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# Rethink Chronic Pain


## Steven Stanos, DO

Executive Medical Director, Rehabilitation & Performance Medicine
Medical Director, Swedish Health System, Pain Medicine & Services
Seattle, WA
Past President,  American Academy of Pain Medicine
Steven.Stanos@Swedish.org

# Disclosures

- Applied VR: consultant
- Averitas: consulting, speaker board
- Emergent Biosolutions: consultant

# Objectives: RETHINK CHRONIC PAIN

- Historical Perspective
- Challenges and opportunities of current environment
- Brain imaging and complexities of pain modulation
- Treatment approaches focusing on brain retraining
  - Pain Neuroscience Education as a tool to retrain the brain
  - Graded Motor Imagery (GMI)
- Biomarkers and pain
- New pain taxonomy & classification

# Can we:

"Rethink" chronic pain ?

View chronic pain as an extension of acute pain?

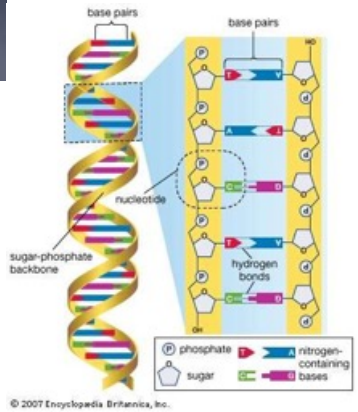
Understand why we hurt ?

Retrain the brain ?

Predict and design care based on individual patient characteristics?

hadoop

twitter




2007

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facebook


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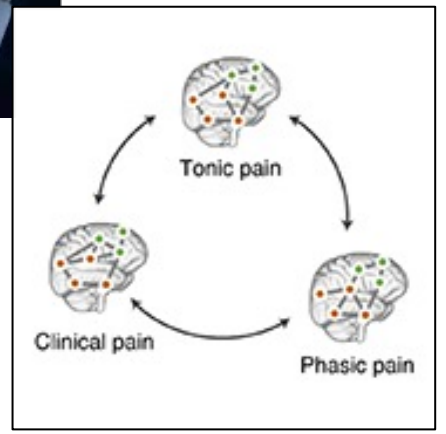
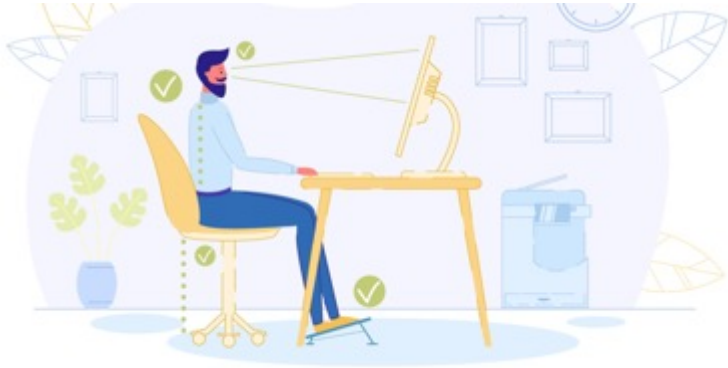
2022



# COVID-19: OPPORTUNITY TO RETHINK CHRONIC PAIN

**People**
(MD/DO, APC, RN, Caregiver surge staffing)



**Places**
(Hospitals, Beds, OR. Med/Surg, ASCs, etc.)

**Products**
(PPE, Ventilators, etc.)



# Patient-Centered Considerations

## Pain

Threat to the biological integrity of an individual

## Suffering

A threat to that person that is affecting who they are

**Anxiety, depression**

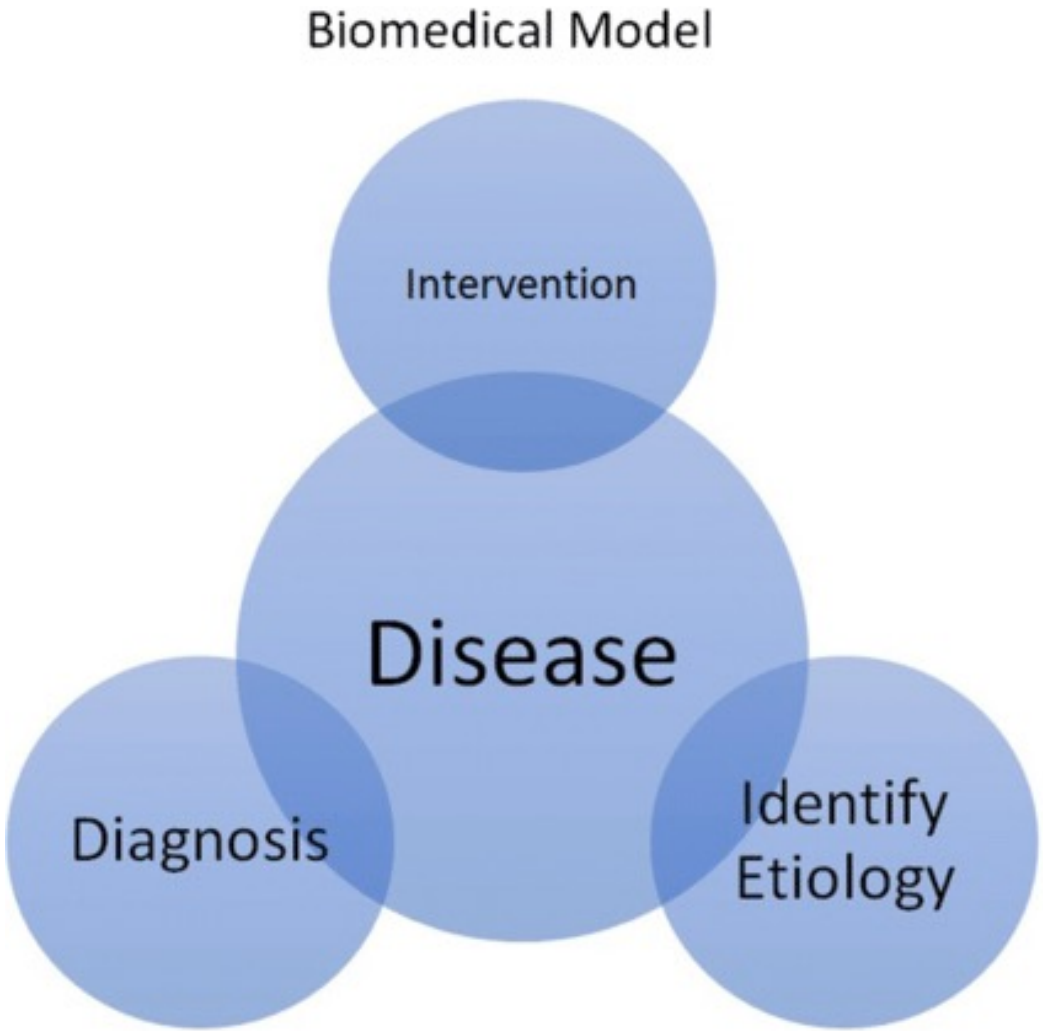
**Distress, hopelessness**

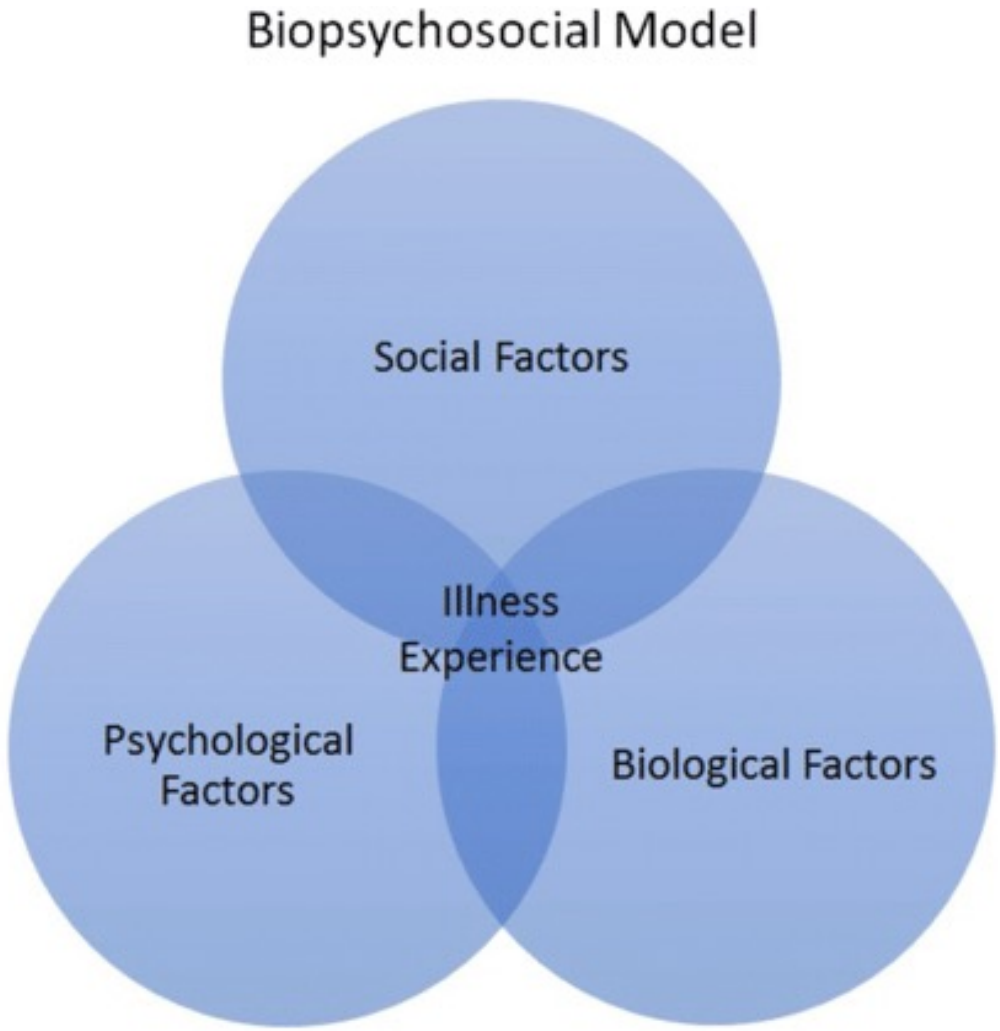
**Change in function**



Fishbain D. et al. *Pain Medicine* 2015:6:1057-72.

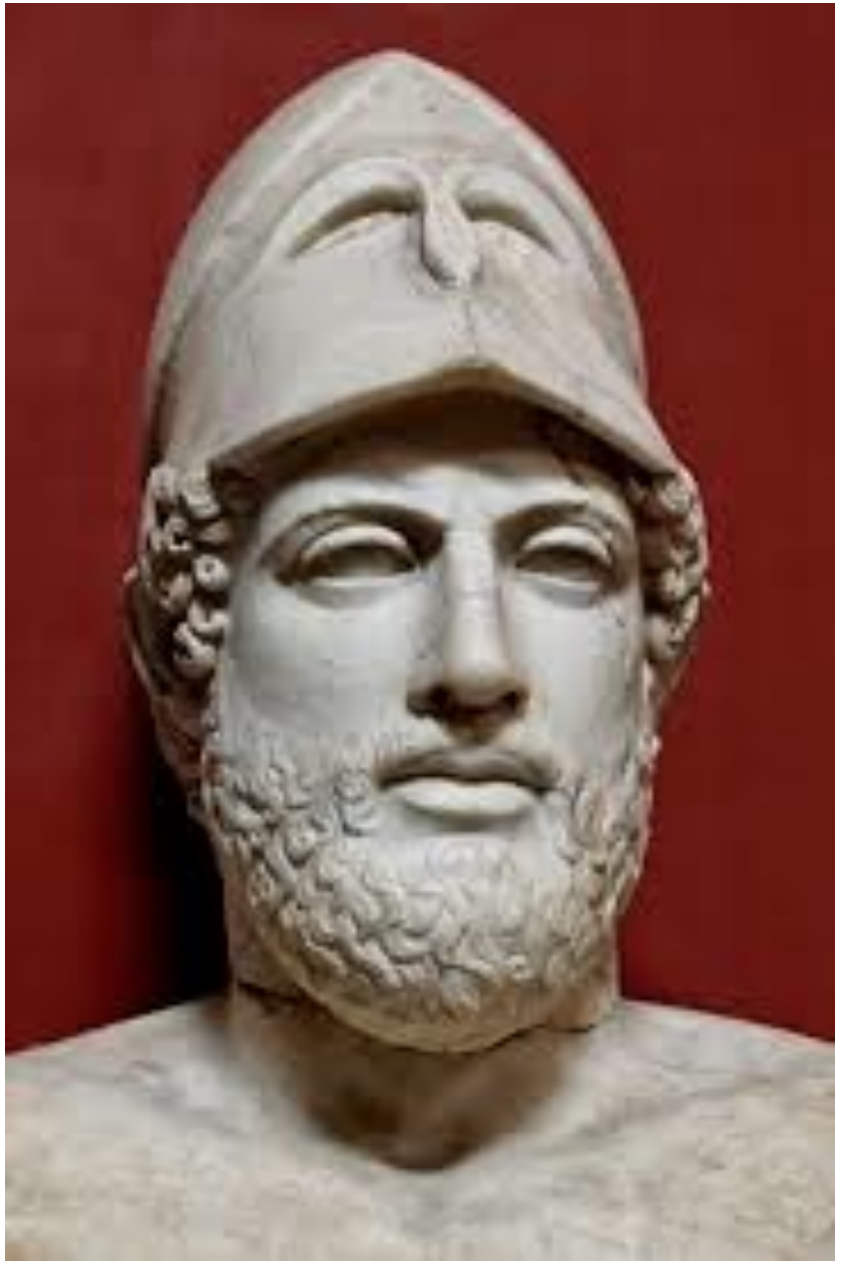
# Biomedical & BioPsychoSocial Models



Time is the best adviser.

*Pericles*
(5th century BC)



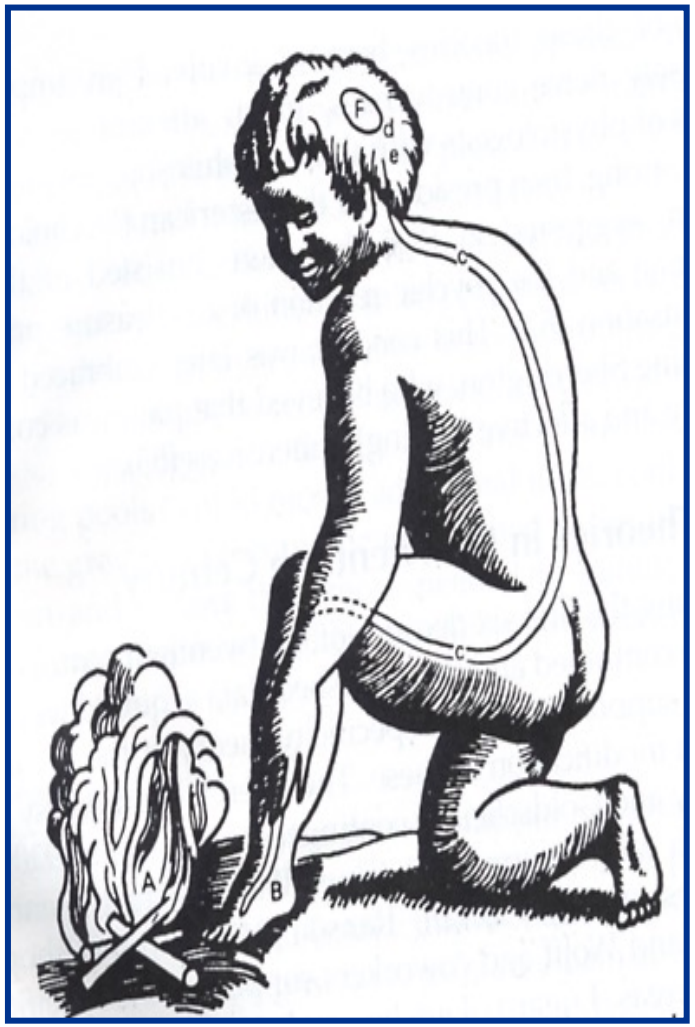
# A Quick Review: Where We Started



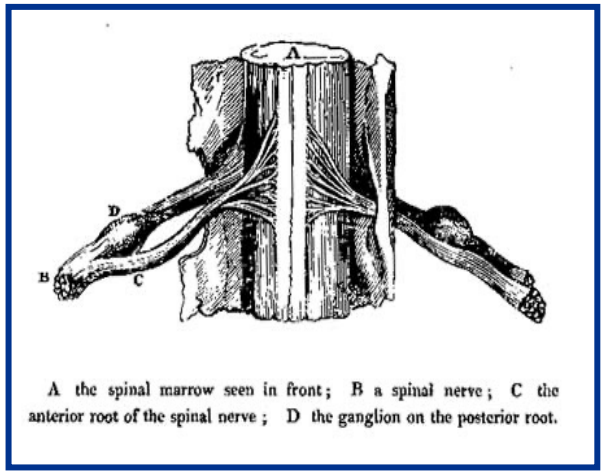
# Rethink Chronic Pain: Is There a  Specific Pathway ?

Decarte

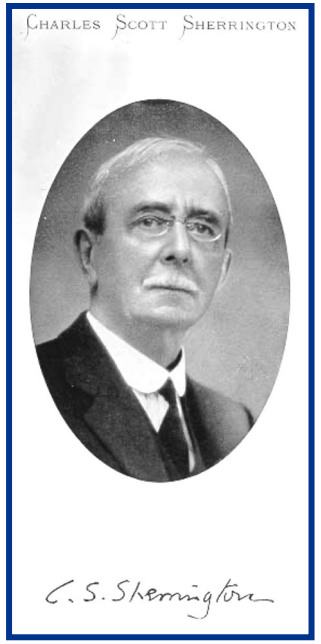
1596-1650




Charles Bell




A the spinal marrow seen in front; B a spinal nerve; C the anterior root of the spinal nerve; D the ganglion on the posterior root.



