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Pain: The Most Prevalent 4 Letter Word in Healthcare

Dr. Mike Studer, PT, MHS, DPT, CEEAA, CWT, CSST, CBFP,
CSRP, FAPTA

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Dr. Mike Studer, PT, MHS, DPT, CEEAA, CWT, CSST, CBFP, CSRP, FAPTA

- 33 years as a PT
- Neurology, geriatrics, athletics
- Clinician, author, scientist
- Innovator (tests, patents, trademarks and interventions)
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- Dr. Studer has been a PT since 1991, an NCS since 1995. He is co-founder and co-owner of Spark Rehabilitation and Wellness in Bend, Oregon and is an adjunct professor at Touro University and is additionally an instructor at UNLV. Mike remains active as a practicing clinician, researcher, author, and both DPT-program and continuing education presenter. Mike was recognized as the 2011 Clinician of the Year in the Neurologic and (in 2014) the Geriatric Academies of the APTA. He is well-traveled presenting invited lectures in all 50 states and 12 countries across 4 continents. Dr. Studer received the highest honor available in PT in 2020, being distinguished as a Catherine Worthingham Fellow of the APTA in 2020. Over his 33 year career, Mike has authored over 35 articles, 6 book chapters, and is a consultant to Major League Baseball.



Disclosures

- **Presenter Disclosure:** Financial: Mike Studer received an honorarium for this course. He is co-founder and co-owner of Spark Rehabilitation and Wellness in Bend, Oregon. Non-financial disclosures: Mike Studer has no non-financial disclosures.
- **Content Disclosure:** This learning event does not focus exclusively on any specific product or service.
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Course Description

- Chronic pain is now the most prevalent condition that persons in the United States experience symptoms-from, disability from, and die from. Over the past 20 years, our understanding of the neurophysiology of pain has improved dramatically. The science continues to improve yet "has arrived" to fully appreciate the bio-psycho-social contributions. However, the translation of science to practice in recognition of pain, the systemic and pervasive effects, and the multifactorial treatment strategies for pain, has lagged behind. In this course, we will bridge these very gaps from science to practice, with an introductory course in pain science and management for the rehabilitation professional.



Learning Outcomes

After this course, participants will be able to:

1. Identify at least four common warning signs that reliably indicate a patient's function is suppressed by the effects of chronic pain.
2. Describe the biological, psychological, and social aspects of pain in keeping with the contemporary models of pain science.
3. Identify at least three evidence-based strategies to positively impact function and direct care for persons experiencing chronic pain.



Course Timeline

- Introduction to the neurodynamics and history of chronic pain (20)
- The multifactorial nature of pain, from a bio-psycho-social perspective (15)
- Pain: A deeper dive to understand and manage (20)
- The relationship of pain and fear to each other, and on function (20)
- The soft skills: providing patient agency, autonomy, and “a way out” (25)
- Summary: Pain – the most prevalent 4 letter word in healthcare (10)
- Questions and Answers: (10)



continued[®]

The neurodynamics and history of chronic pain



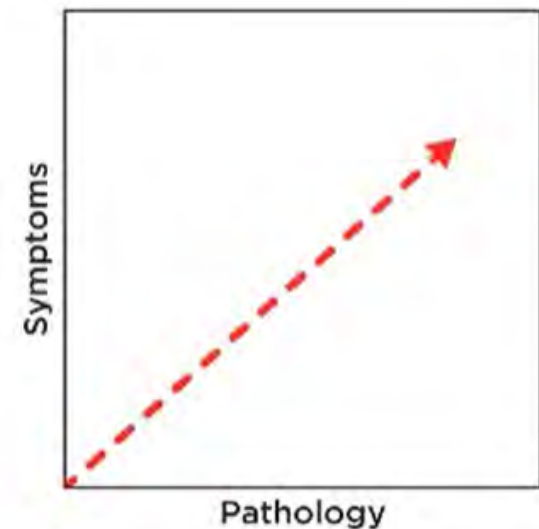
What is Pain?

“A multisystem output of the brain that is produced whenever the brain concludes that body tissue is in danger and action is required.”



Cartesian Model – René Descarte (1644)

- Assumption: there is a direct link between the amount of tissue damage and the level of pain experienced. (Patients truly believe this)
- All pain is caused by injury and increased pain means more damage
- Pain is either physical or psychological (mental versus physical) – dichotomous thinking
- In chronic pain tissues are not healing and damage is ongoing



Cartesian Model – René Descarte (1644)

Limitations:

1. If we remove ourselves from harm (fire, tac, lego, cut) the pain is gone.
(Acute)
2. If we amputate a painful limb, the pain goes away.
(Subacute)
3. If we avoid stimuli that cause pain, we will never experience pain again.
(Chronic)



116 million people in chronic pain

- \$635 Billion annually
- More than heart disease, diabetes, and cancer combined
- Costs approximately \$2000 per person per year in the USA



Definition and Prevalence: Chronic Pain

Persistent pain lasting for > 3 months*

Pain can be acute, meaning new, subacute, lasting for a few weeks or months, and chronic, when it lasts for more than 3 months.

Vranceanu et al., 2019

- Initial onset (now remote) of trauma, surgery, etc.
- Symptoms can be provoked without positional stimuli
- Challenged to describe location of current symptoms
- Predisposing factors of depression, stress, anxiety or panic (as much as 30%)



How *They* Define Pain is More Important

Persistent pain lasting for > 3 months*

Pain can be acute, meaning new, subacute, lasting for a few weeks or months, and chronic, when it lasts for more than 3 months.

Vranceanu et al., 2019

- Initial onset (now remote) of trauma, surgery, etc
- Sx can be provoked without positional stimuli
- Challenged to describe location of current sx
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Pain is a Personal Experience



Image: J Emerg Trauma Shock. 2010 Apr-Jun; 3(2): 193–196.
doi: 10.4103/0974-2700.62115

- Injured tissue would always hurt
- Normal tissue would never hurt
- Sham surgeries would never help
- Instead we see...
 - Funky nail and other dramatic stories
 - Normative data
 - Placebo surgery success

Dimsdale, J. E., & Dantzer, R. (2007). A biological substrate for **somatoform disorders**: importance of pathophysiology. *Psychosomatic medicine*, 69(9), 850–854.
<https://doi.org/10.1097/PSY.0b013e31815b00e7>



Neurophysiologic changes

- Neuroplasticity changes: **Positive**
- Movement, sensation, perception, knowledge

- Neuro (noci)plasticity changes: **Negative**
- Pain syndromes (thalamic)
- Synergistic movement changes, recruitment patterns
- Elevated sensory interpretation: sensitization
- Psychological blunting, REDUCED expectations
- Anxiety and Fear-Avoidant Behavioral Tendencies



Why does pain **persist**?

