The clinical implementation of pain neuroscience education: A survey study

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\section*{ABSTRACT}
Pain neuroscience education (PNE) has gained considerable attention in research. Three systematic reviews have shown increasing efficacy of PNE decreasing pain, disability, pain catastrophization, movement restrictions, and healthcare utilization. In the development of any new therapeutic approach, it is proposed that there are three stages: development, validation, and implementation. To date, the development and validation of PNE have been well-established. The third stage, implementation, however, lacks when it comes to PNE. The purpose of this study was to survey physical therapists (PT) on their experience and implementation of PNE, following a 15-hour PNE class. Upon development and validation of a PT-PNE survey, a random sample of PTs was invited to take the online survey. Two hundred and eighty-six PTs (female 56\%) completed the PNE questionnaire. Ninety-one percent of PTs reported not being taught PNE in PT school. PT's are applying PNE into clinical practice to a variety of patients, experience outcomes in line with the current best-evidence, but struggle establishing which patients are ideal for PNE. The same five patient characteristics associated with success were also associated with failure, albeit in a different ranking order. This finding highlight the need to further investigate the factors associated with success and failure of PNE.

\section*{Introduction}
In recent years, pain neuroscience education (PNE) has gained considerable interest in physical therapy (Louw \textit{et al.} 2011, Louw, Diener, Landers, \textit{et al.} 2014; Moseley and Butler 2015; Nijs \textit{et al.} 2010). PNE is an educational strategy used by physical therapists (PT) that focuses on teaching people in pain more about the biological and physiological processes involved in their pain experience (Meeus \textit{et al.} 2010; Moseley 2002; Moseley \textit{et al.} 2004). The PNE approach differs significantly from the traditional biomedical approach which focuses on anatomy, pathoanatomy, and biomechanics as a means to explain a pain experience to a patient (Louw \textit{et al.} 2013, Zimney, O'Hotto, \textit{et al.} 2016; Nijs \textit{et al.} 2013). In acute, sub-acute or perioperative conditions, these biomedical explanations may be helpful to explain the pathology and biomechanics of the injury portion of a pain experience to patients, but falls short of explaining persistent pain (Moseley 2007; Nijs \textit{et al.} 2013). Additionally, there is growing evidence that biomedical models used in explaining a pain experience may actually induce more fear and anxiety, which in turn has been linked to the development and maintenance of persistent pain (Greene \textit{et al.} 2005; Louw, Diener, Landers, \textit{et al.} 2014). The current best evidence provides strong support for PNE to positively influence pain ratings, dysfunctions, fear-avoidance, and pain catastrophization, limitations in movement, pain knowledge, and healthcare utilization (Louw, Diner, \textit{et al.} 2011, Louw, Zimney, Puentedura, \textit{et al.} 2016). The research associated with PNE initially focused on chronic low back pain (LBP) (Moseley 2002, 2003a, 2004; Moseley \textit{et al.} 2004), and has since expanded to its application in patients with: fibromyalgia (Van Ittersum \textit{et al.} 2014); chronic fatigue syndrome (Meesu \textit{et al.} 2010); chronic whiplash (Van Oosterwijk \textit{et al.} 2011); and lumbar surgery (Louw, Diener, Landers, \textit{et al.} 2014). Additionally, PNE from an educational delivery perspective has been explored with regard to: one-on-one educational sessions (Louw \textit{et al.} 2015; Moseley 2002); group sessions (Louw and Puentedura 2014; Moseley 2003a); professions delivering PNE (Louw, Diener, \textit{et al.} 2011, Louw, Zimney, Puentedura, \textit{et al.} 2016); specific words used in PNE (Louw, Diener, Puentedura 2014); as well as adjunct therapeutic treatments (Louw, Diener, \textit{et al.} 2011, Louw, Zimney, Puentedura, \textit{et al.} 2016).

