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**HAAVIK RESEARCH** **NEW ZEALAND COLLEGE OF CHIROPRACTIC**

**Pain and the Triple Network Model**

De Ridder, D., et al. (2022). "Pain and the triple network model." *Frontiers in neurology* 13: 757241.

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**Major Progress in Neuroscience**

- Understanding of Chronic Pain
- Tripple Brain Network & Consciousness
- Mechanisms of Chiropractic Care

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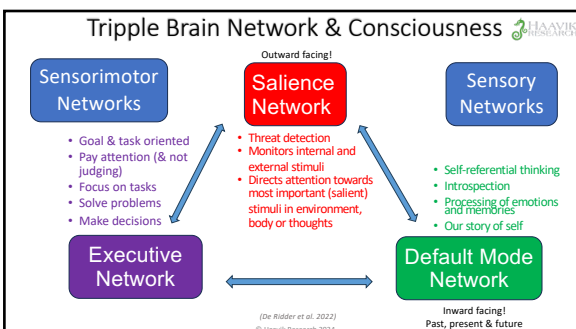
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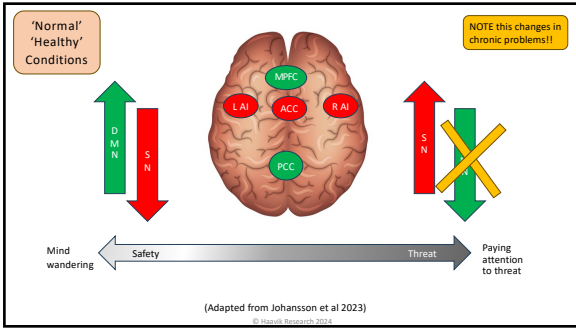
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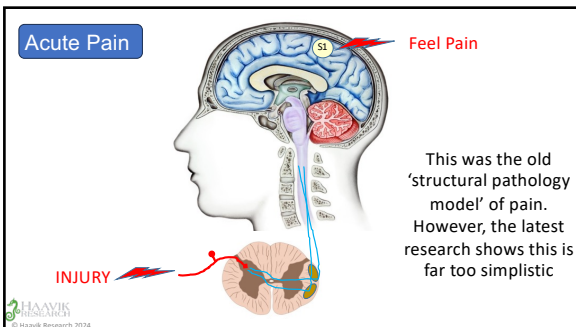
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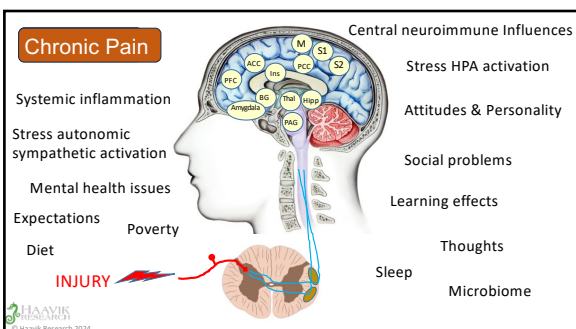
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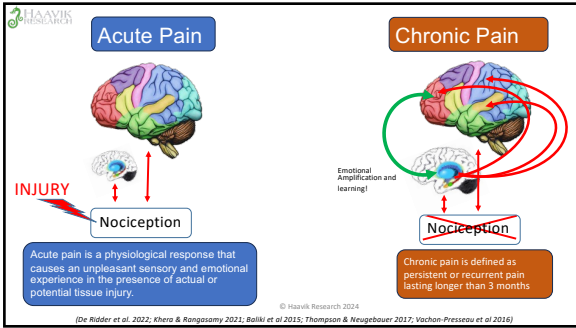
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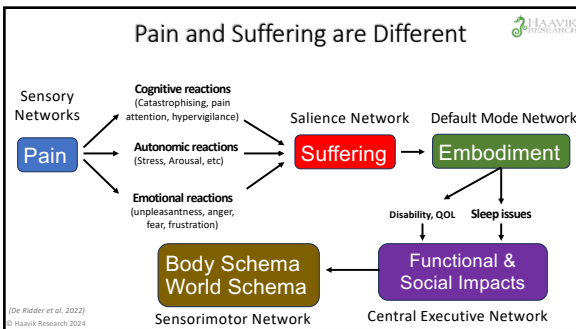
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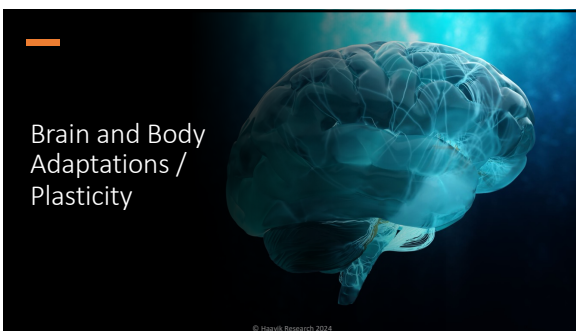
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**Neuroplasticity**


