What Does the Brain Have to Do With Recovery??

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Conflict of Interest

• Mary D Moller is on the Speaker’s Bureau for Alkermes and Otsuka Pharmaceuticals.
• There will be no off-label discussions.

Purpose of This Workshop

Through the introduction of unique way to label significant parts of the brain, participants will learn a fun, new approach to understanding the key structures and functions of the brain.

By viewing and discussing brain scans that depict the neurobiological differences in the brains of individuals living with schizophrenia, bipolar disorder, obsessive-compulsive disorder, panic disorder, major depression, and PTSD, participants will gain a deeper appreciation of the daily struggles facing the clients we serve.
Learning Outcomes

- At the completion of this workshop the participant will:
  1. Describe the key brain structures significant in the recovery process
  2. Discuss the relationship of brain function to overall recovery

Information Processing Systems

1. The low road
   a. Brainstem
   b. Thalamus
   c. Basal ganglia
   d. Amygdala

2. The middle road
   a. Hippocampus
   b. Hypothalamus
   c. Cingulate

3. The high road
   a. Frontal
   b. Pre-frontal
   c. Temporal
   d. Parietal
   e. Occipital
The Low Road To Information Processing

Thalamus: Hal the Computer

Basal Ganglia: “Get us outta here”

Amygdala: “Uh-Oh!! Amy is our safety monitor”

The Low Road--The Brain Stem 'The Traffic Cop'

- Stop-Look-Listen
- Responsible for eye movement
- Coordinates visual and auditory reflexes
- Source of dopamine, norepinephrine and serotonin
- Orienting response
Effects of Psychosis on the Brain Stem

- Over-development of midbrain functions result in
  - Anxiety
  - Impulsivity
  - Poor affect regulation
  - Motor hyperactivity

Thalamus: 'Hal the Computer'

- Processes and distributes almost all sensory and motor information going to the cerebral cortex.
- Regulates and integrates levels of awareness and emotional aspects of sensory experiences through a wide variety of effects on the cortex—initiates the autonomic and endorphin cascades.

Thalamus: 'Hal the Computer'

- Enables us to have impressions of the agreeableness or disagreeableness of a sensation—is it safe? If so, stimulus moves through the brain.
- Monitors sensory input and acts as relay station for nearly all sensory and motor information by connecting cerebral cortex, basal ganglia, hypothalamus, and brain stem.
**Thalamus**

- Responsible for generating different kinds of 'brain rhythms' that correspond with different cognitive states such as wakefulness and sleep.

**Effects of Thalamus on Psychosis**

- Difficulty integrating the emotional aspects of sensory stimuli
- Hyper/hyposensitivity to pain
- Unable to differentiate if something is pleasurable or not
- Difficulty staying present

**Amygdala:**

- Involved in all emotions, especially anxiety and fear
- Core emotions of happy, sad, mad, and afraid are unmodulated and occur without conscious control
- Coordinates actions of the autonomic and endocrine systems
- Functions as a 'safety monitor'
Amygdala: Effects of psychosis

- Over/under response to anxiety
- Unable to learn from mistakes of the past—unconscious memories are stored here as raw data prior to myelination
- Everyday events that cause anxiety seem like they are brand new—results in impulsiveness due to transmitting an immediate experience of pain if not modulated by reflective function of forebrain

Amygdala: Effects of psychosis

- Unable to discern what to do with incoming sensory stimuli—body is unreliable in giving cues and clues
- Due to feedback loop, affects memory of declarative nature—Yogi Berra—I wouldn’t have seen it if I hadn’t believed it!
Basal Ganglia: 'The Bee Gee’s’

- Located at the base of each hemisphere.
- Receive input from all four lobes of the cortex, thalamus, and substantia nigra but only have output (efferent projections) to the frontal cortex via the thalamus.
- Major activities include the planning of movement and all cognitive functions.

