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ABSTRACT

Contemporary conceptualizations of pain emphasize its protective function. The meaning assigned to pain drives cognitive, emotional, and behavioral responses. When pain is threatening, and a person lacks control over their pain experience, it can become distressing, self-perpetuating, and disabling. Although the pathway to disability is well established, the pathway to recovery is less researched and understood. This Perspective draws on recent data on the lived experience of people with pain-related fear to discuss both fear and safety learning processes and their implications for recovery for people living with pain. Recovery is here defined as achievement of control over pain, as well as improvement in functional capacity and quality of life. Based on the common-sense model, this Perspective proposes a framework utilizing cognitive functional therapy to promote safety learning. A process is described in which experiential learning combined with "sense making" disrupts a person's unhelpful cognitive representation and behavioral and emotional response to pain, leading them on a journey to recovery. This framework incorporates principles of inhibitory processing that are fundamental to pain-related fear and safety learning.

[H1] Background

Chronic musculoskeletal pain is now a leading cause of disability world-wide with the disability burden predicted to grow exponentially in the next two decades placing unsustainable strain on health systems.[1]

Once serious pathology has been excluded, a person's musculoskeletal pain experience is influenced by a varying interplay of multidimensional factors including, physical, patho-anatomical, lifestyle, psychological, social, culture, past history, sensory, comorbid health, genetics, sex and life stage.[2-5] The dynamic interplay and the relative contribution from each factor is variable, interrelated, and fluctuates temporally, making chronic pain a unique experience to each individual [4]. These interactions influence tissue sensitivity and continually shape a person's interpretation of their pain experience.[2, 5, 6]

Contemporary conceptualizations of pain emphasize its protective function.[2, 5, 7] The meaning assigned to pain is potentially a powerful cognitive contributor to the need for protection and therefore influences both the pain itself and the person's individual experience and response to pain. For instance, a recent trial randomized patients to receive threatening and non-threatening information from MRI reports. Compared to those who received non-threatening information, patients randomized to threatening information were more likely to perceive a need for interventions that carry greater risk and lower benefit such as opioids, injection and surgery, while also reporting worse pain intensity, disability, pain cognitions, mental health and self-efficacy.[8] This highlights

how both threatening and safety messages can influence a person's pain experience and trajectory in the health system.[9] The meaning of pain also influences emotional (ie, pain-related fear) and behavioral responses (ie, protection and avoidance).[4] Thus, pain-related fear can be defined as a cognitive and emotional response to an evaluation that the body is in danger and needs protecting.[10]

Pain-related fear, psychological distress and self-efficacy have all been shown to mediate the relationship between pain and disability.[11]. High levels of pain-related fear predict increased disability and poorer outcomes in people with chronic musculoskeletal pain.[12,13] Pain-related fear is modifiable,[12] and targeting protective (eg, slow and guarded task performance) and avoidance (eg, not performing a task) behavior may be an opportunity to reduce disability and the burden of chronic musculoskeletal pain.[14]

In this paper, we draw on recent data on the lived experience of people with pain-related fear to discuss both fear and safety learning processes and their implications for the management of musculoskeletal pain. There is now compelling evidence that management of chronic musculoskeletal pain should integrate biological, psychological and social perspectives.[15-19] However, there is a lack of clear directions for clinicians, particularly physical therapists, on how to implement psychologically informed approaches into practice.[20-24] The paper aims to provide physical therapists with a clinical framework that describes how Cognitive

Functional Therapy (CFT) [25] can be implemented through the lens of the common-sense model[26,27] to promote safety learning in people with musculoskeletal pain. CFT is an exposure-based physiotherapy-led approach[25] that was developed to reduce disability in people with chronic musculoskeletal pain. In view of the fact that chronic musculoskeletal pain across different body regions shares common biopsychosocial risk profiles for pain and disability, we consider that this framework is applicable across a range of musculoskeletal pain conditions.[15, 28]

To illustrate the utility of this framework, we present a case study where CFT is used to guide a person with disabling back pain and high pain-related fear on a journey to recovery. Recovery is here defined as a person developing control over pain, confident engagement with valued activities and quality of life.[29]

[H1] Fear Learning

[H2] *Societal beliefs about the body and pain*

In Western society, people of all ages, both with pain and without pain in geographically diverse settings, commonly hold unhelpful beliefs about the body and pain.[30-33] The body is often perceived as fragile and vulnerable to harm; and the experience of pain is interpreted as threatening, and often understood as a sign of structural damage. As such, there is a perception that the painful body

part always needs to be protected and 'fixed'.[30-33] There are examples of this in in people suffering from pain in the back,[30, 34] knee,[35] and hip.[36] Our own clinical studies have demonstrated that people with and without back pain, as well as physiotherapists that manage people with back pain, show an implicit (non-conscious) bias about the vulnerability of the back even when they explicitly report otherwise.[37-39] This suggests that as a society, we are biased towards information that supports fear beliefs about the body and pain.[40]

[H2] *Lived experience of pain-related fear*

A body of qualitative work[31,34,41,42] exploring the lives of people living with chronic pain and high fear, provides compelling evidence that pain-related fear can be understood as a common-sense response to a threatening pain experience described as severe, uncontrollable and unpredictable. For example, when a person believes that performing a painful activity will hurt and/or cause harm to their body, avoiding or modifying that activity is common sense. While avoidance may reduce fear and or pain in the short term, it also prevents the person from having positive learning experiences that would disconfirm their expectations and beliefs. Failed attempts to gain control over the pain experience and its impact can reinforce fear learning and result in increased disability in the long term.[26,27] Qualitative[26,27] and experimental[43,44] data highlighted several factors that can reinforce pain-related fear and behaviors including: diagnostic uncertainty, threatening radiological reports coupled with negative advice (explicit or implicit) received from clinicians during healthcare encounters, conflicting advice from different clinicians, and societal beliefs about the

structural vulnerability of the body. For some, threatening social contexts such as abusive relationships, bullying, stressful life events, and negative healthcare encounters promote a salient learning experience and may also play a role in facilitating fear learning [45].

