

## Therapeutic Neuroscience Education, Pain, Physiotherapy and the Pain Neuromatrix

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### Abstract

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**Background and Purpose:** Chronic pain is often associated with faulty cognitions and beliefs. One approach to alter cognitions and beliefs is to teach patients about the neurophysiology and neurobiology of their pain experience through therapeutic neuroscience education [TNE]. Mounting evidence has shown the benefit of TNE for patients with chronic pain by easing pain, decreasing disability and pain catastrophization, increasing physical movements and increasing adherence to therapeutic treatments such as exercise. Whether TNE is able to help a patient with chronic pain reconceptualize the role of a specific profession in relation to their pain is yet to be determined. The purpose of this study was to examine if an educational session, specifically aimed at increasing a patient's knowledge of how pain works physiologically and biologically, could alter a patient's view of physiotherapy. **Methods:** A questionnaire was developed, validated and used to measure patient attitudes and beliefs regarding physiotherapy. A 3-hour educational session on TNE was delivered to 10 patients with fibromyalgia [FM] in a lecture format allowing for questions, answers and interactive discussion. Questionnaires were administered before and after the TNE session. **Results:** Ten female patients with FM with 14.2 years of pain underwent TNE. Patients underwent a positive shift in all categories associated with physiotherapy. Two shifts reached statistical significance ( $p < 0.05$ ) associated with physiotherapy's ability to explain the pain ( $p = 0.011$ ) and helping patients understand their pain better ( $p = .018$ ). **Discussion:** The current study provides preliminary results showing that an educational session teaching patients with chronic pain about the neurophysiology and neurobiology of pain may in fact help them reconceptualize the role of physiotherapy. This enhanced view of physiotherapy may be yet another important benefit of TNE and the overall recovery of the patient.

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**Keywords:** Education, Neuroscience, Physiotherapy, Pain

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## Introduction

Emerging technologies such as functional MRI (fMRI) and positron emission tomography (PET) scans have allowed scientists to visually demonstrate how the brain processes a painful human experience (Moseley, 2003b, Moseley, 2005, Peyron et al., 2000). During a painful experience various areas of the brain are activated and numerous studies have indicated common areas routinely light up on scans during a painful experience (Moseley, 2003b, Moseley, 2005, Peyron et al., 2000). The net result of all these activated areas is referred to as a pain neural signature or pain neuromatrix (Melzack, 2001b, Moseley, 2003b, Puentedura and Louw, 2012). It is now believed that areas such as the anterior cingulate cortex, premotor cortex, motor cortex, hippocampus, amygdala, sensory cortex, cerebellum, frontal and pre-frontal cortex are involved in the processing of a painful experience (Melzack, 2001b, Moseley, 2003b, Puentedura and Louw, 2012). The multi-nodal activation of various brain areas during a painful experience has been used to explain some of the individual aspects and complexity associated with chronic pain (Moseley, 2007, Puentedura and Louw, 2012). It is, however, also proposed that adjacent neural activation of congruent maps may influence the painful experience by influencing the pain neural signature; for example, maps associated with fear, catastrophization, anticipated consequences, beliefs regarding pain and so forth (Moseley, 2007, Puentedura and Louw, 2012). The adjacent maps may therefore have a positive or negative affect on the pain experience. For example, it has been proposed that high levels of fear increase the pain experience negatively and is associated with prolonged recovery and persistent pain and disability (George and Zeppieri, 2009, George et al., 2009, Fritz and George, 2002). In contrast, the adjacent maps may have a positive experience, for example knowledge (Moseley, 2007, Moseley, 2003c). Increased knowledge of pain or knowledge that nociception and pain are two different issues may positively influence the pain experience (Louw et al., 2013a).

Recent research for treating pain therapeutically has shown an increase in the utilization of therapeutic neuroscience education (TNE) (Louw et al., 2011, Ryan et al., 2010). TNE aims to help patients understand the biology and physiology of their pain experience (Moseley, 2004a, Moseley et al., 2004a, Moseley, 2002a, Louw et al., 2011).

A cornerstone of understanding TNE is the pain neuromatrix. It is hypothesized that TNE disengages parts of the pain neuromatrix (Moseley et al., 2004b, Moseley, 2005), for example, maps associated with fear (Oliveira et al., 2006, Moseley, 2003b), attitudes regarding pain (Moseley, 2003b), pain catastrophization, knowledge of pain, and beliefs of therapeutic experience and pain (Moseley, 2002a).

