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Traumatic Brain Injury – Behavioral Health ECHO

UW Medicine | Psychiatry and Behavioral Sciences

Pain After Traumatic Brain Injury: Complexity, Concepts, and Care

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Speaker disclosures

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Objectives

1. Describe the types of pain
2. Understand related outcomes, conditions, and psychosocial factors associated with TBI and Pain
3. Understand conceptual models of pain and their application to treatment
4. Identify evidence-based approaches for treatment of pain
5. Discuss clinical takeaways for assessment and practice

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Pain Defined

- "an unpleasant sensory and emotional experience arising from actual or potential tissue damage or described in terms of such damage" *(International Association for the Study of Pain, 2014)*
  - Acute Pain: *Less than 3 months. Related to tissue damage, inflammation, injury. Known cause. Predictable course.*
  - Chronic/Persistent Pain: *3 months or more. Often unclear the pathology. Nervous system creates pain. Unpredictable course*

Types of Pain

- Nociceptive
  - Associated with activation of nociceptors (inflammation, mechanical/irritant, injury)
  - Examples: acute injury, arthritis
- Nociplastic
  - Due to change in central processing of pain/pain-related stimuli
  - Examples: fibromyalgia, temporomandibular disorders, non-specific low back pain
- Neuropathic
  - Due to lesion, disease, inflammation of the somatosensory system
  - Diabetic neuropathy, carpal tunnel, complex regional pain syndrome

The Societal Problem of Chronic Pain

- Most common presenting problem in primary care
- Experienced by most individuals at some point in their lives
- Common across most rehabilitation conditions
- One of the greatest expenses in healthcare and drivers of lost productivity

TBI Model Systems Study: Characterization and Treatment of Chronic Pain after Moderate to Severe Traumatic Brain Injury

- Largest study to date on chronic pain in TBI
- Multi-site study across 17 TBI Model Systems (TBIMS) centers + 1 VA center, led by Craig Hospital, to investigate chronic pain post moderate-severe TBI.
- Objectives:
  - Characterize chronic pain types, treatments, and outcomes.
  - Identify treatment barriers/facilitators.
  - Improve pain management guidelines.
- Participants: Enrolled at TBIMS National Database. Meet criteria for moderate to severe TBI.
- Method:
  - During routine TBIMS follow-ups (1/2/5 years post-injury).
  - Data Collection: Web/phone/paper surveys + TBIMS database linkage.

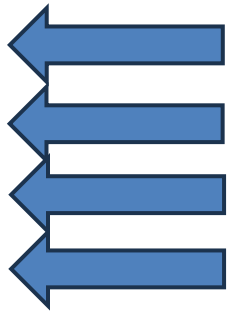
TBI and Pain Prevalence

- Some findings demonstrate up to 71% of patients report chronic pain after moderate to severe TBI
- Prevalence varies based on sampling of civilian versus military/veterans
- Findings from TBI Model System Study (*N* = 3,805):
  - 46% (1,762) current chronic pain (>3 months).
  - 14% (525) past chronic pain (resolved).
  - 40% (1,518) no chronic pain post-TBI.

Harrison-Felix et al., 2024; Hoffman, Lucas, & Dikmen, 2011; Nampiaparampil, 2008

Pain Location(s) for Those Participants with Current Pain

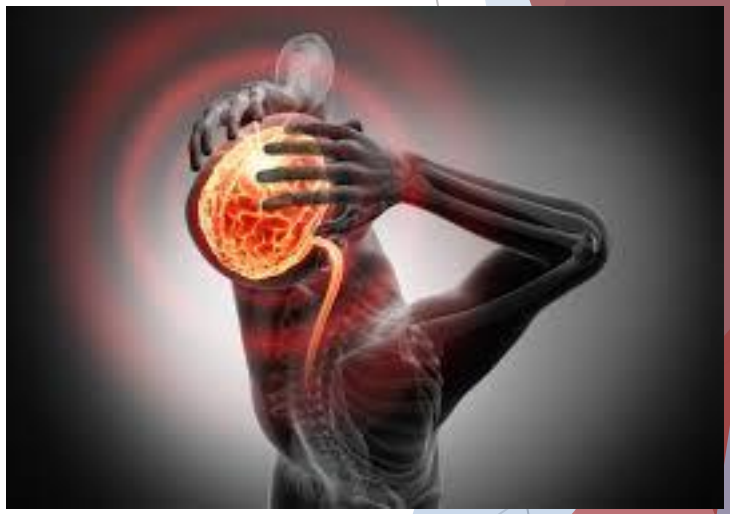
	N	%*
Back	1136	64.5
Legs and/or feet	1064	60.4
Shoulder	838	47.6
Head, such as headache or migraine	828	47.0
Neck	787	44.7
Arms and/or hands	703	39.9
Hips	623	35.4
Face or jaw	310	17.6
Pelvic area or groin	276	15.7
Buttocks	214	12.1
Widespread pain or fibromyalgia	185	10.5
Chest	179	10.2
Abdomen	179	10.2



Harrison-Felix et al., 2024

TBI + Chronic Pain = Increased Complexity

- Compared 3 groups on outcomes: TBI + Chronic Pain vs. TBI with Past Pain (Resolved) vs. TBI without Chronic Pain
  - TBI + Chronic Pain: Reported worse depression, anxiety, PTSD, sleep quality and community participation
    - These negative associations persisted even after adjusting for factors like sociodemographic and concurrent function
    - Large effect size for TBI + Pain group
  - Past Pain (Resolved) group demonstrated means closer to the no pain group
  - **Those with chronic pain and TBI seem to have worse psychosocial outcomes across the board compared to those with TBI and no current or past pain**



