



AALBORG UNIVERSITY
STUDENT REPORT

Can mindfulness alter pain sensitivity?

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Synopsis



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Preface

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1 | Background

1.1 Pain

The definition of pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage [Steeds2013, Mello2016]. Pain can be categories as acute, chronic and intermittent pain or a combination based on the pain experience [Goldberg2011].

Pain is a sudden or slow onset of any intensity from mild to severe pain [Mello2016]. Acute pain is anticipated or predictable [Mello2016]. Contrary, chronic pain is not anticipated or predictable and has a constant or recurring of pain with a duration greater than three months [Mello2016].

1.1.1 Prevalence and incidence

Pain is a worldwide problem, as it has a high prevalence and incidence despite the complexity of quantifying pain[Goldberg2011]. It is estimated that 20% of the world's populations adults suffer from pain and each year is 10 % of adults diagnosed with chronic pain [Goldberg2011]. Pain affects all populations regardless of gender, age, income, ethnicity or geography, but the distribution across the globe differs[Goldberg2011].

The frequently causes of pain are operations, cancer, osteoand rheumatoid arthritis, injuries and spinal cord problems ¹ [Goldberg2011]. Furthermore, can pain causes to different sequelae, such as depression, inability to work, limit social relationships and suicidal thoughts[Goldberg2011].

People with chronic pain often complain of cognitive problems which interfere with their daily functions [Geisser2018]. Additionally, it is indicated that among people with chronic pain there is a consistent evidence for disturbances in attentional capacity, processing speed, and psychomotor speed [Geisser2018]. However, is the relationship between pain and cognitive problems unknown [Geisser2018].

***** MAYBE WRITE SOME MORE ABOUT HOW IT AFFECT THEIR DAILY LIVING? ****

1.1.2 Types of pain

Pain represents a warning sign and is difficult to measure as the experience is subjective [Steeds2013] and is affected by previous experience [Ahmad2014]. The experience

¹FiXme Note: make the etiology of pain a complex transdisciplinary affair

of pain is multidimensional, where the sensory discriminate aspect involves intensity, quality, and location of the pain [Ahmad2014]. The cognitive and emotional factors compose of subjective psychological variables, as attention, anxiety, fear, expectation, and anticipation [Ahmad2014]. Pain can be divided into nociceptor pain and neuropathic pain [Steeds2013]

1.1.3 Nociceptor pain

Nociceptors, also known as tonic receptors or afferent nerve fiber², are nerve cells which initiate the sensation of pain [Steeds2013, Martini2012]. Nociceptors are free nerve endings and have a high threshold for mechanical, chemical or thermal stimulation [Steeds2013]. There are two types of nociceptors $\alpha\delta$ and C fibers. $\alpha\delta$ fibers are very small, between 2-5 μ m, myelinated nerve cells, which produce fast well localized sharp pain [Steeds2013]. The distribution of these is in body surface, muscles and joints. C fibers are small, <2 μ m, unmyelinated nerve cells, which produce slow and poorly localized pain [Steeds2013]. These produce a burning or throbbing pain and the distribution of these is in most tissues [Steeds2013].

Pain pathway

*** MAYBE PICTURE OF PATHWAYS ****

Nociceptors are activated when a noxious stimulation occur and chemicals will be released by immune cells [Martini2012]. These are the factors that stimulate the nociceptors [Martini2012]. When the nociceptors are stimulated they will propagate the pain information to the spinal cord nearby [Martini2012]. The nociceptors will bring this pain information into the spinal cord from the dorsal horn and release neurotransmitter [Martini2012]. A second neuron, the second order neuron, will receive this information and cross over to the opposite side of the spinal cord [Martini2012]. The second order neuron brings the information towards the brain via the lateral spinothalamic tract [Martini2012]. This information will be transmitted by releasing neurotransmitters to the third order neuron in the thalamus [Martini2012]. The third order neuron is location and discrimination the pain [Martini2012]. The location of where the pain has occurred correlates to the area of the somatosensory cortex, as illustrated on figure ?? . Pain on the right side of the body is processed on the left side of the brain and vice versa [Martini2012].

