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Wired: Clinical Guide to Optimizing Neuroplasticity in Neurodevelopmental Disorders

Dr. Matthew Zaideman, DC CFMP, FIBFN-CND

Dr. Matthew Zaideman, DC, CFMP, FIBFN-CND

- Doctorate of Chiropractic Medicine
- Certified Functional Medicine Practitioner from Functional Medicine University
- Fellow of the International Board of Functional Neurology in Childhood Neurodevelopmental disorders
- Melillo Method™ Certified Provider
- Host of Neurotrition Podcast

How Did I Get Here?

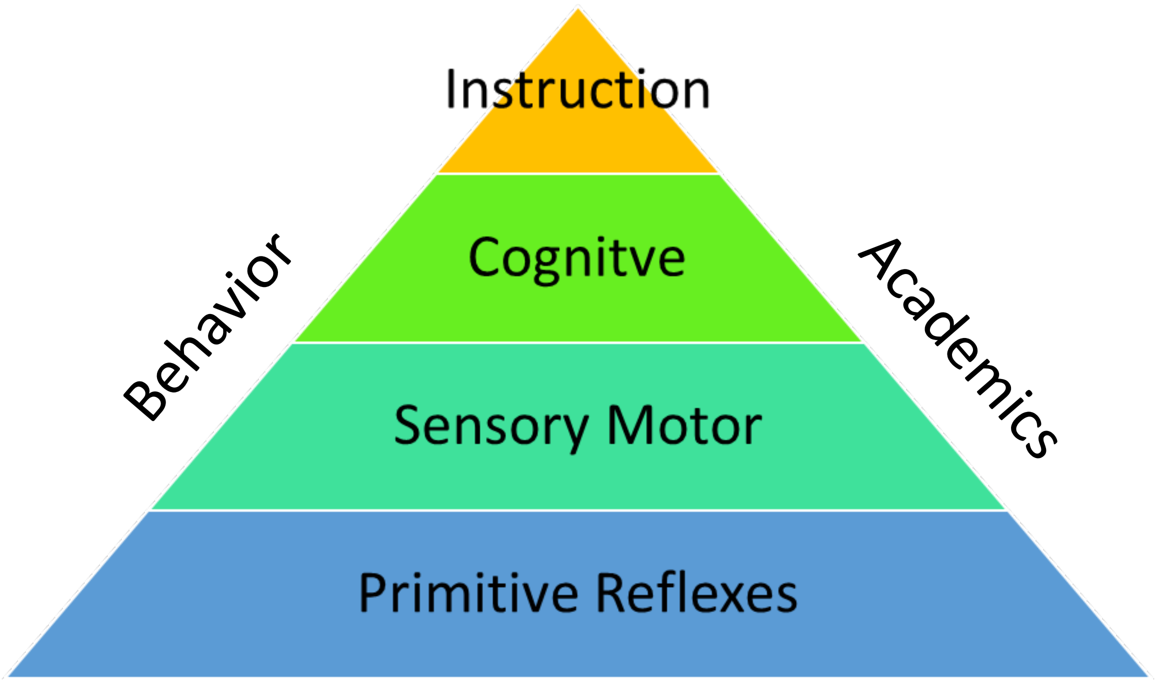
"All I can do is be me, whoever that is…"

–Bob Dylan

Covered Topics and Competencies

- Early Detection and Intervention
- Neuroanatomy of Neurodevelopmental Disorders
- Functional Neurology Evaluation
- Treatment Protocols and Considerations

Early Detection and Intervention



Primitive Reflexes

Primitive Reflex	Age Develops	Age Inhibited
Moro	In utero	2-4 months
Rooting	In utero	3-4 months
Palmer	In utero	2-3 months
ATNR	In utero	6 months
Spinal Gallant	In utero	3-9 months
TLR	Utero-birth	Flexion: 4 months Extension: 3 years
STNR	6-9 months	9-11 months
Landau	4-5 months	3.5 years
Babinski	In utero	12 months

Melillo R, Leisman G, Machado C,Machado-Ferrer Y,Chinchilla-Acosta M, Kamgang S,Melillo T and Carmeli E (2022)Retained Primitive Reflexes andPotential for Intervention in AutisticSpectrum Disorders.Front. Neurol.

CDC Developmental Guidelines

- Changed in February 2022 for the first time since 2004
- Milestones now based off what 75% of children can do vs 50%
- Crawling removed as a milestone
- Walking moved from 12 to 18 months
- Talking moved from 12 to 15 months
- Sitting without support from 6m to 9m
- Use 50 words from 24 months to 30 months

Functional Neurodevelopment
0-3 Months

- Gross Motor: Symmetrical tone; scarf sign; head steady when held; head 45 deg on stomach
- Fine Motor: hands open half the time; bats at objects
- Speech/Language: alerts to sound; startles to loud sounds; turns to voice; cooing
- Cognitive/Problem Solving: visual fixations at 10”; horizontal eye tracking; prefers usual caregiver; attends to novelty; follows past midline
- Social/Emotional: Bonding parent to child; self-soothing; attachment child to parent; social smile;
- Primitive Reflexes:
  - Active: Babinski, Stepping, Moro, Rooting, ATNR, TLR, Spinal Galant, Palmer Grasp
  - Integrated: Palmer Grasp

Compiled by Dr. Debbi Andrews, Division Director, 2009. Amended by D. Andrews and C. Dosman, August 2014. *Milestone ages approximate the 50th percentile. ‡ Sector heading mnemonic created by P. MacPherson, Class of 2012, University of Alberta Faculty of Medicine and Dentistry

Functional Neurodevelopment
4-6 Months

- Gross Motor: Sits w/ support; head up 90 deg prone; rolls front to back; sits tripod; rolls both ways
- Fine Motor: Reaches and obtains items; brings objects to midline; raking grasp; transfers hand to hand
- Speech/Language: Laugh, “ga,” sequel; Babbles (nonspecific)
- Cognitive/Problem Solving: anticipates routine, purposeful sensory exploration (eyes, hands, mouth); stranger anxiety; looks for dropped/partially hidden objects
- Social/Emotional: turn-taking conversations; explores parent’s face; expresses emotions: happy, sad, mad
- Primitive Reflexes:
  - Active: Babinski, ATNR, Spinal Galant, Landau
  - Integrated: Palmar Grasp, Rooting, Moro, TLR (Flexion) *

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Functional Neurodevelopment
7-9 Months

- Gross Motor: Get from all 4s to sitting; sits well with hands free; pulls to stand; creeping/crawling hand and knees
- Fine Motor: Inferior pincer grasp; Pokes at objects
- Speech/Language: “mamma” “dada” (specific); gestures “bye bye”; gesture games (“pattycake”)
- Cognitive/Problem Solving: object permanence; uncovers toy; “Peek a boo”
- Social/Emotional: Separation anxiety
- Primitive Reflexes:
  - Active: Babinski, Spinal Galant, Landau, STNR
  - Integrated: Moro, Palmer Grasp, Rooting, ATNR, TLR (flexion)

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Functional Neurodevelopment
10-12 Months

- Gross Motor: Walks a few steps; wide based gait;
- Fine Motor: Fine pincer; Voluntary release; throws objects; finger feeds;
- Speech/Language: 1 word with meaning (besides mama/dada); inhibits with “no!”; responds to name; 1-step command with gesture
- Cognitive/Problem Solving: cause/effect; trial/error; imitates gestures/sounds; uses objects functionally (rolls toy car);
- Social/Emotional: explore from secure base; points at wanted items; narrative memory begins
- Primitive Reflexes:
  - Active: Babinski, TLR (extension), Landau
  - Integrated: Moro, Rooting, Palmer Grasp, ATNR, Spinal Galant, TLR (flexion), STNR

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Age	Gross Motor	Fine Motor	Speech/Language	Cognitive/Problem Solving	Social/Emotional
15 m	Walks well	Uses spoon, open top cup; 2 block tower	Points to 1 body part; 1 step command no gesture; 5 words	Looks for hidden objects if saw being moved; Experiments with toys to make work	Shared attention; Brings toy to parent
18 m	Stoops/recovers; runs	Carries toys while walking; Removes clothes; 4 block tower; fisted pencil grip	Points to 3 body parts; 10-25 words; Labels familiar objects	Imitates housework; symbolic play doll/bear/etc;	Parallel play Increased independence
2 yr	Jumps on 2 feet; Up and down stairs (single stair)	Dominance established ; 6 block tower	Follows 2 step commands; 50+ words, 50% intelligible; 2 word phrases; Pronouns;	Searches for objects after multiple displacements;	Testing limits; Tantrums; “No!” “Mine!”
3 yr	Pedals trike; Up stairs alternating feet	Undresses; Toilet trained Draw circles/cross Turn pages of books	3 Step commands; 200 words, 75% intelligible; 3-4 word phrases; W questions; Full name, age	Simple time concepts; Compares “bigger/smaller” Counts to 3	Sharing; empathy; Co-op play Pretending
4 yr	Hops on one foot Down stairs, alternating	Draws most shapes; Cuts shapes with scissors Buttons	Sentences, 100% intelligible; Tells a story Past tense	Counts to 4 Opposites Identifies 4 colors	Preferred Friends Elaborate fantasy play
5 yr	Balance on one foot for 10 seconds; Skips; learning to bicycle	Draw person Tripod pencil grasp Prints name, copies letters	5000 words Future tense Word play, jokes	Counts to 10 accurately Recite ABCs Recognizes some letters Pre-literacy skills	Has group of friends Follow group rules Games with rules

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Motor Development and Cognition

frontiers in
SYSTEMS NEUROSCIENCE

REVIEW ARTICLE
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Cognitive-motor interactions of the basal ganglia in development

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Neural circuits linking activity in anatomically segregated populations of neurons in subcortical structures and the neocortex throughout the human brain regulate complex behaviors such as walking, talking, language comprehension, and other cognitive functions associated with frontal lobes. The basal ganglia, which regulate motor control, are also crucial elements in the circuits that confer human reasoning and adaptive function. The basal ganglia are key elements in the control of reward-based learning, sequencing, discrete elements that constitute a complete motor act, and cognitive function. Imaging studies of intact human subjects and electrophysiologic and tracer studies of the brains and behavior of other species confirm these findings. We know that the relation between the basal ganglia and the cerebral cortical region allows for connections organized into discrete circuits. Rather than serving as a means for widespread cortical areas to gain access to the motor system, these loops reciprocally interconnect a large and diverse set of cerebral cortical areas with the basal ganglia. Neuronal activity within the basal ganglia associated with motor areas of the cerebral cortex is highly correlated with parameters of movement. Neuronal activity within the basal ganglia and cerebellar loops associated with the prefrontal cortex is related to the aspects of cognitive function. Thus, individual loops appear to be involved in distinct behavioral functions. Damage to the basal ganglia of circuits with motor areas of the cortex leads to motor symptoms, whereas damage to the subcortical components of circuits with non-motor areas of the cortex causes higher-order deficits. In this report, we review some of the anatomic, physiologic, and behavioral findings that have contributed to a reappraisal of function concerning the basal ganglia and cerebellar loops with the cerebral cortex and apply it in clinical applications to attention deficit/hyperactivity disorder (ADHD) with biomechanics and a discussion of retention of primitive reflexes being highly associated with the condition.

Keywords: basal ganglia, frontal lobe, cognition, autism, ADHD, posture

Importance of Motor Development

Motor Impairment in Sibling Pairs Concordant and Discordant for Autism Spectrum Disorders

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- *Washington University in St Louis, USA* John Constantino *Washington University in St Louis, USA*

- **Abstract**
- *Aim:* Although motor impairment is frequently observed in children with autism spectrum disorders (ASD), the manner in which these impairments aggregate in families affected by autism is unknown. We used a standardized measure of motor proficiency to objectively examine quantitative variation in motor proficiency in sibling pairs concordant and discordant for ASD.
- *Methods:* Motor impairment of sibling pairs from 67 ASD-affected families comprising 29 concordant pairings and 48 discordant pairings were assessed using the Bruininks Oseretsky Test of Motor Proficiency, 2nd Edition, a standardized measure of motor proficiency.
- *Results:* Motor skills were substantially impaired among ASD-affected children and highly correlated with autistic severity and IQ, whereas motor skills in unaffected siblings were essentially normal. Total motor composite scores of at least one standard deviation below the general population mean were seen in 83% of the affected group compared with 6% in the unaffected siblings.
- *Interpretation:* Findings indicate that motor impairment constitutes a core characteristic of ASD (not necessarily an ASD endophenotype), which has distinct implications for taxonomy, diagnosis, and approaches to intervention.

Stress in Pregnancy

The Impact of Maternal Gestational Stress on Motor Development in Late Childhood and Adolescence: A Longitudinal Study.

