

Scientific Research into the Effects of Music

Geetanjali Vaidya says one great problem that arises in trying to study music's emotional power is that the emotional content of music is very subjective. A piece of music may be emotionally powerful but is experienced in very different ways by each person who hears it.

The emotion created by a piece of music may be affected by: –

1. The memories associated with the piece
2. The environment it is being played in
3. The mood of the person listening and their personality
4. The culture they were brought up in
5. Any number of factors both impossible to control and impossible to quantify.

Under such circumstances, it is extremely difficult to deduce what intrinsic quality of the music, if any created a specific emotional response in the listener. Even when such seemingly intrinsic qualities are found, they are often found to be at least partially culturally dependent.

(Geetanjali Vaidya (2002) - Music, Emotion and the Brain)

Musical Tempo

According to studies published in the 'The Economist' and 'The Scientific American' major keys and rapid tempos cause happiness, whereas minor keys and slow tempos cause sadness, and rapid tempos together with dissonance cause fear.

("Exploring the Musical Brain" - Kristin Leutwyler, January 22, 2001 Scientific American)
("The Biology of Music", February 12th - 18th 2000, The Economist)

Dissonance

Most people find dissonant music unpleasant. Dissonance is to a certain degree culture-dependent, but also appears to be partly intrinsic to the music. Studies have shown that infants as young as 4 months old show negative reactions to dissonance.

(Cromie, William J. (2001) - "Music on the brain: Researchers explore biology of music" - Harvard Gazette Archives)

(Tramo, Mark Jude "Biology and music: Enhanced: Music of the Hemispheres" (2001) - Science Vol. 291, Sique 5501, 54-56)

A recent experiment measured responses to dissonance. Dissonance can consistently create feelings of unpleasantness in a subject, even if the subject has never heard the music before. Music of varying dissonance was played for the subjects, while their cerebral blood flow was measured. Increased blood flow in a specific area of the brain corresponded with increased activity. It was found that the varying degrees of dissonance caused increased activity in the paralimbic regions of the brain, which are associated with processing emotions.

(Blood, A.J., Zatorre, R.J., Bermudez, P., and Evans, A.C. (1999) - "Emotional responses to pleasant and unpleasant music correlate with activity in paralimbic brain regions" - Nature Neuroscience, 2, 382-387)

Pleasure

Another recent experiment measured the activity in the brain while subjects were played previously chosen musical pieces that created feelings of intense pleasure for them. The musical pieces had an intrinsic emotional value for the subjects, and no memories or other associations were attached to them. Activity was seen in the reward, motivation, emotion, and arousal areas of the brain. This result was interesting because these areas are associated with the pleasure induced by food, sex, and

recreational drugs, which would imply a connection between such pleasure and the pleasure induced by music.

(Blood, A.J. & Zatorre, R.J. (2001) "Intensely pleasurable responses to music correlate with activity in brain regions implicated with reward and emotion - Proceedings of the National Academy of Sciences, 98, 11818-11823)

Hormones

There are particular biochemical responses in the human body to music. Research shows that college students, when listening to music, have more galvanic skin response peaks, as opposed to when they were not listening to music. This research also indicates a significant decrease of norepinephrine levels in students while they listen to "preferred" music. Norepinephrine is a neurotransmitter that arbitrates chemical communication in the sympathetic nervous system of the human body.

The release of this neurotransmitter, as a consequence of a function of the brain, results in an increased heart rate and raised blood pressure. Therefore, the decrease of norepinephrine in these college students results in a more "relaxed" state. This could suggest that favoured music somehow affects the mind, resulting in the relaxing of the body.

(Vanderark, Sherman D., and Daniel Ely. (1993) - "Cortisol, Biochemical, and Galvanic Skin Responses to Music Stimuli of Different Preference Values by College Students in Biology and Music." - *Perceptual Motor Skills*, 77, pp. 227-234)

Another research project, undertaken at the Tokyo Institute of Psychiatry, focused on the effects of music on the mind using electroencephalograms (EEG). An electroencephalograph is a medical instrument that is capable of showing the electrical activity of the brain by measuring electrical potentials on the scalp. In this experiment, volunteers were exposed to silence, music, white noise (simulated hiss), and then silence. The result of this experiment coincides with the previous findings. The volunteers all reported feeling a calming sensation. However, the researches did not attribute the lowered tension to reduced neurotransmitter levels.

While listening to music, "many of the subjects reported that they felt pleasantly relaxed or comfortable. Music may evoke more organised mental activities which result in subjectively comfortable feelings." The white noise in the experiment produced an even greater effect; the volunteers were so relaxed that many felt drowsy and soporific. The monotonous characteristics of white noise, in contrast to the variations in tone and melody of normal music can explain this sleepy effect.

Furthermore, the researchers found based on the EEGs, that while listening to music, the volunteers maintained a higher consciousness than when they were exposed to silence or white noise. What this experiment shows is that there is a change in the mental state of people while listening to music.

(Ogata, Shigeki. (1995) - "Human EEG Responses to Classical Music and Simulated White Noise: Effects of a Musical Loudness Component on Consciousness" - *Perceptual Motor Skills*, 80, pp. 779-790)

Memory

In one experiment, words were presented to test subjects, while classical music, jazz music, or no music played in the background. When the test subjects were asked to repeat the words a few days later, either the same music or a different background was present. The researcher noticed a "facilitative effect of providing the same [musical] context."

(Sogin, David W. (1988) - "Effects of Three Different Musical Styles of Background Music on Coding by College-Age Students" - *Perceptual Motor Skills*, 67, pp. 275-280)

Similar research has been done on CDM. CDM stands for context-dependent memory, which is the principle that "changing the context or environment in which material was originally learned causes some of that material to be forgotten."

