



MedFit
CLASSROOM



Don't Be Intimidated: Training the Stroke Survivor

Dr. Grove Higgins & Pat Marques

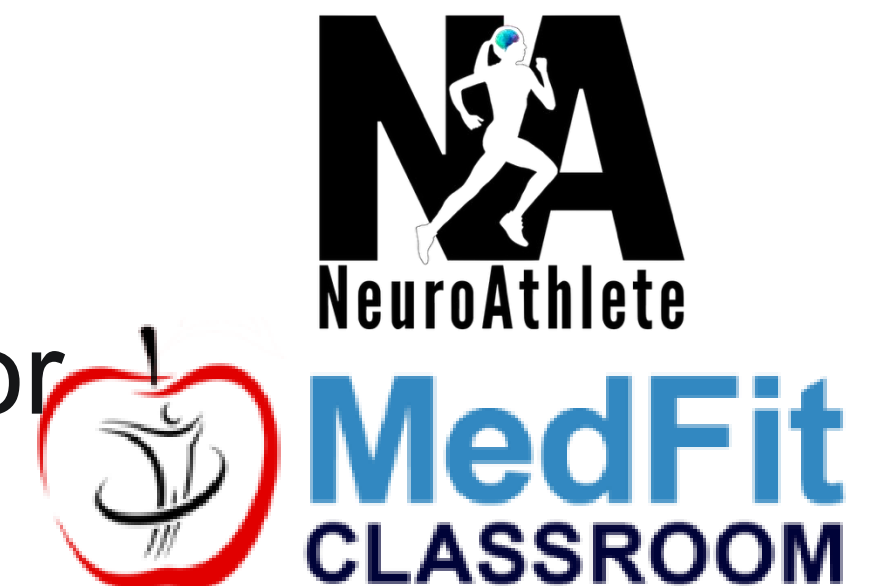
Introduction

- **Dr. Grove Higgins**

- Chiropractor & Soft Tissue Practitioner
- Speaker and Educator
- Functional Anatomy Instructor
- NSCA CSCS
- Researcher
- Co-Author – Stroke Recovery Fitness Specialist
- Worked in medicine since 1993

- **Pat Marques**

- LTC (R) U.S. Army
- BS Exercise Science
- Z-Health Master Trainer & Instructor
- NSCA CPT
- Neuro-Centric Exercise Therapist
- Co-Author – Stroke Recovery Fitness Specialist
- Researcher
- Speaker and Educator

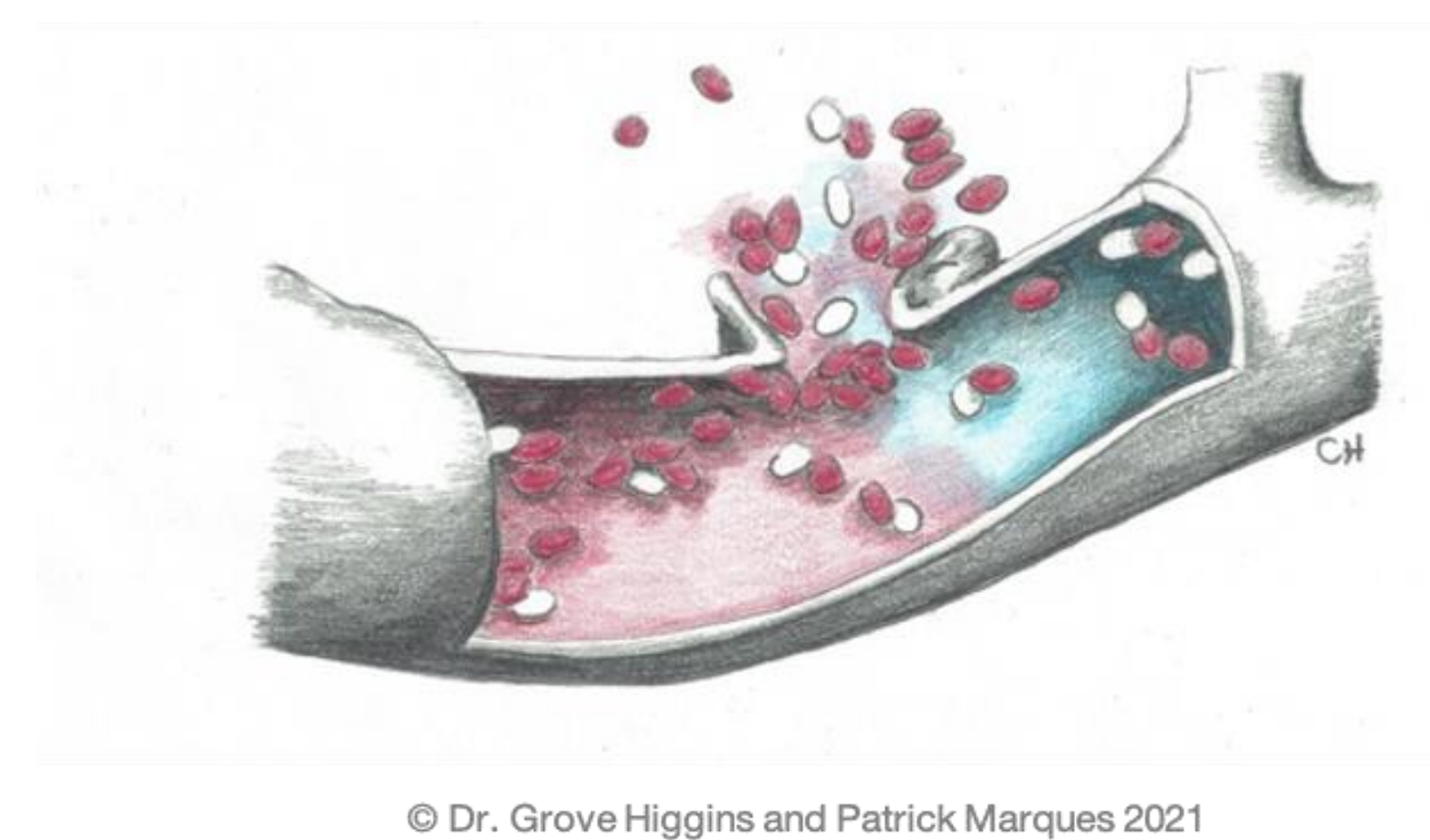
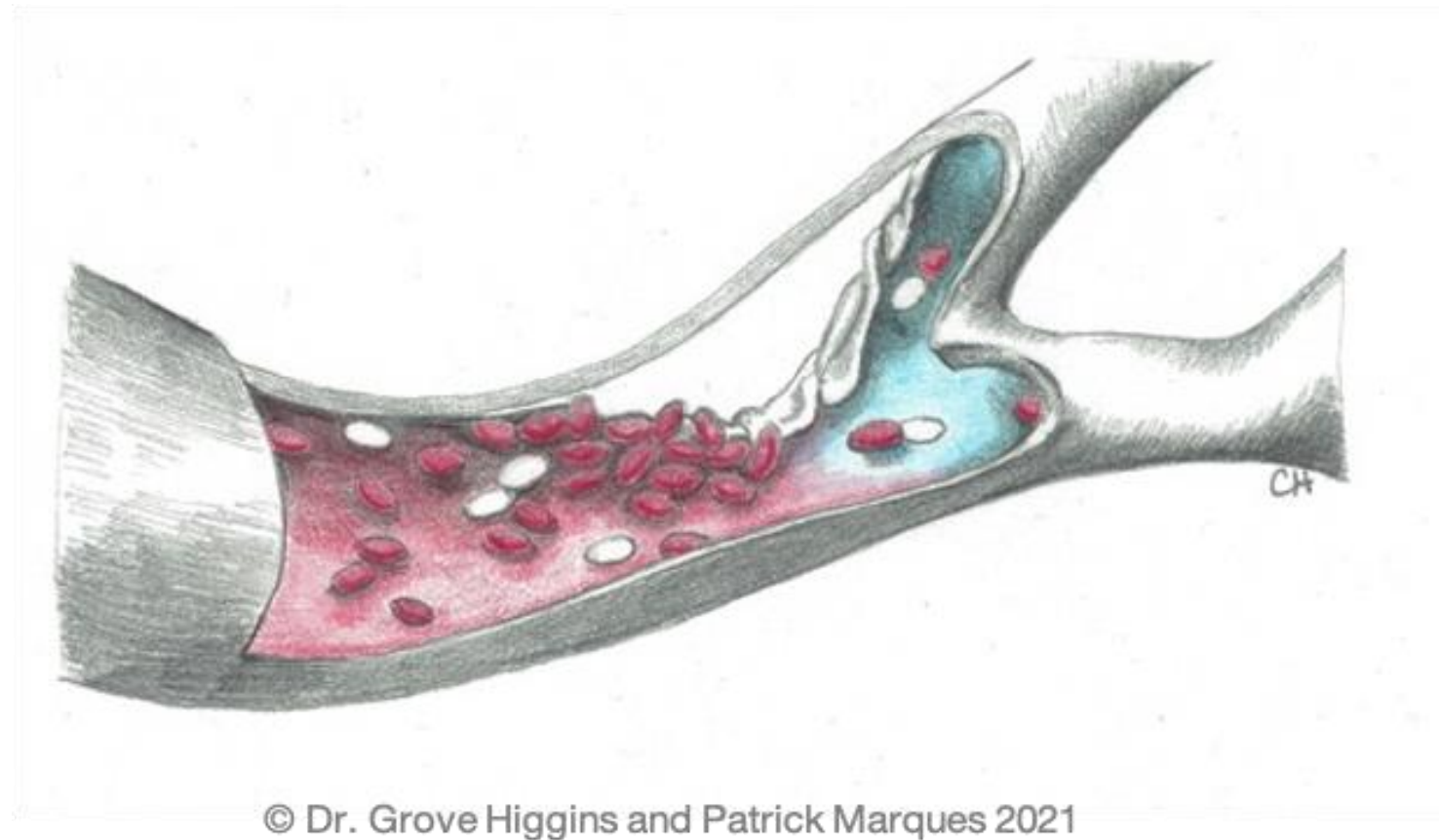


Agenda

- **Stroke Basics & Key Aspects**
 - Definition & types
 - Statistics
 - Common dysfunctions
- **Important Concepts for Training the Stroke Survivor**
 - Neuroplasticity
 - Safety considerations
 - Fueling
 - Sensory input
 - Neurology of movement
 - Vision & vestibular integration

Definition & Types

- **Definition:** A stroke occurs when the blood supply to part of your brain is interrupted or reduced, preventing brain tissue from getting oxygen and nutrients. Brain cells begin to die in minutes.

