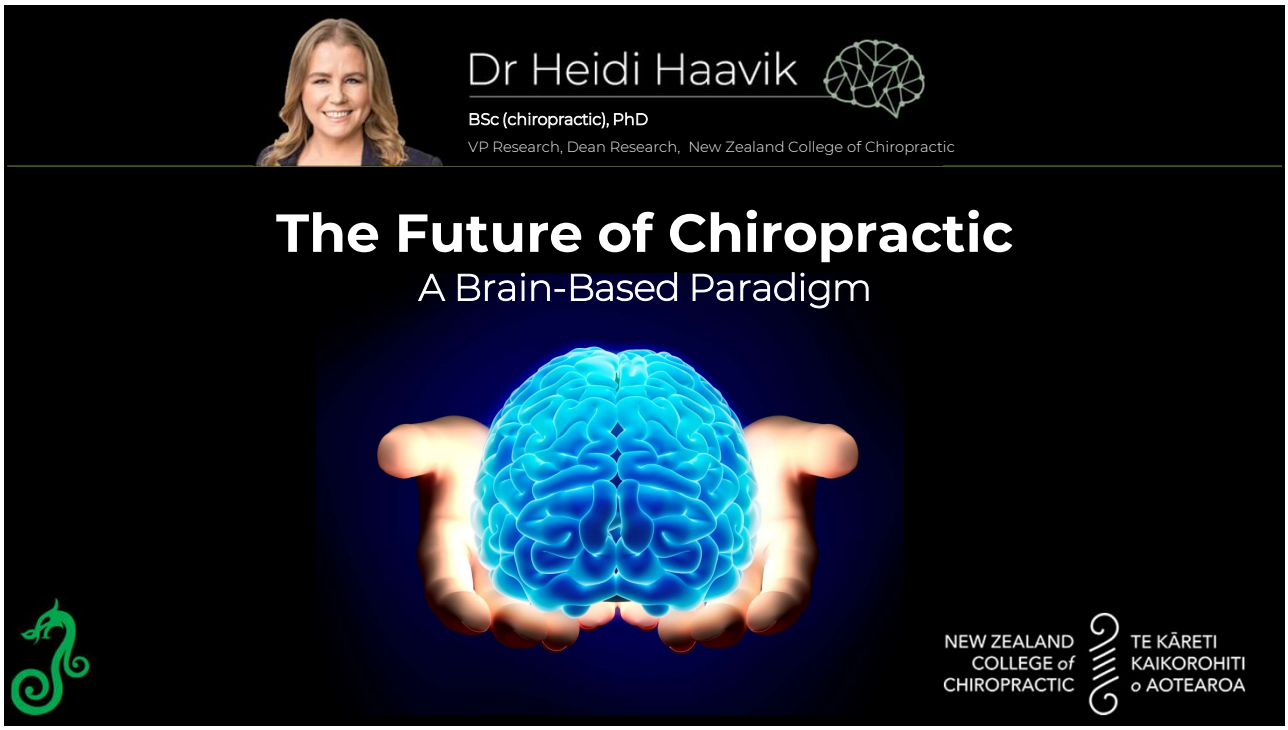

Dr Heidi Haavik
BSc (chiropractic), PhD
VP Research, Dean Research, New Zealand College of Chiropractic
The Future of Chiropractic
A Brain-Based Paradigm
NEW ZEALAND COLLEGE of CHIROPRACTIC
TE KĀRETI KAIKOROHITI o AOTEAROA

1


Thank you!

2

3

Key References for today's talk

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

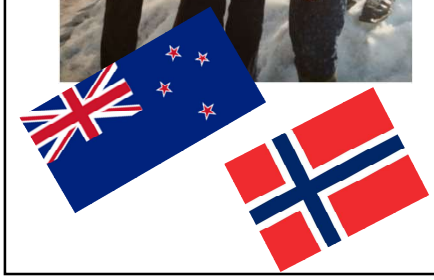
Heidi Haavik, Nitika Kumari, Kelly Holt, Imran Khan Niazi, Imran Amjad, Amit N. Pujari, Kemal Sitki Türker, Bernadette Murphy. (2021a) The contemporary model of vertebral column joint dysfunction and impact of high-velocity, low-amplitude controlled vertebral thrusts on neuromuscular function. Invited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

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

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

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

4



NEW ZEALAND COLLEGE OF CHIROPRACTIC
graduating hands, hearts & minds

1999 NZCC Graduate

2008 PhD

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

5

6

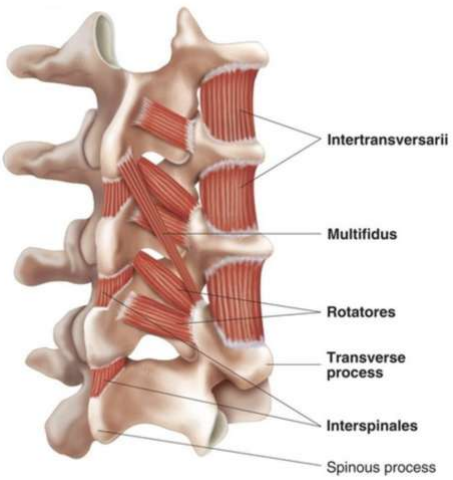
Do you have a spine model in your practice?

7

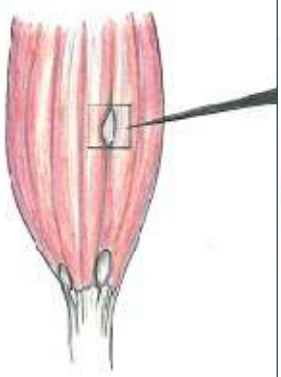
Do you have a brain model in your practice?

