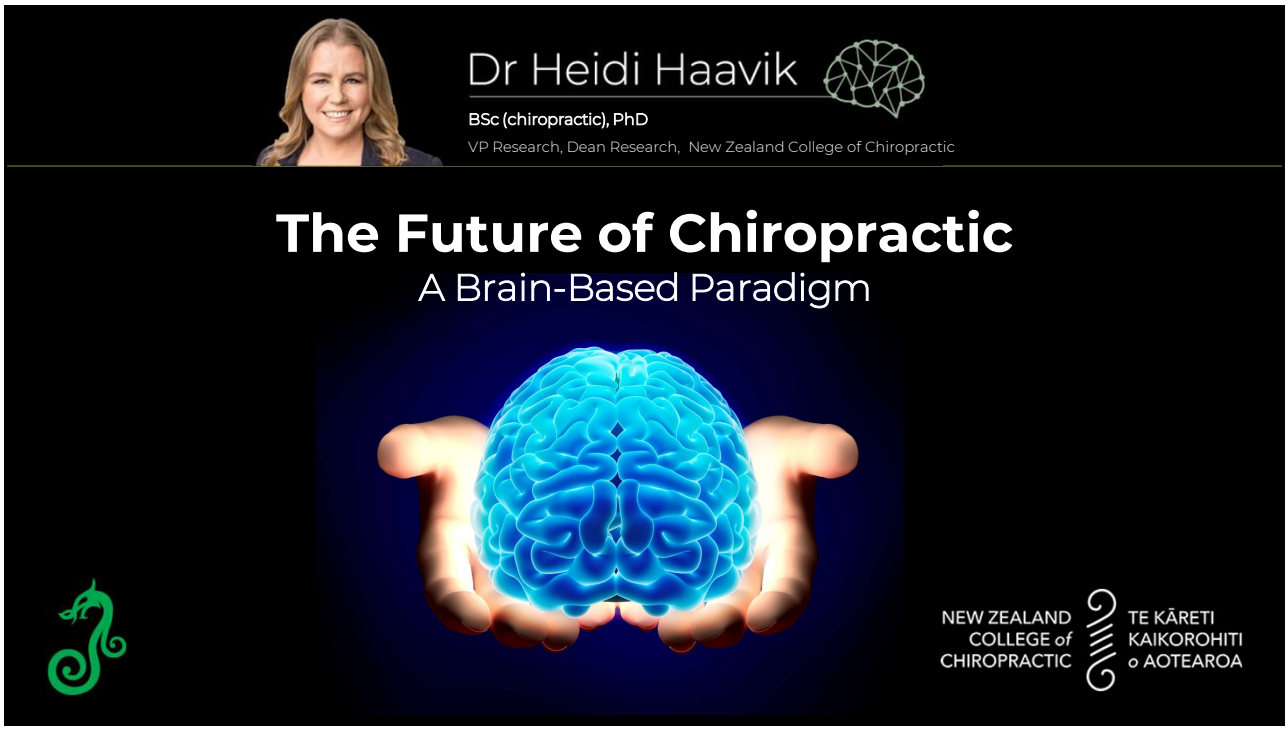
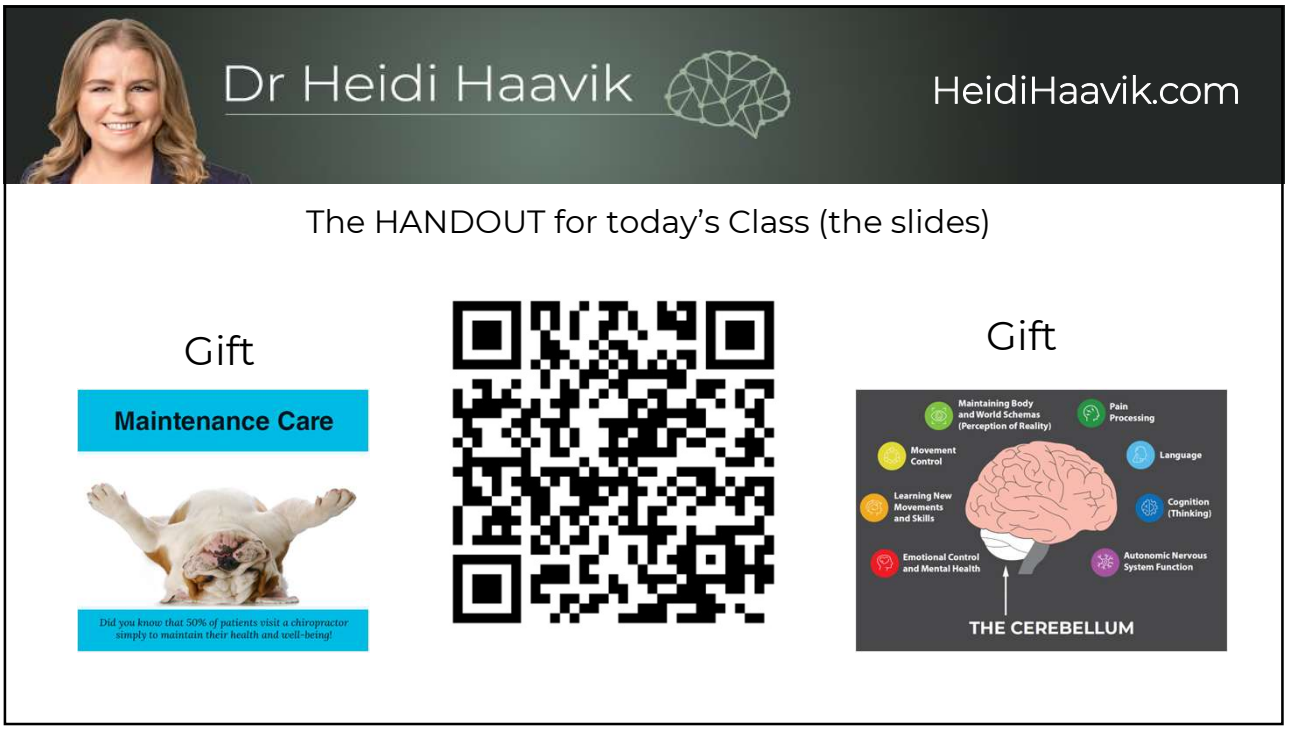

Dr Heidi Haavik
BSc (chiropractic), PhD
VP Research, Dean Research, New Zealand College of Chiropractic
The Future of Chiropractic
A Brain-Based Paradigm
NEW ZEALAND COLLEGE of CHIROPRACTIC
TE KĀRETI KAIKOROHITI o AOTEAROA

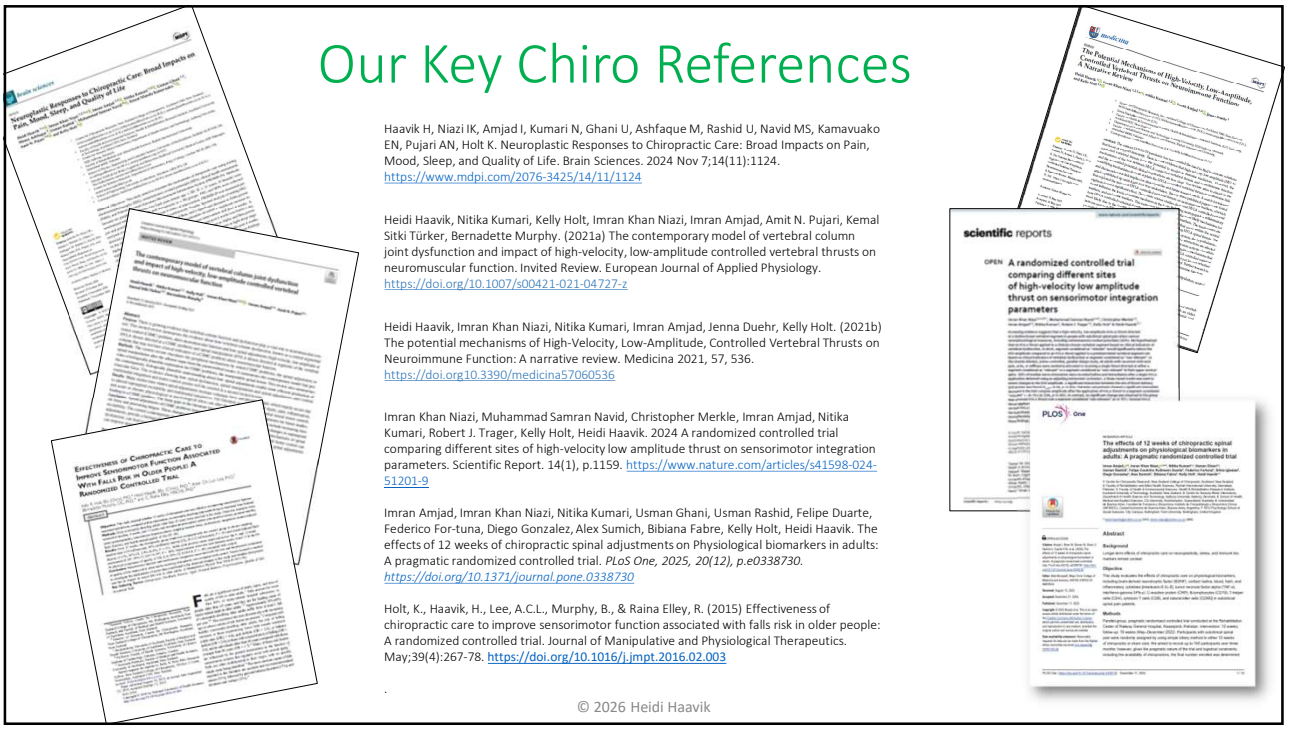
1


Thank you!
MCA
MAINE CHIROPRACTIC ASSOCIATION

2


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

3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scientific reports
OPEN
A randomized controlled trial comparing different sites of high-velocity low amplitude thrust on sensorimotor integration parameters
PLOS One

4

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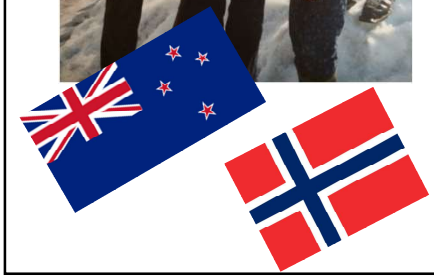
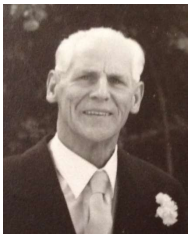




Dr William Charles Lawson - Palmer Graduate 1924

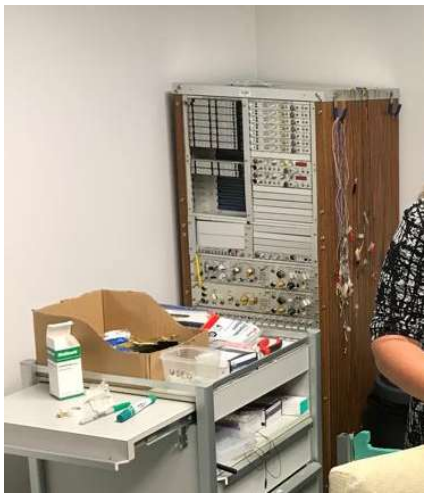
New Zealand College of Chiropractic
graduating hands, hearts & minds

1999 NZCC Graduate

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND
Te Whare Wānanga o Tāmaki Makaurau

2008 PhD

6



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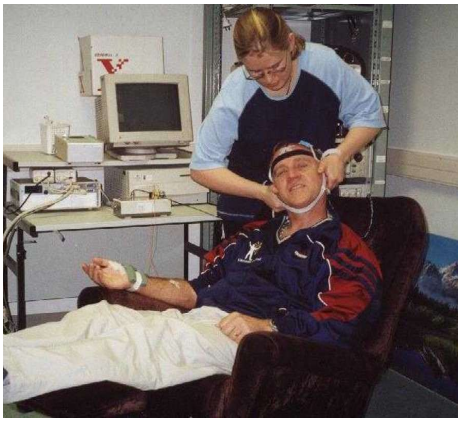

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8

NEW ZEALAND COLLEGE of CHIROPRACTIC
TE KĀRETI KAIKOROHITI o AOTEAROA


Dr Heidi Haavik


Dr Kelly Holt


Dr Nitika Kumari


Dr Imran Khan Niazi


Dr Usman Rashid


Dr Imran Amjad


Dr Usman Ghani

9

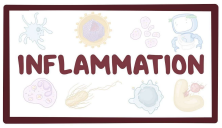
How many of you have a spine model in your practice?

10

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

11

12

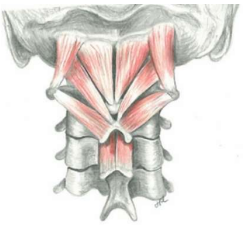


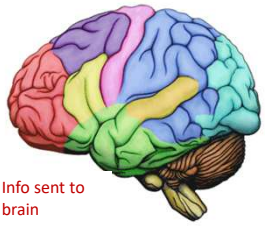
OR

Stress

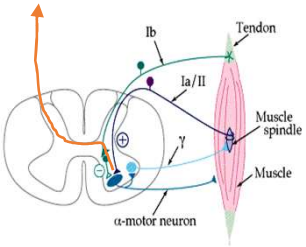
Injury

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

Self perpetuating cycle

So brain does NOT know accurately what is going on

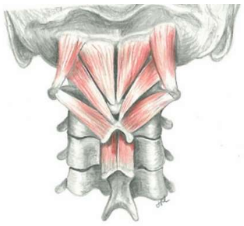
Changes brains internal representations about what is going on inside and outside body

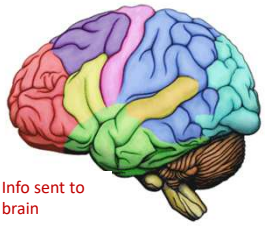
(Haavik et al 2021 EJAP)

13

Adjustment

Stretches small muscles closest to spine and scull





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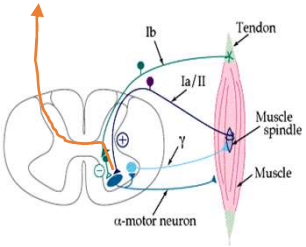


Bombards brain with mechanoreceptor input

Improved body awareness
Improved body control
Improved function

Effects of Adjustment

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)

14

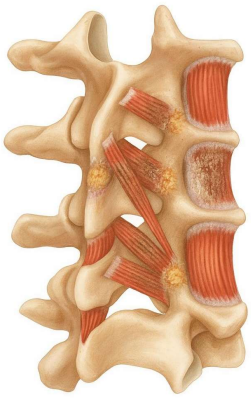
The Short Version

"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

15

Subluxation today vs 2 years of being subluxated



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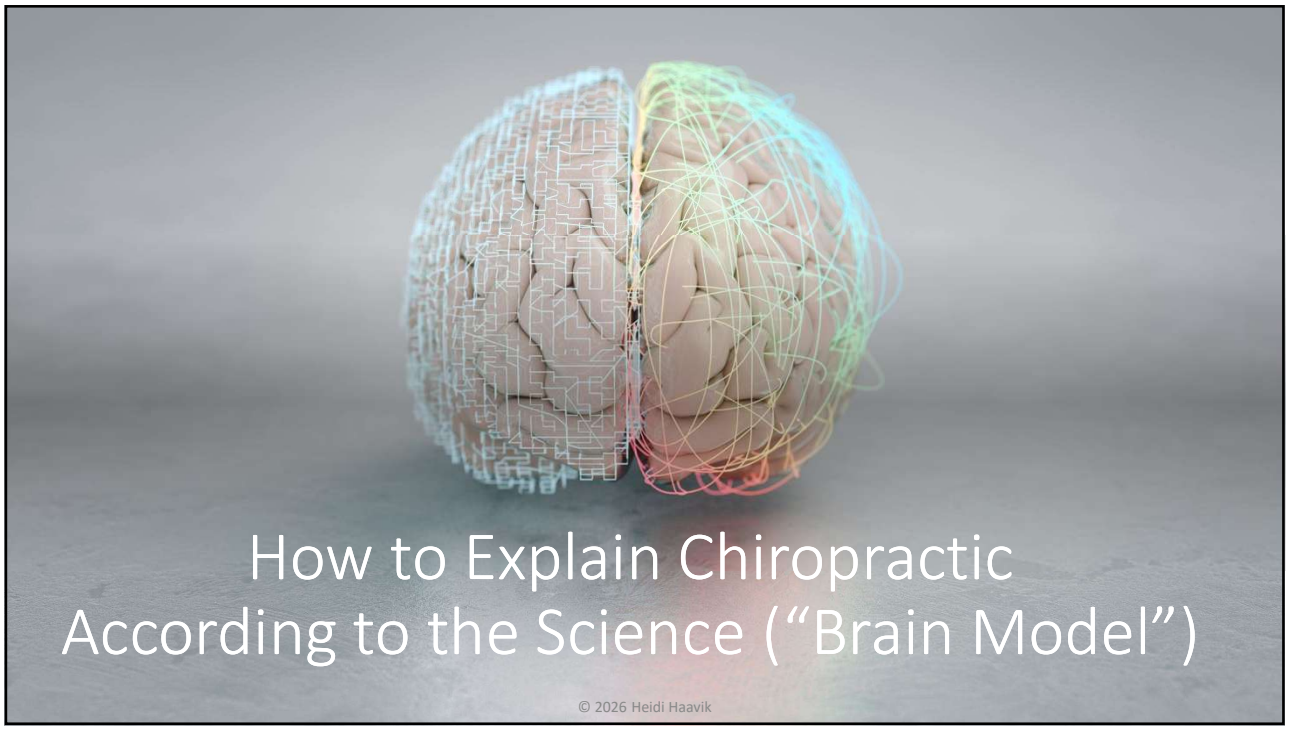
17


How to Explain Chiropractic According to the Science (“Brain Model”)
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18

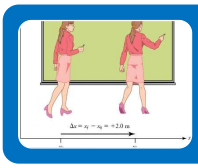
ChirosHub

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

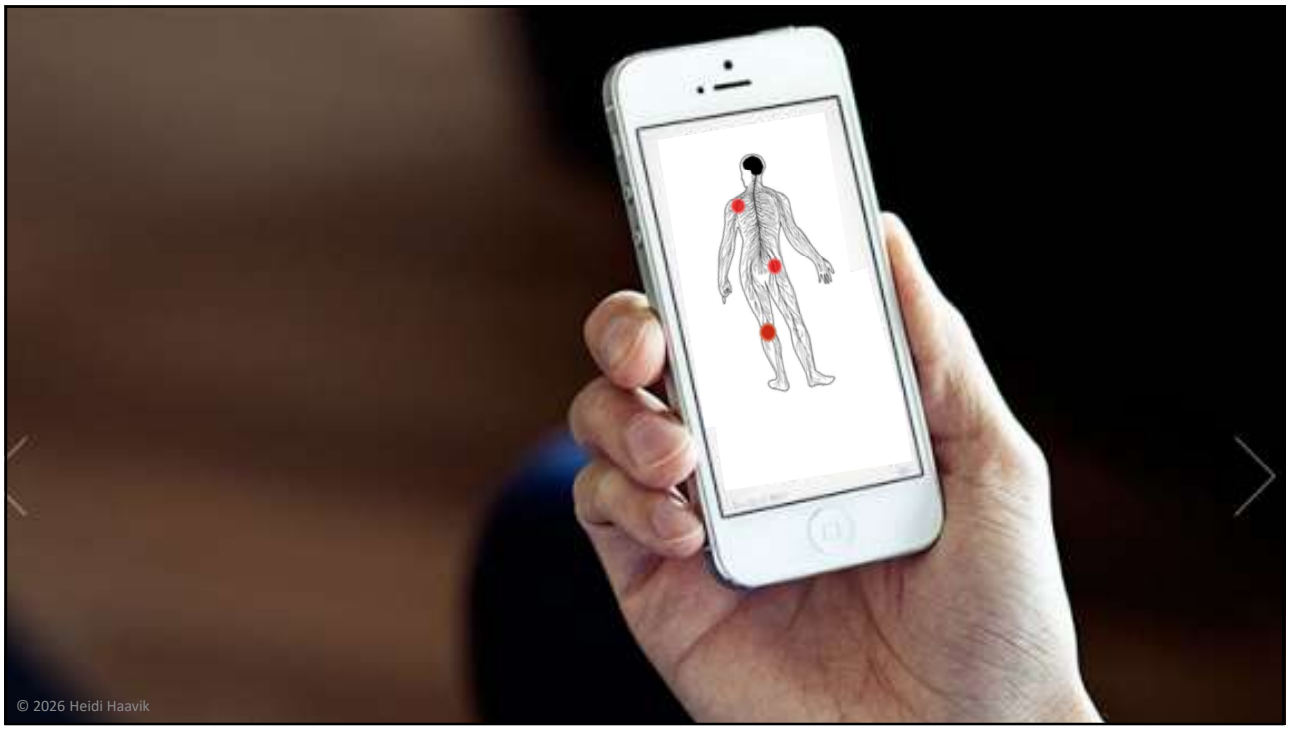
ChirosHub.com

19

ChirosHub

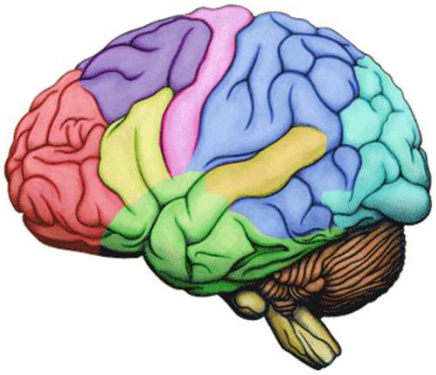
Code heiditalk
Gives you 15% off

20



21

Two Key Components to explain Chiropractic to the Public

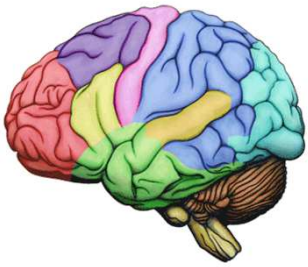


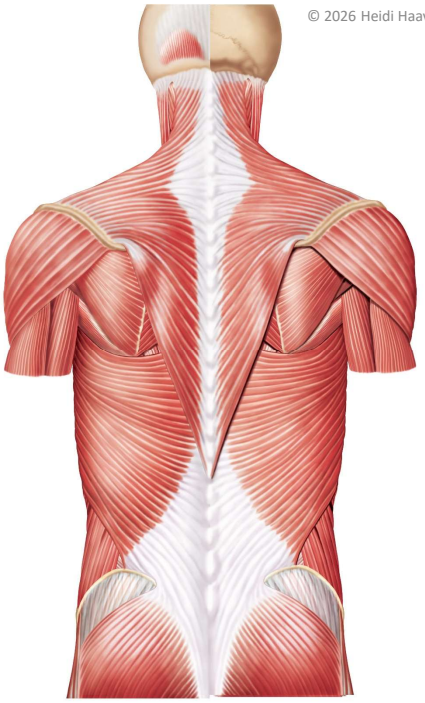
22

23

A healthy spine moves!

However, bones do not move themselves!



