

Predictive Processing: The role of neural circuitry in pain and associated syndromes

Howard Schubiner, MD

Clinical Professor, Michigan State University

College of Human Medicine

Practice: cormendihealth.com

Website: unlearnyourpain.com

Email: hschubiner@gmail.com

Disclosures

Books

- Unlearn Your Pain
- Unlearn Your Anxiety and Depression
- Hidden From View

Consultant/Owner

- OVID Dx mobile training app
- Freedom From Chronic Pain program (Australia)
- Curable health
- Karuna labs

Trends in LBP in the US

Rates of increase in Medicare costs (last decade):

Epidural steroid injections	629%
Opioids for back pain	423%
Lumbar MRI	307%
Spinal fusion surgery	220%
Change in disability and pain	25%

Surgical Treatment for Chronic, Non-specific Low Back Pain

- No difference in long term outcomes between surgery and conservative forms of therapy
 - PT, observation, and exercise
- No sham trials as yet, unlike meniscal tear and arthroplasty trials

Peul, N Engl J Med 2007;356:2245-56.
Brox, Spine 2003, 28:1913–1921.
Osterman, Spine 2006, 31:2409–2414.

Meta-analysis: epidural injections for back pain

While evidence is sparse and inconclusive, epidural injections show no clear benefit for the following conditions:

- Spinal stenosis
- Low back pain without radiculopathy
- Failed back surgery syndrome

Chou, et. al., *Spine*, 2009, 34: 1078–1093.

Friedly, et. al., *N Engl J Med* 2014; 371:11-21.

RCT of spinal cord stimulation treatment:

Among patients with chronic radicular pain after lumbar spine surgery, spinal cord burst stimulation, compared with placebo stimulation, resulted in no significant difference in back pain–related disability.

Effect of Spinal Cord Burst Stimulation vs Placebo Stimulation on Disability in Patients With Chronic Radicular Pain After Lumbar Spine Surgery: A Randomized Clinical Trial. *JAMA*. 2022;328(15):1506-1514. doi:10.1001/jama.2022.18231

How effective is CBT for pain?

- Patient: “How much will my pain improve if I have CBT, rather than my usual care?”
- Clinician: “On a 0 to 10 scale, the average patient’s pain improves about ____ points more after CBT than after treatment as usual.”
 - Negative mood: 0.7 point
 - Functioning / disability: 0.7 point


Cochrane review: Psych Tx for Chronic Low Back Pain

CBT, ACT and BT show:

- weak effects in reducing pain
- small to medium effects reducing disability and mood problems

And mindfulness-based interventions?

Mindfulness Meditation for Chronic Pain: Systematic Review and Meta-analysis

Lara Hilton, MPH¹  • Susanne Hempel, PhD¹ • Brett A. Ewing, MS¹ •
Eric Apaydin, MPP¹ • Lea Xenakis, MPA¹ • Sydne Newberry, PhD¹ •
Ben Colaiaco, MA¹ • Alicia Ruelaz Maher, MD¹ • Roberta M. Shanman, MS¹ •
Melony E. Sorbero, PhD¹ • Margaret A. Maglione, MPP¹

Annals of Behavioral Medicine (2017)

“...small decrease in pain compared with controls in 30 RCTs”
Intervention: 19% pain reduction; Controls: 11% pain reduction
= 0.5 point reduction (vs. control, for patients with baseline pain = 5) !
.....same as with CBT for pain !

Acceptance and Commitment Therapy (ACT)?

Similar to CBT (maybe larger effect on functioning, smaller effect on pain)

Chronic pain is assumed to be both biological and psychological.

Treatment is multidisciplinary.

Yet, we have not been effective in reducing pain.

Limitations of current approaches

- Lack of specific diagnosis of cause of pain
- Methods geared towards coping or living with pain, not reducing it
- Emotional processing is not actively encouraged

The power of the (subconscious) mind

Conversion

PNEA

Contagious symptoms

Hallucinations

Giving up syndrome: “The sleeping beauties”

Stress-related symptoms

An example of predictive
processing...

