

Physio-Logical pain: painful symptoms and bodily distress / somatoform disorders within clinical practice

MATT HUDSON BA Ed

Mental Coach and Behavioural Specialist

MARK I. JOHNSON PhD

Director, Centre for Pain Research, Leeds Beckett University



The complex and personal experience of pain is hard to convey, yet critical to comprehend. This article explores the relationships between emotional trauma, pain perception and persistent pain. Clinical experience, academic expertise and mounting scientific evidence are combined to deliver a fresh perspective on aetiology of chronic pain. Recognising the neurological, physiological and behavioural adaptations that make pain persist, helps physiotherapists more effectively understand and support chronic pain patients.

LEARNING OUTCOMES

TO SUPPORT PHYSIO FIRST QAP

- 1 Discover the psychosocial pathology of pain and trauma from a patient-centred perspective.
- 2 Develop inclusive and effective pain management programmes within clinical physiotherapy to help improve function and quality of life for chronic pain patients.
- 3 Unlock the potential of disruptive technology to add a modality to your clinic that will enhance patient outcomes/pain treatment.

Painful perceptions

Pain is a perplexing array of sensations, emotions and cognitions, often with an unpredictable time course and evolving severity. When attributed to a definite cause, e.g. a broken bone, the individual experience of pain varies greatly.

This individualised experience makes pain, specifically chronic pain, difficult to treat. Fortunately, clinical pain research is rapidly uncovering the personal factors influencing the subjective experience of pain.

Painfully aware

Information from the environment is detected via our sensory system. Nerves transmit coded information to the brain that contributes to the overall picture of perceptual awareness. This relatively small data set of primary sensory information interfaces with a vast repository of beliefs, values and memories. The conscious experience is a “rough and ready” perceptual prediction using recombined data; a far cry from faithfully representing what actually exists (Hoffman 2019; Pearson & Westbrook 2015).

Cognitive neuroscientist Donald Hoffman (2019) said: “Evolution has shaped our senses to keep us alive, not to see objective reality”. Do you perceive the white triangle (figure 1) that isn’t really there? Your brain creates inferences and adds interpretation to sensory data, making perception an “illusion of reality” described by neuroscientists Suzuki *et al* (2017) in their Hallucination Machine study.

Our sensory experience supports survival, it overlays real data with imagination (Pearson 2011) and we can’t tell the difference.

Bodily distress disorders

The World Health Organisation’s (WHO) International Classification of Diseases (ICD-11) categorises bodily symptoms in response to psychological distress as bodily distress disorder (BDD), originally known as somatoform disorders. These seriously affect between 4%-20% of the population, with pain being a key symptom.

Clients presenting with pain “uncoupled” from physical trauma or disease, may have psychosomatic symptoms such as insomnia, weakness and fatigue, that is driven by untreated mental pain from their past and / or present experiences (Allahverdi 2020). Pain that is experienced long after trauma has

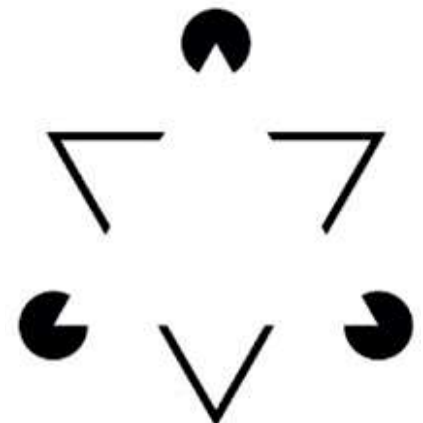


FIGURE 1: Is the white triangle really there?

“IMPROVING OUTCOMES: UNDERSTANDING THE PROTECTIVE MECHANISM AND BEING ABLE TO EXPLAIN IT TO YOUR PATIENT WILL HELP TO ENCOURAGE FUNCTION”

occurred may indicate non-physiological pain that is not due to a physical condition.

Physical and non-physical pain

Pain is a warning sign of actual, or potential, tissue damage and is usually treated from the perspective of a purely physical condition. After tissue damage is resolved, pain should disappear, but some pain fails to resolve. Treating persistent pain can be irritating, confusing, inefficient and expensive for patients and practitioners.

However, not all tissue damage is painful and not all pain is due to damage. An increasing number of imaging studies demonstrate instances where pathology exists in the absence of pain (Brinjikji *et al* 2015) and pain exists independent of pathology (Endean *et al* 2011). Paediatric chronic pain can be heightened by their parent’s mental state, specifically an inability of the parent to tolerate the uncertainty of their child’s pain and prognosis which can increase fear of the pain and pain intensity for the child. Paediatric chronic pain could therefore be seen as an adaptive survival response which, in turn, keeps the child safe within the caring home environment, alleviating the fear of the uncertain outside world.