- Nociception - normal pain reporting to stimuli
- Peripheral neuropathy - follows pattern + hx
- Nociplasticity central changes after prolonged pain (spinal cord interneuron modulators)
- Adaptive changes at the tissue (GTO, etc)that THEN interact with spinal cord interneurons
- Central (perceptual) expectations – lived and vicarious experiences
- Memory – yes...episodic memories of pain, associations by context, position, event, etc.



Changes Due to Acute and Chronic Pain

- Neurotransmitter
- Structural (CNS) – reinforced interconnections through neuroplasticity
- Psychological (expectations from self, media, social connections)
- Changes to pain receptors
- Biomechanical (compensatory)
- Structural changes (contractile tissues - body)
- Personalized perceptions, bio-psycho-social
- Activity (fear avoidance and deconditioning)



Central (CNS) Changes of Neuroplasticity: + and -

Chronic Low Back Pain (CLBP) changes the brain (neuroplasticity):

Reduced brain volume (atrophy) in:

- Ventrolateral prefrontal cortex
- Dorsolateral prefrontal cortex
- Posterior cingulate cortex
- “Significant cluster” of reduced volume in the left superior frontal gyrus

Increased brain volume (hyperactivity) in:

- Amygdala



Persistent Pain: “Stress Axis” Hypothalamus-Pituitary-Adrenal

- **Hypothalamus** receives peripheral pain signals and sends a hormone to the anterior pituitary.
- **Pituitary gland** receives hormone and sends a different hormone to the adrenal glands.
- **Adrenal glands** receive the hormone and release cortisol into the body



Persistent Pain: “Stress Axis” Hypothalamus-Pituitary-Adrenal

STRESS RESPONSE SYSTEM

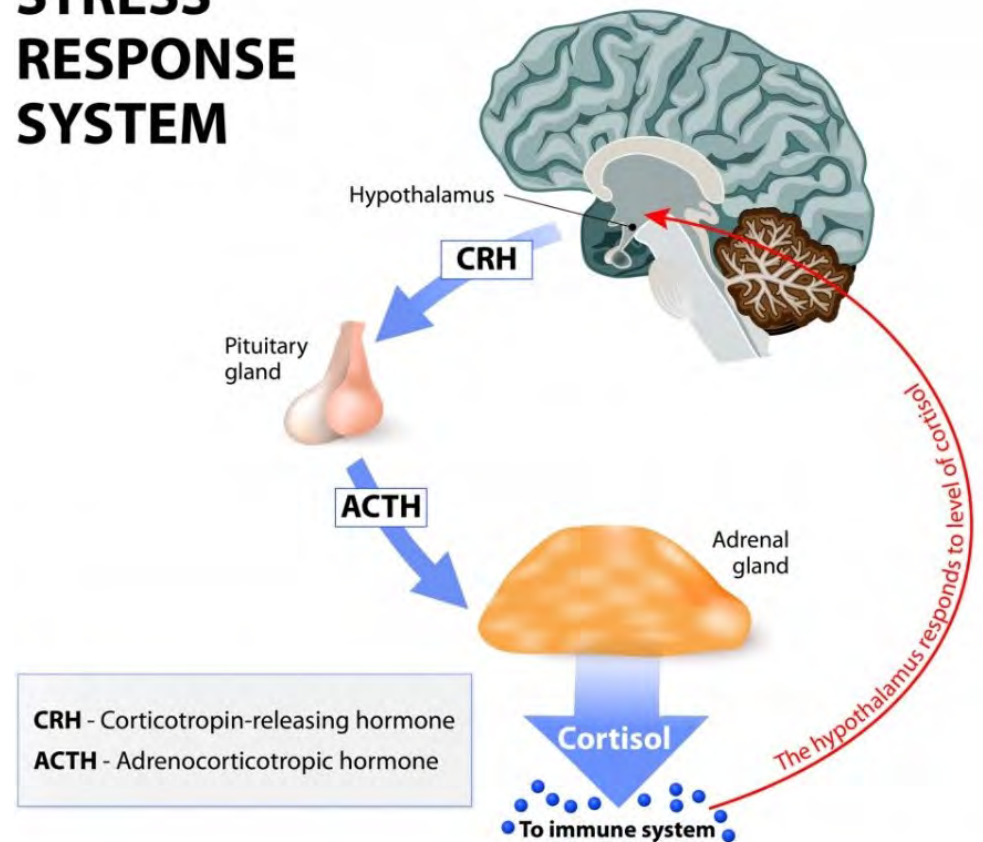


Image: Continued (licensed from Getty Image)

Neuroplasticity is not ALWAYS helpful...

- CNS can spontaneously make connections that are aberrant/unhelpful
- Experiences become associated over time (Hebbian)
- **Recall that our sensory detectors can additionally become sensitized**
- Neurons that fire together, wire together...
 - “If I bend down, I will get pain.”
 - “If I move quickly...”
 - “If I am nudged...”
 - “If I take too long of a step...”
 - “If I ride in her car...”
- Read more: Louw, Moseley, Sullivan, Flynn



Learned non-use and **dysfunctional** neuroplasticity

- Elevated sensory receptors
- Sympathetic potentiation
- Compensatory “Bad habits” – movement/mannerism and behaviors
- Learned non-use: motor AND sensory impairment
- Dysfunctional connections “wiring” – injury or not



Learned non-use and **dysfunctional** neuroplasticity

- Elevated sensory receptors: “Is that my knee going out again?”
- Sympathetic potentiation: enhanced connectivity and Hebbian wiring
- Compensatory “Bad habits”: movement/mannerism and behaviors
- Learned non-use: motor AND sensory impairments secondary to pain
- Dysfunctional connections “wiring” – injury or not



Is my back going out again???



Image: Continued (licensed from Getty Image)

Problem: The detectors are on the lookout!

Pressure

Stiffness

Instability

Fatigue

Post-exertional soreness



Image: CHG, Public domain, via Wikimedia Commons

Problem: The detectors are on the lookout!

Pressure

Stiffness

Instability

Fatigue

Post-exertional soreness



Image: Continued (licensed from Getty Image)

Is this pain...or is it (therapeutic) soreness?

