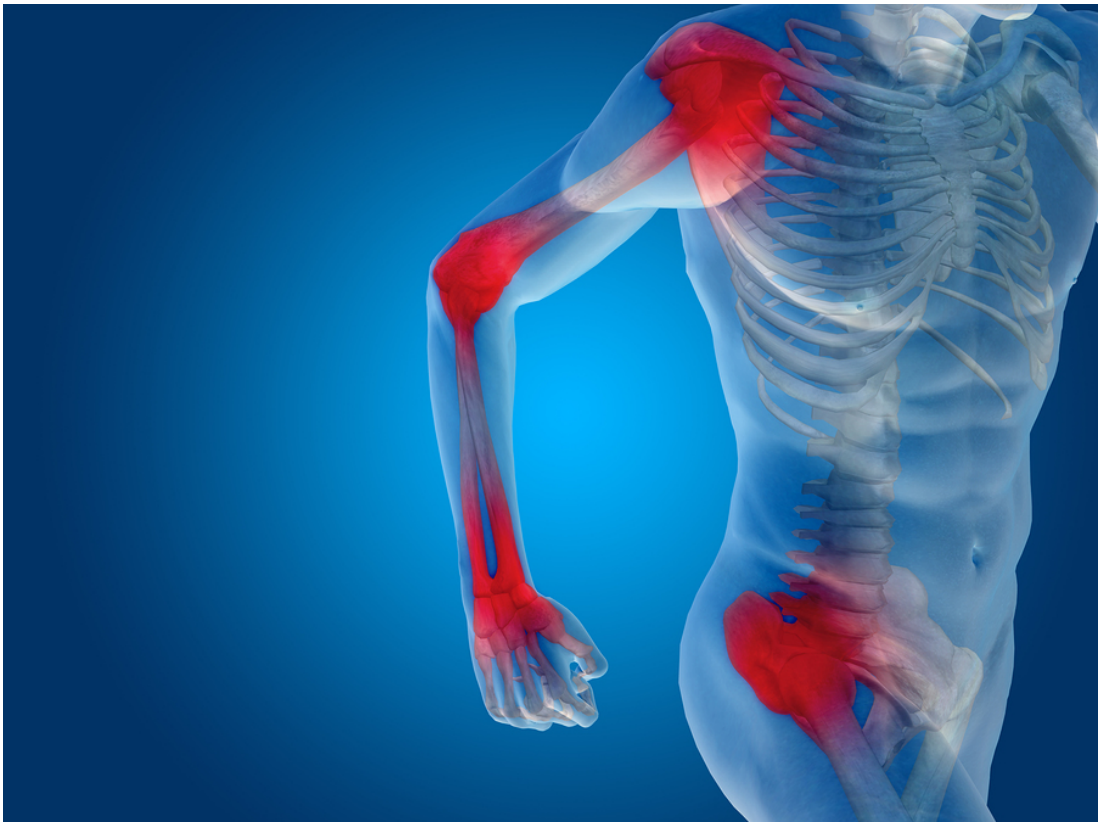
MAMMOTH MAGAZINE

THE OFFICIAL MAGAZINE OF THE CENTRE FOR STUDIES ON HUMAN STRESS

MammothMagazine • Issue 20 • Winter 2019

The Centre for Studies on Human Stress is dedicated to improving the physical and mental health of individuals by empowering them with scientifically grounded information about the effects of stress on the brain and body.



Pain, stress and the brain: A complex phenomenon!

Editorial

Marie-France Marin, Ph.D.
Sonia Lupien, Ph.D., Director of the Centre for Studies on Human Stress

Dear readers,

It is with great pleasure that we present you with our new issue of the Mammoth Magazine focusing on stress and pain. Pain is a complex phenomenon that remains minimally understood. After all, does the pain we feel come from a physiological source or is it more our psychological side that plays a role? One can imagine that the answer is probably somewhere in between ... which renders the task complex for researchers and clinicians working in this field. For the 20th issue of the Mammoth Magazine, we assembled several articles that represent different themes related to pain ... and of course, stress!

Laurence Dumont, a post-doctoral fellow at the Center for Studies on Human Stress, presents the first article in this 20th issue. She met with Dr. Pierre Rainville, a Montreal researcher who is internationally recognized for his work on pain. In this article, Dr. Rainville focuses particularly on his work on pain modulation via non-pharmacological processes. When he says that the mind is important, you will be convinced!

In the second article, Étienne Vachon-Presseau, professor at McGill University, and his student, Christophe Tanguay-Sabourin, uncover the complex relationship between stress and pain. You will see how these two phenomena, both crucial to our survival as a species, interact in many different ways. Just as stress can create an analgesic effect, it can also increase pain in other instances. This article will allow you to better understand these different nuances.

Thereafter, two students at the Center for Studies on Human Stress, Audrey-Ann Journault and Charlotte Longpré, co-write an article on different pathologies that are associated with chronic pain. From this article

you will realize that there is still plenty of research to be done on this very complex phenomenon to better help people with these pathologies.

Alexe Bilodeau-Houle and Valérie Bouchard, graduate students in psychology at the University of Quebec in Montreal, co-write an extremely interesting article on the processes involved in the observation of pain. How does our brain react when we see another person in pain? You will learn about the neural mechanisms that are implicated in pain, in addition to those implicated in observing pain.

Finally, Dr. Sonia Lupien, director of the Center for Studies on Human Stress, presents us with an article on the key role that parents can play in the perception and expression of pain in their child(ren). You will be convinced of the importance of your reactions, as children are very sensitive to their family environment!

Happy reading!

