

Dr Heidi Haavik

BSc (chiropractic), PhD

VP Research, Dean Research, New Zealand College of Chiropractic

# Rewiring the Brain:

## The Neurophysiology of Chiropractic Care in a Stressed World



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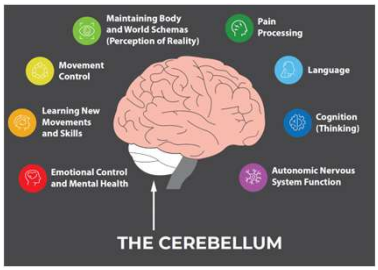
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The HANDOUT for today's Class (the slides)

Gift




Gift




4

# Drinks & Nibbles
# Sat 5pm
# Hotel Lobby Bar

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## Our Key Chiro References




Haavik H, Niazi IK, Amjad I, Kumari N, Ghani U, Ashfaque M, Rashid U, Navid MS, Kamavuako EN, Pujari AN, Holt K. Neuroplastic Responses to Chiropractic Care: Broad Impacts on Pain, Mood, Sleep, and Quality of Life. Brain Sciences. 2024 Nov 7;14(11):1124. https://www.mdpi.com/2076-3425/14/11/1124

Heidi Haavik, Nitika Kumari, Kelly Holt, Imran Khan Niazi, Imran Amjad, Amit N. Pujari, Kemal Sitki Türker, Bernadette Murphy. (2021a) The contemporary model of vertebral column joint dysfunction and impact of high-velocity, low-amplitude controlled vertebral thrusts on neuromuscular function. Invited Review. European Journal of Applied Physiology. https://doi.org/10.1007/s00421-021-04727-z

Heidi Haavik, Imran Khan Niazi, Nitika Kumari, Imran Amjad, Jenna Duehr, Kelly Holt. (2021b) The potential mechanisms of High-Velocity, Low-Amplitude, Controlled Vertebral Thrusts on Neuroimmune Function: A narrative review. Medicina 2021, 57, 536. https://doi.org10.3390/medicina57060536

Imran Khan Niazi, Muhammad Samran Navid, Christopher Merkle, Imran Amjad, Nitika Kumari, Robert J. Trager, Kelly Holt, Heidi Haavik. 2024 A randomized controlled trial comparing different sites of high-velocity low amplitude thrust on sensorimotor integration parameters. Scientific Report. 14(1), p.1159. https://www.nature.com/articles/s41598-024-51201-9

Imran Amjad, Imran Khan Niazi, Nitika Kumari, Usman Ghani, Usman Rashid, Felipe Duarte, Federico For-tuna, Diego Gonzalez, Alex Sumich, Bibiana Fabre, Kelly Holt, Heidi Haavik. The effects of 12 weeks of chiropractic spinal adjustments on Physiological biomarkers in adults: A pragmatic randomized controlled trial. *PLoS One, 2025, 20(12), p.e0338730.* *https://doi.org/10.1371/journal.pone.0338730*

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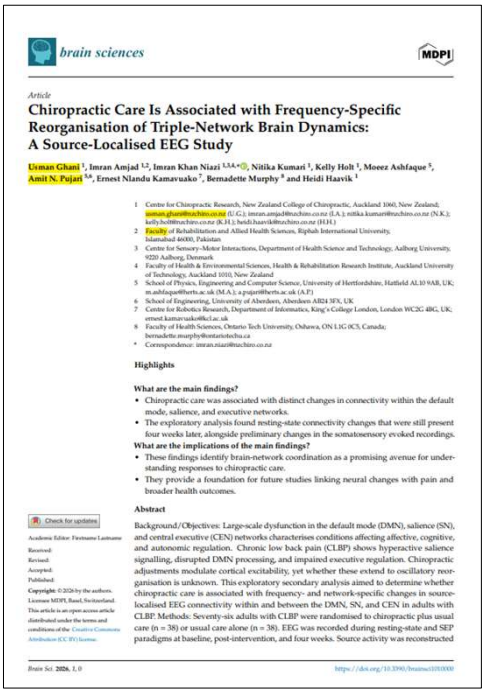
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# Published YESTERDAY!!

Usman Ghani, Imran Amjad, Imran Khan Niazi,Nitika Kumari, Kelly Holt, Moeez Ashfaque, Amit N. Pujari, Ernest Nlandu Kamavuako, Bernadette Murphy and Heidi Haavik.

Chiropractic Care Is Associated with Frequency-Specific Reorganisation of Triple-Network Brain Dynamics: A Source-Localised EEG Study.

*Brain Sciences. 2026; In press.*



brain sciences

MDPI

Article

**Chiropractic Care Is Associated with Frequency-Specific Reorganisation of Triple-Network Brain Dynamics: A Source-Localised EEG Study**

Usman Ghani [1], Imran Amjad [1,2], Imran Khan Niazi [1,3,4,*], Nitika Kumari [1], Kelly Holt [1], Moeez Ashfaque [5], Amit N. Pujari [5,6], Ernest Nlandu Kamavuako [7], Bernadette Murphy [8] and Heidi Haavik [1]

1 Centre for Chiropractic Research, New Zealand College of Chiropractic, Auckland 1060, New Zealand; usman.ghani@nzchiro.co.nz (U.G.); imran.amjad@nzchiro.co.nz (I.A.); nitika.kumari@nzchiro.co.nz (N.K.); kelly.holt@nzchiro.co.nz (K.H.); heidi.haavik@nzchiro.co.nz (H.H.)
2 Faculty of Rehabilitation and Allied Health Sciences, Riphah International University, Islamabad 46000, Pakistan
3 Centre for Sensory–Motor Interactions, Department of Health Science and Technology, Aalborg University, 9220 Aalborg, Denmark
4 Faculty of Health & Environmental Sciences, Health & Rehabilitation Research Institute, Auckland University of Technology, Auckland 1010, New Zealand
5 School of Physics, Engineering and Computer Science, University of Hertfordshire, Hatfield AL10 9AB, UK; m.ashfaque@herts.ac.uk (M.A.); a.pujari@herts.ac.uk (A.P.)
6 School of Engineering, University of Aberdeen, Aberdeen AB24 3FX, UK
7 Centre for Robotics Research, Department of Informatics, King's College London, London WC2G 4BG, UK; ernest.kamavuako@kcl.ac.uk
8 Faculty of Health Sciences, Ontario Tech University, Oshawa, ON L1G 0C5, Canada; bernadette.murphy@ontariotechu.ca
* Correspondence: imran.niazi@nzchiro.co.nz

**Highlights**

**What are the main findings?**

- Chiropractic care was associated with distinct changes in connectivity within the default mode, salience, and executive networks.
- The exploratory analysis found resting-state connectivity changes that were still present four weeks later, alongside preliminary changes in the somatosensory evoked recordings.

**What are the implications of the main findings?**

- These findings identify brain-network coordination as a promising avenue for understanding responses to chiropractic care.
- They provide a foundation for future studies linking neural changes with pain and broader health outcomes.

**Abstract**

Background/Objectives: Large-scale dysfunction in the default mode (DMN), salience (SN), and central executive (CEN) networks characterises conditions affecting affective, cognitive, and autonomic regulation. Chronic low back pain (CLBP) shows hyperactive salience signalling, disrupted DMN processing, and impaired executive regulation. Chiropractic adjustments modulate cortical excitability, yet whether these extend to oscillatory reorganisation is unknown. This exploratory secondary analysis aimed to determine whether chiropractic care is associated with frequency- and network-specific changes in source-localised EEG connectivity within and between the DMN, SN, and CEN in adults with CLBP. Methods: Seventy-six adults with CLBP were randomised to chiropractic plus usual care (n = 38) or usual care alone (n = 38). EEG was recorded during resting-state and SEP paradigms at baseline, post-intervention, and four weeks. Source activity was reconstructed

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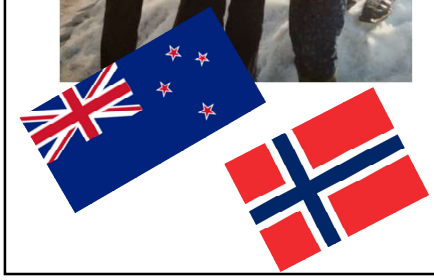
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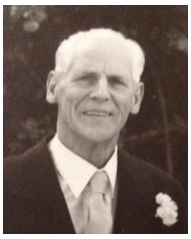

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Dr William Charles Lawson - Palmer Graduate 1924

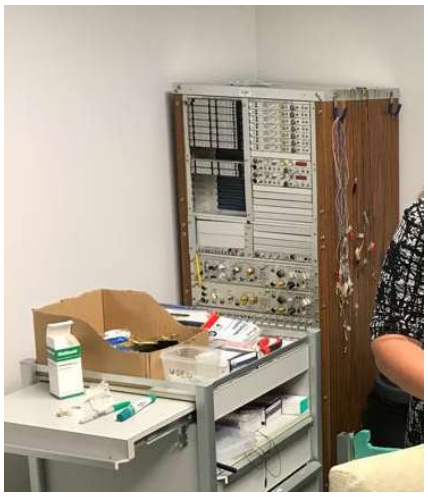


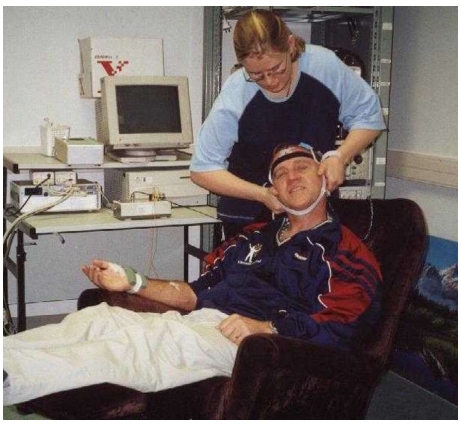
1999 NZCC Graduate



2008 PhD

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Dr Heidi Haavik


Dr Kelly Holt


Dr Nitika Kumari


Dr Imran Khan Niazi


Dr Usman Rashid


Dr Imran Amjad


Dr Usman Ghani

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How many of you have a spine model in your practice?



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How many of you have a brain model in your practice?



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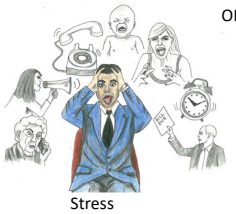


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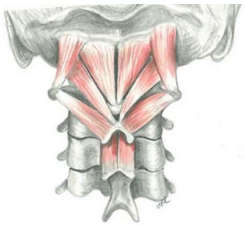


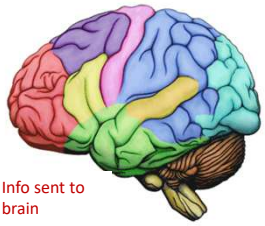
Stress



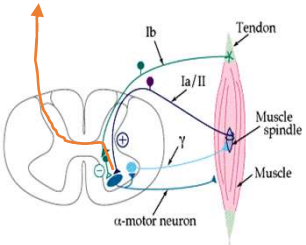
Injury

Small muscles closest to spine and skull go to sleep



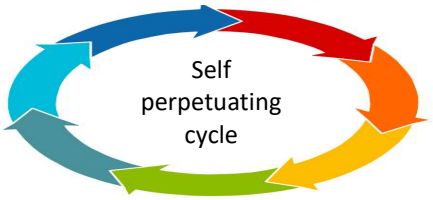


Info sent to brain




Altered messages going to brain from spine

Poor body awareness
Poor body control
Poor function




So brain does NOT know accurately what is going on

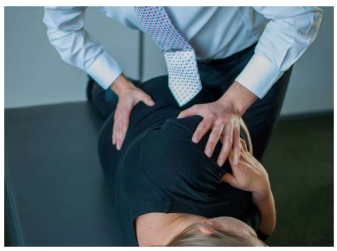


Changes brains internal representations about what is going on inside and outside body

*(Haavik et al 2021 EJAP)*

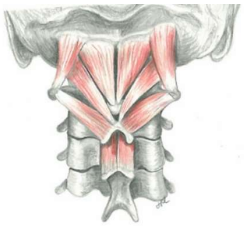
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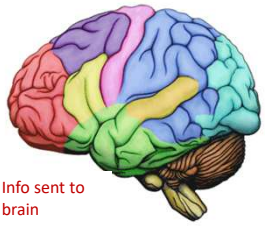
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Adjustment

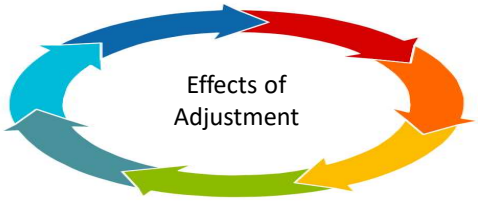
Stretches small muscles closest to spine and scull

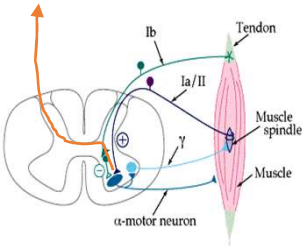




Info sent to brain

Improved body awareness
Improved body control
Improved function




Bombards brain with mechanoreceptor input

So brain knows MORE accurately what is going on



Changes brains internal representations about what is going on inside and outside body

*(Haavik et al 2021 EJAP)*

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# The Short Version

"Research indicates that chiropractic care enhances brain-body communication, allowing your brain to more accurately interpret internal and external signals. This improved perception of what is happening inside you and around you enables your brain to optimize bodily functions and adapt more effectively to your environment."

*Heidi Haavik*

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# Subluxation today vs 2 years of being subluxated

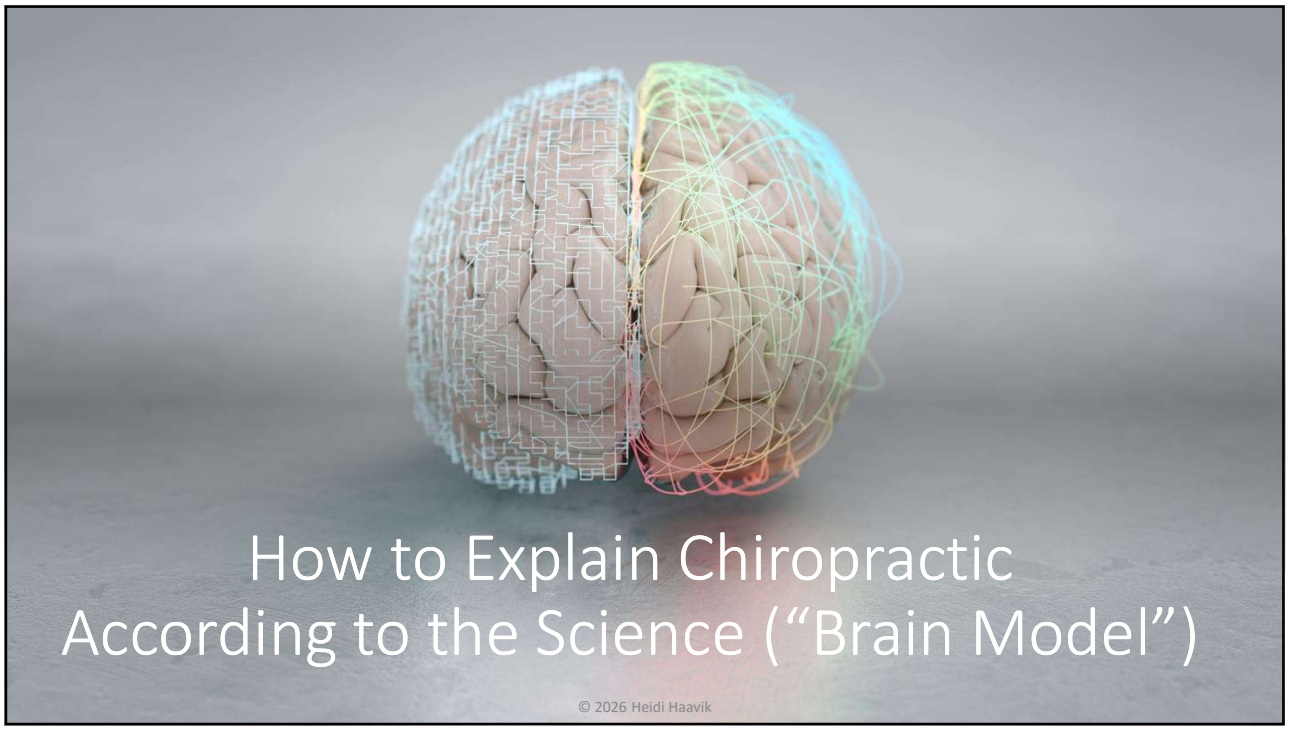


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ChirosHub



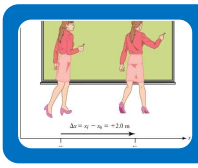
**Searching the Literature**

- Search engines
- Key word strategies



**Evaluating the literature**

- Strengths and weaknesses of different methodologies
- Hierarchy of evidence



**Translating the evidence**

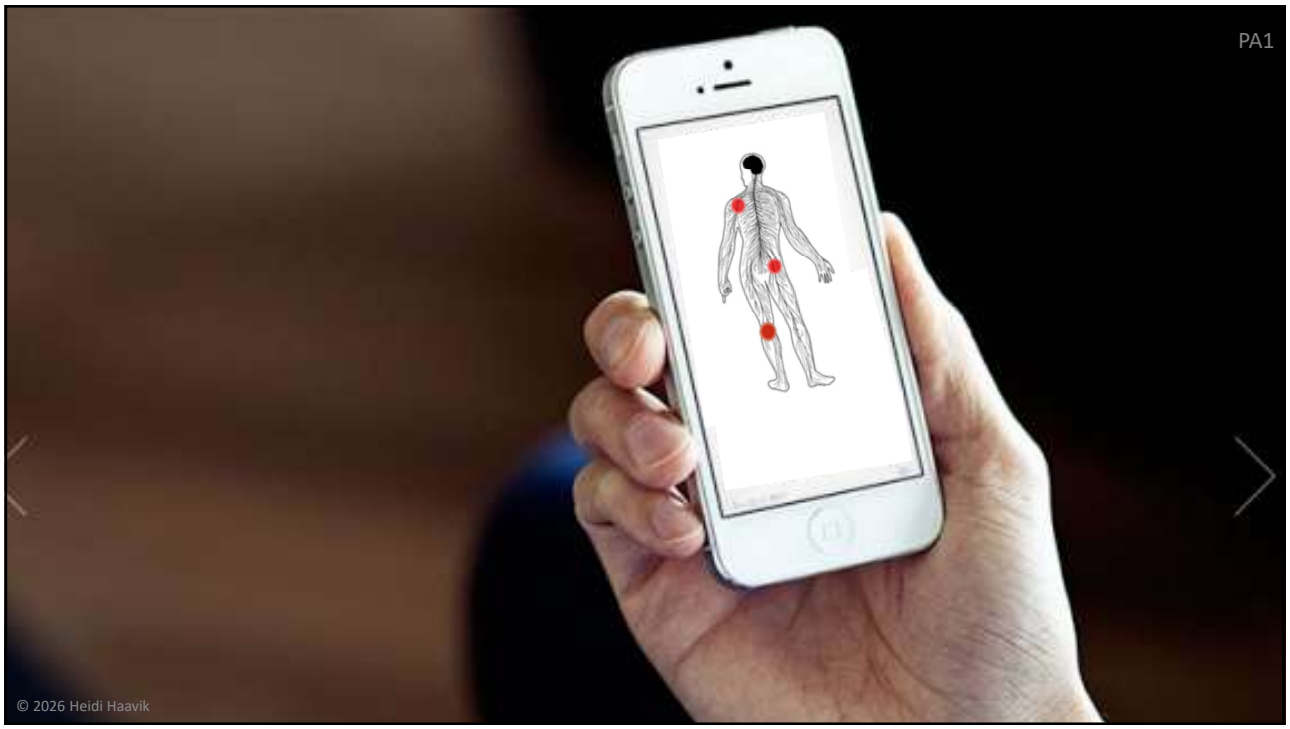
- Simplifying key findings
- Translating meaning to patient language

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GOLD
PLATINUM

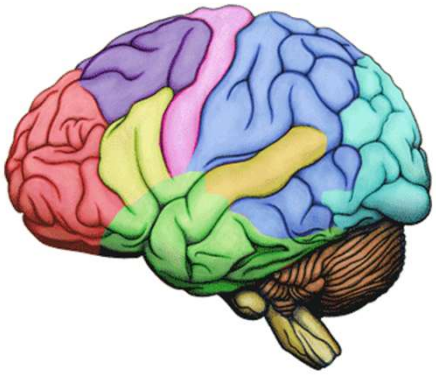
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## Two Key Components to explain Chiropractic to the Public





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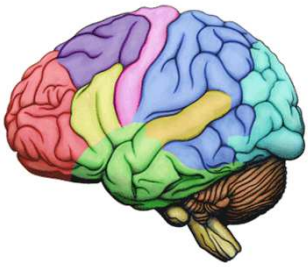


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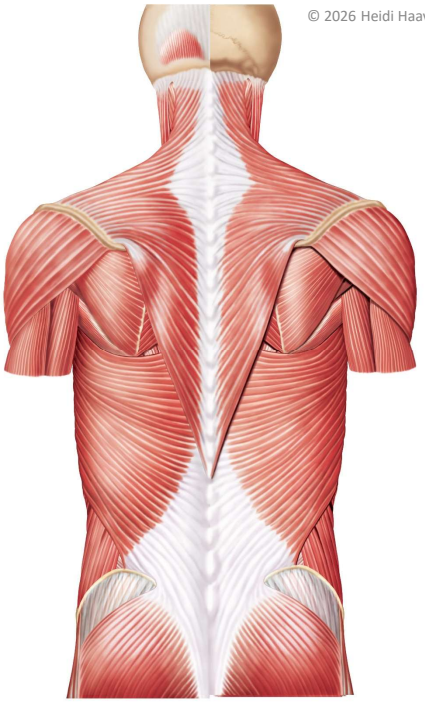
# A healthy spine moves!

**However, bones do not move themselves!**





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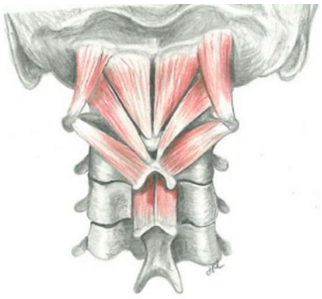


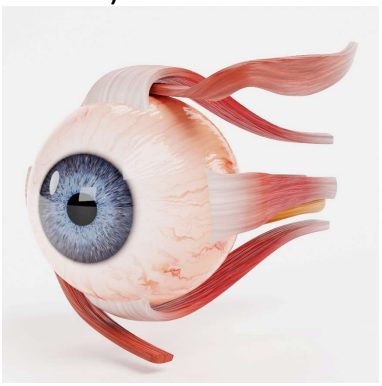
*(Sun et al 2024,; McGill et al 2024; Suehiro et al 2025)*

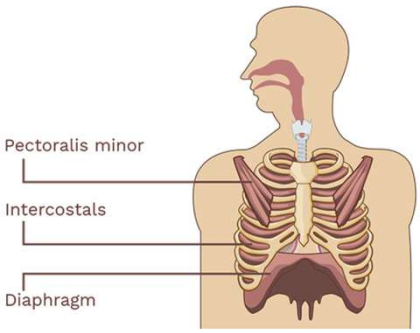
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# It is a complex system

- Reactive
- Feed-forward (predictive)
- Tonic

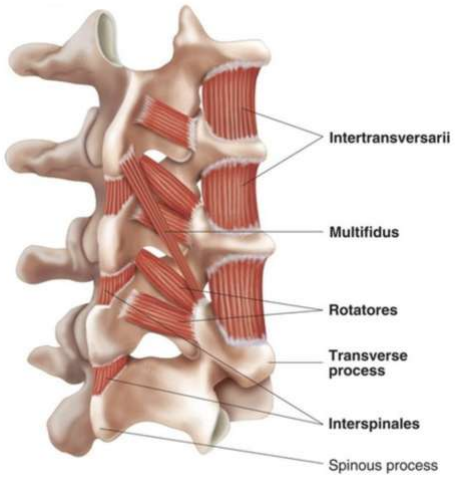




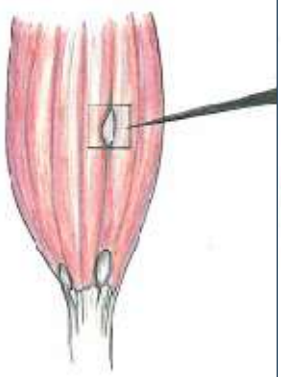


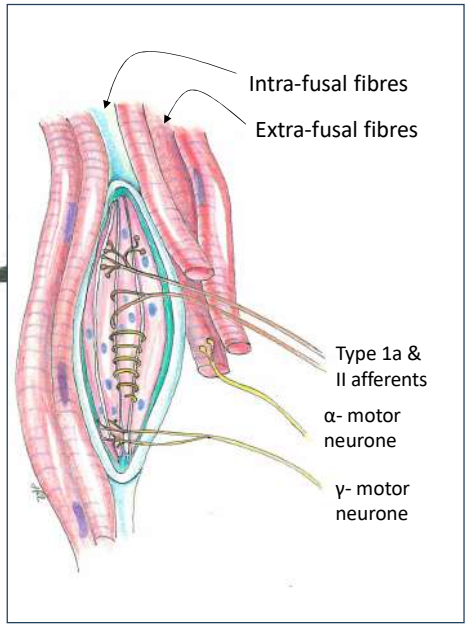

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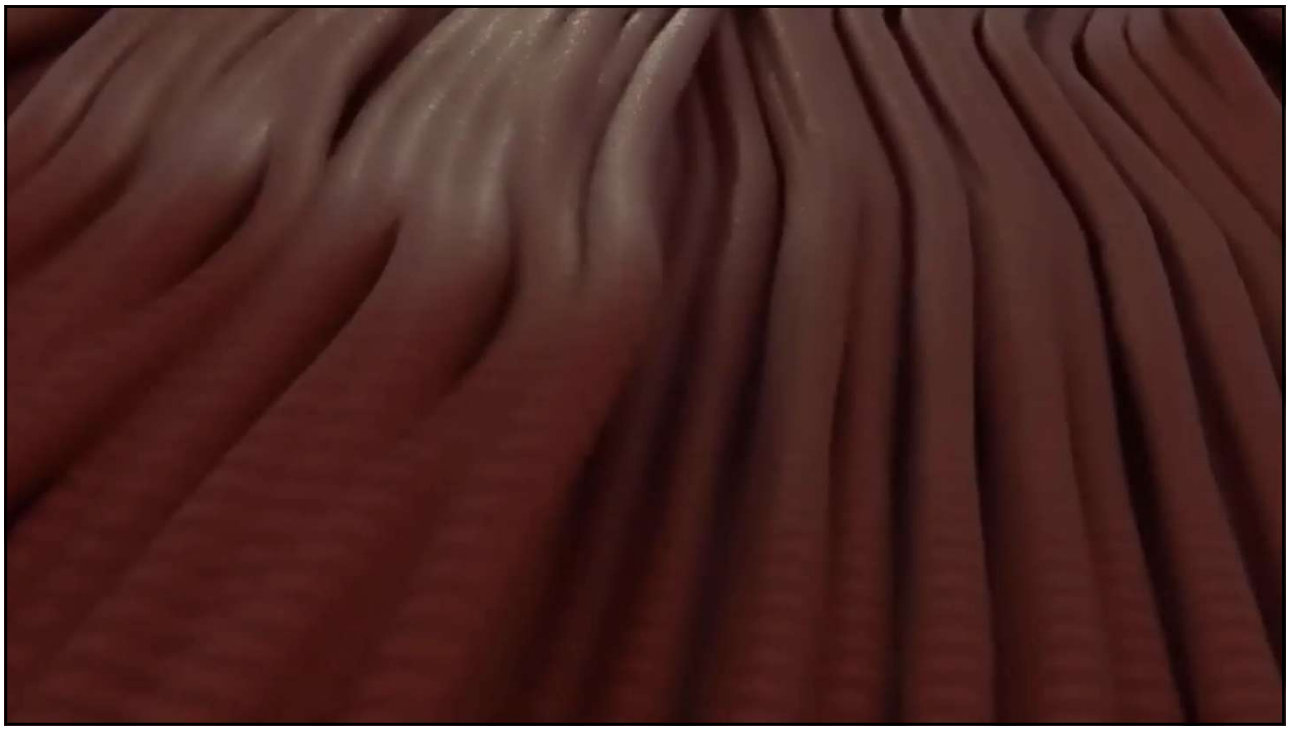

MUSCLE SPINDLES



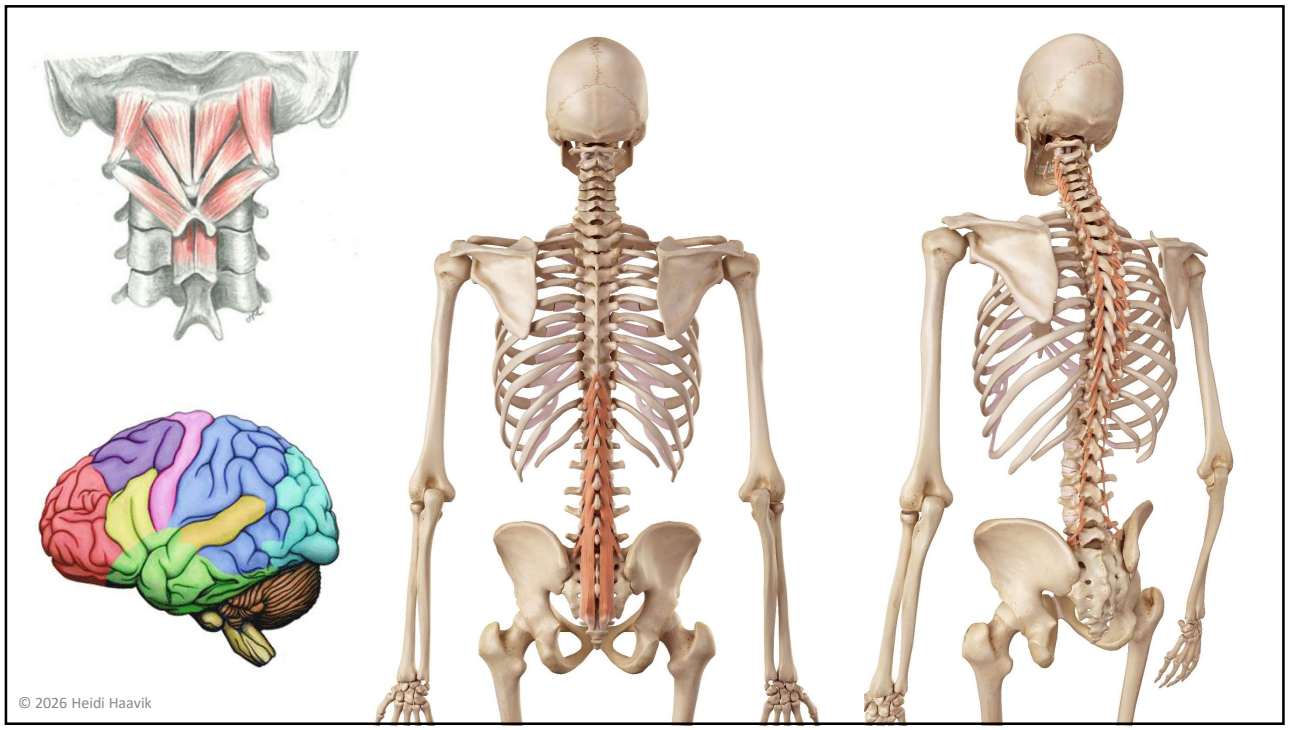



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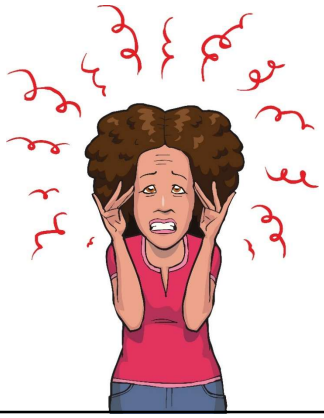


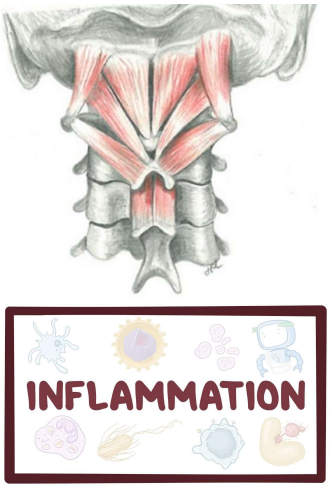
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# What can causes vertebral subluxations?








*(Haavik et al 2021 EJAP)*

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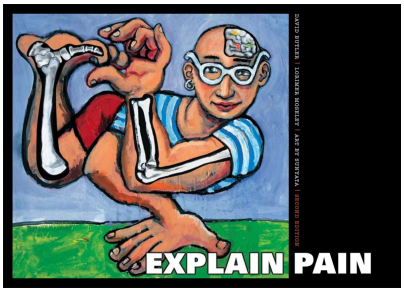
*(Butler & Moseley 2003)*

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## Stress can shut down spine-brain communication

**STRESS** (emotional, chemical or structural)

"However, if the long muscles are turned on, the shorter ones, for example the stabilizing muscles between vertebrae, ***go to sleep*** – there is no need for them if you are trying to avoid danger."