(Smith, S. M. (1985) - "Background Music and Context Dependent Memory" - American Journal of Psychology, 6, pp. 591-603)

A group of scientists tested college undergraduates by asking the students to rate the pleasantness of a sequence of words, while they listened to a certain type of music. Afterwards, they were asked to recall these words. The results indicate that the students were able to recall the sequence more successfully if the same musical piece was playing. Furthermore, the researchers found that if the music played during the recall had a different tempo than the original music, then there was a lowered ability to recall the words.

(Wallace, Wanda T. (1994) - "Memory for Music: Effect of Melody on Recall of Text" - Journal of Experimental Psychology, 20, pp. 1471-1485)

These results are also supported by a supplementary investigation, where it was shown that a musical piece can facilitate learning and recall.

(Balch, William R., Kelley Bowman, and Lauri A. Mohler (1992) - "Music-dependent Memory in Immediate and Delayed Word Recall" - Memory and Cognition, 20, pp. 21- 28)

A common manifestation of this phenomenon is when you remember the jingles in commercials. A test conducted at the University of Washington demonstrated that brand names were more easily recalled when they were presented in the form of a musical tune, instead of just spoken. Hence, this is a consistent example of one relationship between music and memory.

(Yalch, Richard F. (1991) - "Memory in a Jingle Jungle: Music as a Mnemonic Device in Communicating Advertising Slogans" - Journal of Applied Psychology, 76, pp.268-275)

(Russel, P. A. (1987) - "Memory for Music: A Study of Musical and Listener Factors" - The British Journal of Psychology, 78, pp. 335-347)

Communication

A group of specialists at the University of Connecticut studied how people communicate with each other while background music was present. A hundred and four students were paired off and put into rooms with either different types of background music playing, or no music playing. In the rooms, these students were asked to perform some problem solving tasks that required conversation between them. After five minutes, the subjects were asked to rate their conversations.

Of the students who heard background music, almost all reported "significantly higher satisfaction [with communication] than those in the no-music condition." The different types of music also affected the students. The researchers noted that the students who listened to fast music had differently paced conversations than those who listened to slow music. The volunteers who listened to music in a major mode performed notably better than those who listened to music of minor mode.

(Blood, Deborah J., and Stephen J. Ferriss (1993) - "Effects of Background Music on Anxiety, Satisfaction with Communication, and Productivity" - Psychological Reports, 72, pp. 171-177)

Walking

A recent investigation into the effects of music on walking distance was performed at Ursinus College. Volunteers were asked to walk for ninety seconds. The study showed that, "music significantly influenced distance walked." The conclusion reached by the scientists in this instance contradicts the previous results. Instead of "raising the consciousness" of the mind, the researchers hypothesised that the music interfered with or distracted the minds of the test subjects. A related study concurs with this finding.

In this case, college students were asked to complete two hundred and twenty hand-eye coordination problems while listening to different types of music. It was found that the rhythm and loudness of the background music interfered with the attention span of the students. These last two studies seem to refute the findings of the other research; but in a sense, all the studies correlate a modification of behaviour caused by the presence of music.

(Becker, Nancy, Catherine Chambliss, Cathy Marsh, and Roberta Monetmayor (1995) - "Effects of Mellow and Frenetic Music and Stimulating and Relaxing Scents on Walking by Seniors" - Perceptual Motor Skills, 80, pp. 411-415)

Academic Performance

Research carried out at Glassboro State College indicated that when music was played in a psychology class it improved academic performance. Music was played for twenty minutes each day. The researchers reported that the music "stimulated the human alpha and beta brain waves," resulting in the attainment of "significantly higher mean scores on examinations than those who were not exposed to the music."

In addition, music can also be used to aid in the education of mentally handicapped students. In a school district in Prescott, Arizona, music was added to the academic environment of special education students. This resulted in an increase in performance, especially in the area of mathematics.

(Schreiber, Elliott H. (1988) - "Influence of Music on College Students' Achievement" - Perceptual Motor Skills, 66, p. 3380)

(McLaughlin, T. F., and J. L. Helm. (1993) - "Use of Contingent Music to Increase Academic Performance of Middle-School Students" - Psychological Reports, 72, p.658).

Information from the web site 'The Mind, Music, and Behavior' - <http://www.dreamessays.com/customessays/World%20Literature/2328.htm>

Order in Music

Laurence O'Donnell says that key component of music that makes it beneficial is order. The order of the music from the baroque and classical periods causes the brain to respond in special ways. This order includes repetition and changes, certain patterns of rhythm, and pitch and mood contrasts. Music from the baroque and classical periods is mathematically precise. According to O'Donnell this is realised by the body and the human mind performs better when listening to this ordered music. (O'Donnell 1999)

The brain works by looking at different pieces of information and deciding if they are different or the same. This is done in music of the baroque and classical periods by playing a theme and then repeating or changing the theme. The repetition is only done once. More than one repetition causes the music to become displeasing, and also causes a person to either enter a state of sub-conscious thinking or a state of boredom.

Dr. Ballam goes on to say that, "The human mind shuts down after three or four repetitions of a rhythm, or a melody, or a harmonic progression." Furthermore, excessive repetition causes people to release control of their thoughts. (Ballam, Michael - Music and the Mind pp 1-8)

Laurence O'Donnell is a musician from Perth, Scotland.

His web site is - <http://www.cerebromente.org.br/n15/mente/musica.html>

Scientists Show how the Brain Reacts to Favourite Tunes

Samuel Barber's Adagio for Strings is the piece of music that proved to be most popular in Valorie Salimpoor's experiments to find out why certain pieces of music give us intense emotions.