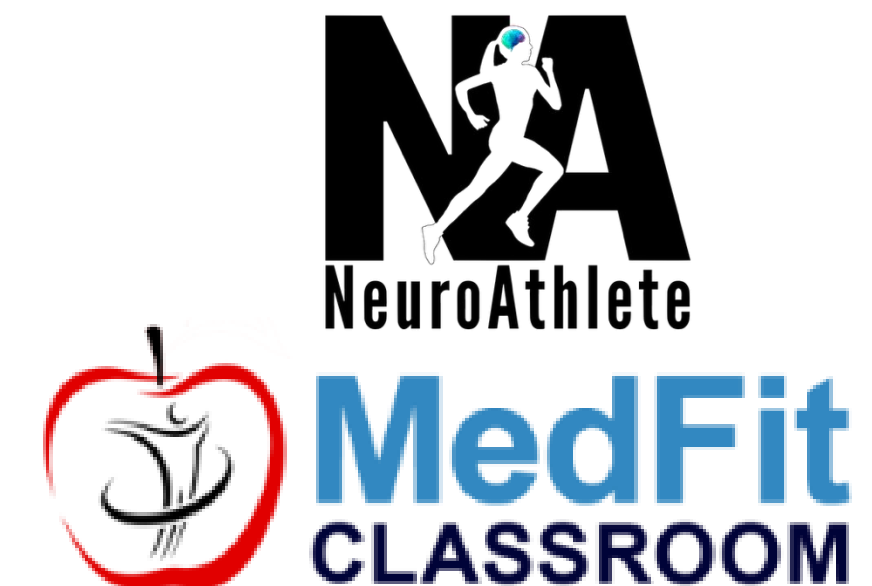


- **Ischemic**
- **Transient Ischemic Attack (TIA)**

- **Hemorrhagic**

Statistics

- Over 795,000 experience stroke every year in US
- 610,000 are first-time strokes
- Only 66% are over 65
- A stroke happens every 40 seconds in the US
- Leading cause of long-term disability
- Black people are twice as likely to have a stroke
- 1 in 3 who suffer a stroke have preexisting risk factors (high blood pressure, high cholesterol, diabetes, or overweight/obesity)
- 55,000 more women die each year from stroke vs. men



Common Dysfunctions

All of the common issues associated with Stroke are due to brain damage / injury

- Movement / coordination
 - Paralysis, spasticity, loss of fine motor
- Language
 - Difficulty using or understanding speech
- Cognition
 - Memory, attention span, planning
- Visual / Balance
 - Oculomotor, visual fields, visual neglect
- Sensory Impairments
 - Loss of sensation, pain



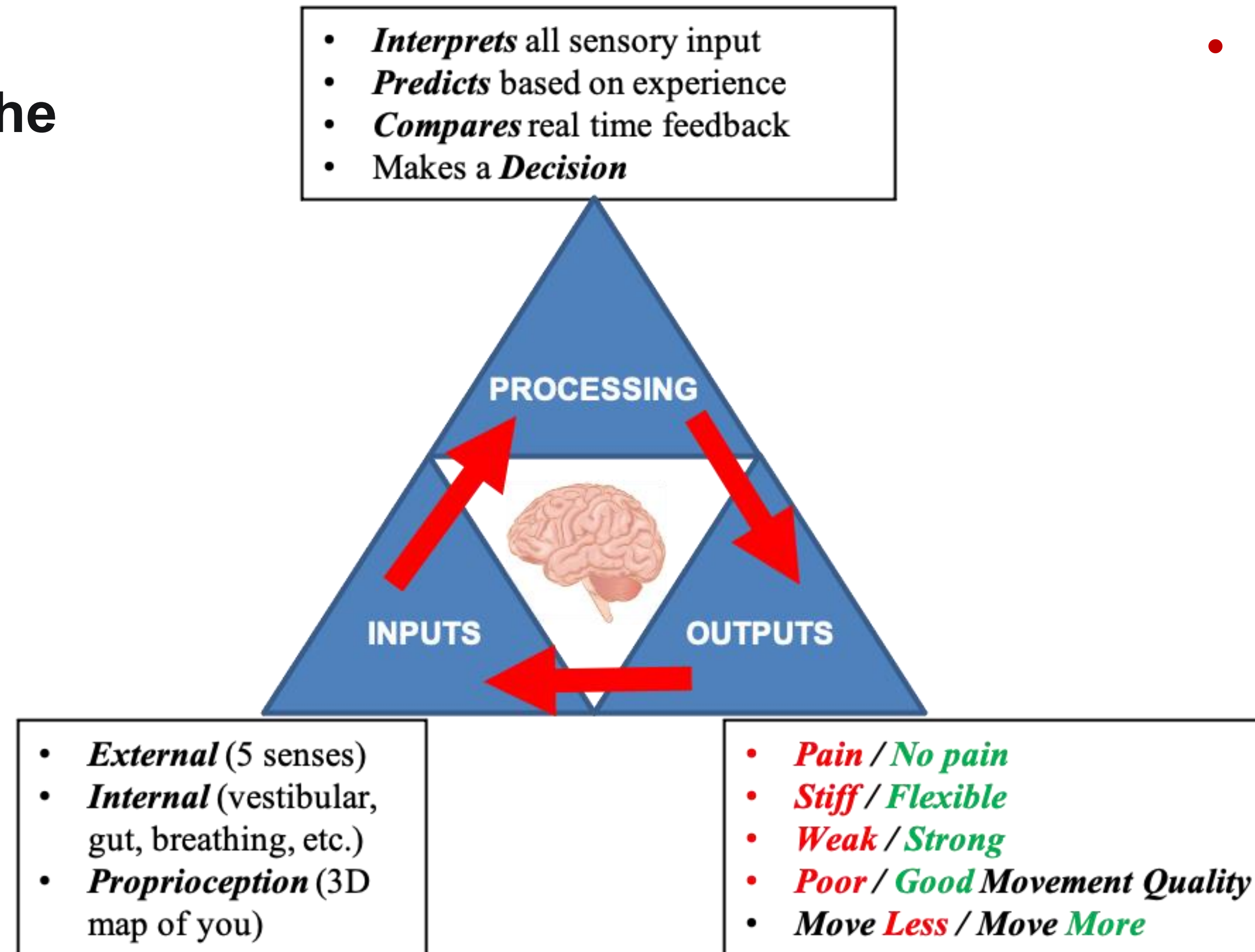
The Intimidation Factor

- **Low energy / quick to fatigue**
 - Many tasks become more “cognitive”, thus more calorically expensive
 - Poor breathing mechanics = less O₂ to the brain (a primary fuel source)
 - Brain injuries create an “energy crisis” in the brain
- **Movement / motor control issues**
 - Requires exercise modification
 - Can vary widely between stroke survivors
 - Incremental progress

Neuro-Centric Strategies for Stroke Recovery Fitness

- The *input* to the brain determines the *output*

- To get a better output, you must:
 - Change the input
 - Improve the processing



