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PERSPECTIVE

The clinical application of teaching people about pain

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ABSTRACT

Teaching people about the neurobiology and neurophysiology of their pain experience has a therapeutic effect and has been referred to as pain neuroscience education (PNE). Various high-quality randomized controlled trials and systematic reviews have shown increasing efficacy of PNE decreasing pain, disability, pain catastrophization, movement restrictions, and healthcare utilization. Research studies, however, by virtue of their design, are very controlled environments and, therefore, in contrast to the ever-increasing evidence for PNE, little is known about the clinical application of this emerging therapy. In contrast, case studies, case series, and expert opinion and perspectives by authorities in the world of pain science provide clinicians with a glimpse into potential "real" clinical application of PNE in the face of the ever-increasing chronic pain epidemic. By taking the material from the randomized controlled trials, systematic reviews, case series, case studies, and expert opinion, this article aims to provide a proposed layout of the clinical application of PNE. The article systematically discusses key elements of PNE including examination, educational content, and delivery methods, merging of PNE with movement, goal setting, and progression. This perspectives article concludes with a call for research into the clinical application of PNE.

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Introduction

Pain is a normal human experience, and without the ability to experience pain, people would not survive (Gifford, 2014; Moseley, 2007a). Living in pain, however, is not normal (Butler and Moseley, 2003; Wall and Melzack, 2005). One strategy to help people experience less pain and disability is to explain to people the biology and physiology of their pain experience (Louw et al, 2011; Moseley, Hodges, and Nicholas, 2004; Nijs and Van Houdenhove, 2009). Traditional physical therapy education uses various anatomical, biomechanical, or pathoanatomical models to help people in pain understand why they hurt (Louw and Butler, 2011; Nijs et al, 2012). These models have proven limited efficacy in helping people suffering from chronic pain with an inability to explain persistent pain, spreading pain, allodynia, pain in absence of injury or disease, immune responses or stress biology (Moseley, 2007a; Nijs et al, 2012). Furthermore, these models have been associated with inducing fear, anxiety and faulty beliefs, which all contribute to an increased pain experience (Louw, Diener, and Puentedura, 2014; Sloan and Walsh, 2010). It has been proposed that this dichotomy of teaching people suffering from pain about anatomy, versus pain science, may be a reason why educational models often fail (Butler and Moseley, 2003; Louw, Diener, Butler, and Puentedura, 2013; Louw, Puentedura, Diener, and Peoples, 2015a; Moseley, 2007a). People in pain are interested in learning more about pain, not necessarily anatomy, biomechanics, and pathoanatomy (Louw et al, 2009).

The concept of teaching people about pain biology and physiology goes by various names, including explain pain (Butler and Moseley, 2003; Moseley and Butler, 2015); pain neuroscience education (Nijs et al, 2011); pain biology education (Moseley, 2002); and therapeutic neuroscience education (PNE) (Louw, Puentedura, Diener, and Peoples, 2015a; Zimney, Louw, and Puentedura, 2014). For the purpose of this paper, it will be referred to as PNE, consistent with the author's previous use of this term in various previous pain education studies (Louw, Diener, and Puentedura, 2015; Louw, Puentedura, Diener, and Peoples, 2015a; Zimney, Louw, and Puentedura, 2014). One of the first documented uses of neuroscience education for pain stems from zoologist turned physical therapist Louis Gifford at the International Association on the Study of Pain conference in Austria in 1999 (Gifford and Muncey, 1999). Since 1999 and subsequently through

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the evidence-based medicine revolution, various scientists started exploring the efficacy of PNE, culminating in various randomized controlled trials and two systematic reviews (Louw et al, 2011; Louw, Diener, Landers, and Puentedura, 2014; Meeus et al, 2010; Moseley, 2002; Moseley, 2004; Moseley, Hodges, and Nicholas, 2004; Ryan, Gray, Newton, and Granat, 2010; Van Oosterwijck et al, 2011). The systematic review of Louw et al. (2011) showed that for musculoskeletal pain, PNE provides compelling evidence for reducing pain, disability, pain catastrophization, and improved physical movement (Louw et al, 2011). Regional, national, and international physical therapy conferences are seeing an influx of presentations about the emerging pain neuroscience information. In contrast to the science, there is a lack of consistent practical application of PNE into the "real world" of clinical practice (Moseley and Butler, 2015; Nijs et al, 2011).

Key features of PNE have been identified in the literature. Successful PNE is matched to the complexity of each person's individual pain experience (Moseley, 2003b; Moseley, 2007a; Puentedura and Louw, 2012). It is dependent on developing a connection with a patient through trust as well as through timing (Fuentes et al, 2014; Pinto et al, 2012). Important clinical elements include thorough examinations (Gifford, 2014), paced education (an active process) (Louw, Butler, Diener, and Puentedura, 2013), home exercise programs (HEP) (Moseley, 2002), movement, pacing, graded exposure, goal setting, and self-efficacy (Gifford, 2014). To help guide clinicians with the application of PNE in clinical practice, the aim of this paper is to utilize various case studies (Louw, 2014; Louw, Puentedura, Diener, and Peoples, 2015a; Louw, Puentedura, and Mintken, 2012; Zimney, Louw, and Puentedura, 2014), case series (Louw, Diener, and Puentedura, 2015), clinical trials (Louw, Diener, Landers, and Puentedura, 2014) and perspectives papers (Moseley and Butler, 2015; Nijs et al, 2011) to extract a proposed approach in an outpatient physical therapy clinic applying PNE to patients in chronic pain.

Visit 1

One of the biggest fallacies associated with PNE is that therapists "*just talk*" to patients. Those not familiar with PNE propose that practitioners potentially miss or minimize potential serious underlying pathological issues and thus put patients in harm. In line with current best-practice guidelines in musculoskeletal medicine, all therapists have to conduct a review of systems, skilled interview, and thorough physical examination prior to embarking on any treatment plan, including PNE (Boissonnault and Ross, 2012; Louw and Butler, 2011; Sizer, Brismee, and Cook, 2007).

