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Published in:
Approaches. Music therapy and special education

Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Sanfi, I., & Christensen, E. (2017). Perspectives on Music Imagery and complex chronic pain. Approaches. Music therapy and special education, 9(2), 233-245.

SPECIAL ISSUE
Guided Imagery and Music: Contemporary European perspectives and developments

Article

Perspectives on Music Imagery and complex chronic pain

Ilan Sanfi & Erik Christensen

ABSTRACT

The aim of the article is to examine the concept of chronic pain as a complex phenomenon and to highlight the potential role of music therapy – in particular, music imagery – in the treatment of chronic pain. Theories of pain, along with research on pain pathways and pain control in the nervous system, support the evidence from clinical practice that music interventions can alleviate the sensation of pain whilst also offering a pleasant aesthetic experience. Music therapy provides opportunities for processing psychological and existential issues and enables patients to better cope with chronic pain. Related research in neuroscience and music medicine provides supplementary evidence that music can have a considerable impact on the physiological and psychological aspects of pain. This article summarises selected theoretical, clinical, and research–based knowledge relevant for music therapy clinicians and other health professionals aiming to alleviate chronic pain.

KEYWORDS

music therapy, music imagery, complex chronic pain, theory, research, clinical implications

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Publication history: Submitted 10 February 2017; First published 22 December 2017.

INTRODUCTION

Pain is a complex, multifaceted phenomenon. Moreover, the experience and perception of pain is individual and culturally influenced. Estimates suggest that 20% of the world's adult population suffer from chronic pain (Goldberg & McGee 2011).

Pain involves sensation, emotion, and cognition. Pain is a sensation in a part, or several parts, of the body, accompanied by unpleasant emotions and implying awareness, memory and evaluation of the experienced pain. Acute pain is a signal of actual or impending tissue damage, e.g. due to fracture, burn, sting, infection or inflammation. It is most often relieved after the healing of the damaged or disturbed tissue. Acute pain serves as a warning sign to the individual to avoid further injury and to promote the healing process (Cousins & Power 2003). However, pain is not necessarily tied to a stimulus. Pain is always subjective, and many people report pain that is not related to tissue damage or any obvious physiological cause (IASP 2012). Biological, lived-experience, and sociocultural factors are important in the perception and understanding of pain. Each culture has its own language for expressing and describing pain, and traditions and cultural resources have an influence on reporting pain and coping with pain (Callister 2003; Pillay, van Zyl & Blackbeard 2014).

Chronic pain continues past normal healing time and lacks the warning function of acute pain (Melzack 2003). It constitutes a major global and societal health issue, which is furthermore not sufficiently addressed and treated in the health care systems of most countries (Breivik, Collett, Ventafridda et al. 2006). For the individual patient, chronic pain inflicts a broad range of substantial physical, cognitive, psychological, social, economic and existential issues. Many patients suffering from chronic pain do not obtain sufficient relief from treatment with drugs (Cherny 2007; Finnerup et al. 2015). This calls for the application of complementary non–pharmacological treatments, including music therapy.

In this paper, we begin by describing various aspects of pain, followed by an examination of the quantitative research literature on music interventions and pain. After describing relevant pain theories, we address the clinical application of music therapy in pain treatment. Finally, we outline the therapeutic potential of music imagery in relation to complex chronic pain. We use the term music imagery as an umbrella term covering a broad spectrum of practices involving active music-listening and imagery performed by a trained music therapist (Grocke & Moe 2015). The article is not a systematic literature review but summarises selected theoretical, clinical, and research–based knowledge relevant to the clinical application of music imagery.