[H2] *Pain-related fear, protection and avoidance of movement*

A large proportion of people with chronic back pain believe that a wrong movement could result in serious negative consequences to their back.[46] This belief potentially increases pain expectation, pain experience and fear, shaping people's behavior[34,47] towards activity avoidance, protective muscle guarding and restricted movement.[48,49] It has been proposed (but not yet empirically established) that over-protective motor responses can be pro-nociceptive, leading to abnormal stress on sensitized spinal structures and in turn, increased pain intensity and pain persistence[50,51] Other studies highlight the role of cognitions and emotions as potential mechanisms that may underlie co-occurrence of pain and fear in pain and fear, and modulate a person's pain experience.[52-54]

[H2] *Generalization of fear, protection and avoidance*

The inability to distinguish what is safe from what is dangerous has been proposed as a core mechanism in the generalization of protective responses that lead to disability.[14,55] This can result in pain being triggered by more functionally dissimilar stimuli,[11]

meaning that people are more likely to disengage from a wider range of movements and activities. For example, when the original painful trigger is associated with bending and lifting, this may result in generalization of fear, avoidance and pain to similar (eg, vacuuming, putting on shoes) and dissimilar (e.g. walking, washing dishes) movements and activities.[11] This generalization of fear and avoidance reduces the opportunities to challenge and disconfirm a person's feared expectations, reinforcing fear as a driver of unhelpful behavior and perpetuating disability.[10, 34] This sustained perceived lack of safety may play a role in the maintenance of pain-related fear.[55]

[H1] Models of Fear Avoidance in Musculoskeletal Pain

[H2] *The fear avoidance model*

A prevailing model explaining the pathway to disability associated with chronic musculoskeletal pain is the fear-avoidance model.[10, 14, 56] The model describes how a threatening pain experience can lead to an unhelpful cycle of catastrophic thoughts, pain-related fear, avoidance of movement and activity, and subsequent disability and depressed mood, that in turn heightens the pain experience.[10,56] Although the fear-avoidance model proposes the return to normal activity in the absence of catastrophizing leads to recovery,[10, 56] the pathway to recovery is less researched and understood.

[H2] *The common-sense model and fear learning*

Sense-making is the process by which an individual makes sense of their pain and what it means now and moving forward. Insights from qualitative research suggest that 'sense-making' processes, beyond pain catastrophizing, play a role in pain-related fear learning and disability.[31, 34] Sense-making is at the heart of the Common-Sense Model.[57] Bunzli et al (2017) proposed the utility of the Common-Sense Model as a framework to assist healthcare professionals to understand the sense-making processes involved in the fear-avoidance cycle and how these processes can be targeted to facilitate fear reduction in people with chronic musculoskeletal pain (see safety learning section).[27] The model describes a dynamic process that constitutes a person's 'cognitive representation' of their pain condition, which is formed by memory structures of their normal functioning *self*, past experiences of pain, treatments, lifestyle and social activities. This is updated based on new information that is heard (eg, media, family, encounters with health care professionals), observed (eg, vicarious experience from friends, family, work colleagues) and felt (eg, bodily sensations, a perceived painful sensation). Once a person experiences pain, their cognitive representation helps them make sense of pain based upon five dimensions: *identity* (What is this pain?), *cause* (What caused this pain?), *consequences* (What are the consequences of having this pain?), *timeline* (For how long will this pain last?) and *cure/controllability* (Can this pain be cured or controlled?) [57]. How a person makes sense of their pain will influence how they respond to it from both a behavioral and emotional perspective.[26, 27] The dynamic process that includes a person's understanding and their behavioral and emotional responses is here defined as 'learning schema'.

For example, when a person with back pain believes that 'spinal flexion will cause pain', the action taken is to avoid and guard against flexion and therefore the predicted outcome is that pain is avoided. If this occurs, it appears that there is coherence between prediction and outcome even though the coherence actually relates to an opposing prediction and its outcome. Nonetheless, the original cognitive representation (that flexion will cause pain) is reinforced *by inference,* and the behavior is maintained (ie, the experience does not promote learning). If the prediction then becomes 'avoiding flexion prevents pain' but this does not occur (ie, pain is experienced despite avoidance of flexion), there is incoherence between prediction and outcome and learning occurs sensibly toward the notion that the cognitive representation does not work and things are even worse than they first appeared. A person's inability to predict what makes their pain worse and the lack of control over their pain experience results in an inability to make sense of pain which is in turn self-perpetuating, distressing and disabling and reinforces fear learning (fear learning schema).[10, 27, 52]

[H1] Safety Learning

Extinction research highlights the importance of learning of a new experience of safety as the primary underlying mechanism in fear reduction.[58] Fear reduction is related to people's ability to form new safety memories that compete with old fear memories, thus regulating their emotional and behavioral response to the source of their fear.[7, 59] This concept is grounded in the inhibitory learning theory from the field of anxiety management which proposes a shift from models that use cognitive restructuring and fear

habituation (ie, exposure until fear reduces) as an index of corrective learning, towards developing safe associations (i.e. new experience of safety).[59-61] Inhibitory learning strategies have been proposed to maximize learning of new safe memories.[59, 60] Figure 1 provides a summary of the information presented in this section, outlining 'How to' principles for clinicians to promote safety learning in clinical practice.

