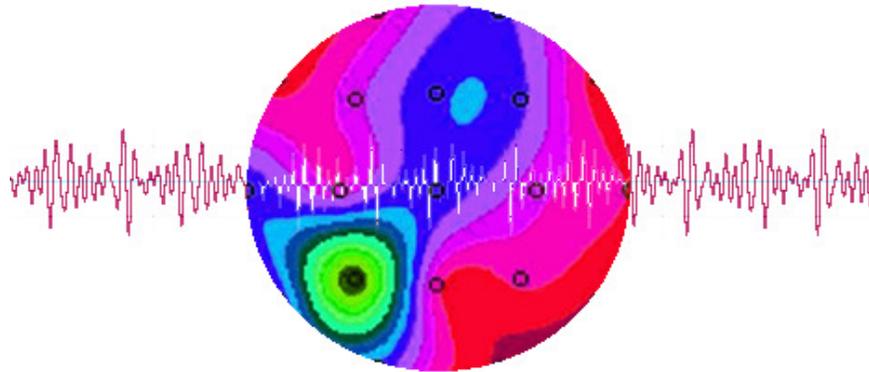


BINAURAL BEATS, BRAIN WAVE ENTRAINMENT AND THE HEMI-SYNC PROCESS



(Curtis 2007e)

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ABSTRACT

This thesis explores binaural beat frequencies, brain wave entrainment and the Hemi-Sync Process as developed by the Monroe Institute. This arching field encompasses psychoacoustics and the technological applications for alteration of brain waves within humans.

The first chapters explore the background and connection that binaural beat frequencies have in affecting the entrainment of brain waves. They examine how sound processed under certain conditions when mapped to brain wave states could induce a frequency following response – where the brain waves follow the sonic input. This in turn could be used for therapeutic applications upon human subjects. The final chapter culminates with an analysis of the Hemi-Sync Process from the Monroe Institute and the marketing and advertising angle they use in promoting their product.

As an addition a CD-ROM is included with audio, visual and textual examples. In the practical application of this work, a software program was created to extend programming skills and a practical hands-on approach, with possible application for use in further studies.

DECLARATION

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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INTRODUCTION

This thesis will examine the workings and role of binaural beats within the context of affecting brain waves in human subjects and analysing closely the commercial application of binaural beat frequencies through the Monroe Institute's Hemi-Sync Process. The purpose of analysing and examining this audio technology is to assess the validity in using the Process for future research purposes, therapeutic and medical applications. Though scientific evaluation and testing has been carried out, from the use of internet resources it becomes apparent throughout this thesis and, wherever possible, proper research was sought out, in order to present a more detailed examination of the application of binaural beats.

The field of binaural beats has been used in the medical and self-help domain for over 30 years and there is scientific evidence to suggest it may be a unique science that can be used for therapeutic application. It was in the researcher's study of the topic and as a result of confusion over the last couple of years that has led to the examination of binaural beats and its application. Then it was as a result of the experience of listening to the audio compact discs utilising Hemi-Sync Processes that led this researcher to see if this specific Process does actually work and if it has future potential for research and application. In the greater context, it was found that the interaction of psychological and physiological factors played a vital role. Thus it is necessary for interdisciplinary research to be undertaken. It is evident from serious scientific research circulating in the official academic journals that the Hemi-Sync Process carried out by the Monroe Institute stands out as one of the most controversial applications of the use of binaural beats.

It becomes apparent very quickly that there are many factors that affect brain wave activity. This, in the researcher's opinion is not recognised nor brought into the equation of many binaural beat studies. The Hemi-Sync Process is different. It claims that it is these other physiological and psychological factors which augment the whole process and make it work. It is by understanding brain wave entrainment and how these can be mapped to binaural beat frequencies that the whole therapeutic domain opens up for the scientific evaluation. The Monroe Institute appears to be dominant in the commercial market place. It is then the serious researcher who has to wade through the glossy campaigns and what some scientists consider 'pseudo-scientific' disciplines employed by the Institute. It does become apparent that the Hemi-Sync Process may be on the 'right track' in

reconsidering this complex interplay of physiological and psychological factors that have been shown to affect brain waves.

The main points that this thesis address include an introduction to binaural beats, which explores how the beats are created sonically and how they operate within the brain. Chapter 2 deals with brain waves and understanding the different brain wave states. Chapter 3 examines with how binaural beats might be able to entrain brain waves for therapeutic use. Chapter 4 explores on a deeper level the Hemi-Sync Process at the Monroe Institute, and how the Institute uses marketing and advertising. It explores how this could have either positive or negative effects for serious scientific research.

In terms of the audio examples provided, this researcher has attempted to explore the inner workings and specific overall ideas of sonic workings of binaural beat frequencies. In the case of the Monroe Institute's Hemi-Sync Process and its specific frequency patterns, besides the journal examples, limited in scope, the specific details of the Process are not easily accessible due to patents and professional membership requirements. Postgraduate students are made aware that specific recordings of binaural beat frequencies are available from the Monroe Institute to further their research if firstly they can get their research idea accepted. Unfortunately this thesis did not qualify and the reason becomes apparent in the last chapter. Audio files, textual and movie examples are provided on a complementary CD-ROM as an appendix to this document.

CHAPTER 1: INTRODUCTION TO BINAURAL BEATS

Binaural beats are auditory phenomena that occur within the brain. Correctly termed 'auditory beats in the brain' they were popularised by Gerald Oster, a researcher into in the auditory phenomena. According to Oster it was a German researcher Heinrich Wilhelm Dove, a professor of physics who in 1841 discovered the phenomena of binaural beats (Oster 1973b : 1). Following on from Dove's research, Oster further explored how binaural beats operate and the findings were published in the *Scientific American* (Oster 1973a). According to Oster, binaural beats can be created by sending separate distinct tones to each ear to produce a third 'phantom' beat within the brain which is perceived by the brain as a real distinct sound. Thus binaural beats occur when the brain detects a phase difference which is perceived as a fluctuating rhythm (Atwater 1997).

To create binaural beats the following conditions must occur:

- A single carrier tone (sine wave), for example, 400 Hz is presented to the left ear via a pair of head phones.
- A single carrier tone (sine wave), for example, 410 Hz is presented to the right ear via a pair of headphones.

Illustrated it would look like the following, also Audio Example 1:

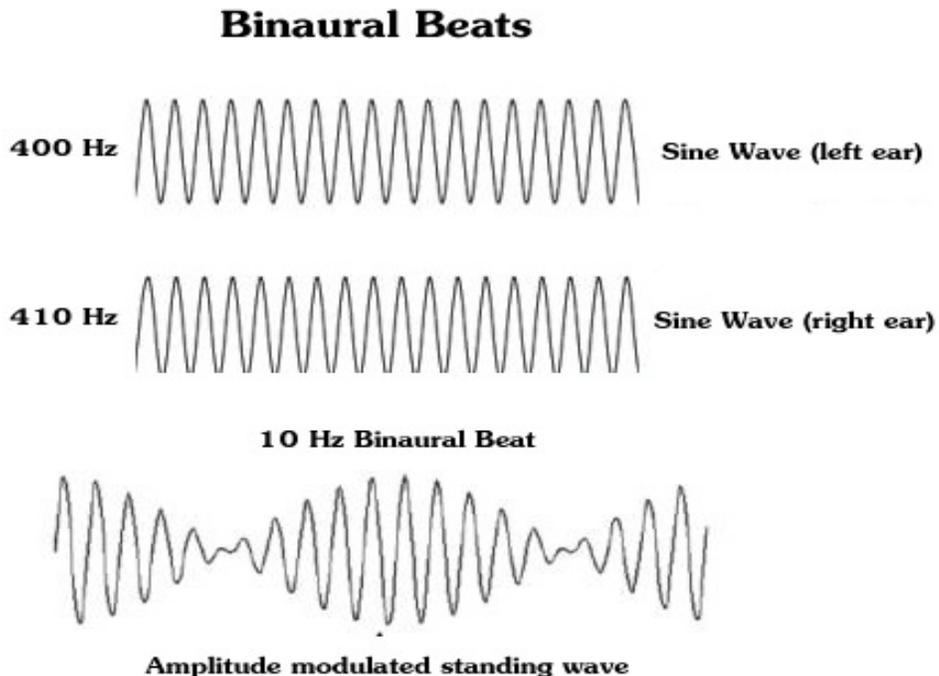


Figure 1: Binaural beats (Curtis 2007a)

In this case both carrier tones 400 Hz and 410 Hz are the same amplitude and therefore the output would result in a 10 Hz amplitude modulated standing wave, called a binaural beat. The unique effect of binaural beats is that the amplitude of each carrier tone does not need to be static to create the desired effect.

