




**Pain Science and Physical Therapy**  
Craig O'Neil PT, DMT, OCS, COMT



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**All pain is in the brain-body**



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<http://www.pain-ed.com/team/>



<http://www.noigroup.com/en/Home>



<http://www.ispinstitute.com>



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## What is pain?



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## Pain Definition:

"An unpleasant sensory or emotional experience associated with actual or potential tissue damage, or described in terms of such damage." - International Association for the Study of Pain (IASP).

**Proposed Definition:** Pain is a distressing experience associated with actual or potential tissue damage with sensory, emotional, cognitive, and social components.

The perception of pain is real, whether or not harm has occurred or is occurring.

Thoughts and emotions are involved in the formulation of this perception.

It's not just physical!

Amanda C. de Williams, Kenneth D. Craig. Updating the definition of pain Pain J. 157 (2016) 2420–2423



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## Nociception and Pain

### Nociception

- Is the activity in high threshold primary fibers (C and A-beta) and their projections

### Pain

- An emergent conscious experience that serves to evoke a behavioral protective response



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### Hyperalgesia

- an increased response to a stimulus which is normally painful' [Merskey and Bogduk, 1994]. Broadly, this means that if you twist your ankle and it hurts, and then later twist it again, it hurts a great deal more than it did the first time.

### Allodynia

- pain that is produced in response to a stimulus which does not normally provoke pain. Modest attempts at inversion will hurt, very gentle palpation of the area will elicit pain



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### The value of pain

- Pain has many valuable functions.
- It often signals injury or disease and produces a wide range of actions to stop it and treat its cause
- To seek help, avoid, or rest
  - Pain from tooth infection
  - Memory of pain role in teaching



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### The value of pain

- What is the value of persistent phantom limb pain to amputees whose stump has healed completely?
- What is the value of backaches, HA's, muscle pains, nerve pains, facial pains that there is no discernable threat?



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“Pain is the output. Nociception is one of the inputs. All of the inputs are evaluated when we’re talking about pain, I think, according to this question: How dangerous is this? Based on everything I know, which is all of the information available to me right now, how dangerous is this really?”

Dr. Lorimer Moseley




There’s no such thing as:

- Pain stimulus.
- Pain receptor
- Pain pathway
- Descending pain control

There are, however:

- noxious stimuli nociceptors,
- nociceptive pathways
- descending nociceptive control.

<https://bodyinmind.org/what-is-pain/>




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### Nonsense terms and aversive conditioning

Nonsense terms	Sensible terms	Friendly AND Accurate terms
<ul style="list-style-type: none"> <li>• Pain receptor</li> <li>• Pain pathway</li> <li>• Pain fibres</li> </ul>	<ul style="list-style-type: none"> <li>• Nociceptor</li> <li>• Spinal Nociceptors</li> <li>• Nociceptive pathways</li> </ul>	<ul style="list-style-type: none"> <li>• Danger detector</li> <li>• Danger transmitter</li> <li>• Danger messenger nerves</li> <li>• Danger message</li> <li>• (Potentially) dangerous stimulus</li> </ul>
<ul style="list-style-type: none"> <li>• Pain message</li> <li>• Pain signal</li> <li>• Pain Stimulus</li> </ul>	<ul style="list-style-type: none"> <li>• Nociceptive message</li> <li>• Nociceptive signal</li> <li>• Nociceptive Stimulus</li> </ul>	

Moseley




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Management for Pain has Changed:

- Management SHOULD NOT focus solely on tissues.
- We need to recognize the importance of the alarm system **sensitivity, fears, attitudes and beliefs** especially in a chronic pain state.
- How we **understand** and cope with pain affects our pain as well as our life.




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**Reconceptualising Pain According to Modern Pain Science**  
G. Lorimer Moseley  
*Physical Therapy Reviews* 2007; 12: 169-178

Pain does not provide a measure of the state of the tissues

Pain is modulated by many factors from across somatic, psychological and social domains

The relationship between pain and the state of the tissues becomes less predictable as pain persists-learned

Pain can be conceptualized as a conscious correlate of the implicit perception that tissue is in danger.