[H2] *Common-sense model and safety learning*

The common-Sense model can also assist clinicians to understand the sense-making processes involved in safety learning in people with chronic musculoskeletal pain.[27] Take the same person with back pain who is fearful, guarded and avoidant of lumbar flexion. If they are reassured that 'spinal flexion is safe', and they experience that flexing their back in graded and relaxed manner does not result in an increase in back pain (or indeed a reduction in pain), there is incoherence between prediction and outcome; subsequently, learning occurs.

Expectancy violation is at the heart of inhibitory learning (or safety learning), meaning that new safe memories (eg, 'flexing my spine is safe') are developed and compete with the original fear memory (eg, 'flexing my spine causes pain') [59]. The development of a strategy that effectively controls the pain experience combined with an explanation that helps a person make sense of their pain, challenges the original fear schema [4], which is sensibly updated towards an experience that is deemed safe (safety learning

schema). The repetition of an experience of safety integrated to the person's life is thought to reduce pain-related fear, disability and distress.[26, 27]

[H1] Utilizing CFT to implement safety learning

We propose a framework that considers the person's journey into pain and disability but focuses on the process of change in which safety learning can lead to recovery. This framework enables clinicians to capture the patient's story, identify targets for recovery and assist patients to acquire a new understanding through an alternative experience of safety. The experiential learning and sense-making process outlined in this framework aims to equip patients with effective strategies to independently control pain and prevent flare-ups in pain intensity, and/or control the impact of pain in their lives and emotional responses to pain. The combination of a new cognitive representation and an effective set of strategies enables patients to problem solve the best course of action in any given context so they can confidently engage in valued life activities.[25, 27, 31] This framework endorses best-practice recommendations,[15] providing clinicians with a clear roadmap of how to implement exposure to promote change clinically.

Not all patients in pain are fearful. Acknowledging that avoidance can also occur as a commonsense response to an unhelpful pain representation based on what they have been told or experienced; we propose that our framework may also be helpful in patients who report low levels of fear.

The proposed clinical framework is schematically illustrated in Figure 2. It displays a pathway to recovery from pain-related fear using CFT as a vehicle to promote safety learning.

[H2] *The therapeutic relationship*

For patients in pain, the use of a communication style that is open, non-judgmental, reflective and provides validation of the person's emotions, beliefs and experiences is paramount to safety learning.[62] This communication style decreases arousal, facilitates disclosure and encourages problem-solving.[63, 64] Communication practices that foster a strong, trusting therapeutic alliance create an environment of reduced distress that sets the stage for safety learning and behavioral change.[63, 65] The use of a screening questionnaire prior to the interview provides the clinician with a perspective on the person's pain and disability levels, cognitions and emotions, providing opportunity for targeted for exploration of their concerns within the interview[66] (Fig. 1 provides examples of screening tools).

Clinicians are encouraged to use the common-sense model to explore the patient's pain representation, emotions and behavioral responses to pain. Patients can be prompted to reflect on experiences that led to their understanding of pain, and how this impacts

their behavior.[27, 67] Insight into the person's feared, avoided and pain provoking activities that are aligned to their goals, provides clear targets for exposure.[25,67] This approach encourages greater partnership in clinical encounters.[63, 68]

[H2] *Exposure*

Behavioral exposure specifically targets pain-related fear and avoidance by gradually exposing the person to the tasks they fear or avoid, while challenging unhelpful cognitions and disconfirming threat expectations (ie, task performance without the occurrence of the expected catastrophic outcome).[69] Traditionally, exposure therapy targets erroneous harm beliefs (eg, "lifting will damage my disc") rather than pain itself.[69] However, the basis of avoidance and the cognitive representation of pain vary between people (ie, fear of damage, fear of pain, fear of the consequences of being in pain, or a common-sense response to what they have been told or experienced).[27] For patients who avoid lifting because they fear an increase in pain and its consequences, exposure to repeated lifting when it leads to an increase in pain and distress may inadvertently reinforce fear learning.

