Pain modulates the perceived location of the pain-relieving switch.

Abby Tabor, Mark J Catley, Michael Thacker, Simon C Gandevia, G Lorimer Moseley

Pain is fundamental to survival, as is the perception of our environment. There is strong evidence that pain is influenced by environmental cues, what is less clear is whether the particular state of the person can influence the way that the stimuli are viewed in the first place. In light of recent research demonstrating the effect of prior state on perception, we aimed to explore the possibility that pain modulates our perceptions, altering the meaning of external cues and subsequently the way the sufferer perceives their environment. It is postulated that human interactions are based on optimal outcome; as such we ‘see’ our environment from the perspective of survival, capitalising on advantageous events and minimising negative consequences of action.

HYPOTHESIS
If a switch will relieve pain, we perceive it to be closer to us than it really is.

DESIGN & PARTICIPANTS
A two (REACHING) by two (PAIN) factorial repeated measures experiment. 20 healthy participants (11 F).

PROTOCOL
The participant sat at a table with their hands resting in front of them. A thermodue was fixed to their left hand. For each trial, the participant closed their eyes, then the investigator placed a computer mouse on the table randomly at five set distances - 25cm, 30cm, 35cm, 40cm and 45cm. The order of distance was randomised and counterbalanced such that there were 10 trials at each distance. The participant then opened their eyes and had 3 seconds to provide an estimate of the distance from a line drawn on the table (Figure) to the computer mouse. The four experimental conditions were determined by two factors: (i) whether the participant had to reach for the mouse with their right hand and click it, or click a second mouse positioned close to the resting position of their right hand; and (ii) whether or not they received a noxious heat stimulus via the thermodue on their left hand. When they did receive a noxious stimulus, clicking the mouse would terminate the stimulus. The order of conditions was randomised and counterbalanced.

RESULTS
Testing the Primary Hypothesis: When participants were in pain and estimated the distance to a mouse that, when clicked, could deliver complete pain relief, they judged the mouse to be closer than it really was. The critical result was a strong interaction between REACHING and PAIN (F(1,181) =4.8, p =0.03). That is, estimated distance was lower when participants were experiencing pain and they needed to reach to the mouse in order to turn off the noxious stimulus and thus relieve their pain (mean, 95% CI estimated distance/true distance = 96%, 93 - 98%) than when they did not (100%, 97 – 102%), regardless of whether or not there was a noxious stimulus (main effect of REACHING: F(1,181) =4.6, p =0.001). The estimated distance was also lower when participants were in pain (96%, 93 - 98%) than when they were not in pain (99%, 97 - 10%), regardless of whether or not they had to reach for the mouse in front of them (main effect of PAIN: F(1,181) =7.16, p =0.008). However, visual inspection of the data show that both main effects were driven to a large extent by the interaction.

The estimated distance was lower when participants needed to subsequently reach for the mouse (mean, 95% CI estimated distance/true distance = 96%, 93 - 98%) than when they did not (100%, 97 – 102%), regardless of whether or not there was a noxious stimulus (main effect of REACHING: F(1,181) =4.6, p =0.001). The estimated distance was also lower when participants were in pain (96%, 93 - 98%) than when they were not in pain (99%, 97 - 10%), regardless of whether or not they had to reach for the mouse in front of them (main effect of PAIN: F(1,181) =7.16, p =0.008). However, visual inspection of the data show that both main effects were driven to a large extent by the interaction.

Our results clearly support the hypothesis that if a switch will relieve pain, we perceive it to be closer to us than it really is. To our knowledge, this is the first evidence that an induced pain state changes the way we perceive our physical environment. It offers a vantage point from which to explore the possibility that perceptual alterations are present in other pain states.
More than a drop in the ocean? Can social media really enhance dissemination in the clinical pain sciences?

Heidi Allen, G. Lorimer Moseley, Tasha R. Stanton, and Flavia Di Pietro

A barrier to dissemination of clinical research is that it depends on the end-user searching for or ‘pulling’ relevant knowledge from the literature base. Social media offers an alternative approach by ‘pushing’ relevant knowledge straight to the end-user, via blogs and sites such as Facebook and Twitter. That social media is very effective at improving dissemination seems well accepted. It seems assumed that reach = impact. Remarkably however, there is no empirical evidence of end-user behavioural change. We aimed to fill this gap in knowledge by quantifying the impact of social media release on dissemination of original articles in the clinical pain sciences.

HYPOTHESIS

We hypothesised that a targeted social media release can increase dissemination of original research articles in the clinical pain sciences. The number of HTML views and PDF downloads of the target article were considered measures of dissemination.