If you have goosebumps or feel euphoric chills when listening to a piece of music, then your brain is reacting to the music in the same way as it would to some delicious food or a psychoactive drug such as cocaine, according to scientists.

When we listen to certain types of music there is a release of the brain's reward chemical, dopamine, according to results of experiments carried out by a team led by Valorie Salimpoor of McGill University in Montreal, Canada, which are published in Nature Neuroscience in January 2011.

Any time we do something our brains want us to do again, dopamine is released. "Now we're showing that this ancient reward system that's involved in biologically adaptive behaviours is being tapped into by a cognitive reward," said Salimpoor.

She said music provided an intellectual reward, because the listener has to follow the sequence of notes to appreciate it. "A single tone won't be pleasurable in isolation. However, a series of single tones arranged in time can become some of the most pleasurable experiences that humans have ever reported. That's amazing because it suggests that somehow our cerebral cortex is following these tones over time and there must be a component of build-up, anticipation, expectation."

In the experiment, participants chose instrumental pieces of music that gave them chills. Lyrics were banned because the researchers did not want their results confounded by any associations participants might have had to the words they heard.

The pieces chosen ranged from classical to rock, punk and electronic dance music. "One piece of music kept coming up for different people – Barber's Adagio for Strings," said Salimpoor. Barber's piece was the favourite classical piece and a remix of the tune was also most popular in the dance, trance and techno genres.

As the participants listened to their music, Salimpoor's team measured a range of physiological factors including heart rate and increases in respiration and sweating. She found that the participants had a 6-9% relative increase in their dopamine levels when compared with a control condition in which the participants listened to each other's choices of music. "One person experienced a 21% increase.

"That demonstrates that, for some people, it can be really intensely pleasurable," she said. Salimpoor and her colleagues concluded: "If music-induced emotional states can lead to dopamine release, as our findings indicate, it may begin to explain why musical experiences are so valued. These results further speak to why music can be effectively used in rituals, marketing or film to manipulate hedonistic states. Our findings provide neurochemical evidence that intense emotional responses to music involve ancient reward circuitry and serve as a starting point for more detailed investigations of the biological substrates that underlie abstract forms of pleasure."

(Favourite music evokes same feelings as good food or drugs - Scientists show how the brain reacts to favourite tunes - Alok Jha, science correspondent of the Guardian - Sunday 9 January 2011)

How Music Affects Us

Music is one of the few activities that is intrinsic to all cultures and can have surprising benefits not only for learning language, improving memory and focusing attention, but also for physical coordination and development. Of course, music can be distracting if it's too loud or too jarring, or if it competes for our attention with what we're trying to do. But for the most part, exposure to many kinds of music has beneficial effects.

These effects are listed under the following headings:

1. Music Heals
2. Music Enhances Intelligence, Learning and IQ
3. Music Improves Physical Performance
4. Music Helps Us Work More Productively
5. Music Calms, Relaxes and Helps us to Sleep

1. Music Heals

Listening to slow classical music causes the heart beat and pulse rate to slow down to the beat of the music. As the body becomes relaxed and alert, the mind is able to concentrate more easily. Furthermore, baroque music decreases blood pressure and enhances the ability to learn. Music affects the amplitude and frequency of brain waves, which can be measured by an electroencephalogram. An electroencephalograph is a medical instrument that is capable of showing the electrical activity of the brain by measuring electrical potentials on the scalp.

Music also affects breathing rate and electrical resistance of the skin. Listening to rapid music can cause the pupils to dilate, increase blood pressure, and increase the heart rate. (O'Donnell 1999)

Heartbeat

Music is good for your heart. Research shows that it is musical tempo, rather than style. Italian and British researchers recruited young men and women, half of whom were trained musicians. The participants slipped on headphones and listened to six styles of music, including rap and classical pieces, with random two-minute pauses. As the participants kicked back and listened, the researchers monitored their breathing, heart rates and blood pressure.

The participants had faster heart and breathing rates when they listened to lively music. When the musical slowed, so did their heart and breathing rates. Some results were surprising. During the musical pauses, heart and breathing rates normalised or reached more optimal levels. Whether or not a person liked the style of music did not matter. The tempo, or pace, of the music had the greatest effect on relaxation.

(Bernardi L, Porta C, Sleight P. - Cardiovascular, cerebrovascular, and respiratory changes induced by different types of music in musicians and non-musicians: the importance of silence - Heart 2006 April 92(4):445-52 E-pub 2005 Sep 30)

Reducing Blood Pressure

By playing recordings of relaxing music every morning and evening, people with high blood pressure can train themselves to lower their blood pressure and keep it low. According to research reported at the American Society of Hypertension meeting in New Orleans, listening to just 30 minutes of classical, Celtic or raga music every day may significantly reduce high blood pressure.

(Teng XF, Wong MY, Zhang YT. - Abstract 'The effect of music on hypertensive patients' - Conf. Proc. IEEE Eng. Med. Biol. Soc. 2007;2007:4649-51)

Heart Disease

A recent review of 23 scientific studies of the use of music in the treatment of coronary heart disease showed that those participants that listened to music as part of their treatment had better health than those who just received standard care (the studies involved 1,500 participants).

Listening to music also had beneficial effects on blood pressure, heart and respiratory rates, anxiety and pain. In most studies participants listened to pre-recorded music as well as their routine care. (Cochrane Database of Systematic Reviews 2009)

Stroke Patients

According to a study carried out in Helsinki, Finland, listening to music for a few hours every day can boost recovery in the early stages following a stroke. The results showed that the recovery of verbal memory and attention improved significantly more with the group of patients who listened to music compared with those patients who listened to audio books or did nothing at all. The music group also felt less depressed and confused than the no-music group. These differences were still present six months later; suggesting that music may have long-term effects on brain function and mood (Brain, 2008; 131: p 866–76)

A daily dose of one's favourite pop melodies, classical music or jazz can speed recovery from debilitating strokes, according to the latest research. When stroke patients in Finland listened to music for a couple of hours each day, verbal memory and attention span improved significantly compared to patients who received no musical stimulation, or who listened only to stories read out loud, the study reports.