In contrast, *exposure with control* is a process of behavioral change that explicitly targets the pain experience itself (where possible), using pain as a hypothesis for testing during behavioral experiments (eg, "lifting will increase my pain"). Behavioral experiments during exposure provide an experience in which learned associations between threatening tasks and increased pain or harm may be corrected (ie, that new "safety" associations are formed). This strategy derives from the premise that the mismatch between

expectancy and experience is helpful for new learning [60] (see the Table; and row 3 in the Supplementary Table , for an example illustrated by the case study). While for some patients the goal is to experience less pain during task performance, for others, it may be engaging with the feared and avoided tasks without damage. In this process, sympathetic responses and safety-seeking behaviors that occur during the performance of painful, feared, or avoided functional tasks are explicitly targeted and controlled in order to create a discrepancy between the patients expected and actual pain responses (ie, *Prior patient expectation*: "I expect my pain will get worse with repeated bending"; *Behavioral experiment*: patient experience "When I relax, breathe and bend my back without protecting it, my pain does not get worse – it in fact reduces"). This includes promotion of body relaxation prior to exposure, reduction of protective behaviors, facilitation of body awareness and control that enables the person to experience the performance of functional activities in non-protective way. [25, 70, 71] For instance, lifting in a relaxed manner and modifying how the person physically performs the task without unhelpful protective responses (ie, breath holding, bracing, avoidance of spinal flexion) may result in a positive experience that promotes safety learning.[25, 70] A recent case-series demonstrated that for the people in which improvements in pain were related to changes in movement, they adopted a new behavior considered as 'less protective' (i.e. greater range and speed of movement, and more relaxed back muscles).[70] In another case-series people with high pain-related fear reengaged with previously feared and avoided activities after undergoing a 12-week CFT intervention.[71] Exposure that promotes 'control' of emotional and behavioral responses to pain provides a potential pathway to return a person to their valued activities without pain escalation and associated distress.[25]

Safety learning is consolidated by asking patients to reflect on what they learned regarding the non-occurrence of the feared event, discrepancies between what was predicted and what occurred, and the degree of "surprise" from the exposure practice.[60] The experience and this reflection process challenges the person's implicit and explicit beliefs.[4] This process is repeated for reinforcement of the new experience, and exposure is progressed to further disconfirm unhelpful beliefs. The new learned strategies are immediately integrated into daily activities to build self-efficacy and promote generalization across contexts and activities.

When pain control is not achievable during this process, the focus is placed away from pain and toward non-protection and reassurance that the activity is safe, while undergoing the process of graded exposure to personally-relevant functional and lifestyle goals. In these cases, the journey towards living is the experiment itself.[25, 72]

Exposure can be very challenging for the patient, as well as the clinician who needs to support the patient along the journey. In order to guide their patient to engage in painful, feared and or avoided movements and activities, clinicians need to be confident they have adequately screened for specific and underlying pathology, and that they will not 'harm' the patient in this process. They also need to be skilled to manage potential emotional responses, as exposure can elicit strong emotional responses, anxiety, and

occasionally panic in a patient. An awareness of the clinician's own pain and movement/activity beliefs, as well as specific training, appears to be important when implementing this approach. This reflects a process of exposure training for both the clinician and the patient.[24, 25, 67, 73]

[H2] *Making sense of pain*

The process of making sense of pain is reflective and uses a persons' own story combined with their experiences during behavioral exposure to gain a new understanding of their pain and build self-efficacy to achieve their goals.[25] The common-sense model can be used to explain this process.[27] Qualitative[31] and clinical[71] data of people with disabling back pain undergoing CFT found that clinical improvement was attributed to a person's ability to make sense of their pain experience in a non-threatening way, and their ability to gain control over the pain experience and/or the effects of pain in their life. This was achieved through developing a new and coherent cognitive representation of pain that guides effective behavior.

Based on the common-sense model, a coherent representation includes diagnostic certainty from a biopsychosocial perspective (*identity*) that can explain a person's symptoms in a meaningful way (*cause*), replacing erroneous beliefs about pain and its damaging or disabling effects (*consequences*) and provides strategies for controlling symptoms and emotions in a manner that re-engages them with living (*timeline and control*) [27]. The development of a new cognitive representation is an interactive learning

process that is achieved via reflecting on the person's own narrative, experience, self-reflection, and education. This process disconfirms previously held unhelpful beliefs and allows a person to reconceptualize and understand their pain symptoms, emotional and behavioral responses to pain in a new way through a biopsychosocial lens, with the aim to gain self-efficacy [25].

[H2] *The journey to recovery*

The experience of 'safety' is key for the recovery of a person who is protective and/or avoidant. The pathway by which a person recovers is unique for each person. This has been previously illustrated in Caneiro et al (2019). [71] While for some this process can occur in a few weeks, for others it may take longer (3-6 months).[25] A study investigating how changes in pain-related fear unfolded over the course of a 12-week CFT intervention demonstrated that changes in pain intensity, pain controllability and pain-related fear were associated with changes in disability. The factors that changed, and the rate and pattern of change, were different for each person, highlighting individual variability in the process of change.[71] A qualitative study found that people with chronic back pain who gained control over pain by modifying the way they move, reported an ability to self-manage pain and flare ups while engaging in valued goals.[27] Among those who did not achieve pain control, some reported poorer outcomes at follow up, while others reported that accepting the unpredictability and uncontrollability of pain, or adopting a new and more positive mindset about the causes and consequences of pain enabled them to control their worry and engage in valued activities.[27] This suggests the likelihood of multiple individual pathways to reducing disability related to chronic pain in people with pain-related fear.

Booster sessions may be necessary for when/if pain again becomes uncontrollable, distressing and/or disabling. During pain flares, the old cognitive representation can resurge strongly, often re-activating unhelpful behavioral and emotional responses. In the study by Caneiro et al (2019) all participants experienced pain flare-ups of variable intensities and duration that provided opportunities to reinforce safety learning.[71] Providing patients with an individualised management plan for pain flare-ups, with the potential to re-engage with care is important (see 'Flare-up plan' in the Table).