TYPES OF PAIN

Pain can be characterised as nociceptive, neuropathic, or idiopathic. *Nociceptive* pain arises from actual or threatened damage to tissue due to the activation of free nerve endings called nociceptors. It may be *somatic,* arising from skin, joints, bones, muscles and other soft tissue, or *visceral,* arising from internal organs. Nociceptive pain occurs within a normally functioning somatosensory nervous system. It serves a purpose as a signal to change behaviour, and has value for health and survival (Cervero & Laird 2004; IASP 2012; Loeser & Treede 2008). *Neuropathic* pain, however, has no beneficial biologic function. It implies a pathological condition of the somatosensory system that can be caused by a range of different diseases and lesions leading to a variety of signs and symptoms (Haanpäa & Treede 2010; Jensen, Baron, Haanpää et al. 2011). Neuropathic pain can be a disabling condition following cancer, diabetes, treatment with chemotherapy, and injury to nerves due to stroke, trauma or surgery (Finnerup & Attal 2016; IASP 2012). *Idiopathic pain,* which is also called *primary pain,* encompasses a number of conditions characterised by a complaint of pain without any precise known origin. Idiopathic pain includes fibromyalgia, irritable bowel syndrome, chronic widespread pain, and back pain that has no well–defined cause (Treede, Rief, Barke et al. 2015). Such conditions are associated with pain amplification, psychological distress and significant functional disability in daily life and social activities (Diatchenko, Nackley, Slade et al. 2006).

CHRONIC PAIN

Chronic pain is recognised as persistent or recurrent pain lasting longer than three months. Chronic pain is a severe health care problem, and a source of significant disability across the globe. The World Health Organization estimates that one in ten adults are newly diagnosed with chronic pain each year (Goldberg & McGee 2011), and comprehensive surveys in European countries have documented that chronic pain of moderate or severe intensity occurs in approximately 20% of the adult population. Chronic pain is a problem not only in terms of human suffering, but also in terms of economic implications for society. Moreover, patients with long-lasting pain often experience negative attitudes from family members, acquaintances and colleagues which seriously affect the quality of their daily activities and their social and working lives. A Pan–European average of 40% does not feel satisfied with the effect of their medical treatment (Breivik, Collett, Ventafridda et al. 2006; Sjøgren, Ekholm, Peukmann et al. 2009).

In preparation for an updated international classification of diseases (ICD-11, expected in 2018), a taskforce created by the International Association for the Study of Pain (IASP) published a classification of chronic pain (Treede, Rief, Barke et al. 2015). The authors propose seven types of chronic pain: primary pain, cancer pain, postsurgical and posttraumatic pain, neuropathic pain, headache and orofacial pain, visceral pain, and musculosketal pain. Chronic pain is a complex, multifaceted phenomenon involving sensation, emotion, cognition, memories and expectation.

In chronic widespread pain, the characteristic symptoms include multifocal pain, fatigue, memory difficulties, and mood disorders such as depression and anxiety (Sarzi-Puttini, Atzeni & Mease 2011). Central sensitisation, which implies increased responsiveness of neurons in the central pain pathways, plays a prominent role in chronic pain (Phillips & Clauw 2011; Woolf 2011).

ASCENDING PAIN PATHWAYS AND DESCENDING PAIN CONTROL

This section provides a brief description of the anatomical basis for pain response and pain perception.

In numerous body parts, including skin, joints, muscles, and internal organs, free nerve endings called *nociceptors* respond to pain. Tissue injury, mechanical impact, high or low temperature, and chemicals can trigger nociceptors. In the *ascending pain pathway,* nerve fibres carry information from the nociceptors to the *dorsal horn of the spinal cord*. From there, the signals continue through the *brainstem* to the *thalamus,* which controls the flow of information in the brain. The thalamus forwards pain messages to the *somatosensory cortex,* inducing the sensation of pain, and the *anterior cingulate cortex,* evoking the emotional experience of pain. The awareness of pain involves the *prefrontal cortex,* which is important for cognition, memory, and executive function (Freberg 2015).

Descending pain control in the central nervous system can influence the perception of pain. Several parts of the brain, including the prefrontal cortex, the thalamus, and the amygdala, can transmit information to structures in the brainstem, the *periaqueductal gray (PAG)* and the *raphe nuclei.* The PAG plays an important role in coordinating bodily reactions to emotional and somatosensory signals. It can activate the raphe nuclei, which contain serotonin, a neurotransmitter that can modify incoming pain information in the dorsal horn of the spinal cord*.* Descending information can alleviate pain, but may also amplify pain, depending on the individual's expectations and emotional state (Brodal 2010; Senkowski, Höfle & Engel 2014). Moreover, the brain produces morphine–like substances called *endorphins*, which can prevent the passage of nociceptive signals on all levels of the pain–related pathways (Bear, Connors & Paradiso 2016).

