Round 26: Autism

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Autism

- Spectrum of disorders that are characterized by:
  - Impairment in social interaction
  - Communication
  - Restricted repetitive and stereotyped patterns of behavior, interests, and activities

- Some Autistic children have difficulty learning, have signs of lower than normal intelligence
- Other children have normal to high intelligence, learn quickly, especially in specific interest categories
  - Yet, have trouble communicating and applying what they know in everyday life
  - Adjusting to social situations

Autism Characteristics

- Social Communication/Interaction
  - Fails to respond to his or her name
  - Resists cuddling and holding, and seems to prefer playing alone, retreating into his or her own world
  - Has poor eye contact and lacks facial expression
  - Doesn't speak or has delayed speech, or loses previous ability to say words or sentences
  - Can't start a conversation or keep one going, or only starts one to make requests or label items
  - Speaks with an abnormal tone or rhythm and may use a singsong voice or robot-like speech
  - Repeats words or phrases verbatim, but doesn't understand how to use them
  - Doesn't appear to understand simple questions or directions
  - Doesn't express emotions or feelings and appears unaware of others' feelings
  - Doesn't point at or bring objects to share interest
  - Inappropriately approaches a social interaction by being passive, aggressive or disruptive
  - Has difficulty recognizing nonverbal cues, such as interpreting other people's facial expressions, body postures or tone of voice

Autism Characteristics

- Patterns of behavior
  - Limited, repetitive patterns of behavior, interests or activities, including:

    •Performs repetitive movements, such as rocking, spinning or hand flapping
    •Performs activities that could cause self-harm, such as biting or head-banging
    •Develops specific routines or rituals and becomes disturbed at the slightest change
    •Has problems with coordination or has odd movement patterns, such as clumsiness or walking on toes, and has odd, stiff or exaggerated body language
    •Is fascinated by details of an object, such as the spinning wheels of a toy car, but doesn't understand the overall purpose or function of the object
    •Is unusually sensitive to light, sound or touch, yet may be indifferent to pain or temperature
    •Doesn't engage in imitative or make-believe play
    •Fixates on an object or activity with abnormal intensity or focus
    •Has specific food preferences, such as eating only a few foods, or refusing foods with a certain texture

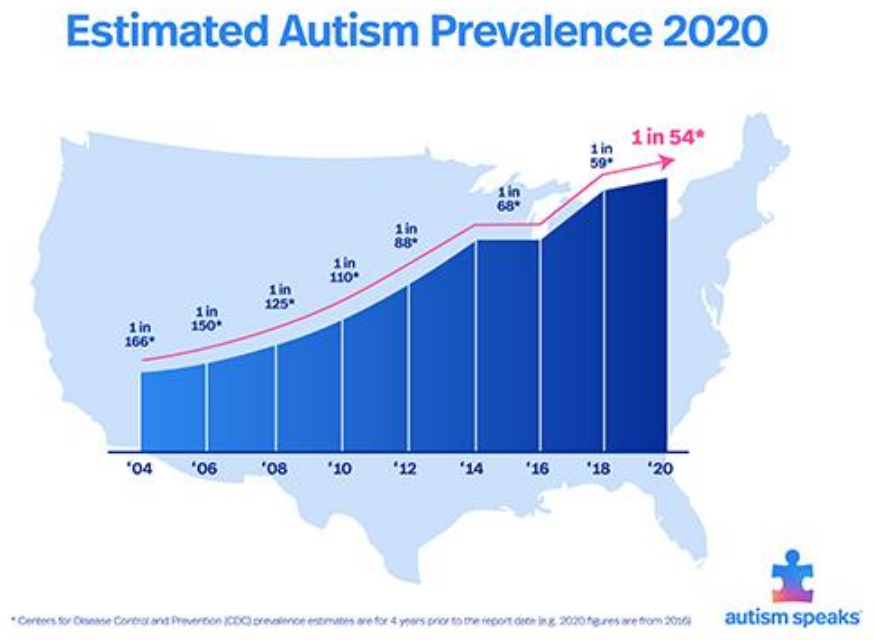
Autism Prevalence & Risk Factors

- 1 in 54 children will be diagnosed with Autism Spectrum Disorder
  - 1 in 34 boys
  - 1 in 144 girls

- Can be diagnosed as early as 2 years old, usually by 4

- Likely the combination of Genetic and Environmental factors
  - 80% Genetic – possible link to chromosome 16
  - 20% Environmental
  - 1% Maternal factors

  - Extreme pre-term babies – born before 26 weeks of gestation
  - Advanced Parental age
  - Exposure to pesticides, toxins, air pollution
  - Previous child with autism, 2-18% chance of having a second child with Autism



https://www.autismspeaks.org/autism-statistics-asd

Autism spectrum disorder - Symptoms and causes - Mayo Clinic

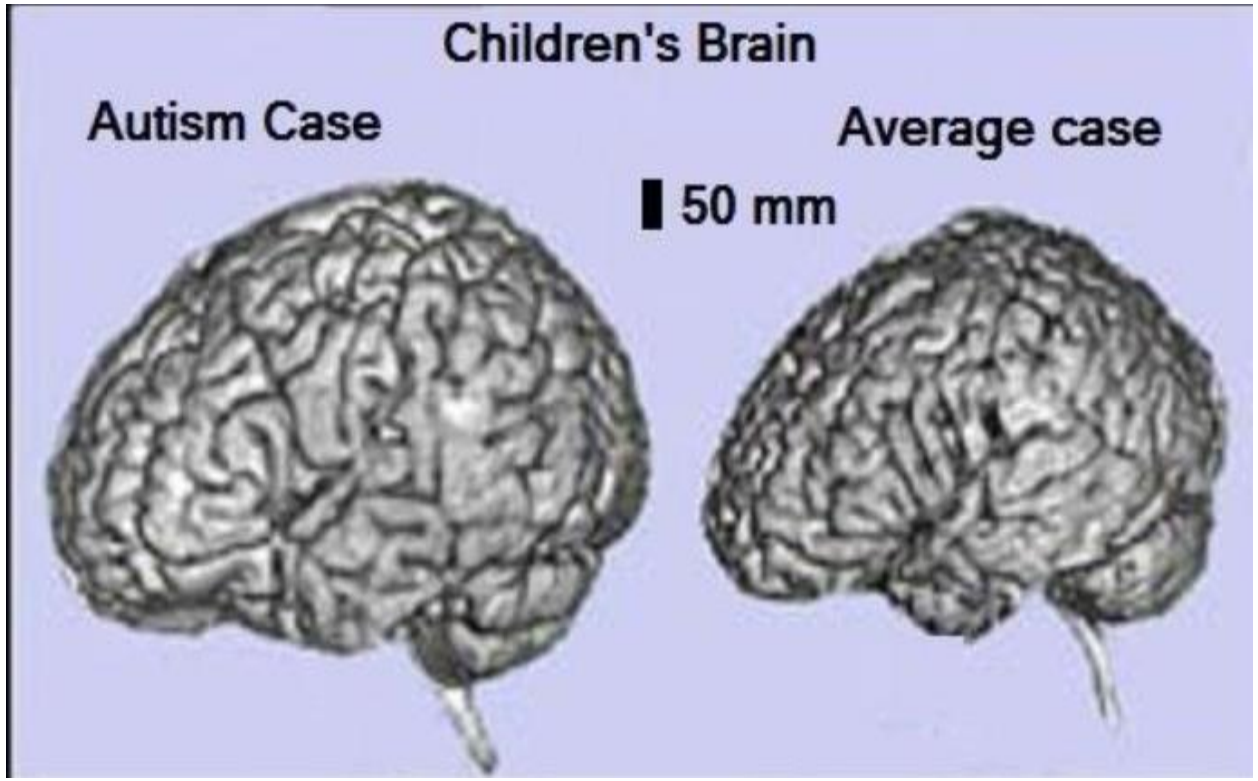
Autism Behavioral Development

- Often children show symptoms of autism within the first year.
  - Some children show signs of autism spectrum disorder in early infancy
    - Reduced eye contact
    - Lack of response to their name or indifference to caregivers.