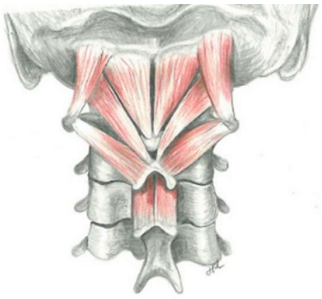


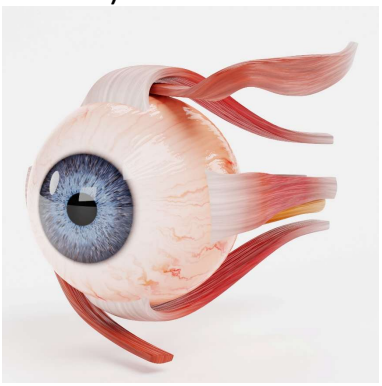
(Sun et al 2024,; McGill et al 2024; Suehiro et al 2025)

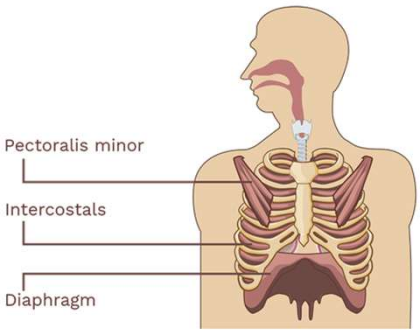
24

It is a complex system

- Reactive
- Feed-forward (predictive)
- Tonic







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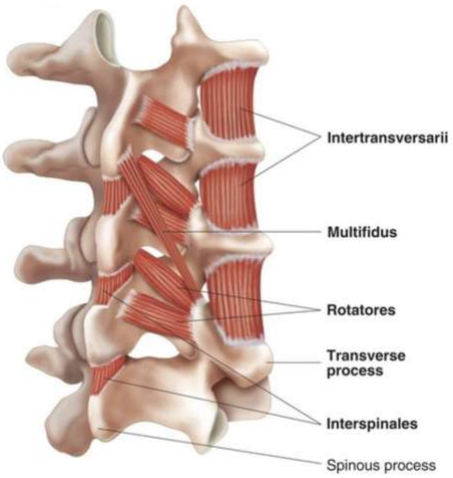
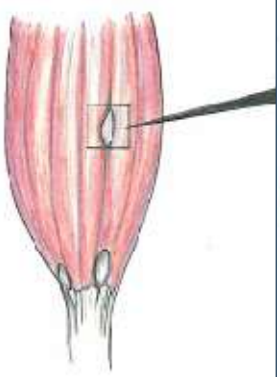
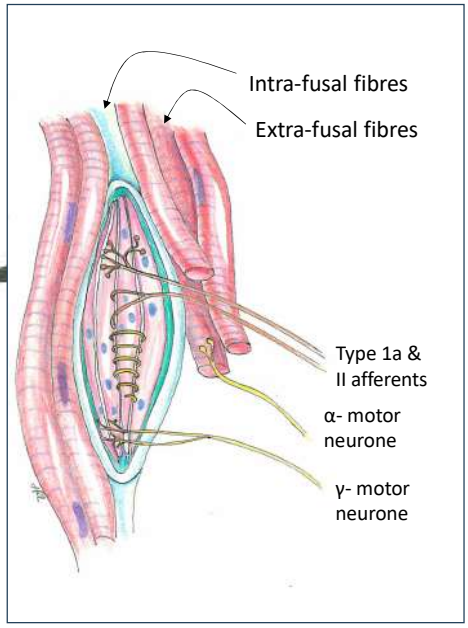


MUSCLE SPINDLES





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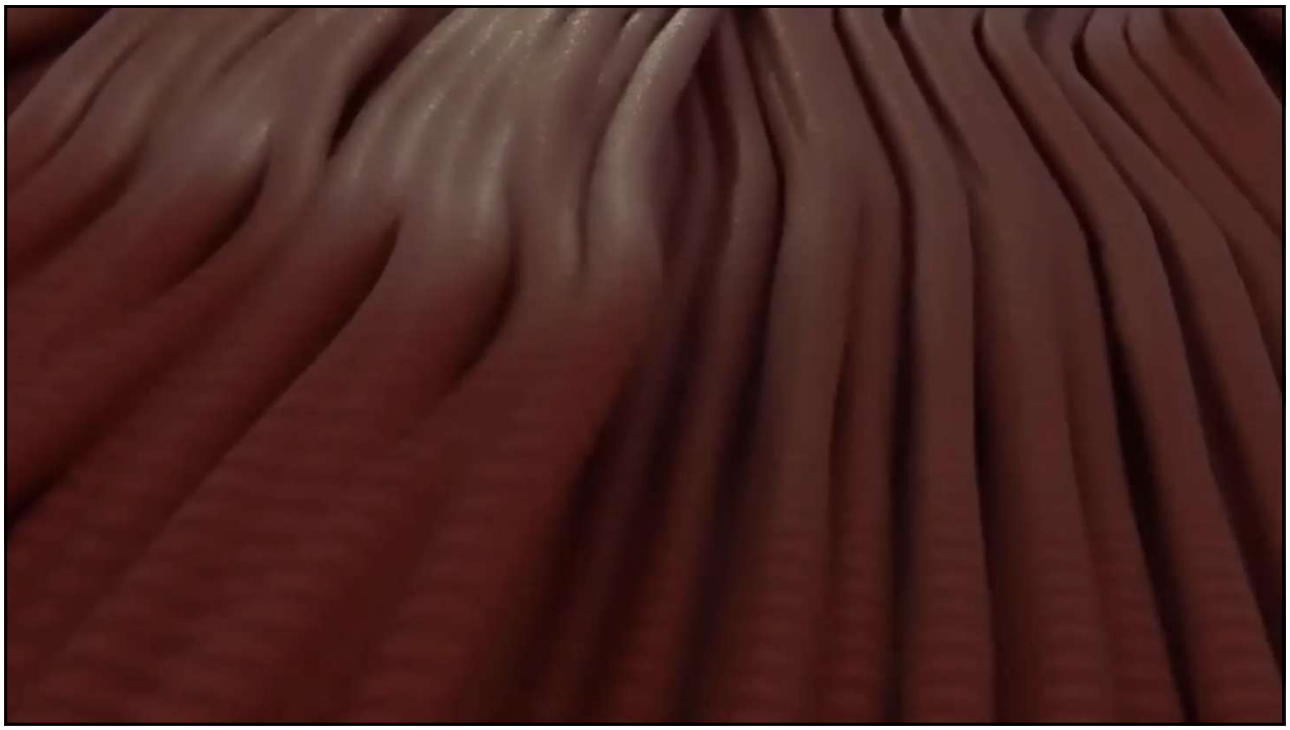

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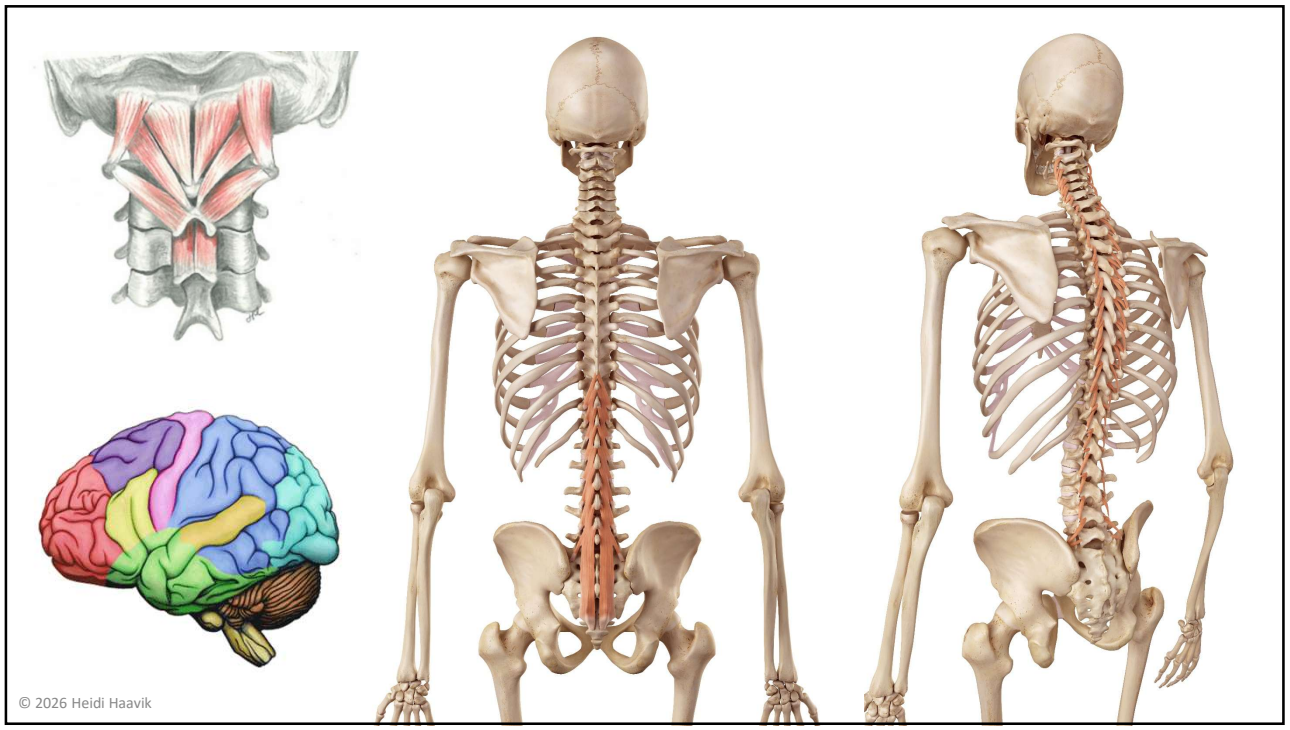
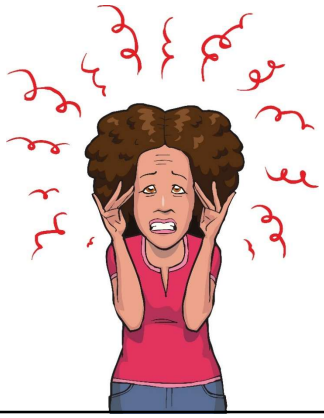
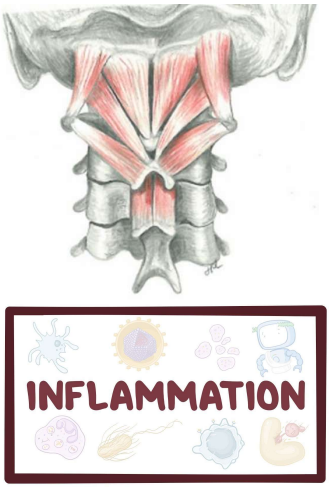


28

What can causes vertebral subluxations?





(Haavik et al 2021 EJAP)

29

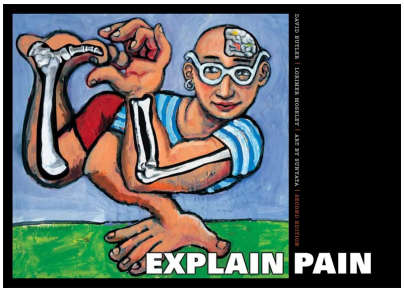
(Butler & Moseley 2003)

30

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."



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

31

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)

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
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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.

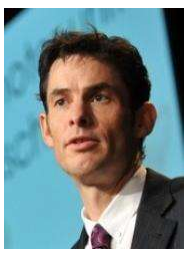
Results Multifidus muscle spindles were located centrally in the muscle and generally near connective tissue. There were no differences in the number or location of muscle spindles after IVD degeneration and only changes in the CSA of nuclear chain fibers. The thickness of connective tissue surrounding 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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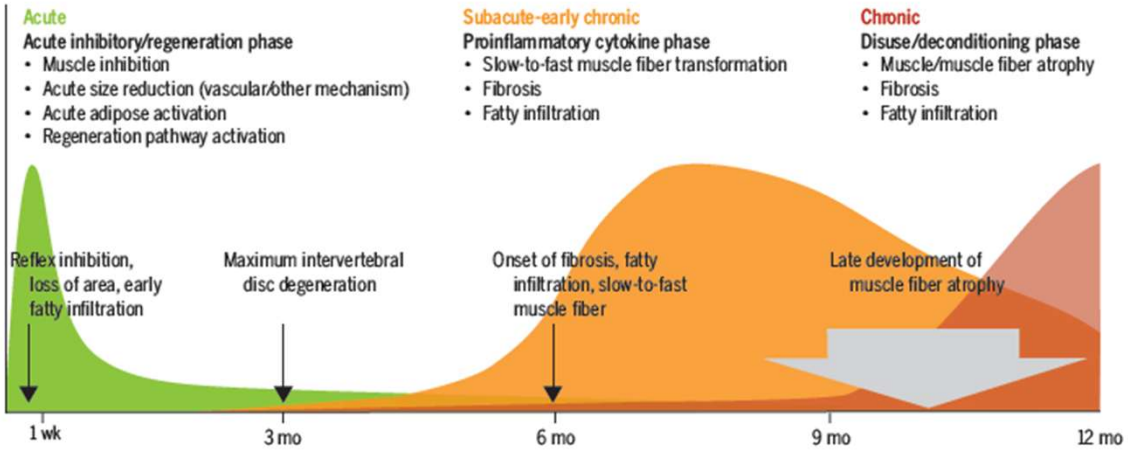
Changes in structure and function of the back muscles in low back pain: different time points, observations, and mechanisms



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

33

Deep paraspinal muscles

Healthy

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

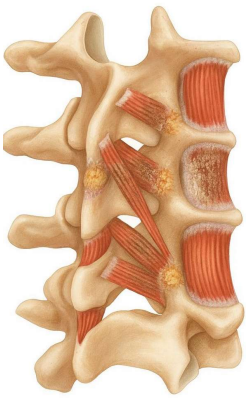
Good

Dysfunction

over time become:

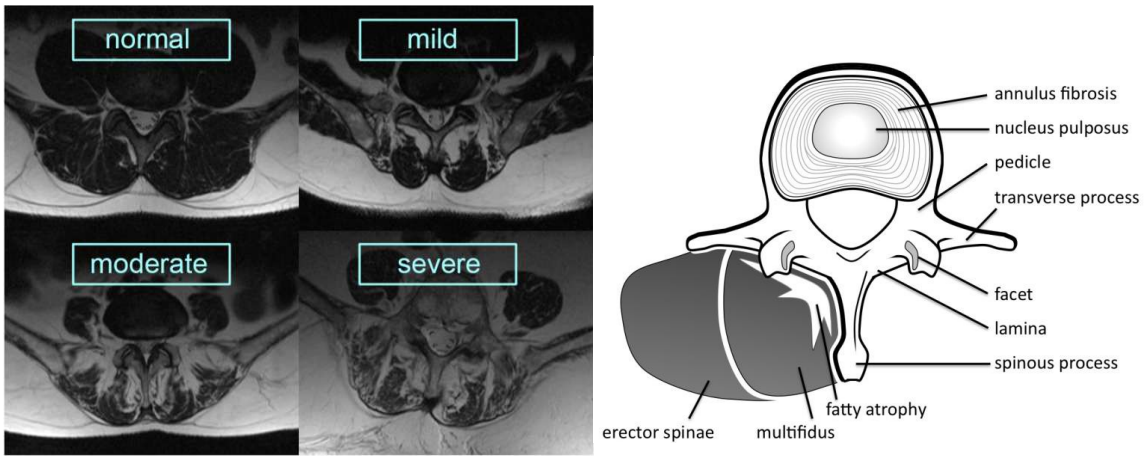
- Stiff and Fibrotic
- Atrophied (shrunk)
- Fatty infiltration
- Change fibre type
- Stretch receptors dysfunction

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)*

34



(Faur et al. 2019)

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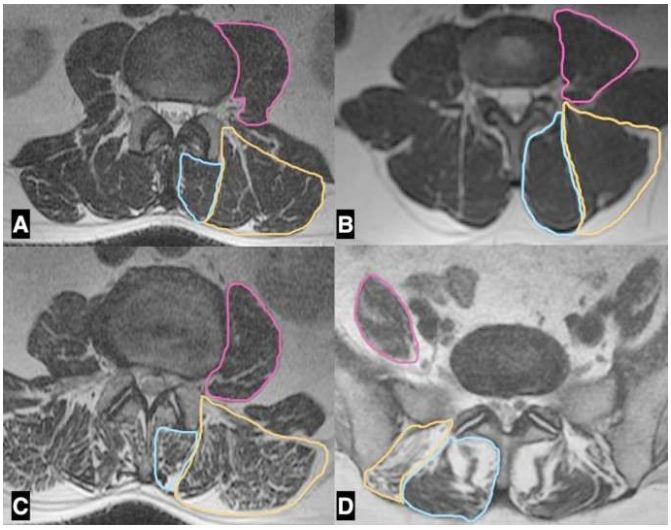
"recent studies revealed that paraspinal muscular atrophy and fatty infiltration were associated with not only the development of bone nonunion, pedicle screw loosening, and proximal junctional kyphosis but also adjacent segmental disease *with* lumbar fusion surgery [4–6]."



(Ikeda et al 2025)

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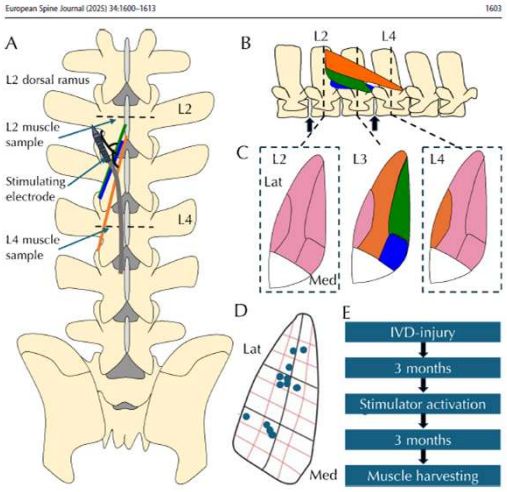
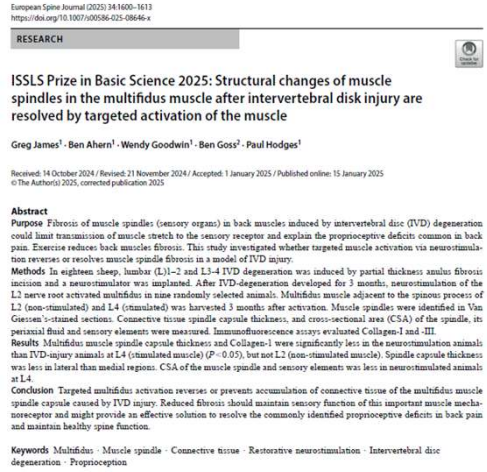
Multifidus muscle spindle capsule thickness and Collagen-1 were significantly less in the neurostimulation animals than IVD-injury animals at L4 (stimulated muscle) ($P < 0.05$), but not L2 (non-stimulated muscle).





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

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.

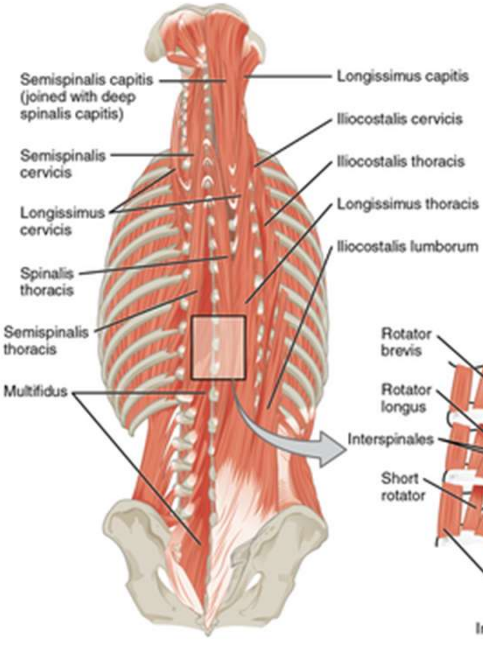
Results Multifidus muscle spindle capsule thickness and Collagen-1 were significantly less in the neurostimulation animals than IVD-injury animals at L4 (stimulated muscle) ($P < 0.05$), but not L2 (non-stimulated muscle). Spindle capsule thickness was less in lateral than medial regions. CSA of the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

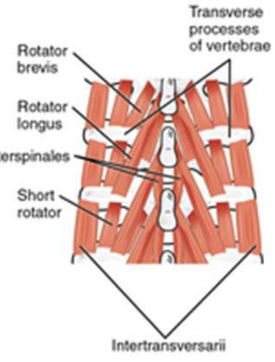
Keywords Multifidus · Muscle spindle · Connective tissue · Restorative neurostimulation · Intervertebral disc degeneration · Proprioception

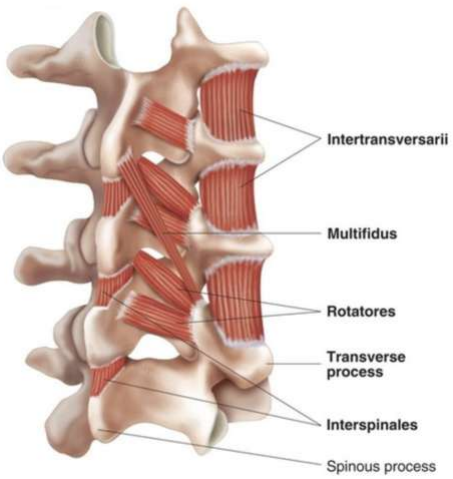
(James, Hodges et al 2025)

37



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





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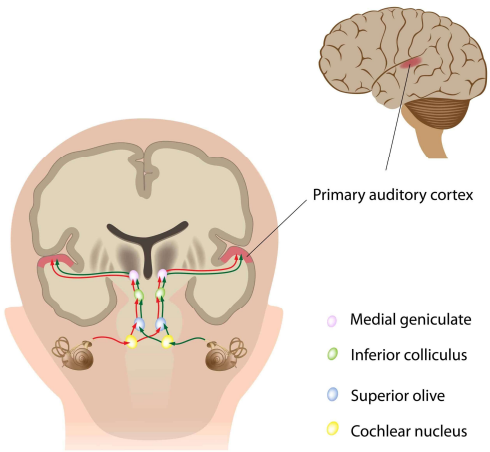
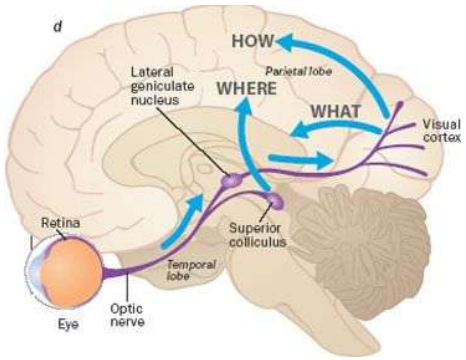
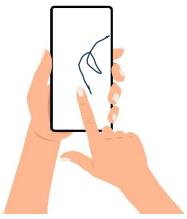
Interpreting sound and visual information

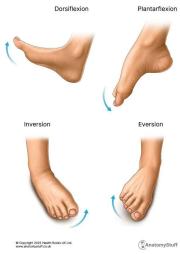




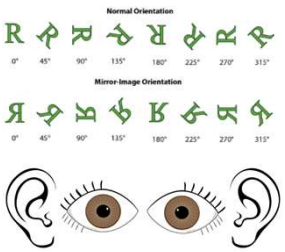
42

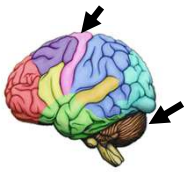
Chiropractic care can improve accurate perception and function





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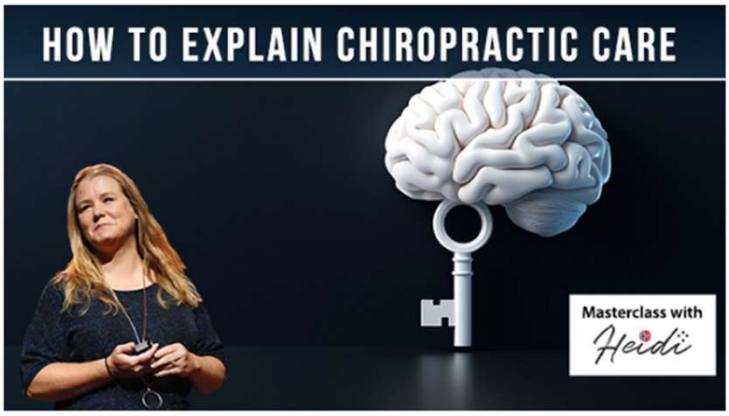
heidihaavik.com/masterclass

Explain Chiropractic Care

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



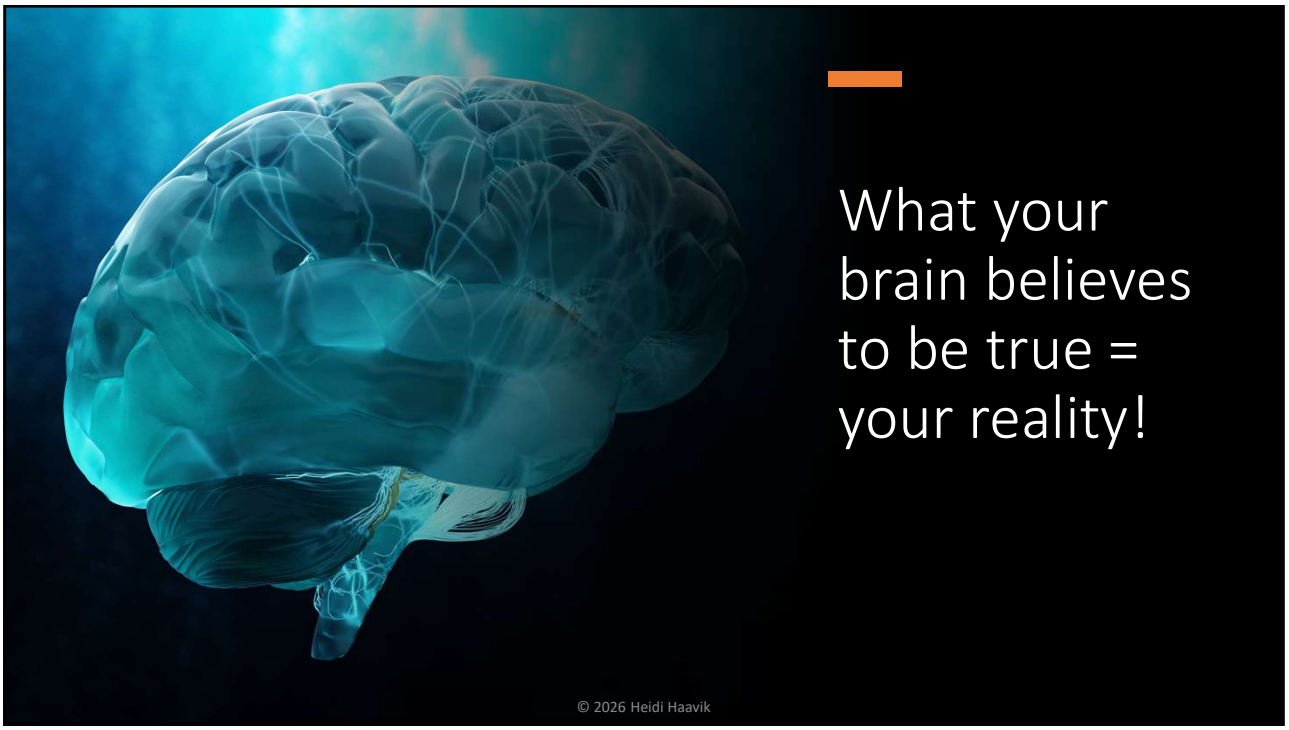
45

TODAY'S HANDOUT & Gifts

46

Pain

47



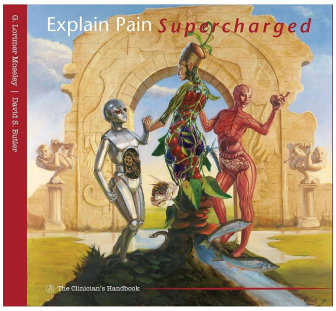
What your brain believes to be true = your reality!