Hanks et al., 2024

Additive Impact of Pain on Cognitive Function

- TBI itself can lead to cognitive changes and deficits.
- Chronic pain is known to negatively impact cognitive function in general pain populations
- Peckham et al., 2025 (*n* = 1762)
  - Individuals with TBI who report current chronic pain exhibit lower cognitive performance compared to those without pain
  - Among those with chronic pain after TBI, greater pain intensity and interference was negatively associated with cognition, even when accounting for TBI severity, age, level of education, anxiety, sleep quality, opioid use, and primary insurance provider.
    - Effects were more pronounced for individuals with head pain versus other parts of the body.
- For individuals with a history of TBI, chronic pain places an additional cognitive burden on patients with history of TBI

TBI, Pain, and Sleep

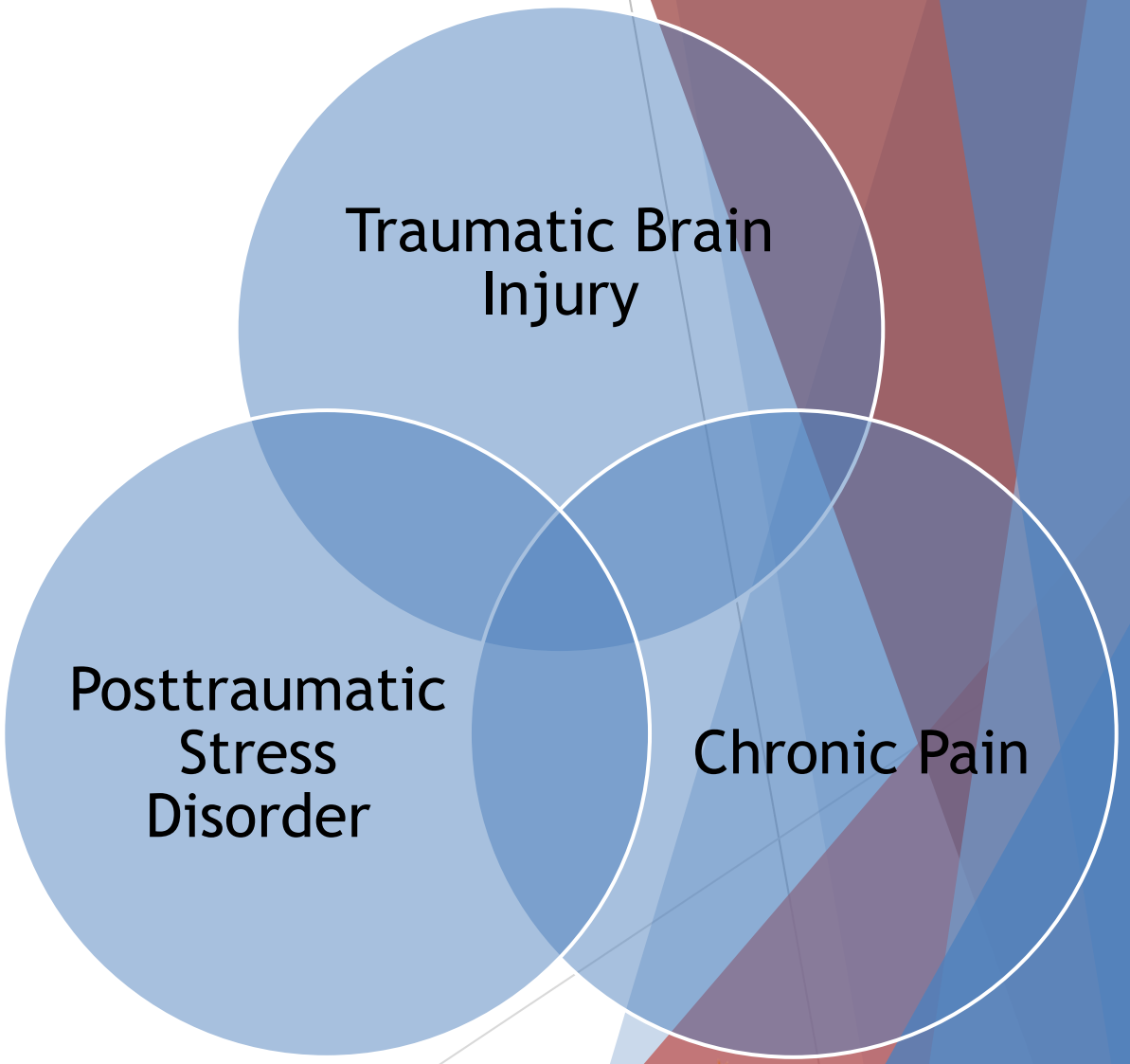
- Sleep disturbances are common after TBI and have a complex and likely bidirectional interaction with pain.
  - Inflammatory processes may underlie the sleep and pain interaction
- TBI patients with chronic pain show categorically worse indicators of sleep-disordered breathing compared to those without chronic pain
  - This includes elevations in central and obstructive apnea events and oxygen desaturation indices
- Both sleep disturbance and pain are common comorbidities after TBI and are associated with higher odds of global disability in this population