- Biomechanics *obey* and *respond* to the nervous system, not vice versa

Neuroplasticity: What it is

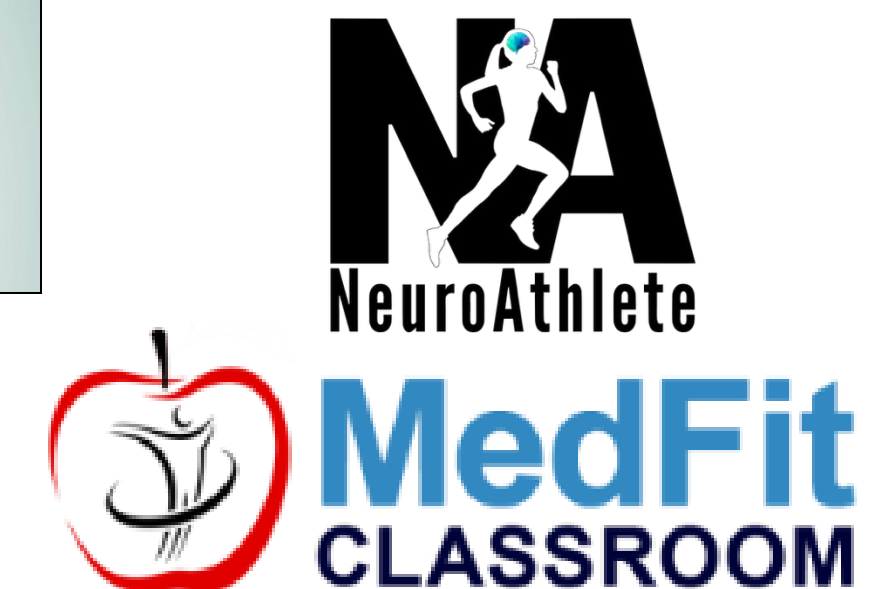
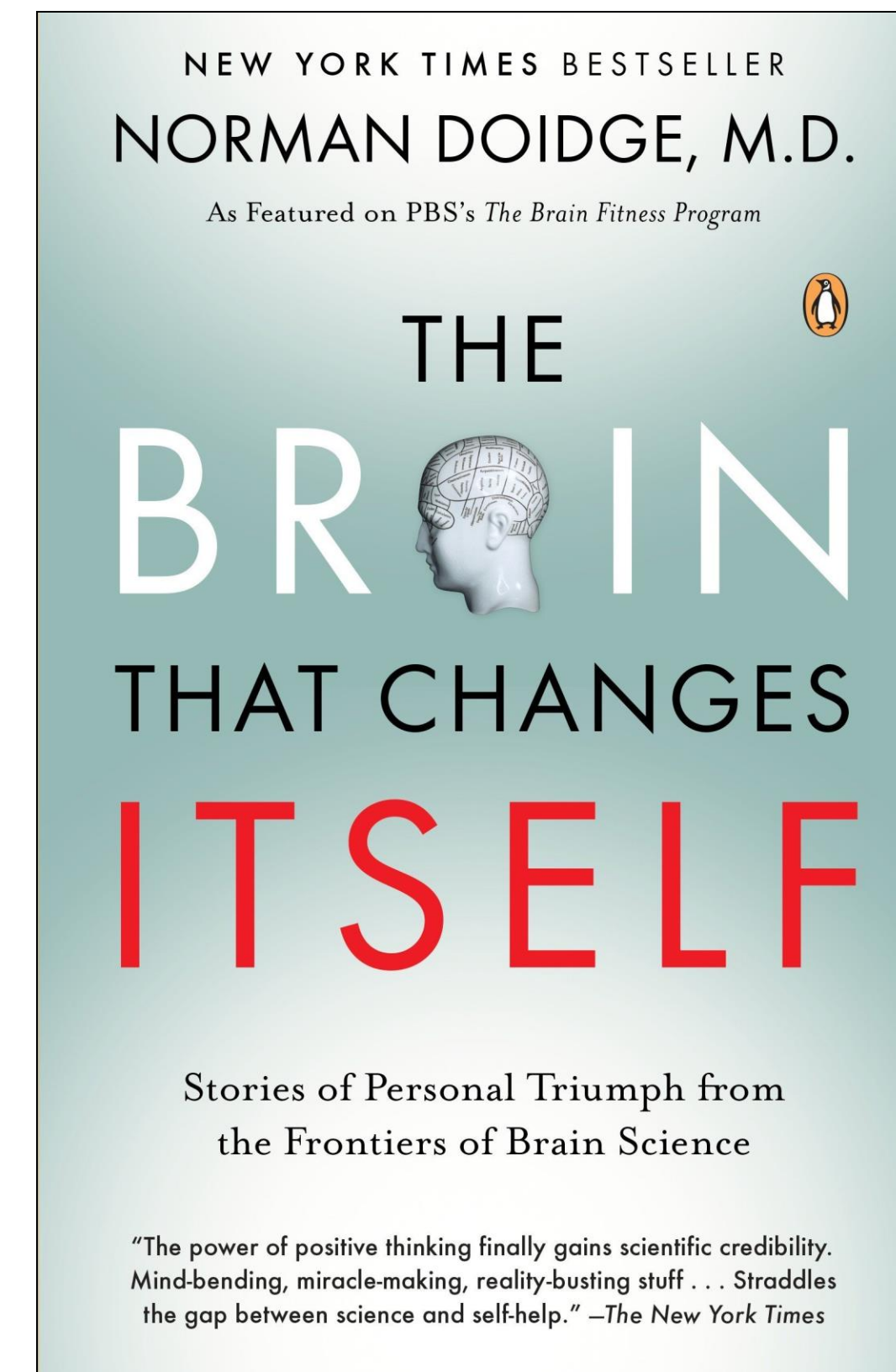
Definition – The brain's ability to reorganize itself by forming new neural connections

- **How:** New experiences change neurons, the organization of their networks, and their function
- **Why:** To regain or improve upon the resulting dysfunction we must harness neuroplasticity to build new neural connections



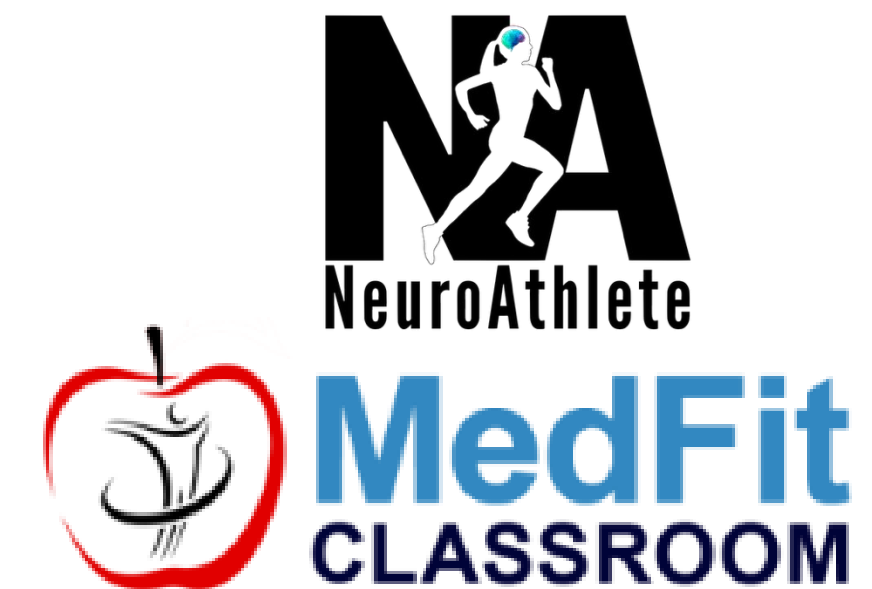
Why Neuroplasticity Matters

- Other areas of the brain, those not normally associated with a given action, can assist if the stimulus is strong enough
- Why neuroplasticity matters:
 - Provides hope
 - Targeted change
 - Neurons that wire together, fire together
 - We have lots of “back up discs” in the brain



Practical Ways to Implement Neuroplasticity

- **Create the stimulus for change**
- **The repetition requirement**
- **Layering input for synergistic effect**
- **Make it matter (saliency)**
- **Novelty**
- **Intensity**



General Stimulation of Neuroplasticity

Exercise

- Powerfully activates neuroplasticity
- Aerobic exercise stimulates the release of Brain-Derived Neurotrophic factor (BDNF)
- Fuels the growth of new synaptic connections and strengthens the signals between neurons

Novel Activities

- Doing new things in general promotes neuroplasticity
- Basically, just try new things!
- Taking a painting class, aqua yoga class, going to concerts, etc.

Play

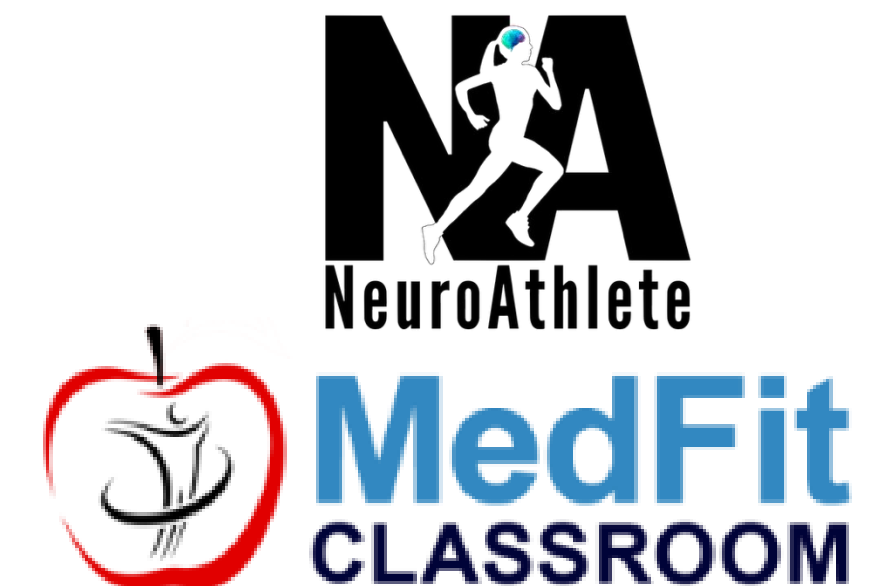
- We simply learn better when we are playing and having fun
- All types of games can fall into this area, even video games

Social Interaction

- Studies show that positive interactions enhance neuroplasticity
- Could be especially important for stroke survivors who tend to interact less with others