Binaural Beats and Psychoacoustics

As phenomena, binaural beats fall within the field of psychoacoustics. Psychoacoustics is the study of the impact of sound within the brain (Moore 2006), or 'the study of auditory sensory responses to the physical stimuli of sound waves' (Crowe 2004c : 55).

Joshua Leeds explains psychoacoustics as:

...the study of the perception of sound, how we listen, our psychological response, and the physiological impact of music and sound on the human nervous system. Applied psychoacoustics is how we put this into practice (Leeds 2001c :2).

The field of psychoacoustics investigates how binaural beats are perceived through different electronic devices. There are two mediums for this delivery into the ears. These are headphones and specifically arranged speakers. Oster (1973b : 1) states earphones create the correct conditions for binaural beats to work, though they can work to a lesser degree with a correct speaker arrangement (Monroe, 2006). The reason that speaker arrangement does not create the correct effect is because as individual sound waves leave the speaker they mix in the air first and create a unified wave, rather than two distinct waves from headphones (Atwater 1997). Music technologist Curtis Roads expounds on this topic:

In psychoacoustic research binaural originally referred to a unique listening situation in which subjects are placed in an anechoic chamber with their heads held still by a mechanical restraints and probe tubes inserted into their ear canals. This binaural effect is best employed through headphones due to the ability of the brain to create a specific illusion of sound at a particular source. Called the 'binaural field' this is known as the space perceived through headphones (Roads 1996 :469).

According to the late Robert Monroe, working with headphones can produce unique and complex effects from binaural beats. For example he states, 'If the intensities of the right-ear and left-ear tones are different, an apparent elliptical orbit of the beating develops' (Monroe 2006). This effect and binaural beat effect in general is due to the psychoacoustic response within the brain by way of the diffraction effect. This diffraction occurs through the following process:

...the frequencies at which binaural beats can be detected change depending upon the size of the species' cranium. In the human, binaural beats can be detected when carrier tones are below approximately 1000 Hz. Below 1000 Hz the wave length of the signal is longer than the diameter of the human skull. Thus signals below 1000 Hz curve around the skull by diffraction (Atwater 1997).

'Diffraction' according to the definition in *Grove Music Online* relates to the path sound takes. For example, Taylor says:

the easiest way to demonstrate this effect is to listen to a high-pitched, steady note in a room; sound will be received direct from the source and also by reflection from the walls and the relative path lengths will depend on position, so that the sound heard can be made to rise and fall in loudness by moving the head (Taylor 2007).

Diffraction is one example of how our perception is altered by the brain's interaction with different frequency ranges of sonic input. There are other factors that must be taken into account besides the carrier wave staying below 1000 Hz. This, according to Oster (1973a), is that the difference in frequency must be between 1 Hz and 30 Hz. This modulation range of the carrier range ties in with the human brain waves and will be explored more in coming chapters.

What is the Neurological Basis of Binaural Beats?

There is common agreement that binaural beats originate in the superior olivary nuclei. Dale Foster, a researcher at the Monroe Institute, agrees with Oster and states 'binaural beats are auditory brainstem responses which originate in the superior olivary nucleus of each hemisphere' (Foster 1990).

It is important to point out that binaural beats do not operate in the same way as beat frequencies we hear on a guitar (Greated 2007). Rather, they are perceived as Foster (1990) explains, as an auditory beat. Below is a diagram illustrating Oster's explanation of how the ear responds to frequencies of binaural beats.

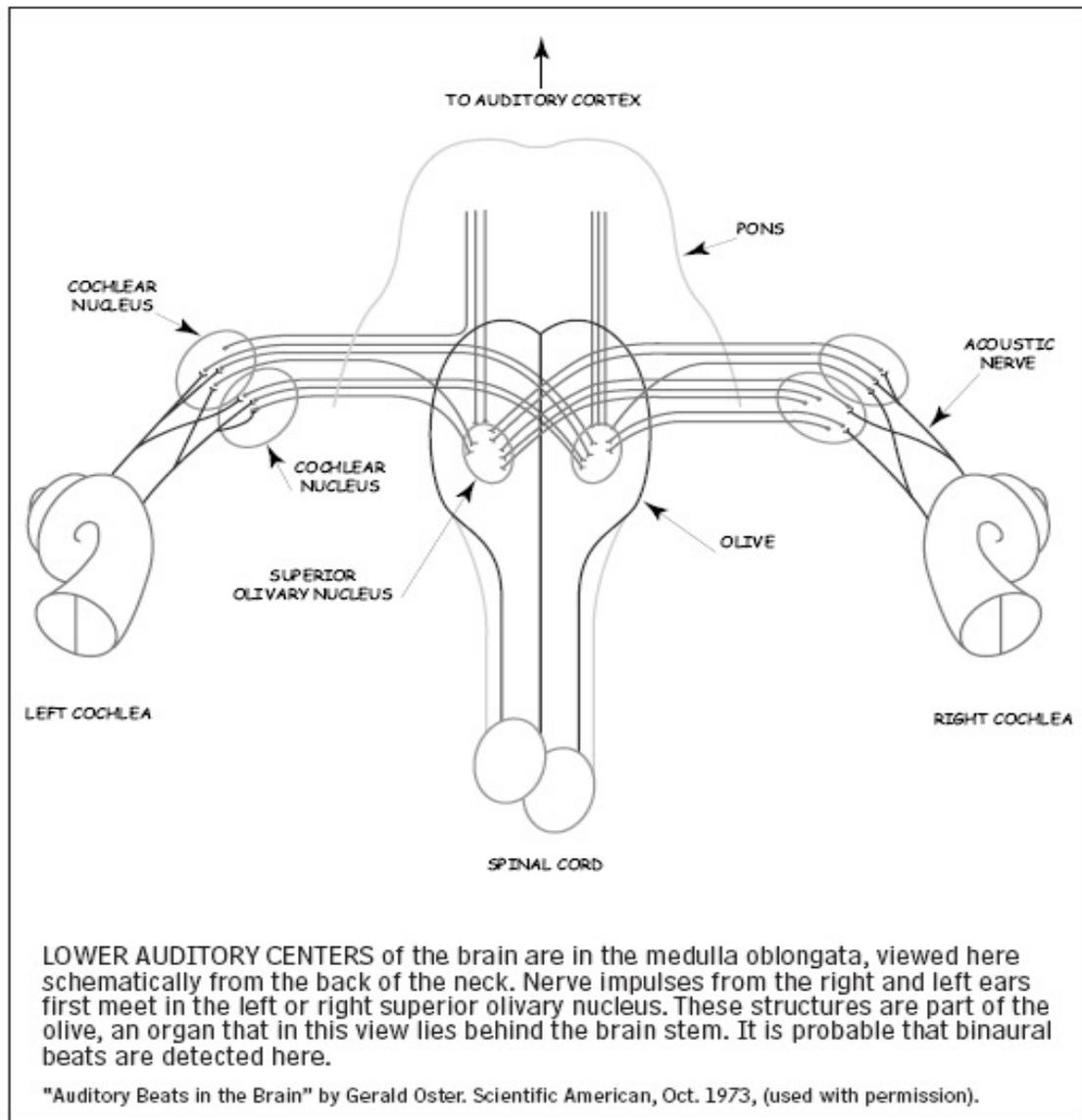


Figure 2: Lower auditory centres (Oster 1973a)