Tissue that has been damaged may become supersensitive. This condition is called *hyperalgesia*, which often occurs in people with chronic pain. Biologically, enhanced sensitivity helps to ensure that the injured body part is kept at rest. In areas near the damaged tissue, enhanced sensitivity may occur as well, known as *secondary hyperalgesia.* Similarly, pain relief is called *analgesia*. In another condition, known as *allodynia,* pain is elicited by stimuli that do not normally provoke pain, such as light touch or moderate temperature changes (Jensen & Finnerup 2014). Allodynia may be related to sensitisation of the skin, e.g. by sunburn or inflammation, or related to increased response of neurons in the central nervous system. Like hyperalgesia, allodynia is a common symptom in chronic pain patients.

After this introductory description of pain we will now look at the evidence of the effects of music on pain present in the quantitative research literature. As mentioned above, this is followed by sections on pain theories, clinical aspects of music therapy in pain treatment, and the therapeutic potential of music imagery in terms of complex chronic pain.

QUANTITATIVE STUDIES ON MUSIC AND PAIN

As studies on chronic pain as well as music imagery are scarce, we broaden the scope of this section to comprise related studies that generate important knowledge on music–induced pain relief. Initially, we summarise meta–analyses of both music medicine and music therapy studies on pain. This is followed by studies on music imagery and chronic pain. And finally, we examine additional studies that illuminate important aspects of music–induced pain modulation.

We define *music medicine* as the use of pre-recorded music administered by the patient, nurses, or other medical staff, and *music therapy* as the systematic use of music experiences aiming at meeting therapeutic objectives, performed by a trained music therapist. Contrary to music medicine, *music therapy* involves a relationship between the client(s), music, and music therapist. In addition, music therapy involves the process of assessment, treatment, and evaluation, plus the possibility of verbal processing and reflection.

Meta-analyses on music medicine and music therapy

Cepeda, Carr, Lau, and Alvarez (2006) conducted the first Cochrane Review and meta–analysis of music and pain. It was updated in 2013 but withdrawn in 2015. At this point, there is no recent Cochrane Review on music interventions and pain. However, Lee (2016) conducted a systematic review and meta–analysis of randomised controlled trials on music interventions and pain, in accordance with the standards of the Cochrane Reviews. The meta–analysis includes 87 music medicine studies and 10 music therapy studies involving a total of 9,184 participants. The 97 studies, published in English, German, Korean, and Japanese between 1995 and 2014, primarily involve adult patients. The analysis comprises various types of pain across 20 different medical specialty areas.

From an overall perspective, the analysis by Lee shows that, statistically, music interventions significantly reduce self–reported pain, emotional distress caused by pain, and the use of anaesthetic, opioid, and non–opioid medication. Likewise, the music interventions decreased heart rate, systolic blood pressure and respiration rate significantly. Lee found no statistically significant differences between music medicine and music therapy, but concluded that the two types of interventions can benefit patients in different ways. His results suggest that music therapy has shown a greater clinical impact on self-reported pain intensity than music medicine; on the other hand, music medicine appears to be more effective in decreasing the use of analgesic medicine.

In relation to chronic/cancer pain, a total of nine studies (751 participants) were included in the meta–analysis by Lee. Of these, five were music therapy studies involving a total of 405 participants. Participants in these music studies were primarily adult oncology patients. The type of interventions in the five music therapy studies varied and two studies used a group therapy format (Kim & Kim 2009; 2010). No study used imagery or the specific combination of relaxation, music and imagery. Clark et al. (2006) provided an introductory psycho–educational session with subsequent music-listening and relaxation sessions which varied individually in frequency and length (two to four weeks). The remaining studies involve only a single session. Fredenburg and Silverman (2014) used preferred music, which was provided by the therapist singing and playing the patient's preferred music. Gutgsell et al. (2013) applied guided relaxation and live harp music played by a music therapist. Kim and Kim (2009) used various types of music experiences (e.g. compositional, receptive). Finally, Kim and Kim (2010) compared two types of music therapy – listening-centred versus singing-centred music therapy.

With regards to the results, Lee found that music therapy is more effective in alleviating chronic pain than music medicine. Music therapy (5 studies, 405 participants) shows a large effect on chronic/cancer pain (mean effect size -1.42, confidence interval -1.99 to -0.84). In comparison, the four music medicine studies on chronic pain (346 participants) show a smaller but still significantly large effect (mean effect size -0,92, confidence interval -1,41 to -0,43). In conclusion, music therapy and music medicine demonstrate a large positive effect on chronic/cancer pain. However, due to the diversity of music therapy interventions, the results cannot be extrapolated directly to the context of chronic pain patients receiving music imagery, or to the possible long-term effects of music imagery.