An apple a day

Canadian construction worker



UK construction worker

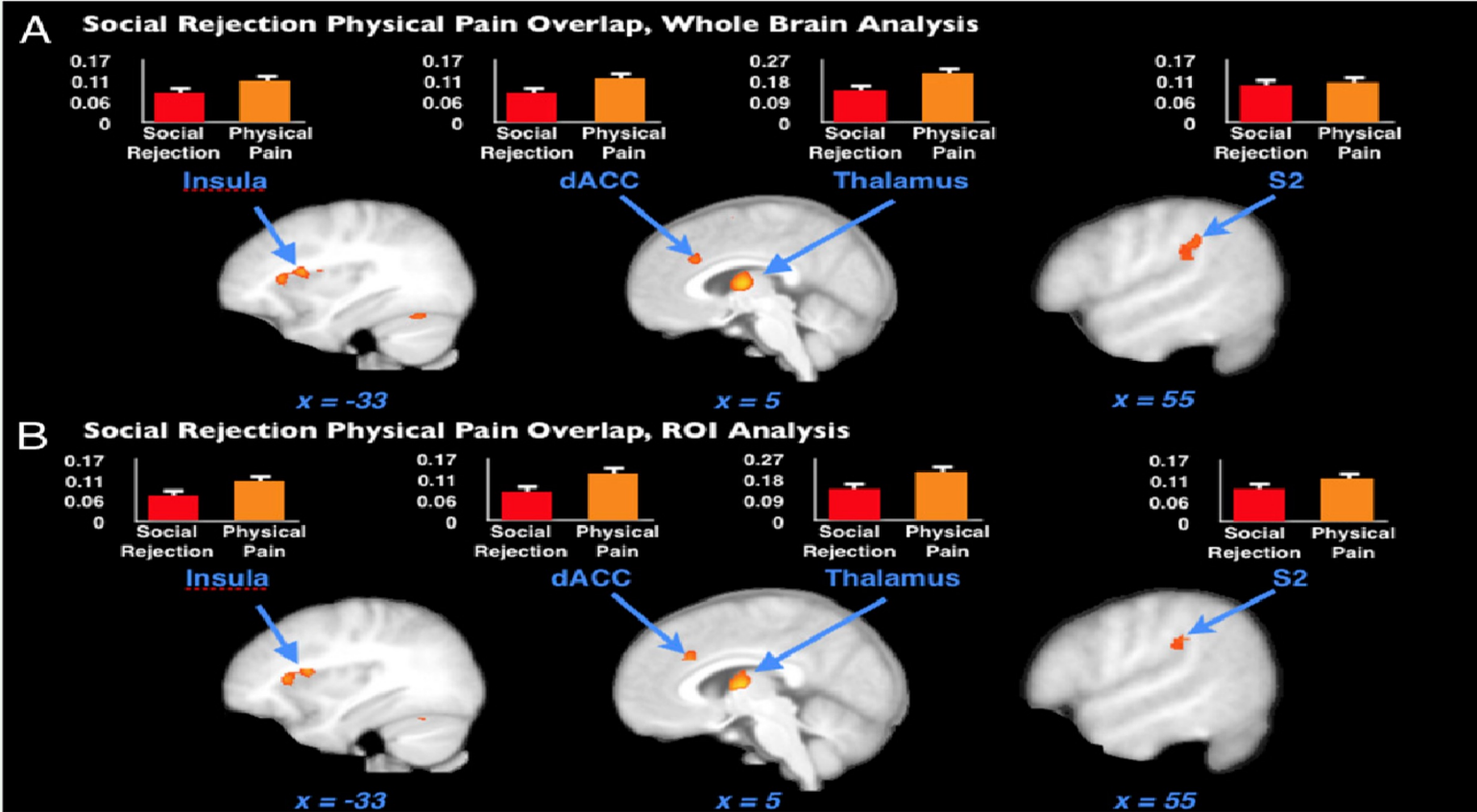


Fisher, et. al. British Medical Journal, January 7, 1995

Vietnam War Injury



Emotional pain equals physical pain



Pain as a dynamic process

- All pain is real. There is not real pain and imaginary pain
- All pain is activated by the brain
- Pain can be triggered by either tissue damage or neural circuits (in the absence of tissue damage)

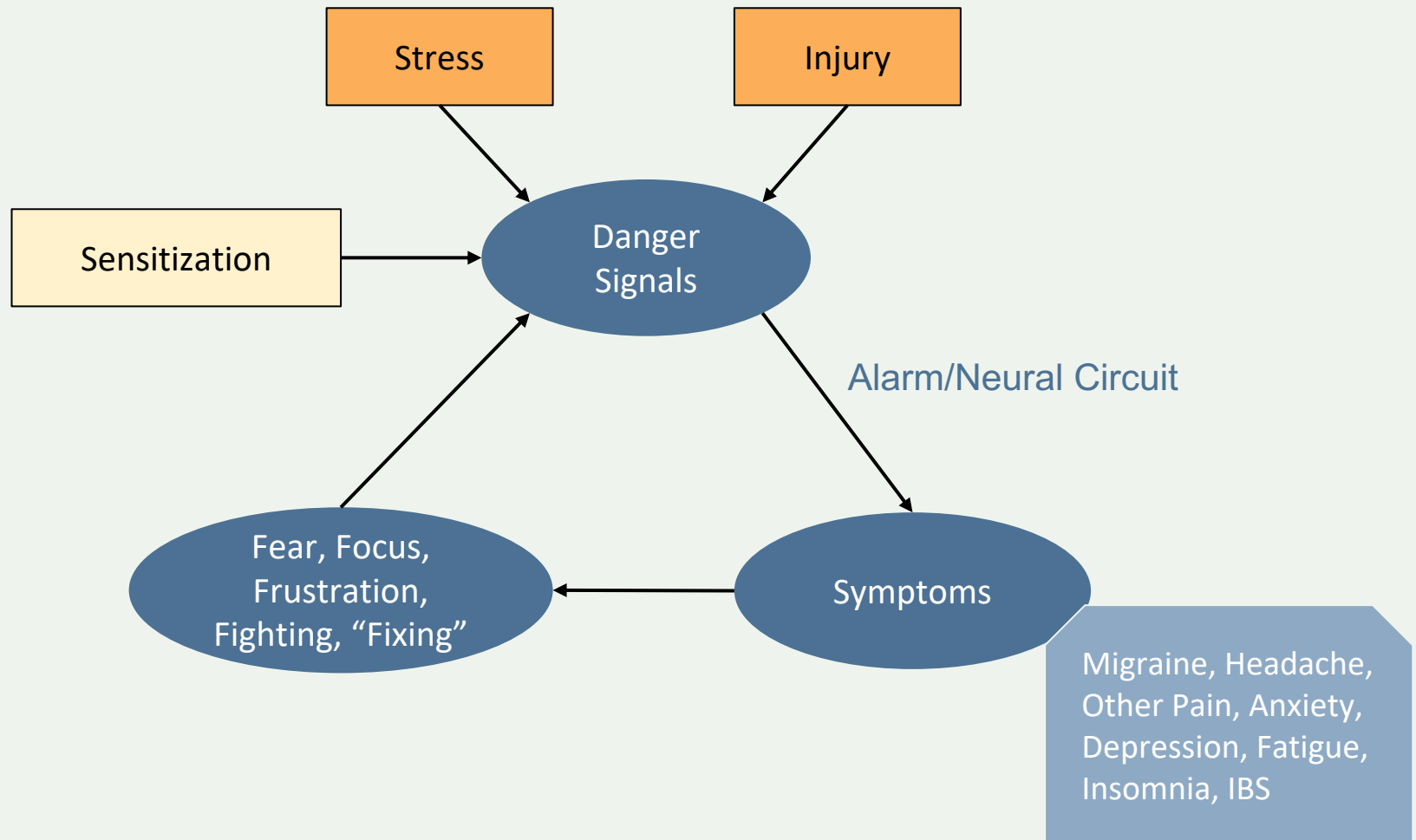
It's all in your head?

“Anyone who says it's all in your head, is being dismissive, judging, and sometimes just mean; They are completely misunderstanding pain and unaware of modern pain science”

“This statement suggests that the pain is imaginary, not real, fake or made up, that you are crazy or nuts, or mental; that this is your fault or that you “want” the pain”

“None of this is true. I know that your symptoms are real; and I can only imagine the suffering you've had; and how much you've gone through to get better. I'm sorry about all of that. I do think, however, that there is reason for hope.”

