

Neurotraining Institute 2-Day-Course

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Disclaimer: Neurotraining for Educational and Training Purposes Only

The information provided in this course is intended for educational and training purposes only. It is not intended to be a substitute for professional medical advice, diagnosis, or treatment. Neurotraining is a form of training that focuses on cognitive and neuro exercises designed to enhance certain cognitive & movement skills.

It is important to note that the content provided in this course is not a substitute for medical or therapeutic interventions. We do not provide medical diagnoses, treatment recommendations, or therapeutic services. If you have or suspect you may have a medical or psychological condition, it is recommended that you consult with a qualified healthcare or mental health professional.

Participation in this course does not establish a therapist-client or doctor-patient relationship. The exercises and information provided are not meant to treat, diagnose, cure, or prevent any medical or psychological conditions. Any reliance you place on the information provided in this course is strictly at your own risk.

Results obtained through Neurotraining may vary and are not guaranteed. Individual responses to Neurotraining can differ due to a range of factors, including individual baseline, commitment to the training program, and consistency of practice. Some individuals may experience significant improvements, while others may experience more modest changes or none at all.

Before beginning any new training program or making changes to your existing routine, it is advisable to consult with a qualified healthcare or mental health professional, especially if you have preexisting medical conditions or concerns.
By enrolling in this course, you acknowledge that Neurotraining is solely for educational and training purposes and is not a substitute for appropriate medical or psychological care.

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TODAY'S AGENDA

In the two days we get to spend together, my goal is to make a big impact in the following ways:

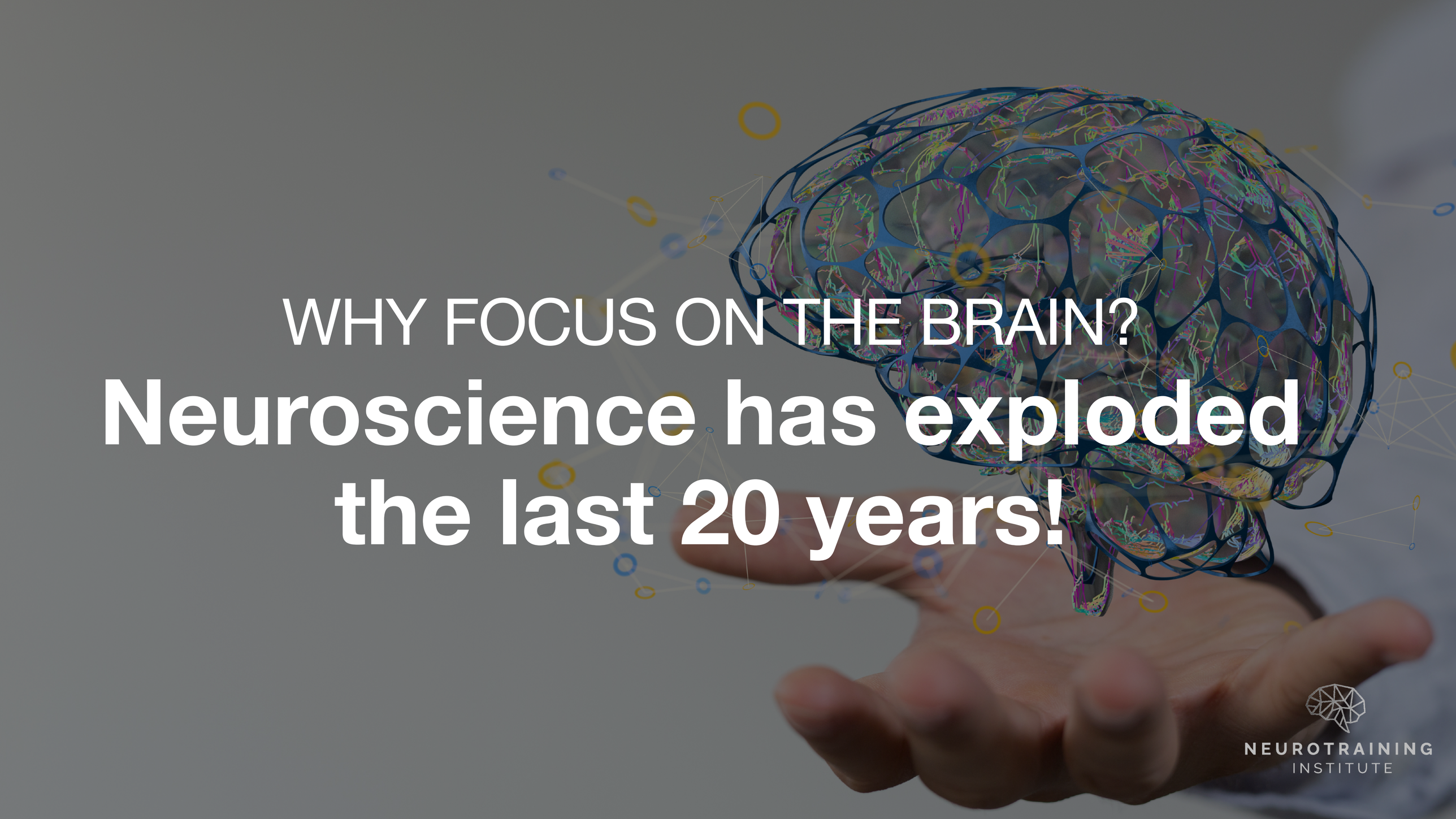
- **CLARITY** - why a brain-based approach is an awesome idea
- **CONFIDENCE -** how to implement Neurotraining step by step into your practice
- **SCIENCE & MECHANISMS-** how the brain works at a deeper level and how to optimize movement, pain & performance with the help of modern Neuroscience
- **SUCCESS -** become the best coach, therapist, or athlete in order to exponentially improve your results & business

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WHAT I NEED FROM YOU…

- **ACTIVE VS. PASSIVE LEARNING -** focus, without distractions, put your phone in airplane mode!
- **OPEN MIND -** put some of your belief systems about how health & performance aside - they will be challenged!
- **IMPLEMENTATION MINDSET -** start on Monday!

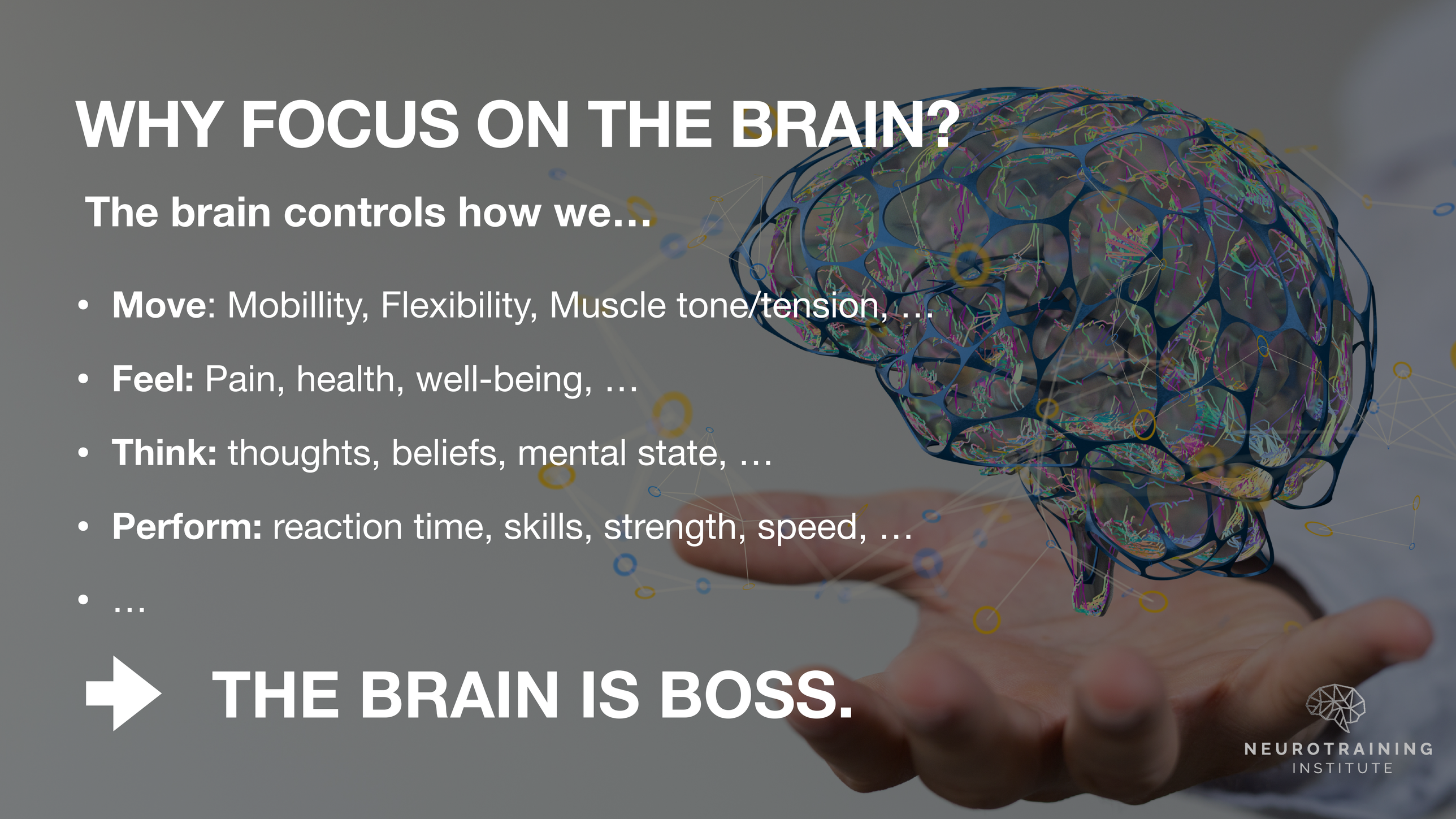
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WHY FOCUS ON THE BRAIN?
Neuroscience has exploded the last 20 years!
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WHY FOCUS ON THE BRAIN?

The brain controls how we…

- **Move**: Mobillity, Flexibility, Muscle tone/tension, …
- **Feel:** Pain, health, well-being, …
- **Think:** thoughts, beliefs, mental state, …
- **Perform:** reaction time, skills, strength, speed, …
- …

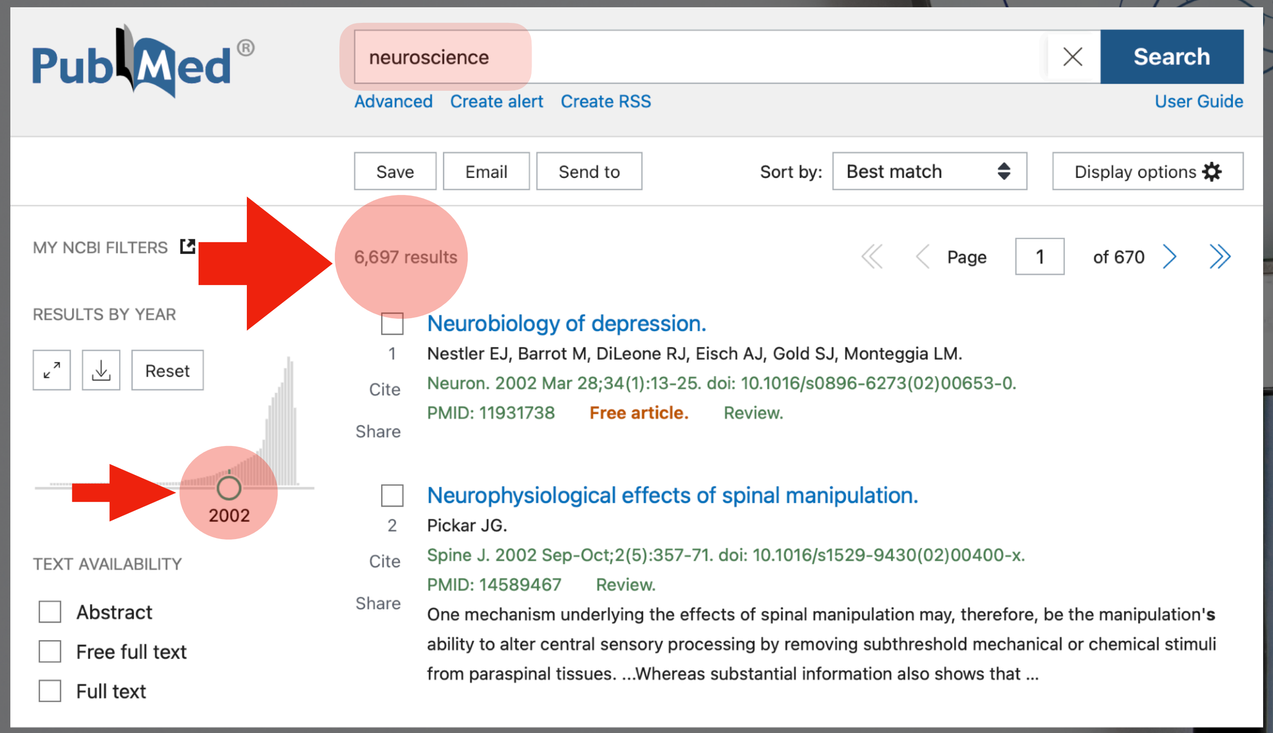


➡ **THE BRAIN IS BOSS.**

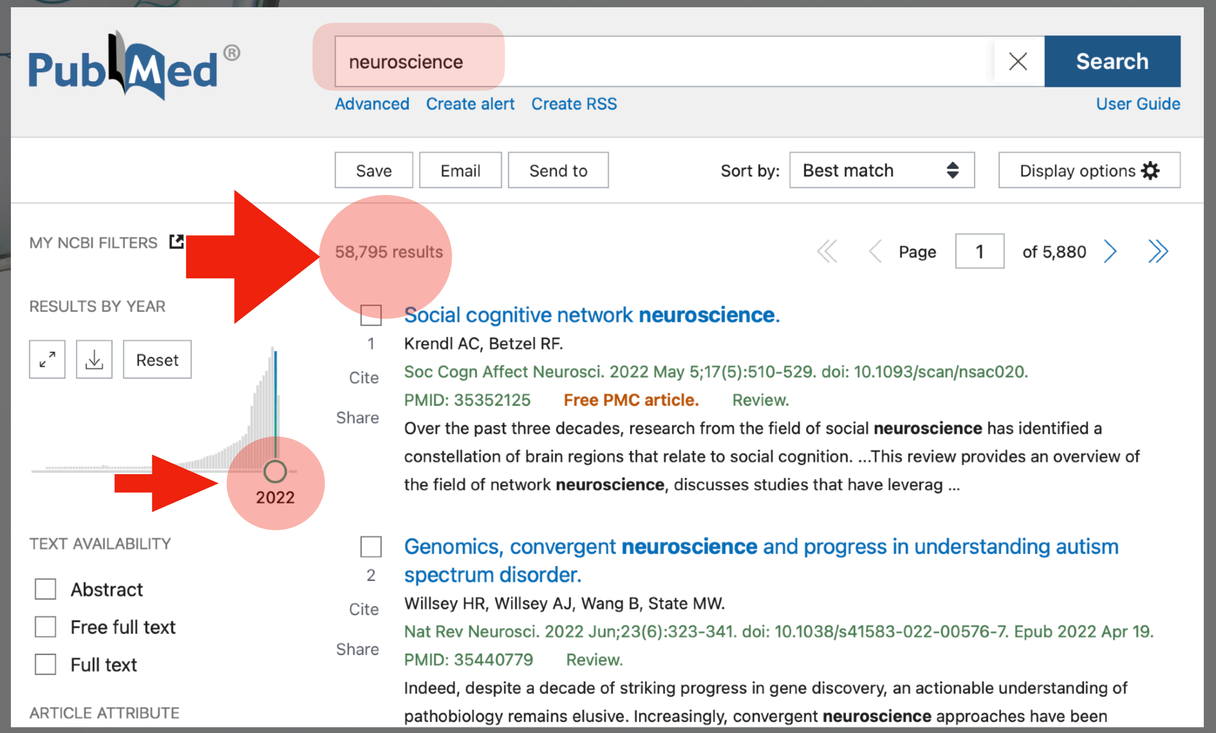
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BRAIN BASED TRAINING IS THE FUTURE

2002



2022



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BEFORE & AFTER NEUROTRAINING RESULTS



BEFORE

AFTER



BEFORE



AFTER 30 MINUTES

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BEFORE & AFTER NEUROTRAINING RESULTS



BEFORE AFTER



BEFORE

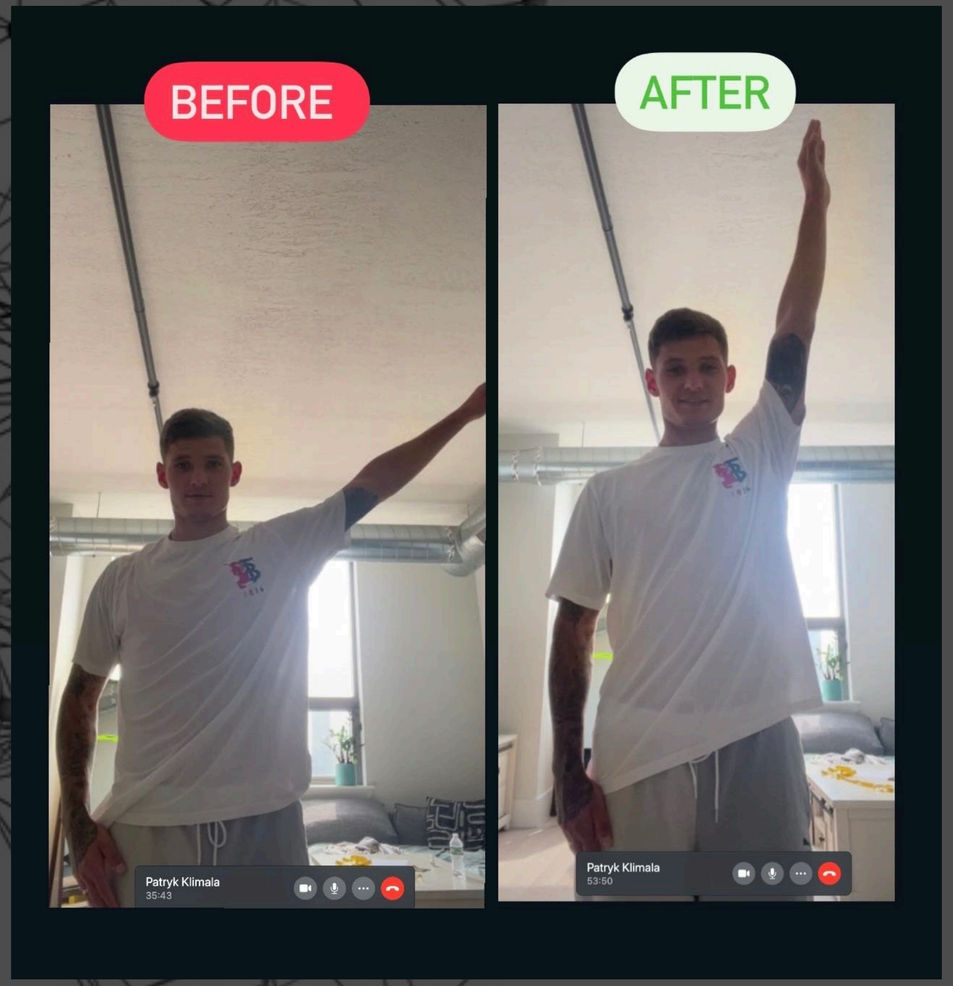
AFTER

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BEFORE & AFTER NEUROTRAINING RESULTS



BEFORE AFTER



BEFORE AFTER

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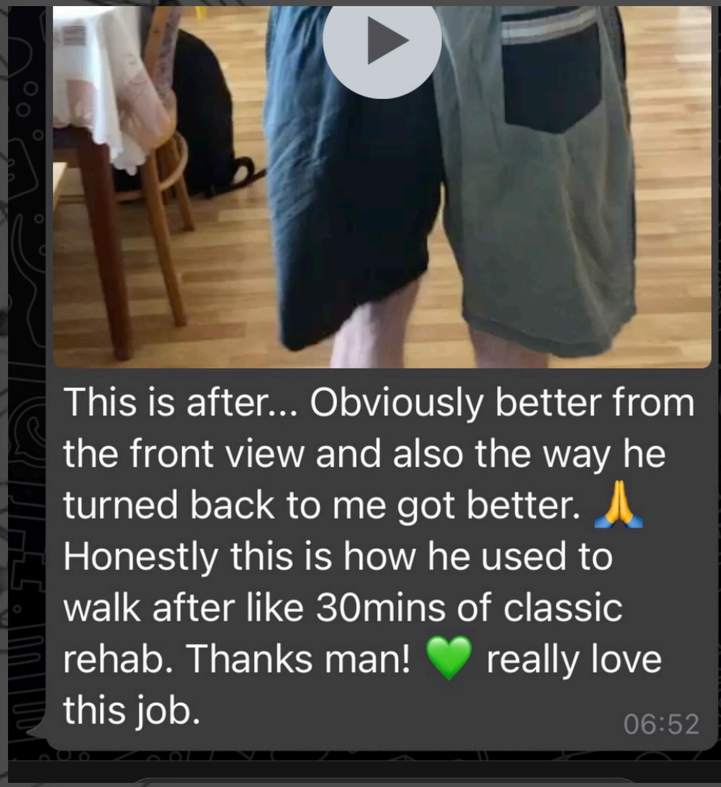
BEFORE & AFTER NEUROTRAINING RESULTS



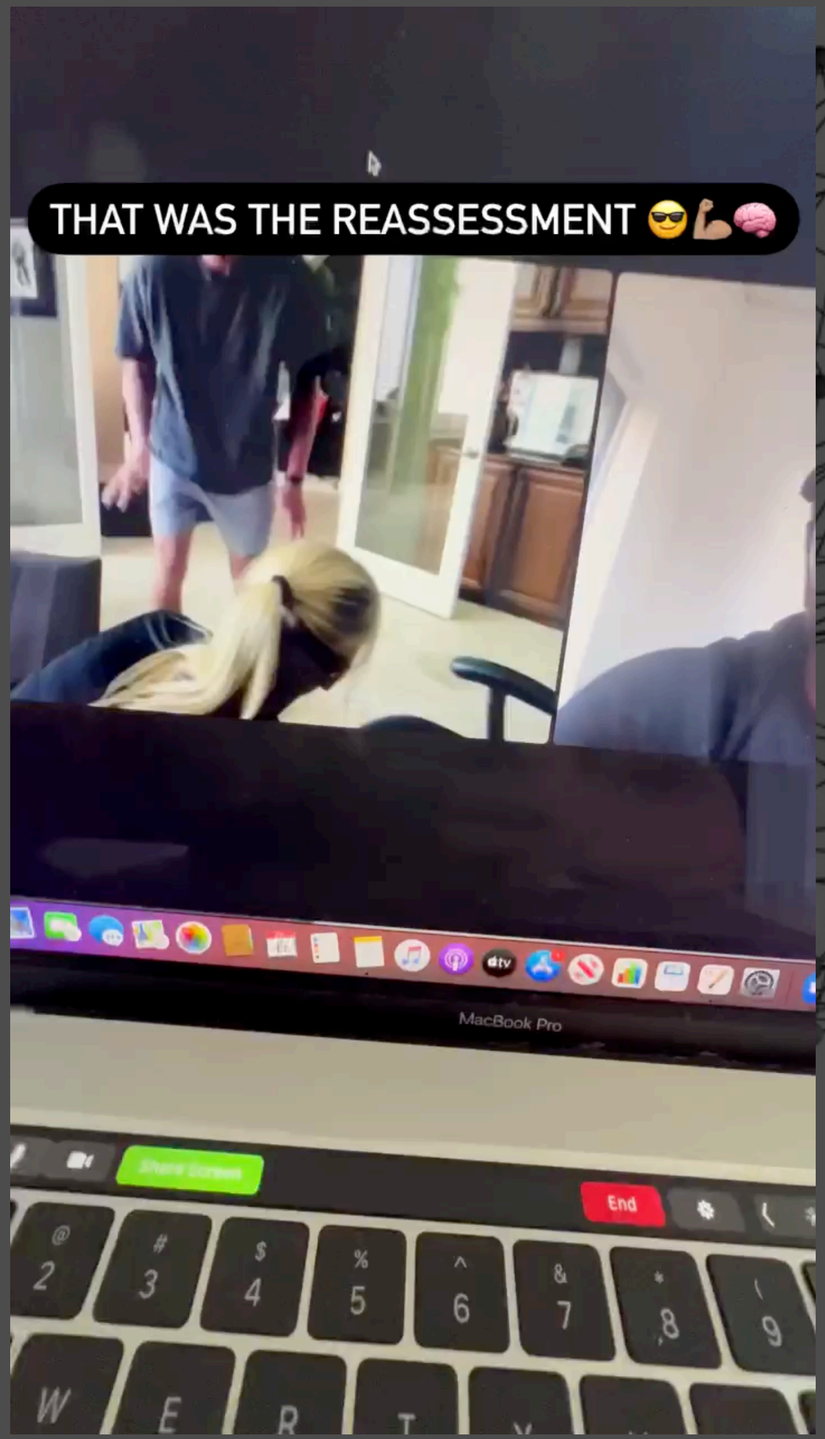
BEFORE



AFTER



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NEUROTRAINING RESULTS

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Let’s get practical!

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Schreyer Fam



Kevin Anderson
(Tennis)



Tyson Fury &
Christian Thun - Boxing



Nathan Pellisier
(Paralympic Medalist)









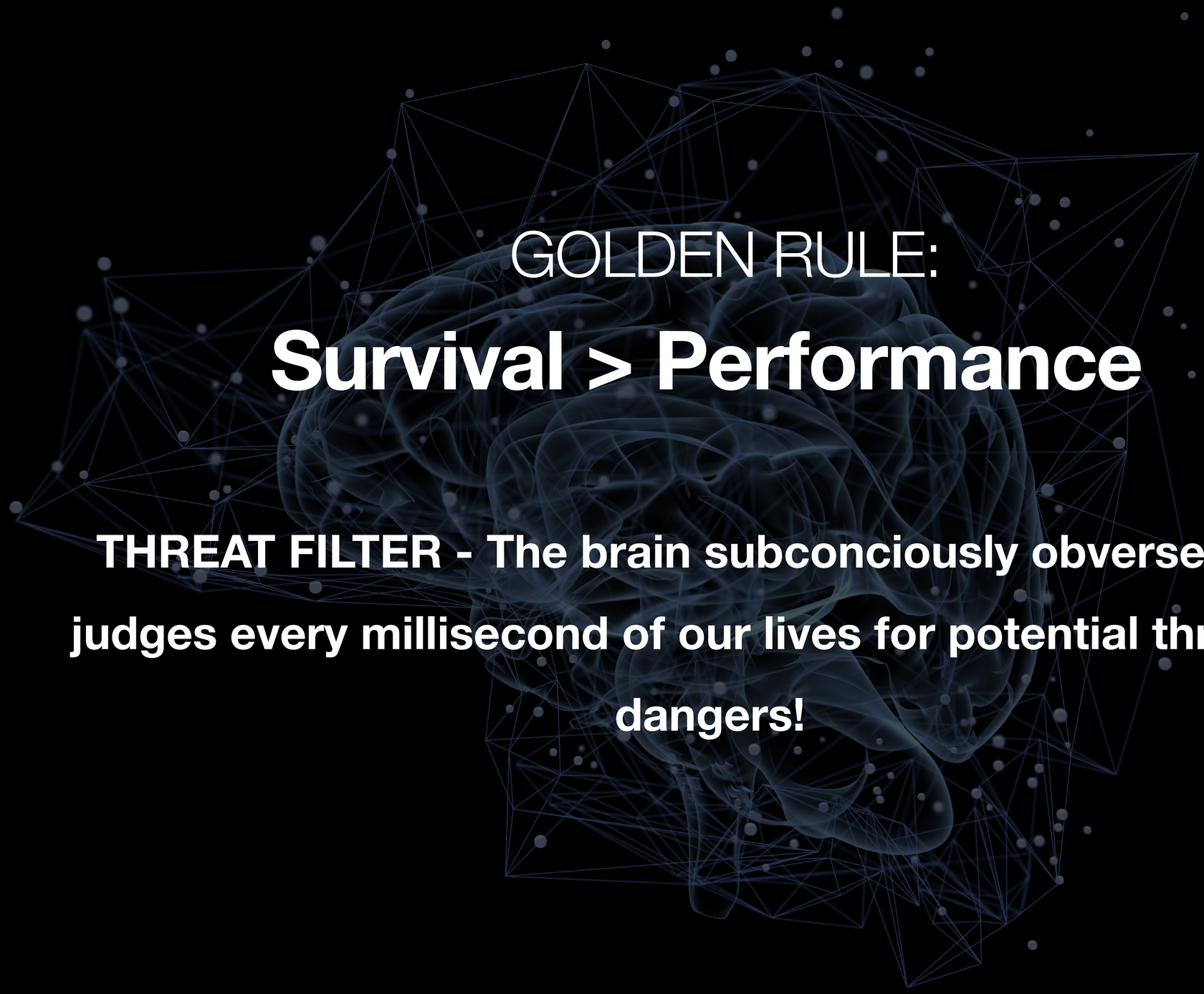


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What's the brain's primary goal?

SURVIVAL

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GOLDEN RULE:

Survival > Performance

THREAT FILTER - The brain subconciously obverses and judges every millisecond of our lives for potential threats & dangers!

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Your goals vs. your brain’s goals!

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Movement/ Mobility



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Sports Performance



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Mindset



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Aches & Pains



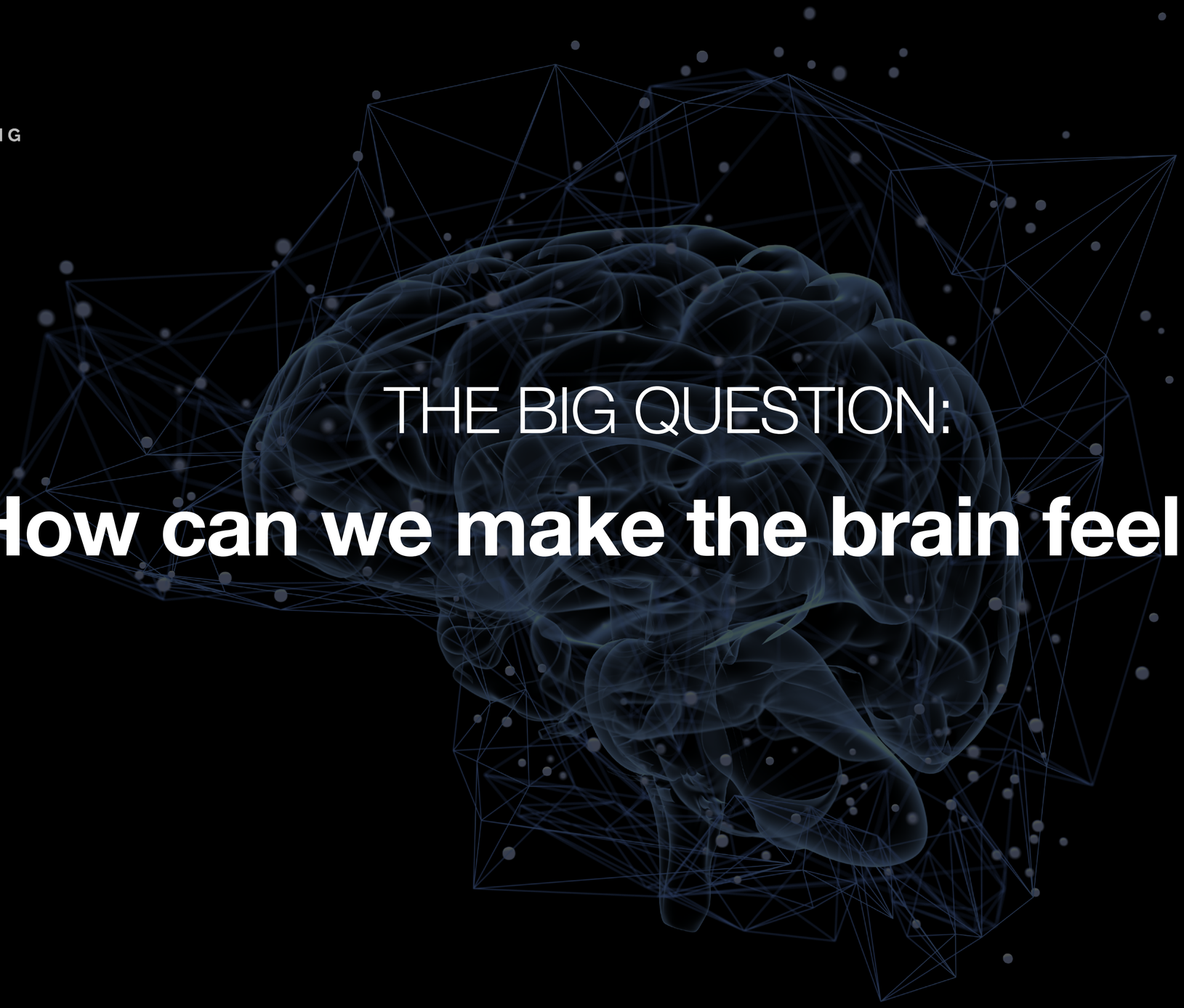
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Bottom line:

Your brain wants to feel safe and doesn’t care about your goals!



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THE BIG QUESTION:

How can we make the brain feel safe?

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THE BRAIN DOES 3 PRIMARY THINGS



1. RECEIVE INPUT

- EXTEROCEPTION
- INTEROCEPTION
- PROPRIOCEPTION

2. INTEGRATE & REACT

- BRAIN AREAS (CEREBRUM, CEREBELLUM, BRAINSTEM, …)



3. CREATE OUTPUT

- MOVEMENT
- PAIN
- POSTURE
- THOUGHTS
- BREATHING
- AND MORE

TO MAKE THIS ACTIONABLE…

WE CAN CLASSIFY THESE DEMANDS AS 8 SKILLS:

1. INPUT

1. *SEE*
2. *BALANCE*
3. *SENSE*
4. *FEEL*

2. INTEGRATION & PROCESSING

5. PROCESS, COORDINATE & REACT

3. OUTPUT

6. MOVE
7. BREATHE
8. THINK

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INPUT PROBLEMS:

1. INPUT

BAD ANKLE PROPRIOCEPTION

2. INTEGRATION & PROCESSING

PARIETAL LOBE & CEREBELLUM CAN'T SENSE WHERE THE ANKLE IS IN SPACE

3. OUTPUT

IMPAIRED MOVEMENT & PERFORMANCE

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INTEGRATION & COORDINATION PROBLEM:

1. INPUT

MECHANORECEPTORS SEND INPUT TO THE BRAIN

2. INTEGRATION & PROCESSING

CEREBELLUM CAN'T COORDINATE THE MOVEMENT WELL

3. OUTPUT

LIMITED MOVEMENT OPTIONS, STIFFNESS, …

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OUTPUT PROBLEMS:

1. INPUT

INTEROCEPTORS SENSE THAT SOMETHING IS OFF

2. INTEGRATION & PROCESSING

INSULAR CORTEX & AMYGDALA SENSE DANGER

3. OUTPUT

RESTRICTED BREATHING MECHANICS

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TO PUT IT INTO A NUTSHELL

ALL THESE 8 SKILLS ARE CONNECTED WITH EACH OTHER..

1. INPUT

1. *SEE*
2. *BALANCE*
3. *SENSE*
4. *FEEL*

2. INTEGRATION & PROCESSING

5. PROCESS COORDINATE & REACT

3. OUTPUT

6. MOVE
7. BREATHE
8. THINK

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What do these four professionals have in common?