In the development of any new therapeutic approach, it is proposed that there are three stages: 1)
development; 2) validation; and 3) implementation (Childs et al. 2004; Fritz et al. 2007). In phase one, development; a new treatment may be formulated based on anecdotal evidence or experience, basic sciences, and recommendations from prior studies calling for a change (Cleland et al. 2007; Flynn et al. 2002; Hicks et al. 2005). In this respect, PNE’s development can be traced back to the increasing pain epidemic encountered by PTs while using a stringent biomedical approach to treat pain with limited efficacy (Gifford 2014; Gifford and Butler 1997; Louw et al. 2016; Moseley and Butler 2015). In the literature, PNE as we currently view it, began approximately 20–25 years ago by Louis Gifford. PNE started as a blend of basic science, clinical experience, collaboration with other professionals and PT’s new found interest in neurodynamics, referred to “neural tension” in the mid to late 1980’s (Gifford 2014; Gifford and Butler 1997; Moseley and Butler 2015). This new found interest culminated in early pain science papers (Gifford 1998; Gifford and Butler 1997), along with the first documented presentation of PNE at the International Association on the Study of Pain conference in Austria in 1999 by Gifford and Muncey (1999). By virtue of explaining a pain experience to a patient with this newfound knowledge of pain, PNE was inadvertently developed.

In phase two, the validation phase, a new approach is tested and validated (Childs et al. 2004; Traeger et al. 2015). In this phase, the newly designed treatment approach undergoes scrutiny from the scientific community. Given PNE’s development in the latter part of the 1990’s, it coincided with the call for evidence-based-medicine (EBM) (Sackett 1998). PNE was formally tested in 2002 with the first randomized controlled trial comparing PNE to traditional back school education for patients struggling with chronic LBP, resulting in a favorable difference for PNE with regard to pain and function (Moseley 2002). Soon various PNE studies were conducted; culminating in 13 randomized controlled trials and three systematic reviews (Clarke et al. 2011; Louw, Diener, et al. 2011; Louw, Zimney, Puentedura, et al. 2016). Although more research is needed for PNE, it could be argued that it has been validated as an intervention that PTs can utilize in treating people suffering from persistent pain (Clarke et al. 2011; Louw et al. 2011, Louw, Zimney, Puentedura, et al. 2016).

The third and final phase entails implementation of the new treatment approach. Once a new technique has been developed and validated, its clinical and academic use need to be established (Boissonnault and Bryan 2005; Fritz et al. 2007). For example, a clinical prediction rule for lumbar spine manipulation was established and then validated in comparison to other treatment approaches for people struggling with acute LBP (Childs et al. 2004; Flynn et al. 2002). With the development and validation of the prediction rule, the next step was, given all the research, to determine if clinicians and/or academics were implementing the prediction rules in clinical practice/academic settings (Boissonnault and Bryan 2005). Similarly, given the development and validation of PNE, the next step is to investigate the implementation of PNE. To date, there have been a handful of case studies and case series showcasing the implementation of, and outcome of PNE in clinical settings (Louw 2014; Louw et al. 2013, Louw, Puentedura, et al. 2012; Moseley 2005; Zimney et al. 2014). There are, however, no studies on determining how PNE is being used and received by PTs after being exposed to PNE. The purpose of this study was to survey PTs on their experience and implementation of PNE.

Methodology

Questionnaire development

Since no similar studies have been conducted, a PT-PNE questionnaire was developed in line with the goals of the study. The questionnaire was designed using previous studies investigating practice patterns by healthcare providers (Adegoke et al. 2008; Mierzejewski and Kumar 1997; Rozenfeld et al. 2010; Shehah et al. 2003) and the objectives of the study (Appendix 1). The questionnaire consisted of four sections. Section 1 gathered demographic and practice information from the responding PTs. Section 2 gathered information regarding pain education during their initial PT training. Section 3 focused on questions specific to the PNE continuing education class they attended, while Section 4 gathered data regarding the clinical application of PNE. To establish face and content validity, the draft questionnaire was sent to a panel of 18 national and international experts in the fields of patient education, questionnaire design and PNE (Powell 2003). Experts were asked to provide feedback on the content and completion of the PT-PNE questionnaire and return comments in 4 weeks. At the completion of 4 weeks, a reminder e-mail was sent to panelists if they had not completed the accompanying checklist for the survey. If 70% agreement was obtained by the expert panel, the survey was deemed ready for the next phase (Louw, Butler, et al. 2012; Powell 2003). Following expert review, small grammatical punctuation and spacing changes were made, making it ready for use. A pilot study comprising a convenience sample of 10 PTs was conducted to review the content, the ease of completion and the time it took to complete the questionnaire. The convenience sample was obtained from personal PT contacts by the authors who have attended a PNE class before. The convenience sample consisted of seven females, all having obtained a doctorate in PT (DPT) with an average
clinical experience of 12.21 years. The convenience sample of therapists reported no confusing statements or difficulty understanding the questions and was also asked to time their completion of the questionnaire. The questionnaire, on average took approximately 15 minutes to complete.