According to research on the superior olivary nucleus there is a signal to different parts of the brain. From different sections of the brain, measurements can be taken to show that the audio stimulus of the binaural beat creates recognisable changes within different sections of the brain. This is connected with brain wave activity which will be explored in following chapters. There are many

studies looking at this effect, for example, (Gerken, Moushegian, Stillman and Rupert 1975) and (Sohmer, Pratt & Kinarti 1977).

Simple and Complex Binaural Beats

In understanding how binaural beats can be used in different combinations, the following illustrations show the difference between two carrier and multiple carrier tones, with binaural beat modulation.

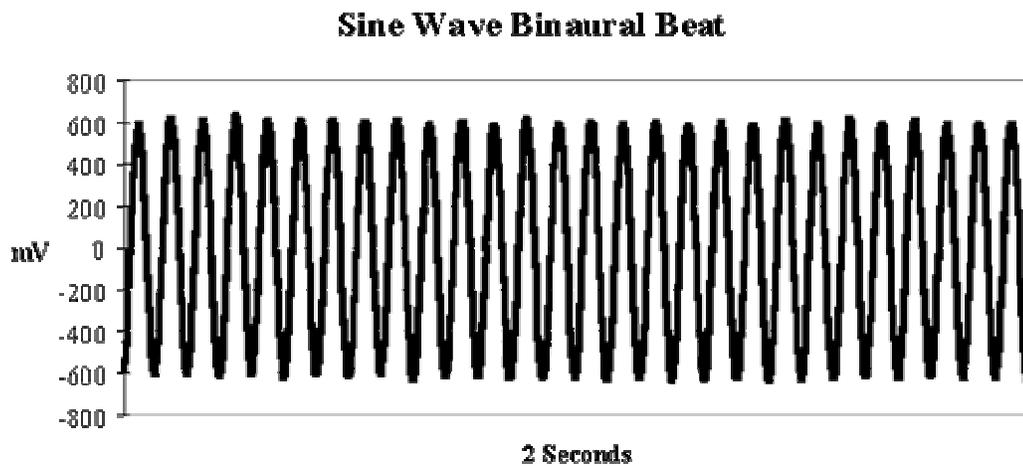


Figure 3: Simple binaural beat (Atwater 1997)

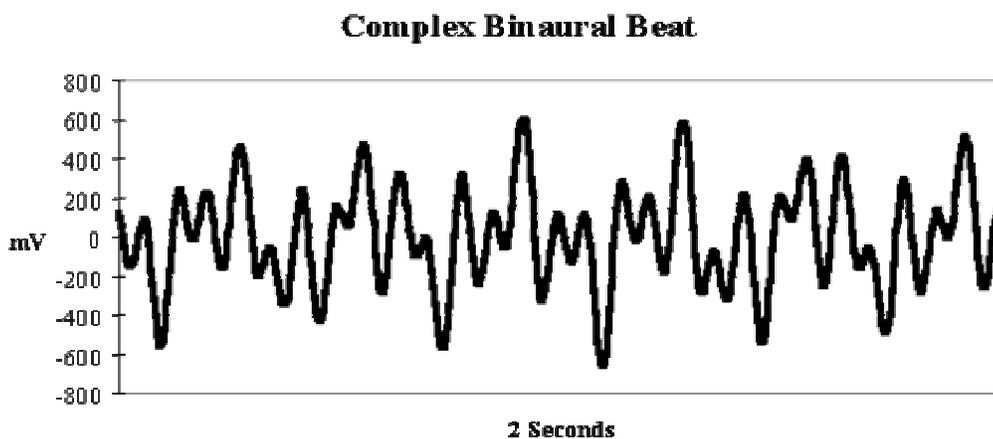


Figure 4: Complex binaural beats (Atwater 1997)

Unfortunately frequency data is not supplied for the second image, but if we were to represent the second image in a hypothetical formula of multiple frequencies the complex binaural beat can be expressed as the following, also Audio Example 2:

$400[4], = (398 \& 402): 500[4], = (498 \& 502): 600[4.0], = (598 \& 602): 750[8.0], = (746 \& 754).$

Where say 398, 498, 598, 746 are presented to the left ear and 402, 502, 602, 754 are presented to the right ear. Where the modulation of 4 Hz, (398 - 402) 4 Hz, (498 - 502) 4 Hz (598 - 602) and 8 Hz (746 - 754) are the modulating frequencies developed by the researcher from analysis of examples similar to current complex binaural beat research.

According to Oster (1973a) and Atwater (1997) binaural beats are auditory phenomena of the brain explained by the process of diffraction. Binaural beats could not be fully explored in this short section, but evidence was examined to support the neurological validity of binaural beats, including psychoacoustics which will be explored more fully in the last chapter. The brain is a complex system and there is enough evidence to prove that binaural beats certainly do exist under certain conditions, using specific ranges of carrier tones and their modulations.

What is interesting is that the modulations, according to Griffiths et al. (2005) really only occur in the 0 > 30-40 Hz range and this is characteristic of human brain waves which Chapter 2 is going to explore.

CHAPTER 2: BRAIN WAVES

The knowledge of the origin of brain waves in human subjects extends back to the 1920s when Hans Berger, a German psychiatrist, invented the Electroencephalograph (EEG), (Delbridge 1992). This is read as a brain wave test where 'brain cells communicate by producing tiny electrical impulses. In an EEG reading electrodes are placed on the scalp over multiple areas of the brain to detect and record patterns of electrical activity' (Campellone 2004). This electrical activity of the brain waves is present, according to Rein (2004 : 60) in the extremely low frequency (ELF) portion of the electromagnetic (EM) spectrum. The brain waves are categorised by four to five main power spectrums and may relate directly to certain psychological and physiological states for instance:

Beta 12 Hz to 22 Hz: high state of arousal and some drug effects;

Alpha 8 Hz to 12 Hz: sedation, hypnosis and relaxed but focused sports activities;

Theta 4 Hz to 8 Hz: deep hypnosis, dreaming; **Delta** 0.5 Hz to 4 Hz sleep, general anaesthesia; **Gamma** above 22-30Hz (Griffiths et al. 2005).