In conclusion, Lee points out that the results of his meta–analysis should be interpreted with caution due to heterogeneity among studies. That said, he stresses that:

> "Considering all the possible benefits, music interventions may provide an effective complementary approach for the relief of acute, procedural, and cancer/chronic pain in the medical setting" (Lee 2016: 430).

With regards to pain related to surgery, Hole, Hirsch, Ball and Meads (2015) conducted a comprehensive systematic review and meta–analysis of music as an aid for postoperative recovery. The meta-analysis includes 73 randomised controlled trials (RCTs), and indicates that music played in the perioperative setting can reduce postoperative pain, anxiety and the need for analgesic drugs, as well as improve patient satisfaction. The researchers suggest that music-listening can reduce the perceived intensity and unpleasantness of the patient's pain and influence autonomous nervous system activity, reducing pulse and respiration rate and decreasing blood pressure. They recommend that music should be available to all patients undergoing operative procedures.

Studies on music and imagery

McKinney and Honig (2016) conducted a systematic review of studies using the Bonny Method of Guided Imagery and Music (BMGIM) to promote various health outcomes in adults. Of these, only one study involves chronic pain (Jacobi & Eisenberg 2001), and this does not feature in Lee's (2016) meta-analysis. Jacobi and Eisenberg examined the effects of BMGIM in adults with arthritis. Various physiological and psychological outcomes were measured, including walking speed, pain intensity, mood, and symptoms of distress. Results show a significant decrease in self–reported pain, distress, walking speed and joint count.

In her RCT study, Torres (2015a) examined the effect of Group Music Imagery (GrpMI) in adults with fibromyalgia. Endpoints were measured at pre–test, post–test, and follow–up after three months; these calculated pain intensity, anxiety, depression, anger, psychological wellbeing, and impact on functional capacity and health. Thirty–three participants were randomised to a GrpMI group and 26 participants to a control group. The former received 12 weekly GrpMI sessions. A high percentage of comorbidity (i.e. 76.6%) was found in the total sample, especially in terms of depression and osteoarticular disorders. Results show significant enhancement of psychological well–being and improvement in state anxiety. Moreover, 57.6% of the participants receiving GrpMI recovered in at least three variables, compared with 8.7% of the participants in the control group. Finally, significant reduction of anxiety was found in the GrpMI group at the three-month follow–up evaluation.

Further studies on music-induced modulation of pain

In a study by Roy, Peretz and Rainville (2008), healthy participants evaluated the pain induced by thermal stimulations applied to the skin of their arm in three conditions: listening to pleasant music, listening to unpleasant music, and a silent control condition. The study shows that only the pleasant music produced significant reductions in both pain intensity and unpleasantness.

Garza–Villareal, Wilson, Vase et al. (2014) investigated the effect of passive exposure to self–chosen, relaxing, pleasant music in fibromyalgia patients. The results show significant reduction of pain after listening to music compared to pink noise. The researchers suggest that music–induced analgesia may act by means of central neural functions, including the release of dopamine, the regulation of the autonomic nervous system, and the involvement of the anterior cingulate cortex (ACC). The ACC is supposed to constitute an integrative hub between affect, pain, and cognition (Menon & Uddin 2010).

Dobek, Beynon, Bosma et al. (2014) investigated the impact of music-listening on pain perception in healthy adults by means of functional magnetic resonance imaging (fMRI). The participants were exposed to brief heat pulses in two conditions: listening to their favourite music and listening to no music. On average, the participants chose pleasant, happy, calm and relaxing music. The selected pain stimulus is known to produce an effect in the central nervous system (CNS). fMRI scans of the brain, brainstem, and spinal cord provided measurements of neural activity in the CNS, permitting comparisons between the music-listening condition (music + pain) and the no-music condition (pain only). The results indicate that music-listening was associated with lower activity in CNS regions involved in pain perception, including the prefrontal cortex, brainstem areas, and the dorsal horn region of the spinal cord. In addition, the participants' subjective ratings of pain were significantly lower in the music-listening condition. The investigation shows that music-listening can modulate pain responses in the brain, brainstem and spinal cord, consistent with engagement of the descending analgesia system. Subjective pain ratings indicated that music-listening does not eliminate pain but produces a minor alleviation of pain. The researchers suggest that music analgesia is connected to the effects of dopamine and endorphins in the central nervous system. They point out that future studies are needed to examine whether music alleviates pain by influencing attention or emotion, or by a different neural process.