**Questionnaire distribution**

Ethics approval was obtained for the study from Southwest Baptist University. To survey a representative sample of PTs in the United States (US) who have been trained in PNE, it was decided to contact a seminar group specializing in teaching PNE courses to PTs and have faculty associated with the current research into PNE. It has been shown that a 16 hour PNE class is associated with a significant shift in attitudes and beliefs about pain (Latimer et al. 2004), while a 3-hour session can change knowledge of pain in line with the current PNE curriculums (Moseley 2003a), thus deeming these PTs ideal for the study. A random sample of the PTs who have attended a PNE class was obtained from the seminar group (n = 1000), to receive the PNE questionnaire. Inclusion criteria were: licensed PTs and PT assistants; having attended a 2-day PNE class within the last 5 years; currently either teaching or treating patients; and have access to Internet to complete the online questionnaire. Exclusion criteria included: professions other than PT; and not fluent in English language. The PNE questionnaire was loaded onto an online survey platform (Survey Monkey™), which has been used in previous survey studies (Bramstedt et al. 2014; George et al. 2013). Upon loading the PNE questionnaire, all authors and the same convenience sample of PT reviewed the online version to ensure it represented the original PNE questionnaire. Online completion of the questionnaire was similar to the paper version (15 minutes). An electronic mail (E-mail) invitation was sent to the 1000 PTs to ask for their participation in the PNE study. Thirty days after the study invitation, a follow-up E-mail was sent thanking the PTs who had completed the questionnaire and reminding those who had not yet competed the questionnaire to please do so (Louw, Butler, et al. 2012). The questionnaire was available for completion for a total of 60 days (Figure 1). In line with other PT survey studies the authors aimed for a response rate in excess of 30% (Grimmer et al. 2002; Madson and Hollman 2015; Wandling and Smith 1997).

**Statistical analysis**

The questionnaire data were entered in an Excel spreadsheet and statistical testing was performed using the SPSS software (SPSS 16.00, SPSS Inc., Chicago, IL). Descriptive statistics such as counts and percentages, frequency distributions, means, standard deviations and confidence intervals were used to describe variables. Some pre-specified comparisons were made between certain variables, including age, gender, years of clinical experience, highest degree obtained and specialty certification. The variables were based on the demographics captured in the survey. Where both variables were categorical, contingency analysis was used to detect association.

**Results**

**Physical therapists**

Two hundred and eighty-six PTs and PT assistants (female 56%) completed the PNE questionnaire for a 31.3% response rate. See Table 1 for the PT and PTA characteristics completing the survey.

**Pain education**

In comparison to the PNE continuing education class they attended, 91% of PTs reported not being taught PNE in their therapy schooling. For the respondents having been taught PNE in school, 71% reported they needed more PNE training. The three most common pain concepts taught in therapy school were the pain gate (98%), spinal inhibition (58%) and spinal facilitation (49%), with the least time being spent on the immune system and pain (8%), pain neuromatrix (10%), endocrine system, and
pain (10%) and endogenous mechanisms (10%) (Figure 2). One hundred percent of the surveyed therapists believed PNE should be taught in PT school, while 97% believed it should be taught in PT assistant school. In clinical practice 63% of the respondents supervise students in clinical settings with 95% reporting that they expose students to PNE during these clinical rotations.

**Clinical application of PNE**

Ninety-seven percent of the therapists completing the survey use PNE in their clinical practice (3% academic). During a typical clinical day, the majority of patients receive PNE (Figure 3).

With regard to outcomes, therapists ranked reduction in fear (mean 3.75 ± 2.9), reduction in pain (mean 4.42 ± 2.55) and improved movement (mean 4.49 ± 1.88) as the most noticeable clinical changes they observe after PNE (Figure 4).

The same five patient characteristics ranked by the PTs associated with PNE’s success, were reported as being associated with PNE’s failure (Table 2), with a difference in ranking order. Table 3 shows clinical issues associated with success and failure with regard to PNE.