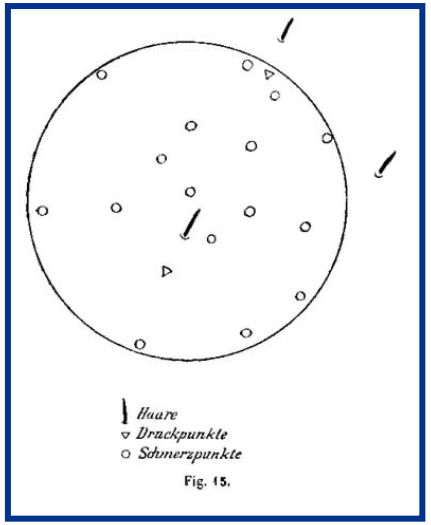




Fig. 15.

CS Sherington

# Thoughts, Beliefs, Context & Modulating Pain Experience

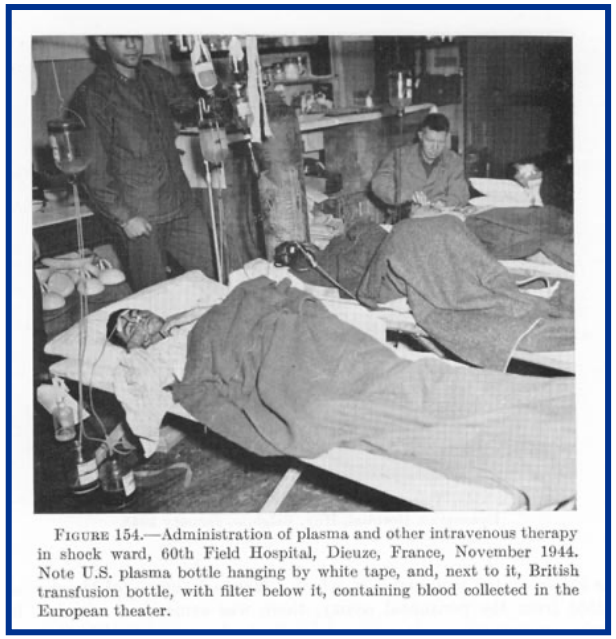


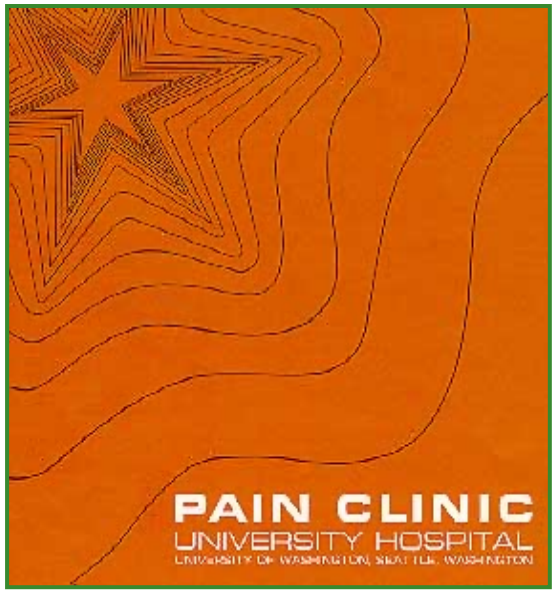
FIGURE 154.—Administration of plasma and other intravenous therapy in shock ward, 60th Field Hospital, Dieuze, France, November 1944. Note U.S. plasma bottle hanging by white tape, and, next to it, British transfusion bottle, with filter below it, containing blood collected in the European theater.

Henry Beecher, MD




**Figure 2.** The motivational component of pain—sensory, affective, and cognitive. All three components of pain interact to provide perceptual information that influences the motor mechanisms characteristic of pain.

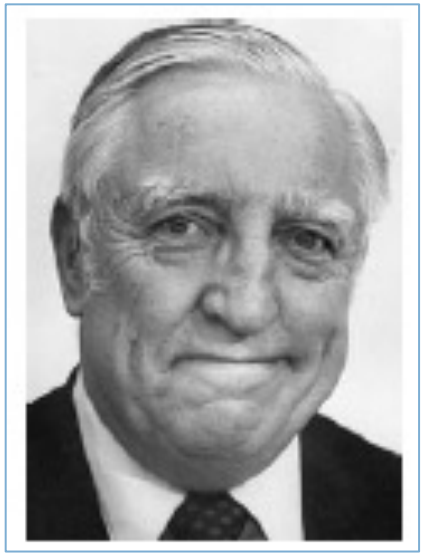
Melzack R. In: Cousins MJ, Bridenbaugh PO, eds. *Neural Blockade in Clinical Anesthesia and M*
Lippincott Williams & Wilkins; 1998.




## John J Bonica, MD

(1917-1994)

First “Multidisciplinary Clinic”
John Bonica, MD
Lowell White, MD
Dorothy Crowley

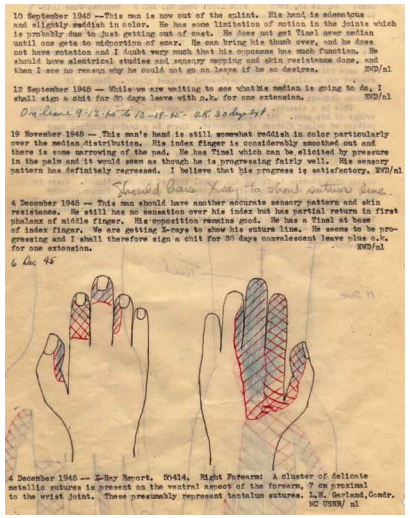


## Wilbert Fordyce, PhD

### “Pain Behavior”

- Factors that maintain pain problem can be different from those that initiated it
- Pain behaviors subject to shift from structural/ mechanical to functional/ environmental control

# Pathways & Circuits: Specificity. Realy?



10 September 1945 —This man is now out of the splint. His hand is edematous and slightly reddish in color. He has some limitation of motion in the joints which is probably due to just getting out of cast. He does not get Tinel over median until one gets to midportion of scar. He can bring his thumb over, and he does not have rotation and I doubt very much that his opponens has much function. He should have electrical studies and sensory mapping and skin resistance done, and then I see no reason why he could not go on leave if he so desires. EVD/al

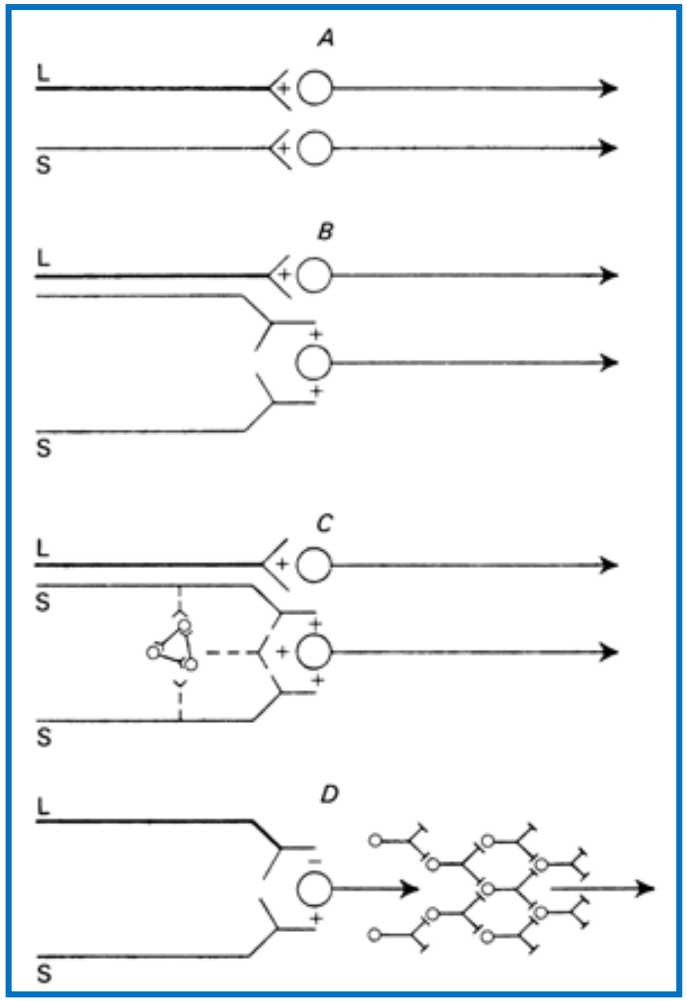
12 September 1945 — While we are waiting to see what his median is going to do, I shall sign a chit for 30 days leave with p.r. for one extension. EVD/al

19 November 1945 — This man's hand is still somewhat reddish in color particularly over the median distribution. His index finger is considerably smoothed out and there is some narrowing of the nail. He has Tinel which can be elicited by pressure in the palm and it would seem as though he is progressing fairly well. His sensory pattern has definitely regressed. I believe that his progress is satisfactory. EVD/al

4 December 1945 — This man should have another accurate sensory pattern and skin resistance. He still has no sensation over his index but has partial return in first phalanx of middle finger. His opposition remains good. He has a Tinel at base of index finger. We are getting X-rays to show his suture line. He seems to be progressing and I shall therefore sign a chit for 30 days convalescent leave plus e.r. for one extension. EVD/al

4 December 1945 — X-Ray Report. 5r414. Right Forearm: A cluster of delicate metallic sutures is present on the ventral aspect of the forearm, 7 cm proximal to the wrist joint. These presumably represent tantalum sutures. L.E. Garland, Comdr. MC USNR/ al

William Livingston, MD




Specificity (von Frey)

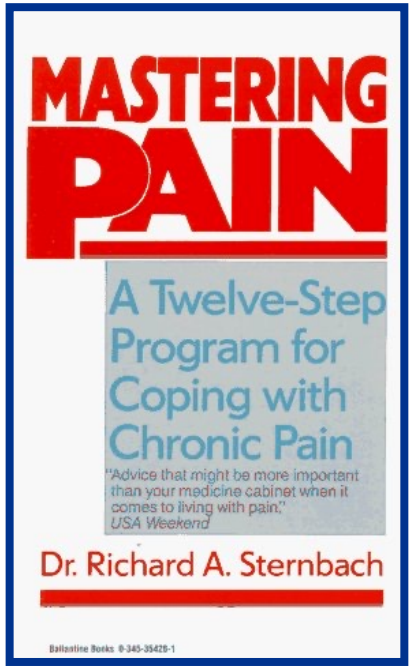
Summation (Goldscheider)

Reverberating circuits (Livingston)

Sensory interaction (Noordenbos)

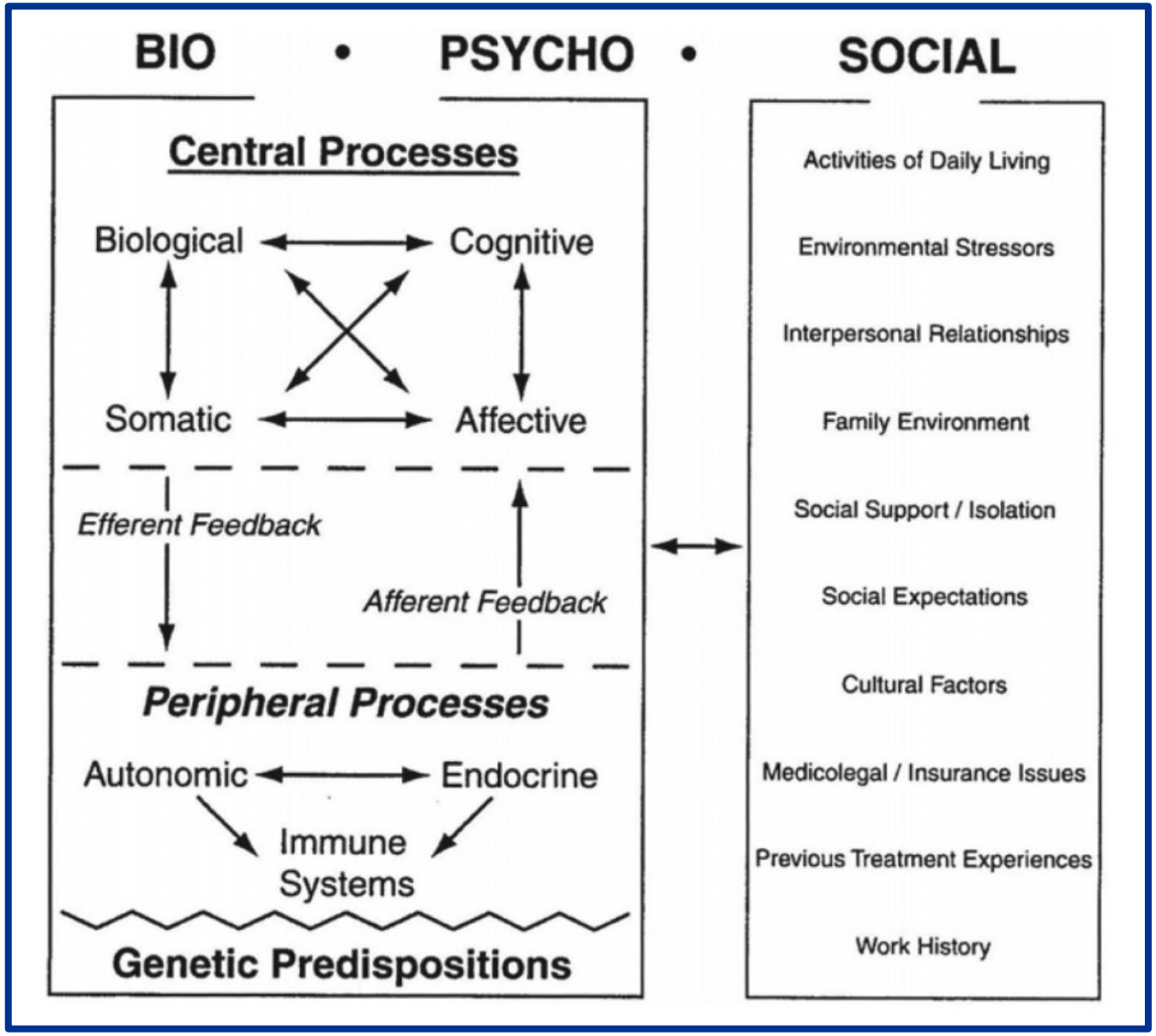
Olson K. History of Pain: A Brief Overview of the 19th and 20th Centuries. Pract Pain Manag. 2013;13(7).

# Learning Theory

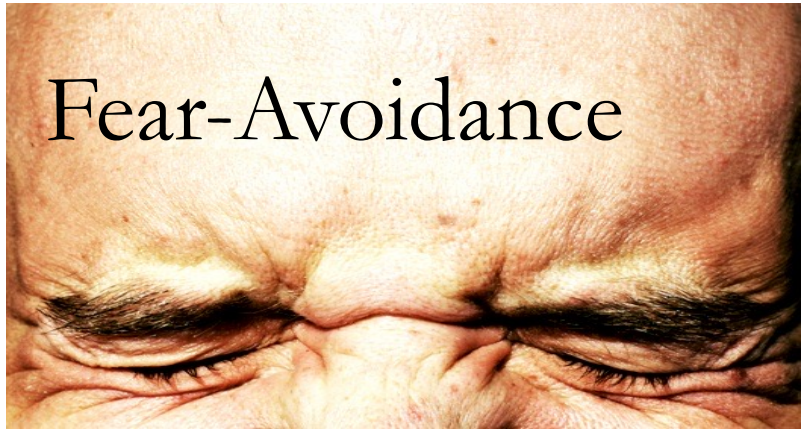



Richard Sternbach, PhD

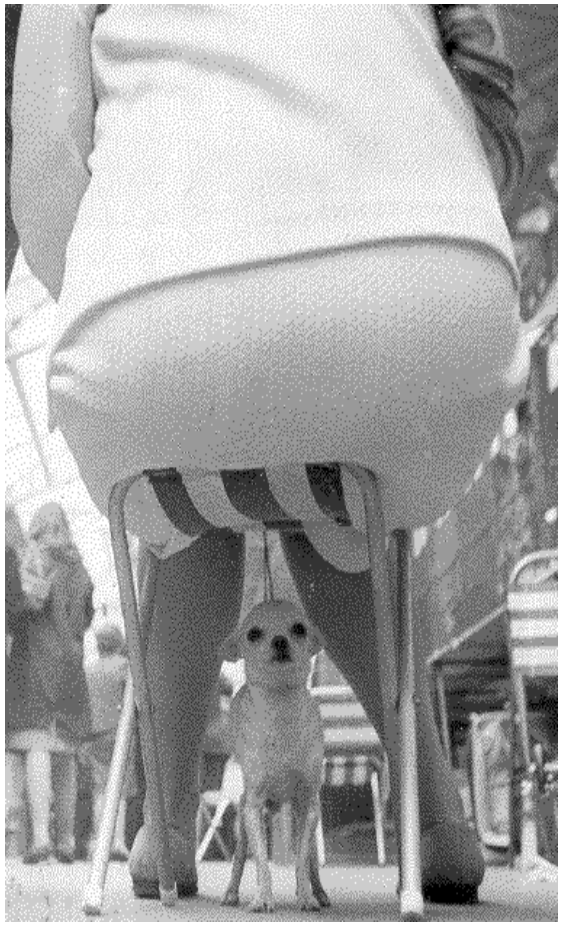
# Bio-Psycho-Social Model



# Catastrophizing




Anger



FEAR

ANXIETY

1. Okifuji Turk Curran 1998
2. Sullivan M, 2008.

# Virtual Reality Immersion &Training

Hoffman HG, *Pain* 2004;111:162-168



Garcia, et al. *J Internet Res*. 2021;23:2.

