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LIMITLESS

Don't Be Intimidated: Training the Stroke Survivor

PRESENTED BY

Dr. Grove Higgins & Pat Marques

# Introduction

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- **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



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# Agenda

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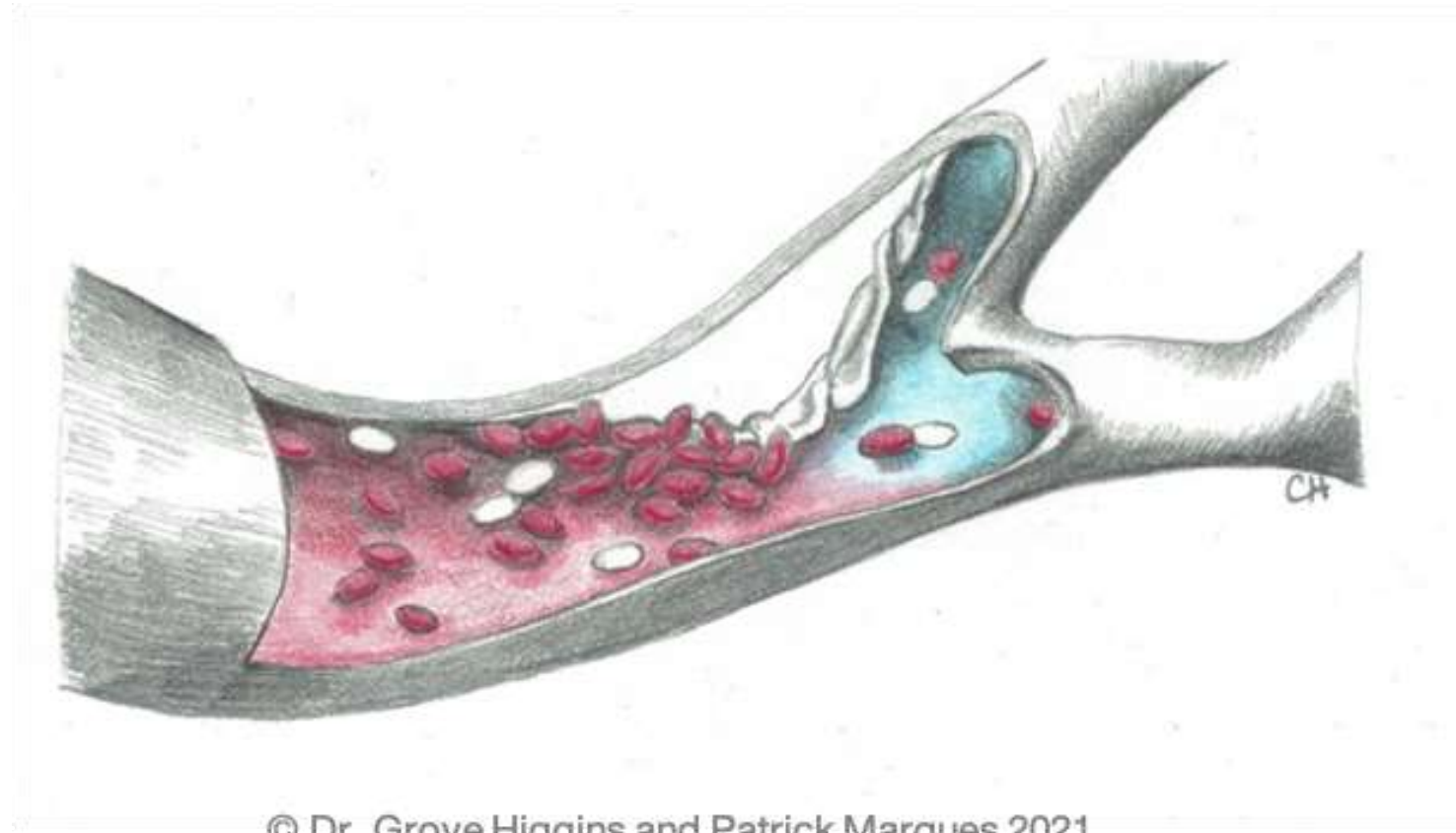
- **Stroke Basics & Key Aspects**
  - Definition & types
  - Statistics
  - Common dysfunctions
- **Important Concepts for Training the Stroke Survivor**
  - Neuroplasticity
  - Safety considerations
  - Fueling
  - Sensory input
  - Neurology of movement
  - Vision & vestibular integration



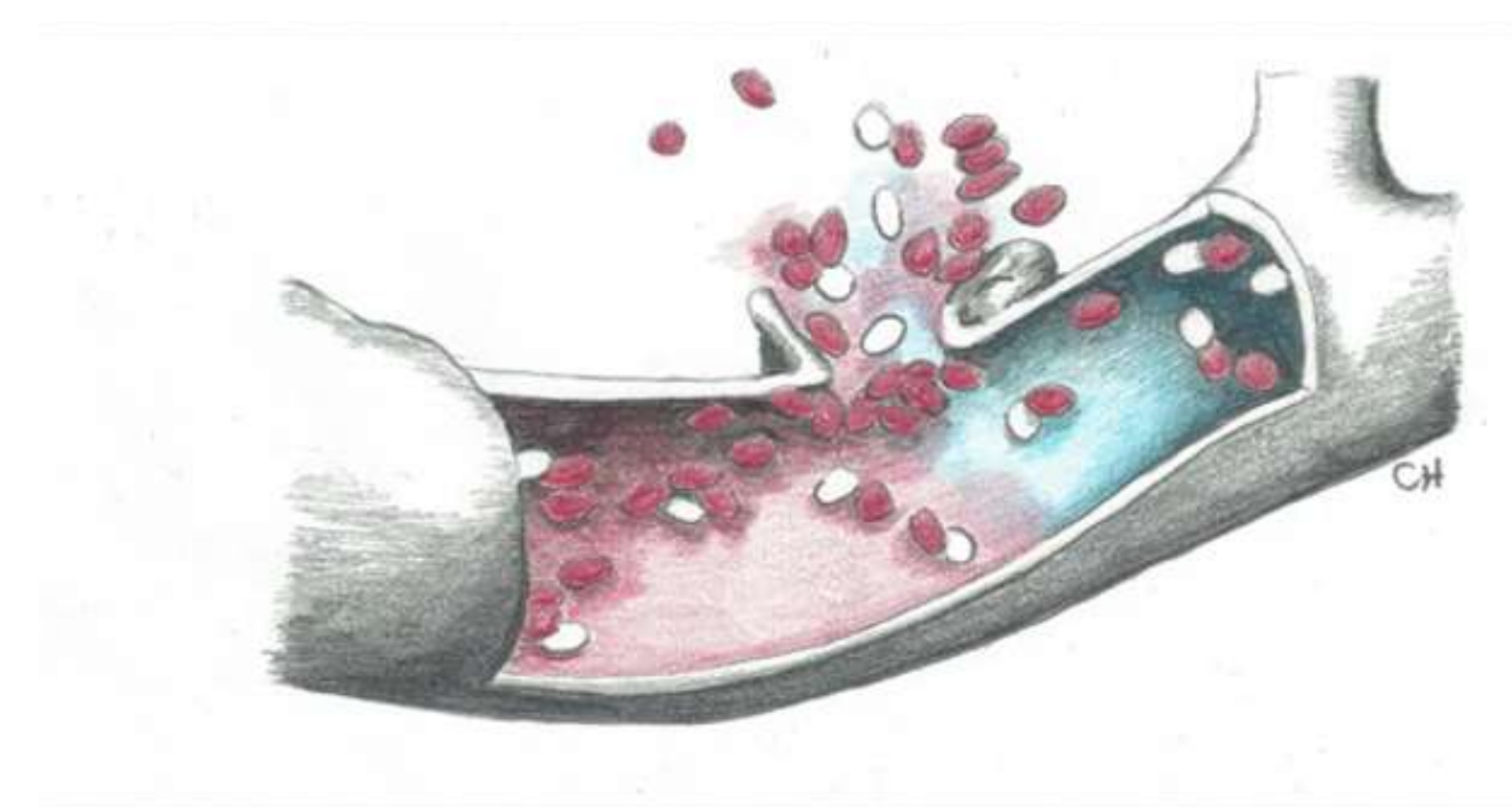
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# Definition & Types

- **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.



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

- **Hemorrhagic**

# Statistics

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- 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