These pain distorted pathologies and psychological factors may seem counterintuitive, until you discover missing pieces of the “pain puzzle”.

Past and present pain

Human life is a succession of moments in time, and the times that we feel physically or emotionally threatened are remembered more vividly. Survival related mental “bookmarks” ensure we learn to avoid dangers in our environment. Unfortunately, these “bookmarks” are rarely updated to reflect the current environment.

Survival responses developed as children or frightened adults dictate behaviours,

expectations, experiences and critically, perception of pain. In 2020, the International Association for the Study of Pain (IASP) revised their definition of pain, emphasising social context and life experience strongly influence pain perception.

Chronic sensitivity

Following tissue damage, the body becomes hypersensitive to stimuli. The central nervous system adjusts whole-body sensitivity to be “protective”, making minor movements painful. This reaction has evolved to immobilise injured structures, promoting healing and sheltering behaviours.

This modulation can, however, become “persistently overly-protective” in the absence of tissue damage. Chronic primary pain is a new ICD-11 classification for pain that persists well beyond the healing of tissue damage (International Association for the Study of Pain 2019). This type of pain causes significant emotional distress and / or disability, persists beyond three months and is not secondary to an underlying condition. Examples include fibromyalgia, chronic widespread pain, complex regional pain syndrome and non-specific musculoskeletal pain.

Experiencing pain

The human pain experience has three dimensions (Casey 1968):

- **Sensory-discriminative:** location, timing and physical characteristics of the noxious stimulus, prompts withdrawal reflexes (lateral pain system).
- **Affective-motivational:** linked with emotion, underlies “unpleasantness” when exposed to a noxious stimulus, activates defensive behaviours (medial pain system).
- **Cognitive-evaluative:** appraisal of the meaning and consequence of an injury or pain.

Parallel neural systems (lateral and medial) support the sensory and affective pain dimensions, providing “emotional coloration” to painful stimuli (Rome & Rome 2000). Persistent pain is accompanied by long-term changes in the morphology and neurochemistry of the anterior cingulate cortex (Shyu & Vogt 2009) which is involved with emotional processing; this exacerbates the pain response (Cao *et al* 2009).

The parallel neural processing of sensory and affective pain dimensions enhances pain sensitisation (Lumley *et al* 2011). This interplay between emotions and pain necessitates a biopsychosocial evaluation of the emotional, mental and physical pain contributing to a client’s sensory experience (figure 2). ➔



FIGURE 2: Classifications of types of adverse childhood experiences

For example, Peter falls at work injuring his wrist. Peter is also being severely bullied at work. He continues to experience pain in his arm months after his wrist has healed. Peter cannot return to work.

The physical pain reduces exposure to the anxiety and uncertainty Peter faces in the workplace.

Persistent pain, when considered holistically, could be more logical than is immediately apparent.

Adverse childhood experiences

The correlation between adverse childhood experiences (ACEs) and negative health outcomes was documented in the 1980s; weight gain was identified as a coping mechanism for adults who had experienced childhood sexual abuse (Stevens 2017).

Adverse childhood experiences were found to have a direct correlation with social, emotional and cognitive impairment; risky behaviours; disease, disability and death. In the USA, 60% of adults have experienced at least one ACE; the incidence of each ACE is between 15%-30% (Centre for Disease Control and Prevention 2010). Later, the CDC-Kaiser-ACE study (n= 17,000) qualified: physical, sexual or emotional abuse, or neglect; exposure to domestic violence, substance abuse or mental illness; parental separation or incarceration (Centre for Disease Control and Prevention 2020).

The persistent stress drains physiological resources (Moffitt & Klaus-Grawe Think Tank 2013) and consequently can have a long-term negative impact on the body. The over-active production of adrenaline, cortisol and other chemical messengers reshape neurological architecture, reducing the “rest and repair” functions of the immune system (McEwen 2017).

Studies have found that traumatic events and negative emotional experience remain in long-term memory, influencing

“IMPROVING OUTCOMES: PRIVATE PHYSIOS ARE MORE LIKELY TO SEE ACUTE PRESENTATION AND THEREFORE CAN IDENTIFY THE DEVELOPMENT OF PAIN BEHAVIOURS EARLY ON. UNDERSTANDING PAIN MECHANISMS AND NORMAL TISSUE REPAIR RESPONSES WILL ENABLE THE APPLICATION OF APPROPRIATE INTERVENTIONS IN AN APPROPRIATE TIMEFRAME”

the chronicity of musculoskeletal pain and headache (Felitti *et al* 1998). Children exposed to adverse experiences are more likely, than children who have not, to suffer from chronic pain (Murray *et al* 2020).