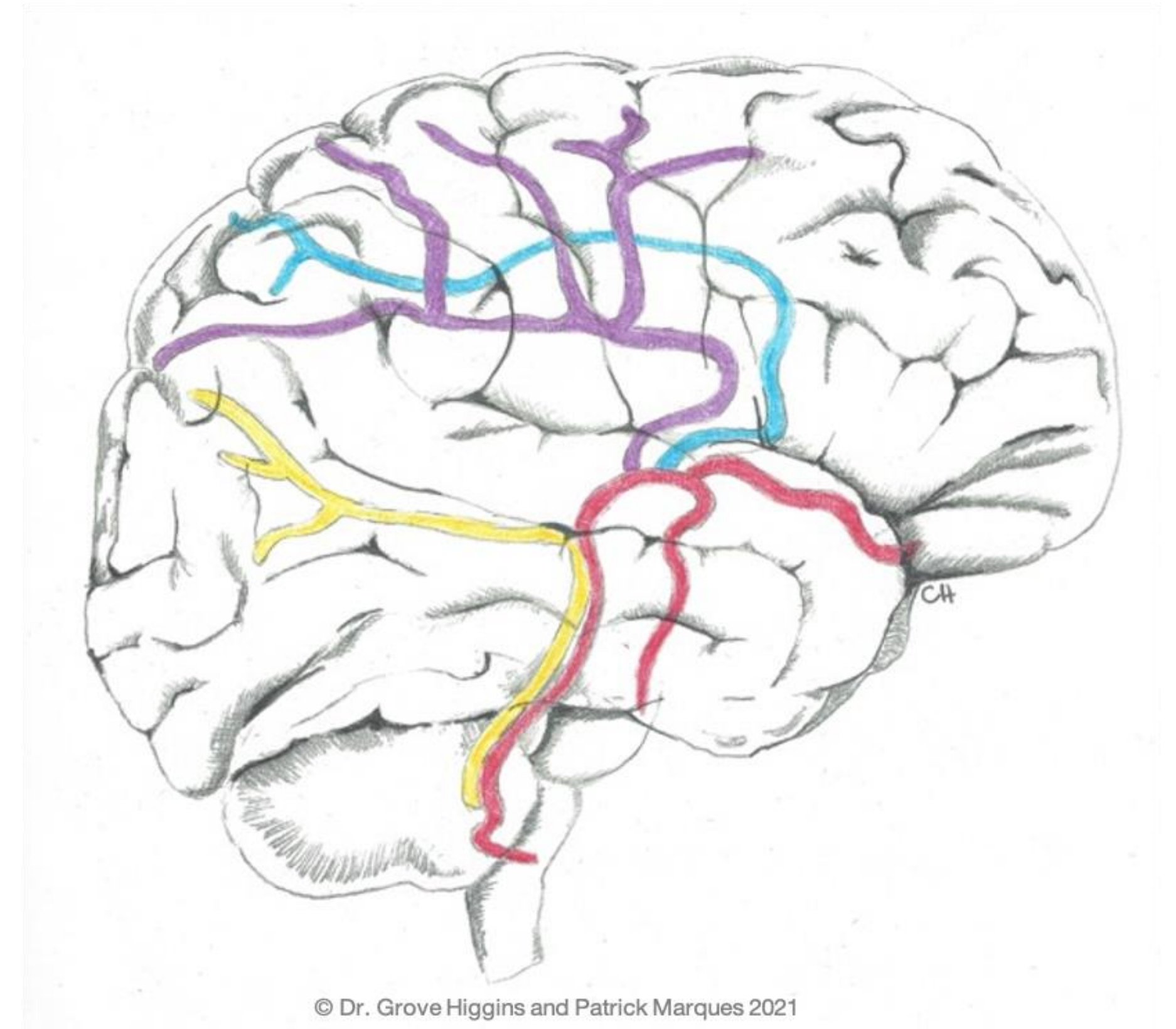
Training Concepts - Safety Considerations

- **Stroke survivors are very quick to fatigue**
- **Facility environment:**
 - Ladder walls
 - Handrails / ballet bar
 - Chairs & adjustable height tables
 - Minimal distractions
- **PCM restrictions**
- **PT history**
- **Caregiver involvement?**



Training Concepts - Fueling the Brain

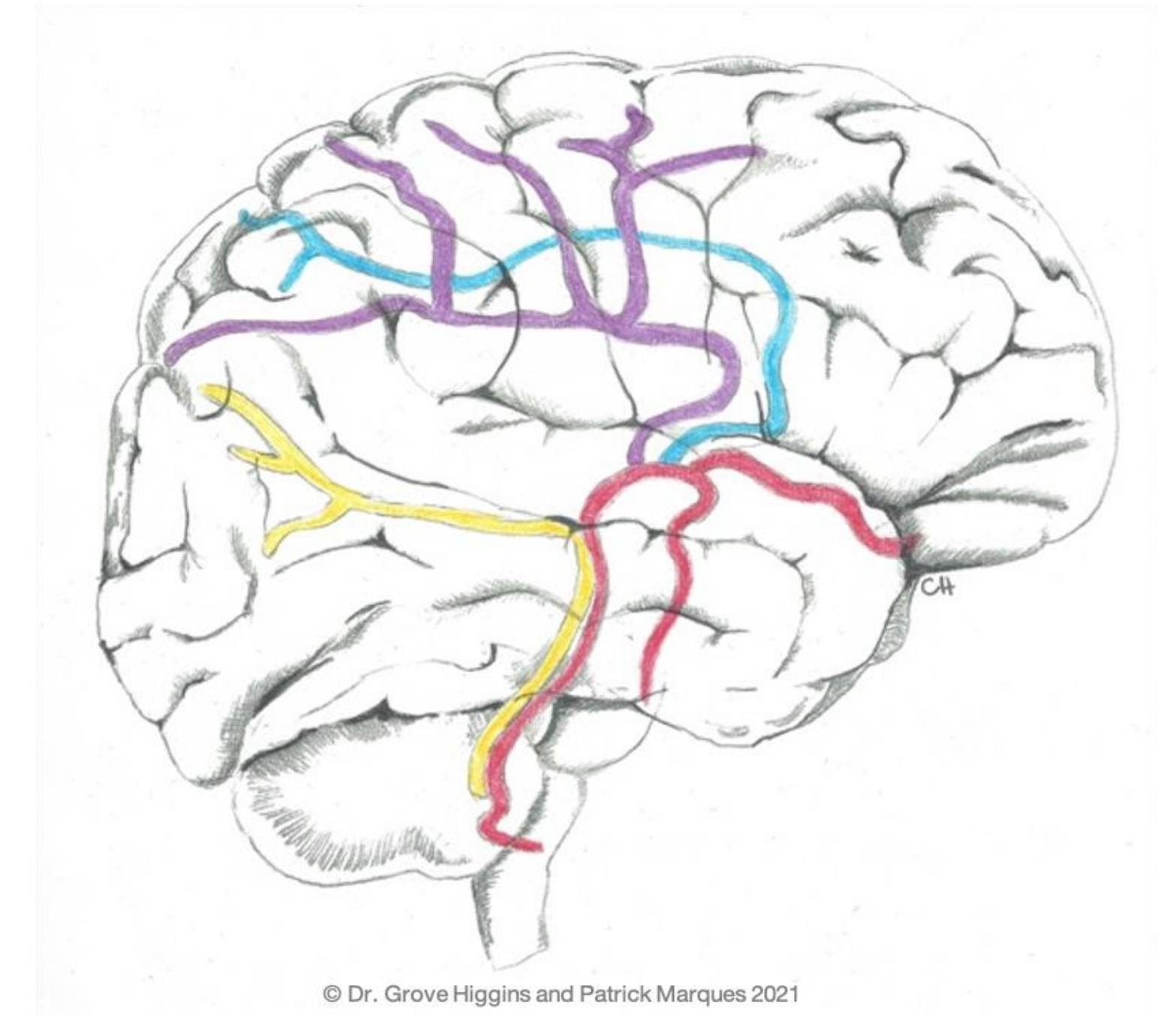
- ~2% of your bodyweight
 - Consumes ~25% of calorie intake
 - Primary fuel sources:
 - Glucose
 - Oxygen
- ~25% of each**
- 3 Strategies for keeping the brain fueled



Training Concepts - Fueling the Brain

1. Cardiorespiratory Exercise:

- **Increases blood flow, thus O₂ & glucose, to the brain**
- **Stimulates release of BDNF (neuroplasticity)**
- **Considerations:**
 - Safe, daily cardio outside of your sessions
 - Will vary for each survivor
 - Ensure they have medical professionals' consent and guidance (intensity & duration)
 - Pre-stroke fitness levels, now reduced
 - Contact their medical professionals when ready to advance



Training Concepts - Fueling the Brain

2. Breathing Mechanics:

- How do they breathe normally?
- Compromised breathing mechanics reduces overall oxygenation of the brain:
 - Short, shallow breathing
 - Mouth breathing at rest
 - Breathing “into the chest”
 - Poor rib expansion
 - Imbalance of O₂ and CO₂

“... Meta-analysis of four studies revealed that the maximum inspiratory pressure and maximum expiratory pressure **were significantly lower ($P < 0.00001$) in stroke patients** compared with healthy individuals...”

Respiratory Muscle Strength and Training in Stroke and Neurology: A Systematic Review

Ross D. Pollock*, Ged F. Rafferty, John Moxham, more...