- Some children appear to develop normally in the first year, and then go through a period of regression between 18 and 24 months
  - Suddenly become withdrawn or aggressive
  - Lose language skills they've already acquired
  - Signs usually are seen by age 2 years

Autism Neuroanatomy

- Most common finding is accelerated brain development early in childhood (2-4 y/o)
    - Significantly faster expansion of the surface area of their cortex from 6 to 12 months of age.
    - In year 2, brain volume increases much faster in autistic children than in their non-autistic peers
    - Amygdala is enlarged in children up to 5 years
        - Extent of enlargement correlates to symptom severity
        - Adolescents & adults amygdala is smaller



Brain Study Finds Evidence that Autism Involves Too Many Synapses | Autism Speaks

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4688328/

Autism Neuroanatomy

- One theory suggests autism is linked to too many synapses – insufficient synaptic pruning
  - Insufficient pruning may be linked to excess of protein mTOR, which disrupts autophagy
  - Medication Rapamycin inhibit mTOR & restores normal synaptic pruning and appears to alleviate symptoms in mouse-model of autism

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Autism Neuroanatomy

- Possible phenotypes
  - Deficits is Social Language Processing & Social Attention
    - Abnormalities in inferior frontal gyrus (IFG, Broca's area), superior temporal sulcus (STS), and Wernicke's area
  - Impairments of Social Behaviors
    - Abnormalities in the frontal lobe, superior temporal cortex, parietal cortex, and amygdala
  - Restrictive, repetitive behaviors of ASD
    - Abnormalities in the orbitofrontal cortex and caudate nucleus
      - Also been found in OCD, GAD, and Schizophrenia

Brain Study Finds Evidence that Autism Involves Too Many Synapses | Autism Speaks

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4688328/

Autism Neuroanatomy

- Poor Face/Emotion Processing
  - Hypo-activation in Bilateral, and specifically left, fusiform face area and occipital face area

- Poor Verbal Processing/Communication
  - More symmetrical brain
    - Reduced leftward language lateralization
    - Higher rate of being left-handed
  - Hypoactivation in
    - Left inferior, middle frontal gyrus, and left angular gyrus
    - Anterior Cingulate Cortex (ACC)
      - Also related to poor response monitoring
- Dysfunction in
  - Sensory processing -> Somatosensory areas
  - Motor control (i.e., Restrictive, repetitive Behaviors) -> Motor cortex, Supplementary motor area
  - Inhibitory control & Cognitive Flexibility -> Frontal regions

https://www.psycom.net/autism-brain-differences

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4688328/

Connectivity Differences

- Poor connectivity between hemispheres – reduced volume of corpus collosum
- Long-range under-connectivity
  - Difficulty in tasks that require integration of information from different parts of the brain (e.g., social function and complex motor tasks)
  - Problem is that visual information can be identified but not put into context – emotionally appraised
- Short-range over-connectivity
  - Excellent performance in very specific tasks that utilize discrete, local brain regions (e.g., paying attention to specific details or narrow, surface level concepts)
- Different patterns of sulci & gyri
  - More folding in left parietal and temporal lobes and in right frontal and temporal lobes
  - Reduced gyrification
    - Children -> Right inferior frontal and medial parieto-occipital cortices
    - 8-40 years -> Left supramarginal gyrus

https://www.psycom.net/autism-brain-differences

https://www.spectrumnews.org/news/brain-structure-changes-in-autism-explained/

Mu Rhythms

- Alpha frequency (9-14 Hz)
- Observed over C3 & C4
- Is suppressed when actively executing an action, passively thinking about a movement, or watching someone else produce a movement

- Believed to represent mirror neuron activity -> understanding of others' actions/ Theory of Mind

- Experimentally inhibit Mu Rhythm Suppression with TMS
  - Participants perform worse on emotion recognition task

mu-ritme_neurofeedback_bij_ass.pdf (qeeg-neurofeedback.org)

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5383811/

Case Study 1

- 15 year old male

- Previously diagnosed with ADHD & Dyslexia
- Parents brought the boy in for possible Dyslexia.

- **<u>Symptoms</u>**
  - Reading, Spelling
  - Comprehension, Word Recognition
  - Attention span
  - Basic life skills
  - Simple tasks, basic motor skills, using utensils
  - Lying
  - Sensory sensitivity to textures
  - Introverted & Socially Awkward

- **Pre/Perinatal**
  - Mother took prescription drugs
  - Mother experienced preeclampsia, high blood pressure, bedrest, emergency c-section
  - Pt was jaundice, had an infection, spent 3 days in NICU

- **Developmental History**
  - Delayed toilet training, completed by 7 years
  - Problems with fine motor movement, sensory issues, narrowed interest
  - Fascinated with cars/wheels, lines up cars and doesn't let anyone touch them
  - Knows a lot regarding cars and Nascar drivers

Case Study 1

- **Neuropsychological testing** indicated the patient fell significantly below expectations on the follow:
  - Attention/concentration for attention to detail with a speeded response
  - Graphomotor speed/learning
  - Sustained auditory attention
  - Visual sustained attention ratings were invalid
  - Learning and memory for visual memory/learning
  - Executive functions for mental switching and visual problem solving
  - Verbal reasoning for expressive language and language memory
  - Perceptual reasoning for facial recognition and social processing

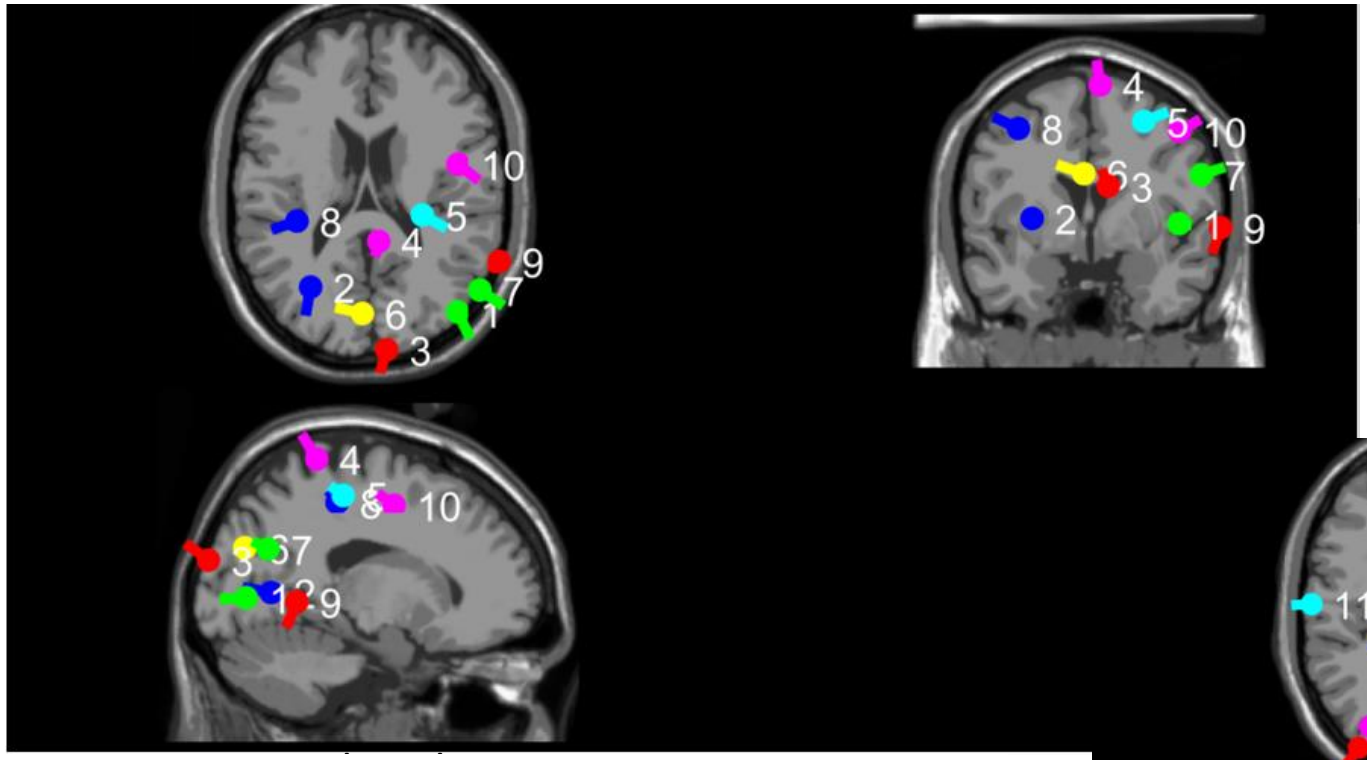
- Scores on achievement tests fell below expectation for:
  - Reading
  - Writing
  - Mathematics