The findings of the study by Murray *et al* (2020) were turned into a questionnaire (<https://americanspcc.org/take-the-aces-quiz/>) for individuals and clinicians to assess ACE burden.

Emotional memory images

The term emotional memory image (EMI) was introduced in 1900 by physician and neurologist Hippolyte Bernheim who noticed that his clients were “looking” at something “external” when experiencing mental imagery or recalling the past. It is also known, within psychology, as “phantom perceptions” or “visual experience in the absence of a retinal stimulus” (Pearson & Westbrook 2015). Bernheim also theorised that EMIs were associated with unconscious ideomotor responses, i.e. similar to facial tics (Bernheim 2019).

Emotional memory images act like “bookmarks” from the past, exerting a powerful effect in the present. The brain’s “fear centre” (amygdalae) responds to the EMI as if it were a present moment threat. The stress in response to the “imagination” (perception) of a threat is the same as the physical threat (Reddan *et al* 2018; Johnson *et al* 2016). A chronic stress response is triggered by EMIs, with downstream neurological, autonomic and endocrine changes.

The stress response is designed to override “slower”, more considered and complex thought processes to prioritise “faster” life-saving reactions to danger (Reuter *et al* 2015; Lacey *et al* 2020). When an individual feels threatened, complex analysis and mental creativity go out of the window, as does emotional control, language and problem solving. Imagine trying to do a maths calculation, or compose a poem, while being chased by a bear, or even when you THINK you are being chased by a bear owing to a “bear EMI” that has been triggered by the smell of pine trees.

Energy modulation

Stress redistributes energy to organs and tissues that are needed to respond to threat. A specific task, e.g. giving a speech, may exert stress and is usually resolved upon completion. Conversely, EMIs, in a similar way to post traumatic stress disorder (Kim *et al* 2020), exert a 24/7 stress response that is repeatedly triggered. The resulting energy deficit and immune down regulation impairs healing and can result in stress induced “wear and tear”, known as the allostatic load that is greatly influenced by past experiences (Peters *et al* 2017)

Psychological stress adversely affects mitochondrial structure and function, reducing energy production (Morris *et al* 2019), while ACEs are associated with enhanced inflammatory status, hypothalamic-pituitary-axis (HPA) dysfunction and autoimmune diseases (Herman 2020; Morris *et al* 2019).

Psychosomatic immune modulation ensures energy is available to fight a “battle”, but constant “battle readiness” wears the body out. Chronic “threat perception” negatively impacts health, impairing cortisol dynamics, HPA regulation, the autonomic nervous system and gene expression (O’Connor *et al* 2021).

Traumatic experiences occurring in a split second remain for years, driving stress and reducing the energy available for biological “work”. Clients are oblivious to subconscious EMIs, so they search for the “cure” outside themselves. “Fix me” is the challenge given to the physiotherapist, but the patient may not be broken.

Clinical experience

Clients come with persistent pain that can include acute, chronic, nociceptive, neuropathic, musculoskeletal and visceral pain, which is unresponsive to conventional treatment. They not only seek a cure but are often desperate to be believed. Many people with persistent pain have an adverse healthcare experience, and feel that their pain severity and personal impact is marginalised (Toye *et al* 2013; Morley 2010). Labelled “complex pain patients” these are the patients that keep therapists awake at night!

However, these long-suffering clients are rarely aware that childhood experiences may relate to their current pain. Fortunately, incongruence between their conscious mind (verbal responses) and subconscious mind (non-verbal responses) highlights activated EMIs that re-trigger mental perceptions and neurological states from the past (Kube *et al* 2020), sometimes decades after they have been experienced.

DETECTING INCONGRUENCE

During clinical conversation, verbal and non-verbal communications (NVCs) are calibrated. Non-verbal communication has been extensively studied for its ability to “point to” hidden truths (Plusquellec & Denault 2018). When conversation moves to a future scenario, e.g. giving a speech,

that triggers anxiety or uncertainty, the individual’s flow of “information”, such as body movement, facial expressions, and linguistic choices becomes incongruent, disjointed and stifled. Uncertainty, characterised via these non-verbal cues, indicates psychophysiological stress (de Berker *et al* 2016).

By identifying incongruent parts of the nonverbal message through observation and evaluation of how the client gesticulates, twitches, their micro-movements, breathing and verbal cues (Hall *et al* 2019), uncertain moments can be “interrupted” and this enhances the client’s self-awareness of their EMI and exposes subconscious sources of stress.

The interruption intervention is applied rapidly, preventing the client from wading into their “story”, and evoking stress-related neurochemicals associated with the original event (Neville *et al* 2021). Using interruptions allows the client to explore “uncertainty,” encourages curiosity, and makes change possible.