In conclusion, the quantitative research literature comprises many studies on the use of music interventions, especially music medicine, on various types of acute pain. The existing studies have been subject to several meta–analyses documenting the beneficial physiological and psychological effects of music. The research literature is rich in terms of studies regarding music medicine and studies which primarily focus on acute pain. However, there are only a few studies on chronic pain, despite the fact that recent research (Lee 2016) shows that music interventions have almost equal effectiveness in alleviating chronic pain as acute pain. Similarly, there is also a lack of studies evaluating the long–term effects of music interventions. Theories of pain, and research on pain pathways and pain control in the nervous system, support the clinical research and anecdotal evidence indicating that music therapy can alleviate the sensation of pain. Likewise, music therapy can be helpful in processing a variety of emotional, social, and associated existential and spiritual issues caused by complex chronic pain.

It is not yet fully understood to what degree these effects are primarily caused by the emotional or distracting qualities of music, or perhaps by the combination of the two.

PAIN THEORIES

In this section we describe theories relevant to the application of music imagery in chronic pain treatment.

Gate control theory

In a seminal paper, Ronald Melzack and Patrick Wall (1965) introduced their 'Gate Control Theory'. They proposed that interactions between nerve cells in the dorsal horn of the spinal cord can act like a gate that determine the degree of transmission of pain signals to the brain. The theory generated vigorous debate, and the authors had to concede that some observations on pain, such as phantom limb pain, could not fit the theory (Nathan 1976; Wall 1978; Melzack 2001). Nevertheless, the basic idea that processes in the brain and spinal cord can modulate pain signals has had lasting impact on the understanding and treatment of pain (Katz & Rosenbloom 2015).

Neuromatrix theory

Three decades later Melzack developed the 'neuromatrix theory', which proposes that the brain possesses a neural network, the 'body–self neuromatrix', that responds to inputs from the whole body and produces characteristic patterns of nerve impulses (Melzack 1999). According to the theory, inputs to the neuromatrix include: (1) impulses from skin and inner organs, (2) visual and other sensory inputs that influence the cognitive interpretation of the situation, (3) cognitive and emotional inputs from other areas of the brain, (4) intrinsic neural inhibitory modulation, and (5) the activity of the body's stress–regulation systems, including the endocrine, autonomic, immune, and opioid systems (Melzack 1999: 121). According to Melzack's theory, the neuromatrix network encompasses brainstem areas, somatosensory cortex, and loops between the cortex and thalamus, as well as loops between the cortex and limbic areas. Parallel cyclic processes and synthesis of nerve impulses in the network create a stream of output patterns, which produce the constantly changing feelings of the whole body.

> "Pain, then, is produced by the output of a widely distributed neural network in the brain rather than directly by sensory input evoked by injury, inflammation, or other pathology" (Melzack 2005: 85).

Moreover, Melzack proposes that some forms of chronic pain are related to the destructive effects of excessive levels of cortisol released by the body's stress–regulation system. Melzack's theory implies that the network responds to all kinds of salient stimuli from the whole body, not just pain–inducing stimuli. Subsequent research has indicated that the processing of feeling, including pain processing, involves brainstem centres, thalamus, insula, the anterior cingulate cortex, and the somatosensory cortices (Craig 2009; Damasio & Carvalho 2013; Heimer & van Hoesen 2006; Shackman, Salomons, Slagter et al. 2011). Differing from Melzack's concept, some researchers have adopted the term 'pain matrix', which suggests the existence of a pain–specific network (Brooks & Tracey 2005; Kulkarni, Bentley, Elliott et al. 2005; Stern, Jeanmonod & Sarnthein 2006). However, this point of view is unlikely to be tenable. Investigations of nociceptive, non–nociceptive, visual, and auditory stimuli by means of functional brain-imaging (fMRI) have provided evidence that the neuromatrix neural network is not specifically related to the perception of pain (Iannetti & Mouraux 2010; Mouraux, Diukova, Lee et al. 2011; Legrain, Iannetti, Plaghki et al. 2011; Senkowski, Höfle & Engel 2014). As originally proposed by Melzack, the neuromatrix can be characterised as a multimodal *salience detection system* devoted to detecting and reacting to all kinds of salient events that are significant for the body's integrity.