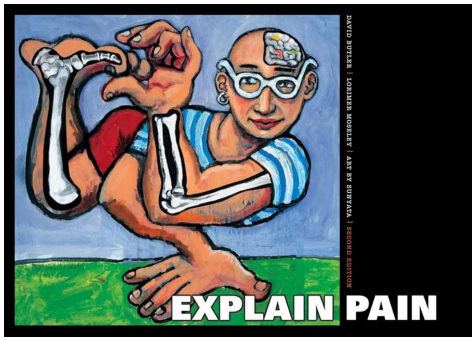
48

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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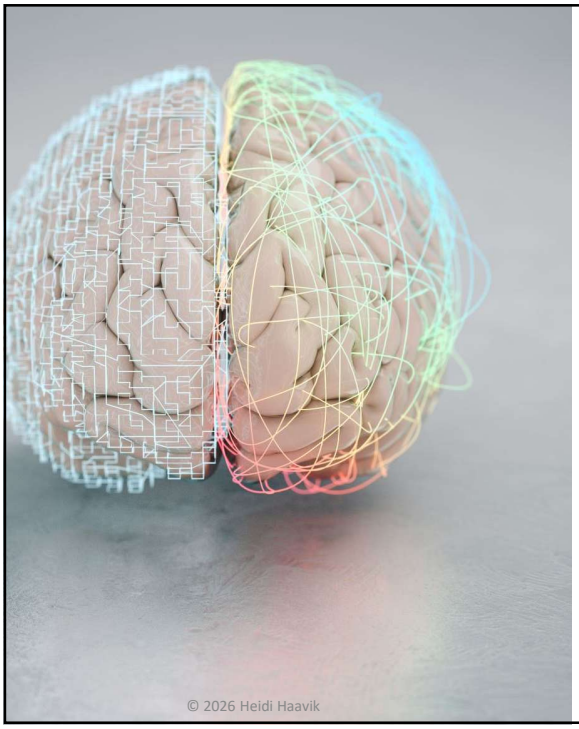


Chiropractic Care

"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

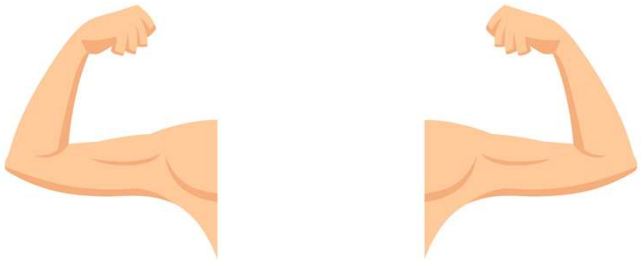
50

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

51

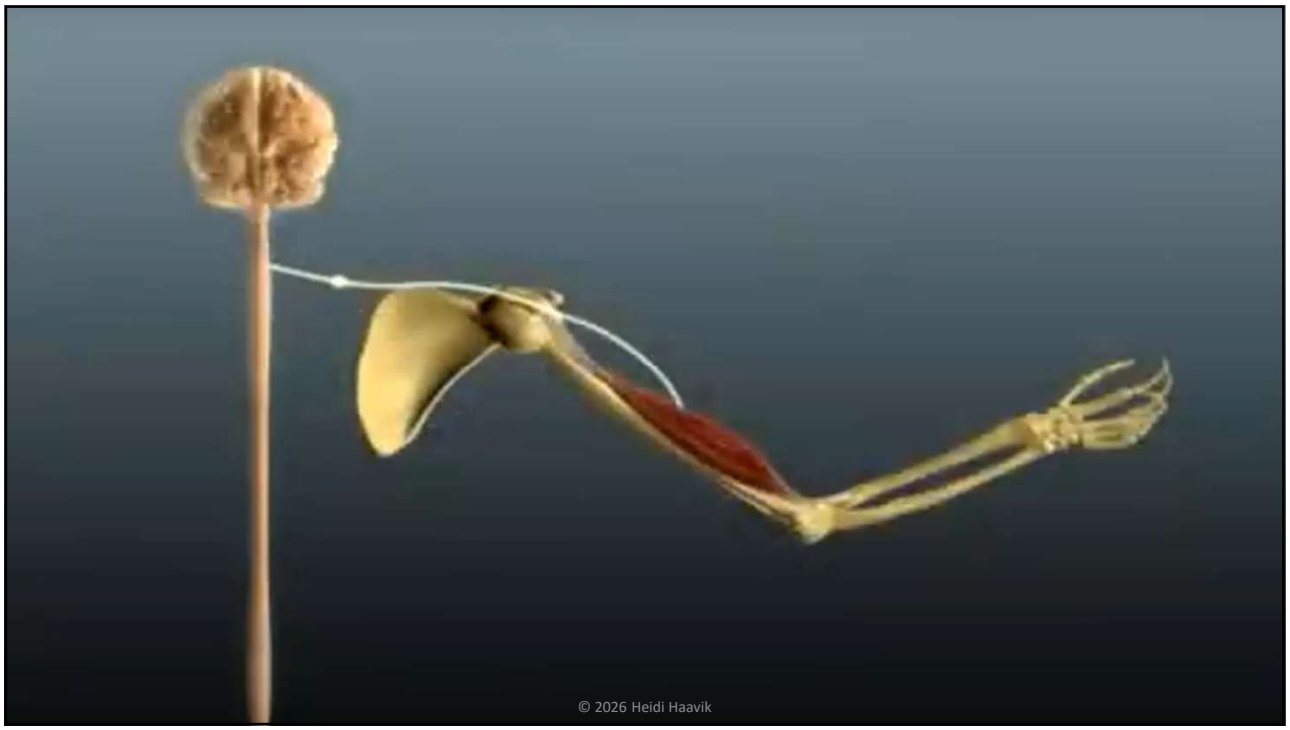
It takes more than two to four weeks of exercise before you alter the size (morphology) of the muscle



The first few weeks are mainly neural changes!!

*(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.)*

52



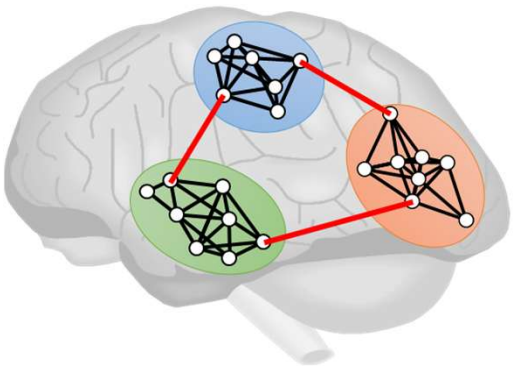
53

54

55

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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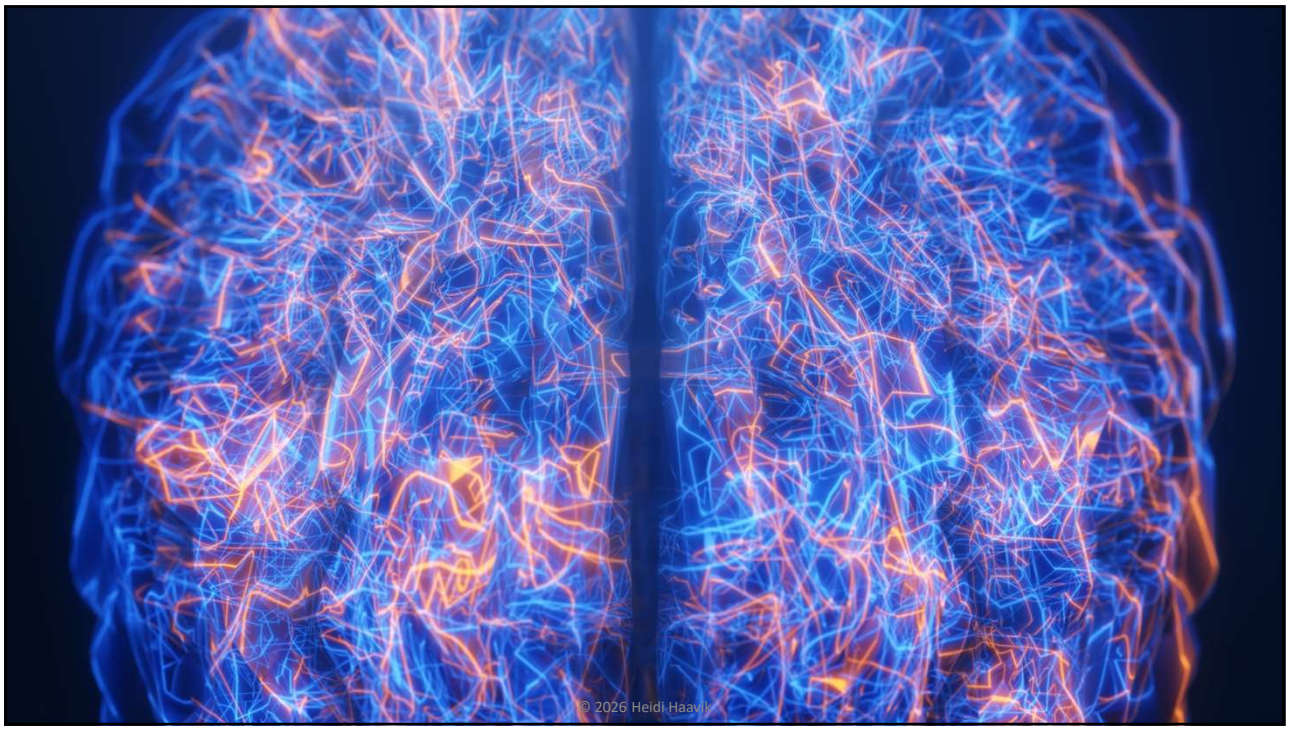

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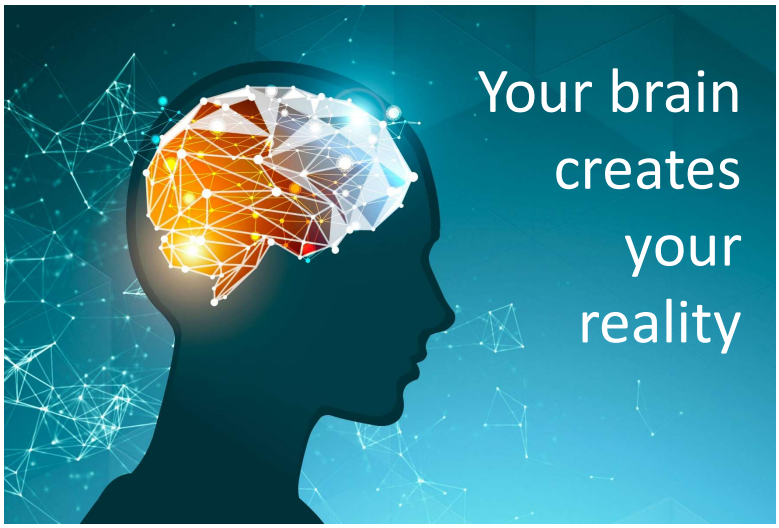


The predictive brain theory (or predictive processing) posits that the brain is an active prediction machine, not a passive receiver of sensory input. It continuously generates top-down models of the world to anticipate sensory data and minimize "prediction errors" (differences between expectation and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

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

58

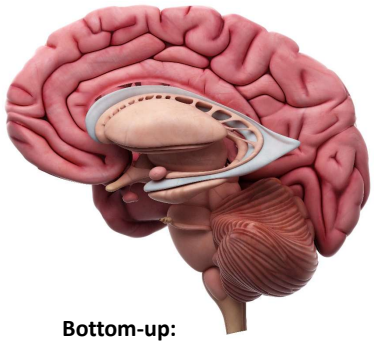
(Alexander & Brown 2018 Scientific Reports)

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


Visual


Smell


Sound


Cutaneous sensory input

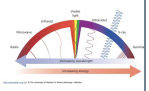

Taste


Vestibular


Muscle sensory input and Efference copies


Thermal


Biochemical (neurotransmitters, ph levels, oxygen levels, etc)


Electromagnetic

59

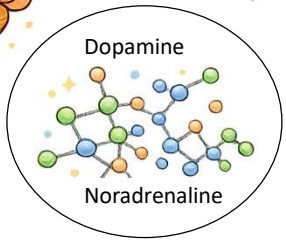
Focused Attention

Awareness + Meaning

What is required for the Brain to Change?

Dopamine

Noradrenaline



Sleep

Optimal Stress

60

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****)*

61

2. Awareness and Meaning

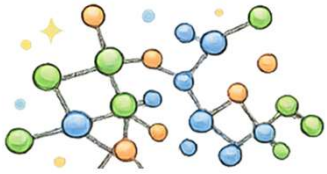
- The brain changes according to what is meaningful and relevant
- Salience Network determines what is important enough to update
- Brain change is driven by prediction errors that is noticed (and deemed important)

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

62

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)

63

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)

64

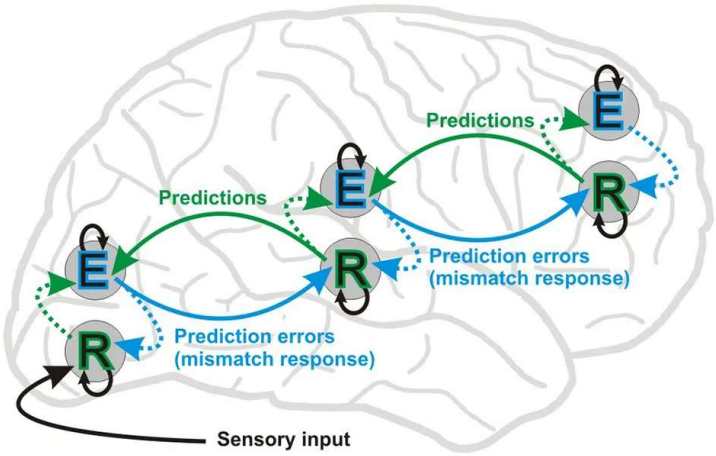
Lets think about the Adjustment

- 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)

65

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

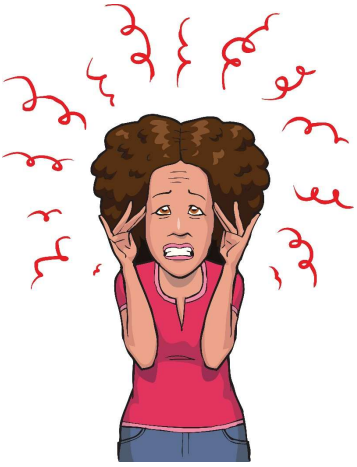


Simplified scheme of the hierarchical predictive coding framework

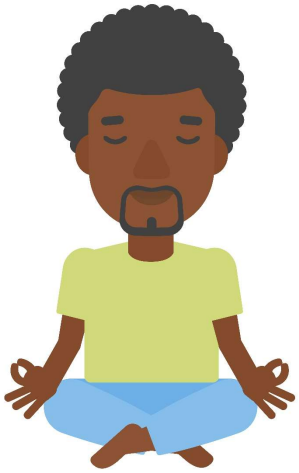
(Friston, 2010, Nat.Rev.Neurosci.)

66

An example of bottom up change



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



67

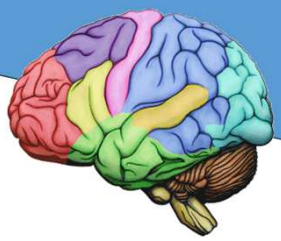
An example of top-down change

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

68

Adjustments Change both Bottom-up and Top-down

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

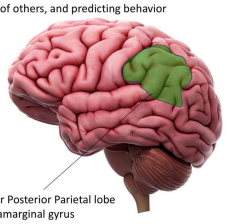


Altering proprioceptive input to brain during and after adjustment (altered intersegmental range of motion)

69

Default Mode Network

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



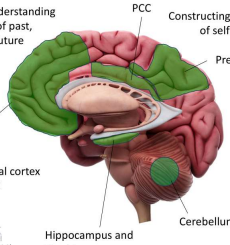
Inferior Posterior Parietal lobe
- Supramarginal gyrus
- Angular Gyrus

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

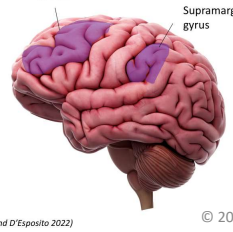
(Sumos et al 2014)

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)

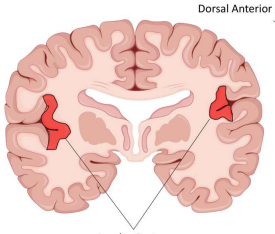
dl PFC

Supramarginal gyrus

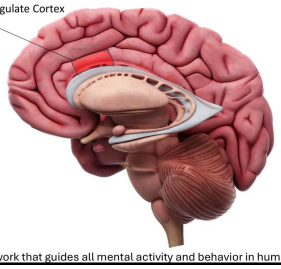


Salience Network

Dorsal Anterior Cingulate Cortex



Insular Cortex



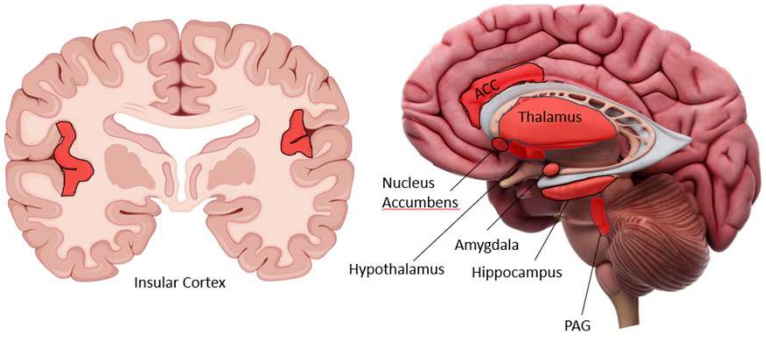
Core control network that guides all mental activity and behavior in humans

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

70

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

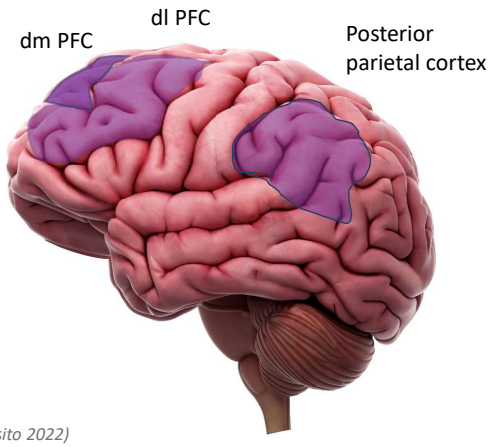


(Seeley, 2019; Menon et al 2010)

71

Central Executive Network (Fronto-parietal Network)

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

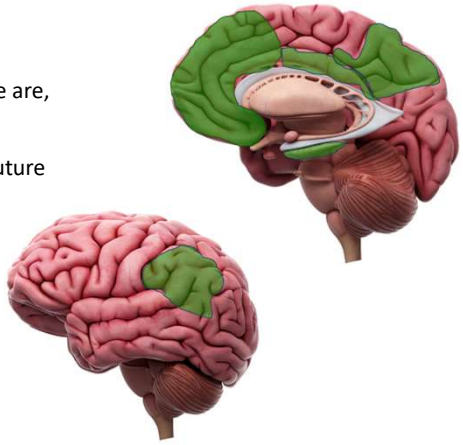


(Witt et al. 2021; Menon and D'Esposito 2022)

72

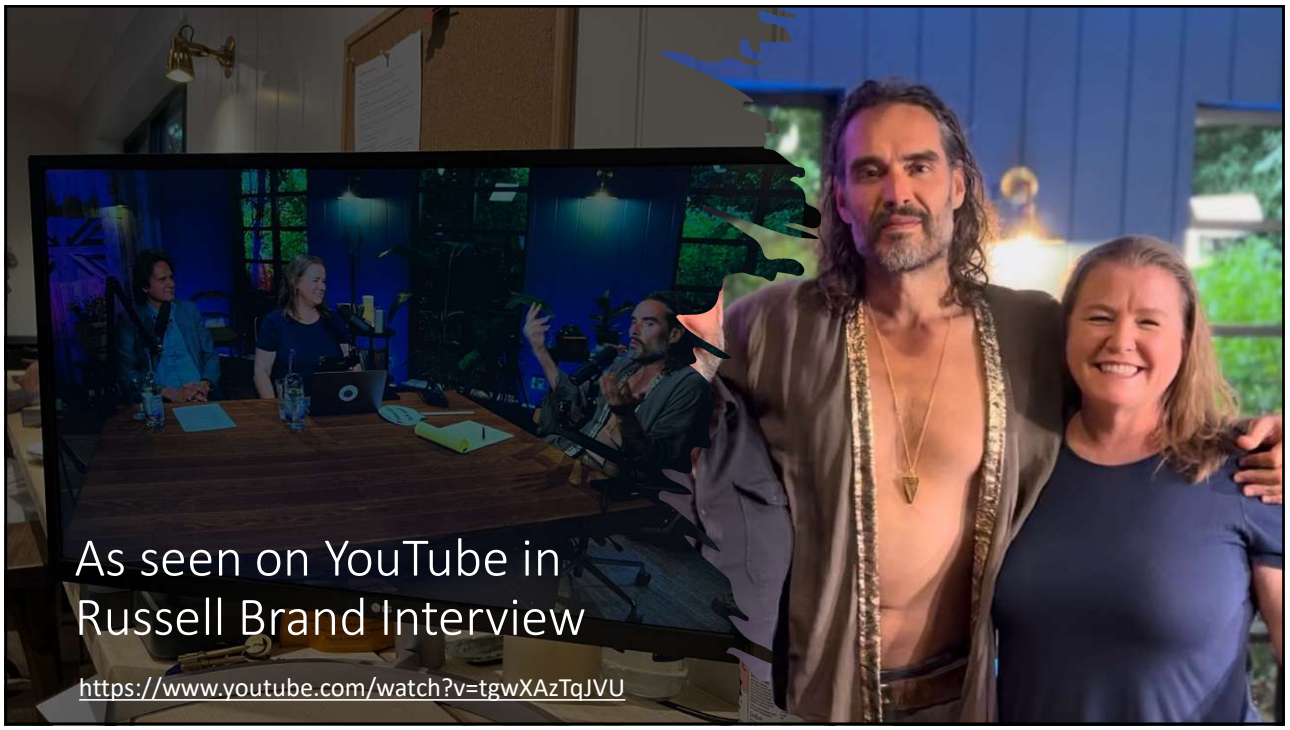
Default Mode Network

- 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)

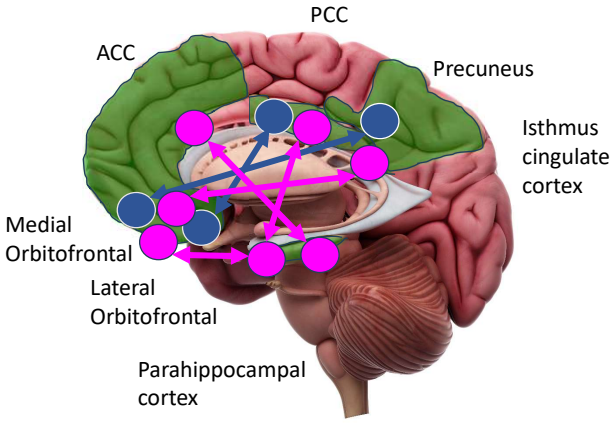
73



74

Default Mode Network changes after Chiro Care

Pre and Post first session

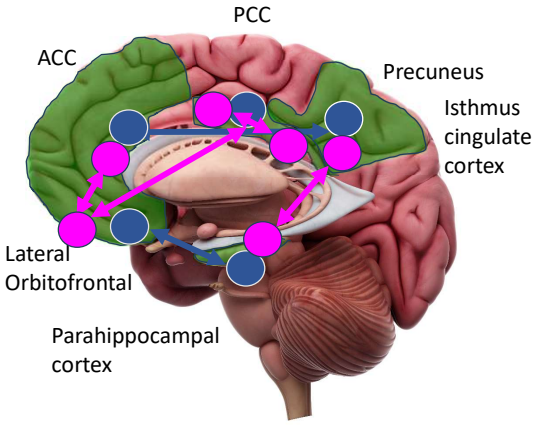


(Haavik et al 2024, Brain Sciences)

75

Default Mode Network changes after Chiro Care

Pre and Post 4 weeks



(Haavik et al 2024, Brain Sciences)

76

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

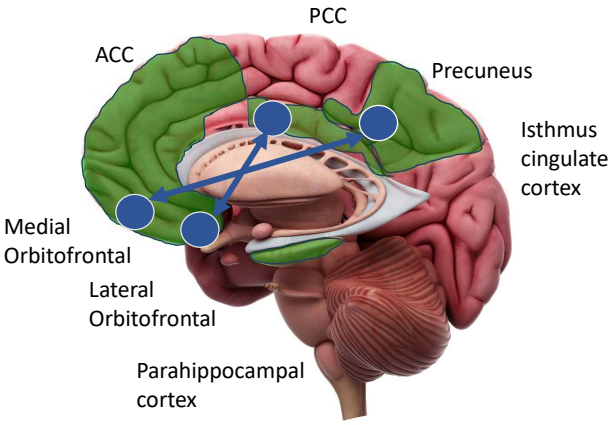
Increased functional connectivity of the posterior cingulate cortex with the lateral orbitofrontal cortex in depression (Cheng, Rolls et al. 2018B)

"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."