- TGrace T, et al. Child Dev. 2016 Jan-Feb.
- Show full citation
- **Abstract**
- The number and timing of stressors experienced during pregnancy were investigated using longitudinal data from the Western Australian Pregnancy (Raine) Study cohort (N = 2,900). Motor development data were collected at 10 (n = 1,622), 14 (n = 1,584), and 17 (n = 1,222) years using the McCarron Assessment of Neuromuscular Development. Linear mixed models were used to examine the effect of stress on motor development, accounting for repeated measures. Number of stressful events and mean Neuromuscular Development Index were negatively related (β = -1.197, p = .001). Stressful events experienced in late pregnancy were negatively related with offspring motor development (β = -0.0541, p = .050), while earlier stressful events had no significant impact.
-

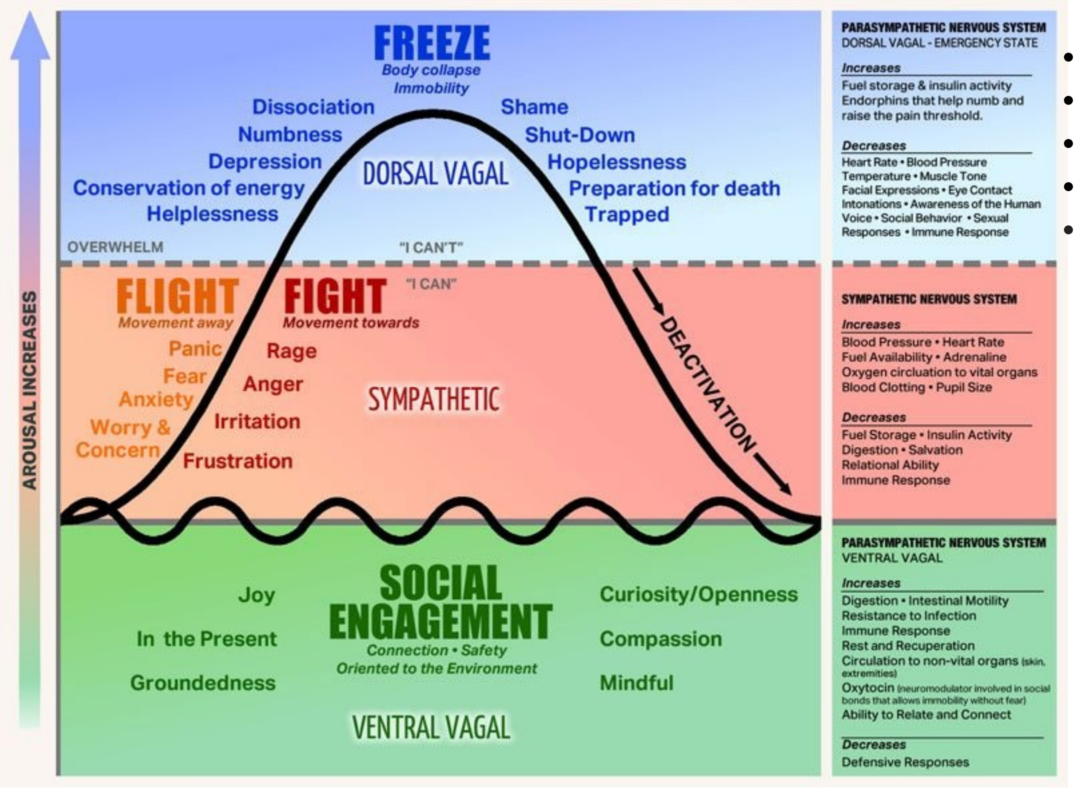
Adverse Childhood Events (ACE)

- Adverse childhood events are potentially traumatic events from ages 0-17
- Common examples are abuse, neglect, violence in the home, caregivers in prison, mental health and substance abuse in the home
- Higher ACEs scores corelate with higher risk to chronic health issues and lower life expectancy
- One study showed that people with 6 or more ACEs died on average 20 years earlier (60.6 years vs 79.1 years)

https://www.cdc.gov/violenceprevention/aces/fastfact.html

https://www.ajpmonline.org/article/S0749-3797(09)00506-6/fulltext

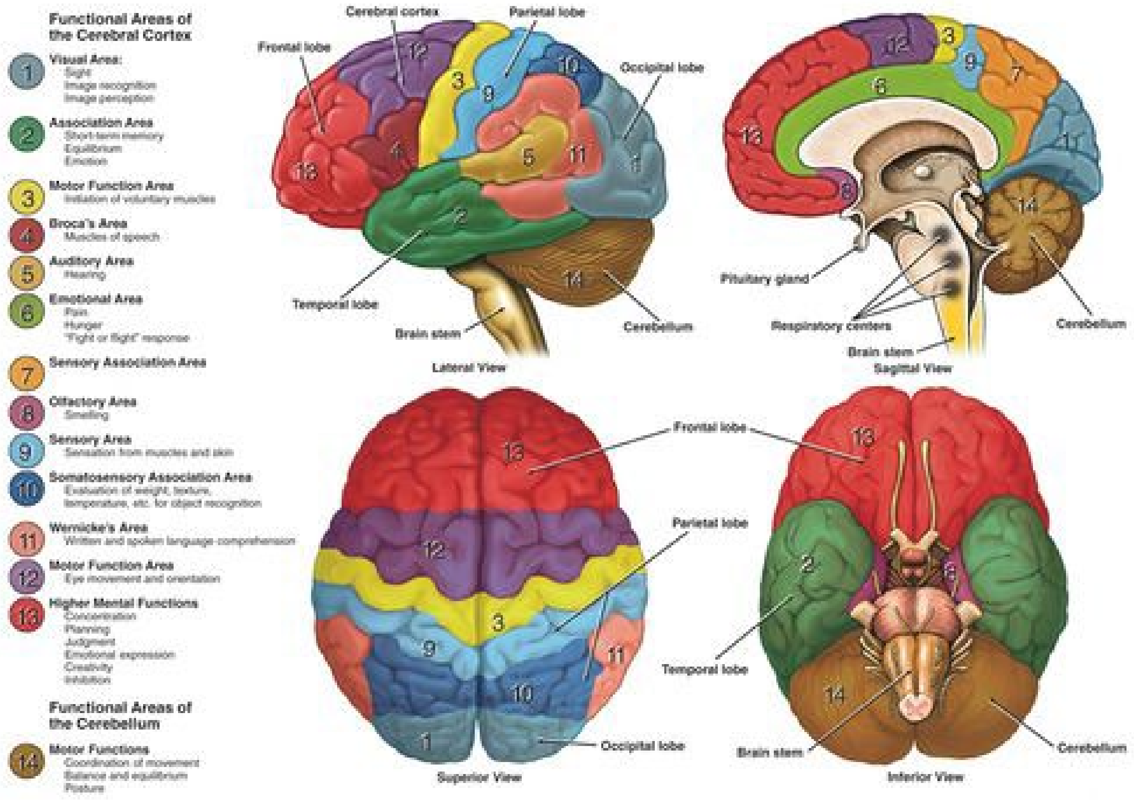
Polyvagal theory



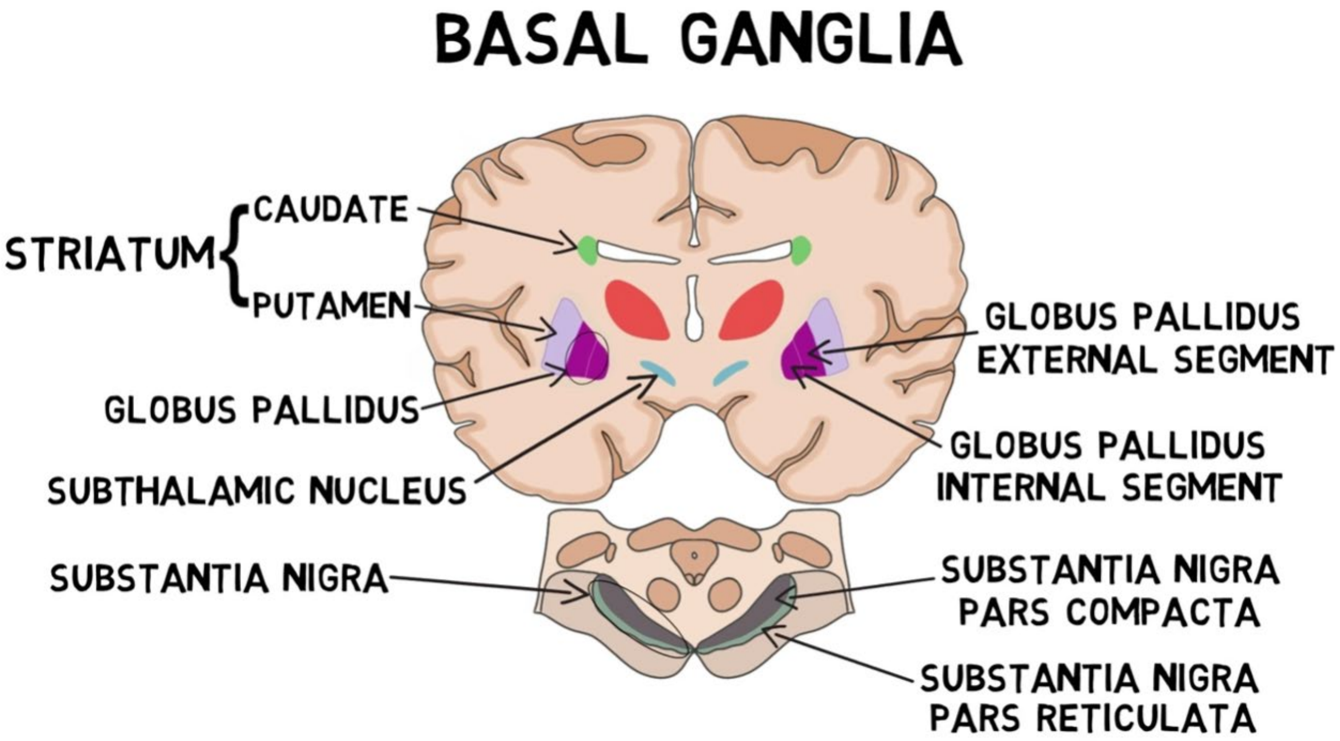
- Developed by Dr. Stephen Porges, PhD
- 2 vagal systems dorsal and ventral
- Dorsal: unmyelinated more
- Ventral: myelinated
- “The theory links the evolution of the autonomic nervous system to affective experience, emotional expression, facial gestures, vocal communication, and contingent social behavior. In this way, the theory provides a plausible explanation for the reported covariation between atypical autonomic regulation (eg, reduced vagal and increased sympathetic influences to the heart) and psychiatric and behavioral disorders that involve difficulties in regulating appropriate social, emotional, and communication behaviors.”

Porges SW. The polyvagal theory: new insights into adaptive reactions of the autonomic nervous system. Cleve Clin J Med. 2009 Apr;76 Suppl 2(Suppl 2):S86-90.

Neuroanatomy



Basal Ganglia



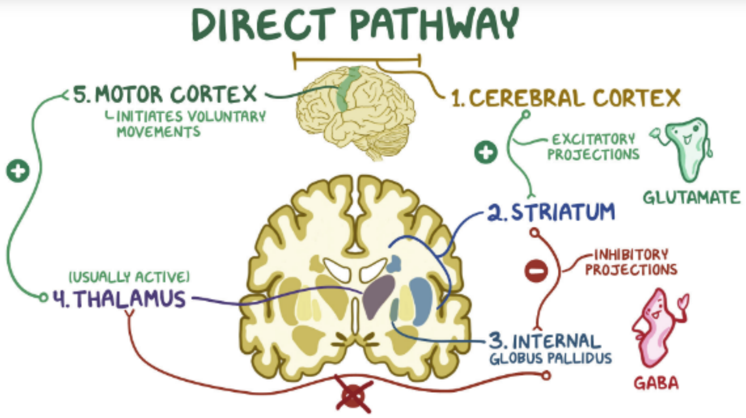


Figure 54.18 Direct pathway. Cerebral cortex sends excitatory projections to striatum → sends inhibitory projections to internal globus pallidus → sends inhibitory projections to thalamus. When striatum inhibits internal globus pallidus, internal globus pallidus can't inhibit thalamus → thalamus is free to send excitatory signals to motor cortex.

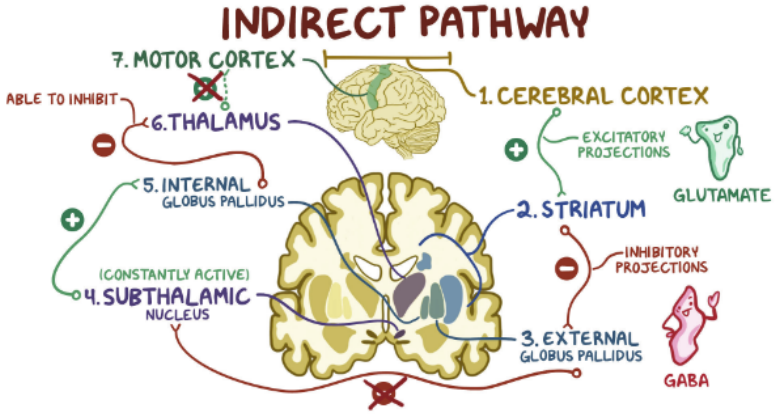


Figure 54.19 Indirect pathway. Cerebral cortex sends excitatory projections to striatum → sends inhibitory projections to external globus pallidus → sends inhibitory projections to subthalamic nucleus. When striatum inhibits external globus pallidus, external globus pallidus can't inhibit subthalamic nucleus → subthalamic nucleus is free to send excitatory signals to internal globus pallidus. Internal globus pallidus inhibits thalamus, preventing it from sending excitatory signals to the motor cortex.