The following clinical case illustrates the processes of fear learning and disability, and safety learning as a roadmap to recovery (Fig. 3).

[H1] Case Study

[H2] *Patient's story*

A 45 year old woman with a 23-year history of (non-specific) back pain. Mother of two, married, works part-time from home. She has seen several healthcare professionals including, general practitioners, chiropractors, massage therapists, physiotherapists, spinal surgeons and pain physicians. She manages her pain with rest, heat pack, massage, light stretches, non-steroidal anti-

inflammatories, gabapentin, several spinal injections and opioids (including Oxycodone for many years). Her goals are to be able to participate in her family activities, be healthier, fitter and stronger. Key contributing factors for this patient's presentation are: unhelpful damage beliefs, high pain-related fear (of pain/flare ups and damage), high pain catastrophizing, guarded movement and avoidance behavior, poor sleep, activity avoidance, low physical conditioning, hyperalgesia to touch and movement. The Table outlines this patient's cognitive representation of her pain, and her behavioral and emotional responses to pain before and after a CFT intervention (key elements of the intervention are outlined in the table). The Supplementary Table outlines how inhibitory learning strategies can be integrated to the management of musculoskeletal pain conditions, using the case patient in this paper as an example.

[H1] Challenges and Implications for Clinical Practice

Despite the promotion and awareness of a biopsychosocial approach to pain, a biomedical model commonly underpins current education and practice.[74] Health system models can limit access to best practice, where health funding frequently offers reimbursements for imaging, medication and surgery (when not indicated by guidelines), but not for person-centered physical and psychological interventions.[75, 76] The biomedical model of care provides a fertile context for fear learning, which can lead a person to believe their body is fragile, damaged, and that it needs protection.[3]

The beliefs of both clinicians and patients that pain is associated with damage (in the absence of trauma or indicators of serious / specific pathology); that scans identify the source of pain; that symptoms occur as a consequence of structural and biomechanical abnormalities; are pervasive.[9, 34, 77, 78] This commonly leads to the view that targeting the structure or body 'abnormalities' will fix pain, which in turn often leads to overmedicalization, unnecessary and potentially unhelpful tests, and limited effectiveness of interventions for most chronic musculoskeletal pain conditions.[3] Threatening advice to patients such as 'let pain guide you', 'your pain is due to wear and tear', 'if it hurts avoid it', 'engage your core when you move', 'lift with a straight back' suggest vulnerability of the body and reinforces an unhelpful cognitive representation that can lead to, or reinforce avoidance/protective behaviors.[77-79] In this way, physical therapists have the capacity to influence patients into fear or safety learning.

There is a need for change in how we communicate about the body and pain to people with and without pain to reduce fear learning, promote safety messages and minimize or prevent the impact of pain in people's lives.[67, 80] To promote safety learning it is imperative to disseminate messages broadly in society that instill positive perceptions about the body and pain, that build confidence in the body, in its capacity to heal and adapt, and that encourage the adoption of healthy behaviors, including movement and physical activity, as safe and helpful. [43, 44, 75] Having a unified narrative among family members, friends, carers, workplace colleagues and advisors is critical as they play an important role in a person's journey to recovery. In contrast, conflicting advice,

unhelpful carers, social stress, mental health and co-morbidities can be obstacles for recovery.[76] This highlights the importance of co-care and communication with community services to support a person's path to recovery.

Clinical pathways that align with evidence and clinical practice guidelines are optimal, but not always delivered.[15] To facilitate safety learning in patients with pain that are fearful and/or avoidant, clinicians require excellent communication skills that are reflective, validating and empowering.[25, 62, 76] Clinicians also need to be specifically trained and mentored to achieve competency to perform exposure with control[25] and changes to physical therapy curriculum are needed to upskill clinicians on the understanding and delivery of person-centered care.

Public health initiatives are needed to change the pervasive societal belief that the body (the back [30, 34], the knee [35], and the hip [36]) is vulnerable [67]. Community outreach initiatives such as the Pain Revolution (https://www.painrevolution.org/), the painHEALTH (https://painhealth.csse.uwa.edu.au/). the joint pain website (https://www.myjointpain.org.au/), and Empowered Beyond Pain podcast (https://open.spotify.com/show/3ogpeLlDGLRLiHofEWvCje) aim to provide credible sources of information for clinicians as well as the general public to bridge the gap between science and practice upskilling society in the understanding of pain.

[H1] Evidence for application of this framework

There is emerging evidence of the effectiveness of exposure-based interventions for people with chronic musculoskeletal pain, utilizing principles outlined in this paper.[81 82 83] Physical Therapists that were trained in this framework reported an increase in confidence and competence in managing the biopsychosocial dimensions of pain.[24,73] A large trial is currently underway to test the effectiveness of this approach against usual care in people with chronic back pain.[84] This framework is aligned with best-practice recommendations to manage musculoskeletal pain irrespective of body region.[15,16,19,28] Further research is needed to assess the efficacy of this approach in other musculoskeletal pain conditions.