Basal Ganglia

- Disorders of affect
- Disorders of cognition
- Inability to complete information processing circuits with thalamus and cortex
- Obsessive-compulsive behaviors
**Hypothalamus: Effects of psychosis**

- Decreases response of glucocorticoid receptors—atrophy of dendritic tree
- Eating disorders
- Disorders of pituitary hormone secretions
- Disorders of emotional expression
- Abnormal sleep/wake cycle
- Disorders of sexual function/behavior

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**Hypothalamus Dysfunction: Treatment**

- Teach conscious regulation of survival functions
- Teach to self-monitor survival functions
- Avoid pressure to perform

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**Cingulate: 'Mood Manager'**

- Sometimes called the limbic lobe
- Located just under the frontal lobe cortex
- Plays a major role in working memory
- Serves as a bridge between the cortex, thalamus, hypothalamus, and hippocampus, this secondarily affects the amygdala
- Reacts when people make mistakes or perform poorly
- Registers gains and losses
The High Road to Information Processing

- Cortex: "Corporate Offices"
- Parietal lobes: "Secretary"
- Frontal lobes: "Boss/CEO"
- Pre-frontal lobes: "Board of Directors"
- Temporal lobes: "Intercom system"
- Occipital lobes: "Surveillance system"
- Insula lobes: "Identity, salience, prosody"

Corpus Callosum 'Holes'

- Difficulty with transferring information between right and left hemispheres
- Disconnect between emotions and logical thinking
- Behavior either emotional or logical without emotion
- Threat to safety triggers emotional response
- Alexithymia
Reductions in Size of Middle Portions of Corpus Collosum Documented in:

- Borderline personality disorder
- Depression
- Panic disorder
- Post-traumatic stress disorder
- Dissociative symptoms
- Memory impairments
- Alexithymia

Alexithymia

- Describe feelings with facts rather than emotions
- Difficulty differentiating emotions from bodily sensations
- Inability to differentiate between emotions or express feelings
- Act impulsively rather than thinking
- Inappropriate relations with others

Disorders With Co-existing Alexithymia

- Eating Disorders
- Borderline Personality Disorder
- Abuse/trauma
- Substance abuse
- AIDS
- Panic Attacks
- Marked Depression
- PTSD
- Fibromyalgia
Cortex: 'Corporate Offices'

- Interpreting sensory and motor stimuli
- Processing sensory and motor stimuli
- Integrating sensory and motor functions.
- Controlling sensory, motor, and motivational systems
- Modulates emotions coming from thalamus, amygdala, hippocampus

Frontal Lobes: 'The CEO'

- Responsible for judgment, decision making, and problem solving
- Right frontal lobe is associated more with nonverbal communication and functions
- Left frontal lobe is associated with verbal functions and controls motor aspects of speech.

Effects of Frontal Lobes: psychosis

- Inappropriate or uninhibited behavior
- Impulsiveness: inability to evaluate and control emotions, judgment, and conduct
- Emotional impoverishment
- Irritability; lability
- Lack of motivation
- Difficulty with all cognitive functions
- Difficulty with abstract thinking
**Prefrontal Lobes:**

- ‘Board of Directors’
- Referred to as the association zone—it remembers where everything is stored!
- Integral in the ability to have cause and effect reasoning (cognitive behavior)
- Primarily concerned with motor skills--particularly in the planning of movements—it decides whether you are going to stay or leave when you are afraid.

**Prefrontal Lobes:**

- Effects of *psychosis*
- Difficulty with recognition of facial expressions
- Great difficulty in the ability to inhibit impulsive behaviors
- Concrete thinking
- Poor cause and effect reasoning

**Parietal Lobes:**

- ‘Secretary’
- Receive and organize sensory information from external and internal sources related to pain, temperature, pressure, and touch.
- Proprioception: knowing the relationship of the body to the environment
- Prioritizes and screens out what is extraneous
**Parietal Lobes:**

*Effects of psychosis*

- Body image disturbance
- Inability to recognize body parts
- **DENIAL OF ILLNESS: ANOSOGNOSIA**
- Impaired right/left orientation
- Loss of memory association
- Impaired spatial abilities
- Loss of the ability to visualize three dimensions

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**Temporal Lobes:**

*‘Intercom system’*

- Concerned with hearing, learning, complex memory, emotion, and reception of speech (usually the left temporal lobe).
- Sensory memory—the brief retention of sensory input while something is scanned, evaluated, and acted on or ignored.
- Musical ability.
- Control of sexual and aggressive drives.

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**Temporal Lobes:**

*‘Effects of Psychosis’*

- Alexithymia: lack of words to express emotions verbally
- Difficulty in using language to express self
- Difficulty understanding intended message
- Sexual inhibition affected
- Facial recognition decreased
Occipital Lobes: 'Surveillance System'

- Serve as both the primary and secondary sites for vision.
- Separate important visual information (foreground) from unimportant (background) information.