Skillful interview

Most outpatient physical therapists are trained in a common interview strategy, in line with Maitland's five categories (Maitland, 1986): *What brings you to therapy?; Where are the symptoms?; The behavior of the symptoms?; The history of the disorder and then special questions*. These are good questions and likely a place to start for the novice therapist to ensure a comprehensive interview. For the more skilled PNE practitioner, these questions can be refined, aiming at understanding more about the patient's experiences, suffering, and beliefs (Butler, 2000; Louw, Diener, and Puentedura, 2014; Louw, Puentedura, and Mintken, 2012; Maitland, 1986). Questions fundamental to PNE would include: *What do you think is going on with your back?; Why do you think you hurt?; What do you think should be done for your back?* and *Where do you see yourself in five years?*

The aim of the interview is to develop an understanding of the person's unique suffering and experiences, as well as discover what may motivate the patient in the goal-setting process (Butler, 2000; Gifford, 2014). Additionally, a good interview develops a therapeutic relationship (connection) with the patient, which leads to trust, a critical component of PNE (Butler, 2000; Gifford and Butler, 1997). During the interview, the clinician needs to listen for (and make a list of) issues the patient mentions that will need to be addressed during PNE. The patient must be given adequate time to tell their story. Clinically, the skillful interview usually lasts 20–25 minutes (Jones and Rivett, 2004).

Physical examination

The physical examination needs to be thorough and skillful to further rule out any significant pathology, alongside the interview findings (Jones and Rivett, 2004). Once significant tissue pathology can be clinically excluded, the practitioner needs to focus on larger global, functional movements ("low tech"; macro versus micro) (Linton, 1998; Louw, Puentedura, and Mintken, 2012). The results of the physical examination need to be sensibly conveyed to the patient without inflated, fear-inducing words (Louw, Diener, and Puentedura, 2014). It is proposed that this may be where many physical therapists falter. They might do a haphazard, quick examination that may undermine the therapist–patient relationship (Ndosi et al, 2016). The opposite may occur with an overly focused examination on small

details, which may not be relevant (i.e., pelvic obliquity and leg length discrepancy) in the face of a patient struggling with widespread pain (Nijs et al, 2012). "Low tech" tests and measures should include gross range of motion, a thorough neurological screening, neurodynamic tests, and applicable special tests as needed (Louw, Puentedura, and Mintken, 2012). Clinically, it is often found that upon completion of both a thorough interview and skilled physical examination, patients often get quite emotional with statements such as: "*That was the most thorough medical examination I have had in years*." This develops confidence and trust, key components of PNE, especially since people struggling with pain may have seen many health care providers for their pain, some of whom have dismissed or marginalized the patient's pain experience. By enhancing the therapeutic relationship, the patient may be more receptive to treatment interventions, including PNE (Ndosi et al, 2016). The "low tech" physical examination typically takes 10 minutes.

Following the skillful interview and physical examination, the therapist may determine that PNE is indicated. Depending on the time available, the initial visit may allow for a brief introduction to PNE. An easy and receptive way for patients to be introduced to PNE is by asking them: "*Has anyone explained to you why you (still) hurt*?" (Louw, Puentedura, and Mintken, 2012). If the patient indicates an interest in learning why they hurt, an introductory metaphor, such as the alarm system, is shared. The brief PNE session at first can vary in length based upon evaluation, time, patient learning needs, and clinical reasoning, and will be built upon during subsequent sessions (paced education).

Therapeutic neuroscience education

Given the popularity of PNE, many clinicians may be eager to delve into various pain metaphors to help people gain an increased understanding of their pain. There is, however, a fundamental part to PNE that is often missed: "de-education" prior to "re-education" (O'Sullivan, Dankaerts, O'Sullivan, and O'Sullivan, 2015). PNE involves a paradigm shift, contrasting very prevalent biomedical models focusing on anatomy, biomechanics, and pathoanatomy (Moseley, 2007a; Nijs et al, 2012). Words such as "tear," "deterioration," "herniation," "wear and tear," and "degeneration" are commonly associated with these models and instead of helping patients, in fact, increase fear and anxiety (Greene, Appel, Reinert, and Palumbo, 2005; Morr et al, 2010). Accompanying these words are anatomical charts, plastic joint models, and educational booklets that perpetuate this message and overall contribute to an increased pain experience (Louw, Butler, Diener, and Puentedura, 2012; Louw, Butler, Diener, and Puentedura, 2013). For PNE to work, a clinical environment should aim to remove provocative images and language as means of educating people and all staff be updated on the "language of PNE." Another part of "de-education" is sharing normative data with patients, thereby helping them understand that various "findings" on medical tests and imaging may not correlate to pain (Nijs et al, 2012). For example, a patient may be extremely nervous to bend forward or return to work since their magnetic resonance imaging (MRI) test showed a "bulging" disc. Explaining to a patient, with compassion and empathy, that 40% of people with no low back pain (LBP) have similar "bulges" and yet continue on with their life, may in fact reduce their fear of movement and catastrophization (Flynn, Smith, and Chou, 2011). In turn, both fear-avoidance and pain catastrophization are key elements predicting the success of PNE (Louw et al, 2011).

The research currently shows PNE works best by using metaphors, examples, and pictures (Gallagher, McAuley, and Moseley, 2013; Louw et al, 2011). An example is whereby the body's nervous system is metaphorically described as an alarm system (Louw, Puentedura, Diener, and Peoples, 2015a). The patient is made aware of the sheer vasPNEss and complexity of the nervous system: "*There are more than 400 individual nerves that combined make more than 45 miles of nerves within your body, and they all are connected like a network of roads*" (Louw, 2013). A picture of the human nervous system can be shown to give the patient an appreciation for its complexity. A normal functioning nervous system is then compared to an alarm system: *When we step on a rusted nail with our barefoot, we need to know about it, so we can take care of it. The nervous system, working like an alarm system ramps up, sends a message to the brain and, upon taking action (taking the nail out, tetanus shot, bandage), the alarm gradually calms down, ready to warn you of another nail in the future* (Figure 1). This is a normal biophysiological process and occurs in every human being. The general example (nail in the foot) is then applied to the patient's clinical presentation with further explanation in nonthreatening language that they likely hurt some tissues when they had an injury or surgery and these tissues are or have gone through a normal healing process over time. *The nerves in the area, working like an alarm system, also ramped up (like the foot example) telling them to go seek treatment and care from a health care provider*.