This can be illustrated in the following image that shows spectral power examples at 6, 40, and 10 Hz measured at various electrode sites:

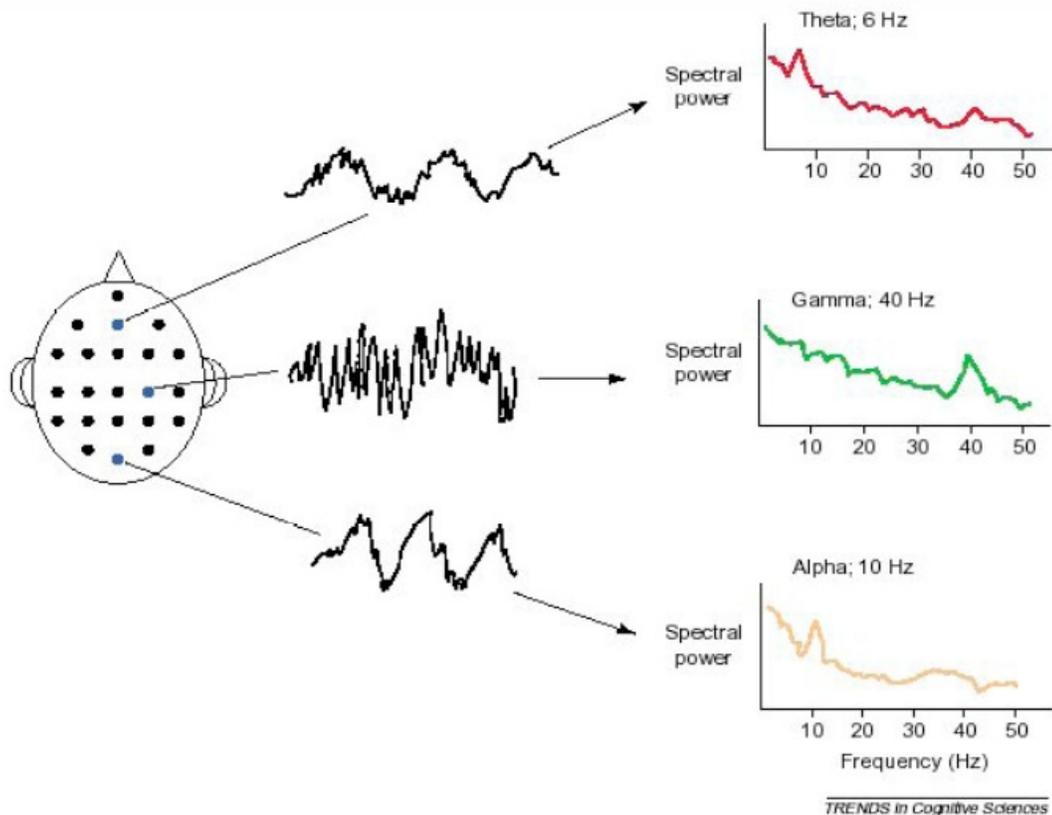


Figure 5: Brain waves (Turow 2005)

The Importance of the Different Brain Wave States

The main application of the EEG is its ability to read the real time variations in brain wave states. This is useful in understanding certain severe mental conditions like epilepsy, arousal, coherence of brain waves in meditation and in the sleep cycle. The sleep cycle is a good example of the brain waves changing as they descend from high spectrum power, that is, Beta brain waves, to low spectrum power, that is, Delta brain waves (Greenfield 1997 : 52-56).

Since Berger's discovery that electrical activity can describe brain functioning by EEG, new findings have emerged in Quantitative EEG (QEEG) by computer methods used to measure EEG activity in humans (Cantor 1999 : 22-23). Instead of raw EEG printed data, according to Evans (1999), large volumes now can be processed through computerised EEG analyses. These have been able in turn to detect subtle changes in neurological conditions.

This research has allowed a vast database of a variety of brain wave states to be documented. From the analysis of this data of QEEG research it is known that various frequency ranges of brain waves reflect positive and negative mind-body conditions. The practitioner attempting to correct brain wave states can do so through feedback applications that can be approached by the control of brain waves using electronic instruments to measure physiological factors, such as blood pressure, skin temperature (Scott 1976 : 248). This feedback can be modified via chemical means or conscious control and gives the human subject the means to induce the desired brainwave state to correct the physiological or psychological condition that is out of balance. A clinical application of this would be as follows:

If QEEG findings reveal a disproportionate ratio of theta to beta amplitude in a given brain region (compared to the normal), a computer game in which one needs to keep a 'Pac-Man' moving solely by developing a more normal theta/beta amplitude ratio is conducted during a therapeutic session (Cantor 1999b : 21-22).

There can be made changes in brain wave states either by chemical or conscious means. The changes in brain wave states in relationship to the specific physiological and psychological conditions have not been explored in this chapter. This evidence is very controversial and would move this argument into the medical field and its related terminology.

Barbara Crowe, music therapist, explains that brain waves in certain instances are connected with certain proper functioning of human systems.

Brain waves are harmonically organized with alpha being twice theta and beta being twice alpha. No healthy individuals show non-harmonic EEG patterns. These abnormal EEG patterns either cause disease or reflect a disease state. In fact, certain EEG (brain wave) frequencies are also directly involved in proper immune functioning. Delta brain waves foster the production of many immune chemicals [Rider, 1997]....Alpha waves may also play a role in immune system function (Crowe 2004b : 23).

The reason why this overview of brain waves is so important is that along side the discipline of 'feedback' and EEG experiments there is another area of research that is not very well known but has developed a vast database of information. This area deals with sound and how it can be used to affect brain wave change in human subjects.

Although feedback is not directly employed as described in this chapter certain electronic devices using sound are used to affect the brain waves of human subjects. This new field works with what was explained in the first chapter about binaural beat frequencies and was explored in this chapter about brain waves. Thus just by the mere ability of certain sound combinations to create alterations in brain wave states there may be a path by which sound and medical researchers could explore to create positive changes through non-invasive means.

CHAPTER 3: BINAURAL BEATS, BRAIN WAVES AND ENTRAINMENT

This chapter, dealing with the hypothesis that binaural beats can affect brain waves, ties together the first chapter on binaural beats and the second chapter on brain waves. There have been two key areas for the use of binaural beats: one to measure psychoacoustic responses within the brain (Oster 1973a); and the second, to modify brain wave states to create a positive effect in the physiological and psychological state of human subjects, by restoring 'normal' healthy brain wave patterns (Leeds 2001c : 325). In understanding how binaural beats can affect brain wave states, it is important to draw upon both areas in order to see how there might be a case for this effect.

Overview

Unlike other modalities that induce changes in brain wave states, that is, music, narcosynthesis and meditation, binaural beats operate on a slightly different premise. It was claimed by Atwater in 1997 and by Leeds in 2001 that binaural beats are able to affect specific brain wave patterns by mapping raw EEG data of human brain waves onto specific sound patterns thus producing binaural beats. The theory extends into ideas of entrainment which states, according to Sauve (2004 : 80), 'two or more close frequencies locking in rhythm with each other can modify certain brain waves states'. An example of this would be if the binaural beats are created in the alpha frequency range. When listening to these sounds hypothetically the brain waves should modulate from their current state to that alpha state associated with the binaural beat. Thus the frequency of the binaural beat can be selected to produce particular EEG-associated states. One would assume that this theory is simple and easy to document, but this researcher has found the contrary. Dealing with the human brain and its intricate workings, there are many factors that need to be taken into account when modifying a subject's brain waves. The question that must be asked is: are all the mind-body variables taken into account? One example could be to use brain waves that mimic healthy 'normal' states in human subjects. Any research must address the exact patterns of binaural beat frequencies that are needed to modulate the EEG patterns into the desired state and establish if certain brain wave states are therapeutic. These are important factors that are not fully covered by this thesis because a medical background would be needed. If there is indeed evidence for this above-mentioned effect then further testing of all these variables would need to take place.