Researcher profile: Pierre Rainville, Ph.D.
Treating pain without medication: The power of the mind

Laurence Dumont, Ph.D., *Post-doctoral fellow, Centre for Studies on Human Stress, Université de Montréal*

We can take different routes to treat pain. Certain routes are pharmacological, like acetaminophen, ibuprofen and anti-inflammatories. These are often our first defense to reduce unpleasant feelings related to pain. These treatments are usually associated with the biological and objective side of our experience of pain. However, it is also important to consider the subjective side of the experience of pain, for which non-pharmacological methods of treatment are beginning to prove their worth. Think of hypnosis, the placebo effect, meditation and psychotherapy.

If, for example, the experimenter mentioned that the participant would plunge their hand into a basin of "rather cool" water, whereas in reality it was quite cold, the neural regions associated with sensory components of pain would be less activated than without this suggestion.

Yet, we tend to think that the effects of non-pharmacological treatments are "less real" because they are subjective or psychological. On the other hand, if we feel less pain psychologically, shouldn't these treatments at least have an impact on our brain and body?

To answer this question, Pierre Rainville, professor in the Faculty of Dental Medicine at the University of Montreal, spent his career studying the biological and neurological mechanisms of action that allow non-pharmacological pain treatments to be effective. He began his studies by combining biology and psychology in his Bachelor's degree, and later specialized in clinical and experimental neuropsychology at the University of Montreal for both his Master's and Doctorate degrees. Following this, and before returning to Montreal to begin his professional career, he completed a post-doctoral fellow in cognitive neuroscience at the University of Iowa under the supervision of Professor Antonio Damasio. His work, and that of his colleagues, has provided us with a better understanding of the link between biology and psychology, between objective and subjective.

His discoveries

Professor Rainville's expertise in the domain of pain developed near the end of the 1990s, where his work contributed to the differentiation of cerebral regions that are implicated in the sensory and emotional components of pain. The sensory components, as their name applies, are related to our senses. When we bang our toe on the corner of the bed, the sensory information is the initial shock and a pulsing sensation that persists after the impact. The emotional component is related more so to our evaluation of the sensory information. Keeping the same example of the injured toe, the emotional component can be very different depending on the situation. Even if we bang our toe with exactly the same amount of force, we intuitively know that it will "hurt more" if this happens when we are already in a bad mood (in that our mood will only make it worse). In knowing that these two aspects of pain have distinct cerebral foundations, it was possible to determine whether pain treatments were effective by acting on only one or both of these aspects, in combination.

A good example of how this discovery has led to a better understanding of how a treatment works is hypnosis. In order to create a certain level of pain in the laboratory, Professor Rainville would ask his participants to plunge their hand into basins of cold or hot water, and give them different hypnotic suggestions in an attempt to change their perception of

the pain. Certain suggestions concerned the sensory component of pain, for example, by exaggerating or minimizing the intensity of the water temperature in which the participant's hand was submerged. Other suggestions touched on the emotional aspects of pain, for example, by mentioning the pleasant or unpleasant nature of the water in which the participants would be dunking their hand. These different suggestions (sensory and emotional) had an impact on their respective brain regions. If, for example, the experimenter mentioned that the participant would plunge their hand into a basin of "rather cool" water, whereas in reality it was quite cold, the neural regions associated with sensory components of pain would be less activated than without this suggestion.

Afterwards, Professor Rainville turned his attention to the clinically used hypnotic suggestions that aim to reduce pain in situations where it is difficult to treat with traditional measures. These can include stressful or emotionally charged medical procedures. Therefore, it is easily understandable that the faculty of dental medicine developed a particular interest towards this line of work!

Following the curiosity of one of his students, Professor Rainville recently developed an interest in the neurobiological processes at play during meditation. Meditation experts are generally seen as individuals with extraordinary attention and self-control skills. Therefore, it is logical to think that when these individuals feel pain, they use these exceptional abilities to reduce their brain activity that is normally related to pain. This would translate to an improved control of their perception of pain. However, results from studies conducted by Professor Rainville demonstrate that this is not the case!

In recent decades, scientific understanding of non-pharmacological treatments for pain has made giant leaps forward. According to Professor Rainville, however, these treatments are still not being used in clinics to their full potential.

When experts in meditation experience pain that is provoked by heat, they demonstrate less activity than non-experts in brain regions related to mechanisms of control and show more activity in brain regions related to pain. Furthermore, they were hyposensitive to pain, meaning that they needed an elevated intensity of stimulation in order to obtain the same level of pain. This means that for the same temperature applied to the skin, expert meditators perceived less pain and tried less to control their perception of the sensation.

For Professor Rainville, this was one of the most important results he had ever obtained in the domain, as it was contrary to the dominant theory in the occidental science of meditation. In this dominant view, meditation is generally seen as a tool to increase performance, productivity and concentration. However, in traditional Zen texts, meditation has never been presented as such. Rather, meditation is seen as a way of cultivating a detached observer rapport and acceptance of our current experience, which seems to be highlighted by the results discussed above.

Obstacles set by false conceptions

In recent decades, scientific understanding of non-pharmacological treatments for pain has made giant leaps forward. According to Professor Rainville, however, these treatments are still not being used in clinics to their full potential. Currently, several issues limit the effective use of the interventions he studies.

On one hand, our healthcare system is based on a biomedical model and has a very favourable bias towards using medication. In this context, non-pharmacological interventions such as hypnosis, meditation or psychotherapy, are systematically disadvantaged. Being able to scientifically demonstrate that there are indeed biological processes behind these non-pharmacological interventions for pain management provides credibility and increases their adoption into the healthcare system. However, there is still a lot of work to be done. This is especially true at the clinical research level.