- Relative differences were also noted for:
  - Working memory
  - Verbal and perceptual intellectual reasoning
  - Visuo-motor integration
  - Visual, rote memorization

*IBH Diagnosis => Autism, specific learning delays in math, reading & writing

Case Study 1

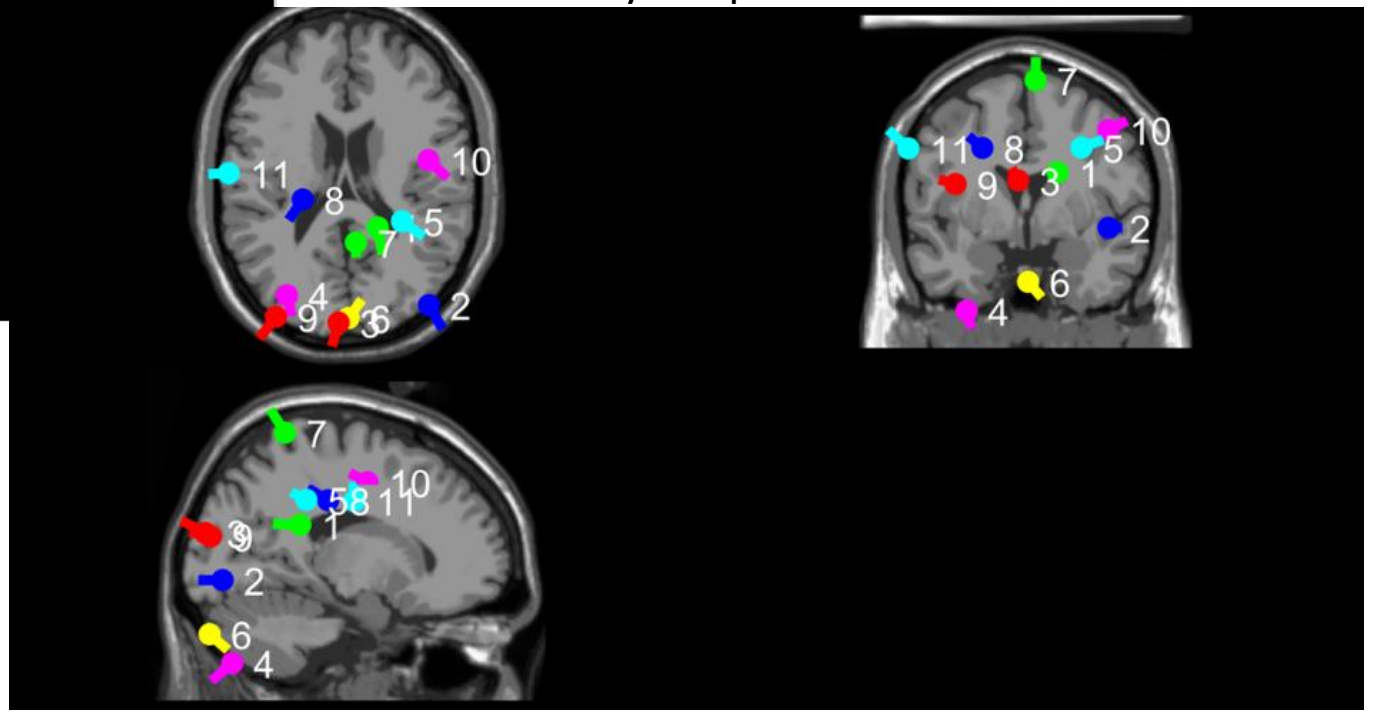
Eyes Closed



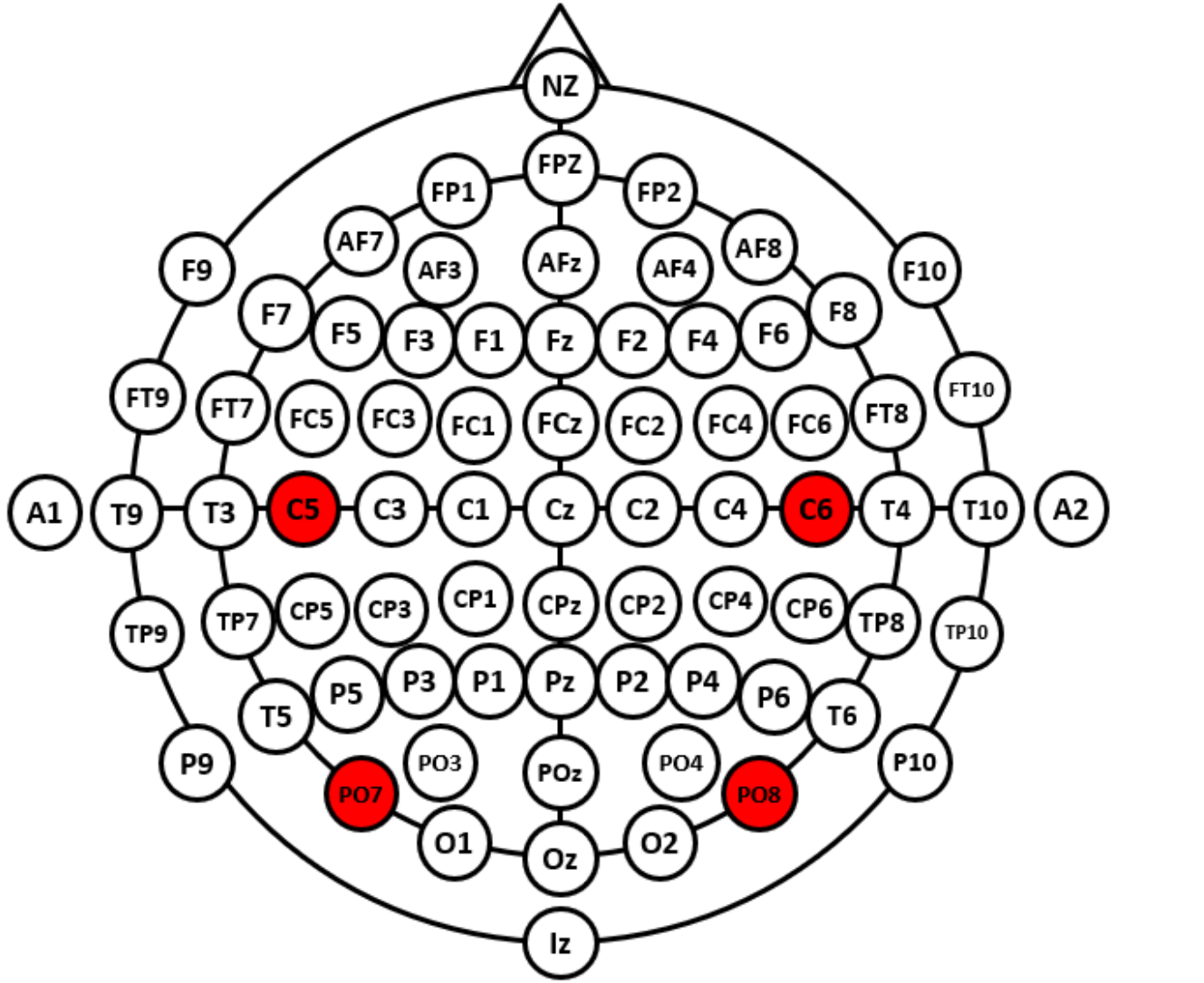
EC: Visual processing, Sensorimotor, Somatosensory, Language processing