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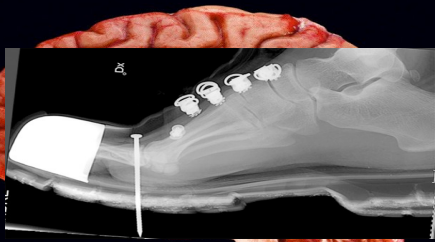
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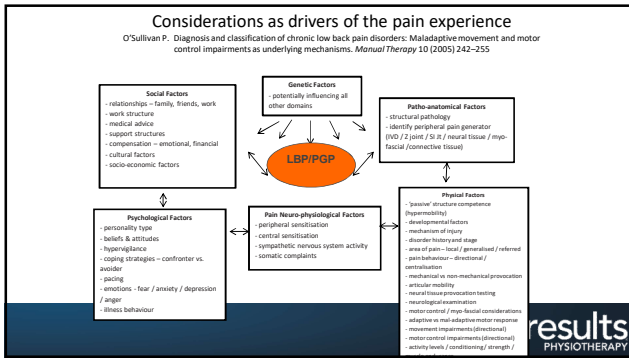
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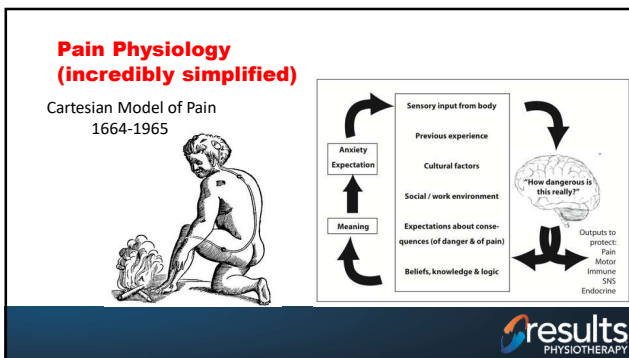
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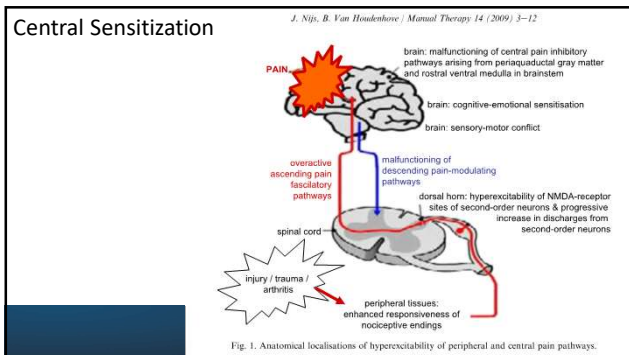
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**When our system/body is threatened or in danger (large or small threats) many things that are happening, all the time, to protect us**

- the immune system releasing inflammatory molecules to kill invaders or repair broken tissue
- the autonomic system increasing our arousal, preparing us to run
- the endocrine system stimulating healing and recovery
- the motor system tweaking our movement patterns to modify and vary mechanical stressors on certain tissues

<https://bodyinmind.org/what-is-pain/>




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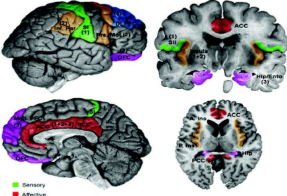
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**Functional measures**  
A. Brain areas functionally related to pain processing.

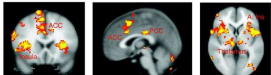


**Persistent Pain**


Consider these systems when danger is detected for prolonged periods.

- immune system
- endocrine system
- movement system
- evaluative (cognitive system)
- very mechanisms by which the brain is representing the body

B. Example of functional MRI response to painful stimulation.



<https://bodyinmind.org/what-is-pain/>




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**What does pain mean to your patient?**



I think about the meaning of pain. Pain is personal. It really belongs to the one feeling it. Probably the only thing that is your own. I like mine.