When asked about the oldest patient to receive PNE, the mean age was 74.75 years, with 103 being reported as the oldest individual patient receiving PNE. The mean age for the youngest patient to receive PNE was 19.12 years, with age 4 being reported as the youngest patient to undergo PNE. Clinically constraints on time were the biggest barrier to implementing PNE in a clinical setting (Figure 5). Table 4 shows the ranking of the five most helpful metaphors (mean score) when teaching patients about PNE. When confronted with PNE, the most commonly reported patient responses were intrigue/interest, relief, and assurance.

**Discussion**

To our knowledge, this is the first study exploring the clinical implementation of PNE from the clinicians’ perspective. The results of this study shows that PTs and PTAs who are taught about PNE are able to clinically apply PNE to a variety of patients and experience outcomes in line with the current best-evidence with regard to PNE by decreasing fear-avoidance, pain, limited movement, limited knowledge of pain, and dysfunction.

The results of this study underscores that clinicians exposed to PNE believe it is a valuable clinical tool,
should be taught in PT schools, and are using it in clinical practice. This is in contrast to other results of this study showing a lack of modern pain science being taught in PT school, especially the clinical application of PNE. It is concerning that the Gate Control Theory, Melzack R, Wall PD (1965) appears to still dominate, especially when considering the respondents graduated on average nearly 15 years ago (Hoeger Bement and Sluka 2015; Hoeger Bement et al. 2014). This is in contrast to the original co-author of Gate Control, Professor Melzack (1996, 1999) who has urged clinicians to move beyond gate control and take on emerging concepts such as the pain neuromatrix. The results from this study highlight a need to expand the current PT curriculums to embrace modern pain science (Hoeger Bement and Sluka 2015; Hoeger Bement et al. 2014).

Recent research with regard to spinal pain has emphasized the need to match treatments to patients (Fritz et al. 2007). For example, it has been shown that spinal

**Figure 3.** Percentage of patients receiving PNE on a daily basis in clinical practice.

**Figure 4.** Most noticeable clinical improvements associated with PNE (X-axis: clinical improvements; Y-axis: mean ranking of importance) Respondents were asked to rank their top 3 improvements, therefore, improvements with the lowest mean ranking were considered of highest importance.
manipulation has a very high probability of success when applied to patients with acute, non-radicular LBP with low fear-avoidance (Childs et al. 2004; Flynn et al. 2002). This call, to match treatments to proper clinical presentations, is a hallmark of the current research into subgrouping of patients (Fritz et al. 2007). It can be argued PNE needs similar guidance (Diener, Kargela, and Louw; 2016; Louw et al. 2016; Moseley and Butler 2015). To date, very little is known about the criteria, when clinically present, that may yield a more favorable response to PNE and which characteristics limit the efficacy. In the absence of such clinical predictive research, this study provides some early insight, which can be compared to expert opinion, to guide clinical choices (Nijs et al. 2011). Although survey research contains recall bias, the results, however, highlights more of a need to know the exact criteria. Interestingly enough the same five patient characteristics associated with success were also associated with failure, albeit in a different ranking order. This finding alone may highlight the need to further investigate the factors associated with success. These results may further underscore the difficulty of cognitive-based PNE aiming for a behavioral shift. The numbers needed to treat for PNE is 3:1 (Moseley 2003b), indicating success in one patient for every three receiving PNE. Although PNE’s success is superior to other behaviorally targeted treatments aimed at issues such as smoking cessation (success rate 15–20%) (Aguirar et al. 2009; Raherison et al. 2005), it highlights the complexity of pain and how PNE might cause a shift in behavior of these patients. The difficulty in assessing who needs PNE is demonstrated in the variety of answers to the question regarding the daily use of PNE. This may indicate difficulty with PTs being

**Table 2. Patient characteristics associated with success and failure for PNE.**

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Patient characteristics for success</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chronic pain</td>
<td>3.02</td>
<td>1.98</td>
</tr>
<tr>
<td>2</td>
<td>High fear avoidance</td>
<td>3.87</td>
<td>2.36</td>
</tr>
<tr>
<td>3</td>
<td>Acute pain</td>
<td>4.14</td>
<td>2.61</td>
</tr>
<tr>
<td>4</td>
<td>Central sensitization</td>
<td>4.56</td>
<td>2.03</td>
</tr>
<tr>
<td>5</td>
<td>Multiple treatment failures</td>
<td>5.08</td>
<td>2.42</td>
</tr>
</tbody>
</table>