By positively influencing maps associated with fear, catastrophization and beliefs about exercise and pain, the altered cognitions may change the pain experience, thus resulting in reduced pain and increased function (Moseley, 2003c, Puentedura and Louw, 2012). One adjacent map, often discussed in the development and maintenance of a pain experience is the perception of the healthcare provider (Puentedura and Louw, 2012). Negative experiences associated with a healthcare provider or profession may likely increase a pain experience due to issues such as belief that the provider cannot help; lack of empathy; patient expectation of failed treatment; etc. Various TNE studies have examined and documented in detail the positive effect of TNE on fear, pain catastrophization, physical movement, pain and disability (Louw et al., 2011, Moseley et al., 2004a, Moseley, 2003c, Moseley, 2003a, Moseley, 2004b, Van Oosterwijck et al., 2011, Meeus et al., 2010). To date, no studies have examined whether a TNE session can influence how patients with chronic pain view a profession. This pilot study set out to examine if an educational session on the neurophysiology and neurobiology of pain could change how patients with chronic pain view physiotherapy.

## **Methods**

### **Design**

Since no previous study of this kind could be found, a pre- and post-education questionnaire was developed (Figure 3). The pre-education questionnaire (8 pages; Arial font; size 12; spaced at 1.5) consisted of three sections. Section one (demographics) collected data on each participants' age, gender, years of being diagnosed with chronic pain, employment and income. Section two contained questions about the treatment of their chronic pain including number of healthcare providers seen; different types of healthcare providers seen; treatments received; and ranking of most beneficial treatments.

Section three (Figure 3) included eleven questions regarding their specific beliefs regarding physiotherapy and its benefit for patients with chronic pain on a Likert (11-point) scale with 0 indicating strongly disagreeing with the statement and 10 indicating strongly agreeing with the statement. Additional measures prior to TNE included pain rating on a numeric rating scale (NRS)(Moseley, 2003a, Moseley, 2002b, Moseley, 2005, Cleland et al., 2008a)and disability using an Oswestry Disability Index (ODI) (Deyo et al., 1998, Fritz and Irrgang, 2001, Hakkinen et al., 2007).

To establish face and content validity, the questionnaire was sent to a panel ofphysiotherapists treating patients with chronic pain and experts in TNE(Powell, 2003).After minor grammatical changes, and agreement by the expert panel, the survey was deemed ready for implementation in this study. Completion of the pre-education questionnaire took 10 minutes.

The post-education questionnaire consisted of the NRS for pain and a repeat of the eleven questions regarding beliefs about physiotherapy (section three of the survey).

### Subjects

Ten patients with chronic pain (fibromyalgia) volunteered to participate in the study. A flyer advertising the education session and study was distributed via electronic mail, websites, social media, clinical flyers and announcements at a chronic pain support group(Moseley, 2003c).Patients were informed they would be asked to complete a questionnaire before, and after, a 3-hour lecture on chronic pain.

Eligible patients had to have a diagnosis of fibromyalgia (as per their medical doctor), willing and able to attend the whole education session, proficient in the writing and reading of English and over the age 18 (Moseley, 2003c). Patients were excluded if they were unable to write or read English and unwilling to complete the pre- and post TNE questionnaires.

### Procedure

The content of TNE is well established and well documented(Louw et al., 2011, Louw et al., 2013b, Moseley et al., 2004a).

The TNE for this study utilized various examples, metaphors and images to explain pain(Louw et al., 2011). There was no specific aim to address physical therapy or its role in treating patients with persistent pain, but rather focused on the neurobiology and neurophysiology of pain(Louw et al., 2011).Physiotherapy was mentioned in only 4 of the 140 slides used in the presentation, including the disclaimer that the presenterwas a physiotherapist specializing in the utilization of TNE.

The TNE was delivered in a lecture room via means of PowerPoint slides containing various descriptions, images, examples, metaphors and mantras.

The slide show was accompanied with interactive discussion (questions and answers) and drawings. The TNE session lasted 2.75 hours with one 15 minute break.

### Ethical Considerations

Patients were required to sign a written consent to participate in the study. As no personal, identifiable data would be collected, this study was deemed exempt by IRB review.

