Autism and the Brain

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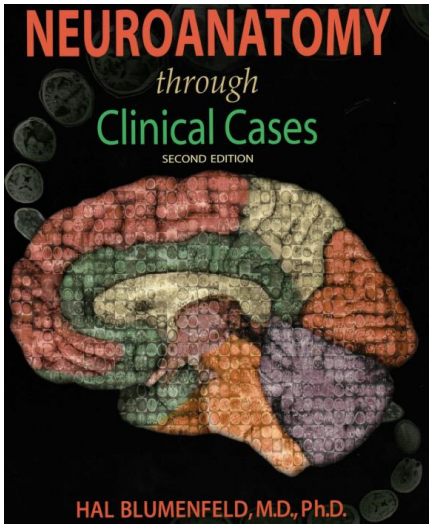
Overview

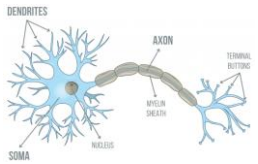
- Neuroanatomy
- The Social Brain
- Autism and Brain
  - Caveats and Cautions
  - Whole Brain Findings
  - Regional Findings
- Applications

A Little Bit of Neuroanatomy

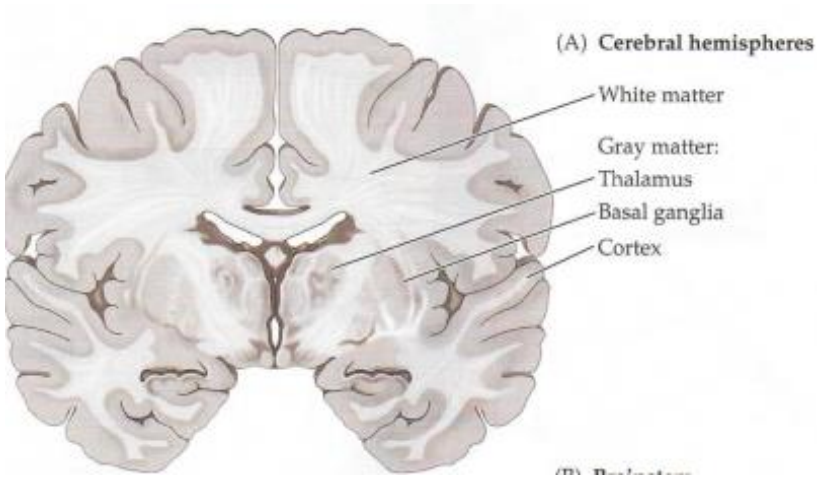
1. Gray & white matter
2. Left & right hemispheres
3. Four lobes of the brain
4. Cerebellum
5. Limbic system
6. Basal ganglia