Prefrontal Connections

- Frontal lobes are responsible for most of the more complex motor, emotional behavioral and cognitive functions.
- Work with involved structures including basal ganglia, thalamus and cerebellum
- Need interconnectivity between hemispheres to regulate and function efficiently

Prefrontal Connections

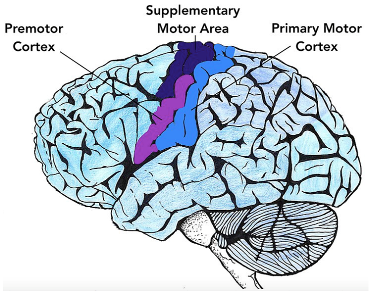
- 1. Supplementary motor area (motor movement)
- 2. Frontal eye fields (saccadic eye movements)
- 3. Dorsal lateral prefrontal (executive function)
- 4. Orbital frontal (social engagement)
- 5. Anterior cingulate (motivation)

Supplementary Motor Area

- Broadman Area 6
- Involved in motor activity
- Overactivity in the left hemisphere activates the direct pathway, increasing unwanted movements, motor tics, and stereotypical movements seen in ADHD, ASD, and Tourette's Syndrome
- Overactivity in left hemisphere and underactivity in right hemisphere is connected to hyperactivity seen ADHD

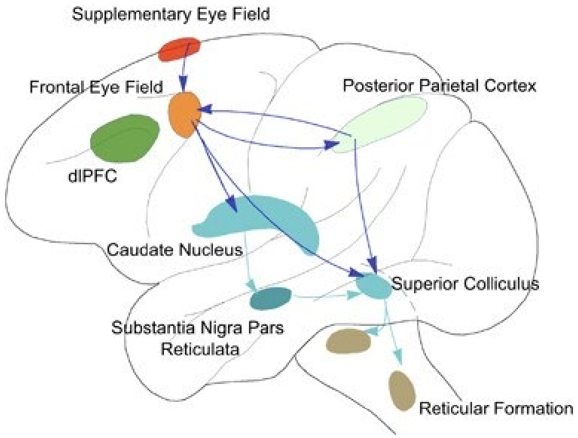
* Leisman G and Melillo R (2022) Front and center: Maturational dysregulation of frontal lobe functional neuroanatomic connections in attention deficit hyperactivity disorder. Front. Neuroanat. 16:936025. doi: 10.3389/fnana.2022.936025

*Melillo, R.; Leisman, G.;Machado, C.; Machado-Ferrer, Y.;Chinchilla-Acosta, M.; Melillo, T.;Carmeli, E.The Relationshipbetween Retained PrimitiveReflexes and HemisphericConnectivity in Autism SpectrumDisorders.Brain Sci.2023,13, 1147.https://doi.org/10.3390/brain-sci13081147



Frontal Eye Fields

- Broadman area 8
- Involved in saccadic eye movement
- Part of the ventral attention network which is more lateralized to the right hemisphere contributing to sustained attention



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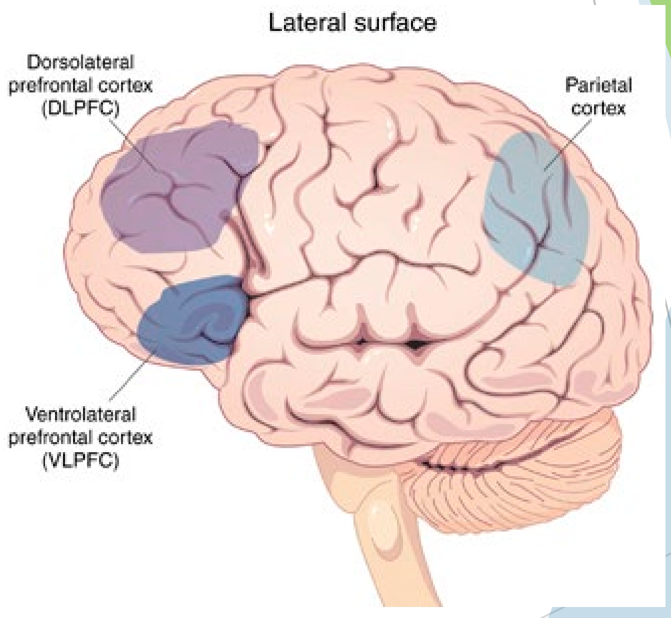
Dorsolateral Prefrontal Cortex

- Broadman area 46,9
- Involved in Executive Function
- Right hemisphere activates hyperdirect pathway of basal ganglia which activates the indirect pathway, inhibiting unwanted or inappropriate, emotions, social behavior, thoughts, etc



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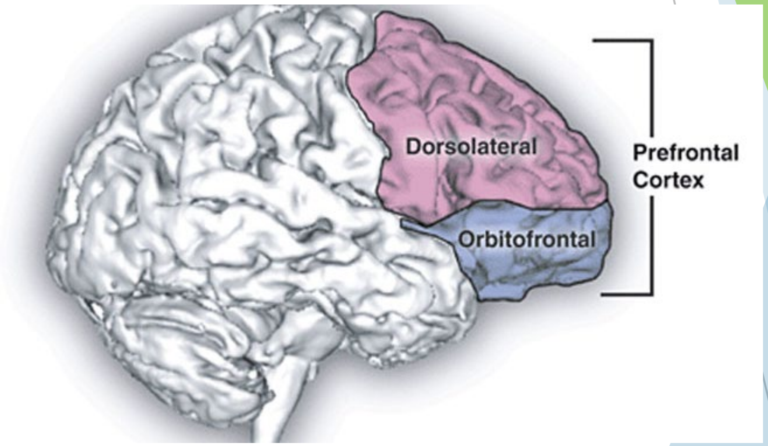
Orbitofrontal Cortex

- Broadman area 10,11
- Involved in social engagement
- Contributes to sensory integration
- Right hemisphere activates hyperdirect pathway of basal ganglia which activates the indirect pathway, inhibiting unwanted or inappropriate, emotions, social behavior, thoughts, etc



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Anterior Cingulate

- Broadman Area 25, 32
- Motivation
- Right hemisphere activates hyperdirect pathway of basal ganglia which activates the indirect pathway, inhibiting unwanted or inappropriate, emotions, social behavior, thoughts, etc

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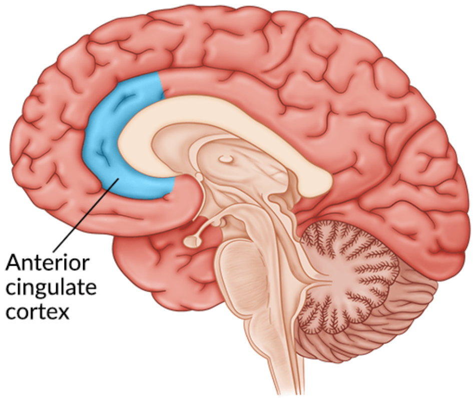

Stroop Test

Red Green Purple
Brown Blue Red

Purple Red Brown
Red Green Blue

Primary Somatosensory Cortex

- Sensory information from the opposite side of the body
- Right hemisphere does final processing via the right insula cortex (BA 13)
- Connects with vestibular system which is integrated via primitive reflexes

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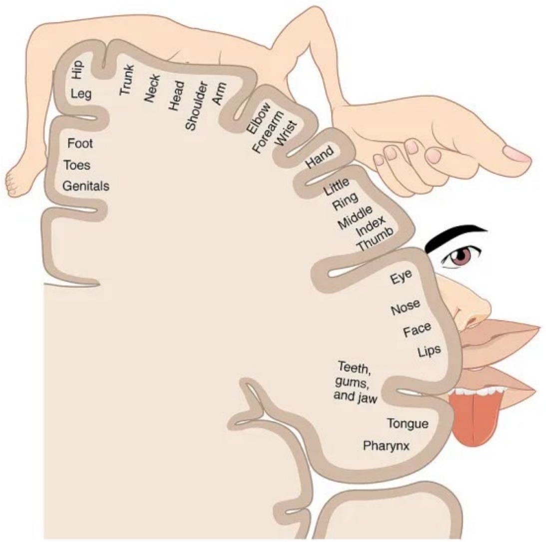
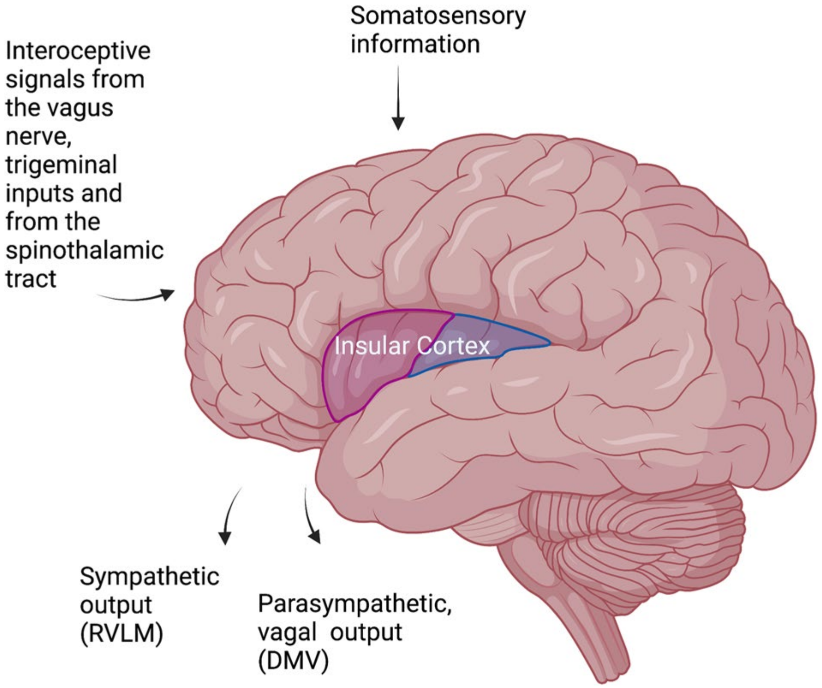


Insular Cortex

- Right hemisphere does final processing via the right insula cortex (BA 13)
- Interoception

*



Evaluation and Treatment Procedures

- Basis of treatment is to integrate primitive reflexes and hemispheric sensory stimulation to the weak hemisphere creating neuroplasticity
- The following treatment strategies are based of the research of Dr. Robert Melillo

Functional Neurology Evaluation

- Primitive Reflexes
- Cranial Nerves/Vitals
- Balance/Cerebellum/Vestibular
- Eye Movements
- Sensory
- Posture
- HRV

Goal of evaluation: Detect signs of cortical immaturity and imbalance

Retained Primitive Reflexes in ASD

- Primitive reflexes are key in the development of motor skills and coordination
- RPRs are a sign of developmental immaturity
- This cortical immaturity and motor coordination can create a cascading effect into abnormal brain development and sequence disrupting normal lateralization and temporal coherence

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REVIEW
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Check for updates

Retained Primitive Reflexes and Potential for Intervention in Autistic Spectrum Disorders

Robert Melillo[1], Gerry Leisman[1,2], Calixto Machado[3], Yanin Machado-Ferrer[3], Mauricio Chinchilla-Acosta[3], Shanine Kamgang[4], Ty Melillo[5] and Eli Carmeli[1]*

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We provide evidence to support the contention that many aspects of Autistic Spectrum Disorder (ASD) are related to interregional brain functional disconnectivity associated with maturational delays in the development of brain networks. We think a delay in brain maturation in some networks may result in an increase in cortical maturation and development in other networks, leading to a developmental asynchrony and an unevenness of functional skills and symptoms. The paper supports the close relationship between retained primitive reflexes and cognitive and motor function in general and in ASD in particular provided to indicate that the inhibition of RPRs can effect positive change in ASD.

Keywords: top-down processing, bottom-up processing, neuronal synchrony, maturational delay, autism spectrum disorders, retained primitive reflexes

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INTRODUCTION

What Are Retained Primitive Reflexes and What Is the Controversy?

The term "primitive reflex" was first used by Buckley (1). Primitive or infantile reflexes are

THE ASYMMETRICAL TONIC NECK REFLEX (ATNR)

DESCRIPTION	AGE DEVELOPS	AGE INHIBITED	SIGNS AND SYMPTOMS OF RETENTION
1. Movement of baby's head to one side will result in extension of the arm and leg to the side that the head is turned and flexion of the limbs on the opposite side of the body 2. ATNR assists in vaginal birth	Begins to develop 18 weeks in utero	Approximately 6 months of life	1. Balance issues 2. Homolateral instead of cross-lateral movements when walking 3. Difficulty crossing midline 4. Poor eye tracking 5. Hand eye coordination issues 6. Poor handwriting

Brain Chat

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Attention deficit hyperactivity disorder is associated with (a) symmetric tonic neck primitive reflexes: a systematic review and meta-analysis

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Introduction: Investigation on the association between attention deficit hyperactivity disorder (ADHD) and primary reflexes is in the initial stage, with considerable differences in the findings. This study evaluated the association between ADHD and primitive reflexes using systematic review and meta-analysis.

Methods: Data were obtained from PubMed, Cochrane Library, Web of Science, EBSCO (Medical Literature Analysis and Retrieval System Online, American Psychological Association PsycInfo, and Education Resources Information Center), Embase, Scopus, and ProQuest. Articles were searched from the date of inception of the respective databases to January 01, 2023, and StataCorp Stata (version 15) was used for the analysis.

Results: Four articles with 229 samples were included in the meta-analysis. Results showed a significant positive and moderate correlation between ADHD and primitive reflexes, particularly asymmetric tonic neck reflex: summary *r* value=0.48, 95% CI=0.27–0.64; symmetric tonic neck reflex: summary *r* value=0.39, 95% CI=0.25–0.52. Overall, findings from the sub-group analysis indicate that the behavioral problem measuring tool (Conners' scale), sex, and primitive reflex test could significantly moderate the relationships between ADHD and ATNR and STNR primitive reflexes.

Conclusion: ADHD symptoms in children are closely related to the non-integration of (a)symmetric tonic neck primitive reflexes. Longitudinal or experimental studies should be conducted to reveal the causal relationship between ADHD and primitive reflexes in the future.

KEYWORDS

primitive reflexes, attention deficit and hyperactivity disorder, meta-analysis, asymmetric tonic neck reflex, symmetric tonic neck reflex

ATNR Testing

Asymmetrical Tonic Neck Reflex Tests

Patient starting Position: Hands and knees.
Tester Position: kneeling in front of patient.

The Tester firmly but gently turns the patient's head to the side and holds for 3-5 seconds. Then the Tester turns the patients head to the opposite side for 3-5 seconds.