This story is used to convey the message that pain may not necessarily be a true reflection of the health of their tissues, but includes various complex biologically

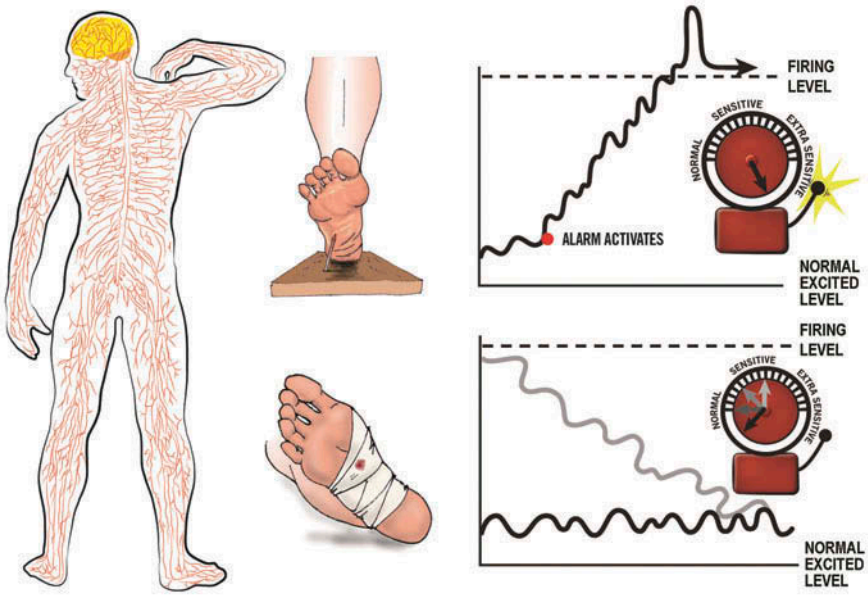

Figure 1. Metaphorical explanation of the nervous system as an alarm system during nociceptive activation (Images with permission from Louw, 2013).

driven processes (as opposed to psychologically driven). This may help patients reconceptualize their pain experience (Gifford, 1998; Moseley, 2007a; Nijs et al, 2012) and aim to avoid patients falling into the mindset of "*you think my pain is in my head*."

The educational story continues with information regarding the fact that, in line with current epidemiology, in approximately one in four people, the alarm system does not calm down after ramping up, but stays extra sensitive (Goldberg and McGee, 2011; Johannes et al, 2010). The extra-sensitive alarm system is a big reason why they are still experiencing pain. Before the onset of this pain, the alarm system had lots of space (tolerance) for activities, but since being extra sensitive, there is less tolerance (Louw, Butler, Diener, and Puentedura, 2013). Now, after only five minutes of walking, the alarm system goes off. This metaphor of nerve sensitization gives the patient a different paradigm about why they still hurt (Louw, Butler, Diener, and Puentedura, 2013). This provides a framework for the therapist to discuss the issues surrounding the injury that have likely caused her alarm system to remain extra sensitive (yellow flags) such as failed treatments, stress and anxiety, different explanations about her constant pain, and lost hope (Kendall, Linton, and Main, 1997). Next, the therapist is able to devise a treatment plan designed to calm down the extra-sensitive alarm system. Options include PNE, aerobic exercise, meditation, relaxation, manual therapy, diaphragmatic breathing, goal setting, sleep hygiene, and more (Figure 2) (Louw, Puentedura, Diener, and Peoples, 2015a; Moseley, 2004; Nijs et al, 2011; Young, 2007).

The introductory PNE metaphor allows clinicians an opportunity to explain and plan future sessions (e.g., decreasing treatment frequency to allow patient more time for processing of information) (Crabtree, Royeen, and Mu, 2001) and continue to develop strategies to "*calm down the alarm system*." While some research studies and initial clinical practice saw this delivery of PNE lasting upward of 1 hour, current clinical practice and research studies have shown that it can be delivered in 10–20 minutes depending on patient-specific needs (Louw, Butler, Diener, and Puentedura, 2013; Louw, Diener, Landers, and Puentedura, 2014; Louw, Puentedura, Diener, and Peoples, 2015b; Zimney, Louw, and Puentedura, 2014). This particular "alarm system" metaphor can often be described to and discussed with a patient in 10 minutes.

Practice and repetition may be essential in order to develop a solid comfort level, clinical effectiveness, and eventual mastery of PNE intervention (Nielsen, Keefe, Bennell, and Jull, 2014; Nijs et al, 2011). Studies acknowledge that each patient may require a different starting point in their individualized PNE program (Moseley, 2003b), yet it is also proposed that new clinicians benefit from moving through specific PNE topics in predictable order as they are mastering the PNE patient language of nociceptive pathways, neurons, synapses, action potentials, spinal inhibition and facilitation, peripheral and central sensitization, and neuroplasticity (Louw and Puentedura, 2013). With

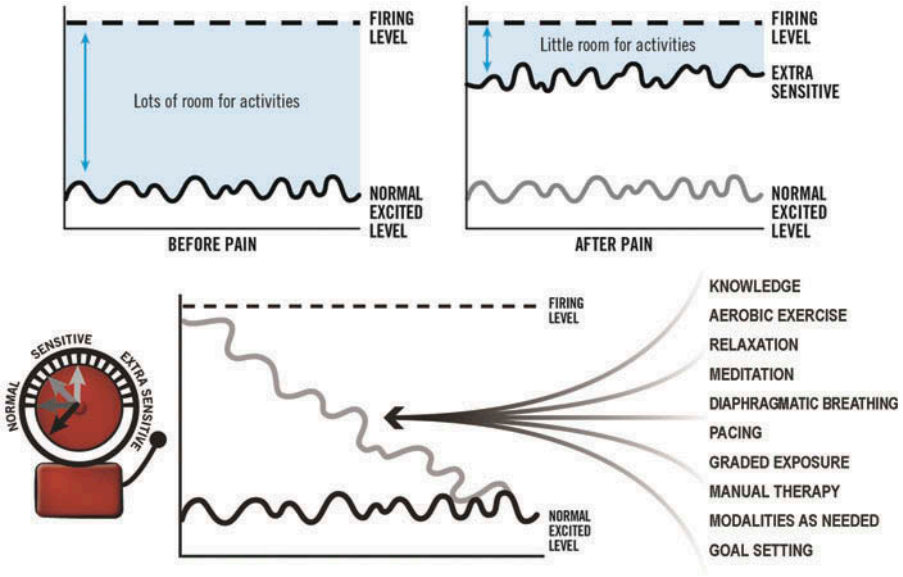

Figure 2. Graphic depiction of nerve sensitization as well as strategies to decrease nerve sensitization (Images with permission from Louw, 2013).

consistent practice, therapists will be able to identify and navigate around topics and starting points most effective for each patient. Additional strategies to help novice clinicians with clinical application of PNE are the use of various measurement tools as educational tools. For example, questions in the pain neurophysiology questionnaire (Catley, O'Connell, and Moseley, 2013; Moseley, 2003c), fear-avoidance beliefs questionnaire (Waddell et al, 1993), and central sensitization inventory (Neblett et al., 2013) can be used as helpful launching points to pose a question, followed by in-depth pain neuroscience education of the particular question. The accumulative time at the conclusion of the interview (20–25 minutes), physical examination (10 minutes), and introductory PNE (10–15 minutes) would be between 40 and 50 minutes.