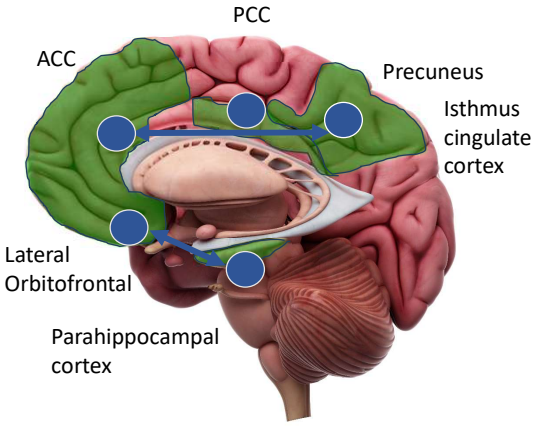
(Cheng, et al 2018A; Cheng, Rolls et al. 2018B*)*

77

Pre and Post Chiro



Pre and Post 4 weeks Chiro



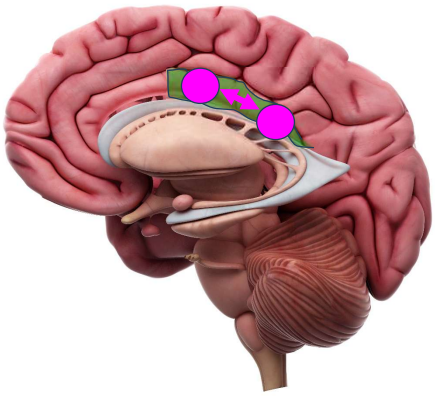
DMN changes after Chiro Care

(Haavik et al 2024, Brain Sciences)

78

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



SEPs Alpha ↑ L isthmus-cingulate- R PCC

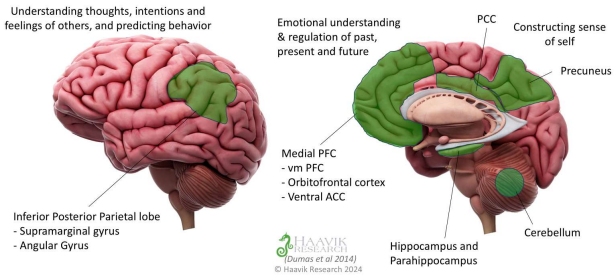
"Thus, this change may reflect altered narrative sense of self in a manner that is reducing symptoms of depression and improvements in fatigue"

(Haavik et al 2024, Brain Sciences)

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

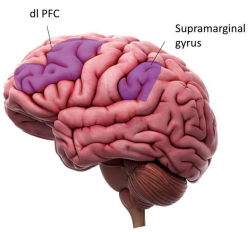
79

Default Mode Network

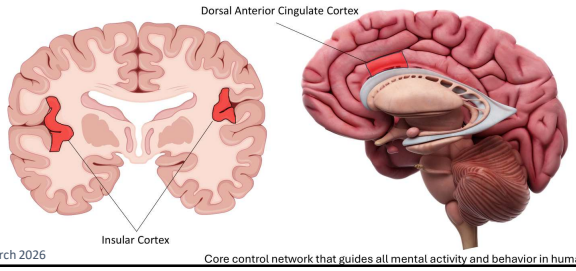


Fronto-parietal (Executive Control) Network

- 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)



Salience Network

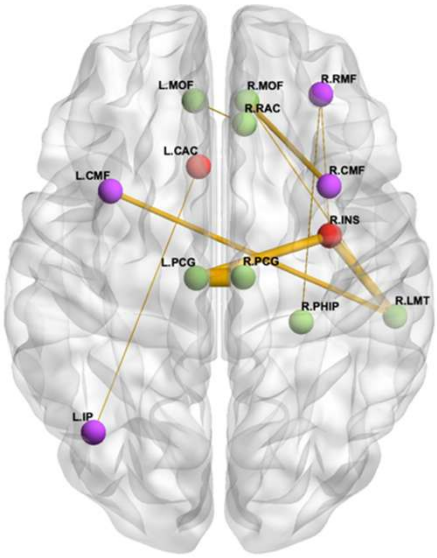


Core control network that guides all mental activity and behavior in humans

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

80

After first Adjustment session Chiro Group



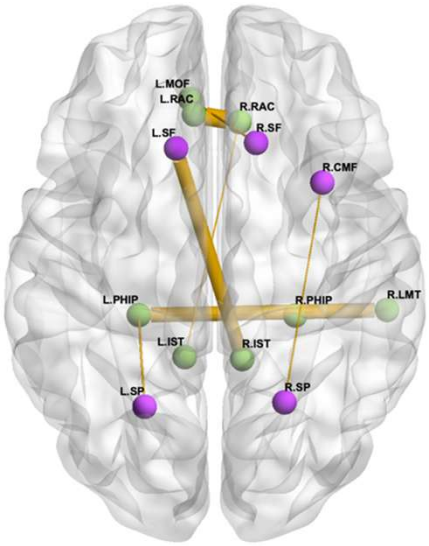
Preliminary Results NOT published yet

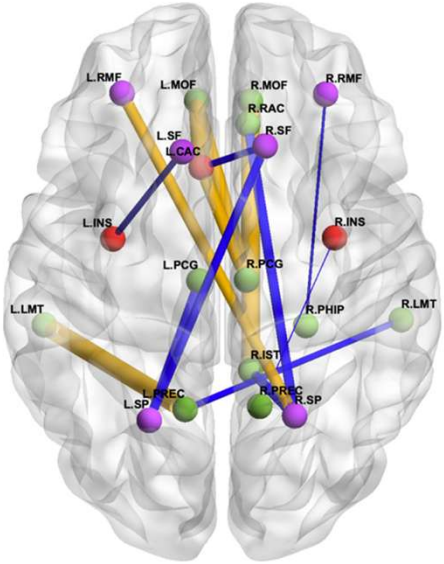
Alpha

81

Preliminary Results NOT published yet

After 4 weeks Chiro Group Brain changes

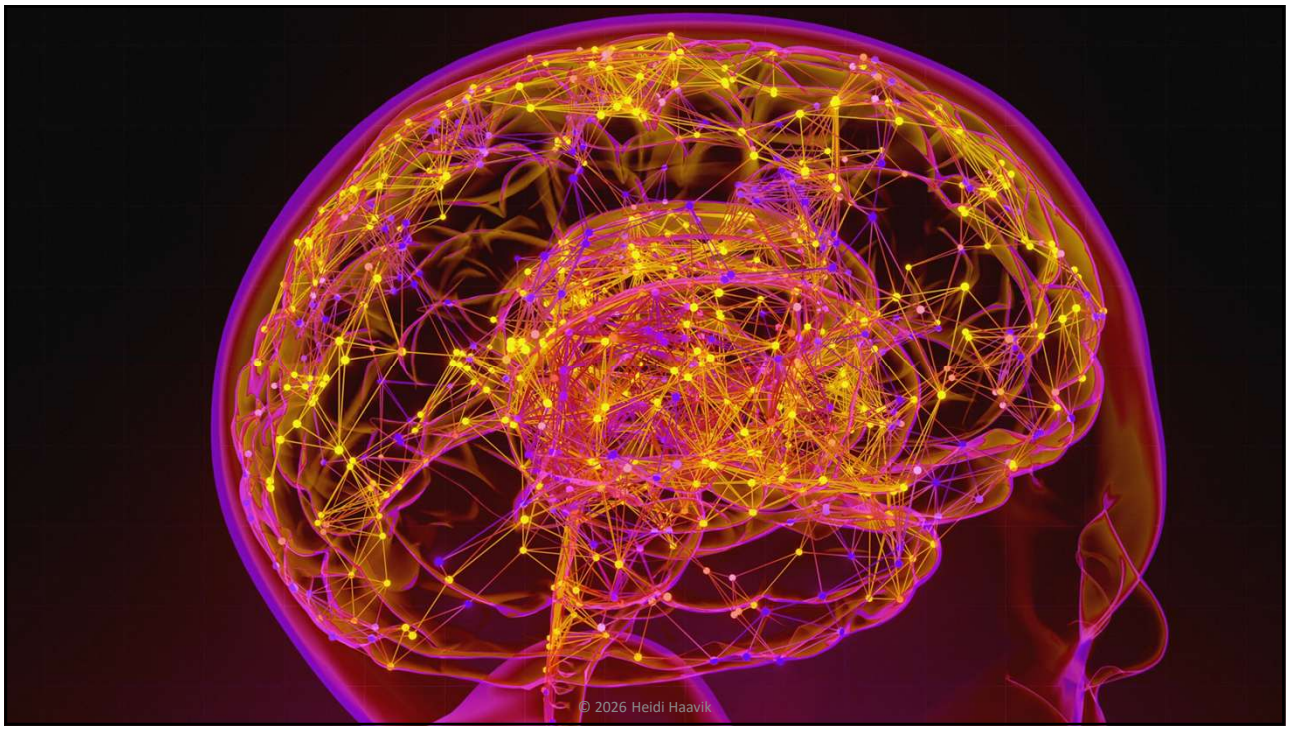




Alpha

Beta

82



83

heidihaavik.com/masterclass

Triple Brain Network

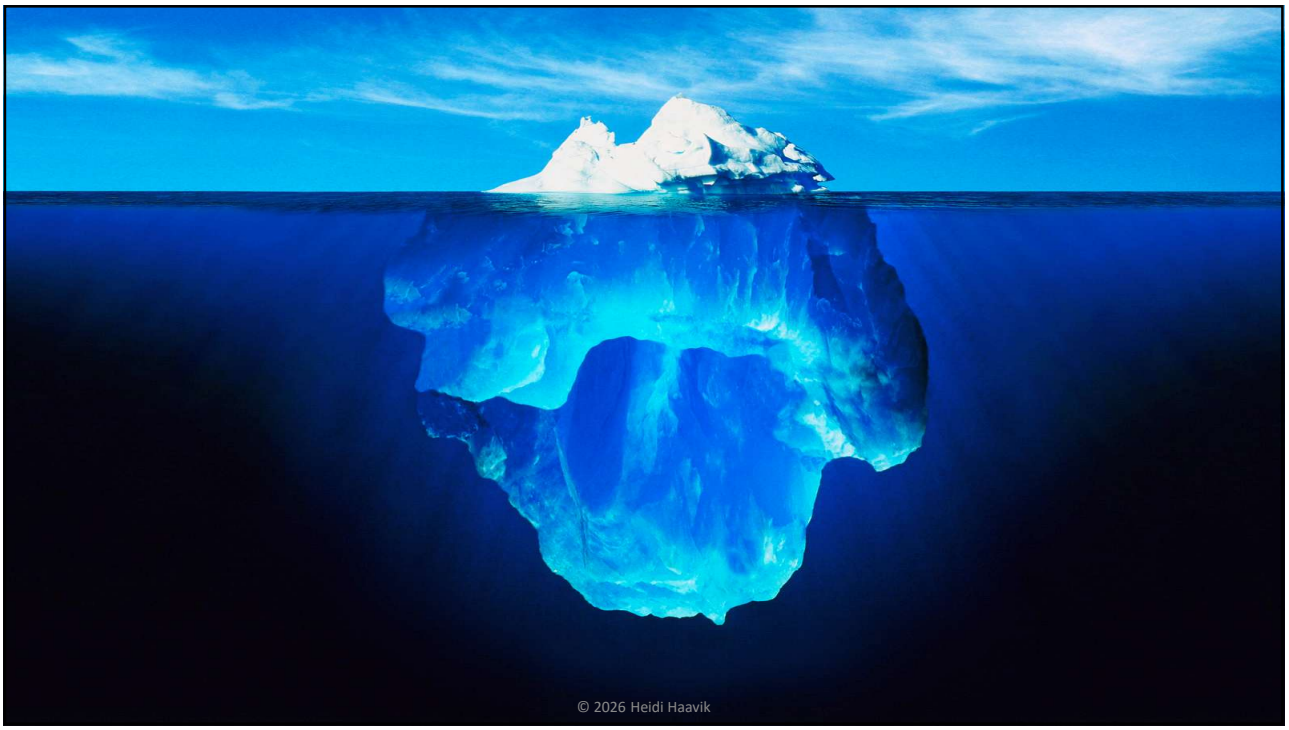
The Triple Brain Network, including the Default Mode Network, Salience Network and the Central Executive Network.

84

NCMIC

We Take Care of Our Own®

85



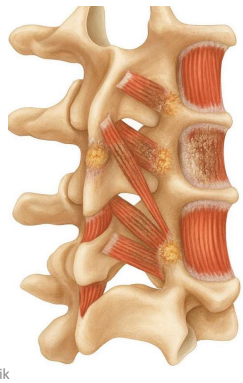
86

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

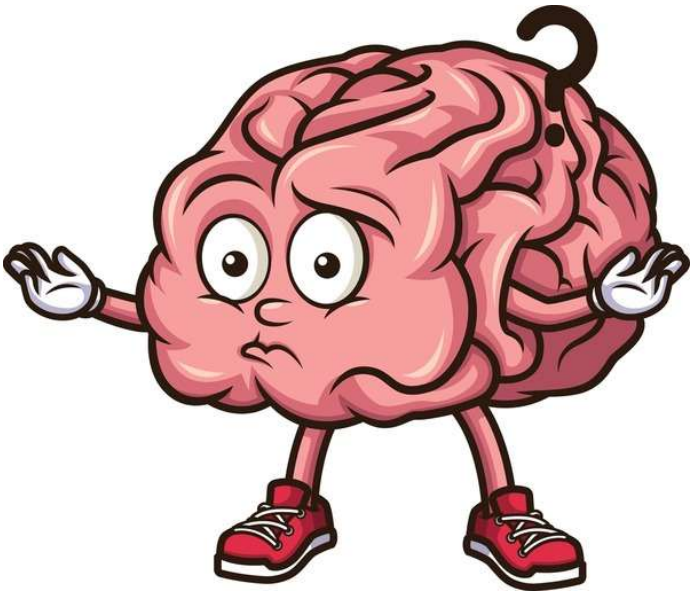
- Larger in size
- Slow-twitch fibre type
- Minimal fatty infiltration
- Move freely
- Healthy stretch receptors (muscle spindles)



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

87

A confused brain is worse than you might think!



88

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 I, 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.

(McCabe et al 2005)

89

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)

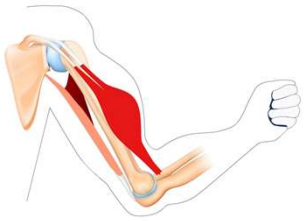
90

Symptoms don't just appear out of thin air

91

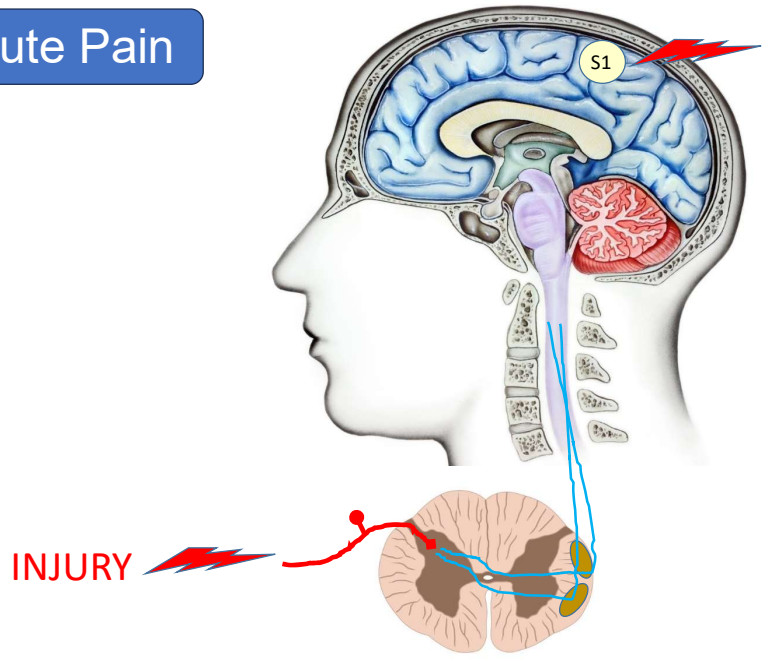
92

Microtrauma



93

Acute Pain



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

94

Chronic Pain

Systemic inflammation

Stress autonomic sympathetic activation

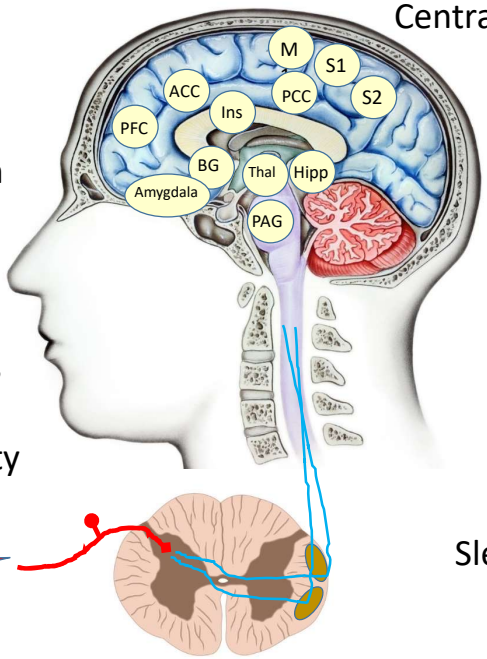
Mental health issues

Expectations

Poverty

Diet

INJURY



Central neuroimmune Influences

Stress HPA activation

Attitudes & Personality

Social problems

Learning effects

Thoughts

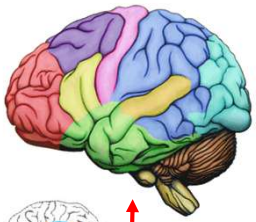
Sleep

Microbiome

95

HAAVIK RESEARCH

Acute Pain

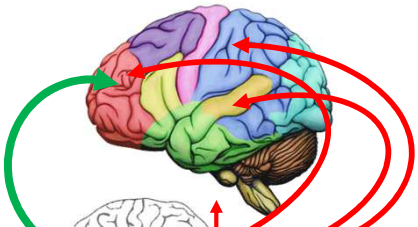


INJURY

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

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

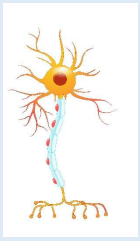
96

Neuroplasticity

HAAVIK RESEARCH

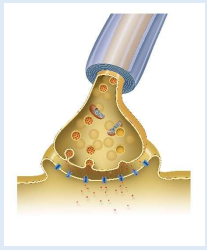
Cellular Level

Structural Plasticity



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

Functional (Synaptic) Plasticity



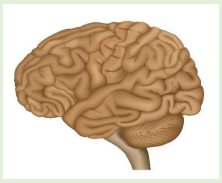
- Long term potentiation
- Long term depression
- Homeostatic plasticity

Network Level

Structural network Plasticity

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

Functional Network Plasticity

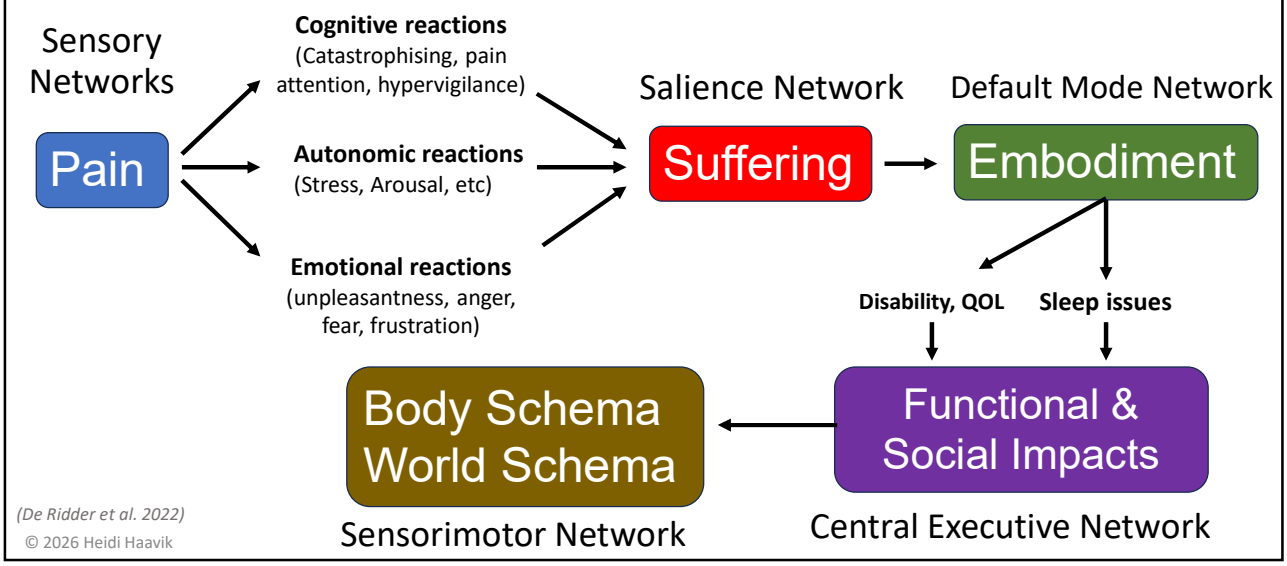


- Sensory maps
- Motor maps
- Inner body schema
- External world schema

97

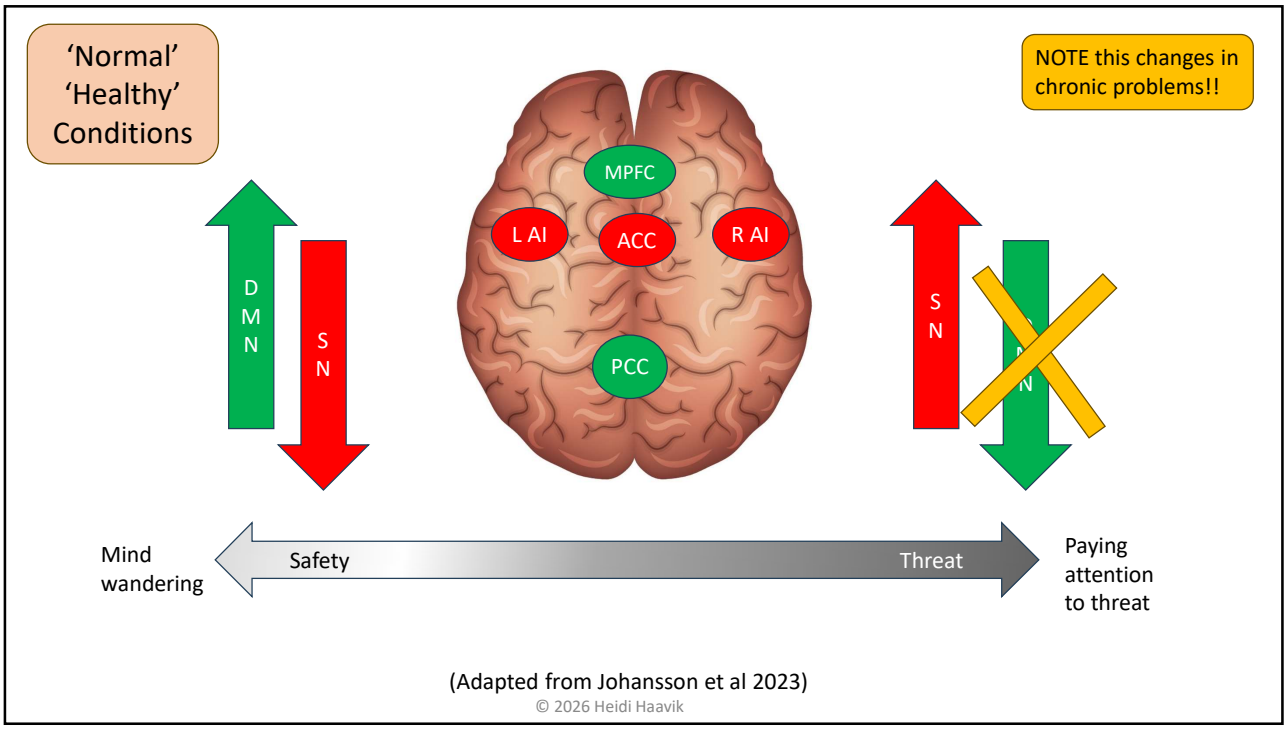
98

Pathway to Chronic Pain and Suffering



(De Ridder et al. 2022)

99

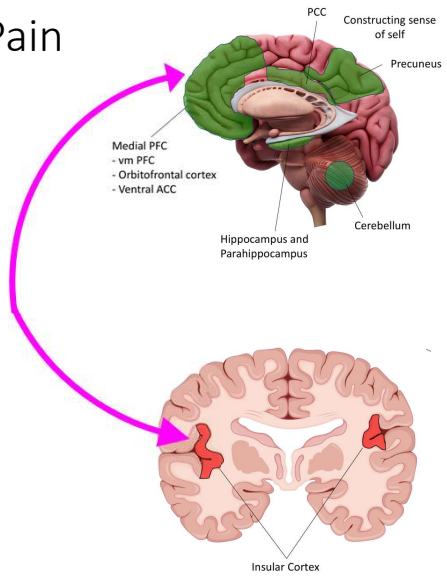


(Adapted from Johansson et al 2023)

100

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.

