

SELECTED SCIENTIFIC STUDIES

By Stephen Kaplan

The scientific study of sound and music in relation to health is a growing field. In the attached article, I have touched on some of the major findings and themes in this research field. Presented here are some additional studies that are representative of a growing body of evidence of the power of sound to influence human health.

Music and Rehabilitation of Language Skills

Dr. Wendy Magee, Head of Music Therapy at the Royal Hospital of Neuro-disability in London, presents clinical findings from her music therapy work with patients with speech and language disorders due to brain damage. Three major music therapy techniques were studied: first, vocal instruction, including breathing, vocal-syllable exercise and song-singing; second, pacing, including metered rhythmic cueing (each syllable cued by steady beat) and passionate rhythmic cueing (speech prosody matched by differentiated duration of rhythmic beats); and third, melodic intonation therapy, modified by enhanced musical components (e.g., more melodic structure) or focus on target words.

Dr. Magee reports that latest studies show the pacing technique is effective in improving speech intelligibility. It is suggested that the effect is most prominent for patients with severe dysarthria, while it is rather contraindicated for patients with mild dysarthria. There are also empirical findings that support both metered and impassioned rhythmic cues are equally effective in increasing speech intelligibility. Singing technique and pacing technique, although effective differently according to the types of speech and language disorder, were both found useful in improving speech intelligibility.

Stroke Patients and Musically Assisted Speech

Dr. David Ramsey, Assistant Director of the Institute for Music and Nerologic Function in New York City, has extensive clinical experience with “musically assisted speech” with stroke patients, Dr. Ramsey emphasizes the importance of the balance between speech rehabilitative exercise and the restoration of “communal” experience, i.e., the “essential

human experience” that was once lost due to the illness. Dr. Ramsey has developed or modified a variety of speech exercise techniques, such as articulation exercise, breathing exercise, and using familiar tunes in normal speech phrase (i.e., musically cued recall). Ramsey has explored how these techniques can, and should be, integrated into the therapeutic effort of enhancing the patients’ communal experience.

Dr. Ramsey stresses that it is through this socially expressive and interactive communal experience that the patients are allowed to enter into a realm of personal, emotional communication and strive for conversing. The notion of shared body of knowledge and dynamics that exist both in ordinary conversation and music is the central basis of Dr. Ramsey’s musically assisted speech. Musical components and dynamics are used to facilitate conversational dynamics. Negotiation of time or manipulation of tones and physical cues are, therefore, fundamental across different speech exercise techniques.

Music and Emotions

Dr. Robert Zatorre, a Professor at McGill University’s Montreal Neurological Institute, has studied neural mechanisms underlying intensely pleasant emotional responses to music. He investigated what he calls “musical chills” response using positron emission tomography (PET). In the investigation, cerebral blood flow changes were measured in response to subject-selected music that elicited highly pleasurable experiences of “chills”. Subjective reports of chills were accompanied by changes in heart rate, electromyogram, and respiration. As intensity of these chills increased, cerebral blood flow increases were observed in the ventral striatum (nucleus accumbance, in particular), the midbrain, and the orbitofrontal cortex, while its decreases were observed in the amygdala and the ventral medial prefrontal cortex.

This research suggests two possible systems that may be involved in emotional response to music. The brain regions comprising these two systems, activated or deactivated, are thought to be involved in reward and motivation, emotion and arousal. These brain structures are also known to be active in response to other euphoria-inducing stimuli, such as food, sex, and drugs and abuse. This finding links music with biologically relevant, survival-related stimuli via their common recruitment of brain circuitry involved in pleasure and reward.

Dr. Zatorre points to the fact that ancient reward/ motivation systems are present in musical emotional response, despite the fact that music has no direct biological survival value. He also shares an interesting speculation on the evolutionary link between phylogenically older, survival-related brain systems and newer more cognitive systems. He suggests that music may possibly represent a special interaction between emotion and cognition.

The Effects of Music on Pain and Stress in Premature Infants

At Harvard Medical School's Institute for Music and Brain Science, researchers are studying the effects of music on pain and stress in premature infants, measuring heart rate, oxygenation and respiratory rate.

"What evidence we have in hand really does show that music makes a difference," says the institute's director, Dr. Mark Jude Tramo, a practicing neurologist. But, he adds, there are many questions yet to answer.