Pain

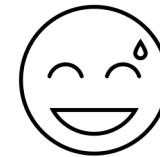
Localized
Persists



Inhibits movement/disrupts
Recurrs and the same place

Soreness

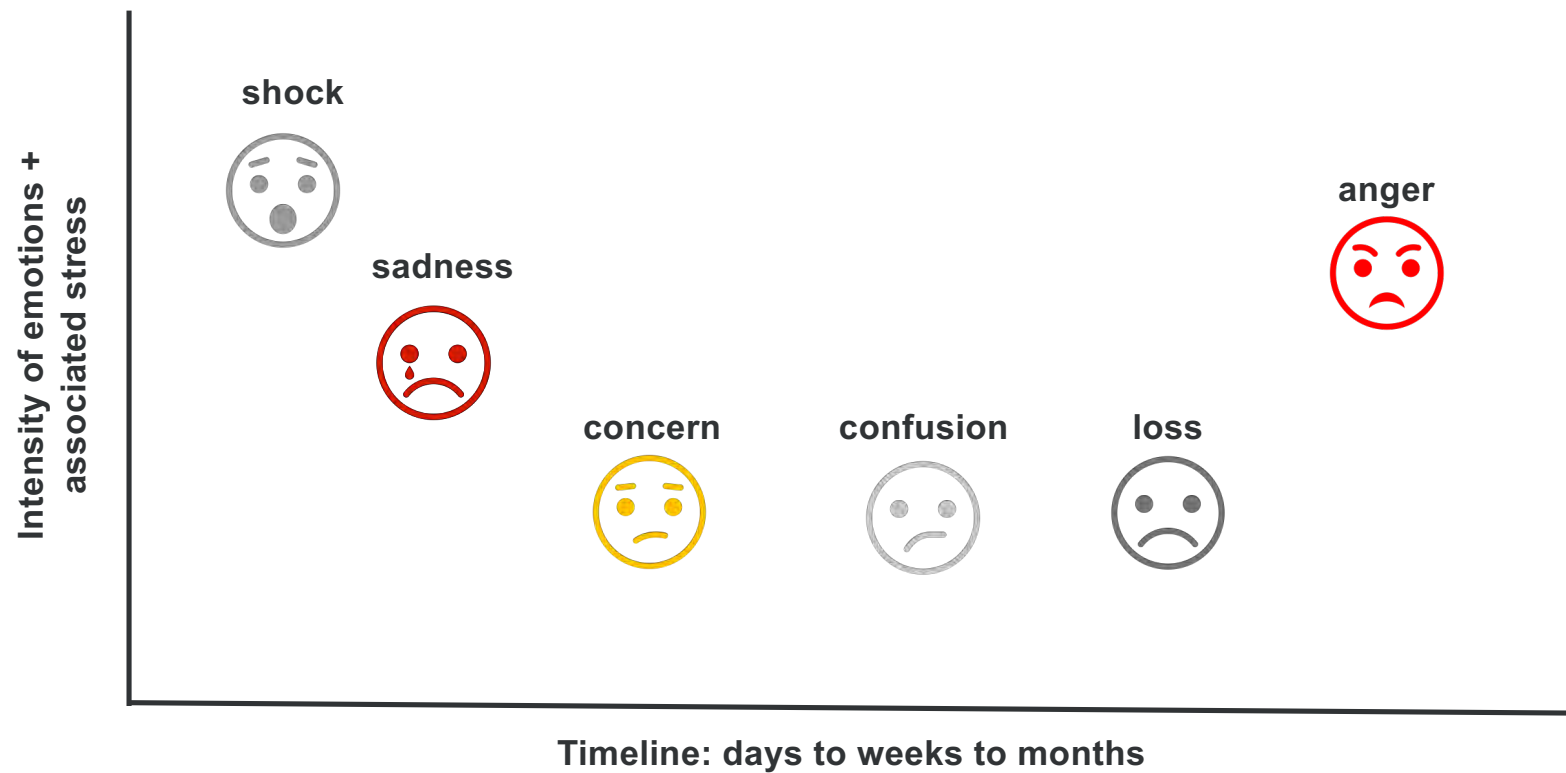
Generalized
Clears with movement, improves



Widely-distributed
“Stiffness”