The patient's elbow should remain straight

Signs of a retained ATNR would be if the elbow bends, the arm shakes, or the trunk rotates

THE MORO REFLEX

DESCRIPTION	AGE DEVELOPS	AGE INHIBITED	SIGNS AND SYMPTOMS OF RETENTION
1. Considered the fight or flight response 2. Triggered by sudden unexpected sound or movement 3. Arms and legs move outwards with quick inhalation, then freeze and slowly move back in as child exhales 4. Accompanied by possible outburst of cries	Begins to develop 9 weeks in utero	2-4 months of life	1. Hypersensitive and/or reactive 2. Poor impulse control 3. Motion sickness and poor coordination 4. Physically timid 5. Visual perception problems 6. Sensitivity to light 7. Sensitivity to sound 8. Dislike changes and surprises

Brain Chat

Moro Reflex

Starting Position for Patient: Standing with eyes closed, feet together, and arms at the individual's sides
The Tester stands behind the patient. Do not do this test if the patient being tested is larger than the Tester or if the Tester would not be able to hold the patient's wieght.

The Patient is instructed to close their eyes, lift their arms up parallel to the floor, and fall backwards when they hear a loud clap.
The Tester will stand behind the Patient and clap loudly. As the individual falls backwards, the test catches them. DO NOT PERFORM THIS TEST ON SOMEONE YOU CAN NOT CATCH

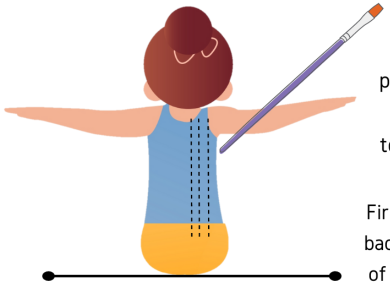
The Patient should be able to fall backwards with no issues keeping their eyes closed, feet together, and arms out in front of them.

Signs of a retained moro reflex are if the Patient cannot fall back, if they put a foot back, if they let out a cry, if their arms extend in any direction.

THE SPINAL GALANT REFLEX

DESCRIPTION	AGE DEVELOPS	AGE INHIBITED	SIGNS AND SYMPTOMS OF RETENTION
1. Assists in birthing process 2. While the child is in the prone position, stimulation of the back on one side of the spine will result in hip flexion (rotation) to 45 degrees towards the side of stimulus	Begins to develop 20 weeks in utero	3-9 months of life	1. Fidgeting 2. Bedwetting 3. Poor concentration 4. Poor short term memory 5. Unilateral or bilateral postural issues

Spinal Galant

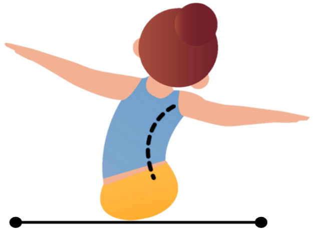


Starting Position: Any position where the Patient's back is accessible. This test is best done directly on skin.

Firmly stroke down the Patient's back with a tool such as the back of a reflex hammer, paint brush, or stick. Stroke from top to bottom starting parallel to the spine and slowly moving outwards. The repeat on opposite side.

The Patient should be able to remain still while being tested

A sign of a retained Spinal Galant would be if the Patient bends to the side being stimulated



NORTH FLORIDA

THE SYMMETRICAL TONIC NECK REFLEX (STNR)

DESCRIPTION	AGE DEVELOPS	AGE INHIBITED	SIGNS AND SYMPTOMS OF RETENTION
1. Two parts to this reflex: flexion and extension 2. When child is prone resting on all four limbs, flexion of the head causes the arms to bend and the legs to extend 3. Head extension causes the legs to flex and the arms to straighten 4. Helps the child to defy gravity by getting off the floor into the prone position 5. Helps to inhibit the TLR	Both flexion and extension emerges 6-9 months of life	Both flexion and extension 9-11 months of life	1. Poor posture 2. Tendency to slump when sitting 3. Simian (ape like) walk 4. Poor hand-eye coordination 5. Difficulty sitting still and concentrating

Brain Chat

Symmetrical Tonic Neck Reflex Test

Patient starting Position: Hands and knees.
Tester Position: kneeling in front of patient.

The Tester firmly but gently bends the patient’s head into flexion and holds for 3-5 seconds. Then the Tester bends the patient’s head into extsion for 3-5 seconds.

The patient’s elbow(s) should remain straight

Signs of a retained STNR would be if the elbow(s) bends, or the hips flex

THE TONIC LABYRINTHINE REFLEX (TLR)

DESCRIPTION

1. Two parts to this reflex: flexion and extension
2. Basis for head management and postural stability using major muscle groups
3. Reflex is elicited by either moving the head forward or backwards (above or below the spine)
4. Assists baby in developing more extensor tone in posture
5. Balance, muscle tone and proprioception are all trained during this process

AGE DEVELOPS

Flexion develops in utero. Extension at birth

AGE INHIBITED

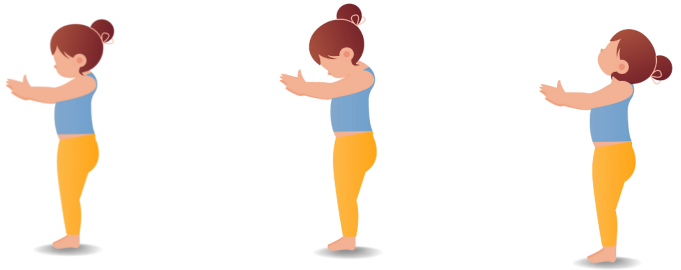
Flexion around 4 months of life. Extension up to 3 years old

SIGNS AND SYMPTOMS OF RETENTION

1. Poor posture
2. Weak muscle tone
3. Visuospatial perception issues
4. Poor sequencing
5. Dislike participating in sports
6. Poor organization skills
7. Poor sense of time

Brain Chat

Tonic Labyrinthine Reflex Test



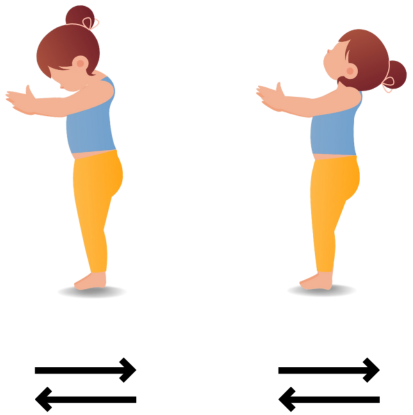
Patient Starting Position: Standing with eyes closed, feet together and arms up parrallel to the floor

Tester puts patient head into flexion

Tester puts patient head into extension

Tester Position: Behind Patient to help stabilize if necessary

The Patient should be able to remain still without swaying



Swaying back and forth is a sign of a retained TLR

THE LANDAU REFLEX

DESCRIPTION	AGE DEVELOPS	AGE INHIBITED	SIGNS AND SYMPTOMS OF RETENTION
1. Helps to inhibit the TLR and forms the bridge to the next stage of development 2. Engages the extensor tone throughout the body in the prone position if the baby is suspended in the air with support under the stomach 3. To assist with posture development	Emerges 4-5 months of life	3.5 years of life	1. Affects the development of balance and muscle tone in rapidly changing conditions 2. Runs with stiff, awkward movements 3. Find hopping, skipping and jumping difficult

Brain Chat

THE PALMAR REFLEX

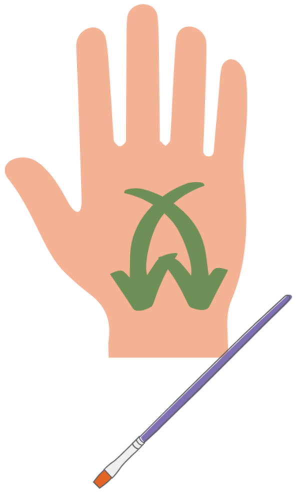
DESCRIPTION	AGE DEVELOPS	AGE INHIBITED	SIGNS AND SYMPTOMS OF RETENTION
1. Light touch or pressure in the palm of the hand will cause the fingers to close and “grasp”	Begins to develop 11 weeks in utero	2-3 months of life	1. Poor manual dexterity and/or fine motor skills 2. Poor writing skills (messy writing or pressing too hard) 3. Speech difficulties (hand and mouth relationship via the Babkin response)

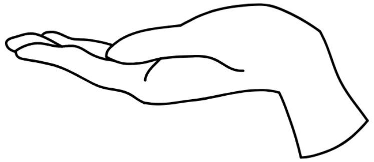
Palmer Grasp Reflex Test

Patient starting position: Hand is accessible to the Tester

Needs: Thin paint brush or a similar item

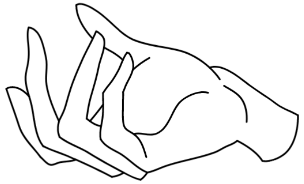
Patient's hand is held out with palm up. The patient is instructed to relax. The Tester gently but firmly makes an "X" on the patient's palm.





The hand should remain still and relaxed

If the hand flexes or curls inward it is a sign of a retained palmer grasp reflex



THE ROOTING REFLEX

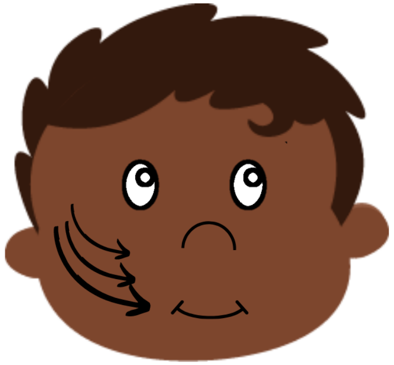
DESCRIPTION	AGE DEVELOPS	AGE INHIBITED	SIGNS AND SYMPTOMS OF RETENTION
1. Searching, sucking and swallowing reflex 2. Light touch of the cheek or stimulation of the edge of the mouth will cause the baby to turn their head toward the side of stimulus and open the mouth in preparation for sucking	Begins to develop 24-28 weeks in utero	3-4 months of life	1. Hypersensitivity around the lips or mouth 2. Tongue may be positioned too far forward in the mouth 3. Speech and articulation problems 4. Poor manual dexterity (Babkin response)

Brain Chat

Rooting Reflex Test

Patient starting position: The face is accessible to the Tester

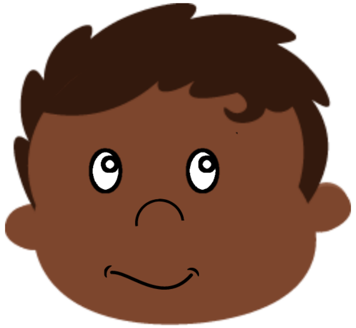
Needs: Thin paint brush or a similar item



The Tester firmly but gently strokes the patient's face using the back of a reflex hammer, paint brush, or something similar. The Tester strokes from the cheek to top of the ear to the corner of the mouth, the middle of the ear to the corner of the mouth, and from the bottom of the ear to the corner of the mouth.

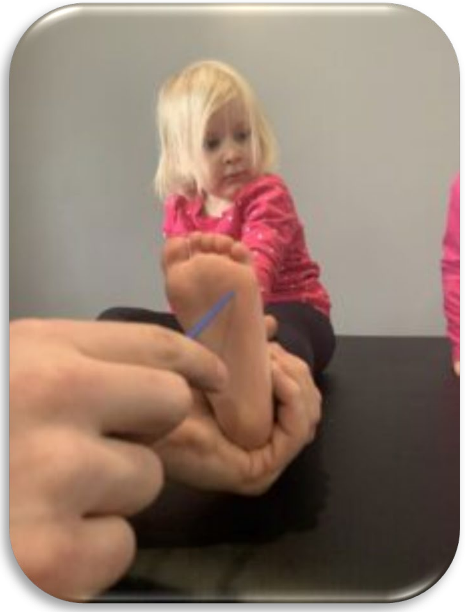
The patient's face should remain in a neutral position

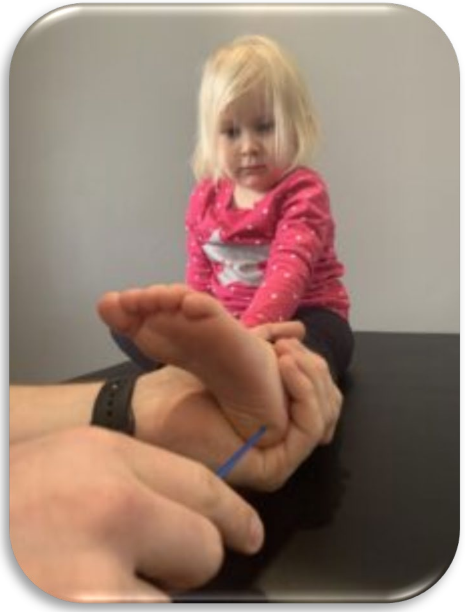
If the head turns towards the side being stimulated, opens their mouth, or the lips twitch it is a sign of a retained rooting reflex



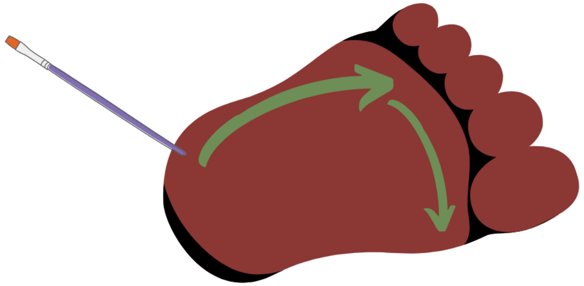
Babinski Reflex

Age present/Age integrated: In utero -12 months
Signs of retention: Delayed walking, toe walking, balance issues





