CONSIDERATION OF THE LINK BETWEEN MUSICAL FREQUENCY AND MUSICAL THERAPY

A Morgan MIOA, British Acupuncture Federation, Acupuncture Association

1 INTRODUCTION

This paper describes acoustic and musical concepts and practices used in medical therapies for a range of physical and emotional maladies. According to historical records, music has been used as a tool for healing since ancient times, with references from across the world indicating the use of instruments and the voice, including Ancient Egypt, China, the Americas, Africa and Australia. The uses of music vary by custom. Music may be used to encourage the patient into a relaxed or even hypnogogic state, from which complementary healing practices can then be used. Alternatively, the sounds themselves can be used to catalyse a healing effect on the body and mind. The purpose of this paper is to expand on this latter practice, where it is the very vibrational nature of the sound itself that triggers either a physical or chemical change in the body, thus leading to an improvement in physical and emotional health.

For the purpose of this paper, references to practices such as sound healing, vibrational healing, sound therapy, acoustic therapy and other similar terminology, will be referred to as 'musical therapy'. The only differentiation between practices and concepts will be between those that are primarily harmonic (those that utilise different musical notes/frequencies and harmonies) or vibrational (being more percussive and related to beat or pulse frequency). These will be referred to as 'harmonic' and 'vibrational' respectively.

2 FUNDAMENTAL FREQUENCIES OF THE HUMAN BODY

Before we can consider the practical methods that are used to stimulate improvements in health in the body, it is first important to introduce and reinforce the concepts of *how and why* musical therapy works. For this reason we shall look at the principles and research into the vibrational frequencies of the human body, both physically and emotionally, and how these may be influenced by sound.

2.1 Manipulation of the physical body

The concept that everything on earth has a fundamental frequency and corresponding harmonics is not one that needs to be delved into owing to its basic and foundational concept in relation to physics and acoustics. It is no stretch, therefore, that every part of the human body; every organ, bone, muscle or area of soft tissue and even the cavities of the body have corresponding fundamental and harmonic frequencies. Von Gierke and Brammer[1] and Chang[2] explored this in their work on the effect of the transmission of building vibrations into the human body. Their work considered fundamental frequencies of specific organs and areas of the human skeleton between the range of 4 to 200 Hz. Whilst they, and many other researchers have hunted for a 'standard' whole human frequency (and those of the organs), it is no surprise that results are found to fall within a range of frequencies. The afore-mentioned papers noted that there were inconsistencies between results for different individuals, and even inconsistencies between the same organ of the same person at different times. This concept too is not complicated to consider, variations in hydration, blood flow, structure (damage or disease) will all alter the fundamental frequency of a body part by affecting how it is able to resonate: e.g. stiffness, structural composition. Even if one was able to induce two harmonic or vibrational stimulations and test in equally rapid succession, the chance that the frequency of the body part (assuming it is part of a living test subject) remains unchanged is highly unlikely. Consider a physical stimulation of a muscle, such as lifting a weight.

Even a single repetition of lifting that weight will increase local blood flow and alter tissue tension, therefore altering the fundamental nature of the muscle, and the fundamental frequency. In fact, as a side note, an experiment by Ranganathan et.al,[3] found that simply the thought of lifting weights, when sustained over a 12 week testing period, resulted in between 13.5 and 35% increase in muscle mass. This suggests that even the non-physical (mental) stimulation of the human body can affect the physical nature of human tissue.

A further consideration is that of healing or deterioration of the tissue as a result of the acoustic exposure. This too would alter the physical structure of the part being tested, and therefore the fundamental frequency, with almost immediate effect.

What these considerations suggest is not that musical therapy is a hit-and-miss adventure, more that the ability to pin down a single standard frequency for a complex body part, operating as part of a living system, is fundamentally difficult at this stage in time.

Is has been demonstrated however, that it is possible to determine the fundamental frequency of an individual cell. Whether it be those of the human body, or even those of pathogens and also altered cells such as cancer. In these instances, the work of Rife[4] and Zimmerman et al.[5] identified the fundamental frequencies of a range of healthy and diseased cells, and then used these to develop healing therapies using low and also high frequency (respectively) electromagnetic fields to target and destroy diseased cells. Their work is part of an ongoing field of research of acoustic-based healing therapies, to which this paper hopes to expand upon with the use of more mundane and accessible methods. It may be that future research seeks to identify standardised fundamental frequencies at a cellular level, rather than at a macro level. This may then enable acoustic practices to be able to affect organs, tissues and bones at the cellular level, to re-harmonise the cells with their fundamental healthy state of activity and vibration.