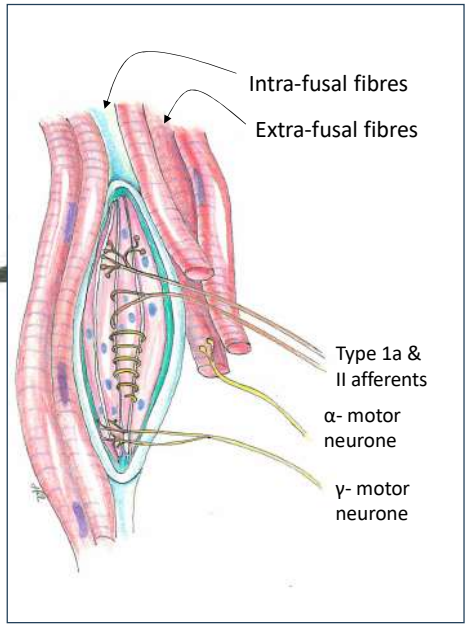
8

9



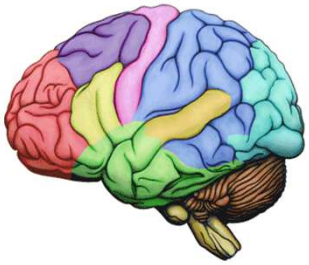
MUSCLE SPINDLES

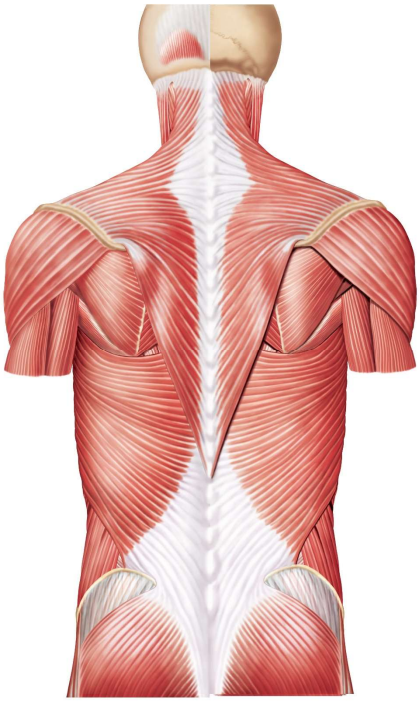




10

A healthy spine moves!

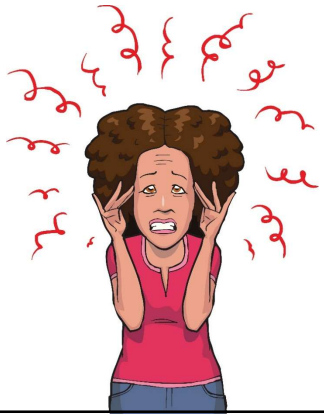


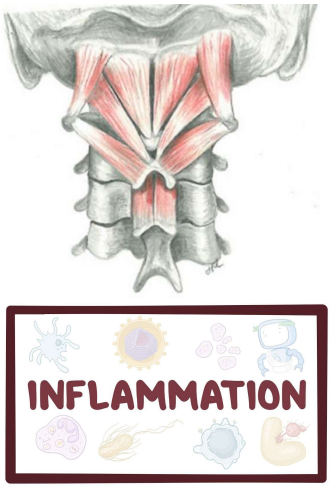


However, bones do not move themselves!

11

What can causes vertebral subluxations?



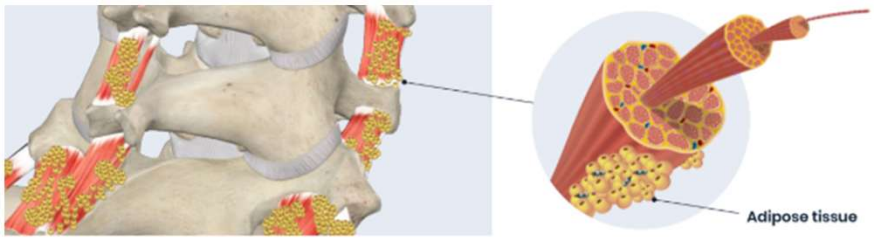


Haavik et al 2021 EJAP

12

HEALTHY

SUBLUXATED



13

Deep paraspinal muscles

Healthy

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

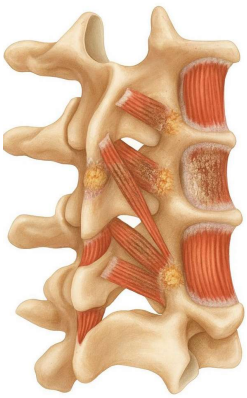
Good

Dysfunction

over time become:

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

NOT Good

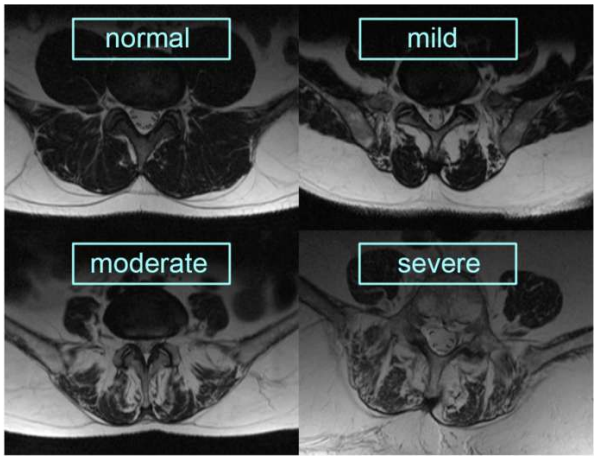


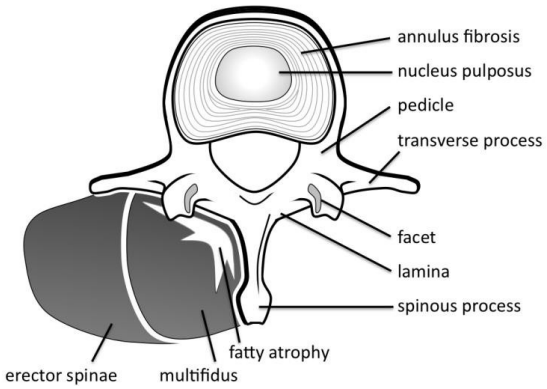
*(Hodges & Danneels, 2019. Changes in structure and function of the back muscles in low back pain: different time points, observations, and mechanisms Journal of orthopaedic & sports physical therapy **49**(6): 464-476)*

14

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

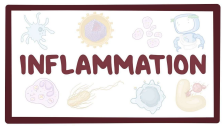
Haavik et al 2021 EJAP





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

15

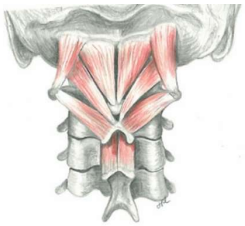


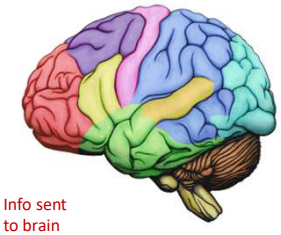
OR

Stress

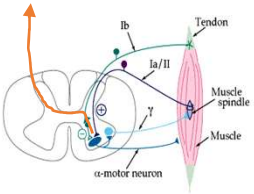
Injury

Small muscles closest to spine and skull go to sleep

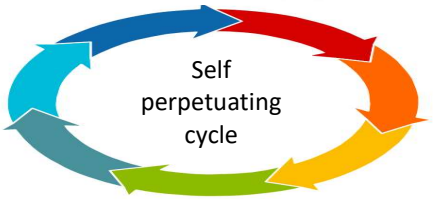




Info sent to brain



Altered messages going to brain from spine



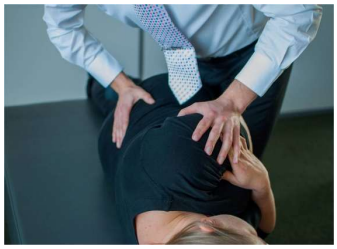
Poor body awareness
Poor body control
Poor function