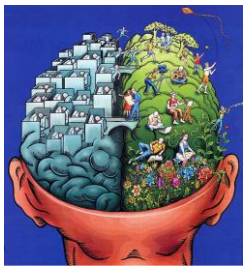
Gray Matter and White Matter

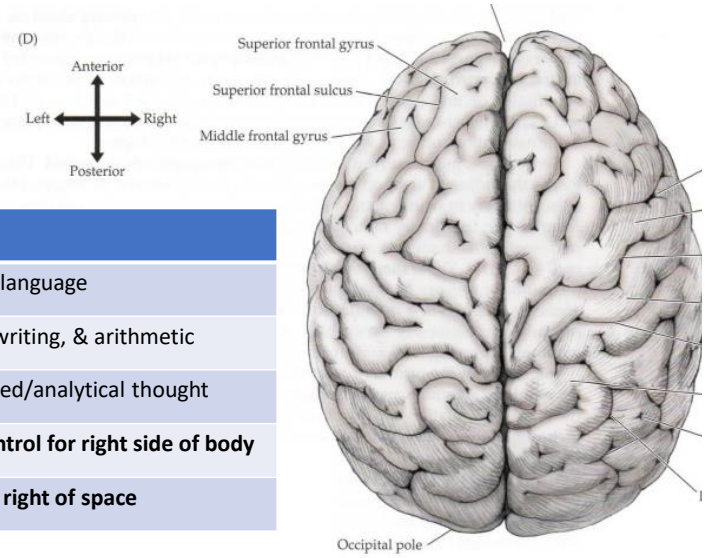


(B) Coronal plane



Right and Left Hemispheres





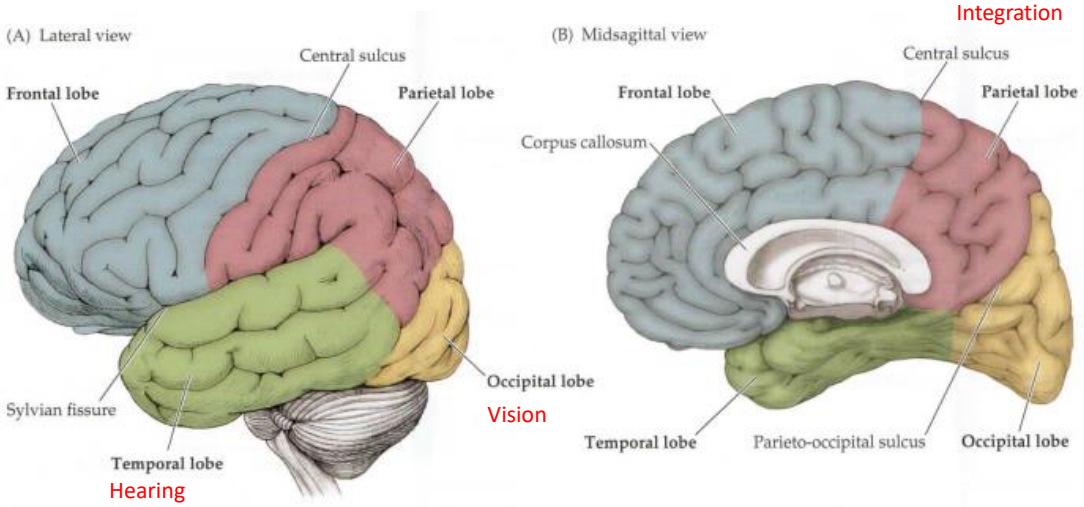
Left
Speech & language
Reading, writing, & arithmetic
Detail-based/analytical thought
Motor control for right side of body
Vision for right of space

Right
Nonverbal communication
Visual-spatial & music
Holistic/gestalt processing
Motor control for left side of body
Vision for left side of space

Lobes of the Brain

Executive functioning
Personality & judgment
Voluntary movement & speech

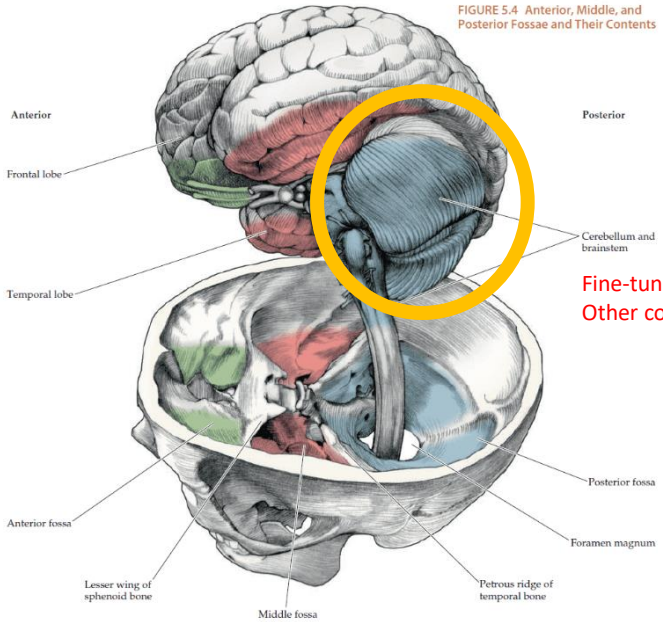
Sensory processing
Integration



Vision

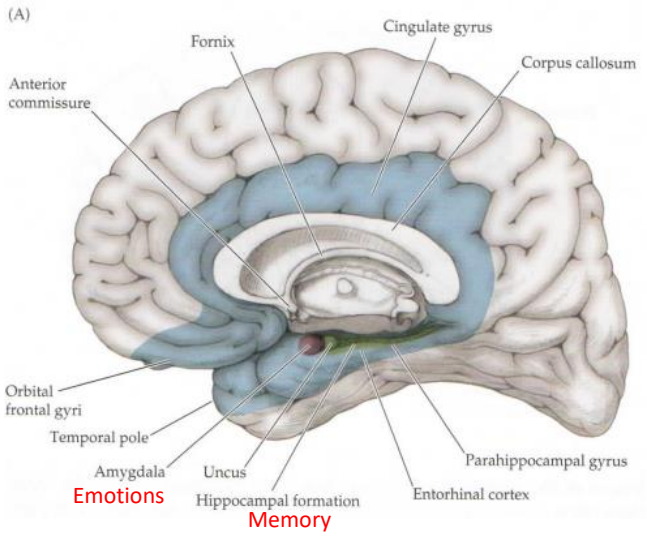
Hearing
Language comprehension
Memory & emotions