Irvine et al., 2018; Herrero Babiloni et al., 2023

Polytrauma Clinical Triad

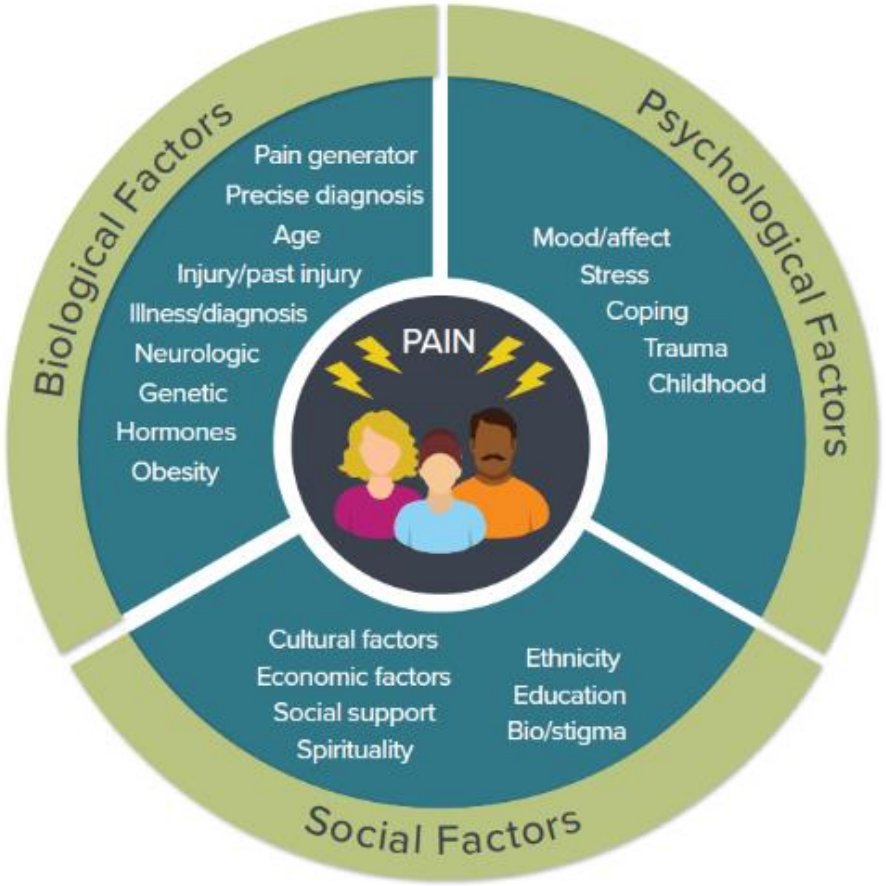
Bryant et al., 1999

- In patients with severe TBI, those with chronic pain were more likely to report PTSD than those without pain.
- Higher pain severity was associated with increased severity of PTSD, depression, poor satisfaction with life, and avoidant coping style.
- After controlling for the effects of PTSD, the only factor that still correlated with pain severity was avoidant coping style.



Conceptual Models of Pain

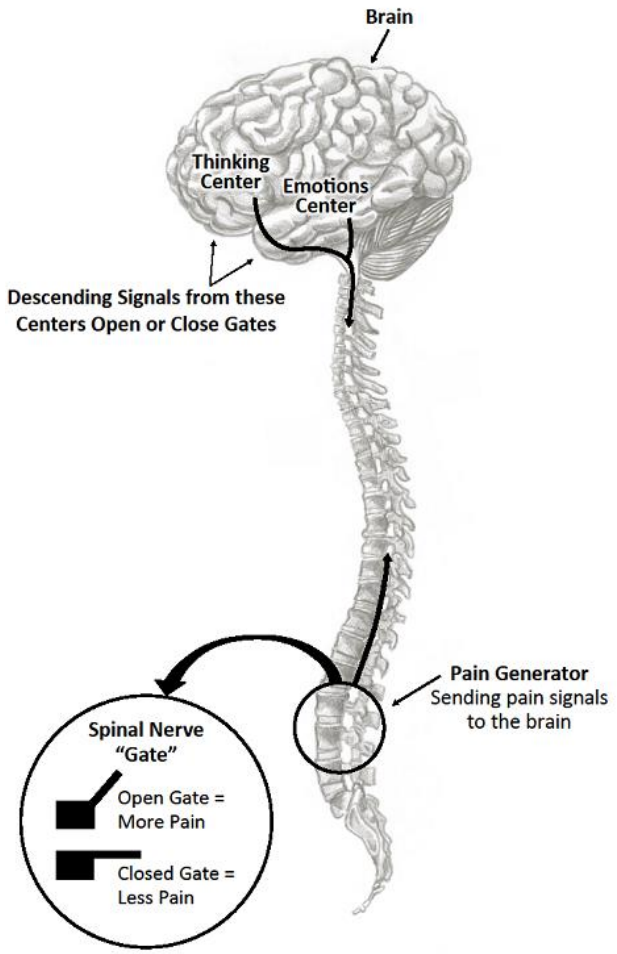
Theories Underlying Pain Treatments



BIOPSYCHO SOCIAL MODEL OF PAIN

Gate Control Theory: The brain is in charge

- The brain is “in charge” of which sensations we feel, and how much we feel them
- This seminal theory accounts for physical and psychological aspects of pain perception
- Certain stimuli can turn the “volume up” and dampen perception
- Factors can function as “gate closers” and “gate openers” on pain
- Physical sensations, emotions, cognitions, past experiences can impact pain perception
- Ex: When you hit your hand against something, what do you usually do?