A lack of high quality clinical research prevents us from currently making precise recommendations on the optimal content of interventions or to determine the conditions that are most conducive to these non-pharmacological treatments. As previously discussed, we know that not all hypnotic suggestions have similar effects on the brain. Some target

the sensory side of pain, while others target the emotional side. However, in current research, the different types of suggestions are often grouped under the same umbrella. The situation is the same for meditation, which includes several types of meditation involving both very different brain regions and activities.

Being able to scientifically demonstrate that there are indeed biological processes behind these non-pharmacological interventions for pain management provides credibility and increases their adoption into the healthcare system.

Grouping all of these interventions under general terms such as hypnosis or meditation, however, can mislead us into comparing apples to oranges. To illustrate why this lack of distinction between practices or techniques is problematic, Professor Rainville quotes one of his students: "Meditation is like sports; there are people who do archery and others who play rugby!". In using this analogy, it is easy to understand that different variations in interventions can have completely different effects and why failing to address these differences can be misleading.

The tendency to group all these interventions under the same umbrella (to evaluate efficiency) can greatly influence the way in which they are presented in the media and public spaces. This is one of Professor Rainville's biggest annoyances. In believing everything in circulating articles, meditating for 10 minutes per day would allow us to erase our stress, be cured of all illnesses and reach unprecedented levels of productivity. However, research is much more nuanced and these exaggerated claims can undermine the credibility of non-pharmaceutical interventions in the treatment of pain.

Upcoming frontiers

Professor Rainville believes that the greatest challenge of the next scientific generation will be to bring attention to the quality of clinical research, and to ensure the integration of different biological, psychological and social factors that may have an impact on pain perception. It will, therefore, take several more decades of research to explore the full potential of this famous mental force.

Stress and pain: a paradoxical relationship

Christophe Tanguay-Sabourin, *Master's student in neuroscience, McGill University*
Etienne Vachon-Presseau, Ph.D. *Assistant Professor, McGill University*

In 1976, the term stress made its appearance in medical jargon. Initially used to describe the interaction occurring in physics when a force is applied to a resistance, Hans Selye used the term stress to describe "a non-specific response of the body to any request made to it". According to him, this response made it possible "to accelerate the intensity of life to the detriment of wear and tears on the body". It, therefore, allows us to temporarily forget our aches and pains to face adversity. This is why stress is recognized as a powerful pain moderator.

One of the best examples stems from the observations of Henry Beecher during the Second World War. Anesthesiologist and researcher, Beecher was interested in the relationship between the severity of the pain and the extent of the injury.

To measure this relationship, he compared wounded soldiers and civilians who underwent surgery. His hypothesis was simple: the more severe a war injury was (or a major surgery), the more that individual would ask for morphine to cope with the pain. To his surprise, Beecher observed that contrary to civilians, the majority of soldiers would not ask for morphine. Even amongst the soldiers who were seriously injured, only a third of them asked for morphine. The intense stress experienced in combat situations allowed them to persevere despite their serious injuries and pain, however excruciating they were.

Psychological stress, similar to acute pain, has an alert system that is beneficial in the short-term. However, it can become harmful in the long-term.

Thus, stress can act in the short-term as an analgesic mechanism. In contrast, numerous studies have suggested that in patients suffering from chronic pain (a pain that persists beyond the expected recovery time), the severity of symptoms is amplified by long-term stress. This pain, contrary to our occasional aches, does not have the alert function that is normally present during acute pain. The pain can sometimes persist after the initial injury appears to have healed.

Evidently, there are numerous types of pain: neuropathic, cancerous, traumatic, muscular, etc. Amongst these, lumbar pain is the most common and costly for the system despite the fact that it remains the most obscure. Affecting nearly half a billion of the earth's population, it still remains a mystery in the eyes of medicine. The so-called injury model is not enough to explain lumbar pain nor its chronicity. In fact, less than 5% of the population with lumbar pain recalls the existence of a trauma or fracture that may have contributed to the development or persistence of their pain.

For this reason, an interest developed towards using brain imaging to attempt to understand pain, beyond just the injury. The *pain matrix* refers to different brain activities that are triggered by the intensity and unpleasantness of pain. Notably, this *pain matrix* is observed and recognized across all different types of pain stimulation and in different locations. Interestingly, patients with chronic pain do not have different brain activity with respect to this *pain matrix*. They often present differences in the cortico-limbic system of the brain, which plays a critical role in motivation and learning. The latter are two essential elements for the regulation of stress. These differences were observed within a longitudinal study that followed the transition of a cohort of patients suffering from lumbar pain over the course of three years. It was observed that the persistence of chronic pain was predetermined by the anatomy of the cortico-limbic system.

The most effects forms of treatment (multidisciplinary) for managing chronic pain are very similar to those used for managing chronic stress: regular exercise, mindfulness exercises, improvement of sleep quality, talking about our emotional baggage with our entourage (emotional disclosure) and avoiding stress or pain triggers.

How are motivation and learning important for chronic pain, or even related to stress regulation? In chronic patients, an at-risk cortico-limbic system can play a role in pain episodes, notably, in the emotional assessment, the generated response or even the motivation generated to manage pain. These differences could also predispose certain individuals to developing inadequate coping behaviours. This could perhaps explain the maintenance of a chronic state of pain and even amplify the severity of an individual's symptoms. Generally, the goal of these behaviors is to manage anxiety. However, they can be dysfunctional and unproductive. Ultimately, leading to more harm than good. Notably, this is why patients who believe they can control their pain, who avoid thinking about their condition and who do not believe that they are seriously handicapped, seem to function better than those who are not. These behavioural mechanisms are also observed in other conditions, including post-traumatic stress disorder and major depression.