2.2 Manipulation of the emotional body

A second, but no less important, goal of musical therapy is to affect the emotional state of the patient. This practice is not only the goal during the therapy session but also with the intent of having a lasting positive healing effect on the patient.

The simplest way to achieve this is through relaxation of body tissues and deepening of breathing. This will automatically result in reduction of heart rate and lead to a reduction in the feelings of tension, stress and anxiety. However, the potential effects of musical stimulation go well beyond simple relaxation, although this effect is no less valuable to a person.

The concept is that sound and vibration can be used to either stimulate or ‘calm’ an organ, also known as tonification or reduction. By affecting the activity of an organ, musical therapy can therefore affect the hormonal production of that organ, and have a corresponding direct biochemical effect on the emotional state of a person. In this way, therapies such as musical therapy can affect both the physical and functional health of an organ.

It is important here to make the link between organ function, hormones and emotions. It is true that the release of hormones from an organ in response to a physical or chemical stimulus is generally an objective reaction. When a kidney or liver is stimulated then it will release chemicals in response to the stimulus. This is its function and nature.

However emotional reactions to such stimuli are generally agreed to be subjective. The person’s relationship to the stimulus or trigger, and indeed to the emotion itself, can all influence the emotional outcome of an event. Whilst this may be a large scale event such as a shock or trauma, it may simply be an item of food or a piece of music. An event that has a triggering effect on organ function may in turn also result in an emotional response.

Most strangely though is the concept that an emotional response to a stimulus, (itself based on the interpretation of hormones and chemicals released from organs and glands in response to an initial stimulus), can then result in further feedback to the body and itself affect organ function. In this way we can see the link that the physical body and organs can affect the mind (emotions), and emotions can in turn affect the physical body and organs.

Researchers must therefore take into account both factors when experimenting on the effect of any stimulus on the mind or body, and consider that each can affect the other.

For those concerned with the psychological risks of such experiments, it is important to consider that many of our negative emotions are largely contextual. For example, adrenalin production (which originates from the adrenal glands and the kidneys) is considered to be responsible for our feelings of excitement and fear. So it could be argued that an investigation conducted to stimulate the kidneys and adrenal glands could result in participants experiencing and even reliving fear and trauma, which is a risky path to take, particularly in extreme cases of those with Post Traumatic Stress Disorder (PTSD). This caution is justly considered and is a daily struggle for those with such conditions. For example, a panic attack is commonly associated with a tightening of the chest, a shortening of breath and an increase in heart rate. But sadly, so is exercise. This means that those prone to panic attacks can find that even mild exercise and exertion be difficult due to it causing them to feel like they are having a panic attack. However, remember that context is important in these emotional cases. In the example of the exercise induced panic attack, in this instance the individual has often lost context with their surroundings and has been taken back to the root event cause of their trauma. With training they can practice remaining present in the reality of the moment and thereby maintain context of their situation. In these instances these individuals can learn to separate memory from reality and be able to exercise in relative comfort. In the previous example of adrenalin production, the key differentiator to triggering or avoiding a feeling of fear is commonly agreed to be in a safe, happy or comfortable situation, as opposed to a stressful or unpleasant one. As well as providing a safe space in the event of an emotional relapse, (which can happen and is generally beneficial, provided the practitioner is trained for such instances), this difference in surroundings also typically results in increase of the levels of so-called ‘feel good’ hormones such as serotonin and dopamine. High levels of these hormones typically result in a ‘feel-good’ experience simply by the nature of their effect on the human brain. Low levels of ‘feel-good’ hormones, as mentioned, have the opposite effect and are more likely to lead to a fear-based experience. Therefore, experimentally, the emotional outcome of kidney and adrenal stimulation can be managed contextually by the situational atmosphere of the treatment space as well as by managing the initial emotional state of the participant before and during acoustic stimulation.