Babinski Reflex

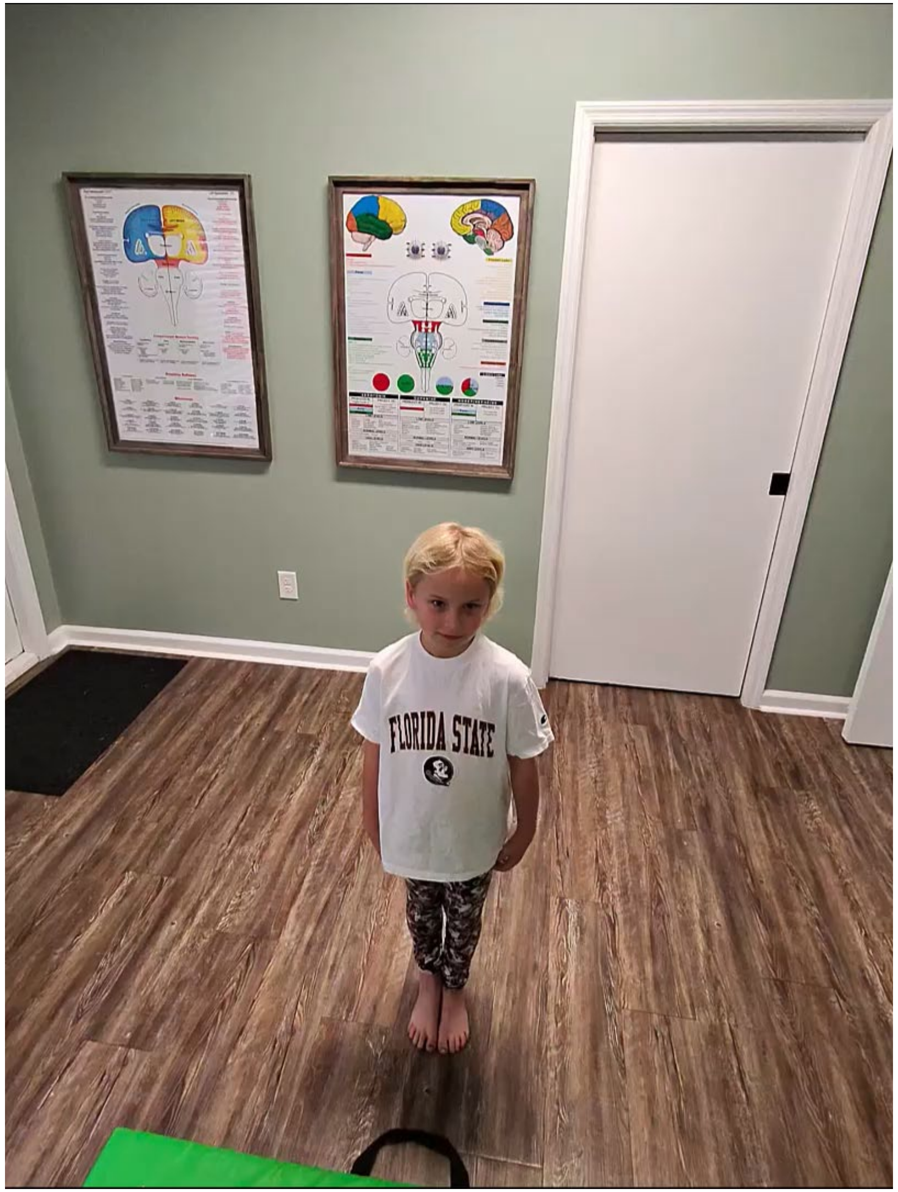


Starting Position: Patient's barefoot accessible
Needs: Thin paint brush or a similar item

Using the back side of a thin paint brush firmly stroke down the bottom of the foot from the side of the heel to just below the pinky toe. Then stroke across from below the pinky toe over the the big toe.

The Patients foot should remain still or withdrawl

If the big toe extends while the other toes splay outward then it is a sign of a retained Babinski reflex


FLORIDA STATE

Left Brain vs Right Brain

L

- Detail Oriented
- Verbal
- Fine Motor
- IQ (Intelligence)
- Positive Emotions
- Conscious Actions, Memory, Learning
- Auditory Processing
- Linear and Logical Thinking

R

- Big Picture
- Non-Verbal
- Gross Motor
- EQ (Emotional)
- Negative Emotions
- Unconscious Actions, Memory, Learning
- Tactile Processing
- Understanding Abstract Concepts

Vitals

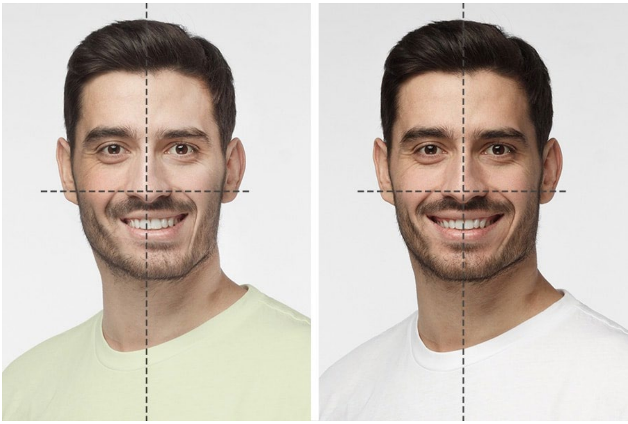
- Bilateral BP, HR, O2%
- Look for asymmetry
- Increased BP, HR, decreased O2% can indicated increased sympathetic tone on that side
- Increased sympathetic tone can indicate hemispheric weakness on ipsilateral side

Cranial Nerves

I. Olfactory testing Check left vs right
II. Pupillary light Response – look for asymmetry
III. Pupillary light response, Convergence, fields of gaze
IV. Convergence, fields of gaze
V. Compare bilateral tone of masseter muscles
VI. Convergence, fields of gaze
VII. Facial muscle symmetry
VIII. Whisper/Tunning fork
IX. Palate symmetry
X. Gag reflex
XI. SCM/Trap muscle testing
XII. Tongue deviation

CN Key Findings

- Slower pupillary constriction to light: ipsilateral weak hemisphere
- Tongue deviation: ipsilateral weak hemisphere
- Soft palate weakness: ipsilateral weak hemisphere
- Facial muscle imbalance: weak side ipsilateral weak hemisphere

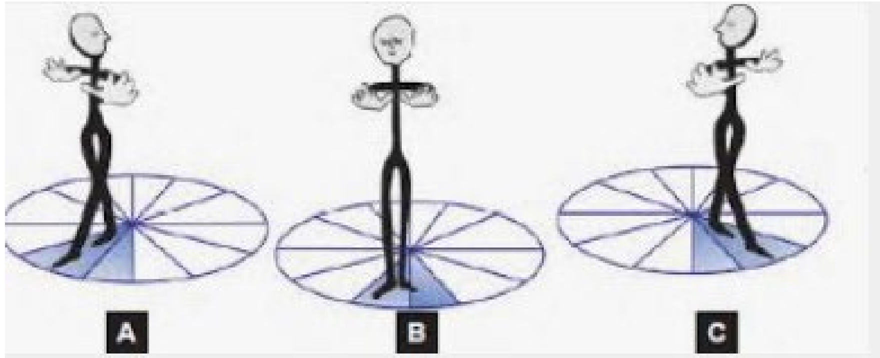


Balance/Cerebellum/Vestibular

- Force balance plate testing
- Romberg
- 1 leg stand
- Fukuda
- VOR
- Post Rotational Nystagmus

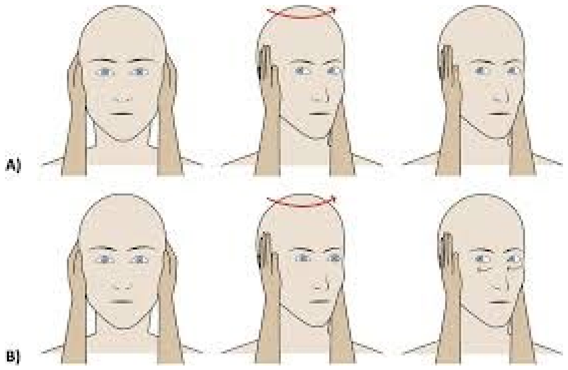
Fukuda Test

- Rotation to one side can indicate ipsilateral vestibular weakness



VOR

- Eyes moving with head/corrective saccade indicates ipsilateral vestibular weakness
- Head turning w/fixation
- Head impulse Test

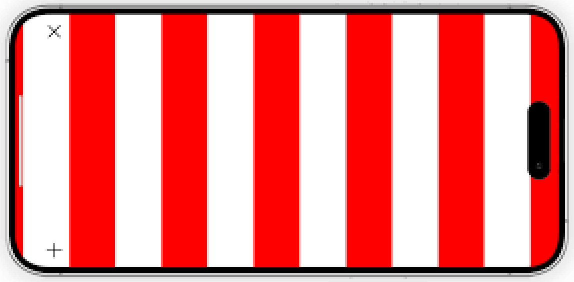


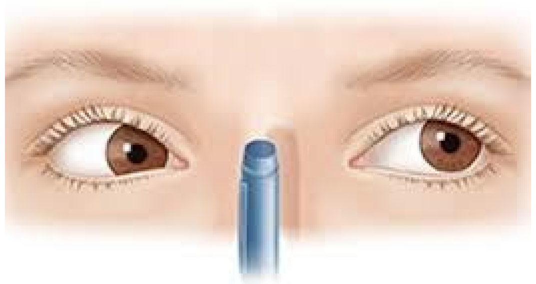
Post Rotational Nystagmus

- 10 rotations at 2 seconds per rotation
- Nystagmus normal for 10-12 seconds
- Decrease nystagmus CW is right hemispheric weakness, CCW left hemispheric weakness

Eye Movements

- Computerized eye tracking
- Optokinetic (OPK)
- Convergence
- Pursuits
- Saccades





Sensory Testing

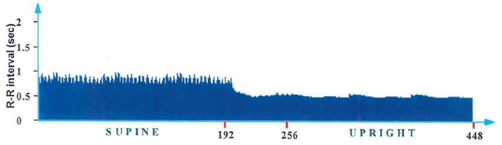
- Olfactory Testing
- Graphesthesia – Tracing numbers/letters onto the hand
- Stereognosis – familiar object in hand (key, coin)
- Extinction- touch each arm individually, then touch both at same time and as which arm they felt

Heart Rate Variability

- Measures the difference in between heart beats or R-R intervals
- Orthostatic testing can challenge ANS regulation by measuring R-R intervals during a normal stressor
- Vagus nerve hypofunction is marked by PSNS hyper-regulation

Testing HRV

Electrocardiographic Rhythm Strip



HR	R(HF)	R(LF1)	R(LF2)
70	11	24	28

HR	R(HF)	R(LF1)	R(LF2)
117	29	29	28

Extrasystoles analysis

Extrasystoles not recognized

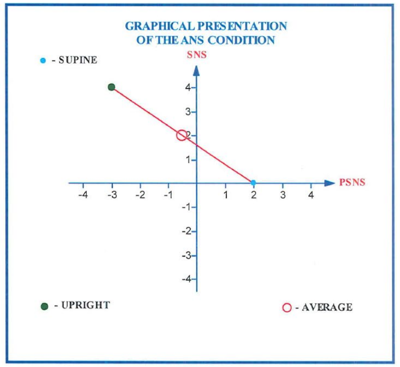
Supine

BP	PP	MAP
N/A	N/A	N/A

Upright

BP	PP	MAP
N/A	N/A	N/A

ANS ASSESSMENT (SUPINE)	ANS ASSESSMENT (UPRIGHT)
INFLUENCE OF PARASYMPATHETIC SYSTEM PREVAILS MODERATELY WHILE SYMPATHETIC ACTIVITY ON AVERAGE LEVEL	PARASYMPATHETIC SYSTEM IS DECREASED SIGNIFICANTLY WHILE SYMPATHETIC IS INCREASED SHARPLY

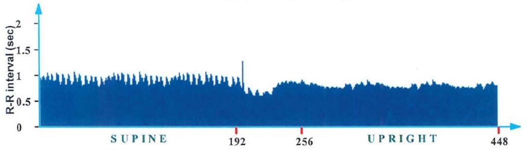


CONCLUSION

- 0.5 - ACTIVITY OF PARASYMPATHETIC SYSTEM

2.0 - ACTIVITY OF SYMPATHETIC SYSTEM

Electrocardiographic Rhythm Strip



HR	R(HF)	R(LF1)	R(LF2)
64	10	19	23

HR	R(HF)	R(LF1)	R(LF2)
75	25	24	29

Extrasystoles analysis

Extrasystoles not recognized

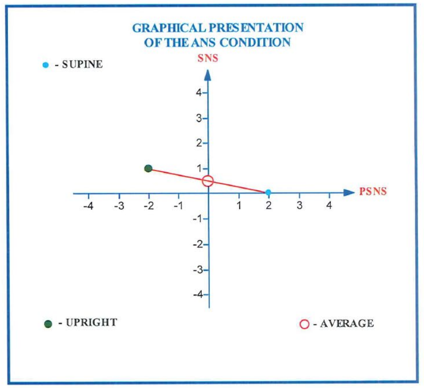
Supine

BP	PP	MAP
N/A	N/A	N/A

Upright

BP	PP	MAP
N/A	N/A	N/A

ANS ASSESSMENT (SUPINE)	ANS ASSESSMENT (UPRIGHT)
INFLUENCE OF PARASYMPATHETIC SYSTEM PREVAILS MODERATELY WHILE SYMPATHETIC ACTIVITY ON AVERAGE LEVEL	PARASYMPATHETIC SYSTEM IS DECREASED MODERATELY WHILE SYMPATHETIC IS INCREASED SLIGHTLY