So brain does NOT know accurately what is going on

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

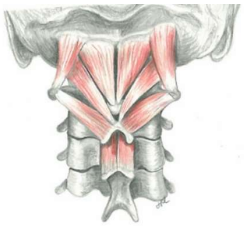
Haavik et al 2021 EJAP

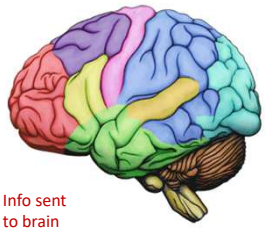
16



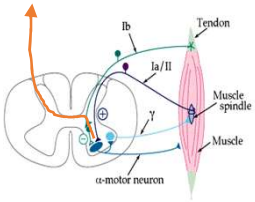
Adjustment

Stretches small muscles closest to spine and scull





Info sent to brain



Bombards brain with mechanoreceptor input

Improved body awareness
Improved body control
Improved function

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

17

The Contemporary Model of the Subluxation

Haavik et al 2021 EJAP

Interoceptive input:
- Pain
- Temperature
- Chemoreception
- Emotions
- Proprioception

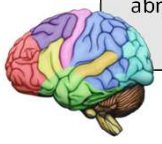
Exteroceptive input:
- Vision
- Olfaction
- Audition
- Gustation

Past experiences and expectations about the future

Spinal adjustment

Altered vertebral column afferent input

Abnormal multisensory processing and filtering of exteroceptive and interoceptive stimuli and abnormal sensorimotor integration



Impacting:
- Whole body proprioception
- Whole body motor control
- Whole body control, homeostasis, neuro- and bio-plasticity
- Resilience, adaptability, function, wellbeing

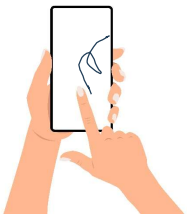
Vertebral subluxation

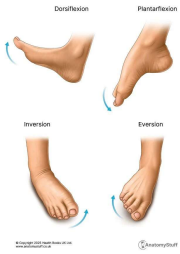
Altered vertebral column function

Altered vertebral column motor control

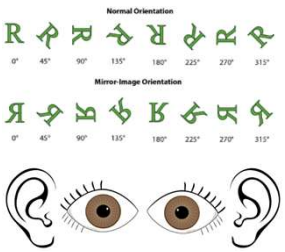
18

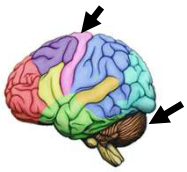
Chiropractic care can improve accurate perception and function





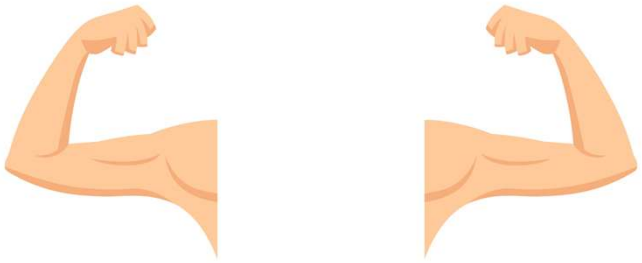
19

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

20

It takes more than four weeks of exercise before you alter the morphology of the muscle

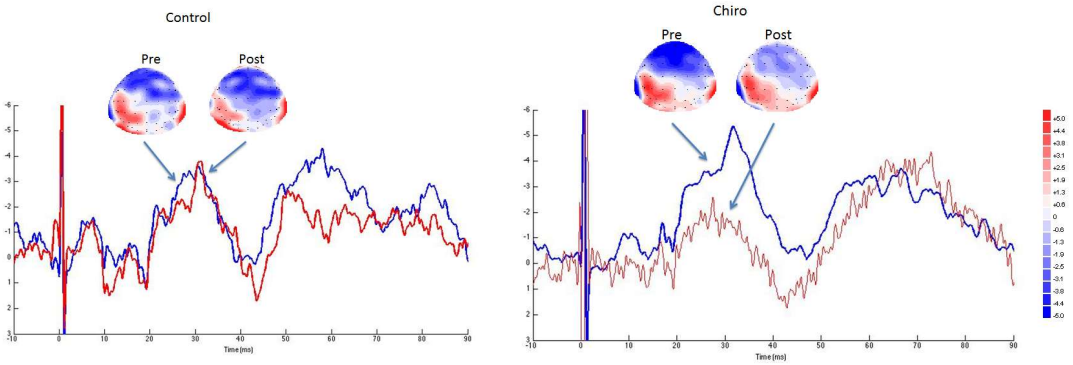


Implications for practice!