Cerebellum



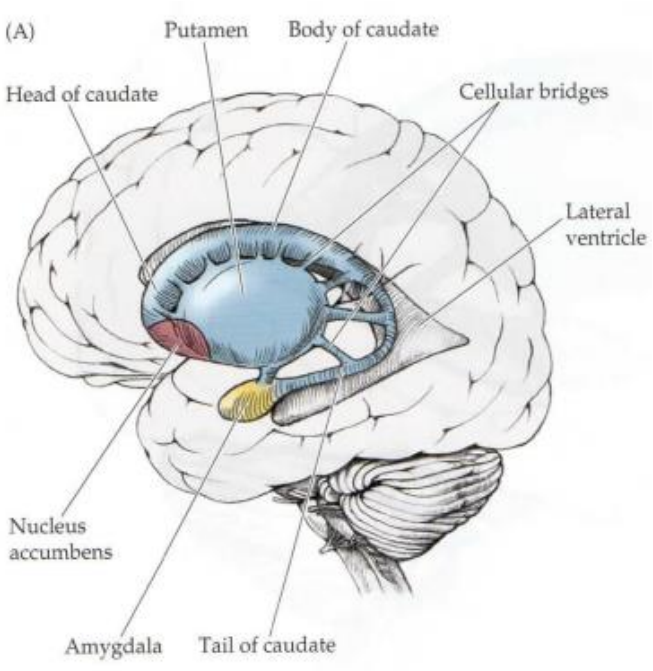
Fine-tuning movements
Other cognitive processes

Limbic System



Basal Ganglia

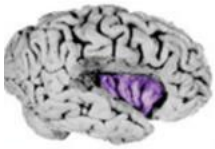
Starting/stopping movement
Reward



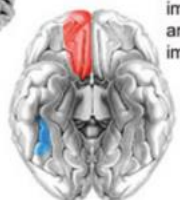
Where is the social part of the brain?

Somatosensory cortex (green), and superior temporal sulcus (orange) in the right hemisphere

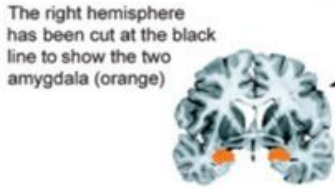
Broca's area (blue) and superior temporal sulcus (orange) in the left hemisphere



Right hemisphere dissected to show the insula, important for emotion



A view from below shows the orbitofrontal cortex (red), important for decision-making and the fusiform gyrus (blue), important for processing face



The right hemisphere has been cut at the black line to show the two amygdala (orange)

The right hemisphere has been cut through the middle to show the orbitofrontal cortex (red) and the anterior cingulate cortex (yellow)

Social Perception → Social Inference → Social Behavior

Autism and the Brain

Caveats and Cautions

- Inconsistent findings across studies are common
- None of the findings are universal
- Relationships between brain and behavior may not be causal

Caveats and Cautions

Why are research studies on the brains of people with autism inconsistent?

- Small samples
- Sample differences
  - Demographics (e.g., age, gender, etc.), ASD symptoms, co-occurring disorders
- Varied etiology of ASD
- Data quality/processing differences

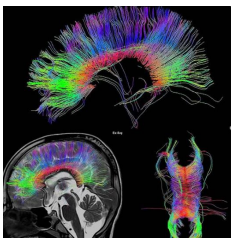
ABIDE
Autism Brain Imaging Data Exchange