Pain Circuitry



Diagnostic Process:

Step One: Rule out a structural disorder

Step Two: Rule in a neural circuit disorder

Proportion of chronic conditions that are brain induced:

Anxiety/Depression	99%
Fibromyalgia	99%
IBS	99%
Headaches	95%
Pelvic pain syndromes	90%
Chronic neck/back pain	88%!!

Application of a Clinical Approach to Diagnosing Primary Pain: Prevalence and Correlates of Primary Back and Neck Pain in a Community Physiatry Clinic

Schubiner, Lowry, Lumley, et. al. *Journal of Pain*, 2023

Chronic back or neck pain (CBNP) can be *primary* (nociplastic or neuroplastic; without a clear peripheral source) or *secondary* (due to nociceptive or neuropathic causes). Expanding on available models of nociplastic pain, we developed a clinic-ready approach to diagnose primary/nociplastic pain: first a standard physical exam and review of imaging to rule out secondary pain, and a detailed history of symptom presentation to rule in primary pain. We trained a physician who evaluated a series of 222 patients (73.9% female, age $M = 59.6$) with chronic back or neck pain (CBNP); patients separately completed pain and psychosocial questionnaires. We estimated the prevalence of primary CBNP and explored biomedical, imaging, and psychological correlates of primary CBNP. **Although almost all patients (97.7%) had at least one spinal anomaly on imaging, the diagnostic approach estimated that 88.3% of patients had primary pain, 5.0% had secondary pain, and 6.8% had mixed pain.** Patients with primary pain were more likely than the other patients to report certain functional conditions, central sensitization, and features such as sensitivity to light touch, spreading pain, and pain worsening with stress; however, depression, anxiety, and pain catastrophizing did not differ significantly between primary and non-primary pain subgroups. These findings are consistent with prior estimates that 85 to 90% of CBNP is “nonspecific.” Further research is needed to validate and perhaps refine this diagnostic approach, which holds the potential for better outcomes if patients are offered treatments targeted to primary pain, such as pain neuroscience education and specific psychological therapies.

Degenerative spine imaging findings in asymptomatic patients

	Age, n=3300						
Imaging Finding	20	30	40	50	60	70	80
Disc Degeneration	37%	52%	68%	80%	88%	93%	96%
Disc Bulge	30%	40%	50%	60%	69%	77%	84%
Disc Protrusion	29%	31%	33%	36%	38%	40%	43%
Annular Fissure	19%	20%	22%	23%	25%	27%	29%
Facet Degeneration	4%	9%	18%	32%	50%	69%	83%
Spondylolisthesis	3%	5%	8%	14%	23%	35%	50%

Scoliosis of 73 degrees:
Pain-free in one month



Diagnostic Process:

Step Two: Rule in a neural circuit disorder

A. Circumstantial Evidence

B. Confirmatory Evidence

NOTE: A new book from the PPDA discusses over 200 diagnoses and categorizes them

A. Circumstantial Evidence

1. Body map and ROS checklist
2. Linkages to onset and exacerbation of symptoms
3. Personality traits
4. ACE scale

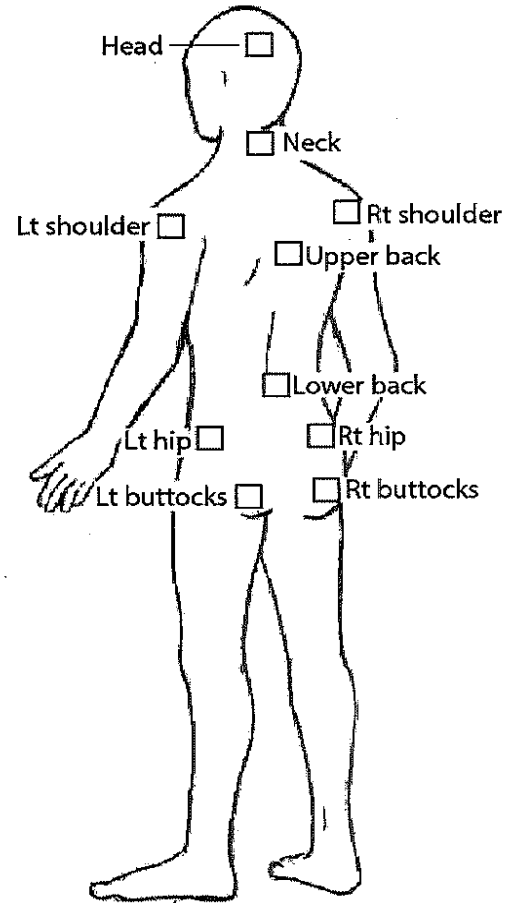
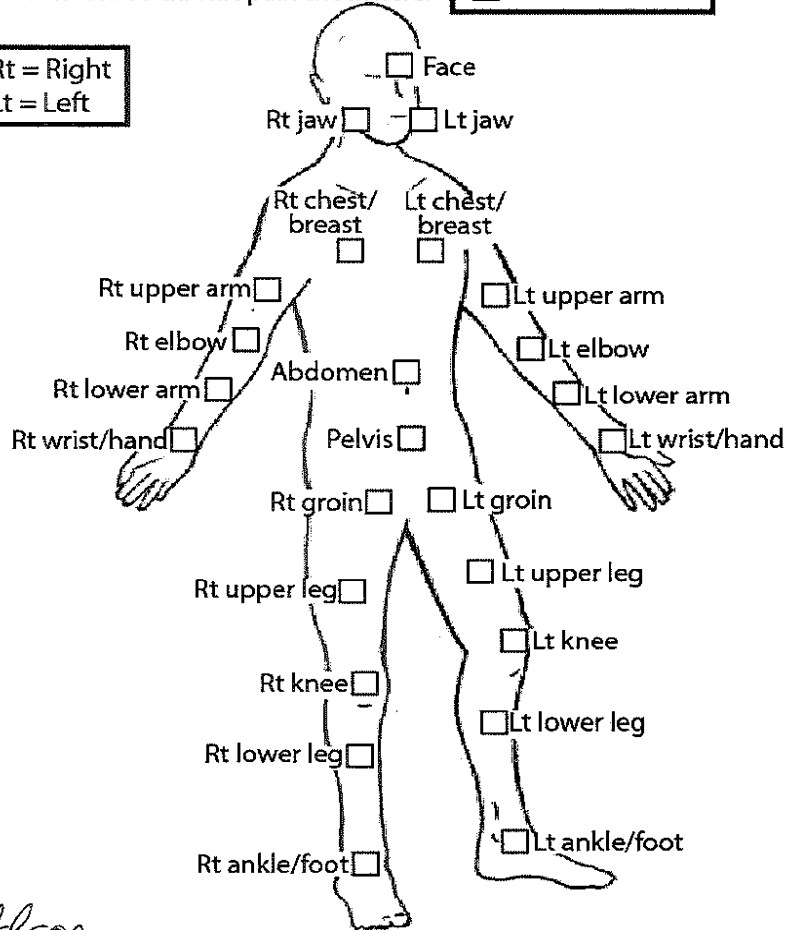
Michigan Body Map