In particular, it is interesting to note the parallel between pain and psychological stress. First, psychological stress, similar to acute pain, has an alert system that is beneficial in the short-term. However, it can become harmful in the long-term. Second, pain and psychological stress increase the risk of developing depressive symptoms. As we know, there exists a strong association between the occurrence of stress life events and episodes of major depressive symptoms. Similarly, patients suffering from chronic pain are also more susceptible to becoming depressed. A German national survey on a large senior population (91,347 individuals) suffering from lumbar pain, with a follow-up of two years (55,690 individuals), revealed a strong association (~40%) between depression severity and pain intensity. Third, the most effective forms of treatment (multidisciplinary) for managing chronic pain are very similar to those used for managing chronic stress: regular physical exercise, mindfulness exercises, improvement of sleep quality, talking about our emotional baggage with our entourage (emotional disclosure) and avoiding stress or pain triggers.

Nevertheless, it is clear that the relationship between pain and stress is complex. When we compare

the role of stress in acute pain in parallel to chronic pain, it can even be seen as contradictory or paradoxical. In one circumstance, stress can act as an analgesic mechanism to lessen pain. In another, stress can amplify pain. This complexity is all the more pronounced given the existence of an important variety of chronic pains, all of which have mechanisms that differentiate them from one another.

References:

Jensen, M. P., Turner, J. A., Romano, J. M., & Karoly, P. (1991). Coping with chronic pain: a critical review of the literature. *Pain*, *47*(3), 249-283.

Beecher, H. K. (1946). Pain in men wounded in battle. *Annals of surgery*, *123*(1), 96.

Bonica, J. J. (1954). The management of pain. *The American Journal of the Medical Sciences*, *227*(5), 593.

Vachon-Presseau, E., Martel, M. O., Roy, M., Caron, E., Albouy, G., Marin, M. F., … & Rainville, P. (2013). Acute stress contributes to individual differences in pain and pain-related brain activity in healthy and chronic pain patients. *Journal of Neuroscience*, *33*(16), 6826-6833.

Vachon-Presseau, E., Tétreault, P., Petre, B., Huang, L., Berger, S. E., Torbey, S., ... & Comasco, E. (2016). Corticolimbic anatomical characteristics predetermine risk for chronic pain. *Brain*, *139*(7), 1958-1970.

Hammen, C. (2005). Stress and depression. *Annu. Rev. Clin. Psychol.*, *1*, 293-319.

Selye, H. (1976). Stress without distress. In *Psychopathology of human adaptation* (pp. 137-146). Springer, Boston, MA.

Meyer, T., Cooper, J., & Raspe, H. (2007). Disabling low back pain and depressive symptoms in the community-dwelling elderly: a prospective study. *Spine*, *32*(21), 2380-2386.

Vlaeyen, J. W., Maher, C. G., Wiech, K., Zundert, J. V., Meloto, C. B., Diatchenko, L…., Linton, S. J. (2018). Low back pain. *Nature Reviews Disease Primers*, 4(55).

Pain disorders…or when the symptoms themselves become a disorder

Audrey-Ann Journault, *Doctoral student in psychology, Centre for Studies on Human Stress, Université de Montréal*
Charlotte Longpré, *Bachelor's student in cognitive neuroscience, Centre for Studies on Human Stress, Université de Montréal*

We have all experienced pain at one time or another. However, more than 1 in 5 Canadians face unpredictable pain that does not lessen, refuses to leave and/or prevents them from carrying out their daily activities. The social costs of chronic pain in Canada are numerous and they collectively surpass the estimated costs for cancer, diabetes and cardiovascular diseases, amounting to between 56 and 60 billion dollars per year. Welcome to the complex and still misunderstood world of chronic pain!

According to the International Association for the Study of Pain (IASP), the definition of pain is "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage." Before going any further, it is important to make the distinction between acute and chronic pain. Acute pain is often associated with damage to the body's tissues (lesion, wound, impact, burn, etc.). The body's physical response (inflammation and the subjective sensation of pain generated by the brain) is intended as a warning signal to inform us that there is a threat to our health. It is, therefore, a symptom with a known cause, in which all possible treatments aim to "cure" the pain (make it disappear).

Chronic pain refers to persistent or recurrent pain lasting 3 to 6 months beyond the normal healing time. Thus, chronic pain has long been considered a symptom associated with an illness or disease. It occurs when the previously mentioned alarm

system becomes overly sensitive or defective. Since the precise cause of this defect is often misunderstood or unknown, the treatment is mainly aimed at relieving the person, without the objective of complete recovery. As a result, chronic pain is now considered its own illness that has numerous impacts on the physical and psychological of affected individuals, and that requires treatment independent of other medical conditions. There are several types of chronic pain - the most well-known being fibromyalgia.

Fibromyalgia

In 1990, fibromyalgia was defined as a widespread pain and sensitivity to palpation in at least 11 of the 18 regions of the musculoskeletal system, as established by Yunus (see Figure 1). Today, we have a better understanding of this condition. To start, fibromyalgia consists of symptoms well beyond those simply associated with pain. This includes fatigue, sleep disorders, mood disorders, cognitive changes, among others. What makes it even more complex is that the symptoms of an individual suffering from fibromyalgia can be inconsistent, vary in intensity over time and even disappear over short periods. As a result, the individual's quality of life and daily functioning are affected in an unpredictable manner. Where does fibromyalgia come from? One of the preferred hypotheses is that of the complex interaction between genetic predisposition, neurophysiological changes (for example, changes in brain hormones) and an abnormal stress response.