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# Common Dysfunctions

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

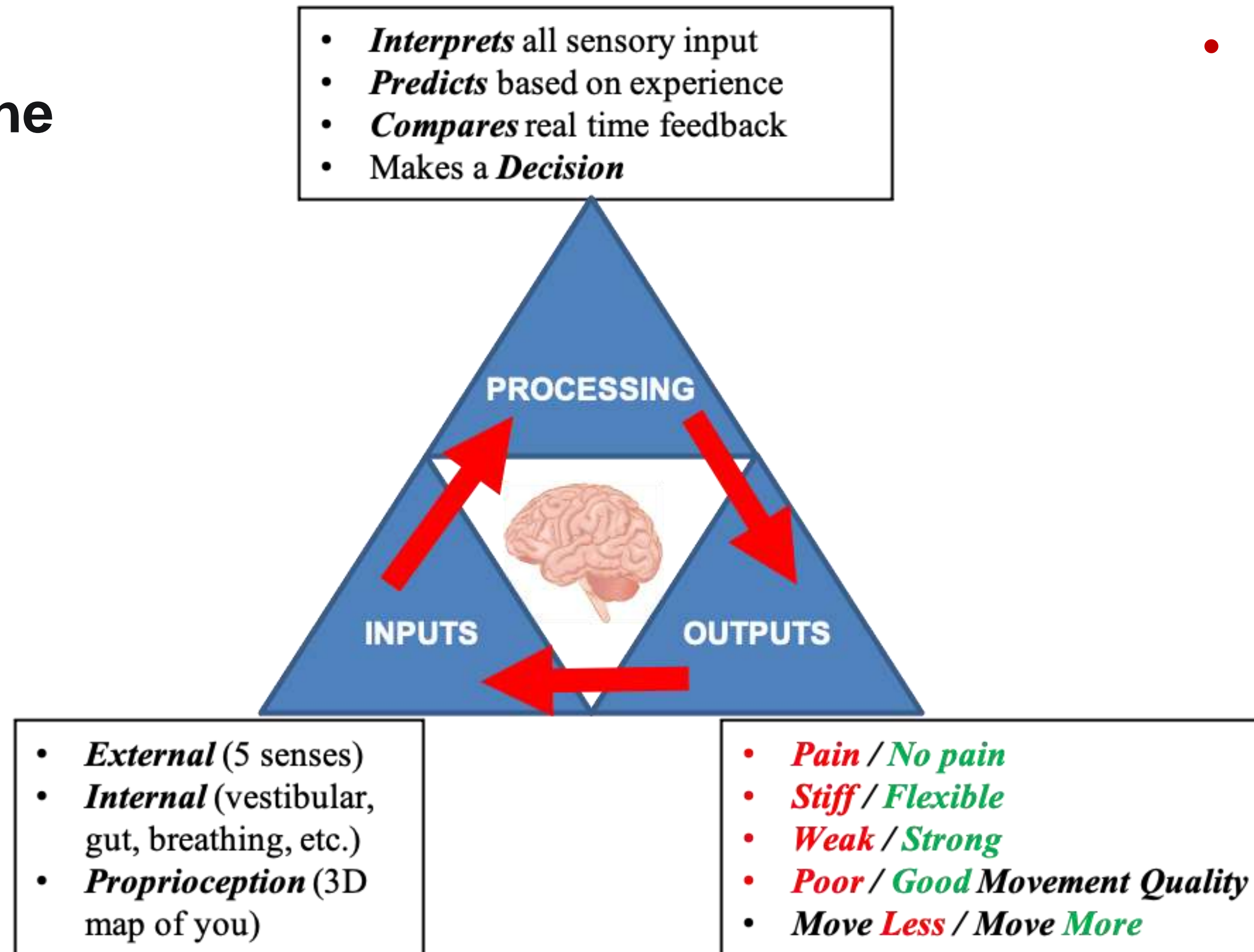
- Movement / coordination
  - Paralysis, spasticity, loss of fine motor
- Language
  - Difficulty using or understanding speech
- Cognition
  - Memory, attention span, planning
- Visual / Balance
  - Oculomotor, visual fields, visual neglect
- Sensory Impairments
  - Loss of sensation, pain



# 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

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# The Intimidation Factor

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- **Low energy / quick to fatigue**
  - Many tasks become more “cognitive”, thus more calorically expensive
  - Poor breathing mechanics = less O<sub>2</sub> 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



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# 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

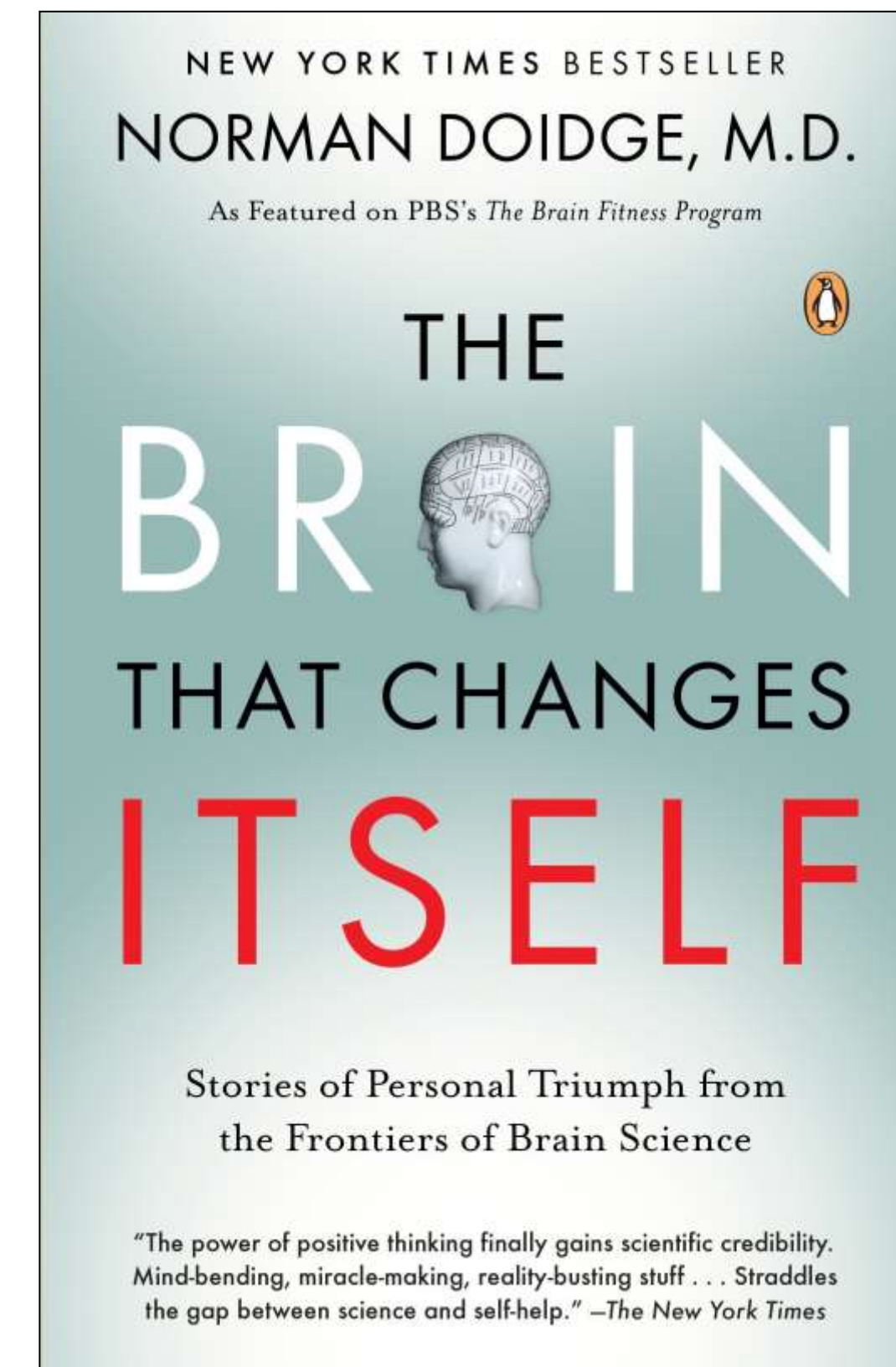


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# Why Neuroplasticity Matters

- **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



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# Practical Ways to Implement Neuroplasticity

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



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# Practical Neuroplasticity – Create the Stimulus for Change

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- **Calf raises don't make your biceps grow...**
- **This is the basis of Constraint Induced Therapy (CIT)**
- **What will get you to the end goal?**
  - Proximal to distal
- **A requirement for visual neglect as well**

**Specificity  
Principle**



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# Practical Neuroplasticity – The Repetition Requirement

- **Repetition is the currency of the brain!**
- **1 or 2 biceps curls will also not make your biceps grow...**
  - Must repeatedly present the stimulus
- **How much is enough?**
  - How many reps do great athletes do to perfect skills?
  - Recall the Phases of Motor Learning
  - Give ideas on how to get vast numbers each day!

Phase 1 (Cognitive) = 1-1000

Phase 2 (Associative) = 1000-10,000

Phase 3 (Autonomic) = 100,000 +



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# Practical Neuroplasticity – Laying Input for Synergistic Effect