METHODS

On a randomly selected week during a three month study period, sixteen PLoS ONE articles were blogged on BodyinMind.org and released via Facebook, Twitter, LinkedIn and ResearchBlogging. A second randomly selected date within the study period was used as a control. The primary outcomes were HTML views and PDF downloads of the target article over 7 days. The former we took to reflect some engagement with the target article itself by visiting it on the PLoS website. The latter we took to reflect a higher level of engagement by downloading the article to an individual library for future reference. We also obtained measures of social media reach – unique blog post viewers and tweets – and social media engagement - Facebook likes, shares or comments, and virality, which is the proportion of unique viewers who then like, share or comment.

Statistical analysis

We undertook a 2 x 2 repeated measures ANOVA on each primary outcome variable. The first factor was “Date” (two levels: release date or control date). The second was “Period” (two levels: before or after the date). To maximise the likelihood of detecting an effect on each primary outcome variable, which we took to reflect levels of engagement and behavioural change, we did not correct for multiple measures and set $\alpha=0.05$.

Relating impact to social media reach and engagement

We calculated the relationship between primary outcomes and social media reach and engagement. We undertook 2 linear regressions with increase in HTML views or PDF downloads as the dependent variable, and the following measures the independent variables:

- **Reach:** (i) number of unique people who viewed the blog in the 28 days after social media release (ii) number of retweets of the initial tweet of the blog;
- **Engagement:** (i) number of people who created a like, comment, or share of the blog post on Facebook, and (ii) virality – the percentage of viewers who then created a story on Facebook.

RESULTS - HTML VIEWS

Social media release increased HTML views of the target article

![HTML Views](image)

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A systematic review & meta-analysis.
Carolyn Berryman, Tasha R Stanton, K Jane Bowering, Abby Tabor, Alexander McFarlane, G Lorimer Moseley

Working memory and chronic pain, is there evidence for dysfunction?

Working memory refers to a limited-capacity, short-term, information retention system, essential to the skill of maintaining and manipulating behaviourally relevant information. People with chronic pain commonly report poor memory and concentration and research findings agree - several studies describe impaired cognitive function in people with chronic pain. The idea that pain could impact working memory function has long been suggested in the literature and there are several mechanisms that could explain this interaction: 1. Theory of limited resources 2. Theory of poor salience detection abilities 3. Disruption of cortical inhibitory mechanisms. This study aimed to systematically evaluate the vast body of literature concerning working memory deficit in people with chronic pain and undertake a meta-analysis of the nature and extent of this deficit.

OBJECTIVE
To summarise and critically appraise the literature that quantifies the difference in working memory function between people with chronic pain and healthy controls.

METHODS
Using a sensitive search strategy, the following databases were searched: Medline, Embase, PsycINFO, CINAHL, AMED and Scopus. Citations related to working memory and chronic pain were retrieved. Important review articles published in the area were hand searched for relevant citations.

Searches were limited to humans and studies were excluded if they met any of these criteria: more than 15% of participants were younger than 18 years old, used a group with any diagnosis of disease or trauma that would impair cognition, had no control group, or used a stimulus that required an emotionally-biased response. Two reviewers independently assessed studies for eligibility and also extracted relevant data.

RISK OF BIAS
Risk of bias was assessed using a modified version of the Cochrane risk of bias tool (eg, using items relevant to case control study designs). Two reviewers independently assessed the risk of bias. Disagreements were resolved through discussion or by the inclusion of a third reviewer.

RESULTS
We identified 1930 records. 19 satisfied the inclusion criteria. Working memory was evaluated using behavioural (16 studies) and physiological (4 studies) tasks. Nine different working memory constructs were tested using 20 different tasks.

DISCUSSION
Chronic pain is associated with reduced performance on working memory tasks. That is, although there was high heterogeneity in some comparisons, the pooled results from the behavioural outcomes reflect a consistent, significant moderate effect.

In contrast to the behavioural measures, the physiological measures present an inconclusive picture. That is, only two studies, which tested running memory, show a clear difference between patients and healthy controls. On the whole, physiological outcomes of latency and amplitude of EEG responses appear no different between patients and controls.

There is a need to standardise definitions of sample conditions and the type of cognitive impairment (ie, verbal working memory) that is measured.

Due to our finding that numerous tests are used to evaluate a working memory construct, it is key to develop a standard paradigm by which to evaluate each construct of working memory.