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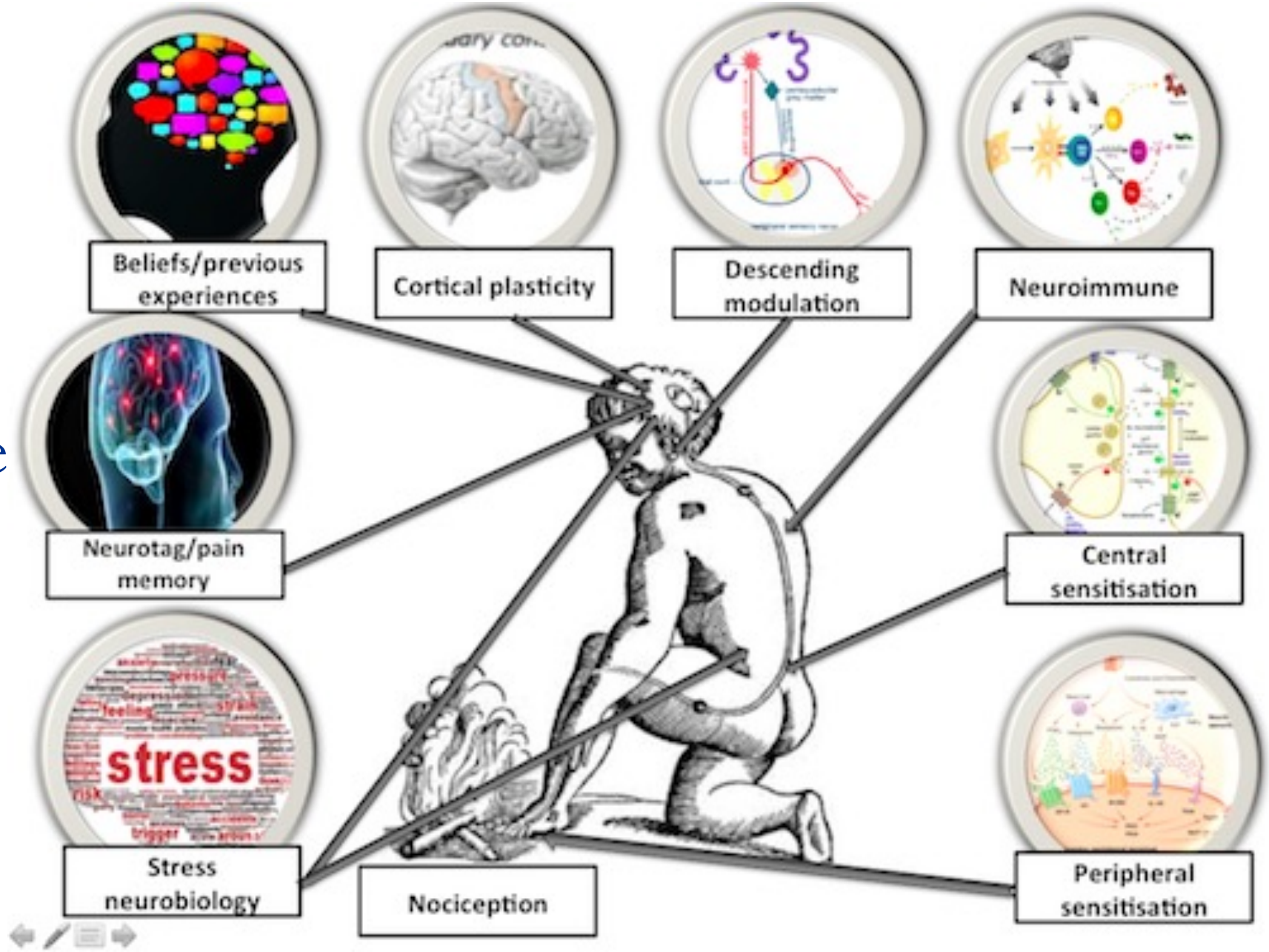
# Pain Is Complex… not just a tissue problem

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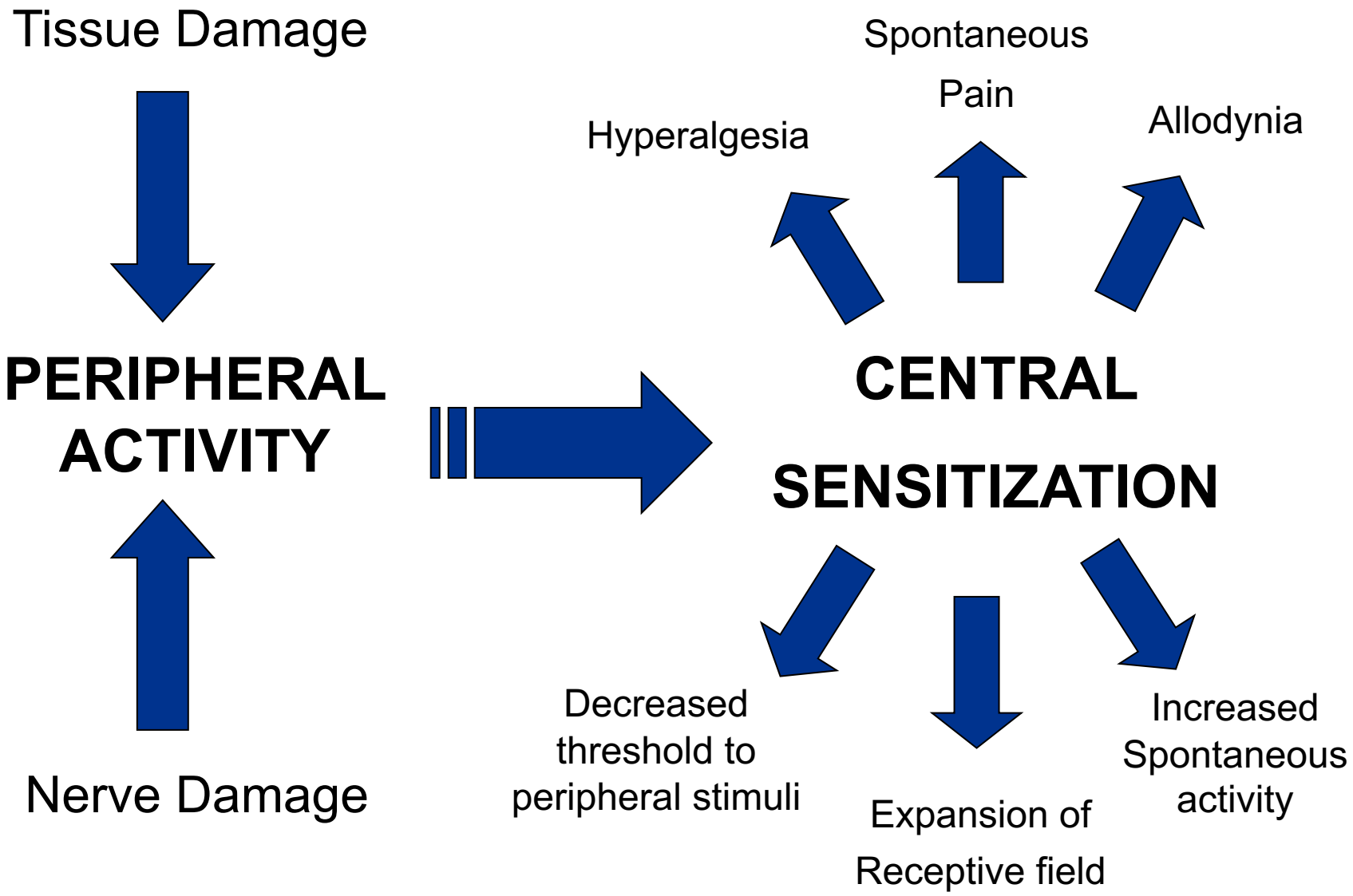
cor-kinetic.com

# Why is treating pain such a challenge?

# INJURY

# SYMPTOMS




Tracey, 2008

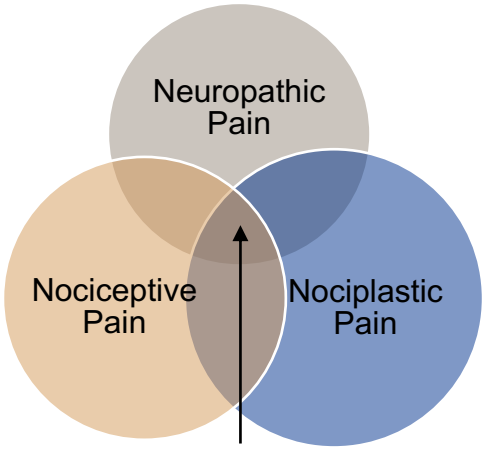
# Pain Classification

## Predominantly **Neuropathic**

- Postherpetic neuralgia
- Painful diabetic peripheral neuro
- Lumbar or cervical radiculopathy
- Stenosis
- Tumor-related neuropathy
- Chemotherapy-induced neurop
- Small fiber neuropathy
- Persistent postoperative pain
- Multiple sclerosis pain
- Post-stroke pain
- Pain associated with spinal cord injury

## Predominantly **Nociceptive**

- Osteoarthritis
- Rheumatoid arthritis
- Tendonitis, bursitis
- Ankylosing spondylitis
- Gout
- Neck and back pain with structural pathology
- Tumor-related nociceptive pain
- Sickle-cell disease
- Inflammatory bowel disease



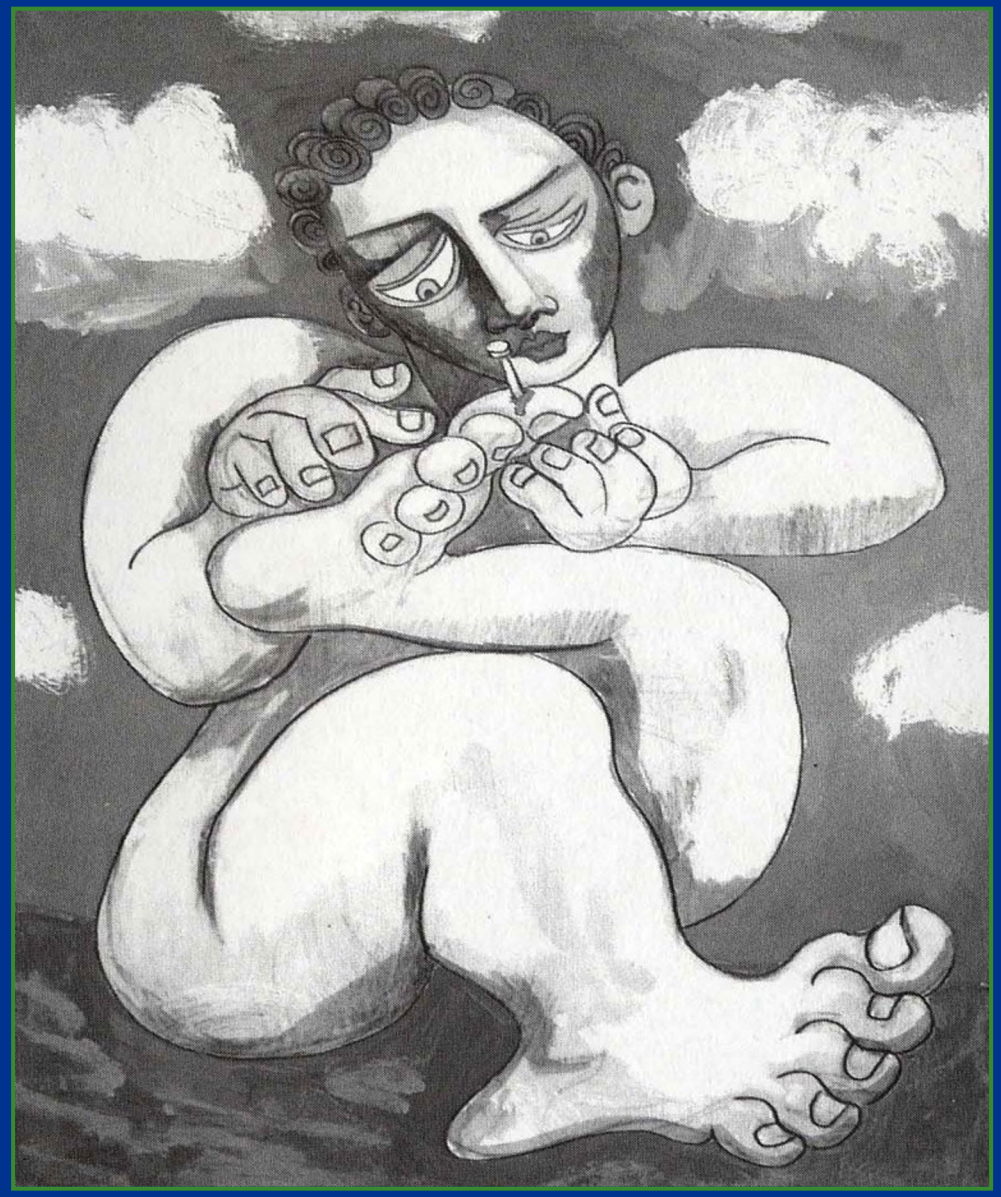

Mixed pain conditions are frequently associated with multiple pain pathophysiologies once pain becomes chronic

## Predominantly **Nociplastic**[2]

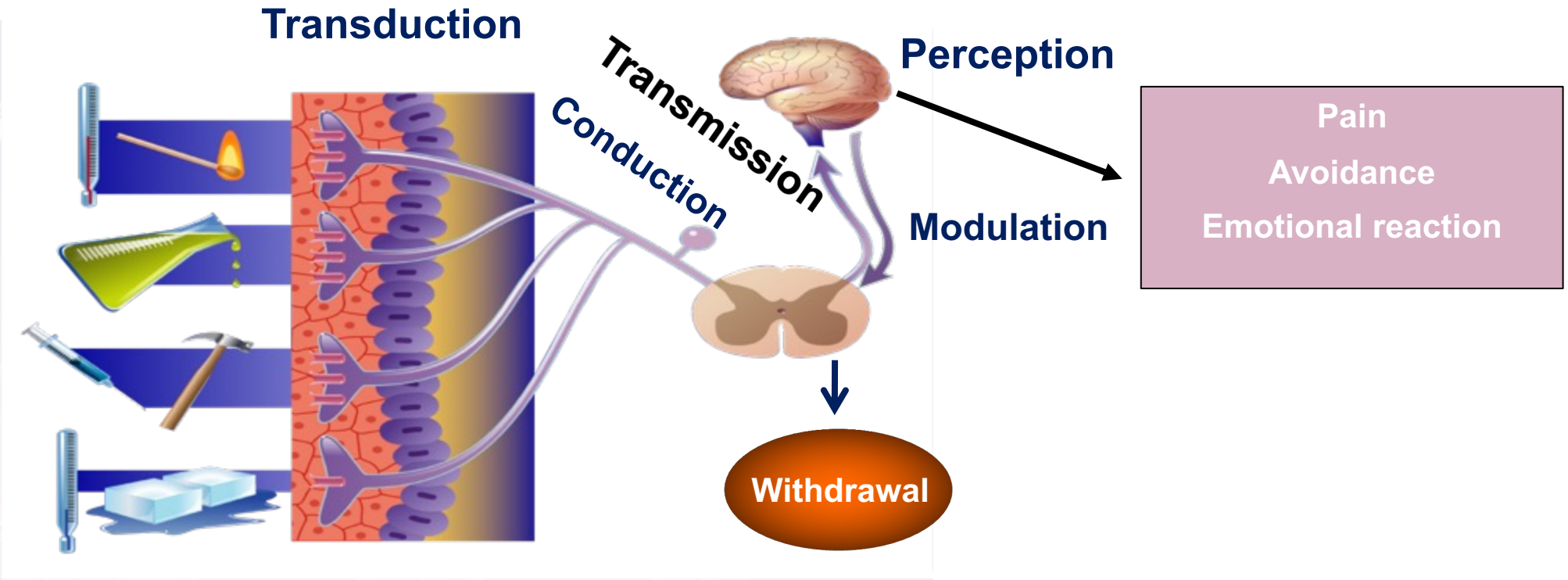
- Fibromyalgia
- Irritable bowel syndrome
- Tension-type pain
- Interstitial cystitis/pelvic pain syndrome
- Tempo-mandibular join disorder
- Chronic fatigue syndrome
- Restless leg syndrome
- Neck and back pain without structural pathology


1. Adapted from Stanos S, et al. *Postgrad Med* 2016;128(5):502-515.;
2. https://www.iasp-pain.org/PublicationsNews/NewsDetail.aspx?ItemNumber=6862