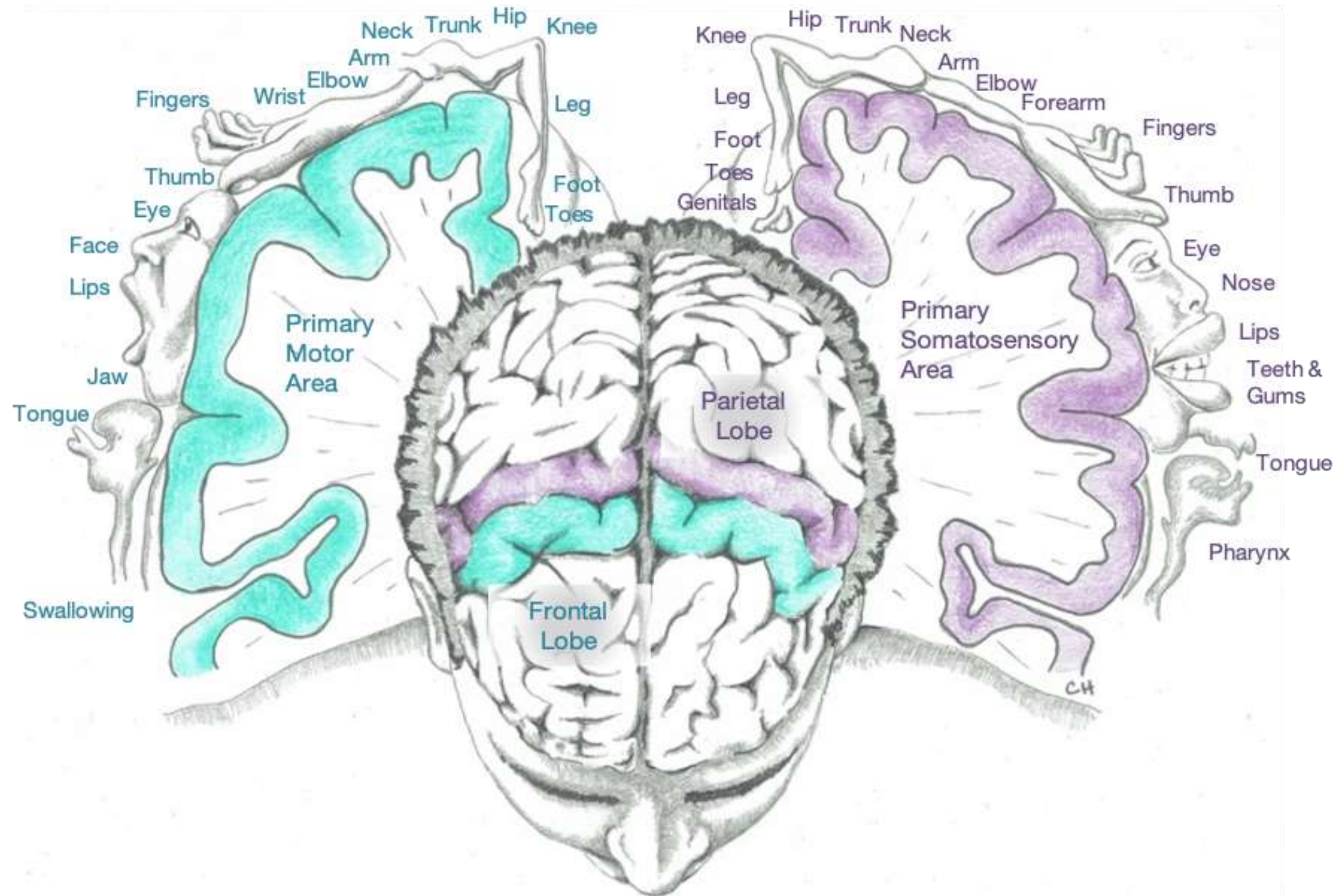
- **Stacking sensory input**

- Touch
- Vestibular
- Visual
- Motor control

- **Gotta test it first!**

- **Layer in phases or simultaneously**

- **Areas that wire together, fire together**



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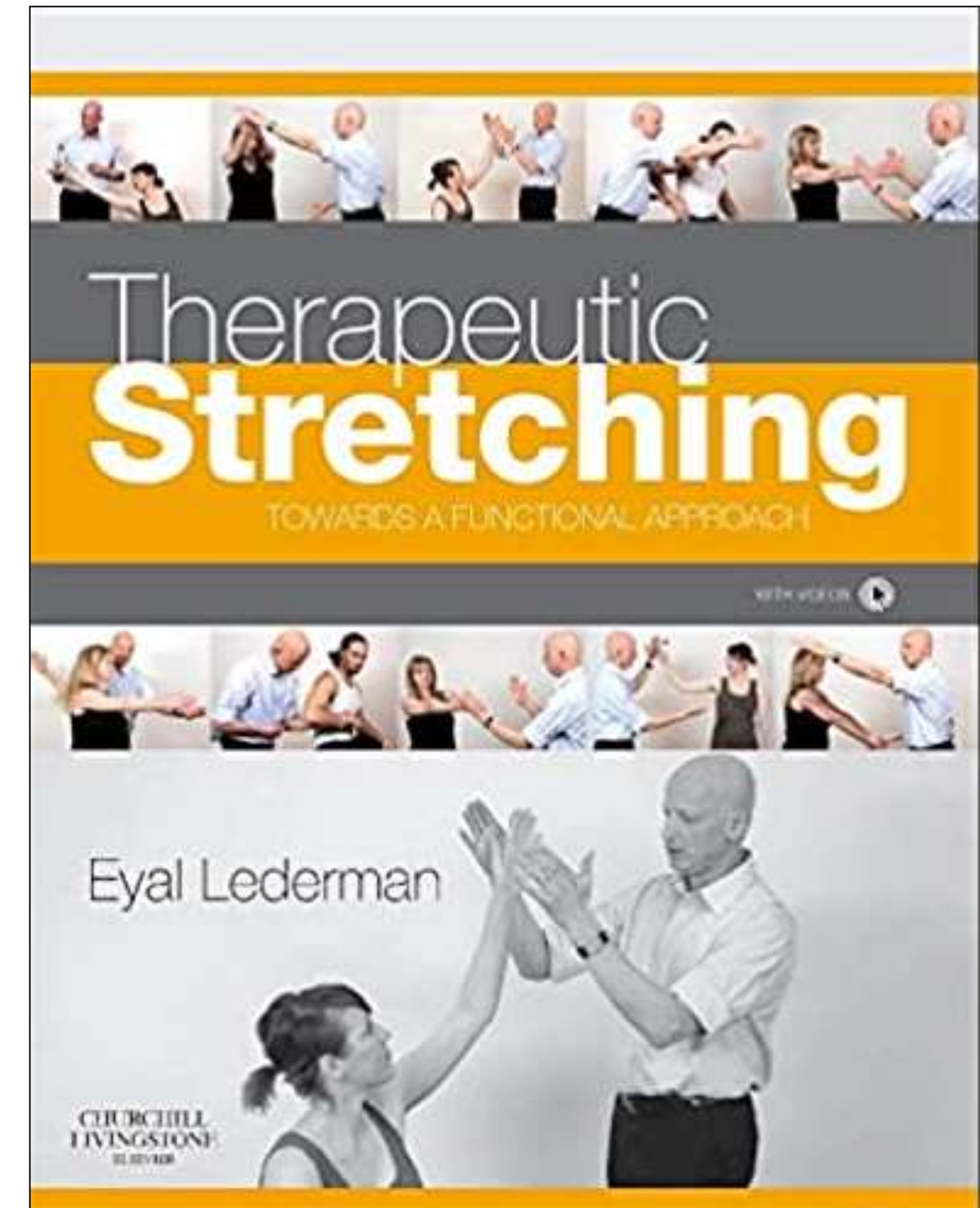


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# Practical Neuroplasticity – Make it Matter (Saliency)

- **Tied to their goals**
- **Show the relative value:**
  - “Toileting on your own means independence...”
  - “Improved grip will help you get back on the golf course...”
  - “Good balance means you can play with your grandchildren without fear of falling...”
- **The brain learns better when it is having fun**



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# Practical Neuroplasticity – Novelty

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- **Must balance with the Repetition Requirement**
- **Novel and varied stimulus increases neuroplastic change**
- **Learn the drill or exercise first, then stimulate in novel ways:**
  - Bands to create tension from different angles
  - Isometrics at the end ROM
  - Perform on different surfaces
  - Limb-mounted laser pointers for visual confirmation



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# Practical Neuroplasticity – Intensity

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- **Not just load in the traditional sense, but also:**
  - Range – a larger ROM increases intensity
  - Speed – faster increases intensity
  - Stability – smaller base of support increases intensity
  - Perturbation – disturbing the normal course of motion increases intensity
  - Cognitive requirements – stimulus-initiated movements or another cognitive task

***“The greater the load, the greater the learning”***

– Dr. Eric Cobb, Z-Health Performance Solutions



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# General Stimulation of Neuroplasticity

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## 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

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- **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?**

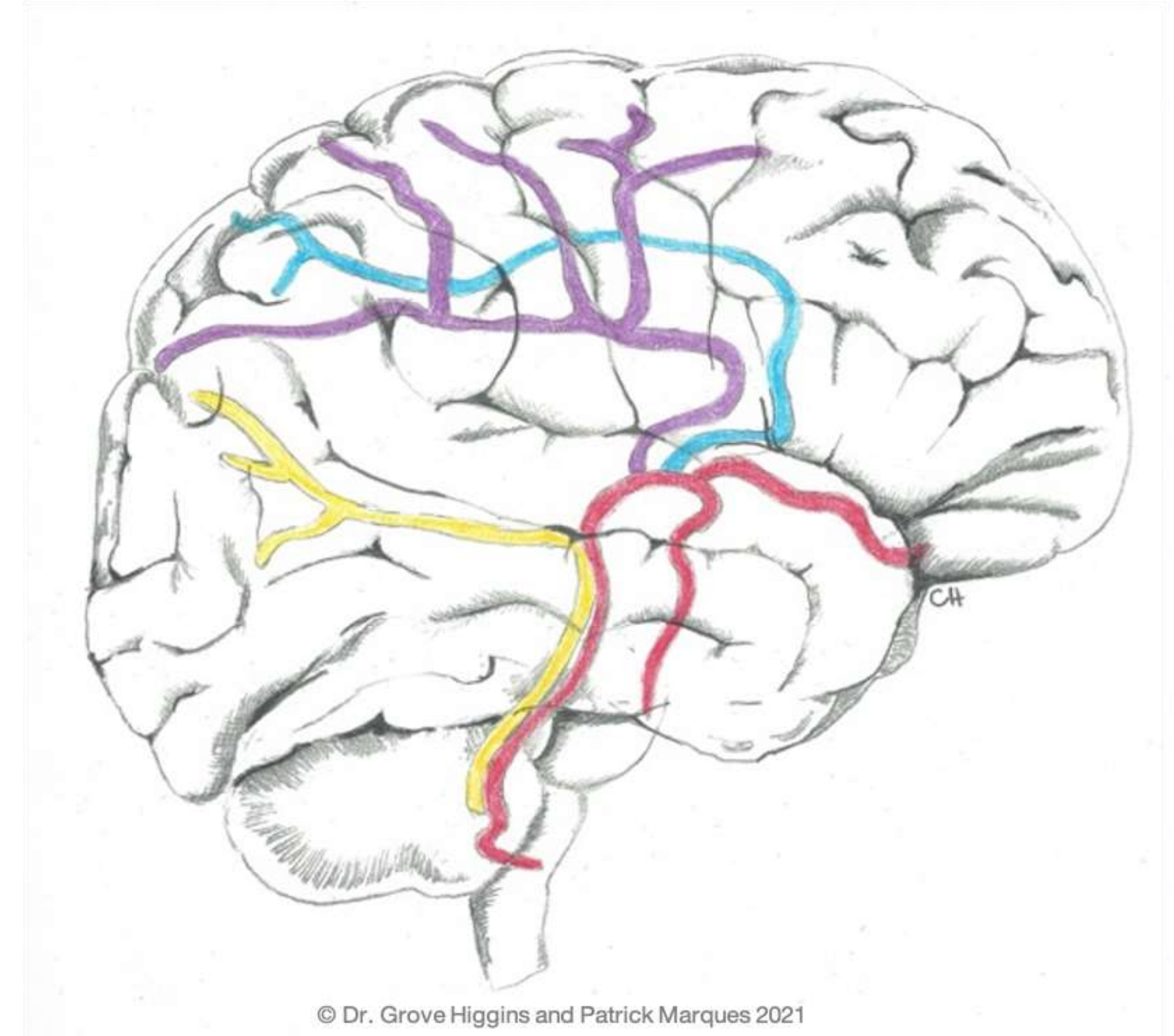


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# Training Concepts - Fueling the Brain

- **~2% of your bodyweight**
- **Consumes ~25% of calorie intake**
- **Primary fuel sources:**
  - Glucose
  - Oxygen