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*(Butler & Moseley. Explain Pain. 2003, p.90)*

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## Deep paraspinal muscle maladaptive changes

- "Muscle spindles provide a vital contribution to proprioception, the sense of body position and movement, and are necessary for control of movement and for health of the musculoskeletal system [10] including the spine [11]."
- "The high density of muscle spindles in the multifidus has been interpreted to suggest a critical sensory role for this muscle [12]"
- "Extrafusal multifidus muscle undergoes substantial structural change (fibrosis, change in collagen subtypes, fatty infiltration, atrophy and fiber-type change of the extrafusal fibers) as a result of neural and immune mechanisms [9]."
- **IVD injury alters the morphology of muscle spindles in the multifidus muscle**

*(James et al 2022)*

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European Spine Journal (2022) 31:1879–1888
https://doi.org/10.1007/s00586-022-07235-6

ORIGINAL ARTICLE

**Muscle spindles of the multifidus muscle undergo structural change after intervertebral disc degeneration**

Gregory James[1] · Carla Stecco[2] · Linda Blomster[1] · Leanne Hall[1] · Annina B. Schmid[1,3] · Cindy C. Shu[4] · Christopher B. Little[4] · James Melrose[4,5] · Paul W. Hodges[1,6]

Received: 19 October 2021 / Revised: 14 March 2022 / Accepted: 17 April 2022 / Published online: 27 May 2022
© The Author(s) 2022

**Abstract**
**Purpose** Proprioceptive deficits are common in low back pain. The multifidus muscle undergoes substantial structural change after back injury, but whether muscle spindles are affected is unclear. This study investigated whether muscle spindles of the multifidus muscle are changed by intervertebral disc (IVD) degeneration in a large animal model.
**Methods** IVD degeneration was induced by partial thickness annulus fibrosus lesion to the L3-4 IVD in nine sheep. Multifidus muscle tissue at L4 was harvested at six months after lesion, and from six age-/sex-matched naïve control animals. Muscle spindles were identified in Van Gieson's-stained sections by morphology. The number, location and cross-sectional area (CSA) of spindles, the number, type and CSA of intrafusal fibers, and thickness of the spindle capsule were measured. Immunofluorescence assays examined Collagen I and III expression.
**Results** Multifidus muscle spindles were located centrally in the muscle and generally near connective tissue. There were no differences in the number or location of muscle spindles after IVD degeneration and only changes in the CSA of nuclear chain fibers. The thickness of connective tissue surrounding the muscle spindle was increased as was the expression of Collagen I and III.
**Conclusion** Changes to the connective tissue and collagen expression of the muscle spindle capsule are likely to impact their mechanical properties. Changes in capsule stiffness may impact the transmission of length change to muscle spindles and thus transduction of sensory information. This change in muscle spindle structure may explain some of the proprioceptive deficits identified with low back pain.

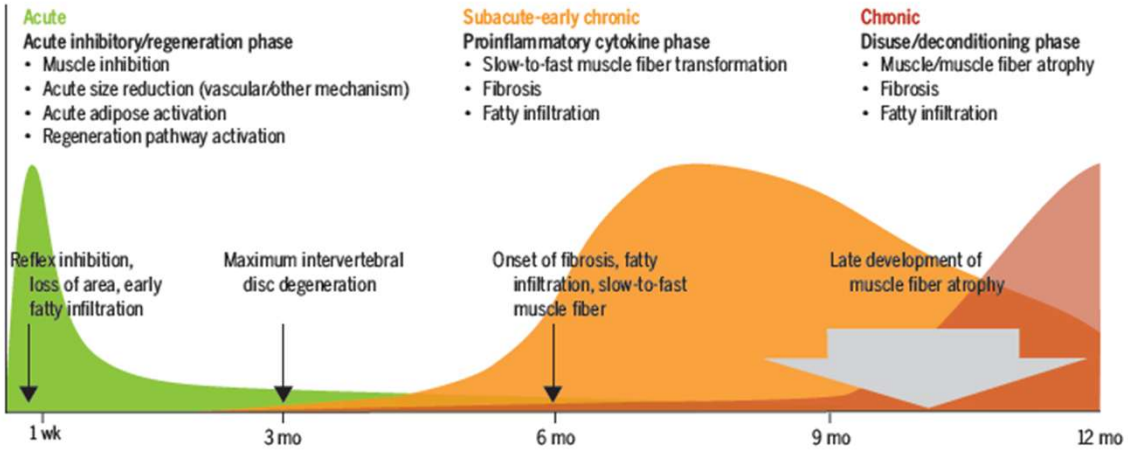
**Keywords** Multifidus · Muscle spindle · Connective tissue · Intervertebral disc degeneration · Proprioception

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

Professor Paul Hodges

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## Changes in structure and function of the back muscles in low back pain: different time points, observations, and mechanisms




*(Hodges & Danneels, 2019 Journal of orthopaedic & sports physical therapy )*

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## Deep paraspinal muscles

### Healthy

- Larger in size
- Slow-twitch fibre type
- Minimal fatty infiltration
- Move freely
- Healthy stretch receptors (muscle spindles)

Good

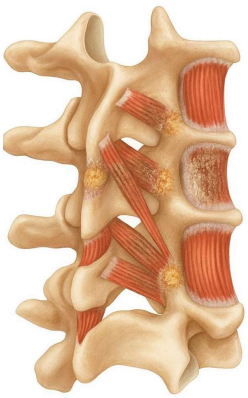


### Dysfunction

over time become:

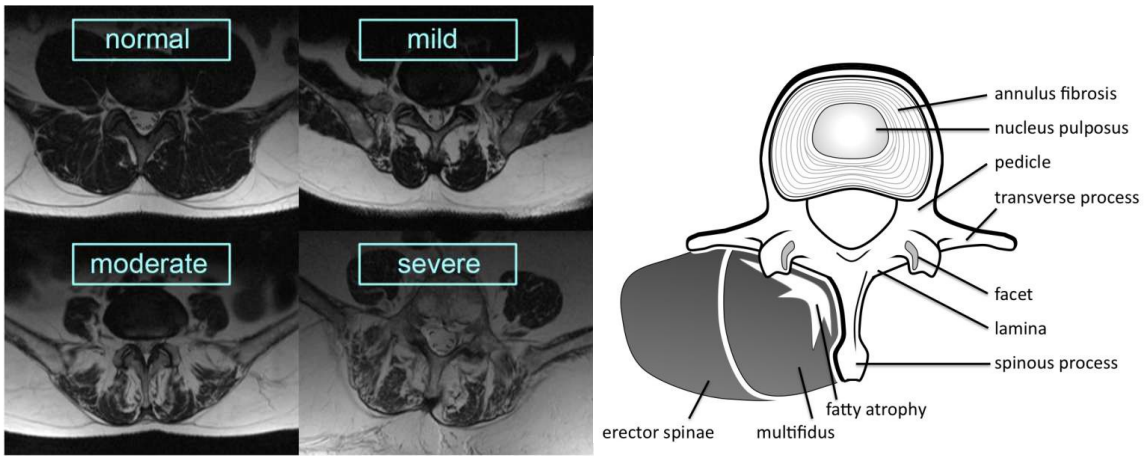
- Stiff and Fibrotic
- Atrophied (shrunk)
- Fatty infiltration
- Change fibre type
- Stretch receptors dysfunction

NOT Good



*(Hodges & Danneels, 2019. Changes in structure and function of the back muscles in low back pain: different time points, observations, and mechanisms Journal of orthopaedic & sports physical therapy **49**(6): 464-476)*

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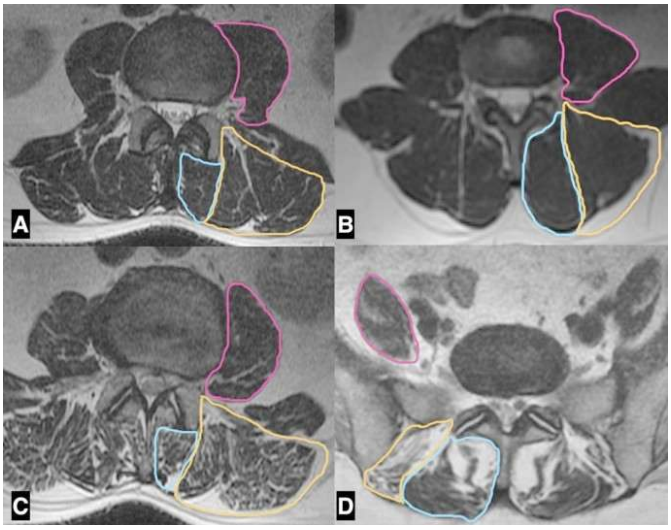



*(Faur et al. 2019)*

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"recent studies revealed that paraspinal muscular atrophy and fatty infiltration were associated with not only the development of bone nonunion, pedicle screw loosening, and proximal junctional kyphosis but also adjacent segmental disease *with* lumbar fusion surgery [4–6]."

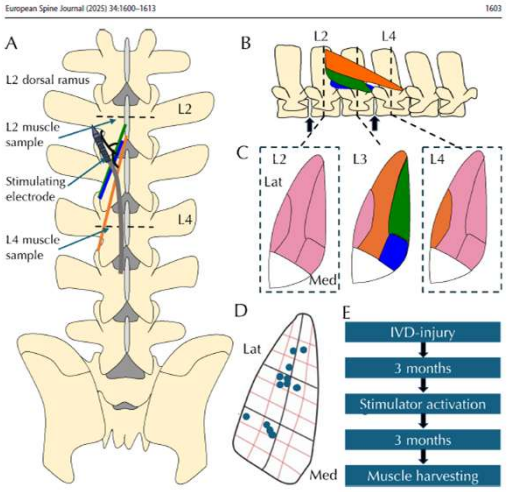



*(Ikeda et al 2025)*

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Multifidus muscle spindle capsule thickness and Collagen-1 were significantly less in the neurostimulation animals than IVD-injury animals at L4 (stimulated muscle) ($P < 0.05$), but not L2 (non-stimulated muscle).




European Spine Journal (2025) 34:1600–1613
https://doi.org/10.1007/s00586-025-08646-x

RESEARCH

**ISSLS Prize in Basic Science 2025: Structural changes of muscle spindles in the multifidus muscle after intervertebral disk injury are resolved by targeted activation of the muscle**

Greg James[1] · Ben Ahern[1] · Wendy Goodwin[1] · Ben Goss[2] · Paul Hodges[1]

Received: 14 October 2024 / Revised: 21 November 2024 / Accepted: 1 January 2025 / Published online: 15 January 2025
© The Author(s) 2025, corrected publication 2025

**Abstract**

**Purpose** Fibrosis of muscle spindles (sensory organs) in back muscles induced by intervertebral disc (IVD) degeneration could limit transmission of muscle stretch to the sensory receptor and explain the proprioceptive deficits common in back pain. Exercise reduces back muscles fibrosis. This study investigated whether targeted muscle activation via neurostimulation reverses or resolves muscle spindle fibrosis in a model of IVD injury.

**Methods** In eighteen sheep, lumbar (L)1–2 and L3-4 IVD degeneration was induced by partial thickness annulus fibrosis incision and a neurostimulator was implanted. After IVD-degeneration developed for 3 months, neurostimulation of the L2 nerve root activated multifidus in nine randomly selected animals. Multifidus muscle adjacent to the spinous process of L2 (non-stimulated) and L4 (stimulated) was harvested 3 months after activation. Muscle spindles were identified in Van Giessen's-stained sections. Connective tissue spindle capsule thickness, and cross-sectional area (CSA) of the spindle, its periaxial fluid and sensory elements were measured. Immunofluorescence assays evaluated Collagen-I and -III.

**Results** Multifidus muscle spindle capsule thickness and Collagen-1 were significantly less in the neurostimulation animals than IVD-injury animals at L4 (stimulated muscle) ($P < 0.05$), but not L2 (non-stimulated muscle). Spindle capsule thickness was less in lateral than medial regions. CSA of the muscle spindle and sensory elements was less in neurostimulated animals at L4.

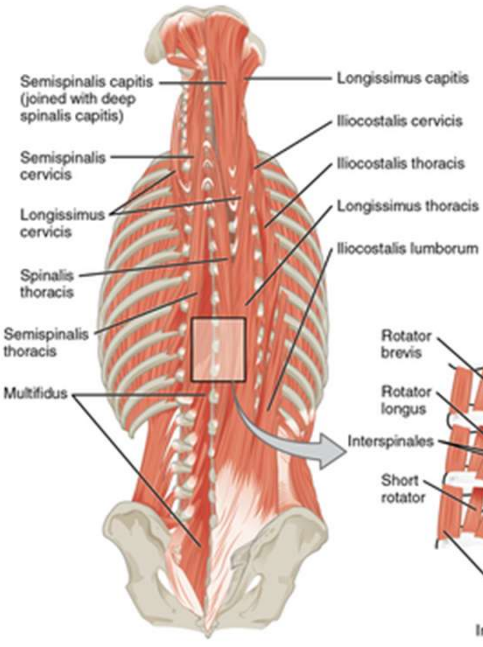
**Conclusion** Targeted multifidus activation reverses or prevents accumulation of connective tissue of the multifidus muscle spindle capsule caused by IVD injury. Reduced fibrosis should maintain sensory function of this important muscle mechanoreceptor and might provide an effective solution to resolve the commonly identified proprioceptive deficits in back pain and maintain healthy spine function.

**Keywords** Multifidus · Muscle spindle · Connective tissue · Restorative neurostimulation · Intervertebral disc degeneration · Proprioception

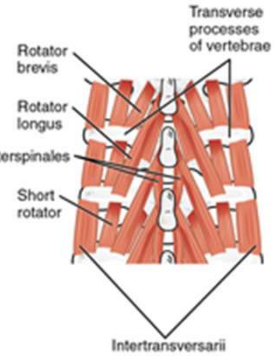
*(James, Hodges et al 2025)*

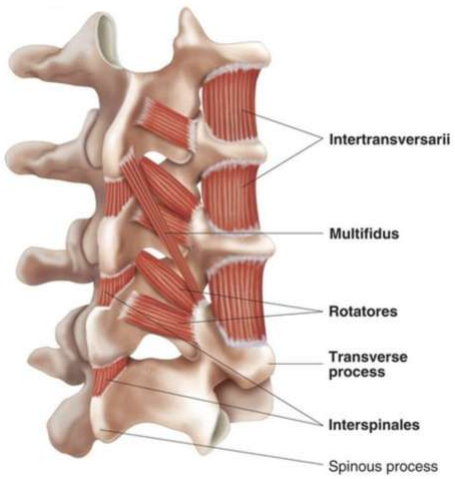
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What happens to these deep paraspinal muscles when we provide an HVLA thrust?




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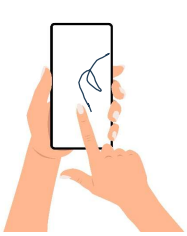
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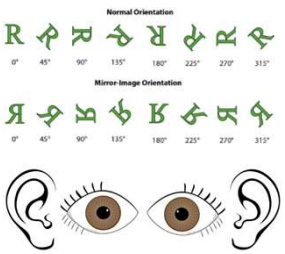
## Chiropractic care can improve accurate perception and function

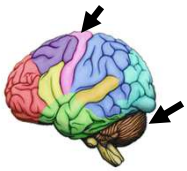








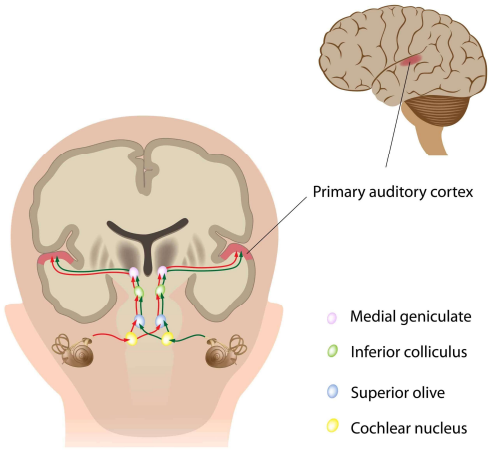


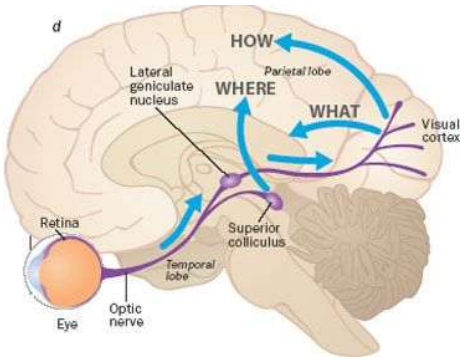



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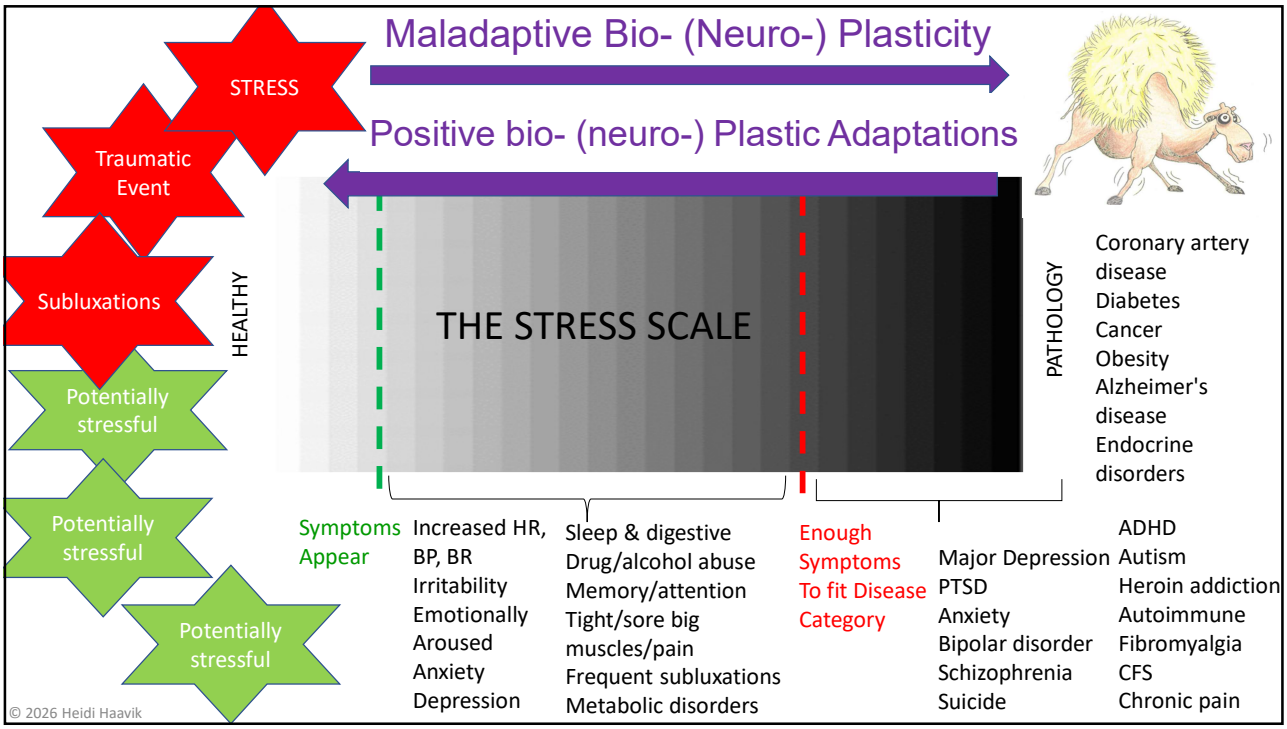
# Interpreting sound and visual information



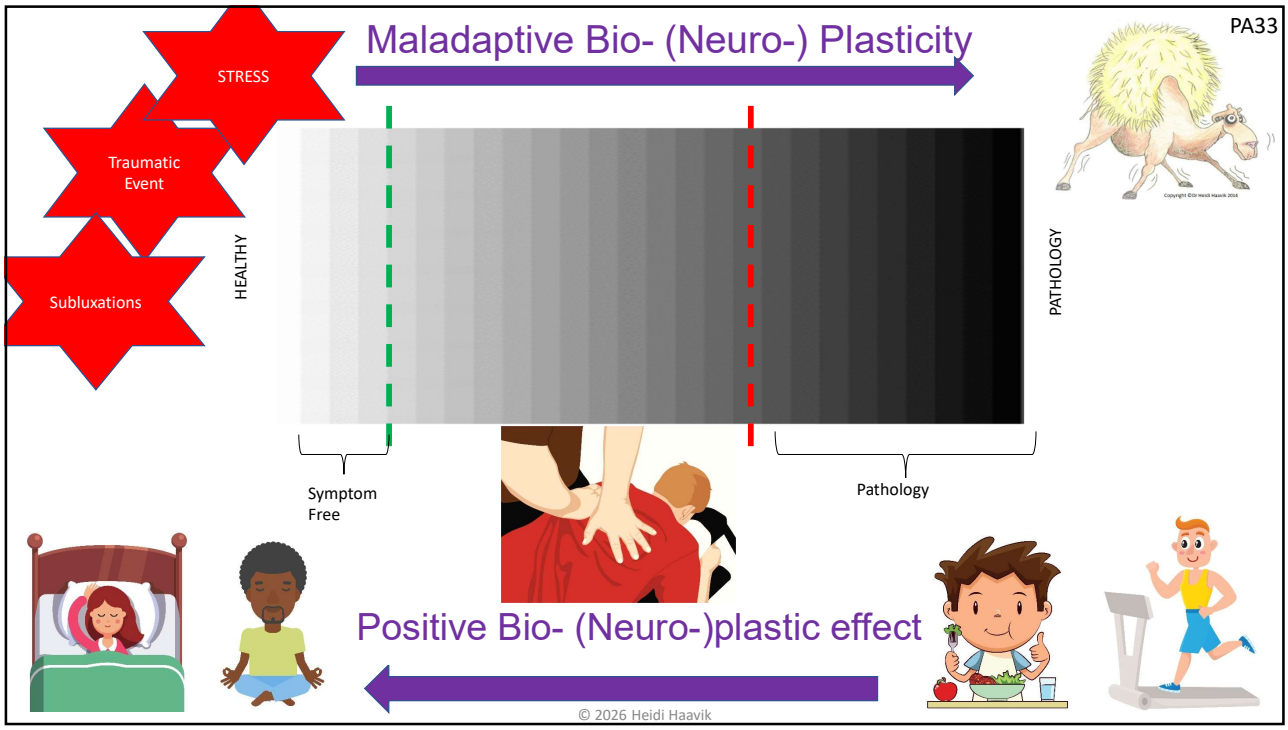




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PA33
Maladaptive Bio- (Neuro-) Plasticity
STRESS
Traumatic Event
Subluxations
HEALTHY
PATHOLOGY
Symptom Free
Pathology
Positive Bio- (Neuro-)plastic effect
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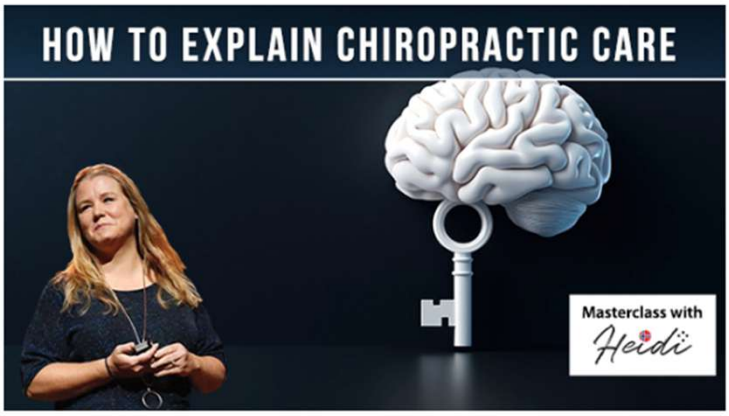


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heidihaavik.com/masterclass

**Explain Chiropractic Care**

How chiropractic care can impact physiology, muscle and organ function, emotional resilience and well-being.




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ChirosAcademy

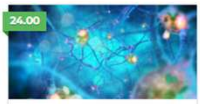


**Basic Science**

LEVEL 2

**Aimed at those who have gained some knowledge about anatomy, physiology, pathology, neuroscience and research methodology, and science in general.**

Dive deeper into what localized areas of spinal dysfunction are. Learn about these central segmental motor control problems that lead to ongoing maladaptive central plastic changes, making it harder for the brain to accurately perceive what is happening inside the body and around it, why they occur and how this impacts health, brain, pain and function.




**BS2.01 Introduction to the Neuroplasticity Model**

94 minutes - this class covers the major changes in neuroscience over the past 20 years

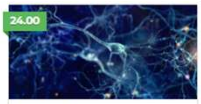
Enroll Now




**BS2.02 Two Models of the Vertebral Subluxation**

65 minutes - the latest research evidence examining what a vertebral subluxation is.

Enroll Now




**BS2.03 The Neurophysiology of the Subluxation**

60 minutes - the consequences of spinal injury and how it affects the brain function.

Enroll Now




**BS2.06 Communicating Chiropractic's impact on the Brain**

69 minutes - how to communicate the science about how stress negatively impacts our health.

Enroll Now

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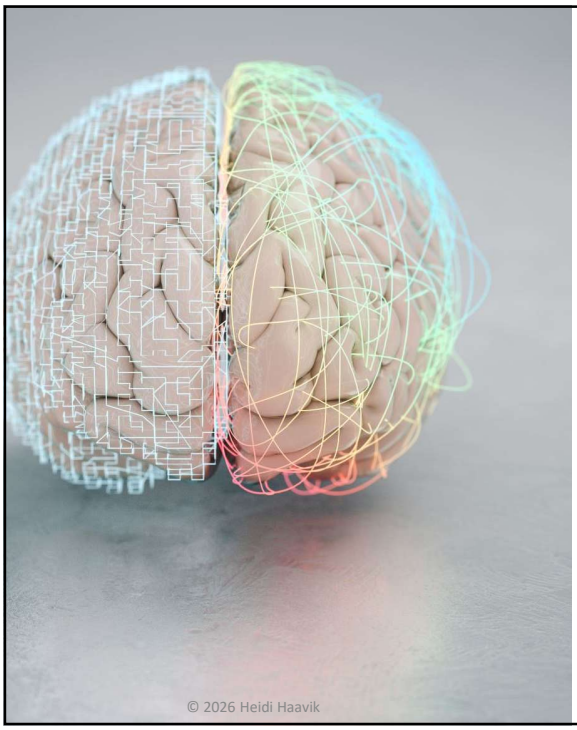
# Questions for Heidi?



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## Chiropractic Care

"Research indicates that chiropractic care, that includes the adjustment of vertebral subluxations, enhances brain-body communication, allowing your brain to more accurately interpret internal and external signals. This improved perception of what is happening inside you and around you enables your brain to optimize bodily functions and adapt more effectively to your environment."

*Heidi Haavik*

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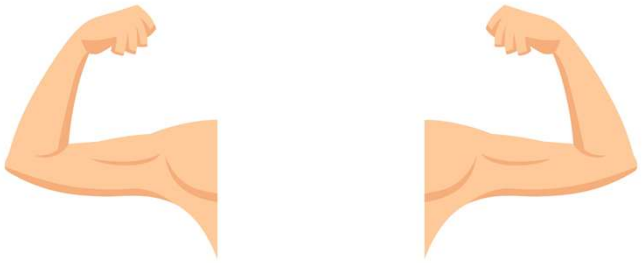
Chiropractic Care is all about exercising the small, deep paraspinal muscles back into proper function to enable the brain to more and more accurately perceive the internal and external environment so it can respond, adapt and heal better

*Heidi Haavik*

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It takes more than two to four weeks of exercise before you alter the size (morphology) of the muscle

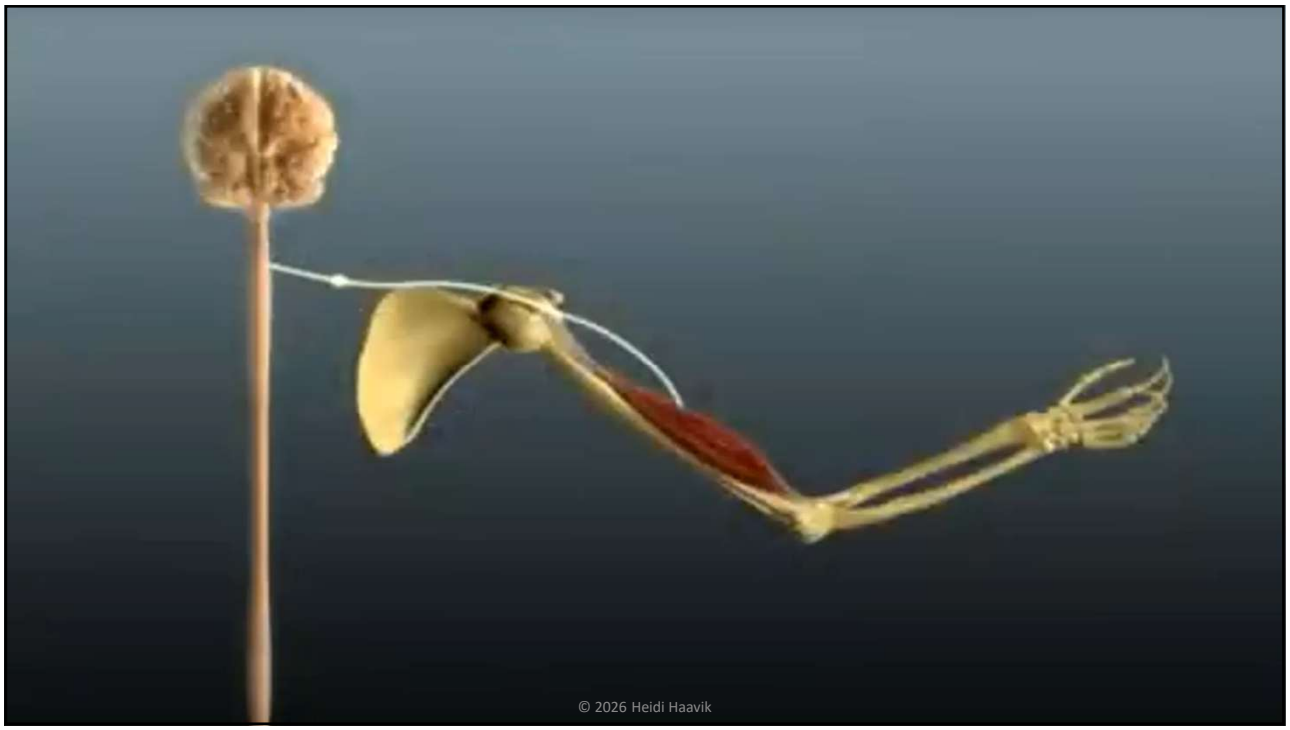


The first few weeks are mainly neural changes!!

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*(Moritani & DeVries (1979). "Neural factors versus hypertrophy in the time course of muscle strength gain." American journal of physical medicine & rehabilitation **58**(3): 115-130.)*

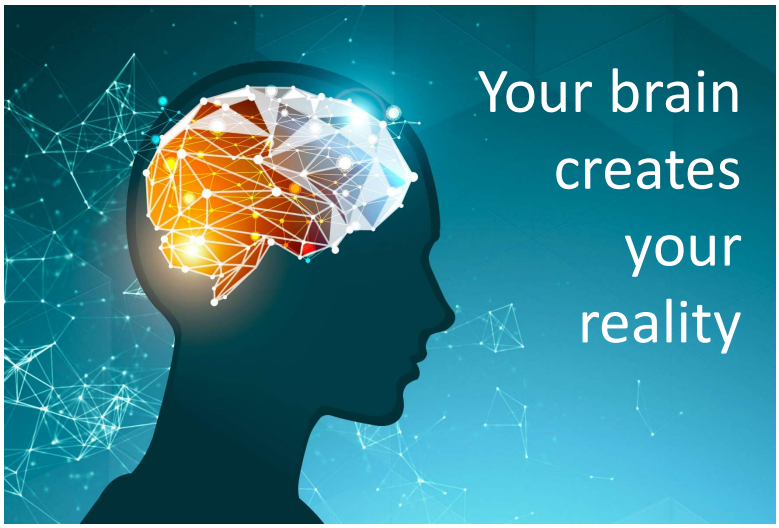
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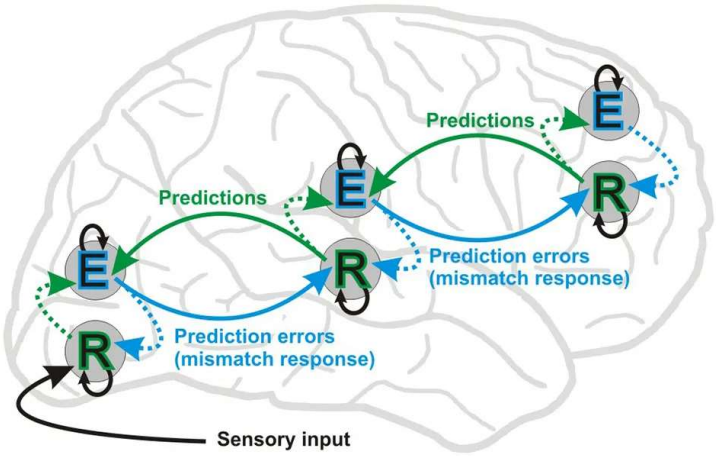

The predictive brain theory (or predictive processing) posits that the brain is an active prediction machine, not a passive receiver of sensory input. It continuously generates top-down models of the world to anticipate sensory data and minimize "prediction errors" (differences between expectation and reality), driving perception, cognition, decision-making, action, and learning.

*(Sprevak & Smith 2023 Top Cogn Sci; Millidge et al 2021* arXiv preprint arXiv:2107.12979*)*

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# Representations in the predictive model are built from past sensory input and learned regularities




**Simplified scheme of the hierarchical predictive coding framework**

*(Friston, 2010, Nat.Rev.Neurosci.)*

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*(Alexander & Brown 2018 Scientific Reports)*

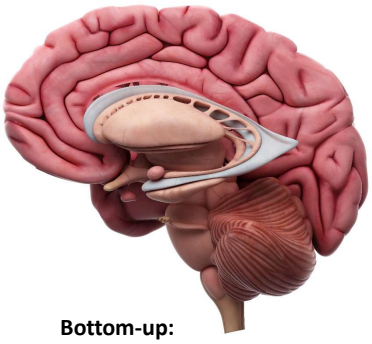
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**Top-down:**
- Predictions flow downward
- Suppress / "explain away" error

Sensory information is processed across distributed cortical hierarchies

At each level incoming input is compared against top-down predictions and prediction errors are generated.

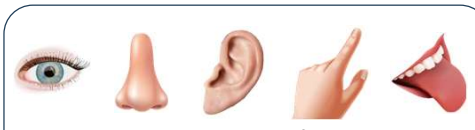
**Front:** Prediction & meaning

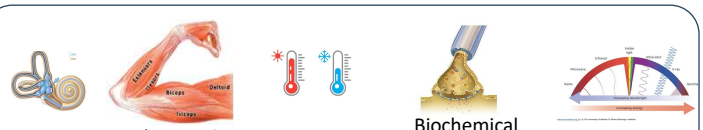


**Back:** Sensory input & error

These error messages are propagated upward and evaluated by salience-related systems (e.g., anterior cingulate and insula), while higher-order regions (e.g., prefrontal cortex) update internal models, which are then projected back down to shape ongoing perception.