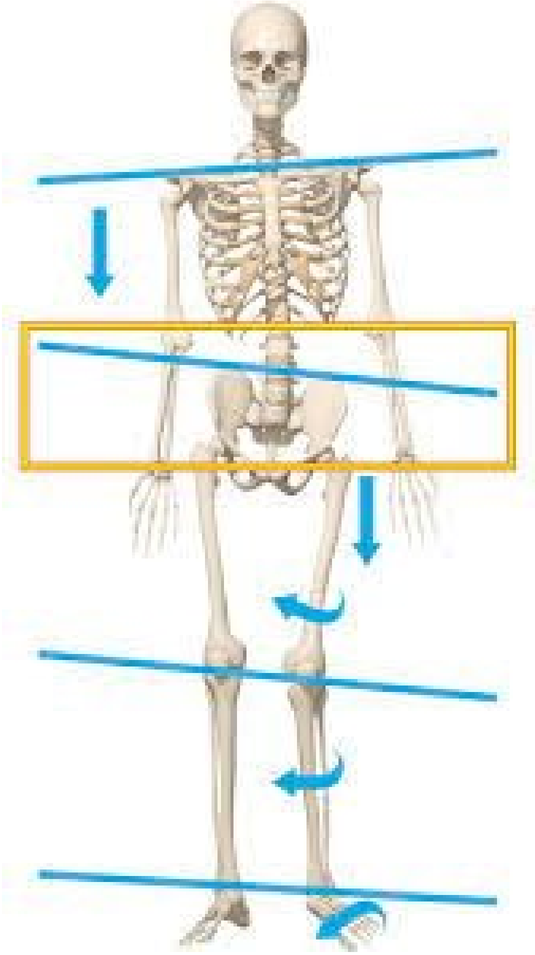


CONCLUSION

0.0 - ACTIVITY OF PARASYMPATHETIC SYSTEM

0.5 - ACTIVITY OF SYMPATHETIC SYSTEM

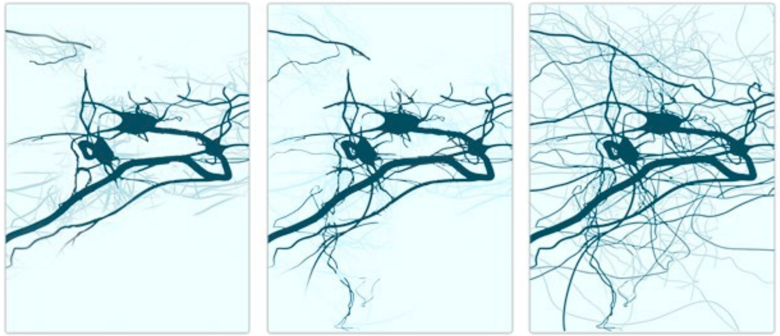
Posture




Brain Hemispheric Weakness Flow Chart
Symptoms
Symptom Check List
More Left Brain Checks
Left Brain Week
More Right Brain Checks
Right Brain Weak
Both Sides Positive
Right Brain or Left Brain Weakness
Primitive Reflexes
Babinski Reflex
Left Positive Reflex
Right Brain Weakness
Right Positive Reflex
Left Brain Weakness
Vitals
O2%
Lower Right O2%
Right Brain Weakness
Lower Left O2%
Left Brain Weakness
HR
Higher Right HR
Right Brain Weanness
Higher Left HR
Left Brain Weakness
BP
Balance
Rhomberg
Positive Left Sway
Right Brain Weakness
Positive Right Sway
Left Brain Weakness
One Legged Stand
Decreased Balance on Left Leg
Right Brain Weakness
Decreased Balance on Right Leg
Left Brain Weakness
Manns Test
Right Sway
Left Brain Weakness
Left way
Right Brain Weakness
Posture
Right Head Tilt
Right Brain Weakness
Left Head Tilt
Left Brain Weakness
Right Standing Body Tilt
Right Brain Weakness
Left Standing Body Tilt
Left Brain Weakness
Increaed right elbow bend
right brain Weakness
Increased left elbow bend
Left Brain Weakness
Vision
Pursuits
Weak Right Pursuits
Right Brain Weakness
Weak Left pursuits
Left Brain Weakness
Saccades
Weak Left Saccades
Right Brain Weakness
Weak right saccades
Left Brain Weakness
OPK
Decreased Left and Up OPK
Left Brain Weakness
Decreased right and down OPK
Right Brain Weakness
Convergence /Divergence
Right Eye Weakness
Left Brain Weakness
Left Eye Weakness
Vestibular
VOR/Head Impulse
Increased eye slippage Right
Left Brain Weakness
Increased eye slippage left
Right Brain Weakness
Fakuda Test
Fast Spinning (PRN)
Decreased Dizziness Clockwise Spin
Right Brain Weakness
Decreased Dizziness Counterclockwise Spin
Left Brain Weakness
Cranial Nerves
Tongue Deviation
Right tongue deviation
Right Brain Weakness
Left tongue deviation
Left Brain Weakness
Soft Palate
Left Palate Weakness
Left Brain Weakness
Right Palate Weakness
Pupillary Light Constriction
Right eye slow to constrict, fast to dialate
Right Brain Weakness
Left eye slow to constrict, fast to dilate
Left Brain Weakness
Facial Muscles
Right facial weakness
Right Brain Weakness
Left Facial Weakness
Left Brain Weakness
Sensory
Auditory
Decreased Left ear tunning fork
Right Brain Weakness
Decreased Right Tunning Fork
Left Brain Weakness
Olfactory
Decreased smell right nostril
Right Brain Weakness
Decreased Smell left nostril
Left Brain Weakness
Tactile
Postive extinction test left
Right Brain Weakness
Postive extinction test right
Left Brain Weakness
Positive Graphestesia Left
Right Brain Weakness
Positive Graphetesia Right
Left Brain Weakness

Neuroplasticity

- A process that involves adaptive structural and functional changes to the brain. It is defined as the ability of the nervous system to change its activity in response to intrinsic or extrinsic stimuli by reorganizing its structure, functions, or connections
- Requires sensory stimulation, movement and metabolic demand



Primitive Reflex and Sensorimotor Training ADHD

2. Alterations in resting state functional connectivity in ADHD participants following Brain Balance / Interactive Metronome treatment.

In this analysis we identified alteration in functional connectivity between regions that produced a statistically significant difference in mean connectivity. As seen in Figure 14, there were four connections associated with a significant increase and three with a significant decrease. The most notable was an increase in the reciprocal connectivity between the default mode network and the salience network. The default mode network is active at rest when individuals are not focused on the outside world and the brain is at wakeful rest, such as during daydreaming and mind-wandering as well as in some tasks involving autobiographical memory and mentalization[69]. The default mode network appears to be reciprocally interconnected with other brain networks involved in performing tasks and attending to stimuli in the outside world[2]. Individuals with ADHD typically show patterns of altered connectivity between the default mode, attention and salience networks[64]. Enhancing the reciprocal connection between the salience and default network may help to reduce daydreaming and mind wandering. Brain Balance / Interactive Metronome training was associated with increased connectivity of the default mode to the parahippocampal gyrus. The parahippocampal gyrus, which is involved in memory coding and retrival, links the default-mode network with the medial temporal lobe memory system[85]. The parahippocampal gyrus is interconnected to the superior frontal gyrus through the cingulum bundle[9], and connectivity between these regions was reduced following BB/IM. The superior frontal gyrus is implicated in several tasks including motor movement, working memory, resting-state, and cognitive control[9]. This may be associated with an enhanced ability to perform tasks automatically without thinking through each step.

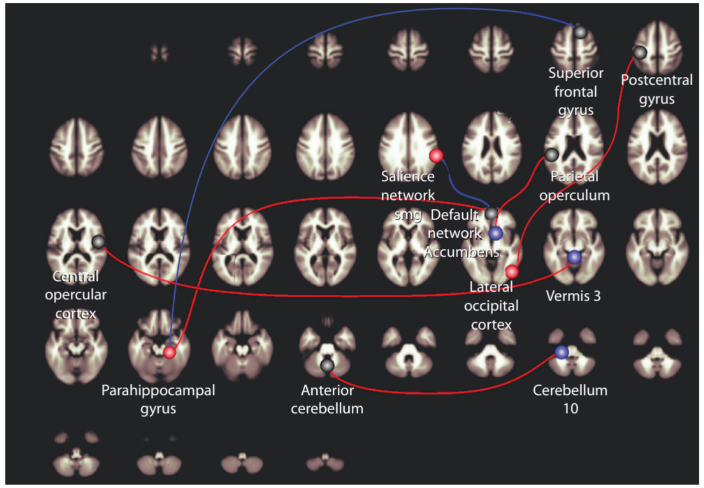


Figure 14. Functional connectivity differences between youths with ADHD prior to and following treatment with Brain Balance / Interactive metronome. Red lines indicate positive connections between regions. Blue lines indicate reciprocal connections. The circles at the end of the lines are also color coded. Gray circles indicate the

Primitive Reflexes Integration

Level 1: Stimulate the reflex

Level 2: Primitive Reflex Exercises

- Important to add sensory stimulation to integrate reflexes (bottom up and top down)
- Repetition is critical
- 5-7 days per week, 1-2 times per day

Core and Muscle Tone

Supine Bridge Level 1

Have the child lay on the floor, hands by the side for stability and legs shoulder width apart. Ask the child to lift his truck off the floor so the spine is straight. Have him hold this position still for as long as possible. Time long he can hold the position. A small child should be able maintain this position for at least 30 seconds; an older child should hold this for 60 seconds.

Supine Bridge Level 2

Have the child put his knees together and cross his arms over his chest. Ask them again to lift their trunk off the floor and a spine-straight position. Time how long they can hold the position. They should be able to hold this position for 60 seconds.

Supine Bridge Level 3

Assume the same position as level 1. Have him lift one leg off of the floor about an inch. Switch legs and repeat. A child should be able to hold the position in each leg for 30 seconds.

Prone Bridge Level 1

Have the child lie belly down on the floor with arms stretched out next to the head which should be down and in the middle. Ask the child to raise his head and one arm off the floor, keeping their arm perfectly straight. Ask him to hold this position for as long as possible up to 15 seconds. Stop counting if they drop or bend their arm at all or drop their head. Count how long he can hold this position. Repeat this with all four limbs separately. They must lift the head each time as well

Prone Bridge Level 2

Have the child assume the same position and ask him to lift his head, one arm and the opposite leg off the floor. Count how long he can keep the position. Relax for 10 second. Switch arm and leg and repeat. He should be able to do each exercise for 30 seconds on each side.

Prone Bridge Level 3

Ask the child to lift all four limbs and off the floor in a Superman position. Ask him to keep the position for as long as possible up to 60 seconds.

Side Plank/Modified Side Plank

Start on your side with feet staggard and forearm directly under your shoulder. Lift yourself off the ground and hold yourself for 10 seconds without shaking and work your way up to 40 seconds. If there is more than a 10% difference on side over the other, then only do WEAK side until strength is equal

Core and Muscle Tone

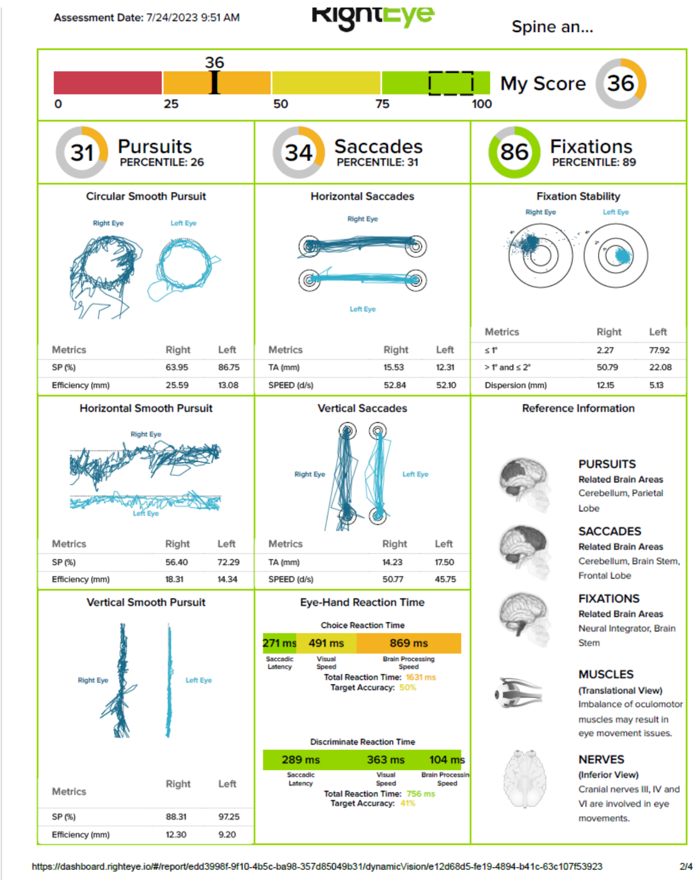
- Sit ups (independent or hands pulling)
- Pushups
- Bar hang
- Chin ups

Vestibular

- Fast Spin CW for right brain (left vestibular) stimulation and CCW for left brain (right vestibular) stimulation. Repeat PRN test up to 3 times until normal nystagmus is reached
- VOR Training

Eye Exercises

- OPK – Right and down for right brain stimulation and left and up for left brain stimulation
- Pencil pushups
- Saccades
- Pursuits
- Anti-saccades



Assessment Date: 7/24/2023 9:51 AM

RightEye

Spine an...