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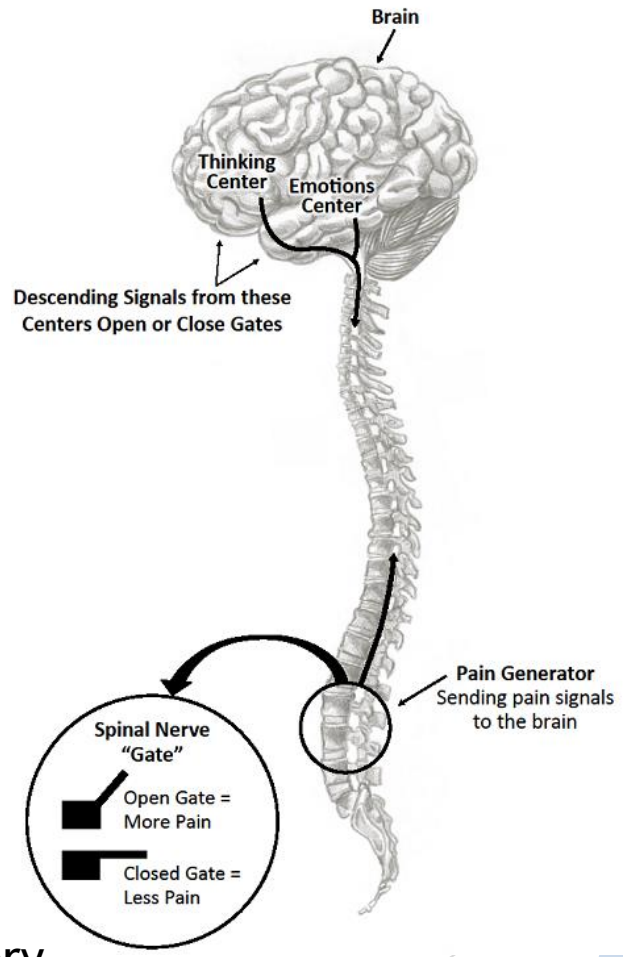
Gate Control Theory: The brain is in charge

Physical/Sensory Stimulation	Movement Based Therapy	Neuromodulation	Psychological Treatments
•Massage •Acupuncture •Heat and Cold •Transcutaneous Electrical Nerve Stimulation (TENS) •Virtual Reality	•Physical Therapy •Graded Exercise Therapy •Yoga/Tai Chi •Graded Motor Imagery •Mirror Therapy	•Spinal Cord Stimulators •Peripheral Nerve Stimulation	•Cognitive Behavioral Therapy •Hypnosis •Acceptance and Commitment Therapy •Mindfulness Based Stress Reduction •Relaxation Training •Distraction •Emotional awareness and Expression Therapy •Pain Reprocessing Therapy



Gate Control Theory explains why stimulating other sensory pathways or shifting cognitive focus can literally reduce the amount of pain information that reaches the brain

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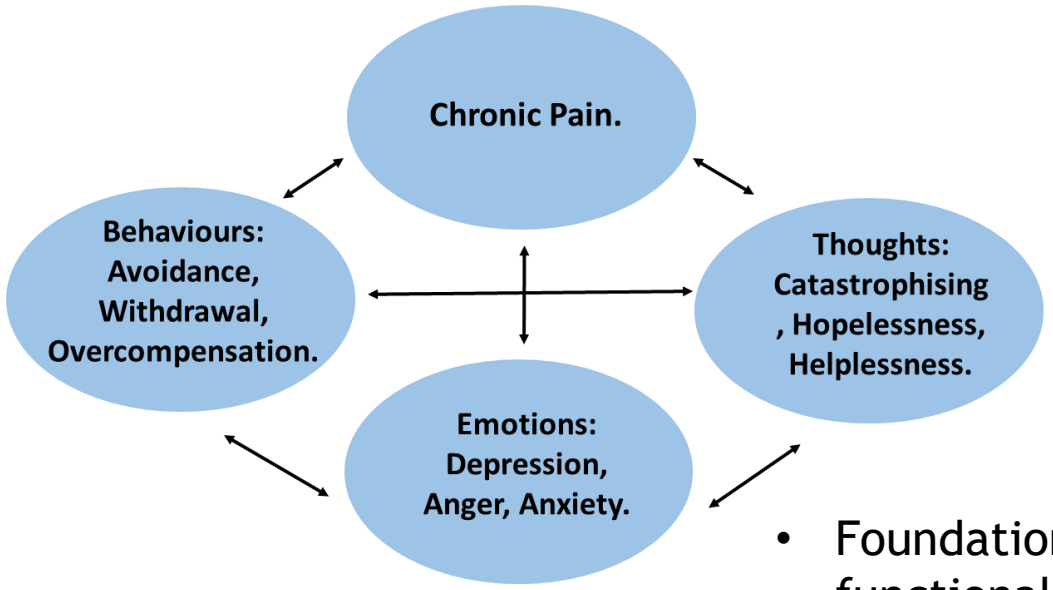


A Way to Conceptualize Chronic Pain: Cognitive-Behavioral Model

- Foundational to individual CBT, and to many functional restoration/pain rehabilitation programs (IRPs)
- Bidirectional associations between thoughts, feelings, and behavior
- **Negative thoughts** → emotional distress → avoidance → more pain
- CBT, ACT, mindfulness can address this cycle

Cognitions and Pain

A major part of helping patients feel and respond better to their pain is improving how they perceive, or appraise their pain (focus of psychotherapies)

Cognitive Appraisals of Pain Experience

Hurt vs. Harm

Expectations about Pain and Management

Modulate Attention to Pain

Cognitive Responses to Pain

Pain Catastrophizing: Helplessness, Magnification, and Rumination

- Unhelpful/Maladaptive Thoughts About Pain

The Role of Pain Catastrophizing in TBI and Pain

Large national study (***N* = 1,762; TBI + chronic pain**)