The ability to modify brain waves came to the mass attention in the early 1970s. Probably the most well known is the alpha wave movement that gained popularity in the early 70s when scientific studies were done on Transcendental Meditation (TM). The meditators had the ability to control certain brain wave states like alpha (in the range of 7-10 Hz), (Lutz, Dunne & Davidson 2006). According to these studies the 'mind awake, body asleep' or alpha state could be created at will by advanced meditators. The results varied but the 7-10 Hz alpha range was established as the general range that could be created (Wallace 1970; Brown 1979). Whether or not these frequencies can induce therapeutic states is still open for evaluation.

Likewise music, according to Barbara Crowe, a music therapist at the University of Arizona, can produce similar effects. She explains:

Music has been associated with the production of various brain wave states, especially production of alpha waves (Crowe 2004g : 315).

In particular Crowe notes that:

... Research though not conclusive has indicated that sedative music can produce an alpha brain wave state (Russell cited in Crowe 2004f : 219).

Along side these modulates of music and meditation that affect brain wave patterns, binaural beats were being explored as an alternative to these other modalities. The area of binaural beats has been researched since the 1970s and more recently has surfaced in academic peer reviewed and alternative medicine journals.

If the theory is correct that brain wave states can be changed from external stimuli like binaural beats then from a medical standpoint it would be beneficial to explore brain wave patterns to restore balance and health to an individual. The implementation of this would need to take into account the physiological and psychological domains of the human subject. This thesis is not intended to prove that binaural beats can create therapeutic states, rather to look at the evidence for the ability of binaural beats to change brain waves states into certain frequency ranges, which may create therapeutic qualities. These theories would need to be further explored in pilot studies and controlled experiments.

Explanation of the Effect of Binaural Beats on Brain Waves

The ability of binaural beats to affect brain waves is believed to depend on the principle of brain wave entrainment. Entrainment in the general context is explained as follows:

The principle of entrainment is of two or more close frequencies locking in rhythm with each other. It was first discovered in 1665 by Huygens, who worked with pendulum clocks. He noticed that if he started the pendulums all at different times, they would eventually synchronize their beating or entrain with each other (Sauve 2004 : 80).

Within this field of binaural beats and brain waves according to Crowe:

Entrainment is a term in psychoacoustics that refers to the effects of a repetitive sound pattern on brain wave patterning (Kenyon cited in Crowe 2004h : 316).

Binaural beats have naturally occurring within them certain rhythmic patterns, for example, an Alpha frequency of 8 Hz cycles per second over a given time period creates a periodicity or repetitive sound pattern. According to Leeds resonance is the overarching process where entrainment, sympathetic vibration, resonant frequencies and resonant systems all fall under the field of resonance. It is by these principles entrainment is put into practice and internal body systems can be affected, that is, brain wave states. In understanding the forces of resonance for one system to entrain another Leeds puts forth three key rules 1. The resonance rule. 2. The power rule and 3. The consistency rule. The first rule delineates that the system being affected must be capable of achieving the same vibratory rate, that is, the systems have to be physically similar. The second rule is that the first system must have sufficient power to overcome the second system and the third rule explains that the frequency pattern that is to effect the secondary system must be constant and have a regular periodicity or rhythmic pattern (Leeds 2001b : 40). In order to apply these rules to entrainment of the brain waves we need to refer to chapter 1 where it was discussed that binaural beats were created in each hemisphere's olivary nucleus. Atwater explains the following in relation to EEG patterns being affected:

Such binaural beats will entrain both hemispheres to the same frequency, establishing equivalent electromagnetic environments and maximizing inter-hemispheric neural communication (Atwater 1988).

This theory of brain wave entrainment works with the left and right hemispheres of the brain, which work together to produce a third electrical signal, which is perceived as a real sound. This naturally occurring effect within the brain is a by product of the two hemispheres of the brain working in unison in order for this effect to occur. Whether or not this causes a significant change in brain wave frequencies is what is explored in this chapter. The idea that these can create therapeutic effects through certain complex brain wave states can only be determined from the real medical EEG scans on healthy subjects, and then rests on the subjects' brain waves being modulated by binaural beats to these desired 'healthy' base line states. Brain wave entrainment and hemispheric synchronization are the key terms that need to be understood and be kept in mind.

Frequency-Following Response (FFR)

There is much confusion relating to the frequency-following response relating specifically to brain wave entrainment and production of a synchronisation of the whole brain. Atwater proposes that the EEG frequency-following response (FFR) is connected with binaural beats. The FFR according to Atwater is 'the result of a low-level coherent oscillation within the central nervous system and the brainstem in particular' (Atwater 2001). According to Smith et al. (1975) 'the response was originally termed "frequency-following response" because its waves reproduce the fundamental frequency of sine-wave stimuli in the range of 100-5000 c/sec' (Smith et al. 1975 : 465). There are many studies looking at his effect and where binaural beats have validity (Gerken, Moushegian, Stillman & Rupert 1975 & Sohmer, Pratt & Kinarti 1977).

Another binaural beat researcher, Bill Harris, explains this process in connection with binaural beats:

...[P]hased sine waves at discernible sound frequencies, when blended to create 'beat' frequencies within the ranges of electrical brain waves found at the various stages of human sleep, will create a frequency-following response (FFR) within the EEG pattern of the individual listening to such audio waveforms. The FFR in turn evokes physiological and mental states in direct relationship to the original stimulus. With the availability of this tool, it becomes possible to

develop and hold the subject into any of the various stages of sleep, from light Alpha relaxation through Theta into Delta and in REM (dreaming).

His conclusion was that 'Binaural beat-frequency stimulation creates a sustaining FFR that is synchronous in both amplitude and frequency between the brain hemispheres' (Schul in Harris 2002 : 136).

Likewise Atwater's research at the Monroe Institute seems to conclude that the frequency-following response is not directly responsible for entrainment, because the EEG signal strength is much too low. Atwater states:

Continuing research revealed, however, that there is no effect-mechanism to support the notion that entrainment of the auditory frequency-following response could occur or is responsible for alterations in consciousness. Comparisons to photic entrainment models are not supported because the EEG signal strength of the measured auditory frequency-following response of binaural beats is too low. At this point it is hard to even speculate that the neural activity of the frequency-following response could, in some electromagnetically inductive way, alter ongoing brain-wave activity (Atwater 1997).

In order to understand how the FFR may affect the brain wave states via binaural beat frequencies it may be important to consider Altshuler's comments which describe even the smallest change in the brain affects brain waves.

The cerebral hemispheres are in a perpetual state of rhythmic swing-day and night. Even the slightest change in the body, such as opening or closing of the eyelids, causes a change in brain rhythm. These brain waves differ in emotional states, fever, intoxication, infections, and such conditions as epilepsy (Altshuler in Gardner 1997 : 87).

What is interesting is that proponents of binaural beats claim that they can create certain effects that differ from random conditions of music and different emotional states. One example that the author has encountered of these factors operating is in the use of Hemi-Sync technology which was developed at the Monroe Institute in the early 1970s (Monroe 2006). This incorporates complex binaural beat patterns as its core audio technology. Dr. Sadigh, a researcher and experimenter in this

field, explains that instead of using forced entrainment, it may be through collaborating with natural rhythms of the brain that entrainment may be possible.

Dr. Sadigh states:

One important observation that we made in a number of Hemi-Sync studies was that subjects exposed to the same Hemi-Sync signals achieved bilateral synchronization at different frequencies. One explanation for this phenomenon is that Hemi-Sync goes beyond 'blind' entrainment. That is to say, unlike other brain-entrainment modalities which force the brain to produce certain frequencies, Hemi-Sync actually collaborates with the brain to enhance its naturally dominant state (Sadigh 1997).

Researchers taking this theory further have suggested that the Reticular Activating System (RAS) may play a key role in the effect of the brain wave patterns.