**Cellular Level**

**Structural Plasticity**



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


**Functional (Synaptic) Plasticity**



- Long term potentiation
- Long term depression
- Homeostatic plasticity


**Network Level**

**Structural network Plasticity**



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

**Functional Network Plasticity**



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

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DO YOU OWN YOUR SCIENCE?



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**Basic Science**

LEVEL 1


For those chiropractic students or chiropractic assistants who have not yet gained any in-depth knowledge about anatomy, physiology, or pathophysiology.

Learn the facts about why good spinal function is so important, what happens when we adjust the spine, the detrimental impacts of stress and trauma, the important role of vision and adaptations in chronic pain, and how chiropractic care can improve strength and alter the prefrontal cortex and cerebellum function.




**B51.05 How Stress affects your Health**  
To change, either make adjustments or understand how chiropractic care can improve strength and alter the prefrontal cortex and cerebellum function.

Dr. James Dwyer  
100 minutes  
\$24.00




**B51.07 Spinal Function Affects Brain Function**  
Spinal cord, neuronal adaptation or sensory level and its function.

Dr. James Dwyer  
100 minutes  
\$24.00




**B51.10 How to Explain Pain**  
To explain - how the brain interprets pain sensation and the benefits of.

Dr. James Dwyer  
100 minutes  
\$24.00




**B51.11 Chiropractic and Pain**  
To explain - the effects of chiropractic on the perception of pain and the benefits.

Dr. James Dwyer  
100 minutes  
\$24.00



**B51.08 Adjustments Improve Strength**  
To explain - the effects of chiropractic on muscle strength and the what.

Dr. James Dwyer  
100 minutes  
\$24.00



**B51.09 The Prefrontal Cortex and...**  
To explain - the effects of chiropractic on the prefrontal cortex and the what.

Dr. James Dwyer  
100 minutes  
\$24.00

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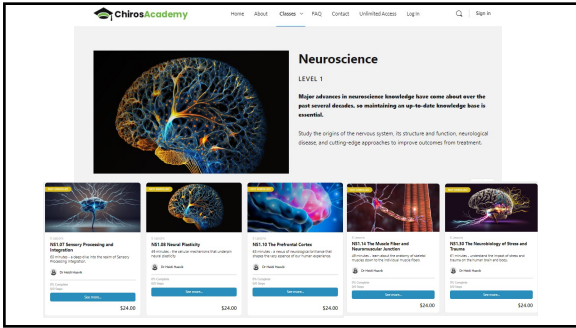
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### Chronic Pain - widespread structural and functional synaptic and cellular changes and spinal cord changes

- Synaptic plasticity**
  - Spinal presynaptic and postsynaptic changes
  - LTP and LTP (fire together, wire together)
- Spinal cord changes**
  - Reduced descending inhibition
  - Remodelling of spinal circuits
- Structural & function changes in glial cells**
  - Noiceptive hypersensitivity
  - Microglia, astrocytes, satellite glial cells, & oligodendrocytes,

(Kuner & Flor 2017) © Haavik Research 2024

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### Structural and Functional changes in chronic pain

- Expansion and shift of cortical representation**  
ACC, insular, M1, S1 & S2
- Altered structural integrity and connectivity**  
PFC and BG
- Impaired descending inhibitory control**  
ACC and PAG
- Alterations in grey matter volume**  
ACC, M1, S1, PFC, BG, Thalamus, insular, Hippocampus
- Altered resting-state and pain-evoked functional connectivity**  
ACC, S1, S2, PFC, BG, Amygdala, Thalamus, Insular, Hippocampus
- Altered glial activity**  
S1 and Thalamus