Total pain

Back in the 1960s, Cicely Saunders proposed the concept of 'total pain' (Saunders, Baines & Dunlop 1995). Saunders was the founder of the modern hospice philosophy and one of the pioneers arguing for a holistic understanding of pain. According to Saunders, total pain refers to the suffering encompassing the person's physical, psychological, social and spiritual pain, and the practical struggle to overcome it (Saunders et al. 1995). Consequently, the notion of total pain recognises that pain is a complex phenomenon with many dimensions that interweave and affect each other. Consequently, this notion implies an interdisciplinary approach and a sophisticated understanding of pain in order to address the individual's physical symptoms, psychological, emotional, and social distress, plus possible existential and spiritual questions. Although Saunders developed the concept of total pain within palliative care, it is relevant for complex chronic pain due to the broad range of similar issues, struggles, and suffering that affect individuals with chronic pain.

In summation, the theories mentioned above take into account the complexity and various dimensions and implications of pain. The Gate Theory emphasises the dynamic and modulating role of the central nervous system. The neuromatrix theory highlights the central role of the brain in pain-processing, in the form of a body–self matrix (a multimodal salience-detection system) in which complex cyclic and mutual interactions occur between physical nerve impulses, cognitive and emotional inputs, and the activity of the body's stress–regulation systems. Finally, Saunders' concept of total pain illuminates the perspective of the person experiencing pain, and takes into account the complexity and many dimensions of distress and pain.

CLINICAL APPLICATION OF MUSIC THERAPY IN PAIN TREATMENT

In this (final) section, we initially outline the application of various types of music interventions in pain treatment within the context of healthcare. Next, we describe therapeutic levels of music therapy and the clinical application of music imagery in chronic-pain treatment. Finally, we illuminate the therapeutic potential of music imagery in relation to the neuromatrix theory and the concept of total pain.

Clinical application of music interventions in pain treatment

The literature documents a broad application of music interventions (music medicine and music therapy) in addressing various types and aspects of acute pain in medical, palliative, and dental settings (Allen 2013; Bradt 2013; Dileo & Bradt 2005; Hole et al. 2015; Lee 2016; Torres 2015a). *Music medicine* is the use of pre-recorded music administered by the patient, nurses, or other medical staff. Music medicine does not involve a therapeutic relationship. It is used to facilitate and support medical treatment and assist in rehabilitation. Therapeutic objectives include reduction of pain, anxiety, and medication, and promotion of relaxation and satisfaction with medical treatment (Hole et al. 2015; Vuust & Gebauer 2014). *Music therapy*, on the other hand, is performed by a trained music therapist and involves the relationship between the client, music and therapist. Likewise, another key element in music therapy is the opportunity to engage the patient in various types of music experiences, including song-writing, instrument-playing, and music imagery (Trondalen & Bonde 2012). In addition, music therapy includes the process of assessment, treatment, and evaluation. As a pain treatment, music therapy is used in hospitals (Allen 2013; Dileo & Bradt 1999; Loewy 1997; Mondanaro & Sara 2013; Sanfi 2012), in palliative care (West 2015), and in pain clinics (Godley 1987). The literature documents the application of a range of music therapy methods and techniques in treating chronic pain (Bradt 2013, 2016; Burke 1997; Clark, Isaacks–Downton, Wells et al. 2006; Dileo & Bradt 1999; Kim & Kim 2010; Rider 1987). Methods of music imagery are described further below.

Compared to music medicine, music therapy has distinctive advantages; it can be applied individually and in groups, and provides a broad range of music experiences with varying degrees of active music participation for the patients. Music therapy involves a therapeutic relationship and the possibility of verbal processing and reflection. The music and the therapeutic objectives can be adjusted in the here and now, according to the patient's varying needs and experience. Current research suggests that music therapy is more effective in reducing pain intensity than music medicine, with exception of pain related to medical procedures (Lee 2016).