EO: Cingulate, Cerebellum, Visual Processing, Sensorimotor, Premotor

Eyes Opened



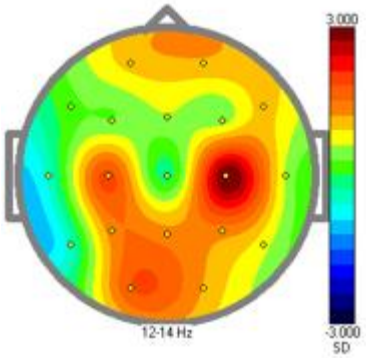
Inhibit	2-7
Inhibit	8-14
Inhibit	16-28
Reward	6-15



Case Study 1

Initial qEEG

Eyes Closed



Follow-up qEEG

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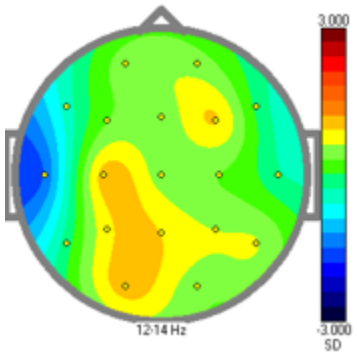
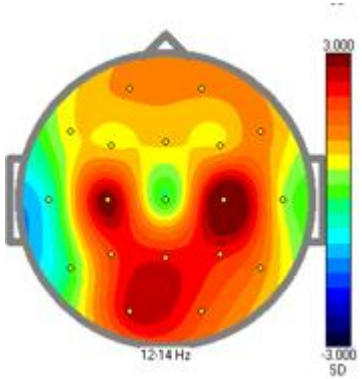


Eyes Open



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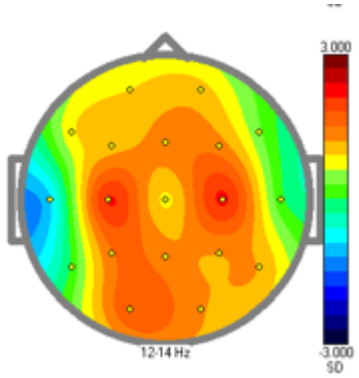


Change in Connectivity (Eyes Closed)

Post

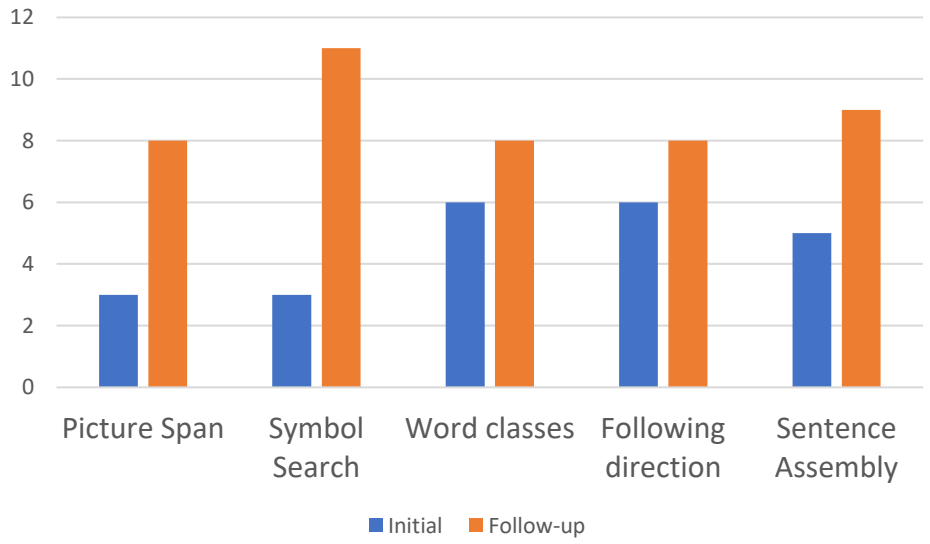
Time Range	Freq Range	Clust Coeff	Path Length	Global Eff	Radius	Diameter
254-305s	8-13Hz	0.015652341	49.22628449	0.02628525	62.73602	99.0001457

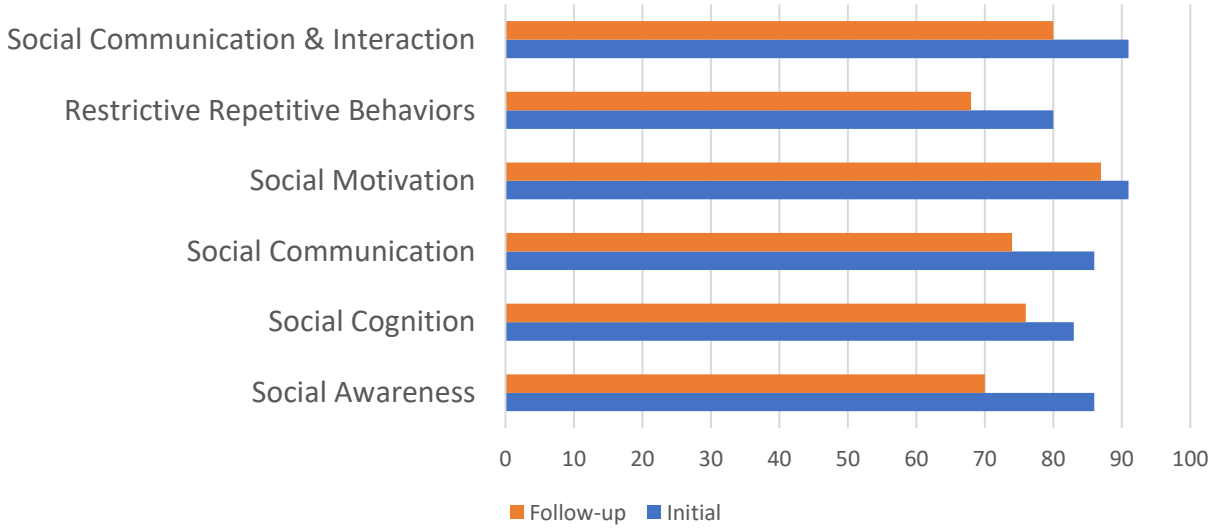
Previous

Time Range	Freq Range	Clust Coeff	Path Length	Global Eff	Radius	Diameter
59-117s	4-14Hz	0.016184928	58.78434724	0.023319799	67.70655	129.899902