21

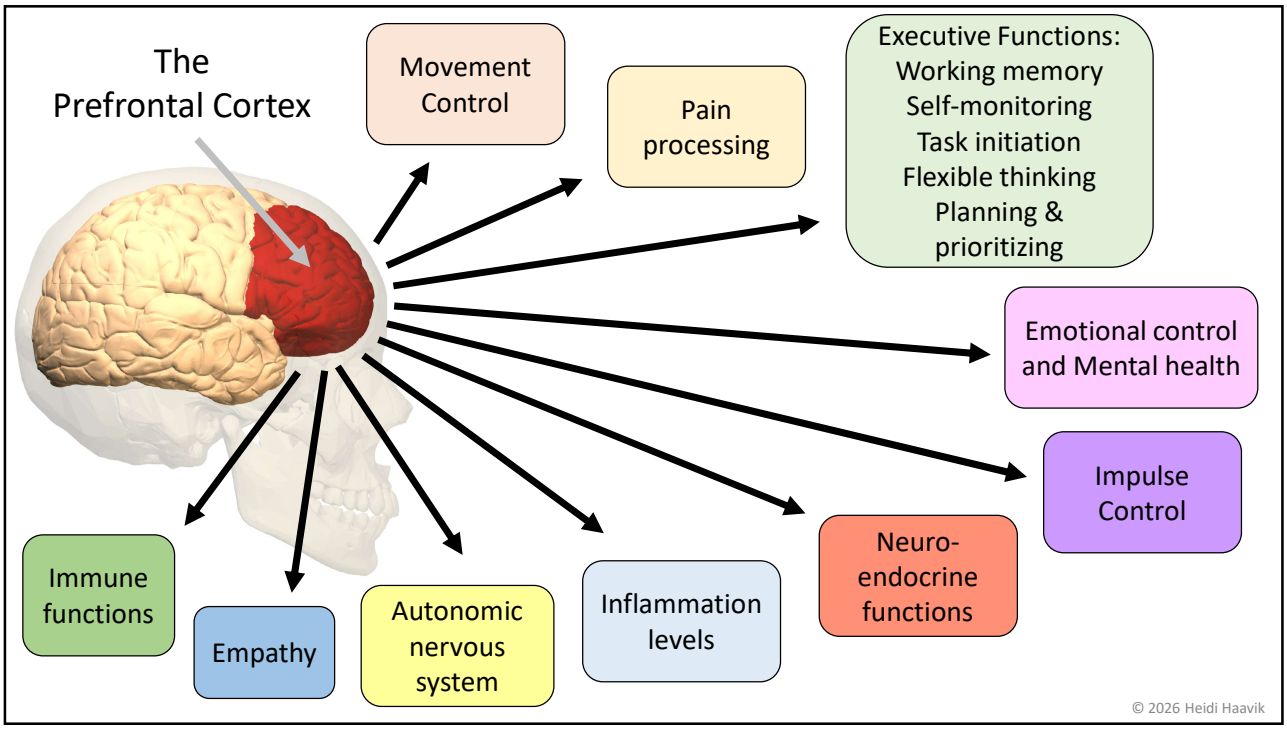
22

Chiropractic Adjustment changes Pre-Frontal Cortex Processing



Lelic, D., Niazi, I.K., Holt, K., Jochumsen, M., Dremstrup, K., Yielder, P., Murphy, B., Drewe,s A. M., & Haavik, H. (2016). Manipulation of dysfunctional spinal joints affects sensorimotor integration in the prefrontal cortex: A brain source localization study. Neural Plasticity, 1.doi:10.1155/2016/3704964.

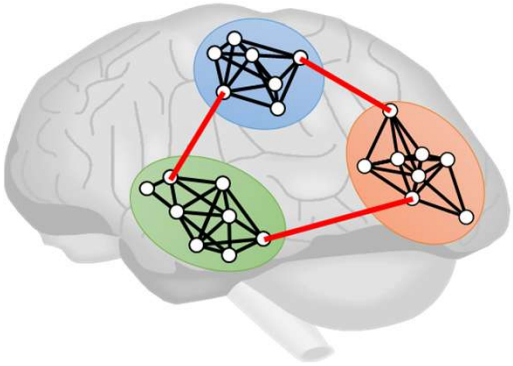
23



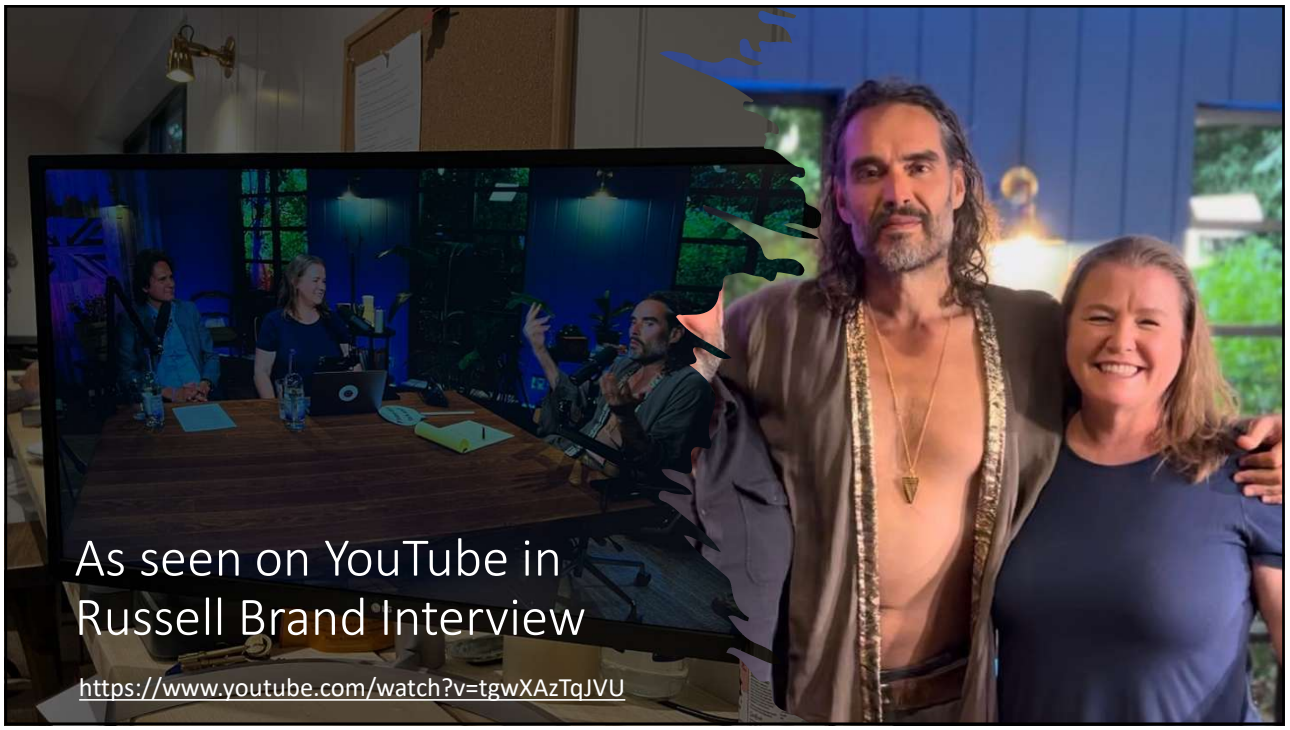
24

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.