*** MAYBE PICTURE OF somatosensory cortex ****

Pain is modulation by the descending pathways, where the Periaqueductal Grey (PAG) and the Nucleus Raphe Magnus (NRM) are involved in reducing pain [Steeds2013]. PAG, also known as anti-nociceptor, is important in the control of pain and surrounds

²FiXme Note: tonic receptors: a sensory receptor that continues to trigger a response for minutes or hours after it is stimulated.

the cerebral aqueduct in Mesencephalon [Steeds2013]. When this region is electrical stimulated it produces profound analgesia and injection of morphine, this can happen when PAG receives an input from the thalamus, hypothalamus, cortex and the correlates from the spinothalamic tract [Steeds2013]. Neurons from the PAG region excite the cells in NRM which have a direction towards the spinal cord and to block pain transmission by the dorsal horn cells [Steeds2013]. Stimulation of NRM produce a strong analgesia and release serotonin which activates the inhibitory interneuron and blocks the pain transmission [Steeds2013]. The key neurotransmitter is noradrenaline and 5-hydroxytryptamine by modulation pain [Steeds2013].

1.1.4 Neuropathic pain

Neuropathic pain is caused by a disorder in the somatosensory system and is often a chronic condition related to injuries or diseases [Mindruta2013]. The disease occurs at different levels in the nervous system and affects the signaling of pain [Mindruta2013]. The neuropathic pain would not be described as a single cause or a single specific lesion, but instead, they would be described based on a mechanism [Mindruta2013]. This mechanism can, however, produce painful symptoms in the same disease, by it would take different aspects [Mindruta2013]. The sensation is described as a sudden pain which is burning, tingling, shooting stabbing or numb and can be paroxysmal or continuous. The pain can be divided by the evoked pain into hyperalgesia, hyperpathia, hyperaesthesia, allodynia, and dysaesthesia. Hyperalgesia is the pain of abnormal severity followed by a noxious stimulation. Hyperpathia is an exaggerated and prolonged response to stimulation, which can be delayed in onset and after repeated stimulation. Hyperaesthesia is defined as an increased sensitivity to stimulation. Allodynia is a painful response to a normally innocuous stimulus. Dysaesthesia is an evoked or spontaneous altered sensation is described as a discomfort rather than pain. It can be difficult to localized the distribution of pain because the distribution is longer respect by nerves, roots, segments, proximal or distal territories as for nociception pain [Mindruta2013]. Neuropathic pain syndromes can be categorized into peripheral, central or mixed [Mindruta2013]. Mixed pain syndromes could example be a chronic low back pain with radiculopathy³. Therefore is a detailed analysis of the somatosensory abnormalities in the given case is important to distinguish neuropathic pain from nociception [Mindruta2013]. An ancillary test can be used to diagnose if the pain is caused by an injury in the somatosensory system [Mindruta2013]. This test divided information on the basis of fibers, sensation, clinical and laboratory tests [Mindruta2013]. **Treatment of chronic pain**

There are several ways of treatment for chronic pain patients, depending on the modalities and intensity of the pain. Habits or life circumstances can intensify chronic pain. Changes of the lifestyle may help to decrease chronic pain. It is known that the pain sensitivity is negatively enhanced by nicotine. Therefore quit smoking can be a step towards relieving chronic pain. Furthermore chronic pain patients often suffer from insomnia. Sleep

³FiXme Note: where one or more nerves do not work properly

hygiene should be applied to reduce the occurrences as well as the severity of the sleep disturbances. If insomnia is due to medication, it should be revised, if it is possible to change the medication to avoid medicine related insomnia. Obesity is a risk factor in the likelihood to develop chronic pain, besides, it encourages other health problems for example cardiovascular disease or diabetes. It is known that chronic pain occurs more often in people which are overweighted. This is encouraged by the side effects of obesity like psychological disability or musculoskeletal pain. To improve this condition, weight loss should be achieved by the combination of diet and exercises. This will influence the recovery abilities from pain positively.