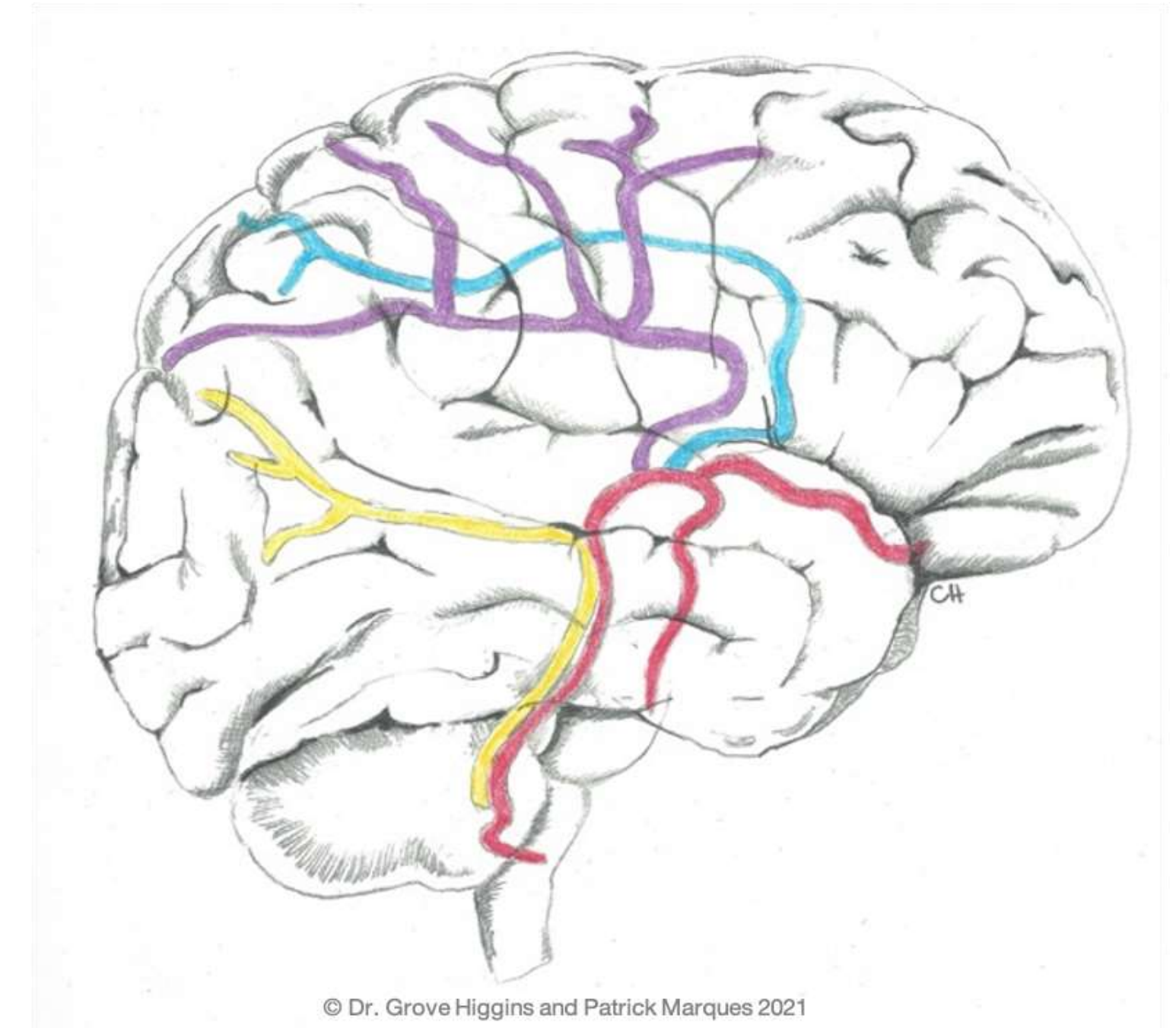
**~25% of each**
- **3 Strategies for keeping the brain fueled**



# Training Concepts - Fueling the Brain

## 1. Cardiorespiratory Exercise:

- **Increases blood flow, thus O<sub>2</sub> & 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



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# 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 O<sub>2</sub> and CO<sub>2</sub>

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

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

Show all authors

First Published May 9, 2012 | Review Article | Find in PubMed

Check for updates

<https://doi.org/10.1111/j.1747-4949.2012.00811.x>

Article information



#### 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  $-54.62$  cmH<sub>2</sub>O, 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  $1.39$  cmH<sub>2</sub>O). Respiratory muscle strength training increased incidence of chest infection. Respiratory muscle strength in neurological patients shows considerable variability between them is a limiting factor in muscle function in neurological conditions, but its

“... 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...”



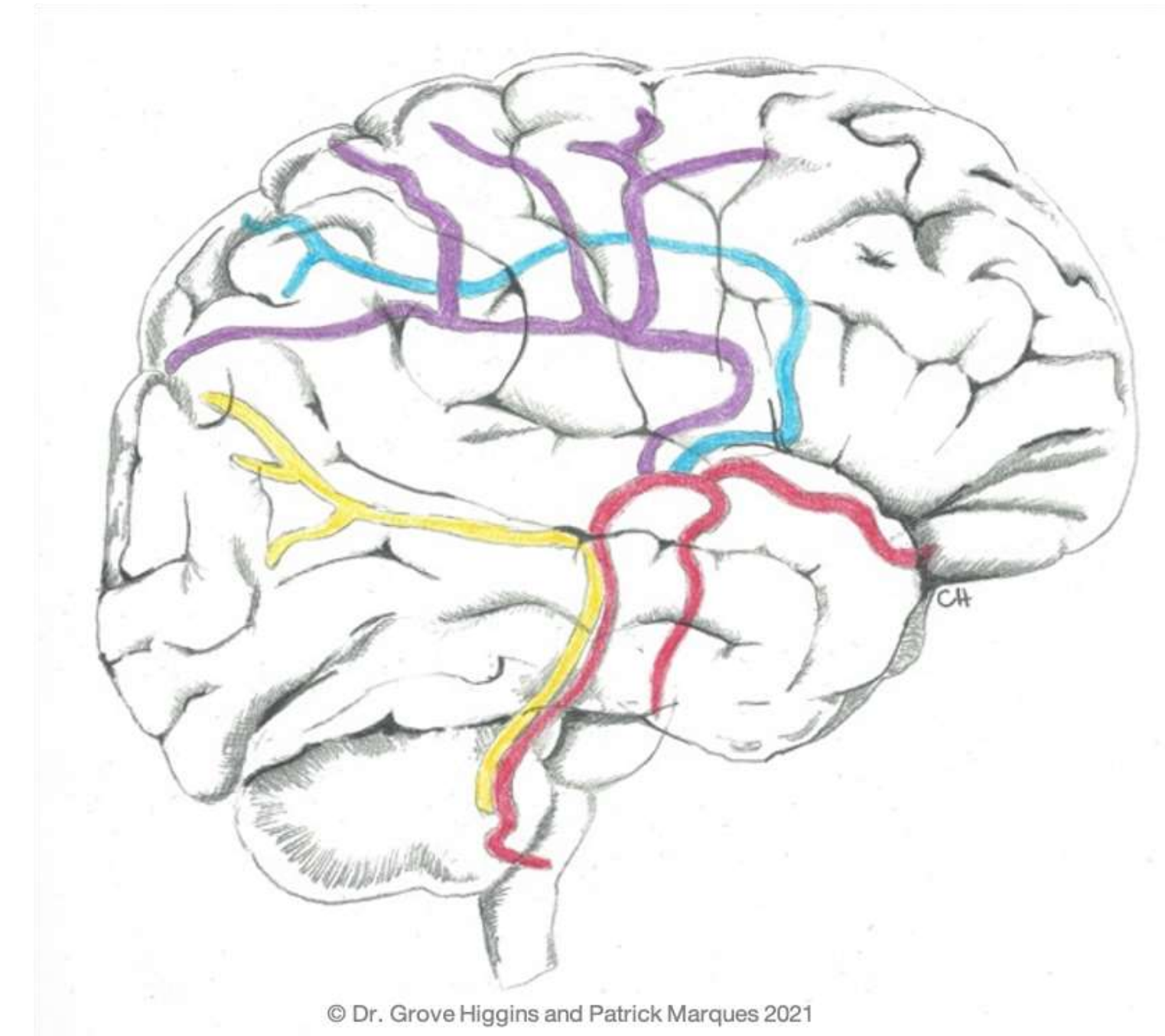
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# Training Concepts - Fueling the Brain

## 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**



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# 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