Some studies show music can reduce the need for blood-pressure medications after heart surgery and help babies in the neonatal intensive care unit (ICU) gain weight, he says.

Our brains are hardwired for music, he says, and our brains' complex response to it might play an important adjunct role in health. For example, by reducing the "acoustic graffiti" that permeates hospitals, music might help reduce fear and anxiety that can hamper healing.

Current research is suggestive, not conclusive as we lack, according to Tramo, "the cold, hard, randomized multi-center large population, statistically sound clinical trials."

Musical Pillows

A study of music's effect on patients is under way at one very high-tech area at Seattle's Northwest Hospital & Medical Center: the Heart Catheterization Laboratory. Here, amid imaging equipment and monitors, randomly selected patients listen through a specially designed pillow to the sounds of oboe, harp and cello, along with bird songs and waterfalls.

In the cath lab, patients are awake as doctors push a long, thin catheter through an artery, typically reached by an incision in the groin. Dye is injected and tracked to show blockages.

Afterward, patients will be asked a series of questions: What sounds did they notice? How do they rate the lab's sound environment? How high was their anxiety during the procedure?

The study also is being conducted at hospitals in Denmark and Canada.

Dr. Per Thorgaard, study organizer and chief physician of anesthesia and intensive care at Aalborg University Hospital in Aalborg, Denmark, says about 400 patients will participate in this study, one of a series he hopes will lead to research into music's role in long-term healing.

The study is one of several Thorgaard has conducted since 1998, when he became concerned that the constant, unfamiliar beeps, whirrs and alarms in intensive-care units were confusing and distressing to patients. "The patient who is in the midst of this chaos gets bombarded, and they can't stand it; they get agitated, psychotic; it develops within a couple of days," he says.

Thorgaard looked for studies about whether music could help patients tune out the environment, but found little of use. He found even less on what kind of music might be best.

"We guessed it should not be Jimi Hendrix or Pearl Jam," he quips. After testing classical composers, he settled on the popular Danish composer Niels Eje.

Thorgaard and his colleagues tested the music on patients, asking them to rate their experience of comfort and pain after leaving the ICU. Music, they found, "was like the best medication we had in the pharmacy."

The Tomatis Method

Alfred Tomatis, M.D. is a famous alternative sound practitioner. There are over 100 centers world wide that utilize his technique (the Tomatis Effect) to treat a variety of symptoms including deafness, various emotional disturbances, hypertension, insomnia, speech defects, epilepsy, hyperactivity, dyslexia, autism, depression and many more. The research

done by Tomatis resulted in the conclusion that the ear is the primary organ of consciousness. According to Tomatis the ear is the vehicle of a much larger human process than previously believed that involves every cell in the body. The diagram in a few pages documents this perspective by illustrating that all major organs of the body have meridians in the ear. Tomatis came to believe that the proper mix of sounds provide nourishment for the entire body in the form of electroneural stimulation to the brain. This nourishment or energizing effect can potentially have many positive results.

A portion of the Tomatis work included recording mother's voices at high frequency ranges above 8,000 hertz. Tomatis would then play the recordings back to the children with disabilities such as autism, dyslexia and hyperactivity. Noticeable immediate improvements in learning abilities and behavior resulted. Tomatis developed and refined his techniques into a recording process called the "electronic ear". This technology switches between high and low frequencies. He found that the use of high frequencies enhanced the benefits of the sound therapy including a noticeable whole-body healing and energizing effect plus a jump in overall mental abilities.

Some believe that the effect of energizing the whole body by using these sound therapies induces an increase in the flow of energy, commonly called prana or chi, throughout the human energy field. Some also further propose that this energizing "Tomatis Effect" is an increase in the exchange of energy and information with the Zero Point Field obtained by improving the level of vibratory synchronization between the ZPF and the human energy field. These conclusions seem rudimentary in light of documented research that shows many positive effects from the Tomatis Effect including increased mental capacity, accelerated learning abilities, improvement in memory, enhanced concentration, weight loss, improvement in the ability to relax, overall reduction of stress and many other benefits.