### Statistical Analysis

The questionnaire data was compiled in Excel spreadsheet files and statistical testing was performed using SPSS software (SPSS 20.00, SPSS Inc., Chicago, IL). This was to a large degree a descriptive study. Descriptive statistics such as counts and percentages, frequency distributions, means, standard deviations and confidence intervals were used to describe variables. Pre- and post-education comparisons of beliefs about physiotherapy were made using Wilcoxon Signed Ranks Test, as the assumptions of normality were violated, this non-parametric testwas used to analyze the data. Statistical significance was set at  $p < 0.05$ . We also conducted paired-samples t-test on the means of the responses to detect significant differences.

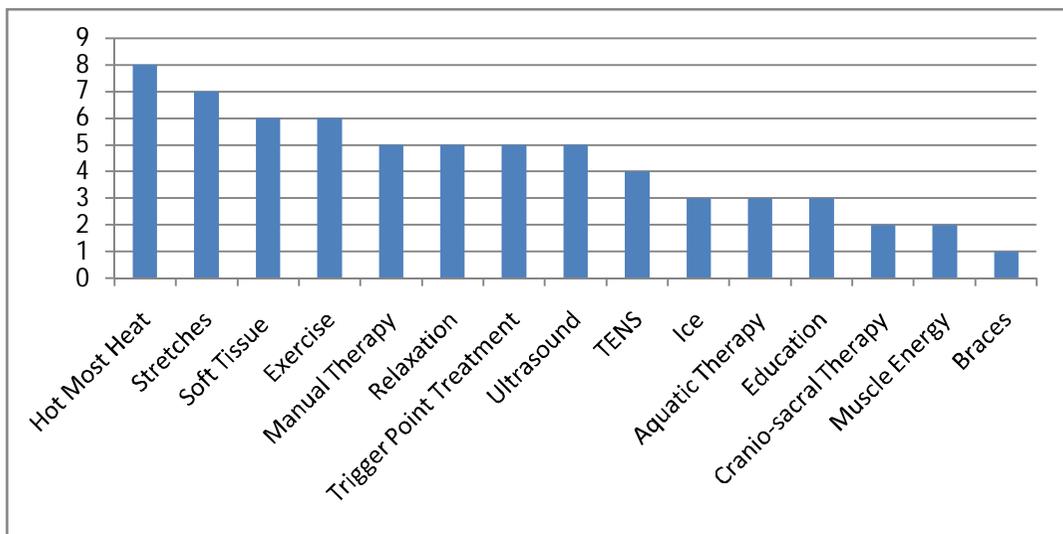
## Results

### Participants

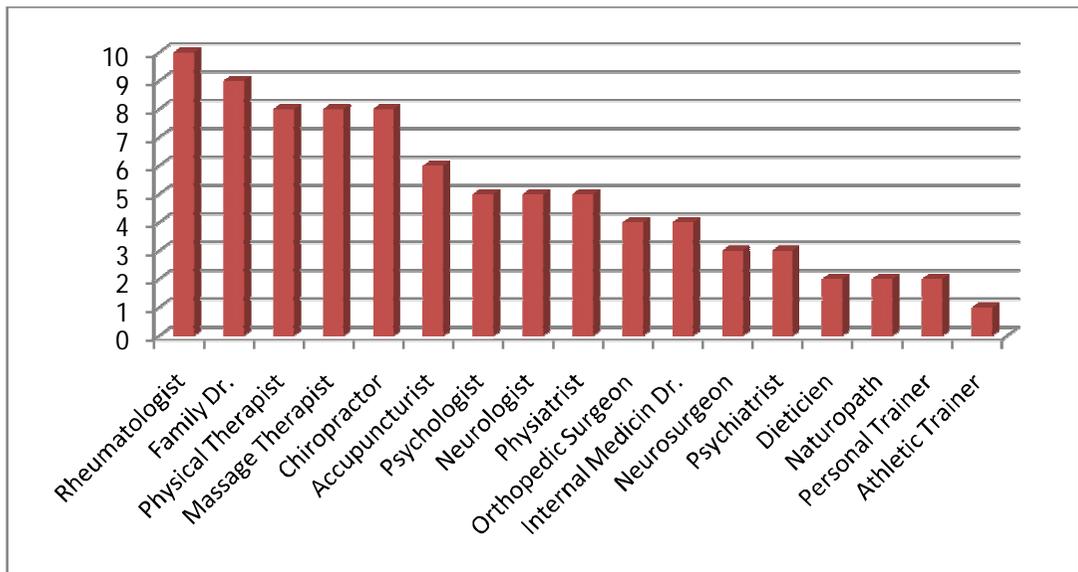
All10 patients attending the TNE session were female, with an average age of 47.5 years and average duration of chronic pain of 14.2 years. Patients attending the TNE had an average pain rating (NRS) of 5.1 and moderate disability (ODI = 42%).