On the image below, **CHECK ALL** areas of your body where you have felt ***persistent or recurrent pain*** present for the last ***3 months or longer (chronic pain)***.

If you do not have chronic pain check here:

No Chronic Pain

Rt = Right
Lt = Left



Also:

Use cross-hatch ## to show where the pain is located on these drawings

Review of systems

For each of the following, check yes if you have had this symptom or condition and indicate the year it began; check again if it is still present.

	Yes?	Began when	Still present?
1. Heartburn, acid reflux	X	Childhood	yes
2. Ulcer symptoms or stomach pains	X		
3. Hiatal hernia	X		
4. Irritable bowel syndrome	X		
5. Colitis, spastic colon		n	n
6. Tension headache	X	child	
7. Migraine headache			
8. Eczema			
9. Anxiety symptoms and/or panic attacks	X	child	n
10. Depression	X	child	
<hr/>			
11. Obsessive-compulsive thought patterns			
12. Eating disorders			
13. Insomnia or trouble sleeping	X		yes
14. Fibromyalgia	X	30's	yes
15. Bell's palsy, facial paralysis			
16. Back pain	X	1981	
17. Neck pain	X	1981	
18. Shoulder pain	X	1981	
19. Repetitive stress injury			
20. Reflex sympathetic dystrophy (RSD)			
21. Temporo-mandibular joint syndrome (TMJ)	X	teen	
22. Chronic tendonitis			
23. Carpal tunnel syndrome			
24. Trigeminal neuralgia, facial pain			
25. Numbness, paresthesias			
26. Fatigue or Chronic fatigue syndrome			
27. Palpitations	X	teen	
28. Chest pain			
29. Hyperventilation	X	teen	
30. Spastic bladder			
31. Interstitial cystitis			
32. Prostate problems			
33. Pelvic pain			
34. Muscle tenderness	X	30's	
35. Tachycardia or low blood pressure	X		
36. Tinnitus			
37. Dizziness			
38. Other symptoms (please list)			

AGE

LIFE EVENT

PATHWAY

SYMPTOMS



Internal Pressures

A higher risk in people who:
put more pressure on themselves,
who are more self-critical,
self-blaming,
feel more obligations,
have a stronger sense of duty,
worry excessively,
take responsibility for external problems,
are overly conscientious and caring about others,
especially to the exclusion of doing things for
themselves

ACE Questionnaire:

- Physical, sexual or verbal abuse
- Physical or emotional neglect
- Separation or divorce
- A family member with mental illness
- A family member addicted to drugs or alcohol
- A family member who is in prison
- Witnessing a parent being abused

B. Confirmatory Evidence

1. Functional
2. Inconsistent
3. Triggered

4. Demonstrate neural circuits on exam and by exercises (provocative testing and close observation)

Functional:

- Symptoms begin without a physical precipitation
- Symptoms persist after an injury has healed
- Symptoms are in a distribution pattern that is symmetric
- Symptoms occur on one whole side of the body or occur on half of the face, head, or torso
- Symptoms spread over time to different areas of the body
- Symptoms radiate to the opposite side of the body or down a whole leg or arm
- Symptoms that occur in many different body parts at the same time
- Symptoms that have the quality of tingling, electric, burning, numb, hot or cold

Inconsistent:

- Symptoms shift from one location in the body to another
- Symptoms are more or less intense depending on the time of day, or occur first thing in the morning or in the middle of the night
- Symptoms occur after, but not during, activity or exercise
- Symptoms occur when one thinks about them or when someone asks about it
- Symptoms occur when stress increases or one thinks about stressful situations
- Symptoms are minimal or non-existent when engaged in joyful or distracting activities, such as when on vacation
- Symptoms are minimal or non-existent after some kind of therapy, such as massage, chiropractic, Reiki, acupuncture, an herbal or vitamin supplement

Triggered:

- Symptoms are triggered by things that are not related to the actual symptom, such as foods, smells, sounds, light, computer screens, changes in the weather
- Symptoms are triggered by the anticipation of stress, such as prior to school, work, a doctor's visit, a medical test, a visit to a relative, or a social gathering; or during those activities
- Symptoms that are triggered by simply imagining engaging in the triggering activity, such as bending over, turning the neck, sitting or standing
- Symptoms are triggered by light touch or other innocuous stimuli, such as the wind or cold

Ryan is a 23-year-old man who developed a severe headache after work one day. He started having headaches in the forehead and temple areas, several days a week. He noted that he would get headaches after drinking alcohol or eating spicy foods.

Over time, the headaches started occurring almost every day and the pain would sometimes occur in the back of his head as well. His mother also had headaches and he recalls his mother being sick in bed at times due to severe headaches.

An MRI of his brain was normal. His neck MRI showed only mild changes.

When asked, his boss was a tyrant for whom nothing was “good enough.” This reminded him of how his father treated him as a child and teenager.

Bethany, a 35-year-old woman, starts to get a tingling sensation in her right hand. She's been working a lot on her computer on a big project, doing a lot of typing after hours. After a week, the tingling starts to occur in her left hand as well. Then it spreads to her feet and becomes a burning sensation at times.

Her doctor confirms that her neurological exam is normal and she gets an MRI of her neck and brain that are also normal.