36

0 25 50 75 100

My Score 36

31 Pursuits PERCENTILE: 26

34 Saccades PERCENTILE: 31

86 Fixations PERCENTILE: 89

Circular Smooth Pursuit

Right Eye Left Eye

Metrics	Right	Left
SP (%)	63.95	86.75
Efficiency (mm)	25.59	13.08

Horizontal Saccades

Right Eye Left Eye

Metrics	Right	Left
TA (mm)	15.53	12.31
SPEED (d/s)	52.84	52.10

Fixation Stability

Right Eye Left Eye

Metrics	Right	Left
≤ 1°	2.27	77.92
> 1° and ≤ 2°	50.79	22.08
Dispersion (mm)	12.15	5.13

Horizontal Smooth Pursuit

Right Eye Left Eye

Metrics	Right	Left
SP (%)	56.40	72.29
Efficiency (mm)	18.31	14.34

Vertical Saccades

Right Eye Left Eye

Metrics	Right	Left
TA (mm)	14.23	17.50
SPEED (d/s)	50.77	45.75

Vertical Smooth Pursuit

Right Eye Left Eye

Metrics	Right	Left
SP (%)	88.31	97.25
Efficiency (mm)	12.30	9.20

Eye-Hand Reaction Time

Choice Reaction Time

271 ms 491 ms 869 ms

Saccadic Latency / Visual Speed / Brain Processing Speed

Total Reaction Time: 1631 ms

Target Accuracy: 50%

Discriminate Reaction Time

289 ms 363 ms 104 ms

Saccadic Latency / Visual Speed / Brain Processing Speed

Total Reaction Time: 756 ms

Target Accuracy: 41%

Reference Information

PURSUITS
Related Brain Areas
Cerebellum, Parietal Lobe

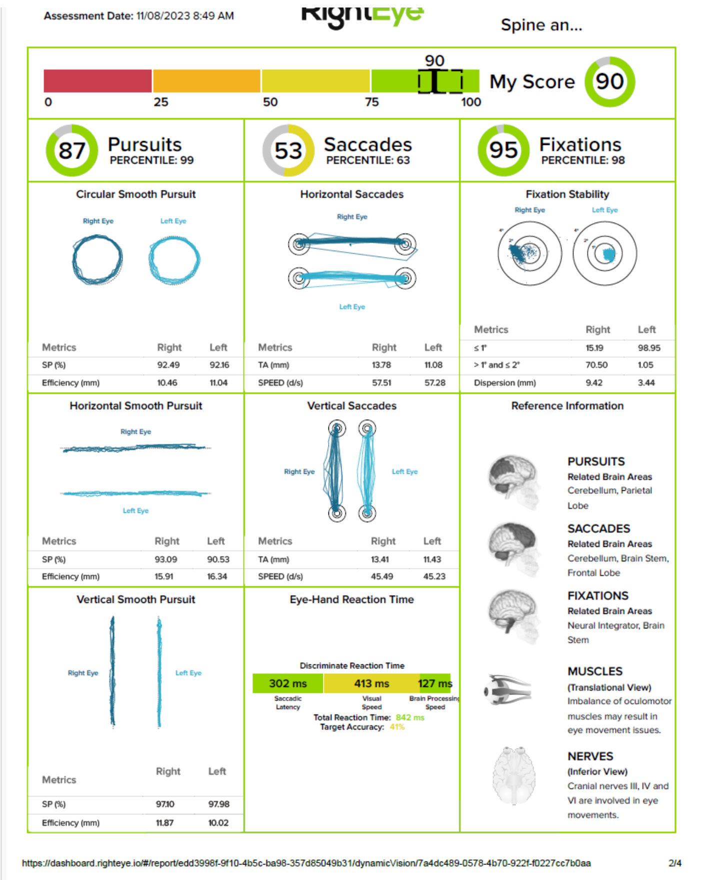
SACCADES
Related Brain Areas
Cerebellum, Brain Stem, Frontal Lobe

FIXATIONS
Related Brain Areas
Neural Integrator, Brain Stem

MUSCLES
(Translational View)
Imbalance of oculomotor muscles may result in eye movement issues.

NERVES
(Inferior View)
Cranial nerves III, IV and VI are involved in eye movements.

https://dashboard.righteye.io/#/report/edd3998f-9f10-4b5c-ba98-357d85049b31/dynamicVision/e12d68d5-fe19-4894-b41c-63c107f53923 2/4



Assessment Date: 11/08/2023 8:49 AM

RightEye

Spine an...

90

0 25 50 75 100

My Score 90

87 Pursuits PERCENTILE: 99

53 Saccades PERCENTILE: 63

95 Fixations PERCENTILE: 98

Circular Smooth Pursuit

Right Eye Left Eye

Metrics	Right	Left
SP (%)	92.49	92.16
Efficiency (mm)	10.46	11.04

Horizontal Saccades

Right Eye Left Eye

Metrics	Right	Left
TA (mm)	13.78	11.08
SPEED (d/s)	57.51	57.28

Fixation Stability

Right Eye Left Eye

Metrics	Right	Left
≤ 1°	15.19	98.95
> 1° and ≤ 2°	70.50	1.05
Dispersion (mm)	9.42	3.44

Horizontal Smooth Pursuit

Right Eye Left Eye

Metrics	Right	Left
SP (%)	93.09	90.53
Efficiency (mm)	15.91	16.34

Vertical Saccades

Right Eye Left Eye

Metrics	Right	Left
TA (mm)	13.41	11.43
SPEED (d/s)	45.49	45.23

Vertical Smooth Pursuit

Right Eye Left Eye

Metrics	Right	Left
SP (%)	97.10	97.98
Efficiency (mm)	11.87	10.02

Eye-Hand Reaction Time

Discriminate Reaction Time

302 ms 413 ms 127 ms

Saccadic Latency / Visual Speed / Brain Processing Speed

Total Reaction Time: 842 ms

Target Accuracy: 41%

Reference Information

PURSUITS
Related Brain Areas
Cerebellum, Parietal Lobe

SACCADES
Related Brain Areas
Cerebellum, Brain Stem, Frontal Lobe

FIXATIONS
Related Brain Areas
Neural Integrator, Brain Stem

MUSCLES
(Translational View)
Imbalance of oculomotor muscles may result in eye movement issues.

NERVES
(Inferior View)
Cranial nerves III, IV and VI are involved in eye movements.

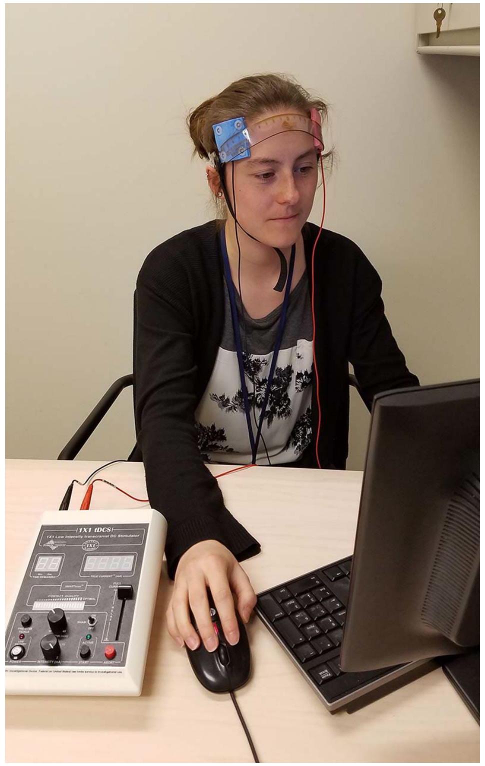
https://dashboard.righteye.io/#/report/edd3998f-9f10-4b5c-ba98-357d85049b31/dynamicVision/7a4dc489-0578-4b70-922f-f0227cc7b0aa 2/4

Hemispheric Sensory Stimulation

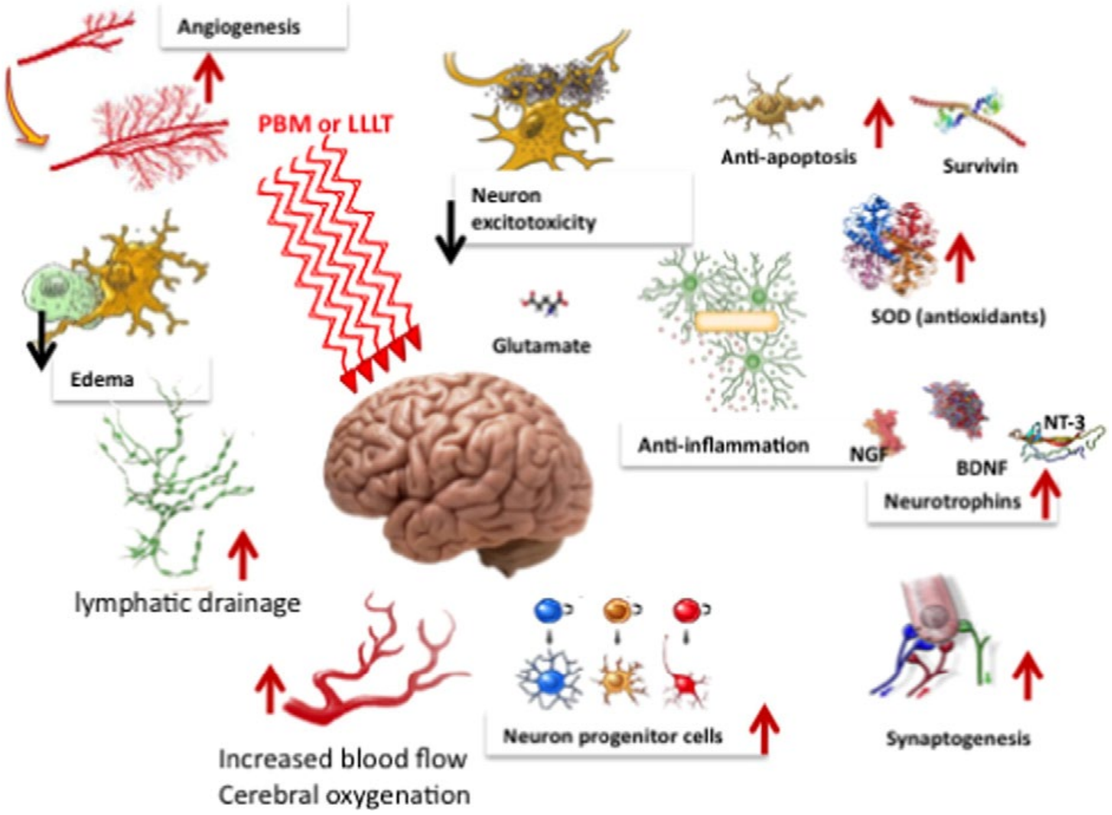
- Vibration: Contralateral to weak hemisphere (leg/arm)
- TENS: Cervicothoracic junction contralateral to weak hemisphere
- Sound: Contralateral to weak hemisphere
- Light: lateral portion of eye contralateral to weak hemisphere
- Smell: Ipsilateral nostril

Transcranial Direct Current Stimulation (tDCS)

- Anode stimulates neurons to fires
- Put Anode on desired region of brain of weak hemisphere



Photobiomodulation/ Low Level Laser Therapy (LLLT)



Photobiomodulation/Low Level Laser Therapy

Adv Exp Med Biol - Clinical and Experimental Biomedicine (2018) 3: 111–130
https://doi.org/10.1007/5584_2018_234

Published online: 29 June 2018

Effects of Low-Level Laser Therapy in Autism Spectrum Disorder

Gerry Leisman, Calixto Machado, Yanin Machado, and Mauricio Chinchilla-Acosta

Abstract

The study examined the efficacy of low-level laser therapy, a form of photobiomodulation, for the treatment of irritability associated with autistic spectrum disorder in children and adolescents aged 5–17 years. Twenty-one of the 40 participants received eight 5-min procedures administered to the base of the skull and temporal areas across a 4-week period (test, i.e., active treatment participants). All the participants were evaluated with the Aberrant Behavior Checklist (ABC), with the global scale and five subscales (irritability/agitation, lethargy/social withdrawal, stereotypic behavior, hyperactivity/noncompliance, and inappropriate speech), and the Clinical Global Impressions (CGI) Scale including a severity-of-illness scale (CGI-S) and a global improvement/change scale (CGI-C). The evaluation took place at baseline, week 2 (interim), week 4 (endpoint), and week 8 (post-procedure) of the study. The adjusted mean difference in the baseline to study endpoint change in the ABC irritability subscale score between test and placebo participants was −15.17 in favor of the test procedure group. ANCOVA analysis found this difference to be statistically significant ($F = 99.34$, $p < 0.0001$) compared to the baseline ABC irritability subscale score. The study found that low-level laser therapy could be an effective tool for reducing irritability and other symptoms and behaviors associated with the autistic spectrum disorder in children and adolescents, with positive changes maintained and augmented over time.