As, during this process, the brain re-evaluates the data, the perspective shift is accompanied by a change in breathing, facial relaxation, softening of the muscles and remarks such as “I’ve never thought about it like that...” This “mind reset” occurs at the same speed it was imposed; in a split-second.

Case studies

CASE STUDY 1: JOHN (AGE 47)

History

John presented with “excruciating pain” diagnosed as trigeminal neuralgia. He had been in a serious bicycle accident 30-years ago that had required surgery, and he recalled that, when his father had visited him in hospital he had “turned white and vomited” when he saw his injuries. Six months *after* the operation, John began to feel pain that he described as like “bad sunburn”. He had undergone many treatments for the pain, with varying degrees of partial relief.

Diagnosis

It was clear that the post-surgical incident with his father had had a

dramatic impact on John. Parents are powerful figures to children and that his father had appeared terrified at the sight of John’s injuries had become a powerful EMI that had amplified the seriousness of the incident in John’s mind.

The EMI was a reoccurring mental stimulus that was contributing to his persistent pain state, and the psychological impact was contributing to the pain more than physical trauma.

Treatment

John’s EMI was cleared through location, interruption and reconciliation, and within 24 hours the pain had diminished. Four years later there was still no recurrence of pain.

CASE HISTORY 2: SARAH (AGE 7)

History

Sarah was a petite child who presented with heel pain that had been diagnosed as calcaneal apophysitis and her pain was so severe that she was unable to walk without the aid of crutches. A medical specialist had told Sarah that the pain was due to “developmental problems with the muscles and bones of her feet because she was small”, and she was advised that there was no need for an operation because the pain would disappear by the age of 12.

Diagnosis

Sarah embodied the specialist’s prognosis with a “white-coat” nocebo effect (Hansen & Zech 2019) creating a powerful EMI that acted like a “post-hypnotic suggestion” that Sarah would be in pain until she was 12 years old. This generated a barrier to learning that trapped Sarah in the moment of her prognosis and the knowledge / belief that she would be pain free by the age of 12.

Treatment

Children find it easier to speak to toys and animals, so during Sarah’s consultation she was given a teddy bear that she was told she could take home with her, but she would have to pretend to “Teddy” that she was 13 years of age so that she was old enough to look after him. ➡

Acceptance of the toy presupposed that Sarah was 13, and this data created a revised EMI for her that resulted in the perception of pain immediately going. At one-year follow up Sarah is still pain free (Hudson 2011).

CASE STUDY 3: JANE (AGE 48)

History

Jane presented with ankylosing spondylitis, a “slight twinge” in her neck, that had been growing worse over a 25-year period. She reported that she had been “devouring” pain medication for many years and had been offered, but had refused, spinal surgery. The pain had started with the onset of her mother’s dementia when it had fallen to Jane to care for her mother as her two sisters worked full-time.

Diagnosis

Although she had never voiced it, Jane resented her sisters and as the pain prevented her from being physically able to care for her mother, Jane’s sisters had been obliged to eventually step in. This had released Jane from the burden of caring for her mother alone. The guilt of being unable to care for her mother had, however, remained heavy on her shoulders.

Treatment

Acknowledging her guilt and pain brought Jane to tears, and relief. Clearing the EMI that was driving the guilt / anger was key to this intervention, as well as exploring the EMI to increase curiosity to build dopamine in the brain and motivate change. The pain cleared immediately after treatment and Jane remains pain free after one-year follow up.

CLINICAL SUMMARY

Attentiveness to NVC identified incongruences between the verbal and non-verbal narrative is essential. The incongruences highlight the “data”, or EMIs distorting sensory processing, seen as disruptions in the flow of client information.

Memory is a meaning making reconstructive process (da Silva & Lyra

CONTACT DETAILS

matt@mindreset.app
m.johnson@leedsbeckett.ac.uk
Mindreset.app

2020), and an “informed guess” at the past. Each time we “remember” we actually “recollect” the data and approximate the event. Reconsolidation happens when a memory is re-engaged and for a short time becomes “malleable” (Ecker & Bridges 2020). “Edits” to the data “upgrade” the memory before storage.

These case studies demonstrate that persistent pain is not solely driven by pathology, nociceptor activity and nociceptive nerve signals. Rather, persistent pain can be driven by the brain’s prediction of “threat” influenced by contextual cues (triggers) and past events (traumas). Locating the EMI flags information for “review” and with a relaxed curiosity the client can consciously re-think or re-set their mind.

Pain and mental health

A 2016 study identified for NHS England that one in six of the population suffered from mental health issues (McManus *et al* 2016). It has, therefore, become increasingly necessary for physical therapists to be aware of their patients’ psychological presentation. Indeed, the aftermath of Covid-19 may unleash pain pandemics relating to 2020/21 as a result of the creation or awakening of traumatic experiences and increased incidents of mental health issues (Kontoangelos *et al* 2020).