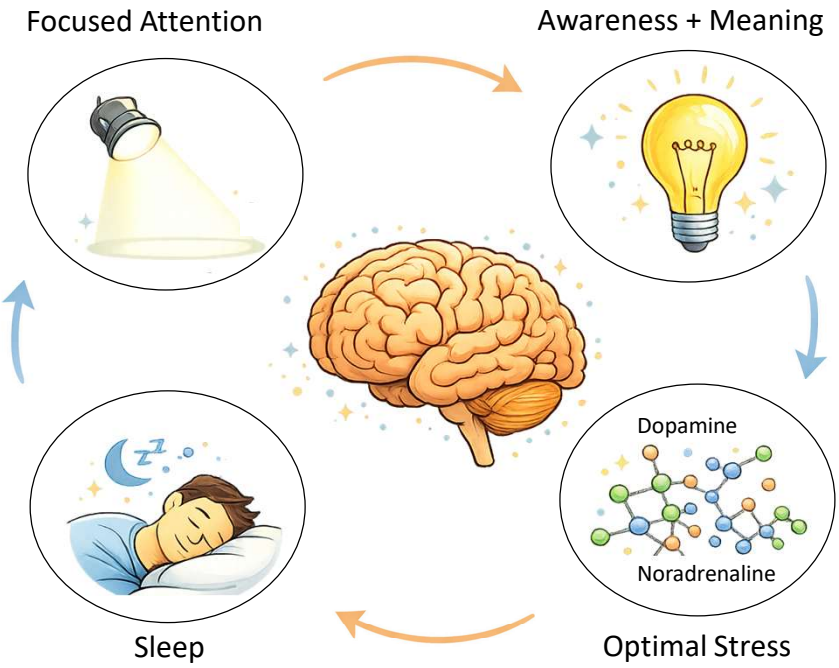
**Bottom-up:**
- Error detection travel upward
- Update higher-level models




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What is required for the Brain to Change?




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# 1. Focussed Attention

- You cannot change what the brain is not paying attention to
- Focused attention is required for cortical remapping
- Attention = precision weighting of sensory input



Acetylcholine (ACh)

*(Merzenich Van Vleet & Nahum, 2014 Frontiers in human neuroscience ; Friston, 2010* ***Nat. Rev. Neurosci****)*

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# 2. Awareness and Meaning

- The brain changes according to what is meaningful and relevant
- Salience Network determines what is important enough to update
- Brain change is driven by prediction errors that is noticed (and deemed important)



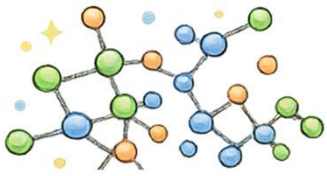
*(Seeley, Menon, et al 2007; Menon & Uddin, 2010; Friston, 2010 Nat. Rev. Neurosci)*

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# 3. Optimal Stress

- The brain changes when it gets something "wrong." When there is a mismatch between expectation and input = prediction error
- **Change requires enough mismatch to challenge the system**
  - Too little → no change
  - Too much → shutdown (threat, cortisol dominance)
  - Just right → plasticity
- **Dopamine** signals error and learning
  - Better than expected → move toward
  - Worse than expected → move away
- **Noradrenaline** optimizes arousal and signal-to-noise ratio
- **BDNF** = key molecular driver of plasticity



*(Alexander & Brown, 2018; Friston, 2010; Joëls et al 2006; Schultz, 2016; Aston-Jones & Cohen, 2005; Kowiański et al 2018)*

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# 4. Good sleep consolidates change

- Change doesn't stick unless it is stabilized
- During sleep, the brain replays what it has learned
- Connections are strengthened, refined, and reorganized
- New learning is integrated into existing brain networks
- Sleep is where change becomes real.



*(Stickgold & Walker, 2005; Marshall & Born, 2007; Lewis & Durrant, 2011; Faghel-Soubeyrand et al 2025)*

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# Lets think about the Adjustment

- Focused attention is first brought to the dysfunctional spinal segments through palpation and assessment
- The adjustment then delivers a novel, high-velocity sensory input
  → a strong burst of proprioceptive information to the brain
- This input represents a prediction error signal
  → particularly from areas that may have been underrepresented or misrepresented since first subluxated
- This is accompanied by known neurochemical responses
  → including changes in cortical excitability and neuromodulators
- We see associated changes in brain network function
  → including the Salience Network
- There is emerging evidence for changes in sleep and recovery
  → with improved sleep commonly reported clinically



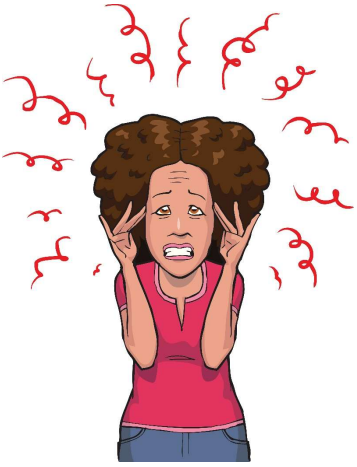


*(Haavik et al 2024 Brain Sciences ; Amjad et al 2025 PLoS One )*

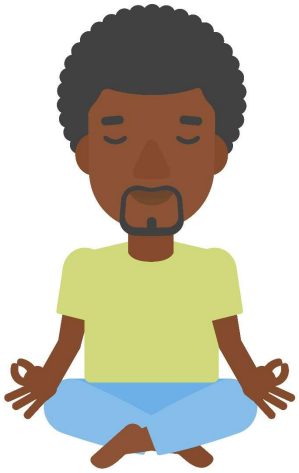
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# An example of bottom up change



You can ‘trick’ your brain (biohacking) into calming down with some nice, slow, big breaths.



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# An example of top-down change



You can induce a top-down change by for example re-framing a past trauma

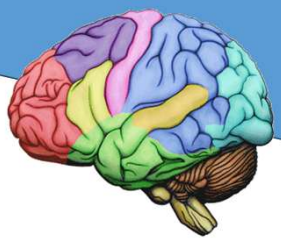


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## Adjustments Change both Bottom-up and Top-down

Directly changing multiple large scale brain networks that can change the story in the brain itself



Altering proprioceptive input to brain during and after adjustment (altered intersegmental range of motion)

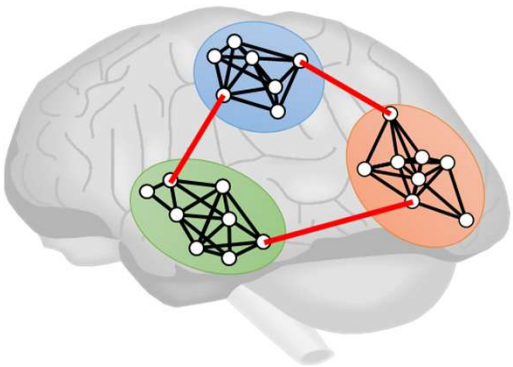


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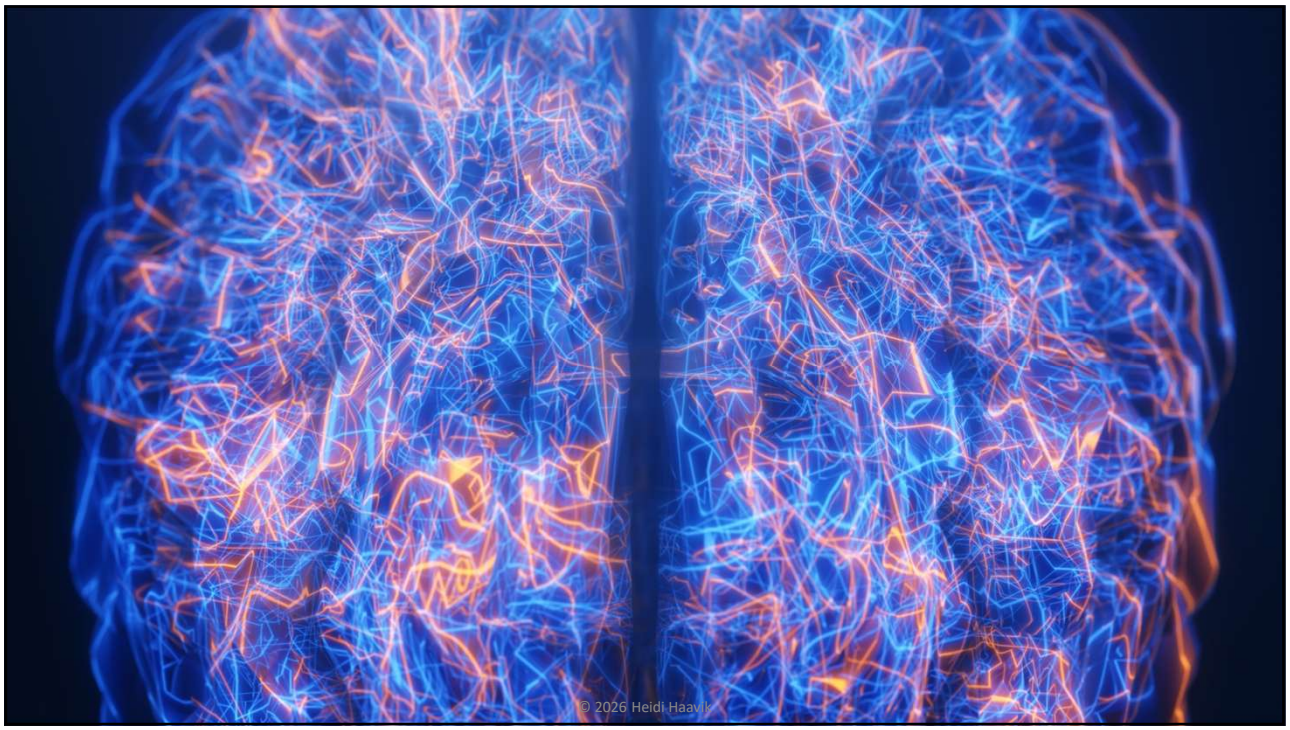
## Biological Networks in the Brain (and Hubs)

- A biological neural network in the brain is a complex network of neurons that are chemically connected by synapses.
- Neurons send and receive electrochemical signals to each other, and the brain uses these signals to process information.



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## Default Mode Network

Understanding thoughts, intentions and feelings of others, and predicting behavior

Inferior Posterior Parietal lobe
- Supramarginal gyrus
- Angular Gyrus

Emotional understanding & regulation of past, present and future

PCC

Constructing sense of self

Precuneus

Medial PFC
- vm PFC
- Orbitofrontal cortex
- Ventral ACC

Cerebellum

Hippocampus and Parahippocampus

(Sumos et al 2014)

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## Fronto-parietal (Executive Control) Network

- It is Goal and Task oriented
- When you are actively engaged in a task
- Actively paying attention (and not judging)
- Capable of recruiting a wide variety of brain systems
- Multiple FP / EC networks
- Key Regions
  - Dorsolateral PFC
  - Posterior parietal cortex (supramarginal gyrus)

dl PFC

Supramarginal gyrus

*(Witt, van Ettinger-Veenstra et al. 2021; Menon and D'Esposito 2022; Menon and D'Esposito 2022)*

## Salience Network

Dorsal Anterior Cingulate Cortex

Insular Cortex

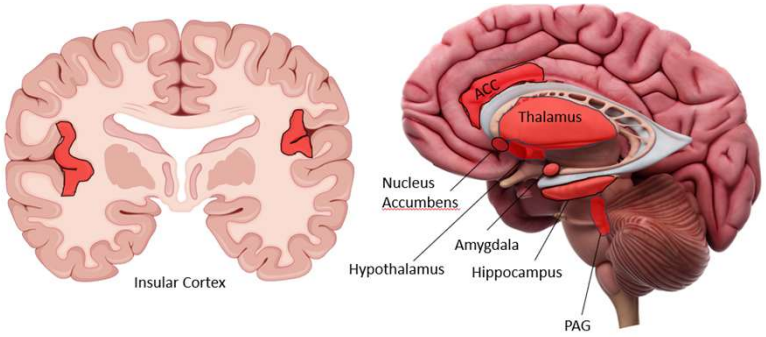
Core control network that guides all mental activity and behavior in humans

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# Salience Network

- **Not all errors matter!!**
- Salience Network decides what matters
- SN determines which errors are important enough to update the models
- Impacts the CEN and DMN



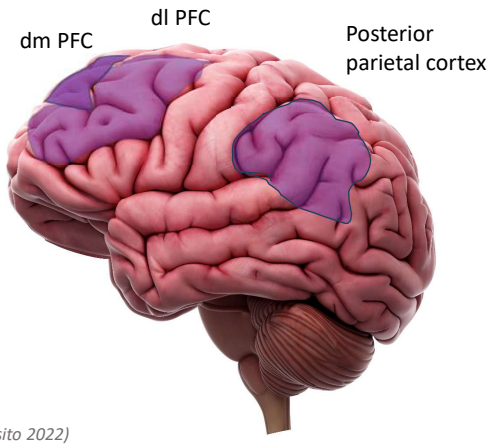

*(Seeley, 2019; Menon et al 2010)*

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# Central Executive Network (Fronto-parietal Network)

- SN activates the CEN
- Prefrontal cortex in CEN Updates the model
- Adjusts:
  - Behaviors
  - Beliefs
  - Strategies



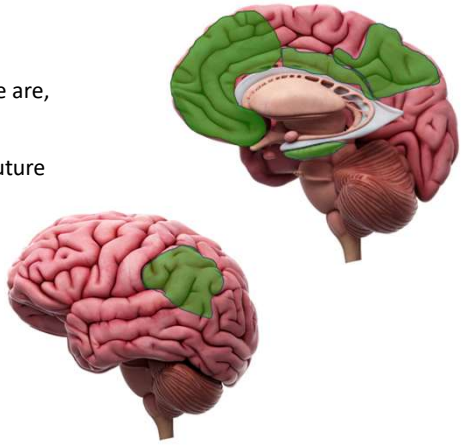

*(Witt et al. 2021; Menon and D'Esposito 2022)*

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# Default Mode Network

- When you are not in threat state, you DMN turns on
- Our internal model that creates our understanding of who we are, what is happening and what it means to us
- Emotional understanding & regulation of past, present and future
- Construction of the narrative sense of self, including autobiographical memories
- Learning and consolidating everyday experiences



*(Dumas et al 2014)*

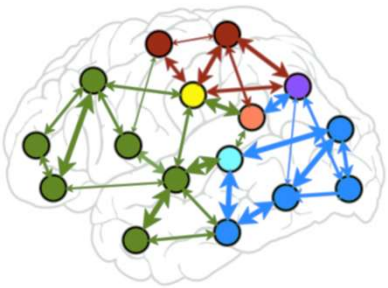
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# Characterising brain network activity changes following chiropractic care using whole head electroencephalography (EEG)

*(Haavik et al 2024, Brain Sciences; Ghani et al 2026, Brain Sciences)*





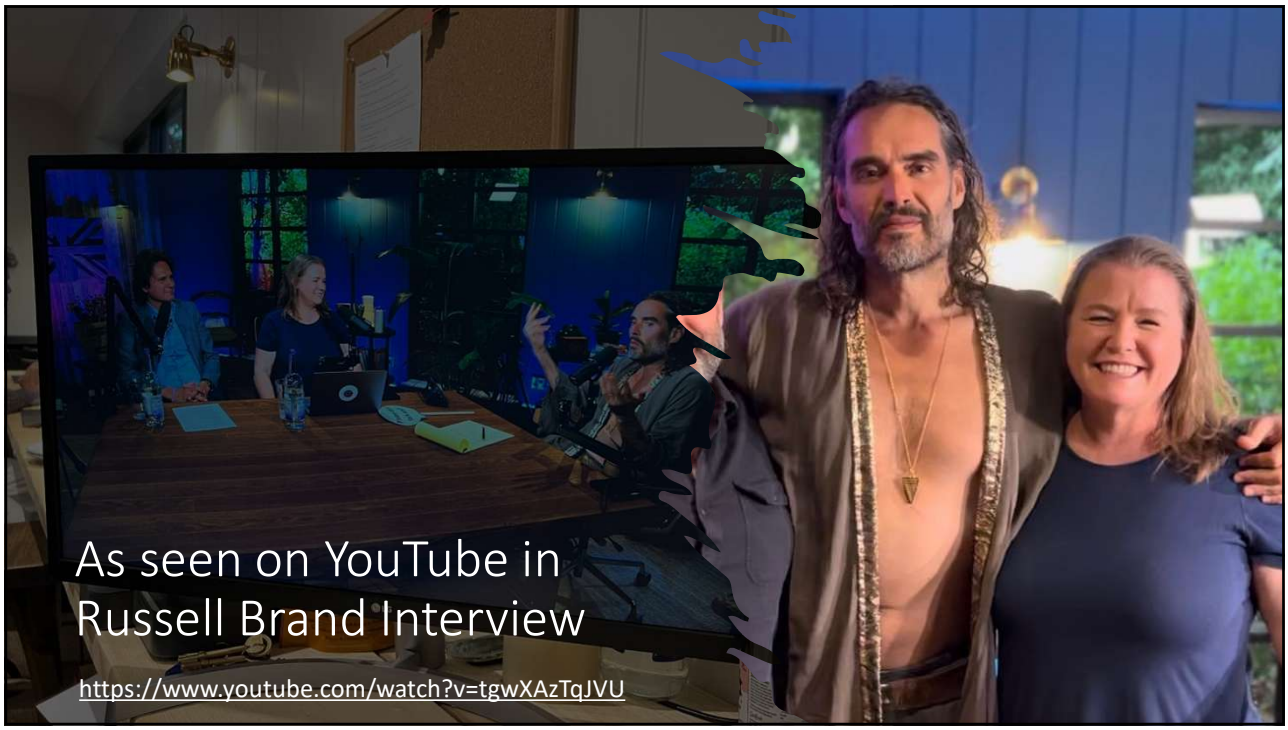
Dr Jerome Poupel





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## Patient's reported outcomes over 4 weeks

**Control Group**

NO significant changes at all

**Chiropractic Group**

- Improved QOL overall
- Improved Physical function
- Less Depression
- Less anxiety
- Less Fatigue
- Less pain interference
- Less pain intensity



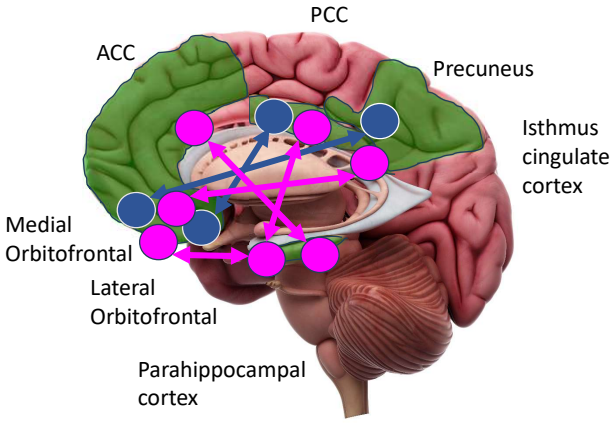
*(Haavik et al 2024, Brain Sciences)*

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# Default Mode Network changes after Chiro Care

## Pre and Post first session



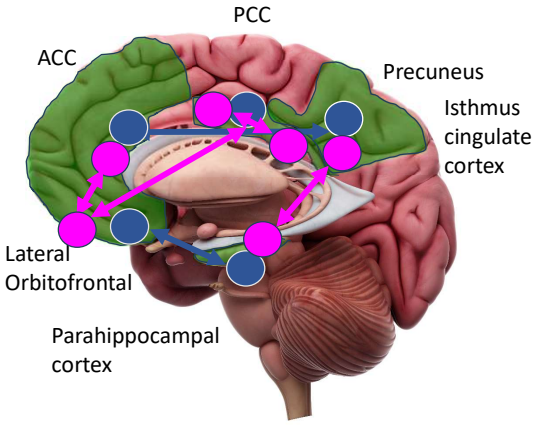

*(Haavik et al 2024, Brain Sciences)*

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# Default Mode Network changes after Chiro Care

## Pre and Post 4 weeks




*(Haavik et al 2024, Brain Sciences)*

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Unmedicated depressed people have significantly increased functional connectivity between the Precuneus and the prefrontal cortex

Increased functional connectivity of the posterior cingulate cortex with the lateral orbitofrontal cortex in depression (Cheng, Rolls et al. 2018B)



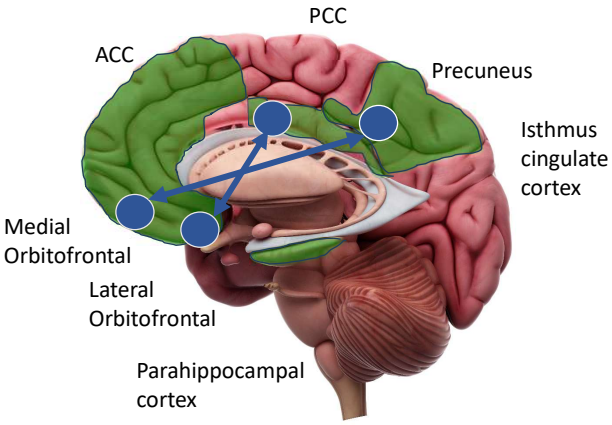
"The increased connectivity of the precuneus and/or PCC with the prefrontal cortex short-term memory system may contribute to the rumination about low self-esteem in depression."

*(Cheng, et al 2018A;* Cheng, Rolls et al. 2018B*)*

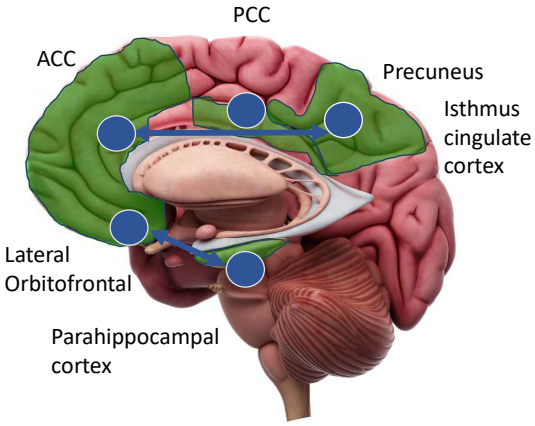
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## Pre and Post Chiro




## Pre and Post 4 weeks Chiro




# DMN changes after Chiro Care

*(Haavik et al 2024, Brain Sciences)*

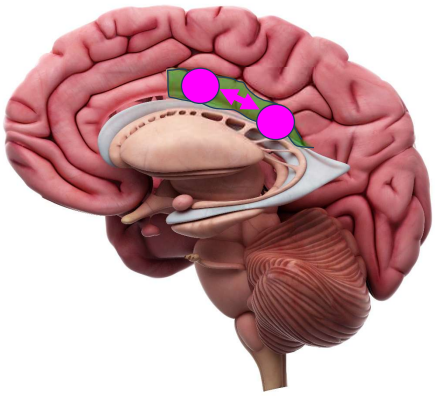
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# In depression there is asymmetry in the thickness of Posterior Cingulate Cortex

- PCC deals with internally focused, self-referential processing
- I.e. Construction of the narrative sense of self, including autobiographical memories
- Implicated in depression: ↑ cortical thickness in left vs right PCC
- Depressed individuals with higher somatic symptoms (e.g. sleep disturbance, appetite disturbance, and fatigue or loss of energy) have greater asymmetry in **PCC** thickness

*(Dotson et al. 2021; van Eijndhoven et al. 2013)*



SEPs Alpha ↑ L isthmus-cingulate- R PCC

"Thus, this change may reflect altered narrative sense of self in a manner that is reducing symptoms of depression and improvements in fatigue"

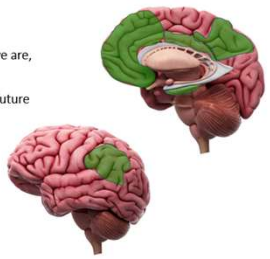
*(Haavik et al 2024, Brain Sciences)*

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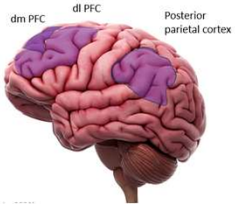
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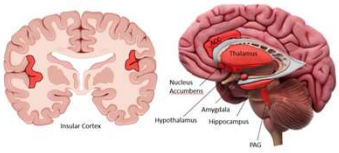
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  - Beliefs
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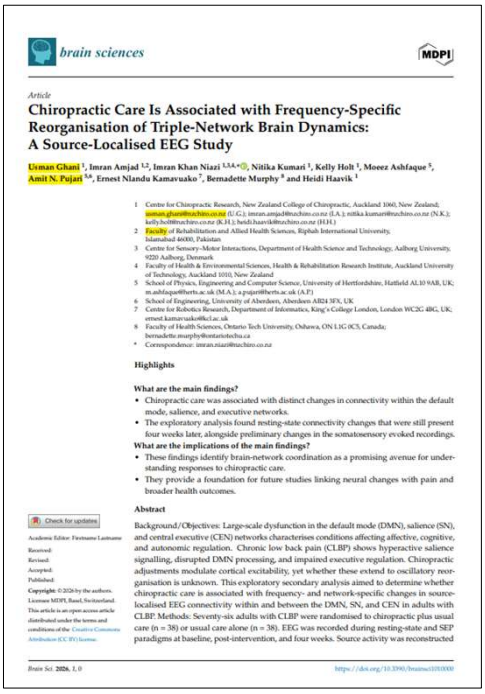
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# Published YESTERDAY!!

Usman Ghani, Imran Amjad, Imran Khan Niazi,Nitika Kumari, Kelly Holt, Moeez Ashfaque, Amit N. Pujari, Ernest Nlandu Kamavuako, Bernadette Murphy and Heidi Haavik.

Chiropractic Care Is Associated with Frequency-Specific Reorganisation of Triple-Network Brain Dynamics: A Source-Localised EEG Study.

*Brain Sciences. 2026; In press.*



brain sciences

MDPI

Article

**Chiropractic Care Is Associated with Frequency-Specific Reorganisation of Triple-Network Brain Dynamics: A Source-Localised EEG Study**

Usman Ghani [1], Imran Amjad [1,2], Imran Khan Niazi [1,3,4,*], Nitika Kumari [1], Kelly Holt [1], Moeez Ashfaque [5], Amit N. Pujari [5,6], Ernest Nlandu Kamavuako [7], Bernadette Murphy [8] and Heidi Haavik [1]

1 Centre for Chiropractic Research, New Zealand College of Chiropractic, Auckland 1060, New Zealand; usman.ghani@nzchiro.co.nz (U.G.); imran.amjad@nzchiro.co.nz (I.A.); nitika.kumari@nzchiro.co.nz (N.K.); kelly.holt@nzchiro.co.nz (K.H.); heidi.haavik@nzchiro.co.nz (H.H.)
2 Faculty of Rehabilitation and Allied Health Sciences, Riphah International University, Islamabad 46000, Pakistan
3 Centre for Sensory–Motor Interactions, Department of Health Science and Technology, Aalborg University, 9220 Aalborg, Denmark
4 Faculty of Health & Environmental Sciences, Health & Rehabilitation Research Institute, Auckland University of Technology, Auckland 1010, New Zealand
5 School of Physics, Engineering and Computer Science, University of Hertfordshire, Hatfield AL10 9AB, UK; m.ashfaque@herts.ac.uk (M.A.); a.pujari@herts.ac.uk (A.P.)
6 School of Engineering, University of Aberdeen, Aberdeen AB24 3FX, UK
7 Centre for Robotics Research, Department of Informatics, King's College London, London WC2G 4BG, UK; ernest.kamavuako@kcl.ac.uk
8 Faculty of Health Sciences, Ontario Tech University, Oshawa, ON L1G 0C5, Canada; bernadette.murphy@ontariotechu.ca
* Correspondence: imran.niazi@nzchiro.co.nz

**Highlights**

**What are the main findings?**

- Chiropractic care was associated with distinct changes in connectivity within the default mode, salience, and executive networks.
- The exploratory analysis found resting-state connectivity changes that were still present four weeks later, alongside preliminary changes in the somatosensory evoked recordings.

**What are the implications of the main findings?**

- These findings identify brain-network coordination as a promising avenue for understanding responses to chiropractic care.
- They provide a foundation for future studies linking neural changes with pain and broader health outcomes.

**Abstract**

Background/Objectives: Large-scale dysfunction in the default mode (DMN), salience (SN), and central executive (CEN) networks characterises conditions affecting affective, cognitive, and autonomic regulation. Chronic low back pain (CLBP) shows hyperactive salience signalling, disrupted DMN processing, and impaired executive regulation. Chiropractic adjustments modulate cortical excitability, yet whether these extend to oscillatory reorganisation is unknown. This exploratory secondary analysis aimed to determine whether chiropractic care is associated with frequency- and network-specific changes in source-localised EEG connectivity within and between the DMN, SN, and CEN in adults with CLBP. Methods: Seventy-six adults with CLBP were randomised to chiropractic plus usual care (n = 38) or usual care alone (n = 38). EEG was recorded during resting-state and SEP paradigms at baseline, post-intervention, and four weeks. Source activity was reconstructed

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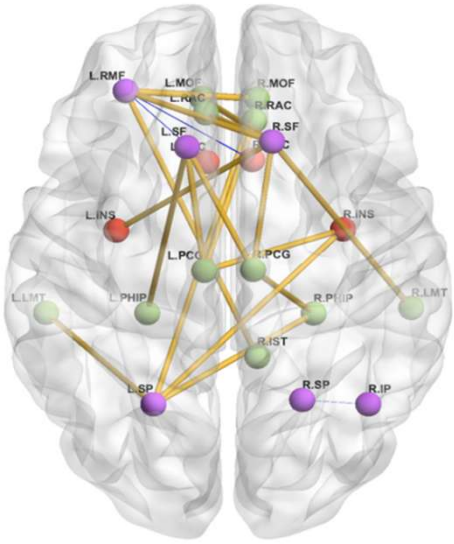
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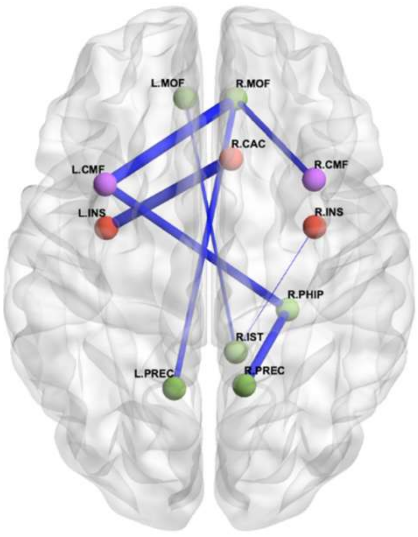


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# After first Adjustment session Chiro Group

rEEG




Alpha

*(Ghani et al 2026, Brain Sciences, Fig6 & 9)*

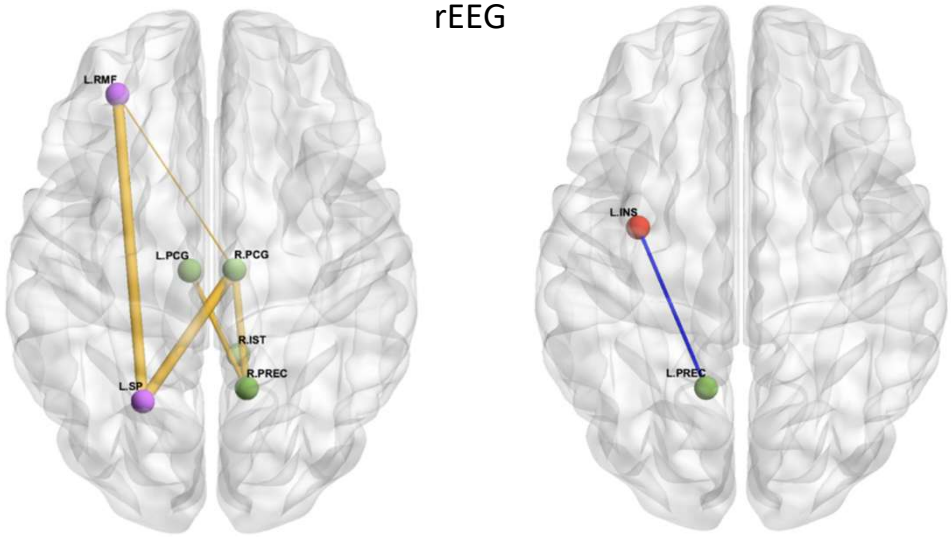
Beta

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# Pre vs 4 weeks Chiro Group Brain changes

rEEG



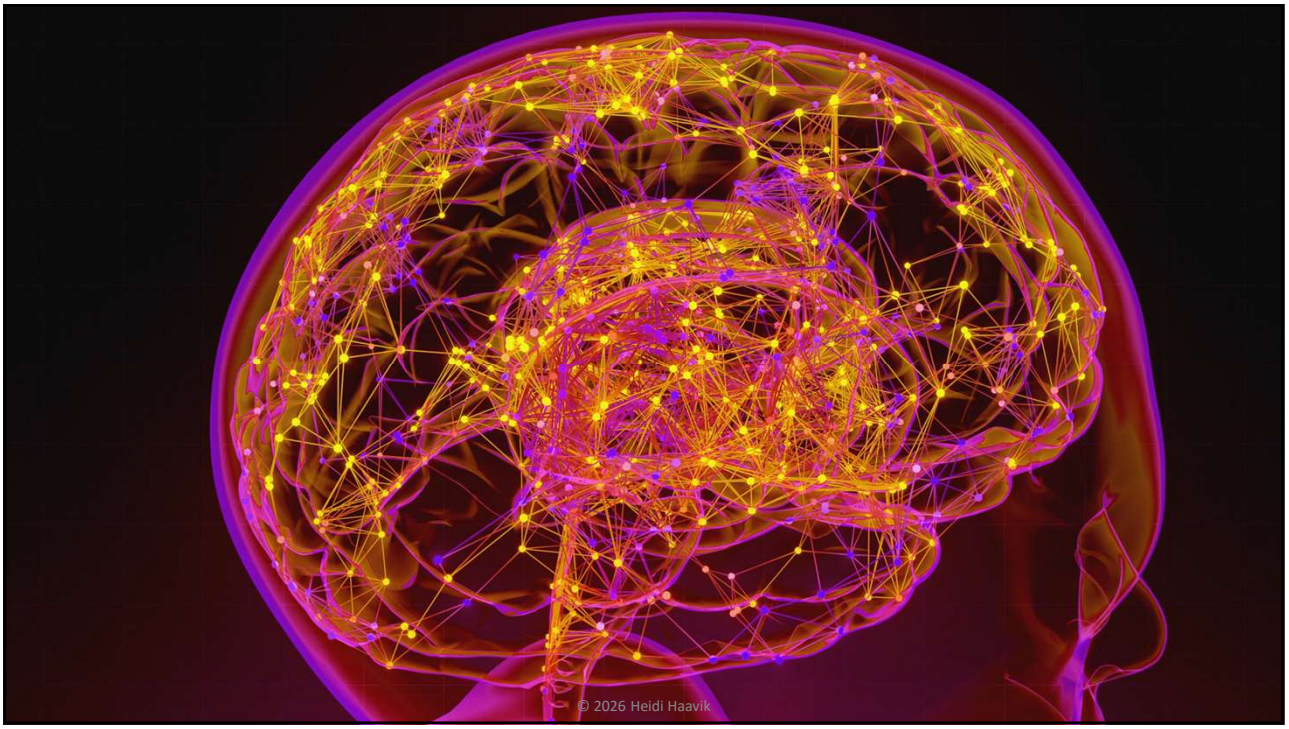

Alpha

*(Ghani et al 2026, Brain Sciences, Fig7 & 10)*

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**Triple Brain Network**

The Triple Brain Network, including the Default Mode Network, Salience Network and the Central Executive Network.