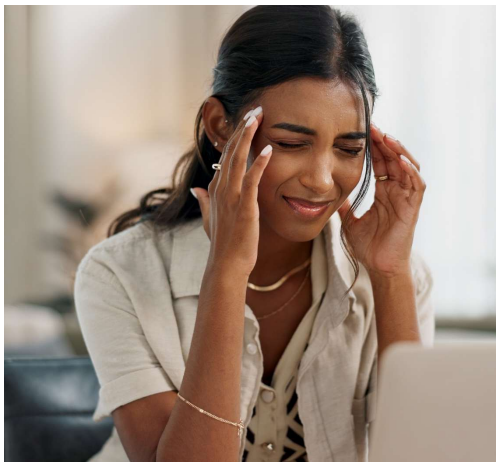


(De Ridder et al. 2022; Baliki et al 2014)

101

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)

102

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)

103

Some changes in the brain take longer

(Holt, Haavik et al 2015)

104

RCT: 60 older adults living at home

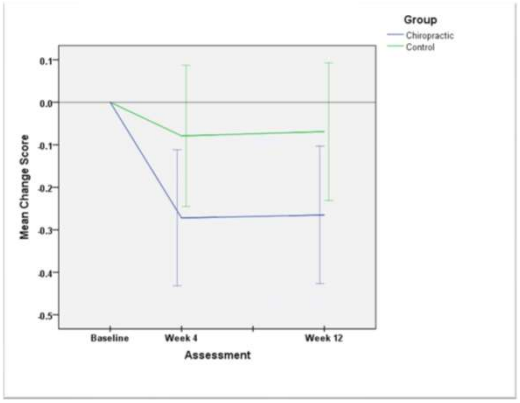
Outcomes
- Ancle joint JPS
- Step reaction task
- Balance
- Sound and light processing
- Quality of life

We recorded at:
Baseline
After 4 weeks
After 12 weeks

(Holt et al 2015)

105

Improved ankle joint position sense

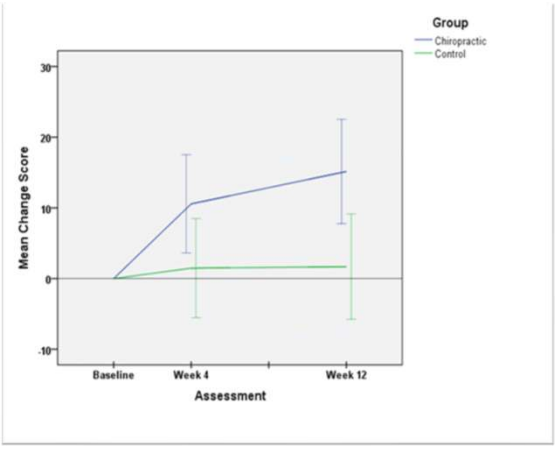


(Holt et al 2015)

106

106

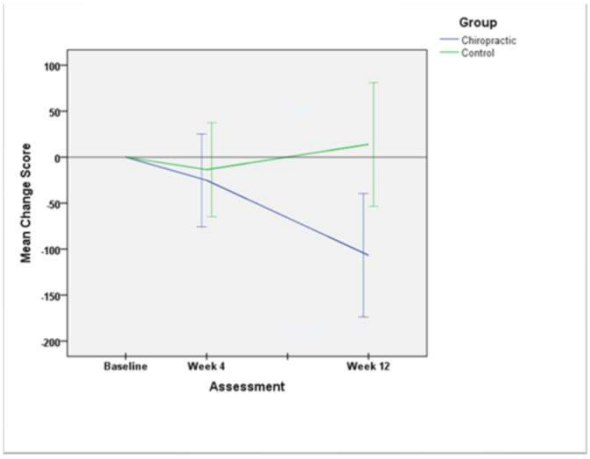
Improved interpretation of sound and visual information at the same time



(Holt et al 2015)

107

Improved stepping times

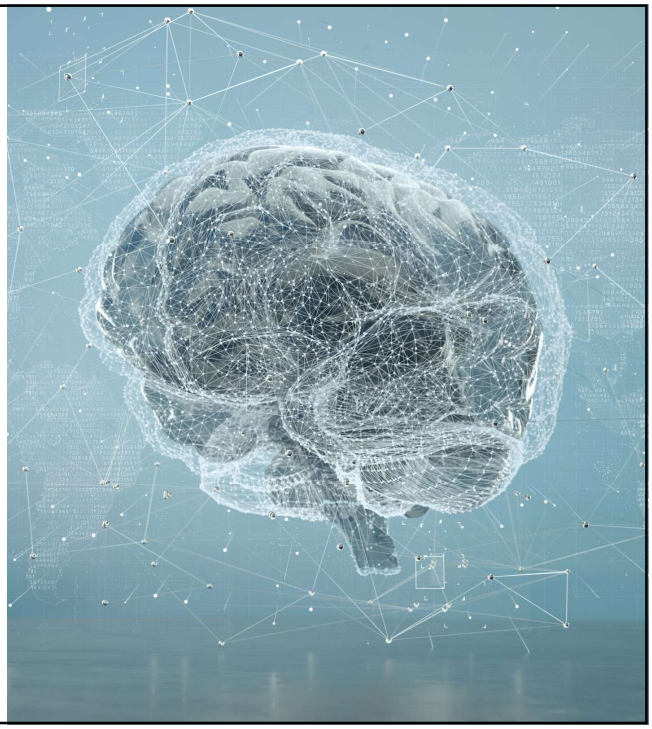


(Holt et al 2015)

108

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



109

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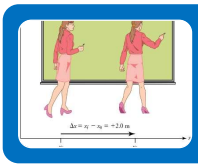
Searching the Literature

- 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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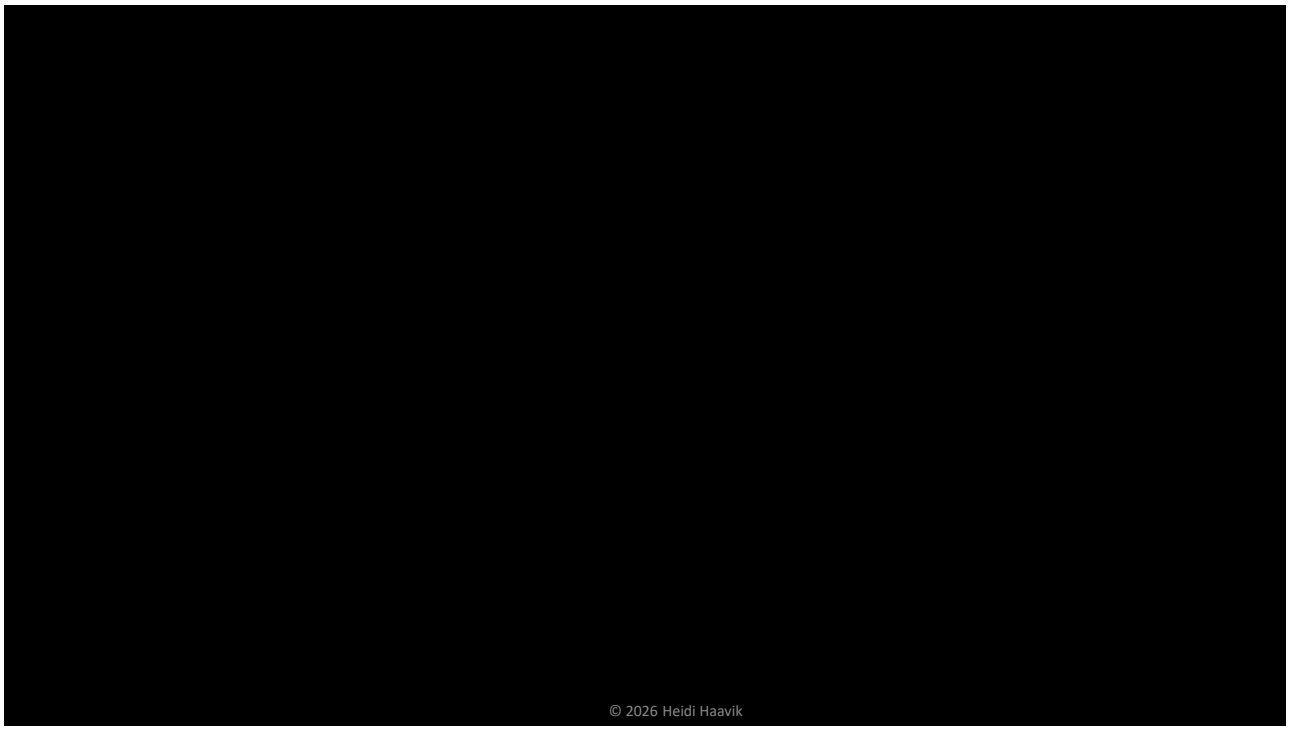
110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111


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114

115

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2

Click on the up arrow

3

Click on 'Add to Home Screen'

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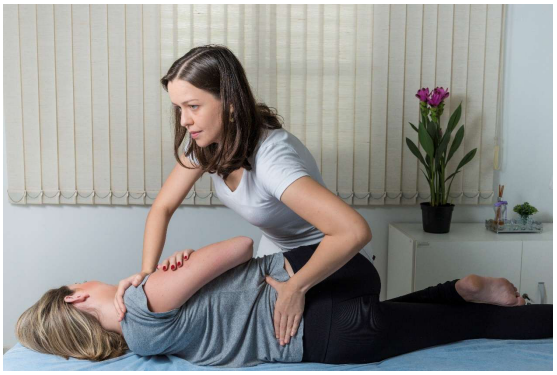
Change the name to 'Chiros Hub'

5

Chiros Hub will now appear as an App on your phone!

116

What does the evidence say about frequency of care?



117

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)

118

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)

119

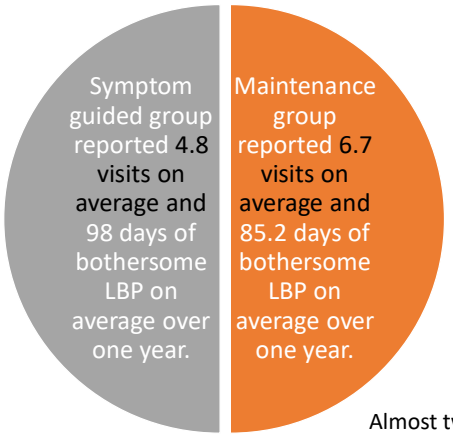
Nordic Maintenance Care Program

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)

120

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)

121

Summary of Frequency of Care

122

Implications for question answers

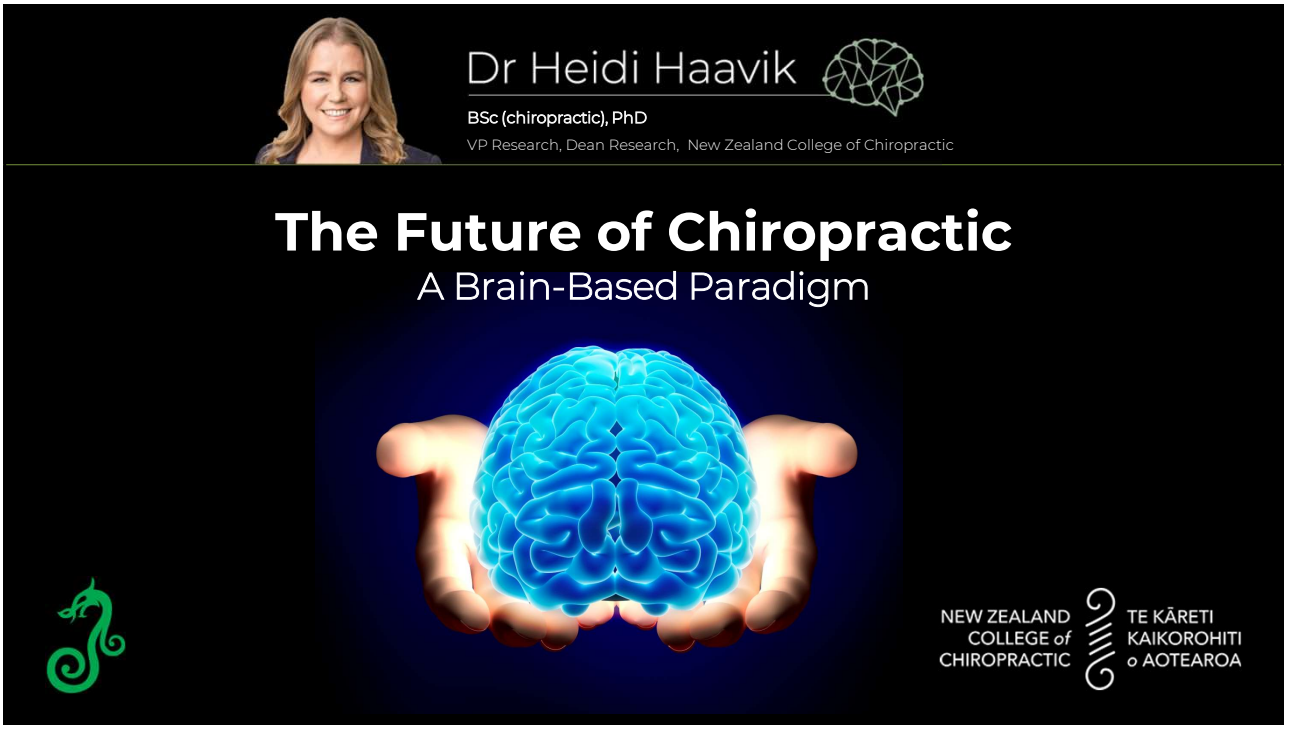
- Chiropractors' role is to exercise the spine back into proper function
- Science shows it's better for you to see me more often early on in care, and this even gives you long term benefits (CGHAs and LBP)
- Science shows maintenance care gives you less days of pain compared to coming back only when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

123

124


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

125


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

126

Thank you!

MCA

MAINE CHIROPRACTIC ASSOCIATION

127

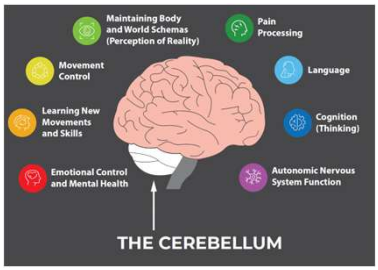
Dr Heidi Haavik

HeidiHaavik.com

The HANDOUT for today's Class (the slides)

Gift

Gift

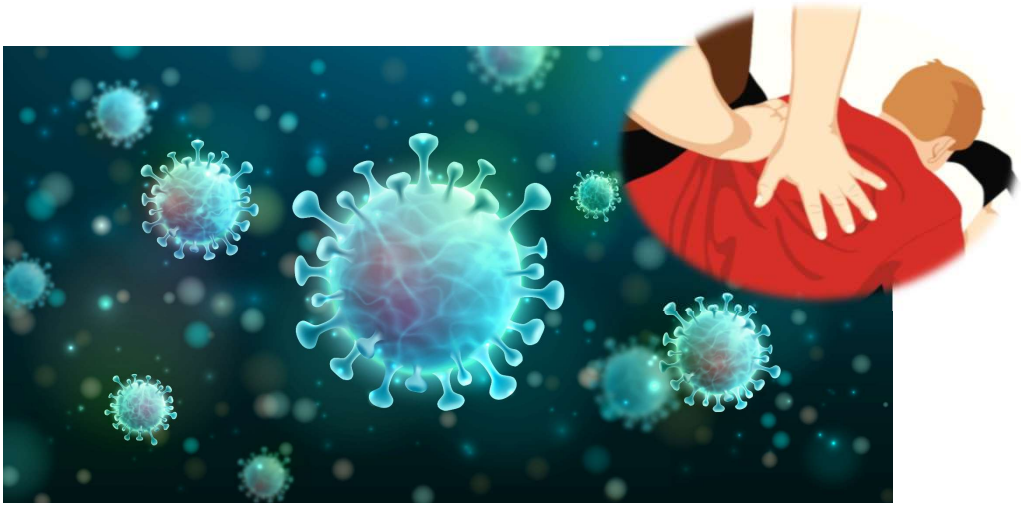


128

Questions for Heidi?

129

Chiropractic and the Immune System



130

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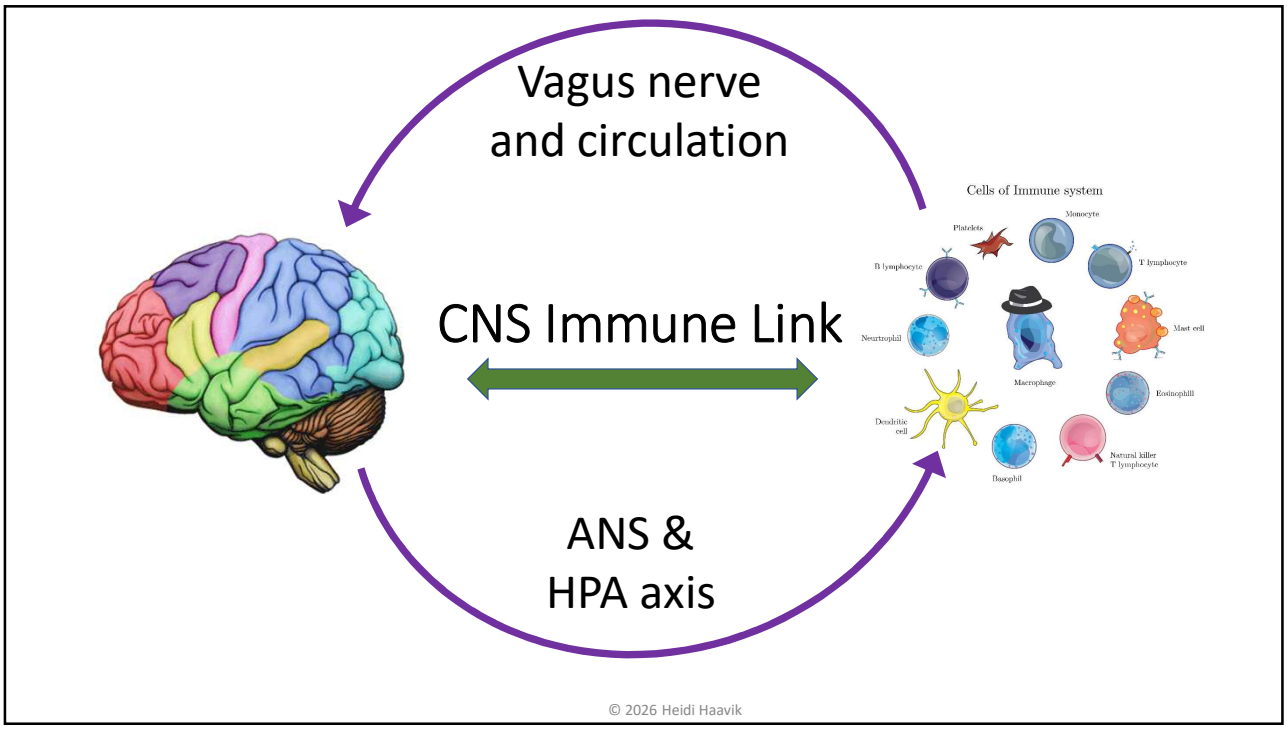
The Chiro-Neuro-Immune Connection

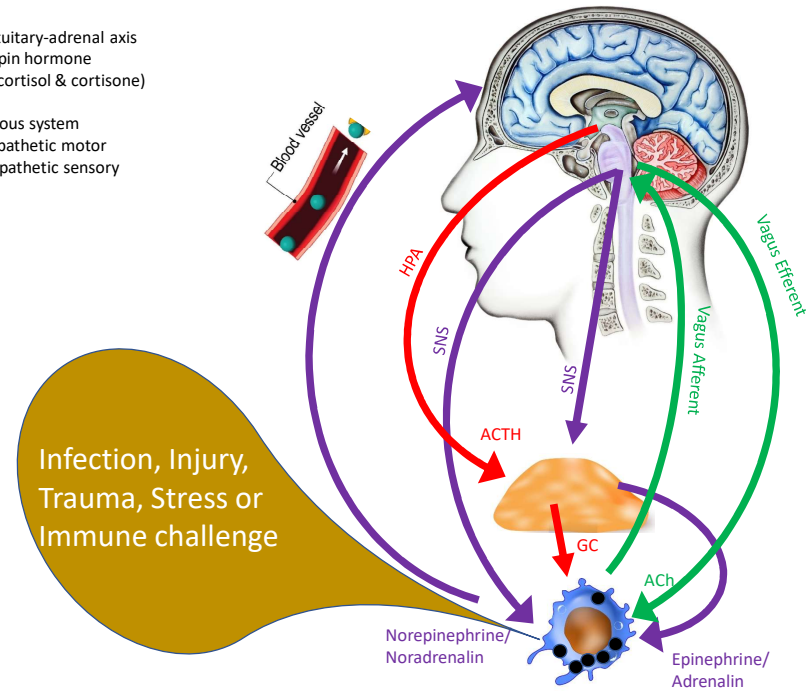
For the first time, we have trial data showing measurable changes in neuroplasticity and stress physiology following chiropractic care.

131



132

HPA	hypothalamus-pituitary-adrenal axis
ACTH	adrenocorticotropin hormone
GC	glucocorticoids (cortisol & cortisone)
Ach	Acetylcholine
SNS	sympathetic nervous system
Vagus	Efferent parasympathetic motor
Vagus	Afferent parasympathetic sensory

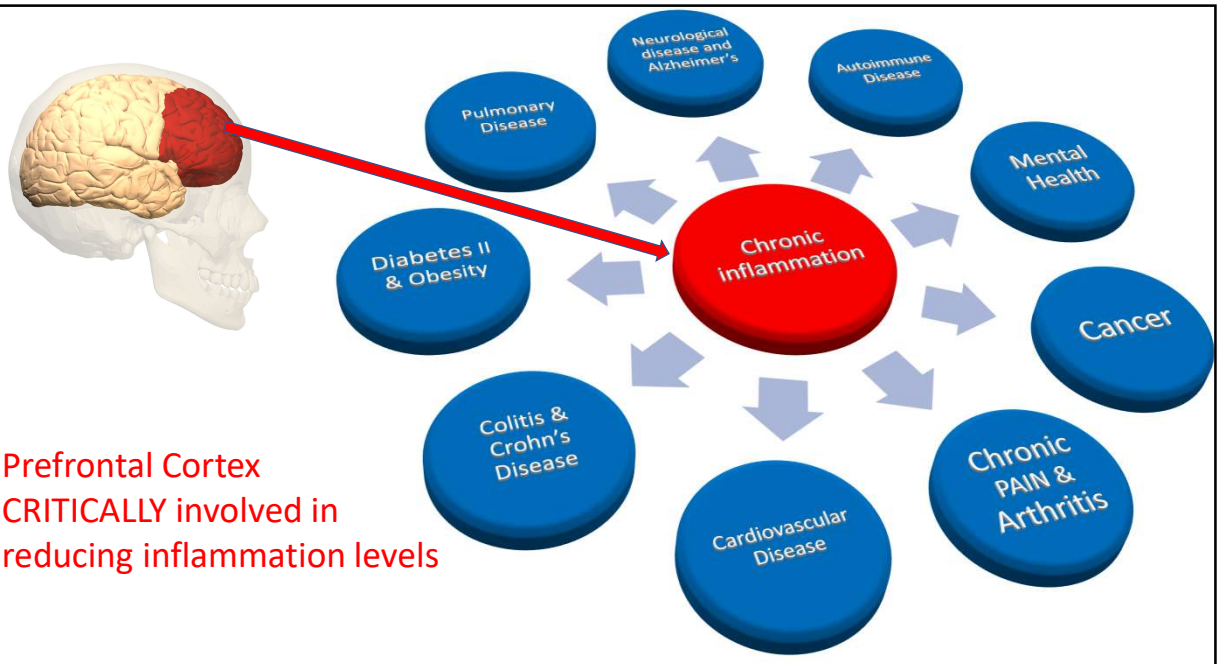


133

STRESS

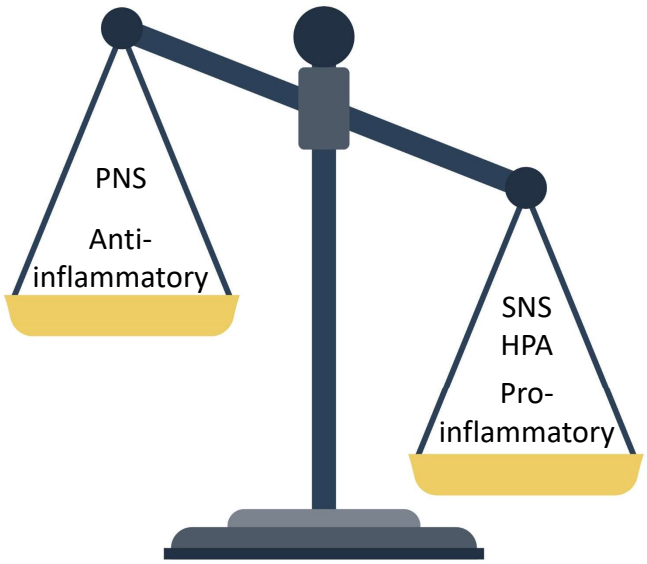
- Reduces Immunity
- Activates SNS
- Activates HPA
- Shuts down prefrontal cortex function
- Increased levels of cortisol, adrenaline/ epinephrine and noradrenaline / norepinephrine
- Higher inflammation

134



Prefrontal Cortex
CRITICALLY involved in
reducing inflammation levels

135



136

Review 1 Conclusion

"spinal manipulation can increase substance-p, neurotensin, oxytocin and interleukin levels and may influence cortisol levels post-intervention"

"more research needs to be done to understand the clinical relevance of such changes"

Musculoskeletal Science and Practice

Review article

Changes in biochemical markers following spinal manipulation–a systematic review and meta-analysis

Kesava Kovanur-Sampath, M.Ost, Ramakrishnan Mani, PhD, Jim Cotter, PhD, Angela Spontelli Gisselman, PT, Steve Tumilty, PhD

Kovanur-Sampath, et al. 2017. Musculoskeletal Science and Practice 29: 120-131

137

Review 2 Conclusion

"Although spinal manipulations seem to trigger the activation of the neuro-immuno-endocrine system, the evidence supporting a biological account for the application of HVLAT in clinical practice is mixed and conflicting.