Treatments

As pain is an extremely complex phenomenon and is largely influenced by the subjective (personal) experience of an individual, it is important to have appropriate measurement tools to assess pain levels as objectively as possible. Moreover, the latter are more practical in the context of chronic pain, knowing that a person's pain levels can fluctuate within the same day. Hence, with these measurements, it is possible to create a treatment plan that is adapted to each individual. There are numerous "pain scales", one of which has been validated in over 28 countries. It allows the intensity of the patient's pain to be evaluated based on cues such as facial expression (relaxed or tense muscles, grimaces, etc.), the intensity of moaning or verbal pain complaints ("ouch", "I'm in pain", etc.). In several other contexts, the patient is also asked to rate their level of pain on a scale of 1 to 10, where 10 is the worst and most unbearable pain they have ever experienced.

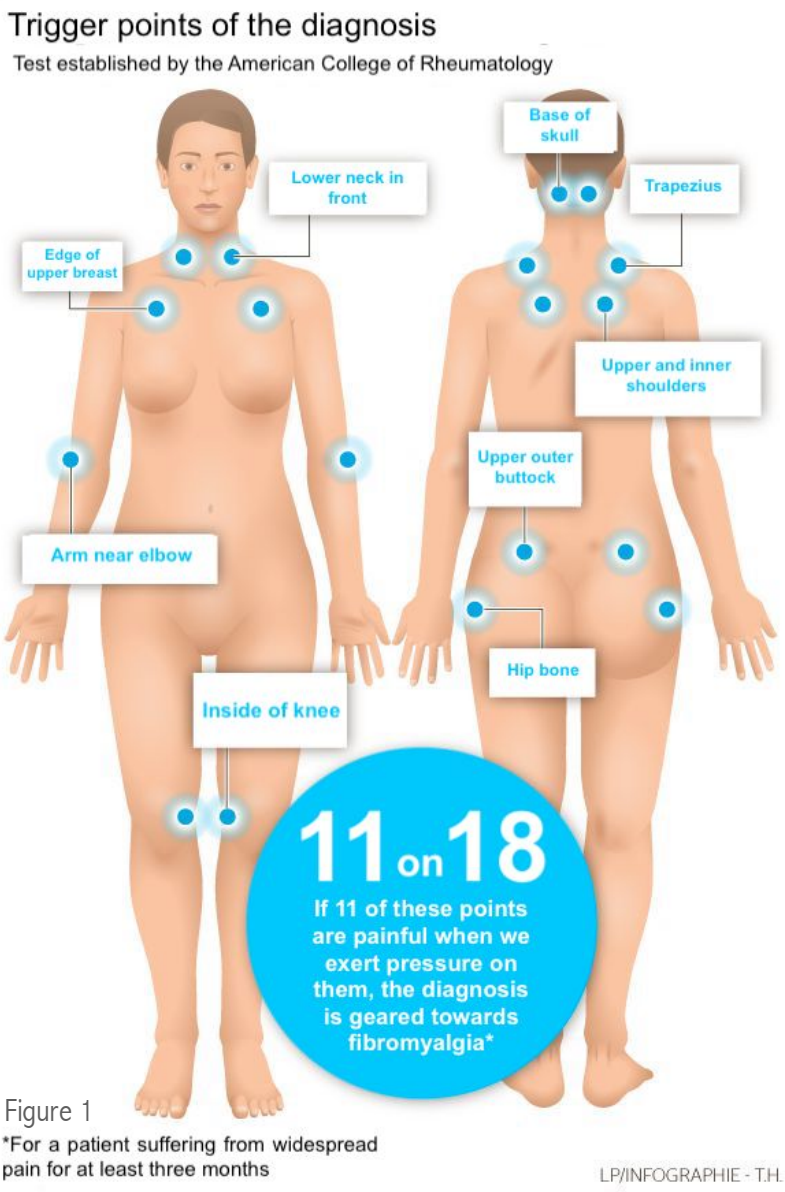


Figure 1

*For a patient suffering from widespread pain for at least three months

Multidisciplinary treatment methods for pain should be considered, as chronic pain impacts an individual's life in its entirety.

As previously mentioned, when it comes to the treatment of chronic pain, the objective is to better manage the person's pain in order to relieve it. Multidisciplinary treatment methods for pain should be considered, as chronic pain impacts an individual's life in its entirety. Often, the first treatment requested is via pharmacological management (for example, taking painkillers).

However, it is a treatment in which its effects vary greatly from one individual to another, and studies show that drugs seem to be more effective when combined with both

psychological and physical treatments. A psychologist's role in chronic pain management is essential; they help the patient develop self-management skills for their pain (relaxation, hypnosis, autosuggestion), in addition to dealing with consequences of the disease. Finally, physical therapies such as massotherapy, acupuncture, cold, hot and physical exercise, are treatments that aim to restore or to sustain the development of a person with chronic pain. To offer these personalized services, several multidisciplinary centers for chronic pain are currently open in Quebec. However, to have access to these services, the waiting list is long and patients often wait years before seeing a specialist. The effects of these multidisciplinary treatments vary according to each patient since there is a lot of individual variability. As such, an optimal treatment for one person will most likely be different from the optimal treatment for another.

Finally, chronic pain is a complex phenomenon that increasingly merits the attention it gets from the scientific community. Recognizing chronic pain as a disease has reduced the stigma that is associated with it. Currently, several studies are underway to better understand the causes of pain and to better control it. These promising studies give hope to individuals suffering from chronic pain, in order to find optimal solutions and to develop programs that are adapted to their situations.

The effects of these multidisciplinary treatments vary according to each patient since there is a lot of individual variability. As such, an optimal treatment for one person will most likely be different from the optimal treatment for another.

References:

Gélinas, C., Puntilo, K.A., Levin, P., Azoulay, E. (2017). The Behavior Pain Assesment Tool for critically ill adults: a validation study in 28 countries. *Pain, 158*(5), 811-821.