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AUSTRALIAN spinal research FOUNDATION



Hamblin Chiropractic Research Fund Trust

NEW ZEALAND COLLEGE of CHIROPRACTIC



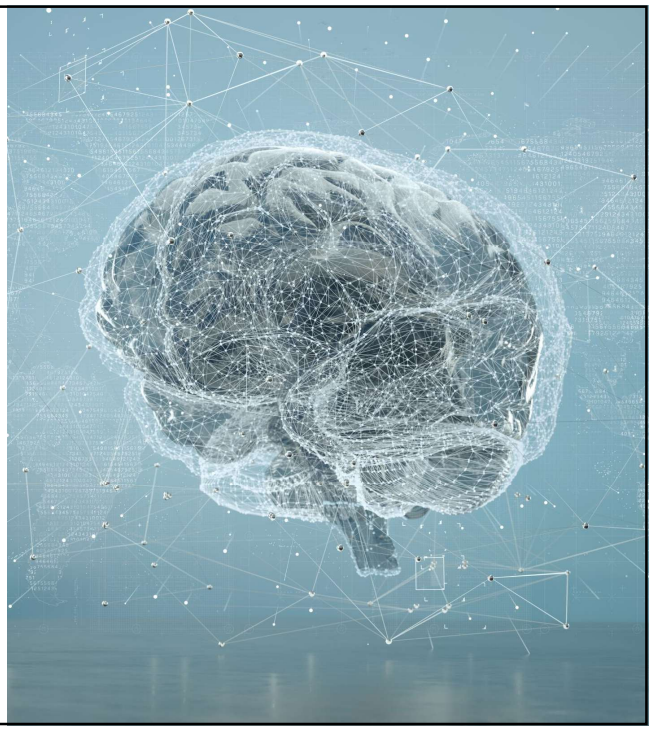
NCMIC We Take Care of Our Own

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## So how do you communicate this to the public?

- I would NOT use the big words I have used today
- I would talk about
  - Rebooting the brain like a computer
  - Reprogramming the brain
  - Allowing the brain to recalibrate

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ChirosHub



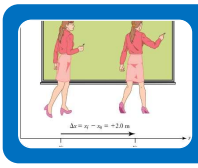
**Searching the Literature**

- Search engines
- Key word strategies



**Evaluating the literature**

- Strengths and weaknesses of different methodologies
- Hierarchy of evidence



**Translating the evidence**

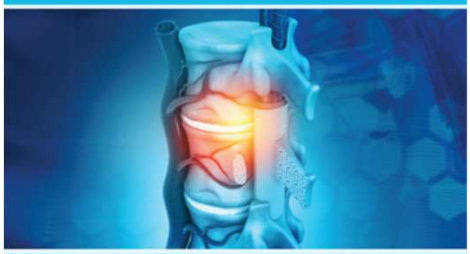
- Simplifying key findings
- Translating meaning to patient language

ChirosHub.com

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PA2

## Effects of an Adjustment



*Did you know that Chiropractors adjust dysfunctional segments in your spine called subluxations?*

Recent scientific studies are revealing a new understanding about how chiropractic spinal adjustments work. We know much more about how the brain and the rest of the central nervous system functions.



**What is a subluxation?**

Originally, many people thought that dysfunctional 'subluxated' spinal segments were 'out of place', or misaligned, and that this put pressure on the nerves exiting the spine. We now know that a vertebral subluxation is not so much the condition of a bone being out of place; it is more that a bone is functioning or moving in a less than ideal way – in a manner that is not 'normal' for the body.

1

## Keep your Spine Moving



*Did you know that even the ancient Greeks knew that movement and physical exercise was good for your brain?*

Modern scientists have shown that movement is one of the keys to promoting a healthy brain.[1] Movement has been shown to help people with dementia, depression, and ADHD.[2]



**Why is spinal movement important?**

Scientists now know that it's not just physical exercise that's important for your brain, but how your spine moves is also very important for keeping your brain healthy. It's even been shown to change the structure of your brain and improve your concentration and how fast you can think and react.[3,4]

1

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# ARE YOU A CONFIDANT COMMUNICATOR?



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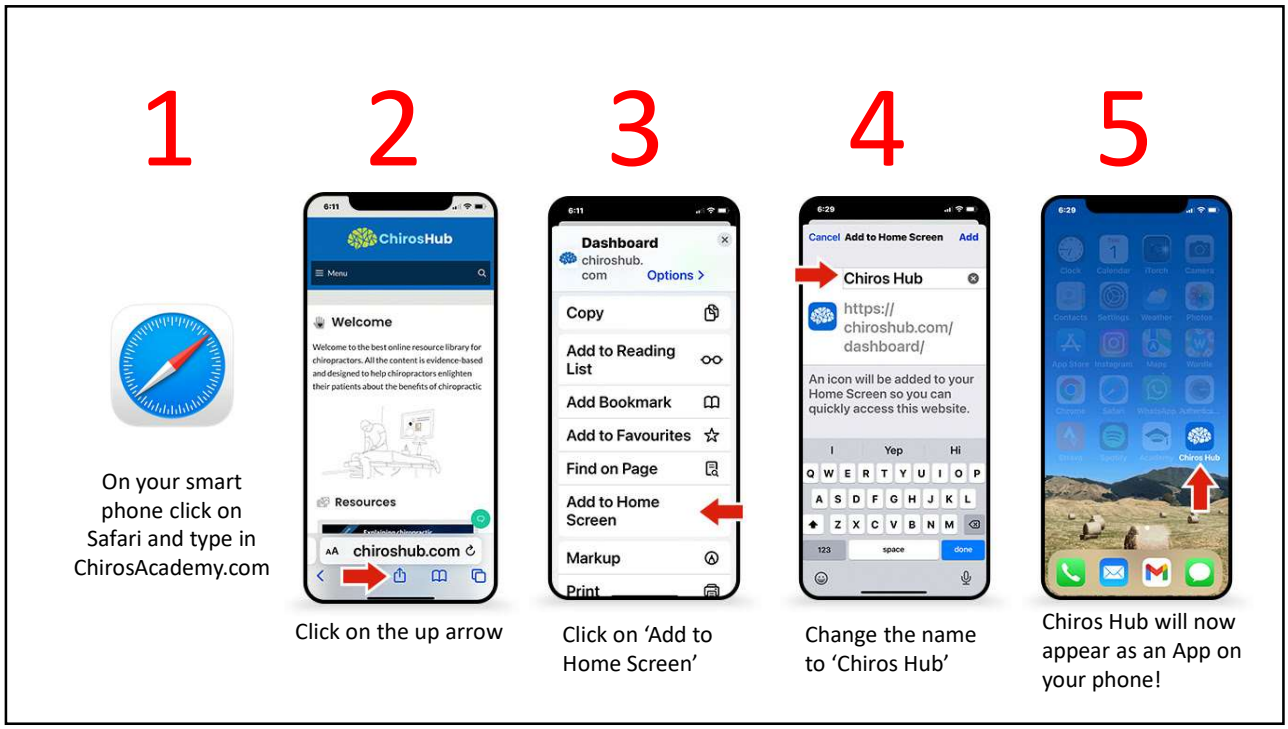
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Neck Pain
Pain is Created in the Brain
Understanding Pain
Lower Back Pain
The Opioid Epidemic
Keep your Spine Moving
Maintenance Care
Did you know that even the ancient Greeks knew that movement and physical exercise was good for your brain?
Why is spinal movement important?
Did you know that 50% of patients visit a chiropractor simply to maintain their health and well-being!
What is maintenance care?
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2
3
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5
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ChirosHub
Welcome
Resources
chiroshub.com
Click on the up arrow
Dashboard
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Options
Copy
Add to Reading List
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Add to Favourites
Find on Page
Add to Home Screen
Markup
Print
Click on 'Add to Home Screen'
Cancel
Add to Home Screen
Add
Chiros Hub
https://chiroshub.com/dashboard/
An icon will be added to your Home Screen so you can quickly access this website.
Change the name to 'Chiros Hub'
Chiros Hub will now appear as an App on your phone!

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# Questions for Heidi?



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THE CHIROPRACTIC ASSOCIATION SINGAPORE

NEW ZEALAND COLLEGE of CHIROPRACTIC

TE KĀRETI KAIKOROHITI o AOTEAROA

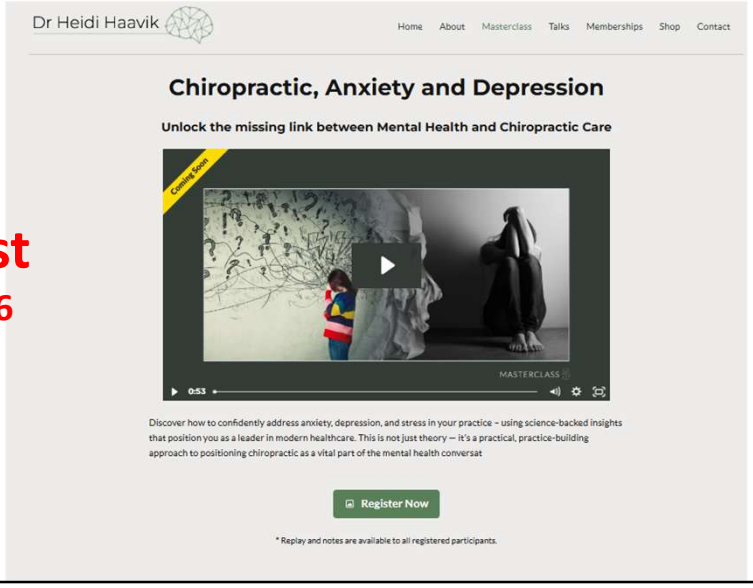
THE ALLIANCE OF CHIROPRACTIC SINGAPORE

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**August**
**7th 2026**




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Drinks & Nibbles
Sat 5pm
Hotel Lobby Bar

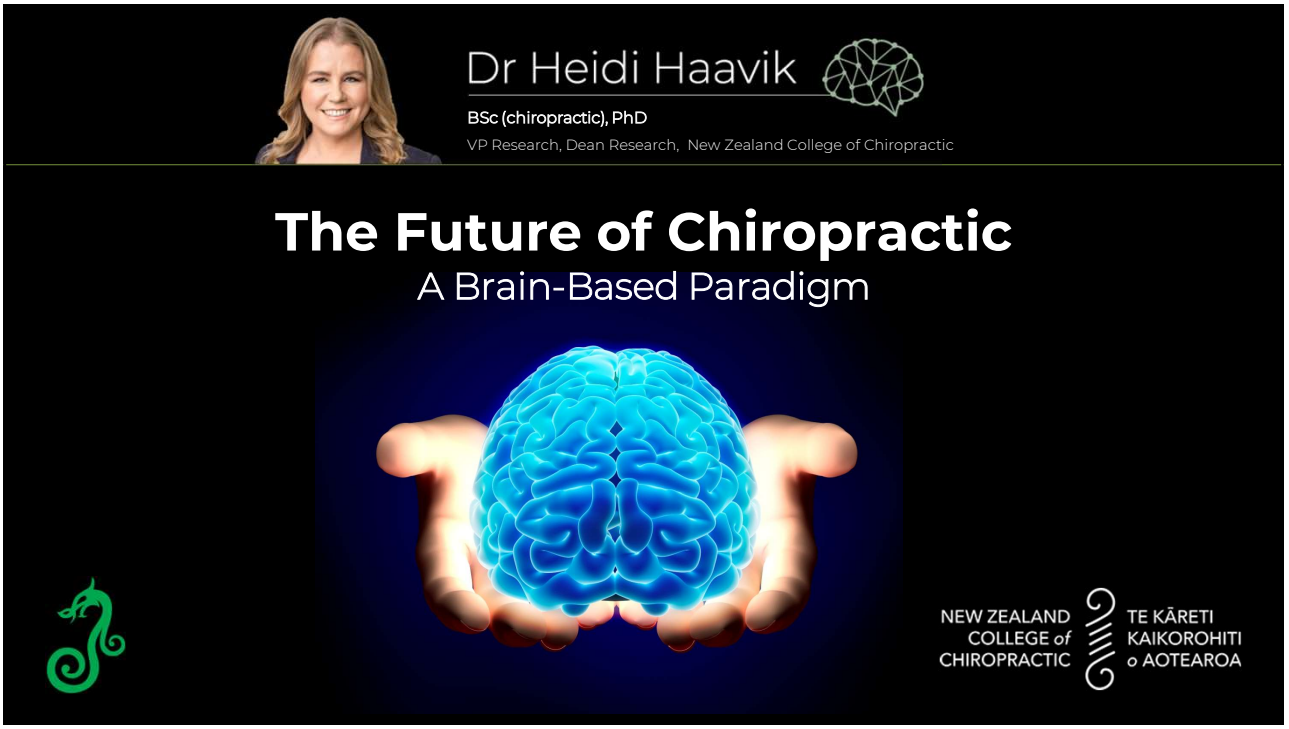
NEW ZEALAND COLLEGE of CHIROPRACTIC
TE KĀRETI KAIKOROHITI o AOTEAROA



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Dr Heidi Haavik
HeidiHaavik.com
The HANDOUT for today's Class (the slides)
Gift
Maintenance Care
Did you know that 50% of patients visit a chiropractor simply to maintain their health and well-being!
Gift
Maintaining Body and World Schemas (Perception of Reality)
Pain Processing
Movement Control
Language
Learning New Movements and Skills
Cognition (Thinking)
Emotional Control and Mental Health
Autonomic Nervous System Function
THE CEREBELLUM

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Dr Heidi Haavik
BSc (chiropractic), PhD
VP Research, Dean Research, New Zealand College of Chiropractic
The Future of Chiropractic
A Brain-Based Paradigm
NEW ZEALAND COLLEGE of CHIROPRACTIC
TE KĀRETI KAIKOROHITI o AOTEAROA

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THE CHIROPRACTIC ASSOCIATION SINGAPORE

NEW ZEALAND COLLEGE of CHIROPRACTIC | TE KĀRETI KAIKOROHITI o AOTEAROA

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Dr Heidi Haavik

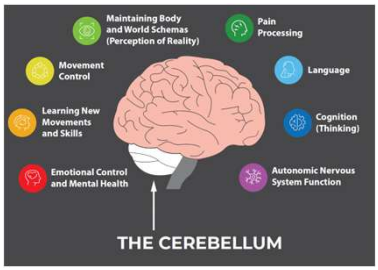
HeidiHaavik.com

The HANDOUT for today's Class (the slides)

Gift




Gift



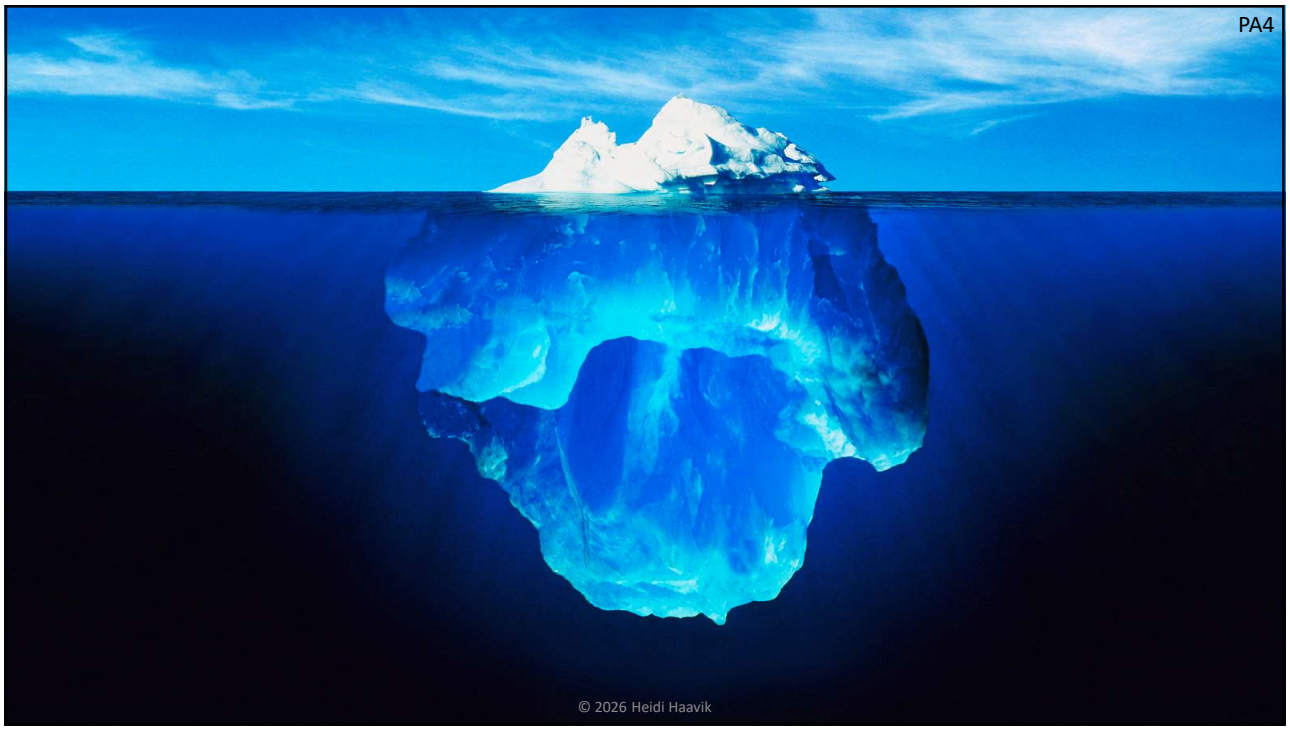

110

# Questions for Heidi?



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PA4




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# VS today vs 2 years ago

- Confused Brain
- Possibly clumsy
- Possibly feel pain

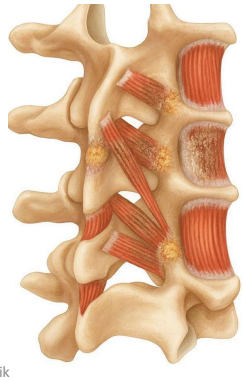




- Inaccurate inner body scheme or external world schema
- Poor body awareness
- Poor body control
- Reduced resilliance
- Probably causing microtraumas daily
- May not be retaining learnt movements

- Larger in size
- Slow-twitch fibre type
- Minimal fatty infiltration
- Move freely
- Healthy stretch receptors (muscle spindles)



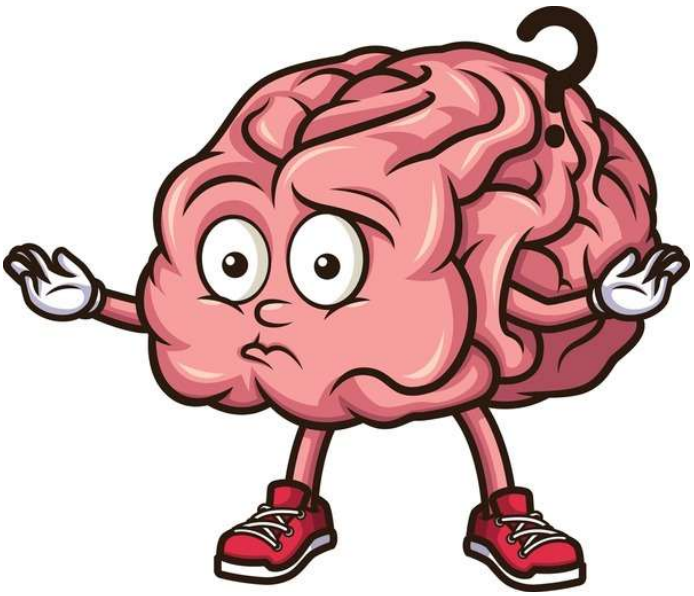


- Stiff and Fibrotic
- Atrophied (shrunk)
- Fatty infiltration
- Change fibre type
- Stretch receptors dysfunction

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A confused brain is worse than you might think!



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Rheumatology 2005;44:509–516 doi:10.1093/rheumatology/keh529
Advance Access publication 11 January 2005

## Simulating sensory–motor incongruence in healthy volunteers: implications for a cortical model of pain

C. S. McCabe, R. C. Haigh[1], P. W. Halligan[2] and D. R. Blake

*Objectives.* Conflict between motor–sensory central nervous processing has been suggested as one cause of pain in those conditions where a demonstrable or local nociceptive aetiology cannot be convincingly established (e.g. complex regional pain syndrome type 1, repetitive strain injury, phantom limb pain and focal hand dystonia). The purpose of this study was to discover whether pain could be induced in pain-free healthy volunteers when this conflict was generated transiently in a laboratory setting.

*Methods.* Forty-one consecutively recruited healthy adult volunteers without a history of motor or proprioceptive disorders performed a series of bilateral upper and lower limb movements whilst viewing a mirror/whiteboard, which created varied degrees of sensory–motor conflict during congruent/incongruent limb movements. A qualitative method recorded any changes in sensory experience.

*Results.* Twenty-seven subjects (66%) reported at least one anomalous sensory symptom at some stage in the protocol despite no peripheral nociceptive input. The most frequent symptoms occurred when incongruent movement was performed whilst viewing the reflected limb in the mirror condition, the time of maximum sensory–motor conflict. Symptoms of pain were described as numbness, pins and needles, moderate aching and/or a definite pain. Other sensations included perceived changes in temperature, limb weight, altered body image and disorientation. There were indications that some individuals were more susceptible to symptom generation than others.

*Conclusions.* Our findings support the hypothesis that motor–sensory conflict can induce pain and sensory disturbances in some normal individuals. We propose that prolonged sensory–motor conflict may induce long-term symptoms in some vulnerable subjects.

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(McCabe et al 2005)

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66% reported at least one of the following symptoms:

- Numbness
- Pins and needles
- Change in temperature
- Change in limb weight
- Body image distortion
- Moderate aching
- Definite pain

*(McCabe et al 2005)*

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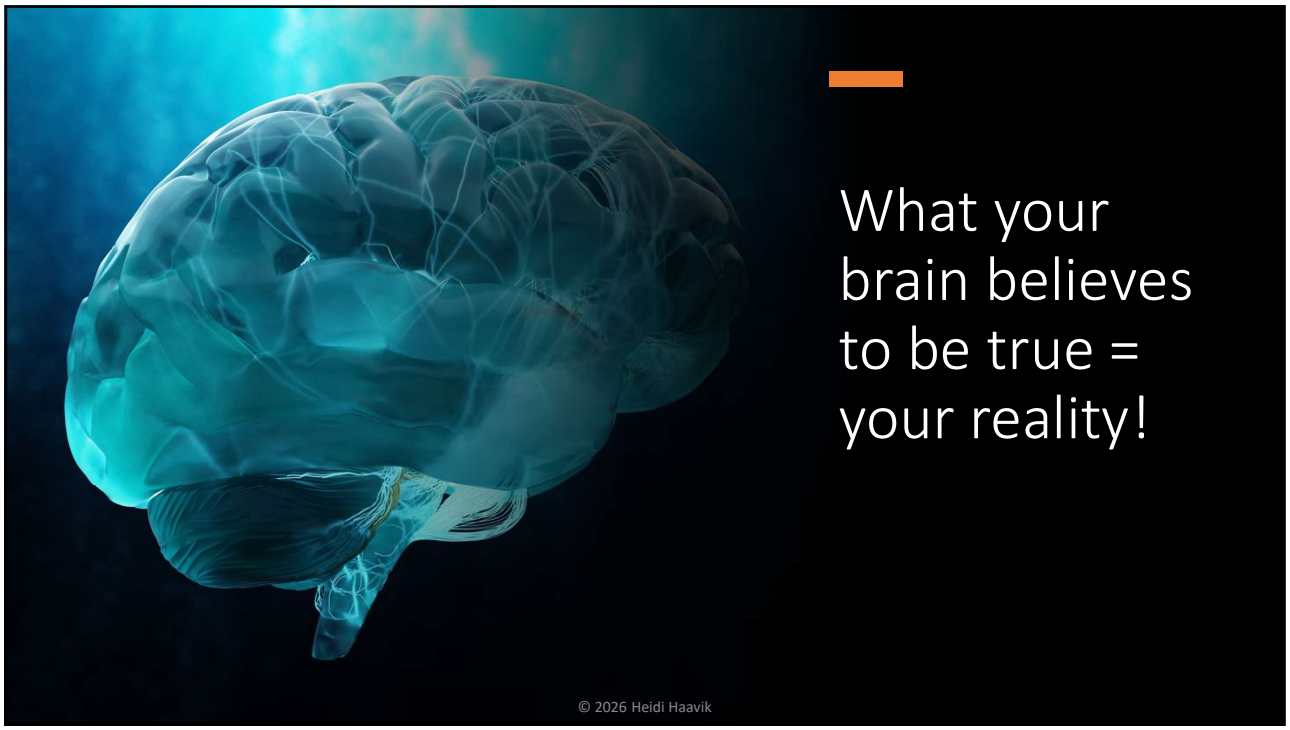
117



# Pain

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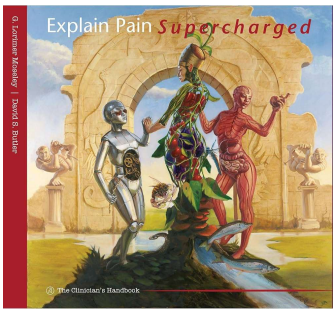


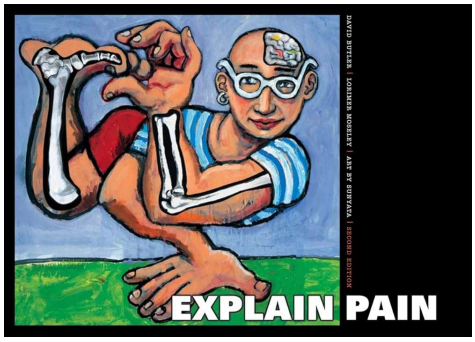

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## Pain is not a direct indicator of tissue damage, but rather a protective output of the brain

- Pain is not a measure of tissue damage but a protective mechanism
- Pain reflects the brain's evaluation of threat, not tissue state
- Pain can persist without ongoing tissue damage, driven by altered processing
- Chronic pain reflects maladaptive neuroplasticity in the brain (structural & functional changes)

*(Moseley 2007 Physical therapy reviews **12**(3): 169-178; Moseley & Butler 2015, The Journal of Pain; Moseley & Butler 2013; Apkarian et al 2011 Pain)*




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PA16

# Symptoms don’t just appear out of thin air



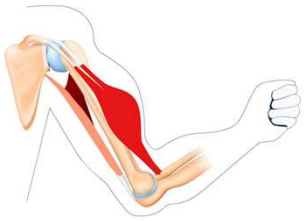
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HAAVIK RESEARCH

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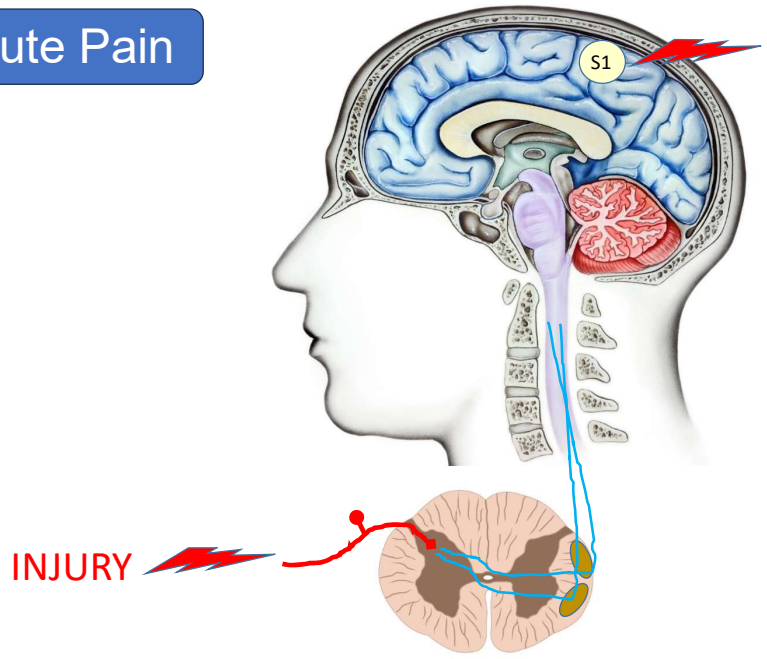
# Microtrauma



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## Acute Pain




This was the old 'structural pathology model' of pain. However, the latest research shows this is far too simplistic

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# Chronic Pain

Systemic inflammation

Stress autonomic sympathetic activation

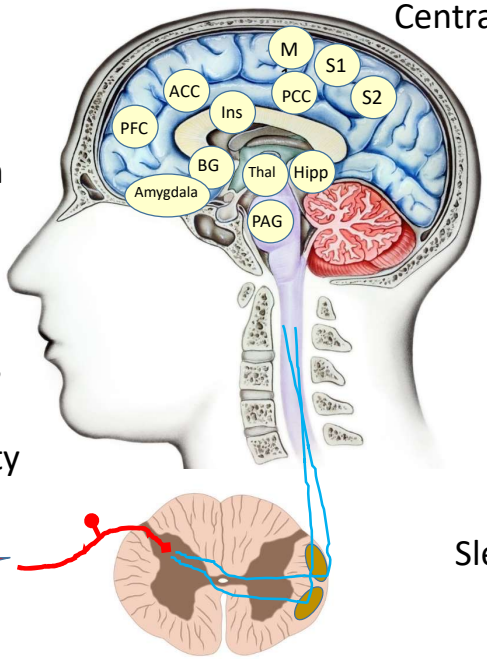
Mental health issues

Expectations

Poverty

Diet

INJURY




Central neuroimmune Influences

Stress HPA activation

Attitudes & Personality

Social problems

Learning effects

Thoughts

Sleep

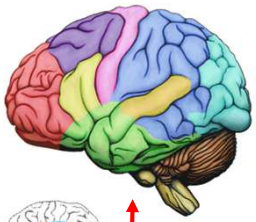
Microbiome

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PA17

# Acute Pain

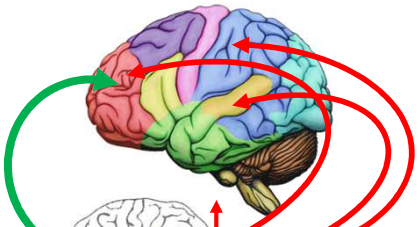


INJURY

Nociception

Acute pain is a physiological response that causes an unpleasant sensory and emotional experience in the presence of actual or potential tissue injury.

# Chronic Pain



Emotional Amplification and learning!

~~Nociception~~

Chronic pain is defined as persistent or recurrent pain lasting longer than 3 months

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*(De Ridder et al. 2022; Khera & Rangasamy 2021; Baliki et al 2015; Thompson & Neugebauer 2017; Vachon-Presseau et al 2016)*

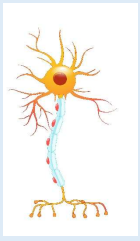
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# Neuroplasticity

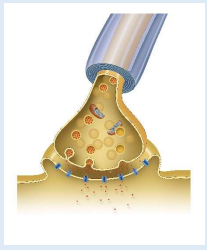
## Cellular Level

### Structural Plasticity



Number, size, density and/or morphology of:
- Dendritic spines
- Axons
- Synapses

### Functional (Synaptic) Plasticity



- Long term potentiation
- Long term depression
- Homeostatic plasticity

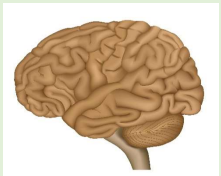
## Network Level

### Structural network Plasticity



– Gray matter density changes
– Changes in size of nuclei, ganglia etc.