**Table 3. Clinical issues associated with success and failure on PNE.**

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Clinical issues predicting success</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Listening to the patient</td>
<td>2.11</td>
<td>1.25</td>
</tr>
<tr>
<td>2</td>
<td>Spending time with the patient</td>
<td>3.48</td>
<td>1.56</td>
</tr>
<tr>
<td>3</td>
<td>Patient developing trust in the therapist</td>
<td>3.55</td>
<td>2.31</td>
</tr>
<tr>
<td>4</td>
<td>Thorough interview</td>
<td>4.63</td>
<td>1.50</td>
</tr>
<tr>
<td>5</td>
<td>Compassion</td>
<td>5.23</td>
<td>2.10</td>
</tr>
</tbody>
</table>

**Figure 5.** Clinical barriers to implementation of PNE (X-axis: clinical challenges; Y-axis: mean ranking of importance) Respondents were asked to rank their top 3 challenges, therefore, challenges with the lowest mean ranking were considered of highest importance.
able to identify who is in most need of PNE. On a positive note, many of the factors identified by the PTs concur with the current PNE models and expert opinion. More research is needed to clearly define clinical characteristics that may increase the likelihood of PNE’s success.

The results from this study do suggest of the persistent influence of the biomedical model on PTs and the delivery of PNE. Beliefs regarding tissue issues and disease states associated with pain, coupled with failed treatments seem to be ranked as high predictors of failure according to the surveyed therapists. This assumption is further fueled by the fact that biomedical models are known to induce fear, which once again, is ranked as a significant predictor of success and/or failure of PNE. This study thus validates the current belief regarding the biomedical model and calls for a greater biopsychosocial approach embracing modern pain science.

### Limitations

The study contains various limitations. The biggest limitation is by design. Questionnaire studies contain recall bias, thus likely not only reflect what clinicians actually observe, but may also contain some of what they “hope” to observe, thus impacting the results. Additionally, a questionnaire study only reports on the findings of the clinicians who completed the questionnaire, further impacting bias. This study further limits itself by not necessarily being representative of the current practicing PTs in the US, but rather ones having taken the PNE class and taking the time to complete the PNE questionnaire. The sampled therapists represented the teachings of one particular seminar group. A second limitation is the limited information available from the PTAs in the study.

### Conclusion

PNE is being implemented into clinical practice by clinicians exposed to PNE. There is a big need to develop a greater understanding of the factors associated with success and even failure.

### Declaration of interest

All authors receive honoraria and teach for the seminar group used in sampling of the therapists for this survey study. The authors alone are responsible for the content and writing of this article.

### References


Clarke CL, Ryan CG, Martin DJ. 2011. Pain neurophysiology education for the management of individuals with chronic low back pain: A systematic review and meta-

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### Table 4. Most helpful metaphors for teaching PNE.

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Metaphor</th>
<th>Metaphor aim</th>
<th>Mean score</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>An extra sensitive alarm system</td>
<td>Hyperalgesia ● Alloynia ●</td>
<td>2.55</td>
<td>±1.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Central Sensitization ●</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Peripheral Sensitization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>The body’s alarm system</td>
<td>Human nervous system ● Action</td>
<td>2.57</td>
<td>±1.53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>potential ● Electrical activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sending information to the spinal cord and brain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Nerve sensors</td>
<td>Ion channels ● Nerve</td>
<td>4.76</td>
<td>±1.46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sensitization ● Neuroplasticity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Nosy neighbors</td>
<td>Spreading pain ● Immune</td>
<td>4.94</td>
<td>±1.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>responses to pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Lions and stress</td>
<td>Stress response ● Larger</td>
<td>5.53</td>
<td>±2.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>biological systems ● Threat</td>
<td></td>
<td></td>
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</table>
math.2011.05.003.

Cleland JA, Childs JD, Fritz JM, Whitman JM, Eberhart SL.
2007. Development of a clinical prediction rule for guiding
treatment of a subgroup of patients with neck pain: Use of
thoracic spine manipulation, exercise, and patient educa-

Diener I, Kargela M, Louw A. 2016. Listening is therapy:
patient interviewing from a pain science perspective.

