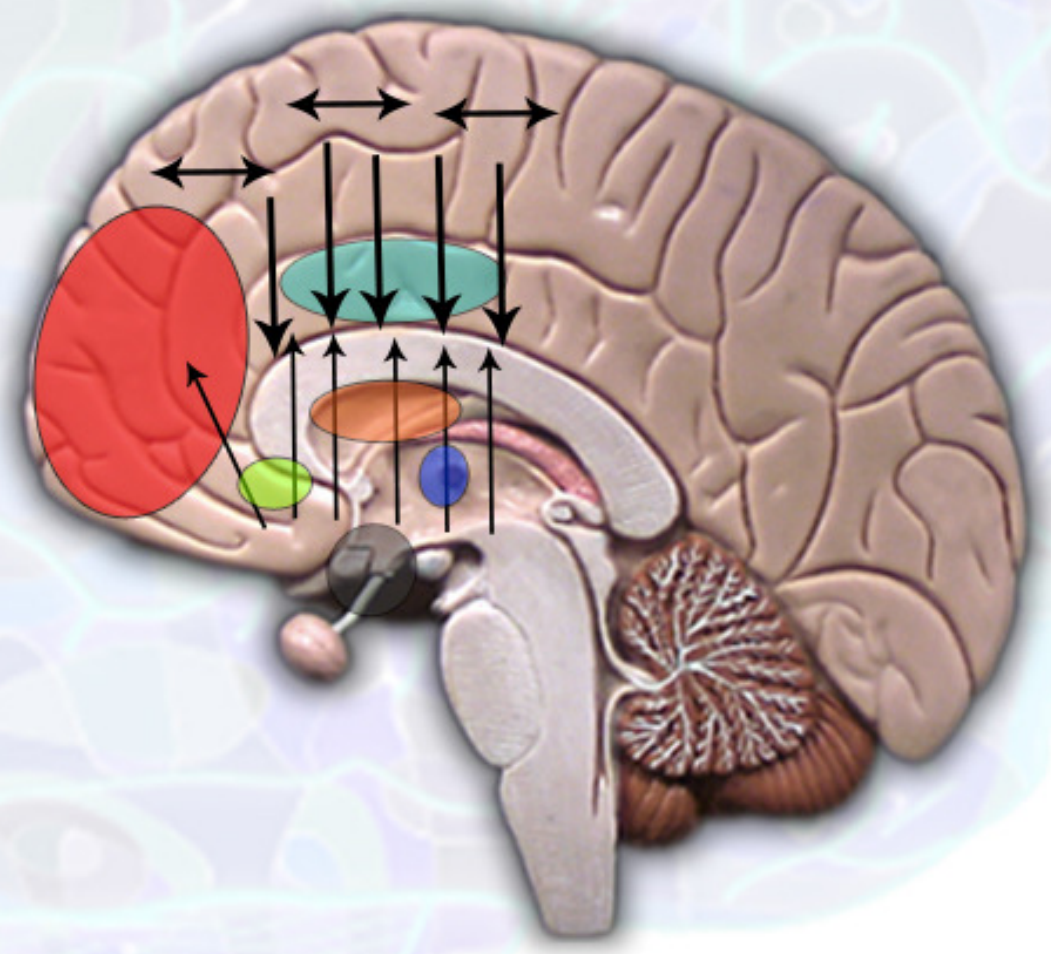
Neuroscience of Resilience



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Build Resilience

Meditations

Transcendental (C)
Mindfulness (O)
Loving Kindness (C)
Mindful Check-In (O)

Breathing

Four Count Breath (C)
Bhastrika (O)
Ujjayi (O)
Square Breath (C)
Diaphragmatic (O/C)

Body-Based

Autogenic Training (C)
Progressive Muscle (C)
Sensory Awareness (O/C)

Movement-Based

Yoga (O/C)
Tai Chi (O)
Qigong (O)