Exercise

Unfortunately, many therapists who are minimally familiar with PNE think of the strategy as *only* an educational and cognitive intervention. This is not the case: various high-level randomized controlled trials and both systematic reviews of PNE reported on various studies combining a movement/manual approach with PNE (Louw et al, 2011). In fact, clinical trials have shown that PNE alone (education only) can benefit a patient (Louw et al., 2011; Louw, Diener, Landers, and Puentedura, 2014; van Oosterwijck et al, 2013), but when PNE is combined with either exercise or manual therapy (Beltran-Alacreu, Lopez-de-Uralde-Villanueva, Fernandez-Carnero, and La Touche, 2015; Louw et al, 2011; Pires, Cruz, and Caeiro, 2015), it is far superior in reducing pain, compared to education alone. Clinically, after PNE, it is customary to either provide a patient with four to five easy exercises to start doing at home, or take their existing exercises and instruct them on the four to five you want them to focus on (Louw, 2014; Louw and Butler, 2011). By proving PNE first, the PNE session could (and should) discuss patient perceptions about exercise and challenge the reason and nature of fears associated with exercise (Nijs et al, 2015). The initial exercise session may only take five minutes. The most common exercises are typically focused on large range-of-motion movements and/or neurodynamics (Butler, 2000; Zimney, Louw, and Puentedura, 2014). Patients may also benefit from brief introduction into relaxation or diaphragmatic breathing exercise during this first session. The key is to introduce movement that is perceived as safe and that also increases functional ability.

Home exercise program

Having the patient help themselves (self-efficacy) and having them take an active role in their recovery is important (Gifford, 2014). The patient is now sent home with four simple tasks:

(1) *Questions*: The patient is asked to think, write down, and bring back to the clinic at her next visit any questions she may have regarding her pain and the PNE material covered during session one. This will be part of every subsequent

session and aims to help remove doubt and develop a deep understanding of her pain experience (Louw, 2014; Zimney, Louw, and Puentedura, 2014).

(2) *Exercise*: The patient is encouraged to perform the key exercises to enhance movement as clinically reasoned through the evaluation and exercise portion of the encounter with focus on breathing and relaxation while doing them.

(3) *Aerobic exercise program*: An aerobic exercise program can have large psychosocial benefits that can promote self-efficacy and potentially contribute to the down-regulation of the sensitized nervous system. For example, it has been shown that a 6-mile run stimulates endorphin release that is equivalent to 10 mg of morphine (Janal, Colt, Clark, and Glusman, 1984). This could include their exercise of choice (walking, riding bike, swimming) (Naugle, Fillingim, and Riley, 2012). The duration will be dependent on the patient's current level of activity and the response to exercise. Start small and add to the duration over time in small increments. The intention is to raise heart rate for the hypoalgesic effect of aerobic exercise (50% of maximum oxygen someone can use [VO_2 max.] for 10 minutes) (Hoffman, Shepanski, Mackenzie, and Clifford, 2005).

(4) *Goals*: The patient is asked to go home and return with a list of five goals that will then be refined and broken down into smaller pieces (graded exposure and pacing). It is often famed: "*If I could flip a switch, and get rid of all your pain, what would you do again?*" This often exposes deep desires of activities that, in most cases, can be done again given pacing and time to get healthier.

Visits number 2, 3, 4 . . .

Once the initial plan of care has been set in motion, subsequent therapy sessions would last approximately 30–40 minutes and include the following focuses.

Questions and answers

Any questions are answered from a PNE perspective. Research describing deep learning theory, conceptual change, and behavior change indicates that patients who ask a lot of questions are often the ones who recover the best (Prochaska and Velicer, 1998; Sandberg and Barnard, 1997). They are engaged, inquisitive, and actively learning. Usually by visit three to four, most questions have been answered. For patients who have no questions, the clinician is urged to ask them about their understanding of their pain to determine to what extent they've undergone the (needed) deep learning process (Crabtree, Royeen, and Mu, 2001; Hardcastle et al, 2015). The question and answer segments also allow the opportunity for patients to expose and challenge core beliefs. As a relationship develops, layers are often exposed, whereby a patient over time reveals a "true belief" or barrier to improvement. Given the large-scale prevalence of the biomedical model, beliefs regarding tissues are often exposed during these sessions. For example, a patient may say: *"I understand this pain stuff you're talking about, but you don't understand. . .I have a bugling disc."* For the novice PNE-practitioner, this may seem devastating: *They did not get it!* For the experienced clinician this is good – the patient exposed a true belief and without altering this for the better, therapy in general, let alone PNE may not work (Vlaeyen and Linton, 2000). In this scenario, normative data (de-educate and then re-educate) is once again key (O'Sullivan, Dankaerts, O'Sullivan, and O'Sullivan, 2015). In this scenario, we once again reiterate "bulging" discs appear on MRIs of people with no LBP (Flynn, Smith, and Chou, 2011); various studies have shown that "bulging" discs reabsorb over time and typically resolved in a few months (Masui et al., 2005; Yukawa et al., 1996); MRIs done supine show "bulging" discs, whereas upright MRIs of the same person are devoid of the "bulging" disc (Miyazaki et al., 2008); etc.

PNE (10 minutes)

At each session it is advised there is some quick review of the previous PNE session's information (recall) and then adding a new metaphor, example, and picture (Figure 4) (Gallagher, McAuley, and Moseley, 2013; Louw et al, 2011). Various pain metaphors chosen to coincide with a specific issue the patient may have are chosen. For example, the metaphor discussing "*nerve sensors*" as a means to explain ion channel contributions to sensitization is used for people who experience increased pain when they are stressed, while "*nosy neighbors*" are used to biologically explain spreading pain associated with peripheral and central sensitization (Louw, 2013). The average time of these stories are 10–12 minutes, leaving the remaining time for traditional therapy interventions (Louw, 2014; Louw, Puentedura, and Mintken, 2012; Zimney, Louw, and Puentedura, 2014). The teaching can sometimes occur while the patient is exercising in the clinic, such as riding a stationary bike, to maximize efficient use of clinic time.

Goals (five minutes)

A quick review, update and changes on goals, pacing and graded exposure is then employed to ensure the patient continues with goal-motivated behavior for therapy (Gifford, 2014).