Eight of the ten patients reported having received physiotherapy for their chronic pain. Patients having attended physiotherapy averaged approximately 4 different therapists (3.75) for a self-reported average 100 therapy sessions for their chronic pain. On a scale of 0 to 10 (0 no help and 10 maximum benefit), patients with chronic pain rated physiotherapy at 5.4 in regards to its benefit to them with their chronic pain. Seven of the eight patients who had attended physiotherapy were referred by their physician and one referred herself to physiotherapy.

The types of interventions received in physiotherapy for the 10 patients in chronic pain are described in Figure 1. Apart from physiotherapy, the patients had attended various practitioners in search of help for their chronic pain from various professions (Figure 2).



**Figure 1: Physiotherapy Treatment Received by the Chronic Pain Patients**

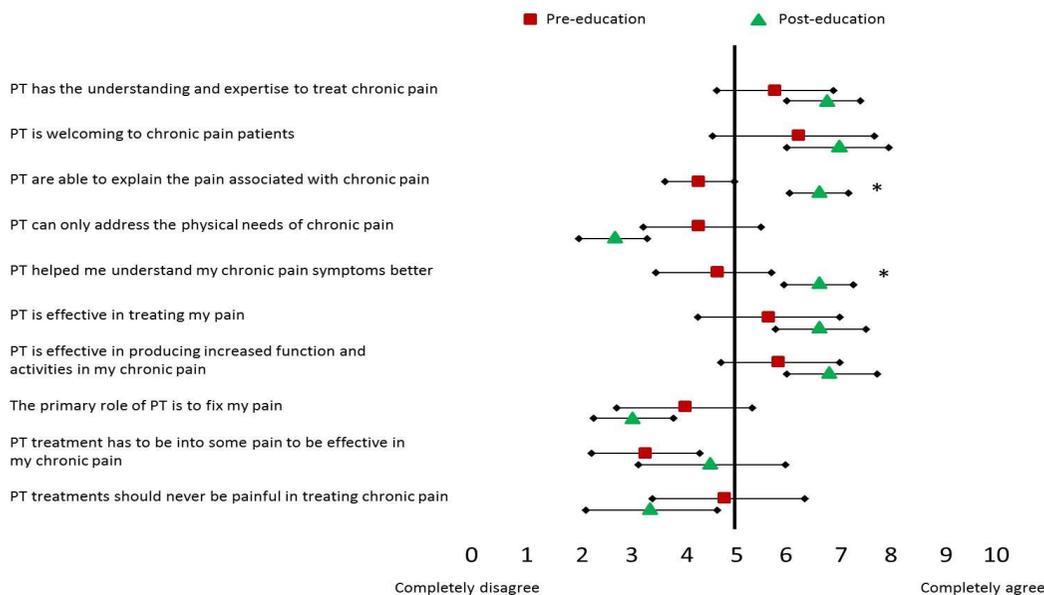


**Figure 2: Professionals Consulted for Chronic Pain Treatment**

Pre-Education Beliefs

Participants with chronic pain tended to agree that physiotherapists had the understanding and expertise to treat chronic pain, and were welcoming towards patients with chronic pain. They also tended to agree that physiotherapy was effective in treating chronic pain and improving function and activity.

Participants tended to disagree that physiotherapists were able to explain the pain associated with chronic pain; that the primary role of physiotherapy was to fix their pain; and that treatment had to cause some pain in order to effectively treat it. There was some degree of ambivalence for the remaining questions.



**Figure 3: Pre- And Post-Education Responses to Questionnaire on Beliefs about Physiotherapy for Chronic Pain**

### Post-Education Beliefs

While participants' attitudes and beliefs about physiotherapy demonstrated some positive shifts in all questions, this was statistically significant for only two questions (Figure 3).