Pain management must involve a patient-centred psychosocial approach using a variety of treatments and practitioners. If patients are to truly heal their pain, past traumas can’t be ignored.

Workplace stress

The impact of stress within the workplace is now recognised by employment law (Hassard *et al* 2014). Employers are responsible for the cost and treatment of employee burnout, even though the origins may be a result of childhood events. Fortunately, this financially led initiative is increasing the interest in investigating the potential of underlying ACEs and EMIs contributing to the stress overload.

Workplace intervention: a pilot study

The initial results of a recent “proof of concept” workplace intervention undertaken by Matt Hudson, using an eye-tracking app to disrupt or reset the stress response, are exceptionally promising. The two-week study involved seven people, using a twice daily, two-minute stress intervention via a mobile app.

The primary goal was subjective stress reduction, using the Oldenburg Burnout Inventory (OLBI): improvements were seen for every data point (figures 3-6).

The percentages were based on comparing the mean score of all seven participants for each question before and after intervention. For example, the question “challenged at work” showed a 20% change because the prior mean score was 2.2 out of a 1-4 scale, and this improved to 1.7.

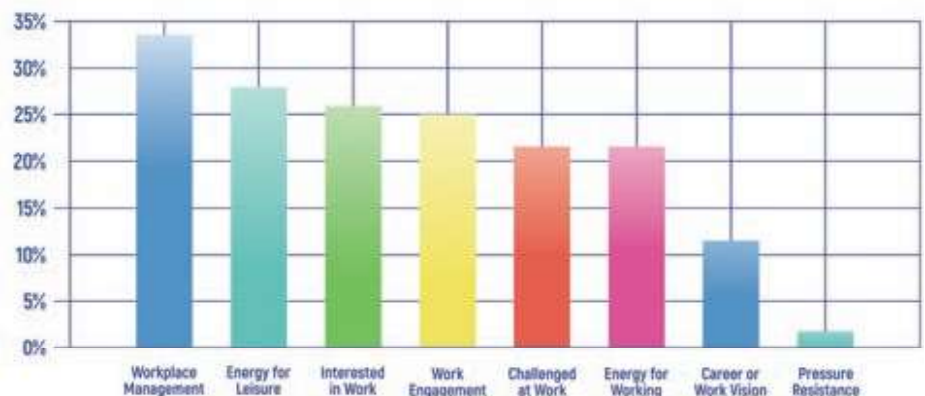


FIGURE 3: Graph 1 illustrating increase in positive (desirable) traits

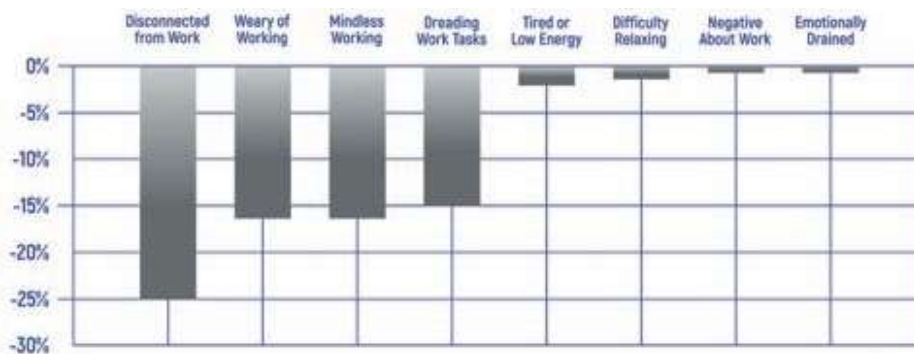


FIGURE 4: Graph 2 showing the reduction in negative (undesirable) traits

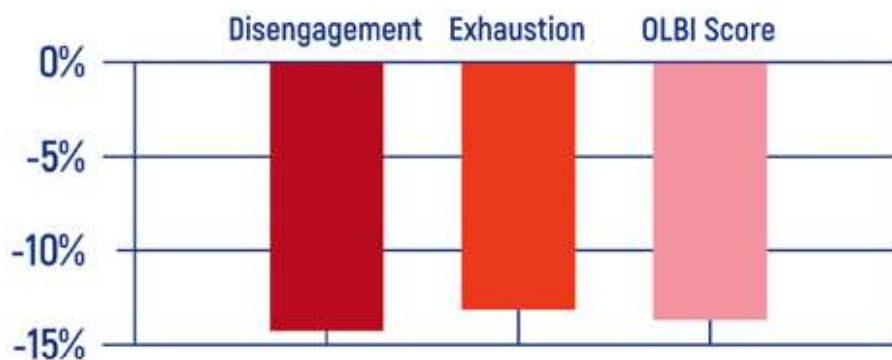


FIGURE 5: Graph 3 showing burnout risk reduction

	Before	After
Disengagement	18.3	15.7
Exhaustion	19.3	16.8
OLBI Score	37.7	32.5

FIGURE 6: Table illustrating burnout score reduction (n=7 participants). Maximum score values as follows: Disengagement (28), Exhaustion (32), OLBI (60)