25

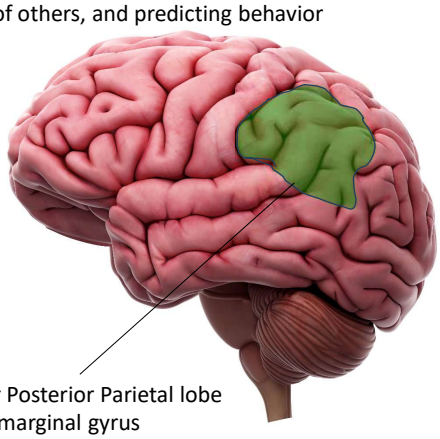


26

Default Mode Network

Constructing sense of self

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

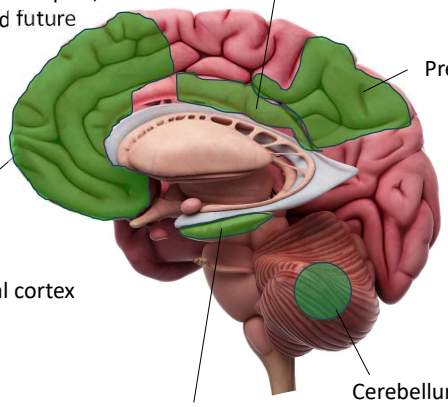


Inferior Posterior Parietal lobe
- Supramarginal gyrus
- Angular Gyrus

Emotional understanding & regulation of past, present and future

PCC

Precuneus



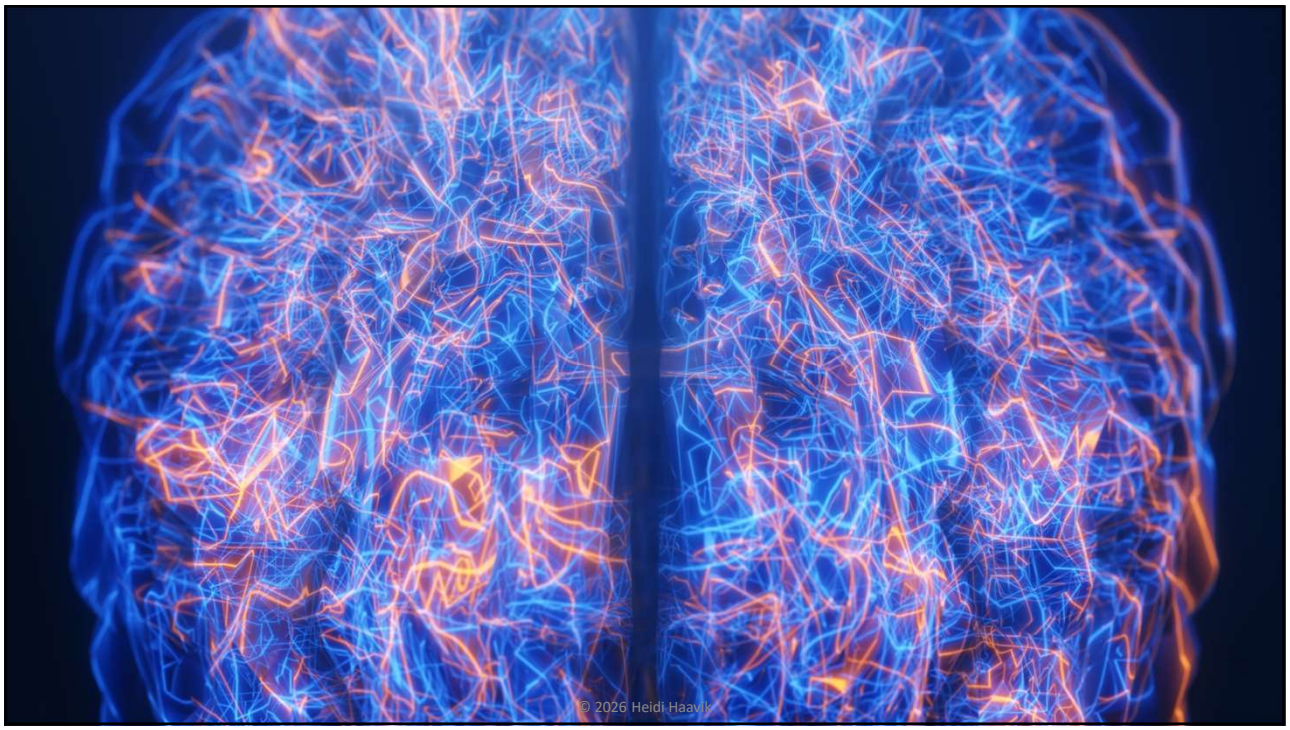
Medial PFC
- vm PFC
- Orbitofrontal cortex
- Ventral ACC

Cerebellum

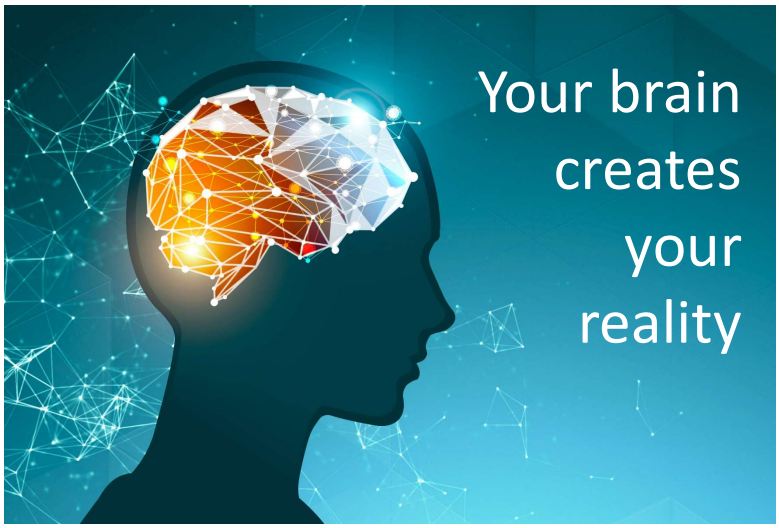
Hippocampus and parahippocampal cortex

(Dohmatob, Dumas & Bzdok 2017)

27



28



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, action, and learning.

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

29

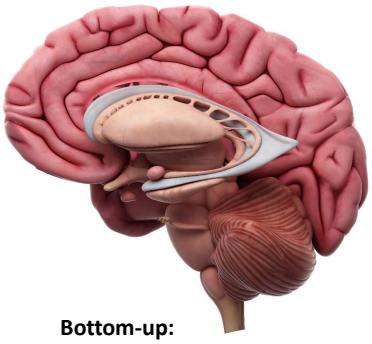
(Alexander & Brown 2018 Scientific Reports)

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.

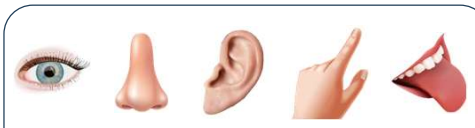
Front: Prediction & meaning

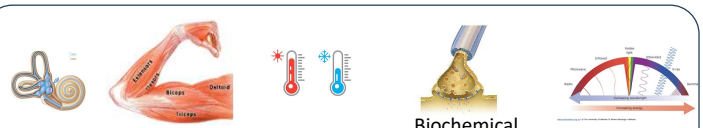


Back: Sensory input & error

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





30

Questionnaire Results

Control Group

NO significant changes at all

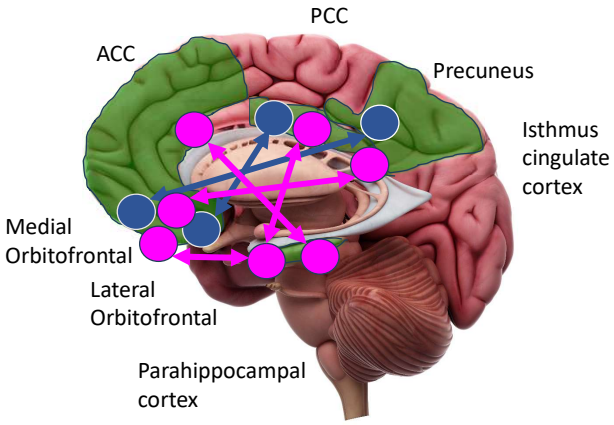
Chiropractic Group

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

31

Default Mode Network changes after Chiro Care

Pre and Post first session

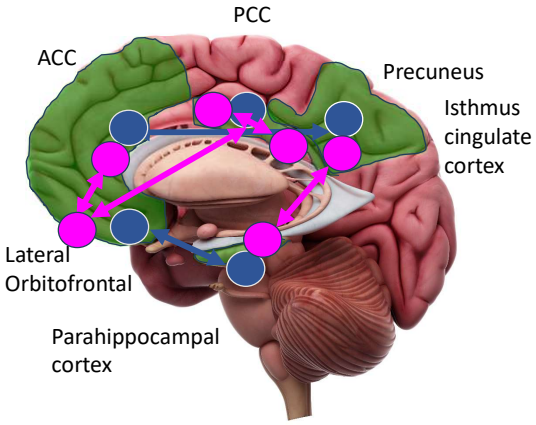


(Haavik et al 2024, Brain Sciences)