References:

Funded by: NHMRC Australia; CIHR Canada
The neurophysiology of pain questionnaire (NPQ) was developed to assess the level of understanding a patient had for the biological mechanisms that underpin chronic pain. That one’s conceptualisation of what causes their pain modulates its intensity and can contribute to chronicity is well established. The NPQ has been used in clinical trials and has provided important information about the relationship between knowledge, thoughts (catastrophising), coping strategies, pain and disability. It has also been successfully used to assess the effect of cognitive/educational interventions. The NPQ is widely used in clinical practice. Clinicians use it to plan and evaluate treatment of chronic pain patients. Despite its widespread use in research and clinical practice, the psychometric properties of the NPQ have not, until now, been interrogated.

We undertook a comprehensive interrogation of the questionnaire, using a contemporary statistical technique called Rasch analysis.

**Rasch analysis of NPQ data.**

**PARTICIPANTS**

300 random chronic spine pain patients randomly selected from a clinical audit database of 1200.

**ANALYSIS**

Rasch analysis uses a mathematical model to formally assess outcome scales. It is a probabilistic model that proposes that the likelihood of a person successfully answering a test item is a logistic function of the difference between that person’s ability and the difficulty of the item. The model assumes that all test items assess a single underlying trait and thus form a unidimensional scale – a requirement if the items in a scale are to be summed to provide a valid total score. Rasch analysis also interrogates other issues crucial to measurement including internal consistency, item invariance, category ordering and item bias. The analysis provides fit indices to detect items that breach these assumptions and may require further attention.

We assessed the following Rasch components:

- **Person fit** – persons with erratic response strings were assessed. Those suspected of guessing were removed from further analysis.
- **Targeting** – the extent to which the difficulty of the test matches the ability of the sample.
- **Unidimensionality** – identifies items that function unexpectedly and may make a construct other than pain knowledge.
- **Reliability** – internal consistency indicate whether the scale is suitable for group or individual use.
- **Item bias** – items should not bias subgroups within the sample. We compared gender, age, diagnosis and ability.
- **Abilities** – items exhibiting excessive fit indices were examined. Those deemed to function poorly were removed and the dataset was then re-analysed with the remaining items.

**NPQ**

1. Receptors on nerves work by opening ion channels in the wall of the nerve.
2. When part of your body is injured, special pain receptors convey the pain message to your brain.
3. Pain only occurs when you are injured or at risk of being injured.
4. Special nerves in your spinal cord convey ‘danger’ messages to your brain.
5. Pain is not possible when there are no nerve messages coming from the painful body part.
6. Pain occurs whenever you are injured.
7. The brain sends messages down your spinal cord that can change the message going up your spinal cord.
8. The brain decides when you will experience pain.
9. Nerves adapt by increasing their resting level of excitability.
10. Chronic pain means that an injury hasn’t healed properly.
11. The body tells the brain when it is in pain.
12. Nerves can adapt by producing more receptors.
13. Worse injuries always result in worse pain.
14. Nerves adapt by making ion channels stay open longer.
15. Descending neurons are always active.
16. When you injure yourself, the environment that you are in will not affect the amount of pain you experience, as long as the injury is exactly the same.
17. It is possible to have pain and not know about it.
18. When you are injured, special receptors convey the danger message to your spinal cord.
19. All other things being equal, an identical finger injury will probably hurt the left little finger more than the right little finger in a violinist but not a piano player.

**RESULTS**

Whilst the true-false nature of the questionnaire made it susceptible to guesses, the NPQ showed acceptable internal consistency for assessment of individuals and effectively targeted the ability of the sample and principal component analysis suggested it constitutes a unidimensional scale. Only four persons scored zero suggesting the scale possesses neither floor, nor ceiling effects. However, the analysis identified several items that either functioned poorly, exhibited item bias or were psychometrically redundant.

Re-analysis of the revised NPQ (R-NPQ), after removal of the problematic items (highlighted in colour), demonstrated superior psychometric properties. The R-NPQ targeted the sample effectively, possessed minimal floor and ceiling effects, showed good internal consistency and was less influenced by poor fit statistics and item bias. Our findings suggest that the R-NPQ constitutes a unidimensional scale and is preferable to the NPQ for measuring pain-related knowledge in chronic spine pain patients. A PSI of 0.88 suggests it is suitable to assess pain-related knowledge in individuals and to monitor their change in knowledge.

The psychometric properties of the revised NPQ (R-NPQ) are superior to those of the original. Recipients of the R-NPQ should utilise the undecided response option as the true-false nature of the test appears to be susceptible to guesses. Despite this limitation, the R-NPQ is easy to administer and can be recommended to provide a useful measure of pain knowledge, and a vehicle for identifying gaps in patient knowledge, in health-care practice and future research.

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How good is the neurophysiology of pain questionnaire? A Rasch analysis of psychometric properties

Mark J. Catley, Neil E. O’Connell & G. Lorimer Moseley