Further research on subjects with spinal MSK conditions with larger sample sizes are needed to obtain more insights about the biological effects of spinal manipulative therapy."

medicina

MDPI

Review

The Effects Induced by Spinal Manipulative Therapy on the Immune and Endocrine Systems

Andrea Colombi and Marco Testa

Colombi and Testa 2019. Medicina 55(8): 448.

138

Review 3 Conclusion

"There is substantial evidence suggesting that the nervous system, the hormonal system and the immune system communicate with one another and are intimately linked in their functions [70,93–97].

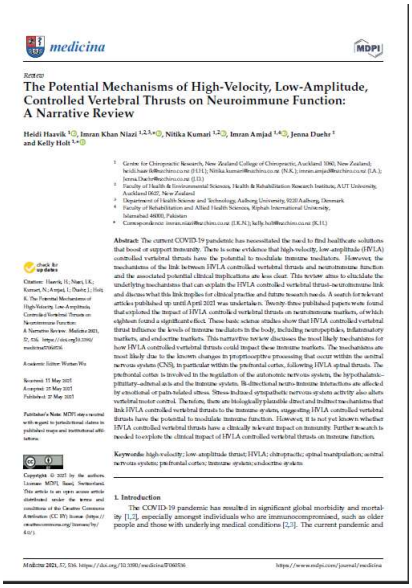
This communication is essential for the body's ability to protect itself and involves a variety of immune mediators, including cytokines, neurotransmitters, hormones, and humoral factors [67,68,70,94,116,117,164,234].

Furthermore, the prefrontal cortex is critically involved in regulating the autonomic nervous system, the HPA axis, and the immune system [94,144–154].

Neuro-immune communication is affected by emotional or pain-related stress [69,144,151,195,260–262].

Stress activates the SNS and HPA axis to increase inflammation in the body. Stress also suppresses the prefrontal cortex, which in turn reduces its inhibitory control on the HPA axis and inhibits the anti-inflammatory PNS activity. This stress-induced inflammation weakens the immune response [95,98–112]. The stress-induced SNS activity also alters the muscle activation patterns to impair vertebral motor control [283–285], thus can cause the establishment of CSMC problems.

HVLA controlled vertebral thrusts have been shown to affect vertebral motor control [123–125,128,131,135], the prefrontal cortex [134], and the levels of immune mediators in the body that are important for a healthy immune response [15–32]."



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MDPI

Review

The Potential Mechanisms of High-Velocity, Low-Amplitude, Controlled Vertebral Thrusts on Neuroimmune Function: A Narrative Review

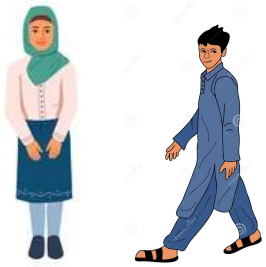
Heidi Haavik [1,2], Imran Khan Niazi [1,2,3,*], Nitika Kumari [1,2], Imran Amjad [1,4], Jenna Duehr [1] and Kelly Holt [1,*]

Haavik et al. 2021, Medicina 2021, 57, 536, p.15.

139

16 week RCT (including 12 weeks of Chiro)

- 106 SCSP participants
- 12 weeks of chiro care
- 4 week follow up
- EEG + Lots of clinical outcomes related to PFC
  - Immune
  - Emotions
  - Sleep
  - executive functions
  - Etc



Measurements taken at baseline, at 12 weeks and at 16 weeks

Amjad et al 2025 *PLoS One*

140

Study Design & Participants

- **Pragmatic parallel-group RCT (Pakistan, 2022)**
- **Adults 20–60 with *subclinical spinal pain***
- **106 randomized → 88 completed 12 weeks → 73 completed follow-up**
- **Groups:** 12 weeks chiropractic care vs sham care
- **Frequency:** ~3 sessions/week, 15–20 min each
- **Blinding:** Participants, assessors, and data analyst blinded
- **Blinding success:** 94% believed they received real chiropractic care
- **Outcomes measured at:** baseline, 12 weeks, 16-week follow-up

Amjad et al 2025 ***PLoS One***

141

Interventions & Biomarker Measures

- **Chiropractic care:** 12 weeks of adjusting vertebral subluxations
- **Sham care:** identical setup, positioning, and clicks with an activator — but *no thrusts* delivered
- **Primary outcome: Blood BDNF**
- **Secondary outcomes:**
  Cortisol: saliva, blood, hair
  Cytokines: IL-6, TNF-α, IFN-γ, CRP
  Immune cells: CD4, CD8, CD19, CD56
- **Samples:** blood, saliva, hair (validated ELISA + chemiluminescent assays)
- **Analysis:** linear mixed-effects models with baseline adjustment

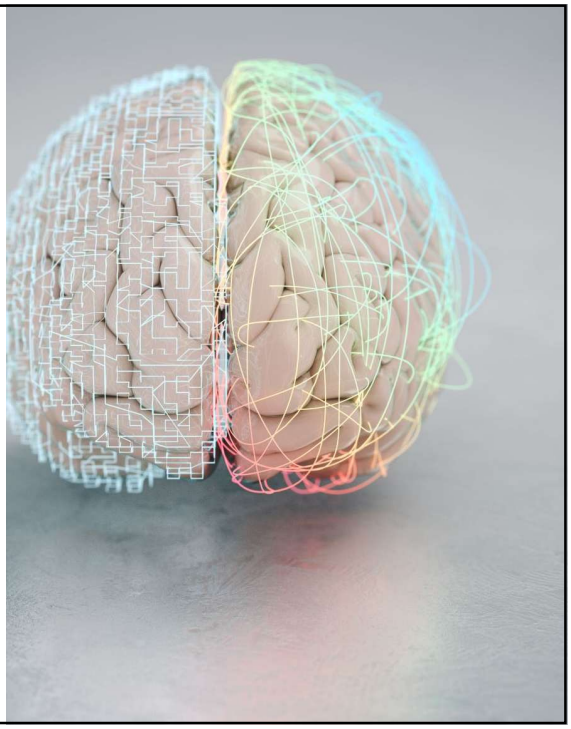
Amjad et al 2025 ***PLoS One***

142

BDNF

- Brain-Derived Neurotrophic Factor (BDNF)
- Key supporter of neuroplasticity
- Helps neurons survive, grow, and adapt
- Linked to learning, memory, mood, and pain modulation

Amjad et al 2025 *PLoS One*

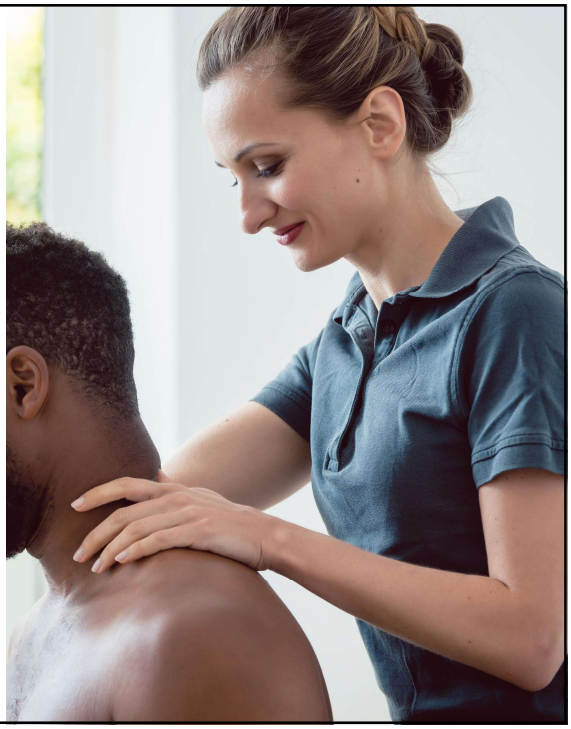


143

BDNF changes with chiropractic care

- Primary outcome of the trial = blood BDNF at 12 weeks of chiropractic vs sham
- Higher BDNF in chiropractic group at 12 weeks
- Trend for higher BDNF still at 16 weeks
- **Suggests enhanced neuroplastic activity in chiropractic group**
- ***"There is emerging evidence that regularly caring for the spine appears to also support the brain's capacity to adapt and reorganize, not just reduce symptoms."***

Amjad et al 2025 *PLoS One*



144

Cortisol

(Stress System – Hair, Blood, Saliva)

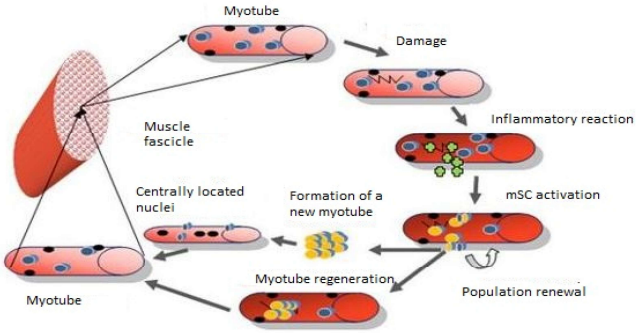
- Cortisol = main stress hormone (HPA axis)
- Short term: helps manage acute stress & inflammation
- Long term: chronically high cortisol can be harmful
- Measured in:
  - Blood & saliva → acute/short-term levels
  - Hair → longer-term, chronic stress load

Amjad et al 2025 *PLoS One*

145

IL-6 (Inflammation & Myokine)

- Interleukin-6 (IL-6) = **dual role** cytokine
- In disease: often **pro-inflammatory** (infection, autoimmunity)
- In muscle: acts as a **myokine** released during exercise
- Can support:
  - **Local tissue repair & regeneration**
  - Regulation of **acute phase response** (e.g., CRP)

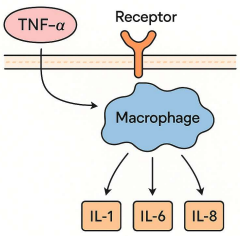


Amjad et al 2025 *PLoS One*

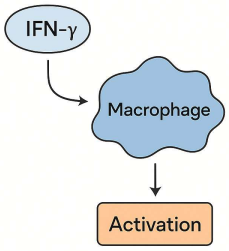
146

Inflammatory Markers

TNF-α and Inflammation

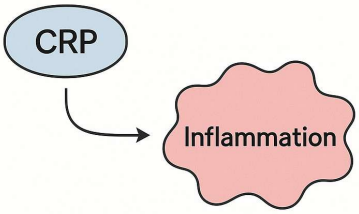


Key Pro-Inflammatory Cytokine



Important for host defense, but chronically high = immune over-activation

C-Reactive Protein



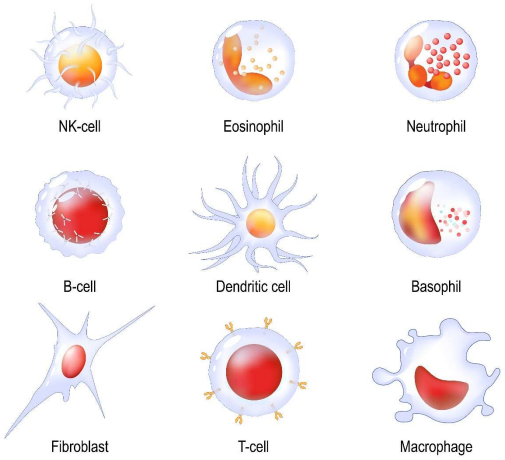
- C-reactive protein (CRP)
- Systemic Inflammation Marker
- Produced by the liver in response to IL-6

Amjad et al 2025 *PLoS One*

147

Immune Cells:

- **CD19** – B-lymphocytes (antibody-producing cells)
- **CD4** – T-helper cells (coordinate immune responses)
- **CD8** – Cytotoxic T cells (kill infected/damaged cells)
- **CD56** – Natural killer (NK) cells (innate defence)



Amjad et al 2025 *PLoS One*

148

"These findings suggest that chiropractic care may modulate neurotrophic, stress, and inflammatory pathways."

Biomarker	12 weeks (Chiro vs Sham)	16 weeks (Follow-up)
BDNF (blood)	↑ Chiro	↑ (trend, Chiro)
Cortisol (saliva)	↑ Chiro	-
Cortisol (blood)	-	↓ Chiro
Cortisol (hair)	↓ (within Chiro, trend)	-
IL-6	↑ Chiro	-
TNF-α	↑ Sham	↑ Sham
IFN-γ	-	↑ Sham
CRP	-	-

Amjad et al 2025 *PLoS One*

149

Previous Research Also shown that HVLA thrusts alter:


medicina

The Potential Mechanisms of High-Velocity, Low-Amplitude, Controlled Vertebral Thrusts on Neuroimmune Function: A Narrative Review

Single thrust session studies mainly:

Neuropeptides
- Neurotensin ↑
- Oxytocin ↑
- Substance P ↑ (short-term)

These molecules influence:
- Inflammation
- Stress responses
- Neuroendocrine regulation
- Pain modulation

Cytokines & Inflammatory Markers
- Pro-inflammatory cytokines ↓
- IL-1β ↓
- TNF-α ↓

Anti-inflammatory cytokines ↑
- IL-2 ↑
- IL-10 ↑ (in some studies)

Endocrine Markers
- Cortisol responses are inconsistent, with some studies showing changes and others not.

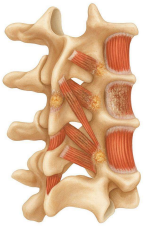
Haavik et al. 2021. Medicina 2021, 57, 536.

150

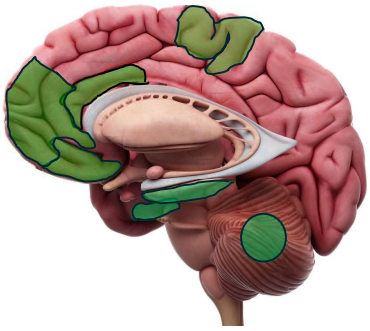
Mechanisms from 2025 RCT

HVLA adjustments

Increase proprioceptive input from deep paraspinal muscles that are stretched rapidly during adjustments



Affect PFC, DMN activity, Cerebellum and SMI



PFC, DMN, Cerebellum and SMI impacts and regulates ANS, HPA axis, Immune system, Stress response, Emotions and pain modulation

151

What you **CANNOT** say based on current science

- Cannot claim chiropractic care **treats, cures, or prevents** any inflammatory, immune, or neurological disease
- Cannot claim chiropractic care **directly boosts immunity**
- Cannot claim biomarker changes = **clinical outcomes** yet
- Cannot generalize beyond this **specific population** (subclinical spinal pain)
- Cannot infer long-term effects beyond **16 weeks**
- Cannot claim effects are large — current results show **modest effect sizes**
- Single RCT → requires **replication** before making broad clinical claims

152

Take Home Messages from this latest publication

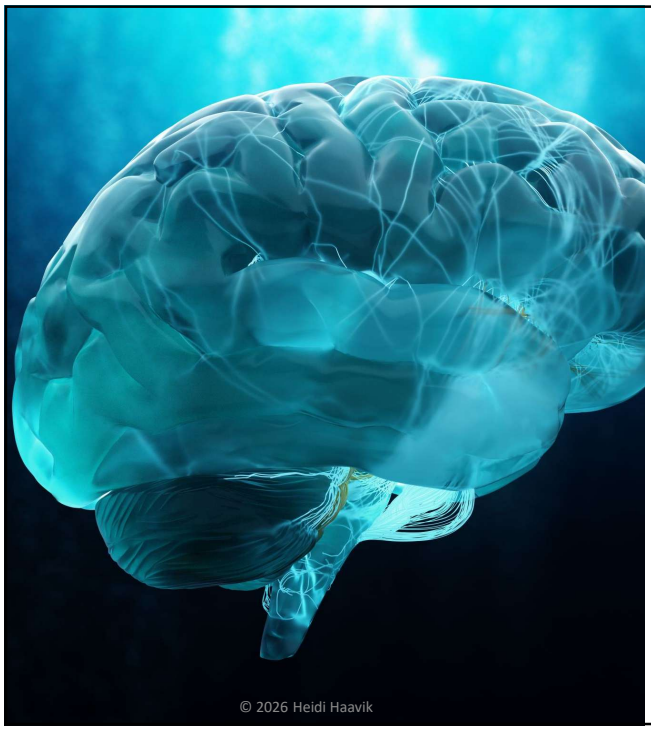
- First-ever **longer-term RCT** showing neuroplasticity + immune biomarker changes with chiropractic care
- **BDNF increased** → suggests enhanced neuroplastic activity
- **IL-6 increased** without CRP rise → consistent with **myokine / muscle repair response**, not harmful inflammation
- **TNF-α lower** in chiropractic group → potentially reduced systemic inflammatory load
- **Cortisol better regulated** over time (lower at 16 weeks)
- Sham group showed **worsening inflammatory/immune profile** (↑ TNF-α, ↑ IFN-γ, ↑ cortisol)
- No evidence of biomarker **harm** from chiropractic care
- Supports the **contemporary brain–immune–stress model** of chiropractic care

153

What we CAN claim based on this research

- Chiropractic care **modulated** key biomarkers (BDNF, IL-6, TNF-α, cortisol)
- Patterns suggest **neuroplastic, stress-regulatory, and immune-balancing** effects
- Changes occurred **over 12 weeks**, not just acutely
- Biomarker shifts were generally **favorable** (↑ BDNF, ↓ TNF-α, ↓ cortisol at follow-up)
- No evidence of **increased systemic inflammation or tissue damage**
- Findings **support**, but do not yet *prove*, broader health benefits
- More research needed → larger sample, longer follow-up, integration with outcomes
- Safe, evidence-aligned message:
  "Chiropractic care may influence neuroplasticity, stress physiology, and immune function."

154



What is yet to come from this RCT

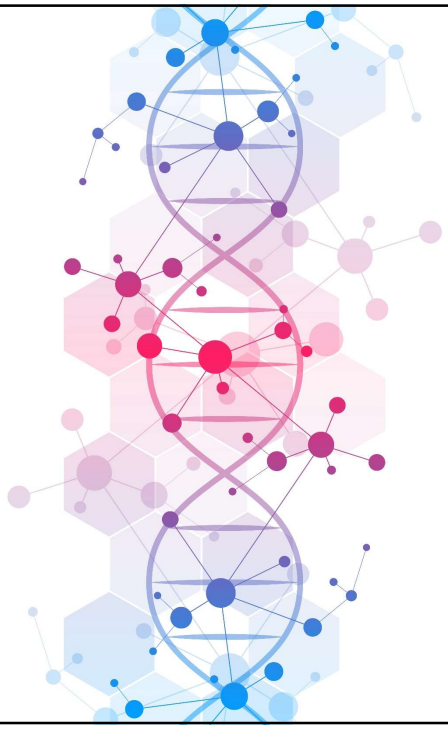
- Patient reported outcome measures (quality of life, stress, emotions)
- Sleep outcomes
- Executive functions outcomes
- Tripple Brain Network changes

155

Gene Study Results HOT OFF THE PRESS (*NOT yet published*)

"Transcriptomic analysis identified key driver genes involved in oxidative stress regulation, oxygen transport, and immune modulation. The chiropractic group's results suggests a more adaptive and regulated physiological state following chiropractic care compared with control group."

156



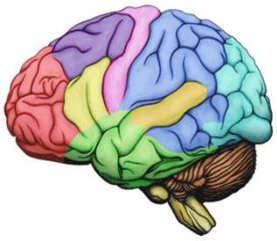
- Across two independent randomized studies we are observing convergent signals suggesting that chiropractic care may influence systemic neuroimmune regulation and cellular stress-response pathways.
- These effects appear to involve antioxidant regulation, immune modulation, and sensory signaling pathways, consistent with a shift toward a more adaptive physiological state.

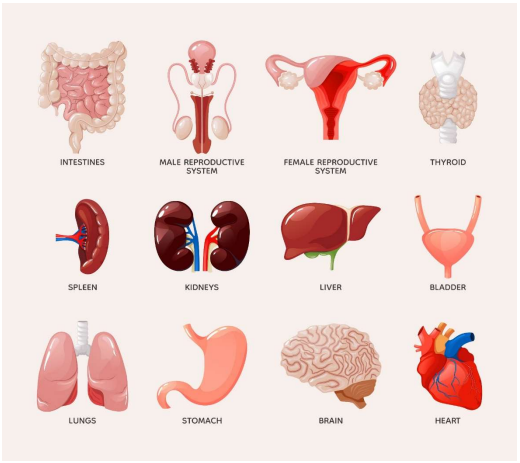
157

TODAY'S HANDOUT
& Gifts

158

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





159

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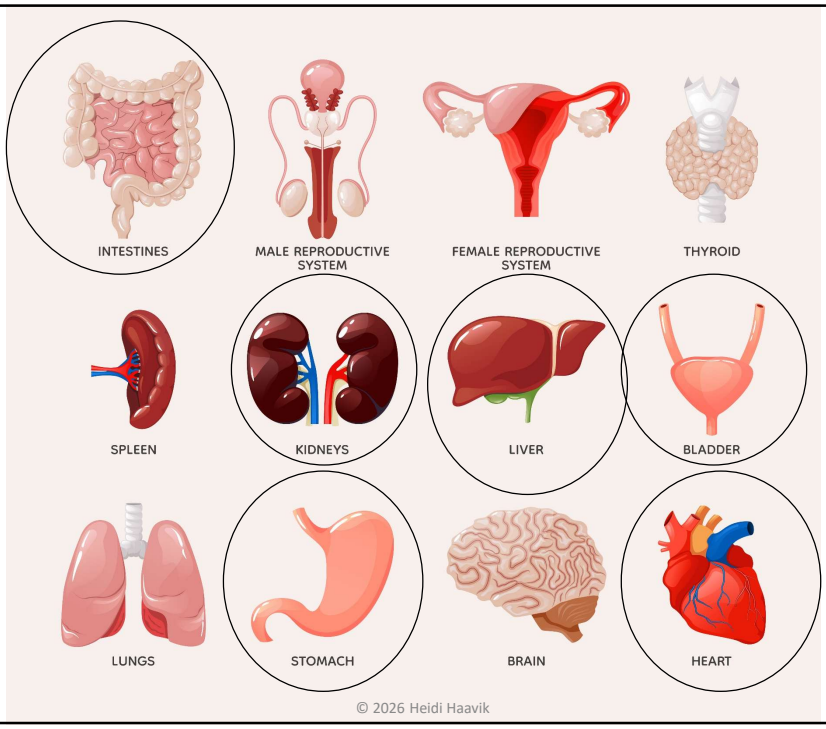
Chiropractic & Organ Function

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

160


INTESTINES
MALE REPRODUCTIVE SYSTEM
FEMALE REPRODUCTIVE SYSTEM
THYROID
SPLEEN
KIDNEYS
LIVER
BLADDER
LUNGS
STOMACH
BRAIN
HEART
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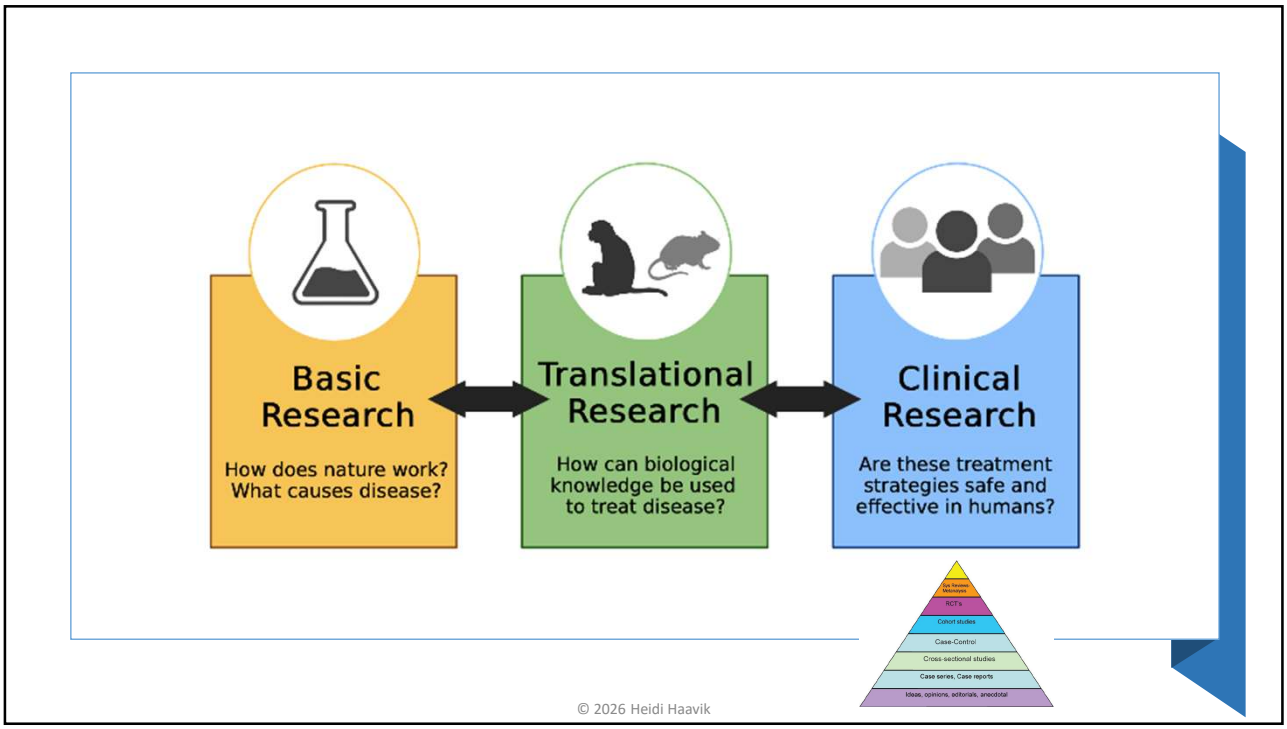
161


Basic Research
How does nature work? What causes disease?
Translational Research
How can biological knowledge be used to treat disease?
Clinical Research
Are these treatment strategies safe and effective in humans?
RCT's
Cohort studies
Case-Control
Cross-sectional studies
Case series, Case reports
Ideas, opinions, editorials, anecdotal
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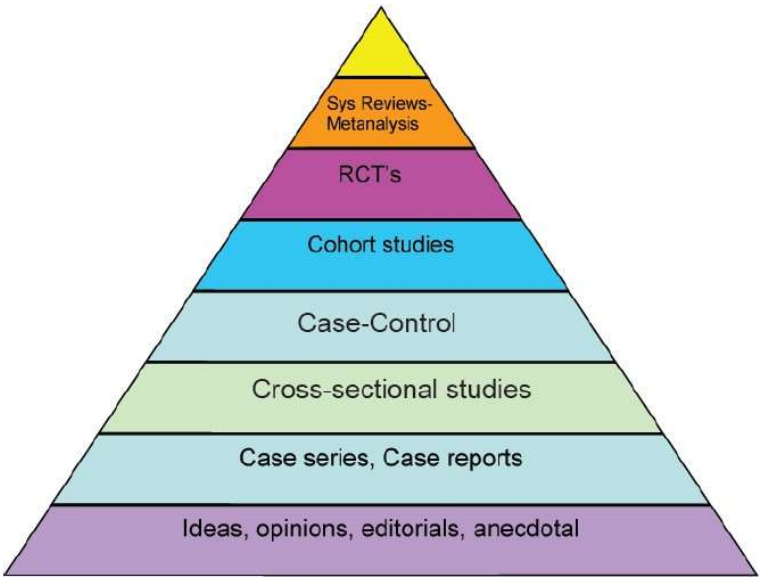
162

The Hierarchy of CLINICAL research evidence



163

Lack of clinical trials about organ function

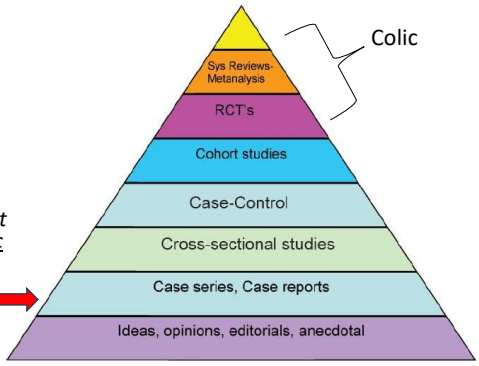
164

Chiropractic diagnosis and management of non-musculoskeletal conditions in children and adolescents

- "Most of the published literature centers around case reports or series. The more scientifically rigorous studies show conflicting results for colic and the crying infant, and there is little data to suggest improvement of otitis media, asthma, nocturnal enuresis or attention deficit hyperactivity disorder."