(Sarkamo T, Tervaniemi M, Laitinen S, Forsblom A, Soinila S, Mikkonen M, Autti T, Silvennoinen HM, Erkkila J, Laine M, Peretz I, Hietanen M. - Music listening enhances cognitive recovery and mood after middle cerebral artery stroke - Brain 2008 March 131 (Pt 3) p866-76)

Chronic Pain

Music can help to reduce pain. Music can help reduce both the sensation and distress of both chronic pain and postoperative pain.

Listening to music can reduce chronic pain from a range of painful conditions, including osteoarthritis, disc problems and rheumatoid arthritis, by up to 21% and depression by up to 25%, according to a paper in the latest UK based Journal of Advanced Nursing.

"The people who took part in the music groups listened to music on a headset for an hour a day and everyone who took part, including the control group, kept a pain diary" explains nurse researcher Dr Sandra L Siedlecki from the Cleveland Clinic Foundation, Ohio.

(The effect of music on power, pain, depression and disability - Journal of Advanced Nursing 2005 Volume 54.5, p 553 to 562)

How Music Positively Affects Pain

There are several theories about how music positively affects perceived pain:

1. Music serves as a distracter
2. Music may give the patient a sense of control
3. Music causes the body to release endorphins to counteract pain
4. Slow music relaxes person by slowing their breathing and heartbeat

Childbirth

Music therapy is increasingly used in hospitals to reduce the need for medication during childbirth, to decrease postoperative pain and complement the use of anaesthesia during surgery.

(Nilsson U, Unosson M, Rawal N. - "Stress reduction and analgesia in patients exposed to calming music postoperatively": a randomized controlled trial - Eur. J. Anaesthesiol 2005 Feb;22(2):96-102)

Babies Listen to Mozart

At a hospital in Slovakia they play Mozart to babies to ease the birth trauma. On their heads, the new born babies in the maternity ward are wearing stereo headphones and their tiny hands seem to move to the rhythm of the music. From the first hours of their lives, the babies are tuned into Mozart at the Kosica-Saca hospital in eastern Slovakia.

One and two-day-old new born babies listen to music with headphones at the 1st Private Hospital in Kosice-Saca.

This is no experiment in producing a generation of musical geniuses. The infants are listening to the classical composer to stimulate their mental and physical functions thanks to the benefits of music therapy.

The birth trauma is "enormously stressful for the baby," said Slavka Viragová, the doctor in charge of the hospital's maternity unit, who launched the music project. "In the womb, the baby listens to the mother's heart beat, which represents a source of protection and good feelings. We have the baby listen to music so he can recall his mother during the period immediately after the birth when he is not with her," she said.

In a room where the walls and windows are covered with animals from fairy tales, about a dozen infants in two rows of cribs are listening to music and sleeping peacefully. Nearby, in another room with incubators, premature babies and those with health problems are also exposed to music, which has been shown to help them stabilise their breathing, Viragová said.

"In general, music therapy helps a baby to gain weight, get rid of stress and handle pain better," she said. Viragová said she used music therapy with her own two children, now teenagers, when they were babies. Again the musical choice was Mozart.

"It has been found that Mozart's music has a very good effect on the development of the intelligence quotient (IQ)," she said. At the hospital, the new born babies listen five or six times a day to a 10-minute piece of music consisting of either one of Mozart's classical works, a piano composition by French pianist Richard Clayderman, a mix of natural forest sounds or some other soothing music.



"The music is very soft and relaxing. Its intensity is between 30 to 50 decibels, which can be compared with the sound of normal footsteps or the opening of a door," Viragová said.

Most of the time the music is played in the entire room. This helps relieve the stress of the nurses who care for 20 to 30 babies in the nursery. But the hospital rooms are also equipped with personal

stereo sets so when the babies are with their mothers they can listen together to soothing music of the mother's choice.

The music therapy project began some two years ago and has been well received by the expectant and new mothers. "It is certainly a very good idea and affects the baby in a very positive way," said Livia Oliarová, 30, who has just given birth to her second son, Adrian. "We are definitely going to continue to have him listen to music even at home," she added.

The Kosice-Saca hospital is now creating quite a noise. Some women are prepared to travel many miles in order to give birth at this hospital, tucked away in the east of Slovakia.

(Slovak Hospital Plays Mozart to Babies to Ease Birth Trauma - Agence France-Presse - 10th September 2005)

Depression

Music's ability to "heal the soul" is the stuff of legend in every culture. Many people find that music lifts their spirits. Modern research tends to confirm music's psychotherapeutic benefits. Bright, cheerful music (e.g. Mozart, Vivaldi, bluegrass, Klezmer, Salsa, reggae) is the most obvious prescription for the blues.

(Maratos AS, Gold C, Wang X, Crawford MJ. - Abstract "Music therapy for depression" - Cochrane Database System Rev. 2008 Jan 23;(1):CD004517)

Listening to music can reduce depression by up to 25 per cent, according to a paper in the Journal of Advanced Nursing. Researchers carried out a controlled clinical trial with sixty people, dividing them into two music groups and a control group.

They found that people who listened to music for an hour every day for a week reported improved physical and psychological symptoms compared to the control group.

The participants, who had an average age of 50, were recruited from pain and chiropractic clinics in Ohio, USA. They had been suffering from a range of painful conditions, including osteo-arthritis, disc problems and rheumatoid arthritis, for an average of six and a half years.