(Kuner & Flor 2017) © Haavik Research 2024

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HAAVIK RESEARCH

### Widespread CNS network changes occur with chronic pain

- Resting-state networks changes within and between
  - Default Network changes
  - Salience Network changes
  - Central Executive Network changes
  - Sensory Networks
  - Sensorimotor Networks



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(Kunzer & Flor 2017; Baliki et al 2015; Weiss 2016; De Ridder et al 2022; Hong, Y, et al. 2016; Johansson et al. 2020; Brandt et al 2022; Kim et al. 2019)

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HAAVIK RESEARCH

### Why is all this important to understand?

Review

**Abstract**  
 Motor control, which relies on constant communication between motor and sensory systems, is crucial for spine posture, stability and movement. Adaptions of motor control occur in low back pain (LBP) while different motor adaption strategies exist across individuals, probably to reduce LBP and risk of injury. However, in some individuals with LBP, adapted motor control strategies might have long-term consequences, such as increased spinal loading that has been linked with degeneration of intervertebral discs and other tissues, potentially maintaining recurrent or chronic LBP. Factors contributing to motor control adaptations in LBP have been extensively studied on the motor output side, but less attention has been paid to changes in sensory input, specifically proprioception. Furthermore, motor cortex reorganization has been linked with chronic and recurrent LBP, but underlying factors are poorly understood. Here, we review current research on behavioral and neural effects of motor control adaption in LBP. We conclude that back pain-induced disrupted or reduced proprioceptive signaling likely plays a pivotal role in driving long-term changes in the top-down control of the motor system via motor and sensory cortical reorganization. In the outlook of this review, we explore whether motor control adaptations are also important for other (musculoskeletal) pain conditions.

Meier, M. L., Vrana, A., & Schweinhardt, P. (2018). Low Back Pain: The Potential Contribution of Supraspinal Motor Control and Proprioception. *The Neuroscientist*, 17(2), 85-94. doi:10.1177/1073858418000074. © Haavik Research 2024

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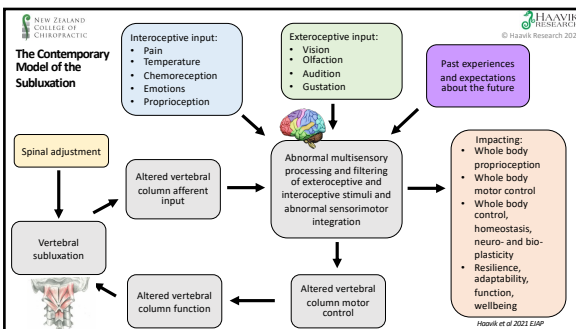
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### Changes in Default Mode Network with Chronic Pain

- Not deactivating under threat or during pain stimuli
- Decreased anterior – posterior DMN connectivity
- Hyper connectivity Salience Network - *DMN*
  - This hyperconnectivity also occurs in Depression and Anxiety - common mechanisms!
- Chronic LBP patients have hyperconnectivity between
  - S1 – DMN (longer pain = stronger connection)
  - S1 – SN
  - S1 - ECN

*DMN changes explain why pain becomes embodied (part of self) and maintained after injury heals!!!*

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 (Kuner & Flor 2017; Baliki et al 2013; Weiss 2016; De Ridder et al 2012; Jiang, Li et al 2016; Johansson et al 2013; Brandt et al 2012; Kim et al 2015)

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### Changes in Salience Network in Chronic Pain

- Hyperconnectivity within SN in chronic widespread pain patients
- Increased SN - DMN connectivity - strongly correlated to pain catastrophizing
- Increased cortisol increases unpleasantness by modulation of ACC
- Perceived unpleasantness and catastrophizing leads to suffering
- When suffering becomes chronic this also leads to
  - Fear and Anxiety (↑ SN & ↑ SN – DMN, ↑ DMN)
  - Depression (↑ DMN & Abnormal SN – DMN – CEN)
  - Frustration and Anger (↑ CEN, ↑ SN, ↓ DMN, & Abnormal SN – DMN – CEN)
  - Functional Disability

**Pain catastrophising**

- Magnification of threat value of pain stimulus
- Sense of helplessness
- Rumination on pain thoughts
- Embodiment of pain

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 (van Ettinger-Veenstra, Lundberg et al 2019; Kim, Morley et al 2019; De Ridder et al 2012)

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### Possibly to conserve energy?