Flyn T, Fritz J, Whitman J, Wainner R, Magel J, Rendeiro D,
Butler B, Garber M, Allison S. 2002. A clinical prediction
rule for classifying patients with low back pain who
 demonstrate short-term improvement with spinal manip-

Fritz JM, Cleland JA, Childs JD. 2007. Subgrouping patients
with low back pain: Evolution of a classification approach

George DR, Dreibelbis TD, Aumiller B. 2013. Google Docs
and SurveyMonkey: Lecture-based active learning tools.

Gifford LS. 1998. Pain, the tissues and the nervous system.
Physiotherapy. 84:27–33. doi:10.1016/S0031-9406(05)
 65900-7.


Gifford LS, Butler D. 1997. The integration of pain sciences

Vienna, Austria: International Association on the Study
of Pain.

Lumbar disc herniation: Evaluation of information on
brs.0000157754.98023.cd.

oidal anti-inflammatory drugs (NSAIDs): Physiotherapists'
use, knowledge and attitudes. Aust J Physiother.

Hicks GE, Fritz JM, Delitto A, McGill SM. 2005. Preliminary
development of a clinical prediction rule for determining
which patients with low back pain will respond to a stabi-

Hoeger Bement MK, Sluka KA. 2015. The current state
of physical therapy pain curricula in the United States: A
jpain.2014.11.001.

Hoeger Bement MK, St Marie BJ, Nordstrom TM,
Christensen N, Mongoven JM, Koebner IJ, Fishman SM,
Sluka KA. 2014. An interprofessional consensus of core
competencies for prelicensure education in pain manage-
ment: Curriculum application for physical therapy.

Latimer J, Maher C, Refshauge K. 2004. The attitudes and
beliefs of physiotherapy students to chronic back pain.
Clin J Pain. 20:45–50. doi:10.1097/00002508-200401000-
00009.

Louw A. 2014. Therapeutic neuroscience education via
e-mail: A case report. Physiother Theory Pract. 30:588–

Preoperative education for lumbar radiculopathy: A
doi:10.1016/j.ijsp.2012.03.001.

The effect of neuroscience education on pain, disability,
and stress in chronic musculoskeletal pain. Arch Phys Med

Preoperative education addressing postoperative pain in
total joint arthroplasty: Review of content and educational

Preoperative pain neuroscience education for lumbar radic-
ulopathy: A multicenter randomized controlled trial with
BRS.0000000000000444.

Louw A, Diener I, Puentedura E. 2014. Comparison of ter-
m inology in patient education booklets for lumbar surgery.

Louw A, Puentedura EJ. 2014. Therapeutic Neuroscience
Education, pain, physiotherapy and the pain neuromatrix.
Int J Health Sci. 2:33–45.

Louw A, Puentedura EJ, Zimney K. 2015. A clinical contrast:
Physical therapists with low back pain treating patients

Louw A, Puentedura EJ, Zimney K, Schmidt S. 2016. Know
pain, know gain? A perspective on pain neuroscience edu-
cation in physical therapy. J Orthopaedic Sports Phys

Louw A, Puentedura EL, Mintken P. 2012. Use of an abbrevi-
ated neuroscience education approach in the treatment
of chronic low back pain: A case report. Physiother Theory

application of teaching people about pain. Physiother
Theory Pract. 32:385–95. doi:10.1080/ 
09593985.2016.1194652.

Louw A, Zimney Puentedura EJ, Diener I. 2016. The efficacy
of pain neuroscience education on musculoskeletal pain: A
systematic review of the literature. Physiother Theory

Madson TJ, Hollman JH. 2015. Lumbar traction for manag-
ing low back pain: A survey of physical therapists in

Meeus M, Nijs J, Van Oosterwick 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

Melzack R. 1996. Gate control theory: On the evolution of
80050-X.
Appendix 1. Physical therapy Pain Neuroscience Education Clinical Impact Study

In the past 5 years, you have attended a pain neuroscience education (PNE) class. We have developed a survey for physical therapists to study the use and impact of PNE in clinical settings. You are invited to complete the online survey to further the research associated with PNE. Your participation is entirely voluntary and no personal identifiable information is gathered during the study. The current study is aimed at physical therapists and physical therapy assistants.