Stress reduction is accompanied by increased energy, interest, enjoyment, ability and vision, and a decline in disconnection, tiredness, mindless working, weariness and dread. The aim of the app is to “clear” EMIs with non-invasive methods, using eye-tracking technology. Feedback from clients participating in the pilot study includes: “I loved using the app, it uplifted me each day, I also felt relaxed after using the app, much better than I did before using it. Even though sometimes I didn’t think that I was stressed, something changed / triggered when I used the app, I can’t really explain what, but it did and whatever it was, it really helped.” – participant in proof of concept workplace intervention study.

In the dynamic and increasingly digital healthcare marketplace, technological opportunity is growing rapidly, and virtual therapy is being positioned as a potential solution to the impending mental healthcare crisis (Bostock 2020).

The promising results of this pilot workplace study indicate that we can reduce and reset stress. Stress reduction leaves more energy available for higher cognitive functions, improved mood and better health outcomes (Schakel *et al* 2019).

The future of pain

In 2012, Gaskin & Richard reported that the cost of chronic pain to the United States economy was more than the combined cost of cancer, heart disease and diabetes (Gaskin & Richard 2012).

Patient outcomes can be dramatically improved when the total burden of pain and stress is factored into pain management / treatment.

The contemporary views on the psychophysiology of pain recognises that a person’s final experience of pain is driven by contextual cues and past

We have developed a system that implements 25 years of experience with the approach described in this article into an automated tool physiotherapists can use for their clients in clinic or even at home. If you would like to be part of our trial, you can access the app free of charge. For more information contact matt@mindreset.app

stressful events. Reducing the negative impact of stress and trauma on the immune system speeds up recovery and boosts health. There is an opportunity to change the way chronic pain is viewed and treated by resetting the mind to relieve the body.

MindReset

Working on the premise that “perception influences pain” Matt Hudson and Lisa Mcloughlin have developed “MindReset”, a digital therapeutic process. This advanced patented technology helps the patient to clear their mental stress. The web-based platform targeting chronic pain is now open, free to physiotherapists who want to bridge the gap between physical and mental health.

About the authors

Matt Hudson is a Mental Coach and Behavioural Change Specialist with a background in education, postgraduate studies in hypnotherapy, psychotherapy, neurolinguistic programming (NLP) and counselling. Matt spent three decades studying the human mind from multiple perspectives including philosophy, neuroscience and quantum physics. Matt has helped thousands of people achieve profound personal transformation, eradicate debilitating pain and restore their health.

Mark Johnson is a Professor of Pain and Analgesia, Director of the Centre for Pain Research, School of Clinical and Applied Sciences, Leeds Beckett University. Mark has researched the science of pain, and its management for three decades. Trained as a neurophysiologist and specialising in Pain Science, Mark has

published more than 200 articles and, together with his team, is committed to improving our understanding and management of pain and its perception.

Acknowledgement

The authors would like to thank Lisa Mcloughlin, Chief Operations Officer at Mind Help Limited for her assistance with this article. Lisa is a BACP Accredited Counsellor with a background of working within the mental health field, specifically CFS/ME and brings a wealth of knowledge which contributes to the development of their digital applications.

Other resources

Oldenburg Burnout Inventory, <http://www.goodmedicine.org.uk/sites/default/files/assessment%2C%20burnout%2C%20olbi.pdf>

References

Allahverdi E. Psychosomatic Pain in: Effects of Stress on Human Health. Intechopen.com 2020; doi:10.5772/intechopen.91328

Bernheim H. *Suggestive Therapeutics: A Treatise on the Nature and Uses of Hypnotism* (Classic Reprint). Forgotten Books 2019; ISBN 0282001360

Bostock B. As the pandemic shatters Americans' mental health, the FDA, psychiatrists, and developers are betting on smartphone Apps to treat them directly. Business Insider 2020; <https://www.businessinsider.com/mental-health-crisis-app-based-therapy-fda-psychiatrists-2020-11?r=US&IR=T>

Brinjikji W, Luetmer PH, Comstock B, Bresnahan BW, *et al.* Systematic literature review of imaging features of spinal degeneration in asymptomatic populations. *American Journal of Neuroradiology* 2015;36:811-816

Casey K. Sensory, motivational and central control determinants of pain. In *The Skin Senses* Eds: Kenshalo DR, Charles C Thomas (pubs) 1968;20:423-439