- The sympathetic system increases energy consumption by 15–35%
- In acute pain, daily energy expenditure is increased by 60%
- Fear increases the daily energy expenditure by 22%
- Chronic anxiety only increases energy expenditure by 6%

*"Energy expenditure could be reduced by rewiring the pain pathways to connect to the default mode network, which overlaps with the parasympathetic central network and disconnect from the energy consuming sympathetic nervous system."* (De Ridder et al 2022)



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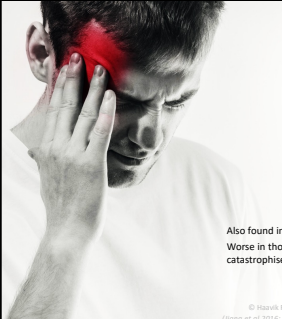
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### Changes in FPN / ECN in Chronic Pain

- Your thoughts, beliefs and expectations can influence your experience of pain
- The FPN / ECN is involved in guiding decisions and performance adjustment
- Chronic pain LBP
  - Hyperconnectivity SN – CEN/FPN
  - Hyperconnectivity S1 – ECN/FPN (and S1 – DMN)

Also found in anxiety  
Worse in those who catastrophise

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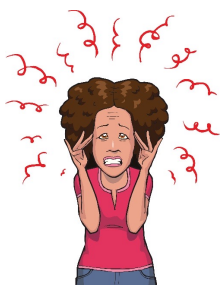
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### Physiological Stress

- Physiological stress is defined as an unpleasant sensory, emotional and subjective experience that is associated with potential damage of body tissue and bodily threat, especially when an environmental demand exceeds the natural regulatory capacity of an organism
- Too much emotional, physical or chemical input
- Pain is considered prototypical stressor!



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### Stress and symptoms build up over time!



INFLAMMATION

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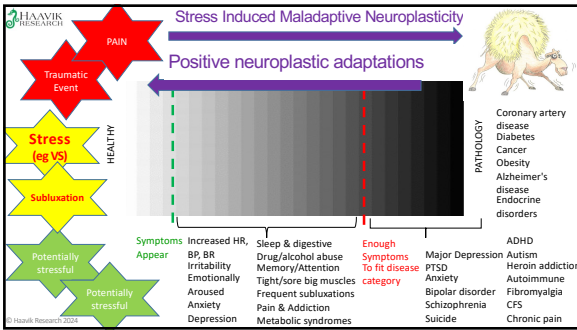
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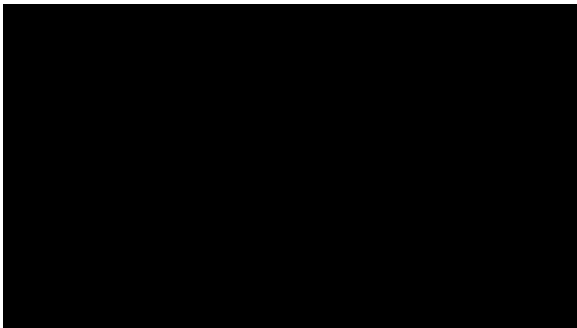
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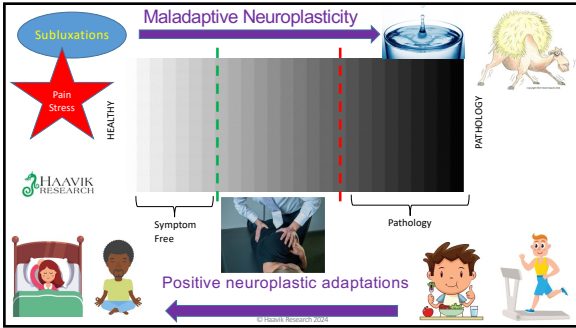
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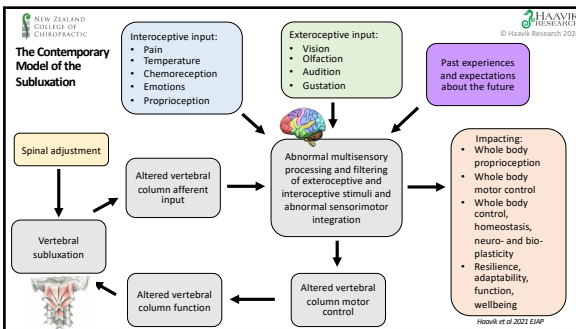
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**ChirosHub**

All the resources for your patients and the public!