Her son is getting bullied at school and comes home crying. The school has been informed, but is not taking any strong action to protect him.

The pain is much worse with typing, but is absent when playing the piano.

Carol, a 53-year old woman, bent down to pick up a light box and suddenly felt a pulling sensation in her lower back. She had back pain when she was a teenager, on and off, for a couple of years, after a car accident. She was told that she had scoliosis of the spine and that she should be careful of her back.

She rested her back for a few days. But the pain got worse over time. It started with one spot in the lower back on the left, but then the pain spread to the other side and up into the mid-back area on both sides.

Her MRI showed 2 bulging discs in the lumbar area, but no changes in the thoracic area. This occurred a week before Thanksgiving and she is dreading having her sister and brother-in-law to their home.

Treatment Overview

1. Make an accurate diagnosis
2. Educate on the nature of pain
3. Reduce fear of pain to rewire neural circuits—Pain Reprocessing Therapy
4. Graded exposure
5. Emotional interventions to process stressful life events—Emotional Awareness and Expression Therapy
6. Make changes in one's life

Symbolic, Familial, Injury, Contagion, Mechanical, Similar situation, Dates

Stress

Injury

Sensitization

Danger Signals

Alarm/Neural Circuit

Fear, Focus, Frustration

Pain

Migraine, Headache, Other Pains, Anxiety, Depression, Fatigue, Insomnia, IBS, IC, etc.

Pain Reprocessing Therapy

- Confirm diagnosis, explore evidence to support the diagnosis, deliver personalized neuroscience education with validation and compassion (“**it is not in your head, it is in your brain!**)
- Change the meaning of the pain to a brain derived sensation that is harmless
- Use somatic tracking/mindfulness to alter the relationship to the pain, observe with interest, indifference, and curiosity
- Create positive mood and instill expectation of relief
- Graded exposure to triggers, such as bending, sitting, standing, walking: opportunities to rewrite the brain

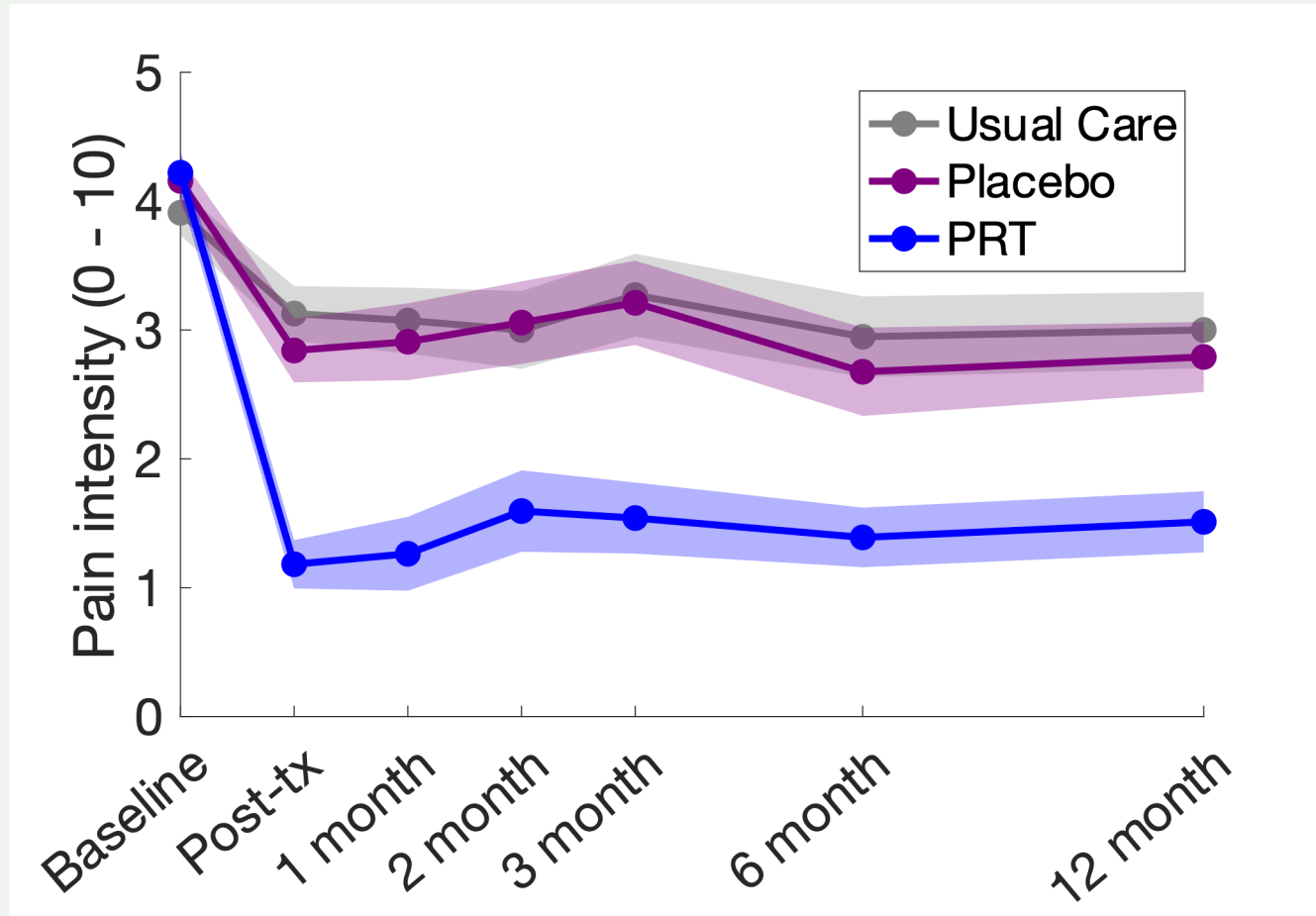
UC Boulder back pain study

- Three arm randomized study (n=150)
- Pain Reprocessing Therapy: 50 randomized; 45 treated; 44 completers
- Placebo injection: 51 randomized; 44 treated; 44 completers
- Wait List: 50 randomized; none treated; 47 completers
- Mean age: 41 years
- Mean duration of back pain: 10 years
- High educational level
- Diagnostic evaluation: 43/45 were non-structural in nature