[H1] Summary

The clinically useful framework we propose posits that experiential learning combined with sense-making, enables people with musculoskeletal pain to gain control over pain and its impact by disrupting unhelpful cognitive representations, behavioral and emotional responses to pain, leading them on a journey to recovery. This clinical framework endorses best-practice recommendations. While low back pain was used as an example in this paper, we consider that this framework is applicable across a range of musculoskeletal pain conditions.

Author Contributions

Concept / idea / research design: JP Caneiro, A. Smith, S. Bunzli, S. Linton, G. L. Moseley, P. O'Sullivan

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Data collection: JP Caneiro

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Project management: JP Caneiro

Consultation (including review of manuscript before submitting): S. Bunzli, S. Linton, G. L. Moseley, P. O'Sullivan

Disclosure

JP Caneiro and Peter O'Sullivan deliver educational workshops on patient-centered care for the management of pain. Specifically, they receive payment for workshops on Cognitive Functional Therapy (CFT).

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Steven Linton, Anne Smith and Samantha Bunzli declare no conflict of interest.

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Table. Qualitative Reports Based on the Common-Sense Model (CSM) Before and After an Exposure-Based Approach

CSM CONSTRUCTS		BASELINE (8 weeks pre-treatment)	MANAGEMENT (12 weeks)	FOLLOW UP (6 months)
REPRESENTATION	**Identity**	Tissue damage (ie, muscles, ligaments, disc, and nerves)	An individualized, exposure-based behavioral approach (Cognitive Functional Therapy) [25] including the following key components: **The story:** an interview centered in the person's narrative to explore their story and experiences of pain. This sets the scene for targeted behavioral experiments and exposure.	"The fear of doing things that would make me sore, and the tension that comes with it…and me disengaging from family, work and all that I wanted

			Exposure with 'control': a process of behavioral change through experiential learning following a 'graded exposure' model designed to violate expectations of pain and damage via guided behavioral experiments. The movements and activities that she feared and avoided were explored and revealed breath-holding, muscle guarding, and avoidance of flexion of the lumbar spine during sitting, bending and lifting. Behavioral experiments revealed that visualization of bending and lifting increased pain and muscle tension. Slow diaphragmatic breathing and relaxation of spine posture in sitting reduced pain. Graduated exposure to lumbar flexion with control (ie, relaxed spinal flexion) led to less pain than she expected. This positive experience confronted her beliefs about bending, pain and damage, allowing her to experience pain control during feared and provocative tasks. Repeated exposure to relaxed bending and lifting was gradually progressed (from 0kg to 15kg) over 12 weeks reinforcing that these movement were safe. The strategies learned were integrated to daily activities to reinforce safety learning and promote generalization. **Making sense of pain:** reconceptualization of pain via self-reflection, behavioral learning and personalized education linked to her story.	to do …. it was a vicious cycle really"
	Cause	"A car accident 23 years ago made my back weak, and then having kids made it worse."		"The fact that I avoided doing a lot of things and moving because I was fearful of making it worse is the reason why I got worse."
	Consequences	"The pain is worsening (…) It affects my life every day. I'm not able to do things that I like…things like gardening…what normal people do."		"A big thing for me has been having the physiotherapist alongside me, guiding me. Another big thing was having a positive experience."
	Control / Curability	"There's not much I can do to control it (…) Avoidance is my control."		"Definitely much more control than I had before. I still get occasional periods of pain, but they are a lot more manageable. I do

			Explained how negative beliefs, distress, poor sleep, fear, worry, lack of confidence, activity avoidance, and protective muscle guarding set up a vicious cycle that sensitizes the spinal structures that lead to pain and disability. The positive experience during guided behavioral experiments reinforced that her back was structurally sound, that pain does not equal harm, and that relaxed movement is healthy and safe. **Generalization:** integration of strategies in her daily life enabled self-learning and self-discovery during the rehabilitation that guided subsequent progression across different sessions in a goal-orientated manner. **Lifestyle change:** behavioral modification addressing unhelpful lifestyle factors, including: **i)** advice to improve sleep hygiene (7h/night, regular sleep time, breathing techniques to relax); **ii)** encouragement to gradually reengage in family activities including walking, bike riding and beach walking. She was advised to perform these activities on a time contingent manner rather than contingent on pain; **iii)** perform body and mind relaxation strategies daily. **Flare–up plan:** that equipped her with effective strategies to independently prevent or manage pain flare-ups, unhelpful responses to pain, and/or control the impact of pain in her life allowed her to engage in valued life activities. **Treatment dose:** 8 sessions over 12 weeks. The initial session was 1 h and the follow ups were 30–45 min. This patient was	things differently, more relaxed, breathing and using my legs and that reduces the pain."
	Timeline	"That's just how it is, and I have to learn to accept it."		"Definitely improving, and it's kind of surprised me as well, because coming down off the Opioids was very hard."
BEHAVIORAL RESPONSE	**Action**	"Just anything that involves bending, just puts that thought in my mind. 'Can I or can I not?' And the majority of the time I'll just avoid."		"There was a process of teaching me how to move differently (in a relaxed manner). This gave me a sense of control over my pain, my life really".
	Appraisal	"Nothing that I have done so far, chiropractor, physiotherapist, massage, Pilates, injections, has been effective – only		"This process gave me confidence I can do most things. Now, I have strategies and a

		avoidance is effective."	seen on a weekly basis for the first three sessions and then progressed to one session every 2–3 weeks. An individualized self-management program was provided that included behavioral strategies, progressive functional exercises and lifestyle changes, tailored to personal goals.	plan, and they work"
COHERENCY		"There is a lot of conflicting advice …. I follow it, but I don't get better….it is confusing really."		"A lot of it now, feels like it's common sense, but it was actually quite empowering for me to learn."
EMOTIONAL RESPONSE	**Emotion**	"It's upsetting, it makes you feel useless, not being able to do what other people can do (…) It is frightening."		"I'm not fearful of bending and lifting. I know I can change it and that makes me feel in control, empowered."