The Progression: From acute to chronic pain

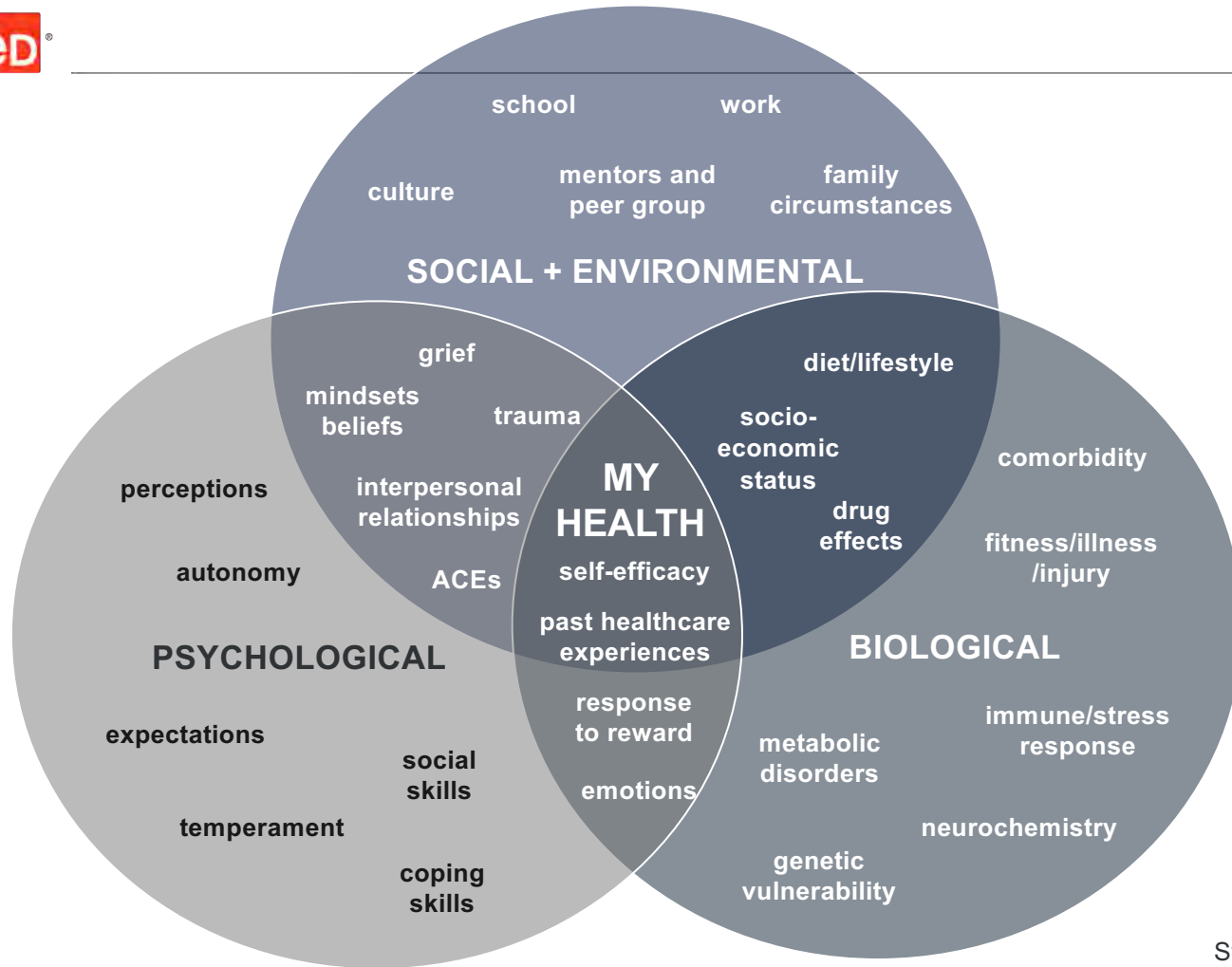


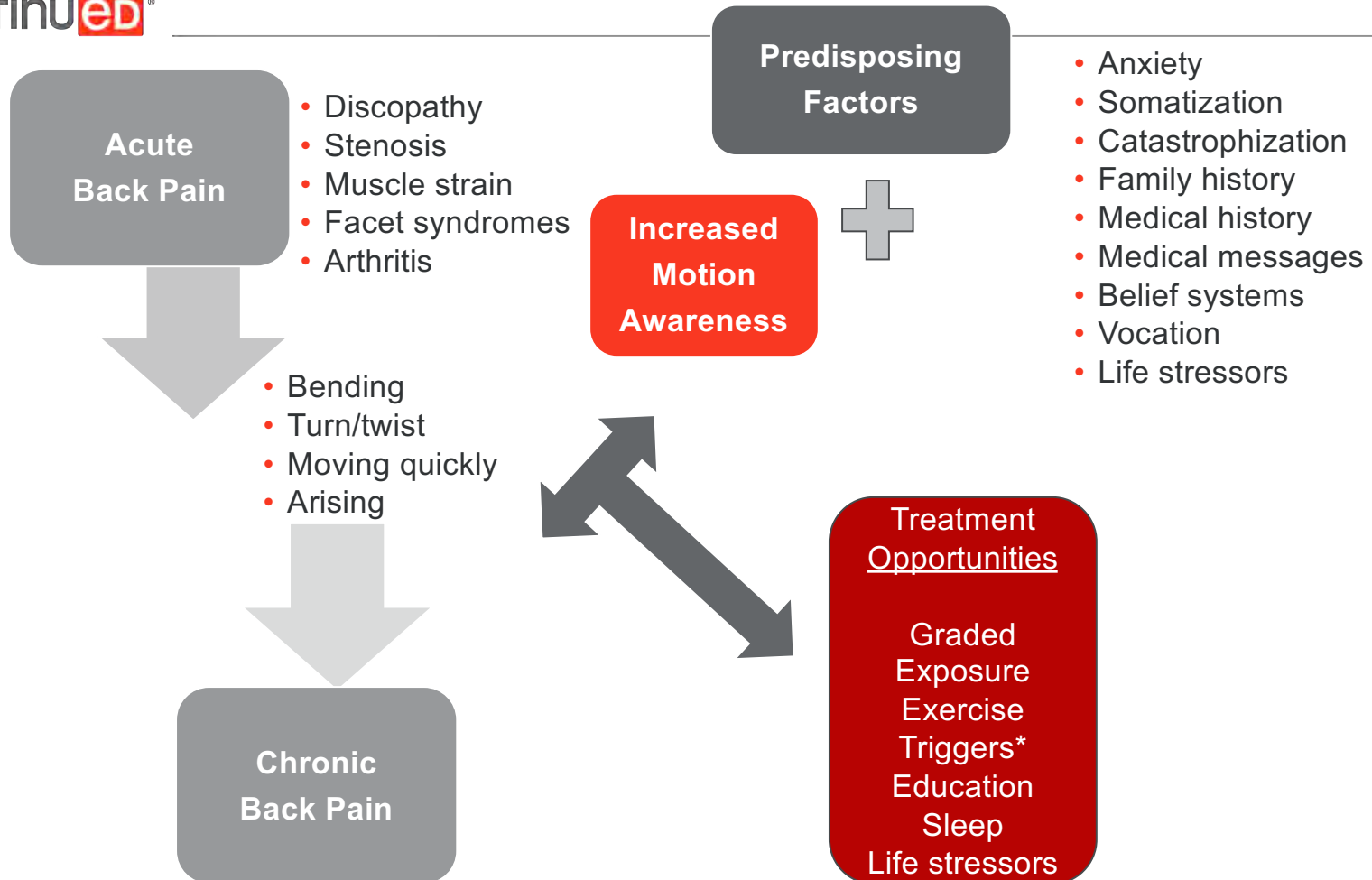
Studer 2017, modified 2022

The multifactorial nature of pain

A bio-psycho-social perspective



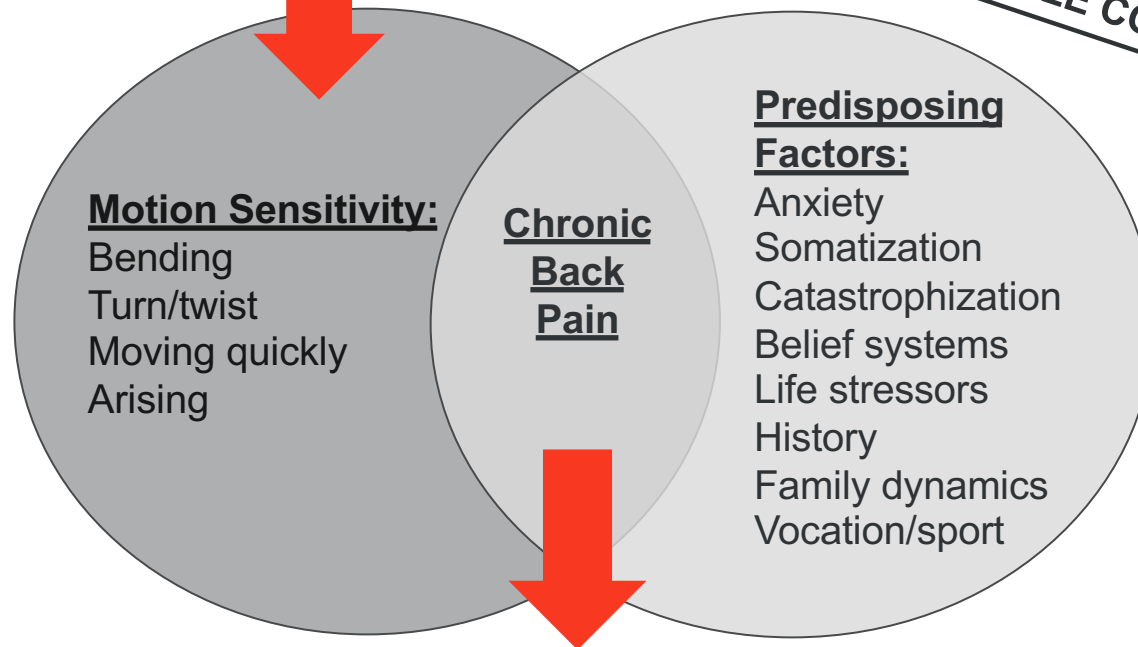




Acute Back Pain:

discopathy, stenosis, muscle strain,
facet syndromes, arthritis, etc.

THIS MODEL IS ACTUALLY
RELEVANT FOR ALL OF THE
INVISIBLE CONDITIONS



Chronic Back Pain: Treatment Continuum

exercise, education, sleep, trigger management, graded exposure, life stressors



I believe you

- Psychological changes are biological changes (consider the source)
- Does pain (or movement disorder) “live” in the body part, after all?
- The need for an explanation: image, test is a natural rationalization that does NOT need to be fulfilled
- You are NOT on trial here...to prove that this is real



The “Terrible Triad” of Pain

- Suffering
- Sleeplessness
- Sadness

All three can lead to changes in movement, mood, function, relationships, and what treatments you may accept



This is your brain...

- Speed of processing:
 - **0.25 seconds to visual**
 - **0.17 for an audio**
 - **0.15 seconds for a touch stimulus.**
- Multitask – may reduce response speeds 10-35% in normal individuals