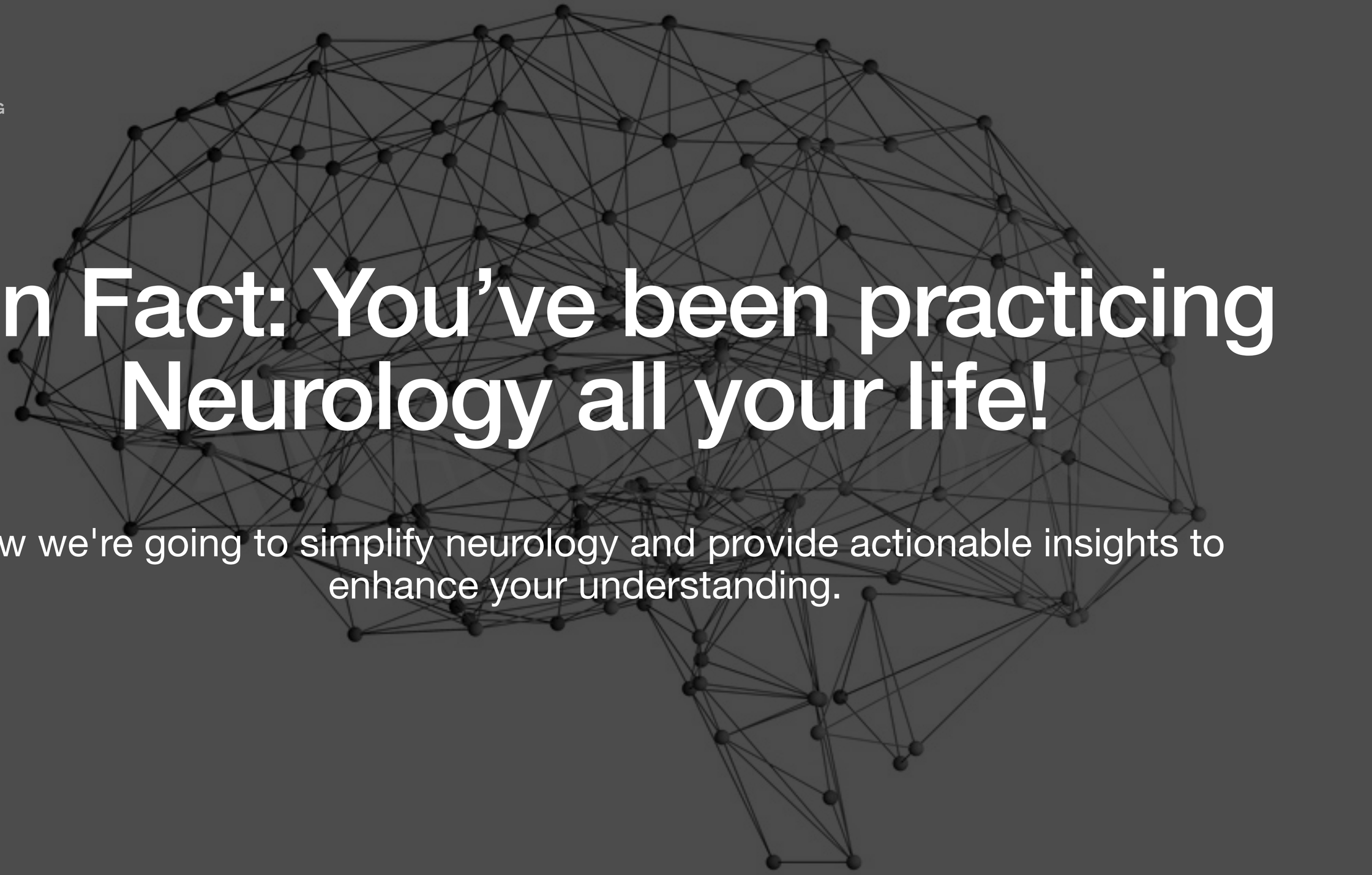






They’re all going after the brain/nervous system!

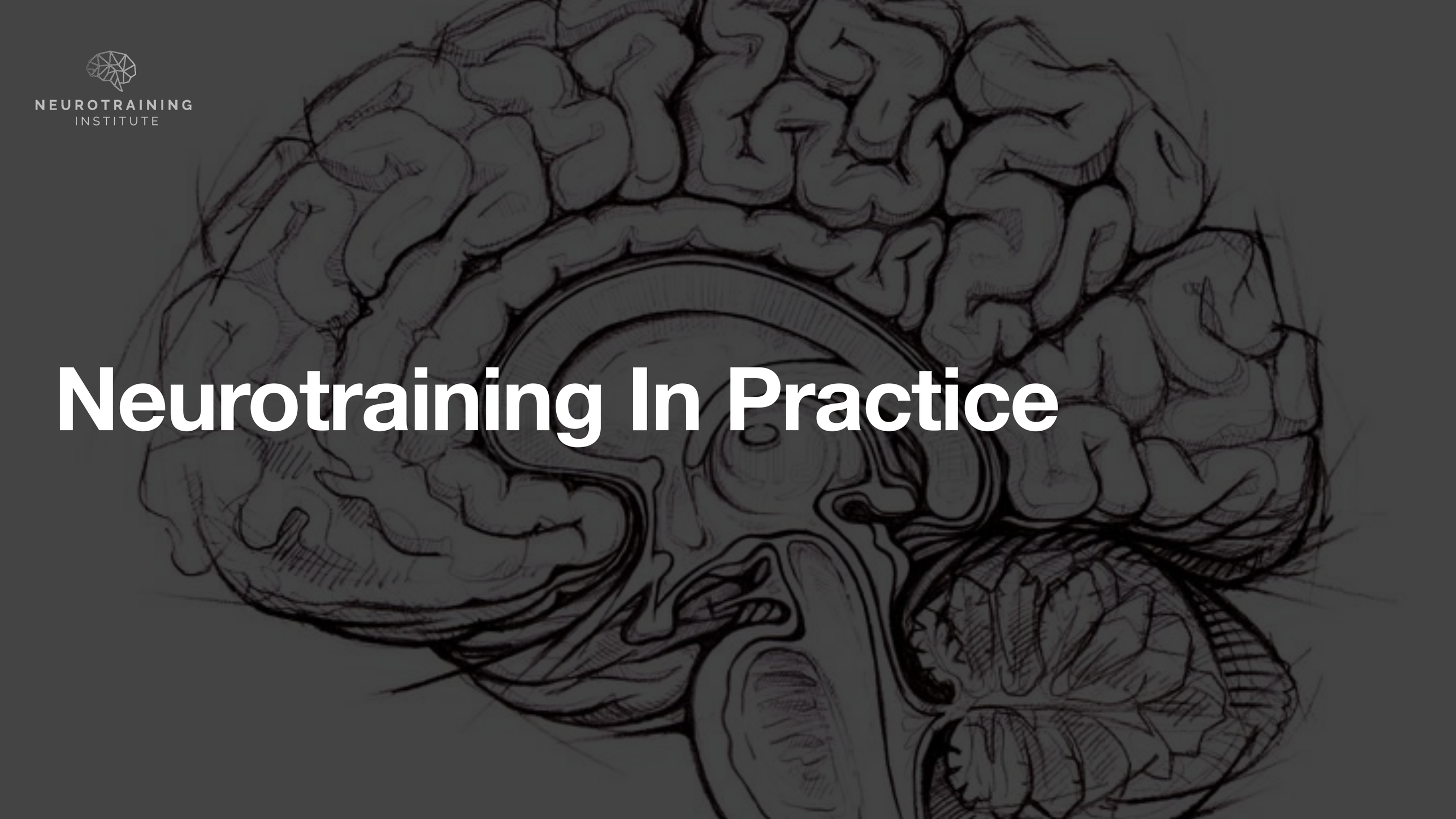
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Fun Fact: You've been practicing Neurology all your life!

Now we're going to simplify neurology and provide actionable insights to enhance your understanding.

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Neurotraining In Practice

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Neurotraining on a micro-level (Single session)

1. 8 SKILL - ASSESSMENTS

- History of the client
- Posture/Biomechanics
- Breathing
- Vision
- Vestibular Function
- Sensory Awareness
- Beliefs/Thoughts
- Interoception
- Proprioception

2. EXERCISE SELECTION

- Vision
- Balance
- Coordination
- Breathing
- Strength
- Mobility
- Sensory Stimulus
- Nerve Work
- ...

3. RE-ASSESSMENT

- Pain
- Movement
- Balance
- Coordination
- Speed
- Strength
- Health
- Reaction Time
- ...

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How fast is the brain at processing?

- Signals from large-diameter, myelinated neurons that link the spinal cord to the muscles can travel at speeds ranging from 70-120 meters per second (m/s) (156-270 miles per hour[mph])!
- Researchers at Massachusetts Institute of Technology (MIT) asked subjects to look for a particular type of image, as they viewed a series of six or 12 images, subjects identified the objects as fast as 13 ms!

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How can we test the nervous systems response?

Practical ways to measure the results:

- Mobility
- Strength
- Pain Level
- Muscle tension
- Speed
- Coordination
- Balance

There is usually 3 possible outcomes:

- Positive Response
- Neutral Response
- Negative Response

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Neurotraining on a macro-level (Eg. 6 weeks)

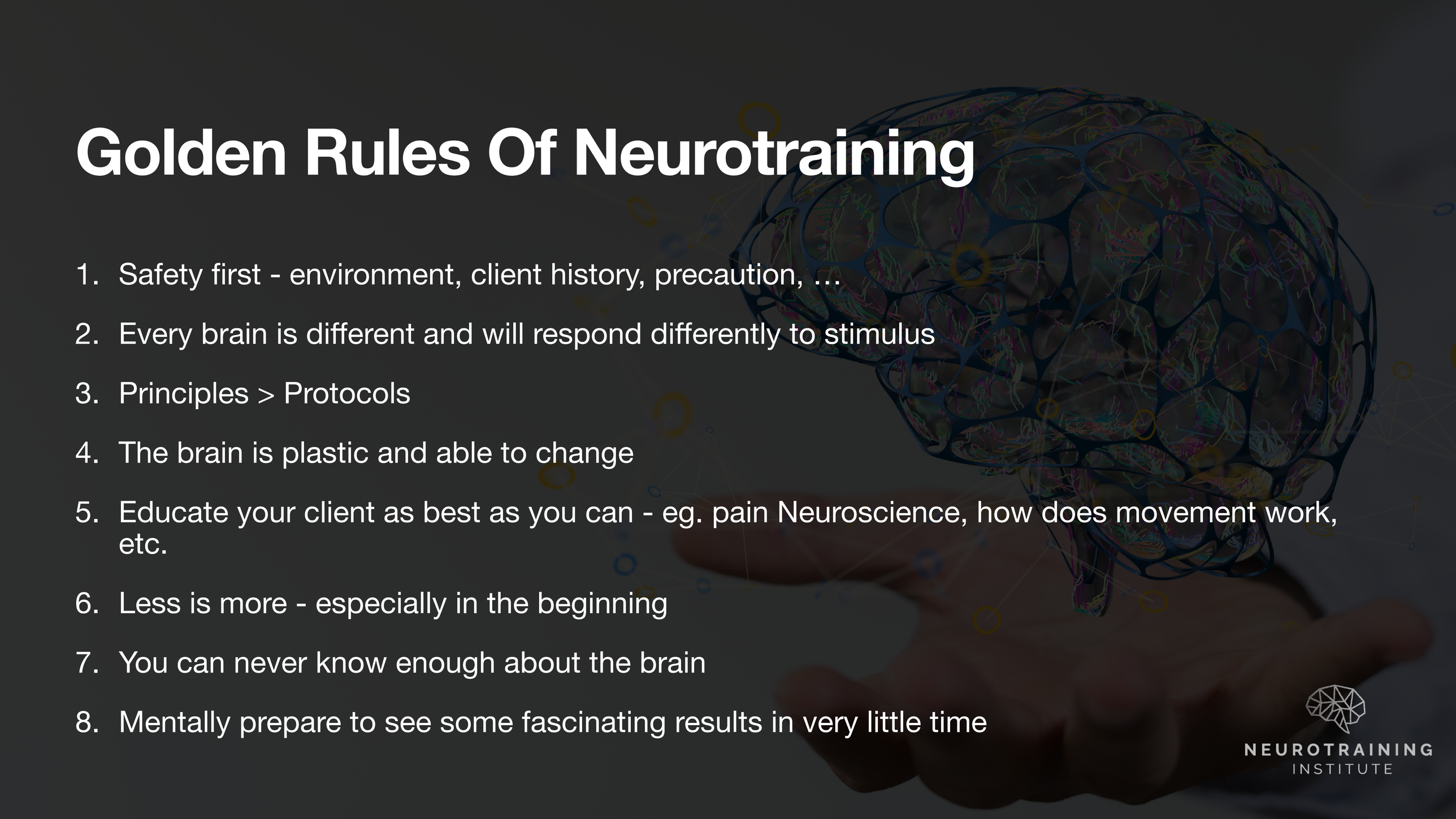


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Vision Training (Example)



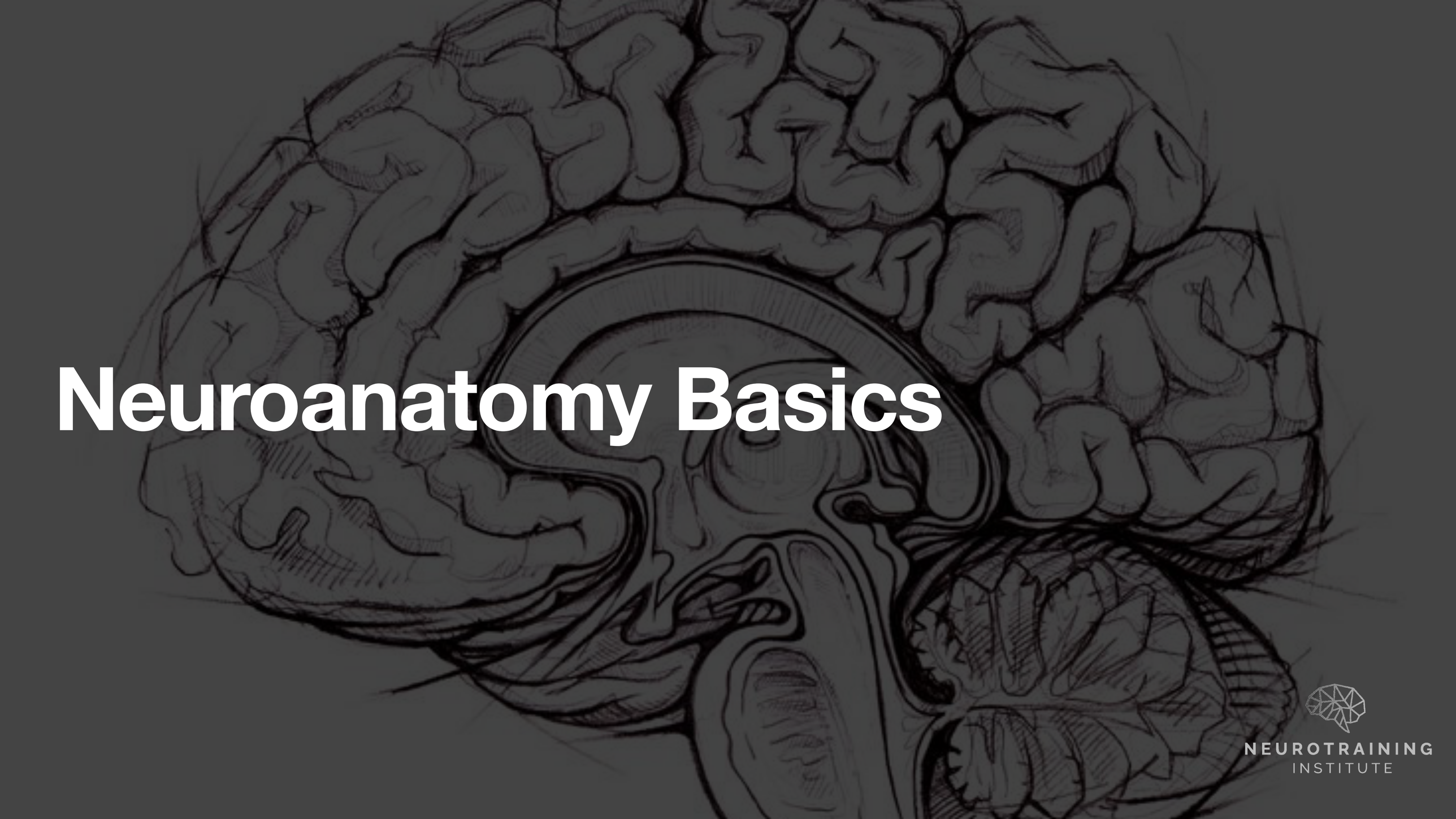
Golden Rules Of Neurotraining



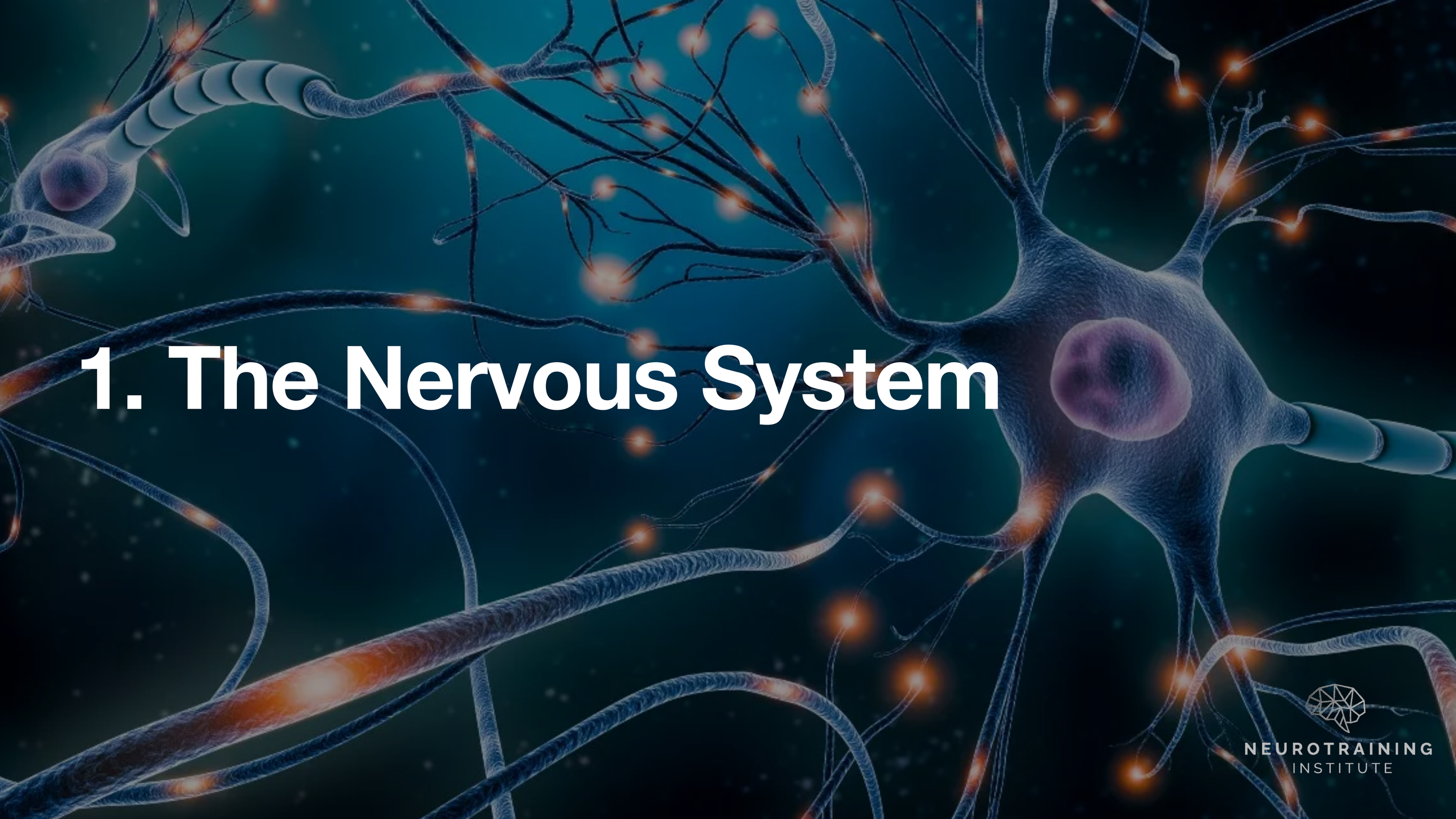
1. Safety first - environment, client history, precaution, …
2. Every brain is different and will respond differently to stimulus
3. Principles > Protocols
4. The brain is plastic and able to change
5. Educate your client as best as you can - eg. pain Neuroscience, how does movement work, etc.
6. Less is more - especially in the beginning
7. You can never know enough about the brain
8. Mentally prepare to see some fascinating results in very little time

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Neuroanatomy Basics



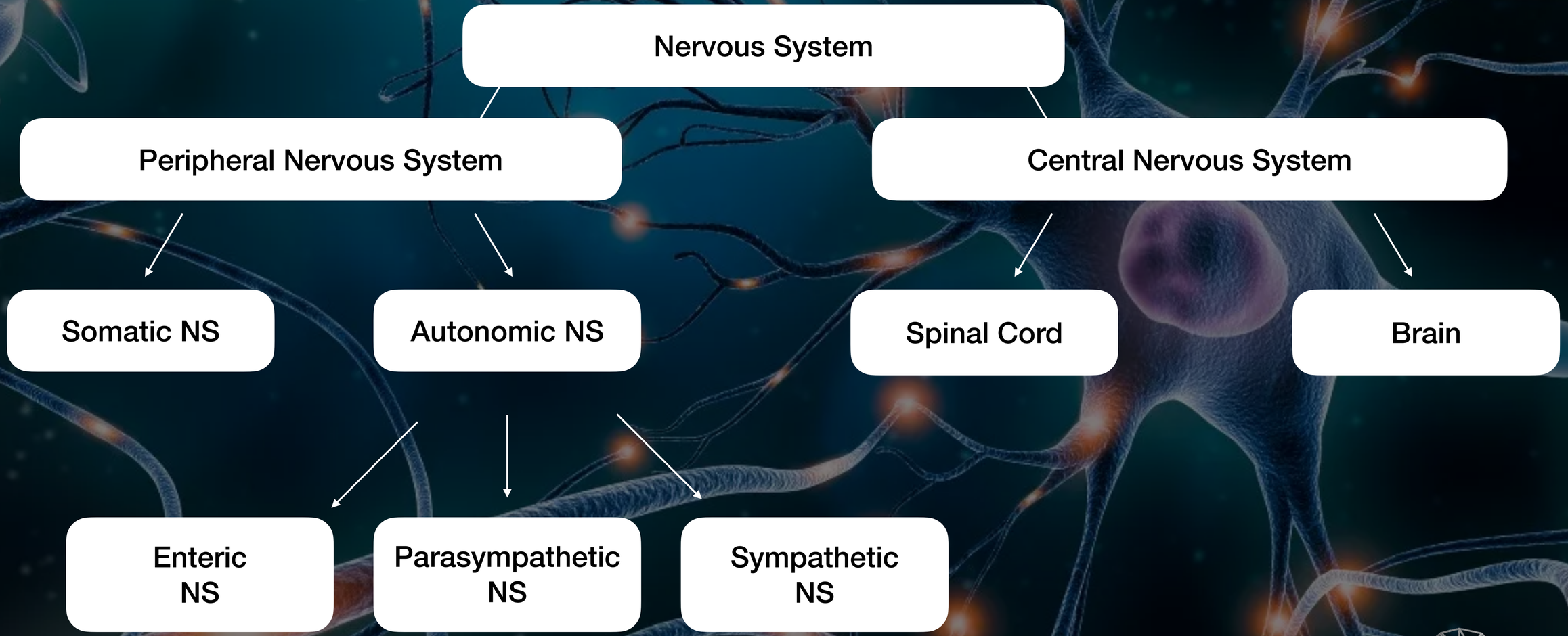
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1. The Nervous System

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The Nervous System



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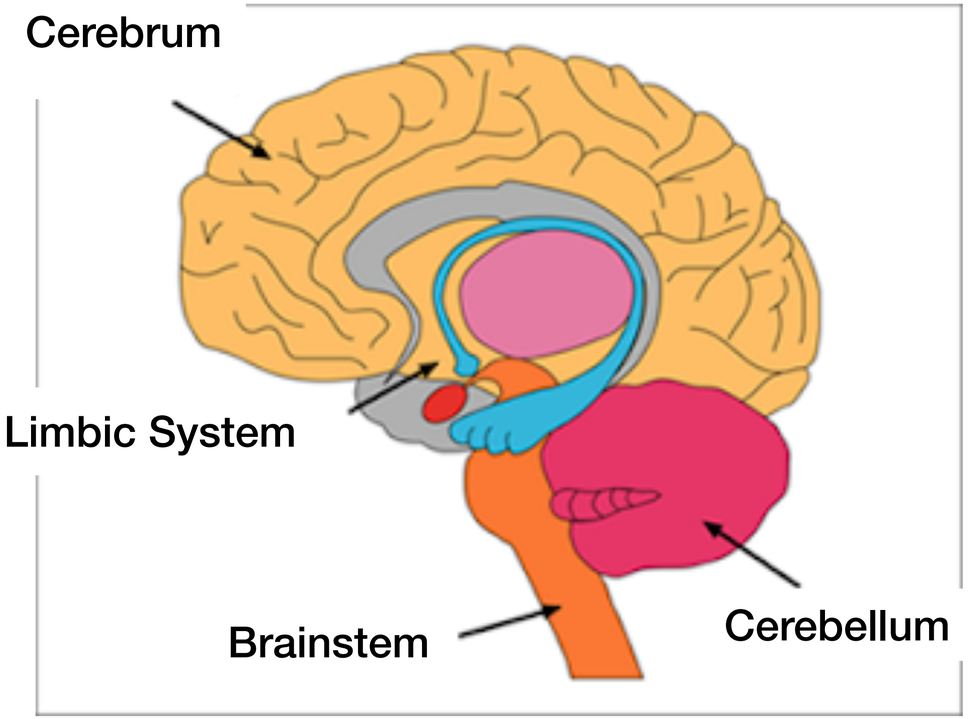
2. Major Brain Areas



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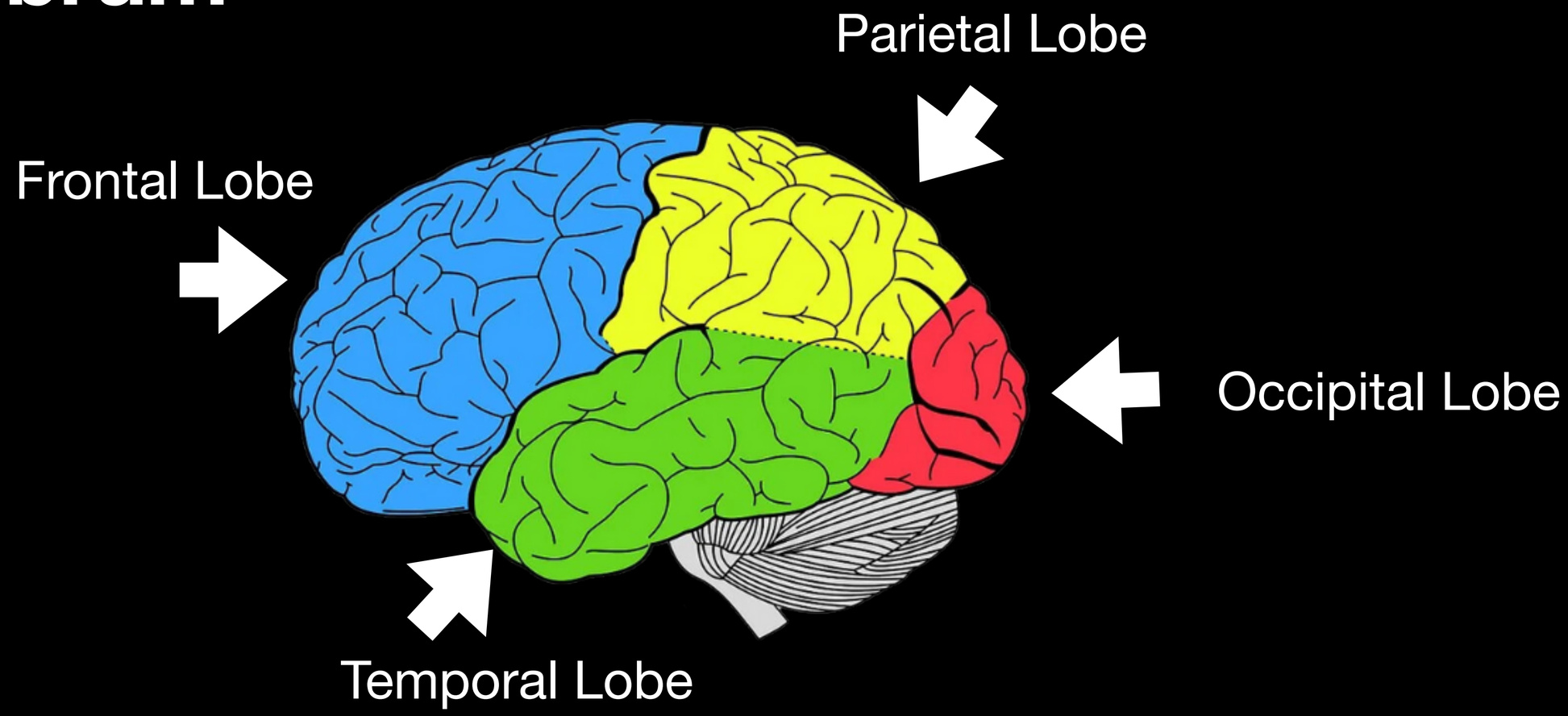
The Big 4

- Cerebrum
- Cerebellum
- Limbic System
- Brainstem



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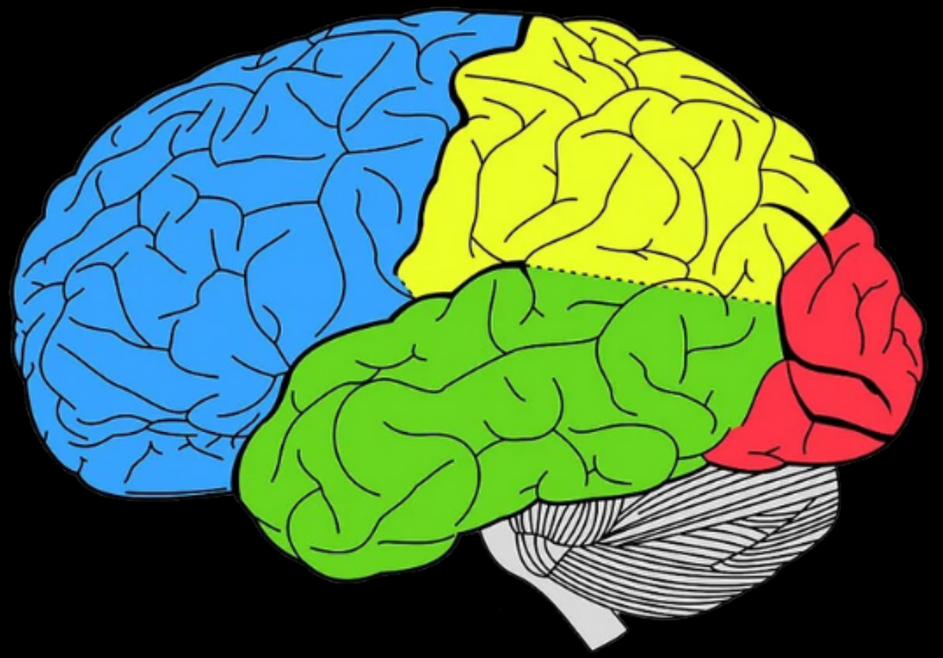
Cerebrum



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Cerebrum

- Each hemisphere of the cerebrum controls the opposite side of the body
- The concept of "left-brained" and "right-brained" individuals is an oversimplification. Both hemispheres work together for most tasks



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Cerebellum

- Latin “little brain”
- Accounts for only 10% of the brain's total volume, but contains approximately 50% of the brain's neurons
- Controls a variety of functions including coordination, posture, muscle tone, cognitive function, motor learning and more



Brainstem

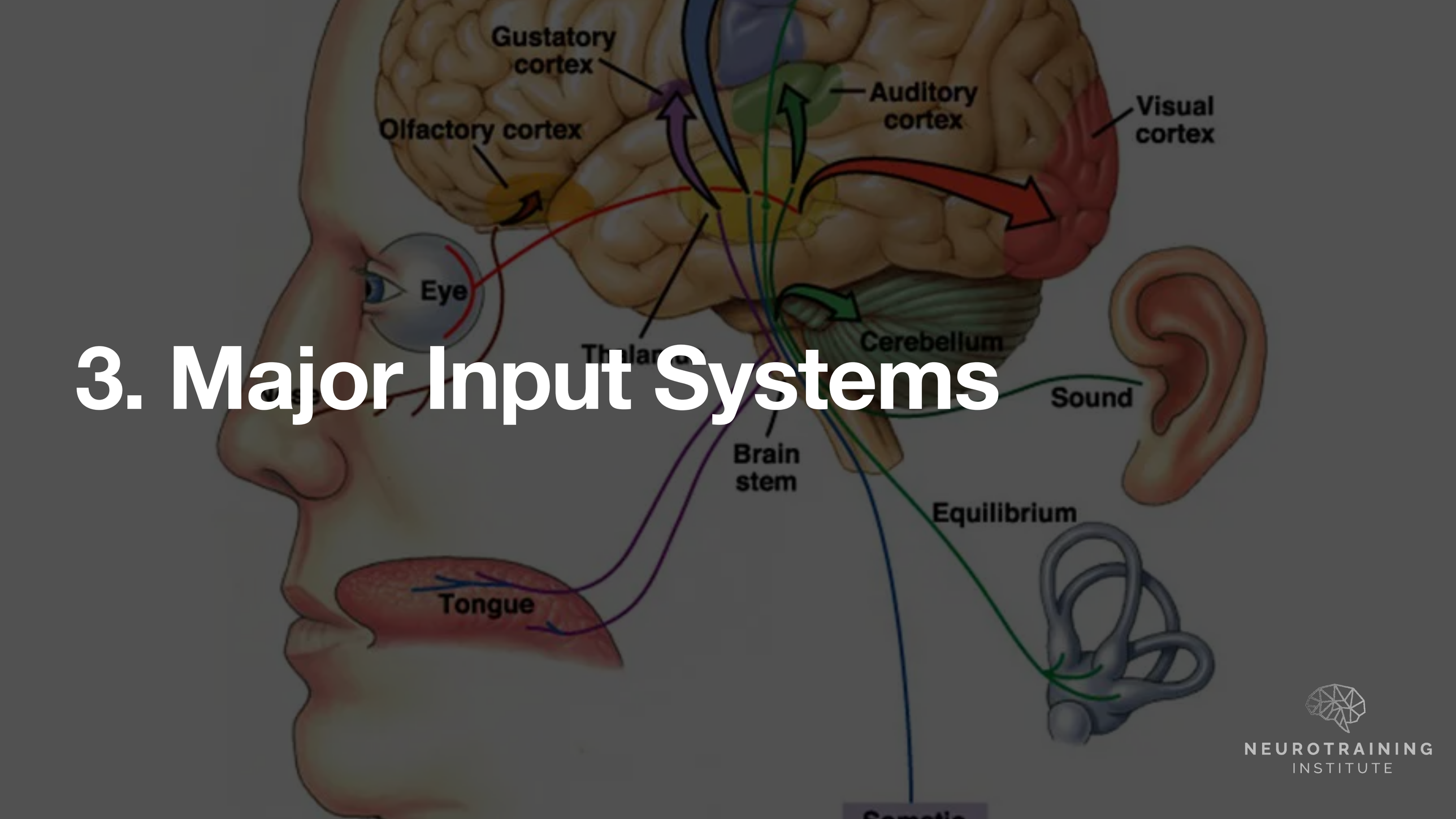
- Crucial for autonomic survival processes like breathing, heart rate, reflexes, etc.
- It consists of 3 primary parts the midbrain, pons & medulla
- Origin of most of our cranial nerves



Limbic system

- The limbic system is a group of interconnected brain structures that control a variety of functions including emotions, social bonds, memory, fear and more
- The main areas include the Amygdala, Thalamus, Hypothalamus, Cingulate Gyrus, Nucleus Accumbens & the Olfactory Bulb