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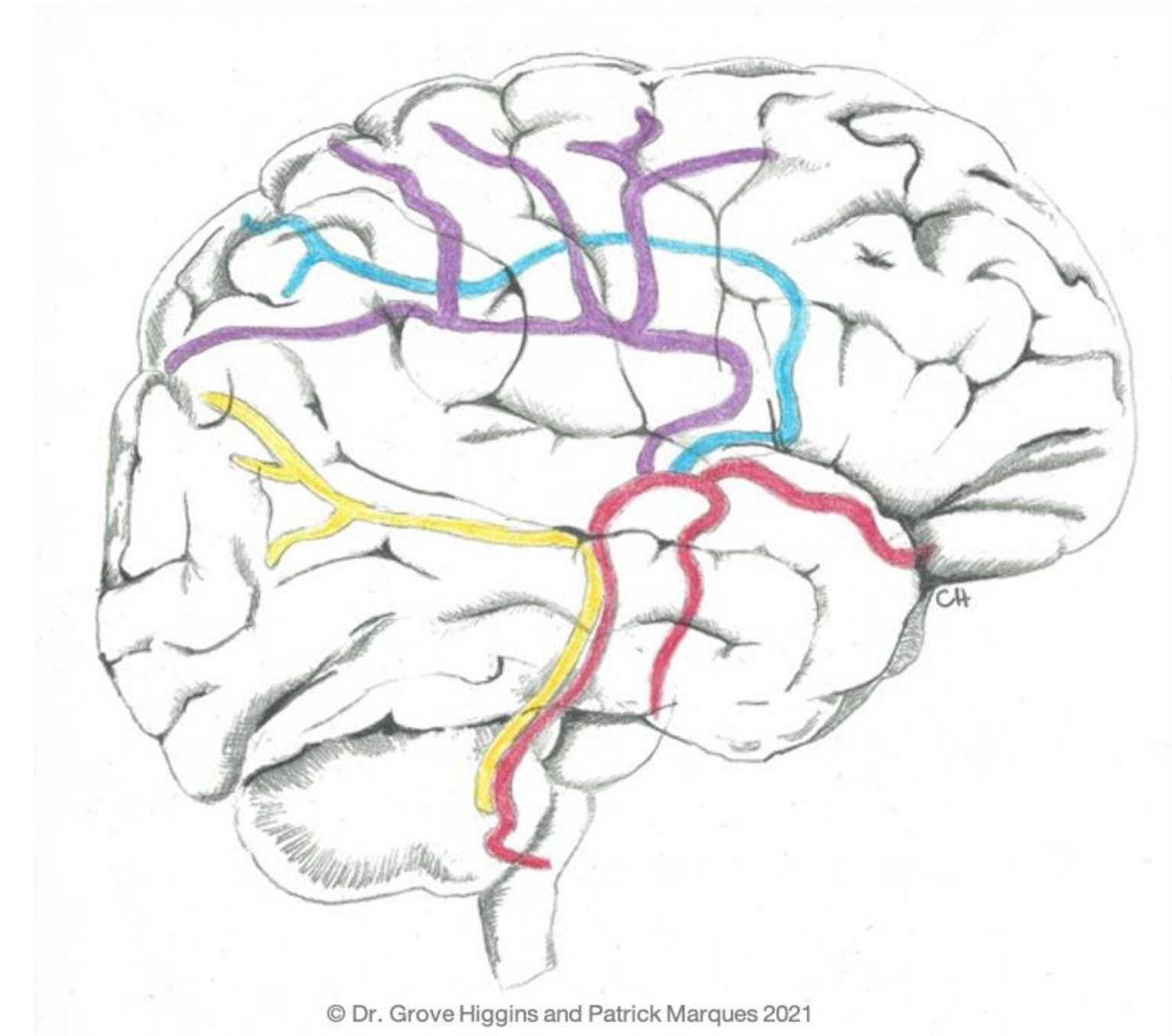
Abstract

We undertook two systematic reviews to determine the levels of respiratory muscle weakness and effects of respiratory muscle training in stroke patients. Two systematic reviews were conducted in June 2011 using a number of electronic databases. Review 1 compared respiratory muscle strength in stroke and healthy controls. Review 2 was expanded to include randomized controlled trials assessing the effects of respiratory muscle training on stroke and other neurological conditions. The primary outcomes of interest were maximum inspiratory and expiratory mouth pressure (maximum inspiratory pressure and maximum expiratory pressure, respectively). Meta-analysis of four studies revealed that the maximum inspiratory pressure and maximum expiratory pressure were significantly lower ($P < 0.00001$) in stroke patients compared with healthy individuals (weighted mean difference -41.39 and -54.62 cmH₂O, respectively). Nine randomized controlled trials indicate a significantly ($P = 0.0009$) greater effect of respiratory muscle training on maximum inspiratory pressure in neurological patients compared with control subjects (weighted mean difference 10.1 cmH₂O). Respiratory muscle strength training increased incidence of chest infection. Respiratory muscle strength in neurological conditions shows considerable variability between them is a limiting factor in muscle function in neurological conditions, but its

Training Concepts - Fueling the Brain

3. Increased glucose:

- **Brain demands a constant supply of glucose**
- **Primarily attained by recently eaten carbs**
- **Low end of glycemic index = steady supply**
- **Balanced diet**
- **Fuel before sessions w/ healthy carbs!**
- **Frontal lobe more sensitive to falling glucose levels**



Practical – Breathing Assessments

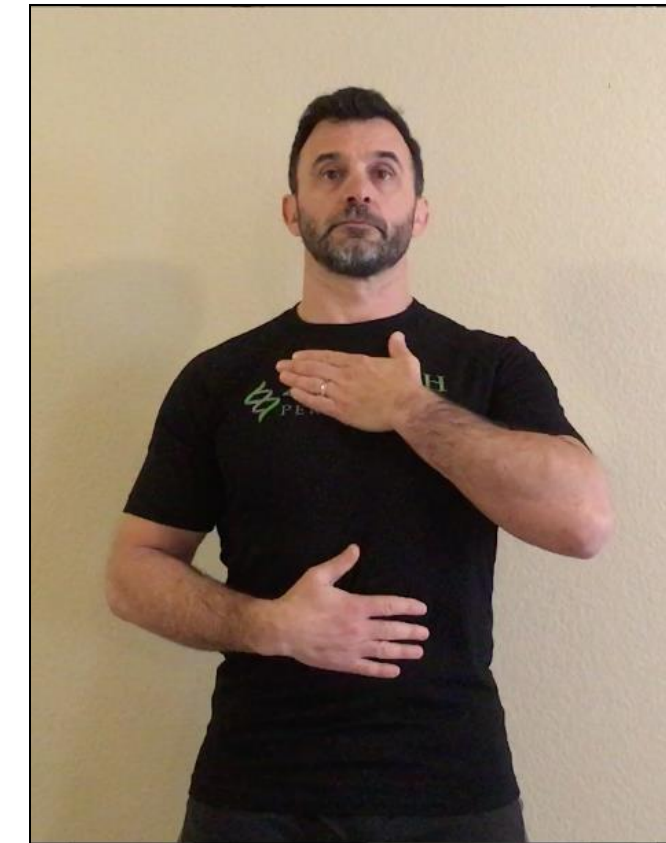
- **Ribcage Excursion:**



- **Looking for:**

- Lateral widening
- Thumbs expand
- Symmetry right vs. left:
 - One side move first, more, or only?

- **High/Low Test:**



- **Looking for:**

- Nasal or mouth inhalation?
- Upper or lower hand moves on inhale?

Practical – Breathing Training

- **Diaphragmatic Breathing:**



- **Focus on:**

- Nasal inhales
- 360° expansion
- “breath into your hands”

- **Variations:**

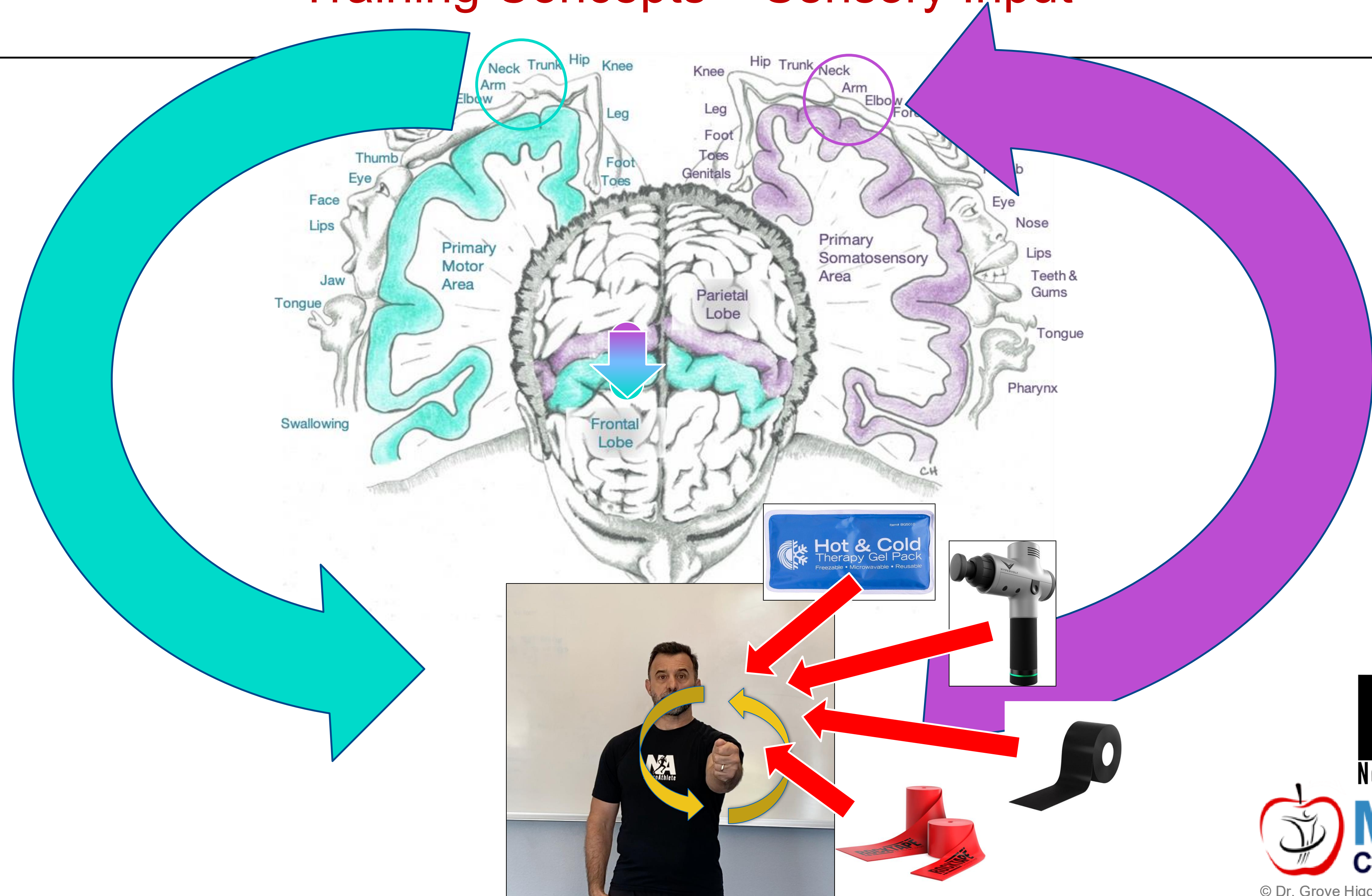
- Rotate towards side of dysfunction
- Banded