### Functional Network Plasticity



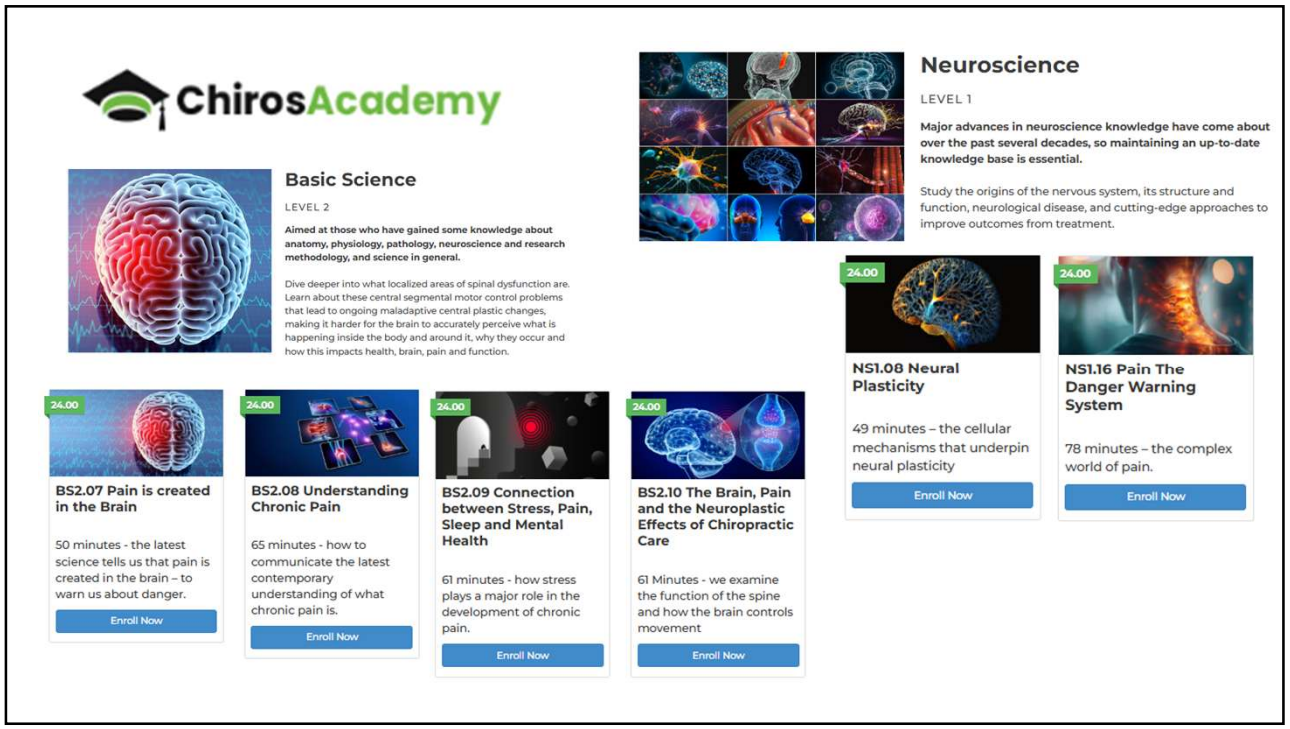
– Sensory maps
– Motor maps
– Inner body schema
– External world schema

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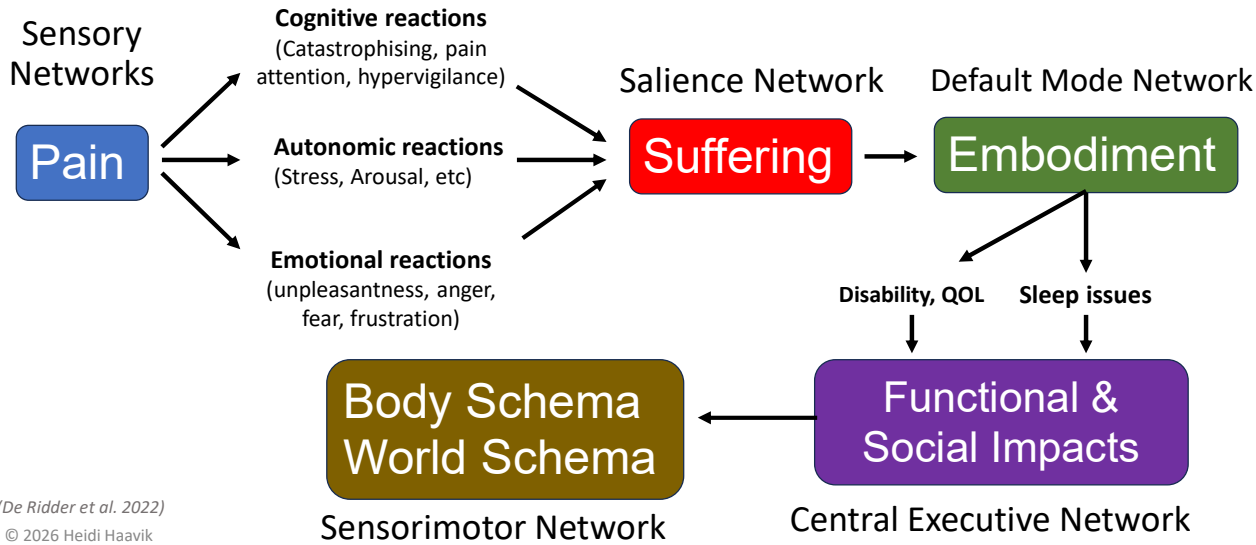

ChirosAcademy
Basic Science
LEVEL 2
Aimed at those who have gained some knowledge about anatomy, physiology, pathology, neuroscience and research methodology, and science in general.
Dive deeper into what localized areas of spinal dysfunction are. Learn about these central segmental motor control problems that lead to ongoing maladaptive central plastic changes, making it harder for the brain to accurately perceive what is happening inside the body and around it, why they occur and how this impacts health, brain, pain and function.
24.00
BS2.07 Pain is created in the Brain
50 minutes - the latest science tells us that pain is created in the brain – to warn us about danger.
Enroll Now
24.00
BS2.08 Understanding Chronic Pain
65 minutes - how to communicate the latest contemporary understanding of what chronic pain is.
Enroll Now
24.00
BS2.09 Connection between Stress, Pain, Sleep and Mental Health
61 minutes - how stress plays a major role in the development of chronic pain.
Enroll Now
24.00
BS2.10 The Brain, Pain and the Neuroplastic Effects of Chiropractic Care
61 Minutes - we examine the function of the spine and how the brain controls movement
Enroll Now
Neuroscience
LEVEL 1
Major advances in neuroscience knowledge have come about over the past several decades, so maintaining an up-to-date knowledge base is essential.
Study the origins of the nervous system, its structure and function, neurological disease, and cutting-edge approaches to improve outcomes from treatment.
24.00
NS1.08 Neural Plasticity
49 minutes – the cellular mechanisms that underpin neural plasticity
Enroll Now
24.00
NS1.16 Pain The Danger Warning System
78 minutes – the complex world of pain.
Enroll Now

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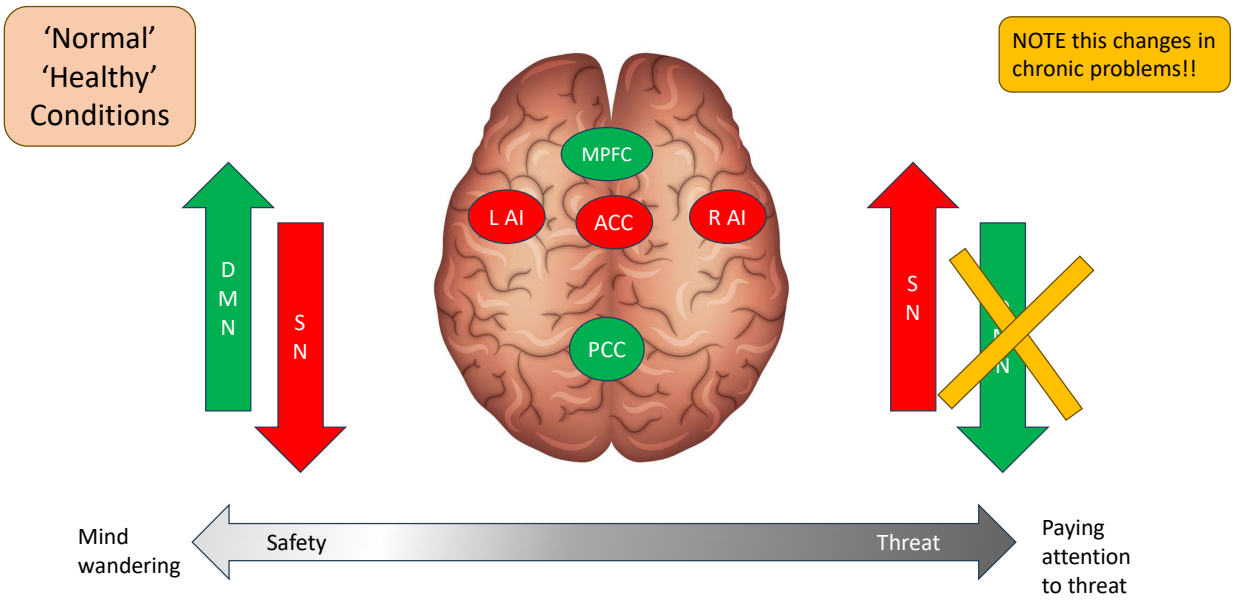
## Pathway to Chronic Pain and Suffering




*(De Ridder et al. 2022)*

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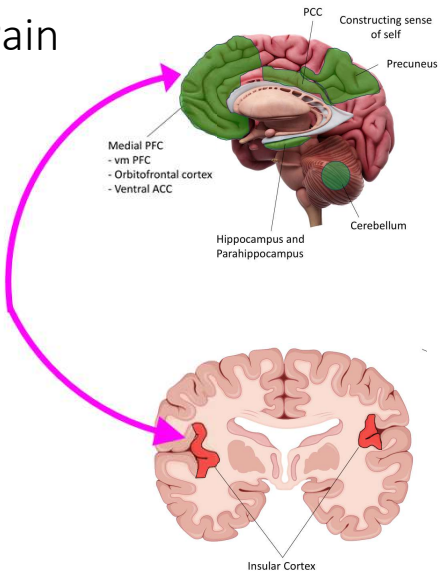

(Adapted from Johansson et al 2023)

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## Increased connectivity in Chronic Pain

- The default mode network, which controls self-representational processing has been suggested to become pathologically coupled to pain provoking networks in chronic pain.
- The longer the pain exists, the stronger the connections between the insular cortex and the medial prefrontal cortex.



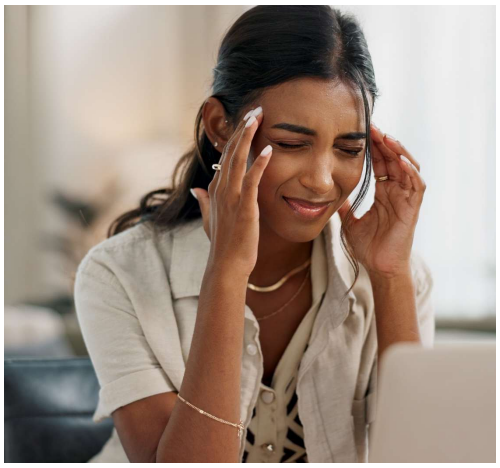

*(De Ridder et al. 2022; Baliki et al 2014)*

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# Why Pain Becomes Chronic

- "The relevance of this finding is enormous, since it could provide a neurobiological explanation for why in chronic pain becomes embodied, that is, becomes an integral part of the self, making treatments more difficult."
- "When the suffering is chronic, not only may the pain become a part one's identity, but fear can develop into worry/anxiety and the sadness into depression."



*(De Ridder et al. 2022)*

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# Why might these changes occur?

**Sympathetic system activation** increases energy consumption by **15–35%**

**Acute pain** increases the daily energy expenditure by **60%**

**Acute Fear** increases the daily energy expenditure by **22%**

**Chronic pain** increases the daily energy expenditure by **15%**

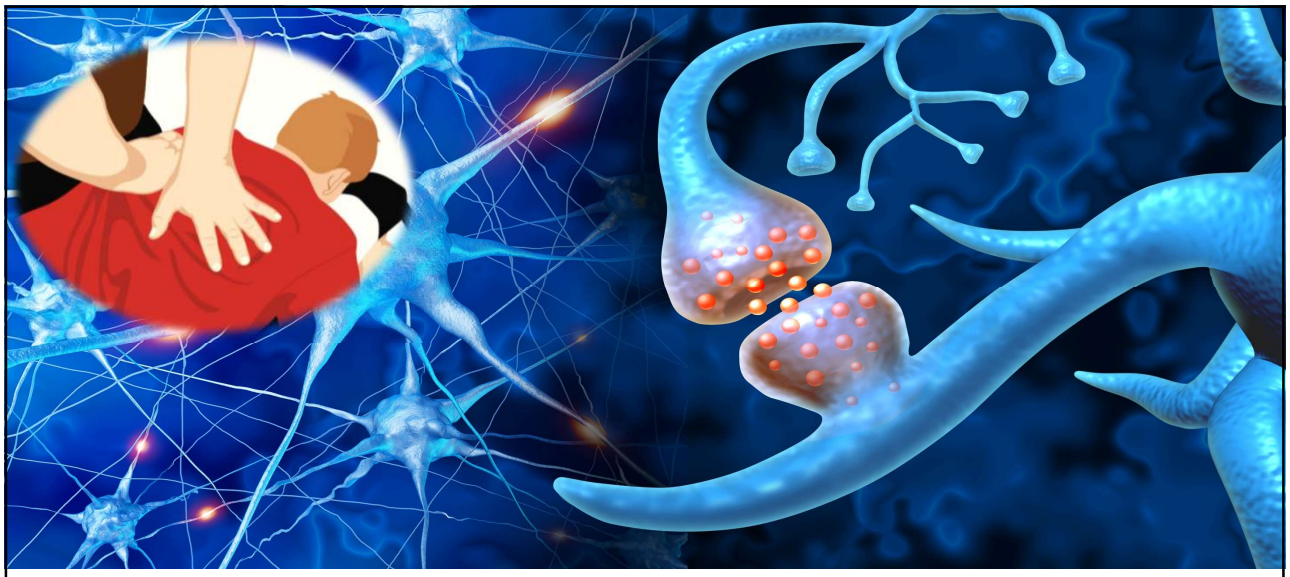
**Chronic Anxiety** increases the daily energy expenditure by **6%**

"Energy expenditure could be reduced by rewiring the pain pathways to connect to the default mode network, which overlaps with the parasympathetic central network and disconnect from the energy consuming sympathetic nervous system."

*(De Ridder et al. 2022)*

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# Some changes in the brain take longer

*(Holt, Haavik et al 2015)*

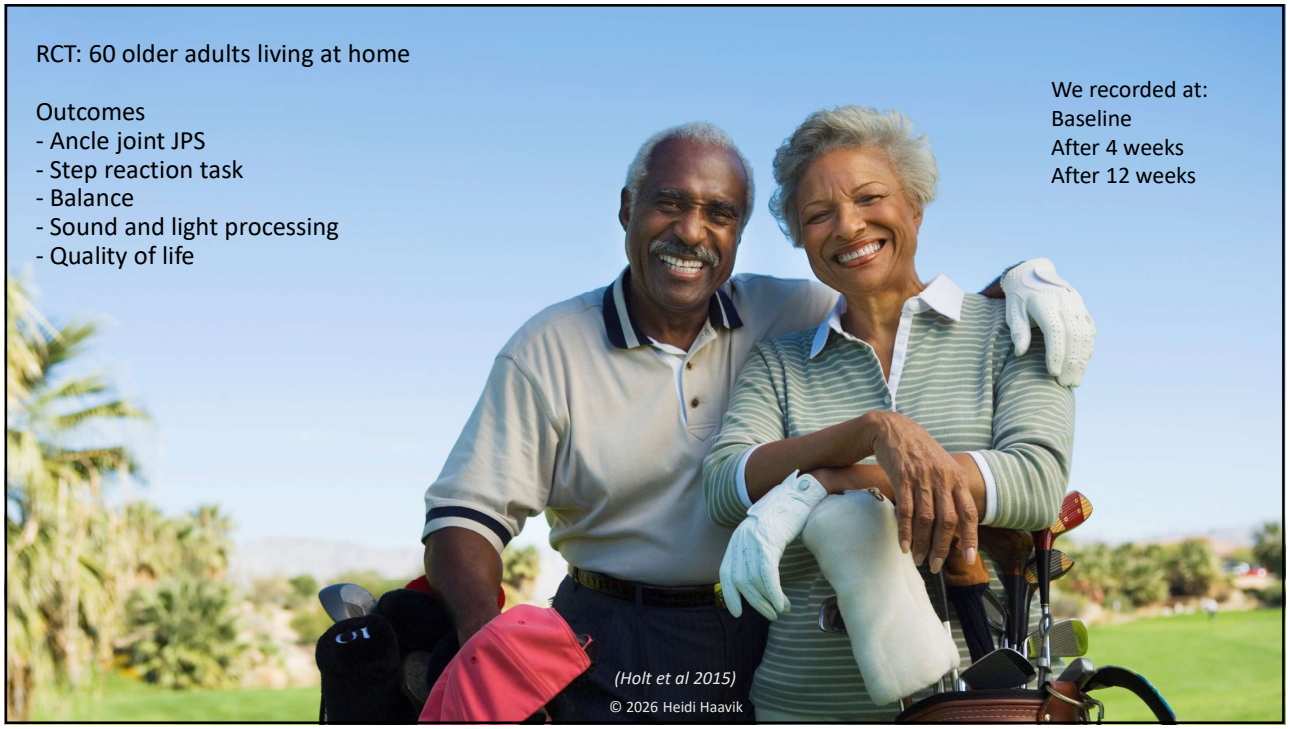
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RCT: 60 older adults living at home

Outcomes
- Ancle joint JPS
- Step reaction task
- Balance
- Sound and light processing
- Quality of life

We recorded at:
Baseline
After 4 weeks
After 12 weeks



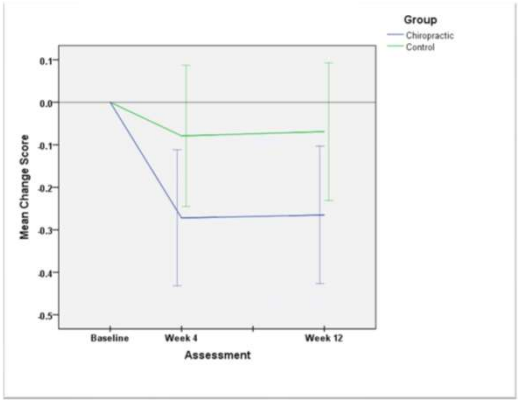
*(Holt et al 2015)*

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# Improved ankle joint position sense






*(Holt et al 2015)*

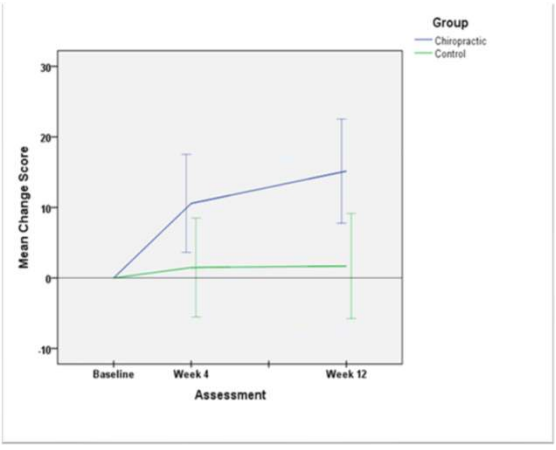
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# Improved interpretation of sound and visual information at the same time






*(Holt et al 2015)*

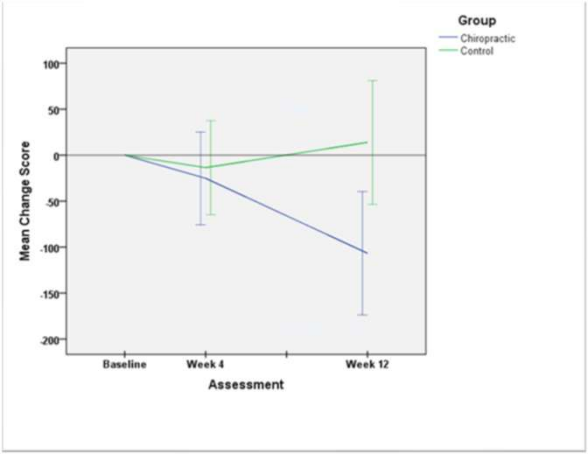
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# Improved stepping times



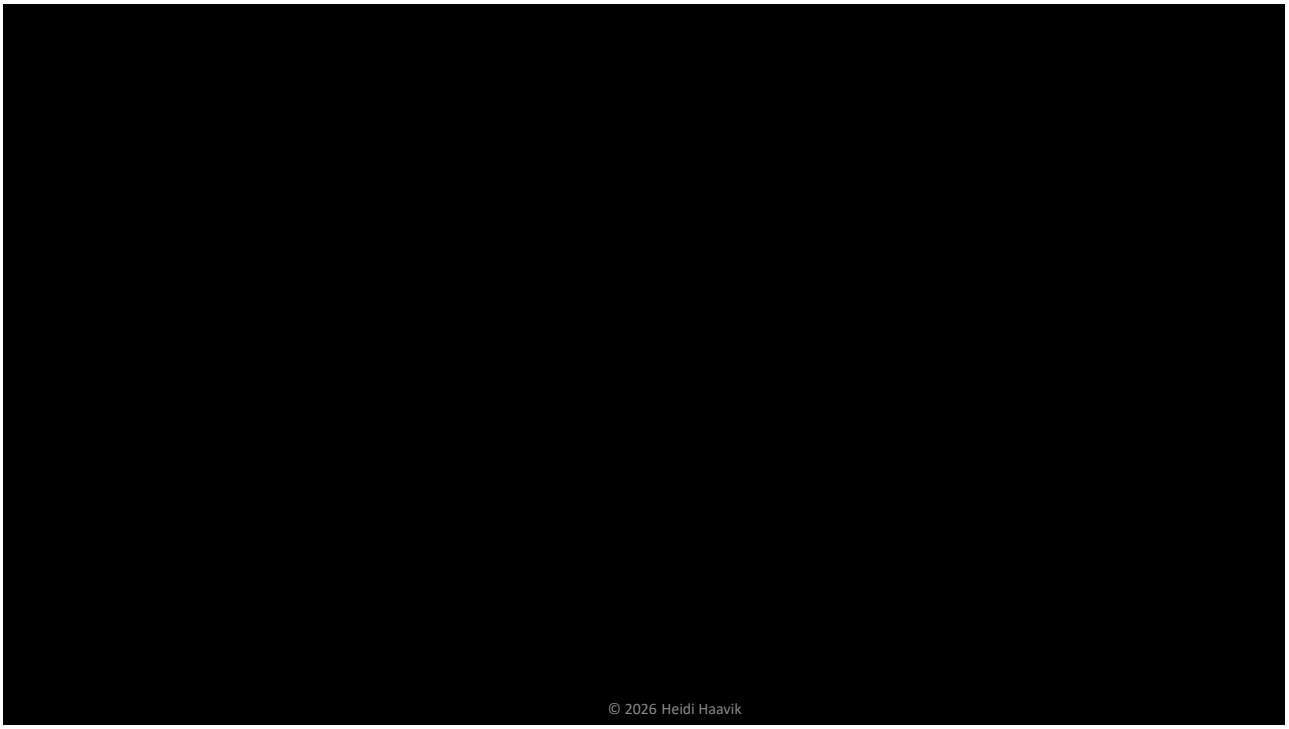



*(Holt et al 2015)*



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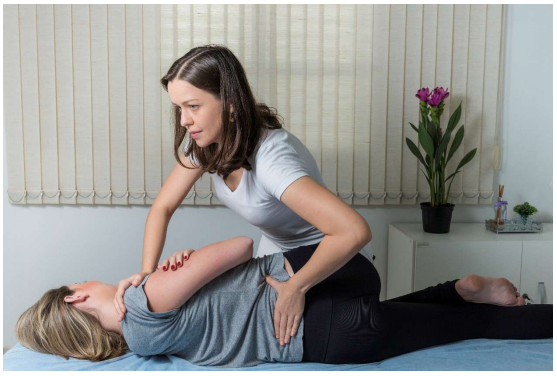
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## What does the evidence say about frequency of care?



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# Large Chronic LBP Study

| | |
|---|---|
| 400 patients with chronic low back pain | 0,6,12, or 18 sessions of SM over 6 weeks |
| Pain scores better in groups getting adjusted | At 12 weeks- 2x per week had best results |
| At 52 weeks- 3x week had best results | Only modest differences so not conclusive results |



*(Haas et al 2014)*

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## Chronic Cervicogenic Headache study

- 256 participants.
- 1, 2, or 3 chiropractic visits per week for six weeks.
- Control group receiving light massage.
- Main outcome assessed of number of headache days at twelve and twenty-four weeks.
- Results:
  - The more adjustment visits, the fewer headache days.



*(Haas et al 2018)*

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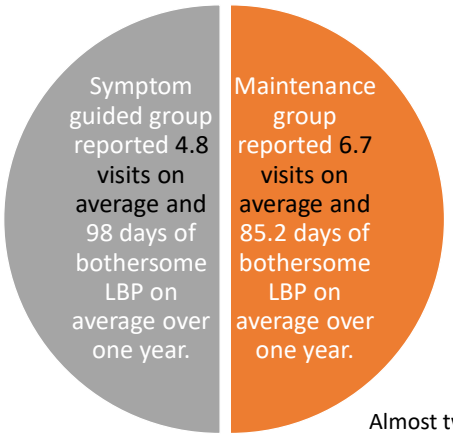
# Nordic Maintenance Care Program

328 patients with non-specific LBP from 40 Swedish chiropractic clinics.

Good responses to care.

Received chiropractic maintenance care for the next year, or symptom-guided care.

Outcomes: number of days with bothersome back pain over one year.




Almost two weeks of less days with pain!!! Only 2 more visits to chiro!

*(Eklund et al 2018 PLoS One)*

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# Take-home Message About Maintenance Care

*"For patients with recurrent low back pain who respond well to chiropractic care, they should consider getting checked regularly by their chiropractor even if their pain doesn't come back because it may help them to have fewer days where their backpain interferes with their lives."*

*(Eklund et al 2018)*

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# Summary of Frequency of Care






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# Implications for question answers

- Chiropractors' role is to exercise the spine back into proper function
- Science shows it's better for you to see me more often early on in care, and this even gives you long term benefits (CGHAs and LBP)
- Science shows maintenance care gives you less days of pain compared to coming back only when it hurts




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PA28

## How often should you visit a Chiropractor?



*When you first see your chiropractor, you will probably ask "how often do I need to come?"*

Often the answer people want to hear is 'once' but chiropractic care, like most things that are really good for us, rarely makes a long-term difference to your health and wellness after just one visit.



### The 1,000th straw that breaks the camel's back

A problem can build up day after day as you sit hunched over your desk, or bend and twist as you lift, or tense up as you deal with your daily stress, and then one day, you bend to tie your shoelaces and all of a sudden something hurts! You can rest assured that tying your shoelaces isn't what caused the problem - it's simply the thousandth straw that broke the camel's back (or was too much for your back) and that's why you're in pain.

## Maintenance Care



*Did you know that 50% of patients visit a chiropractor simply to maintain their health and well-being!*

Lato - Light Aenean ac tincidunt lectus, eu facilisis leo. Donc sodales libero sit amet lacus ornare feugiat. Nulla gravida a lectus vitae efficitur.



### What is maintenance care?

Maintenance care is when patients go to a chiropractor even when they are not in pain or discomfort. The idea with maintenance care is that regular adjustments will help maintain your spine and nervous system function at its optimal level and help you to be your best and to prevent new episodes of pain developing.[1]

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# Questions for Heidi?



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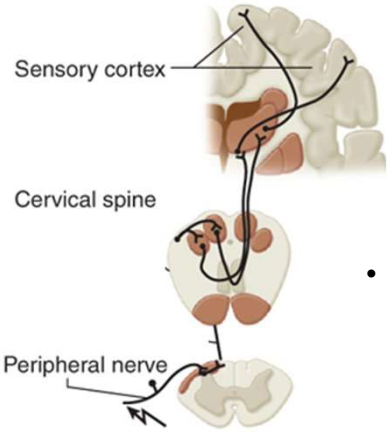
# Questions for Heidi?



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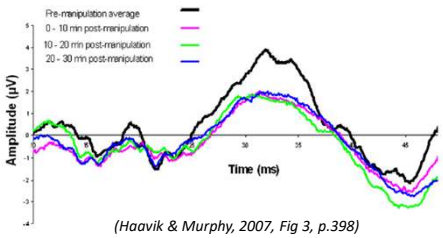
# Somatosensory Evoked Potentials








- N30 Multiple neural generators representing early SMI




*(Haavik & Murphy, 2007, Fig 3, p.398)*

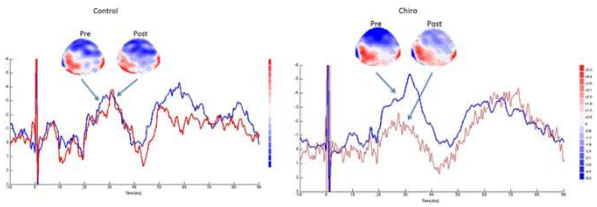
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# Somatosensory Evoked Potentials








- N30 SEP amplitude decreased by ~17% following spinal manipulation
- Source localization identified the PFC as the primary site of change
- No significant changes occurred following the sham intervention

*(Lelic et al 2016)*

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# Elbow Joint Position Sense



Cervical adjustments of subluxations improved arm proprioception

*(Haavik & Murphy, 2011)*

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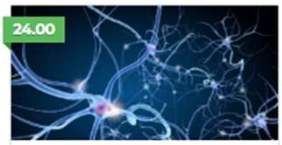


## Basic Science

LEVEL 2

**Aimed at those who have gained some knowledge about anatomy, physiology, pathology, neuroscience and research methodology, and science in general.**

Dive deeper into what localized areas of spinal dysfunction are. Learn about these central segmental motor control problems that lead to ongoing maladaptive central plastic changes, making it harder for the brain to accurately perceive what is happening inside the body and around it, why they occur and how this impacts health, brain, pain and function.



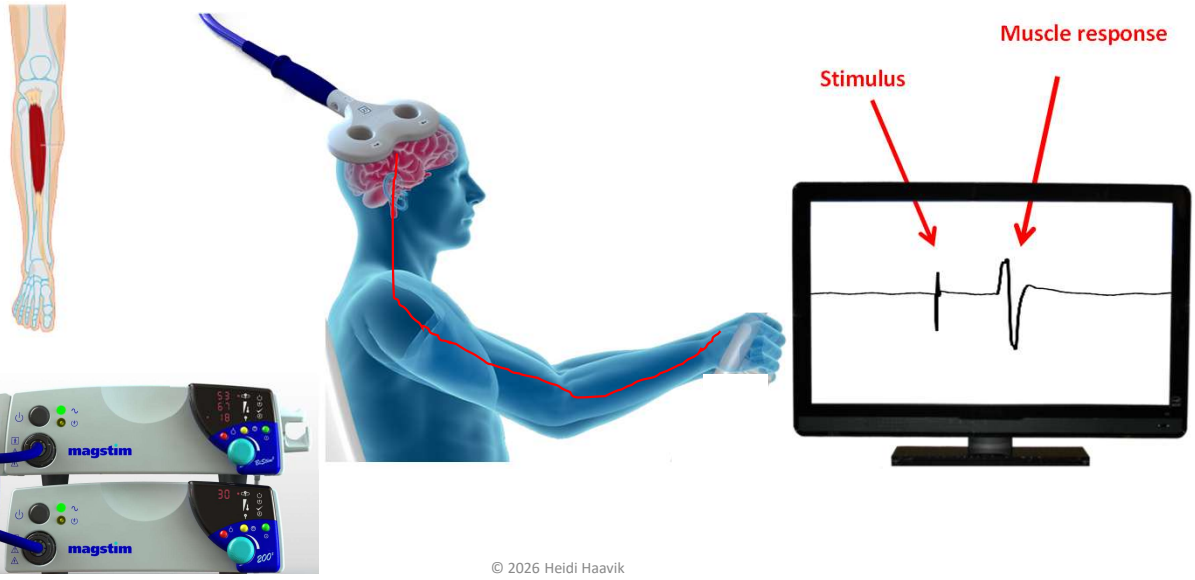

**BS2.11 The Somatosensory Neuroplastic effects of Chiropractic Care**

53 minutes - the known Somatosensory neuroplastic effects of chiropractic care.

Enroll Now

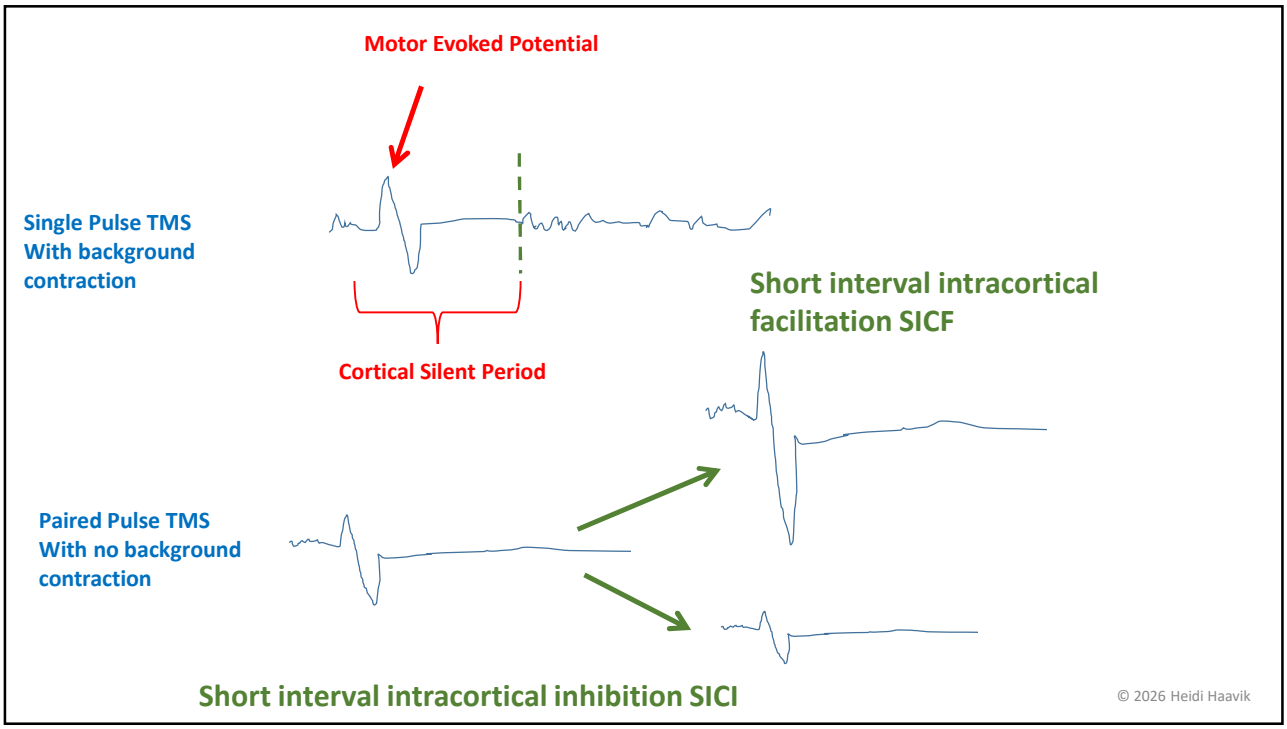
160

# Transcranial Magnetic Stimulation




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# Transcranial Magnetic Stimulation

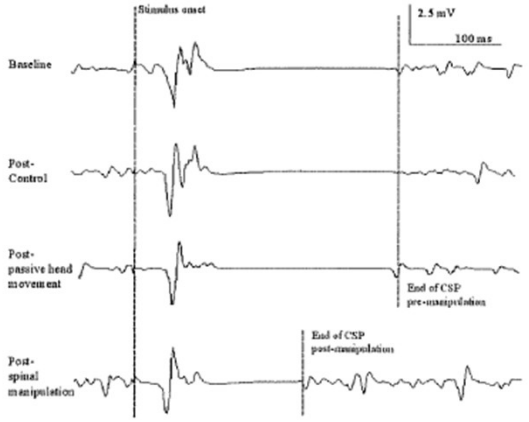



Figure 4. Raw non-rectified EMG traces from one representative subject showing the MEP and CSP prior to and after the various interventions.