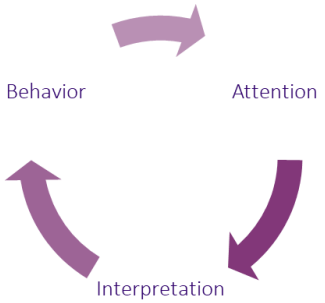
Participants split into **high vs. low catastrophizing groups** (top vs. bottom PCS quartiles)

High Catastrophizing Group	**Low Catastrophizing Group**
Younger	Older
More female	More male
Lower education	Higher education
More likely unemployed	More likely employed
Higher pain intensity	Lower pain intensity
Higher pain interference	Lower pain interference
More neuropathic pain & migraine	Less neuropathic pain
Poorer functional outcomes (FIM, DRS)	Better function

- **Key takeaway:**
- **Pain catastrophizing = strong predictor of poor pain and functional outcomes**
- Identifying extreme catastrophizing may guide **early BH referral**
  - **Catastrophizing is MALLEABLE and can be addressed through CBT/ACT intervention**

Martin et al., 2024

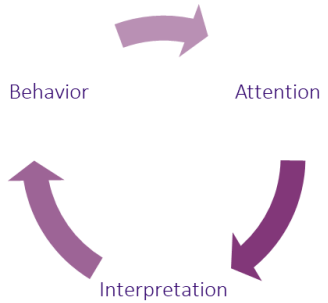
The Role of Cognitions in Pain



1. Attention – on purpose or involuntary
   Bend over and notice pain increase
2. Interpretation – appraisal/reaction
   Something is wrong... Something is broken.... Now I will get worse....
   Sympathetic stress response, stress hormone release, muscle tension, etc. (Body tells the mind, "Yes, there is danger, pay attention to it!")
3. Behavior
   Activity avoidance, increasing physical limitations/loss of function, increased attention to symptoms.

Taken with permission from Kaitlin Touza, PhD

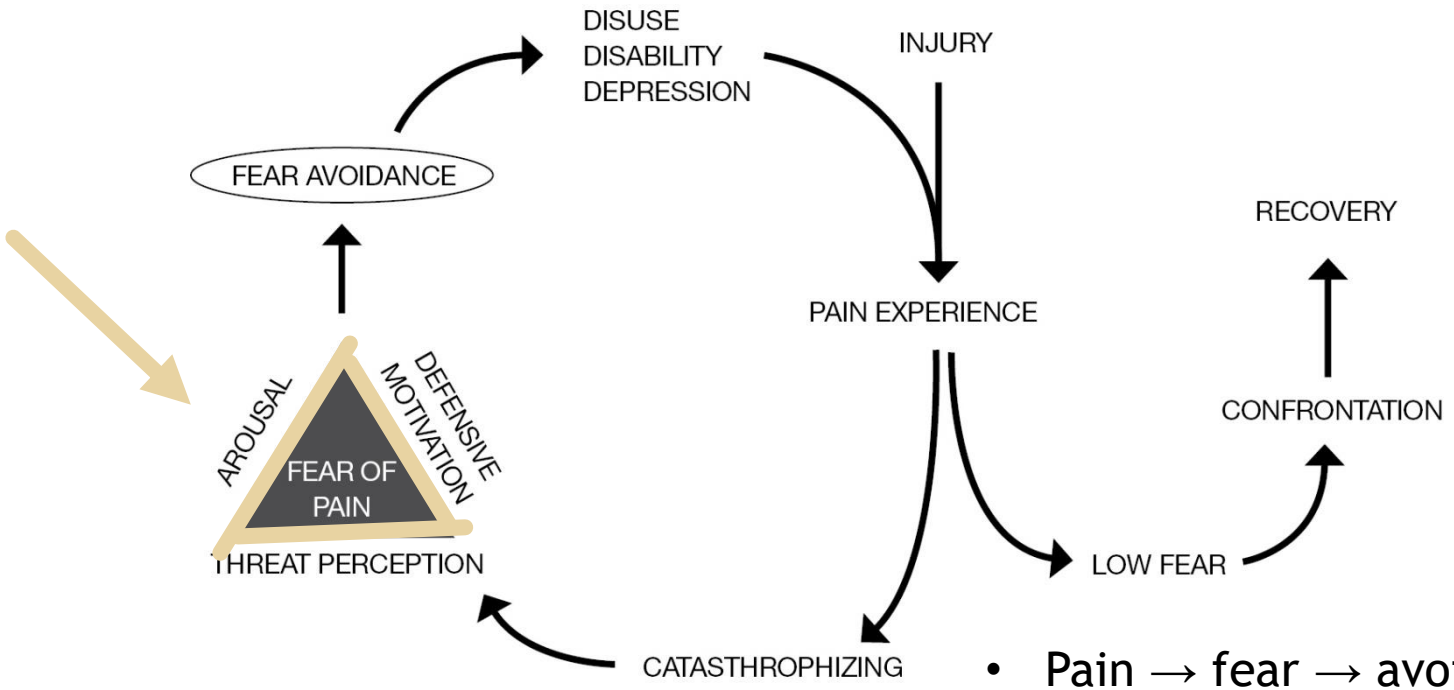
The Role of Cognitions in Pain



1. Attention – on purpose or involuntary
   Bend over and notice pain increase
2. Interpretation – appraisal/reaction
   I know bending is safe. I know this is a sensory experience and hurt ≠ harm. I have strategies to manage this.
   Physical stress response – use of relaxation/calming techniques. (Reduced danger signals from the body, reduced danger monitoring.)
3. Behavior
   Using tools for pain/stress management, reduced stress response to symptoms, reduced activity avoidance, reduced attention to symptoms.