Occipital Lobes: Effects of psychosis

- Disturbed spatial orientation: difficulty with physical and environmental boundaries
- Visual illusions/hallucinations
- Simulated hysteria
- Loss of visual memory and object constancy
- Loss of visual speech (ability to understand the meanings of written words)

Significant News Network: SNN
Central Executive Network: CENEX

SNN=
- Right Anterior Insula: RAI
- Dorsal Anterior Cingulate: DACK

CENEX=
- Dorsal Lateral Orbital PFC: DORLA
- Lateral Parietal: LAPIERRE
Salience Network
(SNN-“Significant News Network”) (CENEX-“Central Executive Network”)

Prefrontal System
(a priori models, goals, plans)

Salience-Preps the Brain for Action


Salience Network
SNN = Significant News Network

- Lies deep in folds of cortex
- Anterior portion of limbic system
- Involved in conscious desires
- Decodes bodily states-capability to translate a bad odor into feeling of disgust/touch into feeling of delight
- Connects to several other areas
- Involved in assessment of whether or not to trust
- Integrates external stimuli with internal homeostatic context
- Marks objects that require further processing


Focus on the Insula

- Facial affect processing (temporal gyrus relays higher order visual information/
- Prosody-emotional aspects of speech
  - Variations in rhythm, stress, intonation
  - Occurs in the insula and the process is nonverbal (you can hear an argument behind doors and know it’s an argument without understanding words)
- Correlates with level of negative symptoms
- Pain processing
- Self vs Non-self
- Cholinergic dysfunction (increased smoking)

**Effects of Schizophrenia on Insula**

<table>
<thead>
<tr>
<th>Failure of Bottom-Up (Magnificent 7) Processes</th>
<th>Loss of Function with Medial Temporal Lobe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anhedonia</td>
<td>Doesn’t ‘switch off’ during cognitive tasks</td>
</tr>
<tr>
<td>Apathy</td>
<td>Default mode network (self-referential activities) impaired</td>
</tr>
<tr>
<td>Negative symptoms</td>
<td>Related to frontal insufficiency results in maladaptive paralimbic gating of executive system</td>
</tr>
<tr>
<td>Cognitive dysfunction</td>
<td></td>
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</tbody>
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**Sali\text{N}ce Network**

\textit{SNN} = Significant News Network

- Sometimes called limbic lobe
- Located under frontal lobe
- Major role in working memory
- Bridges cortex, thalamus, hypothalamus, hippocampus
- Secondary affects amygdala
- Reacts when people make mistakes or perform poorly
- Governs executive function and generates motor programs
  - Planning, maintain attention, problem solving, learning, retrieve remote memories, sequence temporal order of events, shift cognitive/behavioral sets


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**Cenex: Central Executive Network**

Dorsal Lateral PFC (DORLA)

Lateral Parietal Lobe (LAPIERRE)

- Governs executive function and generates motor programs
- Planning, maintain attention, problem solving, learning, retrieve remote memories, sequence temporal order of events, shift cognitive and behavioral sets
- Manipulation of information in working memory

**Cenex: Central Executive Network**

**Dorsal Lateral PFC (DORLA)**

**Lateral Parietal Lobe (LAPIERRE)**

- Anatomically interposed between anterior PFC, dorsolateral PFC, anterior cingulate, anterior insula, anterior inferior parietal cortex
- Mediates dorsal attention and hippocampal-cortical memory circuits
- Working memory
- Sustained attention
- Response selection/response inhibition

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**Cognitive Feedback Loop**

- Sensory input through thalamus to amygdala
- Amygdala to pre-frontal lobe to hippocampus
- Hippocampus to cortex
- Cortex back to amygdala
- Amygdala gives signals of safety or danger

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**Cognitive Feedback Loop Disrupted by psychosis**

- Sensory input through thalamus to amygdala
- Amygdala gives inaccurate signals of danger or safety
- Flight/flight response is triggered even when there is no danger (kindling effect)
Effects of **psychosis** on the Cortex

- Under-development of limbic/cortical functions result in:
  - Problems with empathy
  - Poor problem-solving skills
  - Memory disturbances

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**TODAY WE HAVE A BETTER PICTURE OF MENTAL ILLNESS**

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**AREAS OF CORTEX NEEDED TO PROCESS LANGUAGE**
Normal Blood Flow

Blood Flow in Schizophrenia

Normal

PTSD

SCHIZOPHRENIA
Normal Benzodiazepine Receptors
Blocked Benzodiazepine Receptors

Major Depression