FIGURE LEGENDS

Safety learning - 'How to' principles[a]

- **Screen** for contributing factors to pain using a multidimensional screening tool (eg, short form Orebro,[66] STarT Back Screening Tool[85]; STarT Musculoskeletal Screening tool[86]). Individual items can be used to guide and acts as prompts in the interview.
- **Interview** to enquire about patients' concerns, worries, fears and goals (use items on Orebro to guide and prompt)
  - Listen to the patient's story, considering multiple factors that can influence the person's experience, including but not limited to past pain and healthcare encounter experiences, past trauma, general health, lifestyle, social context, physical activity, etc.
  - Use the common-sense model framework to enquire about the five domains of their representation (identity, cause, consequences, timeline, control/curability), behavioral responses and emotional responses.
  - Identify the most feared, avoided, painful functionally meaningful task for the person
  - Explore person's expectations, goals and values.
- **Examine** using behavioral experiments (in addition to a thorough exam) to determine behavioral and emotional responses to pain; and to determine a person's sensory profile – sensitivity to touch, posture, movement and load.
  - Identify the feared task
  - Observe the task and enquire about the experience
  - Facilitate body relaxation, reduce safety-seeking behaviors teach body awareness/control
  - Reassure
  - Expose in a new way and enquire about the experience
  - Grade up exposure based on emotional and pain response
  - Violate the expectation where possible
  - The experience of moving without (an increase in) pain and without damaging consequences is likely to facilitate a new understanding and development of perceived control over the experience. A new experience that creates a new safe memory.
  - Effective strategies to control pain and manage flare ups.
- **Expose with control** – repeated exposure in new way – linked to goals, valued and essential activities
  - Repetition over time establishes coherency and reinforces safety learning
- **Make sense of pain** - Sense-making process including an explanation/conversation to reframe a person's experience and meaning of pain, using a new safe experience to create a new representation that is coherent and makes sense. Dispel myths where the patient is open. Provide relevant resources, patient stories.
- **Integrate** new representation and response (behavioral and emotional) to daily life, reinforcing safety learning, promoting generalization and facilitating the achievement of independence.
- **Provide** a clear exacerbation plan that provides the person with strategies that help the person achieve a better experience by themselves.
- **Refer** to (and facilitate) co-care as /if needed.

Figure 1. Key principles to promote safety learning in clinical practice (once serious and specific pathology has been screened). [a]*These principles are described in detail elsewhere.* [67 25]