Following education, participants were more likely to agree that physiotherapists were able to explain the pain associated with chronic pain ( $p=.011$ ), and that they were able to help patients better understand their chronic pain symptoms ( $p=.018$ ).

### Discussion

The main finding of this study was that a 3-hour TNE session aimed specifically at reconceptualizing pain was able to positively impact the chronic pain patient's views about physiotherapy. This is evidenced by the changes in pre- and post-education scores regarding the beliefs of physiotherapy, despite a relative negative view and experience of physiotherapy treatments to date.

Pain is complex and it is well established that various cognitions and beliefs impact a patient's overall pain experience (Zusman, 2013, Zimney et al., 2013, Louw et al., 2012). The most well documented psychosocial factors include fear-avoidance and pain catastrophization (Cleland et al., 2008c, Cleland et al., 2008b, Garcia-Campayo et al., 2009, Kovacs et al., 2011). How a patient sees a particular healthcare provider and the treatment may also impact the overall pain experience in a positive or negative view (Verbeek et al., 2004, Puentedura et al., 2012). Placebo, reconceptualized as enhancing the endogenous mechanisms of the brain and central nervous system, is seen as a positive expectation that a treatment may work, for example seeing a particular healthcare provider who is supposed to provide superior care (Moseley, 2008). In contrast, a nocebo event is where a patient has a negative expectation of a proposed treatment. The findings from this study imply a positive shift from an ambivalent view to a more positive view of the physiotherapy profession's ability to ease pain and disability in fibromyalgia. This positive shift, albeit only moderate, should also be viewed from the perspective that the presentation was not specifically geared to enhance or promote physiotherapy and it could be argued a physiotherapy-specific educational session intertwined with the TNE would likely have resulted in superior results, which may have additional benefit.

The pain neuromatrix redefines pain as a multiple system output, activated by the neuromatrix in response to what a patient perceives as a threatening situation (Moseley, 2003b, Melzack, 2001a, Moseley, 2007). It is proposed that the larger a threat is perceived by an individual, the more pain is produced by the brain to defend and protect (Moseley, 2003b, Moseley, 2007).

Conversely, it is proposed that if a perceived threat is decreased, less pain will be produced by the brain to defend. Patients believe pain and injury are synonymous and see increasing pain as a sign of increasing injury or damage (Zusman, 1998, Zusman, 2013). This belief and its reconceptualization is a fundamental cornerstone of TNE. Physiotherapy as a movement-based profession, likely poses a significant threat to the brain of the patient with chronic pain. Therapy is associated with movement and exercise, which patients with chronic pain experience as being increasingly painful. The TNE session is designed to help patients see the dichotomy between tissue injury and pain, with persistent pain more likely due to a sensitized nervous system (Louw et al., 2013b, Louw et al., 2011).

Realizing pain is less about injury and tissues and more due to a sensitive nervous system, coupled with the evidence that aerobic exercise and movement help ease chronic pain (Busch et al., 2007, Van Cauwenbergh et al., 2012), it is easy to understand how patients, afflicted with 14 years of persistent pain and a starting negative view of physiotherapy, shifted to a more positive view. This updated neuroscience view of pain thus allows patients to see the importance of movement, pacing and graded exposure, which a physical therapist can provide during consultation.

### **Limitations**

This study contains various limitations, including the small sample of patients utilized in the educational session and only a moderate effect in changing beliefs. Furthermore, extrapolating the effect of the TNE to other chronic pain diagnoses and non-adults are cautioned.

### **Implications for Physiotherapy Practice**

Increasing evidence supports the use of TNE. TNE has shown various positive effects, including pain, dysfunction, physical movements, various psychometric measures, brain activation and healthcare utilization. This study is the first to show that TNE can also alter how a chronic pain patient sees the role of a physiotherapist, which in turn may impact their pain and disability.