# Why do we hurt?

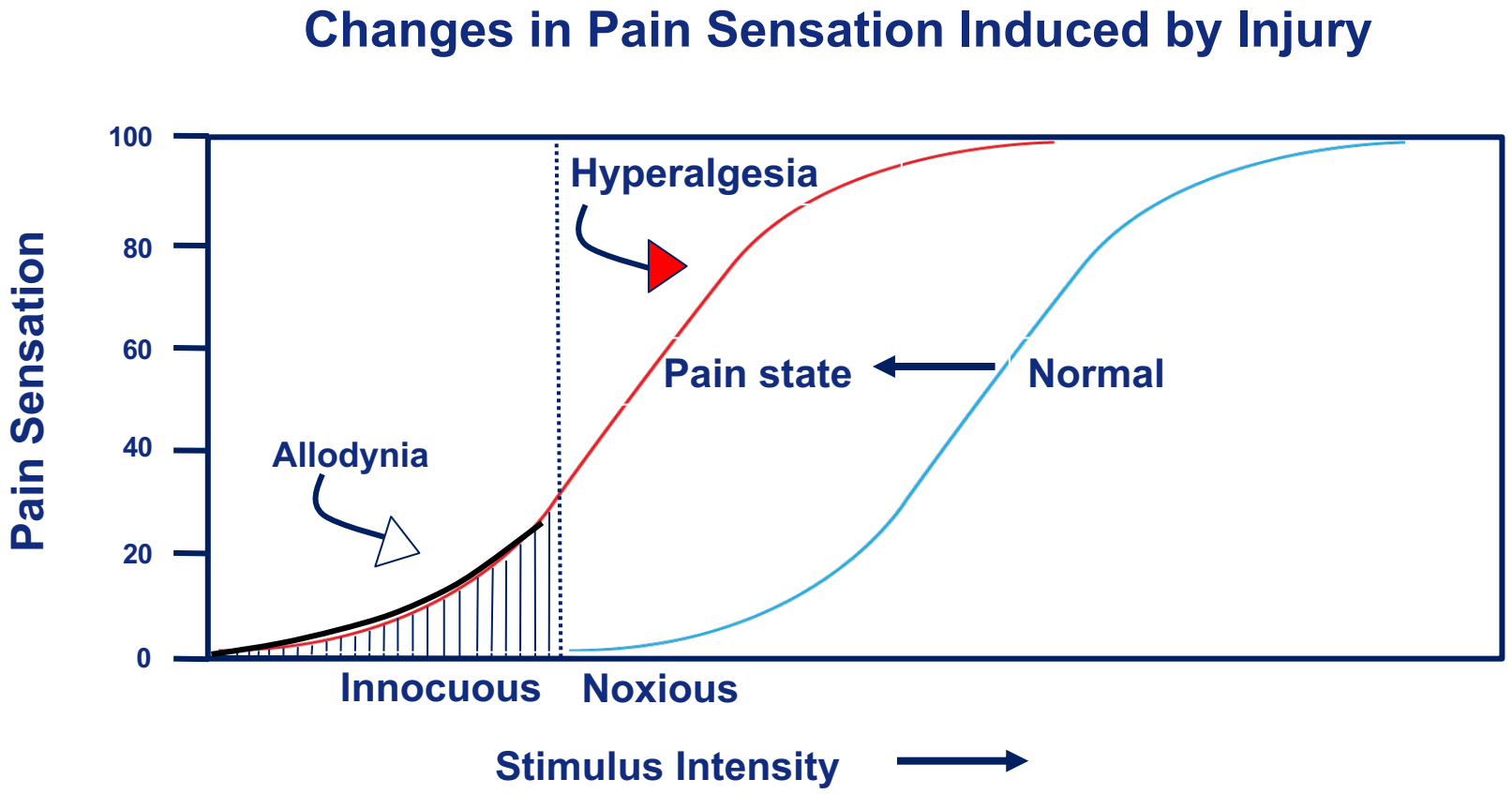


# Nociceptive Pain Processing: Transduction to Perception



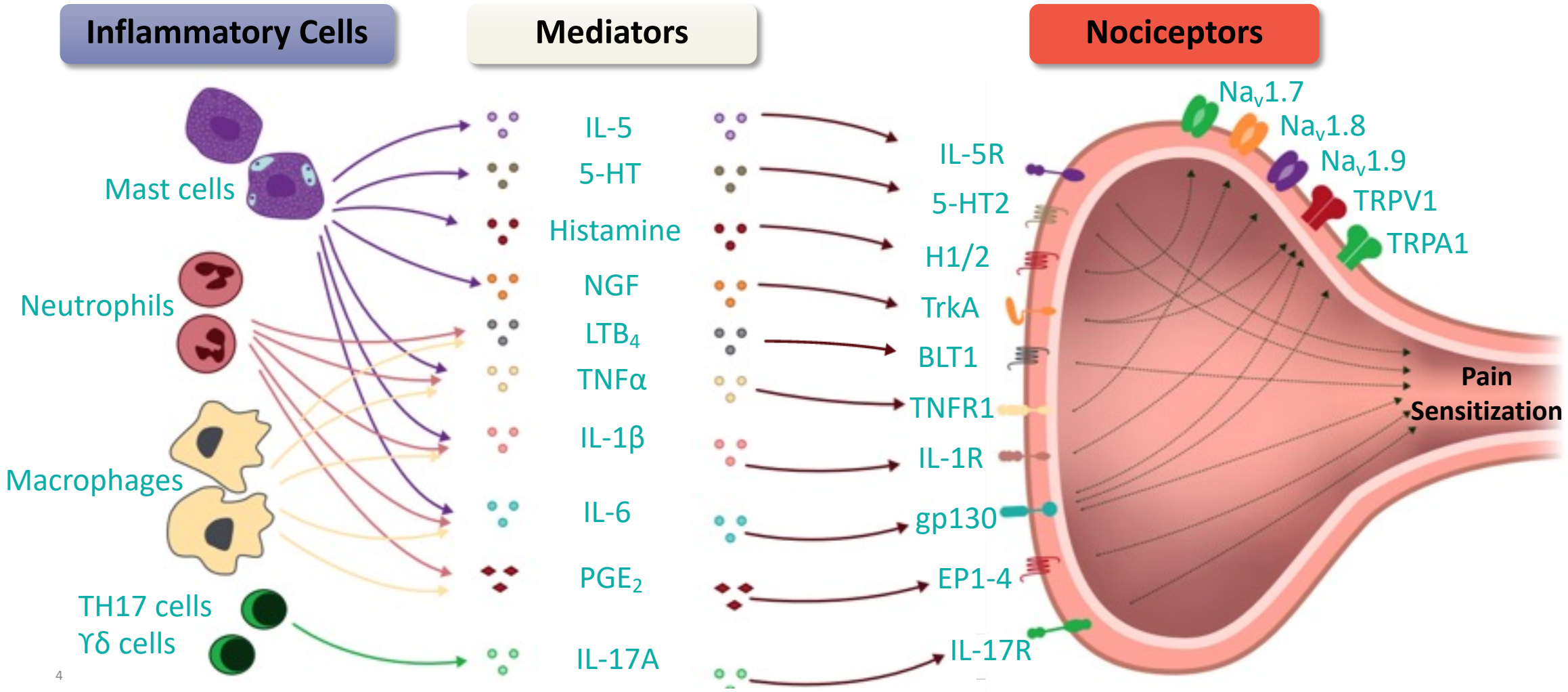

Adapted from Scholz J, Woolf CJ. *Nat Neuroscience.* 2002;(5 suppl):1062-1067.

# Sensitivity Shift in a Pain State



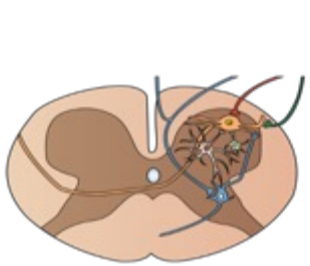

Adapted from Cervero F, Laird JMA. *Pain.* 1996;68:13-23.

# Inflammatory Mediators Can Sensitize Nociceptors

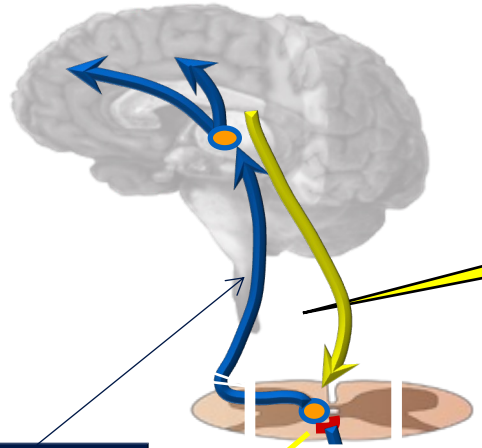



Adapted from Pinho-Ribeiro FA. *Trends Immunol.* 2017;38(1):5-19.

# Key Neurotransmitters and Modulators in Pain Processing



Modulation by neuronal, glial, and endocrine factors



Norepinephrine
⊖ Serotonin

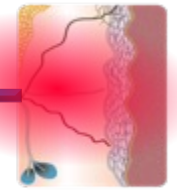
⊕ Glutamate
Substance P

⊖ GABA
Glycine
Endocannabinoids
Endorphins
Monoamines

Neurotransmitters and Neuromodulators

Activation of nociceptors

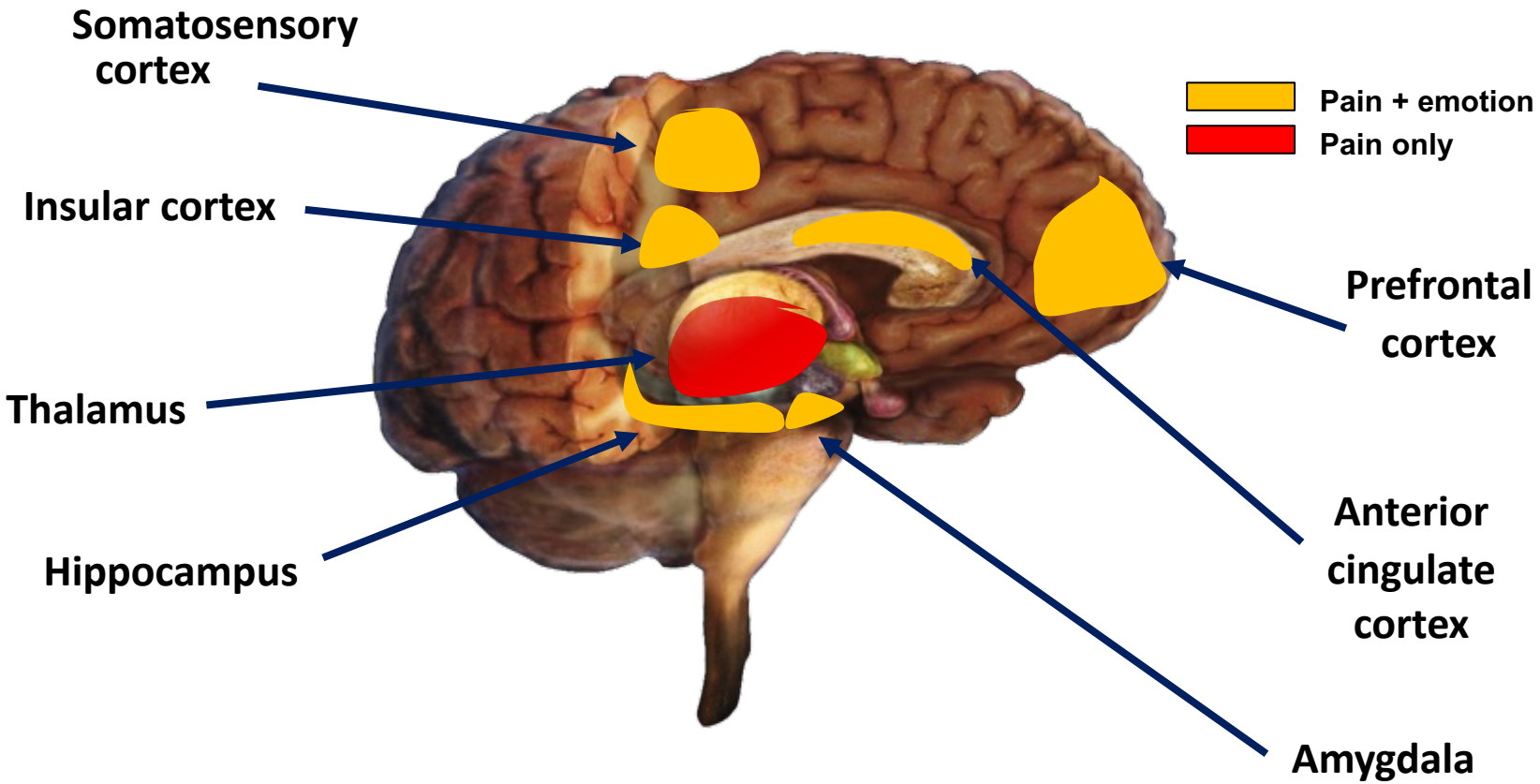
C and Aδ fibers



GABA = γ -aminobutyric acid.

Image courtesy of Apollo Marcom.
Inset image adapted from Baron R. *Nat Clin Pract Neurol* 2006;2(2):95-106.

# Processing of Pain: Pain Matrix ?




Adapted from Apkarian AV, et al. *Eur J Pain*. 2005;9:463-484.
Image courtesy of Apollo Marcom.

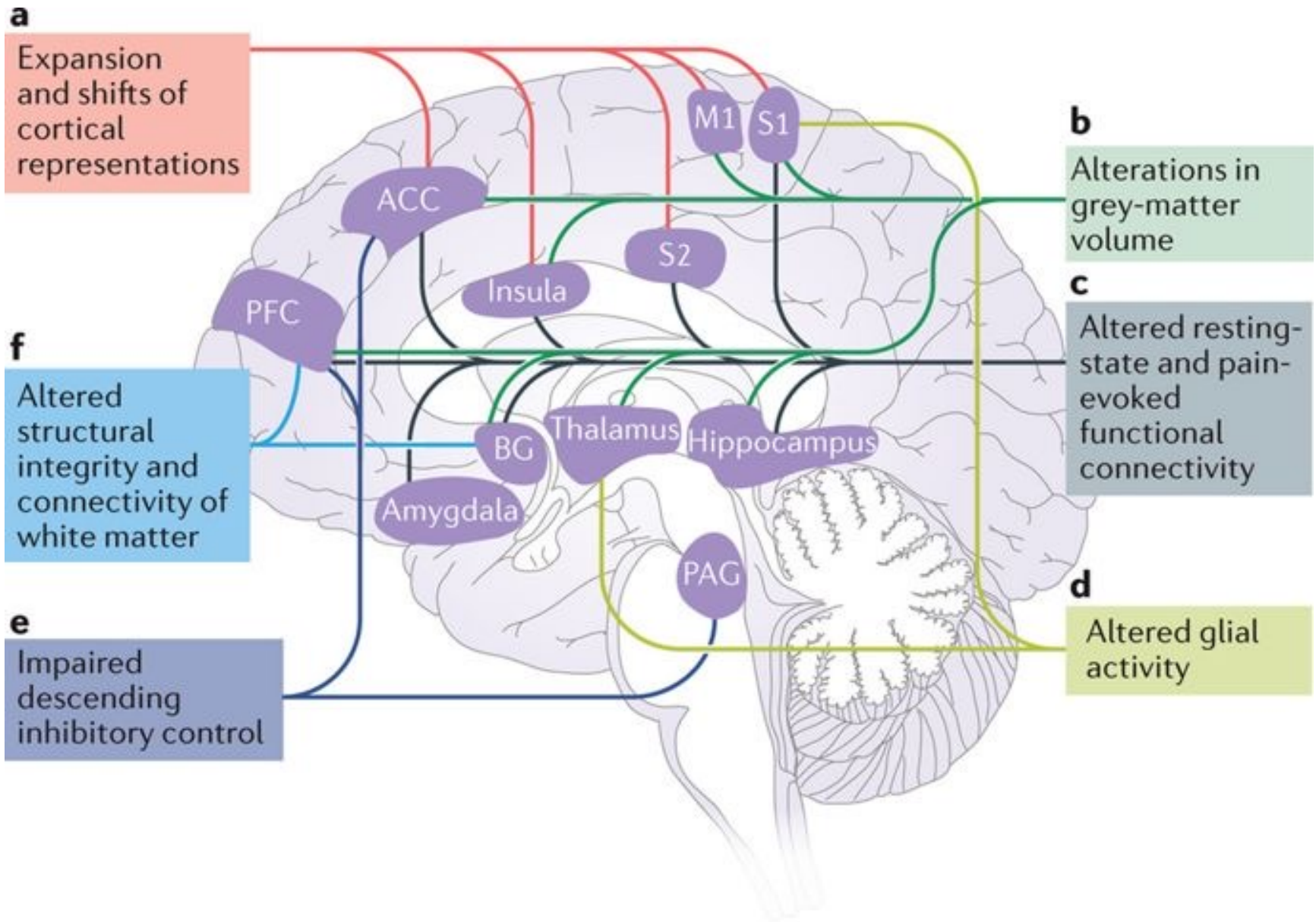
Pain Matrix

Pain Signature

Pain Network

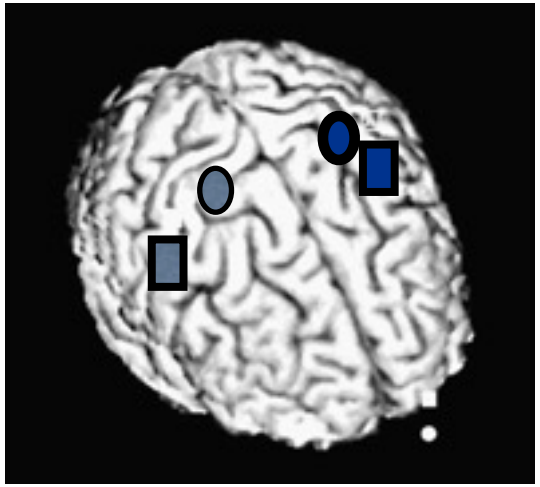
Neural Circuit

# Brain Changes & Persistent Pain

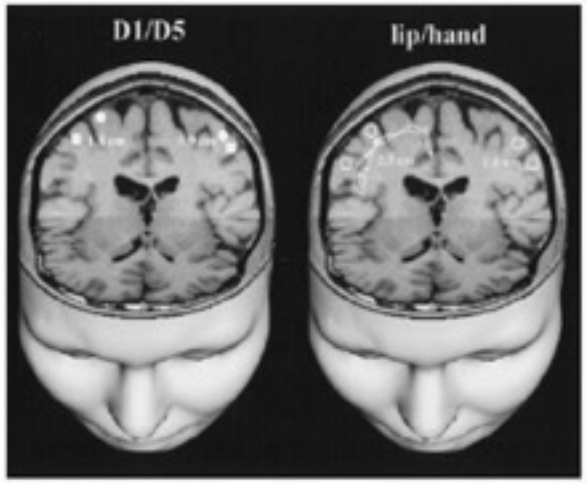


# Rethinking Chronic Pain: Brain Changes & CRPS

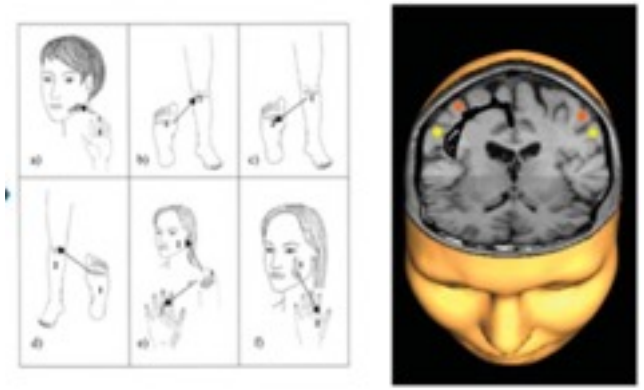
## Central Processing Changes[1]



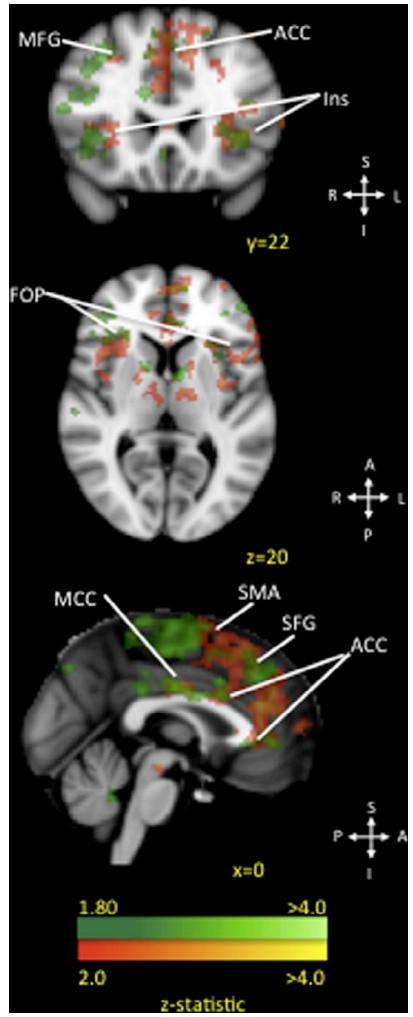
## Cortical Reorganization[2]




## Body Perception Disturbance[3]



## Altered Functional Connectivity[4]




1. Vartiainen NV, et al. Clin Neurophysiology 2008;119:2380-88.
2. Maihofner C et al. Neurology 2003;61:1707-1715.
3. Birklein F, Schlereth T. *Pain.* 2015;156:S94-S103
4. Simons LE et al. PAIN 2014;155:1727-1742.