90 per cent said the pain affected more than one part of their body and 95 per cent said it was continuous. Before the music study, participants reported that their usual pain averaged just under six on a zero to ten pain scale and their worst pain exceeded nine out of ten.

"The people who took part in the music groups listened to music on a headset for an hour a day and everyone who took part, including the control group, kept a pain diary" explains nurse researcher Dr Sandra L Siedlecki from the Cleveland Clinic Foundation, Ohio.

"Forty people were assigned to the two music groups and the other 20 formed the control group. The first group were invited to choose their own favourite music and this included everything from pop and rock to slow and melodious tunes and nature sounds traditionally used to promote sleep or relaxation."

"The second group chose from five relaxing tapes selected by us. These featured piano, jazz, orchestra, harp and synthesiser and had been used in previous pain studies by co-author Professor Marion Good from the Frances Payne Bolton School of Nursing at Case Western Reserve University, Ohio."

(The effect of music on power, pain, depression and disability - Journal of Advanced Nursing 2005 Volume 54.5, p 553 to 562)

Dementia

Professor Clive Holmes, from Southampton University, studied the effects of live music on dementia patients. He says: "Suddenly they came alive – some hadn't spoken for three years." (International Psychogeriatrics - Cambridge University Press 2006)

A recent study looked at the impact of live performances on patients with severe dementia. Bands played popular classics such as The Blue Danube and Glenn Miller's Chattanooga Choo Choo, while researchers scored patients in terms of awareness and alertness. Some residents, who were so profoundly disabled by their dementia they could hardly hold a conversation, danced and sang along with the music. (The Sun 2nd November 2006)

Cancer

Patients having chemotherapy experience less pain and discomfort when they listen to music during their treatment. Patients at the Velindre Cancer Centre in Cardiff are treated to live music with a professional harpist during their cancer treatments. The soothing effects of the music have been shown to ease the side effects of chemotherapy. (BBC News Thursday, 5th January 2006)

In a review of several trials by scientists from Stanford University, music was reported to be an effective treatment for the chronic, often debilitating, pain experienced by cancer patients. Listening to music also improved the patients' quality of life. (Hawaii Medical Journal 2007; 66: 292–5)

Chronic Headaches and Migraines

Music can help migraine and chronic headache sufferers reduce the intensity, frequency, and duration of the headaches.

(Oelkers-Ax R, Leins A, Parzer P, Hillecke T, Bolay HV, Fischer J, Bender S, Hermanns U, Resch F. Abstract - 'Butterbur root extract and music therapy in the prevention of childhood migraine: an explorative study' - Eur. J. Pain. 2008 Apr;12(3):301-13. Epub 2007 Jul 30)

(Risch M, Scherg H, Verres R. - Abstract "Music therapy for chronic headaches. Evaluation of music therapeutic groups for patients suffering from chronic headaches" - Schmerz 2001 Apr;15(2):116-25)

Surgery

Hospitals are using harpists to calm patients on the operating table after research found that the instrument eased pain. The sound and vibrations have also been shown to lower the heart rate, decrease blood pressure and combat heart disease.

Several private hospices and care homes already employ harpists and the National Health Service is following suit with the Royal Brompton Hospital, in London, and Cardiff's Velindre Cancer Centre looking set to become the first trusts to take on players.

Research in the United States found that the range of vibrations emitted by the plucked strings affect the body's nervous system and some American surgeons employ harpists so that patients need less anaesthetic.

Last night, Anne Mills, the head of nursing and therapies at the Velindre Hospital, said using a harpist during chemotherapy and radiotherapy could mean that a patient needed fewer pain-relief drugs.

The hospital has recruited Bethan Hughes, 26, to play to patients during the sessions. Miss Hughes, a harpist from the age of 10, said: "The harp can be a medicine. It works differently to other instruments. "It can help to alter brain patterns and brain waves, slow heart rates and increase oxygenation in the blood. Within 10 minutes of music being played, the patient's blood pressure can change."

The Royal Brompton hopes to employ Liehsja Blaxland-de Lange, also 26, to perform for its patients. Miss Blaxland-de Lange, who has been playing the harp for 17 years, said: "I will perform to patients before and after they have surgery and - depending on the surgeon and the patient - possibly in surgery itself."

The US research has been conducted by Dr Abraham Kocheril, the chief of cardiac electrophysiology at the Carle Heart Centre, in Illinois. He said: "The harp seems to affect the part of the nervous system which regulates the heart. It relaxes the patient and the heart slows down.

"People are not seeing this as some sort of voodoo any more. There's a sound scientific basis for it. What hasn't yet been done is to figure out why the harp works in this way but that is what we are trying to do."

Christina Tourin, a California harpist who visits Britain to teach "harp therapy", said: "I have played in surgery, including while a woman had a lump removed from her breast. She needed hardly any anaesthetic." (Harp Music Eases Pain in Surgery - Jasper Copping - Daily Telegraph 2nd Jan 2006)

In one study, listening to music proved to be just as effective as sedatives in relieving the anxiety of 207 patients before an operation. The researchers found no significant differences in anxiety, cortisol level, heart rate and blood pressure between those taking diazepam and those who listened to music in the run-up to surgery. (Medscape Journal of Medicine, 2008, June 25th)

Other studies have shown the benefits of listening to music for those under-going surgery. Listening to music reduces anxiety and pain in adults and children alike. (South Medical Journal, 2005; 98: p 282–8).

Music Helps Healing Process

The BBC reported that an extensive study had been carried out at the Chelsea and Westminster Hospital into music's healing power. The Chelsea and Westminster Hospital provide regular live music for patients. The scientific study found that patients who listen to live music need fewer drugs and recover more quickly than those who do not listen to music.