Moulin, D.E., Clark, A., Speechley, M., Morley-Forster, P.K. (2002). Chronic pain in Canada – Prevalence, treatment, impact and the role of opioid analgesia. *Pain Res Manag, 7*(4), 179-184.

Schopflocher D, Taenzer, P. & Jovey, R. (2011) La prévalence de la douleur chronique au Canada. *Pain Res Manag. 16*(6):445-50.

Pagé, G., Fortier, M., Ware, M.A., Choinière, M. (2018). As if one pain problem was not enough: prevalence and patterns of coexisting chronic pain conditions and their impact on treatment outcomes. *Journal of Pain Research, 2018*(11), 237-254.

Mary-Ann Fitzcharles and Muhammad B. Yunus, "The Clinical Concept of Fibromyalgia as a Changing Paradigm in the Past 20 Years," *Pain Research and Treatment,* vol. 2012, Article ID 184835, 8 pages, 2012.

Association québécoise de la douleur chronique. (2016). Consultation publique sur le panier de services du MSSS : Presented at the Commissaire à la Santé et au Bien-Être Repéré à https://www.csbe.gouv.qc.ca/fileadmin/www/2016/PanierServices_Memoires_Recus/AQDC.pdf

La science pour la santé. (2016). Douleur : Pour qu'elle ne soit plus vécue comme une fatalité. Found at: https://www.inserm.fr/information-en-sante/dossiers-information/douleur

When seeing someone in pain hurts…

Alexe Bilodeau-Houle, *Doctoral student in psychology, Université du Québec à Montréal*
Valérie Bouchard, *Doctoral student in psychology, Université du Québec à Montréal*

Imagine this scene… You are watching television and you see a man get hit on the hand with a hammer. What do you do? You grab your hand, squint your eyes, "ouch!". It is as if you felt the pain yourself. But you are quietly sitting on your couch, so how can we explain this reaction?

The activating brain

In fact, when you see someone exposed to something painful, the same brain regions are activated just as if you were being exposed to the pain yourself. For example, if you were the one getting hit on the hand with a hammer, the pain information would travel through your spine until it reaches your thalamus (a brain region implicated in the relay of sensory information). The pain information is then transmitted to other brain regions, such as the somatosensory cortex, the cingulate cortex and insular cortex. Each one of these structures has a specific role in the processing of the pain you have experienced. The somatosensory cortex is implicated in the localization of the pain and will, therefore, tell you that the pain is coming from your hand. The role of the cingulate cortex involves the processing of the emotions associated with pain. Do you find the pain intense? Unpleasant? Your cingulate cortex is no stranger to this. Finally, the insular cortex plays a role in the integration of sensory and affective aspects related to pain. For example,

individuals with a lesion to this brain region perceive pain, but do not feel the emotions that are generally associated with it. This disorder is called pain asymbolia. If you have this condition, you are able to state that you are in pain and indicate where it hurts, but that the pain does not bother you. If we return to our initial example, when you saw the man get hit on the hand with a hammer, these regions were activated in your brain. However, it is mainly the regions implicated in the processing of emotions associated with pain that provoked your reaction. Remember when you grabbed your hand and said "ouch!"? Your cingulate and insular cortex are to blame.

Empathy's role in all this…

Feeling pain, when you see someone else in pain, also involves empathy processes. Empathy refers to the capacity to understand and feel the experience of others. A study measured the brain activity of several individuals while their romantic partner was feeling pain. Results showed that individuals with more empathy showed a greater activation in brain regions associated with the processing of pain-related emotions. Another study was interested in the impact of empathy on the perception of pain, where participants had to watch a video where an actor told a story. Half of the participants listened to a video where the actor described the context in which their partner passed away. The other participants listened to a video where the actor described the manner in which they fooled a blind person. Obviously, the second video did not elicit much empathy from the participants towards the actor. Next, all participants watched a video of the actor as he was exposed to a painful stimuli, while they themselves were exposed to the same stimuli. Participants who watched the first video reported that the painful stimuli were more intense and unpleasant than participants who watched the second video. The empathy shown towards the actor, therefore, seemed to influence the intensity of the pain felt by the participants. The researchers hypothesized that when you are empathic towards the pain of another person, you activate your own brain regions that are associated with the processing of pain. As these areas are already sensitized, you are likely to feel more pain if you are exposed to a painful stimulus thereafter.

When it's mom or dad who's hurting…

As our brains are made this way, it is normal to react as so when we see someone else in pain. However, frequent observation of a person suffering can lead to pathological reactions to pain in the observer, particularly within families. In fact, if a parent often feels pain (for example, chronic back pain), it is not uncommon for their children to also present pathological pain throughout their life. Although genetics may explain some of this pain transmission, the child's observation of the parent also plays an important role. During childhood, we learn a lot from observing our parents. For example, if you see your mother get bitten by a cat, you will probably be more vigilant the next time you are around a cat. Several behaviours can be learnt through observation and pain makes no exception! As you will see in the next article, parents play an important role in modulating the sensation and expression of pain in their children!

In sum, the results of different studies showcase the complexity of the phenomenon of pain through observation. More research is necessary to better understand the mechanisms at play and the factors that can modulate these effects. In any case, the next time you see someone hit their hand with a hammer, pay attention to your reaction! You might not be in pain, but your brain is not so convinced! Were you startled? Did you grab your own hand? At least it proves that you are empathetic! ;)

References:

Basbaum, A. I. & Jessell, T. M. (2000). Pain. Dans Kandel, E.R., Schwartz, J.H., Jessell, T.M., Siegelbaum S.A. & Hudspeth, A.J. (dir.), Principles of neural science (5e éd., p. 530-555). New York : The McGraw-Hill Companies, Inc.