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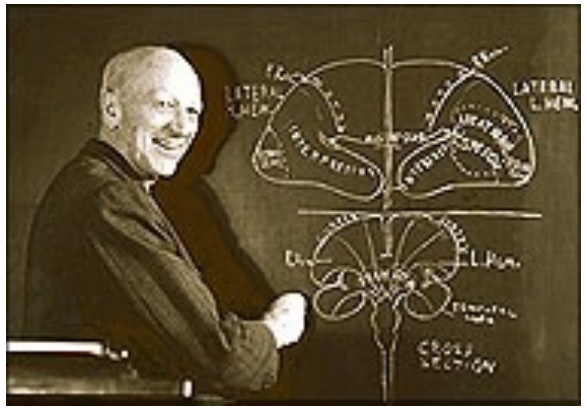
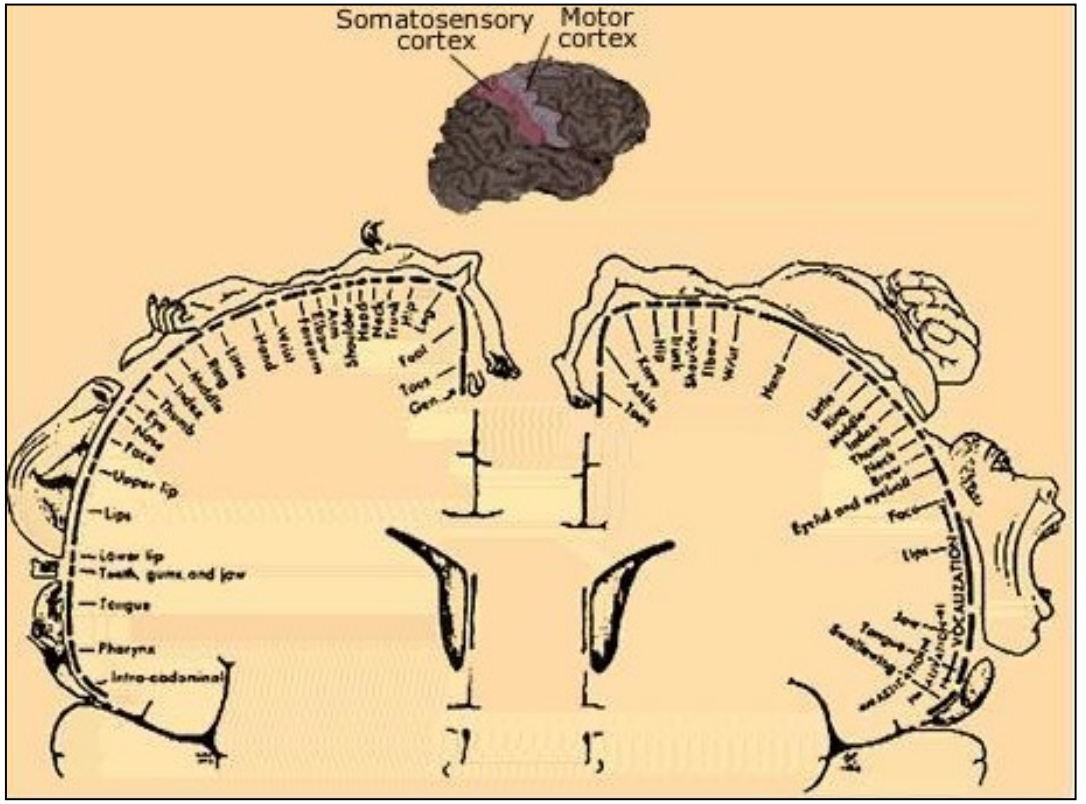
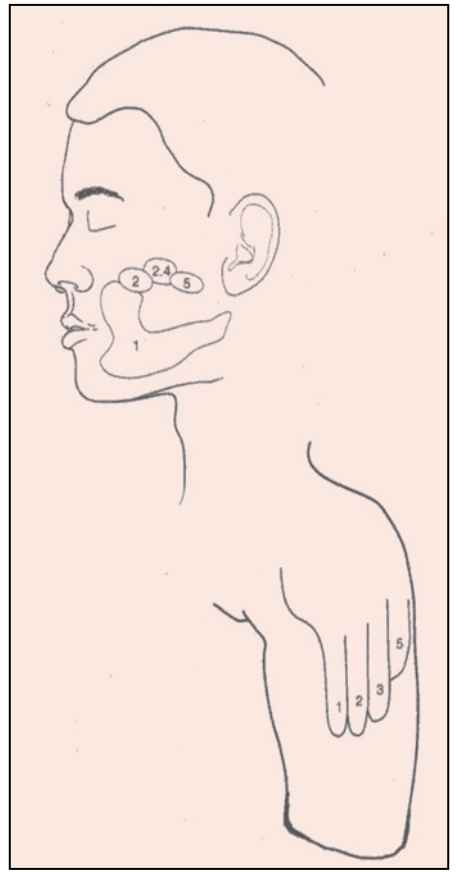


Wilder Penfield, MD

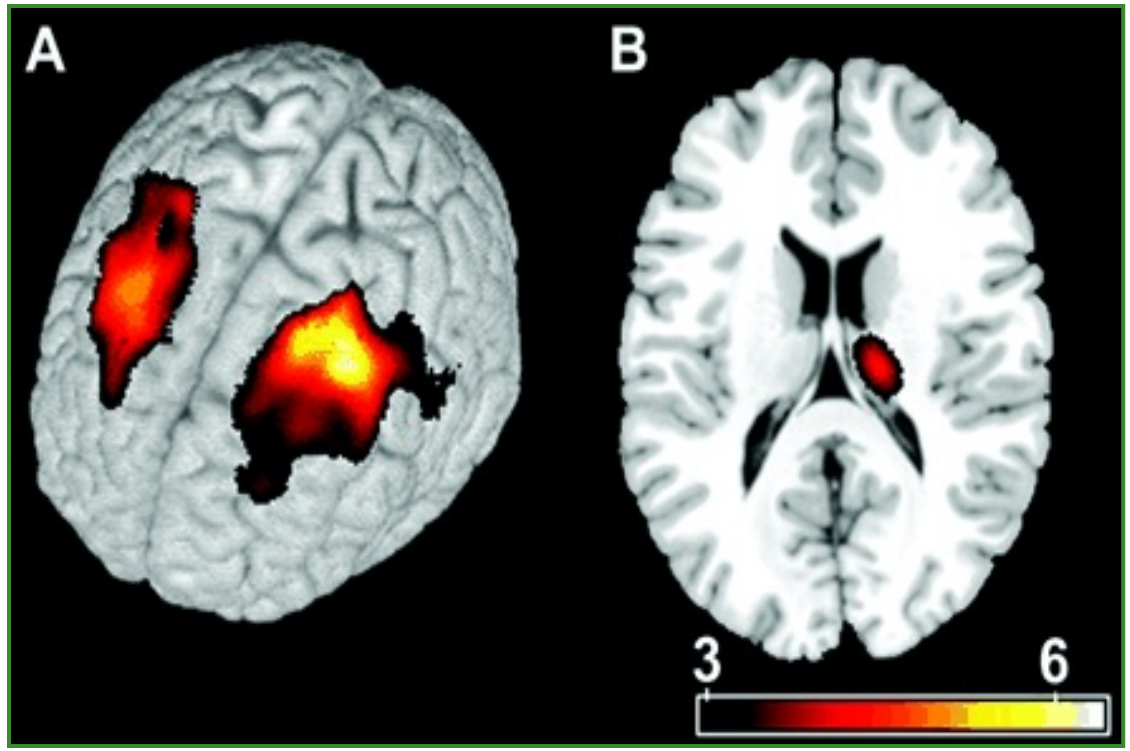


# Penfield's Map: Homunculus

Ramachandran V. *Clin Med*. 2005;4:368-73

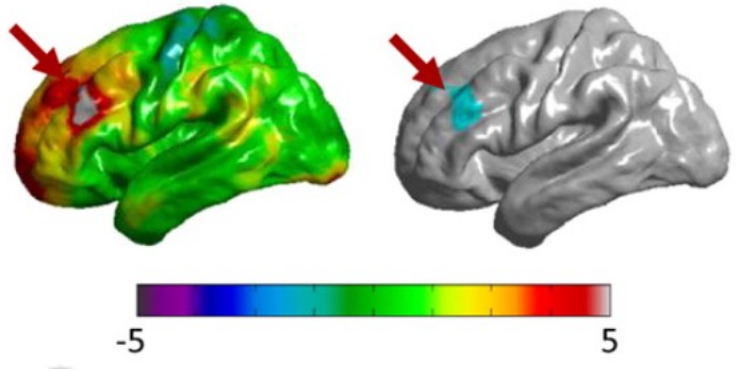
# Brain Changes



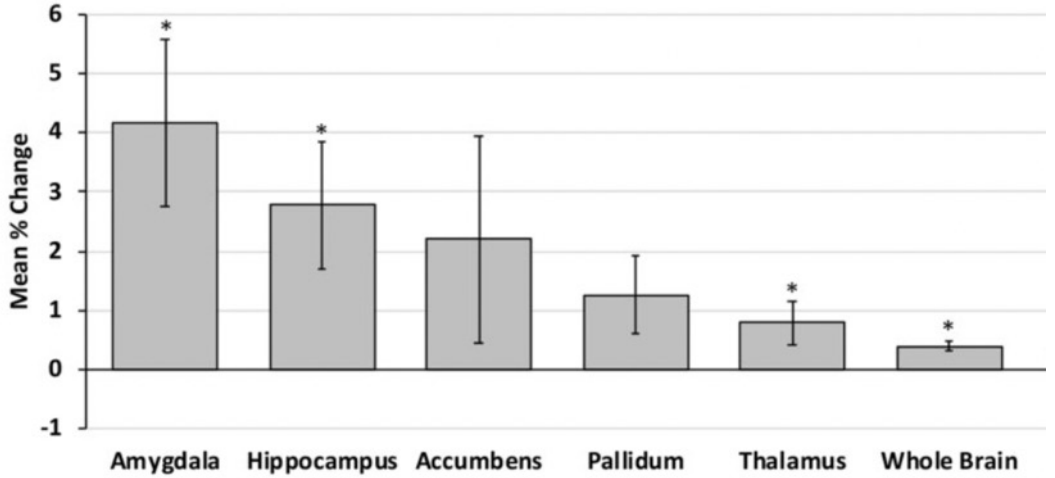

- Decrease in total grey matter related to pain perception, modulation and antinociception[1]
- Increase in gray matter volume in basal ganglia in LBP, FM,& vulvodynia patients
- Improved functional brain architecture in Tai Chi practitioners[2]

1. Apkarian AV, et al. *J of Neuroscience*, 24(46), 2004. 2. Wei t. et *al Aging Neurosci*. 2014;

# Does Treatment Change Brain Function ?




- Left prefrontal cortex thinner in chronic low back pain patients and had abnormal cognitive task-related activity
- Post treatment improvements in brain morphology correlated with extent of improvement in pain
- Treating chronic pain can restore normal brain function

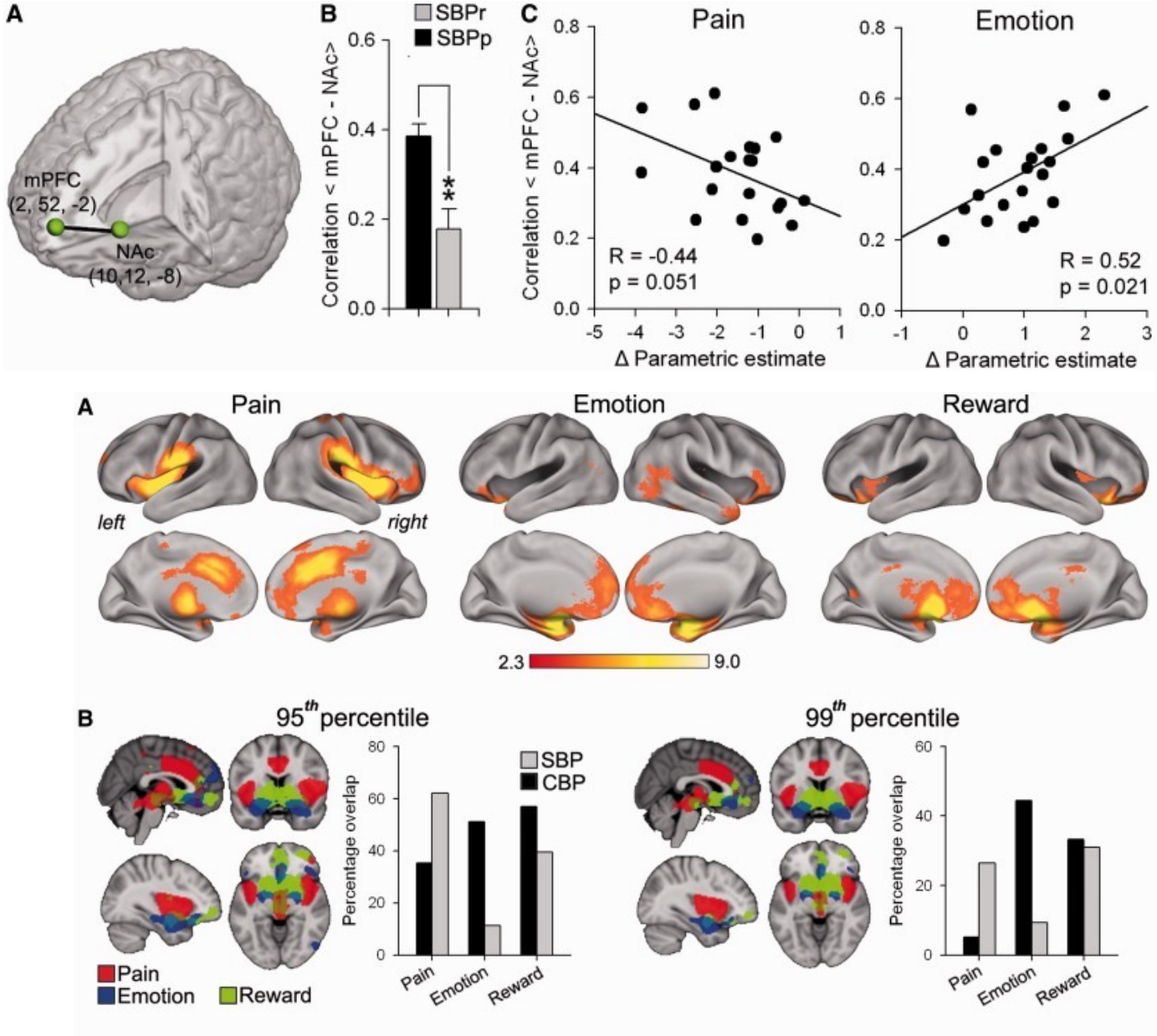



- 4-week interdisciplinary pain program
- Increases in brain volume after treatment in whole brain, amygdala, hippocampus, and thalamus
- Volumetric changes reflect neuronal plasticity stimulated by participation

Seminowicx, D, et al. *J Neuroscience.* 2011;31:7540-7550.

# Acute to Chronic Pain

Conversion from subacute to chronic pain was accompanied by a shift of brain activation patterns from regions involved in nociceptive processing to regions related to emotional processing




Hasmi, et al. *Brain*. 2013;136:2751-68.

# Integrating a BioPsychoSocial Understanding into Pain Management

?