Another way to treat chronic pain is by physical therapy with the aim to enhance the patients' flexibility, general fitness and musculature. A special program is adapted to the patients' needs. Components of this program might be moist heat, cryo therapy, ultrasound and transcutaneous electrical stimulation. Furthermore assistance can be provided by manual therapy or exercise, which should be included to improve the physical fitness, achieve weight loss and decrease the risk of chronic diseases encouraged by inactivity.

Psychological therapy helps patients to reduce depressions or anxiety. Also it assists patients to identify necessary lifestyle changes and implement them.

Surgery is a less frequent treatment technique. Commonly it is used to relieve patients from pain due to anatomic abnormalities.

Medication is a common way to treat severe chronic pain patients, although there are disadvantages. Those medicaments can be divided in three groups, the coanalgesic medications, the non-opioid and the opioid analgesics. Coanalgesics are used to treat other diseases, but provide analgesic qualities. They are often used to treat fibromyalgia, chronic headache and neuropathic pain. Often coanalgesics are combined with analgesics to extended pain-relief. Non-opioid analgesics are used to reduce intermittent mild to moderate pain. To this category belong nonsteroidal anti-inflammatory drugs, which decrease inflammation and give analgesic properties. Non-opioid analgesics are especially used in short-term-therapy. A permanent use of Non-opioid analgesics encourages prostaglandin effects, which conduct in severe organ toxicity. Known side effects are for example gastrointestinal toxicity, nephrotoxicity and a increased risk of cardiovascular diseases. Opioid analgesics provide stronger analgesic qualities than non-opioid analgesics and show no prostaglandin effect. Because of this better long-term tolerability opioid analgesics are used in patients which suffer from chronic non-malignant pain. But the use of opioid analgesics accompanies with the risk of abuse and misuse. Studies have shown, that the median time until abuse behavior is 24 months. Treatment targets and specific requirements are set to minimize this risk. The decision, if non-opioid or opioid analgesics are used, is based on weighing safety, tolerability and effectiveness. The superior effectiveness and the lower organ toxicity of opioid analgesic outweigh the risk of abuse or misuse.

None of the different treatment methods is enough or sufficient when applied alone. But

a individual combination considering the needs of each patient alleviates the suffering of the chronic pain.

1.2 How to measure pain

The International Association for the Study of Pain (IASP) defines pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage[(Marsky and Bogduk, 1994)]. Pain is described as a complex and subjective experience that poses a number of measurement challenges due to its subjective nature. Nevertheless, pain measurements are necessary for pain studies as well as the evaluation of methods to control pain.[libro pain] There is no valid and reliable method of objectively quantifying pain at the moment. However, despite the challenges that pain measurement present, several tools and approaches can be employed in order to collect useful pain estimates. [pain outcomes paper]

1.2.1 The Qualities and Components of Pain

Pain can be classify attending at the site of the origin of the pain in *somatic pain* and *visceral pain*. Somatic pain occurs when pain receptors or *nociceptors* in tissues (skin, muscles, skeleton, joints, and connective tissues) are activated. This kind of pain is usually localized to a specific area. Visceral pain, is defined as pain that results from the activation of nociceptors of the thoracic, pelvic, or abdominal viscera. Unlike somatic pain, is harder to localize within the body. Both types compose what is called *nociceptive pain*. On the other hand the IASP defines *neuropathic pain* as pain initiated or caused by a primary lesion or dysfunction of the peripheral or Central Nervous System (CNS). The main difference between nociceptive and neuropathic pain is the absence of a continuous nociceptive input in the latest [neuropathic pain]. The most common presentations of this condition are *hyperalgesia* and *allodynia*. Neuropathic pain can be sub There is another classification of pain attending to the duration of the same. *Acute pain* is the pain associated with tissue damage, this pain is usually limited to the site of the damage and it is possible to locate it accurately. The magnitude of the pain is dependent on the intensity of the stimulus. However, there are cases when the pain persist for long times or return repeatedly, this forms of pain are called *chronic pain*. Neuropathic pain is a variety of chronic pain.