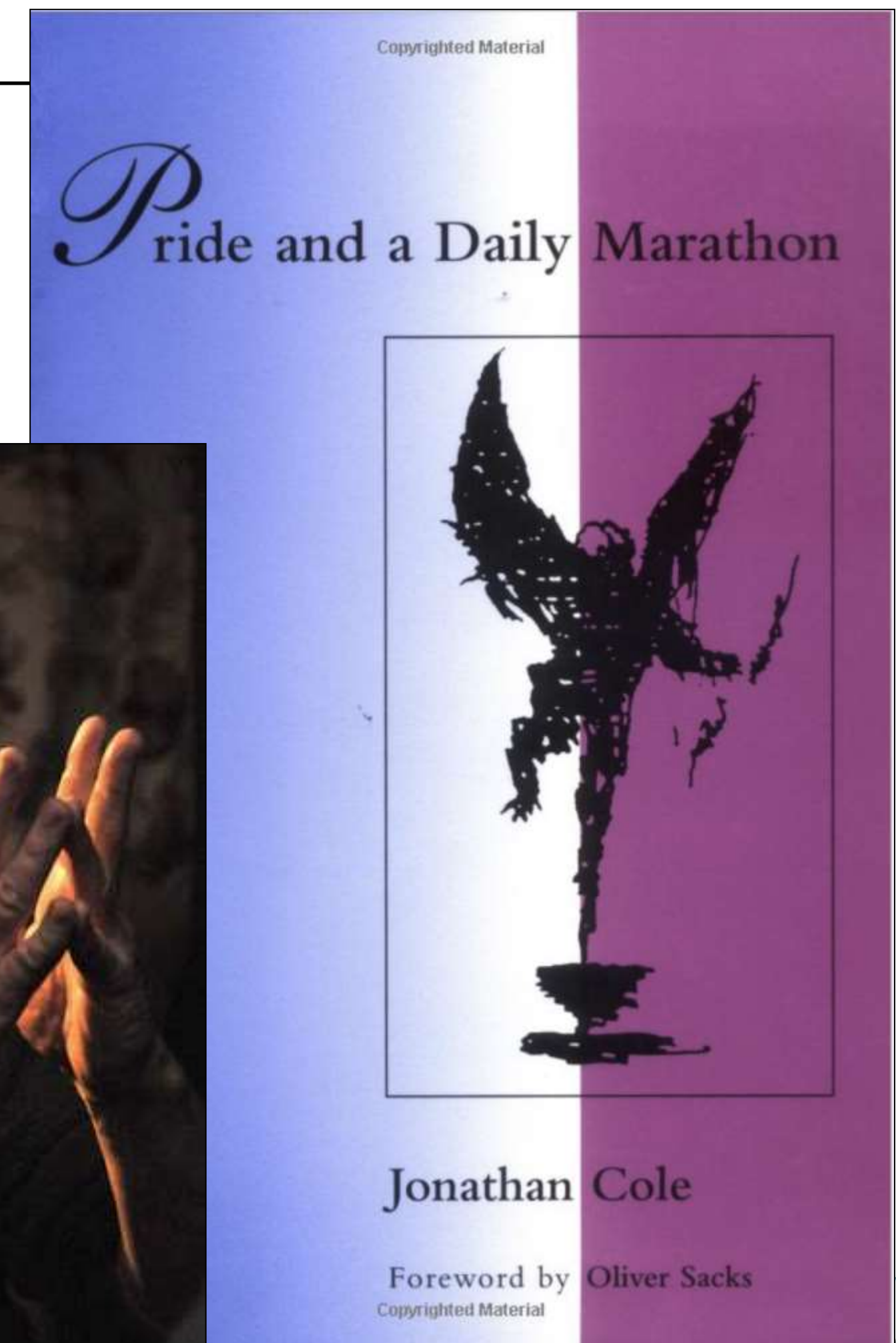
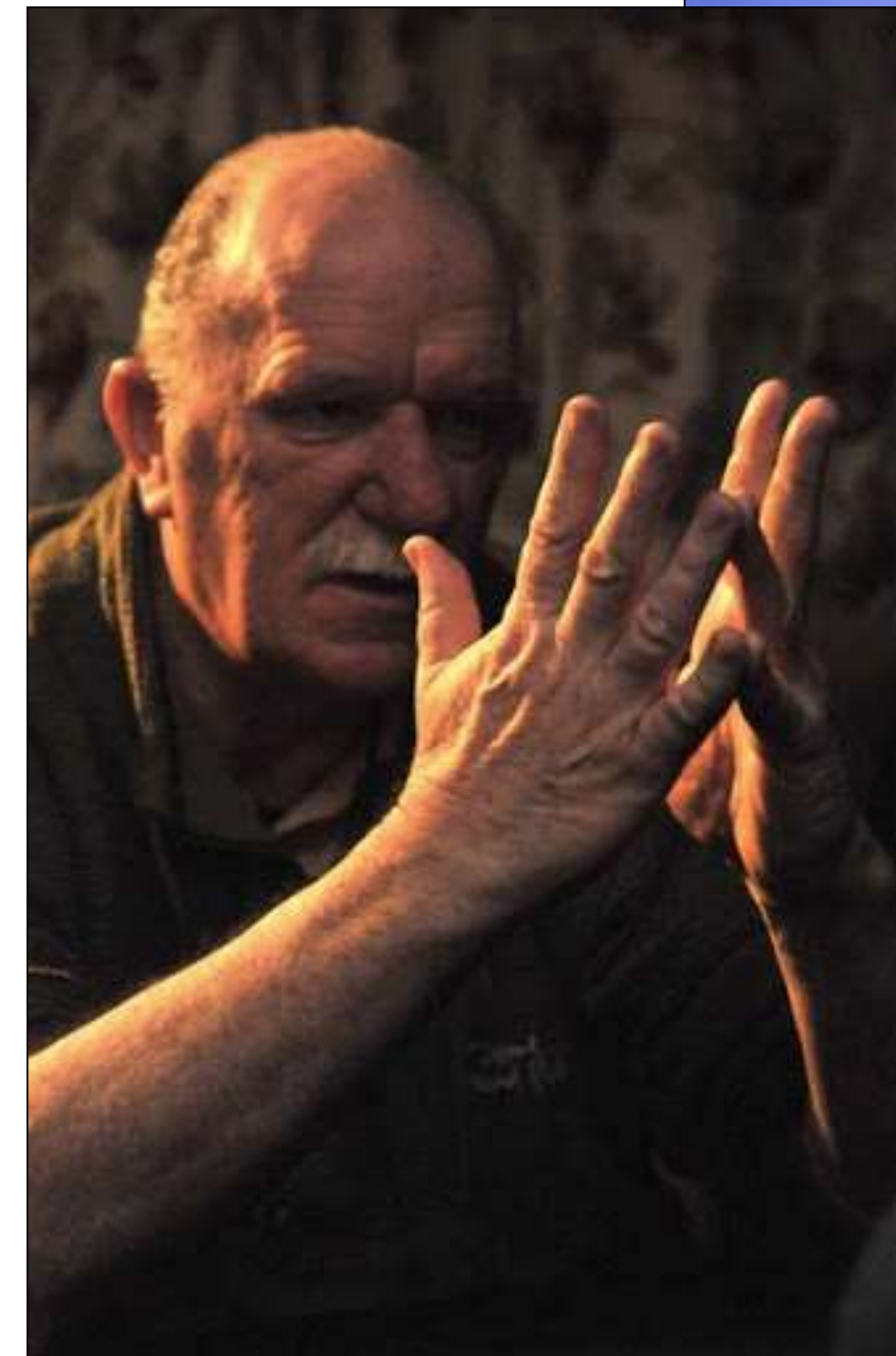
# Training Concepts – Sensory Input

“Though still able to feel temperature and pain and with normal movement or motor nerves, he lost – permanently – all touch and sense of movement and position sense below the neck.

Without seeing where his body was, he had no idea where it was. And ***without peripheral feedback from the limbs, his movement brain could not coordinate movement.*** He could not move in a controlled way at all and was effectively paralyzed not by weakness but by an absence of any ability to make an ordered movement.

He learnt after a few weeks that ***if he looked at, say, his arm and thought about moving it then it could move,*** but that the mental effort to do this was huge.”

<http://www.thearticulatehand.com/ian.html>



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# Training Concepts – Sensory Input

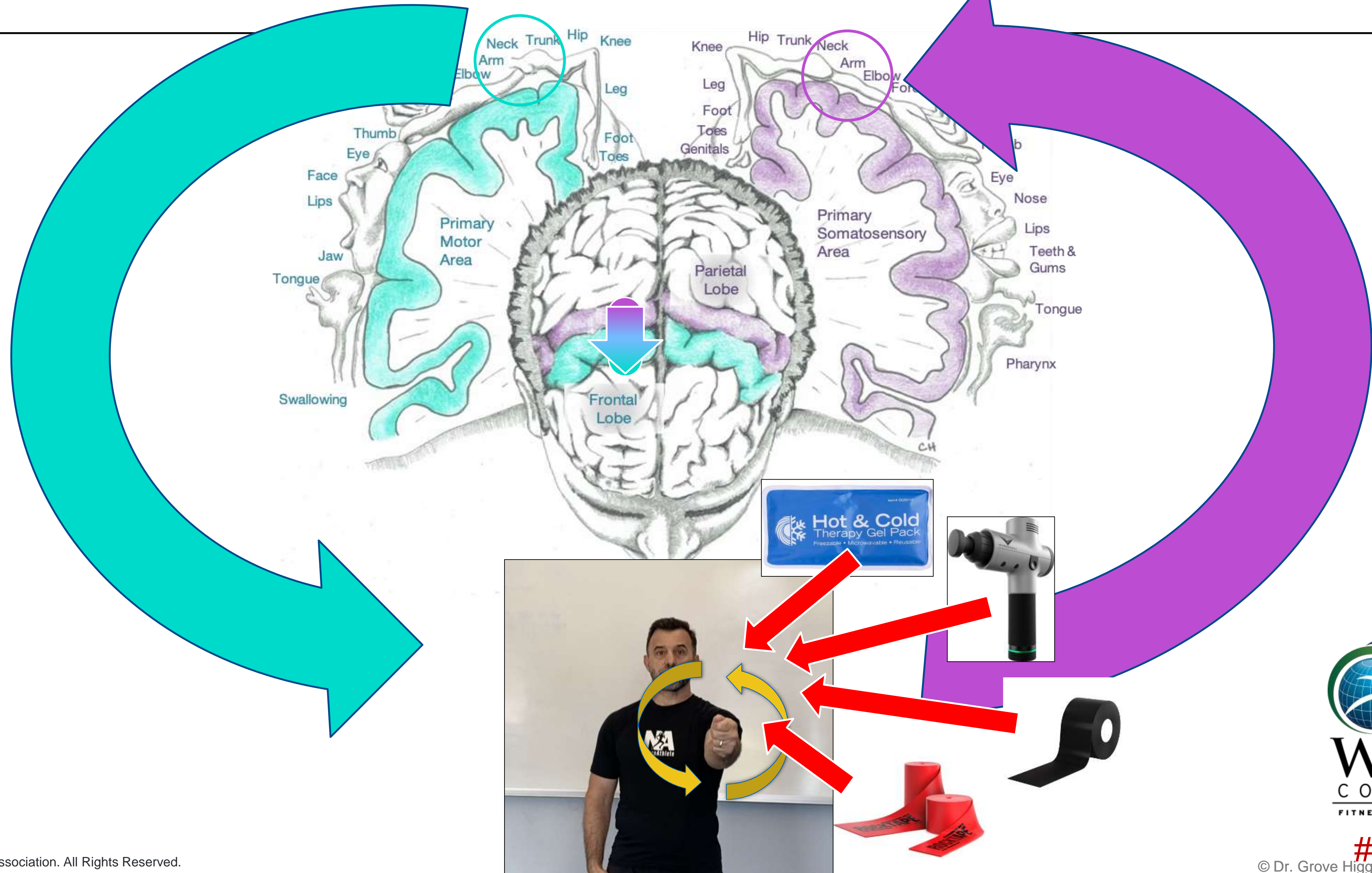
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- **Primary Goal – Improve proprioception**
- **The brain’s 3D Map for movement**
- **Why:**
  - Brain “sees” the area better
  - Informs the motor cortex for better movement
  - Improves spatial orientation
  - Pain reduction
- **How:**
  - Skin stimulation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