Reticular Activating System (RAS)

According to research by Crowe (2004q) Monroe (2006) and Atwater (1997), it is the Reticular Activating system (RAS) that affects brain waves and altered states of consciousness. The RAS is located in the brainstem and according to Atwater helps maintain homeostasis or internal stability. This then connects with the extended reticular thalamic activation system (ERTAS) and might be considered the most important system in application of binaural beats frequencies (Atwater 1997).

This system is most commonly known to connect with emotion, attention, wakefulness and sleep. According to McMurray (a psychology graduate student at the University of Nevada) the RAS is a 'large net-like region in the brain stem, plays a major role in filtering sensory input and focusing attention and awareness and is strongly involved in the cortical processing of binaural beats' (McMurray 2004).

The binaural beat process involves many complex factors. Without denying the innate connection of the mind-body system, it makes sense that other processes would need to be involved. One that is important is the science known as Psychoneuroimmunology (PNI); this is how the mind impacts upon the body – the mind/body connection. More information on this connection is addressed in detail by

Barbara Crowe in 'Music and Soul Making' (Crowe 2004d : 214-217). The mind-body interface, according to the Hemi-Sync Process, is vital in allowing the RAS to be affected. This is because the RAS maintains the internal homeostasis in the body and if that cannot be bypassed then the brain will not accept this new information.

Barbara Crowe states:

As explored previously, auditory nerve input has an effect on the reticular activating system and allows sound to provide a high level of novel information through its complexity (Crowe 2004e : 215).

Even though the body is seen as wanting to attain equilibrium, Atwater suggests working with levels of autosuggestion and breathing, then close-mapping of the complex brain waves with complex binaural beats. In this way, he suggests, the mind-body connection can come into action.

Atwater explains:

In order to alter arousal states, attentional focus, and levels of awareness, it is necessary to provide some sort of information input to the RAS. Hemi-Sync's binaural beats provide this information. The information referred to here is the complex, brain-wave-like pattern of the Hemi-Sync binaural beat. This unique binaural-beat (neurologically evidenced by the EEG frequency-following response) is recognized by the RAS as brain-wave pattern information. If internal stimuli, feelings, attitudes, beliefs, and external sensory stimuli are not in conflict with this information (e.g., an internal, even unconscious, fear may be a source of conflict), the RAS will alter states of consciousness to match the Hemi-Sync stimulus as a natural function of maintaining homeostasis (Atwater 1999).

Therefore, in order to understand hemispheric synchronization and binaural beat frequencies and their effect on brain waves, it may be important to study in detail the PNI connection of mind-body interaction, which the Monroe Institute is actively experimenting with. This process is so complex it is hard to tell in double blind studies what impacts on which system. It is evident that the Monroe Institute has spent thousands of research hours finding which complex binaural beat frequencies work most effectively. Unless the researcher gains insight into the system of measurement with specific testing methods and machine type, a more stringent process and examination may be needed (Griffiths et al. 2005).

Therapeutic Evidence

The evidence supporting the affect of binaural beats on brain waves within the context of therapeutic applications was discovered when Lane, Kasian, Owens & Mars used an approach in their study 'Binaural Auditory Beats Affect Vigilance Performance and Mood'. They found that the binaural beats in the beta range during a 30-minute vigilance task resulted in smaller increases in task-related confusion and fatigue compared to theta/delta beats (Lane, Kasian, Owens & Mars 1998 : 249-252). The main premise for this according to McMurray in her research paper 'Auditory Binaural Beats Enhance EEG-Measured Beta Wave' is 'that research suggests that auditory binaural beats within specific electroencephalograph frequency ranges can enhance corresponding brain-wave activity and may affect levels of cognition' (McMurray 2004). Lane, Kasian, Owens and Mars explain that it is plausible that binaural beat frequencies entrained the EEG patterns into 'beta' state which resulted in an increase of the spectral power in this range. In the paper 'Hemispheric-Synchronisation During Anaesthesia', they show similar results (Kliempt et al. 1999b : 770). This study assumes that brainwaves will be affected as a result of listening to binaural beats frequencies, and once again even though this was not measured directly, the fact that the patient required less antiocipline for general anaesthesia, suggests brain waves would have to be affected in order for this to occur. Research has been carried out to discover whether certain medical conditions may reflect certain states of brain waves, McMurray explores this with Attention Disorder Hyper Disorder (ADHD). Her findings indicate that ADHD subjects may be deficient in delta and theta ranges and that 'below-normal beta frequency brain waves interfere with maintaining attention'. A 1997 study out of Northern Arizona University, 'Binaural-Beat Induced Theta EEG Activity and Hypnotic Susceptibility,' (Brady 1997) reported that five out of six participants showed an elevated presence of theta waves in their EEG and according to the Stanford Hypnotic Susceptibility Scale, demonstrated a higher degree of hypnotizability post-session in the medium and low hypnotizability groups (2 people in each group).

Thus it is clear that certain changes in the complex interplay of the mind-body connection through the use of binaural beats as a external process the brain-waves can be changed to create beneficial therapeutic applications.

Examination of the evidence on the direct effect of binaural beats shows that there is indeed data that illustrate that binaural beats can affect brain wave changes. Whether or not these brain wave changes are beneficial ones still needs to be investigated. A greater number of studies must be done

in order to prove beyond a doubt that binaural beats can be a valid medical discipline. The evidence seems to suggest that that these unique sound patterns called binaural beats do sometimes work and sometimes not. The evidence also seems to point to a more holistic approach where the complete mind-body complex of the human subject is taken into account. The main issue with these studies is that the variables quickly escalate and determining which technique affected which outcome is a somewhat complex and grey area. Therefore new working models must be developed in order to chart the many variables which can and may arise during an experiment. What has not been discussed in this chapter is the method used for measuring EEG patterns. This topic is a thesis in its own accord and is a huge factor in influencing results in testing. Many papers have been written, such as, on the treatment of alcoholic depression (Waldkoetter & Sanders 1997), the promotion of vigilance performance and mood (Lane et al. 1998), anxiety (Scouarnec & Poirer 2001), hypnotic states (Brady & Stevens 2000), and analgesia (Kliempt et al. 1999g). It seems that how one conducts an EEG test can determine to a large extent the accuracy of results. With the advent of technological and systems testing there seems to be a quiet revolution in the way the EEG is used and conducted. The on-flow of the changes to the brain wave patterns can lead to profound changes in the physiological condition of the human subject and when this is understood and new models are mapped then concrete changes might be seen. The more that science can investigate the brain and explain how the mind-body relationship and its intricate working operates, then the more experiments will be able to target directly the system that can bring about the desired change for therapeutic benefits.

CHAPTER 4: THE HEMI-SYNC PROCESS AT THE MONROE INSTITUTE

Part I: The Hemi-Sync Process

This chapter examines the 'Hemi-Sync Process' developed at the Monroe Institute located in the USA (Monroe 2007h). It will consider philosophical and experimental issues, advertising and aesthetics of the complete Hemi-Sync Process.

I have chosen this process for the following reasons:

- The process of Hemi-Sync needs to be examined from an overall critical standpoint, not just from the binaural beat standpoint.
- The Hemi-Sync Process is the most widely used binaural beat technology and has been researched by peer-reviewed journals.
- Hemi-Sync, as developed by the Monroe Institute for the commercial market, has expanded into different technologies and become a very successful company.

In preparation for this thesis and case study of the Hemi-Sync Process, the author contacted the Monroe Institute for application to join professional membership. The following is its official reply.

Dear Darren,

Thanks for your reply.