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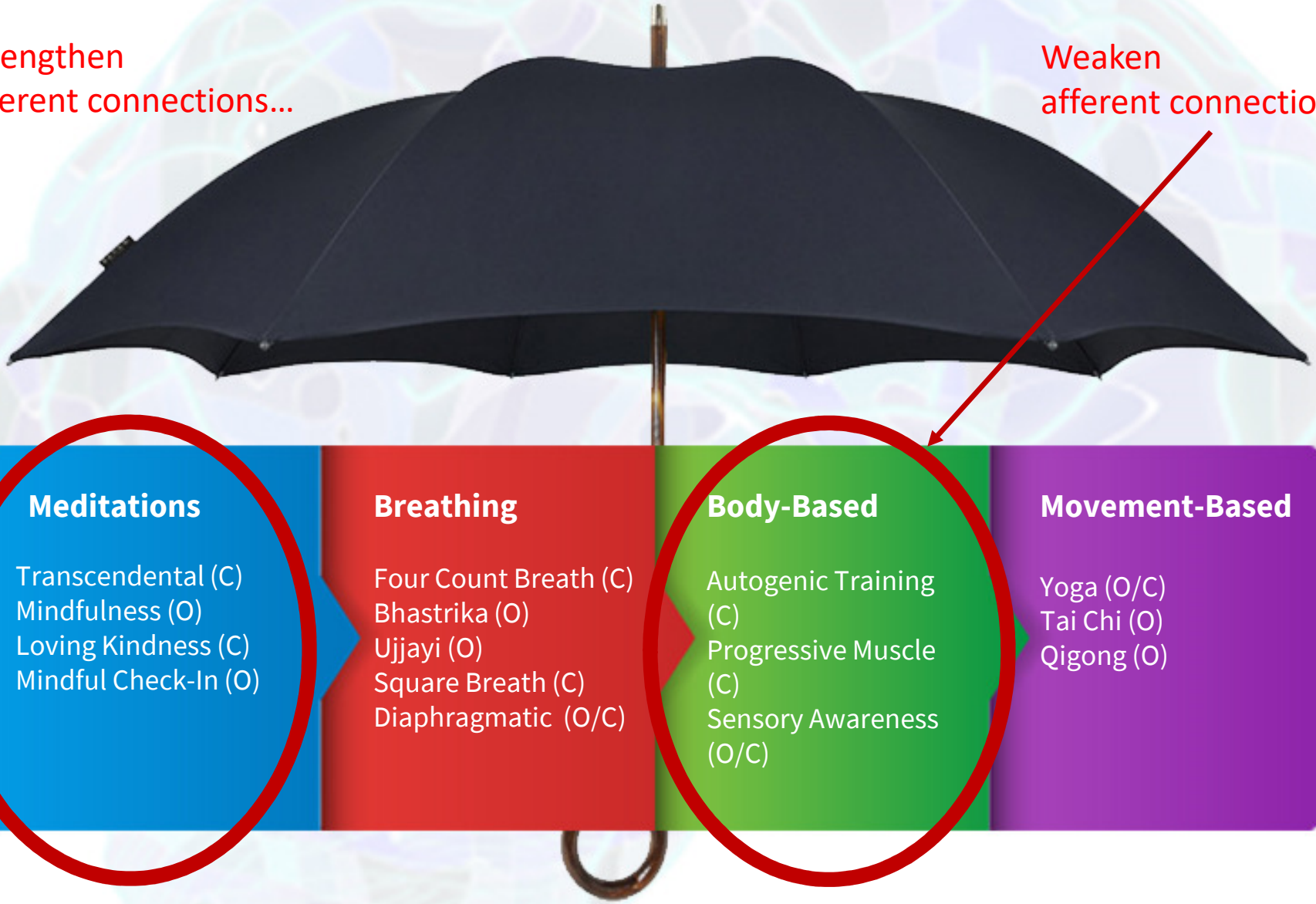
Build Resilience

Strengthen
efferent connections...

Weaken
afferent connections...



Meditations

Transcendental (C)
Mindfulness (O)
Loving Kindness (C)
Mindful Check-In (O)

Breathing

Four Count Breath (C)
Bhastrika (O)
Ujjayi (O)
Square Breath (C)
Diaphragmatic (O/C)

Body-Based

Autogenic Training (C)
Progressive Muscle (C)
Sensory Awareness (O/C)

Movement-Based

Yoga (O/C)
Tai Chi (O)
Qigong (O)

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Trauma Treatment Toolbox can be
Found on Australian Amazon!
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Thank you!
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