Physical Therapy (PT)

Interventional Procedures

Medical

Interdisciplinary Care

Comprehensive Pain Care

Occupational Therapy (OT)

Patient Education

Movement Based Therapy (Tai Chi, Yoga)

Behavioral Health (BH)

Relaxation Training (RT)

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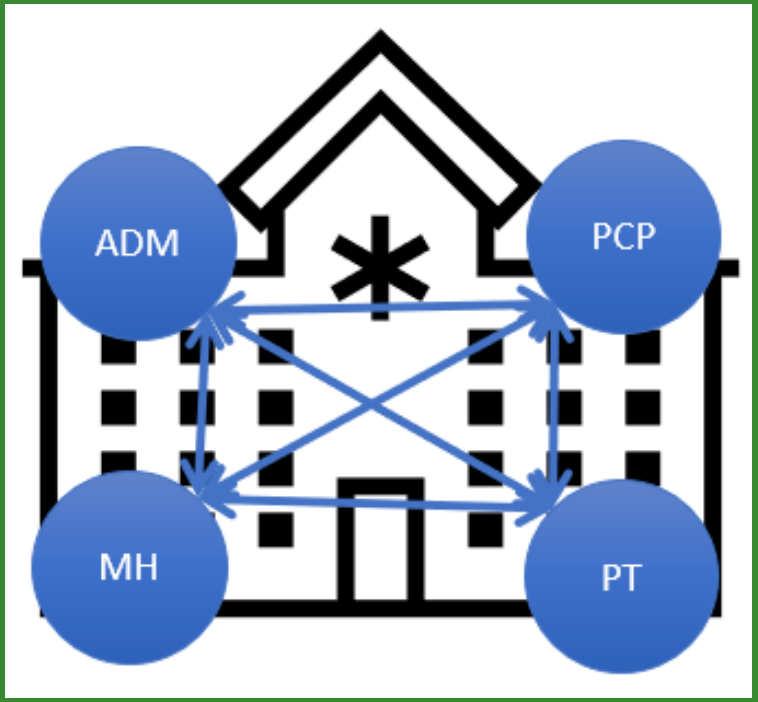
# Interdisciplinary Pain Rehabilitation: A Model to Retrain the Brain

| | |
|---|---|
|  | **Sonja Braasch, OTR/L**<br>*Occupational Therapist*<br>*Seattle* |
|  | **Cheyenne Dixon, OTD, OTR/L**<br>*Occupational Therapist*<br>*Seattle* |
|  | **Tasha Parman, PT, DPT**<br>*Physical Therapist*<br>*Seattle* |
|  | **Nate Hadley, PT, DPT**<br>*Physical Therapist*<br>*Seattle* |

| | |
|---|---|
|  | **Steven Stanos, D.O.**<br>*Pain Management Specialist*<br>*Seattle, Issaquah* |
|  | **Wilson Chang, M.D.**<br>*Pain Management Specialist*<br>*Seattle, Issaquah* |
|  | **Sharon Hsu, PhD**<br>*Pain Psychologist*<br>*Seattle* |
|  | **Becca Taylor, RN PhD**<br>*Nurse Educator & Coordinator*<br>*Seattle* |



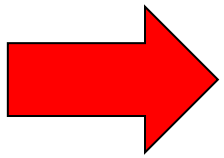
# Interdisciplinary Care: Phases

- Comprehensive Assessment
- Pre-Programming
- Formal Interdisciplinary Care
- After-care

**Medical Diagnosis**:
Chronic low back pain
L5-S1 radiculopathy
Myofascial pain
Sleep disorder

**Behavioral Health**:
Depression
Anxiety
Poor coping
Daily alcohol use

# From “Passive” to “Active” Physically and Psychologically



George Doyle/Stockbyte/Getty Images

# Pain Management: Medical

- Clarify the diagnoses, educate, & guide
- Put patient's "story" together, set context for success
- Sell a new approach, engage patient to change
- Be flexible
- Weekly program visits, review progress across discipline & long-term management
- Celebrate successes and help manage setbacks
- TEAM CONFERENCE

# Yellow Flags

| Nature | Examples |
|---|---|
| Beliefs, Appraisals, & judgments | Unhelpful beliefs about pain<br>Expectations of poor treatment outcome |
| Emotional Responses | Worry, fears, anxiety |
| Pain Behavior (pain coping) | Avoidance of activities of pain and injury<br>Over-reliance on passive treatment |

Nicholas M, et al. *Phys Ther.* 2011; 91:737-753.

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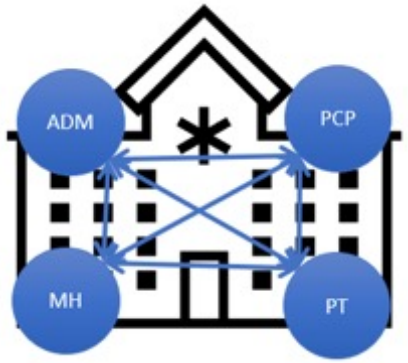
**Pathology** **Psychiatry** **Work/Health** **Contextual**

# Functional Restoration Program




| | Monday | | Wednesday | Thursday |
|---|---|---|---|---|
| Noon | Nursing Lecture | | Group Stretching Class | Nursing Lecture |
| 1:00 | PT | | PT Group | PT |
| 2:00 | OT | Med Visit | OT Group | OT |
| 3:00 | Psychology | | Psychology Group | Psychology |
| 4:00 | Relaxation Training | | Relaxation Group | Relaxation Training |
| 5:00 | Team Conference: | | | |

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# Prime Areas of Opportunity: Rethinking Pain

1. Changing beliefs about pain
2. Reducing avoidant behavior
3. Facilitating a balance between improving strength & decreasing sensitization
4. Helping calm the nervous system

# PT APPROACHES

1. Strengthening & ROM
   - Lumbar Stabilization
   - McKenzie: Mechanical Diagnosis & Treatment (MDT)
   - Neurodynamic Therapy
2. Manual Therapy, Self-Mobilization
3. Balance & Aerobic Exercise

## Nervous System Retraining

1. Pain Neuroscience Education (PNE)
2. “Protectometer”: DIMs & SIMs
3. Movement Visualization
4. Graded Motor Imagery (GMI)

# 1. Pain Neuroscience Education (PNE)

Adriaan Louw, PT, David Butler, PT, Howard Schubiner

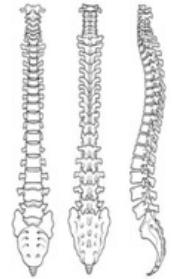
- Traditional model: anatomy, tissue injury or nociception[1,2]
- PNE incorporates how nervous system, via peripheral and central sensitization, synaptic activity, and brain processing, interprets information form tissues[1,2]
- Patients have ability to modulate pain experience
- Nervous system processing injury in conjunction with psychosocial aspects
- Systematic Review: reducing pain, improving knowledge, function, and lowering disability[3]

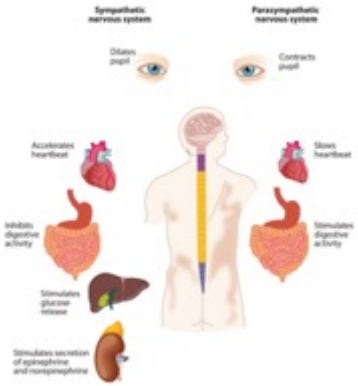
**FASCIA**

**Spine**

**Ligaments**

**Joints**

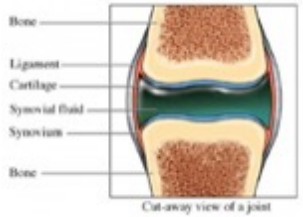




**Autonomic Nervous System**

**Peripheral Sensors**

**Motor Control**




1. Butler, Moseley.2003; Explain Pain. Adelaide, Noigroup Publications.
2. Luow A, et al. *Spine* 2014;39:1449-1457.
3.Louw D, et al. Physio Theory Pract. 2016.

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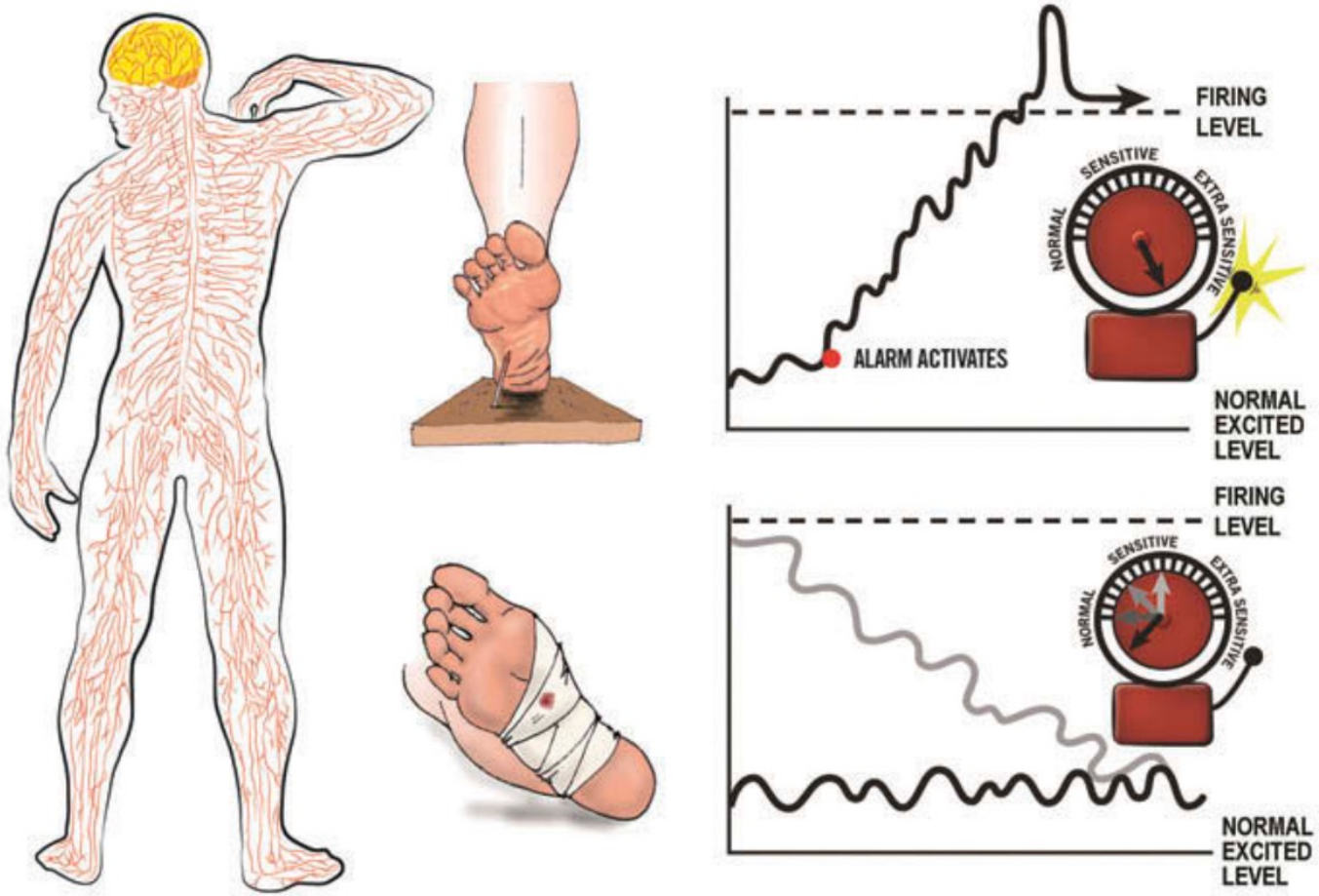
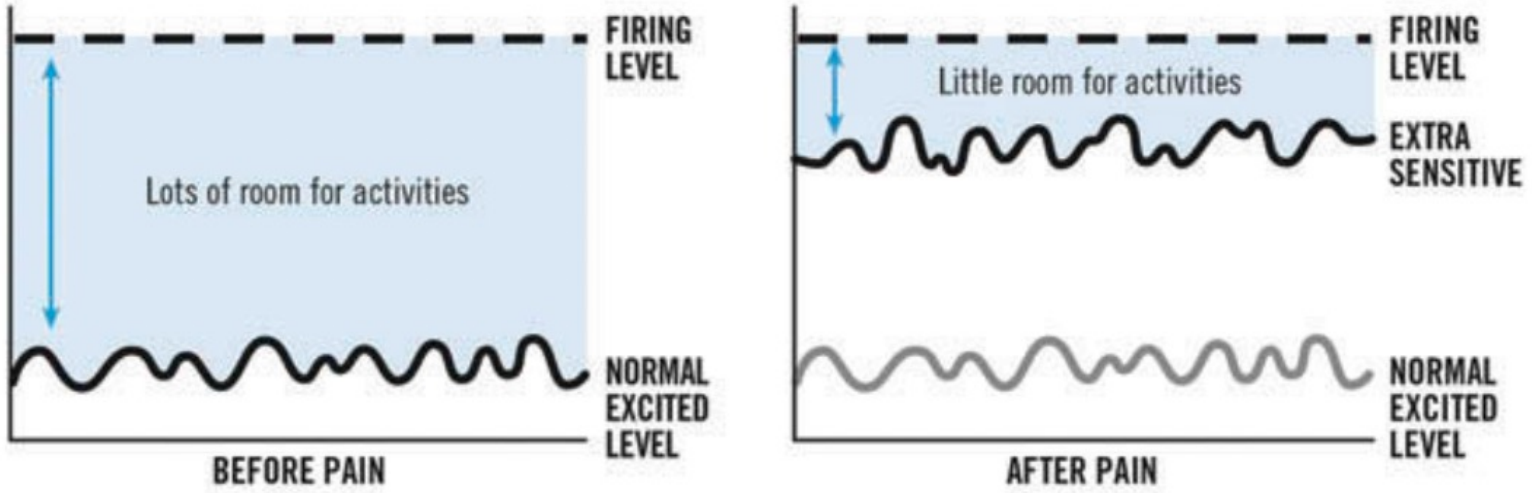
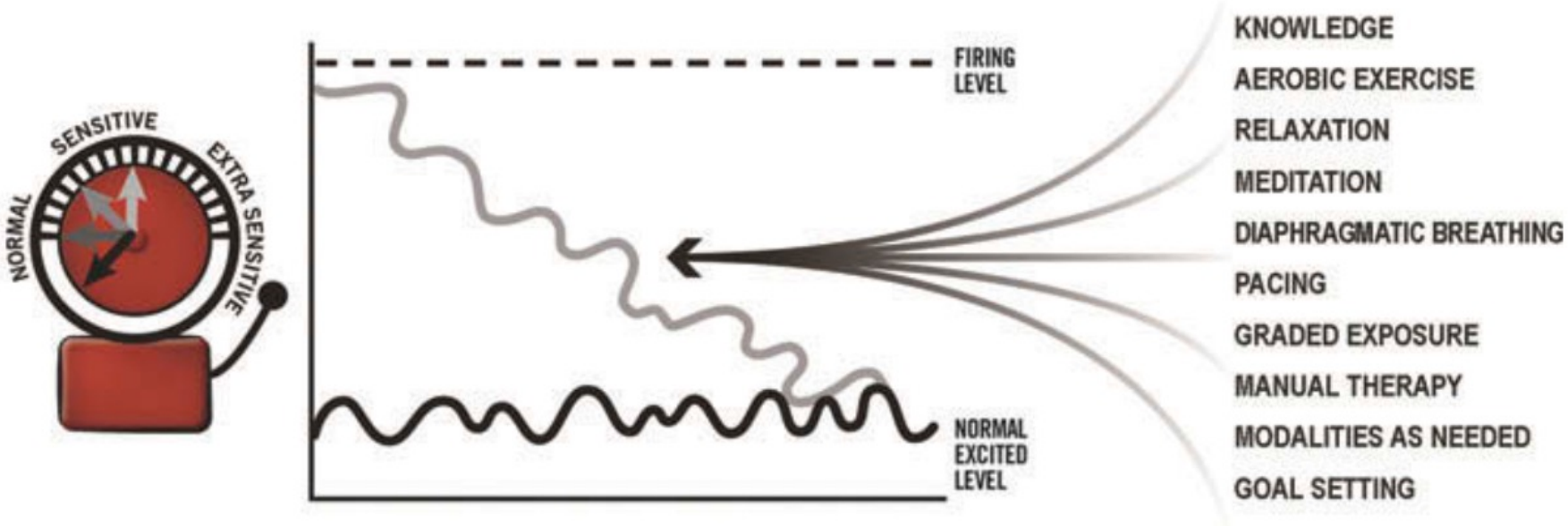
# Teaching with Stories