As an acoustic therapist myself this is one of the key concepts that I incorporate into my introduction scripts to musical therapy sessions and soundbaths. As an aside, the same scripts can be applied to physical massage and acupuncture therapies, which both regularly also result in emotional release in addition to physical relaxation. Participants in musical therapy events may well feel physical or emotional discomfort during an event due to trauma stimulation and release, but they are reminded beforehand that they are in a safe space (to reinforce and remind them of contextual awareness). As part of the opening introduction everyone is encouraged in such instances to ‘sit with the feeling’ and remember where they are; in a calm and ‘safe’ space, with pillows and blankets for warmth and comfort. The result of this typically allows individuals to observe their emotional responses without being taken back to, or becoming ‘lost’ in the trauma event. As one might view a dramatic painting or watch a film. If they can achieve this then very often they are able to release the factual and rational root of the emotional trauma through observation and detached analysis (away from the emotional rollercoaster). In rare cases these acoustic sessions have resulted in triggering a physical pain, which, if allowed to be relaxed and released, have resulted in reduction of physical aches and pains in real time. One regular attendee to soundbath events even reported a reduction in activity of cancer cells correlating with them starting sound therapy. This reference was passed during personal conversation with an attendee under ongoing observation for their condition.

In summary, music can affect the mind and the body, and the body and mind can affect each other, both positively and negatively. Each of these factors can and must be considered and managed by a musical therapy practitioner. Or, in the case of experimental conditions, must be taken into account when trying to determine the effect and efficiency of such therapies and practices.

3 METHODS FOR MUSICAL THERAPY

The methods of musical therapy range from the simplest forms of acoustic stimulation or physical vibration, to those more complex in application. And yet each of them still maintains the same principles for affecting physical and emotional health. The method of delivery may be intentionally acoustic in nature, such as sounds and rhythms, or they may be seemingly less acoustic based, through physical vibration in the form of a vibrational massage tool, a hands-on massage or even a simple conversation. As discussed, the acoustic delivery for musical therapy can be either harmonic or vibrational, or methods and instruments that are a mixture of both.

For example, simple methods of harmonic delivery include the use of pure tones from crystal singing bowls. The nature of construction of crystal bowls enables them to produce precise pure tones, which can be played individually or in simple chord structures. Tuning forks also have a pure tone and are used similarly. The notes or chords chosen can be tailored to the needs of the client and the action to be produced (to be discussed later). The skill of the practitioner here is to be able to match the right notes with the specific needs of the clients. This said, there are 'standard' chord structures that will generally produce known effects. Discordant chords such as 2nds or 7ths are considered best for release or stimulation of the client, owing to the jarring nature of their tones. 3rds, 4ths and 5ths however are generally considered to result in relaxation of the client. Each chord structure is also considered to have specific effects but the nature of these vary by school and practice so have not been included here.

When played, crystal bowls are typically 'rubbed' or 'sung', with the use of a 'wand' or 'puja' to stimulate and vibrate the rim of the bowl (as you would sing a wine glass with a wet finger). Due to their delicate nature crystal bowls are more often sung than tapped, a method whereby the edge of the bowl is gently struck with the wand, causing the tone to ring out, although tapping is still a valid method of playing.

For a more complex acoustic climate, instruments such as Tibetan bowls or gongs can be used. These instruments are typically made of a brass or copper alloy, making them more robust for tapping. Whilst still tuned to a specific fundamental frequency these instruments produce a greater range of overtones, resulting in 'richer' harmonies. Owing to this richness in tone, Tibetan bowls and gongs are generally more 'gentle' on the client, as opposed to the more 'piercing' tone of a crystal bowl. Gongs can gain an additional power and effect through being able to be struck harder and be played at greater volume. Over time the tones of gongs (particularly larger versions) become more complex due to the relaxation of the metal and produce an even greater variety of vibrational modes and resultant tones. Due to their more robust nature, bowls and gongs can be both sung (using a wand (or puja) for the bowls and a tool known as a flumie for gongs), or they may be tapped rhythmically. For this reason Tibetan bowls and gongs represent instruments that cross over between purely harmonic stimulation, which is arguably their primary mechanism, and those that can be played rhythmically.

Research into the use of musical therapy may not be as prevalent as for other forms of therapy but papers such by Goldsby et al.[6] reported "a significant difference…in all endpoints examined", which included mood, tension, anxiety, physical pain and spiritual well-being, as a result of musical therapy using bowls, gongs, bells and chimes. Which adds weight to the concept of music therapy having legitimate value as a medical therapy.

For purely rhythmic sounds therapists will tend towards drums, which come in a wide variety of sizes and tones. Here again, rhythmic patterns have been found that elicit particular effects on clients. General practice consensus is that faster drumming speeds, (three to five beats per second, or 3 to 5Hz) were most effective for deep relaxation and meditation, according to the teachings of The Sound Healing Academy[7]. Ascenso et al.[8] noted improvement in themes including mood, engagement and redefinition of self for health service users and their carers, as a result of a series of drumming events. Perkins et al.[9] noted similar effects with relation to mental health recovery.