According to Dr. Rosalia Staricoff, who carried out the study, there is growing scientific evidence that music aids physical changes that can help heal the body. She said: "The physiological benefits have been measured. Music reduces blood pressure, the heart rate, and hormones related to stress."

Professor Paul Robertson regularly plays violin for patients in various hospitals. He is a scientist as well as an accomplished musician. He is carrying out clinical trials to see how music affects the brain and the body. He said: "We are approaching the point where a doctor would legitimately be negligent not to actually recommend music as a therapeutic intervention.

The world's largest medical charity, The Wellcome Trust, is now bringing together academics and artists to explore the possibility of putting music therapy on a more scientific footing. (BBC News - July 19th 2006)

Music Boosts Immunity

Music can boost the immune function. Scientists explain that a particular type of music can create a positive and profound emotional experience, which leads to secretion of immune-boosting hormones. This helps contribute to a reduction in the factors responsible for illness. Listening to music or singing can also decrease levels of stress-related hormone cortisol. Higher levels of cortisol can lead to a decreased immune response.

(Le Roux FH, Bouic PJ, Bester MM. – "The effect of Bach's 'Magnificat' on emotions, immune, and endocrine parameters during physiotherapy treatment of patients with infectious lung conditions" - Journal of Music Therapy 2007 Summer;44(2):156-68)

(Kreutz G, Bongard S, Rohrmann S, Hodapp V, Grebe D. - 'Effects of choir singing or listening on secretory immunoglobulin A, cortisol, and emotional state' - Journal of Behavioural Medicine 2004 Dec;27(6):623-35)

2. Music Enhances Intelligence, Learning and IQ

The idea that music makes you smarter received considerable attention from scientists and the media. Listening to music or playing an instrument can actually make you learn better. And research confirms this.

Many studies have shown that music has the power to enhance brain function:

1. Reading and literacy skills
2. Spatial-temporal reasoning
3. Emotional intelligence
4. Mathematical abilities

Even children with attention deficit/hyperactivity disorder benefit in mathematics tests from listening to music beforehand.

For more information on these studies please go to <http://www.emedexpert.com/tips/music.shtml>

The Mozart Effect

The term 'The Mozart Effect' was first coined by Alfred A. Tomatis. Tomatis used Mozart's music as the listening stimulus in his work attempting to cure a variety of disorders.

According to the Don Campbell's book 'The Mozart Effect' listening to Mozart's music is good for learning. Research indicated that listening to Mozart's music may induce a short-term improvement on the performance of certain kinds of mental tasks known as "spatial-temporal reasoning;"

Popularised versions of the theory, suggested that "listening to Mozart makes you smarter" and that early childhood exposure to classical music has a beneficial effect on mental development;

Don Campbell claims that The Mozart Effect' has a transformative powers in health, education, and well being.

The approach popularised in the book by Don Campbell, and is based on an experiment published in Nature suggesting that listening to Mozart temporarily boosted students' IQ by 8 to 9 points. As a result, the Governor of Georgia, Zell Miller, proposed a budget to provide every child born in Georgia with a CD of classical music!

In the study referred to above Rauscher, Shaw, and Ky investigated the effect of listening to music by Mozart on spatial reasoning. They gave research participants one of three standard tests of abstract spatial reasoning after they had experienced each of three listening conditions: a sonata by Mozart, repetitive relaxation music, and silence.

They found a temporary enhancement of spatial-temporal reasoning, as measured by the Stanford-Binet IQ test. Shaw and Rauscher claim that their work has been misrepresented. What they have shown is "that there are patterns of neurones that fire in sequences, and that there appear to be pre-existing sites in the brain that respond to specific frequencies." This is not quite the same as showing that listening to Mozart increases intelligence in children.

Rauscher et. al. showed that the enhancing effect of the music condition is only temporary: no student had effects extending beyond the 15-minute period in which they were tested. The study makes no statement of an increase in IQ in general, but in participants' spatial intelligence scores.

(Rauscher, F., Shaw, G., Ky, K. (1993) – "Music and spatial task performance" - Nature, 365 611)

Subsequent research by William Forde Thompson, Glenn Schellenberg and Gabriela Husain (University of Toronto) suggests that the Mozart effect can be attributed to temporary changes in mood and arousal that result from prolonged exposure to music (e.g., 8–10 minutes). Not all music generates the Mozart effect, however. The music must be perceived as having an energetic and positive emotional quality.

(Thompson, W.F.; Schellenberg E.G.; Husain, G.V. - "Arousal, Mood, and the Mozart Effect." - Psychological Science 2001 pp.12(3)248–251)

(Schellenberg E.G., Hallam S. – “Music listening and cognitive abilities in 10- and 11-year-olds: the blur effect” – Ann. NY Acad. Sci. 2005 Dec;1060:202-9)

Music and Language Learning

Georgi Lozanov was born in Sofia, Bulgaria in 1926. He is an educator and psychiatrist who developed 'suggestopedia', a learning/teaching theory based on his early 1960s study of suggestion which is called as 'suggestology'. His suggestopedia theory and practice were examined by UNESCO in the late 1970s and proved to be effective.

Lozanov's theory and practice triggered an accelerated learning movement in the West, where various techniques not originally included in the Lozanov's theory were introduced. Such techniques included elements such as breathing, visualisation and biofeedback.