Cao H, Gao YJ, Ren WH, Li TT, *et al.* Activation of extracellular signal-regulated kinase in the anterior cingulate cortex contributes to the induction and expression of affective pain. *Neuroscience* 2009;29(10):3307-3321

QAP COMMENT

This article highlights that if we, as private physiotherapists, are to be effective at dealing with chronic pain patients, we need to understand the potential causes. We also need to identify when pain may not be due to tissue damage, and recognise the appropriate treatment modalities to apply at the appropriate juncture. This understanding and treatment application will improve the function of this patient group and therefore lead to improved outcomes that can be specifically measured on the PFS scale incorporated in our Physio First Data for Impact tool. Chronic pain patients are a significant burden to the NHS and are, therefore, a potential market for QAPs and QACs.



Reviewed by
Byron Clithero

Centre for Disease Control and Prevention. Violence Prevention. CDC-Kaiser-ACE study revised 2020 https://www.cdc.gov/violenceprevention/aces/about.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fviolenceprevention%2Ffacestudy%2Fabout.html

Centre for Disease Control and Prevention. Adverse childhood experiences reported by adults – five states. Morbidity & Mortality Weekly Report 2010;59(49):1609-1613 <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5949a1.htm>

da Silva JRR, Lyra MC. Learning the concept of chemical substance: the role of reconstructive memory. *Human Arenas* 2020;3:99-118

de Berker AO, Rutledge RB, Mathys C, Marsall L, *et al.* Computations of uncertainty mediate acute stress responses in humans. *Nature Communications* 2016;10996 <https://www.nature.com/articles/ncomms10996>

Ecker B, Bridges SK. How the science of memory reconsolidation advances the effectiveness and unification of psychotherapy. *Clinical Social Work Journal* 2020;48:287-300

Endean A, Palmer KT, Coggon D. Potential of magnetic resonance imaging findings to

refine case definition for mechanical low back pain in epidemiological studies: a systematic review. *Spine* 2011;36:160-169

Felitti VJ, Anda RF, Nordenberg D, Williamson DF, *et al.* Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The adverse childhood experiences (ACE) study. *American Journal of Preventative Medicine* 1998;14(4):245-248

Gaskin D, Richard P. The economic costs of pain in the United States. *Pain* 2012;13(8):715-724

Hall JA, Horgan TG, Murphy NA. Nonverbal communication. *Annual Review of Psychology* 2019;70:271-294

Hansen E, Zech N. Nocebo effects and negative suggestions in daily clinical practice – forms, impact and approaches to avoid them. *Frontiers in Pharmacology* 2019;10:77

Hassard J, Teoh K, Cox T, Dewe P. Calculating the cost of work-related stress and psychosocial risks. *European Risk Observatory Literature Review* 2014; doi: 10.2802/20493

Herman JP. Corticollimbic stress regulatory circuits, hypothalamo-pituitary-adrenocortical adaptation and resilience – chapter 19. *Stress Resilience: Molecular and Behavioural Aspects*, Elsevier 2020

Hoffman DD. *The case against reality. How evolution hid the truth from our eyes.* Allen Lane, Penguin Books 2019

Hudson EM. *The Saboteur Within: The Definitive Guide to Overcoming Self Sabotage.* Leipzig, Germany 2011;17:26

International Association for the Study of Pain. Revised definition of pain. IASP 2020; www.iasp-pain.org/PublicationsNews/NewsDetail.aspx?ItemNumber=10475

International Association for the Study of Pain. Chronic pain has arrived in the ICD-11. 2019; <https://www.iasp-pain.org/PublicationsNews/NewsDetail.aspx?ItemNumber=8340>

Johnson MI, Smith E, Yellow S, Mulvey MR. A preliminary investigation into psychophysiological effects of threatening a perceptually embodied rubber hand in healthy human participants. *Scandinavian Journal of Pain* 2016;11(1): <https://doi.org/10.1016/j.sjpain.2015.10.004>

Kim TD, Lee S, Yoon S. Inflammation in post-traumatic stress disorder (PTSD): a review of potential correlates of PTSD with a neurological perspective. *Antioxidants* 2020;9(2):107

Kontoangelos K, Economou M, Papageorgiou C. Mental health effects of Covid-19 pandemic: a review of clinical and psychological traits. *Psychiatry Investigation* 2020;17(6):491-505

Kube T, Berg, M, Birgit Kleim, Herzon P. Rethinking post-traumatic stress disorder – a predictive processing perspective. *Neuroscience & Biobehavioral Reviews* 2020;113:448-460

Lacey MF, Neal LB, Gable A. Effortful control of motivation, not withdrawal motivation, relates to greater right frontal asymmetry. *International Journal of Psychophysiology* 2020;147:18-25