32

Default Mode Network changes after Chiro Care

Pre and Post 4 weeks



(Haavik et al 2024, Brain Sciences)

33

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

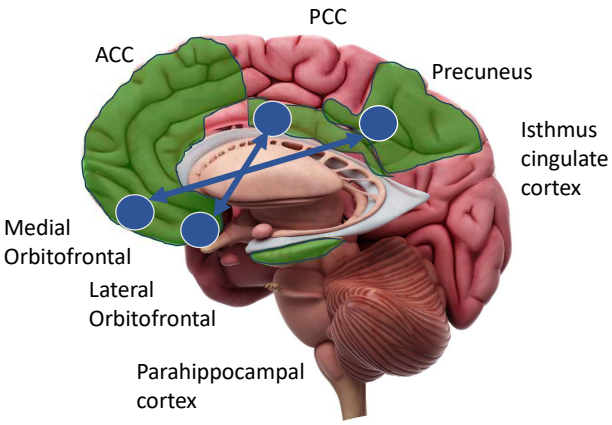
Increased functional connectivity of the posterior cingulate cortex with the lateral orbitofrontal cortex in depression (Cheng, Rolls et al. 2018B)

"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."

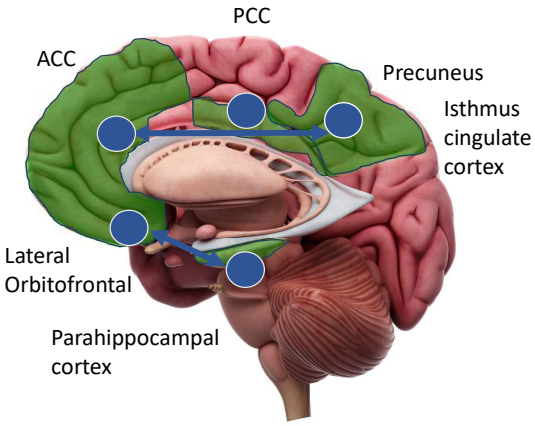
(Cheng, et al 2018A; Cheng, Rolls et al. 2018B*)*

34

Pre and Post Chiro



Pre and Post 4 weeks Chiro



DMN changes after Chiro Care

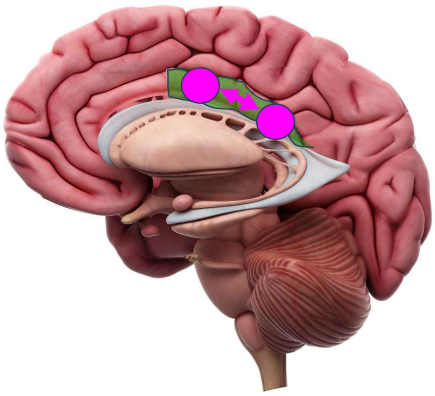
(Haavik et al 2024, Brain Sciences)