Section 1: Demographics

1. Gender: □ Female □ Male

2. Age: __________________ years

3. Are you a:
   □ Physical therapist
   □ Physical therapist assistant

4. How long have you been a physical therapist/assistant? __________________ years

5. Which state do you practice in primarily?

6. Which of the following best describes your current clinical setting?
Section 1: Professional Practice

7. Highest degree:
- □ Associates
- □ Bachelors
- □ Masters
- □ Doctorate (DPT)
- □ PhD

8. Do you have any special certification? □ Yes □ No
- □ Yes, please check all that apply:
  - □ OCS
  - □ SCS
  - □ GCS
  - □ FAAOMPT
  - □ CSCS
  - □ CSMT
  - □ COMPT
  - □ Other: ______________________________________

Section 2: Your Pain Education

10. Using your weekend therapeutic pain neuroscience education class as a measurement, were you taught therapeutic pain neuroscience education in physical therapy or physical therapy assistant program?
- □ No
- □ Yes
  - □ A lot, in line with the weekend class
  - □ Some, but not enough

11. Reflecting back on your physical therapy or physical therapy assistant training in regards to pain, please mark all the items you believe was included in your schooling:
- □ Pain Gate
- □ Pain Neuromatrix
- □ Central Sensitization
- □ Peripheral Sensitization
- □ Endocrine System and Pain
- □ Immune System and Pain
- □ Ion Channel changes
- □ Facilitation
- □ Inhibition
- □ Homoncular changes
- □ Emotions and Pain
- □ Biopsychosocial approach
- □ Endogenous Mechanisms
- □ Dichotomy of nociception and pain

12. Should therapeutic pain neuroscience education be taught in physical therapy programs?
- □ Yes
- □ No

13. Should therapeutic pain neuroscience education be taught in physical therapy assistant programs?
- □ Yes
- □ No

14. Do you currently supervise students in clinical practice?
- □ No

Section 3: Therapeutic Pain Neuroscience Education Class

16. How long ago did you take the therapeutic pain neuroscience class? (most recent one if both/repeat)

17. What prompted you to take the therapeutic pain neuroscience class? (mark all that apply)
- □ Excited about the new research
- □ Colleague encouraged me to take it
- □ Needed continuing education credit
- □ Our facility hosted it
- □ Needed help in treating people with chronic pain
- □ Struggle with chronic pain myself
- □ Other: ______________________________________