I asked if this was a bachelor's project because we have had several unsatisfactory experiences with undergraduate researchers. Four students have been supported with Hemi-Sync CDs, TMI papers, and advice. All of them had a timeline of months when they contacted us. The completed projects were adequate to be accepted for their degree requirement but did not contribute to the advancement of knowledge about binaural beats. Also, none of the students – despite the fact that one of them was at Harvard University – ever submitted a copy of their completed paper.

I share this background so you will understand why we are gun shy regarding undergraduate research. Understanding how sound affects the human system is an enormous topic. I suggest that you meet with your supervisor and concentrate on formulating a narrow question and a specific hypothesis in your area of interest. Once you have done that, we would be pleased to look at a formal research proposal.

The Monroe Institute does not offer grants. We do offer a student professional membership for \$75 yearly, which is 50% of the usual fee. Please think about your next steps and let me know what you decide.

Warmly,

Shirley Bliley

Professional Division Director (Bliley 2006).

As seen the Institute does not work with Honours students. I originally found this frustrating as it made access to deeper levels of information more difficult.

There are two possible interpretations that could explain the reaction of the Institute.

Firstly, this reply could be taken on a professional level, whereby only access will be granted to those serious researchers interested in advancing the Hemi-Sync Process and taking an academic peer-reviewed approach to examine the evidence.

Or secondly, the response could be a filtering mechanism for those who may wish to find fault with an organisation that claims to be a serious research institute but also on the commercial front portrays a 'new age' ideal.

Whatever the intent of the Monroe Institute, whether from a commercial standpoint or from an academic viewpoint, the author finds it necessary to address the following question in this paper:

Do the commercial activities of the Monroe Institute have a positive or a negative impact on the scientific evaluation of the Hemi-Sync Process; in particular, does it encourage the continuation of serious research and development in the use of binaural beats?

Philosophy and Deeper Examination of the Hemi-Sync Process

In this section, an examination is undertaken of the evidence for the Hemi-Sync Process and how it compares to other serious binaural beat research.

There is much more involved in the Hemi-Sync Process than just the implementation of binaural beats as explored in Chapter 3. What is interesting is that the Monroe Institute state that other factors of the Hemi-Sync Process augment the effectiveness of the binaural beat technology making it a viable system that affect brain wave states.

The Hemi-Sync Process was developed in 1972 (Monroe 1972) by Robert Monroe from working originally with sleep devices. Subsequently he patented it in 1975 (Monroe 1975). In his book *Far Journeys* (1985 : 16-25) he describes the Hemi-Sync Process as an abbreviation for Hemi-Spheric Synchronisation, thus establishing the foundation for his future work with brain waves and binaural beat theories. From this base, he patented another update to his theory in 1994 that utilised binaural beat frequency implantation for inducing desired states of consciousness (Monroe 1994).

These patents deal specifically with issues relating to:

- FFR (Frequency Following Response) as examined in Chapter 3 for consciousness and brain wave alteration.
- Using multiple EEG waveforms (as taken from the brain waves of human subjects) then mapped into the sonic domain through the technology of binaural beats.

On the Monroe Institute Website, it states in reference to the overall Hemi-Sync Process:

The trademarked term Hemi-Sync signifies a patented combination of multiplexed audio binaural beats and pink sound (or music) designed to alter arousal levels. Hemi-Sync sounds are

combined with verbal suggestion, relaxation exercises, and guided imagery and carefully crafted to engender desired experiences to focused states of consciousness (Monroe 2006).

In summary, the Hemi-Sync Process consists of the following and also see Audio Examples 3, 4, and 5:

1. Complex binaural beat patterns as examined in Chapter 3
2. Pink noise (new-age to easy-listening)
3. Verbal guided auto-suggestion and affirmations

In thousands of experiments in the 1970s Robert Monroe claimed to entrain the brain into certain altered states of consciousness, via the use of binaural beat frequencies, pink noise or music/nature sounds and sometimes guided visualisation. This was done by mapping brain wave frequencies onto sets of carrier tones (the original sound before modification) and measuring the effect on EEG readings. Readings were done in order to see which patterns create certain states of synchronisation within the brain – and how both hemispheres of the brain, that is, the right and left, work together.

Consciousness and studies related to this subject have been debated with controversy within the scientific community for many years (Noetic 2004). The main area that the Hemi-Sync Process and its branch technologies all aim to tackle is this illusive field of consciousness. This is the key factor in the whole philosophy of the Monroe Institute which explores the idea that certain sound combinations could engender altered states of consciousness for para-physical experiences by changes in brain wave patterns.

This case study is not going to examine whether or not consciousness is in some way separate from the human brain or linked in, but it is aiming to examine the complete philosophy and standpoint from which the Hemi-Sync Process is coming.

The Hemi-Sync Process – An Evaluation

Atwater says on this topic:

A conventional binaural beat generates two amplitude modulated standing waves, one in each hemisphere's olivary nucleus. Such binaural beats will entrain both hemispheres to the same frequency, establishing equivalent electromagnetic environments and maximizing inter-hemispheric neural communication (Atwater 1988)

The field of pseudoscience and the brain has been hotly debated since the early 1970s with the inception of the Alpha Movement, when inspiring meditators, according to Pelletier and Peper (1977) turned to technology to allow them to create the desired peaks in Alpha brain waves. Beyerstein (1999), in his paper, talks about a friend from the University of Calgary who has his own laboratory and went about testing the Hemi-Sync Process to find that interhemispheric coherence (hemispheric synchronization) was not increased with this technique.

Could this, according to Atwater, have been due to the following ideas:

Passively listening to Hemi-Sync binaural beats may not automatically engender a focused state of consciousness. The Hemi-Sync Process includes a number of components; binaural beats are only one element. We all maintain a psychophysiological momentum, a homeostasis that may resist the influence of the binaural beats. Practices such as humming, toning, breathing exercises, autogenic training, and/or biofeedback can be used to interrupt the homeostasis of resistant subjects (Tart 1975). Naturally occurring ultradian rhythms driven by the reticular activating system and characterized by periodic changes in arousal (Webb & Dube 1981; Rossi 1986; Shannahoff-Khalsa 1991), may influence the effectiveness of binaural beats. One's first-person experience in response to binaural-beat stimulation may also be affected by a number of psychological mediating factors (Atwater 1999).

This researcher's investigations have led to a dilemma, however. If what Atwater states is correct then there are underlying factors like the arousal state that might make the testing of the Hemi-Sync Process questionable, because other factors may induce these states. For example, sound/music, light, breathing and eye movement can also have a dramatic effect on the modulating of brain waves.

According to the Hemi-Sync Process, the FFR indicates that brain waves follow the frequency patterns of the binaural beat frequencies, and it is this correlation that demonstrates that Hemi-Sync is a valid process. Unfortunately, outside the Monroe Institute, this exact science has not been thoroughly researched, but the simple use of binaural beats has, from this standpoint, has shown that there is valid evidence that further testing and development is needed.

To elaborate, there is significant evidence that:

- 1) Forced sonic entrainment does not occur in the Hemi-Sync Process.
- 2) All elements, that is, complex binaural beats, pink noise and/or guided verbal suggestions must be present for the complete Hemi-Sync Process.
- 3) Passively listening to Hemi-Sync binaural beats may not automatically engender a focused state of consciousness.

In the overall philosophy of the Hemi-Sync Process, the Monroe Institute seems to suggest that there needs to be feedback with the human subject. This is interesting because the peer-reviewed testing focuses on specific elements of the Hemi-Sync Process and aims to eliminate the 'unclear' factors by implementing double blind trials. If one part or process was to be removed from the Hemi-Sync Process then, according to the Monroe Institute, the Process would be truncated.