### **References**

- BUSCH, A. J., BARBER, K. A., OVEREND, T. J., PELOSO, P. M. & SCHACHTER, C. L. 2007. Exercise for treating fibromyalgia syndrome. *Cochrane Database Syst Rev*, CD003786.
- CLELAND, J. A., CHILDS, J. D. & WHITMAN, J. M. 2008a. Psychometric properties of the Neck Disability Index and Numeric Pain Rating Scale in patients with mechanical neck pain. *Arch Phys Med Rehabil*, 89, 69-74.
- CLELAND, J. A., FRITZ, J. M. & BRENNAN, G. P. 2008b. Predictive validity of initial fear avoidance beliefs in patients with low back pain receiving physical therapy: is the FABQ a useful screening tool for identifying patients at risk for a poor recovery? *Eur Spine J*, 17, 70-9.
- CLELAND, J. A., FRITZ, J. M. & CHILDS, J. D. 2008c. Psychometric Properties of the Fear-Avoidance Beliefs Questionnaire and Tampa Scale of Kinesiophobia in Patients with Neck Pain. *Am J Phys Med Rehabil*, 87, 109-117.

- DEYO, R. A., BATTIE, M., BEURSKENS, A. J., BOMBARDIER, C., CROFT, P., KOES, B., MALMIVAARA, A., ROLAND, M., VON KORFF, M. & WADDELL, G. 1998. Outcome measures for low back pain research. A proposal for standardized use. *Spine (Phila Pa 1976)*, 23, 2003-13.
- FRITZ, J. M. & GEORGE, S. Z. 2002. Identifying psychosocial variables in patients with acute work-related low back pain: the importance of fear-avoidance beliefs. *PhysTher*, 82, 973-83.
- FRITZ, J. M. & IRRGANG, J. J. 2001. A comparison of a modified Oswestry Low Back Pain Disability Questionnaire and the Quebec Back Pain Disability Scale. *PhysTher*, 81, 776-88.
- GARCIA-CAMPAYO, J., SERRANO-BLANCO, A., RODERO, B., MAGALLON, R., ALDA, M., ANDRES, E., LUCIANO, J. V. & DEL HOYO, Y. L. 2009. Effectiveness of the psychological and pharmacological treatment of catastrophization in patients with fibromyalgia: a randomized controlled trial. *Trials*, 10, 24.
- GEORGE, S. Z., VALENCIA, C., ZEPPIERI, G., JR. & ROBINSON, M. E. 2009. Development of a Self-Report Measure of Fearful Activities for Patients With Low Back Pain: The Fear of Daily Activities Questionnaire. *PhysTher*.
- GEORGE, S. Z. & ZEPPIERI, G. 2009. Physical therapy utilization of graded exposure for patients with low back pain. *J Orthop Sports PhysTher*, 39, 496-505.
- HAKKINEN, A., KAUTIAINEN, H., JARVENPAA, S., ARKELA-KAUTIAINEN, M. & YLINEN, J. 2007. Changes in the total Oswestry Index and its ten items in females and males pre- and post-surgery for lumbar disc herniation: a 1-year follow-up. *Eur Spine J*, 16, 347-52.
- KOVACS, F. M., SECO, J., ROYUELA, A., PENA, A. & MURIEL, A. 2011. The correlation between pain, catastrophizing, and disability in subacute and chronic low back pain: a study in the routine clinical practice of the Spanish National Health Service. *Spine*, 36, 339-45.
- LOUW, A., BUTLER, D. S., DIENER, I. & PUENTEDURA, E. J. 2013a. Development of a preoperative neuroscience educational program for patients with lumbar radiculopathy. *American journal of physical medicine & rehabilitation / Association of Academic Physiatrists*, 92, 446-52.
- LOUW, A., BUTLER, D. S., DIENER, I. & PUENTEDURA, E. J. 2013b. Development of a Preoperative Neuroscience Educational Program for Patients with Lumbar Radiculopathy. *American journal of physical medicine & rehabilitation / Association of Academic Physiatrists*.
- LOUW, A., DIENER, I., BUTLER, D. S. & PUENTEDURA, E. J. 2011. The effect of neuroscience education on pain, disability, anxiety, and stress in chronic musculoskeletal pain. *Archives of physical medicine and rehabilitation*, 92, 2041-56.
- LOUW, A., PUENTEDURA, E. L. & 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.
- 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. *Arch Phys Med Rehabil*, 91, 1153-1159.