According to the Centre for New Discoveries in Learning, learning potential can be increased a minimum of five times by using 60 beats per minute music. Dr. George Lozanov designed a way to teach foreign languages in a fraction of the normal learning time. Using his system, students could learn up to one half of the vocabulary and phrases for the whole school term (which amounts to almost 1,000 words or phrases) in one day. (O'Donnell 1999)

Along with this, the average retention rate of his students was 92%. Dr. Lozanov's system involved using certain classical music pieces from the Baroque period, which have around a 60 beats per minute pattern. He has proven that foreign languages can be learned with 85-100% efficiency in only thirty days by using these baroque pieces. His students had a recall accuracy rate of almost 100% even after not reviewing the material for four years.

Memory

According to University of Washington's Neuroscience for Kids website, music can have powerful effects on the development and upkeep of human memory. Since all scales consist of quantifiable auditory relationships, the mere act of listening to music involves subconscious memory usage through the brain organising different pitches in a scale and the rhythms they are played with. Whether listeners realise it or not, the process of experiencing music engages memory and cognition centres in the brain that help make sense of the noise coming from a recording or live band.

According to the Indiana University Human Intelligence website, some scientists believe that exposing young humans to music, even while still in the womb, can increase spatial awareness, reasoning and overall intelligence.

Listening to music facilitates the recall of information. Researchers have shown that certain types of music are a great "keys" for recalling memories. Information learned while listening to a particular song can often be recalled simply by "playing" the songs mentally.

Mammarella N, Fairfield B, Cornoldi C. Does music enhance cognitive performance in healthy older adults? (The Vivaldi Effect - Aging Clin. Exp. Res. 2007 Oct;19(5):394-9 PubMed)

William Balach, Kelly Bowman, and Lauri Mohler, from Pennsylvania State University, studied the effects of music genre and tempo on memory retention. They had four groups learn vocabulary words using one of four instrumental pieces - slow classical, slow jazz, fast classical, and fast jazz. Each of the four groups was divided into smaller groups for the recall test. These sub groups used

either the same (i.e. slow classical, slow classical) or different (i.e. slow jazz, fast classical) pieces when taking the recall test.

The results did show a dependency on the music. Recall was better when the music was the same during learning and testing. These same researchers did another test which restricted the changes in the music to just tempo (i.e. slow to fast jazz) or just genre (i.e. slow jazz to slow classical). Surprisingly, the results showed that changing the genre had no effect on recall but changing the tempo decreased recall.

(William R. Balch, Kelley Bowman, and Lauri A. Mohler (1992) - "Music-dependent Memory in Immediate and Delayed Word Recall." - *Memory and Cognition*, 20, pp. 21-28)

Music Training Boosts Memory

Musical training is even better at improving memory than just listening to classical music. There is clear evidence, that children who take music lessons develop a better memory compared with children who have no musical training.

(Ho Y.C., Cheung M.C., Chan A.S., Music training improves verbal but not visual memory: cross-sectional and longitudinal explorations in children. (*Neuropsychology* 2003 Jul;17(3):439-50)

According to a Canadian study on six-year-old children taking piano lessons, as cited in a Forbes article, the children who received music lessons had larger increases in IQ than the control group.

The Canadian study lends support to the idea that musical training may do more for kids than simply teach them their scales it exercises parts of the brain useful in mathematics, spatial intelligence and other intellectual pursuits.

"With music lessons, because there are so many different facets involved, such as memorising, expressing emotion, learning about musical interval and chords, the multidimensional nature of the experience may be motivating the [IQ] effect," said study author E. Glenn Schellenberg, of the University of Toronto at Mississauga.

(E. Glenn Schellenberg - "Music Lessons Enhance IQ" - *Psychological Science*, 15, p511-514 Ontario 2009)

Music Training Boosts Learning

Researchers from the Northwestern University have revealed that musical training indirectly assists in other learning. The researchers reviewed a great deal of data from scientific literature. The data originated from scientists with a variety of scientific philosophies and from laboratories all over the world.

The researchers found that there was a strong connection between musical training and enhanced learning in speech, memory, language and vocal emotion. Lead author of the paper is Nina Kraus, who said that there has been a huge increase in the amount of research on the way the nervous system is affected by music training.

Scientists use the term neuroplasticity to describe the brain's ability to adapt and change as a result of training and experience over the course of a person's life. The studies covered in the Northwestern review offer a model of neuroplasticity, Kraus said.

The data the researchers studied led to the conclusion that when people undergo music training, neural connections are made that prepare the brain for a variety of other types of human communication. The ability of the brain to adapt and develop over the person's lifetime as a response to experience and training is called neuroplasticity.

Neuroplasticity is enhanced by actively engaging with musical sounds, allowing the nervous system to effectively provide the matrix of meaningful patterns that is essential to learning.

Kraus said, "The brain is unable to process all of the available sensory information from second to second, and thus must selectively enhance what is relevant." While playing an instrument, the brain has to select the relevant within a complex process that includes co-ordinating with other musicians, reading a score and maintaining timing.

"A musician's brain selectively enhances information-bearing elements in sound," said Kraus, who further went on to reveal that "In a beautiful interrelationship between sensory and cognitive processes, the nervous system makes associations between complex sounds and what they mean."

As a conclusion, the researchers declared that: "The effect of music training suggests that, akin to physical exercise and its impact on body fitness, music is a resource that tones the brain for auditory fitness and thus requires society to re-examine the role of music in shaping individual development."

(Kraus N, Chandrasekaran B. (2010) - "Music training for the development of auditory skills" - Nature Reviews Neuroscience 11:599-605)

(Patston LL, Hogg SL, Tippett LJ. - "Attention in musicians is more bilateral than in non-musicians" - Laterality. 2007 May;12(3):262-72)

Music improves concentration and attention

Easy listening music or relaxing classics improves the duration and intensity of concentration in all age groups and ability levels. It's not clear what type of music is better, or what kind of musical structure is necessary to help, but many studies have shown significant effects.