Over 70 online classes about the science of chiropractic for you!

Online classes for your chiropractic assistants!

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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 Members**

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PA 33: Maintenance Care

**ARE YOU A CONFIDANT COMMUNICATOR?**




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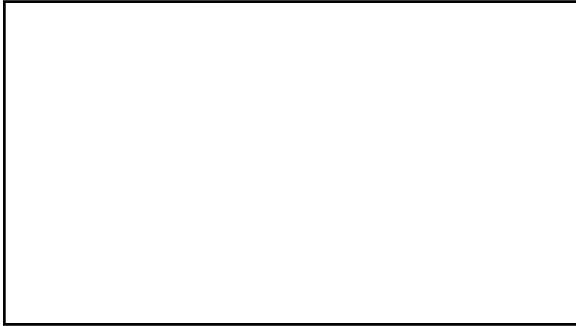
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NEW ZEALAND COLLEGE OF CHIROPRACTIC

HAAVIK RESEARCH

Did you know.....

The latest science is showing us that more frequent adjustments early on when you start care leads to better outcomes up to a year later for people like you with these kinds of headaches that come from your neck

Science is showing us that regular adjustments means less days in pain for you, as opposed to letting it build back up and you only come back in when it hurts

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**References**

- Baliki, M. N. and A. V. Apkarian (2015). "Nociception, pain, negative moods, and behavior selection." *Neuron* **87**(3): 474-481.
- De Ridder, D., D. Adria and S. Vanneste (2021). "The anatomy of pain and suffering in the brain and its clinical implications." *Neuroscience & Biobehavioral Reviews* **139**: 125-146.
- De Ridder, D., S. Vanneste, M. Smith and D. Adria (2022). "Pain and the triple network model." *Frontiers in Neurology* **13**: 757241.
- Dumas, G., D. Batak and E. Dohmatob (2014). "Dark Cognition: A Unified Account of Default Mode Function by Control Theory and Reinforcement Learning."
- Khera, T. and V. Rangasamy (2021). "Cognition and pain: a review." *Frontiers in psychology* **12**: 673962.
- Kim, J., I. Hwang, J. Kong, J. Lee, J. Gerber, A. Ortiz, H. Kim, S.-T. Chan, H. L. Loggia and A. D. Woo (2019). "Somatotopically specific primary somatosensory connectivity to salience and default mode networks encodes clinical pain." *Brain* **142**(16): 1607-1609.
- Kitzbichler, M. G., et al. (2011). "Peripherally inflammation is associated with micro-structural and functional connectivity changes in depression-related brain networks." *Molecular Psychiatry* **16**(12): 7345-7354.
- Kunze, R. and H. Flor (2017). "Structural plasticity and reorganisation in chronic pain." *Nature Reviews Neuroscience* **18**(1): 20-30.
- Mason, V. (2011). "Large-scale brain networks and psychopathology: a unifying triple network model." *Trends in Cognitive Sciences* **15**(10): 483-504.
- Mennes, V. and M. D'Esposito (2022). "The role of PFC networks in cognitive control and executive function." *Neuroscientist* **28**(1): 90-103.
- Seely, W. W. (2019). "The salience network: a neural system for perceiving and responding to homeostatic demands." *Journal of Neuroscience* **39**(5): 9879-9882.
- Thompson, J. M. and V. Neugebauer (2017). "Amygdala plasticity and pain." *Pain Research and Management* **20**(1): 8296501.
- Vachon-Presseau, E. (2018). "Effects of stress on the corticolimbic system: implications for chronic pain." *Progress in Neuro-Psychopharmacology and Biological Psychiatry* **87**: 216-223.
- Witt, S. T., H. van Ettenge-Veenstra, T. Salo, M. C. Riedel and A. R. Laird (2021). "What executive function network is that? An image-based meta-analysis of network labels." *Pain Topography* **34**(5): 598-607.

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TODAY'S HANDOUT  
[www.heidihaavik.com](http://www.heidihaavik.com)

*Thank you!*



Enlightening the world about the science of chiropractic

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