Adaptation to pain

1.2.2 Pain assessment

The aim of pain assessment is to diagnose the cause, understand the impact, identify appropriate pain relief strategies and evaluate their effectiveness.[art and science]. There are different dimensions of pain experience that can be assessed: pain intensity, pain affect, pain quality and pain location. Due to the fact that pain is a multidimensional experience, it is needed a multidimensional assessment. Because of the fact that pain is a

subjective, internal and personal event which cannot be register directly by clinicians, it is frequently use patient self-report indices to asses the experiences of pain [**libro pain**]. Within this category it is possible to find unidimensional as well as multidimensional scales.

1.2.3 Unidimensional scales

Unidimensional scales explore only one dimension of pain. The most common assessed dimension of pain is its intensity. This could be due to the fact that patients are usually able to provide quantitative pain intensity relatively rapidly [**libro pain**]. One commonly used unidimensional tool are the Verbal Rating Scales (VRS) which consists of a list of adjectives describing different levels of pain intensity. It is important for an accurate measure using this scale to provide adjectives which reflect the extremes of the dimension, as well as additional adjectives to represent the different gradations of pain. Patients are asked to select the word that best describes their level of pain intensity. VRSs are usually scored by listing the adjectives in order of pain severity and assigning each one score as a function of its rank. This type of scales are easy to administer, score and apprehend. However, it has several statistical disadvantages and criticism raised due to the fact that assumes equal intervals between adjectives [**libro pain**]. For this particular reasons along with others is used when the patient conditions require it [**six methods paper**]. Other possibility of unidimensional scales is a visual analogue scale (VAS). A VAS consist of a 10 cm line the ends of this line are labeled as the extremes of pain. Patients are asked to indicate the point along the line that best represents the intensity of their pain. The scale is scored by measuring the distance from 'no pain' end to the patient's mark. They are usually measure in millimeters thus, for a 10 cm line gives a high number of response categories. This fact makes the VAS more sensitive to changes in pain intensity. However, one of the drawbacks is that scoring time is higher than for other methods. Numerical Rating Scale (NRS) is also within unidimensional tools of pain intensity measure. A NRS consist of asking the patient to rate his or her perceived level of pain intensity on a numerical scale from 0 to 10 (or 0 to 100), being described 0 as 'no pain' and 10 or 100 equal to 'highest level of pain'. The advantage of NRS is that not require patients mobility because the response is given verbally. NRS are valid and demonstrate positive and significant correlations with other measures of pain intensity [**six methods paper**]. Pictures or Face Scales illustrate facial expressions of different intensities of pain. Even though the primary purpose of this scales was to offer individuals with written language or cognitive difficulties an option to express pain intensity, there is evidence that they are valid [**libro pain**].

1.2.4 Multidimensional scales

Multidimensional scales are convenient in relentless pain conditions. Multidimensional scales measure several dimensions of pain with different combinations of these dimensions. They offer a more detailed reflection of the patient's pain experience [**art and science**].

Within this category we can find the McGill Pain Questionnaire (MPQ), which consist of 78 word that describe pain in sensory, affective and evaluative terms. The words have been arranged in group each one of them with similar sensory qualities and ranked according to their intensity. A six point VRS is also included. It is possible to obtain a numerical score of the components of pain adding a score to the ranked words. The MPQ is been proved as a valid method support by several studies [**libro pain**]. A brief form of this questionnaire it has been introduced, the short-form McGill Pain Questionnaire (SF-MPQ). The patients are able to rate the pain with 15 different descriptors in sensory and affective terms. Each descriptor is rated on a 4-point scale. The SF-MPQ includes a VAS for pain intensity as well as a VRS for rating the overall pain experience. Even though the brief pain inventory (BPI) was developed to assess cancer pain has been proven as a useful instrument to asses different kinds of pain in several clinical settings [**libro pain**]. The BPI measures pain severity, pain quality and the disturbance caused in the patient's 'daily life'. Two subscale scores pain intensity and pain interference.

- treatment outcomes of pain survey

1.2.5 Behavioral Measurements

It is suggested that if a patient has pain, visible signs of discomfort, behavioral and/or physiological will be present. Even so, absence of this signs does not mean absence of pain. For this reason behavioral scales should be used in non-communicative patients (cognitively impaired adults and children), when self-report assessment of pain is not possible and not instead of self-report scales.[**referncia buscar**]

1.3 Alternative methods for pain treatment

Alternative methods for treating pain not involving medication is being explored in the aid of treating patients without risking the side effects of taking medication. The alternative methods of Chiropractic therapy, acupuncture, yoga, massage therapy, hypnosis, biofeedback and mindfulness meditation will be presented and discussed in the following sections.