Keywords
Autism spectrum disorder · Brain · Clinical trial · Low-level laser therapy · Neuronal networks · Photobiomodulation

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1 Introduction

Autism spectrum disorder (ASD) is a complicated syndrome characterized clinically by language impairment, dysfunction in social engagement, stereotypical movements and behaviors, and various cognitive deficits (McPartland and Volkmar 2012; South et al. 2012; Zappella 2012; Melillo and Leisman 2010). In earlier work, we have also

Fig. 1 Aberrant Behavior Checklist (ABC) global score in the test (active treatment) and placebo group participants

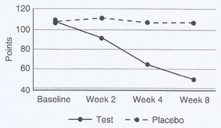


Fig. 2 Aberrant Behavior Checklist (ABC) irritability subscale score in the test (active treatment) and placebo group participants

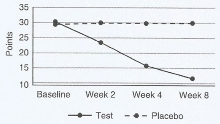


Fig. 3 Aberrant Behavior Checklist (ABC) lethargy/social withdrawal subscale score in the test (active treatment) and placebo group participants

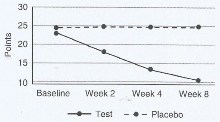


Fig. 4 Aberrant Behavior Checklist (ABC) stereotypic behavior subscale score in the test (active treatment) and placebo group participants

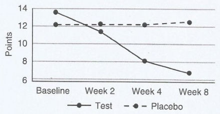


Fig. 5 Aberrant Behavior Checklist (ABC) hyperactivity/noncompliance subscale score in the test (active treatment) and placebo group participants

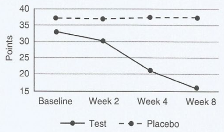


Fig. 6 Aberrant Behavior Checklist (ABC) inappropriate speech subscale score in the test (active treatment) and placebo group participants

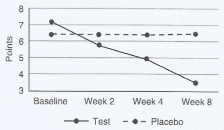
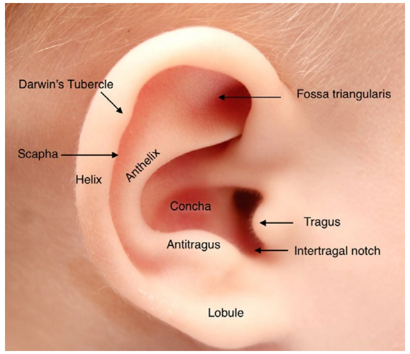


Table 22 One-way ANOVA and Tukey's HSD post hoc follow-up results for the change in the Aberrant Behavior Checklist (ABC) score across the study duration in the test (active treatment) group participants

ABC scale/subscale	F	p	Tukey's HSD
Global score	101.6	<0.0001	Changes between each possible evaluation
			Combination was significant at $p < 0.01$
Irritability	114.5	<0.0001	Changes between each possible evaluation
			Combination was significant at $p < 0.01$
Lethargy and social withdrawal	49.6	<0.0001	Changes between each possible evaluation
			Combination was significant at $p < 0.01$, except week 4–8 which was significant at $p < 0.05$
Stereotypic behavior	38.2	<0.0001	Baseline to week 2 significant at $p < 0.05$
			All others significant at $p < 0.01$, except week 4–8 which was not significant
Hyperactivity and noncompliance	59.4	<0.0001	All significant at $p < 0.01$, except baseline to week 2 which was not significant
Inappropriate speech	26.9	<0.0001	All significant at $p < 0.01$, except week 2–4 which was not significant

Vagus Nerve Treatment

- Vagus nerve stimulation utilizing pulsed radiofrequency on the auricular branch of the vagus nerve
- Daily at home vagus neve exercises
  - Deep breathing
  - Gargling
  - Humming
  - Vibration just anterior to gag reflex
  - Cold showers



RPRs and Hemispheric Connectivity in ASD

brain sciences

MDPI

Article

The Relationship between Retained Primitive Reflexes and Hemispheric Connectivity in Autism Spectrum Disorders

Robert Melillo [1], Gerry Leisman [1,2,*], Calixto Machado [3], Yanin Machado-Ferrer [3], Mauricio Chinchilla-Acosta [3], Ty Melillo [4] and Eli Carmeli [1]

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Abstract: Background: Autism Spectrum Disorder (ASD) can be identified by a general tendency toward a reduction in the expression of low-band, widely dispersed integrative activities, which is made up for by an increase in localized, high-frequency, regionally dispersed activity. The study assessed ASD children and adults all possessing retained primitive reflexes (RPRs) compared with a control group that did not attempt to reduce or remove those RPRs and then examined the effects on qEEG and brain network connectivity. Methods: Analysis of qEEG spectral and functional connectivity was performed, to identify associations with the presence or absence of retained primitive reflexes (RPRs), before and after an intervention based on TENS unilateral stimulation. Results: The results point to abnormal lateralization in ASD, including long-range underconnectivity, a greater left-over-right qEEG functional connectivity ratio, and short-range overconnectivity in ASD. Conclusion:. Clinical improvement and the absence of RPRs may be linked to variations in qEEG frequency bands and more optimized brain networks, resulting in more developmentally appropriate long-range connectivity links, primarily in the right hemisphere.

Keywords: retained primitive reflexes; autism spectrum disorders; maturational delay; neuronal synchrony; bottom-up processing; top-down processing

Citation: Melillo, R.; Leisman, G.; Machado, C.; Machado-Ferrer, Y.; Chinchilla-Acosta, M.; Melillo, T.; Carmeli, E. The Relationship between Retained Primitive

Brain Waves

- Delta waves: Slowest brain wave, seen in deep sleep
- Theta waves: Sleep, meditation, interoception
- Alpha Waves: involved with alertness, calm focus and cognitive function
- Gamma waves: Fastest brain wave, involved in cognitive function, attention, memory

Figure 1. Before treatment, a significant global increment of delta absolute power was found, lateralized to the right hemisphere, and focalized in the frontal-temporal regions. After treatment, a significant reduction in the delta absolute power was found.

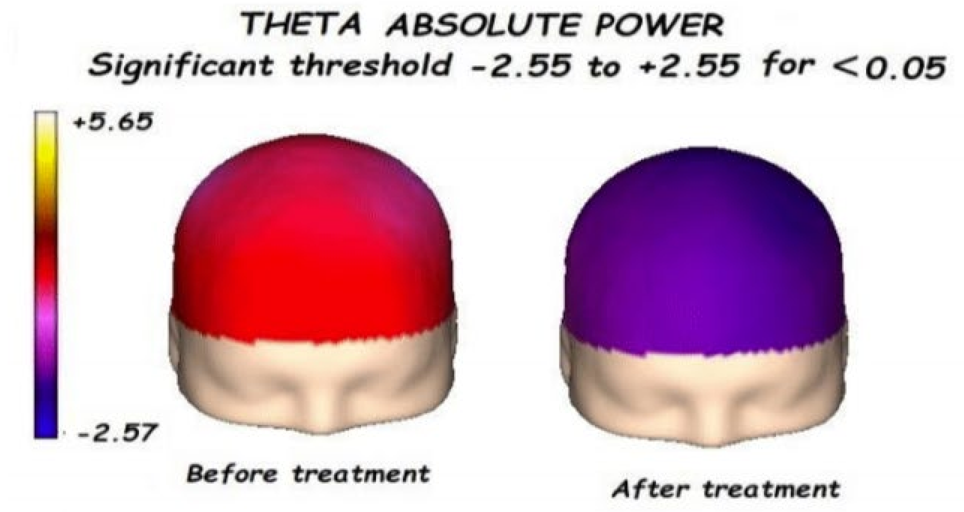

Figure 2. Before treatment, a significant global increment of the theta absolute power was found. After treatment, a significant reduction in the theta absolute power was found.

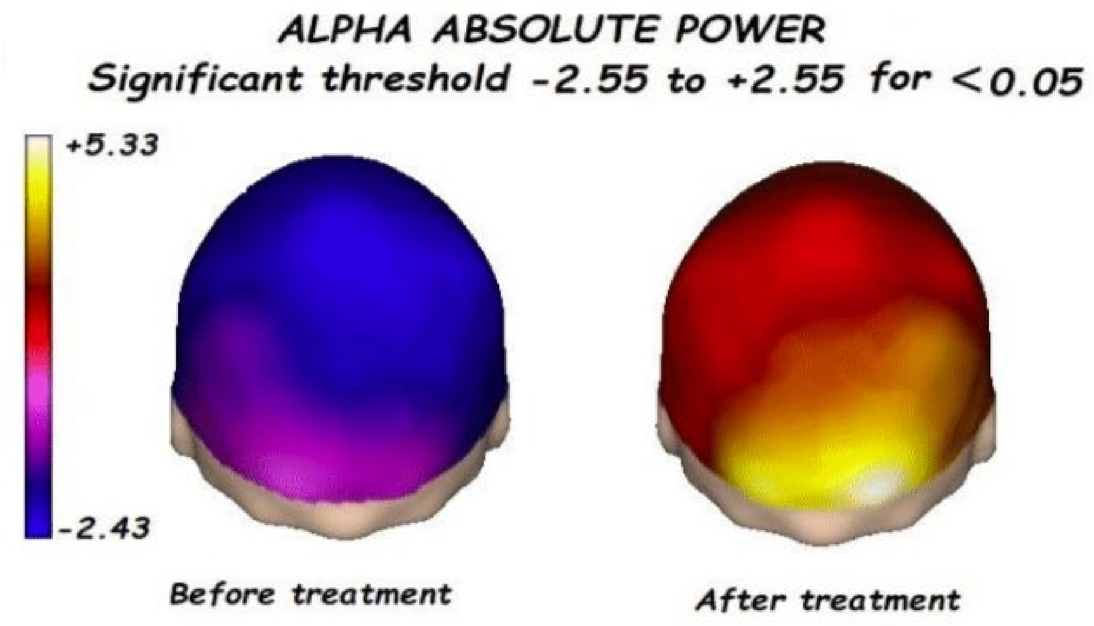

Figure 3. Before treatment, a significant posterior decrement of the alpha absolute power was found. alpha absolute power significantly increases after treatment.

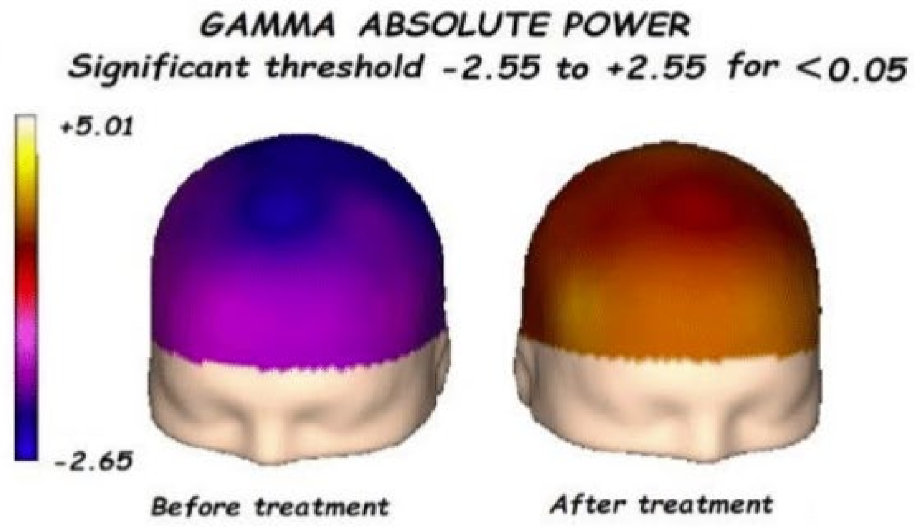

Figure 4. Before treatment, a significant global decrement in the gamma absolute power was found. Gamma absolute power significantly increases after treatment, mainly in the anterior regions.

3.2. Functional Connectivity

Figures 5–9 compare qEEG functional connectivity before and after treatment for delta, theta, alpha, alpha, and gamma bands. We generally found long-range underconnectivity and short-range overconnectivity for all bands lateralized to the right hemisphere. Moreover, after treatment, several significant interhemispheric connections appeared.

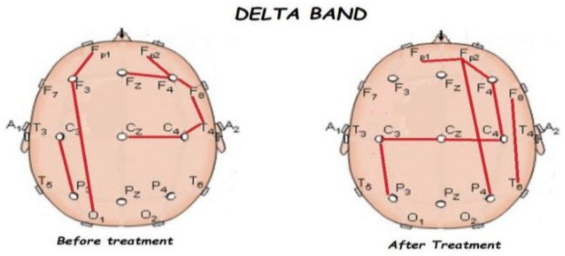

Figure 5. Comparison of functional connectivity before and after treatment for the delta band. Red lines indicate a significant connection in the network.

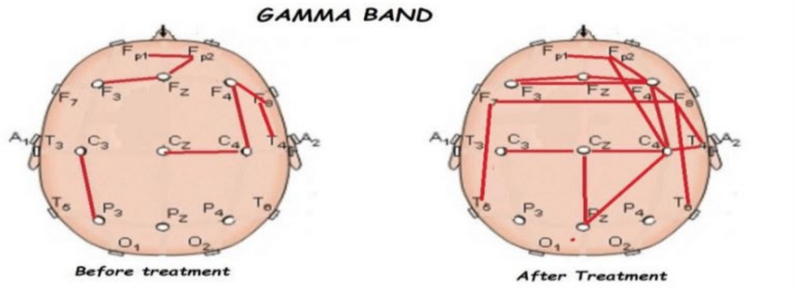

Figure 9. Comparison of functional connectivity before and after treatment, for the gamma band. Red lines indicate a significant connection in the network.

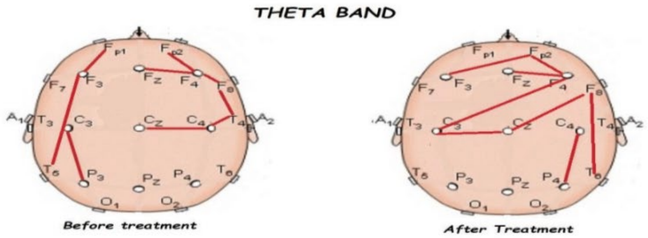

Figure 6. Comparison of functional connectivity before and after treatment for the theta band. Red lines indicate a significant connection in the network.

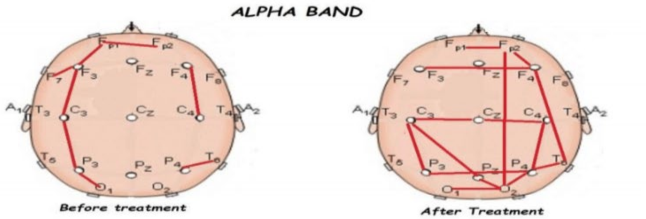

Figure 7. Comparison of functional connectivity before and after treatment for the alpha band. Red lines indicate a significant connection in the network.

Treatment Considerations

- PANS/PANDAS
- Metabolic Dysfunction/Inflammation
- Can the patient handle the stimulation/metabolic demand?

Treatment Models

- Intensives
- In office/home hybrid
- Home Programs
- Frequency, Frequency, Frequency

Thank You!!

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