Autism and the Brain: Whole Brain Findings

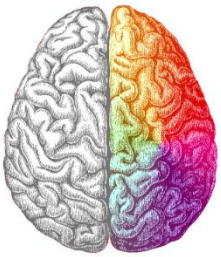
Whole Brain Findings

Increased head and brain size in early childhood

Atypical connections (white matter) within the brain



Atypical right vs. left hemisphere patterns

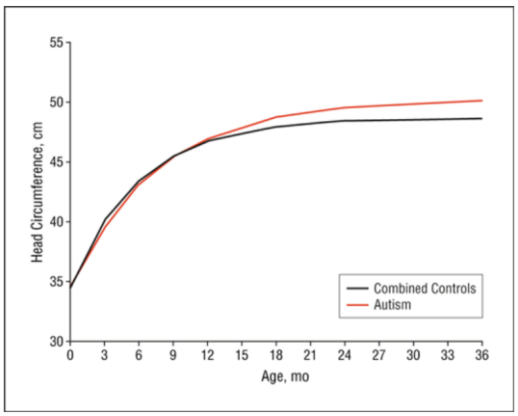


Over-excitability/reduced inhibition

Increased Head (and Brain) Size in Early Childhood

Early brain overgrowth

Figure 2.



Growth trajectory of head circumference by group.

(Hazlett et al., 2005)

Increased Head (and Brain) Size in Early Childhood

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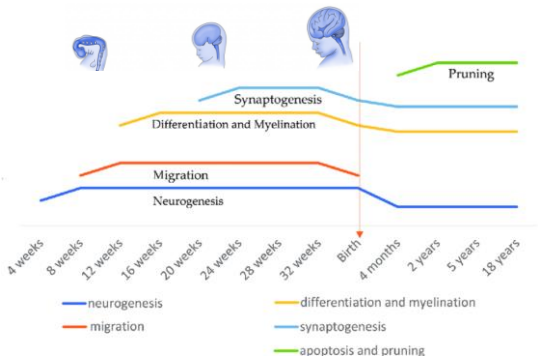
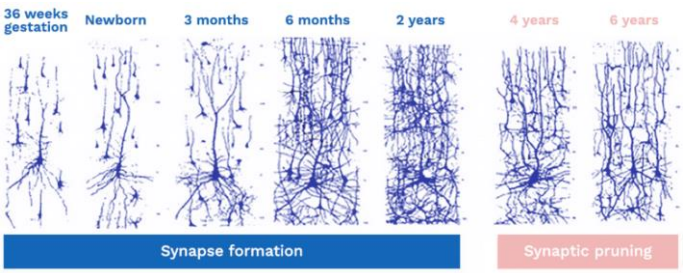
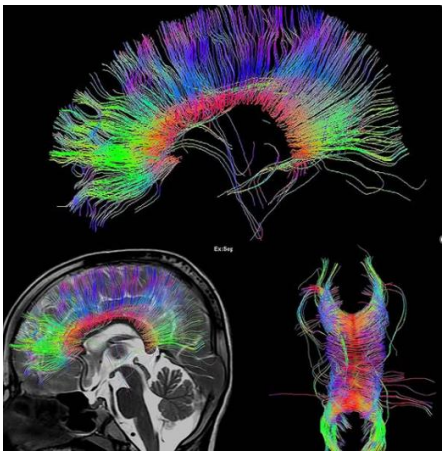


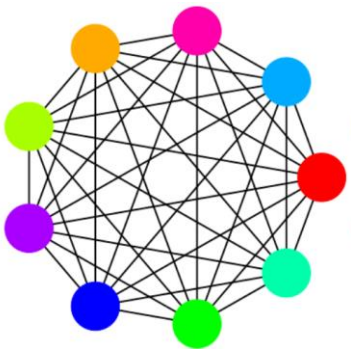


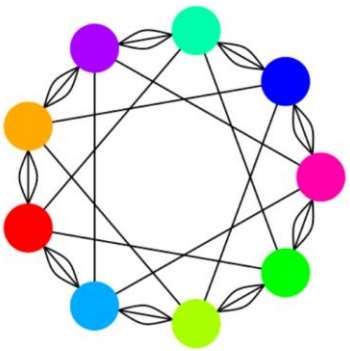
Atypical connections (white matter) in the brain

Short range over-connectivity; long rang under-connectivity?

Conflicting findings, but, generally, white matter abnormalities, are common.