"Traditional therapy"

The remaining 15–20 minutes is used to focus on a variety of treatments the therapists may clinically reason as important. This can include manual therapy, soft tissue treatments, relaxation techniques, diaphragmatic breathing, modalities, neurodynamic exercises, stretches, and conditioning (Louw and Butler, 2011; Louw and Puentedura, 2013).

Clinically, once patients are engaged in an exercise program (or demonstrate a deeper understanding of their pain), develop various strategies to help themselves (sleep, relaxation, stretches) and are pacing themselves to their goals, they see an opportunity to continue their care at home. Patients may confront the physical therapist with "*I could do this at home, couldn't I?*" This culmination of the PNE process, intertwined in pacing, graded exposure, goal setting, and self-efficacy is likely the pinnacle of PNE outcomes – true behavior change. For the clinicians, it implies less focus on pain and more focus on function. The ultimate goal with behavior change in a patient's progress should be "*despite the pain*"; having someone accomplish more (Louw, Diener, Landers, and Puentedura, 2014; Moseley, 2007a). One-year follow-up studies utilizing PNE shows a steady decrease is pain over time, while functional levels (per outcome measures) increase (Figure 3). It is within the framework of "despite the pain" that patients are focused on their functional levels, achievements, and goals, rather than pain.

Clinically, however, the recovery process is not linear. Given the complexities of pain in regard to central and peripheral sensitization, neuroplasticity, ion channel expressions, emotions, etc., pain experiences fluctuate (Nijs et al, 2011). Pain by its nature is inconsistent (Gifford, 2014). In line with these fluctuations, function will fluctuate. It is also proposed that these fluctuations contain potential opportunities for patients to regress and strengthen the argument for continued PNE along the path of recovery (Figure 4).

More than "JUST" PNE

This layout of a "typical" PNE program has many small nuances not to be overlooked. These nuances are

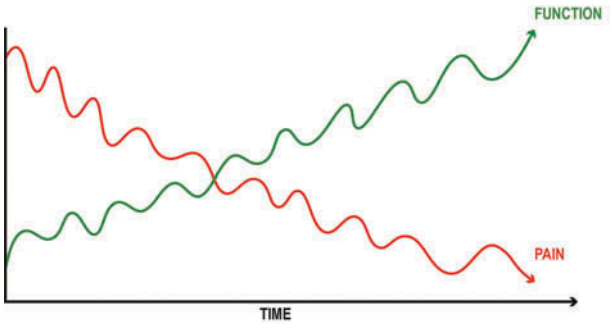

Figure 3. Progression over time related to pain science contrasting pain experience and functional levels (Adapted from Gifford, 2014 by Schmidt S – with permission).

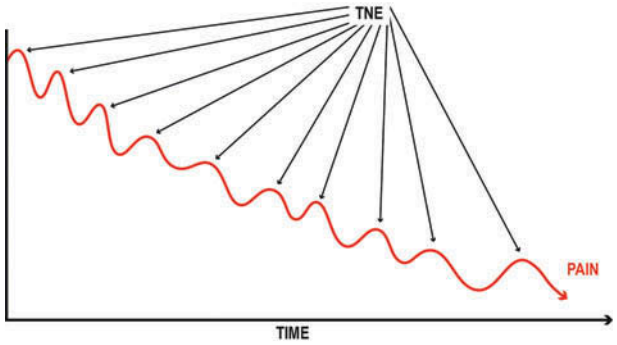

Figure 4. Paced therapeutic neuroscience education.

imbedded in cognitive, motivational, educationa,l and various psychological theories and principles (Gifford, 2014; Moseley and Butler, 2015).

Trust

People in pain often undergo numerous different tests and treatments and are furthermore exposed to various opinions (Louw, 2015). With these approaches come anticipation and expectation of success and if, over time, these are not met, it will add to the patients' pain experience (Toyone et al, 2005). These experiences may often leave patients disillusioned, frustrated, and less trusting of the medical profession. To date, therapy has been heavily focusing on biomedical models to explain pain to patients, which have shown to have limited efficacy, but likely contribute to the patient's overall erosion of trust in the medical community (Nijs et al, 2012). PNE embraces various psychological issues associated with pain. Even more so, PNE intertwines psychosocial aspects of pain with the biological and physiological paradigms of pain (Gifford, 1998). This merger is part of the much-needed biopsychosocial aspects of treating people in

pain and thus requires time spent with a patient; thorough interviewing and physical touch, all of which have been highly ranked by patients seeing care for pain (Robinson and King, 2011; Verbeek, Sengers, Riemens, and Haafkens, 2004).

Compliance

Various studies examining compliance have shown that patients perform better when they have specified parameters or boundaries (Bollini et al, 2006; Roter et al, 1998; Wong and Wong, 1985). The patient is responsible and must take an active role in his or her own care (Roter et al, 1998). A verbal contract is set up to lay out the plan of care associated with being timely for and attending appointments as well as completion of written homework (Louw, 2014; Moseley, 2006). The written homework typically constitutes an exercise log, specific areas to record home exercises, progress toward goals, sleep hours, and space for journaling. It is recommended the diary does not focus or emphasize negative aspects, that is, pain ratings. Keeping patients compliant aids in the overall execution of the PNE program (Louw, 2014; Moseley, 2006).

Environment

PNE is not only teaching patients about the neuroscience of pain, but also a powerful "undoing" of previous dominant biomedical models (O'Sullivan, Dankaerts, O'Sullivan, and O'Sullivan, 2015). Dominant biomedical models, which have been shown to potentially harm patients (Louw, Diener, and Puentedura, 2014; Nijs et al, 2012), also present themselves in daily clinical practice. Visible anatomical pictures and clinical models can undermine the efficacy of a PNE program. In contrast, visual cues using powerful images associated with PNE can be displayed as a means to add to a deep learning process and send a unified message to patients embracing PNE. Additionally, support staff (i.e., receptionists) can also contribute to an overall PNE message with proper exposure of a pain science approach. Receptionists greeting patients warmly, showing empathy, avoiding threatening language, and asking patients about their progress rather over-focusing on pain can all reinforce a PNE approach.