1.3.1 Chiropractor

Adjustment and manipulation of the spinal cord to reduce pressure on the nerves running down the spinal cord. In a study by [**Peterson2012**] evaluating 506 patients with acute and chronic back pain after 3 month of chiropractic treatment. Patients undergoing chiropractic treatment show improvements in their condition, the effect is ongoing after 3 month. [**Peterson2012**]

1.3.2 Acupuncture

Acupuncture is a treatment where small sterile needles are inserted into the skin of the patient. The needles are inserted at specific acupuncture points related to the type of pain that the patient is experiencing. [Dhanani2011] In a study by [Junnilla1983] acupuncture has shown promising results in reducing pain in patients with soft tissue round the shoulder joint, headaches, neck and shoulder pain, arthritis/osteoarthritis and low back pain. A total of 348 patients were evaluated. The mean reduction of the entire patient group was 68 %. Showing best results in soft tissue round the shoulder joint, showing a mean reduction of pain by 79 %. The headache and neck and shoulder patients had a mean reduction by 74 %. Patients with arthritis/osteoarthritis showed a mean reduction by 58 % and the patients with low back pain had a mean reduction by 50 %. In 80 % of the patients the effect of the treatment lasted for more than 3 months and 32 % over one year. [Junnilla1983]

1.3.3 Yoga

Yoga is a form of mind to body practice discipline, or tradition originating from India. In the practice of yoga different physical postures, breathing techniques and more are the routine. Yoga is both a form of personal evolution, but most popular because of the exercise which benefits the health. A review by [Whitehead2017] found that yoga could improve the functionality of the back and a slight effect of treating pain compared to non-yoga participants. ⁴

1.3.4 Hypnosis

Factors as anxiety, depression and other states of mood and the general the social life of the patient has been shown to play a role in chronic pain. These mechanisms might be altered by hypnosis. In the literature hypnosis has shown positive to relieve pain, but only on a short term basis. [Dhanani2011] ⁵

1.3.5 Mindfulness meditation

Enhanced emotion regulation, cognitive control, acceptance and positive mood have been linked with health benefits as well as pain modulation. These mechanisms have been shown to be modulated during mindfulness meditation practice. A study by Perlman et al. ([Perlman2010]) shows that practicing meditation could not lower the intensity of pain, but instead lower pain unpleasantness in the participants. The findings on meditation and pain modulation are split, but experiments in controlled settings are still needed to confirm if the effect of mindfulness meditation works on pain modulation. [Zeidan2012, Perlman2010]

⁴FiXme Note: Maybe a bit more text here?

⁵FiXme Note: maybe a bit more text here?

When using a placebo analgesia the typical response is increased activation of the dorso-lateral prefrontal cortex during anticipation of pain. Effect that predicts reductions in pain perception and activity of pain related brain regions. Mindfulness does not involve DLPFC activation. [Zeidan2012]

6

The method of mindfulness meditation will be used for method to relief pain in this project.

1.4 Mindfulness meditation

Mindfulness is often defined as being in the mental state of Non-Elaborative, non-judgmental awareness [Zeidan2012, Zeidan2016]. Practicing mindfulness meditation includes control over sensory, emotional and cognitive happenings. Hereby the ability to control these sensations without being distracted by them as so the ability to abstract from past and future representations of memory. Two popular practices of mindfulness meditation, focused attention (FA) and open monitoring (OM) are of the most well practiced types of meditation. [Zeidan2016]

Focused attention

FA is the training of concentration, where one keeps his or her focus at an object or specific thing, only focusing on that thing. Often the flow of breath is the focus, when practicing FA meditation. When any disturbance comes by, like a thought, sound or other environmental distractions, which will often lead to a drift in attention, the person should always bring his or her attention back to the focus. [Zeidan2016]

This kind of meditation has shown to enhance focus and concentration. ..