UC Boulder back pain study—Pain Reprocessing Therapy

- **Outcome: 33 of 44 treated were pain-free or virtually pain-free at one month (8 individual counseling sessions)**
- **66% of the 50; 75% of the 44 had BPI scores of 0-1**

Last-week average pain intensity



Research Paper

PAIN[®]

Emotional awareness and expression therapy, cognitive behavioral therapy, and education for fibromyalgia: a cluster-randomized controlled trial

Mark A. Lumley^{a,*}, Howard Schubiner^b, Nancy A. Lockhart^a, Kelley M. Kidwell^c, Steven E. Harte^{d,e}, Daniel J. Clauw^{d,e,f}, David A. Williams^{d,e,f,g}

Multi-site RCT for Fibromyalgia

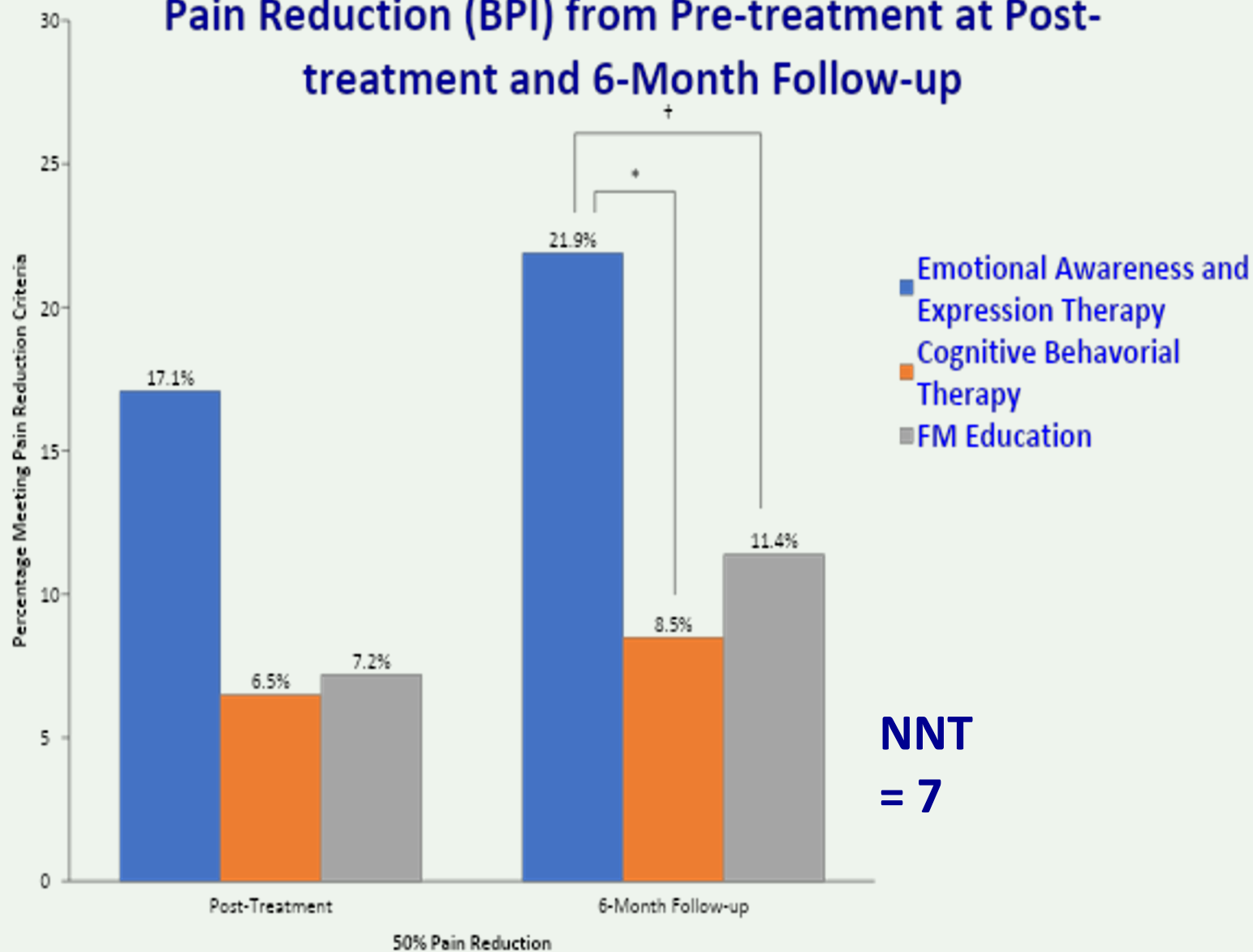
- NIH-funded, 2-site, 3-arm, allegiance-controlled RCT
 - Wayne State University; University of Michigan, Providence Hosp.
- Patients
 - n = 230 (94% female, M = 49 years old)
 - 8 small group sessions, 90-min, once per week
- Assessments
 - Baseline, post-treatment, and 6-month follow-up