Therapeutic levels in music therapy pain treatment

Contrary to music medicine, music therapy can be applied on five therapeutic levels in pain treatment (Dileo 2012, 2013, 2016), ranging from simple distraction from the pain to more advanced psychotherapeutic processing:

1. Distraction/Refocusing
2. Supportive
3. Cathartic/Expressive
4. Existential
5. Transformational

The objective of *Distraction/Refocusing* is to avoid or ignore the pain by redirecting the attention to something else. This level includes different types of music-listening structured by the patient and/or music therapist, for example instrument-playing and music and imagery experiences (Lowey 2013; Sanfi 2012; Short 2002; West 2015). The *Supportive* level refers to practices aimed at alleviating specific symptoms of pain or enhancing the personal resources for dealing with pain, such as music and imagery, toning, music–based relaxation, vibro–acoustics, and song–writing (Burke 1997; Loewy 1999, 2013; Short 2002; West 2015). Objectives regarding the *Cathartic/Expressive* level are to express the experience, suffering and emotional aspects of having pain. Here, the individual establishes contact with the pain or emotions related to having pain. Music interventions include improvisation (voice and/or instruments), song-writing, and song improvisation (Bradt 2016). The *Existential* level aims at supporting the person in finding meaning in the pain experience or new ways of conceptualising the pain. This level comprises music interventions such as song–writing, song discussion, referential or non–referential improvisation, music imagery, and the Bonny Method of Guided Imagery and Music (Bradt 2016; Jackson 2013; Sanfi 2017; Torres 2015). Finally, in the *Transformational* level, the individual enters into the pain or dialogues with the pain, intending to form a relationship with the pain. Applied music therapy methods on this level include entrainment as well as Guided Imagery and Music, including The Bonny Method of Guided Imagery and Music (Bradt 2010, 2013; Dileo & Bradt 1999; Rider 1987; Sanfi 2017; Torres 2015a, 2015b).

Music imagery in the treatment of chronic pain

This paragraph concerns the application of receptive music therapy in the form of music imagery methods (individual and group therapy) provided by a trained music therapist in the treatment of complex chronic pain. In short, methods described in the literature cover music imagery for relaxation and pain relief, Guided Imagery and Music (GIM), and the Bonny Method of Guided Imagery and Music (BMGIM), including individual and group formats (Grocke & Moe 2015). The music imagery methods imply multiple beneficial therapeutic qualities. Music evokes emotions, memories, and associations. Likewise, music has the potential to stimulate and animate inner imagery in almost all sensory modalities simultaneously (e.g. visual, kinaesthetic, auditory). In the music-imagery process, all kinds of images and metaphors may emerge, including inner images reflecting emotional issues as well as inner resources. When working with chronic pain in music-imagery sessions, there are essentially two approaches: focusing directly on the pain or directing attention away from the pain (for example, focusing on images related to personal resources). However, due to the attributes of music and the imagery process, ambivalent feelings as well as images with positive and negative connotations can be contained at the same time. Moreover, this often facilitates a process of integration.

Jacobi and Eisenberg (2001) used BMGIM in addressing various physiological and psychological measures in adults with arthritis, including pain intensity, mood, symptoms of distress, and walking speed. Short (2002) has described the use of BMGIM with a male patient with arthritis suffering from chronic pain and depression. As shown in the study, this music experience can provide a space free from the pain, a positive sense and experience of the body, and improved mood.

In her randomised controlled trial, Torres (2015a; 2015b) used 12 weekly sessions of Group Music Imagery (GrpMI) in adults with fibromyalgia, aiming at reducing pain, anxiety, depression, and anger, and enhancing psychological well–being as well as functional capacity and health.

Sanfi (2017) describes the systematic use of music-imagery methods with a female client suffering from fibromyalgia. The course of music therapy lasted six months and encompassed 22 individual sessions using a music-imagery continuum model. The continuum model comprises various music imagery methods ranging from simple relaxation and music-listening to psychotherapeutic work using the BMGIM, covering all five therapeutic levels described by Dileo (2012, 2013, 2016). The applied methods served specific therapeutic objectives and required different degrees of active participation from the client. In the sessions, specially composed music-imagery journeys, GIM, and BMGIM were used. This was supplemented by almost daily application of recorded relaxation exercises and music-listening for relaxation and pain relief purposes, plus recorded music-imagery journeys. In addition, Healing Music and Imagery (Bush 1995) was also applied by the client at home for supplementary processing of emotional issues. In a closing evaluation interview, the client stated that this combination of methods was beneficial in terms of provision of empowerment, self–mastery, psycho–education, processing of emotional and existential issues due to pain, and continuous training and maintenance of the relaxing and pain–relieving effects of music imagery experienced in the sessions.