(Henry Rollins)

[izquotes.com](http://izquotes.com)




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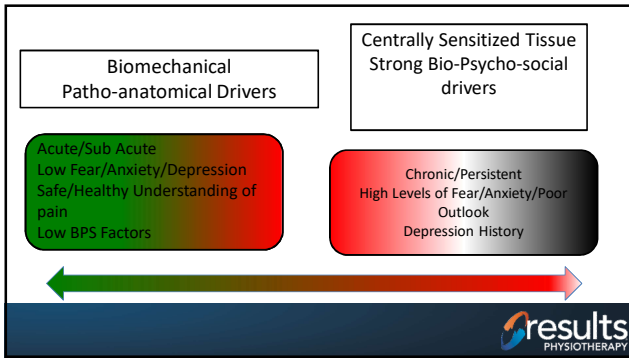
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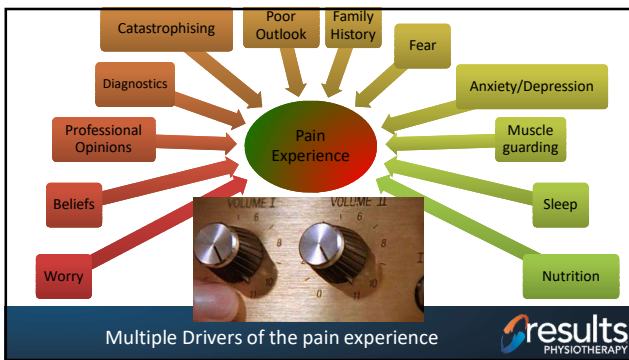
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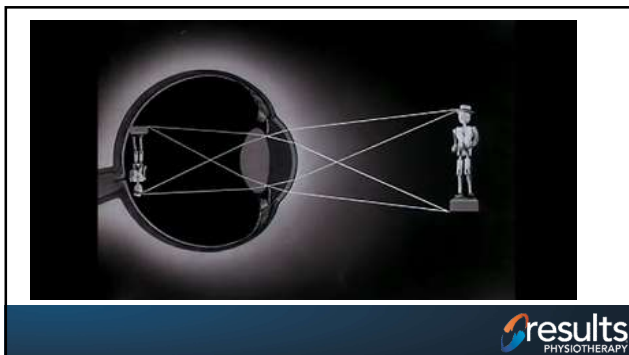
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### So what happens?

- Within split second, outside of your awareness and control, your brain sees - shadows, light sources, soft lines, sharp lines etc
- Complex reasoning mechanisms based on other vision experiences, context, environment...MEANING
- Modified by something you have no control over
- This is analogous to PAIN



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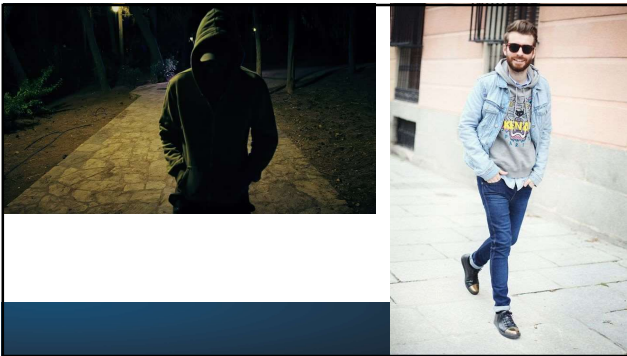
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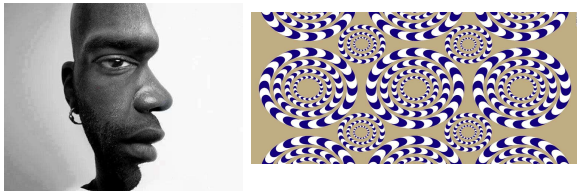
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### Brain interpretation



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**Eyes:** Contain light receptors; not vision.