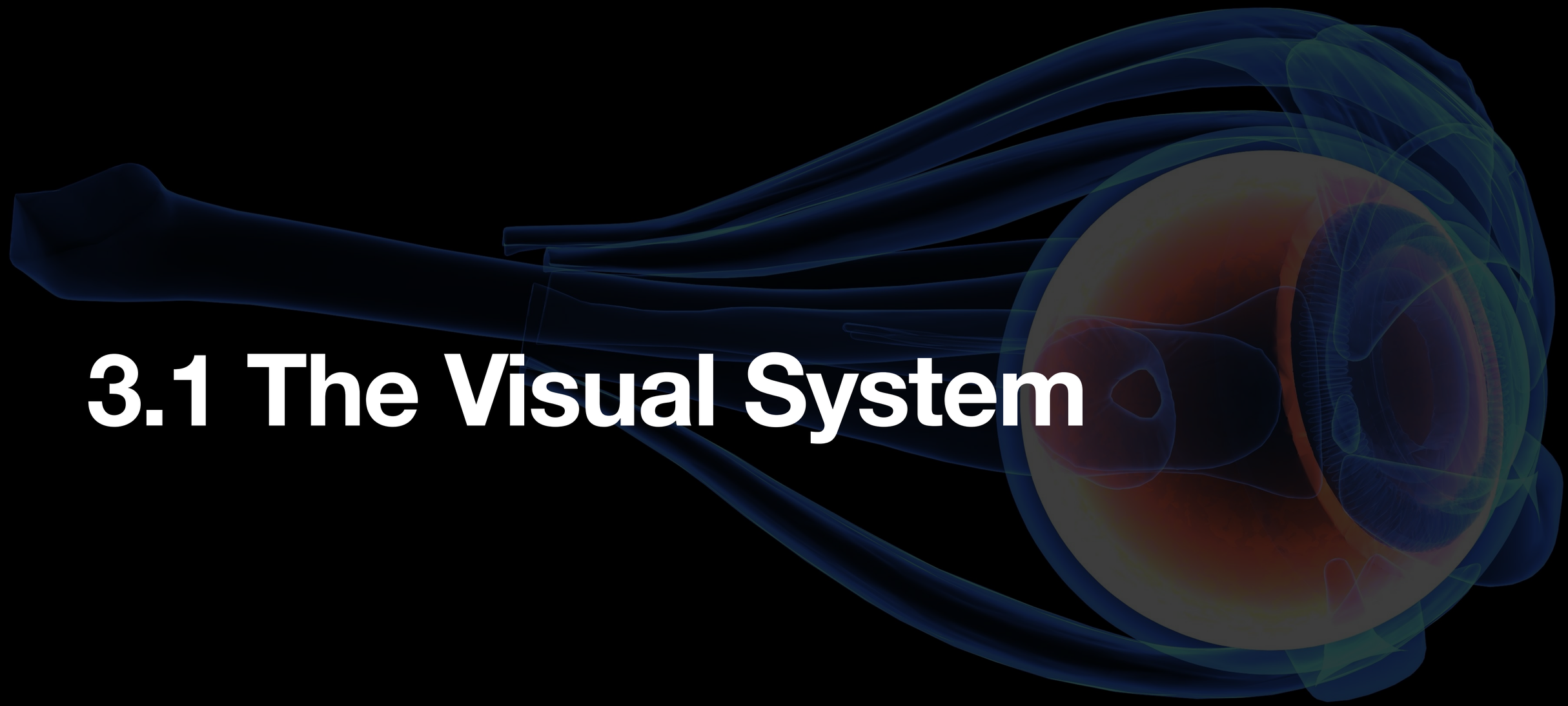




3. Major Input Systems

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3.1 The Visual System



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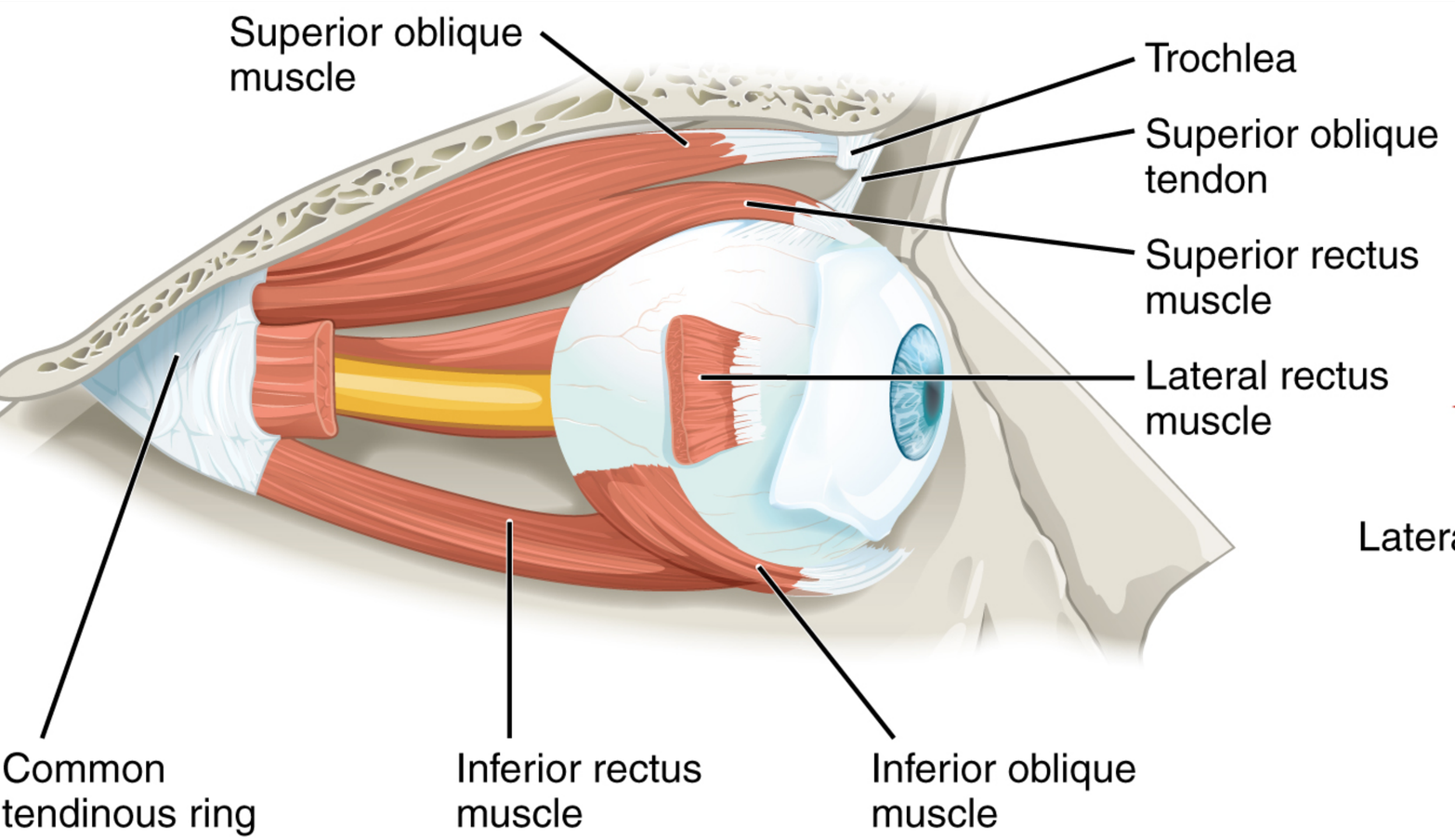
7 Facts to know about the visual system

1. Vision is our most dominant sensory system of our body - 70-80% of sensory input is visual
2. Vision is a highly complex neurological act by the brain (our eyes look, but the brain sees)
3. The eyes are literally the visible part of our brain
4. Each eye is attached to 6 different extraocular muscles
5. Changes in eye movements is one of the first indicators of neurological dysfunction
6. The primary visual cortex contains about 140 million neurons, making it one of the most densely populated areas in the brain
7. Vision can be trained and detrained

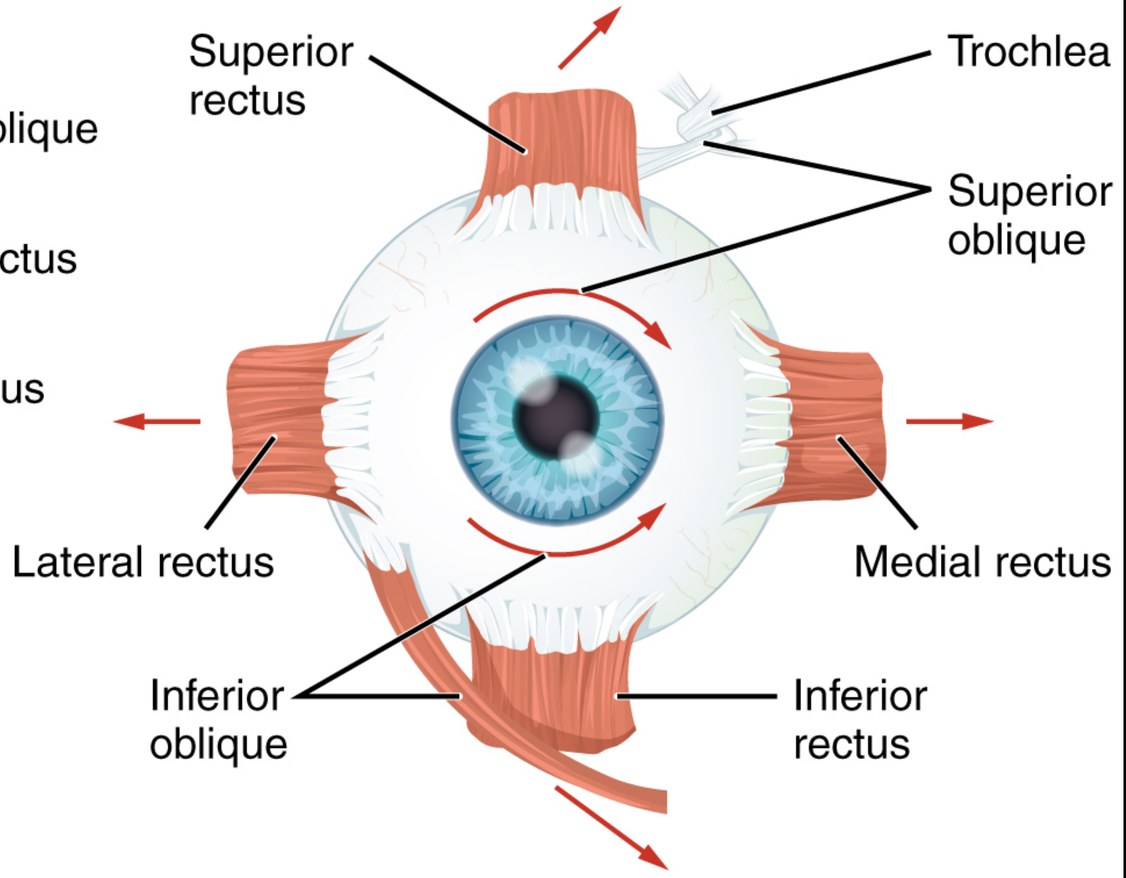
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Anatomy of the visual system



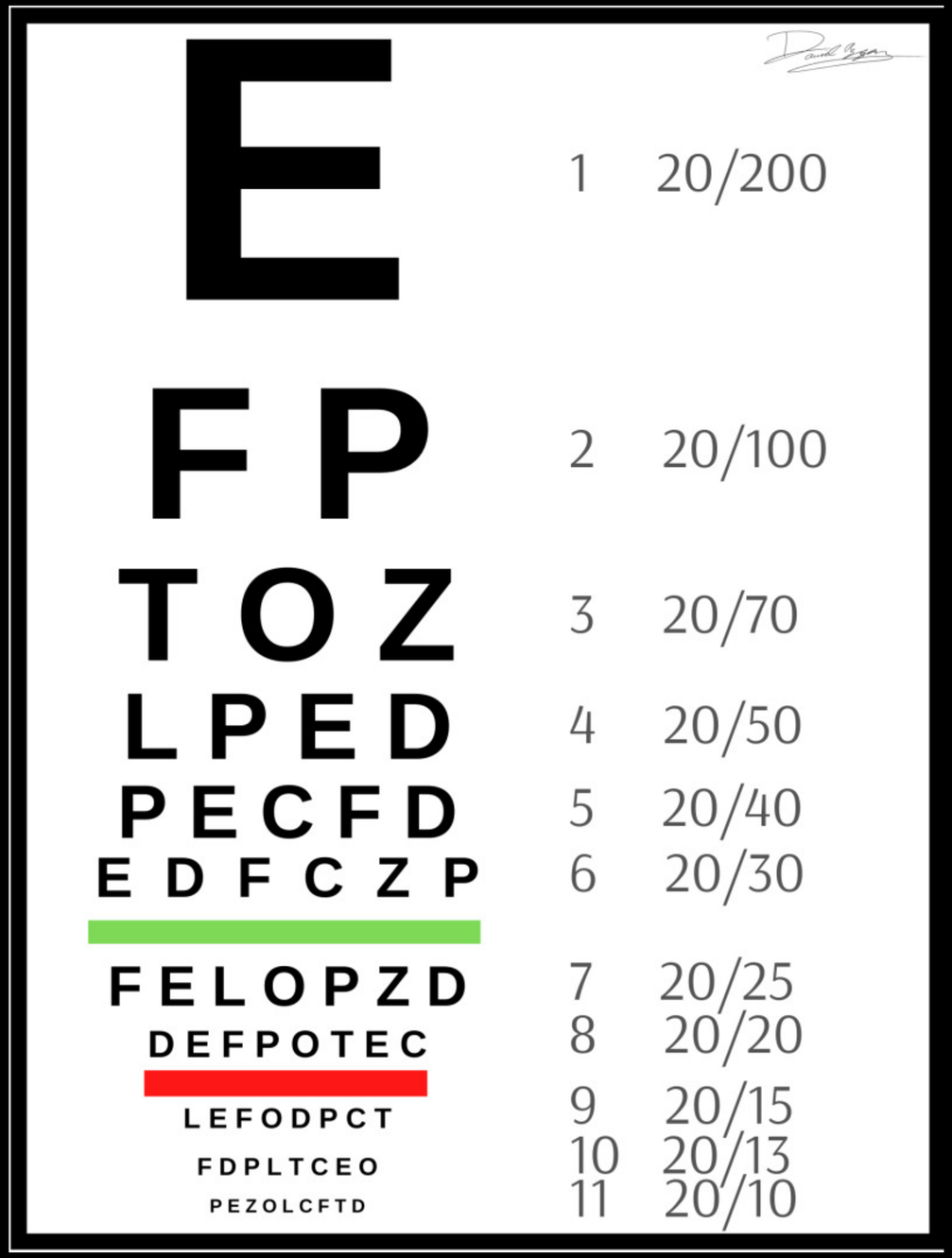
Lateral view of the right eye



Anterior view of the right eye

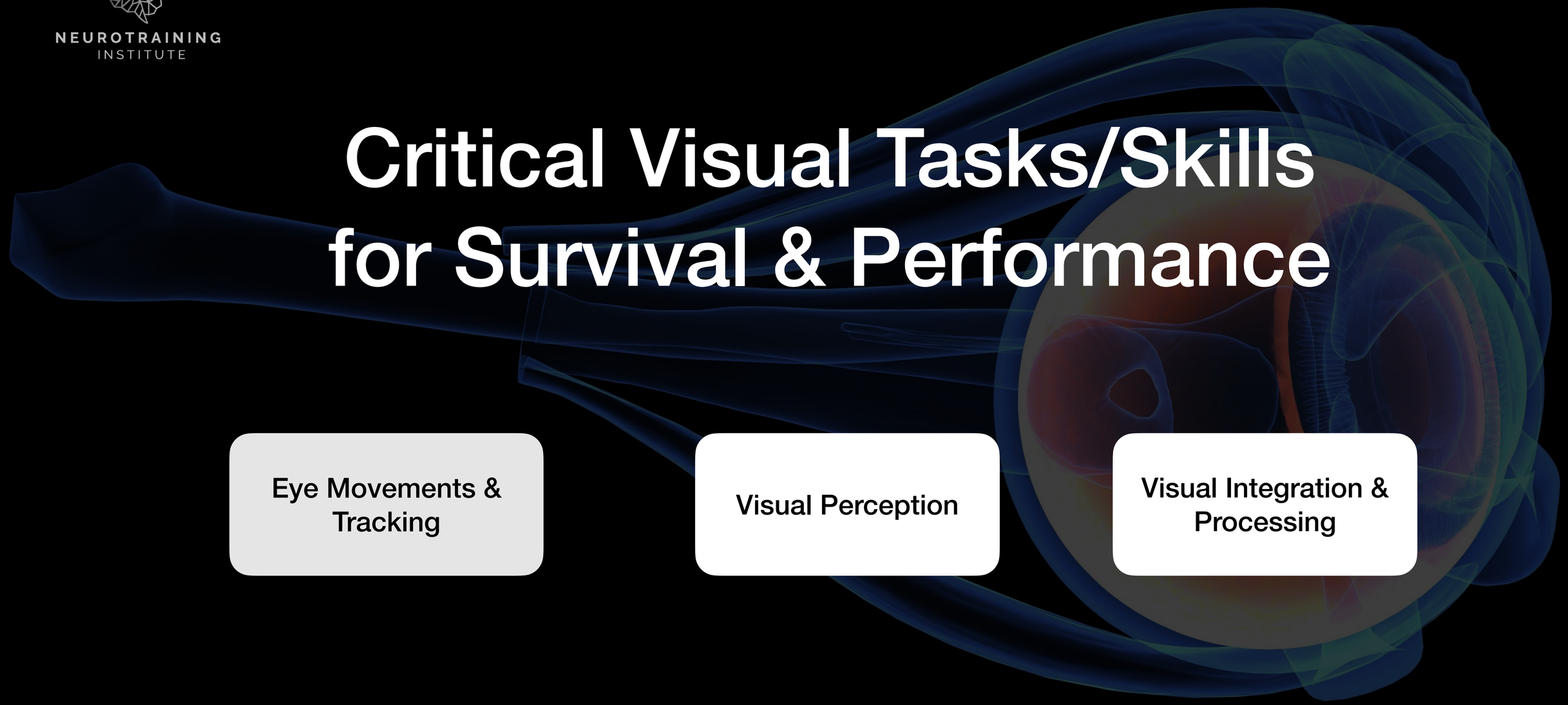
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Vision is more than just seeing “clearly”



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Critical Visual Tasks/Skills for Survival & Performance



Eye Movements & Tracking

Visual Perception

Visual Integration & Processing

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Poor visual skills & anxiety

“The evidence suggests that there is a direct positive feedback loop-a bidirectional causal relationship-between vision-related anxiety and self-reported visual difficulty. “

› Ophthalmic Genet. 2023 Aug;44(4):327-333. doi: 10.1080/13816810.2023.2208211. Epub 2023 May 4.

Positive feedback loop between vision-related anxiety and self-reported visual difficulty

Lilia T Popova [1], Rebhi O Abuzaitoun [2], David M Fresco [3], Maria Fernanda Abalem [2 4], Chris A Andrews [2], David C Musch [2 5], Joshua R Ehrlich [2], K Thiran Jayasundera [2]

Affiliations + expand

PMID: 37140038 DOI: 10.1080/13816810.2023.2208211

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Does vision training really work?

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Vision training & Neurobehavioral Symptoms

"Oculomotor training resulted improved saccadic metrics and a significant reduction in overall symptoms as shown on the NSI (Neurobehavioral Symptom Inventory)"

› Arch Rehabil Res Clin Transl. 2021 Mar 31;3(2):100126. doi: 10.1016/j.arrct.2021.100126. eCollection 2021 Jun.

Oculomotor Training for Poor Saccades Improves Functional Vision Scores and Neurobehavioral Symptoms

Nicholas P Murray [1], Melissa Hunfalvay [2], Claire-Marie Roberts [3], Ankur Tyagi [2], Jason Whittaker [4], Cedrick Noel [5]

Affiliations + expand

PMID: 34179762 PMCID: PMC8212010 DOI: 10.1016/j.arrct.2021.100126

Free PMC article

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Vision training & sports performance

Study Overview: This study assessed the impact of sports vision training on visual performance measures in elite female basketball players.

Findings: The results indicated that sports vision training led to improvements in visual skills, including contrast sensitivity, dynamic visual acuity, and hand-eye coordination.

J Hum Kinet. 2015 Dec 30;49:287-96. doi: 10.1515/hukin-2015-0131. eCollection 2015 Dec 22.

The Effects of Sports Vision Training on Binocular Vision Function in Female University Athletes

Teresa Zwierko [1], Lidia Puchalska-Niedbał [2], Justyna Krzepota [1], Mikołaj Markiewicz [3], Jarosław Woźniak [4], Wojciech Lubiński [2]

Affiliations + expand

PMID: 26925183 PMCID: PMC4723179 DOI: 10.1515/hukin-2015-0131

Free PMC article

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Vision Training & TBI

“A vision rehabilitation plan that includes vision therapy can improve visual dysfunction secondary to TBI. Combining office-based and home-based vision therapy training will maximize visual potential and functional results.”

Review > Phys Med Rehabil Clin N Am. 2019 Feb;30(1):171-188.
doi: 10.1016/j.pmr.2018.09.001. Epub 2018 Oct 31.

Vision Rehabilitation After Traumatic Brain Injury

Sandra M Fox [1], Paul Koons [2], Sally H Dang [3]

Affiliations + expand

PMID: 30470420 DOI: 10.1016/j.pmr.2018.09.001

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Vision Training & Concussion Prevention

"Improved visual–motor control and oculomotor performance enable players to anticipate head collisions, which appears to reduce the severity and frequency of head impacts. Improved visual–motor control and oculomotor performance enable players to anticipate collisions, which appears to reduce the severity and frequency of head hits. Sports vision training is a promising strategy for enhancing visual–motor control and eye speed, which may help reduce the risk of concussion. The effectiveness of a visual and sensorimotor training program can reduce the risk of concussion in a variety of sports."



SYSTEMATIC REVIEW

Prevention of sports-related concussion in soccer: a comprehensive review of the literature

Indharty, Rr Suzy MD, PhD[a]; Siahaan, Andre M. P. MD, PhD[a]; Rosarina, MD[a]; Susanto, Martin MD[a]; Tandean, Steven MD[a]; Risfandi, Marsal MD[b]

Author Information

Annals of Medicine & Surgery 85(3):p 365-373, March 2023. | ***DOI:*** 10.1097/MS9.0000000000000268

OPEN

Metrics

https://journals.lww.com/annals-of-medicine-and-surgery/fulltext/2023/03000/prevention_of_sports_related_concussion_in_soccer_.1.aspx

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3.2 The Vestibular System



7 facts about the vestibular system

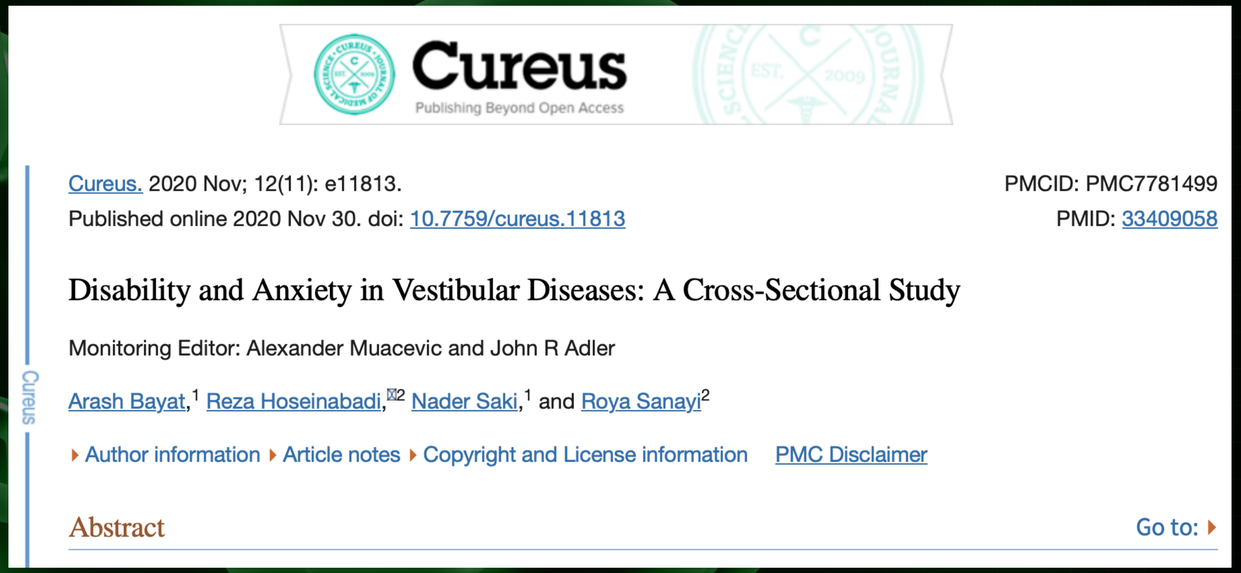
1. The vestibular system sits in our inner ear and is our body's own balancing system
2. The vestibular system is one of the earliest sensory systems to develop in a fetus - around week 3 of gestation
3. The vestibular system provides us with our sense of movement and orientation in space
4. The vestibular system sends signals to the brain at a rate of around 100 to 120 signals per second
5. You often find poor vestibular skills in findings like balance problems, hormonal issues, anxiety and more
6. The vestibular system plays a critical role for horizontal and vertical acceleration as well as stability in a performance context
7. Frequently, the vestibular system can suffer damage due to concussions, head injuries, and similar traumas

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Vestibular issues & anxiety

"In our results, we observed a significant positive correlation between the scores of BAI (Beck Anxiety Inventory) and DHI (Dizziness Handicap Inventory) scales. Furthermore, logistic regression analysis was performed with gender, age, total DHI score, and the types of vestibular disorder as modifying variables for the development of psychological anxiety. Our finding indicated that only the total DHI score was associated significantly with the BAI scores of individuals with the vestibular disorder ($p<0.001$)."



Cureus
Publishing Beyond Open Access

Cureus. 2020 Nov; 12(11): e11813.
Published online 2020 Nov 30. doi: 10.7759/cureus.11813
PMCID: PMC7781499
PMID: 33409058

Disability and Anxiety in Vestibular Diseases: A Cross-Sectional Study

Monitoring Editor: Alexander Muacevic and John R Adler

Arash Bayat,[1] Reza Hoseinabadi,[2] Nader Saki,[1] and Roya Sanayi[2]

Author information ▸ Article notes ▸ Copyright and License information PMC Disclaimer

Abstract Go to: ▸

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7781499/

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Vestibular function & autism

“In conclusion, the results of this retrospective review indicate that balance impairment and vestibular deficits are present in children with ASD, and this may contribute to a whole host of symptoms and challenges faced each day from a very early age such as activity avoidance (decreased confidence and fear), social isolation, and increased risk of physical injury such as falling.”

“Therefore, increased awareness of balance and vestibular problems in children is needed. As stated in a recent publication [9], “vestibular issues are likely under-reported in children with ASD and may go unrecognized”.



Autism Res Treat. 2022; 2022: 7568572. PMCID: PMC9398866
Published online 2022 Aug 16. doi: 10.1155/2022/7568572 PMID: 36016580

Balance and Vestibular Deficits in Pediatric Patients with Autism Spectrum Disorder: An Underappreciated Clinical Aspect

Linda M. Oster [1] and Guangwei Zhou [1,2]

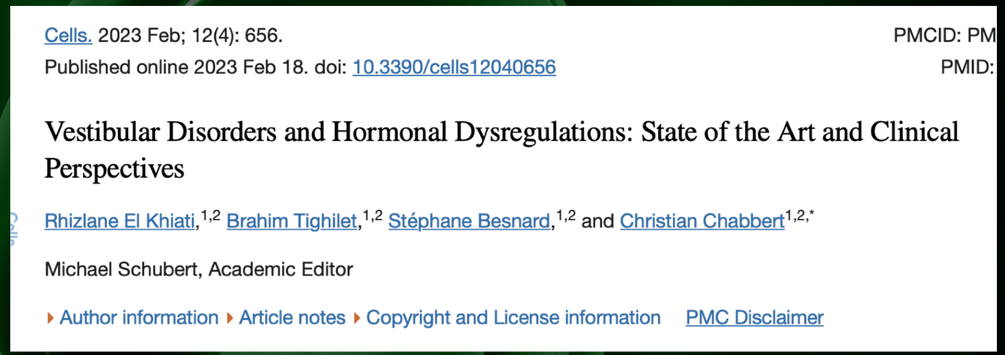
Author information Article notes Copyright and License information PMC Disclaimer

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9398866/

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Vestibular system & hormones

- “For example, it has long been known that receptors of different types of hormones, such as adrenaline [1], vasopressin [1,2], thyroid hormones [3], insulin [4], cortisol [5] or sex hormones, such as testosterone, progesterone, and estrogens [6,7,8], are expressed at the level of the inner ear sensors, along the vestibular nerve, and in the brainstem vestibular nuclei [5].”
- The vestibular system displays projections towards the suprachiasmatic (SCN) and raphe nuclei [28] involved in the secretion of serotonin [29] and melatonin [30], as well as bidirectional projections with orexinergic neurons [31,32]. In turn, the vestibular organs receive inputs from melatonin neurons [33]
- It has also been known for a long time that certain physiological states displaying particular hormonal profiles are commonly associated with vestibular disorders. This is the case, for example, with the strong preponderance of benign paroxysmal positional vertigo (BPPV) in postmenopausal women This is also the case for thyroid pathologies, diabetes and vestibular migraines. We also know that vestibular stimulation activates the sympathetic system and the hypothalamic–pituitary axis with modulation of the secretions of CRH, ACTH, LHRH, and LH. Additionally, metabolic syndromes such as hypo/hyperthyroidism and type I diabetes may affect vestibular organ and functions [58,59].



Cells. 2023 Feb; 12(4): 656. PMCID: PM
Published online 2023 Feb 18. doi: 10.3390/cells12040656 PMID:

Vestibular Disorders and Hormonal Dysregulations: State of the Art and Clinical Perspectives

Rhizlane El Khiati,[1,2] Brahim Tighilet,[1,2] Stéphane Besnard,[1,2] and Christian Chabbert[1,2,*]

Michael Schubert, Academic Editor

Author information Article notes Copyright and License information PMC Disclaimer

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Vestibular function & sports performance

“Balance ability was related to competition level for some sports, with the more proficient athletes displaying greater balance ability. There were significant relationships between balance ability and a number of performance measures. ”

“As a single intervention, balance training has been shown to significantly reduce the recurrence of ankle ligament injuries in soccer, volleyball and recreational athletes”

Review > Sports Med. 2007;37(6):547-56. doi: 10.2165/00007256-200737060-00007.

Relationship between balance ability, training and sports injury risk

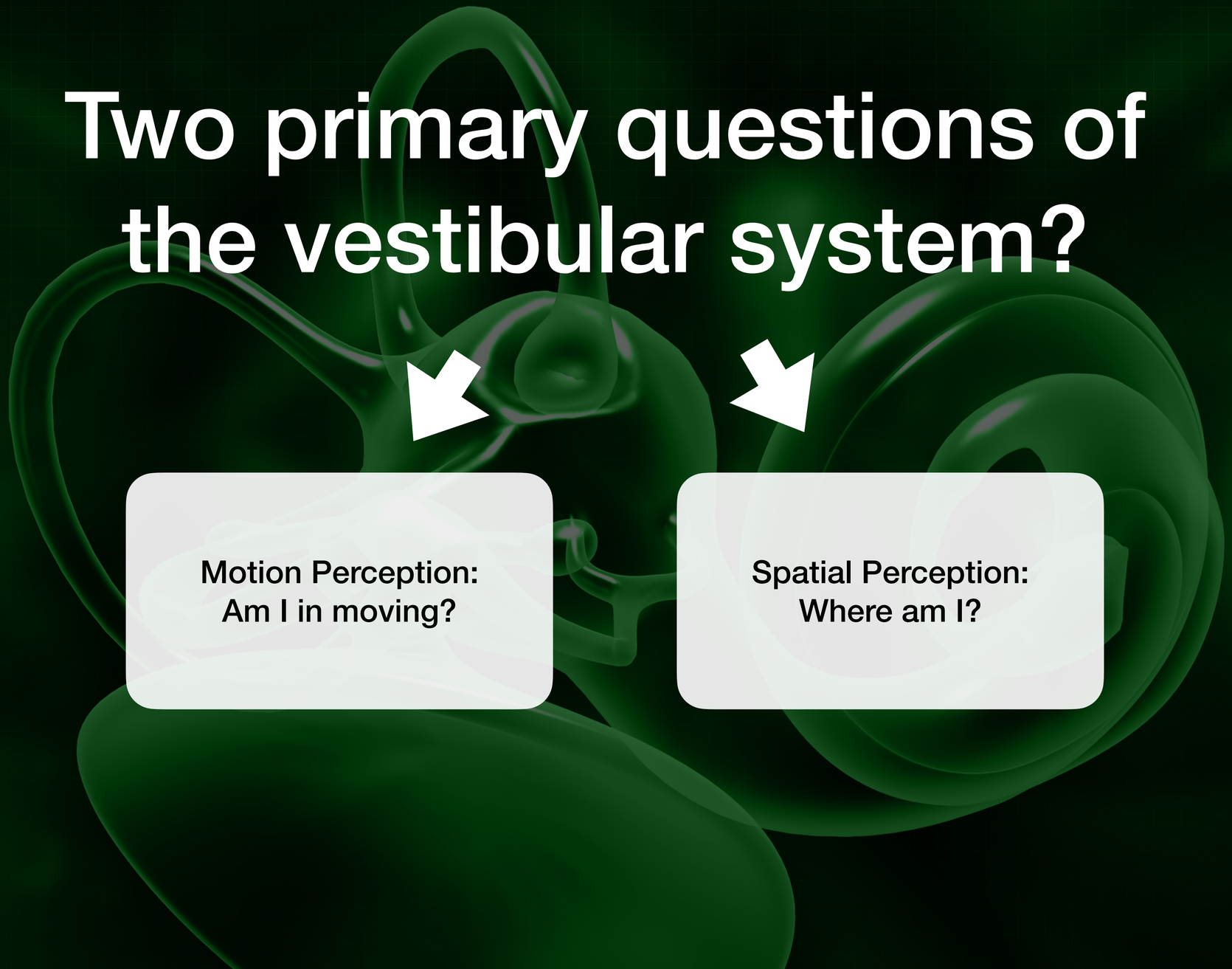
Con Hrysomallis [1]

Affiliations + expand

PMID: 17503879 DOI: 10.2165/00007256-200737060-00007

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Two primary questions of the vestibular system?



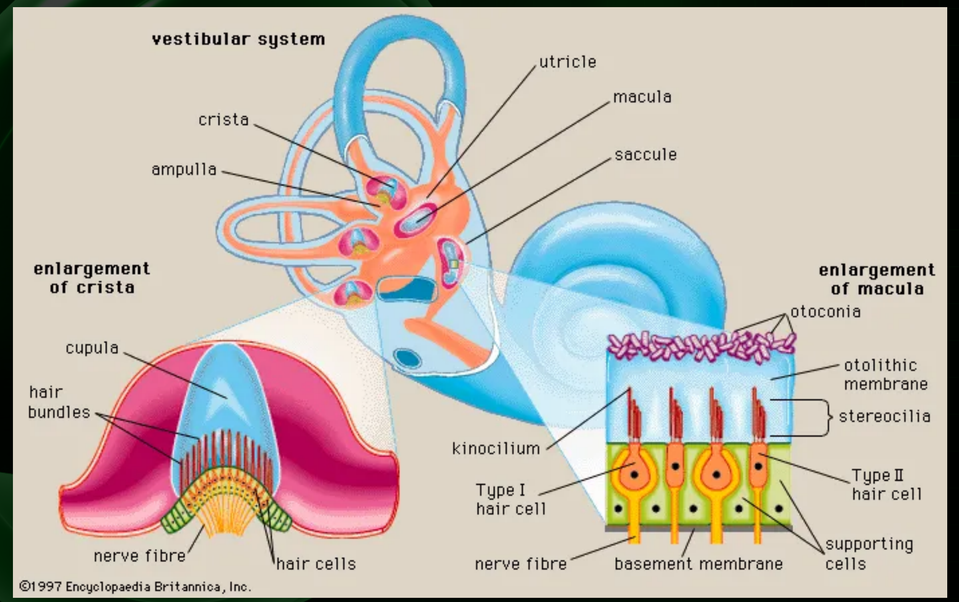
Motion Perception:
Am I in moving?

Spatial Perception:
Where am I?

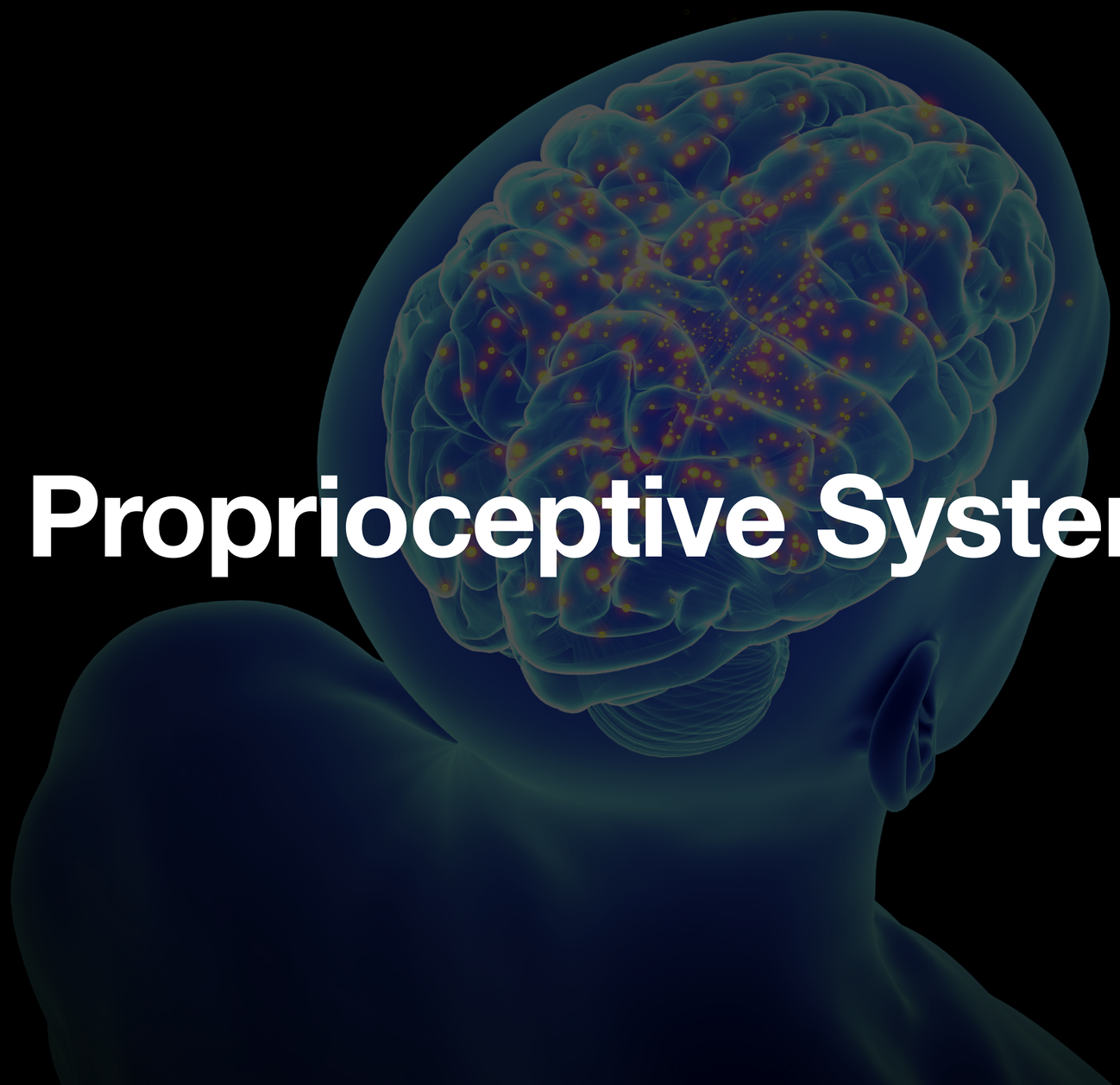
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How does the vestibular system work in detail?