18. How would you rate the weekend therapeutic pain neuroscience class you attended?

Section 4: Clinical Application of Therapeutic Pain Neuroscience Education

20. Do you currently use therapeutic pain neuroscience education in clinical practice?
- □ Yes
If no – you are done with the survey. Thank you
21. During a typical clinical day, what percentage of patients receives some form of therapeutic pain neuroscience education? ______ %
22. Below you will find a list of outcomes. Based on your clinical experience utilizing therapeutic pain neuroscience education, what is the biggest change you see (Rank your top 3):
   □ Reduction in Pain □ Improved Function □ Decreased Fear
   □ Improved Pain Knowledge □ Improved Movements □ Decreased Catastrophization
   □ Decreased Therapy Visits □ Improved Quality of Life □ Empowerment of the Patient
   □ Take Less Pain Medication □ Exercise More
   □ Other: ____________________________
23. Below you will find a list of characteristics. Based on your clinical experience utilizing therapeutic pain neuroscience education, which patients seem to do the BEST with therapeutic pain neuroscience education? (Rank your top 3):
   □ Chronic Pain □ Acute Pain □ Men
   □ People with Central Sensitization □ People with high Fear-Avoidance □ Women
   □ People with multiple treatment failures □ Kids □ Widespread Pain
   □ Localized Pain □ Multiple providers □ Other
   □ Thorough interview □ Questioning □ Answering questions
   □ Patient too young □ Shared story □ Patient too old
   □ Sharing personal story □ Patient developing trust in the therapist □ The experience of the therapist
   □ The science of pain education □ The experience of the therapist □ Empowerment of the Patient
   □ Other: ____________________________
24. Below you will find a list of characteristics. Based on your clinical experience utilizing therapeutic pain neuroscience education, which patients seem to do the WORST with therapeutic pain neuroscience education? (Rank your top 3):
   □ Chronic Pain □ Acute Pain □ Men
   □ People with Central Sensitization □ People with high Fear-Avoidance □ Women
   □ People with multiple treatment failures □ Kids □ Widespread Pain
   □ Localized Pain □ Multiple providers □ Other
   □ Extra sensitive alarm system – action potential □ Other
   □ Other: ____________________________
25. Below is a list of clinical issues that may impact the delivery of therapeutic pain neuroscience education. Please mark the ones you have encountered as the most challenging in being able to apply therapeutic pain neuroscience education to your patients. Pick only 3.
   □ Time constraints □ Documentation □ Insurance
   □ Physicians □ Other therapists □ Management/ownership
   □ Non-compliance of patients □ Don’t know it well enough □ Too many failures
   □ Own personal stress/anxiety □ Fear it may go wrong □ Evidence
   □ Language barrier □ Cultural differences □ Other
   □ Not having enough time □ How long the patient has had pain
   □ Male □ Female □ Patient too young
   □ Patient too old □ Doctor’s influence on the patient’s pain □ The location of pain
   □ The experience of the therapist □ Other: ____________________________
26. Below are some issues associated with therapeutic pain neuroscience education. If you reflect back on your successes, which single factor (Rank your top 3) do you think is the most associated with successful outcomes utilization of therapeutic pain neuroscience education?
   □ Listening to the patient □ Spreading time with the patient
   □ Thorough interview □ Thorough physical examination
   □ Compassion □ Patient developing trust in the therapist
   □ The science of pain education □ The experience of the therapist
   □ Answering questions □ Sharing personal story □ Other: ____________________________
27. Below are some issues associated with therapeutic pain neuroscience education. If you reflect back on your failures, which single factor (chose 1) do you think is the most associated with a poor outcomes utilization of therapeutic pain neuroscience education?
   □ Not having enough time □ How long the patient has had pain
   □ Male □ Female □ Patient too young
   □ Patient too old □ Doctor’s influence on the patient’s pain □ The location of pain
   □ The experience of the therapist □ Other: ____________________________
28. Reflecting back on your therapeutic pain neuroscience educational experiences, what is the:
   Oldest patient ___________________, Youngest patient ___________________.
   □ Not having enough time □ How long the patient has had pain
   □ Male □ Female □ Patient too young
   □ Patient too old □ Doctor’s influence on the patient’s pain □ The location of pain
   □ The experience of the therapist □ Other: ____________________________
29. Below are common stories/metaphors used in therapeutic pain neuroscience education. Of all the stories/metaphors, which ones have helped your patients the most? (Rank your top 3)
   □ The nervous system works like an alarm system – action potential
   □ Extra sensitive alarm system - sensitization □ Nerve sensors in the alarm system – ion channels
   □ Nosy neighbors – spreading pain □ Brain meetings – pain neuromatrix
   □ Lion jumps into the room – output mechanisms □ Body map in the brain – homunculus
   □ Police officers – immune molecules □ Wet brain – endogenous mechanisms
   □ Bouncer at the bar – interneuron gating □ Brain CEO – central sensitization
   □ Issues in the Tissues – nociception versus pain □ Bus versus Ankle Sprain – Pain is an output
30. In therapeutic neuroscience education classes and behavioral medicine it is commonly taught that patients, upon receiving the new information, can only respond in one of three ways (listed below). Based on your clinical experience with therapeutic pain neuroscience education, can you indicate what percentage of your patients who have received therapeutic neuroscience education fit into each category? The total amount (spread between the 3 categories should add up to 100%)
   □ Don’t get it; not receptive to the message ______ %
- Get it, but don’t make changes (going through the motions) ________% 
- Get it – deep learning and true shift ________% 

31. Upon completion of your initial therapeutic pain neuroscience education session, introducing the material to the patient, what do you believe are the most common patient responses you get (pick two) 
□ Anger □ Fear 
□ Relief □ Emotional

□ Excitement □ Resentment 
□ Intrigue/Interest □ Peace 
□ Calmness □ Assurance 
□ Confidence □ Mindfulness 
□ Introspective □ Thoughtfulness
□ Other: ________________

Thank you very much for your participation in this study.