**Ears:** Contain vibration receptors; not hearing.

**Tissues:** Contain nociceptive, receptors; not pain.

**Tissues:** Contain danger receptors; not pain.




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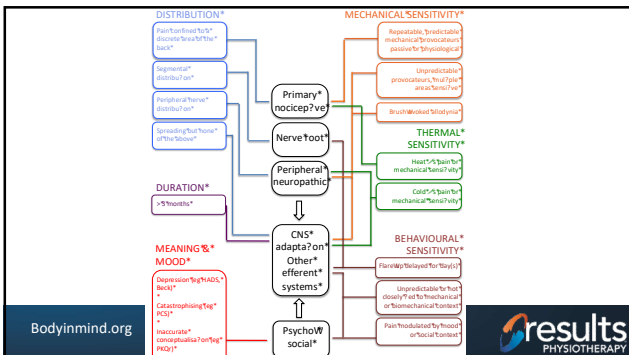
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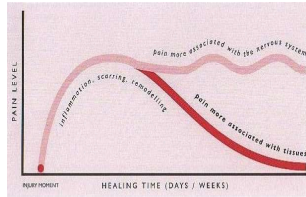
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### Tissue Healing:

- As the tissue heals, pain from the tissue should decrease.
- Chronic and disabling pain is defined as: *pain that remains after tissue healing process should be completed.*
- Therefore, there are other factors continuing to drive the pain.



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### What is the “spider” in your patients life?

- Bending
- Lifting
- What it might be?
- Boss
- Home life
- Ability to provide



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What do these words mean?

- Instability
- Your spine or pelvis is "out"
- Slipped disc
- Degenerative Disc Disease
- Spondylitic Changes
- Nerve Impingement
- Degenerative Changes
- Arthritis



sults  
PHYSIOTHERAPY

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Explanations for Chronic Pain - Nervous System Sensitization Component:

- When we have had pain for a while, the systems of our body including our nervous system can get into an **overprotective pattern** and so things like pain and inflammation can be produced more than they are required.
- So it becomes **more sensitive**, like a house alarm that goes off with a knock at the door.
- The more we do something the better we get at doing it, including processing pain!

results  
PHYSIOTHERAPY

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Characteristics of the Sensitized Nervous System:

- Less movement or activity is required before pain is produced, even imagining a movement can produce pain eg. back study.
- Skin may be persistently sensitive to touch.
- Diagnosis based purely on tissue injury doesn't fit.
- Pain can be unpredictable eg. good and bad days for no obvious reason.
- Biological process has occurred which means inputs that don't normally hurt now hurt, or painful inputs now hurt a lot more. (Neurotag hijacking).
- The brain is making decisions based on potentially faulty information about the condition of the tissues, (a perceived increased threat results in a need to protect).
- More sensory receptors, more messages being sent, less filtering spinal cord and easier pain production by the brain.

results  
PHYSIOTHERAPY

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**Movement Avoidance and Overactive Muscles Can Cause Ongoing Pain:**

- Muscle guarding and rigid movement.
- Can be related to thinking pain is harmful = anxiety.
- Adopted coping strategy to initial pain is causing the problem to continue.
- Increased strain on joints and muscles.
- Can start sensitization and keep it going.
- Becomes a habit that involves the nervous system overprotecting (consciously and subconsciously driven) = Mal-adaptive pattern of movement.



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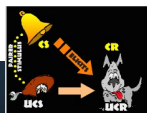
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**Beyond nociception: the imprecision hypothesis of chronic pain**  
G. Lorimer Moseley, J.W.S. Vlaeyen, Pain. 156 (2015) 35–38

Hypothesis of neuromatrix/neurotags are developed similar to the associative learning model and is based on 2 core assumptions

1. Pain can be considered a response, not just a stimulus
2. Encoding non-nociceptive information predictably coincident with nociceptive input underpins the response to subsequent similar events.

Pavlovian response



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- So is pain learned?
- Can it be unlearned?



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- Nerves that fire together, wire together.
- Nerves that fire apart, wire apart.




