Brain Functioning & ADHD

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Primary Source of Information

- Thomas E. Brown, Ph.D.
- “Attention Deficit Disorder: The Unfocused Mind in Children and Adults.”
- Yale University Press, 2005
- Also visit: drthomasebrown.com

Some basics

- Brain functions are primarily neuro-chemical in nature.

- Neurons: brain cells
- Dendrites: branches
- Axon: cell body
- Vesicles: House the neurotransmitter
- Synapse: gaps between neurons

More basics

- Electric impulses travel down the axon.
- The impulse triggers release of the cell's neurochemical transmitter.
- There are 50 types of transmitters in the brain.
- The neurochemical transmitter is discharged into the synapse.

Even more …

- The message is transmitted to the adjoining neuron's receptors.
- The neurotransmitter left in the synaptic gap is taken back up into the neuron which has just fired.
- This entire process takes ~ 50 miliseconds
- "A piece of brain the size of a grain of sand … contain(s) 100,000 neurons, 2 million axons, and 1 billion synapses."

Even more …

- Neuronal connections act either to brake or accelerate information.
- Neurons are grouped in networks: systems and subsystems.
- “These interacting networks have to communicate rapidly with one another moment to moment in order to manage the body, all mental functions, and the person’s ongoing interactions with the world.”

So what's the problem with AD/HD?

- The problem with AD/HD resides in the brain pathways which are primarily regulated by two types of neurotransmitters:
  - Dopamine
  - Norepinephrine
  - These pathways are those involved in executive functioning.

What do meds do?

- AD/HD medications primarily work by increasing the amount of Dopamine or Norepinephrine neurotransmitter in the synaptic gap, and decreasing the amount of neurotransmitter taken up again after discharge.

- The primary class of meds (psychostimulants) have a paradoxical effect, i.e., the student becomes more focused and less distracted, rather than the opposite.

Neuronal Pathways involved in Executive Functioning

Main players are the management systems in the brain:

Area 1:

- Midbrain: reticular formation & locus coeruleus
- Regulates:
- Alertness, vigilance

More Pathways

- Area 1: Cerebellum:
- The cerebellum acts a fine tuning device.
- What does it fine tune?
- Example: Adjusting social behaviors to specific situations.
- Example: Fine tuning the use of active working memory

And more pathways … Area 3

- The amygdala and dopamine circuits assess rewards and consequences.

- These circuits are involved in sustaining effort and in motivation.

Also Area 4

- The prefrontal cortex.

- “The prefrontal cortex is the only segment of the brain fully connected with other aspects of the brain and the neural pathways that link them.”

More about the Prefrontal Cortex

- This is the primary center for brain management, and is connected with all of the following:
  - Receiving sensory input
  - Controlling movement
  - Managing memory
  - Regulating emotion
  - Making decisions
  - Controlling activation of responses

The Hippocampus: Area 5

- The hippocampus is basically a center which converts active working memory into long term memory.
- Here's what I think:
- What is active working memory? It is those functions of the brain which select the part/s of incoming information attended to (saliency), holds that information, and then pulls out related information in long-term memory. Incoming information and long term information then work together in order to successfully work on a task at hand.
- Important to think about: How efficient and effective is the response and output?

Executive Functions and Teens

- MRIs:

- Around the onset of puberty: brain volume rapidly increases, there is a huge increase in the size and number of neural networks particularly in the frontal lobes and cerebellum.

- Rapid proliferation is followed by a period of rapid pruning of neural networks, allowing for more efficient operation of the overall system.

Also changing is …

- Myelination increases by 100%
- Myelin is a fatty substance which coats neurons and helps them work more effectively.
- Myelination is particularly affecting the integration of emotional reactions with cognitive processes.
- Example: impulse control

Finally, the corpus callosum Area 6

- The corpus callosum also experiences a burst of increased myelination.
- It is the area of the brain which links the left and right hemispheres.
- "…Myelination of the corpus callosum improves connectsions between areas crucial for both the more complex, emotionally sensitive use of language for logical thinking."

And what does this prove?

- The “…widespread advances in development of the brain during adolescence – large increases in brain volume followed by greatly increased pruning of neural networks and dramatically accelerated rates of myelination – provide substantial evidence that the circuits that support executive functioning of the human brain are not fully developed until after” … adolescence.

Teens with AD/HD

- Academic demands challenge most students executive functions.

- When a student has a disorder affecting executive functioning that student is going to experience more academic struggles particularly in an academically rigorous program.

Executive Functions

- Here is Brown's schema:

1. Organizing, prioritizing & activating
2. Focusing, sustaining and shifting attention to tasks
3. Regulating alertness, sustaining effort and processing speed.

Executive Functions, II

4. Managing frustration and modulating emotions.
5. Utilizing active working memory and accessing recall
6. Monitoring and self-regulating action / output.