35

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

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

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

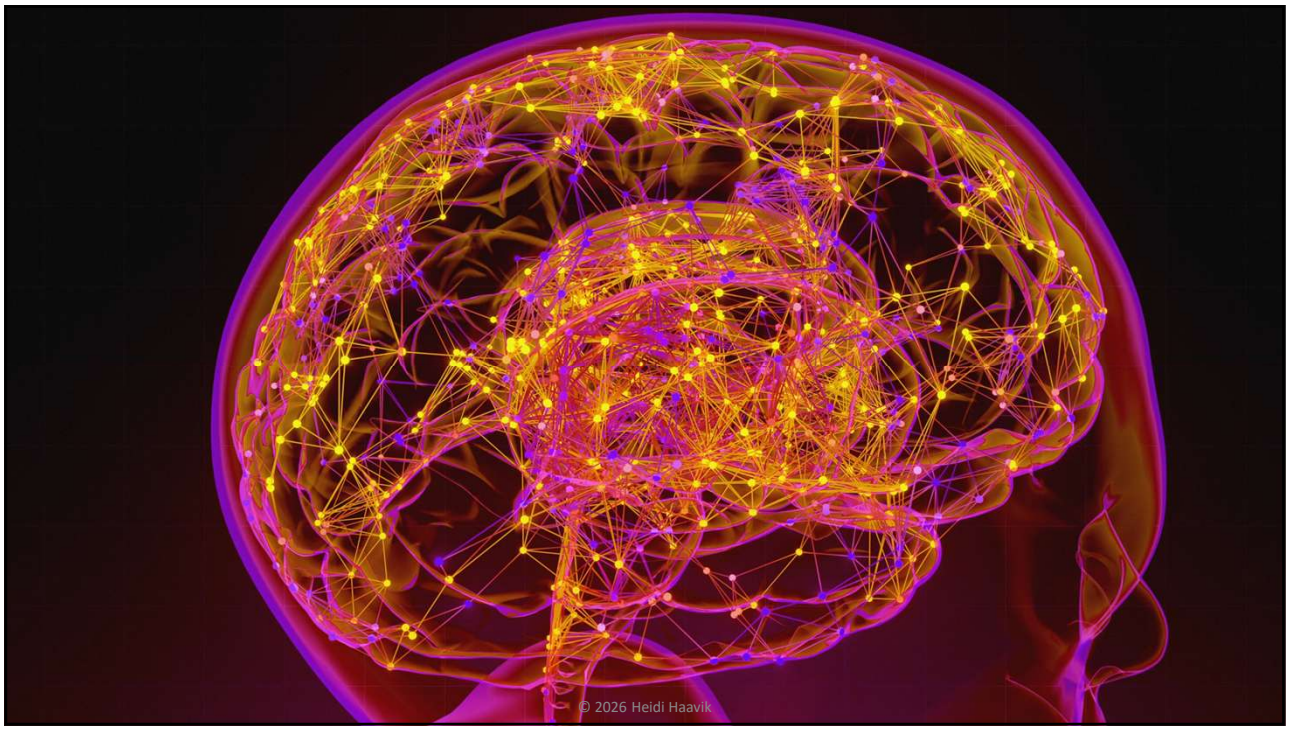


SEPs Alpha ↑ L isthmus-cingulate- R PCC

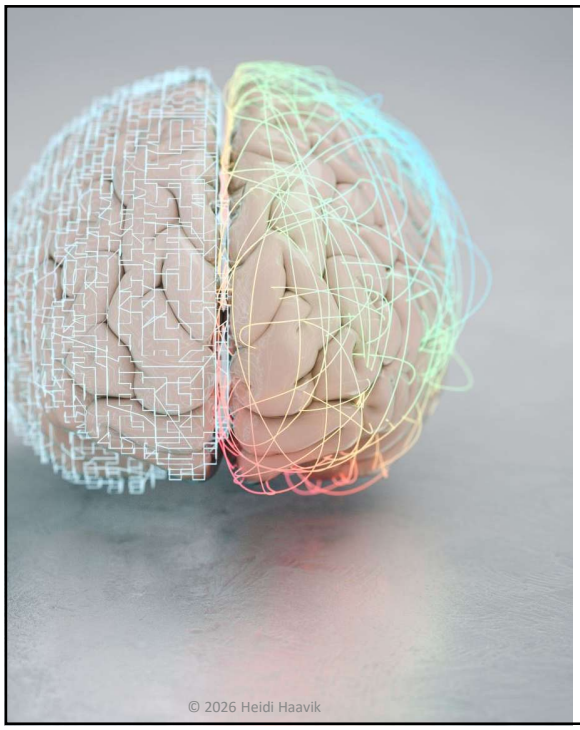
"Thus, this change may reflect altered narrative sense of self in a manner that is reducing symptoms of depression and improvements in fatigue"

(Haavik et al 2024, Brain Sciences)

36



37



Chiropractic Care

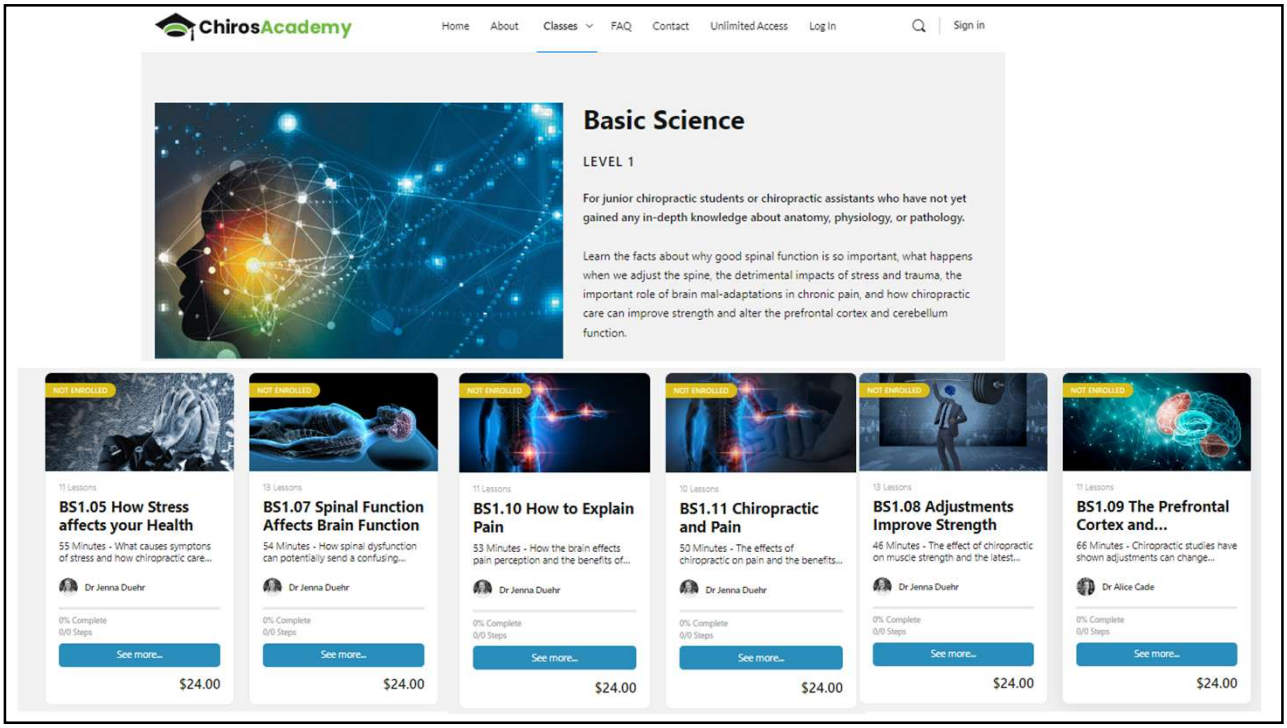
"Research indicates that chiropractic care, that includes the adjustment of vertebral subluxations, enhances brain-body communication, allowing your brain to more accurately interpret internal and external signals. This improved perception of what is happening inside you and around you enables your brain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