- **Fluid-Filled Chambers:** Inside your inner ear, there are small, fluid-filled chambers called the semicircular canals and the otolith organs
- **Endolymph Fluid:** These chambers are filled with a special fluid called endolymph. Think of endolymph as the "water" in these balance tanks
- **Motion Detection:** When you move your head, the endolymph in these chambers also moves. This motion is detected by tiny hair-like sensors called hair cells
- **Sending Signals:** When the hair cells sense movement of the endolymph, they send signals to your brain via the vestibular nerve
- **Brain's Interpretation:** Your brain receives these signals and quickly figures out how your head is moving and where it's positioned. That way your brain's way knows if you're tilting, turning, or staying still
- **Maintaining Balance:** Based on the signals from the vestibular system, your brain coordinates with your eyes, muscles, and other senses to help you keep your balance and fight gravity



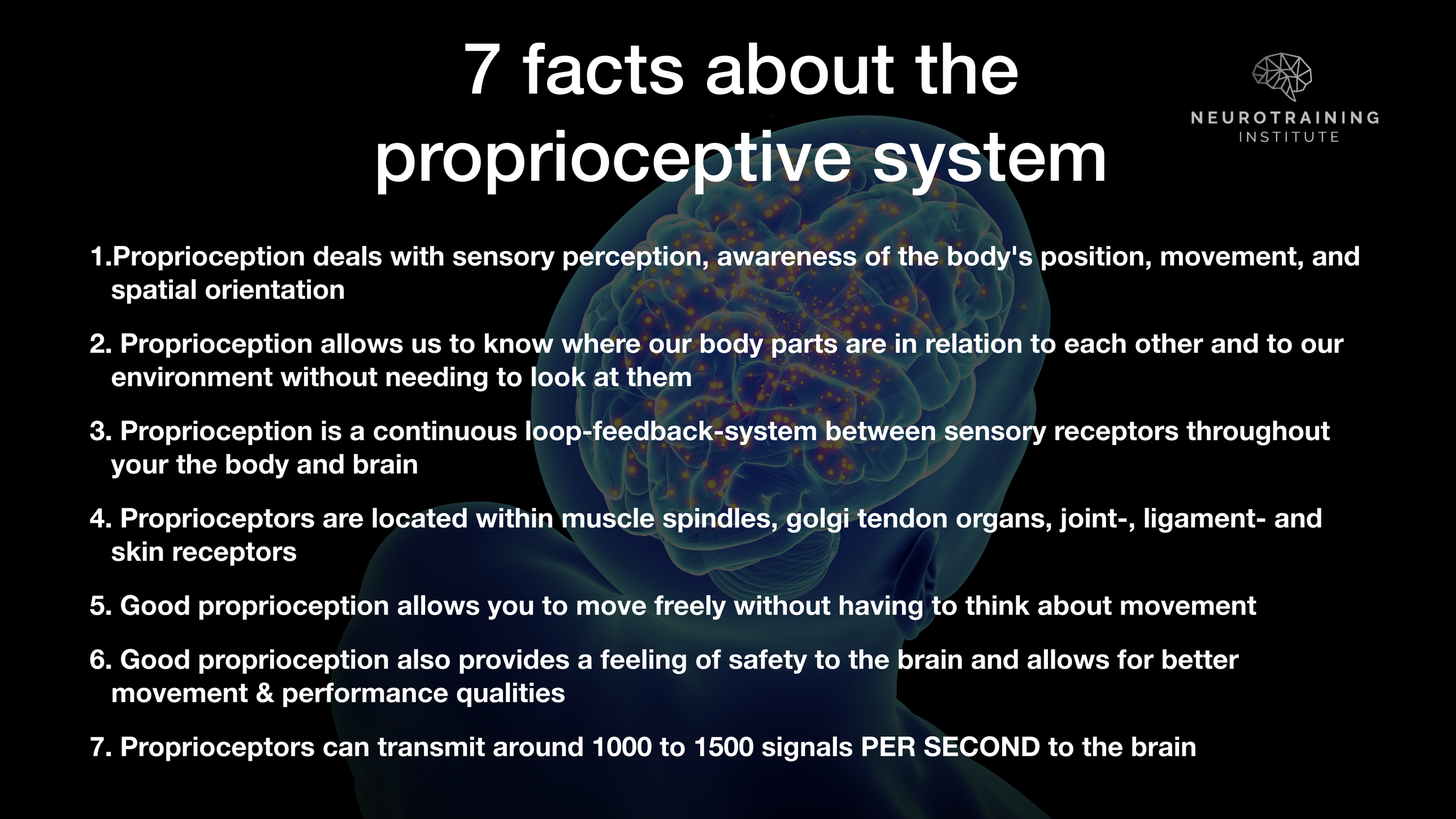
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3.3 The Proprioceptive System

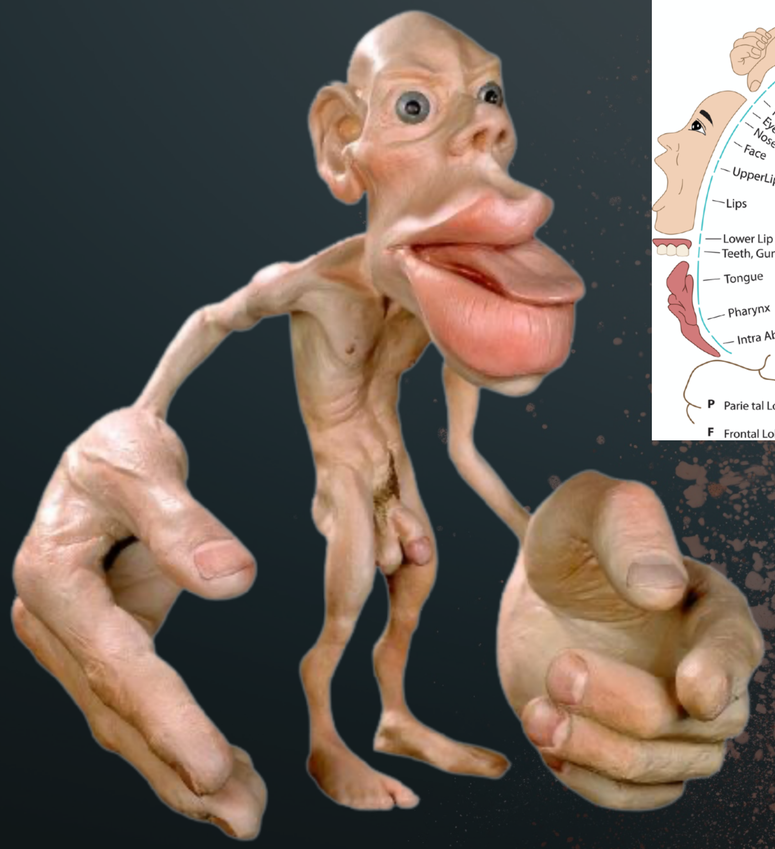
7 facts about the proprioceptive system

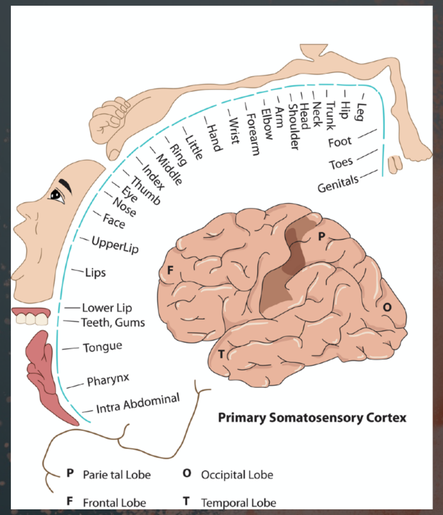
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1. Proprioception deals with sensory perception, awareness of the body's position, movement, and spatial orientation
2. Proprioception allows us to know where our body parts are in relation to each other and to our environment without needing to look at them
3. Proprioception is a continuous loop-feedback-system between sensory receptors throughout your the body and brain
4. Proprioceptors are located within muscle spindles, golgi tendon organs, joint-, ligament- and skin receptors
5. Good proprioception allows you to move freely without having to think about movement
6. Good proprioception also provides a feeling of safety to the brain and allows for better movement & performance qualities
7. Proprioceptors can transmit around 1000 to 1500 signals PER SECOND to the brain

The Sensory Homunculus





- The model portrays distorted body parts to illustrate the extent of representation in the somatosensory cortex of the brain dedicated to each area

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Proprioception & ankle sprains

- **Participants:** 3726 participants from 7 studies were included.
  - Analyses Conducted:
  - Preventing ankle sprains regardless of history (n = 3654)
  - Preventing recurrent ankle sprains (n = 1542)
  - Primary preventive measure for those without an ankle sprain history (n = 946)

Results:
- Regardless of ankle sprain history, proprioceptive training reduced ankle sprain rates (RR = 0.65, NNT = 17).
- For those with a history of ankle sprains, proprioceptive training reduced repeat ankle sprains (RR = 0.64, NNT = 13).
- Proprioceptive training as a primary preventive measure showed significant results (RR = 0.57, NNT = 33).

- **Conclusions:** Proprioceptive training effectively reduced ankle sprain incidence rates in athletes, both with and without a history of ankle sprains.



https://pubmed.ncbi.nlm.nih.gov/29140127/

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Proprioception & Agility

- Study: Cha, J., & Kim, D. (2016). The effects of balance training on agility performance and visual reaction time of youth soccer players. Journal of Exercise Rehabilitation, 12(6), 573-577.
- Findings: “There was a statistically significant difference of 2.81% ($p < 0.01$) in the agility value and 12.67% ($p < 0.01$) in the vertical jump value in the training group. ($p > 0.05$)It was found in the study carried out that static and dynamic equilibrium training for 6 weeks improved soccer players’agility and explosive power performance. Balance training should be used as a supportive training for soccer-training.”



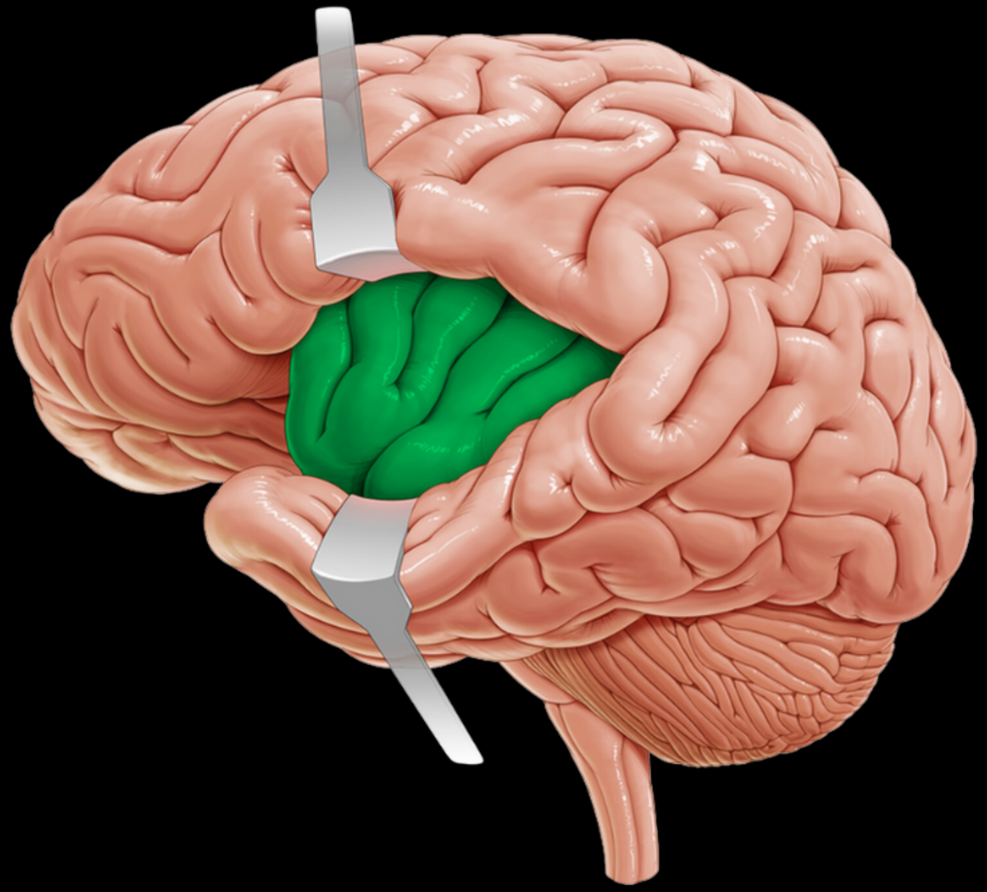
7 facts about the interoceptive system

1. Interoception detects and interprets our body's internal state and the understandings are fairly new in Neuroscience research
2. It plays a crucial role in maintaining homeostasis to ensure optimal internal conditions for overall health and well-being
3. The interoceptive system communicates closely with the autonomic nervous system
4. Interoception is intertwined with emotional processing and plays a role in recognizing and responding to emotional states, influencing feelings and behavior
5. Key players involved in Interoception include the insula cortex and the anterior cingulate cortex and the vagus nerve
6. It is often referred to as our 8th sense
7. Dysfunctions in interoception have been linked to various medical and psychological conditions, including anxiety, eating disorders, gut issues and certain chronic pain conditions

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The Insular Cortex



- The Insular Cortex is a multifunctional brain area that is connected to various systems and other brain areas
- Aside from interoception it is involved in many crucial tasks like pain perception & tolerance as well as emotional empathy and many more
- Brain studies have found that people with high interoception awareness tend to have thicker insulas. While poor interoception awareness is linked with less gray matter in the insula and less activity in the insula Critchley et al. 2004 -https://pubmed.ncbi.nlm.nih.gov/14730305/)

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Issues with Interoception can display in the following ways:

1. Self-control issues
2. A vague sense of identity and others
3. Difficulties in interpersonal connections
4. Emotional regulation problems
5. Chronic Anxiety, pain, muscle tension and more

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Interoception & Chronic Pain

“Results identified low interoceptive accuracy and confidence across CP conditions. Moreover, interoceptive and mood variables predicted pain severity across the whole CP sample, with interoceptive accuracy positively predicting and interoceptive confidence negatively predicting pain severity.”

J Pers Med. 2020 Dec; 10(4): 201.
Published online 2020 Oct 29. doi: 10.3390/jpm10040201
PMCID: PMC7712753
PMID: 33138185

Altered Interoceptive Perception and the Effects of Interoceptive Analgesia in Musculoskeletal, Primary, and Neuropathic Chronic Pain Conditions

Daniele Di Lernia,[1,2,*] Marco Lacerenza,[3] Vivien Ainley,[4] and Giuseppe Riva[1,2,5]

Author information ▸ Article notes ▸ Copyright and License information PMC Disclaimer

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7712753/

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Interoception & The Vagus Nerve

Hum Brain Mapp. 2021 Apr 1; 42(5): 1227–1242.
Published online 2020 Dec 16. doi: 10.1002/hbm.25288
PMCID: PMC7927286
PMID: 33325575

Behavioral and neurophysiological signatures of interoceptive enhancements following vagus nerve stimulation

Fabian Richter, [1] Adolfo M. García, [2,3,4,5] Nicolas Rodriguez Arriagada, [2,6] Adrian Yoris, [3,7] Agustina Birba, [2,3] David Huepe, [8] Heinz Zimmer, [1] Agustín Ibáñez, [2,3,5,8,9] and Lucas Sedeño [3]

“Taken together, these results constitute unprecedented evidence that the vagus nerve plays a direct role in neurovisceral integration during interoception. This finding can constrain mechanistic models of the domain while informing a promising transdiagnostic agenda for interoceptive impairments across neuropsychiatric conditions.”

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7927286/

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Interoception problems usually fall into one of these 3 categories:

- Hyperawareness
- Hypoawareness
- Distorted Interoception

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Let’s get practical!

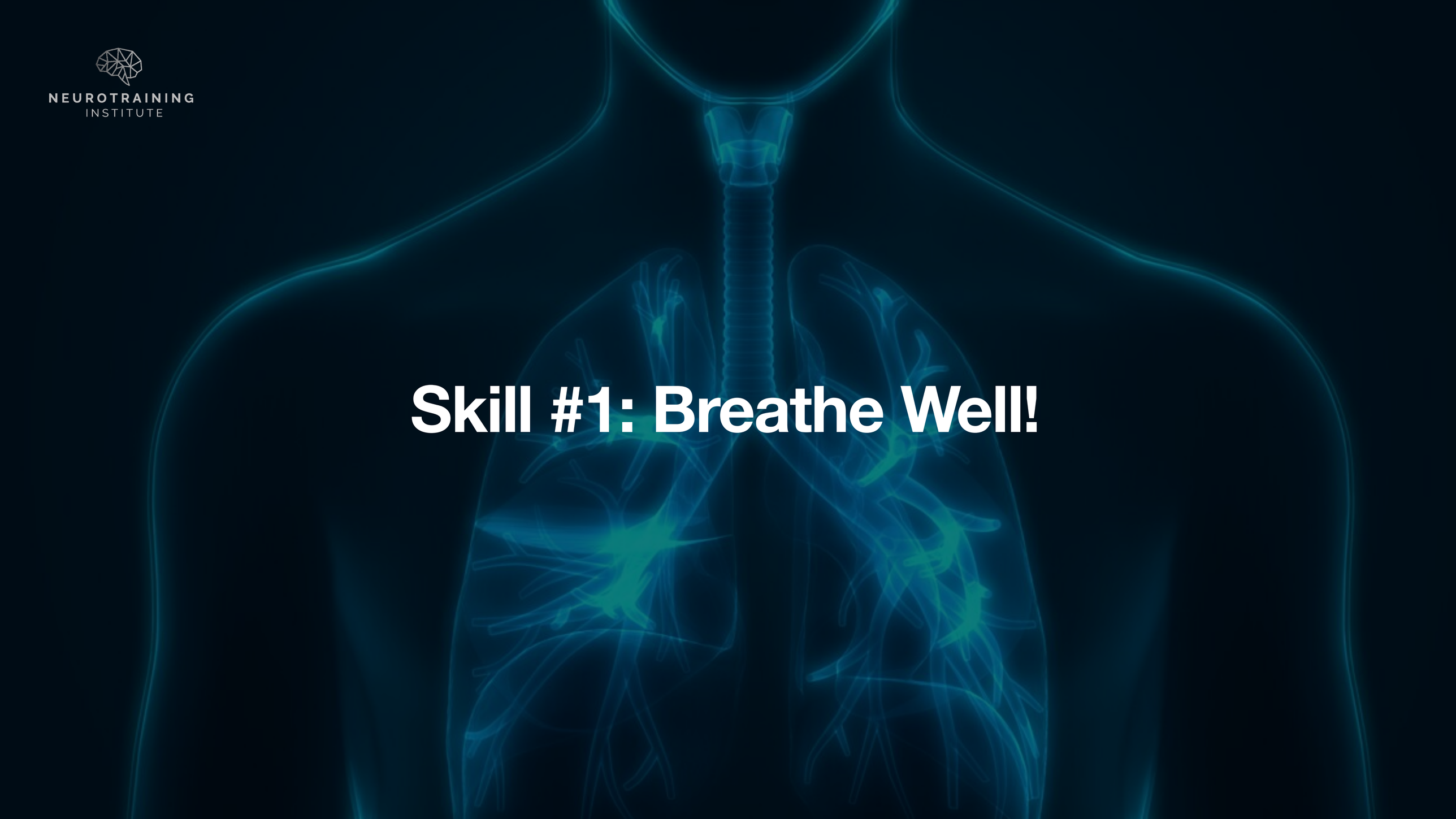
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Movement Assessments

Every test needs to be done with a few repetitions to make up a valid assessment

- Toe Touch
- Squat
- Supine Hip Flexion
- Straight Leg Raise
- Hip Internal/External Rotation
- Multi-Segmental-Rotation
- Cervical Rotation & Lateral Flexion
- Shoulder Internal Rotation/External Rotation
- Shoulder Flexion

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Skill #1: Breathe Well!

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Breathing & The Brain

- Breathing is our brain’s ultimate survival tool!
- On average we breath about 22.000 times a day
- Breathing is mostly an autonomic process mainly regulated by the brainstem
- Inhalation = Sympathetic in nature
- Exhalation = Parasympathetic in nature
- During respiration, muscles, ligaments, joints, fascia, and bones experience movement
- By changing the way we breath we can tremendously impact brain function, posture, muscle stiffness, performance, and more

Slow Breathing & Brain Function

“The main effects of slow breathing techniques cover autonomic and central nervous systems activities as well as the psychological status. Slow breathing techniques promote autonomic changes increasing Heart Rate Variability and Respiratory Sinus Arrhythmia paralleled by Central Nervous System (CNS) activity modifications. EEG studies show an increase in alpha and a decrease in theta power. Anatomically, the only available fMRI study highlights increased activity in cortical (e.g., prefrontal, motor, and parietal cortices) and subcortical (e.g., pons, thalamus, sub-parabrachial nucleus, periaqueductal gray, and hypothalamus) structures. Psychological/behavioral outputs related to the abovementioned changes are increased comfort, relaxation, pleasantness, vigor and alertness, and reduced symptoms of arousal, anxiety, depression, anger, and confusion.”

› Front Hum Neurosci. 2018 Sep 7;12:353. doi: 10.3389/fnhum.2018.00353. eCollection 2018.

How Breath-Control Can Change Your Life: A Systematic Review on Psycho-Physiological Correlates of Slow Breathing

Andrea Zaccaro [1], Andrea Piarulli [1 2], Marco Laurino [3], Erika Garbella [4], Danilo Menicucci [1], Bruno Neri [5], Angelo Gemignani [1 3 6]

Affiliations + expand

PMID: 30245619 PMCID: PMC6137615 DOI: 10.3389/fnhum.2018.00353

Free PMC article

How can we optimize breathing?

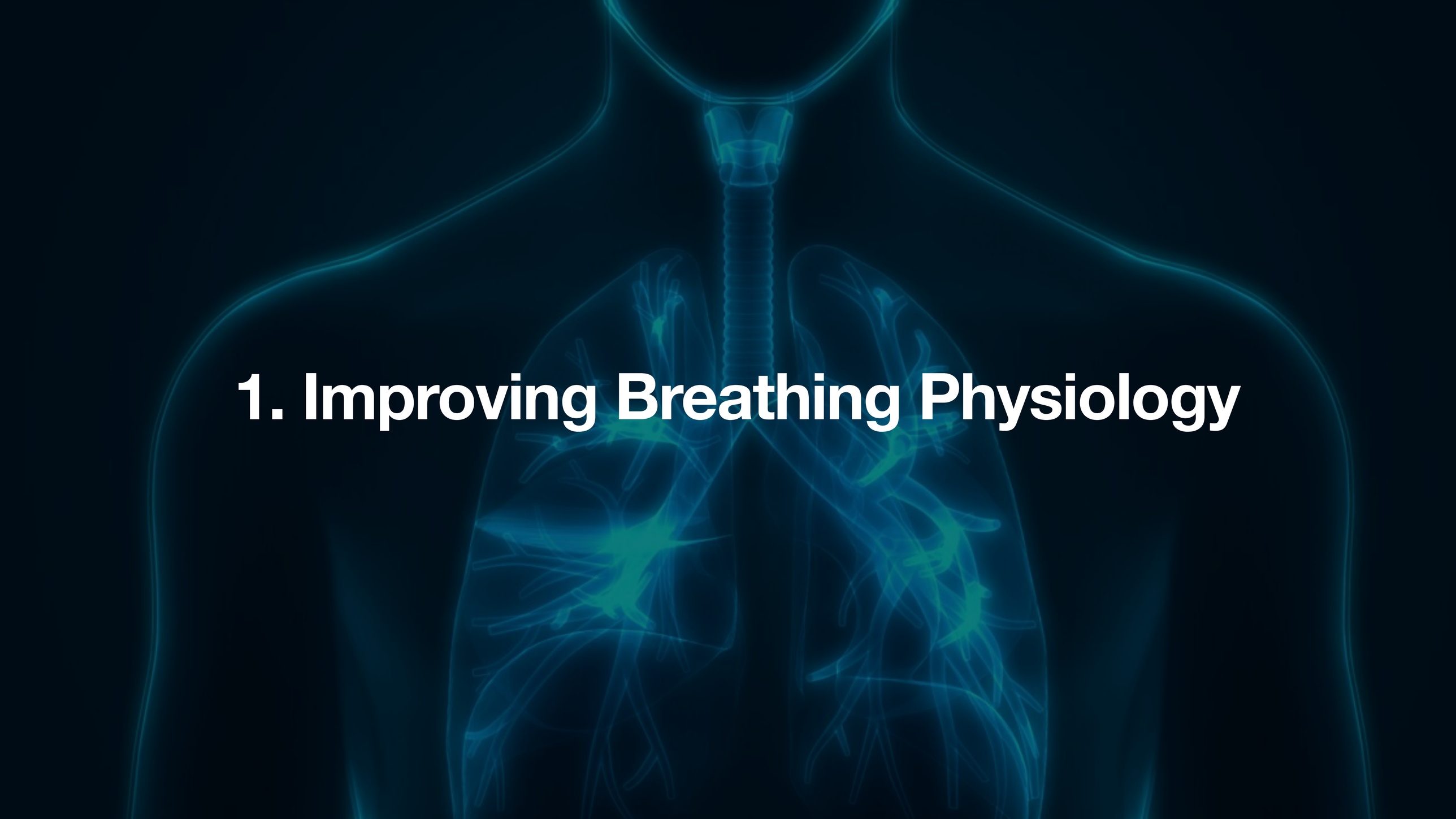
Breathing Physiology

- Gas exchange (O2/Co2)
- Breathing Rate
- PH balance

Breathing Mechanics

- Muscular Compression/ Expansion

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1. Improving Breathing Physiology

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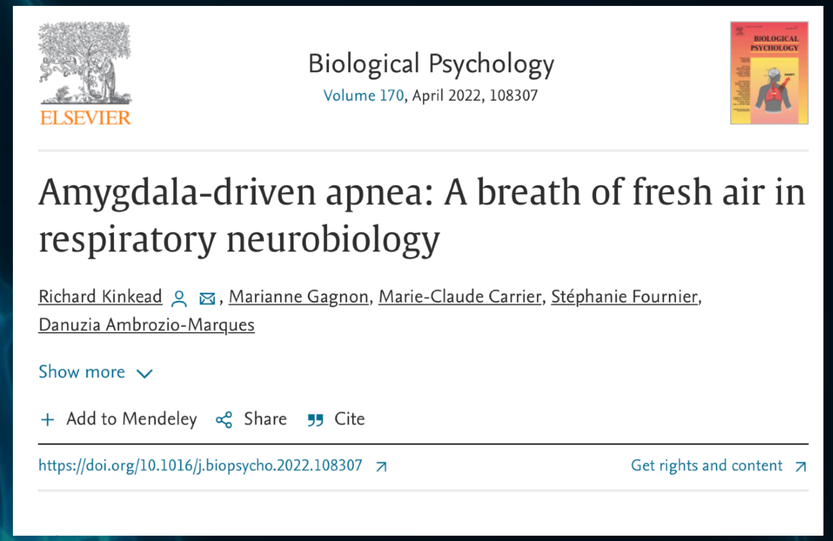
What is CO2 Tolerance and why is it important?

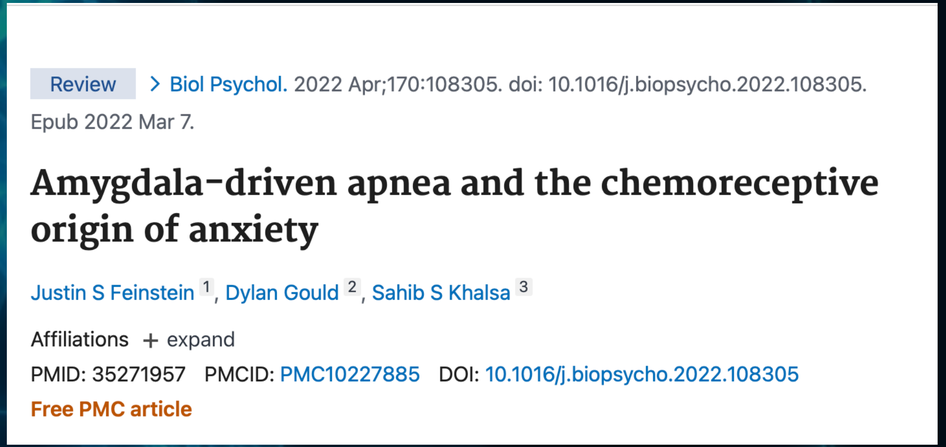
- CO2 tolerance refers to the body's ability to tolerate and regulate carbon dioxide levels in the blood
- CO2 is a byproduct of cellular metabolism and needs to be removed from the body to maintain proper pH levels
- Low CO2 tolerance can result in symptoms like anxiety, shortness of breath, dizziness, and more
- Improving CO2 tolerance can improve athletic performance, endurance and general health by increasing the body's ability to tolerate high levels of CO2 and delay the onset of fatigue

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Co2 tolerance & anxiety

- “However, there is growing evidence showing that the amygdala's ability to respond to internal stimuli such as CO2 is limited, thereby challenging its role in the brain-behavior relationship. Based on these results and the strong inhibitory connections between the central nucleus of the amygdala and key brainstem areas regulating the reflexive respiratory responses to CO2.”
- “The above findings elucidate an entirely novel role for the amygdala in the induction of apnea and inhibition of Co2 induced fear.”





- https://www.sciencedirect.com/science/article/abs/pii/S0301051122000497?via=ihub
- https://pubmed.ncbi.nlm.nih.gov/35271957/

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How to test CO2 tolerance

- Take 4 full breaths, 1 breath every 5-10 seconds:
- At the top of the 4th inhale (totally full), start a timer and exhale as slowly as possible
- Stretch out the exhale for as long as possible
- It’s helpful to close your eyes for relaxation purposes
- Stop the timer when you run out of air, or you need to inhale

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How to interpret the results:

>80 seconds: Elite
World-class tolerance - breathing & stress control

60-80 seconds: Advanced
Healthy respiratory system, great breathing & stress control

40-60 seconds: Intermediate
Good CO2 tolerance, stress & breathing control

20-40 seconds: Average
Moderate to high stress/anxiety state, breathing mechanics need improvement

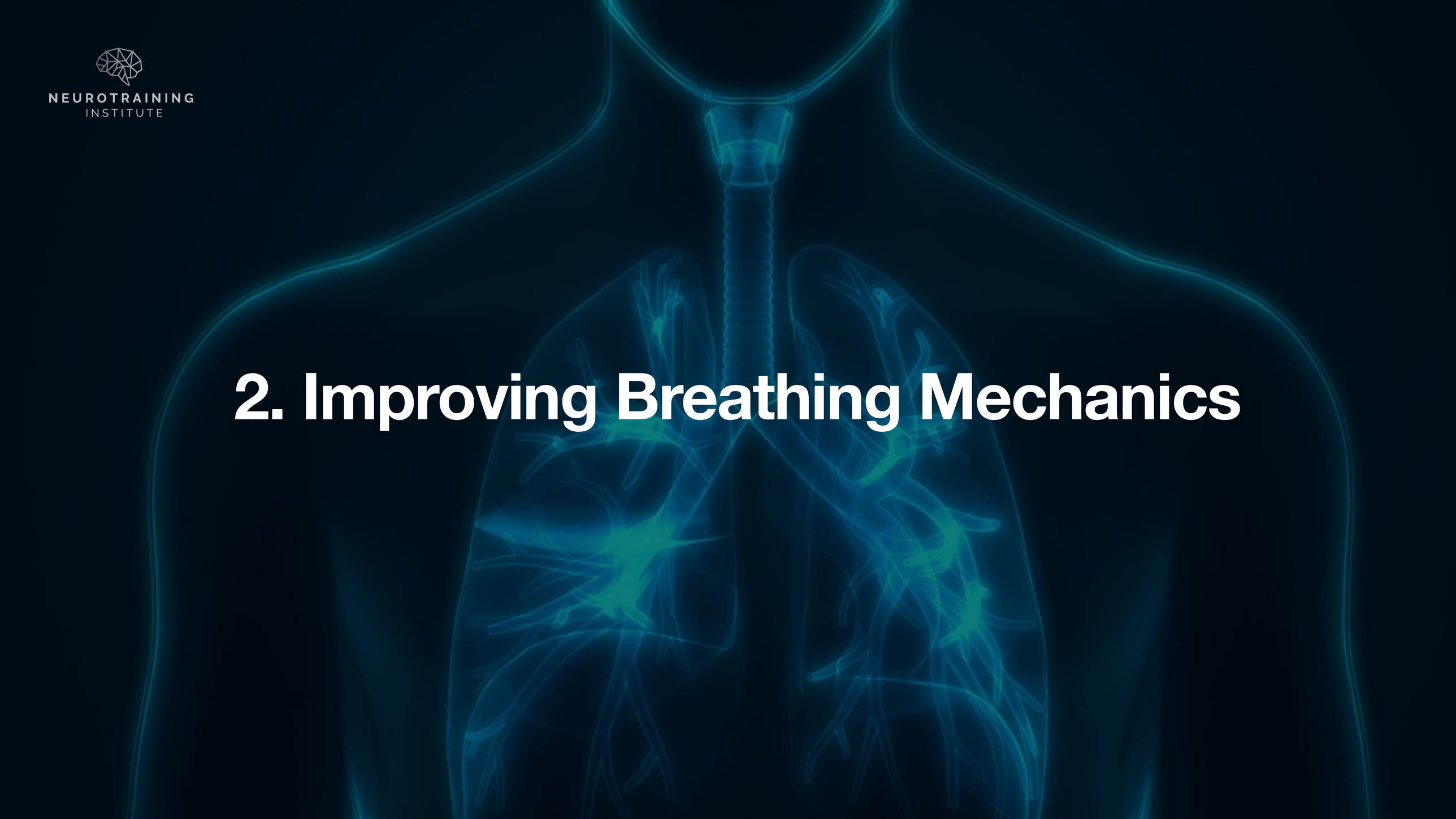
<20 seconds: Below Average
High anxiety and stress sensitivity, mechanical restriction possible

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How to improve Co2 tolerance?

- Switching from mouth to nose breathing
- Teaching healthy tongue position (“the spot”)
- Mouth taping at night
- Box breathing - adjust to test results (eg. 20 seconds - 2 second box, 30 seconds - 3 second box)
- And more

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2. Improving Breathing Mechanics

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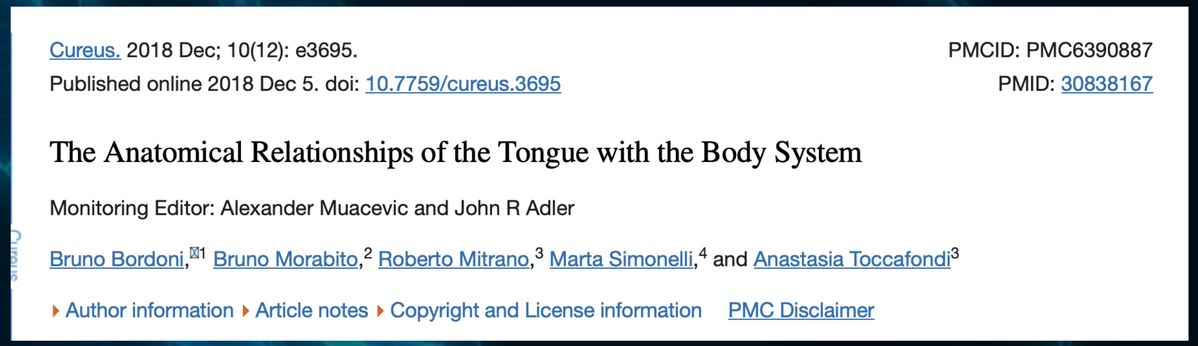


2.1 Tongue position & breathing

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Tongue Position & breathing

"The tongue influences and interacts with the body system. Its dysfunction leads to different local and systemic pathologies. During the assessment of the tongue, other associations that may influence its physiological behavior, such as the lower limb, the TMJ, the neck, the respiratory, and the pelvic diaphragm, and the muscles of the thoracic outlet, should not be neglected."



