White paper

The **science** of brain optimization through Sound Therapy c

The cerebral cortex is a rare and complex instrument, requiring special treatment and precise tuning for peak performance. Our brain is a highly integrated network, enabling billions of transactions between neurons every second.

Often compared to a computer, it would be more appropriately compared to an orchestra, where each section has its own job to do, and the coordinated whole is synchronised by the conductor (Johnson 2010.)

Today, the ever-accelerating speed of change requires optimum brain performance to keep pace with work place demands. Without regular practice, the brain (or the orchestra) doesn't perform well.

Directly stimulating the brain with sound in the form of spectrally altered music offers an appealing and time efficient way to achieve significant improvements in brain function.

Research has proven that:

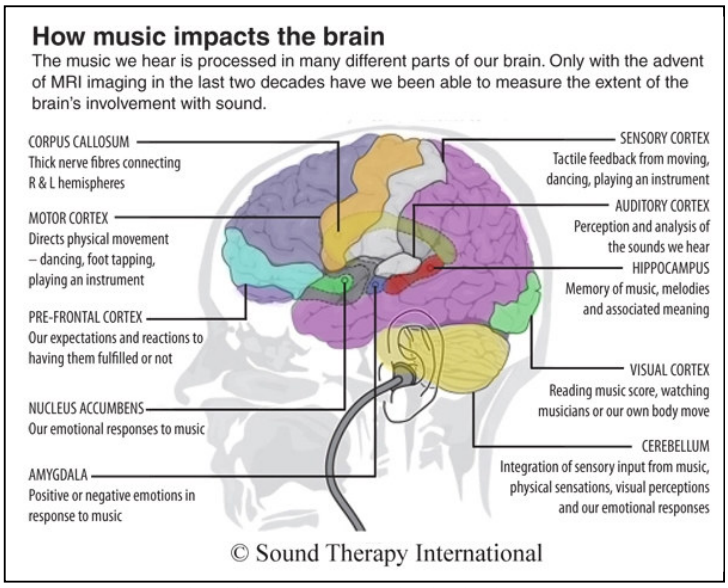
- The ear is the gateway to the brain.
- High-frequency sound is beneficial for the brain
- Complex music builds new brain connections
- Sound Therapy creates links between many parts of the brain
- Left hemisphere stimulation improves brain function

The ear brain connection

The ear has been called " the Rome of the body," for just as all roads lead to Rome, it appears that all cranial nerves lead to the ear. There are twelve cranial nerves which emerge directly from the skull and innervate our primary sense organs and certain functions of the head face and neck. Ten of these nerves are connected to, or interact in some way with, the ear or the hearing nerves. (Weeks1989)

Our auditory sense is the most profound of our sensory systems in terms of its influence on brain function and daily performance. Because perception of sound occurs at all three levels of the brain—the brain stem, the midbrain and the cortex—it affects our functioning more profoundly than we realise. Therefore any stimulation delivered to this system has a profound ability to change brain structures and responses. While brain function can be improved through training and education, another, easier and possibly more fundamental method of improving the brain is through sound stimulation .

High-frequency sound proven beneficial for the brain.



High frequency sounds, including those sounds that are above the range of human hearing, when combined with full range sound have been found to stimulate more alpha activity, thalamic circulation and reward response in the brain. (Tsutomu, 2000.) See Table 1.

Brain science researchers at Kyoto University conducted a study which demonstrated that music containing high frequencies, above the audible range, had a significant effect on brain activity. They identified increased blood flow to certain brain centres along with increased electrical activity. They dubbed at this phenomenon the "hypersonic effect." Tsutomu et al (2003) found that:

"Simultaneous EEG measurements showed that the power of occipital alpha-EEGs correlated significantly with the rCBF (regional cerebral blood flow) in the left thalamus. Psychological evaluation indicated that the subjects felt the sound containing an HFC (high frequency component) to be more pleasant than the same sound lacking an HFC. These results suggest the existence of a previously unrecognized response to complex sound containing particular types of high frequencies above the audible range. We term this phenomenon the "hypersonic effect"."

Researchers suggest that this positive physiological response to high frequencies stems from the fact that

"...the natural environment, such as tropical rain forests, usually contains sounds that are extremely rich in HFCs over 100 kHz. From an anthropogenetic point of view, the sensory system of human beings exposed to a natural environment would stand a good chance of developing some physiological sensitivity to HFCs." (Tsutomu 2003).