Training Concepts – Sensory Input

- **Primary Goal – Improve proprioception**
- **The brain's 3D Map for movement**
- **Why:**
 - Brain “sees” the area better
 - Informs the motor cortex for better movement
 - Improves spatial orientation
 - Pain reduction
- **How:**
 - Skin stimulation – hands / brush
 - Vibration – vibration tools
 - Temperature – hot/cold pack
 - Pressure – wraps / floss
 - Skin stretch – kinesiology tape

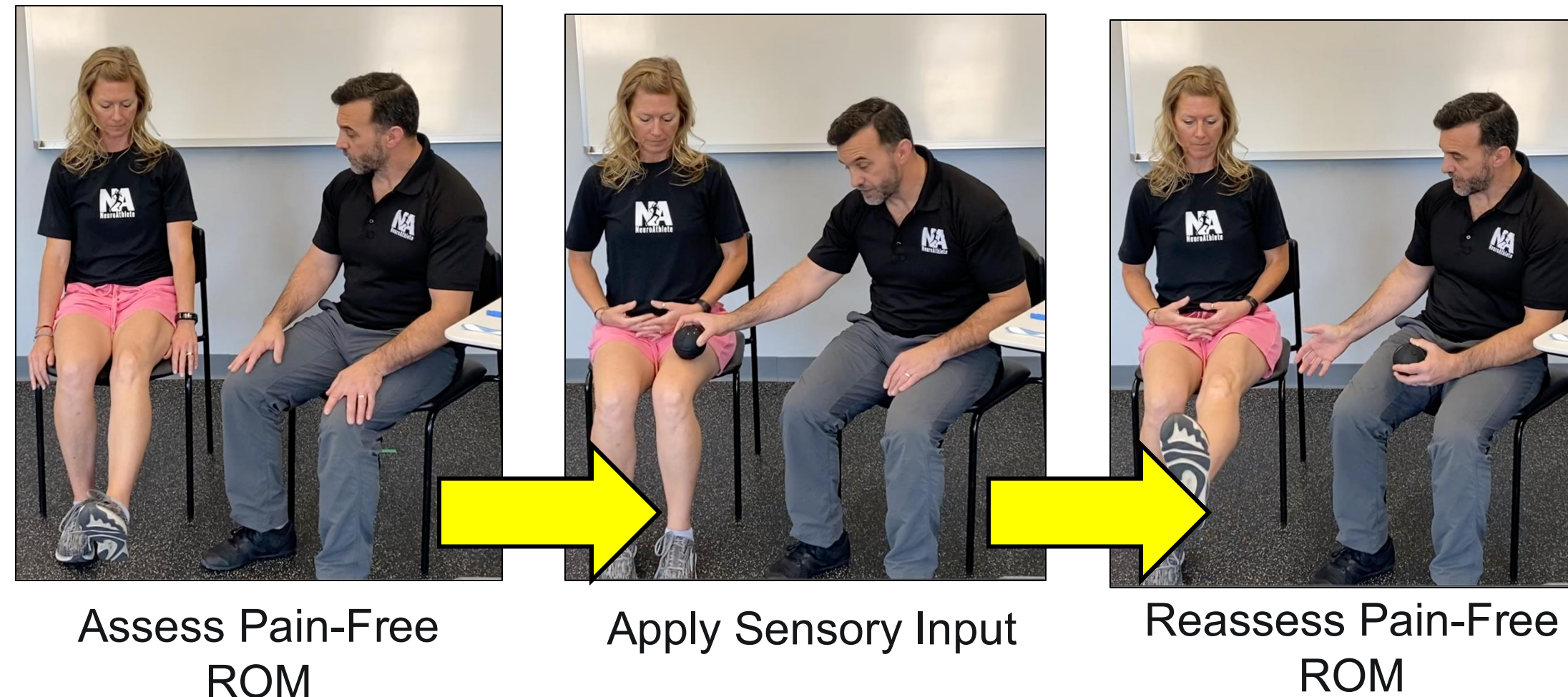


Training Concepts – Sensory Input



Practical – Sensory Input

- **Basic Process – Assess/Reassess Protocol:**



Types of Sensory Input:

- Skin stimulation – hands / brush
- Vibration – vibration tools
- Temperature – hot/cold pack
- Pressure – wraps / floss
- Skin stretch – kinesiology tape

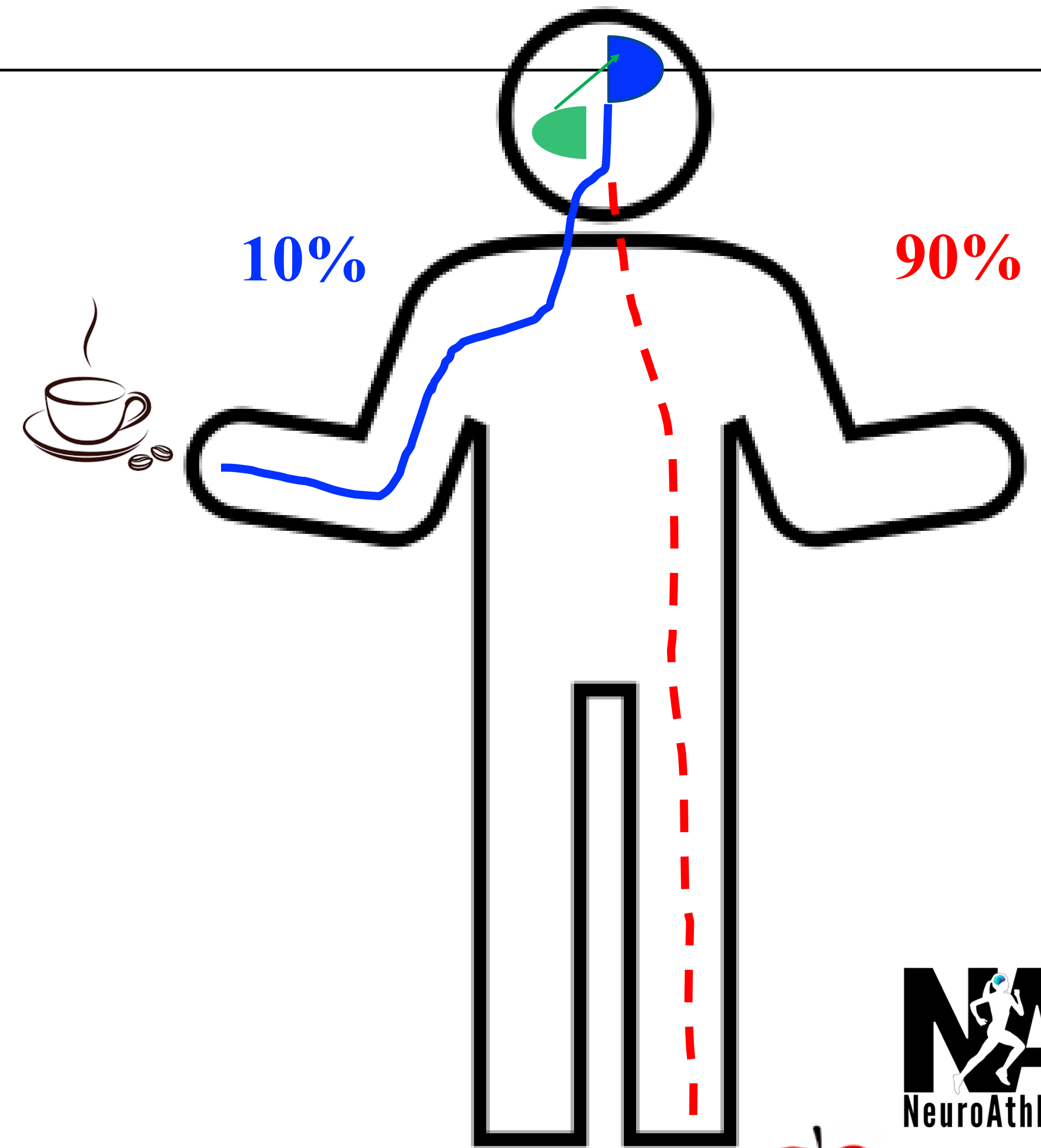
- **Could also assess lunge, squat, etc.**
- **Apply the sensory stimulus to:**
 - Muscles that perform the lost movement
 - Areas of pain

How to use:

- Before/during exercise
- Between sets
- At home

Training Concepts – Neurology of Movement

1. You decide to grab a cup of coffee with your **RIGHT** hand
2. The motor command comes from your **LEFT motor cortex** in the Frontal Lobe
3. Only about **10%** of the total neural signal crosses over to your **RIGHT side** to do the **volitional movement**
4. About **90%** of the total neural signal stays on your **LEFT side via the brainstem**, driving *reflexive stabilization* through muscles on the opposite side of the voluntary movement
5. The **RIGHT Cerebellum** tells the **LEFT cortex** the accuracy, balance, & coordination of the movements executed



Training Concepts - Neurology of Movement

- **Train both sides**
 - Do unaffected side first
 - Sends reflexive stabilization signal to dysfunctional side
- **May need to work proximal to distal**
- **General progressions of motor control training:**
 - Basic Motor Control training
 - External Targeting Motor Control training
 - Visual/Auditory Motor Control training



Practical – Motor Control Training

- **Motor Control Drill Progressions (shoulder abduction example):**



Basic



External Targeting



Visual/Auditory

How much/how often:

- Good starting point is 4-5 sets of 3-5 reps
- Increase reps and/or neuroplastic enhancers shown
- Reps at home

- **Enhancing Neuroplasticity:**

- Specificity: Train the specific dysfunctional movement
- Repetition: Come up w/ ways to do it at home
- Layering Input: Sensory input & visual/auditory stimulus
- Saliency: Make it a game
- Novelty: Add bands, isometrics, lasers, etc.
- Intensity: Add speed, cognitive aspects, stability, etc.