Binaural Beat

When different frequencies are played through right and left channels of stereo headphones the difference between those frequencies creates what is referred to as binaural beats. Robert Monroe made this practice well known in the 1960's with his book, *Journeys Out of the Body*. Today the Monroe Institute continues the work started by Robert Monroe and is considered by many to be the leader in alternative sound therapy. Monroe utilized this binaural beat technique to induce a variety of responses and benefits. For

example, if frequencies of 300 and 400 hertz are played in the right and left ears respectively, 100 and 700 hertz binaural beats are created. The difference between or the sums of the frequencies played into each ear creates an electrical signal by both hemispheres of the brain working together. Properly used binaural beats have been shown to alter and refine existing brain wave patterns into what Monroe called hemisphere synchronization. Simply stated, this technique facilitates improving brain-wave activity into a more organized, coherent and synchronized pattern.

Research has shown the proper use of the binaural beat technique can result in a variety of positive effects including accelerated learning abilities, reduction of pain and enhanced immune system functions. Electroencephalogram (EEG) research has shown that the binaural beat technique must incorporate existing brain-wave patterns. The proper techniques produce expanded higher-order brain wave patterns out of which expanded states of consciousness emerge.

Ultrasound Cancer Treatment

An interesting article from Reuters on the use of ultrasound in cancer treatment presents findings which parallel those in the research by Maman reported above.

LONDON (Reuters) - Scientists at a Northern Ireland biotech company have developed a new non-invasive technique that can destroy cancer cells in mice.

Instead of surgery, drugs or radiation treatment, researchers at Gendel used an electric field and ultrasound to kill cancerous cells in the laboratory, as well as in the tumors of 50 mice, a science magazine said Wednesday.

Although it is in early stages of development, the company believes the technique could one day be used to treat head and neck tumors and hopes to begin human trials in two years.

"The technique relies on the application of an electric field to a tumor to make it susceptible to a follow-up blast of ultrasound," according to New Scientist. "The combination appears to cause tumor cells to self-destruct."

The new procedure is based on a drug delivery technique that Gendel hopes to test in human trials later this year. It involves transporting drugs to hard-to-reach areas of the body by using the patient's own red blood cells.

The blood cells are sensitized outside the body with the electric field, which makes them permeable, and then filled with a drug and put back into the patient.

Ultrasound is directed to the tumor site and the cells with the drug burst open, putting the drug exactly where it is needed.

Gendel scientists are still perfecting the double whammy cancer treatment and admitted they do not know why the cells rupture when hit by ultrasound.

The ultrasound fields used in the cancer treatment are stronger than those used to monitor the growth of babies in the womb and are similar to the strength applied to muscles in sports medicine.

But other cancer treatments that have worked in animals have not been successful in humans. Cancer experts said more information about the new technique is needed.

Multidimensional Music

Jacotte Chollett, former television documentary film producer, was inspired to expand her cerebral faculties. Her quest led to a ten year period of intensive research into acoustical phenomena beyond the limits of human perception. Next she spent seventeen years in her studio creating what she calls Multidimensional Music. In 1985 Jacotte started to test the effect of her music on willing participants to see what healing properties the music contained.

Participants listened to Multidimensional music for one to one-and-one-half hours in private sessions or workshops. Blood samples were taken immediately before and after listening to the music. These tests repeatedly showed a spectacular increase of up to one gram in the hemoglobin level of the blood samples. Resonance with the expanded consciousness field present in the music was inducing physiological, somatic transformations in blood

Jacotte says, "Unity of consciousness can be established or re-established by direct contact between the music and the person experiencing it, which releases emotional knots and what might be called 'cysts' in the parasympathetic systems. It may be observed that, in resonance with Multi-dimensional Music, these phenomena tend to disintegrate, and the effects are communicated from cell to cell through the connected system. The re-balancing of potentials along the meridians of acupuncture is also noted. The effects are physical, psychic and holistic. The phenomenon, originating with cellular perception of vibrations, is translated in part by increasingly specific sensations which correspond to a holistic self awareness."

Vibroacoustic Music and Symptom Reduction in Hospitalized Patients

The need for hospitalized patients to experience the relaxation response as an antidote to the stress of treatment and adjustment to the possibility of chronic or life threatening conditions is clear. The systematic application of music to promote positive changes in behavior has been used successfully in a variety of hospital settings. The effectiveness of music interventions has been measured physiologically and behaviorally.