Emotional Awareness and Expression Therapy

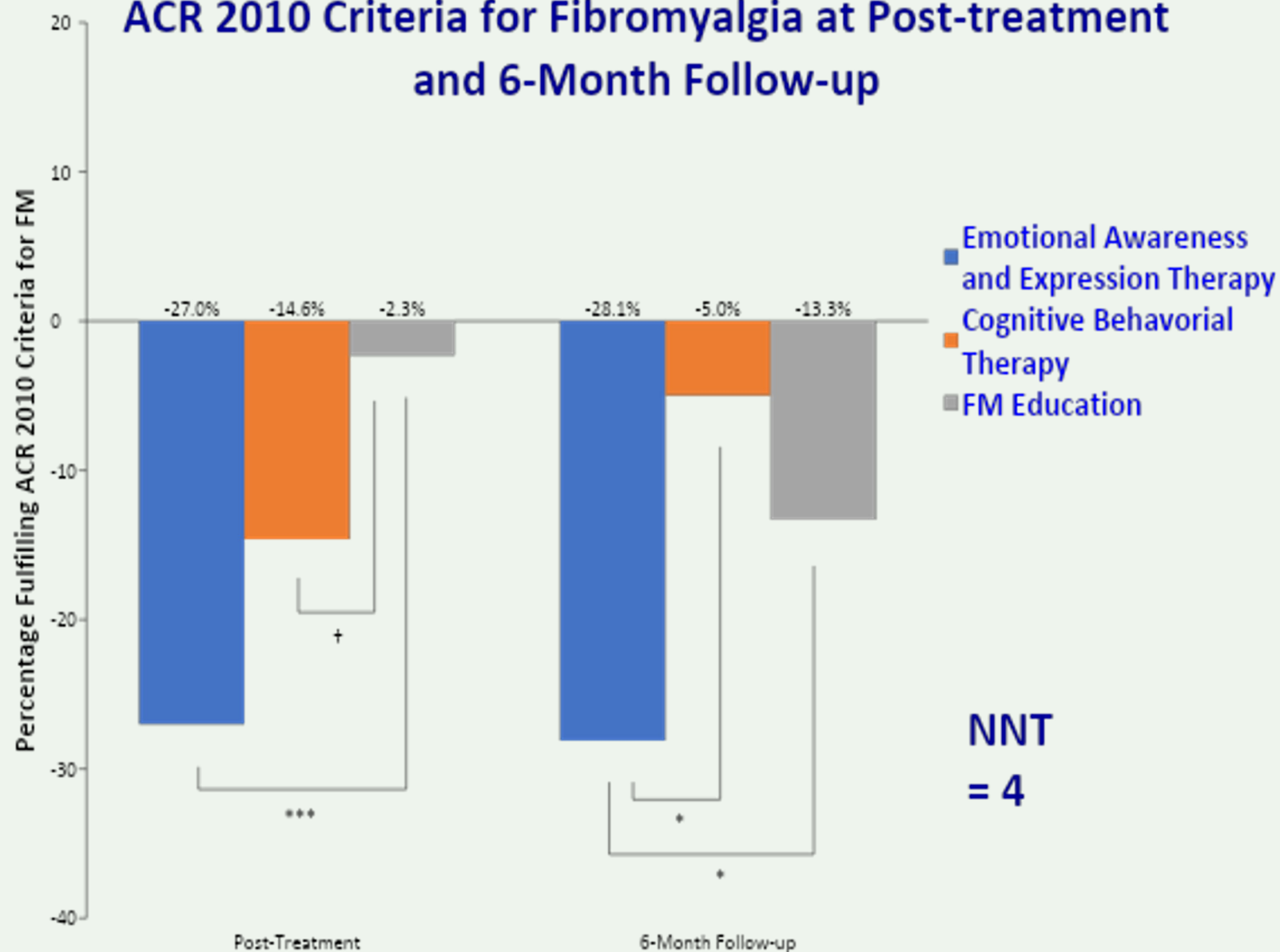
EAET consists of the following components:

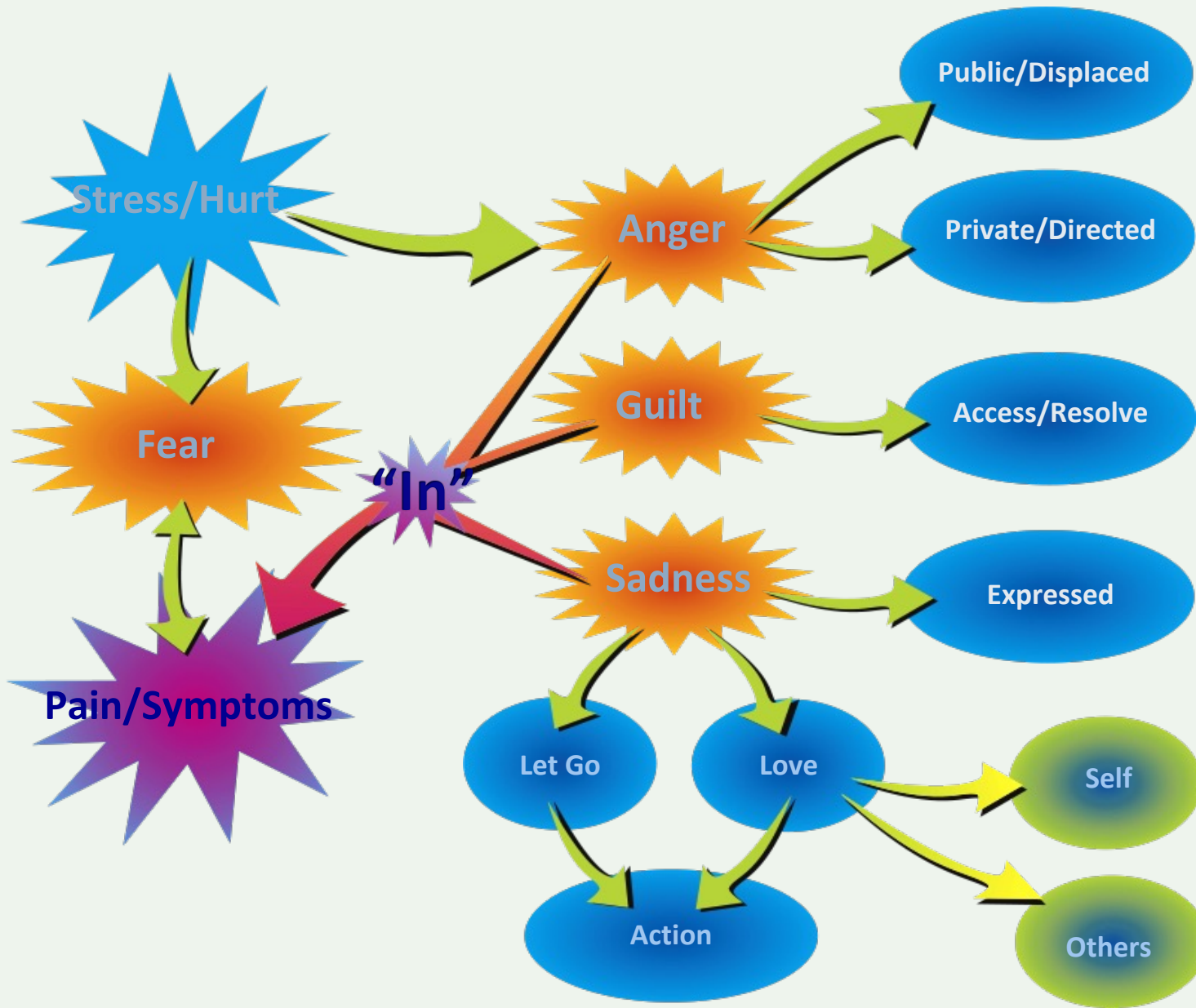
- Education about the role of emotions
- Exercises to identify and express emotions in safe and healthy ways
- Exercises to activate compassion for self, forgiveness of others to the extent justified, and letting go
- Making any necessary changes in one's life to be more connected and empowered