Conclusion

Patients are interested in pain (Louw et al., 2009). In acute injuries or immediate postoperative periods, traditional biomedical models teaching patients about the health of tissues may be quite beneficial (Gifford, 2014; Louw and Butler, 2011). For chronic pain, however, these traditional models may not only be limited in their efficacy, but also induce fear (Greene, Appel, Reinert, and Palumbo, 2005; Louw, Diener, and Puentedura, 2014). PNE as an emerging science teaches patients how pain works from a biological and physiological perspective. PNE research is dominated with randomized controlled trials and systematic reviews, all aiming to explore the efficacy of PNE (Louw et al, 2011; Louw, Diener, Landers, and Puentedura, 2014; Moseley, 2002; Moseley, Hodges, and Nicholas, 2004). Writing a perspectives paper on the clinical application of PNE is far more daunting than a report of, or review of, the evidence for PNE. The aforementioned proposal of clinical application of PNE is a combination of previous proposals (Nijs et al, 2011), past experiences (Butler, 2000; Gifford, 2014), summary of educational delivery methods (Nijs et al, 2011), various case studies reporting on clinical utilization of PNE (Louw, 2014; Louw, Puentedura, and Mintken, 2012; Puentedura, Brooksby, Wallmann, and Landers, 2009; Zimney, Louw, and Puentedura, 2014) and textbooks written by authors researching PNE (Butler and Moseley, 2003; Gifford, 2014; Louw and Puentedura, 2013; Moseley, 2007b). There is no doubt that a perspectives paper such as this will receive criticism, and needs to be recognized for the level of evidence it provides and its role in evidence-based medicine (Burns, Rohrich, and Chung, 2011). First, its aim is to use the current evidence and published literature to develop a possible clinical layout of a proposed PNE program. Second, the paper aims to allow clinicians, limited by the reality of clinical practice (time, frequency, cost, and accessibility) to have a blueprint that can be personalized and adapted to a specific clinical practice. Third, and likely most important, the paper should stimulate discussion and fuel research. The efficacy of PNE is ever increasing, along with its prevalence at regional, national, and international conferences, yet little is known about clinical application. Scientists are urged to examine this paper and from it design research proposals to answer much-needed clinical questions. We are already seeing such work, including application of PNE in acute conditions (Louw, Diener, Landers, and Puentedura, 2014; Zimney, Louw, and Puentedura, 2014), abbreviated PNE (Louw, Puentedura, and Mintken, 2012), group versus one-on-one verbal education (Moseley, 2003a), telehealth and PNE (Louw, 2014), aquatic therapy and PNE (Pires, Cruz, and Caeiro, 2015), dry needling and PNE (Tellez-Garcia et al, 2015), and more. But there

is more, including predictors of success with PNE, optimal timing, and duration, etc. The ultimate expression of PNE's efficacy is clinical application and helping people who suffer from persistent pain.

References

Beltran-Alacreu H, Lopez-de-Uralde-Villanueva I, Fernandez-Carnero J, La Touche R 2015 Manual therapy, therapeutic patient education, and therapeutic exercise, an effective multimodal treatment of nonspecific chronic neck pain: A randomized controlled trial. American Journal of Physical Medicine and Rehabilitation 94 (10 Suppl 1): 887–897.

Boissonnault WG, Ross MD 2012 Physical therapists referring patients to physicians: A review of case reports and series. Journal of Orthopaedic and Sports Physical Therapy 42: 446–454.

Bollini P, Pampallona S, Kupelnick B, Tibaldi G, Munizza C 2006 Improving compliance in depression: a systematic review of narrative reviews. Journal of Clinical Pharmacy and Therapeutics 31: 253–260.

Burns PB, Rohrich RJ, Chung KC 2011 The levels of evidence and their role in evidence-based medicine. Plastic and Reconstructive Surgery 128: 305–310.

Butler DS 2000 The Sensitive Nervous System. Adelaide, Noigroup.

Butler DS, Moseley LS 2003 Explain Pain. Adelaide, NOI Publications.

Catley MJ, O'Connell NE, Moseley GL 2013 How good is the neurophysiology of pain questionnaire? A Rasch analysis of psychometric properties. Journal of Pain 14: 818–827.

Crabtree JL, Royeen CB, Mu K 2001 The effects of learning through discussion in a course in occupational therapy: A search for deep learning. Journal of Allied Health 30: 243–247.

Flynn TW, Smith B, Chou R 2011 Appropriate use of diagnostic imaging in low back pain: A reminder that unnecessary imaging may do as much harm as good. Journal of Orthopaedic and Sports Physical Therapy 41: 838–846.

Fuentes J, Armijo-Olivo S, Funabashi M, Miciak M, Dick B, Warren S, Rashiq S, Magee D J, Gross DP 2014 Enhanced therapeutic alliance modulates pain intensity and muscle pain sensitivity in patients with chronic low back pain: An experimental controlled study. Physical Therapy 94: 477–489.

Gallagher L, McAuley J, Moseley GL 2013 A randomized-controlled trial of using a book of metaphors to reconceptualize pain and decrease catastrophizing in people with chronic pain. Clinical Journal of Pain 29: 20–25.

Gifford LS 1998 Pain, the tissues and the nervous system. Physiotherapy 84: 27–33.

Gifford LS 2014 Aches and Pain. Cornwall, Wordpress.

Gifford LS, Butler DS 1997 The integration of pain sciences into clinical practice. Journal of Hand Therapy 10: 86–95.

Gifford LS, Muncey H 1999 Explaining Pain to Patients. Paper presented at the International Association on the Study of Pain, Vienna, Austria.

Goldberg DS, McGee S J 2011 Pain as a global public health priority. BMC Public Health 11: 770.

Greene DL, Appel AJ, Reinert SE, Palumbo M A 2005 Lumbar disc herniation: Evaluation of information on the internet. Spine 30: 826–829.

Hardcastle SJ, Hancox J, Hattar A, Maxwell-Smith C, Thogersen-Ntoumani C, Hagger MS 2015 Motivating the unmotivated: How can health behavior be changed in those unwilling to change? Frontiers in Psychology 6: 835.

Hoffman MD, Shepanski MA, Mackenzie SP, Clifford PS 2005 Experimentally induced pain perception is acutely reduced by aerobic exercise in people with chronic low back pain. Journal of Rehabilitation Research and Development 42: 183–190.

Janal MN, Colt EW, Clark WC, Glusman M 1984 Pain sensitivity, mood and plasma endocrine levels in man following long-distance running: Effects of naloxone. Pain 19: 13–25.

Johannes CB, Le TK, Zhou X, Johnston JA, Dworkin RH 2010 The prevalence of chronic pain in United States adults: Results of an Internet-based survey. Journal of Pain 11: 1230–1239.

Jones MA, Rivett DA 2004 Clinical Reasoning for Manual Therapists. Edinburgh, Butterworth Heinemann.