*(Haavik & Murphy 2007, Fig 4, p.110)*

- Adjustments of subluxations altered the cortical silent period.
- No changes in the motor evoked potentials (MEPs)







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# Paired pulse TMS

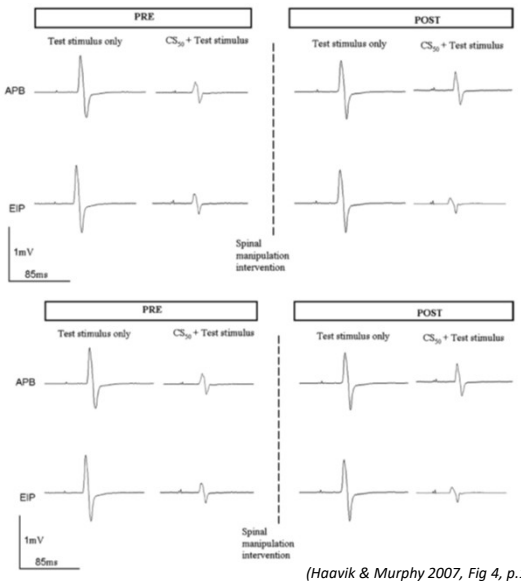
- Adjustments of subluxations altered the short-interval, intracortical inhibition (SICI) and short-interval intracortical facilitation (SICF) of the APB and EIP in a muscle specific manner.












*(Haavik & Murphy 2007, Fig 4, p.110)*

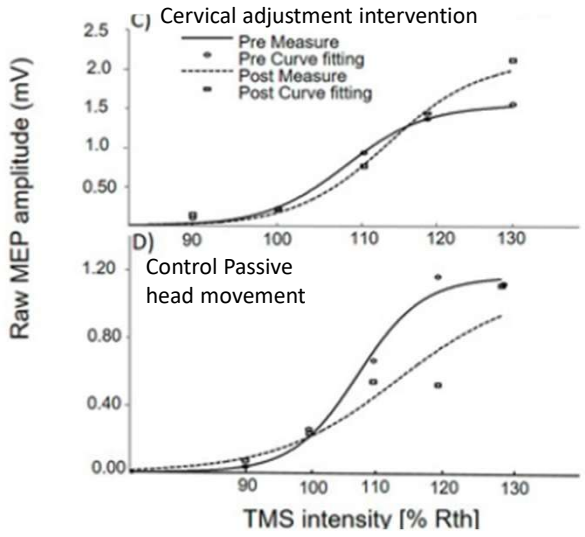
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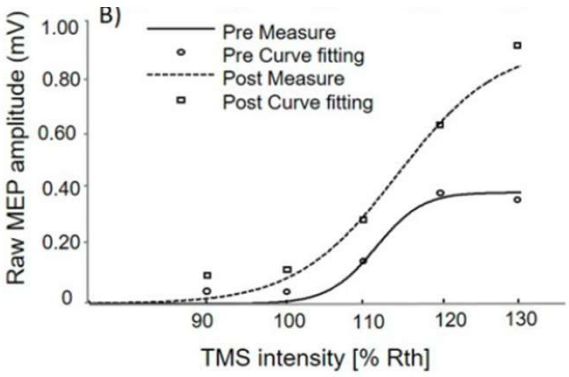
# TMS Recruitment Curves

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**Upper limb muscle (APB)**




**Lower limb muscle (TA)**




*(Haavik et al. 2017, Fig 1C & D, 2B, p 8&9)*

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ChirosAcademy

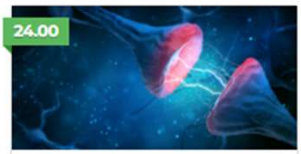


## Basic Science

LEVEL 2

**Aimed at those who have gained some knowledge about anatomy, physiology, pathology, neuroscience and research methodology, and science in general.**

Dive deeper into what localized areas of spinal dysfunction are. Learn about these central segmental motor control problems that lead to ongoing maladaptive central plastic changes, making it harder for the brain to accurately perceive what is happening inside the body and around it, why they occur and how this impacts health, brain, pain and function.




**BS2.12 The Motor Control effects of Chiropractic Care**

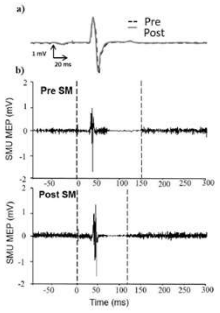
67 minutes - the known motor control neuroplastic effects of chiropractic care.

Enroll Now

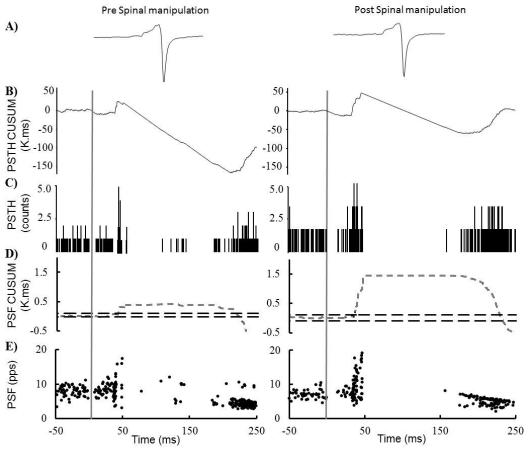
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# Intramuscular EMG






- Single pulse TMS via a double cone coil over TA motor area during weak isometric dorsiflexion
- pre/post spinal manipulation (n=18) and pre/post a control (n=12)
- No change in MEP amplitude
- ↓ Cortical silent period (19–35 ms shorter)
- No change following control intervention
- 21 SMUs across 18 participants / 12 SMUs across 12 controls
- constructed peristimulus time histogram (PSTH) and peristimulus frequencygram (PSF)
- ↑ I-wave excitability following spinal manipulation
- spinal manipulation reduces the TMS-induced cortical silent period and increases low threshold motoneurone excitability in the lower limb muscle

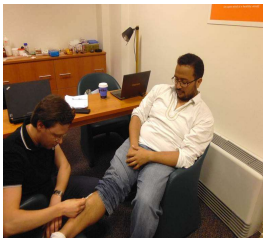




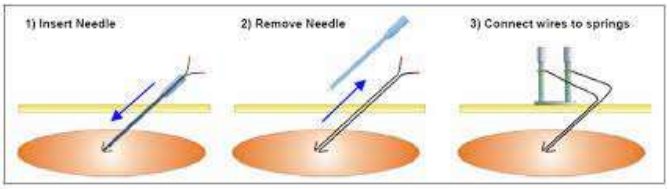

*(Haavik, Niazi, Jochumsen, P. Uginčius, O. Sebik, G. Yılmaz, M. S. Navid, M. G. Özyurt and K. S. Türker, 2018)*

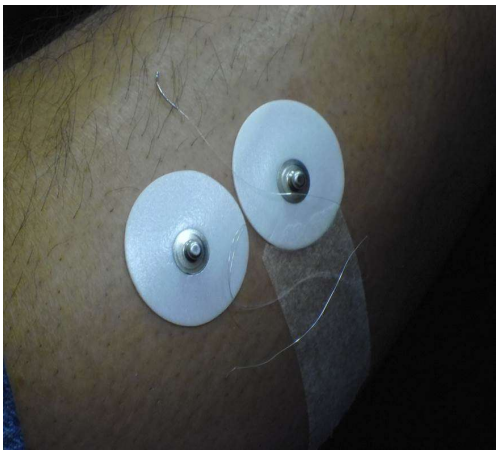
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# Intramuscular EMG



we were able to record 85 single motor units (using the needle-based technique) across 19 participants

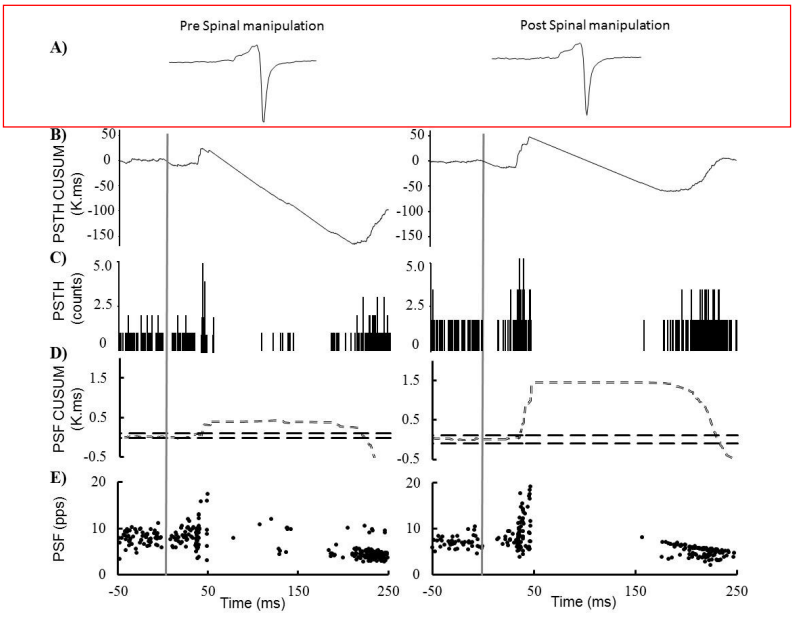


*Haavik H, Niazi IK, Jochumsen M, et al. Chiropractic spinal manipulation alters TMS induced I-wave excitability and shortens the cortical silent period. J Electromyogr Kinesiol 2018;42:24-35. doi: 10.1016/j.jelekin.2018.06.010 [published Online First: 2018/06/25]*

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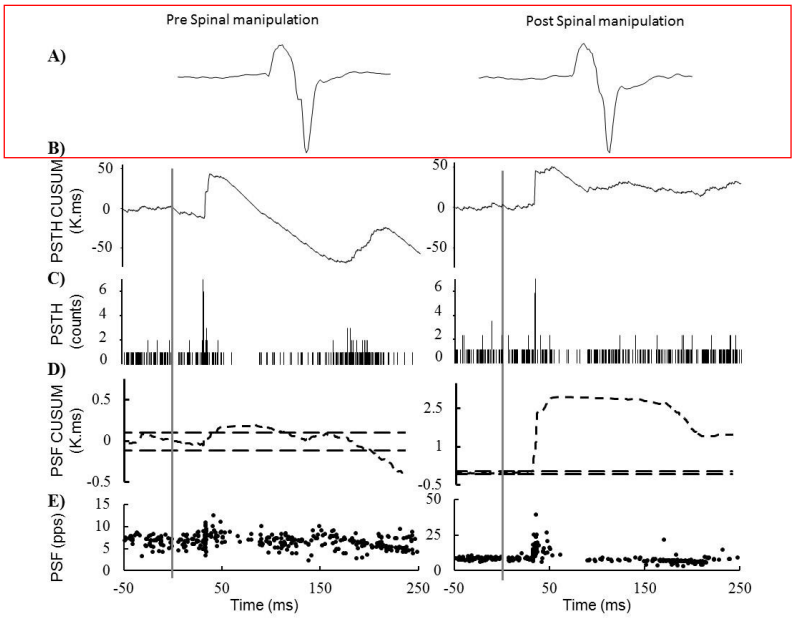
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Haavik H, Niazi IK, Jochumsen M, et al. Chiropractic spinal manipulation alters TMS induced I-wave excitability and shortens the cortical silent period. *J Electromyogr Kinesiol* 2018;42:24-35. doi: 10.1016/j.jelekin.2018.06.010 [published Online First: 2018/06/25]

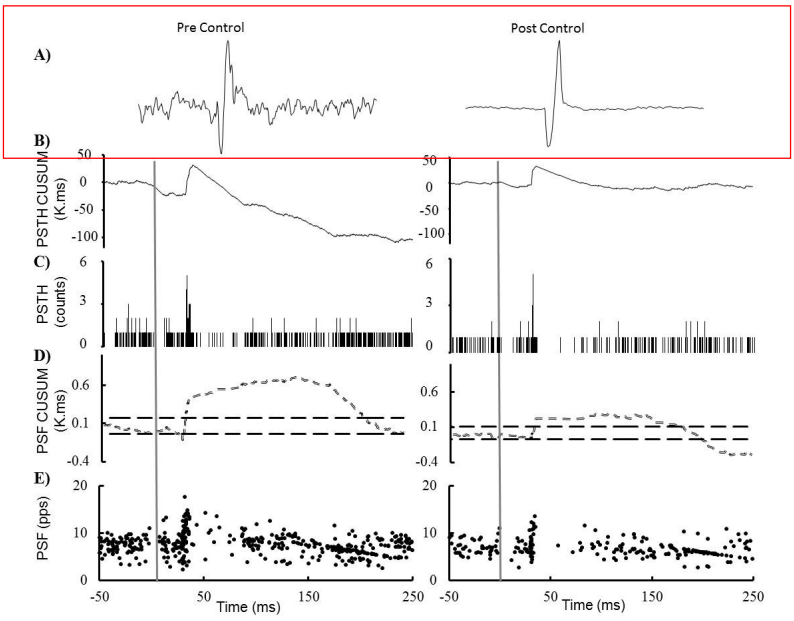
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Haavik H, Niazi IK, Jochumsen M, et al. Chiropractic spinal manipulation alters TMS induced I-wave excitability and shortens the cortical silent period. *J Electromyogr Kinesiol* 2018;42:24-35. doi: 10.1016/j.jelekin.2018.06.010 [published Online First: 2018/06/25]

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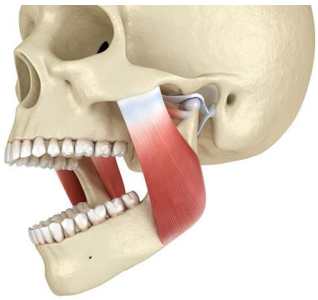
Haavik H, Niazi IK, Jochumsen M, et al. Chiropractic spinal manipulation alters TMS induced I-wave excitability and shortens the cortical silent period. *J Electromyogr Kinesiol* 2018;42:24-35. doi: 10.1016/j.jelekin.2018.06.010 [published Online First: 2018/06/25]

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## Jaw Muscle strength, sEMG and iEMG

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*Haavik H, Özyurt MG, Niazi IK, et al. Chiropractic Manipulation Increases Maximal Bite Force in Healthy Individuals. Brain Sciences 2018;8(5):76. doi: 10.3390/brainsci8050076*

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## Sham Chiropractic Care

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Sham did not change outcome



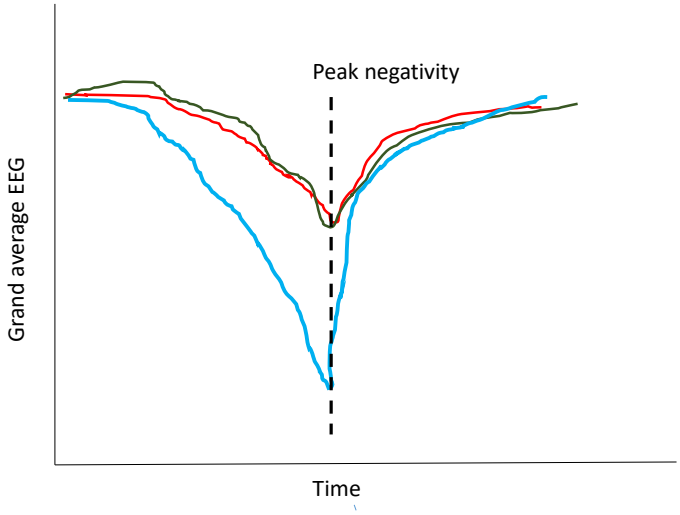


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## Movement Related Cortical Potentials (MRCPs)

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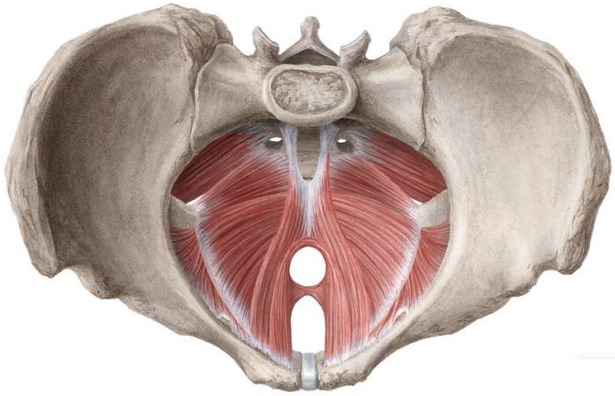



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Haavik H, Niazi I, Jochumsen M, Sherwin D, Flavel S, Türker K. Impact of Spinal Manipulation on Cortical Drive to Upper and Lower Limb Muscles. Brain Sciences. 2017;7(1):2.

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# Female Pelvic Floor muscle function



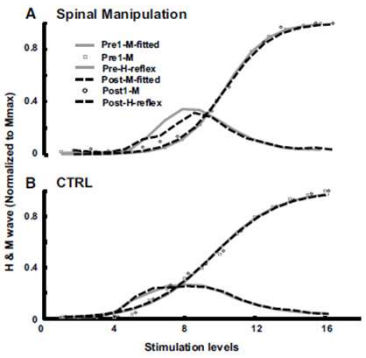


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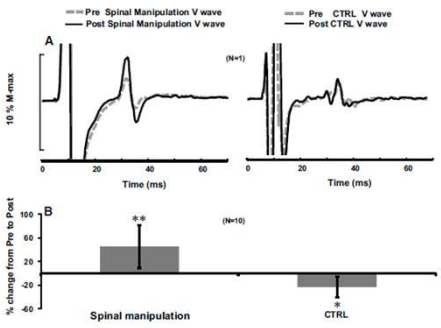
*Haavik, H., Kruger, J., & Murphy, B. (2016) Pelvic floor functional changes with spinal manipulation in pregnant and non-pregnant women: A preliminary study. Journal of Manipulative and Physiological Therapeutics. Jun;39(5):339-47.*

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# H-Reflex & V waves






**Spinal Adjustments:**

- increased MVC (sEMG) by 59.5 ± 103.4 % (p = 0.03) and
- Increased MVC force by 16.05 ± 6.16 4 % (p = 0.0002)
- increased V/Mmax ratio by 44.97 ± 36.02 % (p = 0.006)
- reduced H-reflex threshold (p = 0.018).

**Control intervention:**

- decrease in MVC (sEMG) by 13.31 ± 7.27 % (p = 0.001) and
- Decrease force by 11.35 ± 9.99 % (p = 0.030),
- decreased V/Mmax ratio (23.45 ± 17.65 %; p = 0.03) and
- a decrease in the median frequency of the power spectrum (p = 0.04) of the SEMG during MVC.

*(Niazi, et al EBR 2015)*

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# Elite Taekwondo Athletes

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In Elite Taekwondo Athletes (n=11) SM increased:

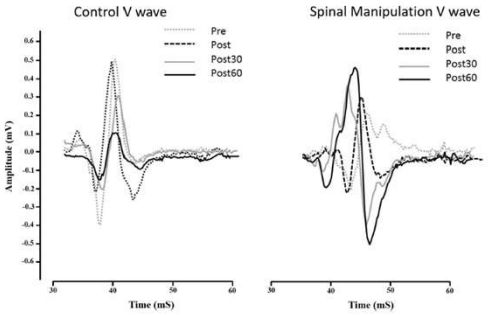
- MVC force [$F(3,30) = 5.95$, $p < 0.01$] by almost 8% post*, 4% post30*, 2% post60
- V-waves [$F(3,30) = 4.25$, $p = 0.01$] by 34% post*, 41% post30*, 46% post60*
- No sig change in H-reflex

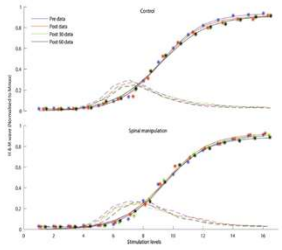
Following the control intervention

- MVC force decreased 3.5% post*, 10% post30*, 8% post 60
- V wave decreased by 12% post*, 21% post30*, 22% post60*
- No sig change in H-reflex



Thomas Lykke Christiansen
Jan Hartvigsen
Nordic Institute of Chiropractic and Clinical Biomechanics, Odense, Denmark



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(Christiansen, et al EJAP 2018)

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# Chronic Stroke Survivors

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Riphah International University, Islamabad, Pakistan



## Single intervention Study

**Spinal manipulation compared**

- Increased MVC force (F (1,11) = 14.49, p = 0.002; avg 64.2 ± 77.7%)
- Increased V/Mmax ratio (F(1,11) = 9.67, p = 0.009; avg 54.0 ± 65.2%)

**Control intervention:**

- Significant decrease MVC force avg 26.5 ± 15.5% (p = 0.001)
- non-significant decrease in V-wave/Mmax ratio occurred after the control intervention (−12.1 ± 13.8%, p = 0.07).

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(Holt, et al Scientific Reports 2019)

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# Chronic Stroke Survivors 4 week RCT

Riphah International University, Islamabad, Pakistan



## 4-week intervention RCT

(ClinicalTrials.gov Identifier NCT03849794.)

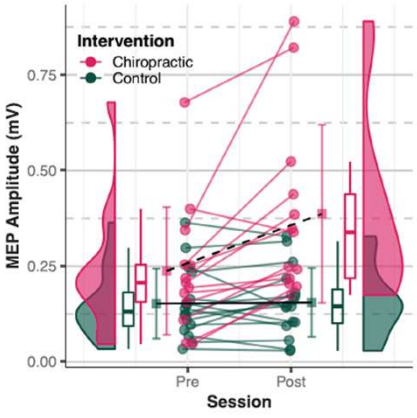
- Physical Therapy + sham vs Physical Therapy + Chiro in 63 subacute stroke victims
- Motor Function (Fugl Meyer Assessment) and Quality of Life (week 0, week 4, week 8)
- Week 4 – LARGE effect in chiro group vs sham on the FMA (difference = 6.1, $p$ = 0.04).
- The responder analysis suggested the improvements in motor function seen following chiropractic spinal adjustments may have been clinically significant.
- Both groups improved at 8 weeks

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(Holt et al Brain Sciences 2021)

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# Stroke survivors




In chronic stroke survivors (n=29) recorded MEPs (@120% RTh) Railway General Hospital in Rawalpindi, Pakistan.

- Post SM increased the average MEP amplitude in
- both absolute (by 0.15mV) and relative (by 126%) units.
- Post Control no significant changes

A single session of chiropractic spinal adjustment increases the corticomotor excitability in chronic stroke survivors by increasing the TA MEPs.



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Muhammad Samran Navid, Imran Khan Niazi, Dina Lelic, Imran Amjad, Nitika Kumari, Muhammad Shafique, Kelly Holt, Usman Rashid, Asbjørn Mohr Drewes, Haavik Heidi, 2018 Frontiers in neurology

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# 12-week RCT Older Adults

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RCT: 60 older adults living at home
We recorded at:
Baseline
After 4 weeks
After 12 weeks

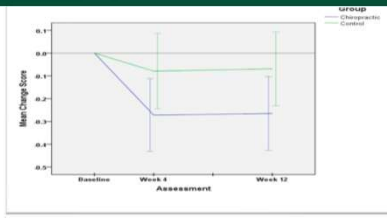
Outcomes
- Ancle JPS (0.20°; 95% CI, 0.01°-0.39°; P = .049)
- sound-induced flash illusion @12 weeks (13.5%; 95% CI, 2.9%-24.0%; P = .01)
- Choice stepping reaction time @12 weeks (119 milliseconds; 95% confidence interval [CI], 26-212 milliseconds; P = .01)
- SF-36 physical component of quality of life (2.4; 95% CI, 0.04-4.8; P = .04)

UNIVERSITY OF AUCKLAND
Waipapa Taumata Rau
NEW ZEALAND

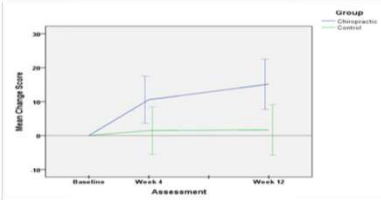


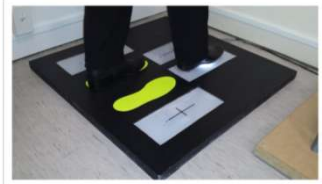
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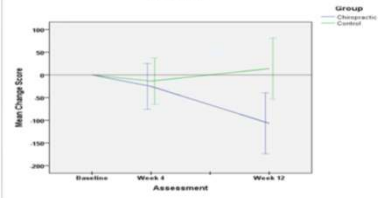









2016 Holt, K., H. Haavik, B. Murphy,
JMPT A. Chi Lun Lee and C. Elley

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# Questions for Heidi?

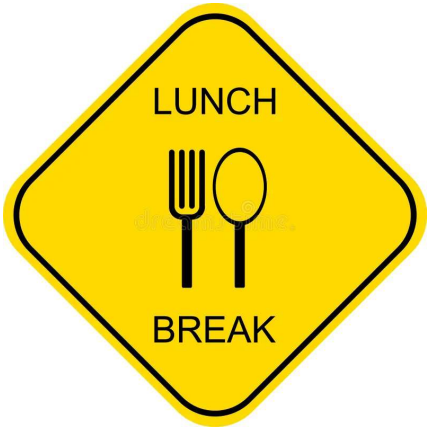


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Dr Heidi Haavik

HeidiHaavik.com



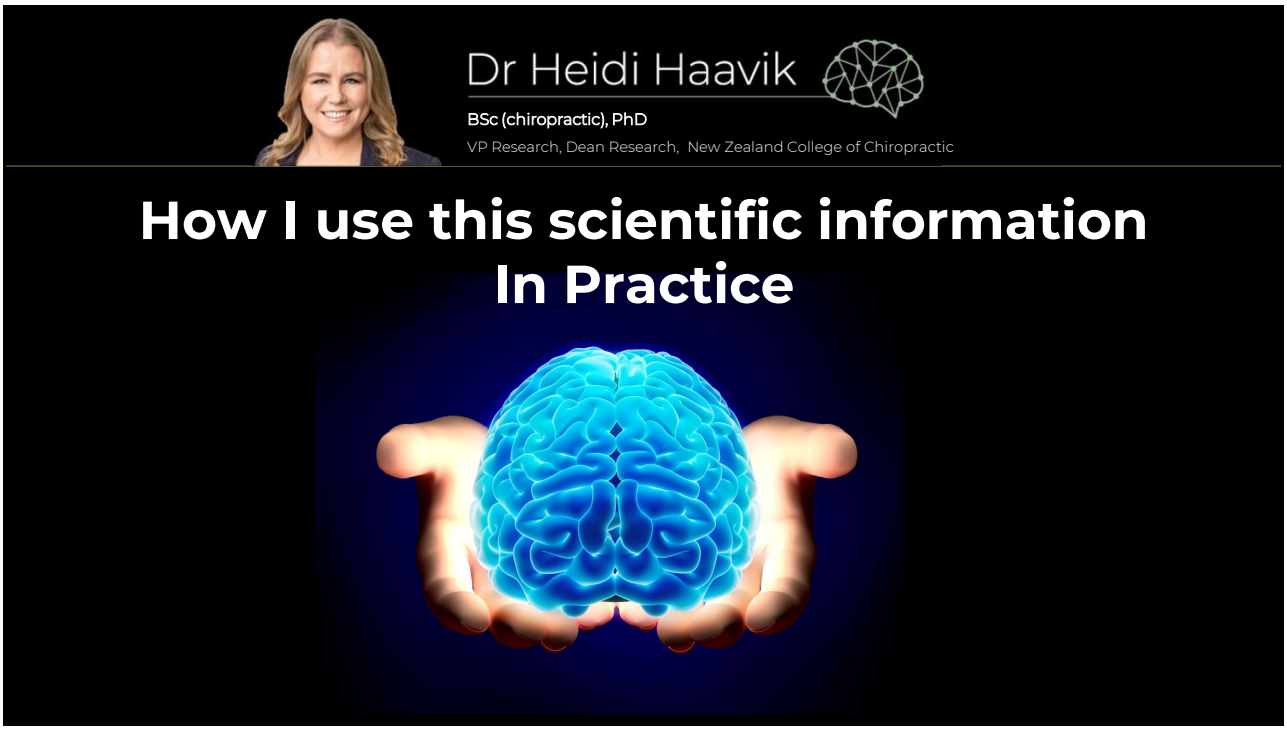

**TODAY'S HANDOUT & Gifts**

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## Questions for Heidi?



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## Case 1: 10 year old boy Luke (and his mum)

- Soccer player
- Back pain and headaches
- History of bedwetting
- Several injuries as a child

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ChirosAcademy

# Background Prep Prior to First Meeting




**CS2.12 Chiropractic Care and Enuresis**

61 minutes

Enroll Now




**CS2.01 Chiropractic Care and Lower Back Pain**

67 minutes

Enroll Now




**CS2.05 Safety of Chiropractic Care for Kids and Babies**

54 minutes

Enroll Now




**BS1.02 The Brain Model of the Chiropractic Subluxation**

76 Minutes - How a healthy and a dysfunctional spine communicates with the brain

Enroll Now




**BS1.03 Your first visit to a Chiropractor**

45 Minutes - What to expect from your first visit and "what is that popping sound"

Enroll Now



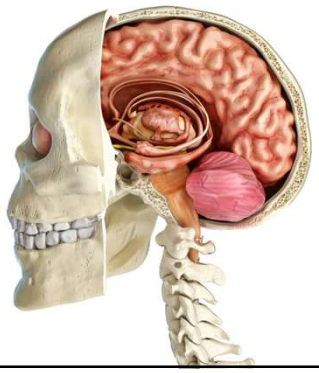

**BS1.04 Your first adjustment**

42 Minutes - What is an adjustment, how does it work and what to expect.

Enroll Now

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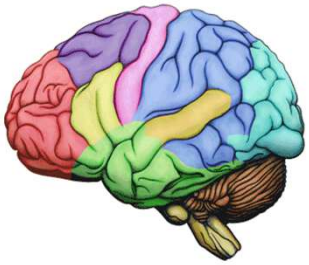
# What is Chiropractic





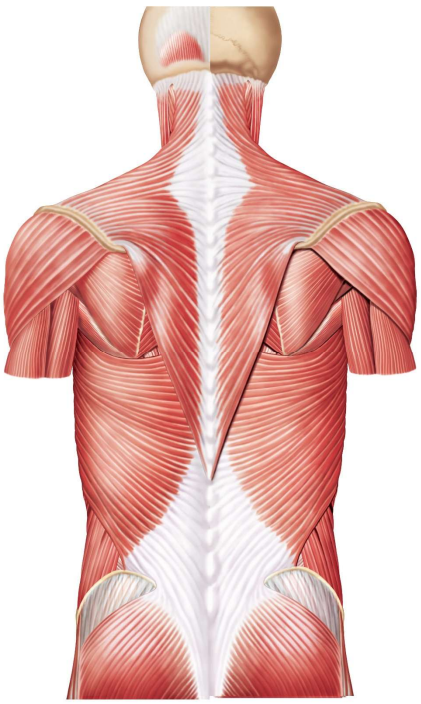
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# A healthy spine moves!



Your Brain tells the muscles how to move your spine



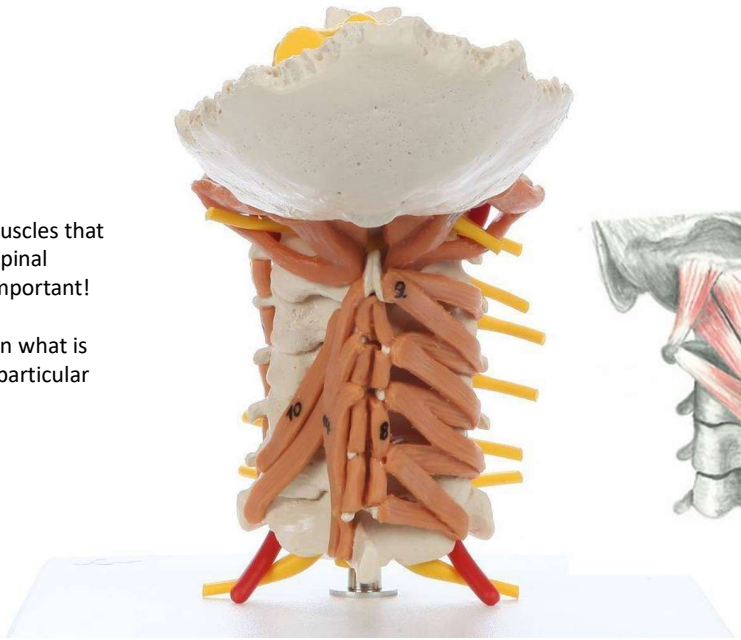


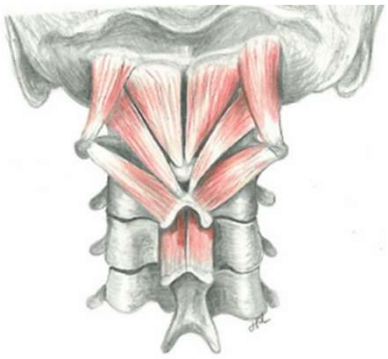
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So these small muscles that cross individual spinal bones are very important!

