Overview

- Current Understanding
- New Research
- How Brain differences impact:
  - Cognition and Information Processing
  - Sensory Processing
- Importance of Early Intervention

Parts of the Brain Affected by Autism

Correllate Cortex: This is the gray matter on the surface of the cerebral hemispheres.

Amygdala: This is responsible for all emotional responses including aggressive behavior.

Hippocampus: This region enables to remember new information and recent events.

Basal Ganglia: This group of nuclei within the cerebral hemisphere that regulates the muscles and the cerebral cortex, it controls the fine motor activity of the body, essential to survival including breathing and heart rate.

Corpus Callosum: This complex of neural fibers connects the two hemispheres of the brain, allowing them to communicate with one another.
Connections between areas of the Brain

- Numerous parts of the brain and brain connectivity are affected
- Example: Pointing to share interest - visual perception, attention, motor behavior & emotion act together

Head Circumference

- Structural MRI
- Early period of brain overgrowth in people who are eventually diagnosed with an ASD.
  - Normal at birth, it begins to rapidly increase beyond the norm
- Eventually, brain growth slows down so that people with ASDs catch up to "typical" people;
- No difference in brain volume between adults with ASDs and other adults

- In one study, abnormal accelerated early brain growth between ages of 1 to 2 months and 6 to 14 months
  - other signs of autism might not yet have been noticed by parents or pediatricians.
- It is not yet known exactly what causes the brain overgrowth in autism, or how the increased brain volume is related to actual symptoms of ASD
- One theory involves a stalled out "synaptic pruning" process.

-Interactive Autism Network (IAN)
Synaptic Pruning

- It becomes very clear why so much emphasis is put on early intervention in autism. The brain is not fixed at birth, but constantly transforming itself. If it’s transforming in the wrong direction, jumping in and intervening in the process makes a great deal of sense.

New Research Findings

- Infant Brain Imaging Study (UNC-Chapel Hill)
- Changes in brain development that are a part of ASD may be detected as early as 6 months of age
  - Again, before behavioral symptoms are noticed
- Brain scans of infants at 6, 12, 24 months old
  - Older siblings with ASD (high risk sample)
  - 92 participants
    - 28 of which identified with ASD at 24 months old
Method

- Brain scans of infants at 6, 12, 24 months old
  - Older siblings with ASD (high risk sample)
  - 92 participants
    - 28 of which identified with ASD at 24 months old
- Used Diffusion Tensor Imaging (DTI)
  - MRI technology
  - Looks at "white matter" pathways in the brain between different regions
    - White matter is the part of the brain that is rich in nerve fibers and form information pathways
Results

- 28 infants who developed ASD
  - different white matter development for 12 of 15 major pathways studied compared to 64 infants who did not develop ASD
  - Over time, slowing of white matter development
- Evident as early as 6 months of age
  - Networks that connect brain regions are not developing normally in siblings who later develop ASD

Importance

- Helps explain difficulties with complex behaviors
  - Social interactions involve coordination of many brain regions (e.g., eye contact, vocalization, gesture)
- Role of experience on development
- Biomarker before behavioral symptoms present

Important Considerations

- Still a lot of work to do! The findings are preliminary!
- Scans can not provide a diagnosis mechanisms rather than diagnosis
- Brain scan diagnoses will NOT provide critical information needed for development of a treatment/intervention plan. Behavioral assessments will still be needed
- Are these brain patterns seen in people with other complex disorders (e.g., SLI, ADHD)? Are they seen in unaffected siblings?
- Need longitudinal studies to track development
How Brain Differences Affect Cognition

- Cognition: The mental process of knowing, including aspects such as awareness, perception, reasoning, and judgment.

"Thinking differently is not a choice in autism, but a consequence of very real differences in the brain" (Minshew & Williams, 2008)

**Intact or Enhanced Cognitive Abilities**

<table>
<thead>
<tr>
<th>Attention</th>
<th>Complex Motor</th>
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<tr>
<td>Simple Sensory Perception</td>
<td>Complex Memory</td>
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<td>Elementary Motor</td>
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<td>Simple Memory</td>
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<td>Rule-learning</td>
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<td>Visualspatial processing</td>
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Summary: Acquisition of information is intact; information processing capacity is reduced especially when the demands of the task are high.