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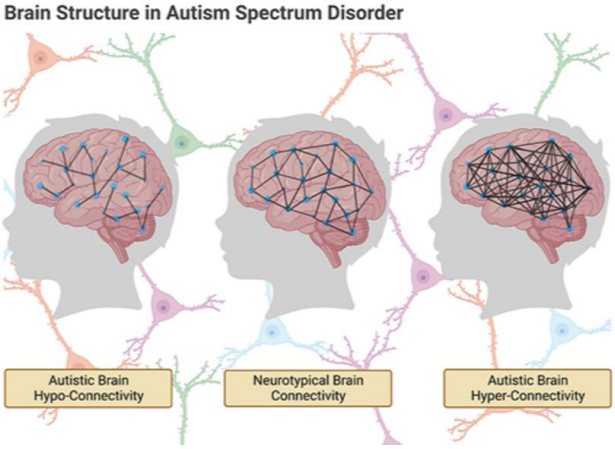

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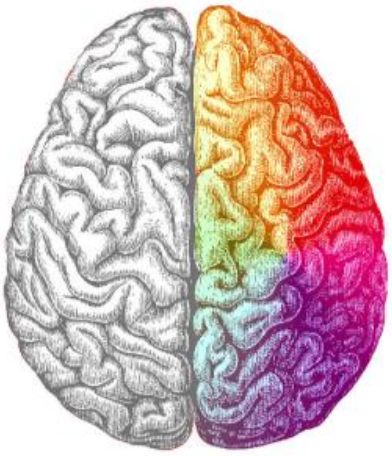
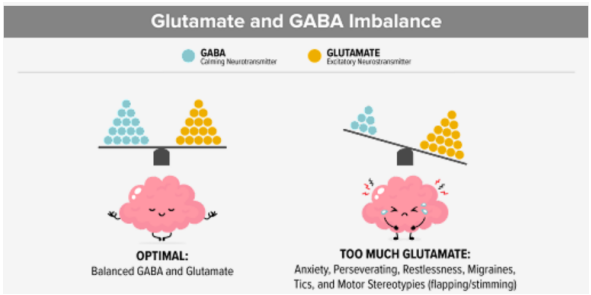


- Reduced asymmetry between hemispheres
  (Postema et al., 2019)
- Reduced right hemisphere volume, esp. temporal
  (Del Casale et al., 2022)

Atypical right vs. left hemisphere patterns

Over-excitability/reduced inhibition



Over-excitability/reduced inhibition

Autism and the Brain: Regional Differences

Regional Differences

Frontal Lobes

Amygdala

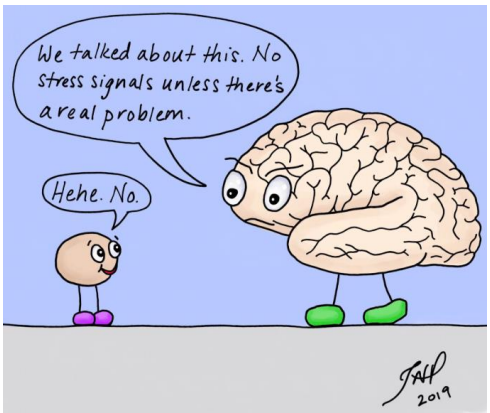
Cerebellum

Frontal Lobes

- Regulate behavior
- Abnormal organization of cell layers
- Abnormal circuits involving the frontal lobes
  - Frontal-striatal (i.e. basal ganglia)

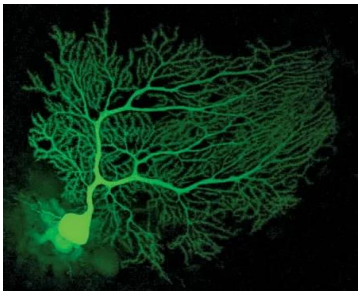
Amygdala

- Processing emotions, esp. fear
- Larger than usual size of amygdala in children



Cerebellum

- Fine tuning movement
- Higher order cognitive functions, including procedural learning
- Reduced/abnormal Purkinje cells



Applications

Applications

- Early identification
- Treatments
- Education and understanding

Applications: Education and understanding

Why bring up the brain?

1. Diffuse the blame
   a. For the child: Reframing a “won’t” as a “can’t”
   b. For the parent: You did not cause your child’s challenges
2. Encourage buy-in for interventions
   a. Behavioral: Practice makes pathways!
   b. Pharmacological: There may be a chemical imbalance
3. Promote consideration of physiological needs
4. Comfort via understanding

Questions

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