Cureus. 2018 Dec; 10(12): e3695.
Published online 2018 Dec 5. doi: 10.7759/cureus.3695
PMCID: PMC6390887
PMID: 30838167

The Anatomical Relationships of the Tongue with the Body System

Monitoring Editor: Alexander Muacevic and John R Adler

Bruno Bordoni,[1] Bruno Morabito,[2] Roberto Mitrano,[3] Marta Simonelli,[4] and Anastasia Toccafondi[3]

Author information · Article notes · Copyright and License information PMC Disclaimer

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6390887/

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Tongue position & lower limb strength

“Statistical analysis of the data revealed an about 30% significant increase of knee flexion peak torque in UP with respect to MID at both angular speeds.”

› Muscles Ligaments Tendons J. 2014 Feb 24;3(4):318-23. eCollection 2013 Oct.

The acute effect of the tongue position in the mouth on knee isokinetic test performance: a highly surprising pilot study

Rosa di Vico [1], Luca Paolo Ardigò [2], Gianluca Salernitano [1], Karim Chamari [3], Johnny Padulo [4]

Affiliations + expand

PMID: 24596696 PMCID: PMC3940506

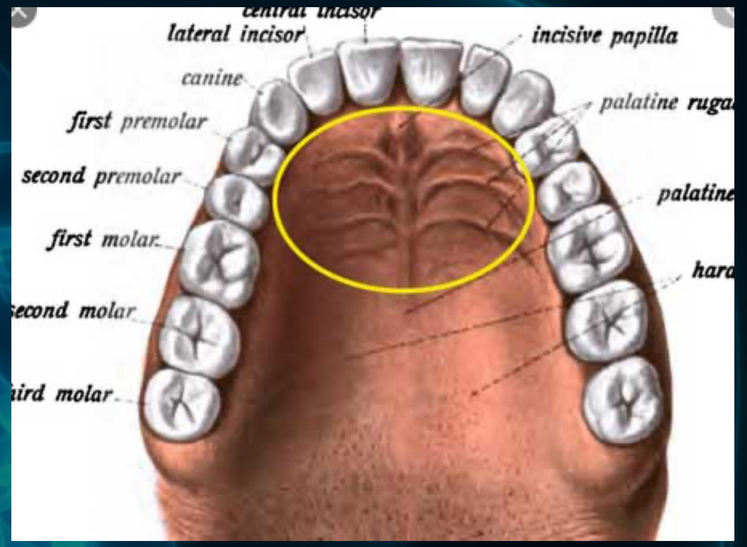
Free PMC article

https://pubmed.ncbi.nlm.nih.gov/24596696/

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Finding “the spot”

- Bring the tongue up to the roof of the mouth
- Touch the palate on the roof of your mouth
- The tongue should be resting right on the palate behind the teeth
- Make sure the tongue doesn’t touch the teeth



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2.2 Ribcage, Respiration Muscles & Diaphragm mechanics

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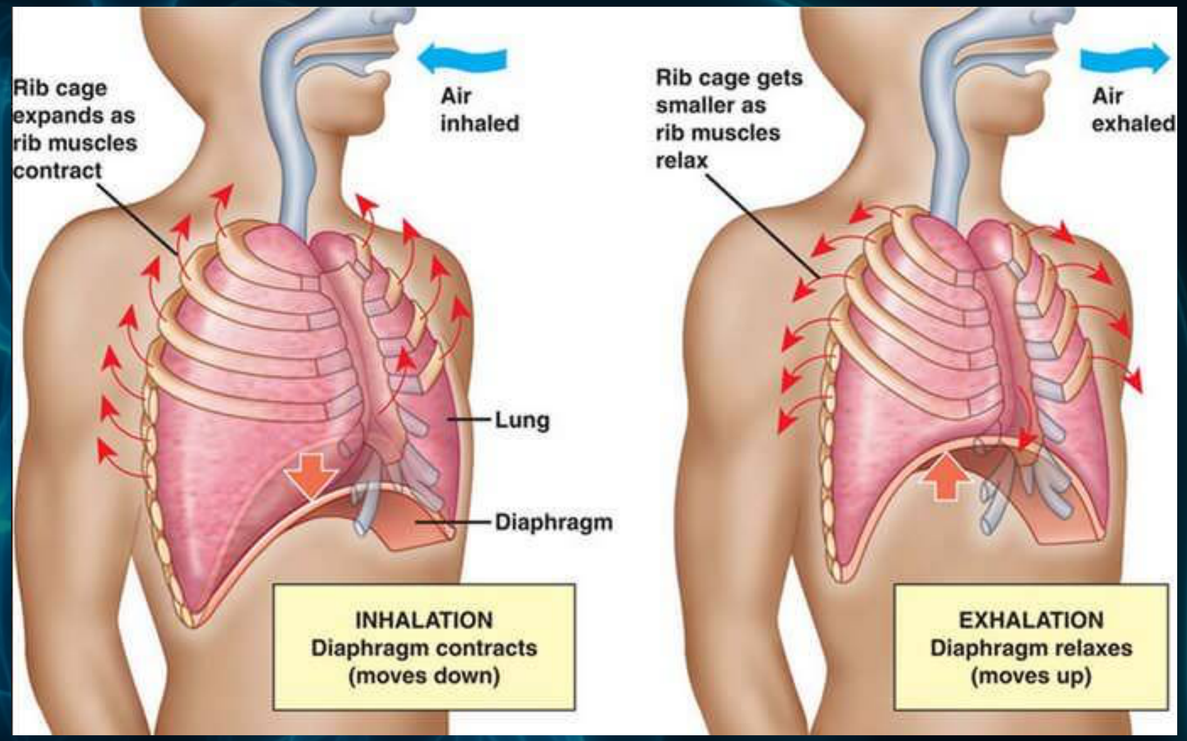
Respiration Mechanics 101

Inhalation:

Diaphragm contraction & downward movement
Ribcage expands
Pelvis ER

Exhalation:

Diaphragm relaxation & upward movement
Ribcage closes
Pelvis IR



Diaphragm acts a breathing, but also a stabilizing muscle

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Is belly breathing really the healthiest way to breathe?

- Multiple studies prove that diaphragmatic breathing can improve stress, anxiety, improve sleep, etc.
- However the way it's being taught is not optimal for your breathing MECHANICS..
- Problem: If you ONLY expand the lower ribcage and abdomen, ONLY the lower parts of the lungs contract..
- It's critical to expand the ribcage as well, so we can also expand the UPPER lungs



Let’s take a closer look..

Real time MRI of breathing



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Improving breathing mechanics

- The ribcage needs to expand 3D in order to allow efficient breathing
- If the main inspiration & expiration muscles can’t contract & move well, the accessory breathing muscles have to take over!

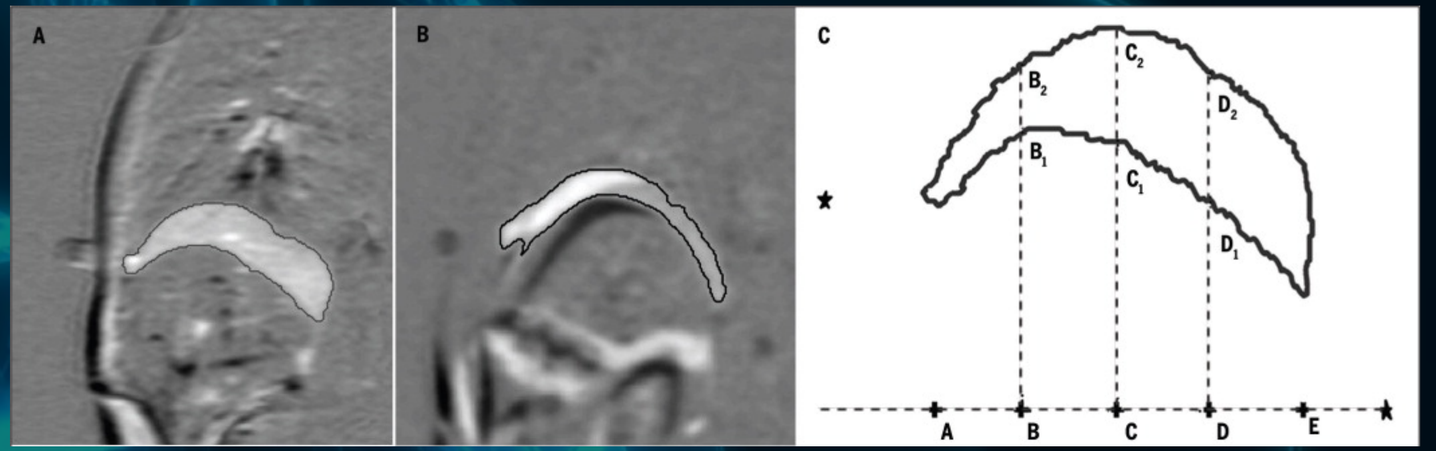
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Diaphragm movement in people with low back pain

"We found reduced diaphragm movement in patients with chronic low back pain compared to healthy controls when isometric flexion against resistance of the upper or lower extremity was applied, mainly in the anterior and middle portions."

https://pubmed.ncbi.nlm.nih.gov/22236541/



Healthy Individual

Individual with LBP

› J Orthop Sports Phys Ther. 2012 Apr;42(4):352-62. doi: 10.2519/jospt.2012.3830. Epub 2011 Dec 21.

Postural function of the diaphragm in persons with and without chronic low back pain

Pavel Kolar [1], Jan Sulc, Martin Kyncl, Jan Sanda, Ondrej Cakrt, Ross Andel, Kathryn Kumagai, Alena Kobesova

Affiliations + expand

PMID: 22236541 DOI: 10.2519/jospt.2012.3830

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The anatomical structure of the ribcage and pelvis also plays an important role in breathing mechanics!





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Practical application

Teaching proper breathing mechanics:

1. Put the hands on the lower stomach AND chest
2. Keep the full foot flat on the ground while pressing the heel and the inside of the foot into the floor
3. Inhale silently through the nose (feel the expansion in the belly & ribcage)
4. Exhale fully through the mouth
5. You can adjust the duration of the inhale & exhale according to the individual
6. Make sure to test & retest shoulder or neck mobility

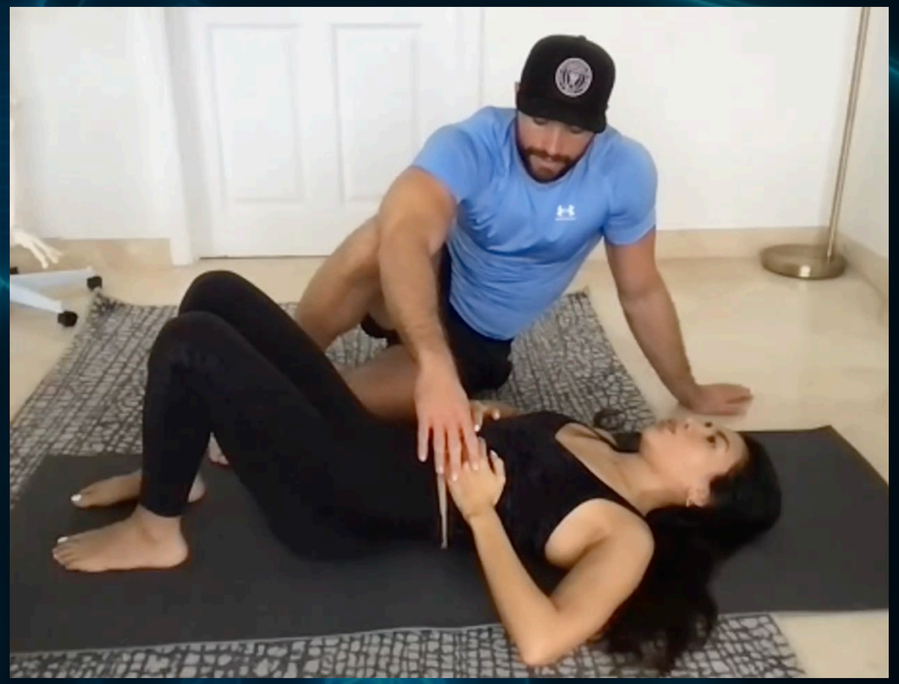
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Breathing positions

There are many different possible breathing positions that we use, here's 2 possible variations:



- Quadruped Position



- Hook-Lying

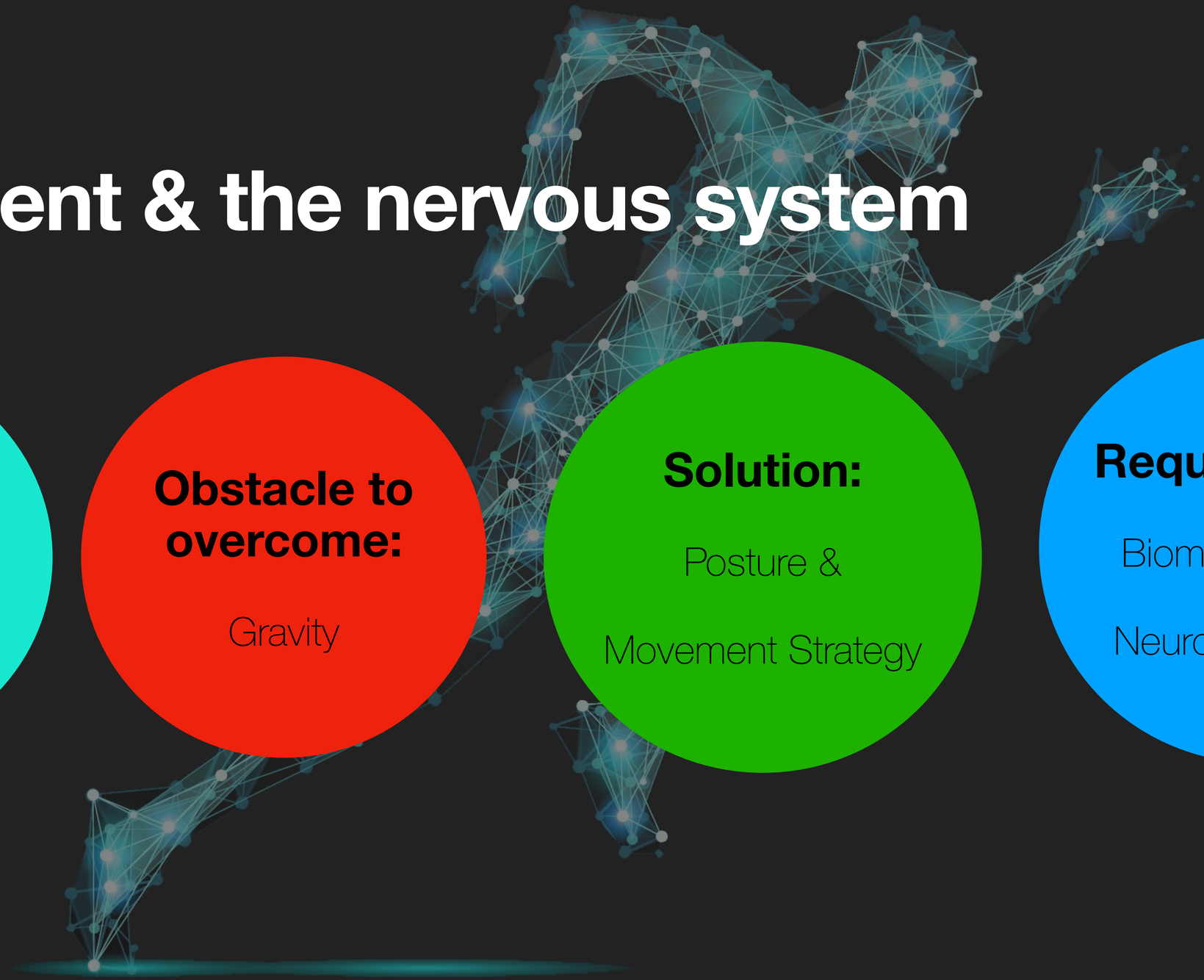
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Skill #2: Move well!

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Movement & the nervous system



Goals of the brain:

Don’t fall!

Don’t get hurt!

Obstacle to overcome:

Gravity

Solution:

Posture &

Movement Strategy

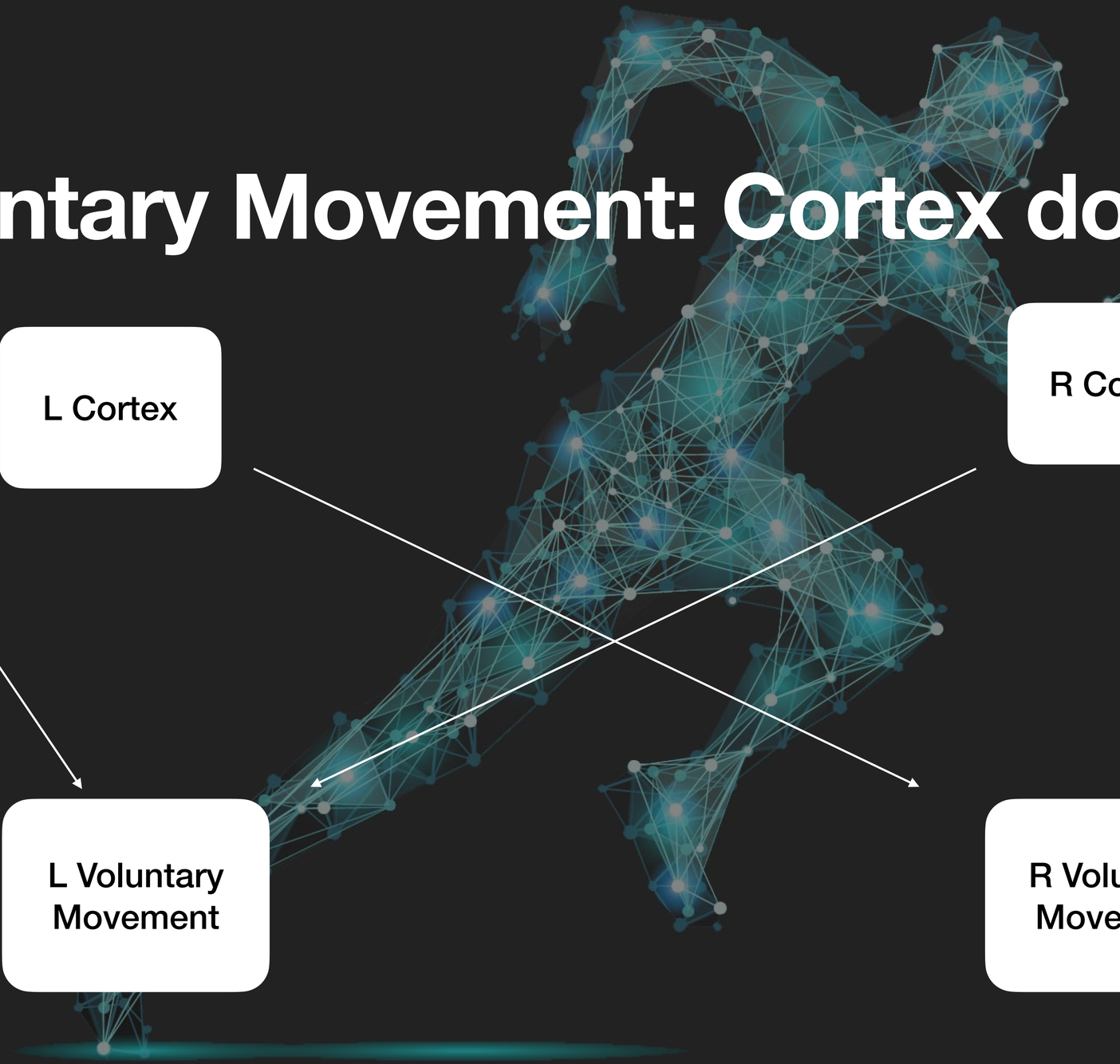
Requirements:

Biomechanical &

Neurological skills

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Voluntary Movement: Cortex dominant



L Cerebellum

L Cortex

R Cortex

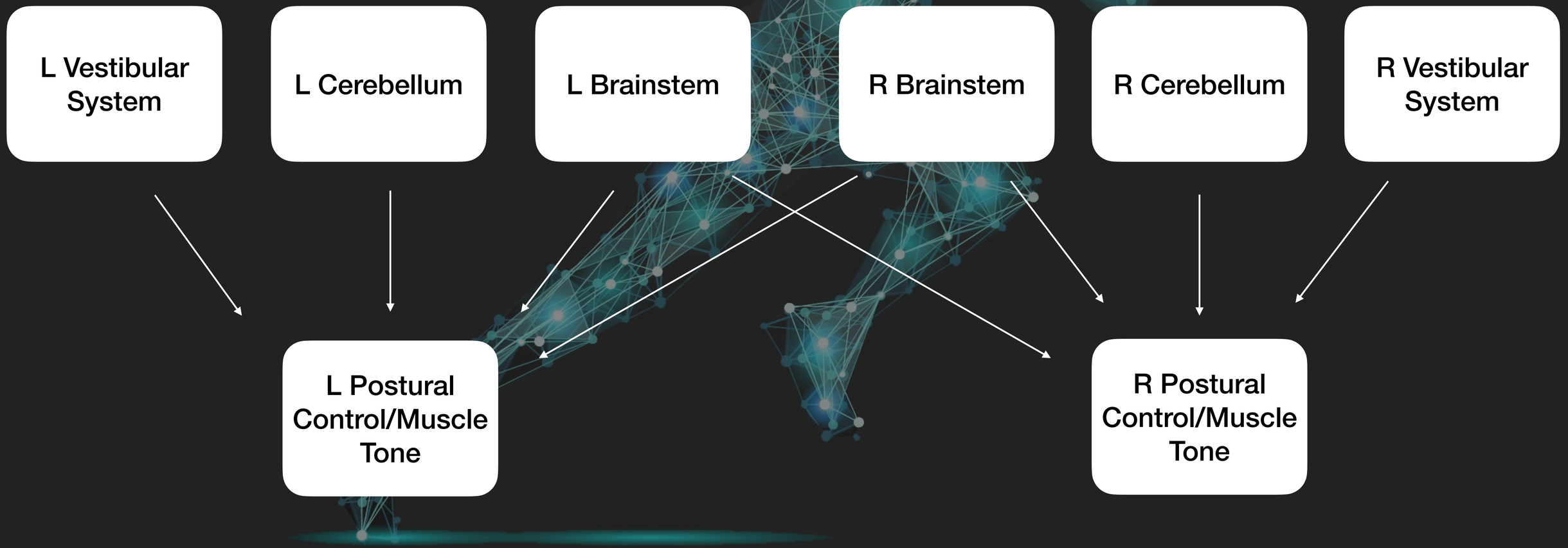
R Cerebellum

L Voluntary Movement

R Voluntary Movement

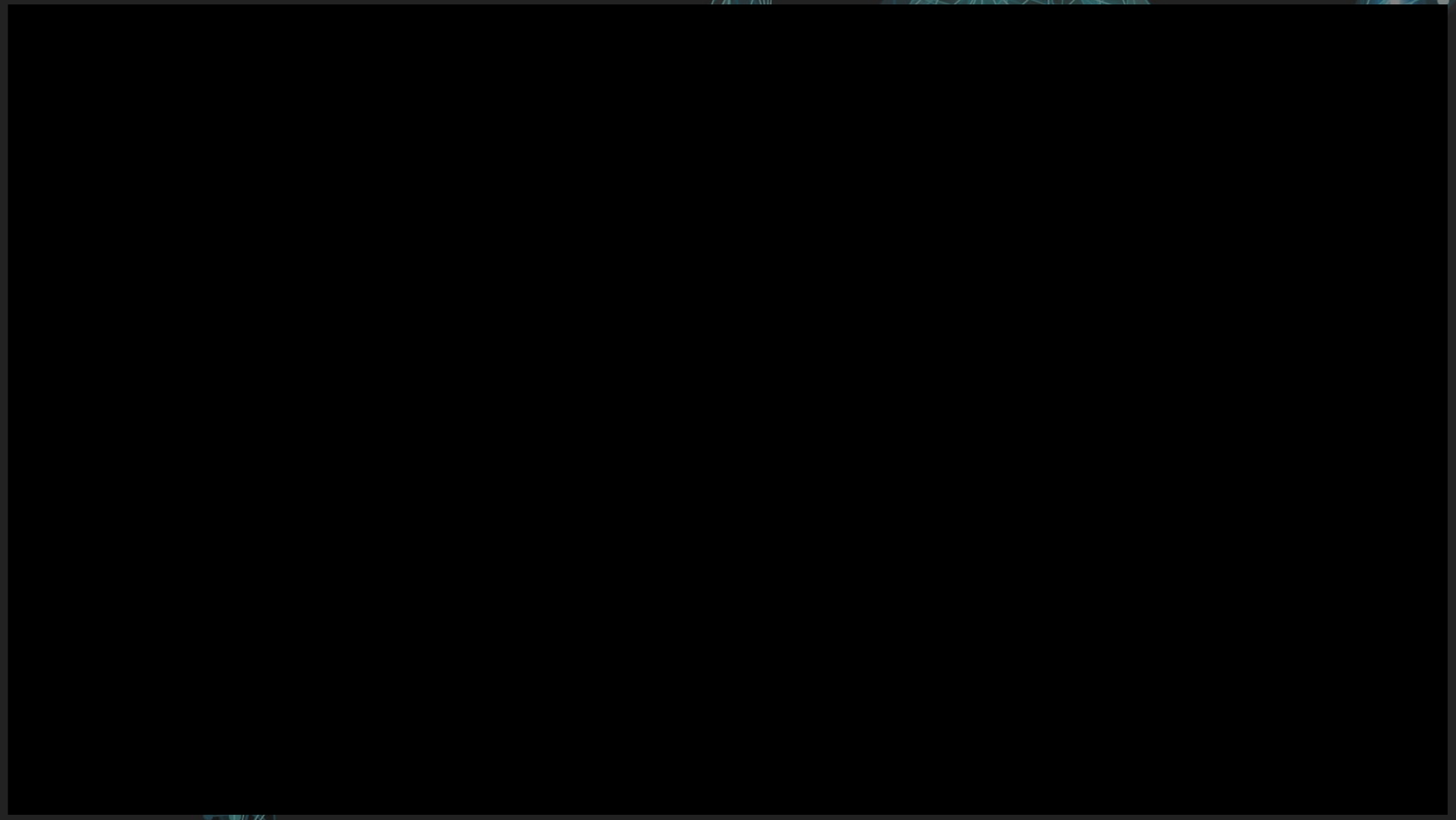
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Reflexive “Movement”: Cerebellar, Vestibular & Brainstem dominant

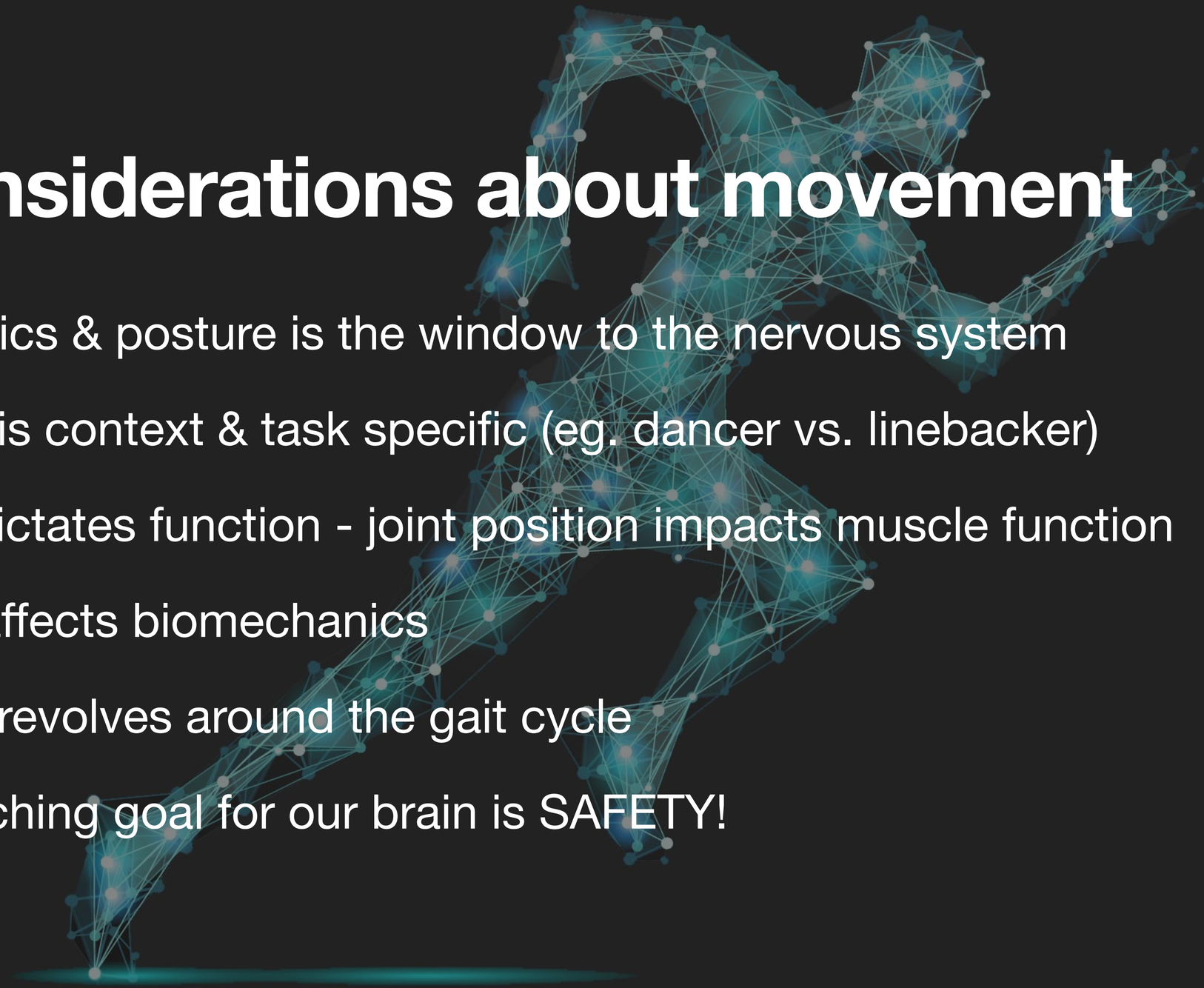


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Goal: Make movement as effortless & automatic as possible!



Key considerations about movement



- Biomechanics & posture is the window to the nervous system
- Movement is context & task specific (eg. dancer vs. linebacker)
- Structure dictates function - joint position impacts muscle function
- Breathing affects biomechanics
- Movement revolves around the gait cycle
- The overarching goal for our brain is SAFETY!

What makes good movement?

- Coordination & Balance
- Postural Control
- Good Proprioception
- Strength
- Range of motion
- Adaptation & Self organization
- Biomechanical Alignment
- Good Vision



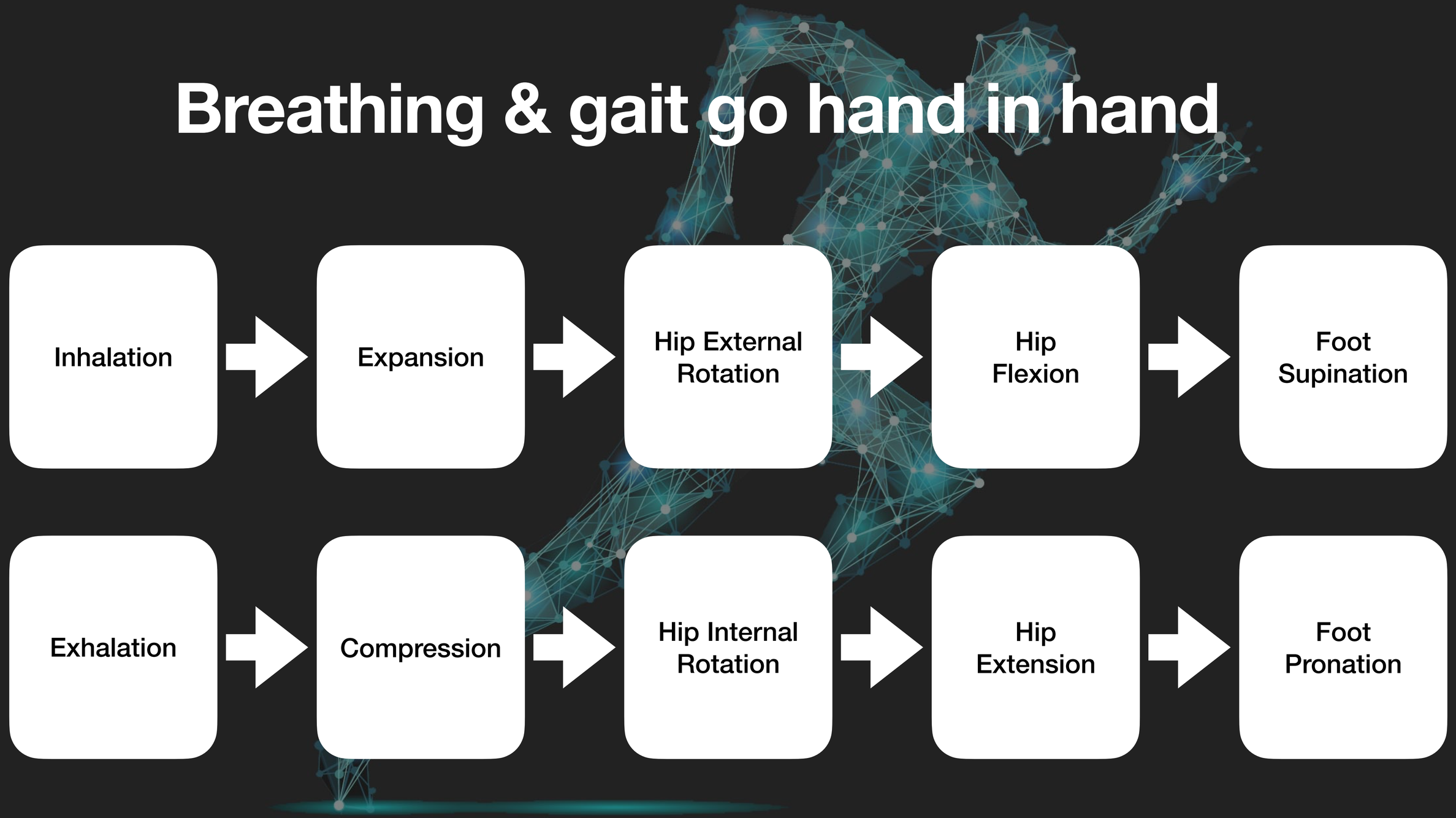
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The GAIT Cycle



- All phases of gait have their specific functions & muscle involvements (force absorption, stability/force production, propulsion)
- Each phase also has it's "neurological character"

Breathing & gait go hand in hand



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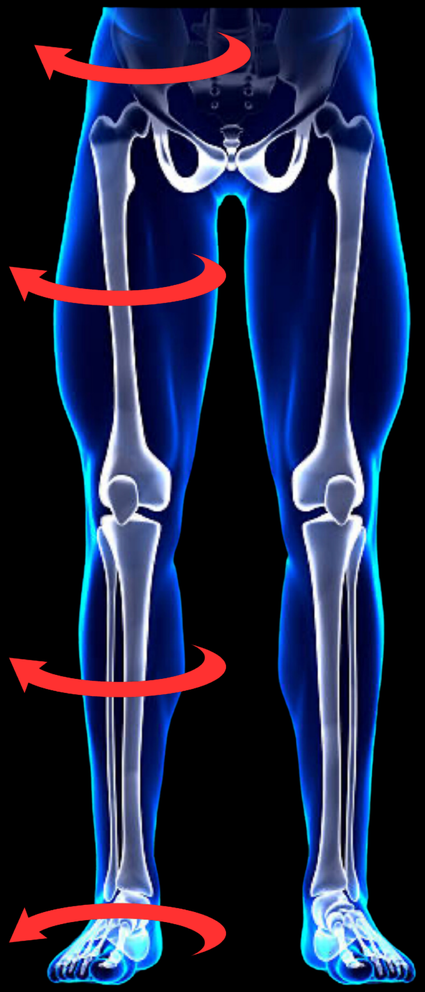
Lower Body Biomechanics: ER & IR

Pelvis External Rotation

Femoral External Rotation

Tibial External Rotation

Foot Supination

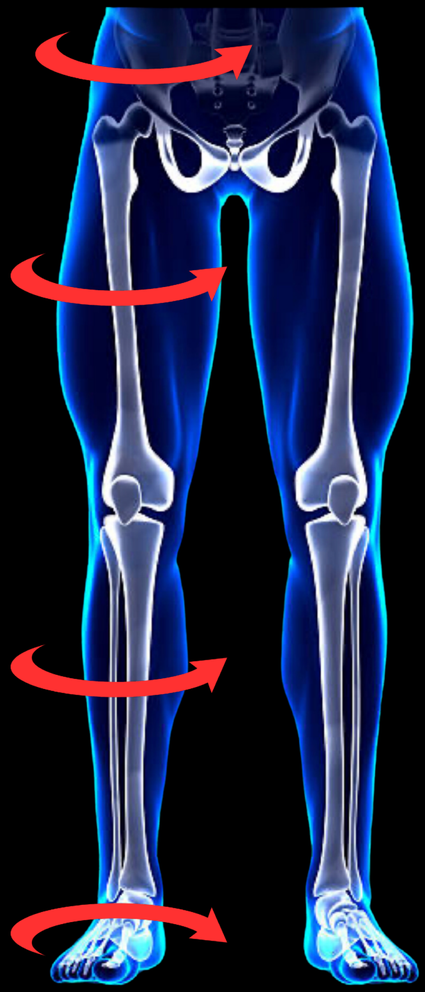


Pelvis Internal Rotation

Femoral Internal Rotation

Tibial Internal Rotation

Foot Pronation



Joint synergy & movement compensations

If we lose the ability to efficiently allow joints to “interact” with each other (eg. Hip internal rotation, shoulder external rotation, …) our brain has to come up with movement compensations to fight gravity or produce force:

Upper body examples:

- Forward head position
- Rounded shoulders
- (Over) Arched lower back
- Flaired ribs
- …

Lower body examples:

- Hiked hips
- Legs/feet pointing out/in
- Valgus/Varus knees
- Knee Hyperextension
- “Overpronated” feet
- High foot arches
- …

What can we do in practice?