In order to provide patients with assistance in achieving a relaxation response, recreation therapists at a major research hospital created several relaxation opportunities for patients and their family members. Among them are a weekly class, "The Art of Relaxation." This class is both didactic and experiential. Held in a patient lounge, it can accommodate up to nine individuals. The content includes a short introduction, an explanation of four components of relaxation (from Benson), and examples of short form relaxation techniques (i.e. eye roll-sigh). This is followed by a 15-20 minute experiential session using one of the following techniques: progressive relaxation, guided imagery, rhythmic breathing, body scan, or autogenic training.

The recreation therapists also created a relaxation room with four Somatrons, a commercially available vibroacoustic recliner. The Somatrons deliver ear level stereo auditory and tactile vibrations that allow the body to feel the music that is normally only heard. Patients can access an initial session in the relaxation room using Therasound music titled "Balance" designed for its anxiolytic properties. Subsequent uses of the relaxation room have used either "Balance" or music from "The Musical Body"

(Therasound). In all cases, this is a therapist guided session with about 10 minutes of debriefing after the music.

This presentation of the program evaluation data from the use of the vibroacoustic recliners with anxiolytic music gathered from 268 adult patients with varying diagnoses over the last 17 months. The measures were patient self-report instruments completed immediately pre and post to assess symptom intensity and relaxation. Symptoms, up to three, were identified by the patients. Symptom intensity was measured on a visual analogue scale. Relaxation was measured seven item Self-Report Rating Scale for Tension and Relaxation (Poppen, 1988, p.126).

The results follow. The most frequently identified symptoms were tension-anxiety (73), pain (67), fatigue (62), nausea (27), headache (23), and depression (15) which comprised 92% of the first symptoms mentioned. (Note: patients could state up to three symptoms and rate each, But this report analyzed only the first mentioned symptom.) Each of these symptoms showed reduction in intensity based on pre-post mean scores. Cumulatively, the pre rating mean was 67.20 (of 100) and the post rating mean was 31.55, a 53% reduction of symptoms. The most frequently self-reported symptoms that were reduced included tension-anxiety ($p < .001$), pain ($p < .0001$), fatigue ($p < .0001$), nausea ($p < .0005$), headache ($p < .0001$), and depressed mood ($p < .0004$). The intensity of symptoms was reduced from pre to post by following percentages: tension-anxiety, 54.65%; pain, 58.31%; fatigue, 46.63%; nausea, 56.44%; headache, 51.64%; and depressed mood, 46.63%.

To measure the state of relaxation, the seven point Self-Report Rating Scale for Tension and Relaxation was used. With an $N=272$, the pre rating was 5.12 (5 is "Feeling Some Tension in Some Parts of My Body") while the post rating was 2.77 (3 is "Feeling More Relaxed Than Usual"), a statistically significant difference ($p < .0001$). Although this scale is nominal, tests of fit allow for estimation of effective improvement of 33.4% in state of relaxation.

Clinical impressions of the group of five recreation therapists were commensurate with the statistical significance levels indicated. Most patients were buoyed by having a perceived effect on their symptom burden. We used this positive outcome to point out that patients could clearly benefit by regular practice of an effective relaxation technique. They were given

additional training in the "Art of Relaxation" class, through individual instruction, or by readings.

This program evaluation data was not a research study. It did not use random assignment, control group, or a comparison group. Nonetheless, it did generate enough data to suggest the worthiness of writing a research plan for several sequential research protocols.

Future studies will measure the duration of the symptom intensity reduction beyond the vibroacoustic session, the effects of additional treatment, the impact of the treatment on patients with differing sets of symptoms per diagnosis. These studies will also consider: 1) What could constitute an adequate control group (e.g., no treatment, music with no tactile input, different kinds of music, music of choice vs. prescribed music); 2) How vibroacoustic music compares with the other relaxation techniques, such as progressive relaxation, autogenic training, mindfulness meditation, and guided imagery; 3) The inclusion criteria for selecting research participants; 4) The proper sequencing of studies so that a cluster of studies could be done in such a way as to build a body of knowledge around vibroacoustic music as a developing technology?

The recliners referred to in this study are four Somatron Professional Power Models.

Written for Sera Soma <http://www.sera-soma.com>