Percentage of Patients in Each Treatment with 50% Pain Reduction (BPI) from Pre-treatment at Post-treatment and 6-Month Follow-up



Percentage of Patients in Each Treatment Fulfilling ACR 2010 Criteria for Fibromyalgia at Post-treatment and 6-Month Follow-up





A 50 y.o. single African American female with lower back pain for several years of moderate to severe intensity. The client reported she had been struggling with being passive or aggressive with others. In particular, she had been passive with her significant other for years because she did not want to appear ungrateful. Some of his behaviors annoyed her and she felt guilty for thinking this way since he is the primary breadwinner. She did not want to appear as if she was ungrateful since she was unemployed.

A few months ago, she was angered from an encounter where she disagreed with him and instead of communicating assertively, she suppressed the anger and passively left the conversation feeling unheard. As she recalled the scenario, the writer asked her if she felt any sensation in her body and she reported pain in the lower back.

The writer utilized the empty chair intervention and instructed the client to have the conversation with her significant other that had transpired a few months ago - one that she had not let go. Initially, the client was quiet in her speech and uncertain of how to express her emotions. The writer modeled how to be more demonstrative with her actions and challenged her to increase her voice volume as she would in a real encounter. She was encouraged to use her imagination to help since she was struggling to be in the moment. "I was hurt and you dismissed my feelings. I need you to hear me and validate me. What I have to say is valuable and important. I need to be heard," said the client. The client remarked that it felt empowering to release and she was surprised by how much anger she had been carrying. She also felt guilty since he was a good provider.

The client was able to begin accepting some compassion for herself. This session helped her to practice the above strategies that empowered her to have a conversation with her significant other when she arrived home later.

The client reported two weeks later at the follow-up session that the back pain left that same day later at home after a conversation with her partner. Her significant other listened to her, validated her feelings, she felt better emotionally, and the back pain left immediately.

She is now employed. No back pain. She is earning her own income!

Review:

- Brain generates all pain, in presence or absence of injury
- Diagnose accurately using rule out serious structural, then rule in neural circuit disorders by circumstantial evidence and confirmatory evidence (FIT)
- Educate re: brain induced pain with stories
- Confirm and convey diagnosis confidently and empathetically
- Demonstrate neural circuits by history, exam, and provocative testing (pressure and triggers/imagination)
- Outline treatment plan—diagnosis, education, pain reprocessing therapy and emotional processing, plus life changes as needed
- Explain that it takes time to retrain the brain and expect ups and downs along the way
- Support the journey

Controversial topics in mind-body medicine:

1. Do all injuries heal? Or can some injuries persist and continue to cause pain over many months or year? Can tissues learn pain and carry painful memories?
2. Do scars hurt? Can scars produce ongoing pain due to lack of healing or change in alignment or function?
3. Does hyperflexibility cause pain? Do people with EDS have higher rates of chronic pain?
4. Are there genetic predispositions to pain? Is migraine genetic? What about depression, is that genetic?
5. Do foods cause pain? Is inflammation a significant source of chronic pain?

For each illness that doctors cure with medicine, they provoke ten in healthy people by inoculating them with the virus that is a thousand times more powerful than any microbe: the idea that one is ill.

-- Marcel Proust, ~1900

Paradigm Shift

- This is a **radical shift in thinking about pain**, insomnia, fatigue, anxiety and depression and associated disorders, including “long haul COVID”
- It **recognizes the power of the brain** to determine our internal experiences based on emerging neuroscience
- It **challenges much of current treatments**
- It offers the **potential for low cost, patient centered treatments** for ailments which are epidemic in our society

Psychophysiological Disorders

- Stress and unresolved emotions create **real, physical pain** via neural pathways
- **No disease process in the body**
 - *i.e.* physiological, without pathological changes
- **Symptoms are a message** created by subconscious processes
- Pain and other symptoms **can persist for years** due to learned neural circuits
- **Reversal** of mind-body symptoms can occur by cognitive, behavioral and affective interventions

Web Resources:

- TMSwiki.org—peer run website
- Curablehealth.org—mobile app
- Thedocjourney.com--mobile app
- Freedomfromchronicpain.org—online program, based in Australia
- PPDAssociation.org—professional organization
- Pain Psychology Center—Alan Gordon's center in LA
- BackIncontrol.com—Dr. Hanscom's website
- SirpaUK.com—British website

Books for patients:

- John Sarno: The Mindbody Connection, Healing Back Pain, The Divided Mind
- David Hanscom: Back in Control, Do you need back surgery?
- David Clarke: They can't find anything wrong
- David Schechter: Think away your pain
- Georgie Oldfield: Chronic Pain: Your key to recovery
- Clarke, Abbass, Schubiner, Smith-Clark: Psychophysiologic Disorders textbook (for professionals)

Documentary Films

All The Rage: Michael Galinsky

At rumur.com

This Might Hurt: Kent Bassett, Marion Cunningham

At thismighthurtfilm.com

Pain Brain: Mitch Dickman

At painbrainfilm.com

I am deeply grateful for the role that mind-body symptoms has had I my life. The unique way it has impacted me. The one diamond that is forged from the fires of these symptoms is that it offers you an opportunity, time and time again, to finally and eventually take a stand as your own best friend. I believe that I will never in my heart of hearts betray myself again. I'm no one special, but I've earned my self-respect. There will be moments, perhaps extended periods, when I will again be bewildered, self-doubtful and confused, but I will land on my feet because I have found a home within myself and I've discovered that the instincts of my heart can be trusted.

--Tim H.

Thank you!

- Reach me at hschubiner@gmail.com