- Recall of old information - Lu Chao of China, who, in 2005, recited 67,890 digits of pi
- Digit span capacities – Average 7+/-2; , in 2015, Alex Mullen, recalled **3029 digits**
- WR holders in memory tasks – **2,530 cards**, achieved by Kim Surim
- Motor tasks: Fastest time to arrange a deck of shuffled playing cards is 36.16 sec



This is your brain on pain

- **Primary sensory cortex:** Parietal lobe, sensory processing – accuracy and efficiency. Accuracy by sensation, region, and magnitude
- **Amygdala:** Fear, threat and sympathetic nervous system regulation, addiction
- **Prefrontal cortex:** Decision-making, prioritization, attention, and compulsion
- **Cingulate cortex:** Associations, attention
- **Premotor and primary motor cortex:** Movement organization, selection
- **Cerebellum:** Coordination, comparison, cognition, and episodic memories
- **Hypothalamus/thalamus:** Autonomic and hormonal regulation
- **Spinal cord:** Transmission and interruption/modulation
- **Hippocampus:** Memory storage, perception of facts and events

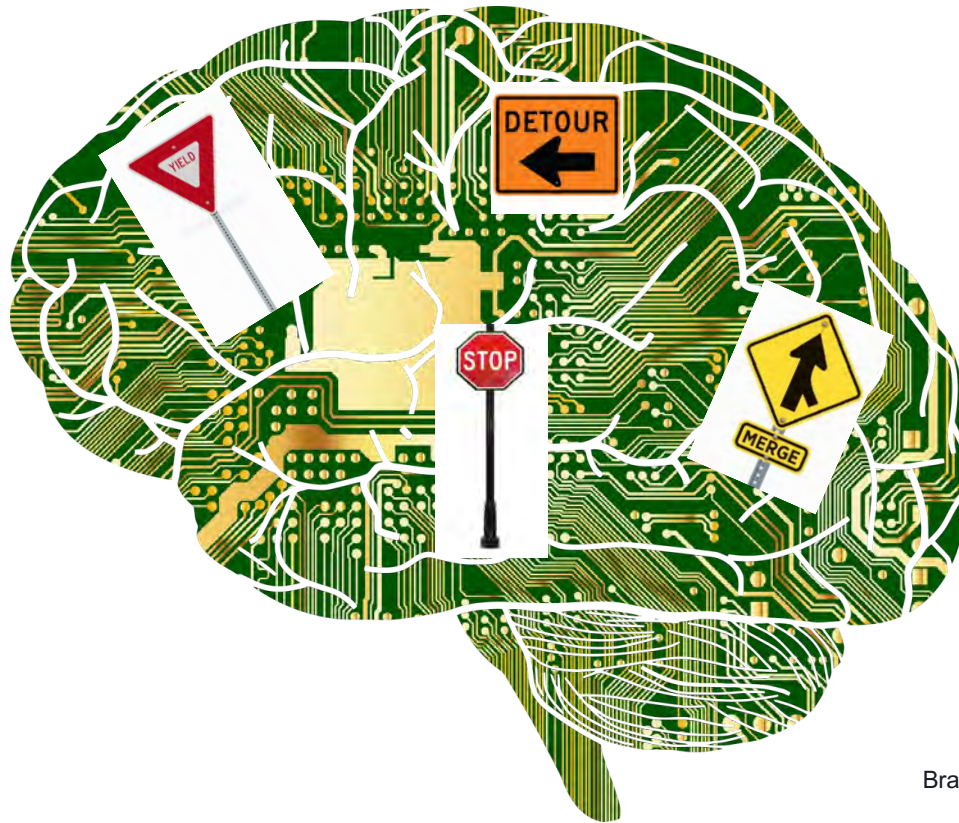


Opportunities and Challenges: Pain in the nervous system

- 83 billion neurons
- EACH: 5,000 to 100,000 connections (EACH)