Taken with permission from Kaitlin Touza, PhD

Targeting Fear of Pain in Fear Avoidance Model



- Pain → fear → avoidance → deconditioning → worse pain
- Behavioral activation and pacing break the cycle
- Especially relevant in TBI due to fear of re-injury or worsening

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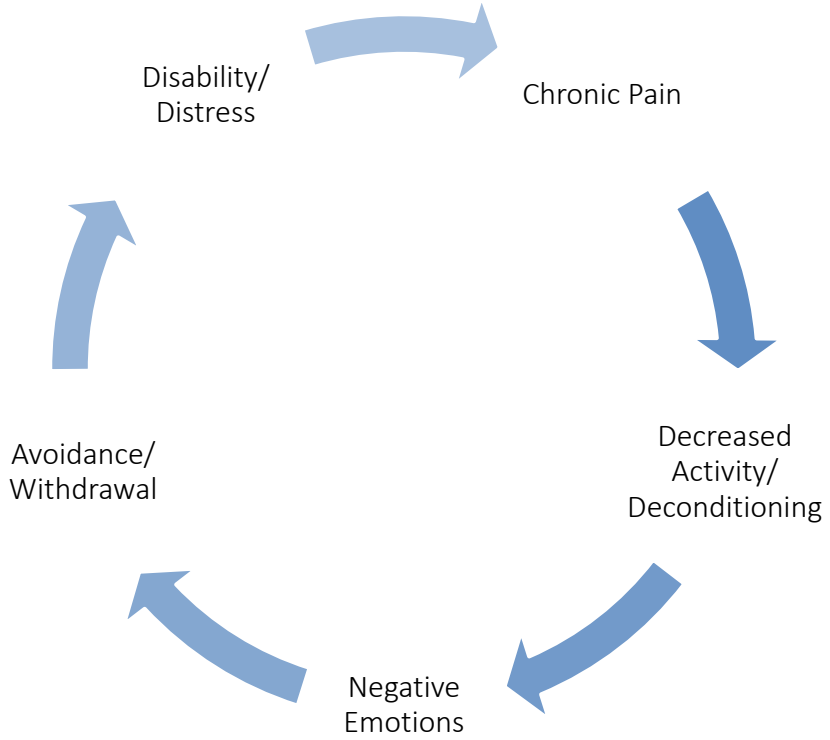
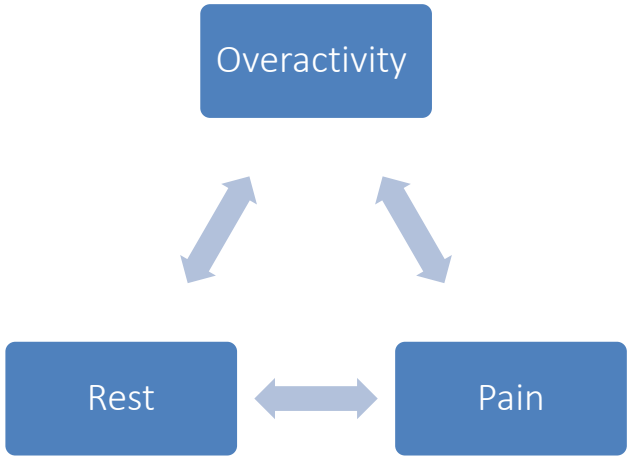
Activity: Too Little, or Too Much





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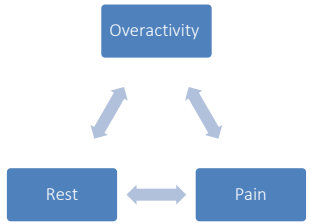
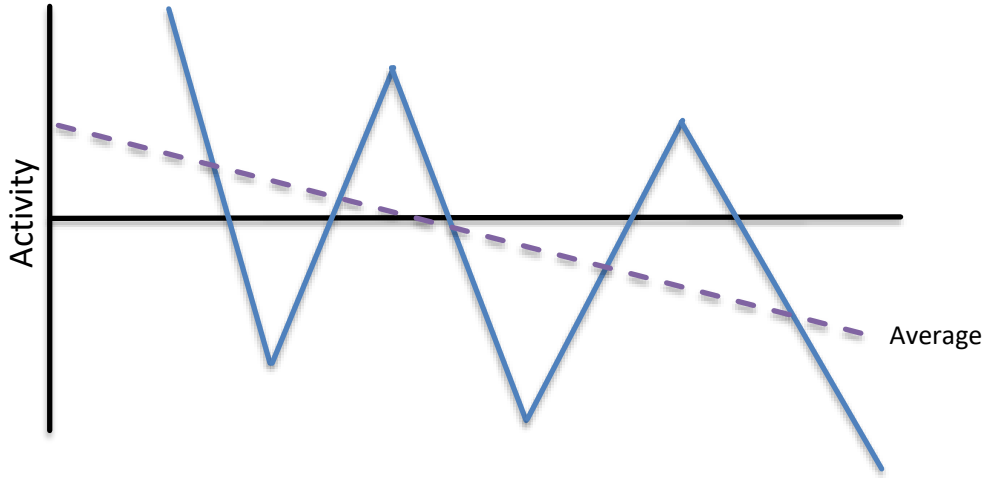
Pushing through and crashing



- Boom and bust cycle leads to gradual worsening over time. In this pattern, patients tend to do and tolerate less activity over time.