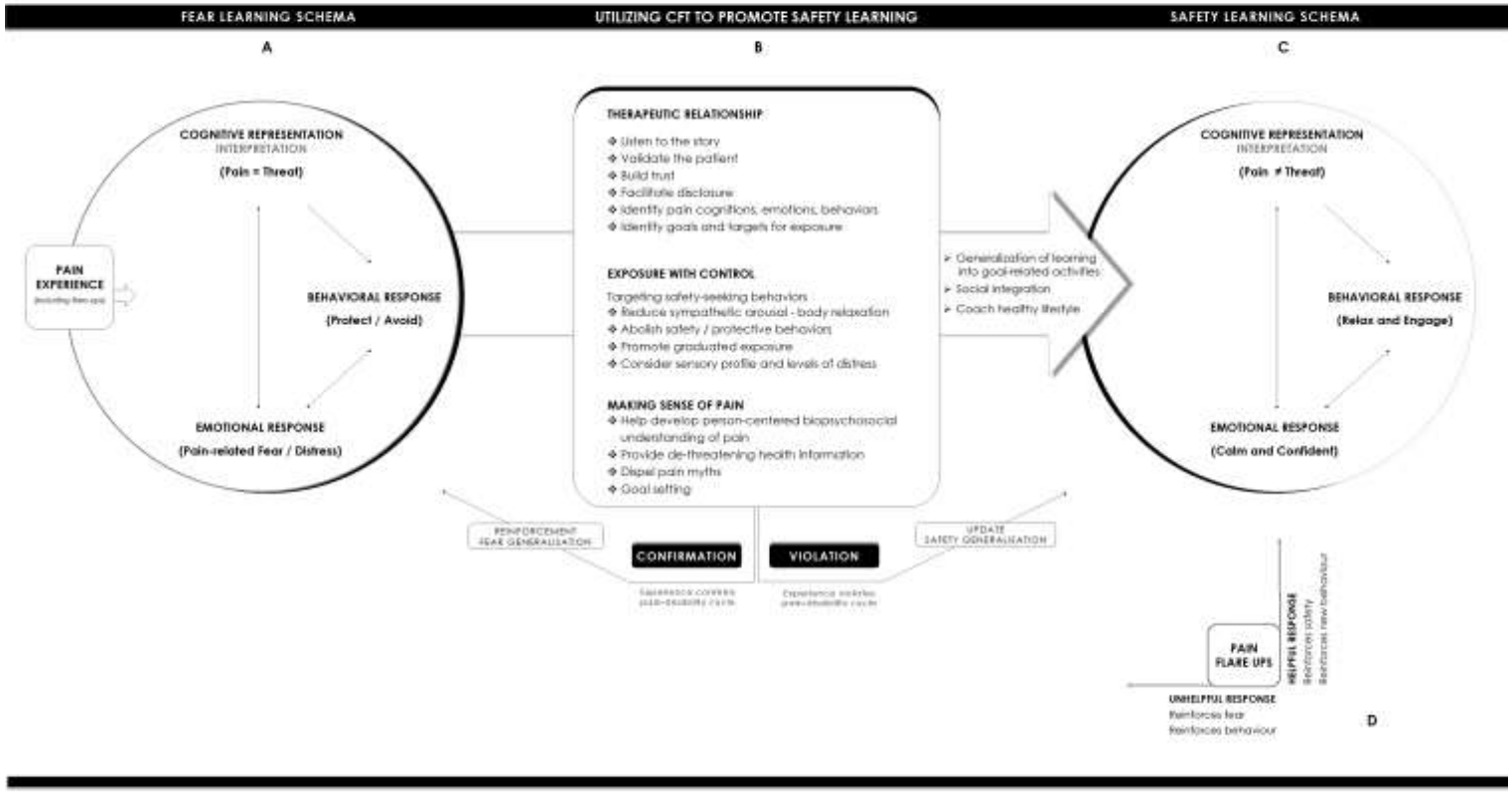


Figure 2. Schematic illustration of the proposed clinical framework. **(A)** Person's common-sense response to a pain experience interpreted as threatening (Fear schema). **(B)** Core elements of Cognitive Functional Therapy as a vehicle to promote safety

learning. The experience may confirm or violate the original schema. Confirmation of pain as a threatening experience (ie, learning does not occur) leads to the reinforcement of the person's fear response. Violation of pain as a threatening experience (ie, learning of safety occurs) can powerfully disconfirm fear-avoidance beliefs while reinforcing that valued activities can be safely confronted when performed without safety behaviors and reduced pain vigilance. This leads to an update of the person's response that promotes generalization of safety. **(C)** Person's common-sense response to an experience interpreted as safe (Safety schema). **(D)** Response to a pain-flare, which may reinforce fear or safety learning. This is a crucial learning opportunity that influences a person's process to recovery.

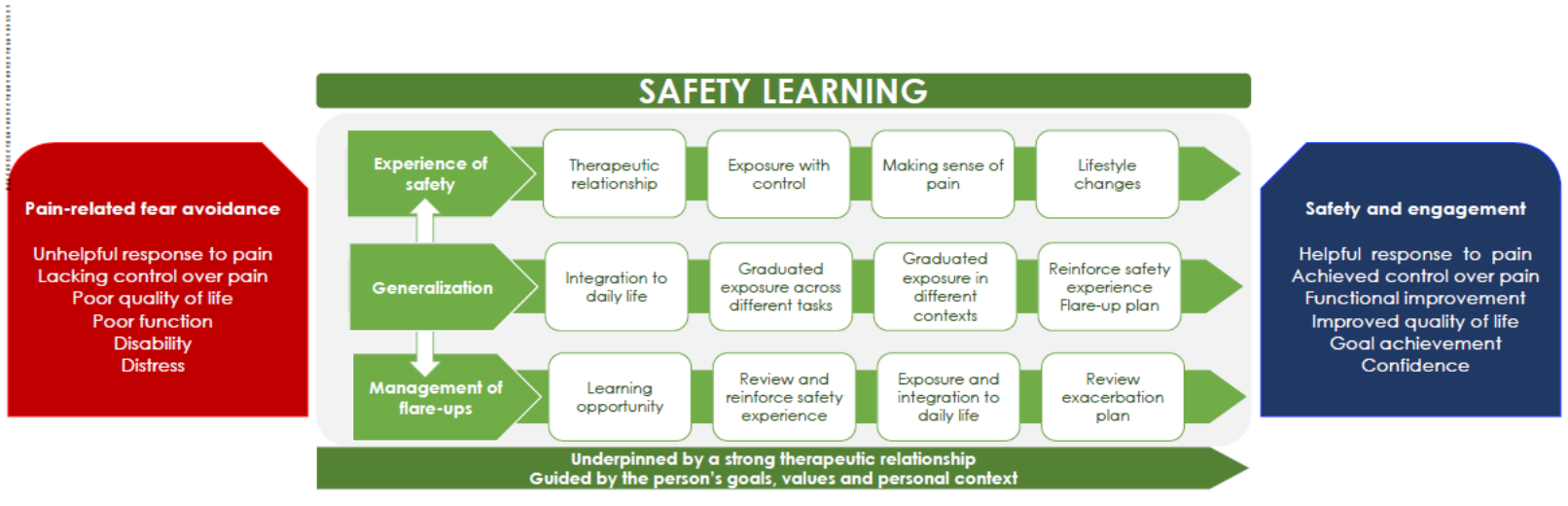


Figure 3. Roadmap to recovery.