They tell the brain what is going on at that particular spinal level



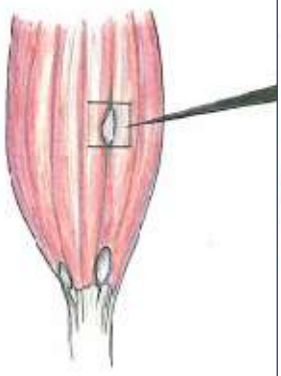


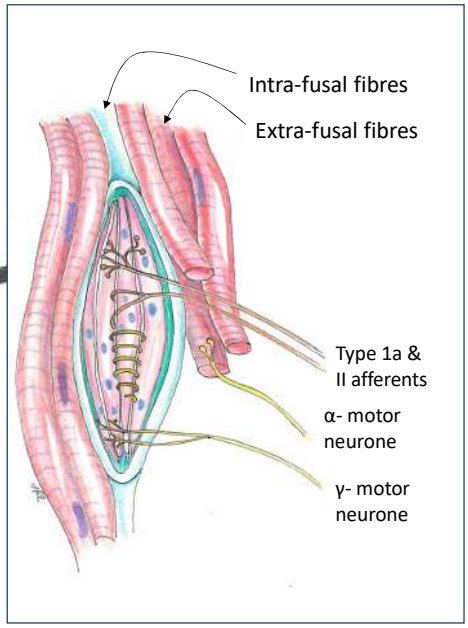
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MUSCLE SPINDLES

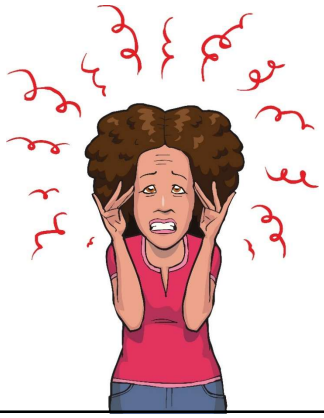


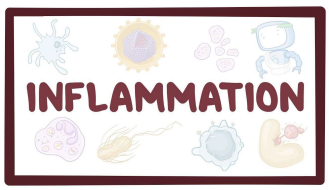



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# What can causes the breakdown?








*Haavik et al 2021 EJAP*

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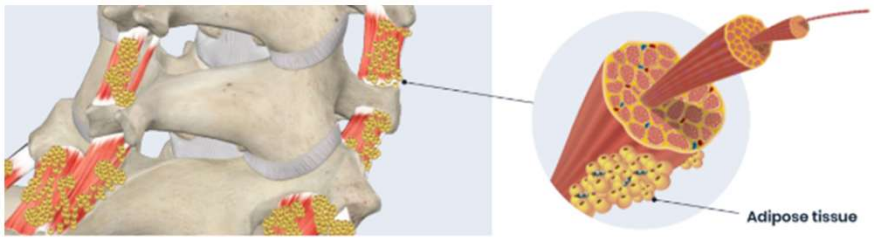
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# HEALTHY






# SUBLUXATED




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# Deep paraspinal muscles

## Healthy

- Larger in size
- Slow-twitch fibre type
- Minimal fatty infiltration
- Move freely
- Healthy stretch receptors (muscle spindles)

Good

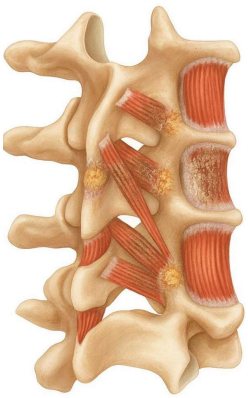


## Dysfunction

over time become:

- Stiff and Fibrotic
- Atrophied (shrunk)
- Fatty infiltration
- Change fibre type
- Stretch receptors dysfunction

NOT Good

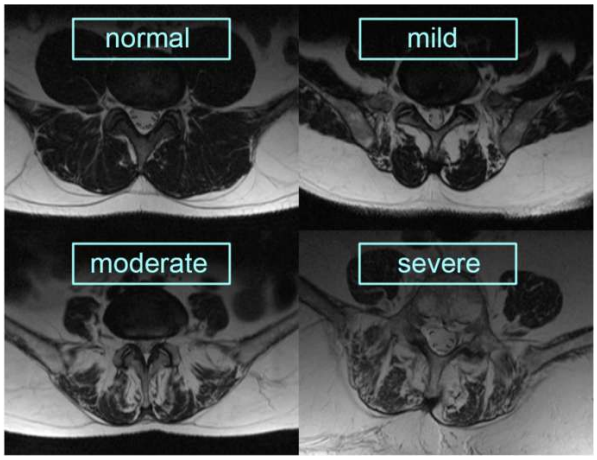


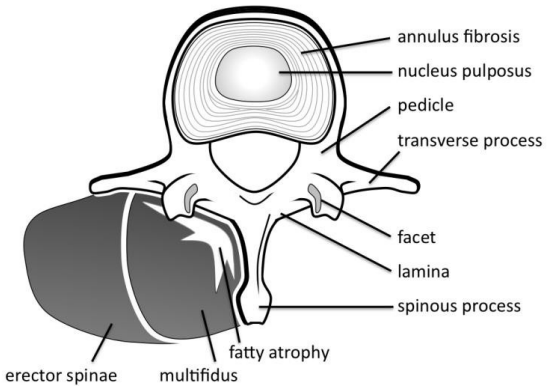
*(Hodges & Danneels, 2019. Changes in structure and function of the back muscles in low back pain: different time points, observations, and mechanisms Journal of orthopaedic & sports physical therapy **49**(6): 464-476)*

196

## Physical Injury, Emotional overload, Inflammation turn off the deep paraspinal muscles (neurological inhibition)

*Haavik et al 2021 EJAP*




*Faur, C., Patrascu, J.M., Haragus, H. and Anglitoiu, B., 2019. Correlation between multifidus fatty atrophy and lumbar disc degeneration in low back pain. BMC musculoskeletal disorders, 20(1), pp.1-6.*

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## Your Brain Is Always Learning

But it can learn good things as well as bad habits



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# Pain does not necessarily go away by itself!

- 1300 kids in Denmark aged 11 – followed for two years
- Pain is extremely common in 11–13-year-olds
- Pain spreads to more regions of the spine!
- Pain becomes more frequent and more intense!

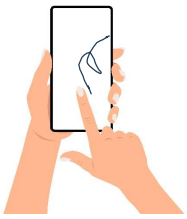


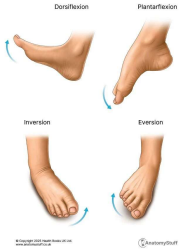
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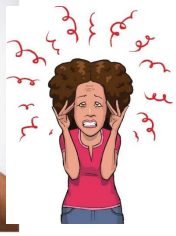
*(Aartun et al 2014 Spinal pain in adolescents: prevalence, incidence, and course: a school-based two-year prospective cohort study in 1,300 Danes aged 11–13. BMC Musculoskeletal Disorders. 2014;15:187)*

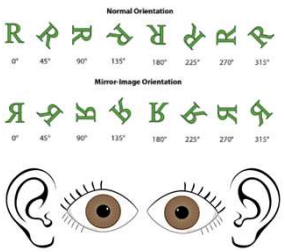
200

When your brain and body aren't communicating properly, it can affect lots of things, not just pain.



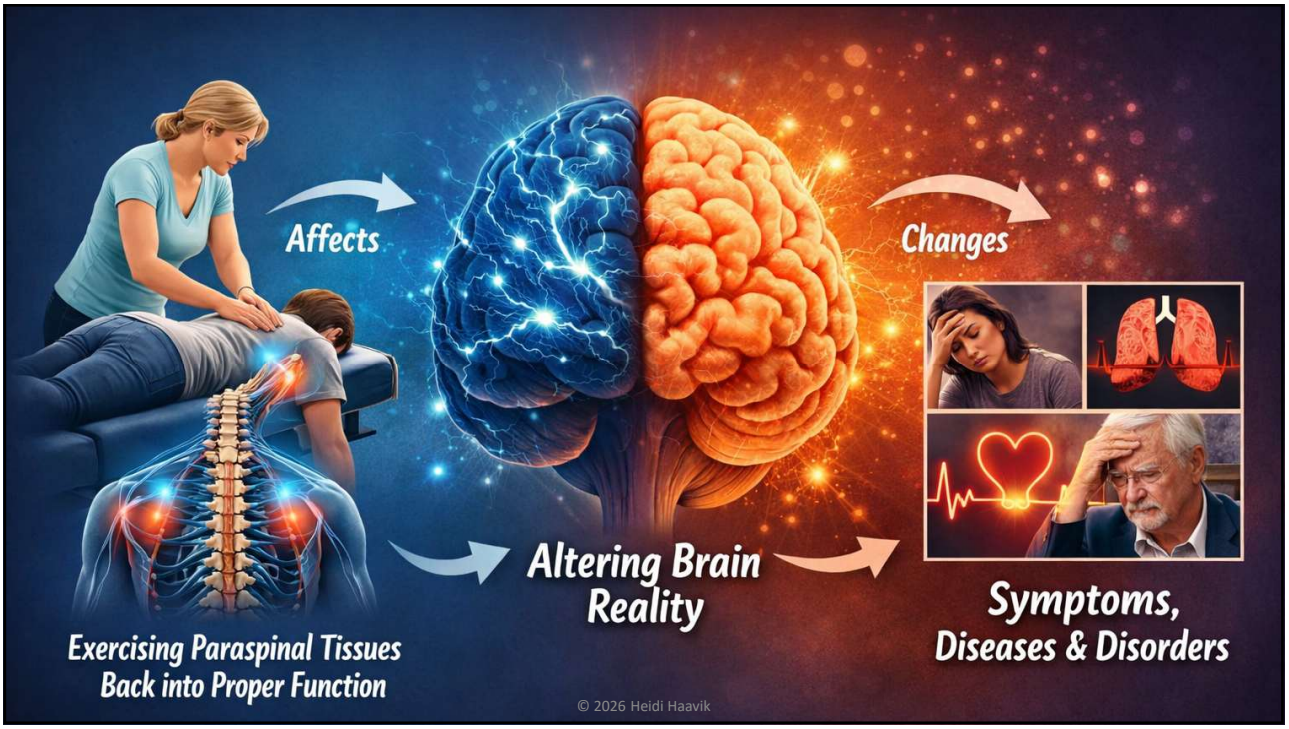






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## Poor spine-brain communication can lead to more sports injuries in students!

- Tested 303 young college students (who had no problems or pain)
- Tested for Spine – brain communication
- Predicted accurately which students would end up with an injury (based on those who had poor spine-brain communication at the beginning of the study)




(Cholewicki et al (2005). "Delayed trunk muscle reflex responses increase the risk of low back injuries." Spine (Phila Pa 1976) **30**(23): 2614-2620)

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## Chiropractors Help Your Brain Get Better Information

- Adjusting your spinal subluxations is like rebooting your computer!
- Brain becomes more accurately aware of what is going on inside you and around you
- Brain can control your body better
- This can mean better feeling and function!

(Amjad et al 2025; Haavik et al 2021; Haavik et al 2024)



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# Chiropractic Care helps kids with Headaches

Chiropractic spinal adjustments resulted in fewer headaches and higher global perceived effect, with only minor side effects!



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*(Lynge, et al (2021). "Effectiveness of chiropractic manipulation versus sham manipulation for recurrent headaches in children aged 7–14 years-a randomised clinical trial." Chiropractic & Manual Therapies **29**: 1-13.)*

205

# Chiropractic Care for Kids with Bedwetting

- Only 25% of the kids getting chiropractic care noticed improvements in their bedwetting
- But those kids who did respond – on average- got over 50% better
- And this was only a 2 week study!!



*(Reed et al 1994 "Chiropractic management of primary nocturnal enuresis." J Manipulative Physiol Ther **17**(9): 596-600.)*

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# Chiropractic Care is Very Safe!!

*Chiropractic care for children and infants is very safe and is rarely associated with adverse events.*

*When they do occur, they invariably involve short periods of muscle soreness or irritability following an adjustment.*

*When a thorough history and exam are performed, and appropriate technique choices are made, you can be confident that you are in safe hands.*

*(Alcantara et al 2009; Todd et al 2014; Doyle 2011, Driehuis et al 2019, Parnell et al 2019)*

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This has the potential to help YOU…

- Move better
- Focus better
- Feel better
- Recover better
- Kick the ball harder (and more accurately)
- Think clearly
- Sleep better
- Learn better
- Be less clumsy
- Have less accidents
- Have less pain

*(Amjad et al 2025; Haavik et al 2021; Haavik et al 2024)*

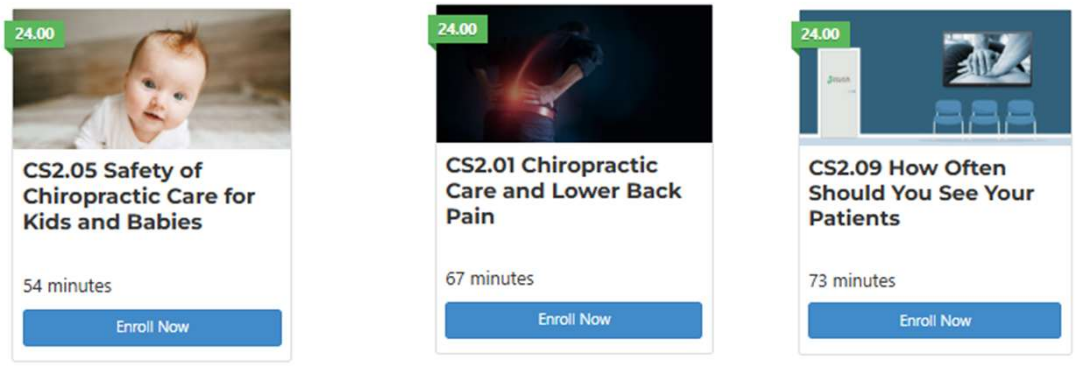
208

# DAY 2 – REPORT OF FINDINGS

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ChirosAcademy

## Background prep prior to ROF




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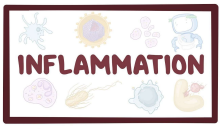


# Reminder about the spine-brain communication



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OR

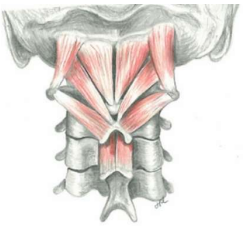


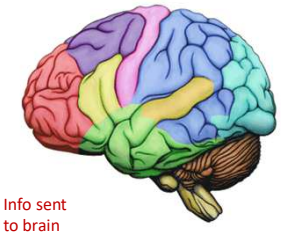
Stress



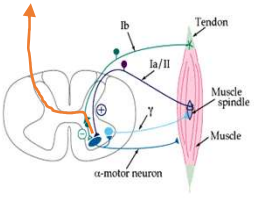
Injury

Small muscles closest to spine and skull go to sleep





Info sent to brain




Altered messages going to brain from spine

Poor body awareness
Poor body control
Poor function




So brain does NOT know accurately what is going on

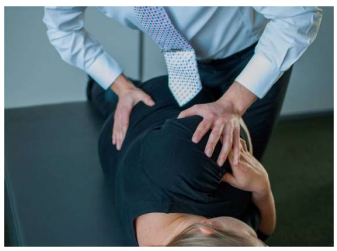


Changes brains internal representations about what is going on inside and outside body

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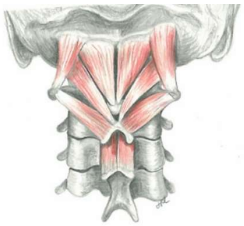
*Haavik et al 2021 EJAP*

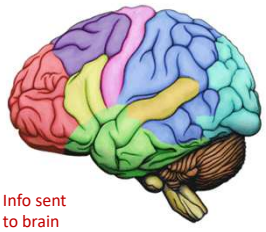
212



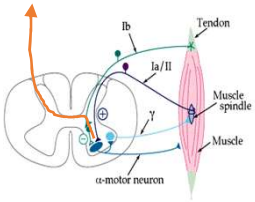
Adjustment

Stretches small muscles closest to spine and scull



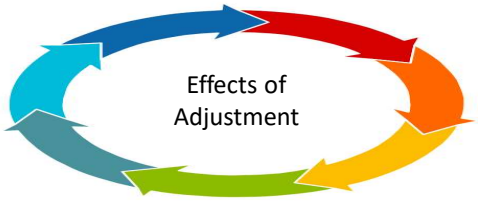


Info sent to brain




Bombards brain with mechanoreceptor input

Improved body awareness
Improved body control
Improved function




So brain knows MORE accurately what is going on



Changes brains internal representations about what is going on inside and outside body

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*Haavik et al 2021 EJAP*

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# What we tested

- Spinal function
- Movement
- Balance
- Posture
- Nervous system tests
- The peg test

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# What We Found

Some Areas Aren't Working as Well as They Could



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# What That Means

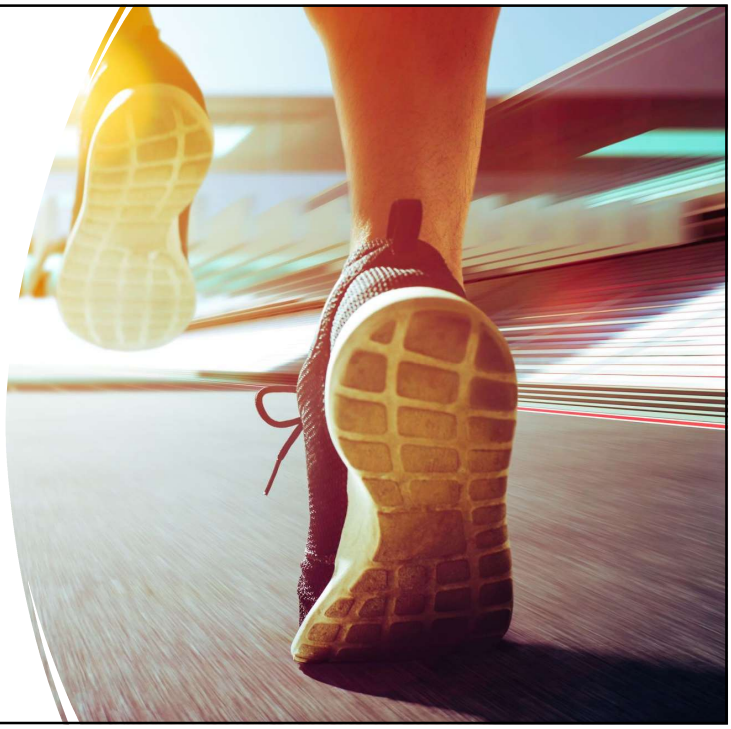
- Coordination not as sharp
- Body not responding as quickly
- Brain getting less clear input



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# Why This Might Matter for you

- Sport performance
- Focus at school
- Energy
- Growing body
- Body (bladder) control



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# What We Can Do

Help improve communication



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# What we expect

- Changes over time
- Not instant fix
- Brain adapting
- Step-by-step improvement
- Common effects
  - Minor aches and pains that go away by themselves (a bit like going to the gym)
  - Sleep better
  - Feel better
  - Perform better



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# The Plan

- Frequency of visits
- Re-checks




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# Large Chronic Low Back Pain Study Shows More Frequent Care Early On is Best for You

| | |
|---|---|
| 400 patients with chronic low back pain | 0,6,12, or 18 sessions of SM over 6 weeks |
| Pain scores better in groups getting adjusted | At 12 weeks- 2x per week had best results |
| At 52 weeks- 3x week had best results | 2 -3 /week Best at One year follow up!! |



*(Haas et al 2014)*

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# Chronic Cervicogenic Headache study showed More Frequent Care Early On is Best for You!

- 256 participants.
- 1, 2, or 3 chiropractic visits per week for six weeks.
- Control group receiving light massage.
- Main outcome assessed of number of headache days at twelve and twenty-four weeks.
- Results:
  - The more adjustment visits, the fewer headache days at the end of the study (after one year!!!)



*(Haas et al 2018)*

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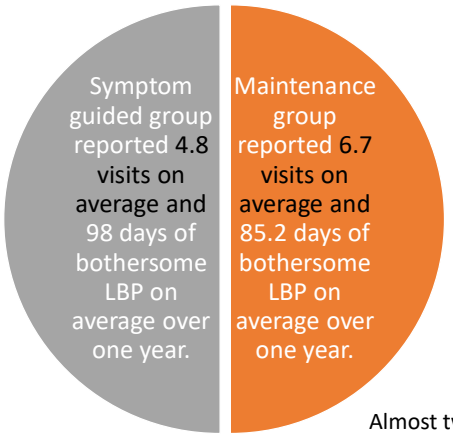
# Nordic Maintenance Care Program

328 patients with non-specific LBP from 40 Swedish chiropractic clinics.

Good responses to care.

Received chiropractic maintenance care for the next year, or symptom-guided care.

Outcomes: number of days with bothersome back pain over one year.




Almost two weeks of less days with pain!!! Only 2 more visits to chiro!

*(Eklund et al 2018 PLoS One)*

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# Take-home Message About Maintenance Care

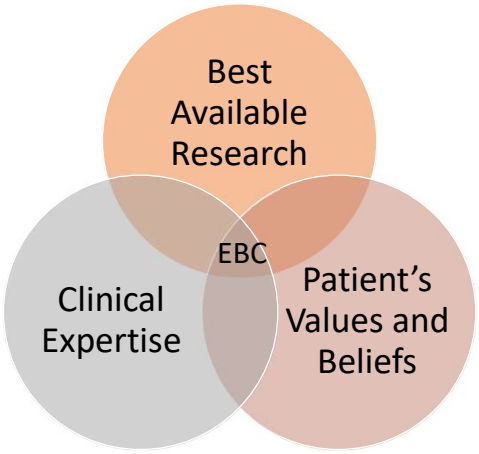
*"For patients with recurrent low back pain who respond well to chiropractic care, they should consider getting checked regularly by their chiropractor even if their pain doesn't come back because it may help them to have fewer days where their backpain interferes with their lives."*

*(Eklund et al 2018)*

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# Summary of Frequency of Care Evidence Based Chiropractic






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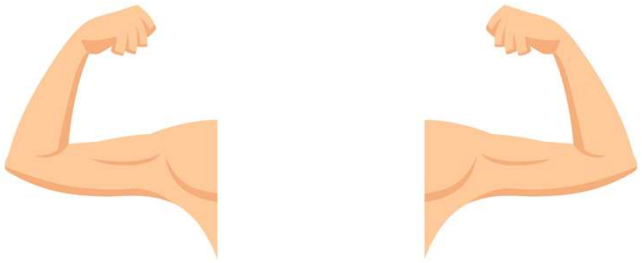
Chiropractic Care is all about exercising the small, deep paraspinal muscles back into proper function to enable the brain to more and more accurately perceive the internal and external environment so it can respond, adapt and heal better

*Heidi Haavik*

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It takes more than two to four weeks of exercise before you alter the size (morphology) of the muscle



The first few weeks are mainly neural changes!!

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*Moritani & DeVries (1979). "Neural factors versus hypertrophy in the time course of muscle strength gain." American journal of physical medicine & rehabilitation **58**(3): 115-130.*

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# Our Goals

- My Goal is to Help Your Brain and Body Work at Their Best
- What goal(s) would you like us to work towards?



- Do you have any questions?

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# Questions for Heidi?



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Dr Heidi Haavik

HeidiHaavik.com



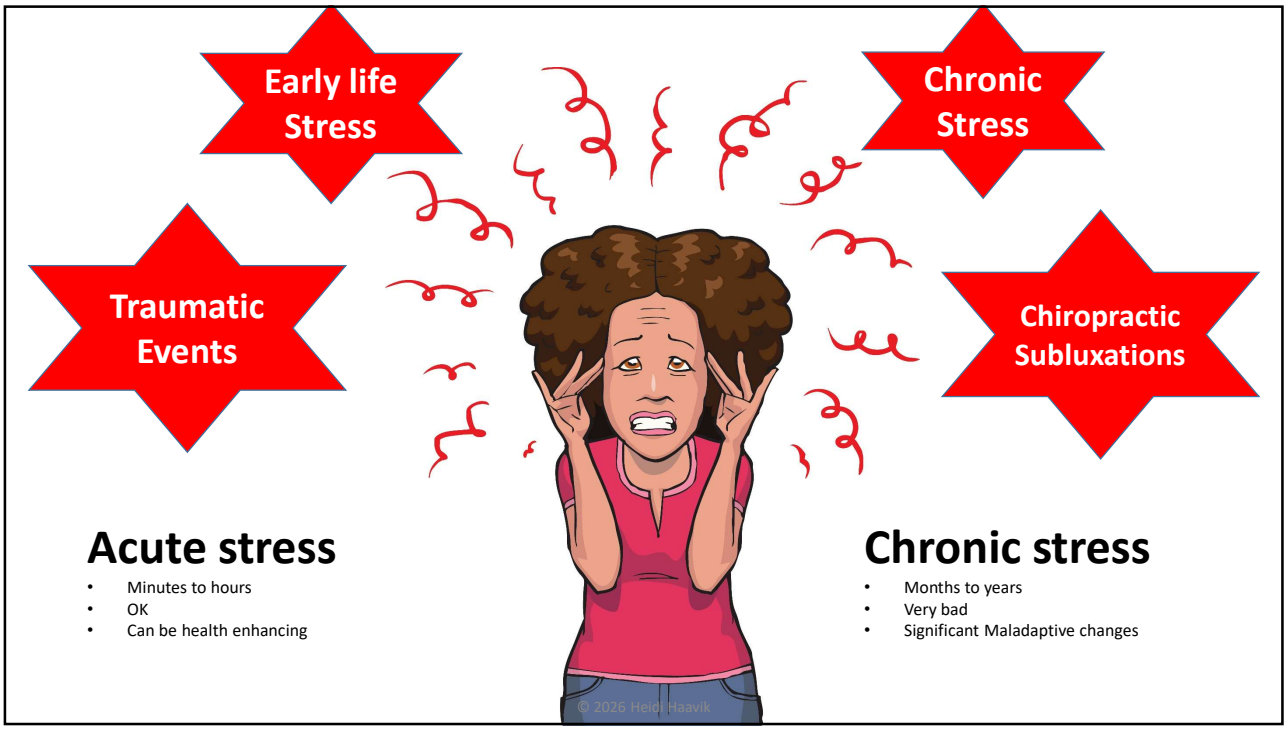

**TODAY'S HANDOUT**
**& Gifts**

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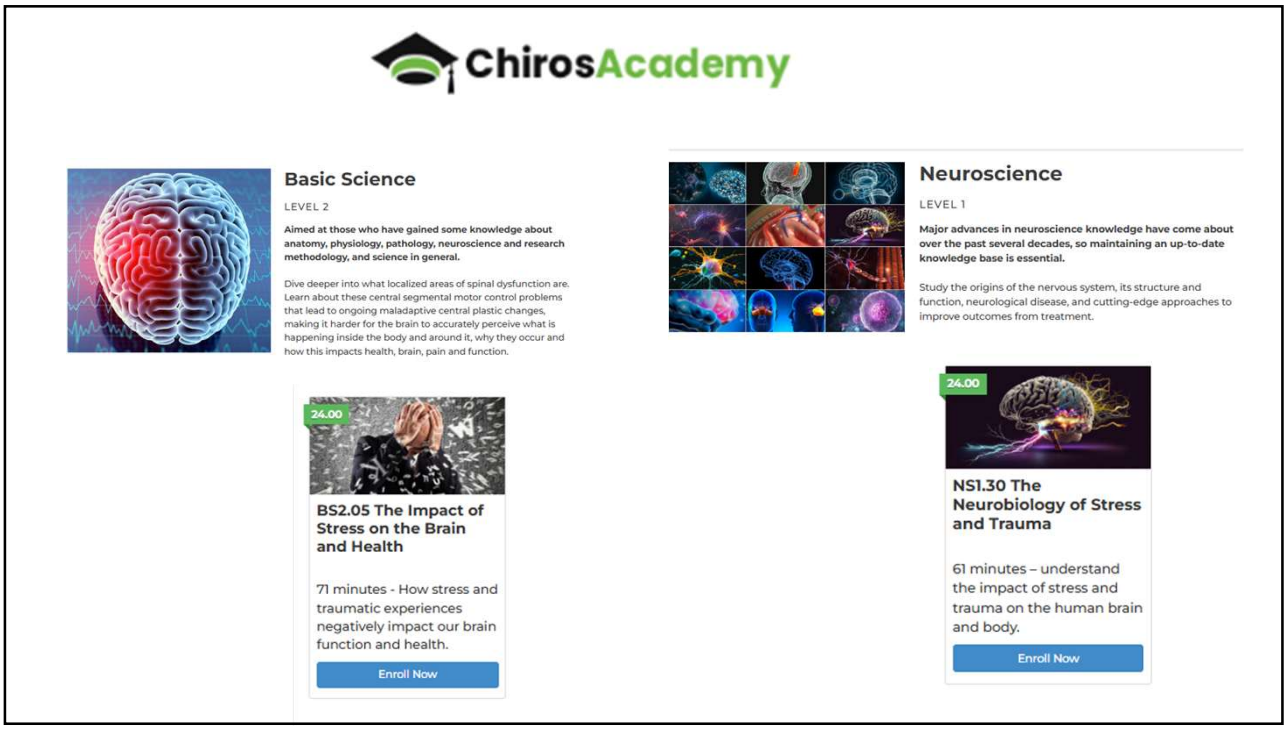
## Questions for Heidi?



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Early life Stress
Chronic Stress
Traumatic Events
Chiropractic Subluxations
Acute stress
• Minutes to hours
• OK
• Can be health enhancing
Chronic stress
• Months to years
• Very bad
• Significant Maladaptive changes
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ChirosAcademy
Basic Science
LEVEL 2
Aimed at those who have gained some knowledge about anatomy, physiology, pathology, neuroscience and research methodology, and science in general.
Dive deeper into what localized areas of spinal dysfunction are. Learn about these central segmental motor control problems that lead to ongoing maladaptive central plastic changes, making it harder for the brain to accurately perceive what is happening inside the body and around it, why they occur and how this impacts health, brain, pain and function.
24.00
BS2.05 The Impact of Stress on the Brain and Health
71 minutes - How stress and traumatic experiences negatively impact our brain function and health.
Enroll Now
Neuroscience
LEVEL 1
Major advances in neuroscience knowledge have come about over the past several decades, so maintaining an up-to-date knowledge base is essential.
Study the origins of the nervous system, its structure and function, neurological disease, and cutting-edge approaches to improve outcomes from treatment.
24.00
NS1.30 The Neurobiology of Stress and Trauma
61 minutes – understand the impact of stress and trauma on the human brain and body.
Enroll Now

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# The Stress-response Is Self-generated

- You brain determines if a situation is stressful or not.
- Stress is NOT objective.
- not all individuals are at equal risk for poor health following stress.
- peoples' brain's perceptions of stress are entirely self-generated.
- If the brain perceives a threat, it will initiate a complex cascade of events that culminate in what is generally referred to as the **biological stress response.**

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# Internal & External Stressors

**Physical Stressors (internal)**

- Fatigue
- Overload / overtraining
- Burnout
- Pain
- Acute infections
- Chronic illnesses
- Dehydration
- Digestion
- Pregnancy
- Chiropractic subluxation



**Physical Stressors (external)**

- Exercise
- Sleep
- Physical workload
- Stimulants e.g., coffee,
- Medications
- Alcohol or other substances,
- hangover
- Sauna
- Temperature
- Noise
- Altitude
- Jetlag

**Psychological Stressors**

- Anxiety, depression, sorrow
- Negative emotions
- Traumatic events
- Work stress
- Psychological conditions
- Fear, tension
- Relationship problems
- Excitement e.g., falling in love

**Social Stressors**

- Pressures
- Lack of social support
- Isolation, loneliness
- Presentation / speech
- Fear of social situations



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# Traumatic Experiences

A traumatic event is an incident that causes physical, emotional, spiritual, or psychological harm, as perceived by your brain.

This significantly affects the amygdala, anterior cingulate cortex, hippocampus, and prefrontal cortex.

90% of people report exposure to at least one traumatic event.