Kendall NA, Linton SJ, Main CJ 1997 Guide to assessing psychosocial yellow flags in acute low back pain: Risk factors for long term disability and work loss. Wellington, Accident Rehabilitation and Compensation Insurance Corporation of New Zealand and the National Health Committee.

Linton SJ 1998 The socioeconomic impact of chronic back pain: is anyone benefiting? Pain 75: 163–168.

Louw A 2013 Why Do I Hurt? A Neuroscience Approach to Pain. Minneapolis, OPTP.

Louw A 2014 Therapeutic neuroscience education via e-mail: A case report. Physiotherapy Theory and Practice 30: 588–596.

Louw A 2015 Treating the brain in chronic pain. In: Fernandez de las Penas C, Cleland J, Dommerholt J (Eds), Manual Therapy for Musculoskeletal Pain Syndromes (Vol. 1). London, Churchill Livingston.

Louw A, Butler DS 2011 Chronic pain. In: Brotzman SB, Manske RC (Eds), Clinical Orthopaedic Rehabilitation, 3rd edn. Philadelphia, PA, Elsevier.

Louw A, Butler DS, Diener I, Puentedura EJ 2012 Preoperative education for lumbar radiculopathy: A Survey of US spine surgeons. International Journal of Spine Surgery 6: 130–139.

Louw A, Butler DS, Diener I, Puentedura EJ 2013 Development of a preoperative neuroscience educational program for patients with lumbar radiculopathy. American Journal of Physical Medicine and Rehabilitation 92: 446–452.

Louw A, Diener I, Butler DS, Puentedura EJ 2011 The effect of neuroscience education on pain, disability, anxiety, and stress in chronic musculoskeletal pain. Archives of Physical Medicine and Rehabilitation 92: 2041–2056.

Louw A, Diener I, Butler DS, Puentedura EJ 2013 Preoperative education addressing postoperative pain in total joint arthroplasty: Review of content and educational delivery methods. Physiotherapy Theory and Practice 29: 175–194.

Louw A, Diener I, Landers MR, Puentedura EJ 2014 Preoperative pain neuroscience education for lumbar radiculopathy: A multicenter randomized controlled trial with 1-year follow-up. Spine 39: 1449–1457.

Louw A, Diener I, Puentedura E 2014 Comparison of terminology in patient education booklets for lumbar surgery. International Journal of Health Sciences 2: 47–56.

Louw A, Diener I, Puentedura EJ 2015 The short term effects of preoperative neuroscience education for lumbar radiculopathy: A case series. International Journal of Spine Surgery 9: 11.

Louw A, Louw Q, Crous LC 2009 Preoperative education for lumbar surgery for radiculopathy. South African Journal of Physiotherapy 65(2): 3–8.

Louw A, Puentedura EJ 2013 Therapeutic Neuroscience Education (Vol. 1). Minneapolis, MN, OPTP.

Louw A, Puentedura EJ, Diener I, Peoples RC 2015a Preoperative therapeutic neuroscience education for lumbar radiculopathy: A single-case fMRI report. Physiotherapy Theory and Practice.

Louw A, Puentedura EJ, Diener I, Peoples RR 2015b Preoperative therapeutic neuroscience education for lumbar radiculopathy: A single-case fMRI report. Physiotherapy Theory and Practice 31(7): 496–508.

Louw A, Puentedura EJ, Mintken P 2012 Use of an abbreviated neuroscience education approach in the treatment of chronic low back pain: A case report. Physiotherapy Theory and Practice 28: 50–62.

Maitland GD 1986 Vertebral Manipulation, 6th edn. London, Butterworths.

Masui T, Yukawa Y, Nakamura S, Kajino G, Matsubara Y, Kato F, Ishiguro N 2005 Natural history of patients with lumbar disc herniation observed by magnetic resonance imaging for minimum 7 years. Journal of Spinal Disorders and Techniques 18: 121–126.

Meeus M, Nijs J, Van Oosterwijck J, Van Alsenoy V, Truijen S 2010 Pain physiology education improves pain beliefs in patients with chronic fatigue syndrome compared with pacing and self-management education: A double-blind randomized controlled trial. Archives of Physical Medicine and Rehabilitation 91: 1153–1159.

Miyazaki M, Hong SW, Yoon SH, Zou J, Tow B, Alanay A, Abitbol JJ, Wang JC 2008 Kinematic analysis of the relationship between the grade of disc degeneration and motion unit of the cervical spine. Spine 33: 187–193.

Morr S, Shanti N, Carrer A, Kubeck J, Gerling MC 2010 Quality of information concerning cervical disc herniation on the Internet. Spine Journal 10: 350–354.

Moseley GL 2002 Combined physiotherapy and education is efficacious for chronic low back pain. Australian Journal of Physiotherapy 48: 297–302.

Moseley GL 2003a Joining forces - combining cognition-targeted motor control training with group or individual pain physiology education: a successful treatment for chronic low back pain. Journal of Manual and Manipulative Therapy 11: 88–94.

Moseley GL 2003b A pain neuromatrix approach to patients with chronic pain. Manual Therapy 8: 130–140.

Moseley GL 2003c Unraveling the barriers to reconceptualization of the problem in chronic pain: the actual and perceived ability of patients and health professionals to understand the neurophysiology. Journal of Pain 4: 184–189.

Moseley GL 2004 Evidence for a direct relationship between cognitive and physical change during an education intervention in people with chronic low back pain. European Journal of Pain 8: 39–45.

Moseley GL 2006 Do training diaries affect and reflect adherence to home programs? Arthritis and Rheumatism 55: 662–664.

Moseley GL 2007a Reconceptualising pain according to modern pain sciences. Physical Therapy Reviews 12: 169–178.

Moseley GL 2007b Painful Yarns. Minneapolis, MN, OPTP.

Moseley GL, Butler DS 2015 Fifteen years of explaining pain: The past, present, and future. Journal of Pain 16: 807–813.

Moseley GL, Hodges PW, Nicholas MK 2004 A randomized controlled trial of intensive neurophysiology education in chronic low back pain. Clinical Journal of Pain 20: 324–330.

Naugle KM, Fillingim RB, Riley JL 2012 A meta-analytic review of the hypoalgesic effects of exercise. Journal of Pain 13: 1139–1150.

Ndosi M, Johnson D, Young T, Hardware B, Hill J, Hale C, Maxwell J, Roussou E, Adebajo A 2016 Effects of needs-based patient education on self-efficacy and health outcomes in people with rheumatoid arthritis: A multicentre, single blind, randomised controlled trial. Annals of the Rheumatic Diseases 75: 1126–1132.