*Ferrance, R. J. and J. Miller (2010). "Chiropractic diagnosis and management of non-musculoskeletal conditions in children and adolescents." Chiropractic & Osteopathy **18**: 1-8.*

Most clinical research on kids and teenagers



165

Reed et al, 1994

What they did

- Measured bed-wetting frequency of 46 children for 2 weeks
- Divided children into 2 groups
- One group received chiropractic care for 10 weeks
- The other group received a sham control intervention for 10 weeks
- Measured bedwetting frequency for another 2 weeks

What they found

- After 10 weeks chiropractic group dropped from 9.1 wet nights to 7.6
- 25% of the chiropractic group had a 50% or more reduction in wet night frequency over the course of the trial
- Control group saw minimal change and no such improvement

Key messages to share

What this means

- Study suggests chiropractic care can help some children suffering from bed-wetting
- Parents of suffering children should consider chiropractic care
- Reduction in bed-wetting can have a large impact on the child's life

Limitations

- Sample size was small
- Baseline bed-wetting frequencies differed between the 2 groups
- Chiropractic care was given by students

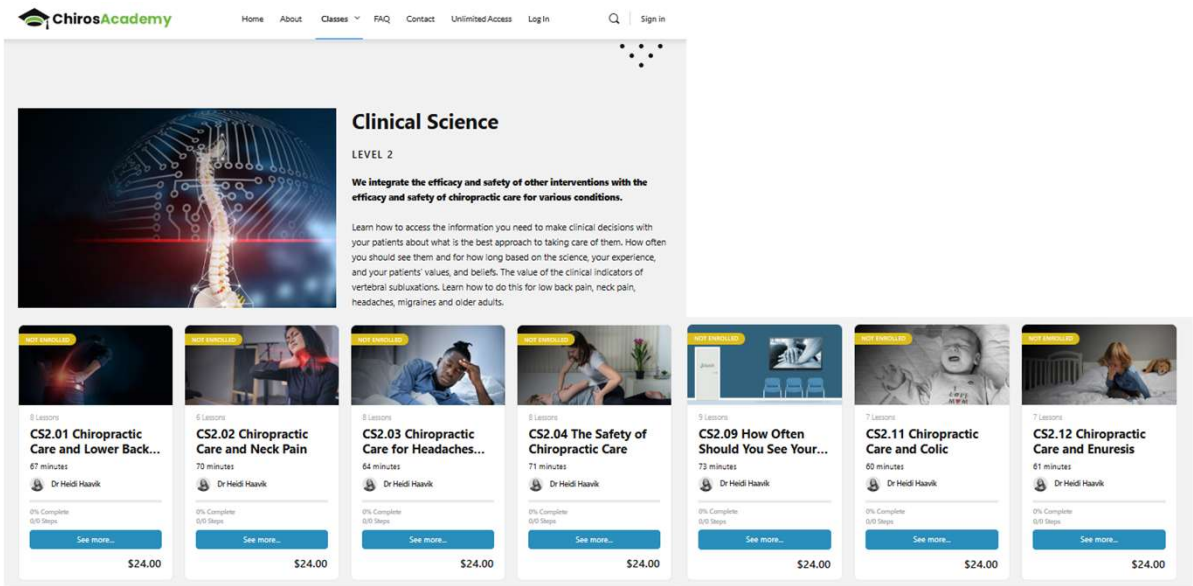
166

Colic and sleep outcomes of nonpharmacological intervention in infants with infantile colic: systematic review and meta-analysis

- OBJECTIVE: The aim of this study was to systematically review the colic and sleep outcomes of nonpharmacological intervention in infants with infantile colic and perform a meta-analysis of the available evidence.
- This meta-analysis included three studies involving a total of 386 infantile colic infants.
- CONCLUSION: According to the meta-analysis findings, it was determined that the risk of bias was low in the studies included and that nonpharmacological *chiropractic*, craniosacral, and acupuncture treatments applied to infantile colic infants in the three included studies *reduced crying time and intensity and increased sleep duration*.

Tanrıverdi, D. Ç., et al. (2023). "Colic and sleep outcomes of nonpharmacological intervention in infants with infantile colic: systematic review and metaanalysis." Revista da Associação Médica Brasileira **69**(5): e20230071.

167



168

Chiropractic care for hypertension: Review of the literature and study of biological and genetic bases

- "Results: We found 38 original studies that analyzed the effect of chiropractic therapy on hypertension. Of these studies, 10 were case reports and the statistical significance of the effects of chiropractic on blood pressure was not evaluated on these articles, so we focused on the remaining 28 articles."
- "Conclusions: The results of the review relative to chiropractic care were promising, but often contradictory, suggesting more research should be done. "

*Sullivan, S. G., et al. (2020). "Chiropractic care for hypertension: Review of the literature and study of biological and genetic bases." Acta Bio Medica: Atenei Parmensis **91**(Suppl 13): e2020017.*

169

What effect does chiropractic treatment have on gastrointestinal (GI) disorders: a narrative review of the literature

- "Twenty-one articles were found that met our inclusion criteria. Retrievable articles varied from case reports to clinical trials to review articles of management options."
- "The majority of articles chronicling patient experiences under chiropractic care reported they demonstrated mild to moderate improvements in presenting symptoms."
- "No adverse side effects were reported."

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What effect does chiropractic treatment have on gastrointestinal (GI) disorders: a narrative review of the literature

Katherine Angus, BSc(Kin), DC[1]
Sepideh Asgharifar, BSc(Hons), DC[2]
Brian Gleberzon, DC, MHSc[3]

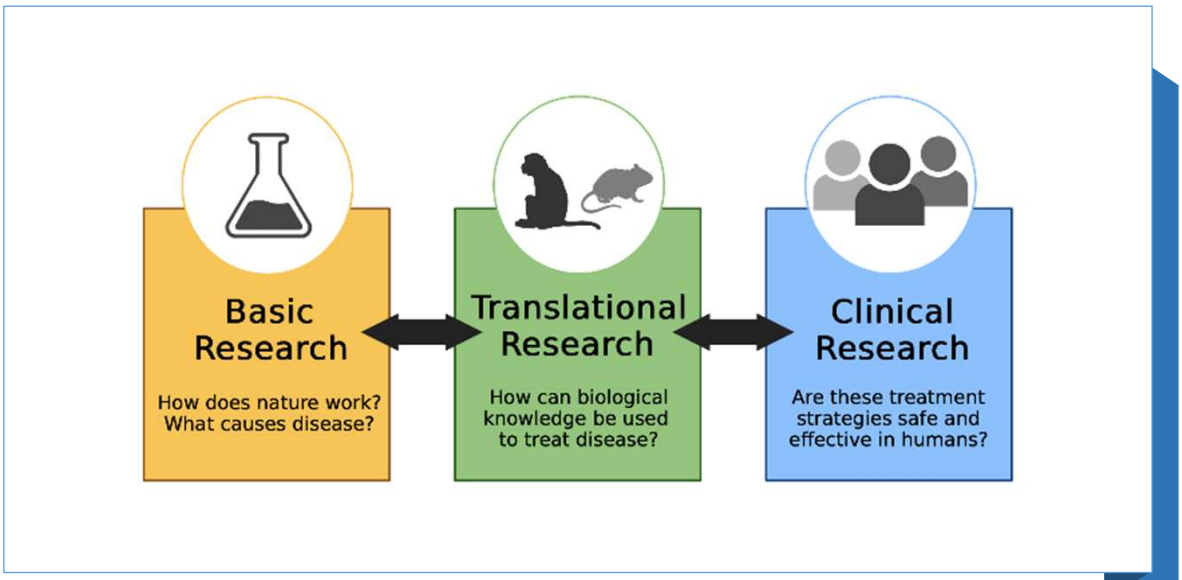
The purpose of this study was to provide a narrative review of the literature of studies describing the management of disorders of the gastro-intestinal (GI) tract using "chiropractic therapy" broadly defined here as spinal manipulation therapy, mobilizations, soft tissue therapy, modalities and stretches. Search limiters include access to full text studies published between 1900 and November 2012 in peer-reviewed journals, English language only involving human subjects. Twenty-one articles were found that met our inclusion criteria. Retrievable articles varied from case reports to clinical trials to review articles of management options. The majority of articles chronicling patient experiences under chiropractic care reported they demonstrated mild to moderate improvements in presenting symptoms. No adverse side effects were reported. This suggests chiropractic care can be considered as an adjunctive therapy for patients with various GI conditions providing there are no co-morbidities.

L'objectif de cette étude était d'offrir un examen narratif des documents d'études décrivant la gestion de troubles du tractus gastro-intestinal (GI) à l'aide d'un traitement chiropratique ici au sens large, comme la manipulation vertébrale, les mobilisations, le traitement des tissus mous, les modalités et les étirements. Les limites de la recherche comprennent l'accès aux textes d'étude complets entre 1900 et novembre 2012 dans les journaux révisés par des pairs en anglais concernant des sujets humains. Vingt et un articles correspondant à nos critères d'inclusion ont été trouvés. Les articles consultables vont des exposés de cas et essais cliniques aux articles de revues sur les options de gestion. La majorité des articles rapportant des expériences de patients de soins chiropratiques indiquent qu'ils ont connu une amélioration légère à moyenne des symptômes présentés. Aucune réaction indésirable n'a été signalée, ce qui laisse entendre qu'on peut considérer les soins chiropratiques comme un traitement auxiliaire pour plusieurs maladies gastro-intestinales en absence de comorbidité.

(JCCA 2015; 59(2):122-133)

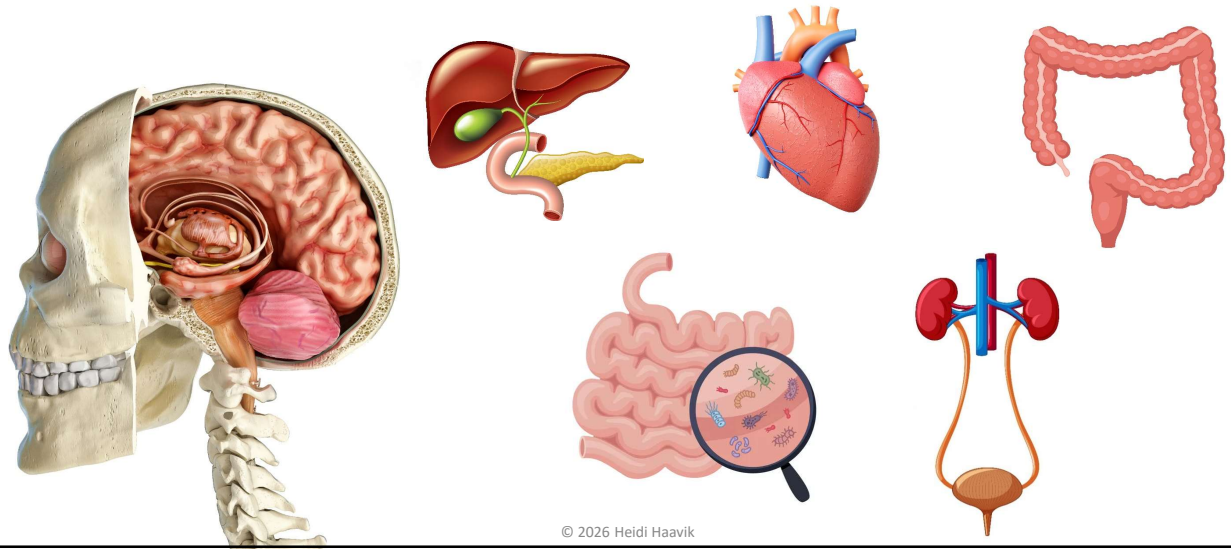
*Angus, K., et al. (2015). "What effect does chiropractic treatment have on gastrointestinal (GI) disorders: a narrative review of the literature." The Journal of the Canadian Chiropractic Association **59**(2): 122.*

170



171

So according to the BRAIN model
How might chiropractic care alter organ physiology?



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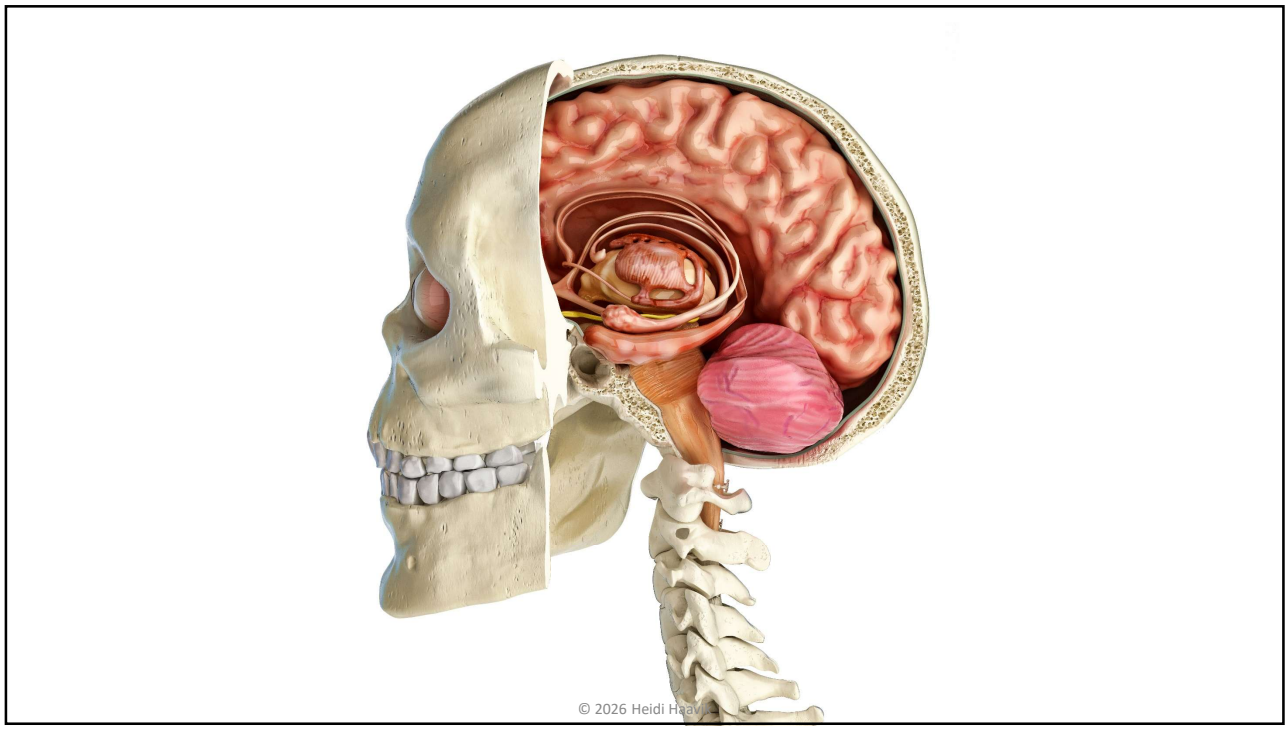
173



174

Mechanisms Brain - Body Communication

1. Autonomic Nervous System (ANS)

Sympathetic nervous system (SNS) – "fight or flight"
Parasympathetic nervous system (PNS) – "rest and digest"

These systems send and receive signals to and from organs using neurotransmitters like acetylcholine and norepinephrine.

2. Endocrine System Regulation

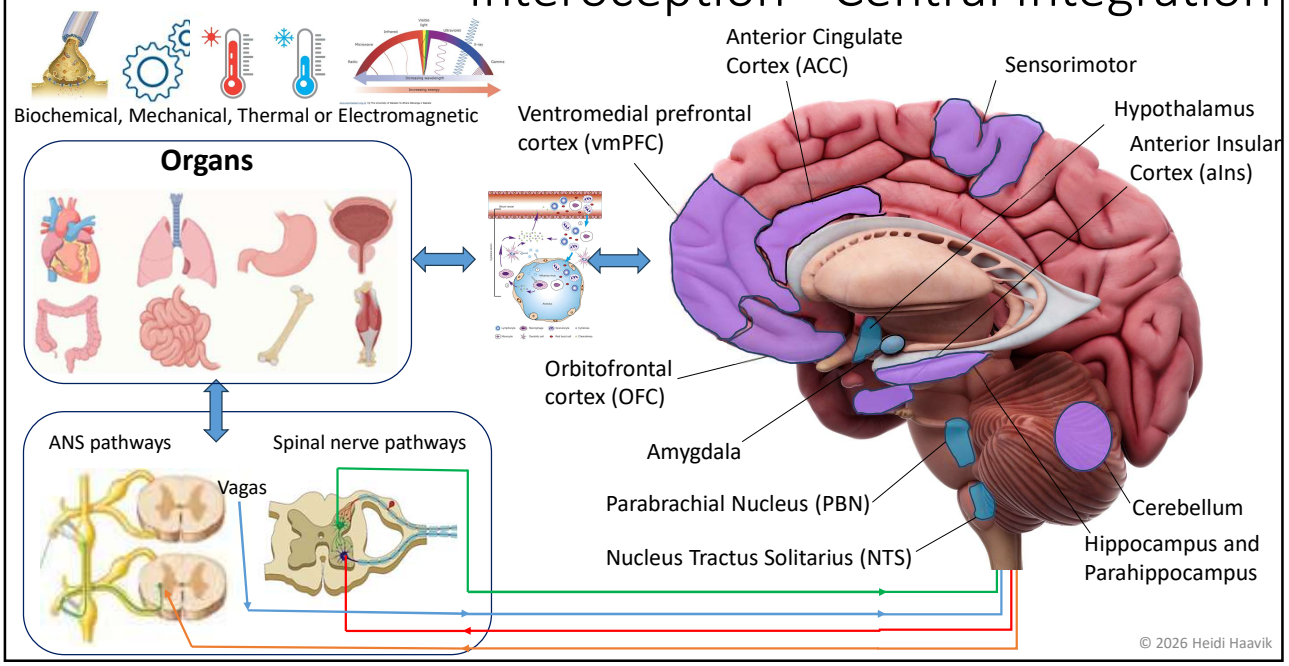
The brain (especially the **hypothalamus**) controls hormone release via the **pituitary gland**.
Hormones regulate various organs, such as the **adrenal glands**, which release cortisol during stress.
Hypothalamus Pituitary Thyroid; Hypothalamus Pituitary Gonads; Hypothalamus Pituitary Adrenals

3. Reflex Loops & Direct Neural Control

Spinal cord can mediate reflexes (e.g., pulling away from pain), bypassing the brain for quick reactions; some reflex loops go via the brain as well.
Voluntary neural control (e.g. muscles; bearing down; voiding bladder, etc)

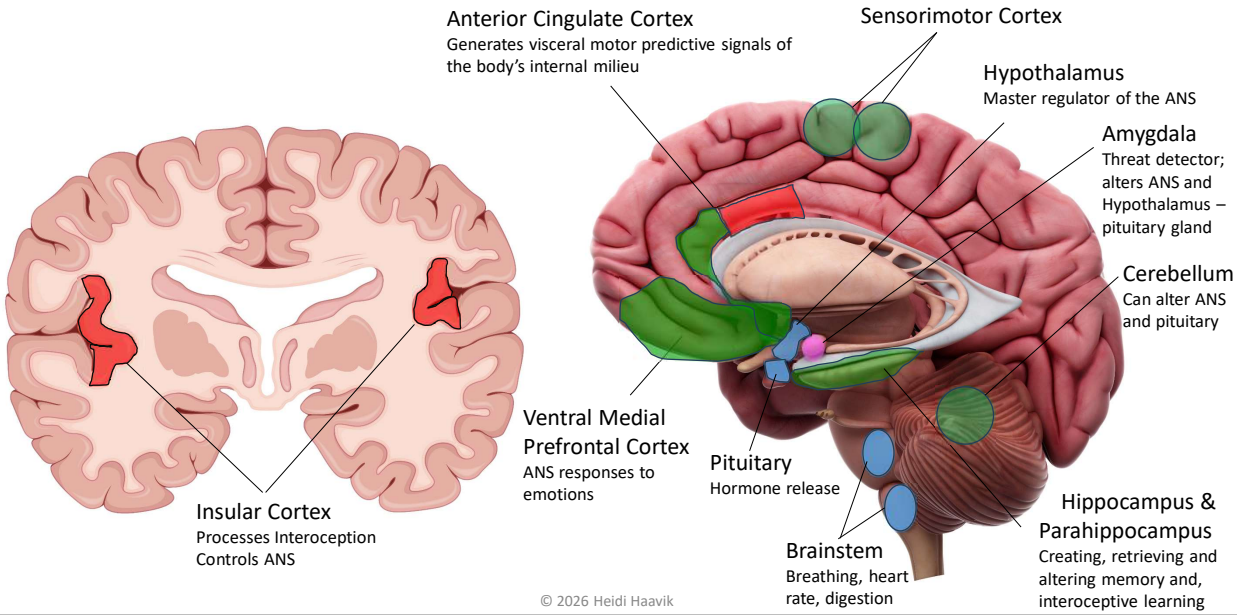
175

Interoception - Central Integration



176

Some Brain Regions known to activate ANS & NeuroEndocrine Systems?