24%

Case Study 1





- Picture span -> working memory
- Symbol search -> processing speed domain
- Word class, following directions, sentence assembly -> Language

Case Study 2

- 6 year old male
- Previously diagnosed with autism and sensory processing disorder

- Evaluation for attention deficits
  - High energy level
  - Short attention span
  - Inability to sit still/Fidgeting/Waiting his turn
  - Talkative/interrupting
  - Frequently loses items

  - Other Symptoms
    - Poor emotion regulation
    - Poor fine motor skills (e.g., opening snack, tying shoes, pants with zippers/buttons)
    - Delayed developmental milestones
      - Turning over, crawling, walking, potty training
    - Sensory issues
      - Textures (foods, clothes)
      - Loud sounds
    - Struggles with social cues

Case Study 2

- Neuropsychological testing -> significantly below expectations:
  - Sensory-motor functions for visual motor precision
  - Attention/concentration for visual working memory
  - Verbal reasoning for understanding spoken paragraphs
  - Social perception for neutral facial expressions

- Achievement test scores for oral reading and reading fluency fell greater than two years behind

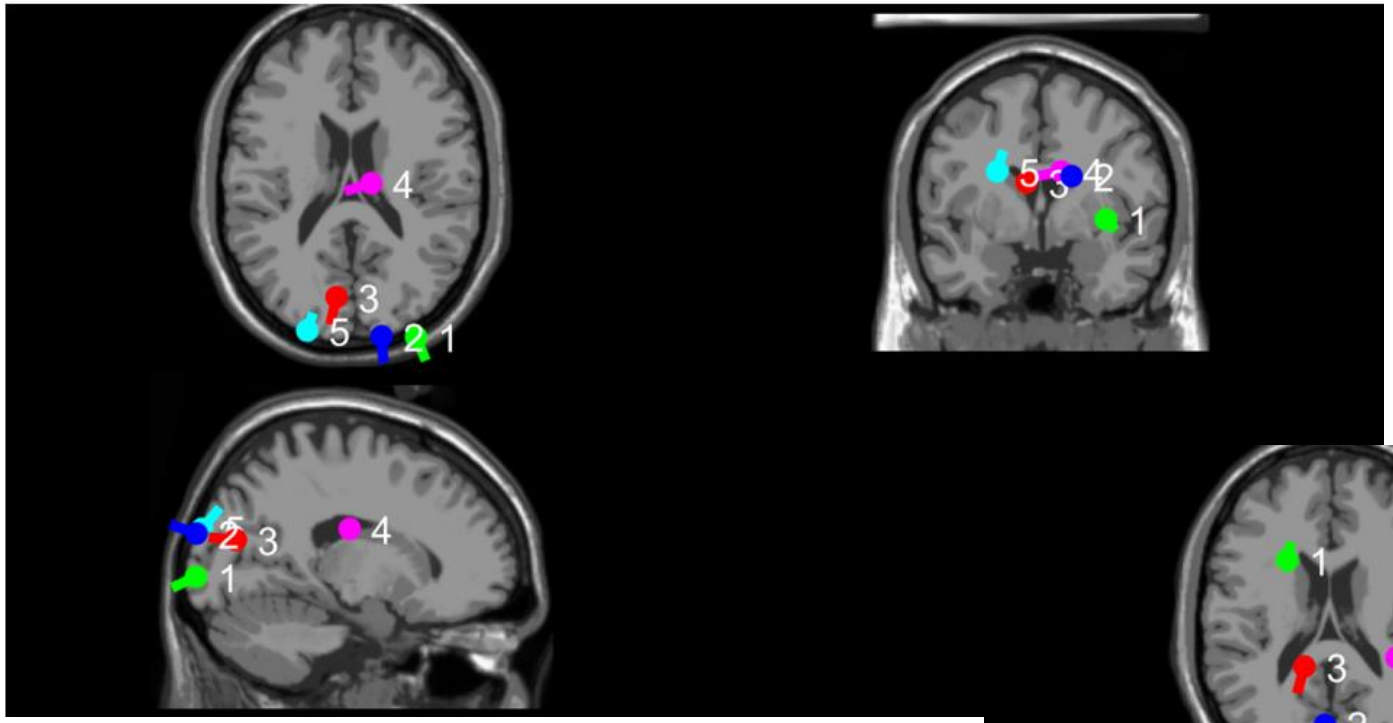
- Relative differences were also noted for:
  - Finger tapping sequences and imitating hand positions
  - Recalling sentences
  - Graphomotor speed/learning
  - Inhibition
  - Written expression

IBH Diagnoses -> Autism, Specific Learning delay reading, Generalized Anxiety Disorder

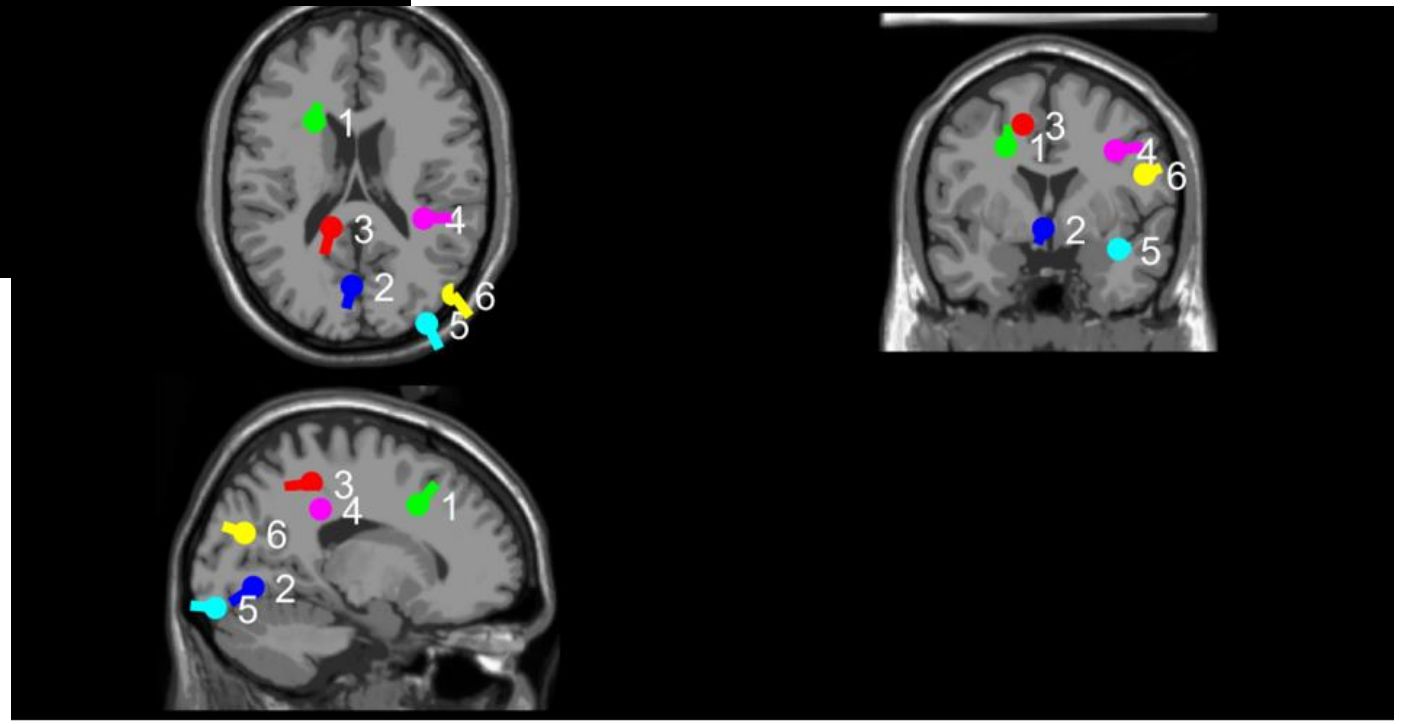
- The parent report & clinical evaluations consistent with the following problem areas:
  - Self-care, behavioral regulation, social skills, emotional regulation
  - Autism