Of course the methods outlined here are those typically used by music therapy practitioners for individual or group therapy sessions. The choice of instruments that may be used to induce healing effects are limitless, owing to the concepts being universal across any acoustic or rhythmic practice. Music therapy practitioners have been known to use instruments such as handpans, didgeridoos, chimes, rattles, shakers, stringed instruments and woodwind, depending on their skills and preferences. It is commonly considered that the music of Mozart or Bach is ideal for inducing relaxed and beneficial physical and mental states.

Purely musical methods such as these are simple in nature when used for musical therapy, in-as-much-as they employ musical means to produce musical stimulation. Methods that are more complex in their application (but which follow the same musical principles) include massage, mechanical or electrical stimulation and the use of the voice. Whilst not technically musical in practice, these have been included here to demonstrate that the potential practices, principles and applications of musical therapy are far more complex than just the use of musical instruments.

Acoustics in massage is a very personal application but I invite you to consider the concept. As a physical therapist who integrates acoustic concepts, I have found that speed (frequency) of the massage (either maintaining a regular rhythm during a massage, or altering the speeds), has differing effects on the client and their ability to relax. For example, maintaining a constant rhythm can lull the client into a hypnogogic state that can be very relaxing. When this occurs during a treatment, the massage practitioner may be altering techniques and angles and positions during the massage, but, to the client the rhythm remains the same, which rocks them to sleep. I have found that even with strong techniques a client can remain asleep throughout a session. Although they will occasionally wake up to report a painful area, only to fall back to sleep. As well as improving the client's ability to relax, this technique often results in clients completely losing track of time and feeling very relaxed after the session, as if they have had a full night of sleep, despite the fact that the massage was only 40 minutes. This concept matches with that of drumming or any musical technique that relies on repetition to induce the hypnogogic relaxation effect. Those who practice relaxation techniques, meditation or soundbaths often report a difference in their perceptions of time.

A deeper action of this concept relates to finding the best speed (which could be considered the fundamental frequency or a harmonic) of the area being worked on. Often, if a muscle is failing to relax with fast and shallow movements, then a shift to a longer and slower action will result in more rapid release and relaxation. The reverse can also be true, changing from slow to fast, depending on the area and the client. This concept and practice also correlates to the principles of electro stimulation (and the musical stimulation already discussed), whereby if the fundamental or harmonic frequency of the treatment area can be identified during the treatment, then the therapeutic benefits can be far greater than using standardised frequencies. Amplitude also comes into play here. Just as a strong massage may be preferred to a weaker technique, so a client may find that louder music has a more beneficial effect than quieter, or vice versa.

Electrical stimulation is, in practice, no different to the use of audible frequencies or vibrational patterns. The difference is in the nature of the application to the client. Methods such as electrical pads (as used in transcutaneous electrical nerve stimulation (TENS)) or electro-acupuncture use electrical pulses to stimulate muscles and body tissues for therapeutic means. These methods are more direct in nature, being administered through equipment that is either adhered too or inserted into the area of the body to be treated. They are therefore typically more directly effective at

releasing physical muscle tension and knots and improving blood flow. This does not mean that they are ineffective at treating emotional issues. Remember that the mind and body affect each other, so releasing the body can also result in a relaxation and release of the mind and emotions.

With regard to these forms of non-musical therapy, the consideration here isn't to replace physical or electrical stimulation for acoustic, but instead to enhance non-musical therapies with acoustic concepts. As mentioned with regard to stimulation of fundamental frequencies or harmonies of the body through acoustic means, if a therapist is able to physically or electrically stimulate the body in harmony with natural 'healthy' frequencies then the therapeutic effect of the technique may be greatly improved. This concept was investigated and used successfully by Rife[4] and Zimmerman et. al.[5] as previously discussed.

The use of the voice is more complex than any of the methods described so far, simply because, as a tool, the voice has the capacity to be used harmonically, rhythmically and much more. The use of the voice can incorporate concepts of tone, inflection, speed, pitch, intent and must even consider the choice of the words or sounds produced.