This type of sound also made people feel happier and more positive. Subjects felt that full range sound that contained high frequencies was softer, more reverberant, with a better balance of instruments, more comfortable to the ears, and richer in nuance than sound from which high frequencies had been removed. Experiments showed that sound containing inaudible high frequencies naturally occurring in the music significantly enhanced the power of the spontaneous EEG activity in the alpha range when compared with the same sound lacking these inaudible high frequencies.

These sounds were found to cause activation in the deep-lying brain structures, including the brain stem and thalamus. In addition, sound containing hypersonic high frequencies was found to intensify the subjects' emotional pleasure in listening to music. As Tsutomu (2000) states:

"We pay special attention to the fact that FRS (full range sound) is accompanied by an intensification of the pleasure with which the sound is perceived, and envisage the participation of the neuronal pathways in

connection with reward-generating systems (Cooper 1991; Olds and Milner 1954; Wise 1980),"

Researchers established that the high frequencies must be naturally contained within complex music in order to have these beneficial effects and cannot be achieved simply in response to isolated frequencies above the audible range.

The probable neurological cause for high frequency sounds to have such a profound effect on our brain function and well-being is that high frequencies appear to affect our limbic system, (the deep lying part of the brain which plays an important role in the control of emotions) and the way in which different types of sensory information gain access to the cortex—our thinking brain. Tsutomu (2003) states:

"The activation of the thalamus may reflect its function as part of the limbic system, which also plays an important role in the control of emotions (LeDoux 1993; Vogt and Gabriel 1993). It might also reflect the role of the thalamus in gating sensory input to the cortex (Andreasen et al. 1994)."

Complex music builds new brain connections.

The science of brain plasticity has proved in recent decades that sensory stimulation results in the creation of new brain pathways. Frequent repetition of complex cognitive behaviours such as music practice causes an increase in the volume of the cerebellum, a portion of the brain involved in integrating different types of sensory input. (Waever 2005.)

Sound Therapy creates links between many parts of the brain.

Multiple brain centres are used for sound so that different parts of the brain fire in response to the identification of, for example, pitch, rhythm and melody. Such distinctions were identified first by Penfield, famous for mapping the Homonuculus, which maps certain functions to particular brain centres. (Penfield 1958.)

Western classical music, which combines the richest tapestry of complex and varied rhythm, melody and harmony, is therefore accepted as the most beneficial type of music for brain development.

In particular, Mozart was found to improve attention and spatial reasoning by increasing alpha brain waves as measured by EEG,
(Jausovec 2003.)

Listening to music at an early age is also known to improve the type of spatial-temporal reasoning that underlies maths, engineering and chess. (Science, 1998)

Left hemisphere stimulation improves brain function

Musicians have greater brain asymmetry. Outstanding musical ability is associated with musically related functions being located more specifically in the left brain, (Schlaug, 1995.)

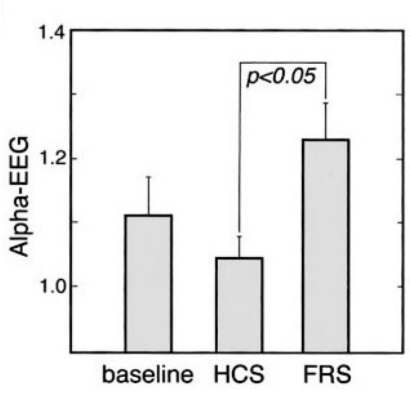


Table 1. Graph showing increased alpha responses to Full Range Sound containing high frequencies, as opposed to High Cut Sound, with diminished high frequencies. Tsutomu, 2000.

Sound Therapy: the definitive tool for brain stimulation

Sound Therapy draws together these principles of musical stimulation to increase brain efficiency. The entire nervous system is influenced via many points of access through the cranial nerves. (Weeks 1889, Joudry 2009.)

Enhanced high frequencies are introduced through special filtering algorithms which raise the natural high frequency content of classical music to a point of saturation, providing the brain with its optimum levels of stimulation. According to Dr Alfred Tomatis, the French ENT who pioneered the development of Sound Therapy, the brain requires 4 billion stimuli per day in order to function at maximum potential. (Tomatis, 1991.) This level of stimulation can be guaranteed with a daily Sound Therapy regimen.

The brain responds to complexity. Classical music alone is naturally more complex than other forms of music and the introduction of the Sound Therapy filtering further adds to this complex and stimulating mix.

New learning builds new brain connections. (Doidge, 2008.)The progressively increasing high filtering pattern in Sound Therapy progressively builds, layer on layer, helping the brain to restructure itself for improved memory and computation.

Certain left hemisphere centres are known to improve mood, attention and linear sequential processing needed for rational thought. Sound Therapy specifically targets these centres, leading to improved cognitive and affective responses to demanding life situations. (Tomatis 1991.)

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