**Examples of traumatic events include:**

- Serious accidents, such as car accident
- Sexual assault or abuse
- Discovering you have a life-threatening illness
- Bereavement (death of a loved one)
- Violent personal assault, e.g., physical attack
- Domestic or family violence, dating violence, community violence (shooting, mugging, burglary, assault, bullying)
- Military combat
- Terrorist attack
- Being taken hostage, or a prisoner of war
- Natural disaster such as a hurricane, flood, fire, or earthquake
- Sudden unexpected or violent death of someone close (suicide, accident)
- Serious injury (burns, dog attack)
- Major surgery
- War or political violence
- Serious illness of a loved one
- Dismissal from work
- Retirement
- Prison stay
- Marriage and divorce

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# Most Common Traumatic Experiences (N = 2,953)

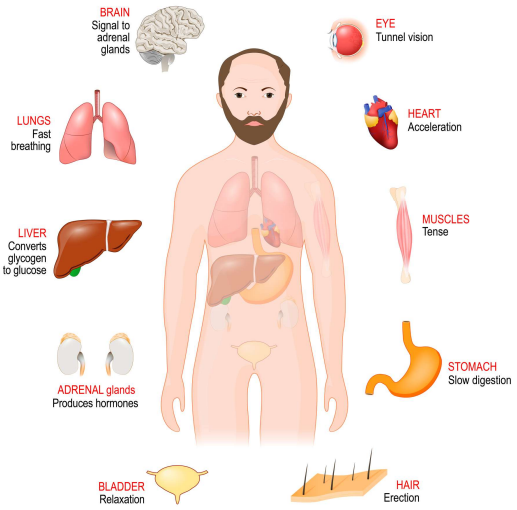
| | | |
|---|---|---|
| • Sexual/physical assault | 1,568 | 53% |
| • Death due to violence/accident/disaster | 1,529 | 52% |
| • Disaster | 1,491 | 50% |
| • Accident/fire | 1,427 | 48% |
| • Witnessed sexual or physical assault | 982 | 33% |
| • Family/close friend threat/injury | 956 | 32% |
| • Witnessed dead bodies | 667 | 23% |
| • Work/secondary exposure | 340 | 12% |
| • Combat/war zone | 231 | 8% |
| • Any *DSM-5* Criterion A event | **2,647** | **90%** |

- ***Marriage and divorce not included as options***

*Kilpatrick et al (2013). National estimates of exposure to traumatic events and PTSD prevalence using DSM-IV and DSM-5 criteria. Journal of Traumatic Stress, 26(5), 537-547.*

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Fight-or-flight response



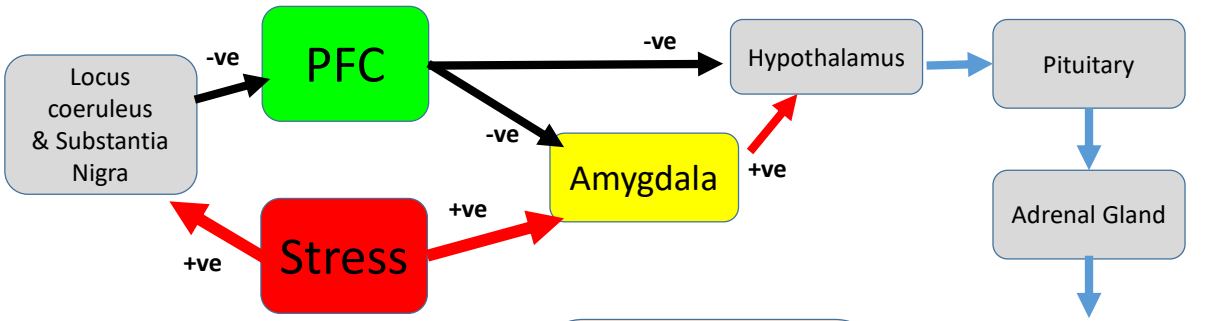

# Neurobiology of Stress

There are four major systems involved:

1. Hypothalamic–pituitary–adrenal axis
2. Hypothalamic–pituitary–gonadal axis
3. Sympathetic nervous system activation (and Sympathetic–adrenal–medullary axis)
4. The immune system

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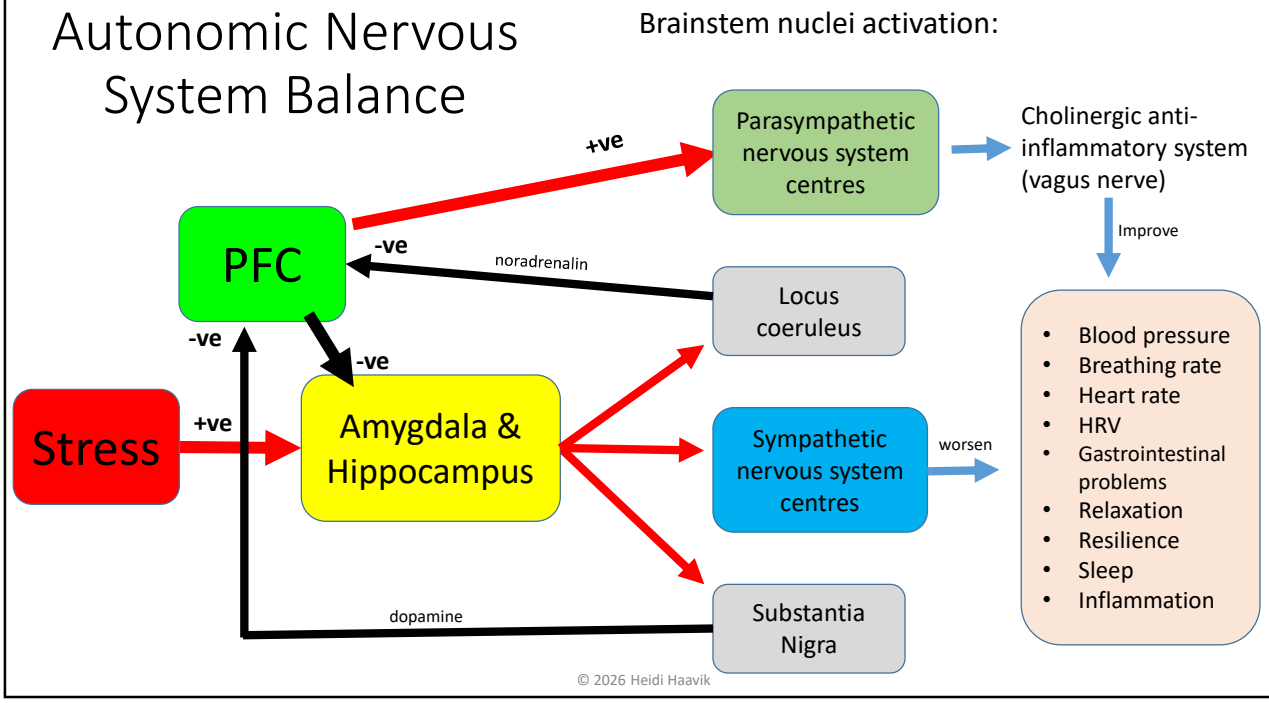



Neuro-endocrine Influence

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# Autonomic Nervous System Balance




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# Typical Symptoms of Acute Stress Response

- High blood pressure, high heart rate, high breathing rate
- Low HRV
- Sweating and increased body temp
- Dry mouth
- Headache, migraine
- Insomnia
- Dilated pupils
- Social withdrawal
- Difficulty relaxing
- Heightened alternes and vigilance
- Racing thoughts, difficulty concentrating
- Very emotional (anxiety, fear, nervousness, sadness, crying, irritable, restless, sense of overwhelmed)

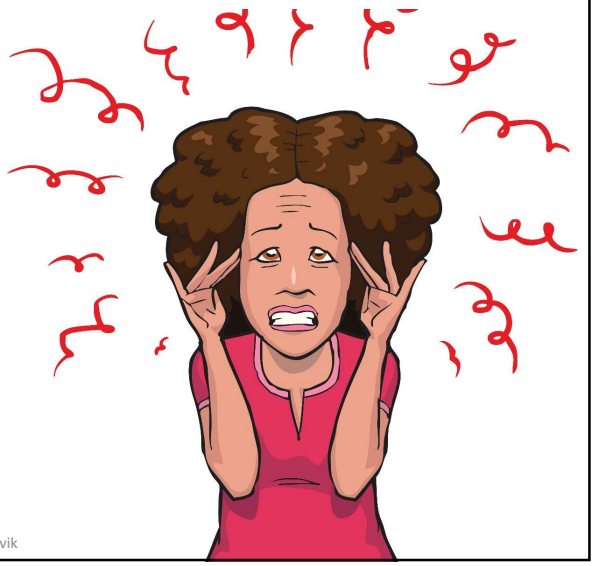


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# Typical Symptoms of Medium-term Stress Response

- Changes in sleep patterns (insomnia or excessive sleep)
- More digestive problems
- Memory/attention problems
- Tight/sore big muscles
- Frequent subluxations
- More pain
- Metabolic disorders, such as insulin resistance, hyperlipidemia & obesity
- Increased aggression or irritability
- Social withdrawal or isolation
- Difficulty relaxing or sitting still
- Changes in appetite (increased or decreased)
- Impaired performance at work, school, or daily tasks
- Avoidance of situations associated with the stressor
- Excessive use of substances (e.g., alcohol, tobacco) as a coping mechanism



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# Typical Symptoms of Long-term Stress Response

Lots of pain, tight sore muscles, lots of subluxations that reoccur often.

Takes medication for stress, anxiety, depression and /or drinks a lot of alcohol and/or smokes, overeating, overweight, takes drugs, and /or lots of avoidance behavior (watches lots of TV, sports, etc to avoid feeling), workaholic.

Very 'on edge', jittery, startles easy, tremors, disassociates easy, highly emotional and/or irritable, and often sleep problems.

Memory and attention problems, appears irrational, paranoid, and usually always has functional digestive issues.

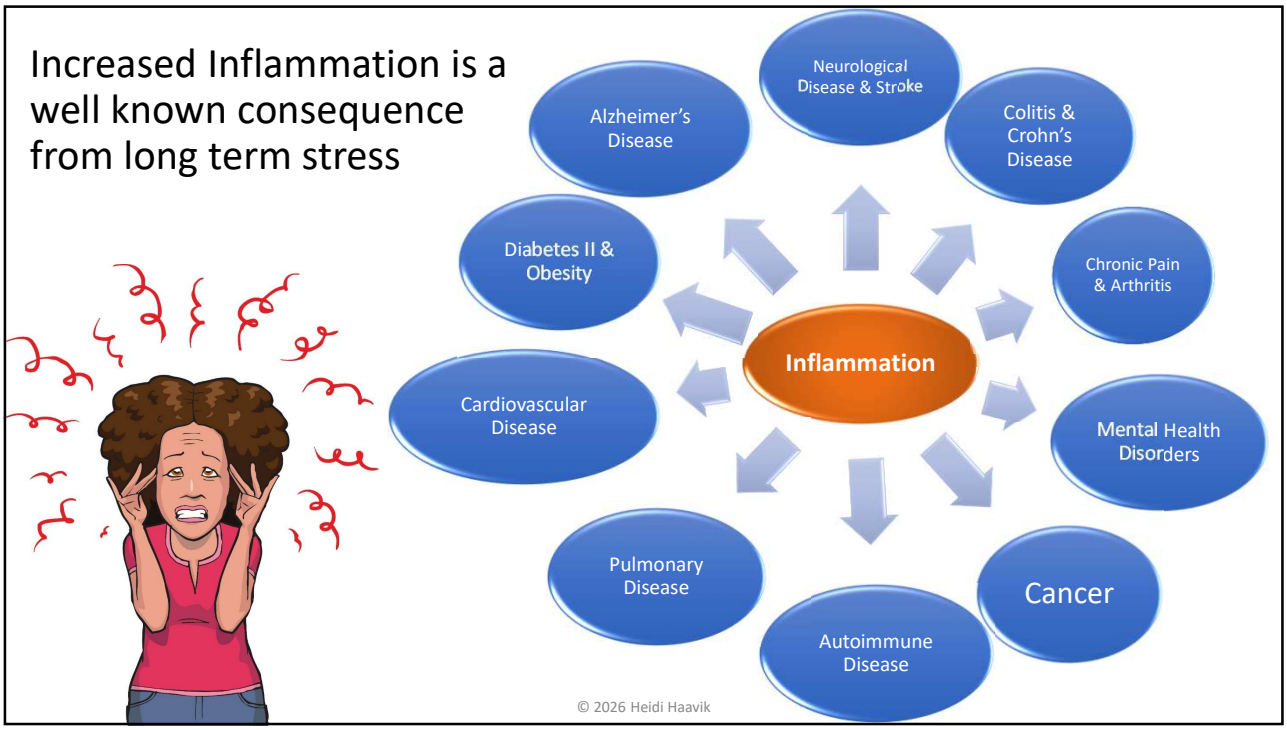
High blood pressure, high heart rate, and/or high breathing rate, low HRV.

Increased Inflammation

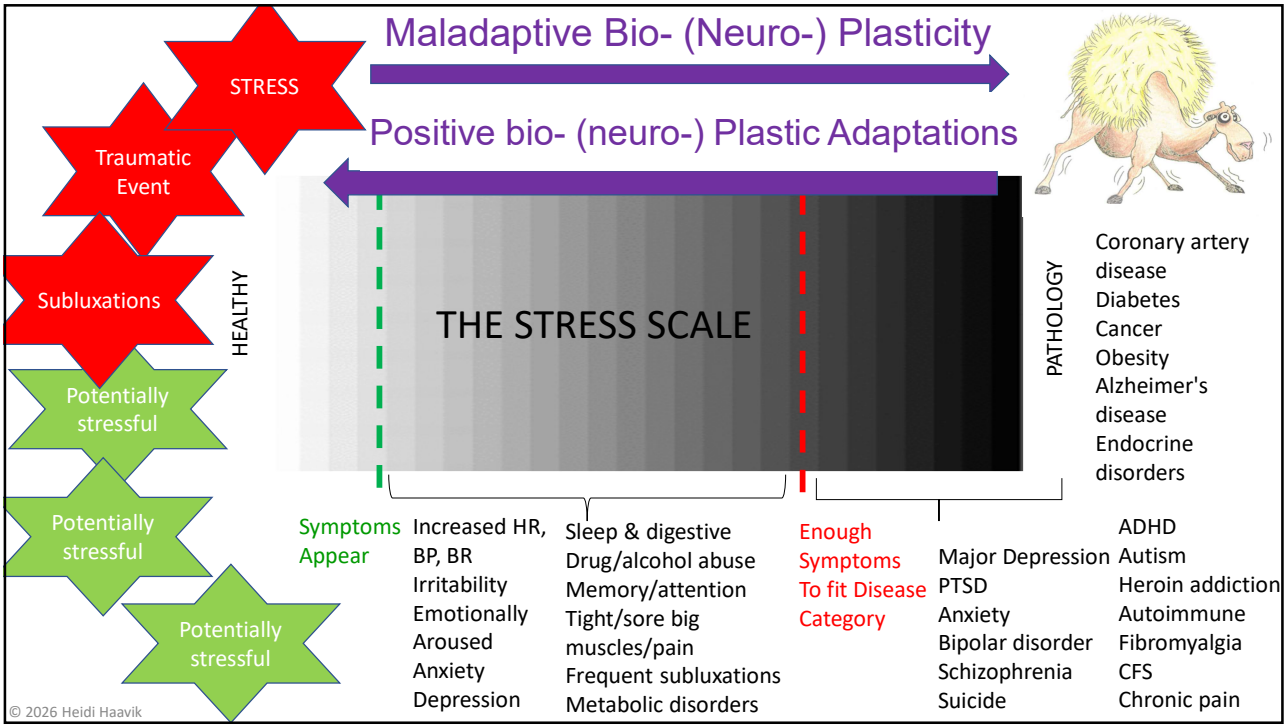


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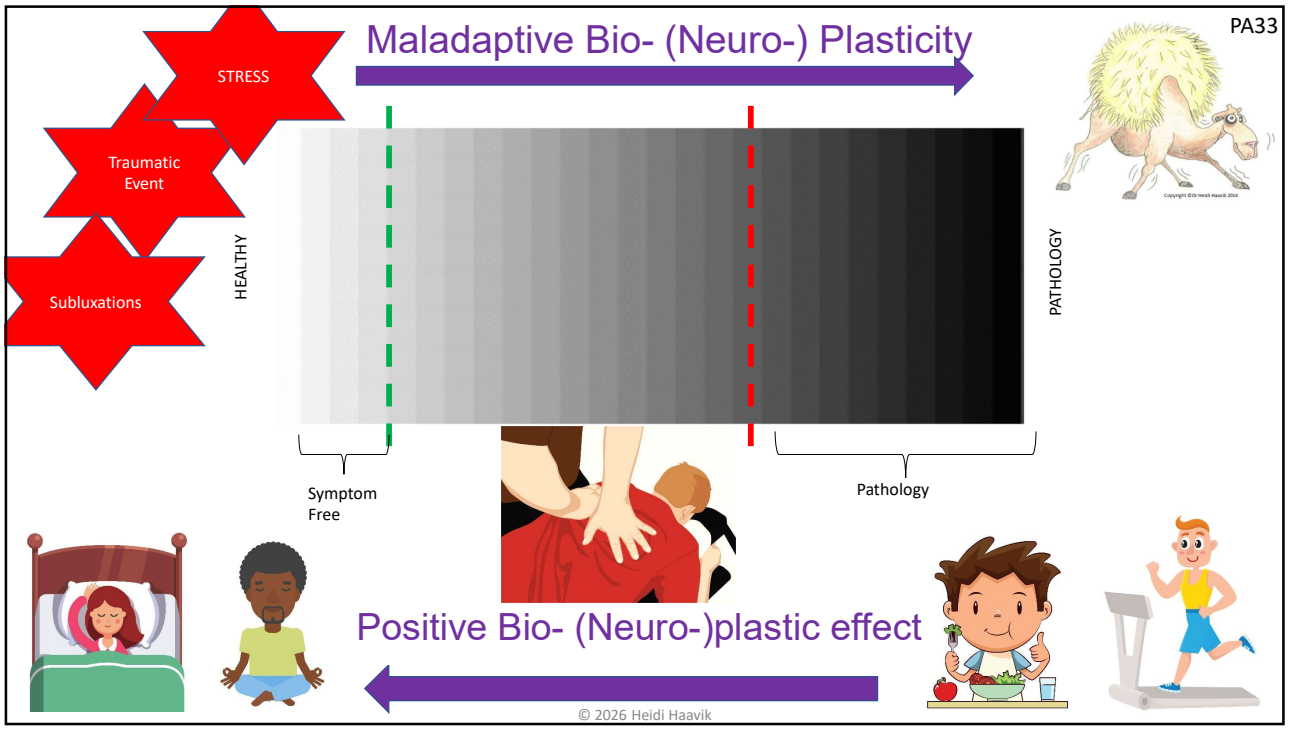
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Increased Inflammation is a well known consequence from long term stress
Neurological Disease & Stroke
Alzheimer's Disease
Colitis & Crohn's Disease
Diabetes II & Obesity
Chronic Pain & Arthritis
Inflammation
Cardiovascular Disease
Mental Health Disorders
Pulmonary Disease
Cancer
Autoimmune Disease
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Maladaptive Bio- (Neuro-) Plasticity
Positive bio- (neuro-) Plastic Adaptations
STRESS
Traumatic Event
Subluxations
Potentially stressful
Potentially stressful
Potentially stressful
HEALTHY
THE STRESS SCALE
PATHOLOGY
Coronary artery disease
Diabetes
Cancer
Obesity
Alzheimer's disease
Endocrine disorders
Symptoms Appear
Increased HR, BP, BR
Irritability
Emotionally Aroused
Anxiety
Depression
Sleep & digestive
Drug/alcohol abuse
Memory/attention
Tight/sore big muscles/pain
Frequent subluxations
Metabolic disorders
Enough Symptoms To fit Disease Category
Major Depression
PTSD
Anxiety
Bipolar disorder
Schizophrenia
Suicide
ADHD
Autism
Heroin addiction
Autoimmune
Fibromyalgia
CFS
Chronic pain
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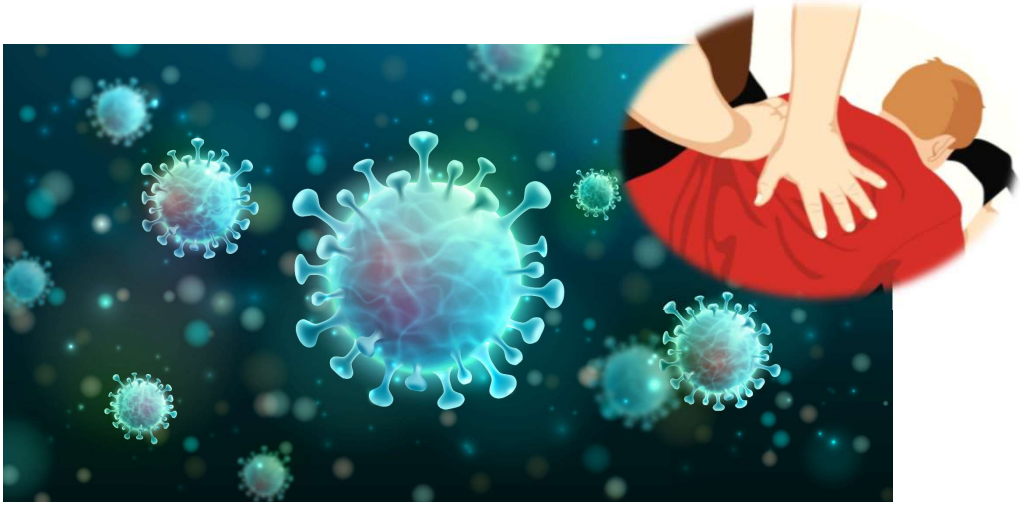

PA33
Maladaptive Bio- (Neuro-) Plasticity
STRESS
Traumatic Event
Subluxations
HEALTHY
PATHOLOGY
Symptom Free
Pathology
Positive Bio- (Neuro-)plastic effect
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# Chiropractic and the Immune System



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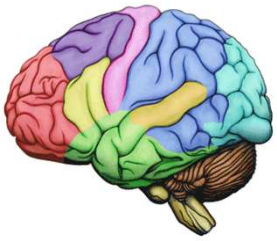
**The Chiro-Neuro-Immune Connection**

For the first time, we have trial data showing measurable changes in neuroplasticity and stress physiology following chiropractic care.

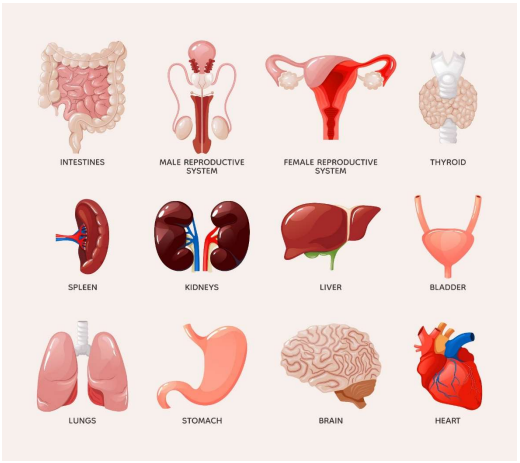



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# According to the Brain Model
# How can chiropractic care alter Organ function










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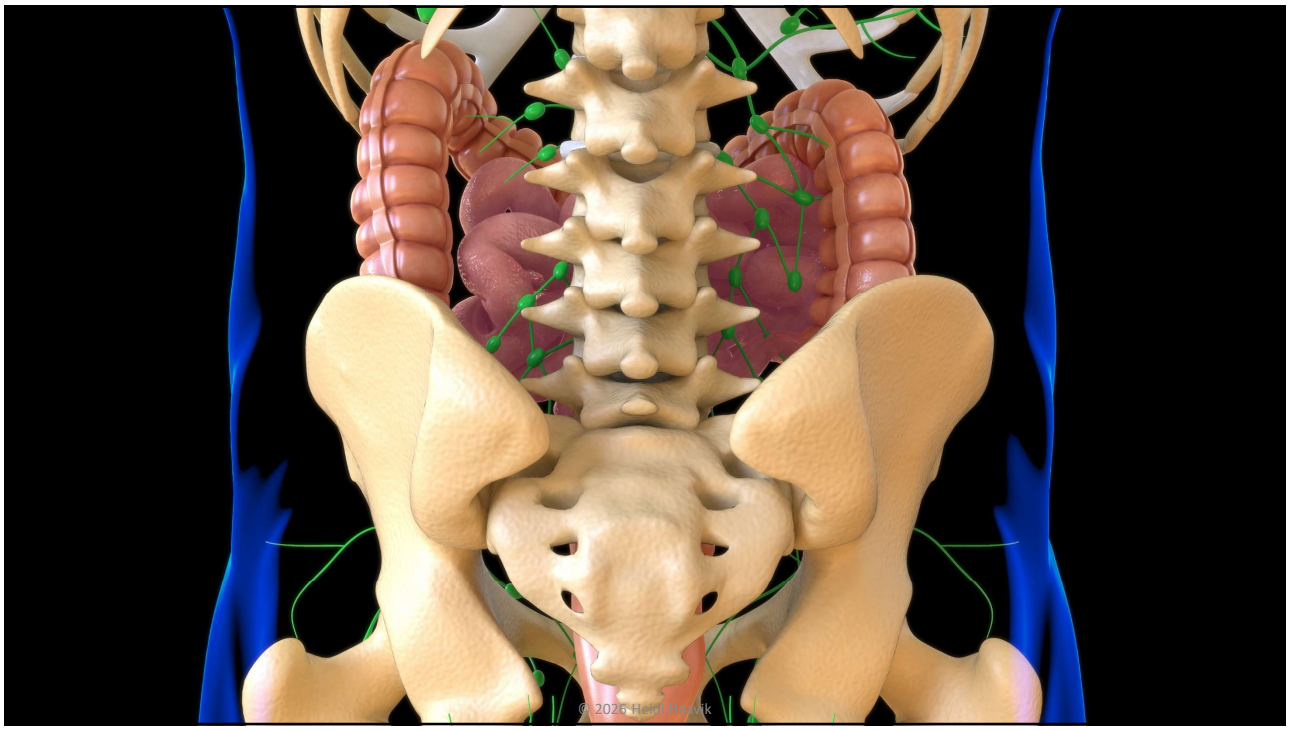
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**Chiropractic & Organ Function**

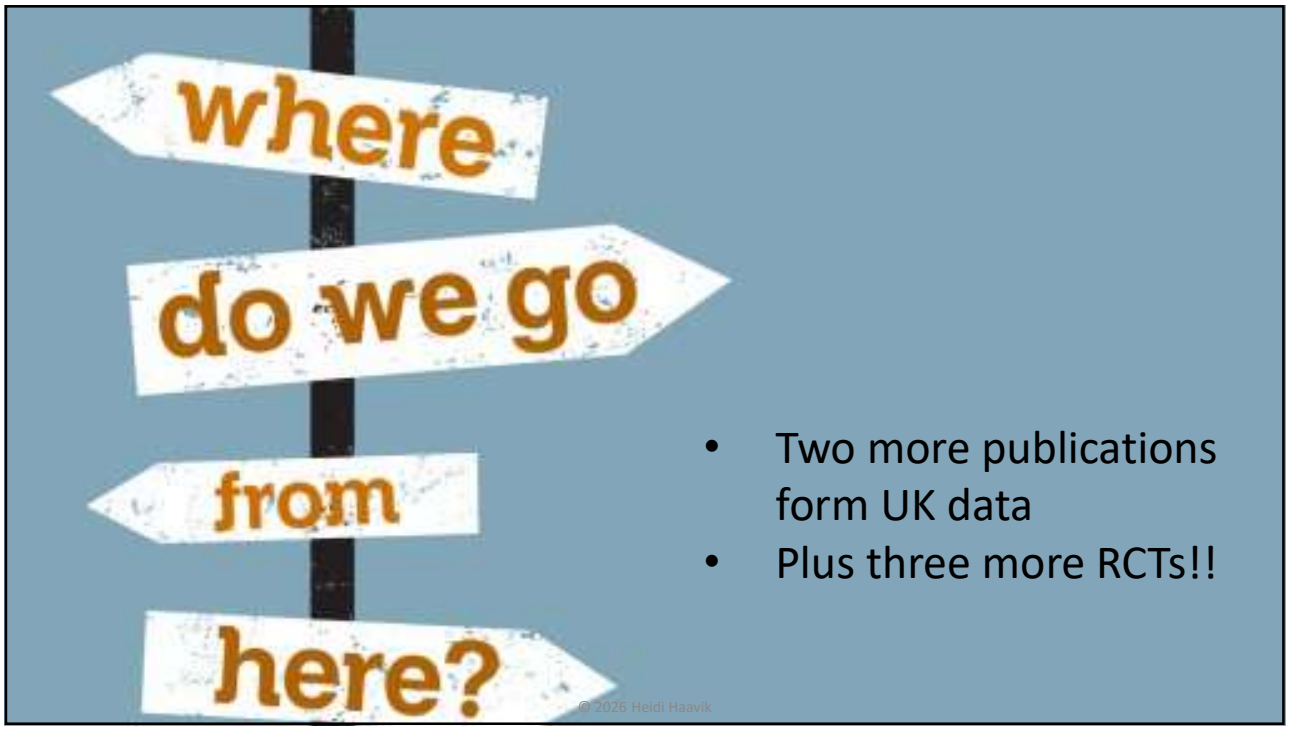
Explaining how chiropractic care can impact organ function – according to the Brain Model.




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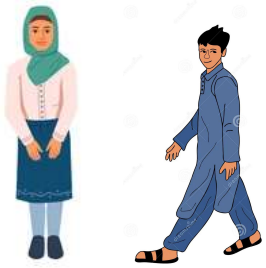



- Two more publications form UK data
- Plus three more RCTs!!

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# Two Large RCTs also conducted in Pakistan!

- Two separate groups
  - Adults
  - Teenagers
- 12 weeks of chiro care
- 4 week follow up
- EEG + Lots of clinical outcomes related to PFC
  - Immune
  - Emotions
  - Sleep
  - executive functions
  - etc





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Jenna Duehr

# Exploring the neurophysiological effects of chiropractic care on infants

- Dr Jenna Duher's PhD project at Auckland University
- Baby RCT
- Infant babies
- 8 weeks chiro care
- EEG and HRV
- Breastfeeding & asymmetry outcomes



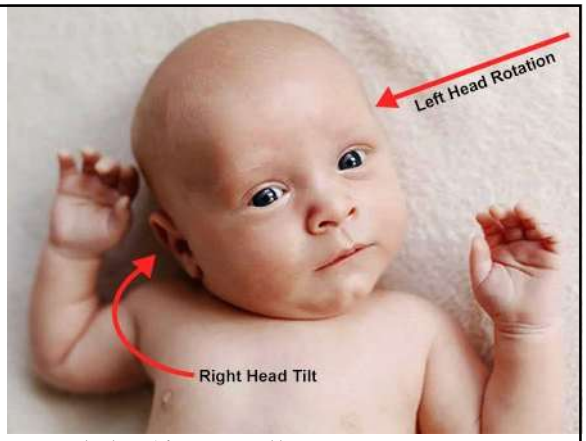
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Infantile postural asymmetry (IPA) = Abnormal positional preferences of the head or trunk

- **Short term consequences:**
  - Suboptimal breastfeeding (1, 2, 3)
  - Abnormal sensory input, visual field preferences (4,5,6)
  - Developmental delay, particularly in the motor domain (7,8,9)
  - Plagiocephaly (10, 11, 12, 13)
  - Developmental hip dysplasia (14, 15)
- **Long term consequences:**
  - Neurodevelopmental disorders (9, 16, 18, 19)
  - Learning and behavioural difficulties as children (16, 19)
  - Sensory processing disorders (9, 16, 19)

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# Outcome measures

- **Postural asymmetry measurements**
  - Video based analysis using automated infant pose recognition system
    - Head bend angle
    - Trunk bend angle
- **Musculoskeletal Infant Breastfeeding Assessment Questionnaire** (1)
- **Parent reported outcome measure**
  - Based on the United Kingdom Infant Questionnaire (2)
    - Sleeping
    - Feeding
    - Crying
    - Head position preference
    - Health

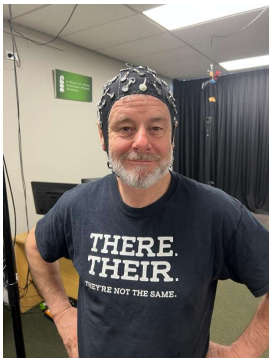


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# Intent Study










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# Our Future lies in BIG DATA

https://chiropracticfuture.org/

CHIROPRACTIC FUTURE STRATEGIC PLAN

BIG DATA






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# DO YOU OWN YOUR SCIENCE?

ChirosAcademy

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# ARE YOU A CONFIDANT COMMUNICATOR?



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ChirosHub

Code heiditalk
Gives you 15% off










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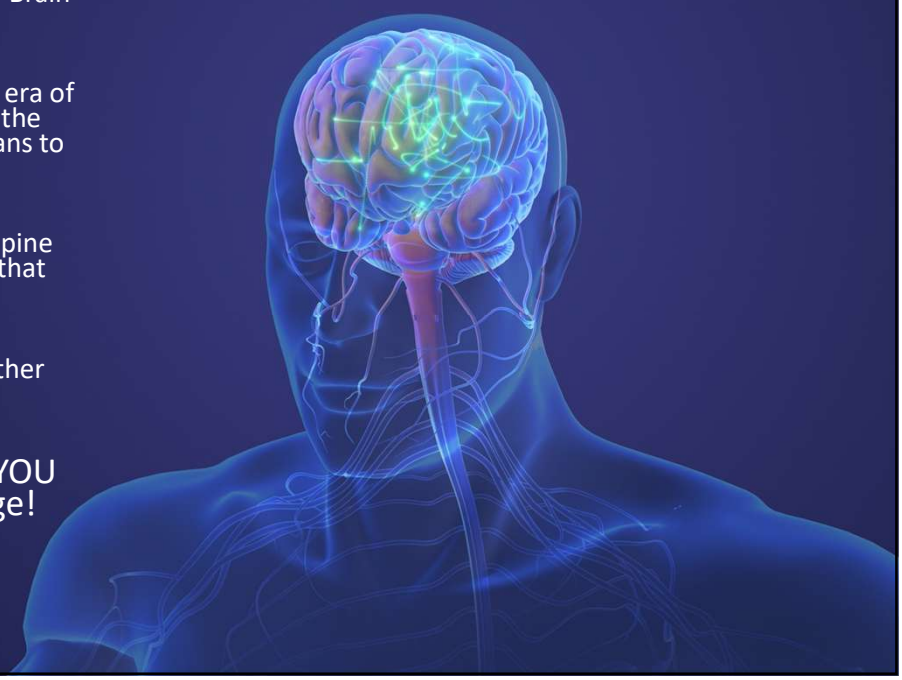
We are entering a bold new Brain era for chiropractic

We are entering a bold new era of understanding the brain, the body, and what it truly means to be human

From what I can see, the spine sits right at the center of that story

The question is NOT whether things are changing

The question is: are YOU ready for this change!



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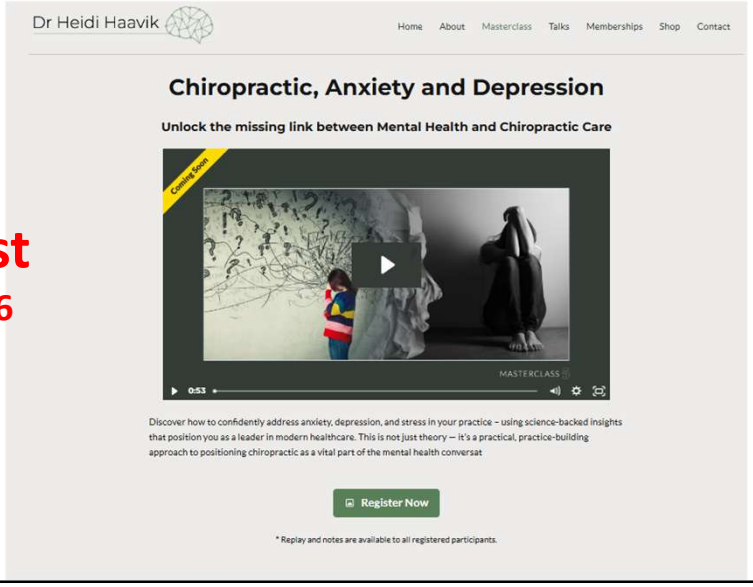
# Questions for Heidi?



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**August 7th 2026**




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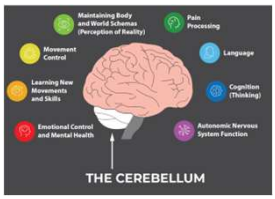
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The HANDOUT for today's Class (the slides)

Gift




Gift




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