Open monitoring

OM is the cultivation of open presence, where the mind is open to anything, not focusing on any specific thing, just being in the present. If any thought or disturbance comes by, the thought or sensation should be noticed briefly, but then left without thinking more over it. It is believed that this form of meditation is easier to learn when the person masters the meditation of FA, whereby the OM form is easier to master. [Zeidan2016]

This kind of meditation has been shown to reduce pain more compared to FA, likely because the areas of the brain affected during this form of meditation is...[Perlman2010]

The neural mechanisms behind mindfulness meditation in reliving pain has been researched and in experiments where stimulating with nociceptive pain there has been

⁶FiXme Note:and then we need something like: or maybe a summary of alle the methods and then saying, because of this and this, mindfulness meditation will be looked further upon as method for reliving pain...

shown an increase in activity of the orbitofrontal cortex when meditating. Participants telling that they are able to feel the pain but able to deal with it better during meditation focusing on the breath. The same mechanisms working in analgesia is not the same as the mechanisms during meditation, why the two methods don't interfere with each other. [Jacob2016]

The different areas of the brain show either a reduction or increase in activity when performing meditation. When practicing meditation the person trains the mind, and areas of specific regions will grow. [Zeidan2012]⁷

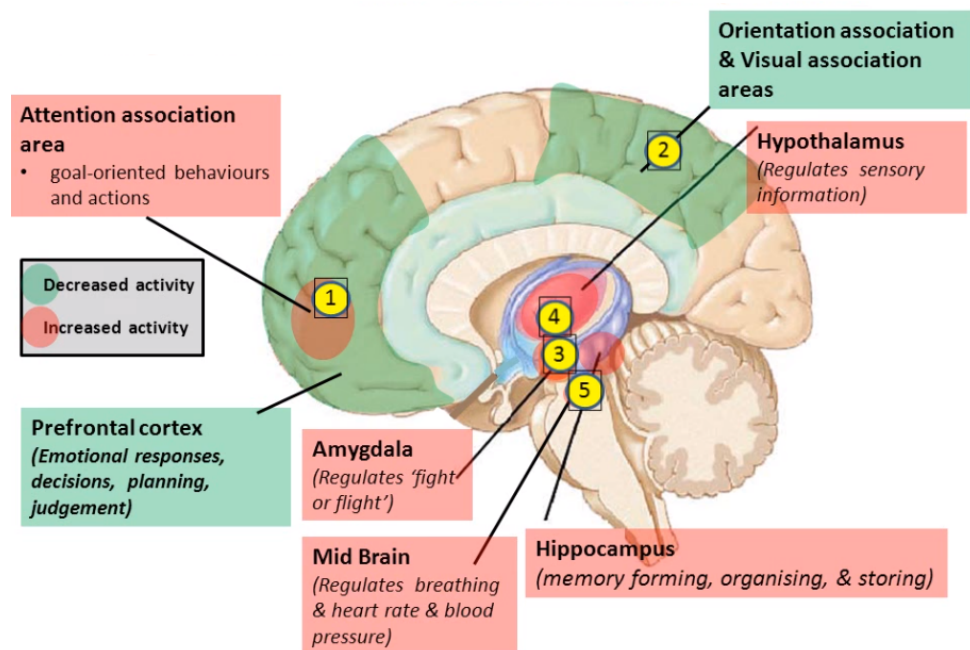


Figure 1.1: Image of the brain and activation of specific brain regions when practicing meditation

.... The figure needs to be changed to another one of better citation, but this was the best i could find by now :)....

The method of mindfulness meditation will not make the pain go away, but the patient will be able to deal with the pain easier, as mentioned, making the patient engage more in the treatment than focusing on and reeling on the medication. [Jacob2016] Very little mindfulness training can have an effect, the study by [Zeidan2012] explaining an effect of training mindfulness meditation examined for 20 min sessions for 4 days of mindfulness meditation, but most studies conduct the experiments for a period of more than six weeks. [Zeidan2012]

FA and OM can alter pain in different ways... OM is more effective in reducing pain after extensive meditation training compared to FA. [Varilly2012]

⁷FiXme Note:need a bit more elaboration....

2 | Methods

3 | Data analysis

4 | Results

5 | Appendices