Lumley MA, Cohen JL, Borszcz GS, Cano A, et al. Pain and emotion: a biopsychosocial review of recent research. *Clinical Psychology* 2011;67(9):942-968

McEwen BS. Neurobiological and systemic effects of chronic stress. *Chronic Stress* 2017;1: doi: 10.1177/2470547017692328

McManus S, Bebbington P, Jenkins R, Brugha T [eds]. Mental health and wellbeing in England: adult psychiatric morbidity survey 2014. Leeds: NHS digital. 2016; <http://content.digital.nhs.uk/catalogue/PUB21748/apms-2014-full-rpt.pdf> [Accessed 5 October 2016]

Moffitt TE, Klause Grawe 2012 Think Tank. Childhood exposure to violence and lifelong health: clinical intervention science and stress biology research join forces. *Development & Psychopathology* 2013;25: doi: 10.1017/S0954579413000801

Morley S. The self in pain. *Reviews in Pain* 2010;4:24-27

Morris G, Berk M, Maes M, Carvalho AF, Puri BK. Socioeconomic deprivation, adverse childhood experiences and medical disorders in adulthood: mechanisms and associations. *Molecular Neurobiology* 2019; <https://link.springer.com/article/10.1007/s12035-019-1498-1>

Murray CB, Groenewald CB, Palermo TM. Adverse childhood experiences and chronic pain among children and adolescents in the United States. *Pain Reports* 2020;5(5):e839 doi: 10.1097/PR9.0000000000000839

Neville A, Soltani S, Kopala-Sibley DC, Asmundson GJ, et al. A longitudinal examination of the interpersonal fear avoidance model of pain: the role of intolerance of uncertainty. *Pain* 2021;162(1):152-160 doi: 10.1097/j.pain.0000000000002009

O'Connor DB, Thayer JF, Vedhara K. Stress and health: a review of psychobiological processes. *Annual Review of Psychology* 2021;72:663-688

Pearson J. Imagination can influence perception. *Association for Psychological Science* 2011; <https://www.psychologicalscience.org/news/releases/imagination-can-influence-perception.html>

Pearson J, Westbrook F. Phantom perception: voluntary and non-voluntary retinal vision. *Trends in Cognitive Science* 2015;19(5):278-284

Peters A, McEwen BS, Friston K. Uncertainty and stress: why it causes diseases and how it is mastered by the brain. *Progress in Neurobiology* 2017;156:164-188

Plusquellec P, Denault V. The 1000 most cited papers on visible nonverbal behavior: a bibliometric analysis. *Nonverbal Behavior* 2018; doi:10.1007/s10919-018-0280-9

Reddan MC, Wager TD, Schiller A. Attenuating neural threat expression with imagination. *Neuron* 2018;100(4):994-1005

Reuter M, Cooper AJ, Smillie LD, Markett S, Montag C. A new measure for the revised reinforcement sensitivity theory psychometric criteria and genetic validation. *Frontiers in Systems Neuroscience* 2015;9:38 doi: 10.3389/fnsys.2015.00038

Rome HP, Rome JD. Limbically augmented pain syndrome (LAPS): kindling, corticolimbic


sensitization, and the convergence of affective and sensory symptoms in chronic pain disorders. *Pain Medicine* 2000;1(1):7-23 doi: 10.1046/j.1526-4637.2000.99105.x

Schakel L, Veldhuijzen DD, Cromptvoets PI, Bosch JA, et al. Effectiveness of stress-reducing interventions on the respond to challenges to the immune system: a meta-analytic review. *Psychotherapy & Psychosomatics* 2019;88:274-286

Shyu B-C, Vogt BA. Short-term synaptic plasticity in the nociceptive thalamic-anterior cingulate pathway. *Molecular Pain* 2009;5:51 doi: 10.1186/1744-8069-5-51

Stevens JE. The adverse childhood experiences study – the largest public health study you never heard of. *Huffington Post* 2017; https://www.huffpost.com/entry/the-adverse-childhood-exp_1_b_1943647?guccounter=1

Suzuki K, Roseboom W, Schwartzman DJ, et al. A Deep-Dream Virtual Reality Platform for Studying Altered Perceptual Phenomenology. *Scientific Reports* 7, 15982 (2017). <https://doi.org/10.1038/s41598-017-16316-2>

Toye F, Seers K, Allcock N, Briggs M, Carr E, Andrews J, Barker K. Patients' experiences of chronic non-malignant musculoskeletal pain: a qualitative systematic review. *British Journal of General Practice* 2013;63: e829-41. 



The mind's perception influences pain

You are doing your best to clear the body from pain...
Now, you can help clear the mind too!

JOIN FREE (limited to first 50)
clinic.mindreset.app