Wonderful normal brain + plasticity



Brain Image by [Gordon Johnson](#) from [Pixabay](#)

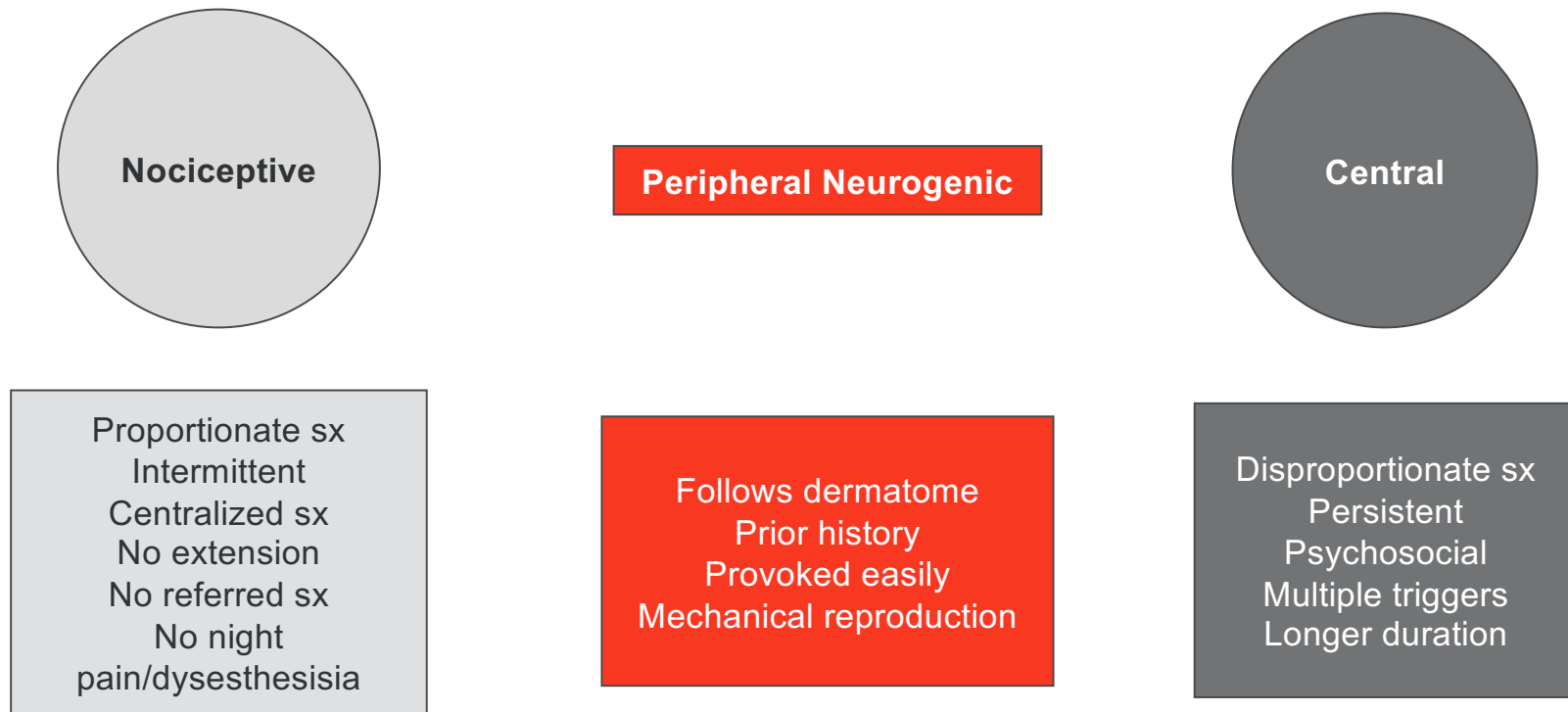


Nociception Vs. Pain

- Receptors report: mechanical, thermal, and chemical changes
- CNS can enhance or suppress the perception of pain



A deeper dive into pain science...



Smart et al., 2012. Symptoms and signs of central sensitization

The Soft Skills in Pain:

Agency, autonomy, and “a way out”



Patient story and beliefs

Beliefs, mindsets (personal **and** what peers/mentors/family members think)

- Educational background*
- Vocational background
- Personal interests



Save for
educational
moments/analogies



Beliefs

Beliefs, mindsets (personal ***and*** what peers/mentors/family members think)

- What will work for me – my direct experiences
- What works for people like me – vicarious experiences and media
- Will anything work for me – efficacy vs. catastrophization
- My contribution to the plan – active vs. passive role
- Halo effect, confirmation bias, early wins (gamification), and more



Medical hx + care for **this condition + this person**

Patient

- What has worked for you?
- What has not worked for you?
- Have you been listened to?

Practitioner

- What has worked for me, with people like you
- What the science says
- What my exam indicates



Diagnosis: Medical and “My-diagnosis”

- What you have read as a medical professional (chart, research, etc)...
- What the patient believes...
 - “my leg length discrepancy”
 - “extensive arthritis in my spine”
 - “bed is too soft”
 - “my mom had back problems”
- What you believe...



Inhibitory Learning Model

Treating fear of pain is most effective when:

- The frequency of “worst outcome” is so infrequent that fear is reduced?
- The likelihood is reframed sufficiently to reduce obsession on fear?
- Worst outcome is experienced, and tolerated, removing need for fear?

Clearly, the “best” is both person and situation-specific



Perfecting the patient interview

- Diagnosis
- Medical history and care for this condition
- Patient story and beliefs
- Your agenda
- Generalized exercise
- Hitchhiker analogy
- Productivity
- Autonomy



Medical hx + care for this condition



Image: Continued (licensed from Getty Image)

- What has worked for you?
- What has not worked for you?
- Have you been listened-to?



Ready for your mind to be blown?



Image by [CryptoSkylark](#) from [Pixabay](#)



Ready for your mind to be blown?