Analyse posture & biomechanics

Improve or manipulate sensory input (vestibular, proprioceptive, etc.)

Restore movement options & relative motion between joints

Better movement & posture

More safety for the brain

Improved performance & health



Example: Hypermobility

Example: Flat Feet

Feet can usually tell us a whole story…





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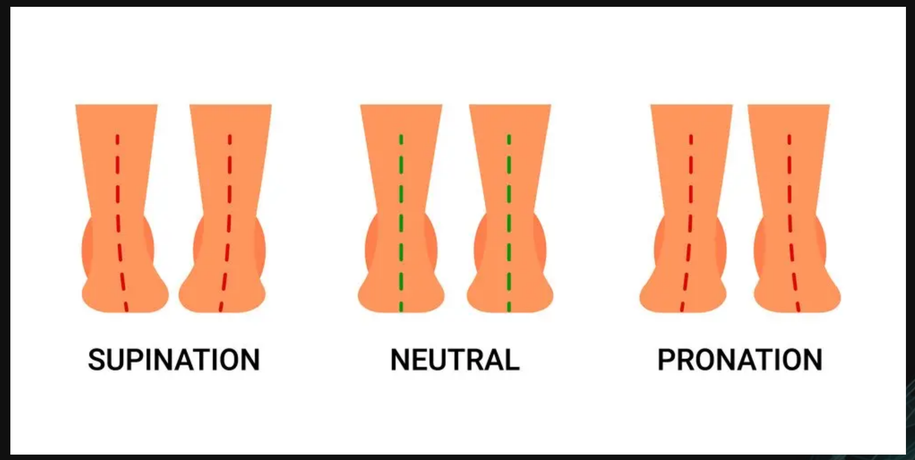
Is pronation really bad?

- Pronation gets demonized in the health, performance & rehab industry
- Pronation however is a naturally occurring movement in human gait
- Pronation is a joint synergy consisting of rear foot eversion, fore foot inversion, toe eversion
- It helps absorb shock and allows us to move with ease
- What we consider overpronation usually is caused by a whole leg dumping inwards, oftentimes because the brain tries to find a way for internal rotation
- Which oftentimes is caused by an INABILITY to pronate in the first place!
- Proper Pronation mechanics are absolutely critical for movement & balance



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Two foot shapes: Pronation & Supination



- If the foot can change shape it allows full access to the structures in the feet
- This will feed up into the knees, hip, spine, etc.

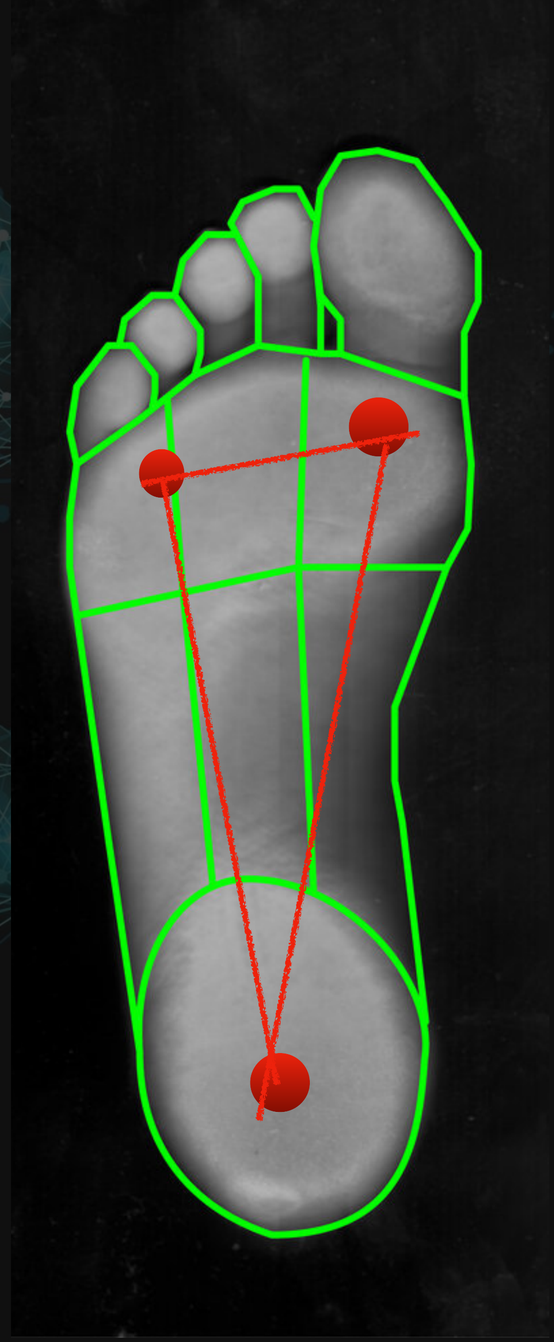
- **Pronation:**
- Foot gets longer and wider
- Mobile Adaptor

- **Supination:**
- Foot gets shorter and narrower
- Rigid Lever

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-

The foot as a tripod



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Pronation exercise

1. Start in a split stance & place your front foot flat on the ground

2. Start with a negative shin angle and slowly travel your bodyweight and shin forward

3. Keep your flat on the ground at all times and feel the pressure first from your medial heel traveling to the first metatarsal

4. Don’t compensate by letting the knee cave in

5. Feel the medial arch slightly dropping as you’re moving forward

6. Don’t scrunch the toes - keep them relaxed at all times

7. Place an ankle sock beneath the arch for sensory feedback (optional)





Example 2: Tight/weak glutes, lower back tension

Restoring movement by teaching the nervous system muscle & joint synergy without compensations in relationship to gravity.



Lateral Lunge



Staggered Stance Hinge

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Skill #3 Think Well

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What is pain?

The International Association for the Study of Pain (IASP) defines pain as “An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage”. Pain is a subjective, unpleasant sensation in the body, which is therefore emotional. Dimensions that contribute to the pain experience are physical, psychological, social and cultural, which support a multidimensional framework for the biopsychosocial experience of pain. Any clinical assessment process must address relevant dimensions of pain in the given setting.

Home > Pain > Chapter

Pain as a Subjective, Multidimensional Experience

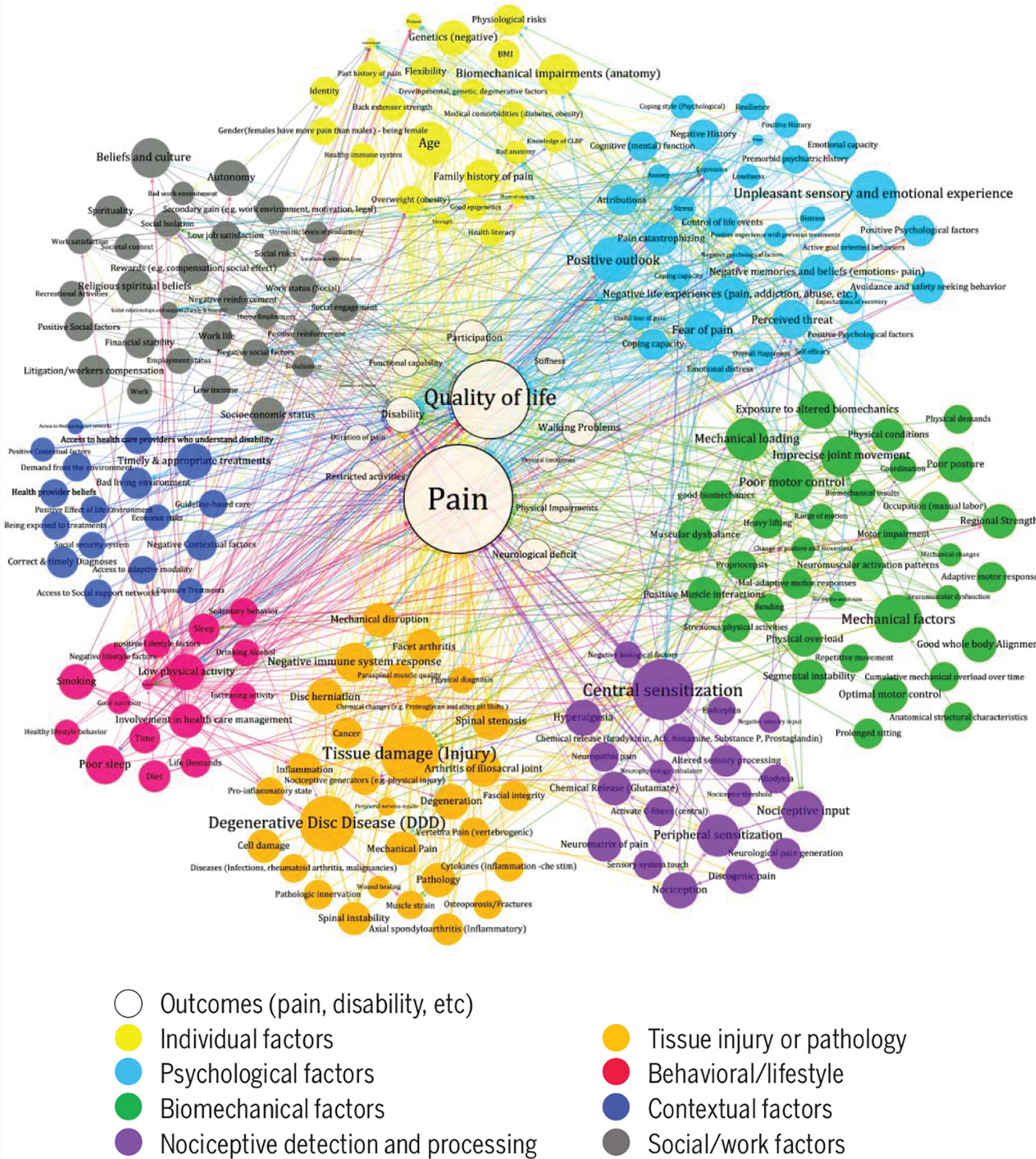
Sarah J. Love-Jones

Chapter | First Online: 11 May 2019

805 Accesses | **3** Citations

https://pubmed.ncbi.nlm.nih.gov/31092123/

Cholewicki et al 2019



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Pain lives in the brain - Sham surgery example





- https://pubmed.ncbi.nlm.nih.gov/12110735/

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Glass of water analogy

We have 2 options:

Empty the cup
(Protect)

Make the cup bigger
(Expose)



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Pain, Movement & Beliefs

“ While all believe staying active is beneficial for back pain, residual negative beliefs regarding the vulnerability of the spine persist. Education campaigns may need to emphasise a 'trust your back' message rather than a 'protect your back' message while encouraging activity.”

› Musculoskelet Sci Pract. 2019 Feb;39:101-106. doi: 10.1016/j.msksp.2018.11.009. Epub 2018 Dec 1.

How do manual handling advisors and physiotherapists construct their back beliefs, and do safe lifting posture beliefs influence them?

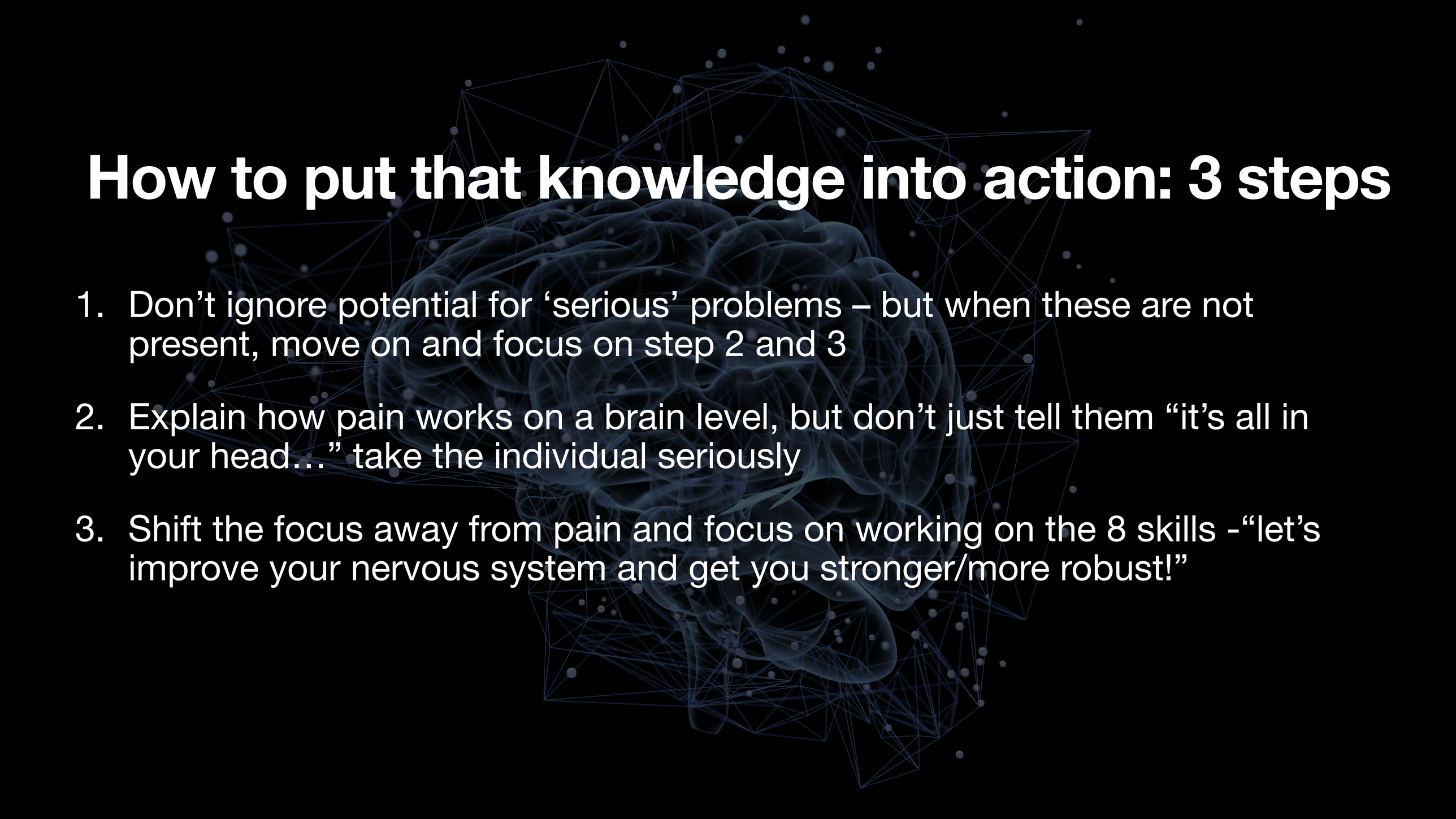
David Nolan [1], Kieran O'Sullivan [2], John Stephenson [3], Peter O'Sullivan [4], Michael Lucock [5]

Affiliations + expand

PMID: 30553985 DOI: 10.1016/j.msksp.2018.11.009

➡ Movement optimism!

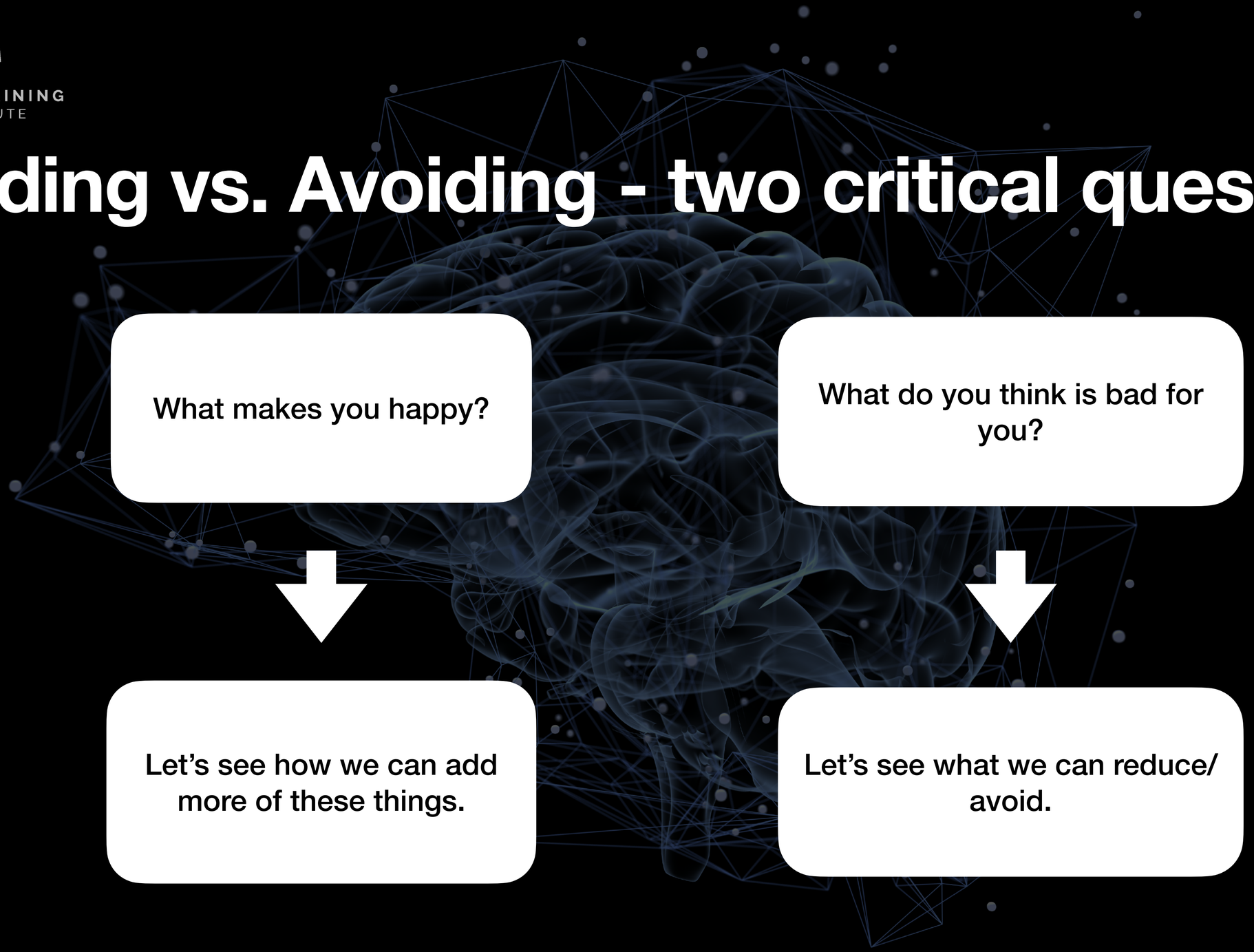
How to put that knowledge into action: 3 steps



1. Don’t ignore potential for ‘serious’ problems – but when these are not present, move on and focus on step 2 and 3
2. Explain how pain works on a brain level, but don’t just tell them “it’s all in your head…” take the individual seriously
3. Shift the focus away from pain and focus on working on the 8 skills -“let’s improve your nervous system and get you stronger/more robust!”

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Adding vs. Avoiding - two critical questions?



What makes you happy?

What do you think is bad for you?

Let’s see how we can add more of these things.

Let’s see what we can reduce/ avoid.

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One of the most underrated “antidepressants”

- Strength & Endurance Training…

J Res Med Sci. 2012 Nov; 17(11): 1072–1076.

PMCID: PMC3702091
PMID: 23833584

An investigation on the effect of strength and endurance training on depression, anxiety, and C-reactive protein's inflammatory biomarker changes

Majid Khorvash, Ahmadreza Askari,[1] Fatemeh Rafiemanzelat,[2] Manijeh Botshekan,[3] and Farzin Khorvash[4]

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“Findings in covariance analysis showed that 37% of the depression level of the subjects had reduced following strength and endurance training”

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Meditation/Mindfulness

Scientific evidence exists for the following areas:

- **Pain reduction:** (Goyal et al. 2014 0 Meditation programs for psychological stress and well-being: a systematic review and meta-analysis)
- **Anxiety:** (Hofmann et al. 2019 - Mindfulness-Based Interventions for Anxiety and Depression)
- **Sleep:** (Ong et al. 2014 - A Randomized Controlled Trial of Mindfulness Meditation for Chronic Insomnia)
- **Addictions:** (Tang et al. 2014 - translational neuroscience perspective on mindfulness meditation as a prevention strategy)
- And more

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Great way to start: MBSR

N Am J Med Sci. 2011 Jan; 3(1): 20–23.
doi: 10.4297/najms.2011.320
PMCID: PMC3336928
PMID: 22540058

Mindfulness-based stress reduction: a non-pharmacological approach for chronic illnesses

Asfandyar Khan Niazi[1] and Shaharyar Khan Niazi[2]

Author information Copyright and License information PMC Disclaimer

All the 18 studies included in this systematic review showed improvement in the condition of patients after MBSR therapy. These studies were focused on patients with chronic diseases like cancer, hypertension, diabetes, HIV/AIDS, chronic pain and skin disorders, before and after MBSR therapy.

Free resource:

- Free online course: https://palousemindfulness.com/index.html
- This online MBSR training course is 100% free, created by a fully certified MBSR instructor, and is based on the program founded by Jon Kabat-Zinn at the University of Massachusetts Medical School.
- Includes free meditations, videos, tutorials and resources

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Mindfulness Meditation - Possible Risks



Glob Adv Health Med. 2022; 11: 2164957X221096640.
Published online 2022 Apr 19. doi: 10.1177/2164957X221096640
PMCID: PMC9024164
PMID: 35464906

What Are Adverse Events in Mindfulness Meditation?

Dhanesh D. Binda, BS,[1,*] Carol M. Greco, PhD,[2] and Natalia E. Morone, MD, MS[3]

Author information ▸ Article notes ▸ Copyright and License information PMC Disclaimer

Abstract

Go to: ▸

“Additionally, the reflective approach of mindfulness will not appeal to all persons, especially for those not ready to work with the increased awareness of thoughts, emotions, and sensations that occurs with mindfulness methods. Therefore, it is important to accept that mindfulness is not for everyone.”

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9024164/

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Skill #4: Feel Well (Interoception)

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Interoception Assessments & Strategies

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Interoception Assessment: Heartbeat detection test

- Set a timer of 60 seconds and let the client observe their own heartbeat
- Tell the client to track how many heartbeats they were able to track in the 60 seconds
- After finishing, or while doing the observation track the clients heart rate with either an App or tracking device (eg. Oura Ring, Whoop band, etc.)
- Compare their personal detection with the actual measurement
- If you see a significant difference (anything over 10 heartbeats) can be considered “bad” interoceptive awareness
- iPhone: HeartRate Lite
- Android: Heart Rate Monitor - REPS



Interoception Exercise #1
PMR - Progressive Muscle Relaxation

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PMR - Progressive Muscle Relaxation

“PMR and interoceptive exposure have been widely used to treat panic and other anxiety disorders, and have been found to reduce many symptoms of these disorders (Craske & Barlow, 2014). Findings from this field suggest that using PMR to improve interoception may reduce other psychological outcomes related to interoception."



ELSEVIER

Behavior Therapy

Volume 52, Issue 5, September 2021, Pages 1145-1157

Reconnecting to Internal Sensation and Experiences: A Pilot Feasibility Study of an Online Intervention to Improve Interoception and Reduce Suicidal Ideation ☆

April R. Smith, Lauren N. Forrest, Natalie M. Perkins, Shruti Kinkel-Ram, Michael J. Bernstein, Tracy K. Witte

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https://doi.org/10.1016/j.beth.2021.02.001 Get rights and content

https://www.sciencedirect.com/science/article/abs/pii/S000578942100023X

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PMR AFTER JACOBSON

Follow these steps to successfully use PMR with your clients:

- Pick a calm place to perform PMR
- Slow down the breath
- Gradually increase tension until you feel like you've received max tension
- Relax all other areas of the body as much as possible!
- Perceive the tension for 6-8 seconds
- Observe if there's similar tension in all areas of the muscle
- Relieve tension immediately
- Feel into the body area and perceive the relaxation and lightness for 15 seconds
- Observe if there's areas that aren't fully relaxed
- Perform the exercise for about 10-15 minutes
- It's ok to start off with just 2-3 areas, preferably the 'weakly mapped' areas

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PMR - Progresive Muscle Relaxation

Tense & relax the following muscle groups for 8/15 seconds

- Foot
- Calf
- Shin
- Quad
- Hamstrings
- Glutes
- Hands
- Forearm & Hands
- Biceps
- Triceps
- Abdomen
- Chest
- Upper Back
- Neck
- Jaw
- Cheeks
- Eyes

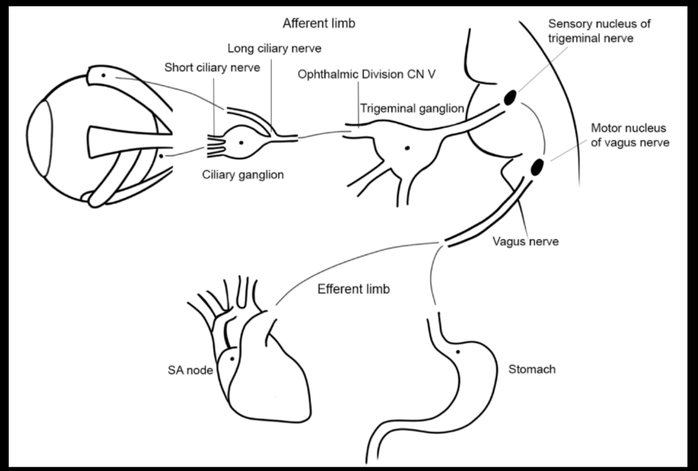


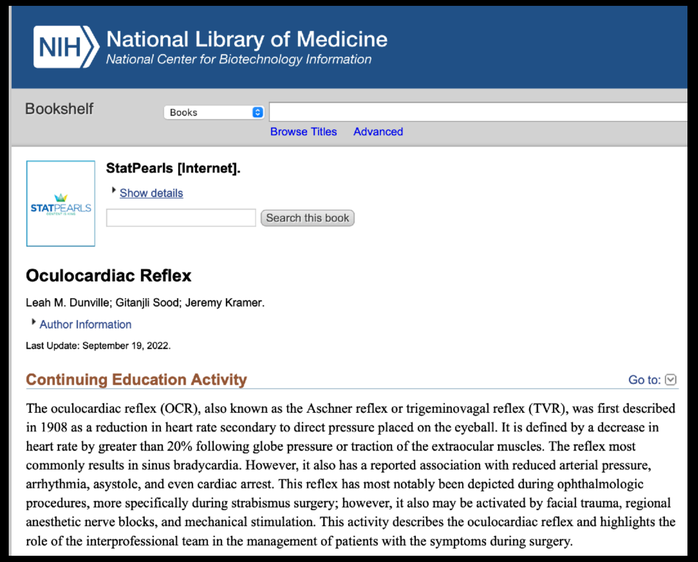
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Vagus Nerve Stimulation: Oculocardiac Reflex

- This is a technique that can be used in low doses in episodes of severe stress or panic attacks
- It's helpful to use eyedrops before applying pressure
- GENTLY apply pressure on the eyeball
- The Oculocardiac Reflex is a reflex that will lower the heart rate via the vagus nerve





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National Center for Biotechnology Information

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StatPearls [Internet].

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Search this book

Oculocardiac Reflex

Leah M. Dunville; Gitanjli Sood; Jeremy Kramer.

Author Information

Last Update: September 19, 2022.

Continuing Education Activity

Go to:

The oculocardiac reflex (OCR), also known as the Aschner reflex or trigeminovagal reflex (TVR), was first described in 1908 as a reduction in heart rate secondary to direct pressure placed on the eyeball. It is defined by a decrease in heart rate by greater than 20% following globe pressure or traction of the extraocular muscles. The reflex most commonly results in sinus bradycardia. However, it also has a reported association with reduced arterial pressure, arrhythmia, asystole, and even cardiac arrest. This reflex has most notably been depicted during ophthalmologic procedures, more specifically during strabismus surgery; however, it also may be activated by facial trauma, regional anesthetic nerve blocks, and mechanical stimulation. This activity describes the oculocardiac reflex and highlights the role of the interprofessional team in the management of patients with the symptoms during surgery.

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Physiological Sighs - Amygdala Downregulation

- Discovered in the 1930s
- Spontaneous breathing pattern in claustrophobic environments, stressful situations, or during sleep
- Physiological sighs stretch the lung tissue, preventing it from becoming too stiff - ensures efficient gas exchange
- 2 strong nasal inhales - followed by a long exhale through the mouth
- 1st inhale longer - long exhale
- 1-3 sighs - to calm down nervous system



Cell Reports Medicine

Report

Brief structured respiration practices enhance mood and reduce physiological arousal

Melis Yilmaz Balban,[1] Eric Neri,[2] Manuela M. Kogon,[2,3] Lara Weed,[4] Bita Nouriani,[2] Booil Jo,[2] Gary Holl,[1] Jamie M. Zeitzer,[2,5] David Spiegel,[2,6,*] and Andrew D. Huberman[1,7,8,9,*]
[1]Department of Neurobiology, School of Medicine, Stanford University, Stanford, CA 94305, USA
[2]Department of Psychiatry & Behavioral Sciences, School of Medicine, Stanford University, Stanford, CA 94305, USA
[3]Stanford Center for Integrative Medicine, Stanford Health Care, Palo Alto, CA 94304, USA
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[7]Department of Ophthalmology, School of Medicine, Stanford University, Stanford, CA 94305, USA
[8]BioX, School of Medicine, Stanford University, Stanford, CA 94305, USA
[9]Lead contact
*Correspondence: dspiegel@stanford.edu (D.S.), adh1@stanford.edu (A.D.H.)
https://doi.org/10.1016/j.xcrm.2022.100895

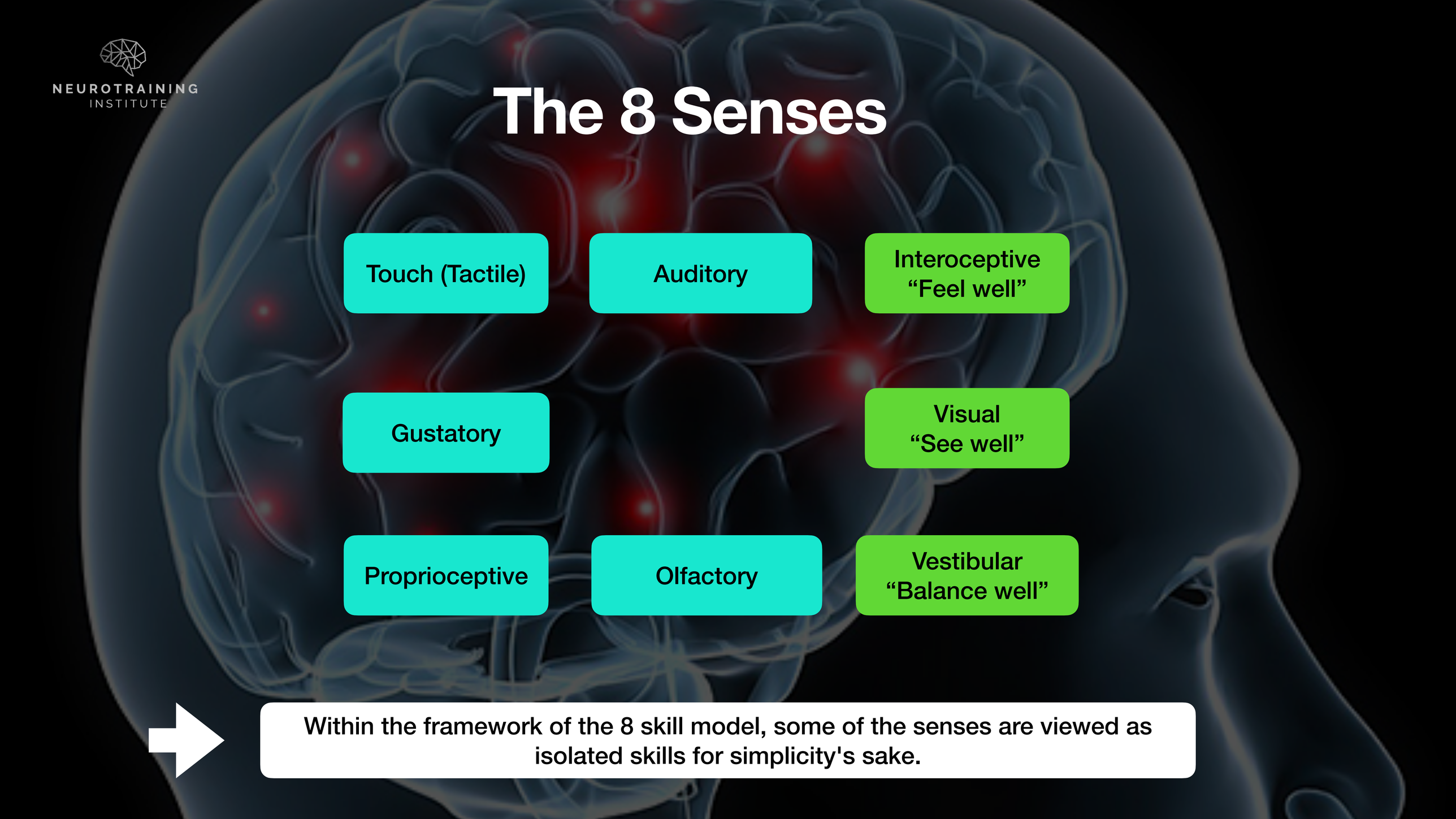
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Skill #5: Sense Well

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The 8 Senses



Within the framework of the 8 skill model, some of the senses are viewed as isolated skills for simplicity's sake.