Neblett R, Cohen H, Choi Y, Hartzell MM, Williams M, Mayer TG, Gatchel RJ 2013 The Central Sensitization Inventory (CSI): Establishing clinically significant values for identifying central sensitivity syndromes in an outpatient chronic pain sample. Journal of Pain 14: 438–445.

Nielsen M, Keefe FJ, Bennell K, Jull GA 2014 Physical therapist-delivered cognitive-behavioral therapy: a qualitative study of physical therapists' perceptions and experiences. Physical therapy 94: 197–209.

Nijs J, Lluch Girbes E, Lundberg M, Malfliet A, Sterling M 2015 Exercise therapy for chronic musculoskeletal pain: Innovation by altering pain memories. Manual Therapy 20: 216–220.

Nijs J, Paul van Wilgen C, Van Oosterwijck J, van Ittersum M, Meeus M 2011 How to explain central sensitization to patients with 'unexplained' chronic musculoskeletal pain: Practice guidelines. Manual Therapy 16: 413–418.

Nijs J, Roussel N, Paul van Wilgen C, Koke A, Smeets R 2013 Thinking beyond muscles and joints: Therapists' and patients' attitudes and beliefs regarding chronic musculoskeletal pain are key to applying effective treatment. Manual Therapy 18: 96–102.

Nijs J, Van Houdenhove B 2009 From acute musculoskeletal pain to chronic widespread pain and fibromyalgia: Application of pain neurophysiology in manual therapy practice. Manual Therapy 14: 3–12.

O'Sullivan K, Dankaerts W, O'Sullivan L, O'Sullivan P B 2015 Cognitive functional therapy for disabling nonspecific chronic low back pain: Multiple case-cohort study. Physical Therapy 95: 1478–1488.

Pinto RZ, Ferreira ML, Oliveira VC, Franco MR, Adams R, Maher CG, Ferreira PH 2012 Patient-centred communication is associated with positive therapeutic alliance: A systematic review. Journal of physiotherapy 58: 77–87.

Pires D, Cruz EB, Caeiro C 2015 Aquatic exercise and pain neurophysiology education versus aquatic exercise alone for patients with chronic low back pain: A randomized controlled trial. Clinical Rehabilitation 29: 538–547.

Prochaska JO, Velicer WF 1998 Behavior change: The transtheoretical model of health behaviour change. American Journal of Health Promotion 12: 38–48.

Puentedura EJ, Brooksby CL, Wallmann HW, Landers MR 2009 Rehabilitation following lumbosacral percutaneous nucleoplasty: A case report. Journal of Orthopaedic and Sports Physical Therapy 40: 214–224.

Puentedura EJ, Louw A 2012 A neuroscience approach to managing athletes with low back pain. Physical Therapy in Sport 13: 123–133.

Robinson V, King R 2011 'Explain Pain' as part of a pain management service improves patient's understanding of the neurophysiology of chronic pain. Journal of the Physiotherapy Pain Association 32: 27–30.

Roter DL, Hall JA, Merisca R, Nordstrom B, Cretin D, Svarstad B 1998 Effectiveness of interventions to improve patient compliance: A meta-analysis. Medical Care 36: 1138–1161.

Ryan CG, Gray HG, Newton M, Granat MH 2010 Pain biology education and exercise classes compared to pain biology education alone for individuals with chronic low back pain: A pilot randomised controlled trial. Manual Therapy 15: 382–387.

Sandberg J, Barnard Y 1997 Deep learning is difficult. Instructional Science 25: 15–36.

Sizer PS, Brismee JM, Cook C 2007 Medical screening for red flags in the diagnosis and management of musculoskeletal spine pain. Pain Practice 7: 53–71.

Sloan TJ, Walsh DA 2010 Explanatory and diagnostic labels and perceived prognosis in chronic low back pain. Spine 35: E1120–1125.

Tellez-Garcia M, de-la-Llave-Rincon AI, Salom-Moreno J, Palacios-Cena M, Ortega-Santiago R, Fernandez-de-Las-Penas C 2015 Neuroscience education in addition to trigger point dry needling for the management of patients with mechanical chronic low back pain: A preliminary clinical trial. Journal of Bodywork and Movement Therapies 19: 464–472.

Toyone T, Tanaka T, Kato D, Kaneyama R, Otsuka M 2005 Patients' expectations and satisfaction in lumbar spine surgery. Spine 30: 2689–2694.

Van Oosterwijck J, Meeus M, Paul L, De Schryver M, Pascal A, Lambrecht L, Nijs J 2013 Pain physiology education improves health status and endogenous pain inhibition in fibromyalgia: a double-blind randomized controlled trial. Clinical Journal of Pain 29: 873–882.

Van Oosterwijck J, Nijs J, Meeus M, Truijen S, Craps J, Van den Keybus N,Paul L 2011 Pain neurophysiology education improves cognitions, pain thresholds, and movement performance in people with chronic whiplash: a pilot study. Journal of Rehabilitation Research and Development 48: 43–58.

Verbeek J, Sengers MJ, Riemens L, Haafkens J 2004 Patient expectations of treatment for back pain: a systematic review of qualitative and quantitative studies. Spine 29: 2309–2318.

Vlaeyen JW, Linton SJ 2000 Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. Pain 85: 317–322.

Waddell G, Newton M, Henderson I, Somerville D, Main CJ 1993 A fear-avoidance beliefs questionnaire (FABQ) and the role of fear avoidance beliefs in chronic low back pain and disability. Pain 52: 157–168.

Wall PD, Melzack R 2005 Textbook of Pain, 5th edn. London, Elsevier.

Wong J, Wong S 1985 A randomized controlled trial of a new approach to preoperative teaching and patient compliance. International Journal of Nursing Studies 22: 105–115.

Young SN 2007 How to increase serotonin in the human brain without drugs. Journal of Psychiatry and Neuroscience 32: 394–399.

Yukawa Y, Kato F, Matsubara Y, Kajino G, Nakamura S, Nitta H 1996 Serial magnetic resonance imaging follow-up study of lumbar disc herniation conservatively treated for average 30 months: Relation between reduction of herniation and degeneration of disc. Journal of Spinal Disorders 9: 251–256.

Zimney K, Louw A, Puentedura E J 2014 Use of Therapeutic Neuroscience Education to address psychosocial factors associated with acute low back pain: A case report. Physiotherapy Theory and Practice 30: 202–209.