**Complex Information Processing Deficit: Implications**

- Multi-tasking is very difficult
  - Most common tasks involve multi-tasking
  - Speed of processing is also compromised
- Complex grammatical construction (both receptive and expressive) reduces comprehension
  - Longer phrases/sentences may become single encoded units
  - Doing is the test of understanding, not saying
- Individuals with ASD generally operate on facts and rules
  - Convey information succinctly with the fewest words possible
Functional Magnetic Resonance Imaging (first done in 2002) suggest:

- When demands change and different abilities are needed the brain has less flexibility, fewer and smaller resources
- Brain regions do not work in harmony
- Imagery (thinking in pictures) is activated regardless of content
- Decreased connectivity
  - Both connections within neural systems and between neural systems are underdeveloped

Intellectual Disability & Autism

- Intellectual Disability
  - Simple and complex abilities equally affected
- Autism
  - Acquisition is intact
  - Information processing is reduced
- Autism at its most severe:
  - No capacity to attach meaning to sensory information (despite no blindness, deafness or cerebral palsy)

“because individuals with autism can’t change the way they think and perceive the world, changes have to be made to accommodate them.”

- “Uncooperative”
  - Lacking in executive function, decision-making and reacts primarily to what is comfortable
- “He can do it. He just won’t.”
  - The environment changed - he may not recognize it as the same task
  - Doesn’t understand what is expected
  - “I’ve already done it, why should I do it again?”
Tips for Teachers

- Determine the main points and focus on that material
- Preprocess by highlighting/presenting in an organized way
- Use clear and concise language & give time to process
- Break down demanding tasks; present aspects of the task one at a time
  - Brainstorm, then think of key words, then write sentence
- Determine language level by the response of the individual, not the expressive language used
- If you increase the complexity of a task, the individual may not be able to do it
- Using complex information (verbal, written, visual) can be difficult
  - Visual is better than auditory

How Brain differences affect Sensory Processing

- Sensory processing . . . refers to the method the nervous system uses to receive, organize and understand sensory input. It is considered an internal process of the nervous system that enables people to figure out how to respond to environmental demands based on the sensory information that was available to make the person aware of what is going on both around the person (e.g., from auditory and visual input) and from within the person’s body (e.g., from touch, joint receptors).

How do individuals with autism receive, organize and understand sensory input?

"If you have all these sights and sounds coming at you but you can’t put them together in a meaningful way, the world can be an overwhelming place."  
Sophie Malholm, 2010  
(Statement based on findings of electroencephalogram recordings)

"The brain locates, sorts, and orders sensations—somewhat as a traffic policeman directs moving cars. When sensations flow in a well-organized manner, the brain can use those sensations to form perceptions, behaviors, and learning. When the flow of sensations is disorganized, life can be like a rush hour traffic jam."

Jean Ayres, 1979  
(Sensory Integration theory)
How do individuals with autism respond to environmental demands based on the sensory information?

• Typically developing
  - Information from a single sensory system takes 20 milliseconds to arrive in the brain
  - Information from multiple senses takes 100-200 milliseconds

• Autism
  - Information from a single sensory system takes 20 milliseconds to arrive in the brain
  - Information from multiple senses takes 310 milliseconds

What difference does that make?

• Information coming from a single source makes more sense
• Individuals with ASD are slower to integrate (understand and use) information that requires multi-channel input
• Individuals with ASD may block out what seems to be extraneous stimulation

What about Sensory Integration

*Involves specific sensory activities (swinging, bouncing, brushing, and more) that are intended to help the patient regulate his or her sensory response*

• At present there is no objective measures to determine if it works
• Ongoing research
In Conclusion

- Need for Early Identification and Intervention
  - Experiences sculpt the brain
  - Infants with autism respond differently to the environment
    - Fewer social interaction
    - Overly fixated on objects
    - Engaged in repetitive play
  - As life becomes increasingly different, connections and responses are diverging

Early intervention

“These brain changes, though, are considered to be ‘reactive,’ not part of the core neural features of autism but secondary and associated to the altered life patterns that accompany infant autism, and that are, perhaps, preventable.” (Dawson, 2008)

“The activities children engage in across their day are not neutral - they are either building a more social and communicative brain or building a more object-oriented brain.”
Rogers & Dawson, 2010
Resources

- Autism Speaks  
  http://autismspeaks.org
- Simons Foundation Autism Research Initiative  
  http://sfari.org
- Infant Brain Imaging Study  
  www.ibis-network.org
- First Signs  
  www.firstsigns.org