Case Study 2

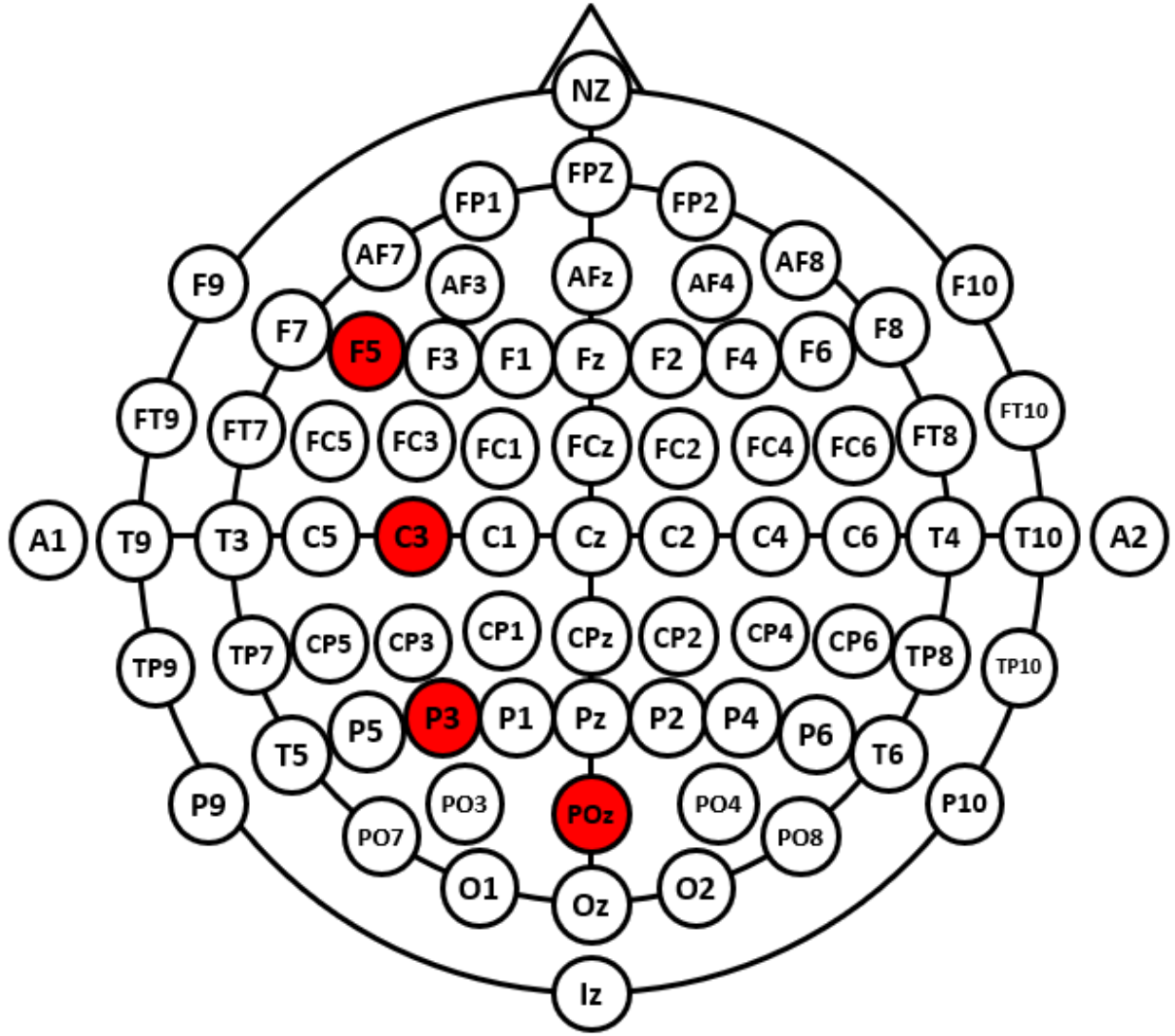
Eyes Closed



Eyes Opened



Inhibit	4-6
Inhibit	10-12
Inhibit	20-30
Reward	3-21



Case Study 2

- **Parent-report**
  - Improvements in black and white thinking, emotion regulation, & phonics/reading/writing
  - Better attention span
  - Fewer meltdowns

- **Neuropsychological Tests**
  - Improvements in visuomotor precision
  - Decreases in aggression, conduct problems, & Depression

Post

Time Range	Freq Range	Clust Coeff	Path Length	Global Eff	Radius	Diameter
27-55s	4-21Hz	0.022023777	48.44819485	0.027721917	57.97599	100.216607

Previous

Time Range	Freq Range	Clust Coeff	Path Length	Global Eff	Radius	Diameter
63-78s	3-21Hz	0.016994242	54.58975181	0.025637671	59.36918	133.644323

25%

Case Study 3

- 11 year old male
- Evaluate for ADHD

- Symptoms
  - Struggles with spelling, writing but excels in math
  - Attention span/listening
  - Recall
  - Excessive talking, distractibility

  - High need for organization (i.e., Closet, color coding schoolwork)
  - Exhibits compulsions or “must do” behaviors related to cleanliness

- Developmental History
  - Mother had gestational diabetes
  - Required oxygen for 45 mins after delivery

Case Study 3

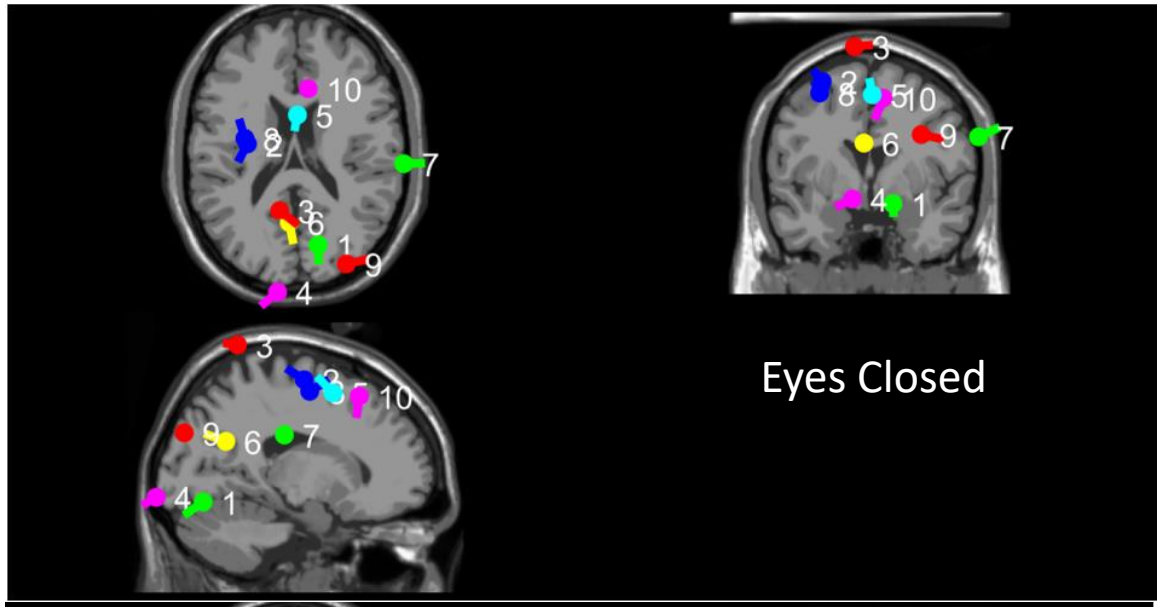
- Neuropsychological assessment
  - Significantly below expectations
    - Sensory-motor functions for imitating hand positions and manual motor sequencing
    - Perceptual Processing/Reasoning for visuomotor integration
    - Oromotor sequencing
    - Attention/concentration for sustained focus
    - Verbal Reasoning/Processing for abstract reasoning
    - Phonological processing
    - Quantitative analysis and social processing