Goodman, J. E., & McGrath, P. J. (2003). Mothers' modeling influences children's pain during a cold pressor task. Pain, 104(3), 559-565.

Goubert, L., Vlaeyen, J. W., Crombez, G., & Craig, K. D. (2011). Learning about pain from others: an observational learning account. The Journal of Pain, 12(2), 167-174.

Loggia, M. L., Mogil, J. S., & Bushnell, M. C. (2008). Empathy hurts: compassion for another increases both sensory & affective components of pain perception. Pain, 136(1-2), 168-176.

Lamm, C., Decety, J., & Singer, T. (2011). Meta-analytic evidence for common and distinct neural networks associated with directly experienced pain and empathy for pain. Neuroimage, 54(3), 2492-2502.

Singer, T., Seymour, B., O'doherty, J., Kaube, H., Dolan, R. J., & Frith, C. D. (2004). Empathy for pain involves the affective but not sensory components of pain. Science, 303 (5661), 1157-1162.

Mom/Dad, it hurts! The role of parents in the expression and sensation of pain in children

Sonia Lupien, Ph.D., *Director of the Centre for Studies on Human Stress*

You are walking in the park with your five year old child when, suddenly, he loses his footing and falls on the ground. He's hurt and you know it. The little one gets up and looks at you with his bottom lip trembling. You have three choices. If you cry out: "Ooooh my god! Are you okay my sweetheart?", it is extremely likely that he will starting screaming at the top of his lungs. Conversely, if you looked at him calmly and say: "Don't worry sweetheart, it's just a scratch", it is quite possible that the little one swallows his tears and continues on his way. You can also tell the child that you know he is in pain, but encourage him to keep going because the pain will lessen over time. This scenario will cause a few tears, but they will stop rather quickly.

You have to vaccinate your youngest at the local medical clinic. You hate seeing your child in pain and it is very stressful for you to vaccinate your child because you know that he will suffer from the shot. You know

that he will suffer from the shot. You know this because every time you go to receive an injection, you suffer terribly. When you arrive at the clinic, the doctor asks you to hold the little one in your arms while he prepares the syringe. You squeeze him tightly as you squint your eyes and clench your lips very tightly. The doctor has yet to turn around with the syringe and the little one has already begun screaming in your arms.

Introduction

It is generally situations like those described above that have led some researchers to question whether parents can play a role in the expression and/or sensation of pain in children.

Here, two research approaches were used. First, researchers sought to better understand how a parent's response to a child's pain could modulate the development of weak or strong expressions of pain in children. Second, research investigated the process by which children would mimic parental behaviour (in terms of pain), which could modulate their own feelings of pain. These models predict that the more pain behaviours a parent exhibits, the more likely their child will be to develop a low pain tolerance threshold. That is, the more likely their child will also exhibit high pain sensations.

Parental responses to a child's expression of pain

In the early 1980s, studies in which researchers directly observed parental behaviours, while children reported pain, showed that the more parents pay attention to the child's pain, the more pain the child expresses.

Scientific studies of parental responses to a child's pain have examined the impact of the following three distinct parental behaviours in reaction to infantile pain:

-soliciting/protection
-pain minimization
-encouragement

These three types of behaviours are measured via questionnaires that ask questions for each type of parental behaviour.

Protection behaviours: These behaviours refer to giving particular attention to the child in pain (e.g. bringing gifts to the suffering child, giving them important advantages over their brothers and sisters), limiting their normal activities and/or responsibilities of the child in pain (e.g. not going to school when they are in pain).

Minimization behaviours: These behaviours refer to the minimization of the child's pain (e.g. telling them to stop complaining for nothing) and criticizing the child by telling them that the pain they feel is excessive (e.g. tell them that they should learn to be stronger).

Encouragement/monitoring behaviours: These behaviours refer to reassuring the child (e.g. telling them that it will be OK) and encouraging them to engage in activities (e.g. you can continue to play ball even if you cannot run as fast as you would like to) all while continuing to monitor the pain.

A study published in 2008, by researchers at the Boston Children's Hospital, investigated the effects of three types of parental behaviours on pain felt by the child. These include somatic symptoms (diverse symptoms reported by the child but were not associated with the source of pain) and an inability to function (the fact of not being able to do certain activities). This study was conducted in 327 children, aged 8 to 17, living with chronic pain due to various diseases.

Results of the study showed that, in general, parents report using a lot of encouragement/monitoring behaviours and few minimization and/or protection behaviours when their child shows that they are in pain. In addition, researchers showed that the impact of parental behaviour on the pain experienced by the child depends on the child's anxiety level.

In anxious children, the more overprotective behaviours that parents adopt, the more pain, somatic symptoms and functional disabilities children will express. In non-anxious children, parental protection behaviour does not predict the expression of pain, somatic symptoms, nor a functional disability in children.

Researchers also showed that minimization of pain behaviours in parents are associated with an increase in somatic symptoms displayed by the child and this effect is greater in anxious children than in less anxious children. The

authors suggest that anxious children may develop their somatic symptoms under conditions where their pain is not considered by parents - to make them realize their condition.

In anxious children, the more overprotective behaviours that parents adopt, the more pain, somatic symptoms and functional disabilities children will express. In non-anxious children, parental protection behaviour does not predict the expression of pain, somatic symptoms, nor a functional disability in children.

Finally, researchers showed that encouragement behaviours are seldomly associated with functional disability, reports of pain and somatization in children.

Although these results are interesting, it is important to remember that parents completed questionnaires on the nature of their behaviours in response to their child's pain. It is very possible that biases such as 'social desirability' may have led many parents to minimize the extent of their child's pain protection or minimization behaviours, and to increase reports concerning their encouraging behaviours.