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Tactile Input

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Tactile Exercise:
Two-Point-Discrimination



Two Point Discrimination Test/Drill

1. Have your athlete close their eyes
2. Use either two or one sharp object
3. Press evenly on skin and ask for 1 or 2 points
4. Start wide, decrease till they can't tell
5. Note threshold distance
6. Test different areas of the body
7. Small threshold = high sensitivity; larger = reduced sensitivity

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Two Point Discrimination Test/Drill

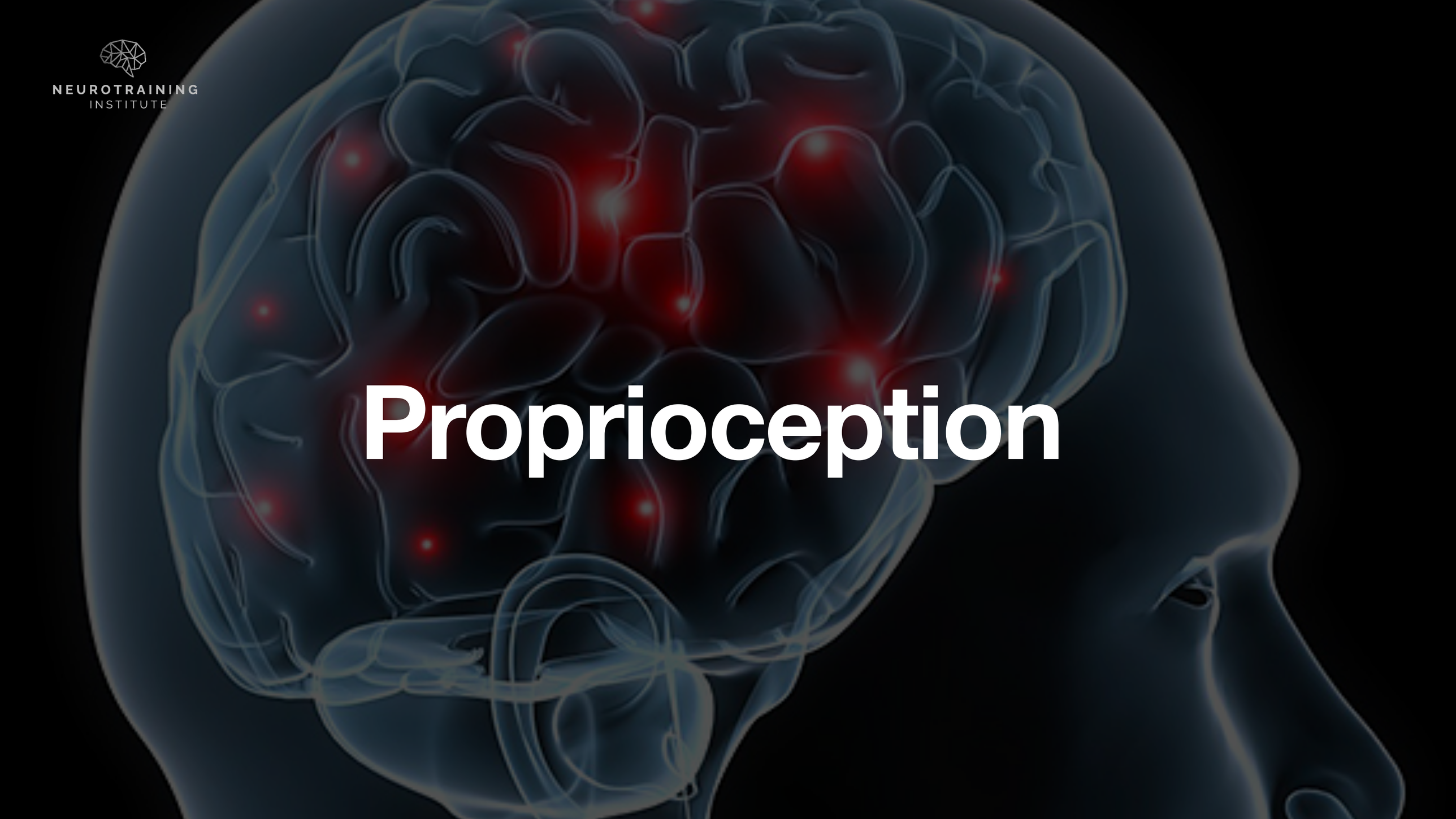
Body areas differ both in tactile receptor density and somatosensory cortical representation:

Normally, a person should be able to recognize two points separated by:

- Fingertips: 2 - 8 mm
- Lips: 2 - 4 mm
- Palms: 8 - 12 mm
- Shins/Back 30 – 40 mm

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Proprioception

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Proprioception Assessment: Rombergs Test

- Find a safe place to do the test (no sharp objects around)
- Ask the athlete to stand with their feet together and arms by their sides. Eyes are open at this point
- Have the athlete stand as still as possible with their feet together and eyes open. Observe balance and stability for about 30 seconds
- Instruct the athlete to close their eyes while maintaining the same position—feet together and arms by their sides. They should try to keep their balance without the aid of visual cues
- Watch for any swaying, unsteadiness, or loss of balance. Pay attention to how well the athlete can maintain their balance with their eyes closed

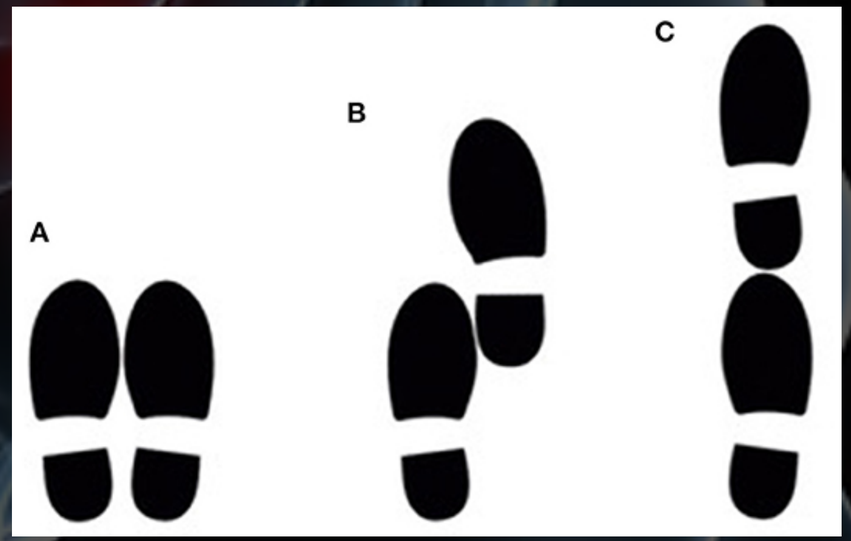
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Rombergs Progression

A. Narrow Stance

B. Semi-Tandem Stance

C. Tandem Stance



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Proprioception Drill: Lower Body Compass





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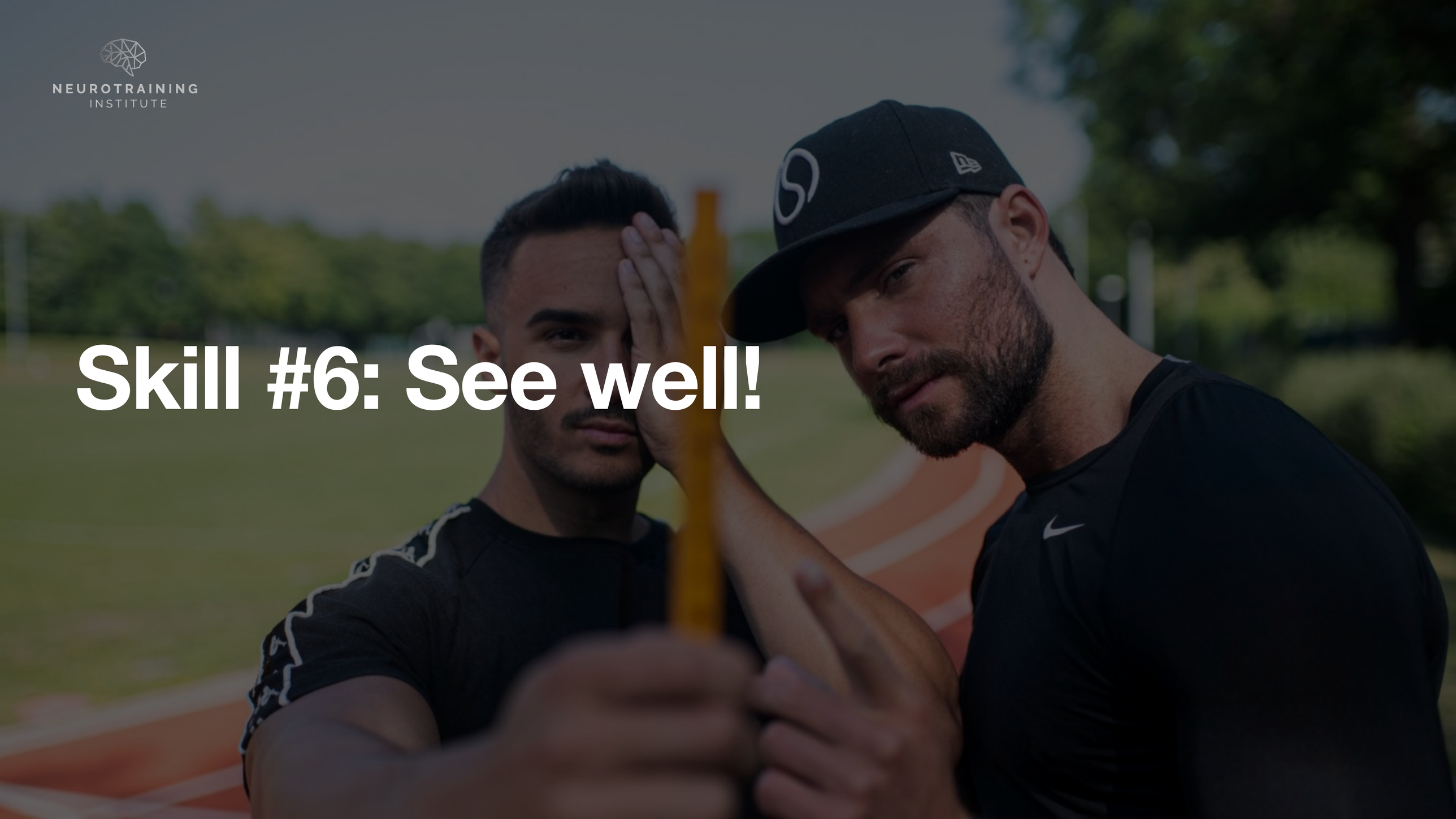
Proprioception Drill: Shoulder & Neck





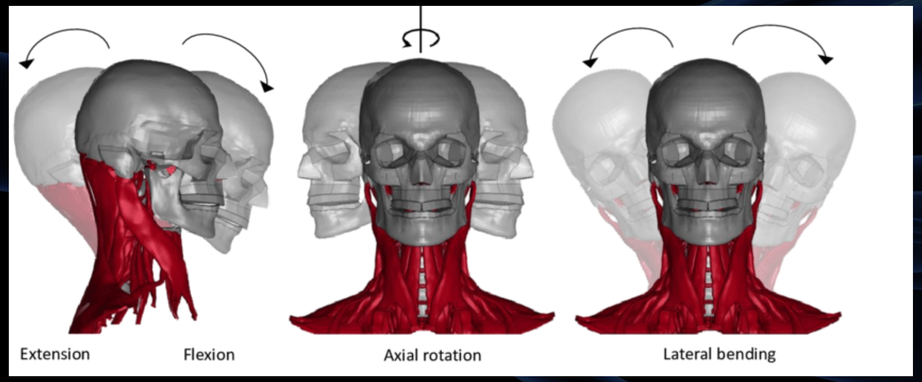
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Skill #6: See well!



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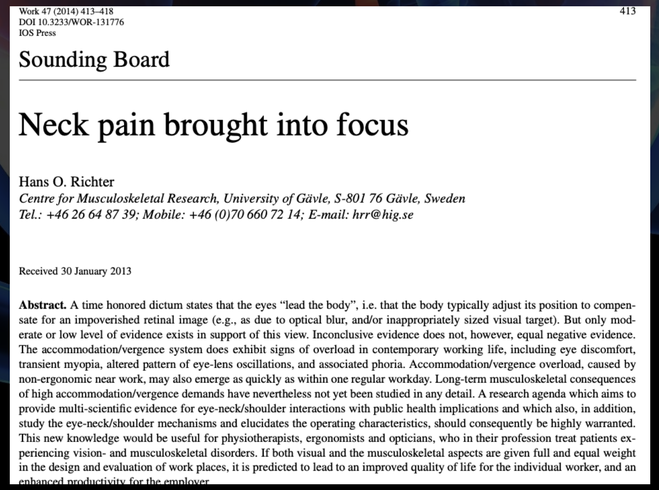
Vision & Neck Movements



“Our study confirmed the relationship between cervical driven oculomotor deficits and some visual complaints.”

“Neck muscle activation, caused by postural changes in response to visual stress is known to influence aspects of eye-lens accommodation, which opens the possibility for dysfunctional cross-talk between the two systems”




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Sounding Board

Neck pain brought into focus

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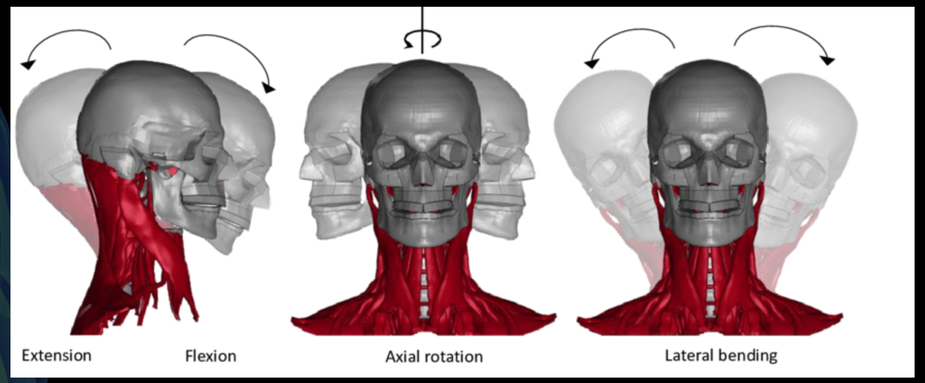
Received 30 January 2013

Abstract. A time honored dictum states that the eyes “lead the body”, i.e. that the body typically adjust its position to compensate for an impoverished retinal image (e.g., as due to optical blur, and/or inappropriately sized visual target). But only moderate or low level of evidence exists in support of this view. Inconclusive evidence does not, however, equal negative evidence. The accommodation/vergence system does exhibit signs of overload in contemporary working life, including eye discomfort, transient myopia, altered pattern of eye-lens oscillations, and associated phoria. Accommodation/vergence overload, caused by non-ergonomic near work, may also emerge as quickly as within one regular workday. Long-term musculoskeletal consequences of high accommodation/vergence demands have nevertheless not yet been studied in any detail. A research agenda which aims to provide multi-scientific evidence for eye-neck/shoulder interactions with public health implications and which also, in addition, study the eye-neck/shoulder mechanisms and elucidates the operating characteristics, should consequently be highly warranted. This new knowledge would be useful for physiotherapists, ergonomists and opticians, who in their profession treat patients experiencing vision- and musculoskeletal disorders. If both visual and the musculoskeletal aspects are given full and equal weight in the design and evaluation of work places, it is predicted to lead to an improved quality of life for the individual worker, and an enhanced productivity for the employer.

https://pubmed.ncbi.nlm.nih.gov/35409472/
https://content.iospress.com/download/work/wor01776?id=work/wor01776

Vision & Neck Movements

“Analysis of the results demonstrated a marked difference in tonic activity of the named muscles between the myopic and the normal groups.”



› Surg Radiol Anat. 1993;15(4):321-3. doi: 10.1007/BF01627885.

Interaction between the muscles of the neck and the extraocular muscles of the myopic eye. An electromyographic study

B Valentino [1], A Fabozzo

Affiliations + expand

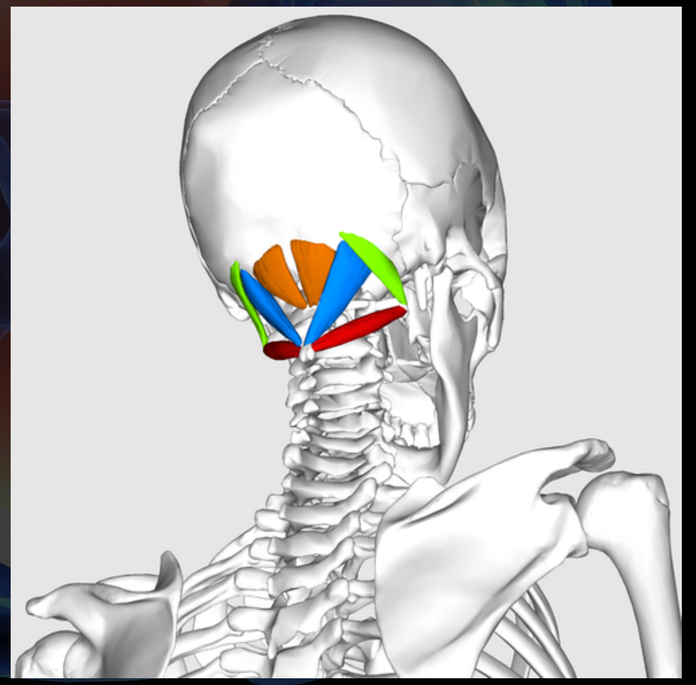
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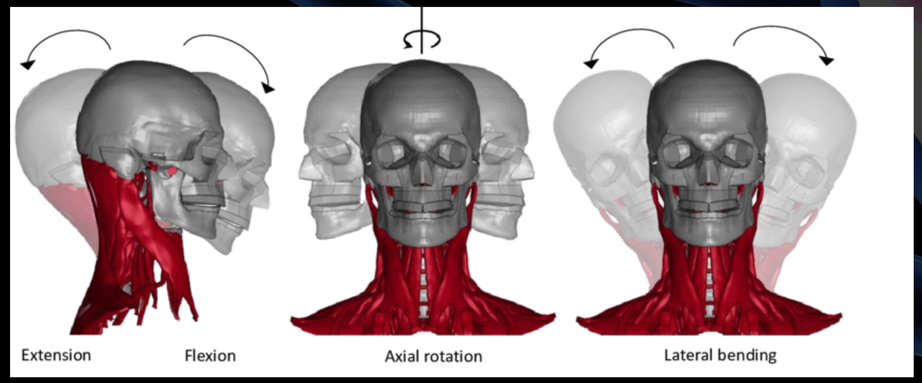
Suboccipitals & Eye Movements

- Palpate the back of your head right where the suboccipital muscles are located
- Start moving your eyes in a circular motion
- Feel the movement occurring in the back of your head



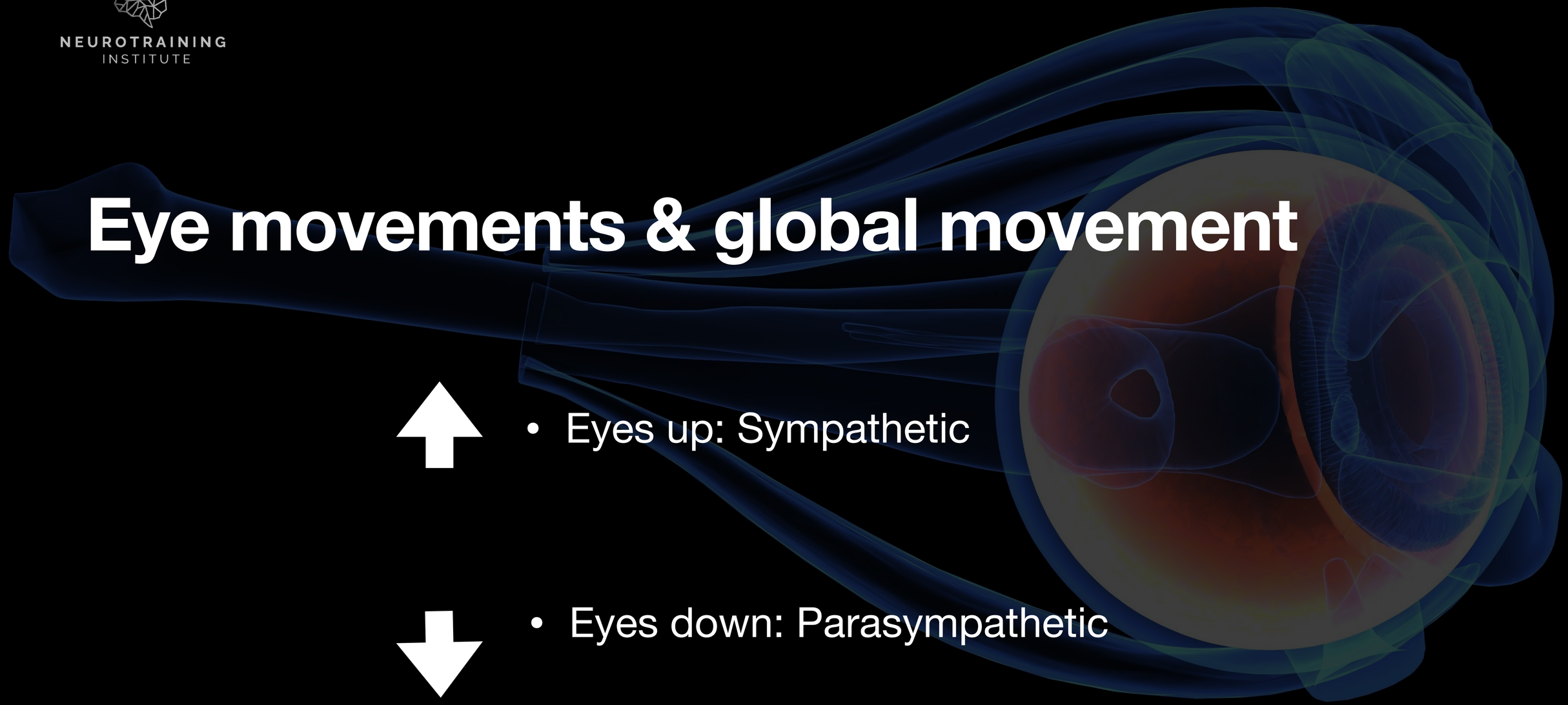
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Before doing visual drills or assessments test neck ROM!



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Eye movements & global movement

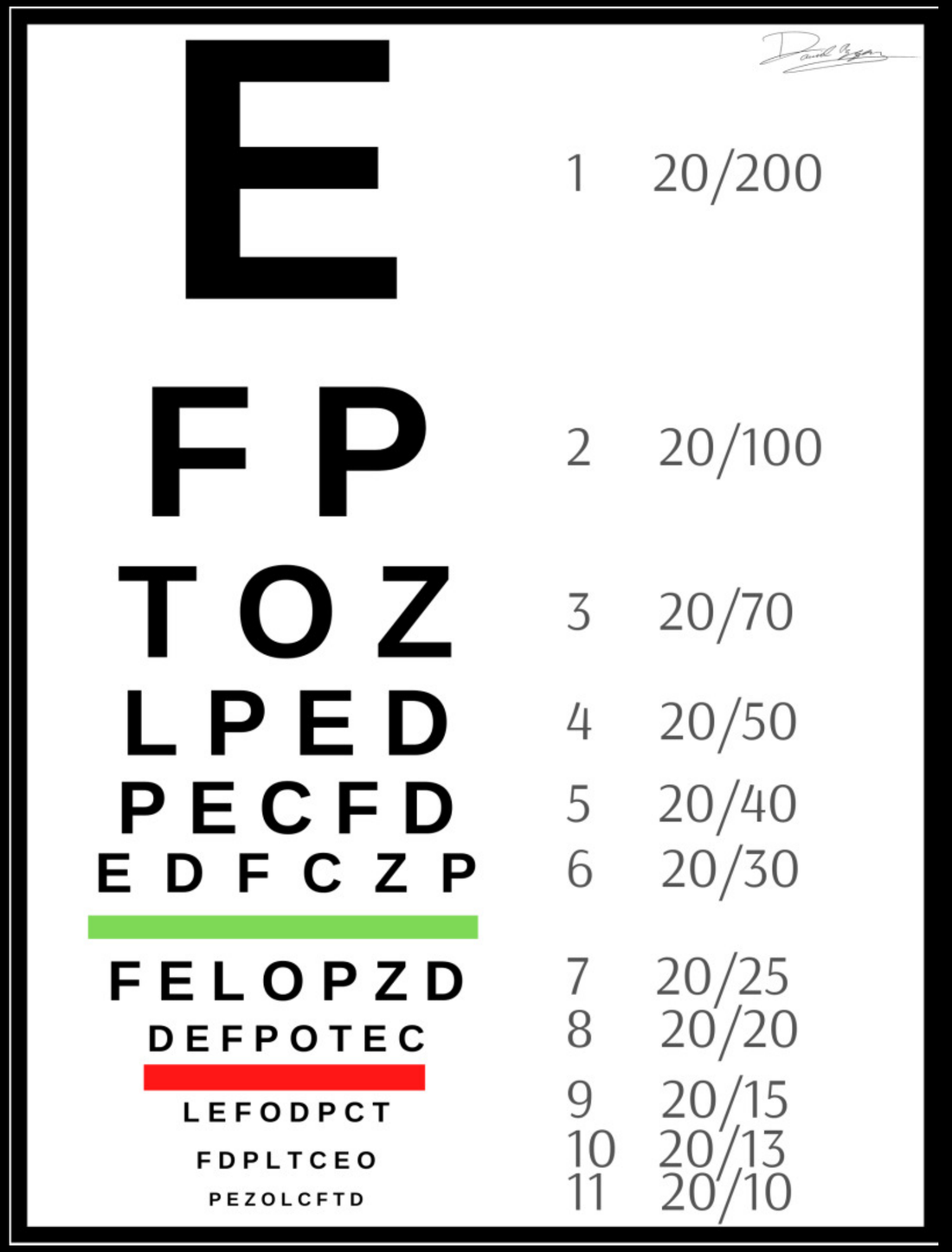


- Eyes up: Sympathetic

- Eyes down: Parasympathetic

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Snellen Chart Test (Visual Acuity)



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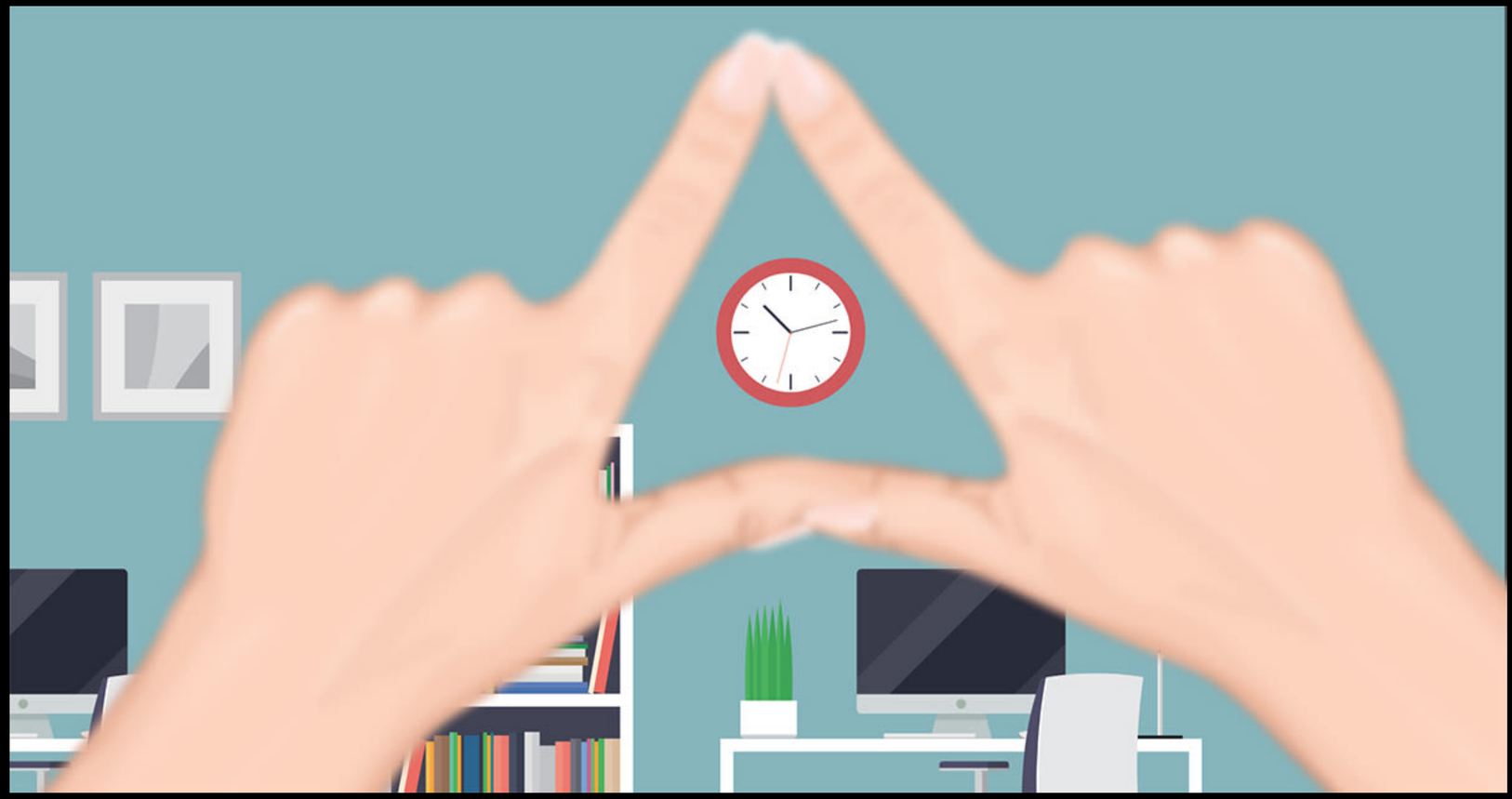
Eye dominance

- Eye dominance and handedness have been shown to have a very weak relationship, with 66% of right-handers having a right DE and 60% of left-handers having a left DE (Bourassa et al., 1996)
- Approximately two-thirds of the population are right-eye dominant, while one-third are left-eye dominant
- Eye dominance can also be mixed or neutral, occurring in approximately 7-8% of the population
- Eye dominance can affect how a person uses their eyes and body, but it is not usually associated with significant visual problems



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Eye dominance testing



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What to do with the test?

1. Test how the athlete responds to training the non-don eye (vision drills, with the dominant eye closed) - often you'll see significant improvements when working on the dominant eye.
2. In some cases it's possible to wear an eye patch during daily activities to train the non-dominant eye (eg. Watching TV, household work, etc.)

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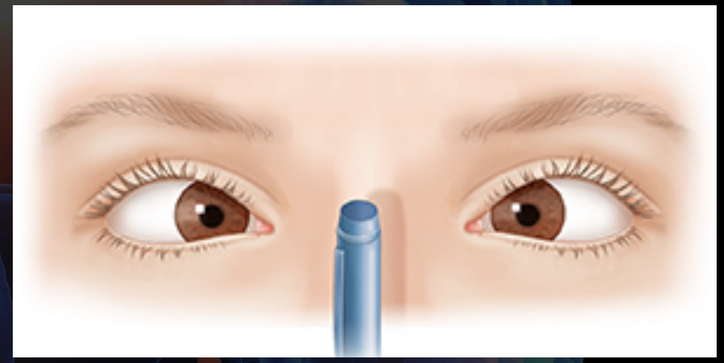
Convergence test

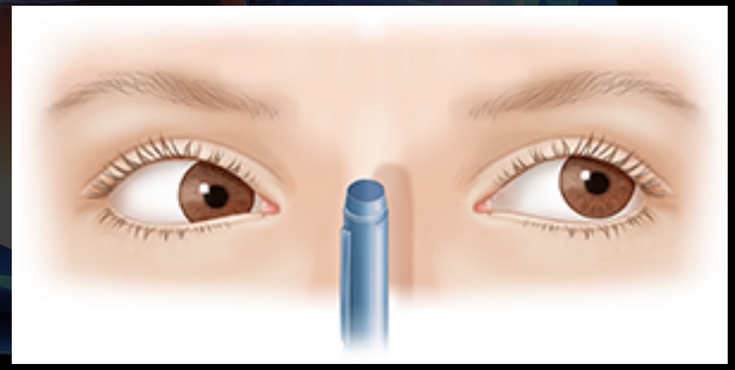
Inability to converge the eyes:

- The eyes struggle to coordinate when focusing on nearby objects
- One of the most common issues of eye coordination issues



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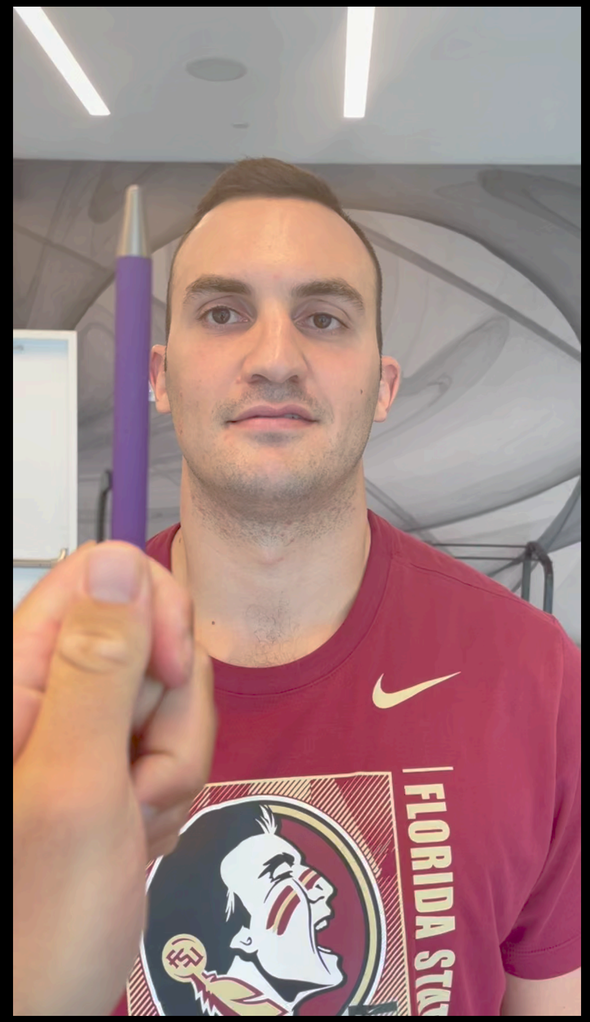
What are common symptoms?

- Double vision
- Eyestrain
- Headaches
- Focus issues
- Neck tension
- Problems with near tasks

Convergence: Practical Examples



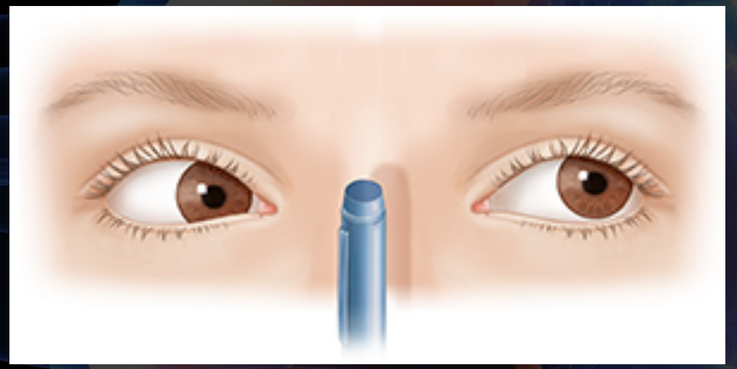




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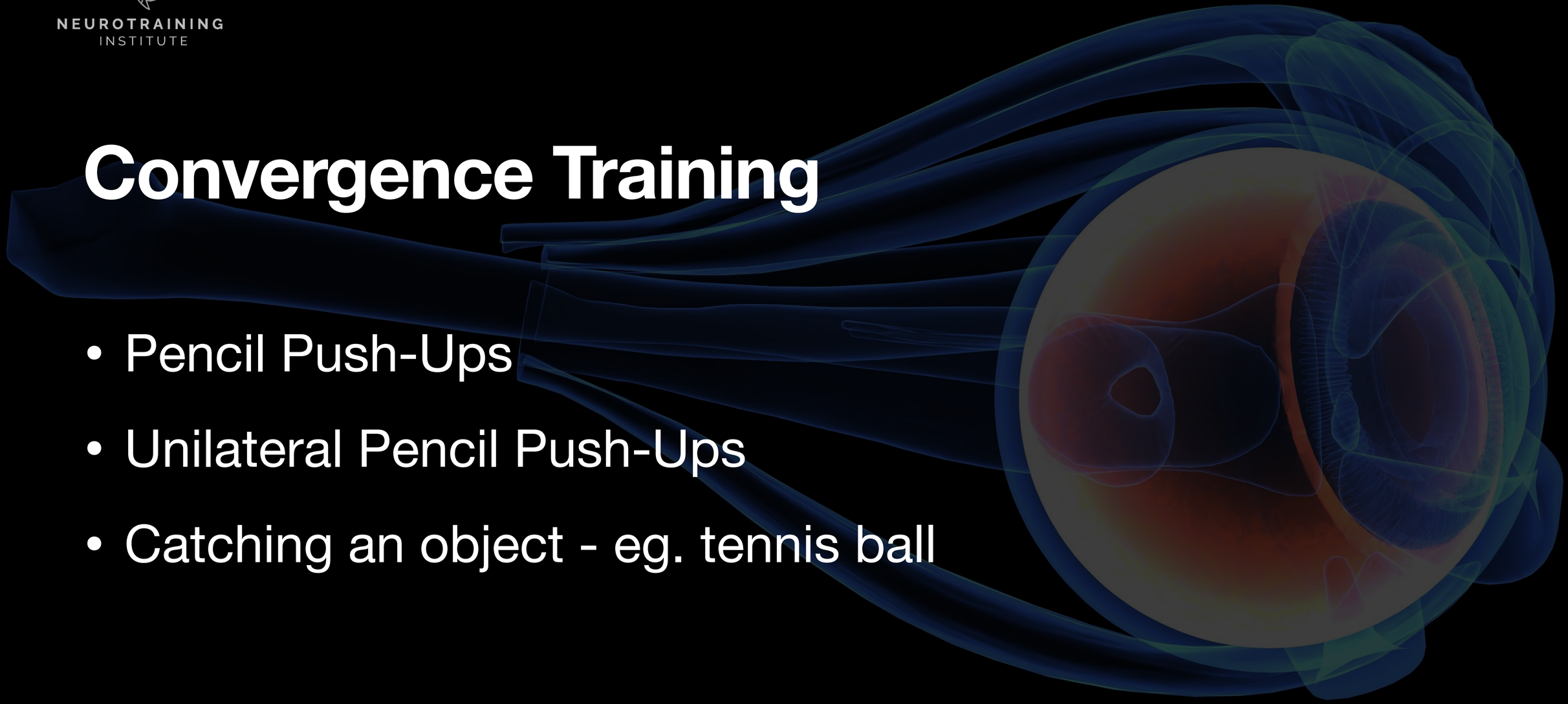
What to look out for?