Training Concepts – Visual & Vestibular Integration

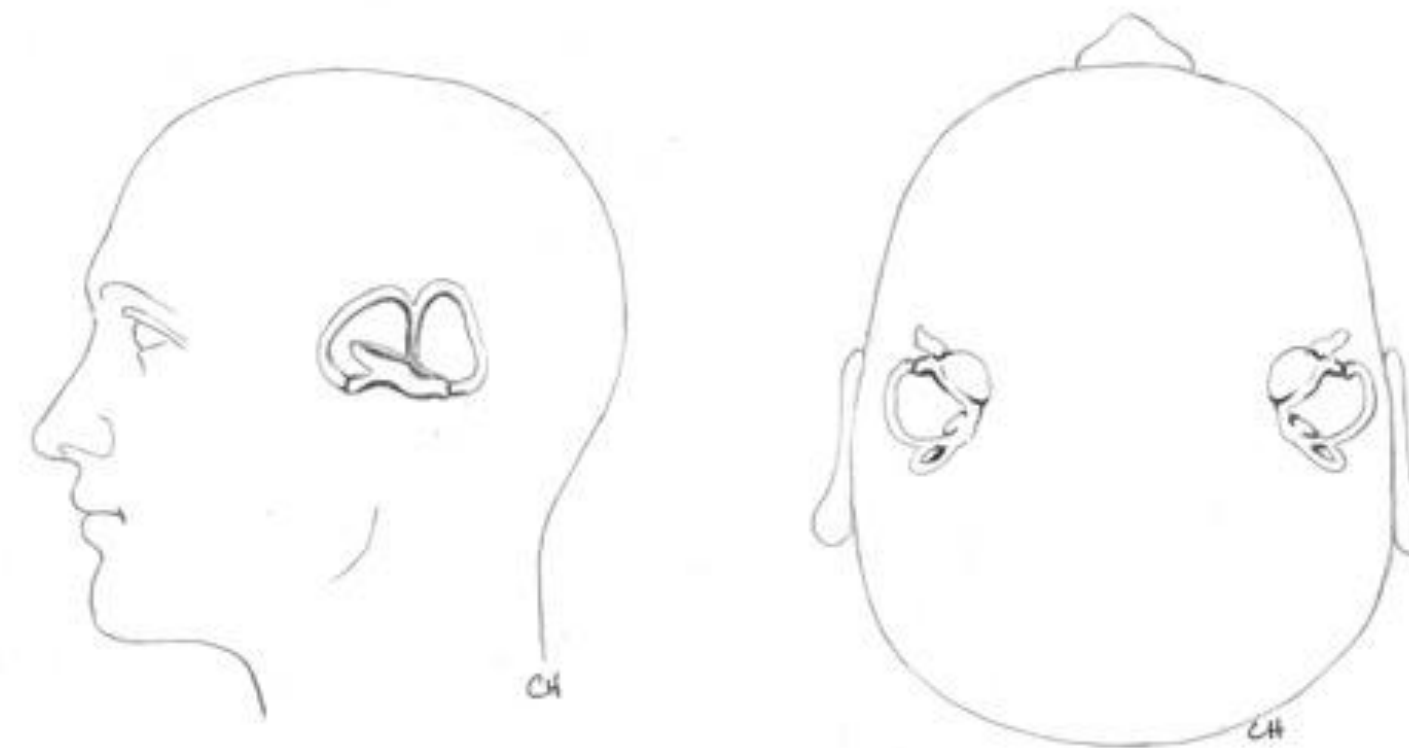
- **Vision:**

- Approximately 70% of all sensory information to the brain is visual
- 32 areas of the brain dedicated to vision
- The primary sensory input by which humans navigate the world



- **Vestibular:**

- Orients you to gravity; Answers:
 - “which way is up?”
 - “which way am I going?”
- Vestibular input drives extensor tone



Training Concepts – Visual & Vestibular Integration

- **If Job #1 of the brain is survival...**
- **Job #2 is... movement!**
- **We have 3 primary systems for movement**
- **Best analogy is a GPS**



The Three Input Systems for Good Movement

Vestibular (Inner Ear)

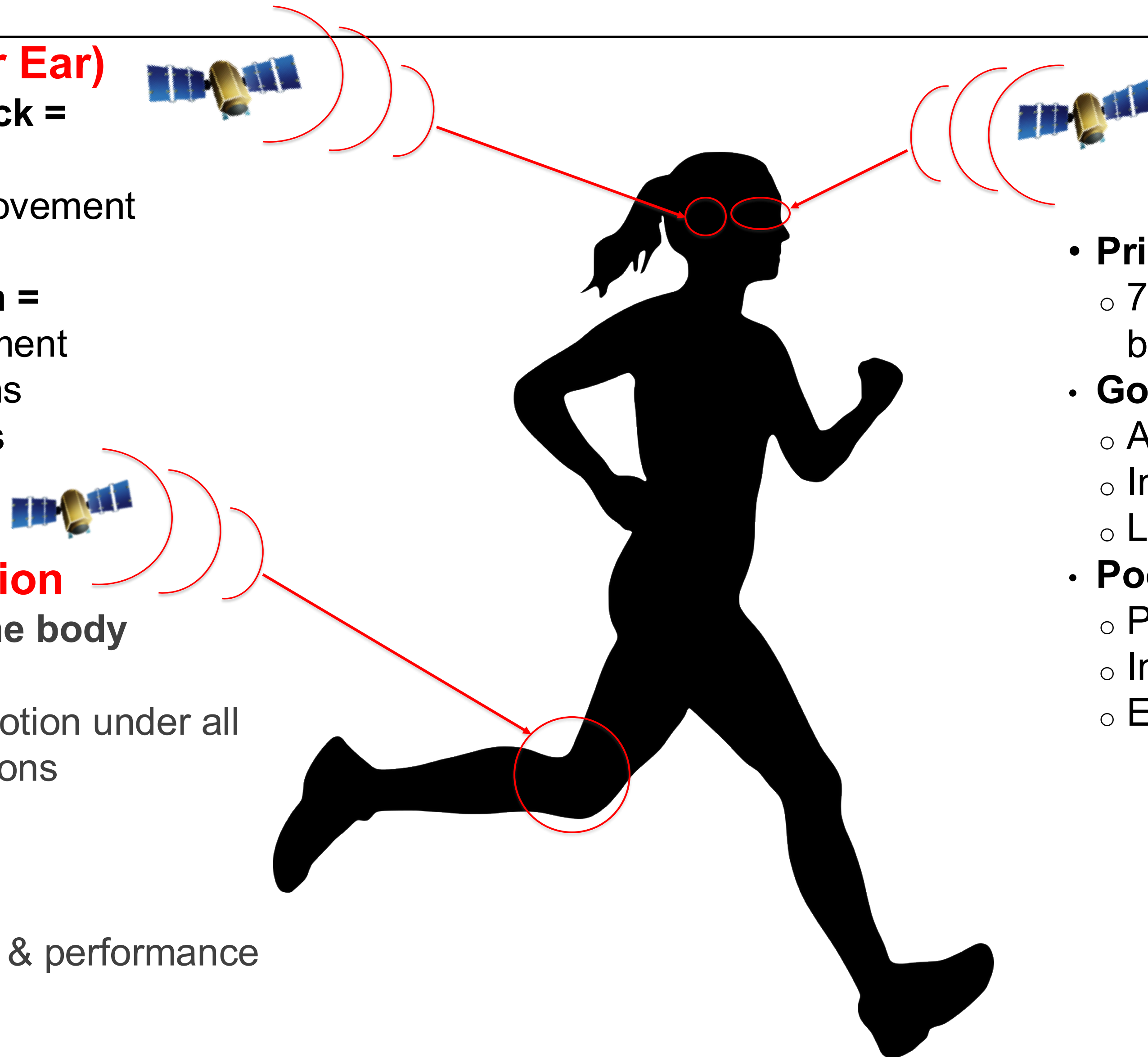
- **Good vestibular feedback =**
 - Good balance
 - Good stability during movement
 - Good reflexive posture
- **Poor vestibular function =**
 - Slow, inaccurate movement
 - Poor postural corrections
 - Postural compensations

Proprioception

- **The brain's 3D map of the body**
- **Good proprioception =**
 - Joints with full range of motion under all the loads, speeds & positions
- **Poor proprioception =**
 - Immobile joints
 - Increased risk of injury
 - Decreased biomechanics & performance
 - Pain

Vision

- **Primary source of information**
 - 70-80% of sensory input to your brain
- **Good vision =**
 - Accurate, fast movements
 - Increased awareness
 - Less stress
- **Poor vision =**
 - Poor movements
 - Increased stress levels
 - Even pain!