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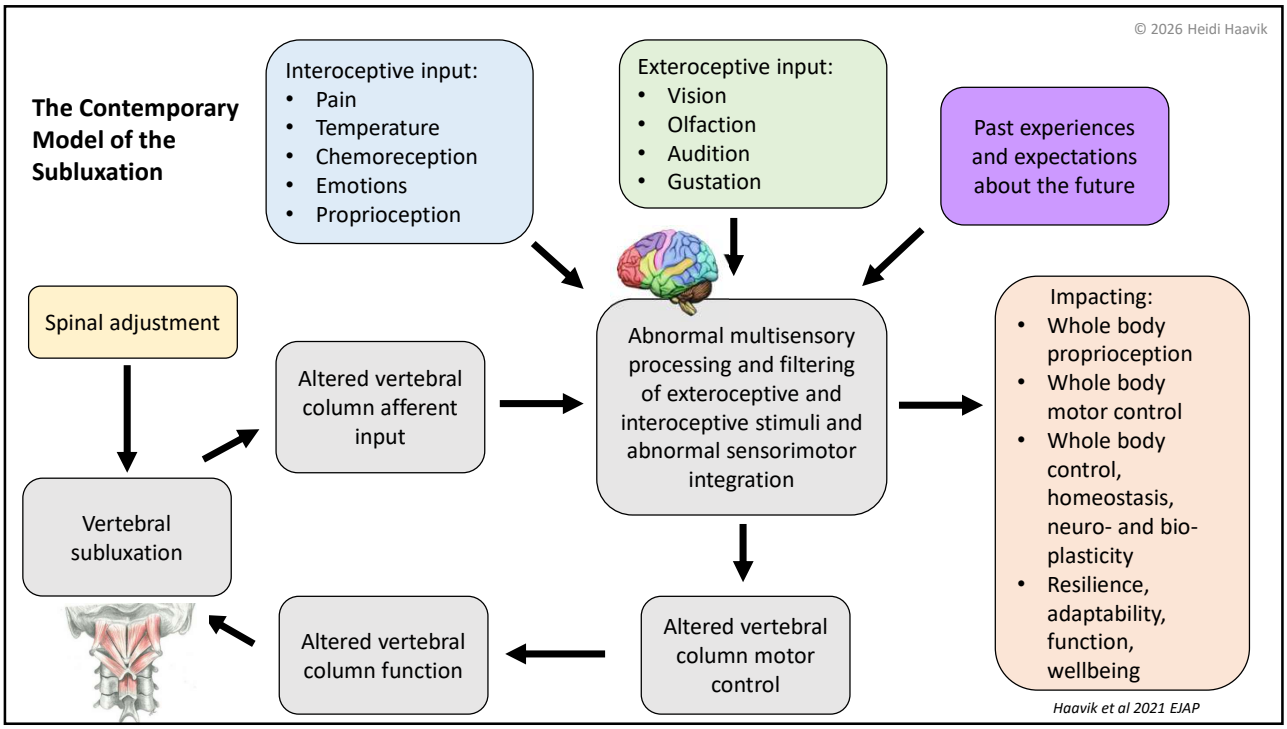

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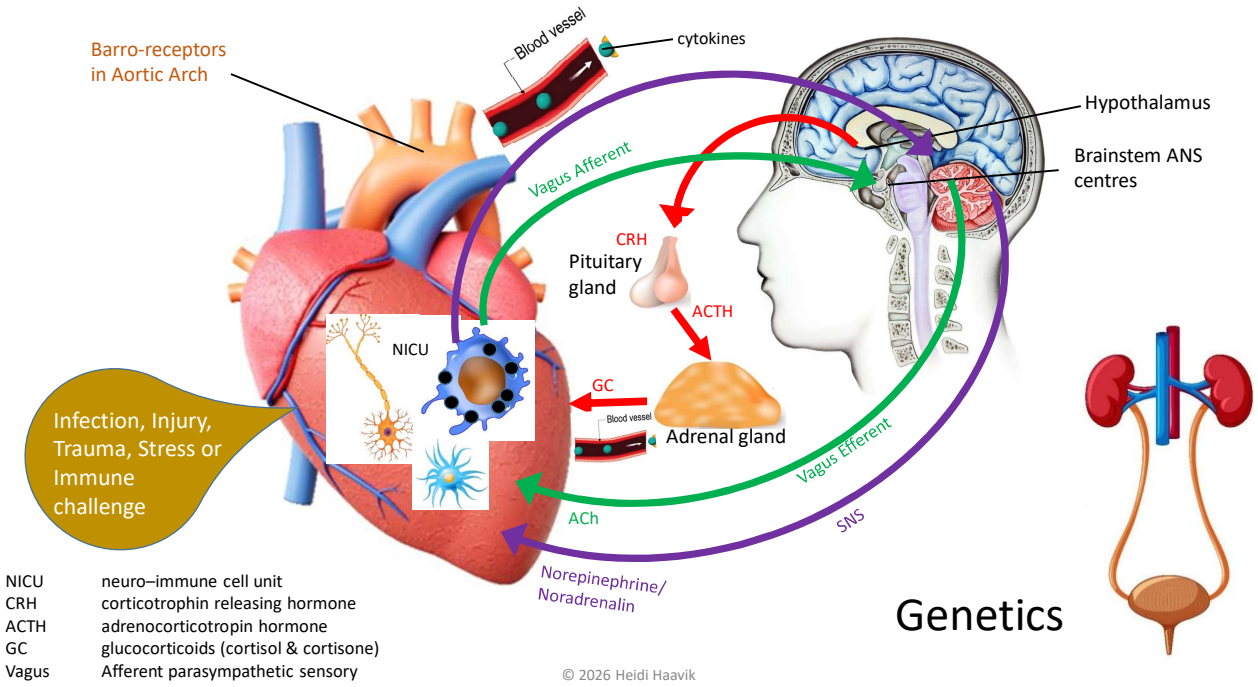


NICU	neuro–immune cell unit
CRH	corticotrophin releasing hormone
ACTH	adrenocorticotropin hormone
GC	glucocorticoids (cortisol & cortisone)
Vagus	Afferent parasympathetic sensory

179

What NOT to say

- "Blood flow to the brain increases because C1 was out of place"
- "Adjustments directly affect blood vessels"
- "Realigns the atlas to fix BP"
- "Removes pressure on nerves"

- Why not?
  - too structural
  - not supported by modern neurophysiology
  - too simplistic and
  - not evidence-based

180

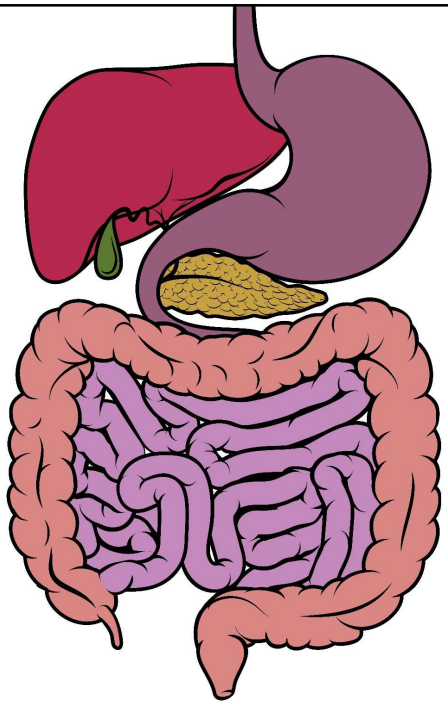
Most Scientifically Plausible Mechanisms

1. Normalising dysafferentation from deep paraspinal muscles → ANS regulation
2. Improved Prefrontal Cortex (PFC) function → Inhibition of sympathetic overdrive
3. Improved baroreflex sensitivity (BRS) (better interoception)
4. Reduced stress-system reactivity (HPA axis)
5. Pain reduction → Reduced sympathetic arousal
6. Improved thoracic mobility & rib mechanics → Better respiratory autonomic coupling
7. Reduction in local inflammation → improved afferent signalling

181

Brain – Gut Communication

- Spinal nerve pathway
- Autonomic Nervous System
  - Parasympathetic
  - Sympathetic
- Hormonal pathway
- Enteric Nervous System
- GI lining
- Immune mechanisms
- Microbiome



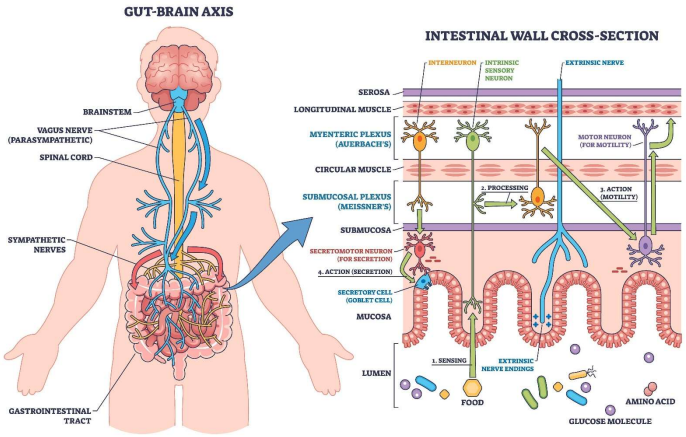
Integration of mechanical, chemical, microbial, and hormonal signals maintains energy balance, digestion, immunity, and stress regulation.

Disruption contributes to obesity, IBS, metabolic disorders, anxiety, and depression.

182

The Enteric Nervous System

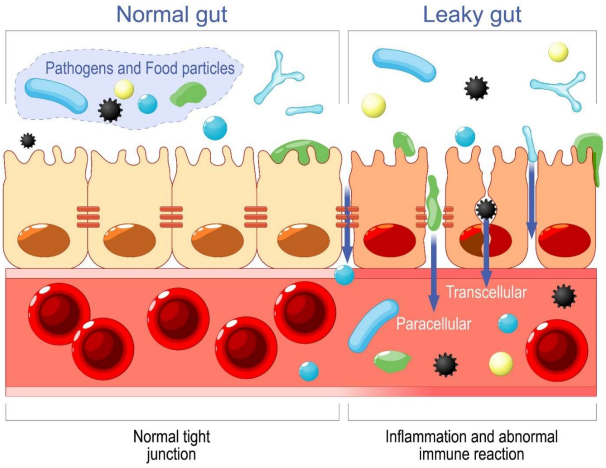
- The ENS has **~200–600 million neurons**
- More neurons than the spinal cord
- Found throughout entire GI tract from mouth to anus
- It is modulated by:
  - vagal parasympathetics
  - sympathetic chain
  - hormones from the gut
  - immune signals
- ENS sends processed information back to the CNS, similar to a "local mini-brain" optimising digestion in real time.



183

Leaky Gut

- Inflamed gut tissue releases:
  - Cytokines
  - Chemokines
  - Reactive metabolites
- These can:
  - Activate **vagal afferents**
  - Sensitise **spinal nociceptors (TRPV1, TRPA1)**
  - Increase visceral pain
  - Increase nausea/satiety signalling
  - Increase central inflammatory tone
- This is why GI inflammation is linked to:
  - Anxiety
  - Depression
  - Brain fog
  - Heightened pain sensitivity
  - Fatigue



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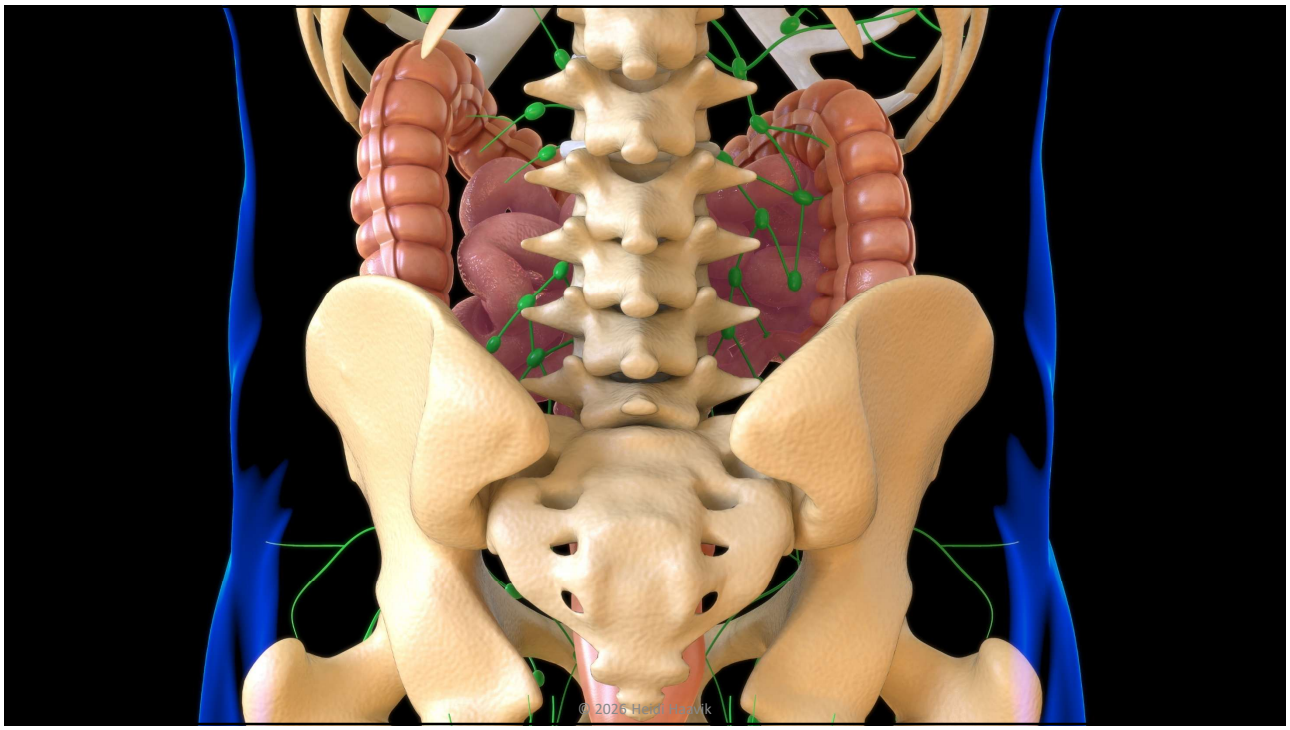
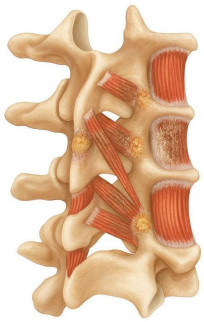
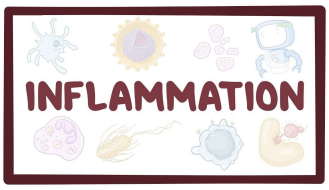
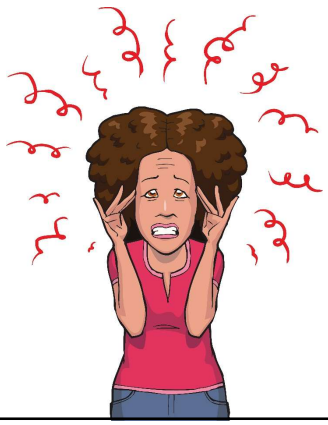


185

What can cause vertebral subluxations?







186

Gut Function Likely affects Spinal Function & Chiropractic Care Likely Affects Gut Function

- Chiropractic care affects brain regions that control the gut
  - Prefrontal cortex function
  - Cerebellar processing
  - Sensorimotor integration
  - Default Mode Network stability
  - Proprioceptive and somatosensory processing
  - Central motor excitability
- These areas strongly regulate:
  - Vagal output (via PFC → brainstem pathways)
  - Autonomic balance (sympathetic vs parasympathetic)
  - HPA axis activity (stress → gut permeability & motility)
  - Interoception and visceral pain modulation
- If chiropractic care modulates these systems → gut function should change.

Local Inflammation affects proprioceptive signalling to the brain from paraspinal muscles, i.e. causes subluxations

187

Inflammation Alters Proprioception

- The experimental muscle pain was induced by injecting hypertonic saline in right cervical multifidus
- The hypertonic solution triggers a local inflammatory cascade:
  - Release of inflammatory mediators (bradykinin, prostaglandins, substance P)
  - Sensitization of peripheral nociceptors
  - Activation of chemically-sensitive pain fibers (particularly C-fibers and A-delta fibers)
- This worsens cervical spine reposition errors

Wang et al. BMC Musculoskeletal Disorders (2022) 23:259
https://doi.org/10.1186/s12891-022-05170-7

BMC Musculoskeletal Disorders

RESEARCH Open Access

Effects of experimental pain on the cervical spine reposition errors

Xu Wang[1], Ning Qu[2], Yang Wang[1], Jian Dong[3], Jianhang Jiao[3] and Minfei Wu[1*]

Abstract

Background: Healthy subjects showed normal variance of cervical spine reposition errors of approximately 2 degrees. Effects of experimental pain on cervical spine reposition errors were unknown; thus, the purpose of this study was to investigate the effects of experimental pain on cervical spine reposition errors.

Methods: A repeated measured study design was applied. Thirty healthy subjects (12 males) were recruited. Reposition errors were extracted from upright cervical positions before and after cervical flexion movement in healthy subjects before and during experimental neck pain. Cervical spine reposition errors were calculated based on anatomical landmarks of each cervical joint. Reposition errors were extracted in degrees as constant errors and absolute errors for further statistical analysis. Repeated measures analysis of variance (RM-ANOVA) was applied to analyse experimental pain effects on either constant errors or absolute errors of different cervical joints.

Results: The cervical spine showed non-significant difference in reposition errors regarding the constant errors ($P>0.05$) while larger reposition errors regarding the absolute errors during experimental pain compared to before experimental pain ($P<0.001$). In addition, the pain level joint (C4/C5) and its adjacent joints (C3/C4 and C5/C6) indicated larger reposition errors regarding absolute errors ($P=0.035$, $P=0.329$ and $P=0.103$, respectively).

Conclusions: This study firstly investigated the cervical spine reposition errors in experimental neck pain and further found the joints adjacent to the pain level showed larger errors compared to the distant joints regarding absolute errors. It may imply that the larger reposition errors in specific cervical joint indicate probable injury or pain existed adjacent to the joints.

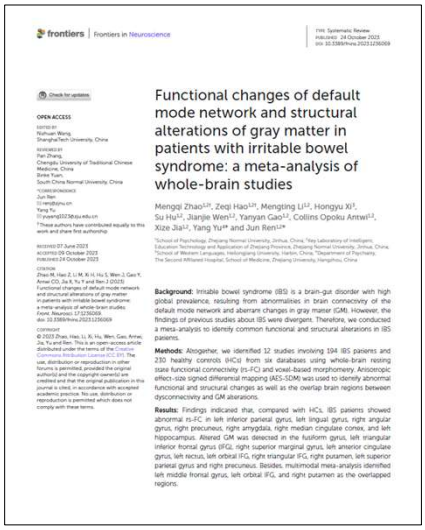
Keywords: Cervical spine, Experimental pain, Reposition errors, Cervical joint reposition, Spine

*Wang, X., et al. (2022). "Effects of experimental pain on the cervical spine reposition errors." BMC Musculoskeletal Disorders **23**(1): 259.*

188

DMN changes in IBS patients

- Findings indicated that, compared with Healthy controls, IBS patients showed abnormal resting-state functional connectivity in left inferior parietal gyrus, left lingual gyrus, right angular gyrus, right precuneus, right amygdala, right median cingulate cortex, and left hippocampus.
- Altered gray matter was detected in the fusiform gyrus, left triangular inferior frontal gyrus (IFG), right superior marginal gyrus, left anterior cingulate gyrus, left rectus, left orbital IFG, right triangular IFG, right putamen, left superior parietal gyrus and right precuneus.
- Besides, multimodal meta-analysis identified left middle frontal gyrus, left orbital IFG, and right putamen as the overlapped regions.



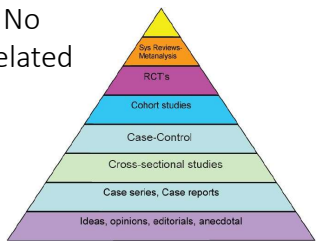
frontiers | Frontiers in Neuroscience

Functional changes of default mode network and structural alterations of gray matter in patients with irritable bowel syndrome: a meta-analysis of whole-brain studies

189

So what can we claim? CLINICAL

- Clinical research directly supporting organ function changes from chiropractic care is limited!
- Most published clinical literature for non-musculoskeletal organ claims consists of case reports or series rather than large, well-controlled trials.
- Research into conditions like colic, enuresis (bedwetting), hypertension, and gastrointestinal problems shows mixed or tentative results. No strong, consistent clinical trial evidence supports broad organ-related health claims.

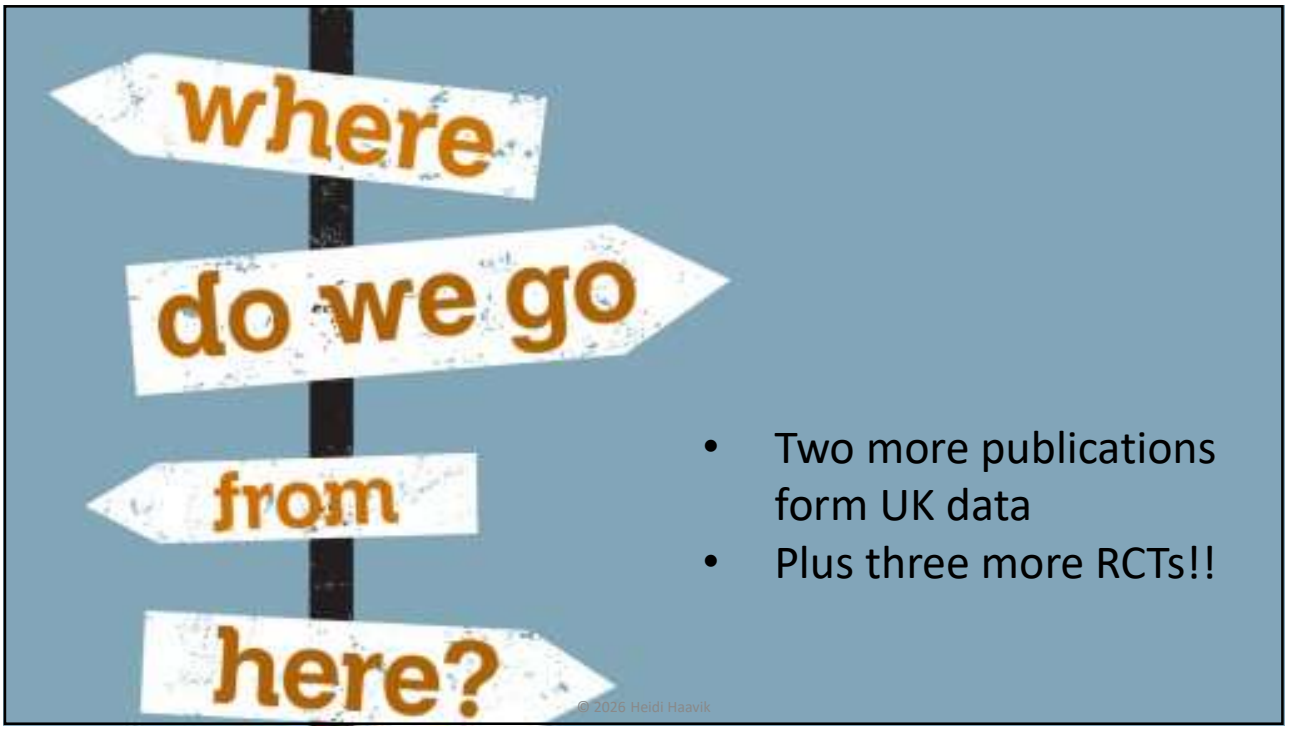


190

So what can we claim? Mechanisms

- Current basic science evidence supports that spinal adjustments affect the nervous system—especially the autonomic nervous system (ANS), endocrine regulation, and reflex loops—all of which can theoretically influence organ function.
- Mechanisms include:
  - Modulation of ANS balance (sympathetic and parasympathetic outflow) through neural pathways, including the vagus nerve and spinal afferents.
  - Changes in how the brain processes signals from the body, especially via regions known to regulate organ systems such as the hypothalamus and prefrontal cortex.
  - Impact on sensorimotor integration and interoceptive awareness, which can affect homeostasis and whole-body regulation.
  - Theoretical influence on hormonal and immune signaling through neuroendocrine routes, as the central nervous system coordinates with organs using neurotransmitters and hormones.

191

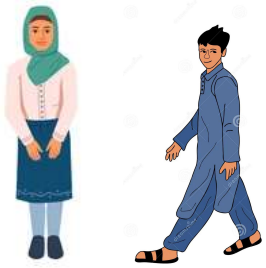


- Two more publications form UK data
- Plus three more RCTs!!

192

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



193

Jenna Duehr

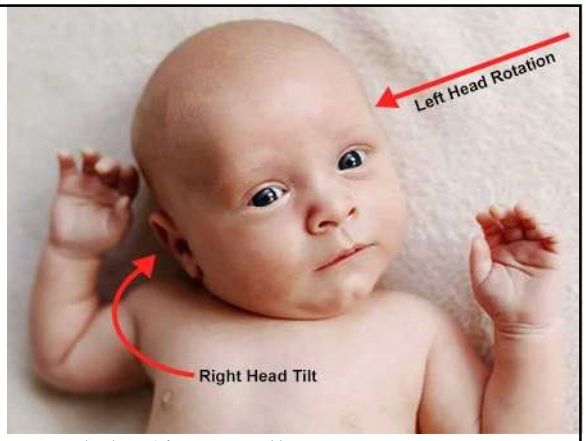
Exploring the neurophysiological effects of chiropractic care on infants

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

194

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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195

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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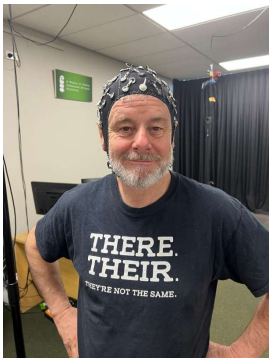
196

Intent Study



197

Our Future lies in BIG DATA

https://chiropracticfuture.org/

CHIROPRACTIC FUTURE STRATEGIC PLAN

BIG DATA

198

CHIROPRACTIC FUTURE STRATEGIC PLAN

Better Access Better Reimbursement Brighter Future

Technology

Research

Legislation

chiropracticfuture.org

199

DO YOU OWN YOUR SCIENCE?

ChirosAcademy

200

ChirosHub

ARE YOU A CONFIDANT COMMUNICATOR?

201

ChirosHub

Code heiditalk
Gives you 15% off

202

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

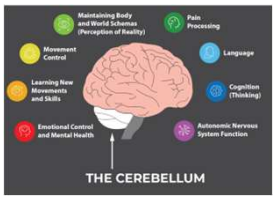
The question is: are YOU ready for this change!

203

The HANDOUT for today's Class (the slides)

Gift

Gift



204