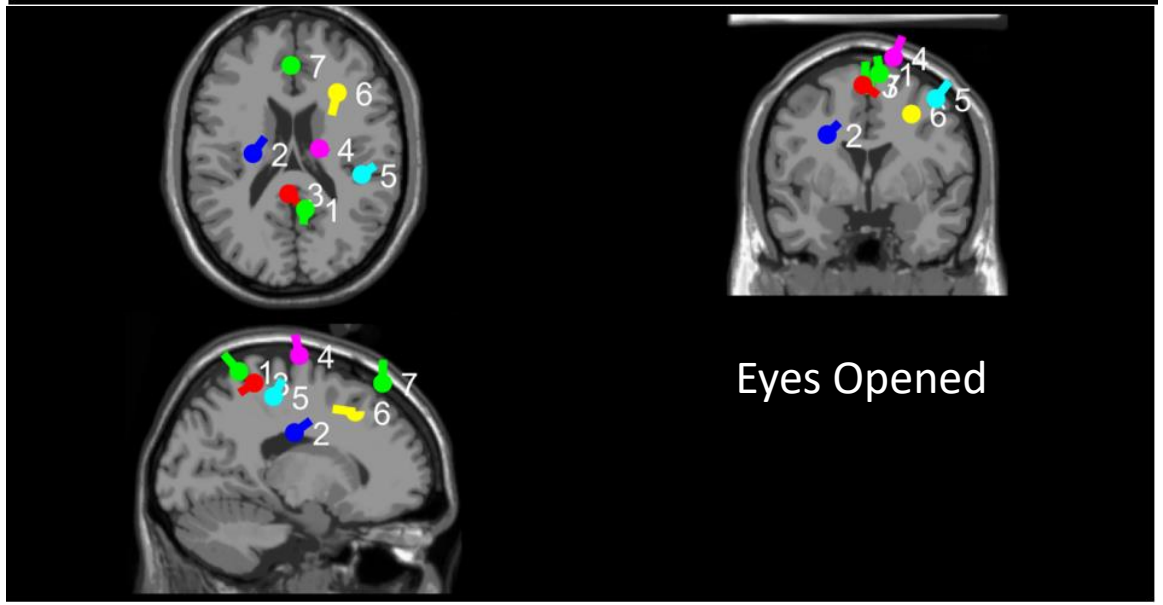
  - Achievement tests fell below expectation for
    - Reading, Written Language and Mathematics, falling at least two years delayed.
    - Word Attack, Oral Reading, Passage Comprehension, Math Fluency, and Spelling each fell at least 3-years below expectations.

  - Scales endorsed by the parents included those evaluating autism symptoms, externalizing problems, executive dysfunction and conduct issues.

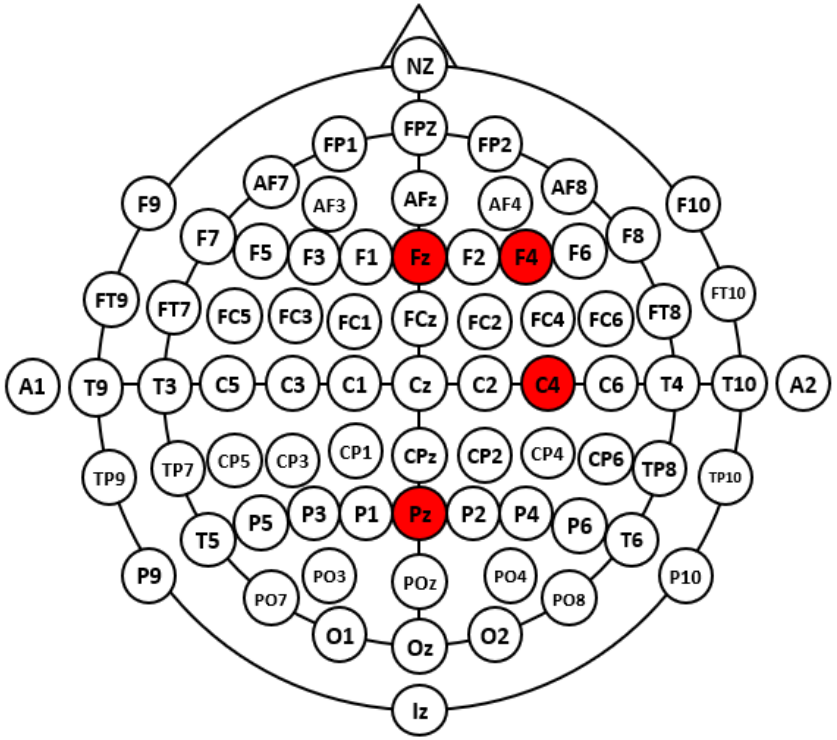
*IBH Diagnosis => Pervasive Developmental Disorder, ADHD, Specific learning delays in math, reading & writing