Likewise, related clinical use of GIM (modified BMGIM) in adults with work–related stress (Beck 2012, 2015; Beck, Hansen & Gold 2015) and music imagery in adult refugees with post–traumatic stress disorders (Messell 2016) show that long–term pain can be transformed and mitigated. Beck et al. found significant reduction with a large effect size of physical symptoms, including chronic pain. Similarly, the applied music-imagery intervention had a positive impact on emotional and social issues. The beneficial effects of BMGIM on emotional issues and physiological parameters are well–described in the literature. As documented in their meta–analysis, McKinney and Honig (2016) found positive effects of BMGIM in various health outcomes in adults, including physiological as well as psychological outcomes.

Potential of music imagery in relation to the neuromatrix theory and total pain

As described above, Melzack (1999) proposes that five types of inputs from the body may influence the neuromatrix. Music imagery can potentially influence four of these inputs:

1. *Sensory inputs that influence cognitive interpretation of the situation:* Music imagery can provide relaxation and promote pleasant bodily sensations. Music imagery can evoke positive images in all sensory modalities (e.g. pleasant bodily sensations), which can counteract the experience of pain and associated suffering. In addition, music imagery can change the perception of time and place, and provide insights which result in new ways of relating to and conceptualising pain.
2. *Cognitive and emotional inputs from other areas of the brain (including the limbic system):* Music imagery can evoke and maintain positive emotions, and contain and express the suffering associated with the pain.
3. *Intrinsic neural inhibitory modulation:* Music can stimulate and support the pain-modulating mechanisms of the central nervous system and thereby inhibit ascending pain signals (Dobek et al. 2014).
4. *The activity of the body's stress–regulation systems:* Music can entrain the immune system, the autonomous nervous system (regulate arousal), and the hormone system (e.g. reduce cortisol) (Christensen 2014, 2017; Schneck & Berger 2006).

It is important for understanding the processing and experience of chronic pain that the neuromatrix theory underlines the existence of a multimodal *salience-detection system* in the brain. Likewise, the neuromatrix theory stresses the importance of the interaction between this network and the body's stress–regulating systems. Due to the multimodal nature of the musical experience, music imagery can exert beneficial influence on the salience-detection system. Furthermore, the application of music imagery resonates with the concept of total pain, as music imagery affords a holistic approach to therapy capable of addressing physical, psychological, social, existential and spiritual issues.

In summation, the application of music interventions for acute pain is evident in various health care settings. Music therapy can be used on five therapeutic levels of pain treatment, from simple distraction from the pain to advanced psychotherapeutic processing. In contrast to music medicine, music therapy involves a therapeutic relationship and offers a broad range of methods and techniques that are applicable and beneficial in the treatment of complex chronic pain. Music imagery can potentially affect the salience-detection system in the brain and the stress–regulation system, and consequently promote relaxation, pain relief, empowerment, self-mastery, and the processing of emotional and spiritual issues. According to the quantitative research literature, music therapy is more effective than music medicine in the treatment of chronic pain.

CONCLUSION

Chronic pain is a global health problem that imposes a broad range of physical, psychological, social, existential and economic implications on the individuals suffering from pain, as well as on their families and social relationships. Studies on the physiology of pain and studies on music interventions indicate that various types of music interventions have beneficial effects on patients suffering from chronic pain. Music therapy affords the processing of psychological and existential issues and enables patients to better cope with chronic pain. Related research in neuroscience and music medicine provides supplementary evidence that music interventions exert a considerable impact on the physiological and psychological aspects of pain. More studies are needed to confirm the short–term and long–term effects of music imagery interventions on complex chronic pain.

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Suggested citation:

Sanfi, I., & Christensen , E. (2017). Perspectives on Music Imagery and complex chronic pain. *Approaches: An Interdisciplinary Journal of Music Therapy, Special Issue 9*(2), 233-245.