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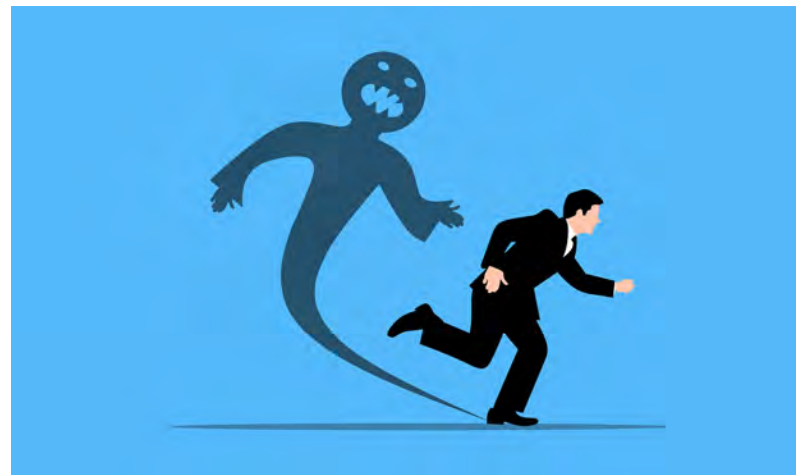


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Unwarranted fear and placebo are two sides of the same pendulum, coin, etc.



continued

Should we use “the placebo”

- How much can we gain by leveraging a placebo?
- What happens when we leave placebo on the table?



continued

Why do we ascribe negative externalities to “the placebo...”

- Is the placebo fake?
- Is it snake-oil?
- Or is it the self-efficacy of an efficacious plan?



Using the Placebo...

When I have autonomy, I...

1. Believe that my/our solution will work best
2. Will try harder to see that my solution succeeds
3. Will be more attentive to the outcome



Practical strategies that leverage patient belief

1. Maximize autonomy in movement (exercise, dance/music, recreation, competition, active travel, purpose, play)
2. Maximize self-efficacy
3. Vicarious experiences
4. Enhanced expectancies
5. Reveal accountability
6. Unbiased observers (includes technology)
7. Gamification



Using Beliefs to Your Collective advantage

- Mindsets or beliefs
- Social context
- Natural processes physiologic



Crum et al., 2021 "Can exercising and eating healthy be fun and indulgent instead of boring and depriving? Targeting mindsets about the process of engaging in healthy behaviors. *Frontiers in Psychology*."

Using the Placebo...

When I have autonomy, I...

1. Believe that my/our solution will work best
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I believe you

- Psychological changes are biological changes (consider the source)
- Does pain (or movement disorder) “live” in the body part, after all?
- The need for an explanation: image, test is a natural rationalization that does NOT need to be fulfilled
- You are NOT on trial here...to prove that this is real



The relationship of pain and
fear

...to each other – and on
function



How do pain and fear of future pain affect movement quality and quantity?

1. Stop us from moving (avoidant)
2. Increase internal focus when we do move
3. Draw from finite attentional resources (fear is a distraction)



Hebbian Learning: Clinical application

- I turn fast = I get dizzy
- I bend down = I have pain
- The unexpected happens = My arm tremors
- I eat too fast = I pass out

*These can be aphysiologic and STILL learned...!



Remember “fire together, wire together”?

Experiences become associated over time
(Hebbian)

Neurons that fire together, wire together...

- “If I bend down, I will get pain.”
- “If I move quickly...”
- “If I am nudged...”
- “If I take too long of a step...”
- “If I ride in her car...”

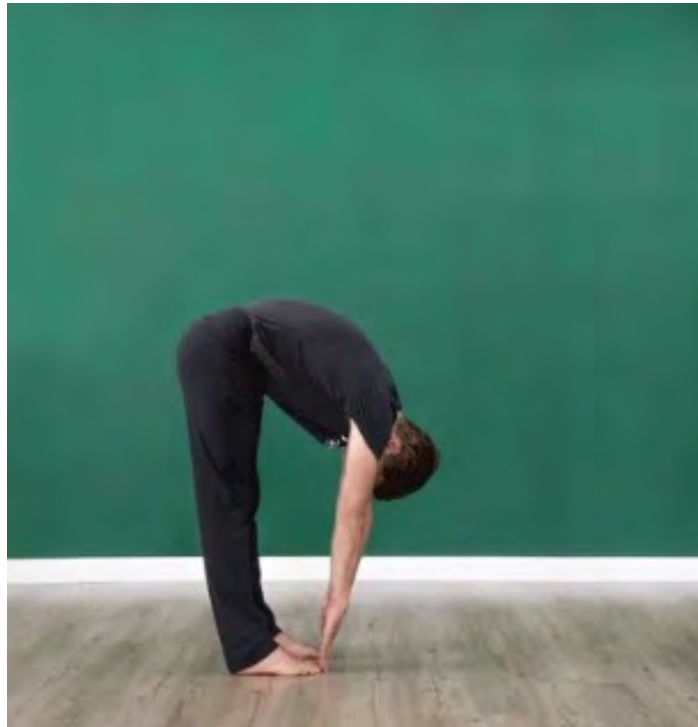


Exposure and Response Prevention (ERP)

- ERP reduces (or *extinguishes*) fear
- Systematically confronting feared situations to “unlearn” or “erase”
- *Habituation* —fear naturally declines over time with repetitions
- Habituation indicates that exposure is “working.”



Exposure and Response Prevention (ERP)



Inhibitory Learning Model

- **ERP needs to help people feel safe to confront their fears in such a way that it is strong enough to block out (or *inhibit*) the original fear**
- Fear extinction is maximized when a person uses ERP to learn new safety information that inhibits existing obsessional fear.
- The goal of ERP is therefore to learn safety in a way that permanently inhibits obsessional fear.

Craske, M. G., Treanor, M., Conway, C. C., Zbozinek, T., & Vervliet, B. (2014). Maximizing exposure therapy: an inhibitory learning approach. *Behaviour research and therapy*, 58, 10–23. <https://doi.org/10.1016/j.brat.2014.04.006>



Move with music...

- Autonomy
- Spontaneity
- Dopaminergic
- Positive episodic memories (Hebbian rewiring)



Generalized ~~exercise~~ movement

- What I like to do in movement...
- Reducing internal focus
- Cardio-respiratory drive toward HRV and parasympathetic drive
- Change of sensations
- Serotonergic and potentially dopaminergic
- Productive, viewable

Bonus features: Endorphins, BDNF, sleep, systemic changes



Generalized ~~exercise~~ movement

- What I like to do in movement...
- Reducing internal focus
- Cardio-respiratory drive toward HRV and parasympathetic drive
- Change of sensations
- Serotonergic and potentially dopaminergic
- Productive, viewable



Purposeful + Productive

- Musculoskeletal and fitness benefits of movement
- Dopamine
- Serotonin
- Oxytocin
- Distraction
- Self efficacy



Images: Continued (licensed from Getty Image)



Letter to Self: Chronic Pain

Dear Brind,

Thank you for using your tools to alert me that something has gone awry. I accept that you are using pain as a warning signal that there is something to be attended to, including elevated stress in my life, a deficit of sleep in my life, and a disconnect between you and my body. Thank you for your warning signals, without which it might be hard for me to attend to these underlying issues that I can control. I do not want to place faults and how you have warned me. I want to thank you for warning me, so that I may be able to begin to help myself and seek help.