Heidi Haavik

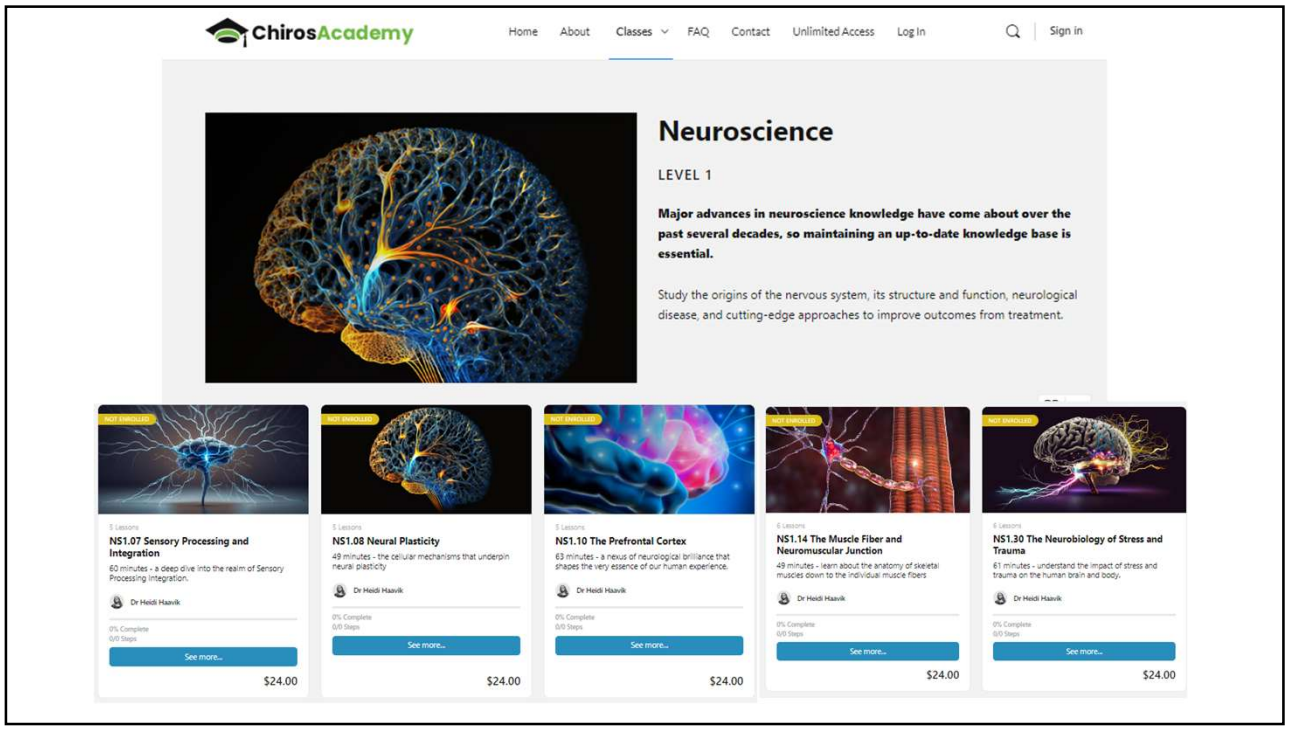
38

Do you now think it would be a good idea to get yourself a brain model for your practice?

39



40



41

Student Access to ChirosAcademy.com

$50 per year

https://chirosacademy.com/downloads/student-yearly-all-access-pass/

42

ChirosHub

Built to help you implement the brain model of chiropractic in practice

- 50+ videos to use on website / social channels
- Chiropractic research articles fully referenced
- Posters, screensavers and digital resources

And much more for Gold & Platinum Members

43

ChirosHub

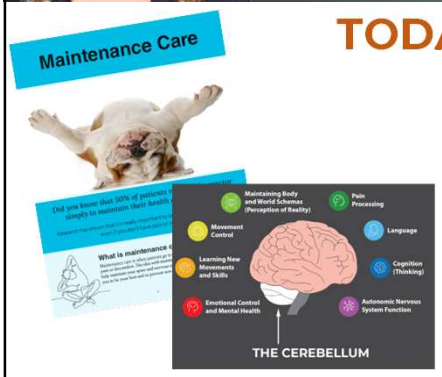
Code heiditalk
Gives you 15% off

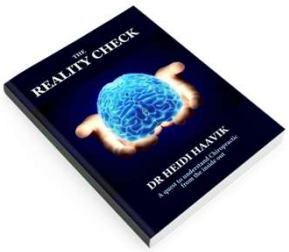
44

Dr Heidi Haavik

HeidiHaavik.com

TODAY'S HANDOUT & GIFTS





Enlightening the world about the Science of the Spine & Brain

45

References

- Haavik H, Niazi IK, Amjad I, Kumari N, Ghani U, Ashfaque M, Rashid U, Navid MS, Kamavuako EN, Pujari AN, Holt K. Neuroplastic Responses to Chiropractic Care: Broad Impacts on Pain, Mood, Sleep, and Quality of Life. Brain Sciences. 2024 Nov 7;14(11):1124. https://www.mdpi.com/2076-3425/14/11/1124
- Heidi Haavik, Nitika Kumari, Kelly Holt, Imran Khan Niazi, Imran Amjad, Amit N. Pujari, Kemal Sitki Türker, Bernadette Murphy. (2021a) The contemporary model of vertebral column joint dysfunction and impact of high-velocity, low-amplitude controlled vertebral thrusts on neuromuscular function. Invited Review. European Journal of Applied Physiology. https://doi.org/10.1007/s00421-021-04727-z
- Heidi Haavik, Imran Khan Niazi, Nitika Kumari, Imran Amjad, Jenna Duehr, Kelly Holt. (2021b) The potential mechanisms of High-Velocity, Low-Amplitude, Controlled Vertebral Thrusts on Neuroimmune Function: A narrative review. Medicina 2021, 57, 536. https://doi.org10.3390/medicina57060536
- Imran Khan Niazi, Muhammad Samran Navid, Christopher Merkle, Imran Amjad, Nitika Kumari, Robert J. Trager, Kelly Holt, Heidi Haavik. 2024 A randomized controlled trial comparing different sites of high-velocity low amplitude thrust on sensorimotor integration parameters. Scientific Report. 14(1), p.1159. https://www.nature.com/articles/s41598-024-51201-9
- Imran Amjad, Imran Khan Niazi, Nitika Kumari, Usman Ghani, Usman Rashid, Felipe Duarte, Federico For-tuna, Diego Gonzalez, Alex Sumich, Bibiana Fabre, Kelly Holt, Heidi Haavik. The effects of 12 weeks of chiropractic spinal adjustments on Physiological biomarkers in adults: A pragmatic randomized controlled trial. PLoS One, 2025, 20(12), p.e0338730. https://doi.org/10.1371/journal.pone.0338730
- 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
- Faur, C., Patrascu, J.M., Haragus, H. and Anglitoiu, B., 2019. Correlation between multifidus fatty atrophy and lumbar disc degeneration in low back pain. BMC musculoskeletal disorders, 20(1), pp.1-6
- Lelic, D., Niazi, I.K., Holt, K., Jochumsen, M., Dremstrup, K., Yielder, P., Murphy, B., Drewe,s A. M., & Haavik, H. (2016). Manipulation of dysfunctional spinal joints affects sensorimotor integration in the prefrontal cortex: A brain source localization study. Neural Plasticity, 1.doi:10.1155/2016/3704964.
- Dohmatob, E., G. Dumas and D. Bzdok (2014). "Dark Control: A Unified Account of Default Mode Function by Control Theory and Reinforcement Learning." BioRxiv: 1-28.
- FristonK. (2010). The free-energy principle: a unified brain theory. Nat. Rev. Neurosci. 11, 127–138. 10.1038/nrn2787
- Alexander, W. H. and J. W. Brown (2018). "Frontal cortex function as derived from hierarchical predictive coding." Scientific Reports 8(1): 3843.
- Cheng, W., Rolls, E.T., Qiu, J., Yang, D., Ruan, H., Wei, D., Zhao, L., Meng, J., Xie, P. and Feng, J., 2018. Functional connectivity of the precuneus in unmedicated patients with depression. Biological Psychiatry: Cognitive Neuroscience and Neuroimaging, 3(12), pp.1040-1049.
- Cheng, W., et al. (2018). "Increased functional connectivity of the posterior cingulate cortex with the lateral orbitofrontal cortex in depression." Translational Psychiatry 8(1): 90.
- Dotson, V.M., et al., Orbitofrontal and Cingulate Thickness Asymmetry Associated with Depressive Symptom Dimensions. Cognitive, Affective, & Behavioral Neuroscience, 2021. 21(6): p. 1297-1305.
- Philip van Eijndhoven, M.D., Ph.D. ,, et al., Paralimbic Cortical Thickness in First-Episode Depression: Evidence for Trait-Related Differences in Mood Regulation. American Journal of Psychiatry, 2013. 170(12): p. 1477-1486.

46