Adriaan Louw, *Why do I hurt?*

# Decreasing a Sensitized Nervous System



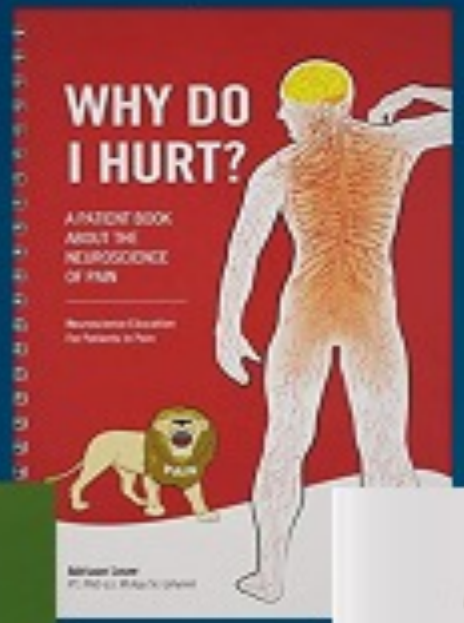

Adriaan Louw, *Why do I hurt?*

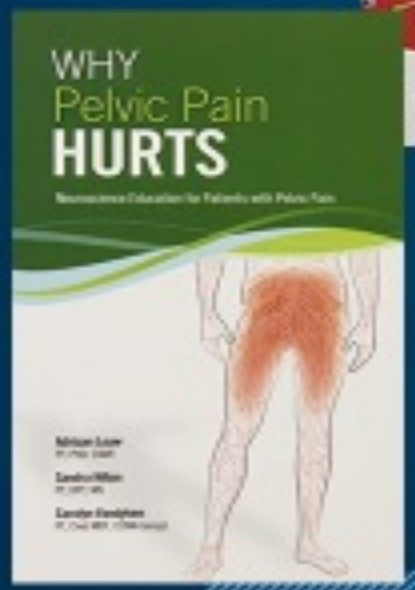
# Pain Neuroscience Education

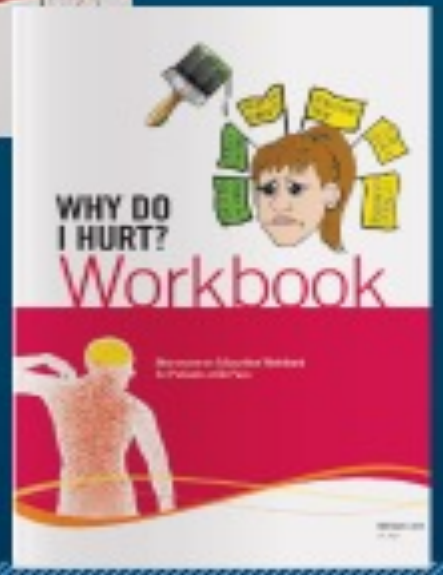
SWEDISH | HEALTH FOR GOOD

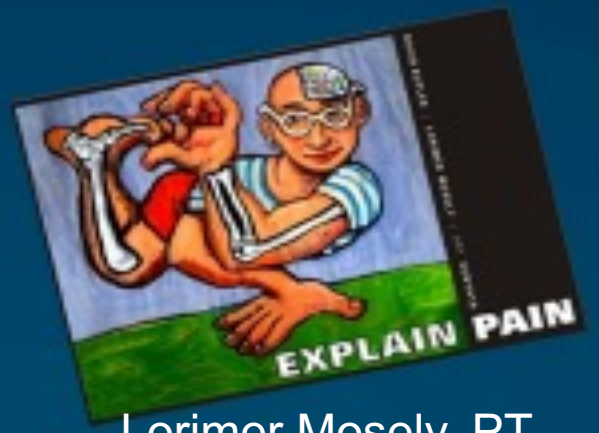
## Patient Resources

Adriaane Louw, PT



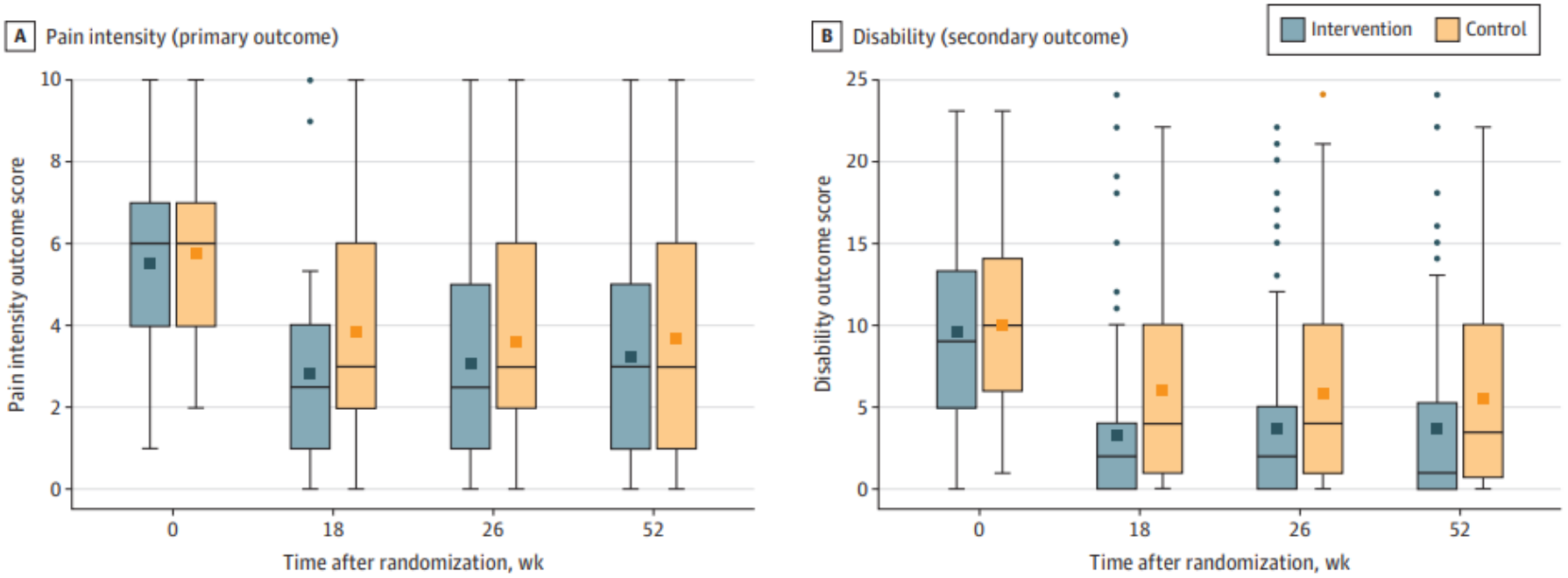




Lorimer Mosely, PT


# Graded Sensory Retraining




Think about their body - Process sensory information - Move their back during activities

Bagg M, et al. *JAMA*.2022;328:430-439.

# Graded Exercise Approach

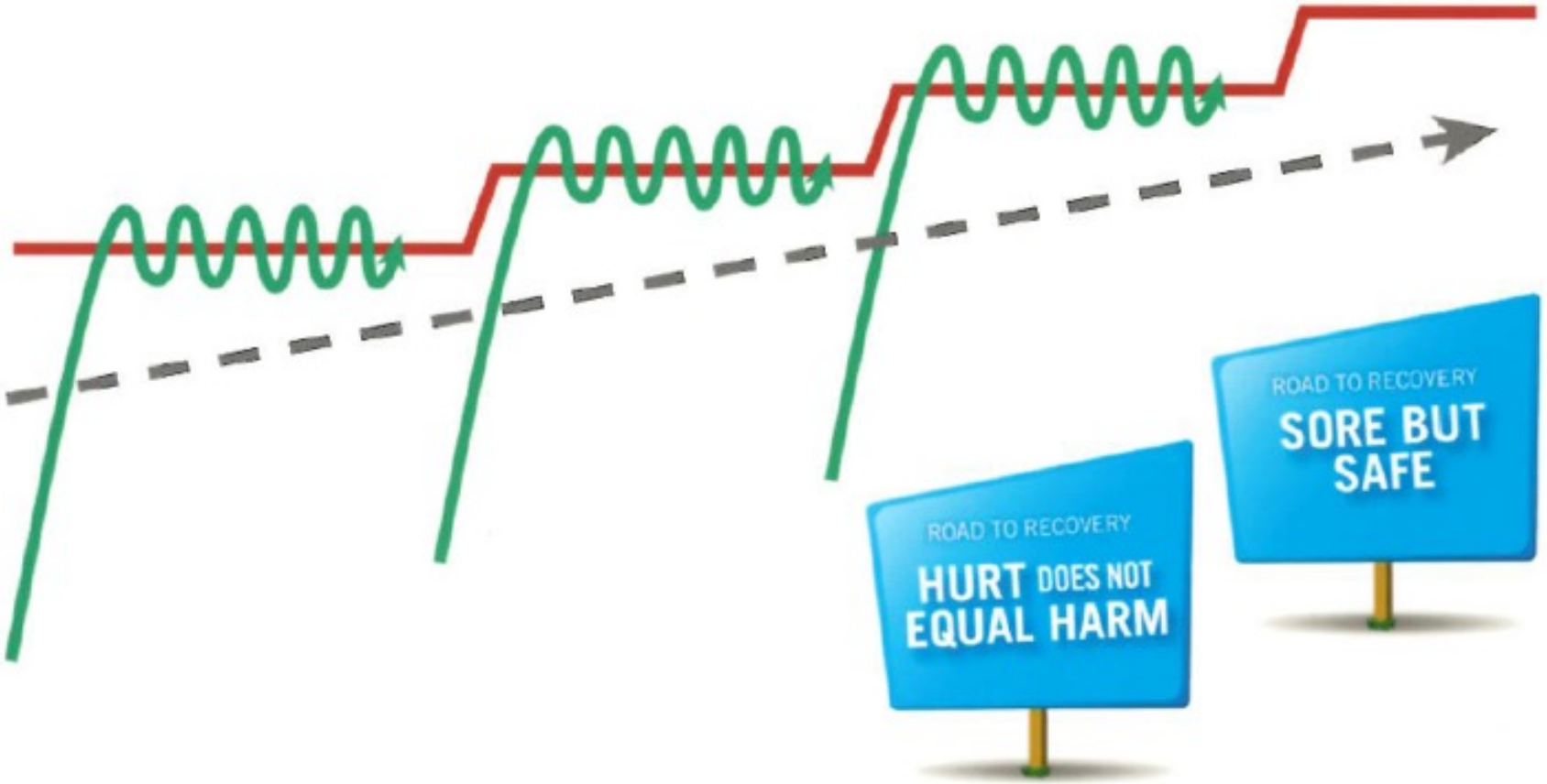



*Image: A. Louw/ISPI.*

# Pain Revolution

Pain is always real

Depends on context

Doesn’t equal tissue damage

Overprotective pain system

Retrain your pain system


## Protectometer


pain revolution

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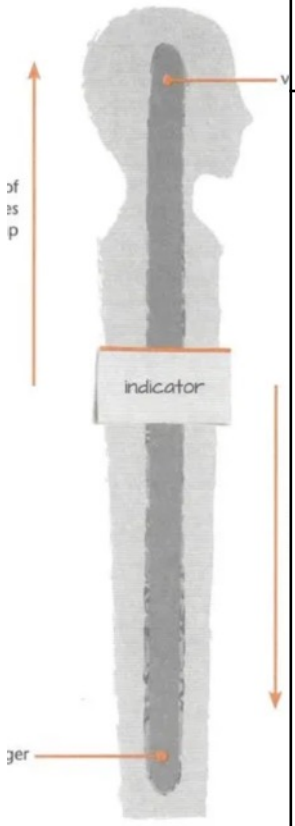
# 2. Pain as Brain Output




| Protectometer | Danger in Me (DIMs) | Safety In Me (SIMs) |
|---|---|---|
| • Your brain will make pain when it concludes body tissues are in danger<br>• You will have pain when your brain concludes there is more evidence of danger related to your body than safety | Anything that is dangerous to body tissues, life, lifestyle, job, happiness or day to day function – threat to you as a person | Things that make you stronger, better, healthier, more confident, more sure or certain – within or about yourself |

D Buter, PT

L. Moseley, PT

# All active challenges

Things you hear, see, smell, taste or touch

Places you go

Things you say

People in your life

Thoughts and beliefs

Things you do

Things happening in your body

Random Tasks

# PT & OT: Exercise Evolution

## Progress Over Time

- Start with 2 sets, build to 3
- Build more repetitions (>10 reps) to increase endurance
- Increase the range of the movement
- Improve coordination and control
- Improve body awareness and sensation connection
- Add weight or resistance if necessary or possible

## Modify when pain is high

- Decrease number of sets
- Decrease repetitions
- Add rest between each repetition
- Decrease range of movement to within comfort
- Decrease total time of activity
- Use relaxation breathing to support movement and breathe between sets while resting
- Practice imagery of movement with no pain while resting

# 3. Movement Visualization

**1st person Imagery:**
Imagine  yourself moving
**3rd Person Imagery**:
Imagine someone else moving

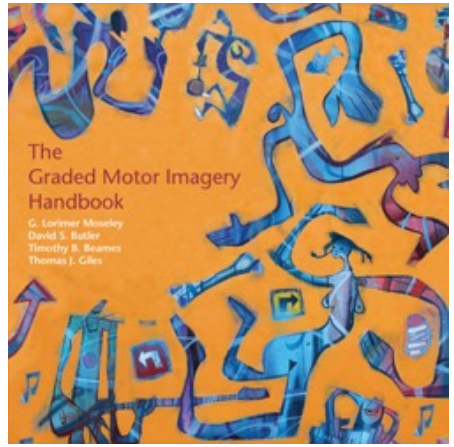
**If struggling with visualization**:

**Visualize the opposite side**

**Watch others**

**Visualize nearby body areas and move closer to more painful area gradually**

# 4. Graded Motor Imagery (GMI) Program




I. Recognition of Hand Laterality
II. Imagined Movements/ Motor Imagery
III. Mirror Therapy


Moseley L. *Pain* 2004:108:192-98.

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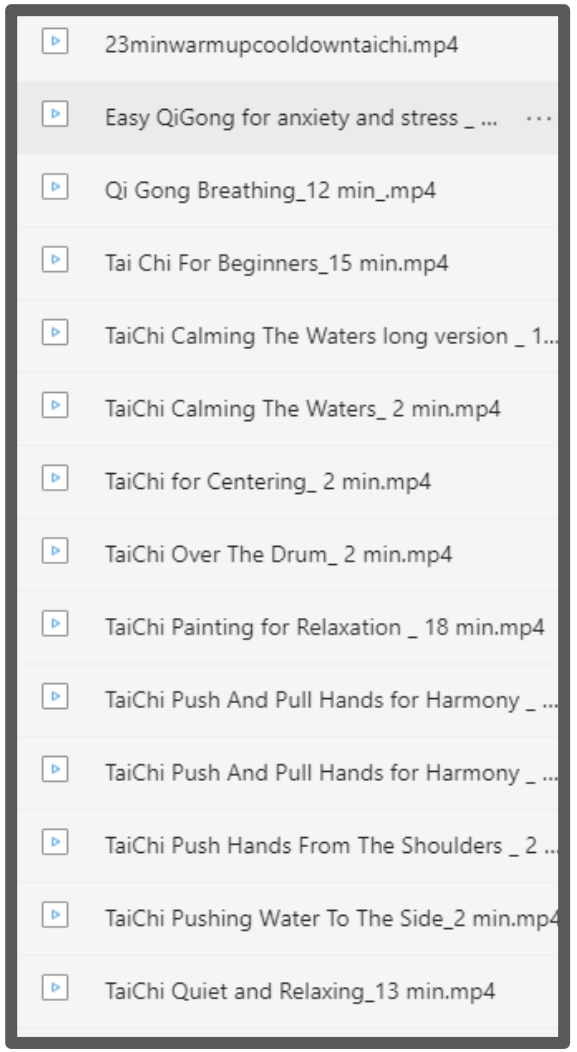
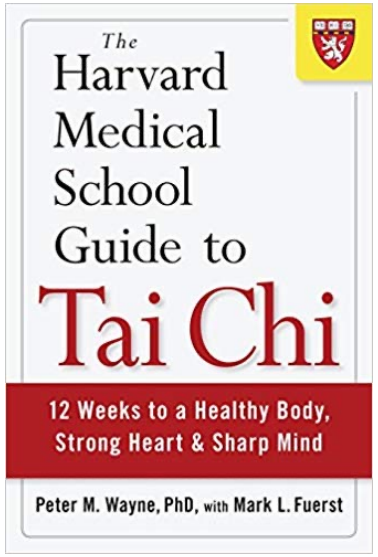
# Tai Chi: Meditative Movement

| Characteristics |
| --- |
| Circular |
| Relax |
| Calm |
| Continuous |
| Intent |
| Energy |





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Phuphanich M, et al. *Phys Med Rehabil Clin N Am*. 2020;31:577-591.

# Pain Psychology

Psychoeducation

Stress Reduction Training

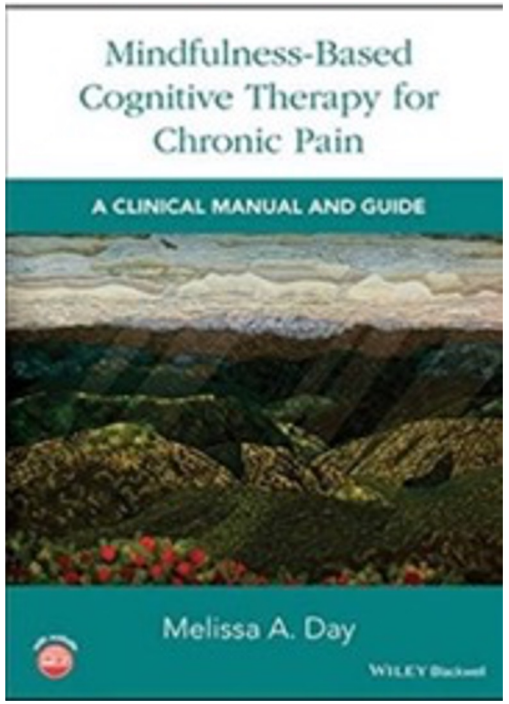
Cognitive Restructuring

Acceptance as a Coping Strategy

Structured Functional Restoration Program, Swedish Pain Services 2022

# Mindfulness Training

- Observing
- Describing
- Acting with awareness
- Non-judging of experience
- Non-reactivity to experience




Melissa Day, PhD, 2017.