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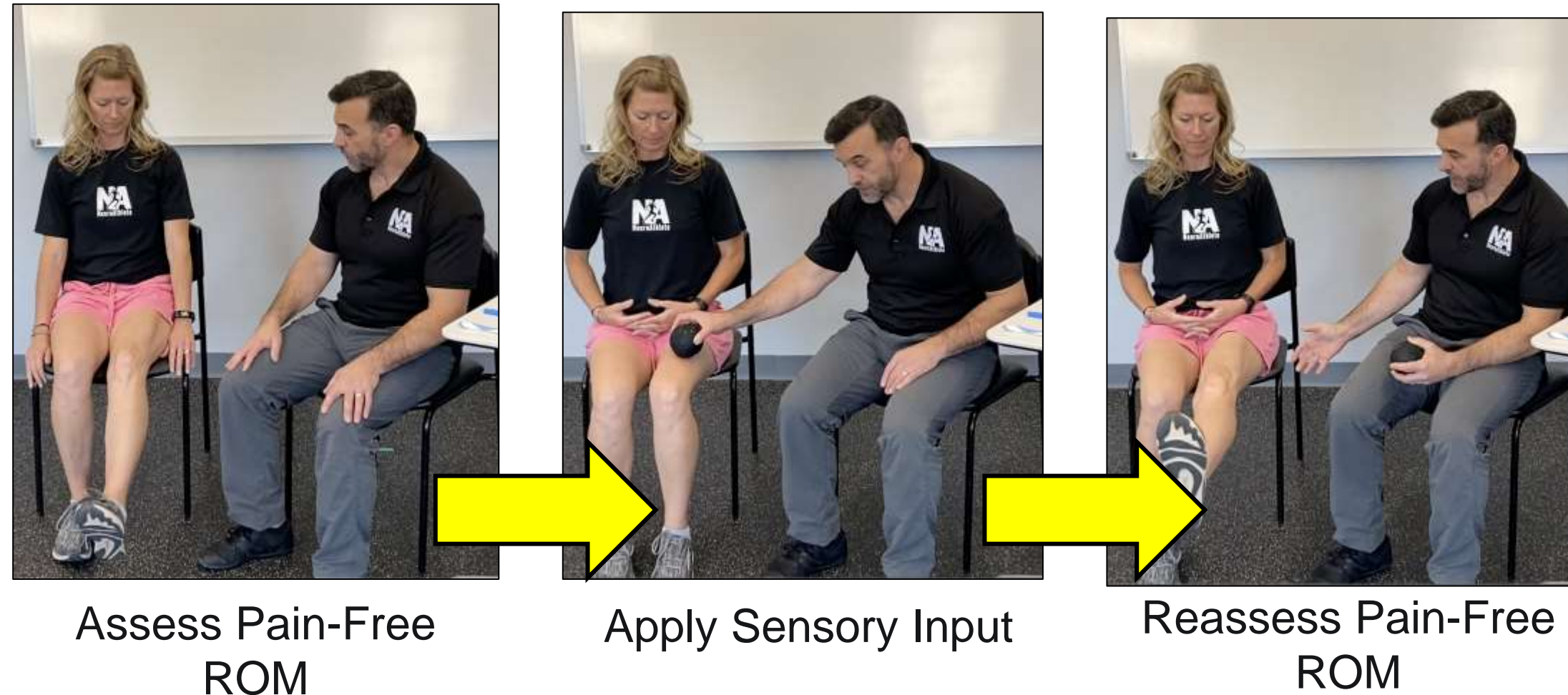
# Training Concepts – Sensory Input



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# 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:

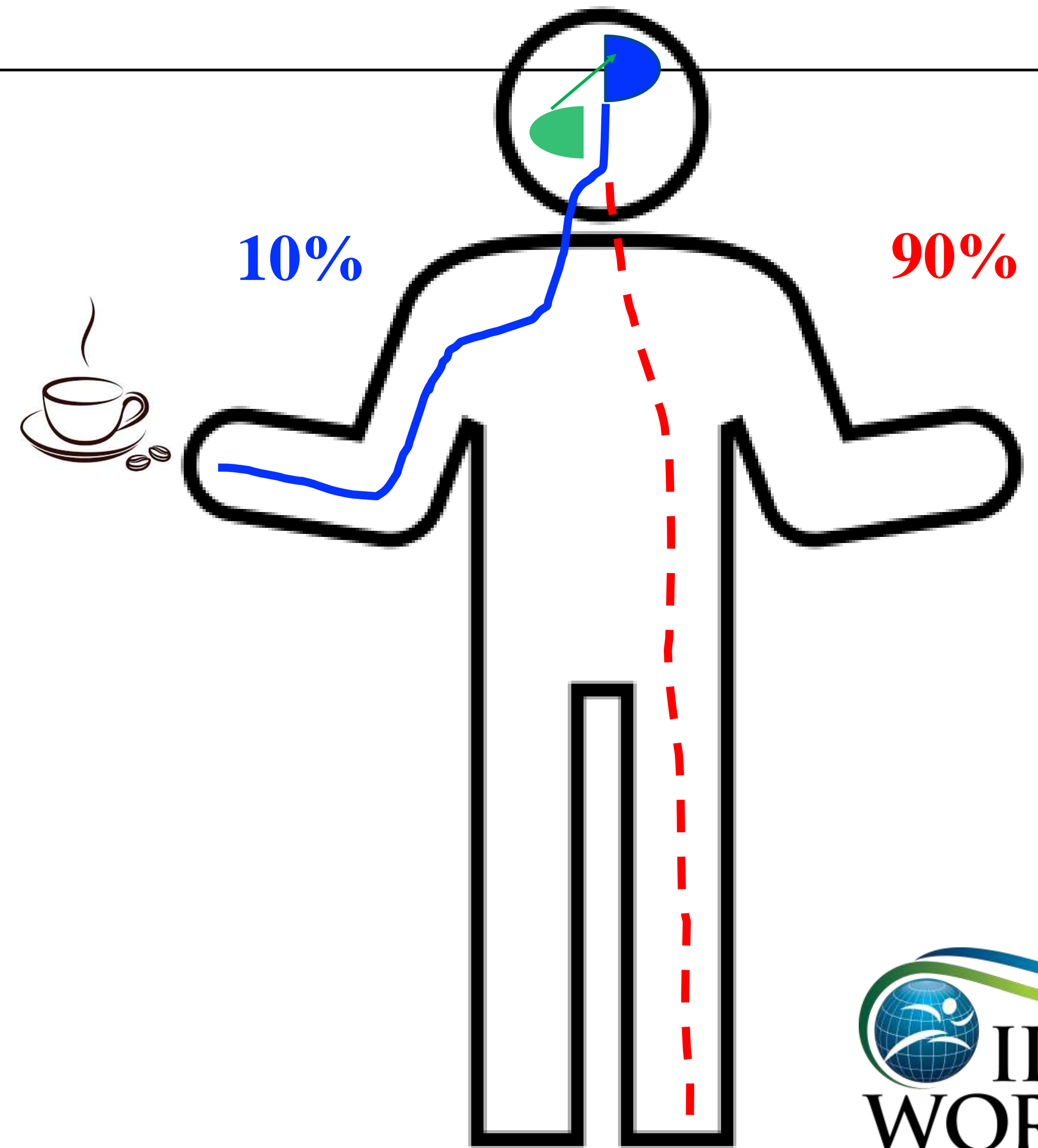
- Before/during exercise
- Between sets
- At home



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# 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



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# 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 Assessments

- **Range of Motion:**



**Scoring:**

- 5 = full ROM/smooth
- 4 =  $\frac{3}{4}$  ROM/generally smooth
- 3 =  $\frac{1}{2}$  ROM/lacks control
- 2 =  $<\frac{1}{2}$  ROM/uncoordinated
- 1 = no ROM/pain/very choppy

- **Strength/Muscle Test:**



**Scoring:**

- 5 = full strength/"locks"
- 4 = good, but fatigues
- 3 = some resistance
- 2 = very little resistance
- 1 = no resistance/pain

- **How to perform:**

- **Looking for:**

- Available pain-free range
- Quality of movement
- Compare both sides

- Client initiates, you meet the force, then try to push them out (~3 sec)
- Test both sides
- Don't touch the muscle
- No pain



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# Practical – Motor Control Training

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



Basic



External Targeting



Visual/Auditory

- **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.