The widely publicised IKEA plant experiment[10], as well as similar work by Choube and Sharma[11], and Dr Emoto's rice experiment[12] all aimed to investigate whether words, pitch and the factor of 'intent' (the feeling behind the words) can influence the growth and development of plants. We must also consider the concept that such practices have a similar effect on humans. In simple terms, the words spoken to us have been tested by researchers such as Snatcher and Trentacosta[13] to have a psychological effect on not only our emotional development but also our actions and emotional effectiveness as an adult. It seems that these verbal effects are in fact most likely to be immediate in their influence on our bodies, just as they might be through musical or physical stimulation. Conversely (and more positively) the use of the voice for singing and toning has been shown, for example by Cooper[14], to have beneficial effects on patient's physical and mental health. In the practice of hypnotherapy, pitch and cadence of the words spoken by the therapist are crucial to achieving a deep hypnogogic state, as well as inducing the desired effect without disturbing the emotional or mental state of the client. This concept extends beyond the realms of clinical practice of hypnotherapy and includes physical and psychological therapies as well. A physical therapist who invites clients to focus on how much pain they are in and how tight a muscle feels are less likely to achieve a positive result when compared to a practitioner who infers how relaxed a person feels and how loose and comfortable the muscles are. This may appear to be nothing more than semantics but as an experienced therapist and teacher I can attest that phraseology, wording, tone and even the physical and mental state of the practitioner can all have an influence on the physical and mental state of the client and the effectiveness of the therapy. Extend this concept into the practice of 'self-talk' (the words we say to ourselves and about ourselves and others on a daily basis) and you can see the benefit of increasingly popular concepts such as affirmations, self-love and introspection. It is all well and good smiling, putting on a brave face and telling people that we are fine and happy with our lives, or that we are not sad or angry or afraid, when in our minds we are repeating the opposite, and far worse. The power of thoughts may be dismissed as non-physical but whether the words are spoken or merely thought, the concept does not change. This was demonstrated in the 1966 by Cleve Backster[15], when he reportedly conducted experiments by attaching plants to lie detectors. Backster reported fluctuations on the lie detector not only when he threatened to burn the plant, but also when he simply thought about burning the plant, suggesting the plants, and most likely other animals, including humans, are able to pick up on the mental thoughts and intent of those around them and may have a physical or possibly even hormonal (and therefore emotional) response.

4 DISCUSSION

At a basic level music can help relax the body, aid sleep and result in release of knots and pain. At a deeper level music has been shown to have the ability to alter the fundamental activity of our

internal organs, help in the release of trauma and promote a deepening in our physical and mental well-being. Historical tests by researchers have suggested that sound can have a direct effect on our physical biology at a cellular and even molecular level, helping to cure disease and cancer. Whilst this work has been met with much skepticism, modern testing into these concepts is gaining traction again. Unfortunately, research often lacks the diligent experimental control criteria to produce results that are considered 'robust' and can lead to dismissal or undermining of such findings and the concepts they have the potential to enhance. It is the hope of the author that work such as this finds a larger place in acoustic academic fields of study, which can only result in a deepening of music and acoustic concepts as a therapeutic mechanism.

Whilst much of the research seems to lack the depth of understanding as to how music therapy affects the human body, at least in a way that can be standardised, there is no lack of evidence that music *does* affect humans in mind, body and spirit. The aim for this paper is not only to introduce those who may not be familiar with the concepts of music as a tool for healing, but also to deepen the knowledge of those who are and widen the gaze for these sorts of acoustic concepts and practices into the non-musical realms. It is standard understanding with historical World Health Organisation and International Organisation for Standardisation (ISO) guidance that regular sounds are less disturbing than non-regular, and that very low and high frequencies can be cause for nuisance. Typically though these references only consider the human reaction side: the likelihood for causing nuisance or triggering complaints. As we can see, it is vitally important to also consider the direct human health effects of such sounds in relation to physical, hormonal and emotional effects that can result, and the potential for ill-health that may occur from long-term exposure. Whilst it is not always feasible (or financially appealing) to delve into the deeper acoustic effects on health, especially in the opinion of a client, just as it can be complex when considering the environmental aspects to a new development, it is crucially important that these kinds of effects at least be made aware. As consultants for new developments, our goal is to regularly consider the potential health impacts on residents, construction workers and future operators. As musicians our focus is often on the quality or tonality of the sounds, or the methods of sound production and propagation. Here we have an opportunity from both perspectives to consider the effects of how and where sound is received and the potential physiological, emotional, metabolic and even molecular effects of sound and vibration.

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