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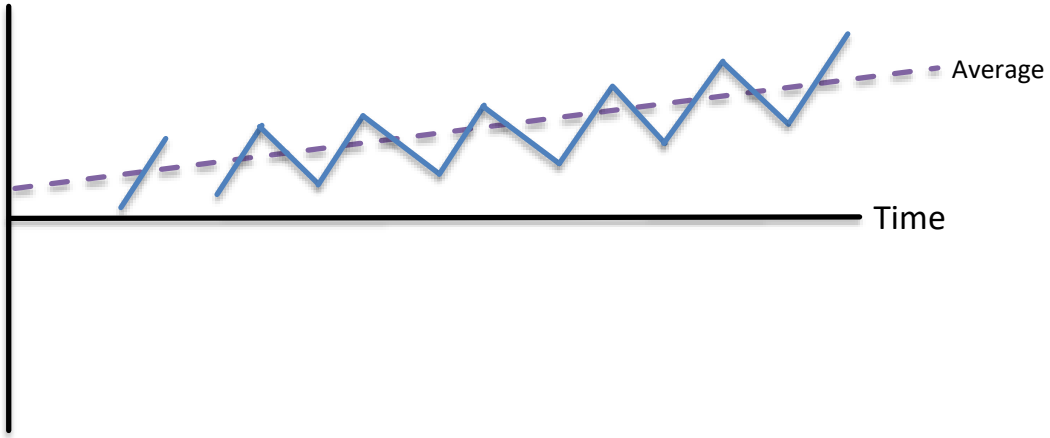
Activity Pacing

Finding the amount of activity that can be consistently tolerated over time with frequent breaks, building up to increased activity tolerance slowly, helping the nervous system learn movement is safe.



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Evidence Based Treatment for Pain

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More Disciplines, the Better

The most effective clinical care of chronic pain involves multimodal treatment and is multi- or interdisciplinary in nature

Teams typically involve physician, psychology, pharmacy, PT, OT, nurse

Unfortunately, multi and interdisciplinary treatment is not as common due to insurance billing structures as barriers

Treatment should focus on restoration of function, not elimination of pain

Gatchel et al., 2014; Turk et al., 2010

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TABLE 3 *Pain treatment history for individuals with current and past chronic pain following TBI*[a]

	Current pain ($n = 1762$)	Past pain ($n = 525$)	*P* value	Effect size
Treatment type[b]				
Medical services or treatments, yes, *n* (%)	1616 (93.7%)	473 (91.3%)	.0616[c]	0.04[d]
Medication, yes	1571 (91.2%)	465 (89.6%)	.2738[c]	0.02[d]
Injection, yes	548 (31.7%)	63 (12.2%)	*<.0001*[c]	0.18[d]
Surgery, yes	303 (17.5%)	83 (16.0%)	.4268[c]	0.02[d]
Implanted device, yes	54 (3.1%)	7 (1.4%)	.0299[c]	0.05[d]
Nonimplanted electrical stimulator, yes	475 (27.5%)	44 (8.5%)	*<.0001*[c]	0.19[d]
Other, yes	194 (11.2%)	43 (8.3%)	.0583[c]	0.04[d]
Exercise therapies, yes, *n* (%)	1408 (81.5%)	405 (77.9%)	.0650[c]	0.04[d]
Physical therapy, yes	1160 (67.2%)	338 (65.0%)	.3491[c]	0.02[d]
Pool or aquatic therapy, yes	464 (26.9%)	90 (17.3%)	*<.0001*[c]	0.09[d]
Occupational therapy, yes	672 (39.0%)	192 (37.0%)	.4205[c]	0.02[d]
Yoga, yes	412 (23.9%)	77 (14.8%)	*<.0001*[c]	0.09[d]
Tai chi, yes	94 (5.4%)	12 (2.3%)	.0032[c]	0.06[d]
Home exercise program, yes	1075 (62.2%)	330 (63.5%)	.6158[c]	0.01[d]
Other, yes	123 (7.1%)	31 (6.0%)	.3605[c]	0.02[d]
Psychological services, yes, *n* (%)	757 (43.8%)	181 (34.8%)	*.0003*[c]	0.08[d]
Psychotherapy (eg, CBT and ACT), yes	307 (17.8%)	47 (9.0%)	*<.0001*[c]	0.10[d]
Biofeedback, yes	109 (6.3%)	15 (2.9%)	.0026[c]	0.06[d]
Deep breathing, yes	610 (35.3%)	151 (29.0%)	.0078[c]	0.06[d]
Guided imagery, yes	200 (11.6%)	36 (6.9%)	.0023[c]	0.06[d]
Mindfulness therapy, yes	337 (19.5%)	68 (13.1%)	*.0008*[c]	0.07[d]
Hypnotherapy, yes	45 (2.6%)	5 (1.0%)	.0257[c]	0.05[d]
Other, yes	63 (3.7%)	13 (2.5%)	.2015[c]	0.03[d]
Complementary/alternative Medicine, yes, *n* (%)	994 (57.6%)	207 (39.8%)	*<.0001*[c]	0.15[d]
Chiropractic, yes	543 (31.5%)	87 (16.7%)	*<.0001*[c]	0.14[d]
Acupuncture, yes	358 (20.8%)	50 (9.6%)	*<.0001*[c]	0.12[d]
Massage, yes	791 (45.9%)	164 (31.5%)	*<.0001*[c]	0.12[d]
Other, yes	190 (11.0%)	31 (6.0%)	*.0007*[c]	0.07[d]
Comprehensive pain rehabilitation program, yes, n (%)	251 (14.6%)	36 (6.9%)	*<.0001*[c]	0.10[d]
Perceived improvement (PGIC[e]*), median (IQR)*	3 (2, 5)	6 (5, 7)	*<.0001*[f]	*0.18*[g]