The results of these and many other studies in this area of research show the different ways in which parents can influence how their child will express pain in medical conditions that can cause pain. Nevertheless, other studies have attempted to investigate a parents' role in the normal sensation of pain in healthy children.

When children imitate pain sensation behaviours of their parents

The majority of parents have children that do not suffer from chronic pain. However, certain researchers suspect that children can learn to feel pain by imitating parental behaviours. Many of us have interacted with parents who tend to show a lot of pain. We can often see a phenomenon of "family pain aggregation", in which one or more of the children in families where one parent shows strong pain behaviours, seem to report more pain sensations. Researchers, therefore, considered whether children would tend to mimic the pain behaviours of parents and whether boys and girls tended to mimic the pain behaviours of same-sex parents more strongly - given studies showing that children tend to mimic people who resemble them the most.

A study published in 2017, by Dr. Boerner and his team at Dalhousie University in Nova Scotia, attempted to answer this question with a very interesting experiment. The researchers recruited 168 parent and child (children ages 6 to 8 years old) dyads (a group consisting of 2 people), which were separated according to the following 4 groups:

-Mother-daughter
-Mother-son
-Father-daughter
-Father-son

To verify whether children tend to experience pain that is similar to that of their parent, the researchers brought the dyads to the laboratory and exposed the parents and children to the following conditions.

First, they exposed the parents to the "Cold Pressor Test" while the child observed. The "Cold Pressor Test" is a test where a person is asked to plunge their arm in a basin filled with ice and the participant is asked to keep their arm in the basin for as long as possible. Not long after, the procedure induces pain and it is calculated how long the participant can keep their hand in the basin.

Each parent underwent the "Cold Pressor Test" in front of their child, but the researchers separated the parents into 3 groups. The researchers asked the first group of parents to amplify their pain response while they were doing the test, as if they were suffering a great deal. The researchers asked the second group of parents to reduce their pain response while doing the test, as if they were suffering but only minimally. The researchers asked the third group to respond normally, that is, to not change their pain response while doing the test.

Once the parents had finished the test, the researchers asked the children to rate their parent's pain level and their own levels of anxiety (of the child). Next, they asked the

parents and children to switch places, and subsequently exposed the children to the "Cold Pressor Test". They measured the level of pain felt by the child and their level of anxiety during the test.

These results show that children can "learn" to feel different levels of pain by observing their parents while they are experiencing pain. These result also show that a mother's pain can have a larger impact on this learning than the pain of the father.

Results show that children in the "exaggerated pain" parental condition rated their parent's pain as higher than children in the "minimized pain" or "normal pain" parental conditions. Children in the "exaggerated pain" parental condition reported feeling significantly more anxiety than children in the "minimized pain" parental condition. Furthermore, children judging their mothers reported that their mothers expressed feeling more pain than children rating their fathers.

When exposed to the "Cold Pressor Test", young girls observing their mother in the "exaggerated pain" condition reported feeling significantly more pain compared to young boys who had observed their mother in the same situation. Finally, no observational effects of the father were observed in children.

These results show that children can "learn" to feel different levels of pain by observing their parents while they are experiencing pain. These results also show that a mother's pain can have a larger impact on this learning than the pain of the father.

According to the authors, such a mechanism for imitating parental pain in children could partly explain the development of various phobias, such as needle phobias in young children. In fact, a child observing their parent becoming green when seeing a needle may be inclined to unconsciously imitate this behaviour and develop a similar phobia over time.

According to the authors, the fact that young girls more strongly imitate the pain of the mother, in comparison to the father, could be due to the fact that it is more socially acceptable for girls to report pain as compared to young boys.

As we still have the tendency to educate our young boys to hide their pain, this could have diminished the imitation behaviours of young boys as compared to young girls.

Conclusion

In conclusion, studies on the impact of parental behaviours on children's expression and/or sensation of pain show a fairly clear effect of parental behaviour on the pain experienced by the child.

According to researchers, it is important to continue to study this domain with the goal of developing interventions that involve the whole family, particularly in cases where the young child has to live with chronic pain as a consequence of a disease.

Furthermore, if we can better understand the mechanisms by which our parental behaviours can modulate the sensation of pain in our children, we can develop new methods to negotiate our own pain so that it does affect that felt by our children.

References:

Boerner, K. E., C. T. Chambers, P. J. McGrath, V. LoLordo and R. Uher (2017). The Effect of Parental Modeling on Child Pain Responses: The Role of Parent and Child Sex. J Pain **18**(6): 702-715.

Claar, R. L., L. E. Simons and D. E. Logan (2008). Parental response to children's pain: the moderating impact of children's emotional distress on symptoms and disability. Pain **138**(1): 172-179.

NEXT ISSUE

Our next issue will focus on stress and sports. As you know, physical activity is recognized as an effective way to better control stress. It has effects on our body, just as much as on our brain. In some contexts, sports can become a source of stress. Are sports beneficial or stressful for high caliber athletes? These are some of the questions that will be addressed in our next issue. We hope to see you there!

MAMMOTH MAGAZINE

Editors-in-chief:
Sonia Lupien, Ph.D.
Marie-France Marin, Ph.D.

Editorial Team:
Alexe Bilodeau-Houle, M.Sc.
Valérie Bouchard, M.Sc.
Laurence Dumont, Ph.D.
Audrey-Ann Journault, M.Sc.
Charlotte Longpré, B.Sc.
Sonia Lupien, Ph.D.
Christophe Tanguay-Sabourin, B.Sc.
Etienne Vachon-Presseau, Ph.D.

Translation:
Rebecca Segall Cernik, B.Sc.

Revision:
Sarah Leclaire, M.Sc. (French version)
Nathalie Wan, M.A. (English version)

Graphic design:
Nathalie Wan, M.A.