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### The Three Dimensions of Pain:

**Sensory** : awareness of where the pain is coming from, how intense the pain is, how the pain is behaving over time and the type or quality of the pain

Louis Gifford, Aches and Pains  
CNS Press Falmouth UK  
ISBN 978 0 9533423 5 8




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### The Three Dimensions of Pain:

**Cognitive**: How we think about it.  
Assessment of how bad the damage is, what to do about it and alterations of planning for work and recreation

- I better seek help from my nearest physiotherapist/acupuncturist/healer'
- I better go to bed for two weeks
- I'll ignore it and get on with my plans and see how it goes'
- I think I have broken it
- I'm not going to move until the ambulance arrives
- Last time I did this it took 4 months: this isn't looking good at all
- Oh great I can take a week off work

Louis Gifford, Aches and Pains  
CNS Press Falmouth UK  
ISBN 978 0 9533423 5 8




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### The Three Dimensions of Pain:

**Affective:** How we feel about it:

- Anger, mild annoyance, worry and anxiety
- Recognizes' that for every pain we have, an emotional reaction is expressed that is fundamental to the pain experience and not just a reaction to the sensory appreciation of pain
- The emotional impact that has at one end modest psychological distress and at the other extreme a status of clinical depression

Louis Gifford: Aches and Pains  
CNS Press, Plymouth, UK  
ISBN 978 0 9533423 5 8



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### Pain and the Neuromatrix in the Brain Ronald Melzack, Ph.D.

- Pain is a multidimensional experience produced by characteristic "neurosignature" patterns of nerve impulses generated by a widely distributed neural network.
- Neurosignature patterns may be triggered by sensory inputs, but they may also be generated independently of them



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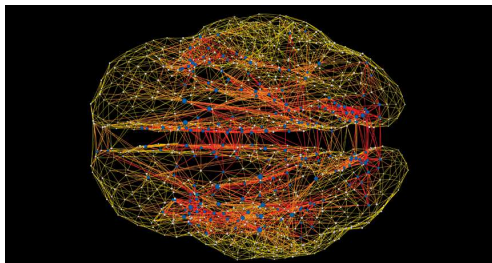
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Think of chronic pain as a song stuck in your head

Sweeeet Caroline!! Buh, buh, buuuuuh!!



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So how do we best treat persistent pain?



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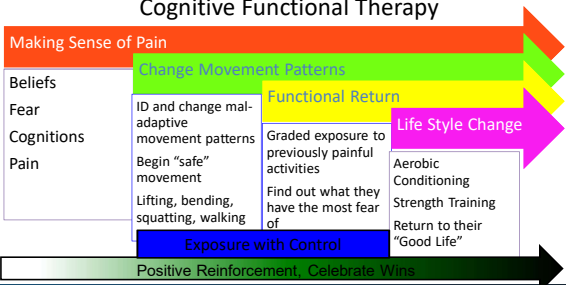
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### Cognitive Functional Therapy




The diagram illustrates the components of Cognitive Functional Therapy as a series of overlapping horizontal bars with arrows pointing right. The components are:

- Making Sense of Pain** (orange bar)
- Change Movement Patterns** (green bar)
- Functional Return** (yellow bar)
- Life Style Change** (purple bar)
- Exposure with Control** (blue bar)
- Positive Reinforcement, Celebrate Wins** (dark green bar)

On the left, a box lists the target areas: Beliefs, Fear, Cognitions, and Pain. On the right, a box lists the interventions: Aerobic Conditioning, Strength Training, and Return to their "Good Life".

Below the diagram, a small text block reads: "O'Sullivan K, Dankaerts W, O'Sullivan L, O'Sullivan PB. Cognitive functional therapy for disabling management practices, functional enhancement, and goal orientation. nonspecific chronic low back pain: multiple case-cohort study. Phys Ther. 2015;95:1478-1488"



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### Making sense of Chronic/Persistent Pain

- Personalized
- Reassurance
- Challenge beliefs/Behaviors/Thoughts/Response to pain
- Goal setting
- Target Behavioral Change



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### Language that helps

- Patients need empowering-not crushing
- Reduce fear and catastrophising
- Promote hope and confidence
- Simple language and metaphors