(Mammarella N, Fairfield B, Cornoldi C. - "Does music enhance cognitive performance in healthy older adults?"- The Vivaldi Effect - Aging Clin. Exp. Res. 2007 Oct;19(5):394-9)

3. Music Improves Physical Performance

Choosing music that motivates you will make it easier to start moving, walking, dancing, or any other type of exercise that you enjoy. Music can make exercise feel more like recreation and less like work. Furthermore, music enhances athletic performance! Anyone who has ever gone on a long run with their iPod or taken a particularly energetic spinning class knows that music can make the time pass more quickly.

(Simpson SD, Karageorghis CI. - "The effects of synchronous music on 400-m sprint performance"- J Sports Sci. 2006 Oct;24(10):1095-102)

(Edworthy J, Waring H. - "The effects of music tempo and loudness level on treadmill exercise"- Ergonomics. 2006 Dec 15;49(15):1597-610)

(Copeland BL, Franks BD. - "Effects of types and intensities of background music on treadmill endurance" - J Sports Med. Phys. Fitness 1991 Mar;31(1):100-3)

These effects may be due to: -

1. Reduction in the feeling of fatigue
2. Increase in levels of psychological arousal
3. Physiological relaxation response
4. Improvement in motor co-ordination

Music Improves Body Movement and Co-ordination

Music reduces muscle tension and improves body movement and co-ordination. Music may play an important role in developing, maintaining and restoring physical functioning in the rehabilitation of persons with movement disorders.

(Bernatzky G, Bernatzky P, Hesse HP, Staffen W, Ladurner G. - 'Stimulating music increases motor coordination in patients afflicted with Morbus Parkinson' - *Neurosci Lett.* 2004 May 6;361(1-3):4-8)

4. Music Helps Us Work More Productively

Listening to upbeat music can be a great way to find some extra energy. Music can effectively eliminate exercise-induced fatigue and fatigue symptoms caused by monotonous work.

(Jing L, Xudong W. - "Evaluation on the effects of relaxing music on the recovery from aerobic exercise-induced fatigue" - *J Sports Med. Phys. Fitness* 2008 Mar;48(1):102-6)

(Ladenberger Leo E. - "Effect of music on the general feeling of persons performing monotonous work" - *Med. Pr.* 1986;37(6):347-52)

According to a report in the journal *Neuroscience of Behavior and Physiology*, a person's ability to recognise visual images, including letters and numbers is faster when either rock or classical music is playing in the background.

(Pavlygina RA, Frolov MV, Davydov VI, Milovanova GB, Sulimov AV. - "Recognition of visual images in a rich sensory environment: musical accompaniment" - *Neurosci. Behav. Physiol.* 1999 Mar-Apr;29(2):197-204)

5. Music Calms, Relaxes and Helps us to Sleep

Relaxing classical music is safe, cheap and easy way to beat insomnia. Many people who suffer from insomnia find that Bach's music helps them. Relaxing music reduces sympathetic nervous system activity, decreases anxiety, blood pressure, heart and respiratory rate and may have positive effects on sleep via muscle relaxation and distraction from thoughts.

(Harmat L, Taka'cs J, Bo'dizs R. - 'Music improves sleep quality in students'. - *Journal of Advanced Nursing.* 2008 May; 62(3):327-35)

Research by Professor Good and Hui-Ling Lai, published in the *Journal of Advanced Nursing* in 2005 showed that listening to 45 minutes of soft music before bedtime can improve sleep by more than a third.

(Lai HL, Good M. - 'Music improves sleep quality in older adults' - *J. Adv. Nurs.* 2005 Feb; 49(3) p234-44)

Another quantifiable aspect of emotional responses to music is its effect on hormone levels in the body. There is evidence that music can lower levels of cortisol in the body (associated with arousal and stress), and raise levels of melatonin (which can induce sleep). This is outwardly visible in terms of music's ability to relax, to calm, and to give peace. Music is often used in the background hospitals to relax the patients, or in mental hospitals to calm potentially belligerent patients. It also can cause the release of endorphins, and can therefore help relieve pain.

(Lemonick, Michael - "Music on the Brain: Biologists and psychologists join forces to investigate how and why humans appreciate music." - *Time Magazine* June 5, 2000)

Music Reduces Stress and Aids Relaxation

Listening to slow, quiet classical music is proven to reduce stress. Countless studies have shown that music's relaxing effects can be seen on anyone, including newborn babies.

(Labbe' E, Schmidt N, Babin J, Pharr M. - 'Coping with stress: the effectiveness of different types of music' - *Appl. Psychophysiol Biofeedback* 2007 Dec 32(3-4):163-8. Epub 2007 Oct 27)

How Does Music Reduces Stress?

1. Physical relaxation - Music can promote relaxation of tense muscles, enabling you to easily release some of the tension you carry from a stressful day.
2. Aids in stress relief activities - Music can help you get "into the zone" when practising yoga, self hypnosis or guided imagery, can help you feel energised when exercising and recover after exercising, help dissolve the stress when you're soaking in the tub.
3. Music reduces negative emotions - Music, especially upbeat tunes, can take your mind off what stresses you, and help you feel more optimistic and positive. This helps release stress and can even help you keep from getting as stressed over life's little frustrations in the future. Researchers discovered that listening to music can decrease the amount of the cortisol, a stress-related hormone produced by the body in response to stress.

(Khalifa S, Bella SD, Roy M, Peretz I, Lupien SJ. - 'Effects of relaxing music on salivary cortisol level after psychological stress' - Ann N Y Acad. Sci. 2003 Nov;999:374-6)

Information from the web site - <http://www.emedexpert.com/tips/music.shtml>