- MELZACK, R. 2001a. Pain and the neuromatrix in the brain *Journal of Dental Education*, 65, 1378-1382.
- MELZACK, R. 2001b. Pain and the neuromatrix in the brain. *J Dent Educ.*, 65, 1378-1382.
- MOSELEY, G. L. 2002a. Combined physiotherapy and education is efficacious for chronic low back pain. *Aust J Physiother*, 48, 297-302.
- MOSELEY, G. L. 2003a. Joining forces - combining cognition-targeted motor control training with group or individual pain physiology education: a successful treatment for chronic low back pain. *J Man ManipTherap*, 11, 88-94.
- MOSELEY, G. L. 2003b. A pain neuromatrix approach to patients with chronic pain. *Man Ther*, 8, 130-40.
- MOSELEY, G. L. 2003c. Unravelling the barriers to reconceptualisation of the problem in chronic pain: the actual and perceived ability of patients and health professionals to understand the neurophysiology. *J Pain*, 4, 184-189.
- MOSELEY, G. L. 2004a. Evidence for a direct relationship between cognitive and physical change during an education intervention in people with chronic low back pain. *Eur J Pain*, 8, 39-45.
- MOSELEY, G. L. 2004b. 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, G. L. 2005. Widespread brain activity during an abdominal task markedly reduced after pain physiology education: fMRI evaluation of a single patient with chronic low back pain. *Aust J Physiother*, 51, 49-52.
- MOSELEY, G. L. 2007. Reconceptualising pain according to modern pain sciences. *Physical Therapy Reviews*, 12, 169-178.
- MOSELEY, G. L. 2008. Placebo effect: Reconceptualising placebo. *BMJ*, 336, 1086.
- MOSELEY, G. L., HODGES, P. W. & NICHOLAS, M. K. 2004a. A randomized controlled trial of intensive neurophysiology education in chronic low back pain. *Clinical Journal of Pain*, 20, 324-330.
- MOSELEY, G. L., NICHOLAS, M. K. & HODGES, P. W. 2004b. A randomized controlled trial of intensive neurophysiology education in chronic low back pain. *Clin J Pain*, 20, 324-30.
- MOSELEY, L. 2002b. Combined physiotherapy and education is efficacious for chronic low back pain. *Aust J Physiother*, 48, 297-302.
- OLIVEIRA, A., GEVIRTZ, R. & HUBBARD, D. 2006. A psycho-educational video used in the emergency department provides effective treatment for whiplash injuries. *Spine*, 31, 1652-7.
- PEYRON, R., LAURENT, B. & GARCIA-LARREA, L. 2000. Functional imaging of brain responses to pain. A review and meta-analysis (2000). *NeurophysiolClin*, 30, 263-88.
- POWELL, C. 2003. The Delphi technique: myths and realities. *J AdvNurs*, 41, 376-82.
- PUENTEDURA, E. J., CLELAND, J. A., LANDERS, M. R., MINTKEN, P. E., LOUW, A. & FERNANDEZ-DE-LAS-PENAS, C. 2012. Development of a clinical prediction rule to identify patients with neck pain likely to benefit from thrust joint manipulation to the cervical spine. *The Journal of orthopaedic and sports physical therapy*, 42, 577-92.
- PUENTEDURA, E. J. & LOUW, A. 2012. A neuroscience approach to managing athletes with low back pain. *Physical therapy in sport : official journal of the Association of Chartered Physiotherapists in Sports Medicine*, 13, 123-33.

- RYAN, C. G., GRAY, H. G., NEWTON, M. & GRANAT, M. H. 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. *Man Ther*, 15, 382-7.
- VAN CAUWENBERGH, D., DE KOONING, M., ICKMANS, K. & NIJS, J. 2012. How to exercise people with chronic fatigue syndrome: evidence-based practice guidelines. *European journal of clinical investigation*, 42, 1136-44.
- 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, M. J., RIEMENS, L. & HAAFKENS, J. 2004. Patient expectations of treatment for back pain: a systematic review of qualitative and quantitative studies. *Spine*, 29, 2309-18.
- ZIMNEY, K., LOUW, A. & PUENTEDURA, E. J. 2013. Use of Therapeutic Neuroscience Education to address psychosocial factors associated with acute low back pain: a case report. *Physiotherapy theory and practice*.
- ZUSMAN, M. 1998. Structure-orientated beliefs and disability due to back pain. *Australian Journal of Physiotherapy*, 44, 13-20.
- ZUSMAN, M. 2013. Belief reinforcement: one reason why costs for low back pain have not decreased. *Journal of multidisciplinary healthcare*, 6, 197-204.