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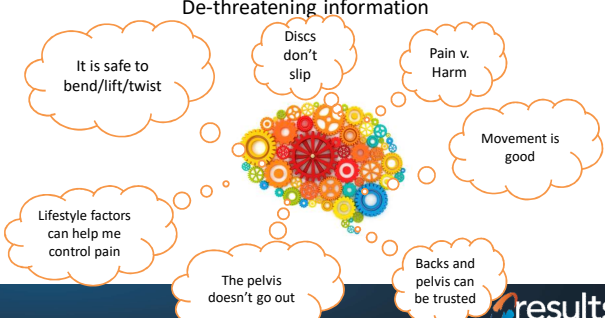
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### De-threatening information



- It is safe to bend/lift/twist
- Discs don't slip
- Pain v. Harm
- Movement is good
- Lifestyle factors can help me control pain
- The pelvis doesn't go out
- Backs and pelvis can be trusted



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### Challenging Beliefs

results  
PHYSIOTHERAPY

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### Metaphors for peripheral sensitization

results  
PHYSIOTHERAPY

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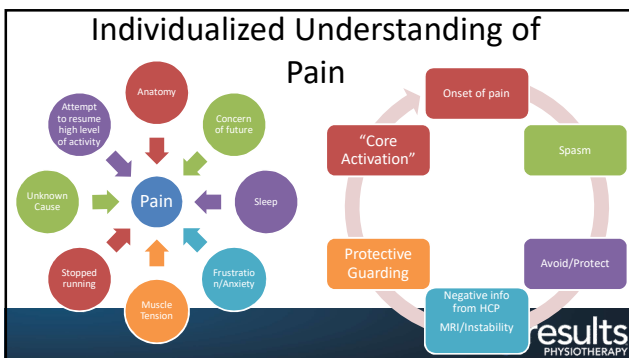
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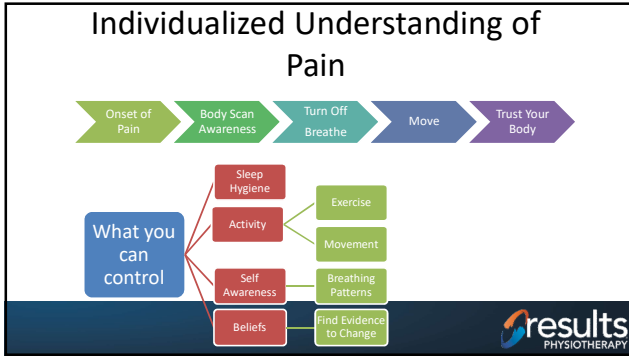
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### Exposure with Control

- Behavior experiments to enhance pain control
- Individualized to activities that hurt, are feared or avoided
- Focused relaxation and body awareness of patterns
- Build self efficacy



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### Integrate into Valued Activities

- Integrate new movements to ADL's and goals
- Graduated exposure into daily life
- Reduce threat



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### Lifestyle Change – Activity levels

- Patient preference
- Set goals
- Exercise diary/pacing
- View 23 ½ hours you tube video
- Aim for minimum 3x per week

Physical Activity:  
Hypo-algesic effects, improved mood, decreased anxiety,  
immune system response, muscle relaxation, , improved  
cognitive function, anti-inflammatory, improved sleep



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### Lifestyle Change-Sleep

- Pain control- sleep posture, relaxation
- Sleep hygiene
- No screen time, no stimulants, consistent time,
- Don't sleep during the day
- EXERCISE

Sleep:  
Hypo-algesic effects, improved mood, decreased anxiety,  
immune system response, muscle relaxation, , improved  
cognitive function, anti-inflammatory, improved energy



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### Education and Understanding:

- Taking an active approach and using health professionals as required to identify aggravating factors and aim to change them.
- Learning about the physiology of pain reduces the threat value of pain.
- Learning about what to do, and not learning why, will have an effect on your attitude and beliefs.
- So understand as much as you can about what is causing pain, not just what to do about it!



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Thank you!



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