The Three Input Systems for Good Movement

Vestibular (Inner Ear)

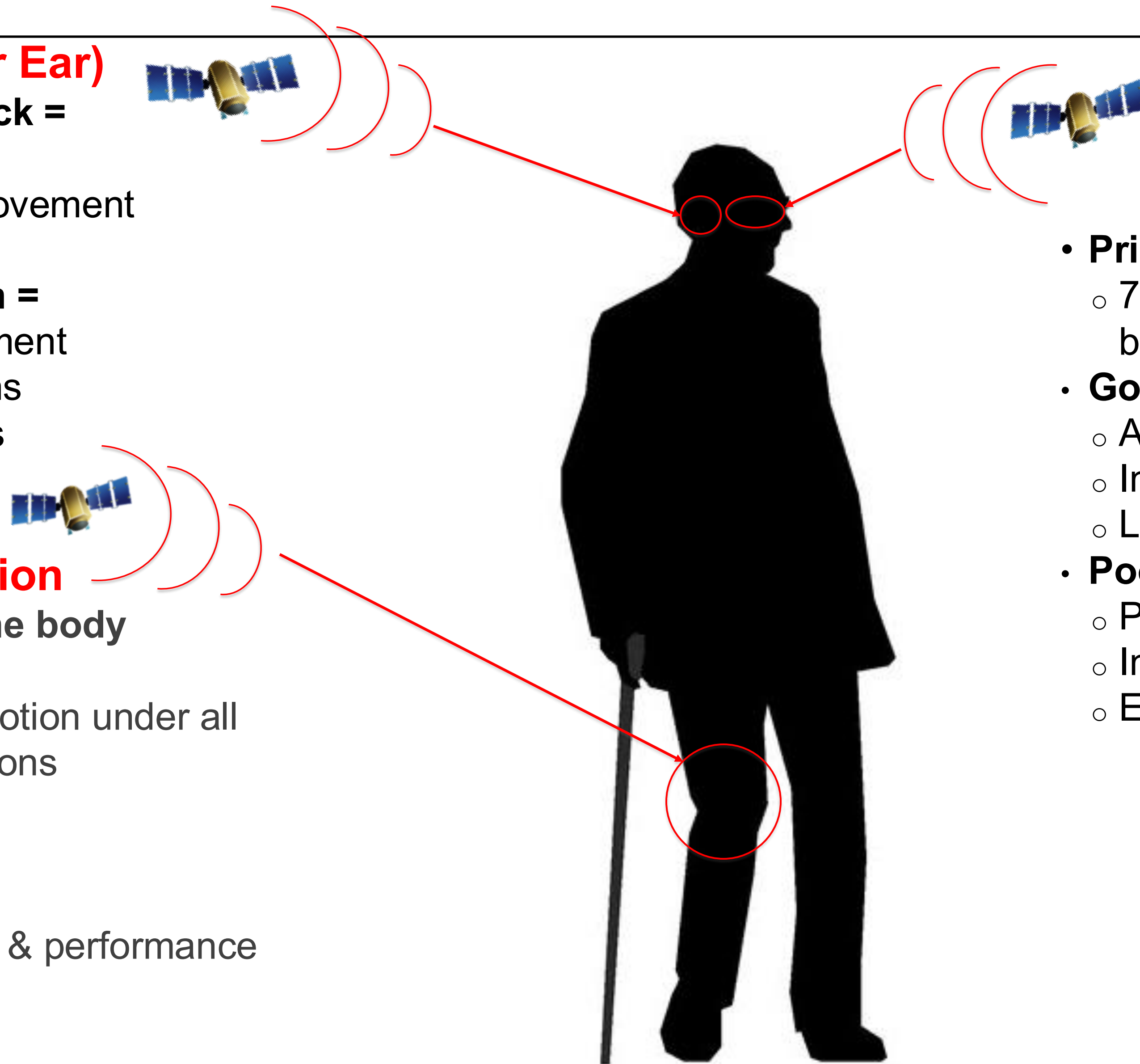
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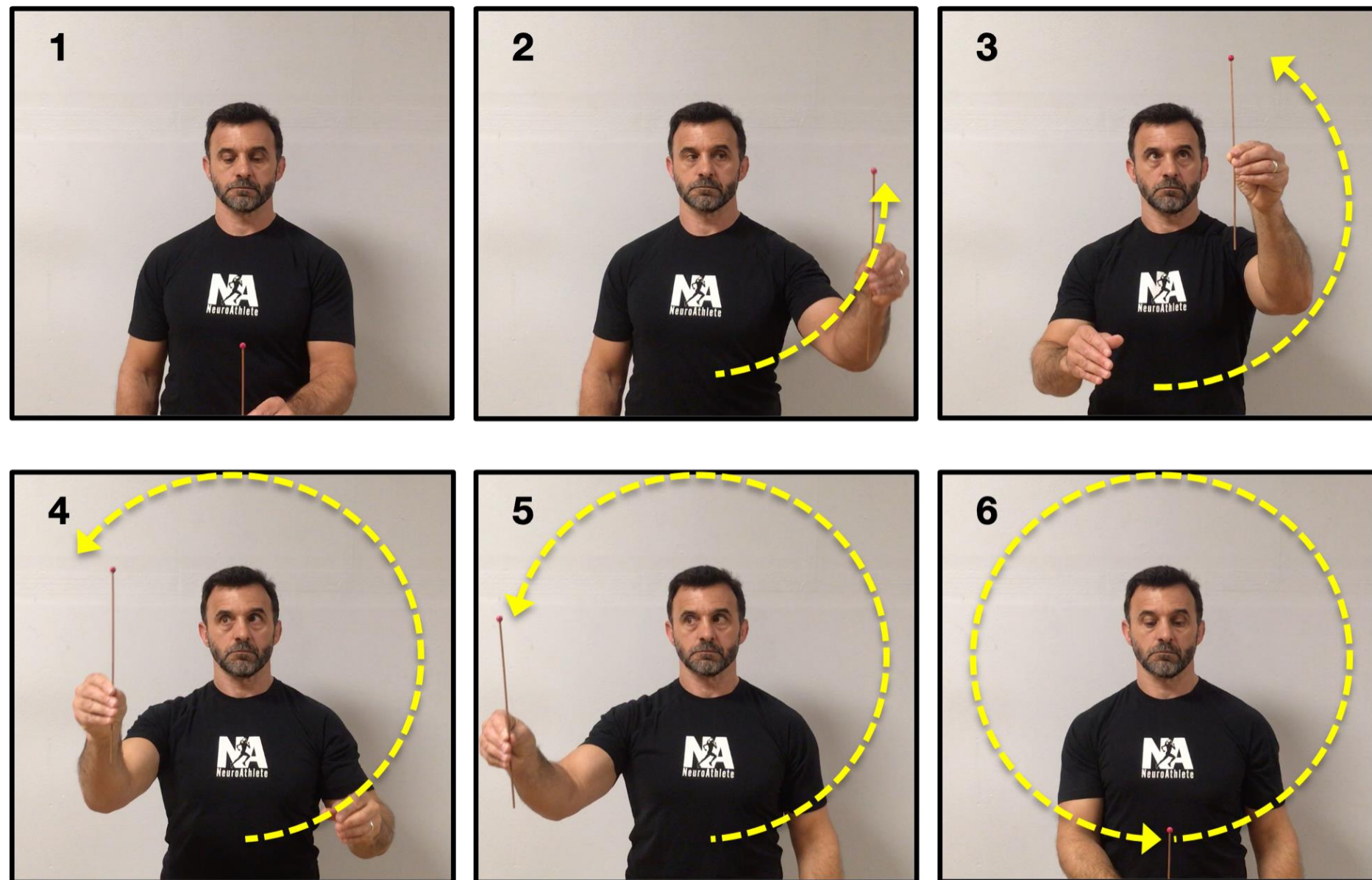
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Practical – Vision & Vestibular

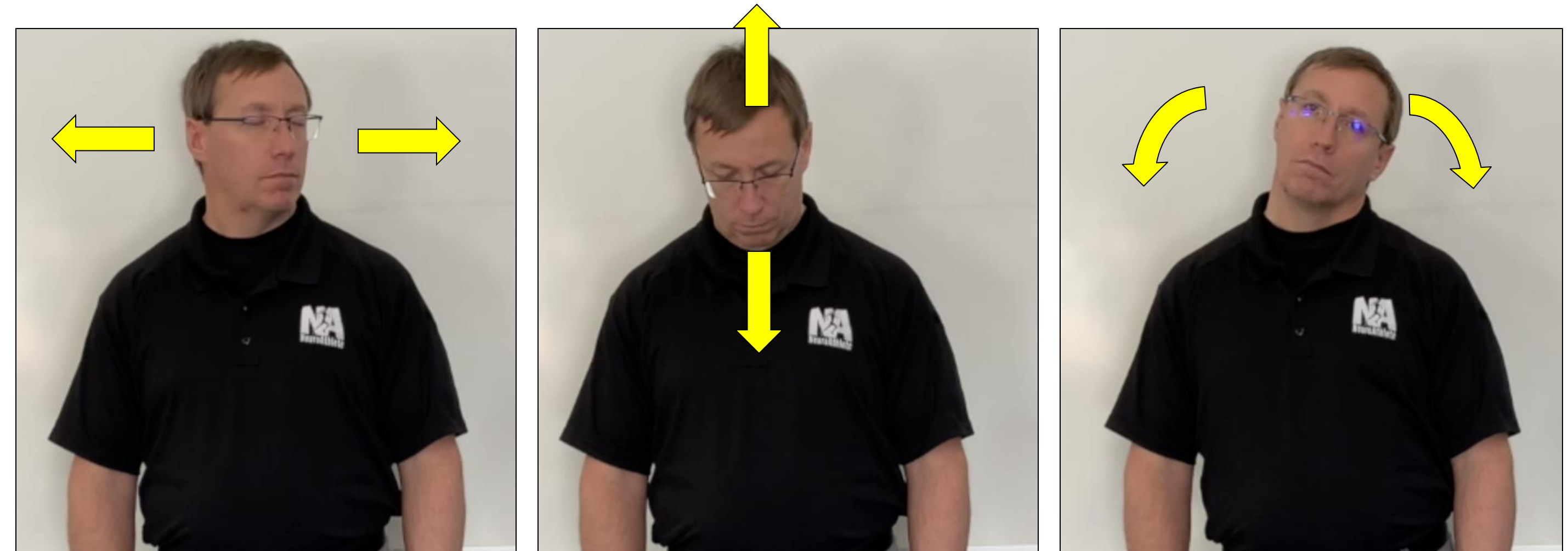
- **Eye Circles:**



- **Rules:**

- Head stays still
- Both eyes can see target
- 2 circles, both directions

- **Head Movements:**



Rotations

Nods

Tilts

- **Rules:**

- Shoulders still
- Challenging but safe stance
- 5 reps in each direction



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