Harrison-Felix et al., 2024

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New Models of Care: Collaborative Care Model for TBI and Pain

- Collaborative care model for patients with TBI and chronic pain
- Team-based approach to providing evidence-based care, and promoting self-management and treatment adherence
  - Rehab Physician + Care manager (CM) + TBI subject experts/Consultants (Physiatrist, psychologist, psychiatrist, and neurologist)
  - Emphasized non-pharmacological approaches, care management, alongside optimizing medication
- CM provided CBT skills for pain, modified for individuals with cognitive difficulties and individually tailored to specific needs.
- RCT (*n* = 158) of adults with mild to severe TBI.
- CC group (*n* = 79) vs. TAU (*n* = 79)
  - At 4 months, CC group reported significant reduction of pain interference compared to TAU.
  - Pain interference improvement was sustained at 8 months
  - High satisfaction and global report of change

Hoffman et al., 2024; Curran et al., 2024

Providers Perceived Barriers to Chronic Pain Treatment

Barriers	
	Healthcare providers encounter significant difficulties in engaging individuals with TBI in chronic pain treatments
	Cognitive deficits are identified as a leading barrier
	Other patient-related barriers perceived by providers include high rates of noncompliance and poor follow-up, complex medical presentations, and mental health

Nakase-Richardson et al., 2024

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Providers Perceived Facilitators to Chronic Pain Treatment

Facilitators	Having time to provide **education tailored to individuals experiencing cognitive challenges** is a key facilitator endorsed by providers. This includes explaining what is happening in their brain to help them understand symptoms.
	Establishing patient **motivation and buy-in** with the treatment plan is important. Setting functional and realistic goals regarding pain treatment is helpful [Source n.d. (provider perspectives paper)].
	Having treatments that can be modified or tailored to meet patient needs was identified as a facilitator, particularly by psychologists and VA providers.
	Accommodations might include reducing noise, adjusting appointment timing, or extending session numbers

Nakase-Richardson et al., 2024

Current Gaps and Considerations in Treating Chronic Pain After TBI

- There are no formal clinical practice guidelines or robust evidence to guide pharmacologic or non-pharmacologic treatment of chronic pain after TBI.
- Pharmacologic approaches are generally similar to those for other pain populations (e.g., nociplastic, neuropathic pain), but may require adjustments for injury-related complexity and sequelae.
- Medication management emphasizes non-opioid, non-sedating options, minimizing polypharmacy, and integrating non-pharmacologic options.
- More research is needed to determine which treatments are most effective for this population and under which circumstances.

Chen et al., 2023

Clinical Takeaways

- Chronic pain impacts cognitive function, psychosocial well-being, and overall outcomes for individuals with TBI
- Tailoring interventions to individual needs and injury characteristics is essential.
- Screen for and address pain and cognitive responses to pain as part of overall TBI care
  - Early assessment of pain catastrophizing to facilitate BH treatment and support functional outcomes
    - High catastrophizing predicts poor response + greater disability
- Screen for and address comorbid concerns
- Address sleep disturbances (e.g., sleep apnea) given the link between sleep-disordered breathing and chronic pain s/p TBI
  - Treatment like CPAP for sleep apnea has been shown to reduce pain sensitivity in other populations

Clinical Takeaways

- Facilitate Multimodal Treatment (ensuring both pharmacological and non-pharmacological)
- Pain management may benefit from integration with cognitive rehabilitation after TBI
  - After CBT for Chronic Pain: Improved executive function, attention, prefrontal cortex, and reduced limbic system reactivity AFTER CBT
  - Reframing pain psychology as having a neuropsychological benefit
- Patients might require **more time and tailored education** to understand their condition and treatment options due to cognitive challenges.
  - Providers with training in working with patients with TBI
- *Anticipate* and *accommodate* cognitive barriers

Jensen et al., 2012, Beck et al., 2018; Yu et al., 2022; Peckham et al., 2025; Nakase-Richardson et al., 2024

Possible Clinical Adaptations After TBI

Environmental / System-Level	•Minimize distractions: reduce noise and stimuli. •Offer telehealth to overcome transportation or access barriers. •Adjust appointment timing and structure to fit patient needs.
Global Patient-Centered Care	•Person-centered, tailored care: adapt content and delivery to cognitive abilities. •Clinician flexibility: adjust session pace and length based on individual challenges. •Care management: use reminders and follow-up for missed sessions or treatment plans. •Involve family: include family members for support and symptom understanding. •Emphasize non-pharmacological pain management approaches. •Address comorbid conditions to reduce overall medical and functional complexity.
Psychotherapy-Focused	•Use modular CBT to address both pain and comorbidities flexibly. •Behavioral activation: encourage self-monitoring and meaningful activities despite pain. •Skills training and rehearsal: practice techniques in-session and provide recordings for home practice. •Psychoeducation: explain symptoms and treatment in simple, relatable terms. •Focus on concrete, attainable, and functional goals to reinforce treatment engagement.
Medication / Treatment Management	•Be mindful of cognitive limitations in medication adherence; simplify plans as needed.

Nakase-Richardson et al., 2024; Curran et al., 2024

Resources for Follow-Up

- https://pain.tbindsc.org/

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Thank you! Questions?

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