- Does one eye drift off?
- Does one eye move slower or faster?
- Are both eyes able to focus?
- Is the movement of the eyes fluid?



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Convergence Training

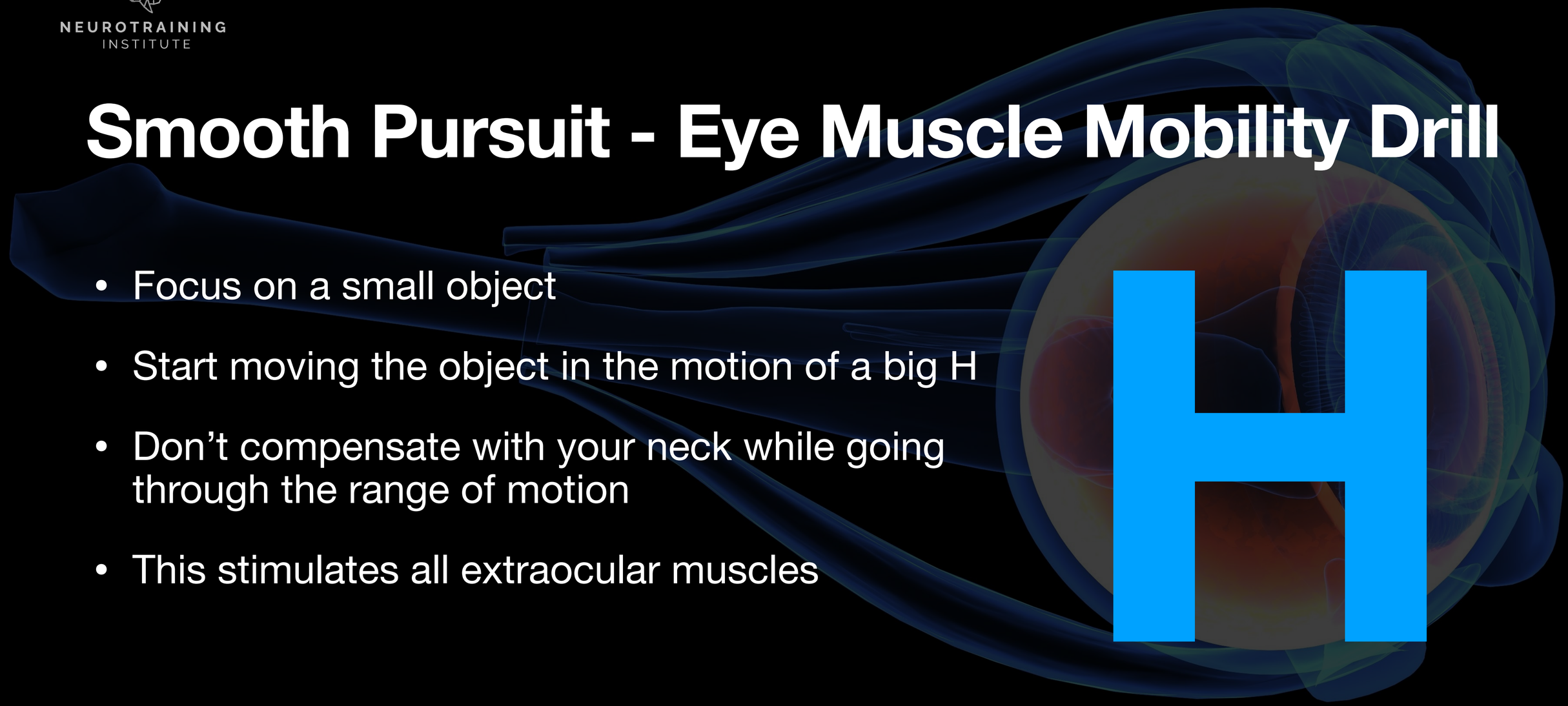


- Pencil Push-Ups
- Unilateral Pencil Push-Ups
- Catching an object - eg. tennis ball

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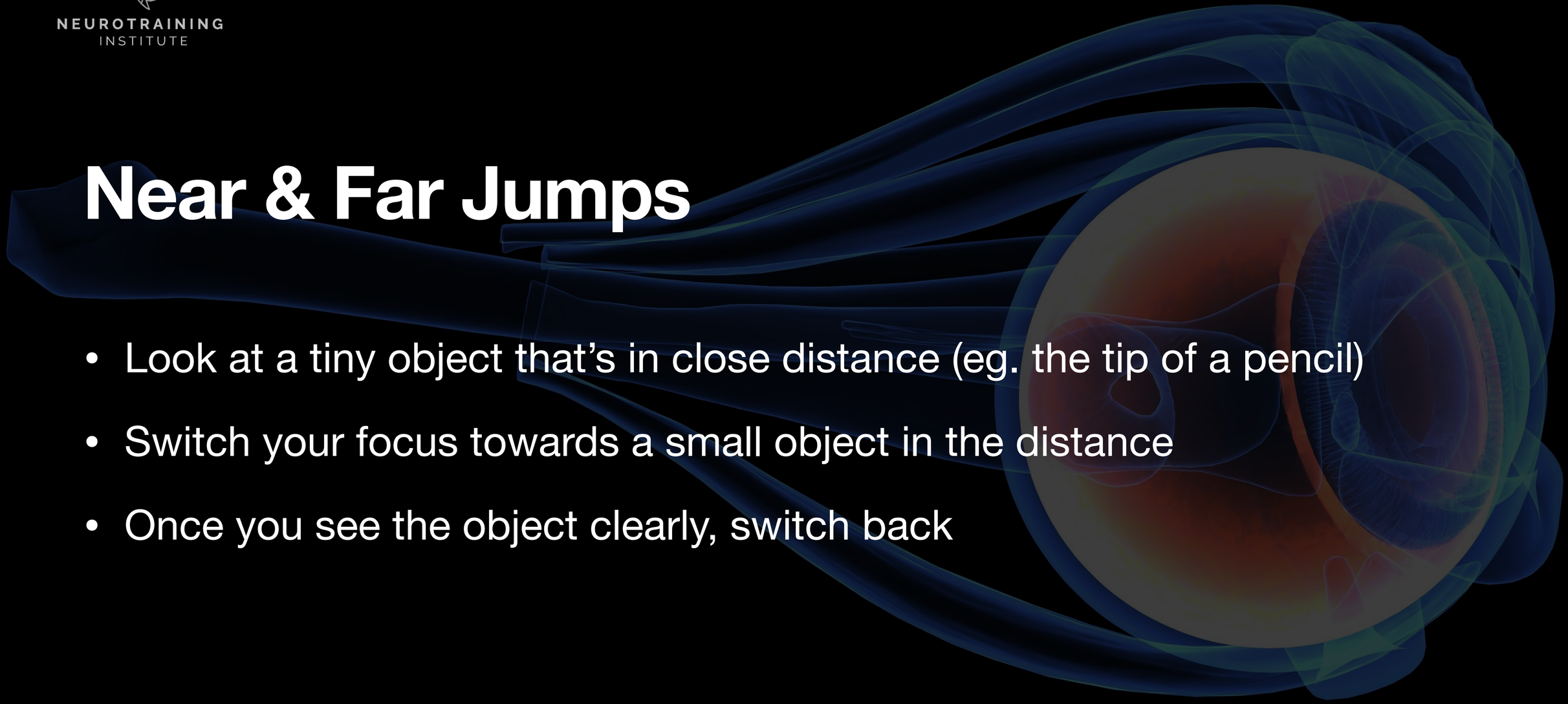
Smooth Pursuit - Eye Muscle Mobility Drill

- Focus on a small object
- Start moving the object in the motion of a big H
- Don’t compensate with your neck while going through the range of motion
- This stimulates all extraocular muscles



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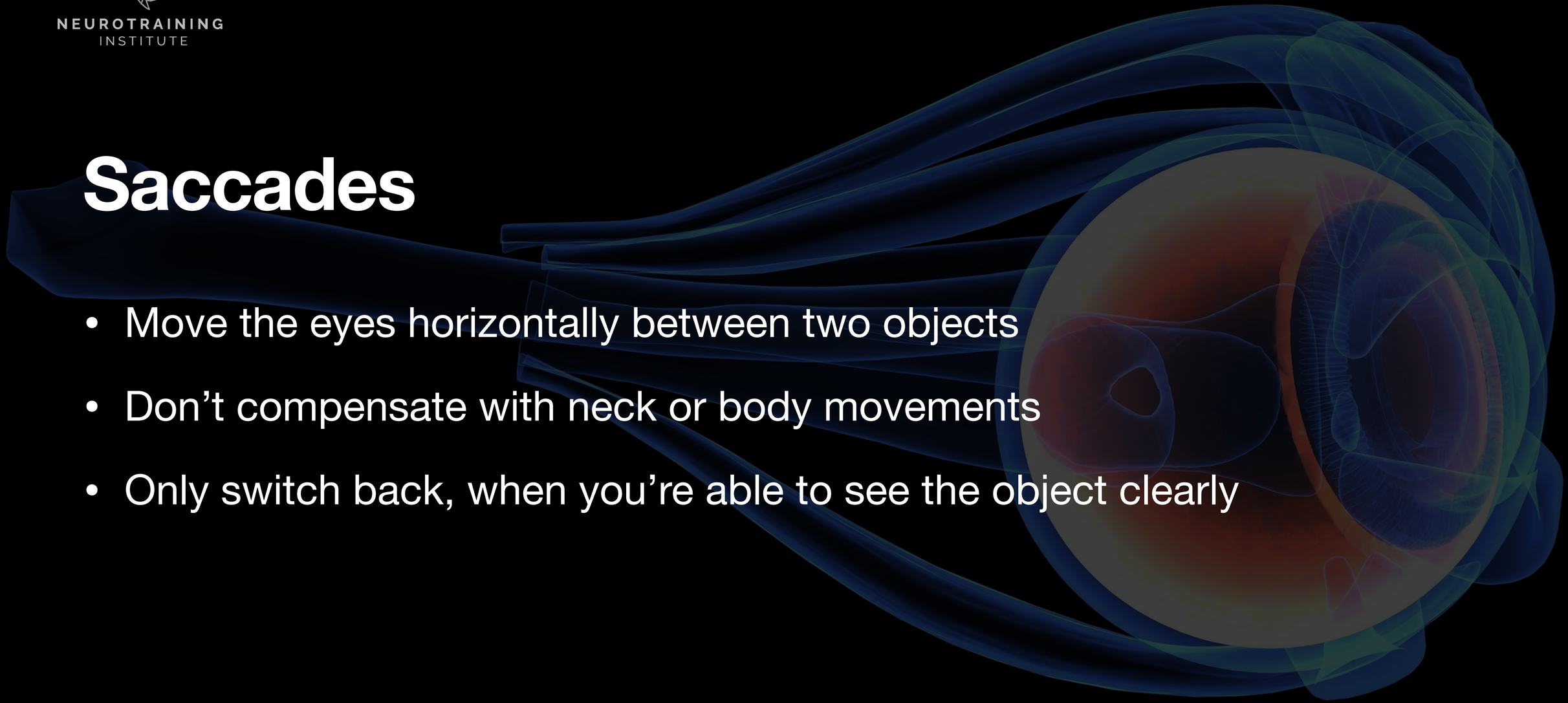
Near & Far Jumps



- Look at a tiny object that’s in close distance (eg. the tip of a pencil)
- Switch your focus towards a small object in the distance
- Once you see the object clearly, switch back

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Saccades



- Move the eyes horizontally between two objects
- Don’t compensate with neck or body movements
- Only switch back, when you’re able to see the object clearly

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Skill #7: Balance well!



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Is this the only way we can train balance?



The Vestibulo-Ocular Reflex

- Maintains visual stability during head movements
- Preserves clear vision during head movements
- Stabilizes gaze relative to the environment
- Reduces motion sickness
- Operates automatically and rapidly



It’s a vital reflex for survival and performance!

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How can you assess balance/vestibular skills?

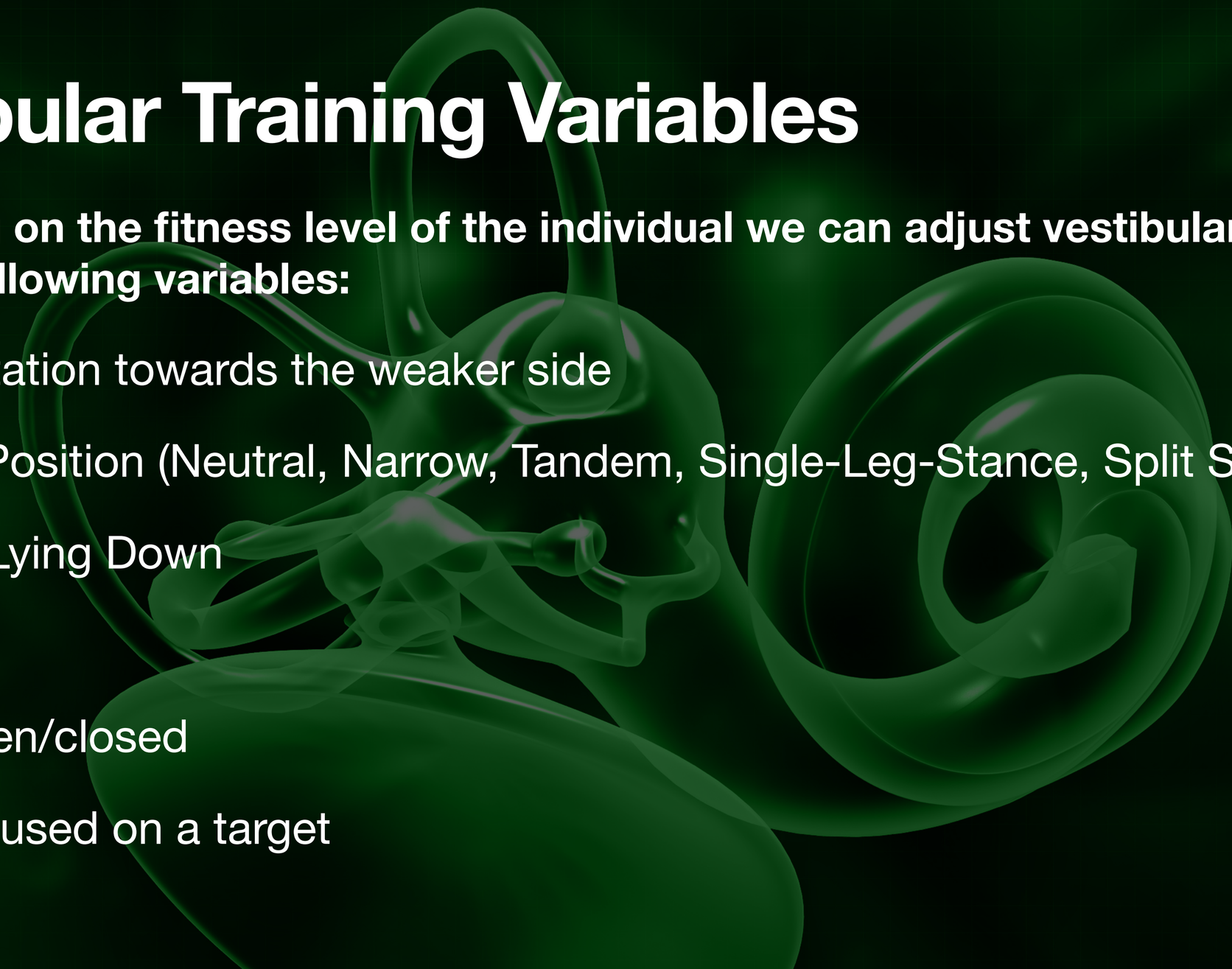
- Pick a stance the client has decent balance in
- Have the client focus on a small target in front of them
- Tell the client to quickly rotate the side towards the left for 3-5 times without losing track of the object, repeat the same on the right side
- Compare overall balance - side to side

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Vestibular Training Variables

Depending on the fitness level of the individual we can adjust vestibular training with the following variables:

- Head rotation towards the weaker side
- Stance Position (Neutral, Narrow, Tandem, Single-Leg-Stance, Split Stance, …)
- Seated/Lying Down
- Rolling
- Eyes open/closed
- Eyes focused on a target

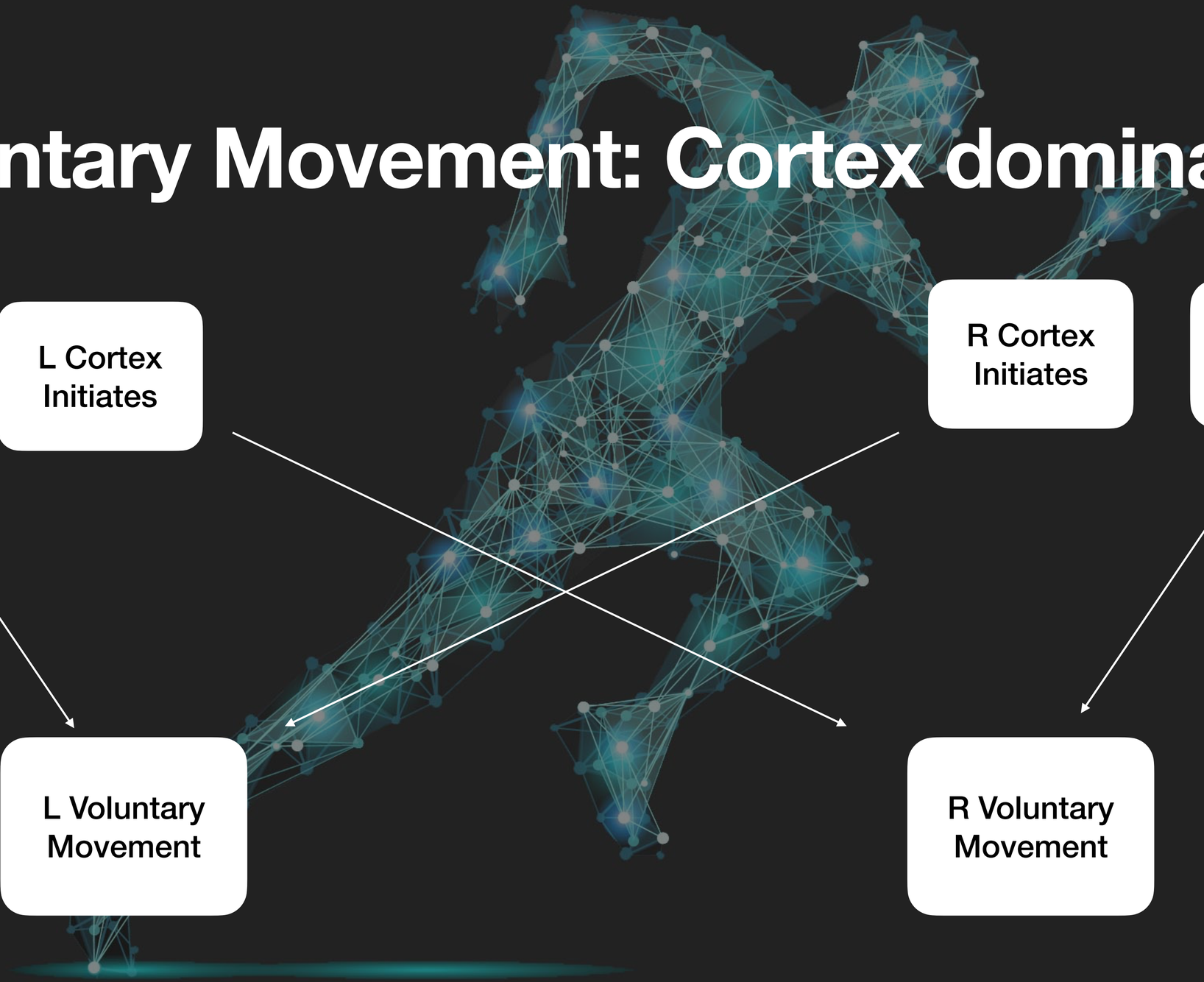


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Skill #8: React & Coordinate Well

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Voluntary Movement: Cortex dominant



L Cerebellum coordinates

L Cortex Initiates

R Cortex Initiates

R Cerebellum coordinates

L Voluntary Movement

R Voluntary Movement

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Coordination Testing & Training

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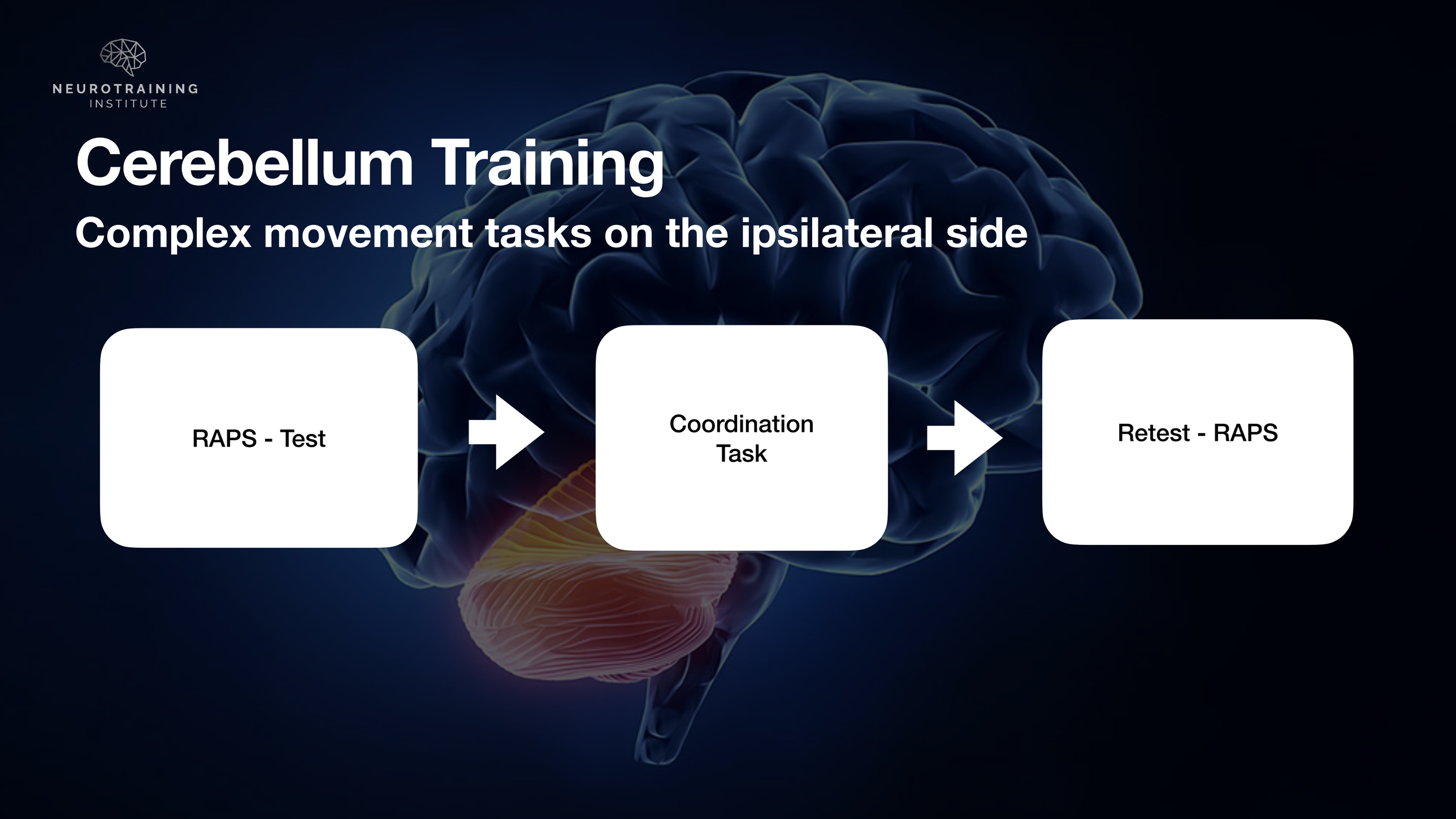
Cerebellum Test: Rapid-Alternating-Pronation-Supination

- The Rapid Alternating Pronation-Supination (RAPS) test evaluates upper extremity motor control
- It's used to assess nervous system function, particularly the ipsilateral cerebellum and its connections
- During the test, the athlete stands or sits and places one hand's palm down (pronation) and the other hand's palm up (supination) on top of each other
- The athlete rapidly alternates forearm movements between pronation and supination while keeping one hand over the other
- The examiner observes for smooth, rapid, and precise movements without hesitations or tremors
- The test assesses coordination, movement speed, and precision
- Compare side to side to get insights into ipsilateral cerebellum function

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Cerebellum Training

Complex movement tasks on the ipsilateral side



RAPS - Test

Coordination Task

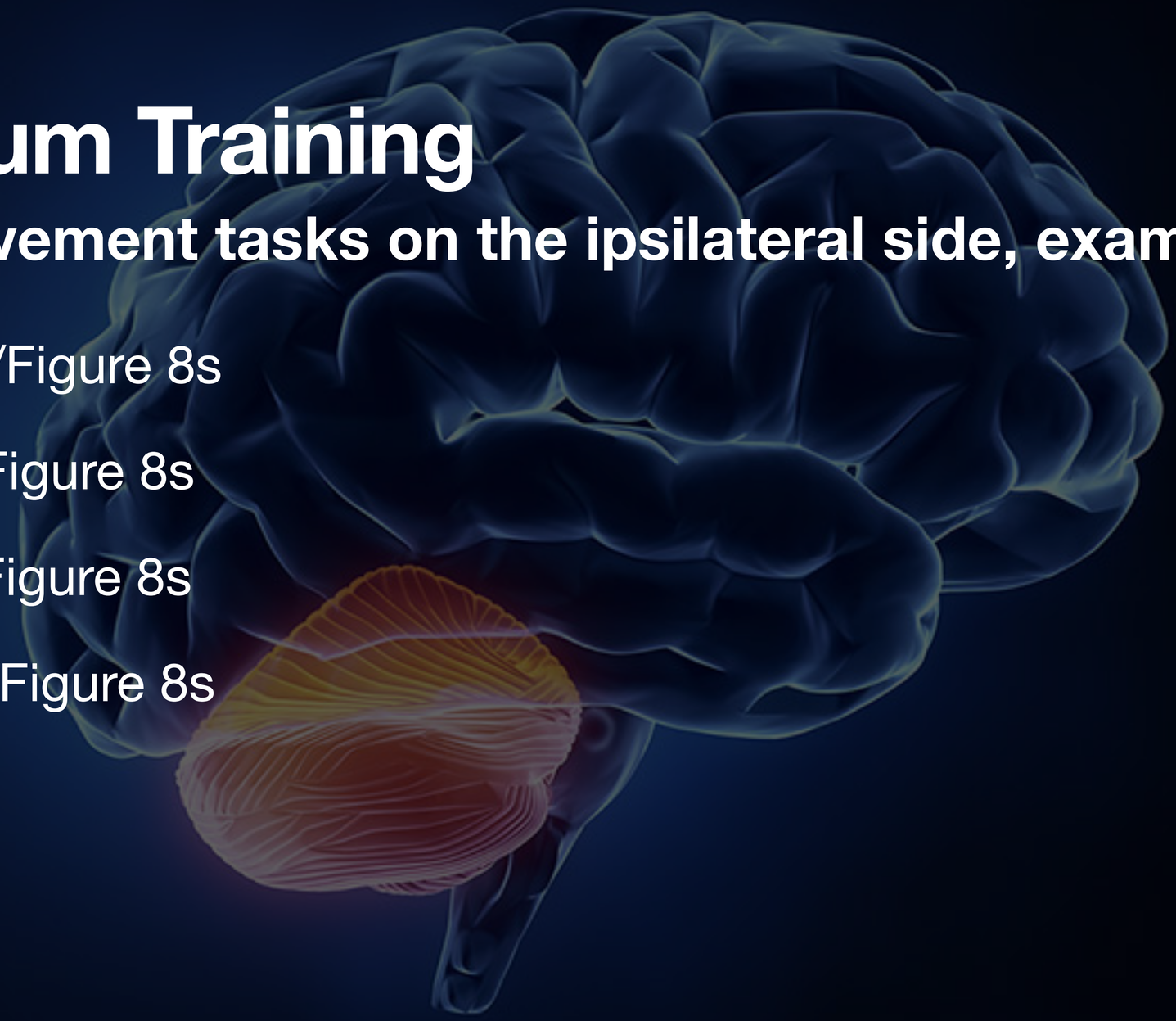
Retest - RAPS

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Cerebellum Training

Complex movement tasks on the ipsilateral side, examples:

- Finger circles/Figure 8s
- Wrist circles/Figure 8s
- Foot Circles/Figure 8s
- Ankle Circles/Figure 8s
- …



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React Well



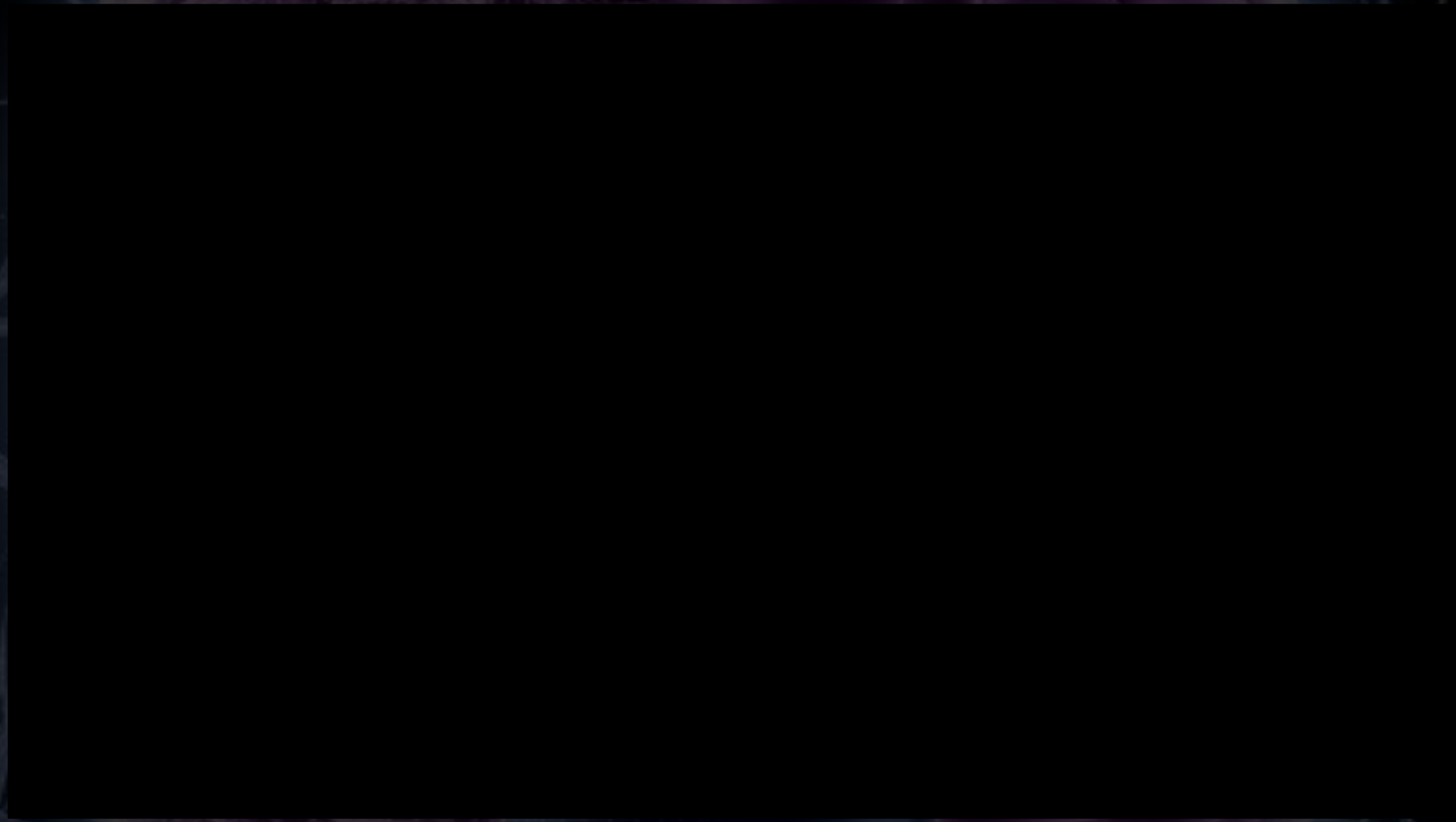
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Stroop Test/Drill

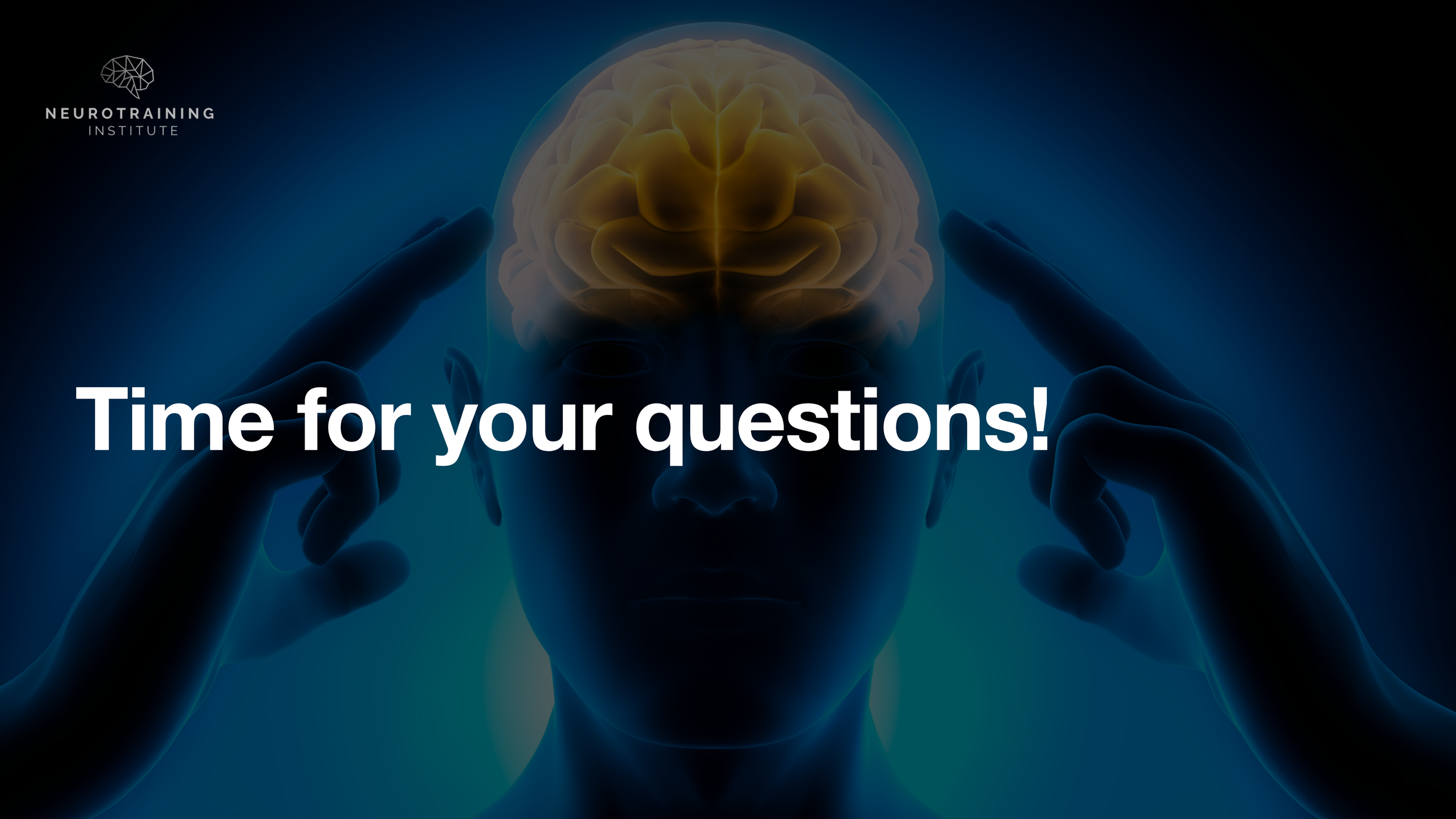
- Explain to the athlete that they will be presented with a list of words and their task is to name the color of the ink in which each word is printed
- The goals is to do this as accurately and fast as possible
- The task for the brain is to ignore the actual word meaning

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Stroop Test/Drill



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Time for your questions!