## 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



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# Training Concepts – Visual & Vestibular Integration

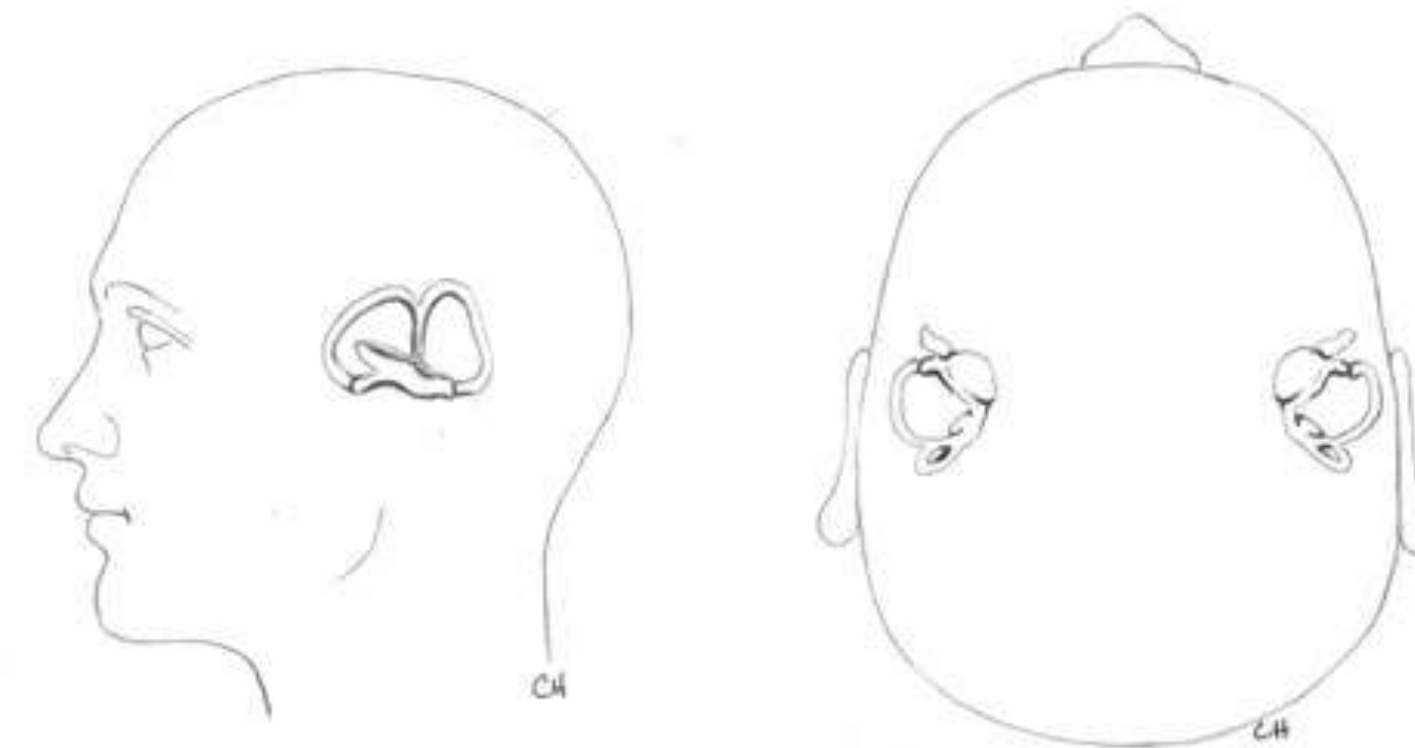
- **Vision:**

- 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



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# Training Concepts – Visual & Vestibular Integration

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



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# The Three Input Systems for Good Movement

## Vestibular (Inner Ear)

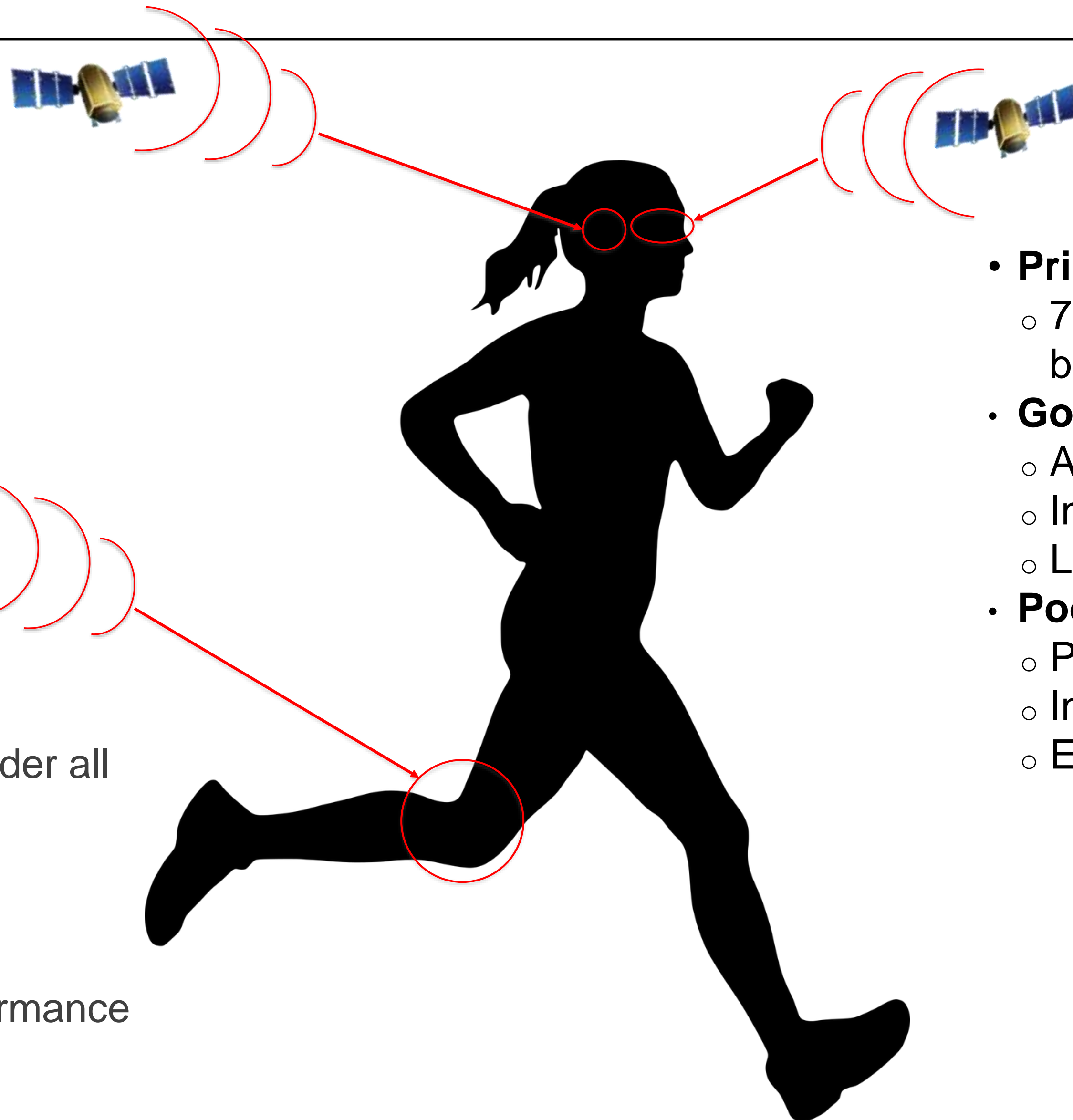
- **Good vestibular feedback =**
  - Good balance
  - Good stability during movement
  - Good reflexive posture
- **Poor vestibular function =**
  - Slow, inaccurate movement
  - Poor postural corrections
  - Postural compensations

## 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!



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# The Three Input Systems for Good Movement