Hitchhiker analogy



Image: Continued
(licensed from Getty Image)



Hitchhiker analogy

- Find the road that this patient is on...
- How they got this far (prior care, etc.)
- Desired destination
- Preferred ride/pace (include stops)
- Expectations for the ride (music, bumpy road)
- Are you the right driver (match)?
- Have you been (destination) there before?



Image: Continued (licensed from Getty Image)



A Balance of Autonomy

Patient control

- Attention
- Agency
- Responsibility
- Burden of choice



Therapist control

- Reduced cortisol
- Professionalism
- Order/clarity
- Objectivity



The Benefits of Feeling Helpful and Productive...

- Accurate anticipation of homeostatic feeling states associated with gain, loss or control outcomes facilitates motor execution
- Links interoceptive (self awareness) and motor domains
- Reduces cortisol, allowing for success, performance, neuroplasticity
- Releases oxytocin if your productivity is helping others
- Releases serotonin if your productivity came with your own choice
- Releases dopamine if you have a surprising success

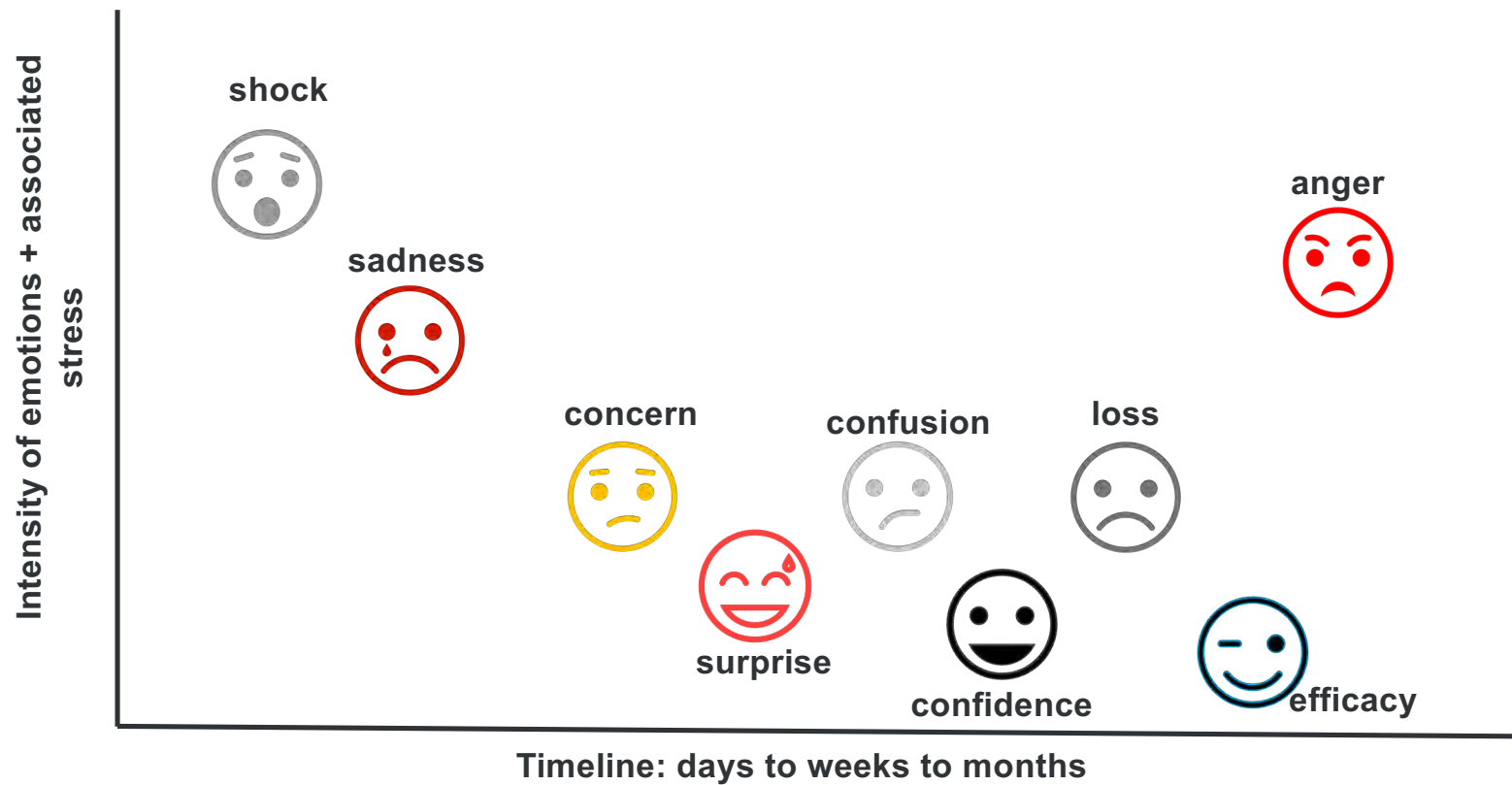


Course Summary:

Pain – the most prevalent 4 letter word in healthcare



The Progression: Resolving persistent pain



The main points...

- Use generalized exercise to release healing properties
- “Control the controllables”: sleep, stress, nutrition.
- Limit focus on the painful body parts – but do not pretend inexistence
- Don’t try to find a solution in imaging
- Don’t try to prove that pain is not real or will suddenly go away
- Normalize chronic pain and fear (116 million people/yr in the US)
- Allow the patient to SEE a measurable difference/change
- Allow patients to see the plans and hold accountability
- Resist temptations to predict patient performance
- Celebrate accomplishments without excess, acknowledge, don’t “party”



Thank you!

Mike Studer, PT, DPT, NCS, CEEAA, CWT, CSST,
CBFP, CSRP, FAPTA

- Contact me: mike@mikestuder.com
- Instagram and YouTube: @mikestuderdpt



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