**Behavioral Health**
Khoury B, et al *Clin Psych Review.* 2013:33:763-71.
Keng S, et al. *Clin Psych Review*. 2011;31:1041-56.
Hilton et a. *Ann Behav Med*. 2017

**LBP & Pain Management**
Tang Y. *Transl Behav Med.*2016;6:63-72.
Cherkin D, et al . JAMA 2016;315:1240-49.
Goyal M *JAMA*. 2016;315:1236-7.
Jacob J. *JAMA*. 2016.
Garland E, et al. *J Cons Clin Psychol.* 2014;82:448-9

# Relaxation Training

**Goals**

- Nervous system balancing
- Maintain physiologic balance
- Increase sense of calm and decrease overall tension

**“A physiologic and homeostatic state that counteracts stress.”**.

- Benson (1970)

| 1 | 2 | 3 |
| --- | --- | --- |
| Ways to Use | Practice | Adapting |

# Shared Role of PT and OT

- Postural re-educ.
- Body awareness
- Activity simulation
- Body mechanics
- Ergonomics

**Occupational Therapy**

**Transdisciplinary**

- Pain physiology education
- Pacing training
- Graded exposure to movement
- Biofeedback
- Mindfulness
- CBT/ACT principles

- HEP targeting strengthening, flexibility
- Cardiovascular conditioning
- Aquatic therapy

**Physical Therapy**

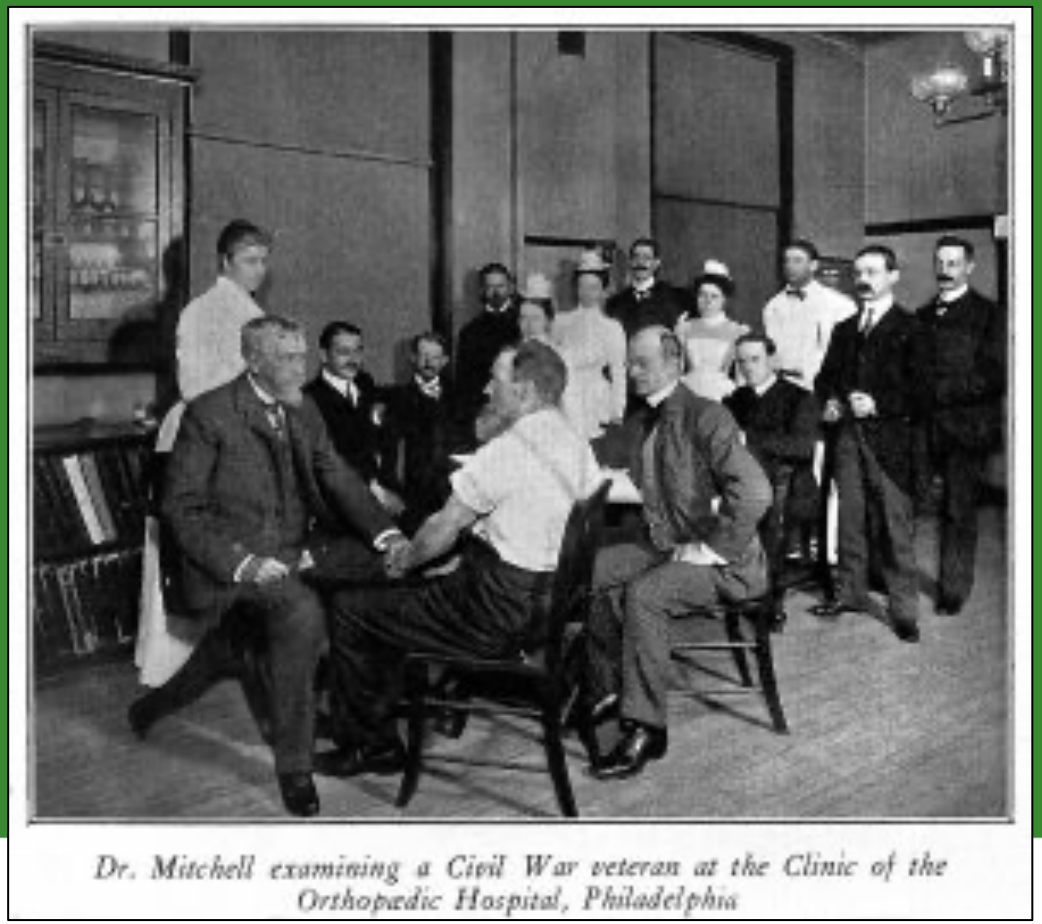
# Rethinking Tim's PT Home Program

- Aerobic exercise, walking program
- Lumbar stabilization
- Stretching
- Nerve glides
- Breathing integration
- Mindfulness
- Tai Chi & movement meditation

- Pain Neuroscience Education
- Protectometer
- Motor Visualization
- Graded Motor Imagery

"There are among us those who haply please  to think our business is to treat disease. And all unknowingly lack this lesson still 'tis not the body, but the man is ill."

*- Silas Weir Mitchell*

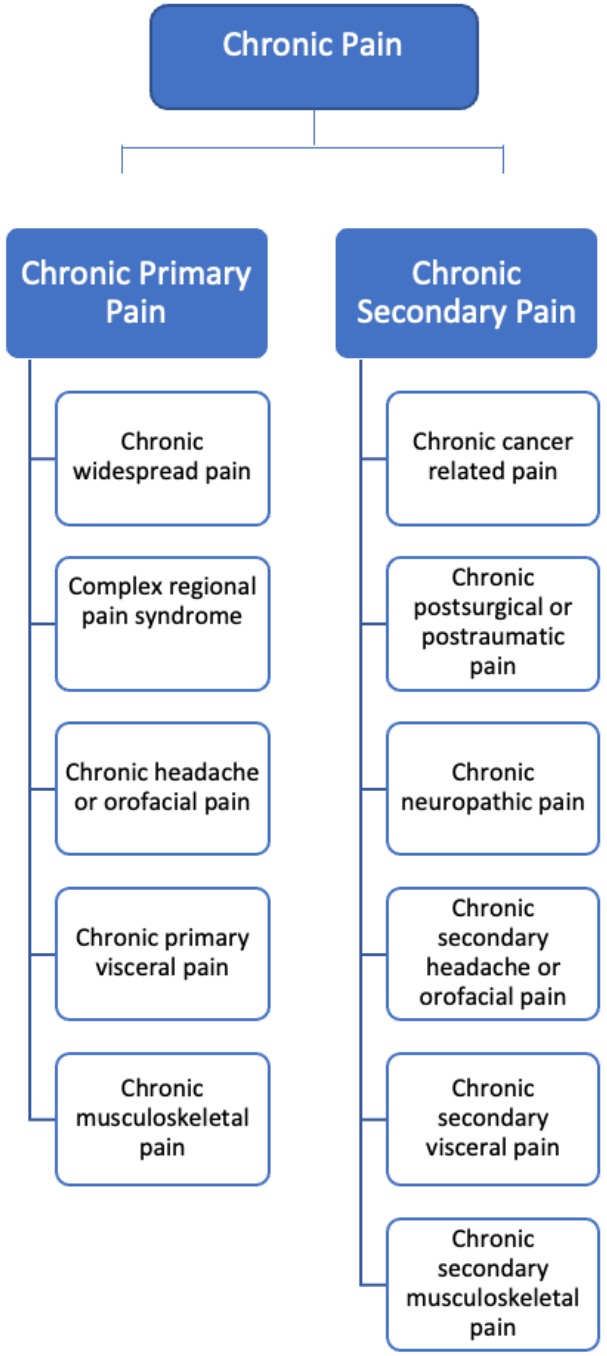


*Dr. Mitchell examining a Civil War veteran at the Clinic of the Orthopaedic Hospital, Philadelphia*


(Kent, *Frontiers in Psych*, 2021)

# IASP Classification of Pain: 2019

- ICD, chronic pain diagnoses are not represented systematically, need pragmatic classification system
- Challenges on HC systems, referral may be dependent on ICD codes
- Lack of codes leads to limited and clearly defined treatment pathways
- New criteria distinguishes chronic primary and chronic secondary pain




Treede R, et al. *Pain*. 2019; 160(1): 19-27.

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# **Severity** and Other Extension Codes


- Pain Severity
- Temporal Characteristics
- Presence of Psychosocial Factors
  - Cognitive (catastrophizing or worry and rumination)
  - Behavioral (avoidance or endurance)
  - Emotional (fear or anger)

Treede R, et al. *Pain*. 2019; 160(1): 19-27.

Biomarker: a defined characteristic that is measured as an indicator of normal or pathological biological processes, or of responses to an exposure of intervention.

# Biomarkers for Pain Treatment

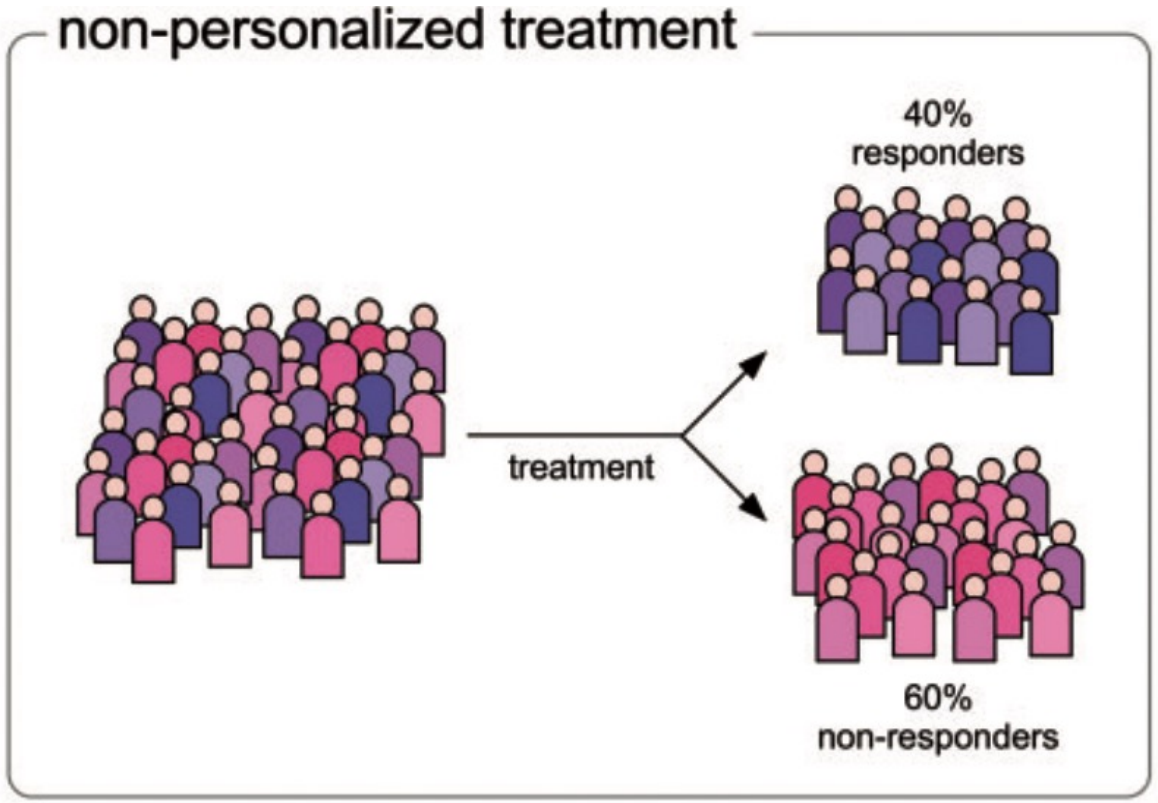
- HEAL Initiative of 2018
- Enhancement of pain management through non-addictive pharmacological therapeutics and non-pharmacological interventions

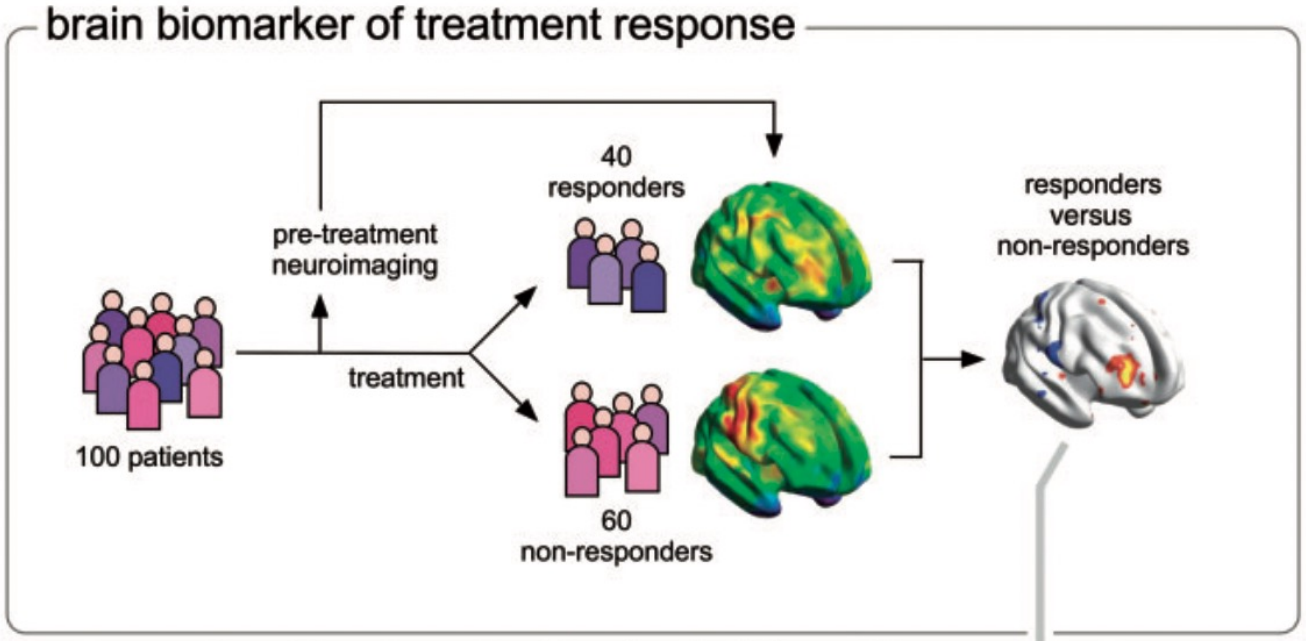
Categories

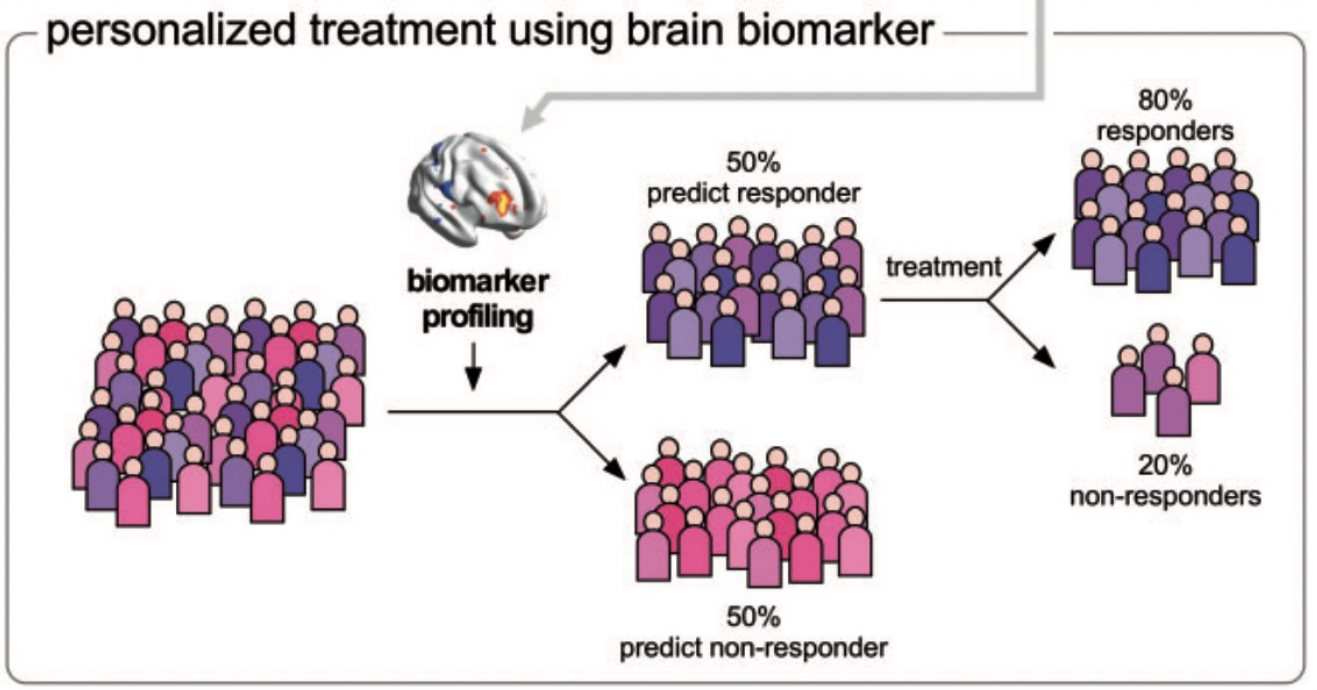
- Susceptibility/risk
- Diagnostic
- Prognostic
- Pharmacodynamic/response
- Predictive
- Monitoring
- Safety

Davis K, et al. Nature Reviews Neurology. 2020;16:381-400.

# Biomarkers for Pain Treatment




Mouraux A, Iannetti G. *BRAIN* 2018:141:3290-3307.

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# WE CAN RETHINK CHRONIC PAIN

- Historical perspective more biopsychosocial
- Greater understanding of the nervous system and pain
- Treatment approaches focusing on brain retraining as additional tools
  - Pain Neuroscience Education as a tool to retrain the brain
  - Graded Motor Imagery (GMI)
- Biomarkers and pain may help improve treatment outcome
- New ICD-12 Pain Taxonomy & Classification

# Thank you

steven.stanos@swedish.org

AAPM
American Academy of Pain Medicine

# ADVOCATE.
# EDUCATE.
# COLLABORATE.

**EFFECTIVE PAIN CARE IS MULTIDISCIPLINARY.
WE ARE, TOO!**

Become A Part Of The Distinguished
Community Of Pain Medicine Clinicians

**SAVE THE DATE**

# 39TH ANNUAL MEETING

# Patient Educational Videos


Understanding Pain Rebrand


Persistent pain explained in 3 minutes


Understanding Pain: Brainman chooses


TEDxAdelaide - Lorimer Moseley - Why Things Hurt