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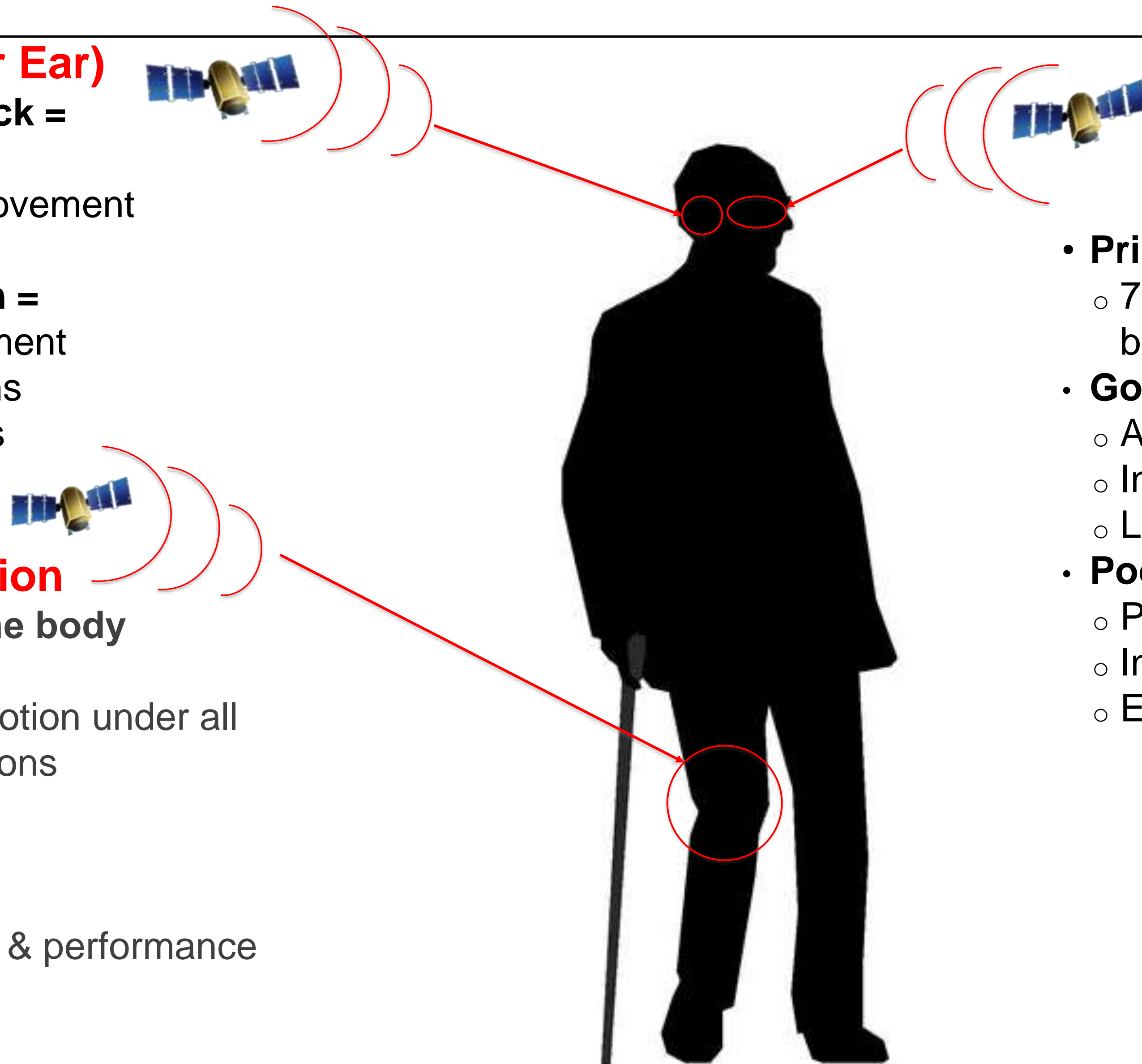
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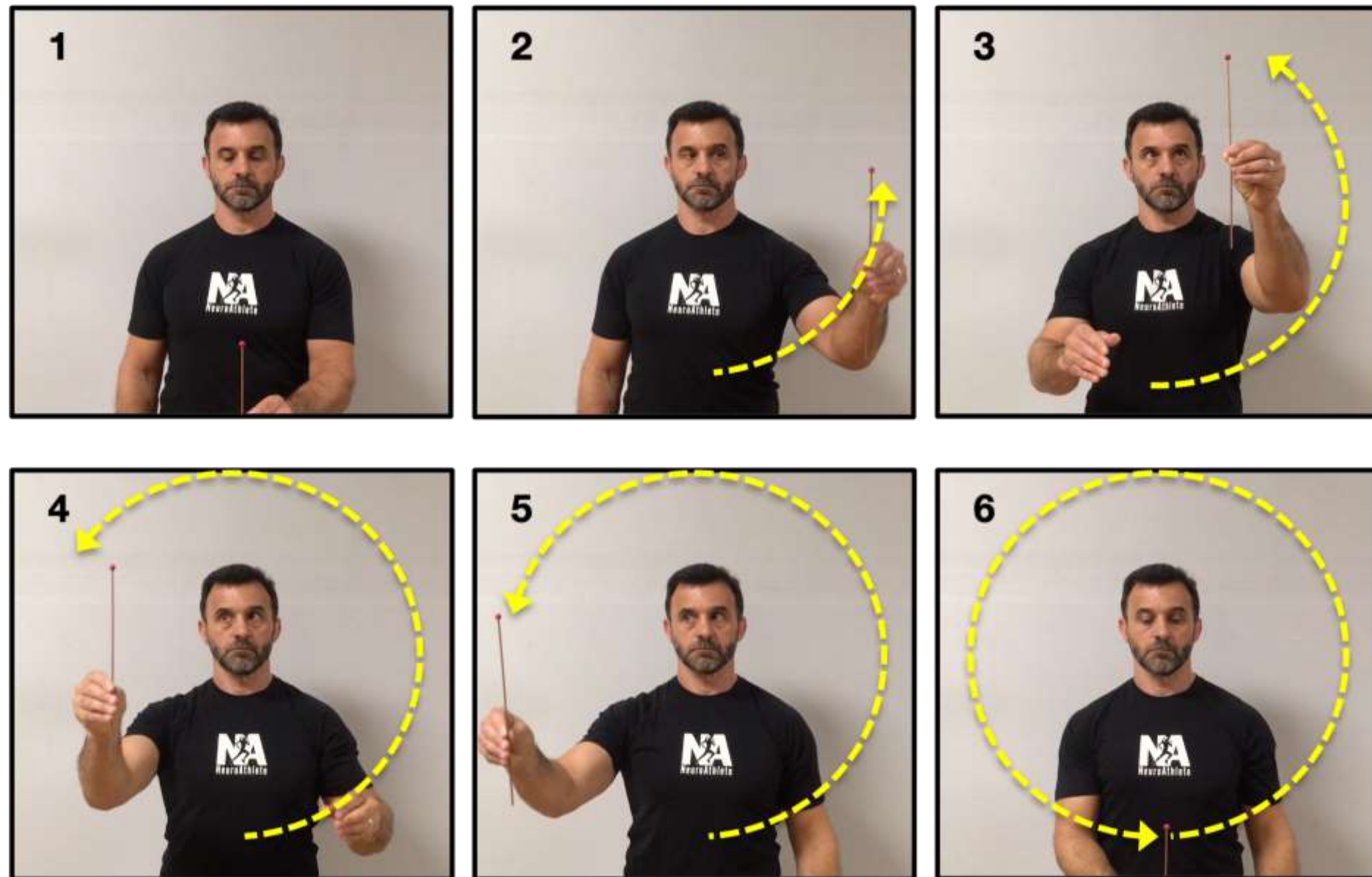
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# Practical – Vision & Vestibular

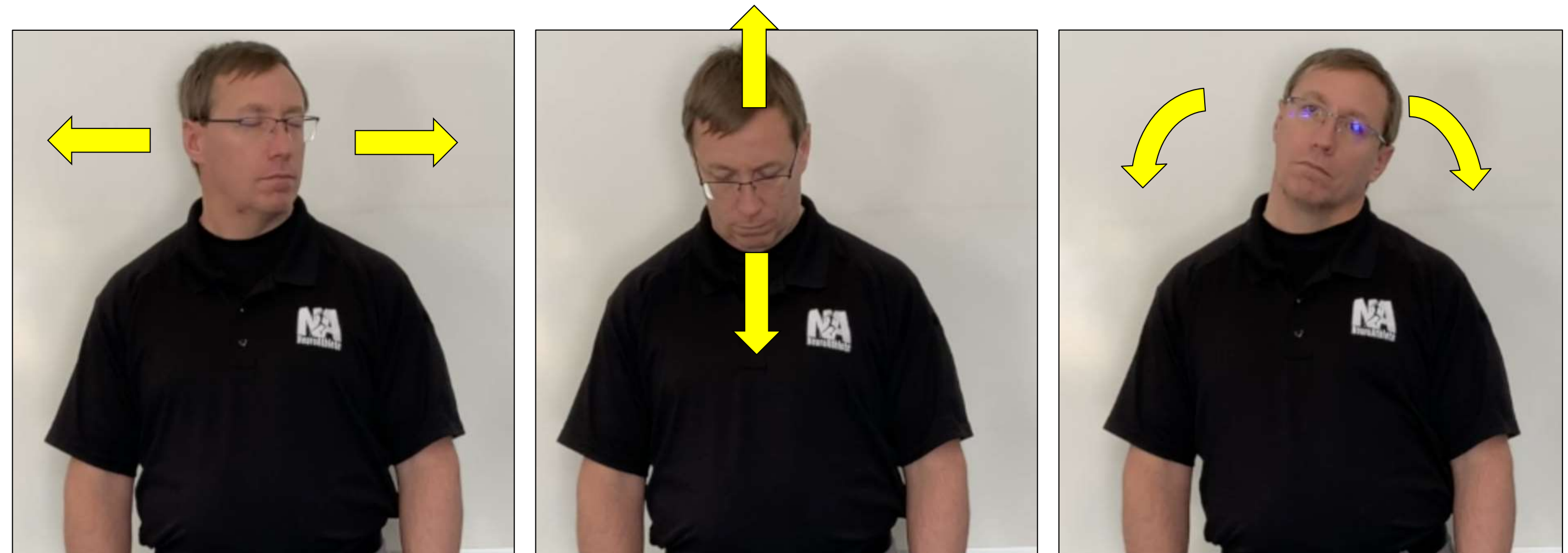
- **Eye Circles:**



- **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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# Resources

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- **How to find us:**
  - Website: [www.clinic.neuroathlete.com](http://www.clinic.neuroathlete.com)
  - Facebook: NeuroAthlete Clinic
  - Instagram: @neuroathleteclinic
  - YouTube: NeuroAthlete Clinic
  - Email: [info@neuroathleteclinic.com](mailto:info@neuroathleteclinic.com)
  
- **Neuro-Centric Education:**
  - Z-Health Performance Solutions - [www.zhealtheducation.com](http://www.zhealtheducation.com)
  
- **Stroke Recovery Fitness Specialist certification**
  - MedFit – [www.medfitclassroom.org](http://www.medfitclassroom.org) (Specialist Courses)



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# About MedFit

MedFit Network was founded in 2013 by fitness industry veteran Lisa Dougherty. MFN is a membership organization for medical fitness professionals, and a free directory for the public to find qualified fitness professionals in their area who can safely work with their medical conditions.



As MedFit Network grew, Lisa noticed a lack of available medical fitness education for professionals. In 2017, she founded the MedFit Education Foundation, a nonprofit dedicated to elevating the quality and amount of medical fitness education. Through the Foundation, Lisa's led the way to creating education via MedFit Classroom, MedFit Tour and MedFit TV. In 2022, Lisa co-founded MedFit Care with Dr. David Kruse to provide exercise prescriptions for consumers to use with fitness professionals.

## *MedFit Family of Organizations*



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# Current and Upcoming Specialist Courses

*Blue = course currently available*

- **Adaptive Fitness Specialist**
- **Alzheimer's Disease Fitness Specialist**
- **Arthritis Fitness Specialist**
- Autism Spectrum Disorder (ASD) Fitness Specialist
- **Cancer Exercise Specialist**
- Cardiac Rehab Fitness Specialist
- **Type 2 Diabetes Fitness Specialist**
- **Drug and Alcohol Recovery Fitness Specialist**
- Fibromyalgia Fitness Specialist
- **Foundations of Medical Fitness: A Comprehensive Course for Fitness Specialists**
- **Geriatric Fitness & Lifestyle Specialist**
- **Joint Replacement Fitness Specialist**
- **Longevity Lifestyle & Fitness Specialist**
- Medically-based Aquatics Specialist
- Meditation Specialist
- **Menopause Fitness & Health Specialist**
- **Multiple Sclerosis Fitness Specialist**
- **Obesity Fitness Specialist**
- Orthopedic
- **Osteoporosis Fitness Specialist**
- **Parkinson's Disease Fitness Specialist**
- Prenatal & Postpartum Fitness Specialist
- Respiratory Disease Fitness Specialist
- Sleep Coach Specialist
- **Sports Medicine Fitness Specialist**
- **Stroke Recovery Fitness Specialist**
- Weight Loss & Management Specialist
- Youth Fitness & Nutrition Specialist



medical fitness tour  
Gain Knowledge to Change Lives

SAVE THE DATE  
March 16-18, 2023

Medical Fitness Tour: Southern California  
Los Angeles Athletic Club

Pre-registration will open in July. Join our mailing list to be notified:  
[medicalfitnessstour.org/mft2023](https://medicalfitnessstour.org/mft2023)

*\*Attendance will provide 12-20 CECs. Pending approval.*



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