Case Study 3



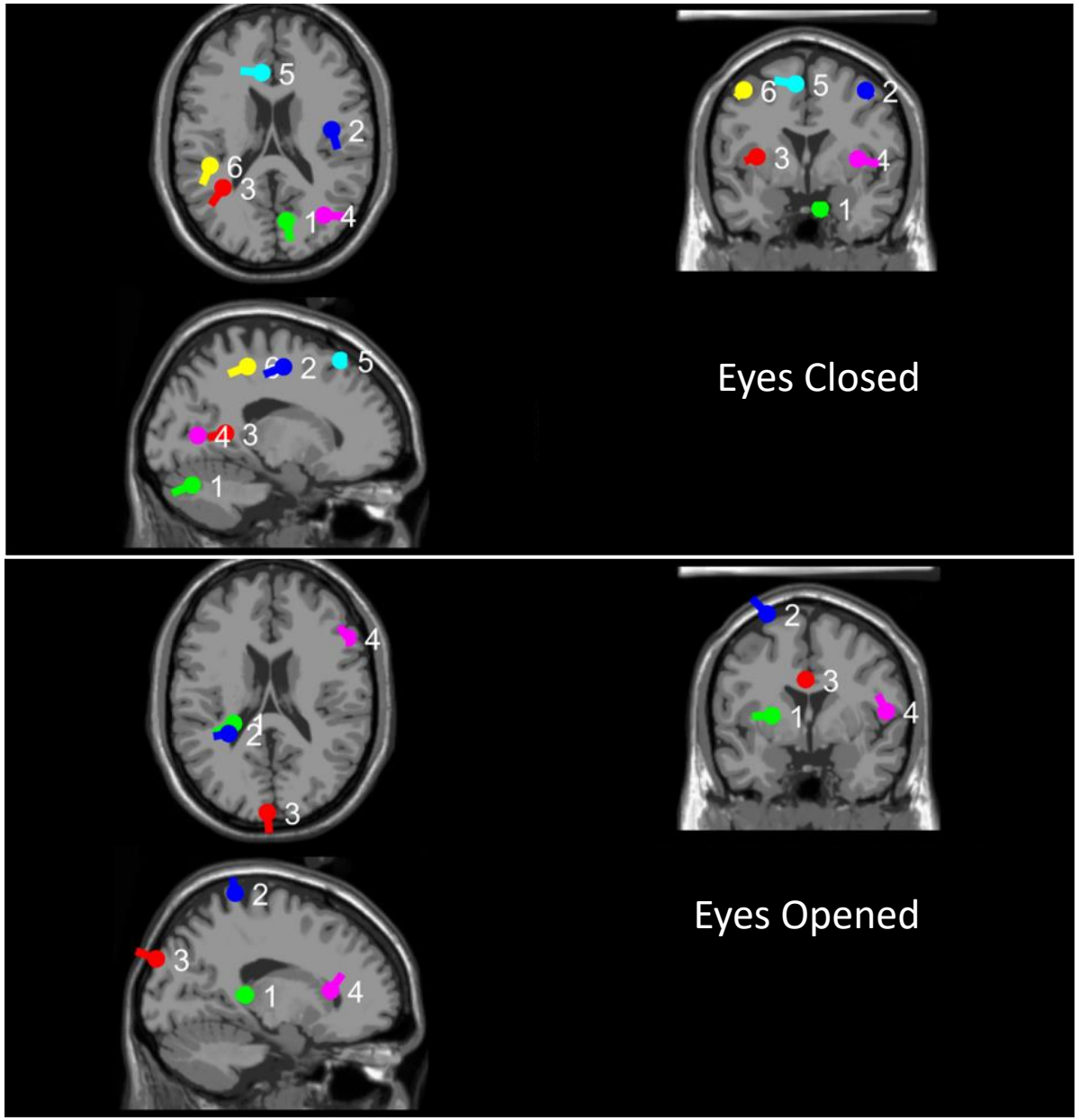


Inhibit	8-12
Inhibit	16-20
Inhibit	26-30
Reward	3-20

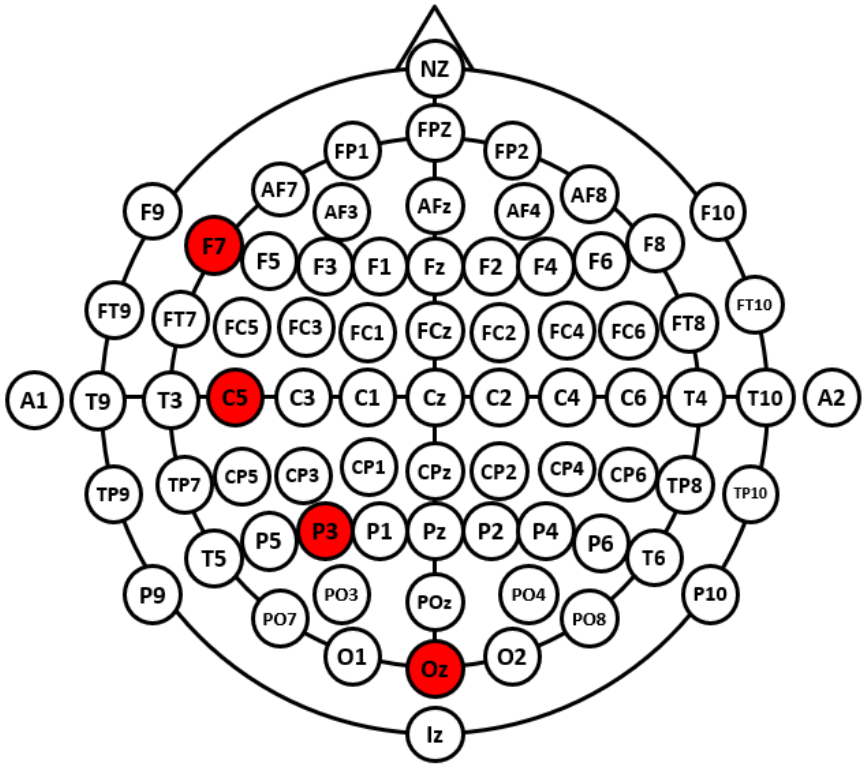


Neuropsychological tests showed improvements on a number of attention measures, but self-reports indicated no-change

Case Study 3



Inhibit	2-6
Inhibit	8-10
Inhibit	20-30
Reward	2-20



Case Study 3

- Self-report indicated:
  - Fluency -> slightly improved
  - Ability to read out loud -> much improved
  - Attention/Focus -> much improved
  - Teachers indicate much improved behavior

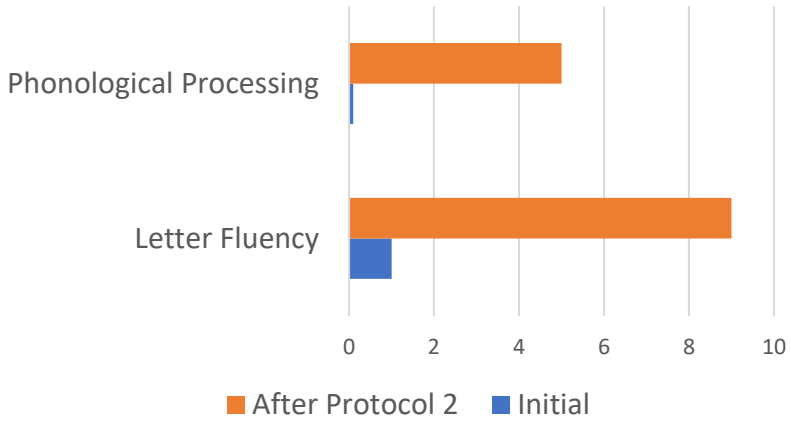
Post

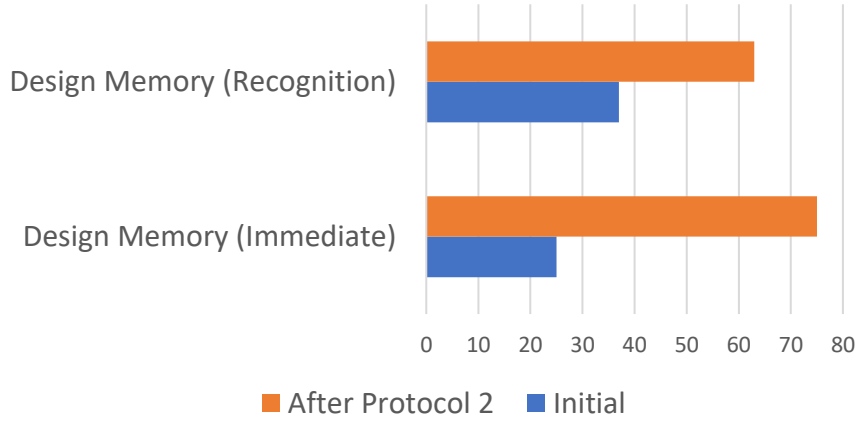
Time Range	Freq Range	Clust Coeff	Path Length	Global Eff	Radius	Diameter
63-94s	3-20Hz	0.009927007	89.39164156	0.018501664	118.6873	200.550825

Previous

Time Range	Freq Range	Clust Coeff	Path Length	Global Eff	Radius	Diameter
47-94s	2-20Hz	0.007062285	150.9438165	0.010735914	130.8422	371.774539

46%





Thank You