What is unique about Monroe's ideas and theories is his claim to have discovered what researchers studying meditation have claimed for many years: that unique synchronisation of brain waves could occur through entrainment of binaural beats. Hemispheric synchronisation has been a very well researched topic since the late 1960s (Noetic 2004). Most of the early scientific studies focused on the effects of meditation, producing this response. The most well known is from the Transcendental Meditation (TM) Movement (Lutz, Dunne, & Davidson 2006). These meditations are claimed to affect brain wave states and create hemispheric synchronisation, called 'mind awake, body asleep' or the Alpha state. The results are vast but some mentioned peaks or spikes in Alpha dominance of around 7-10 Hz on the EEG scale (Wallace 1970). This was also the effect of the claimed 'Alpha' Movement in the late 1970s that explored the science of biofeedback and how an individual could control

internal systems, to provide desired brain wave changes (Gardner 1997 : 87). Thus some evidence states that they could triple the amount of Alpha waves (Brown 1974).

For example:

Research, though not conclusive, has indicated that sedative music can produce an alpha brain wave state (Benson, 1975; Borling, 1981; Kenyon, 1994). This slower brain wave pattern is associated with meditative states, drowsiness, and daydreaming, which are all states of increased relaxation. A similar approach involves the synchronization of neural discharge patterns between the two hemispheres of the brain (Russell cited in Crowe 1993f : 219).

The author would argue that there are so many factors in the Hemi-Sync Process that it is difficult or impossible to arrive at a consensus about what cause affects what physiological system. Though there are many anecdotal reports about the effectiveness of Hemi-Sync for nociception control, no randomised controlled trial has yet been published which supports these claims. So a planned double-blind randomised controlled trial to compare the effects of Hemi-Sync sounds, classical music and a blank tape on nociception control in patients undergoing surgery under general anaesthesia was carried out, leading to the following observations:

In conclusion, our findings demonstrate that patients using intra-operative Hemi-Sync tapes whilst undergoing a range of different surgical procedures under standardized general anaesthesia with a laryngeal mask require substantially less fentanyl when compared with controls (Kliempt et al. 1999c : 772).

Barbara Crowe, in her interview in 2006 (Appendix I) with this author, sees that there is the need for interdisciplinary research, whereby the medical scientists collaborate with the sonic engineers and, in this way, a fuller and more complete process of the pitfalls and grey areas can be addressed.

To explore further a fuller study would have to examine the different elements of the Hemi-Sync Process individually and the Hemi-Sync Process as a whole. According to the philosophy and conception of the Hemi-Sync Process a homeostatic principle exists in the human subject. These need to be acknowledged before the relevant Hemi-Sync recordings can be implemented as part of the holistic approach.

CHAPTER 4: THE HEMI-SYNC PROCESS AT THE MONROE INSTITUTE

Part II: Marketing and Advertising

This part examines the marketing and advertising components of the Monroe Institute and their impact on the serious scientific development of the Hemi-Sync Process.

The marketing and advertising of the Institute plays a vital role in the development of the Hemi-Sync Process and its further development as a therapeutic tool for medical application. Marketing and advertising are the foundation of the Institute and its primary focus. The work of the Institute could be jeopardised by this commercial marketing and potentially deter other dedicated scientific researchers. At first glance, the Monroe Institute could appear to be comprised of a group of pseudoscientific researchers. This image, could in turn, may cause damage by other scientists not considering the continuation of research and development into the use of binaural beats and its applications as being a valid field of pursuit.

By way of attempting to counteract any impression of lack of scientific validity in the work carried out by the Monroe Institute, an analysis of four main sections of the Institute's activities is presented in this part that will illustrate a good cross-section of where the Hemi-Sync Process is proceeding as a scientific tool. Examples have also been included on CD-ROM 2007 so that the reader can obtain a visual representation of what the author is referring to (Appendix III).

The four main sections are:

1. 'An Introduction to Hemi-Sync' Video
2. Monroe Institute Website
3. Monroe Institute Official Brochure
4. Hemi-Sync Journal

These sections could be considered as a route a new researcher could follow when exploring the whole of the background information available about the Hemi-Sync Process. The author reiterates that it needs to be analysed before there could be any likelihood of adverse impact on further research into this field.

The role of the Monroe Institute is that 'conventional scientific procedures are employed whenever feasible, but research is not limited to such processes.' The results of such research efforts are meaningful only if there are practical applications – something of value for our contemporary culture. The Monroe Institute proposes to introduce, at all levels of human endeavour, abilities that will constructively change humankind's direction and destiny (Monroe 2007q).

It is clear from these statements that other procedures are undertaken in order to get what are viewed by the Institute to be 'sustainable' results. Topics listed on the Website confront one with a plethora of mind-body, new-age and scientific disciplines that would be considered fringe science to the main stream academic community.

Marketing and the Hemi-Sync Process

The marketing aim of the Monroe Institute focuses on the general public and 'alternative' medical practitioners. This is evident in the kinds of programs offered by the Institute, such as, extended development of experimentation of an individual's mind-body-spirit health and include the Gateway™ and other residency programs offering in-house services and further self-development (Monroe 2007h).

It is apparent, in the advancement and expansion of the information technology age, that within the medical domain a whole area of self-diagnosis and self-help has taken hold of the consumer, whereby marketing and advertising has convinced the buyer 'to try and buy' (King & Moreggi 1998). A self-fix philosophy has taken grip by flooding the consumer with technological and pseudo-scientific data whereby the so-called 'scientific' studies are often designed to prove the case of the developer of the product.

In the case of the Monroe Institute, their scientists have serious peer-reviewed journal studies about the Hemi-Sync Process that do lay claim to success with binaural beats (Monroe 2007g). The articles

mostly state that more research is needed to prove the theory of the Hemi-Sync Process in order for it to stand its own ground. Of the programs offered by the Institute, the Hemi-Sync Process is the cornerstone for the majority. Thus, the consumer entering the field of inquiry of the Hemi-Sync Process will find supporting scientific journal evidence and possibly be convinced about the nature of the extended services offered. This loose conclusion of scientific validity is used to the advantage of the Monroe Institute in its marketing arm.

Introduction to Hemi-Sync Video

Referring to Point 1, the video 'An Introduction to Hemi-Sync' is a good example that illustrates this aspect of the Monroe Institute's policy. It addresses all aspects of the scientific, marketing and advertising of the Hemi-Sync Process (Monroe 2007f). It aims to entice every aspect of an individual's therapeutic needs through the work of the Hemi-Sync Process. At the very beginning of the video it is claimed that the process is scientifically and clinically proven over '40 years of development'. It is suggested that if you join the programs results will be achieved by the finish. The programs offered would appeal to nearly every alternative therapeutic need of the consumer. This six-minute video gives a good overview of the complete marketing ideals of the Monroe Institute and the core Hemi-Sync Process.

Monroe Institute Website

The first information a researcher on this topic would most likely encounter in enquiring into the function of the Monroe Institute could be its website www.monroeinstitute.com (Monroe 2007h). All references including those referred to in Points 1, 2 and 3 can be accessed from this website and it allows the researcher a deeper investigation into the Hemi-Sync Process.

In relation to the website, what needs to be addressed is how the public image of the Monroe Institute may either damage or may advance the real scientific study of the Hemi-Sync Process.

On the website there are sections for articles and research papers, residential programs an individual could undertake and plenty of on-line shopping. There are plenty of glossy images explaining the Hemi-Sync Process and the sister products that could assist the Process. The author points out these facts because there is no separate website or section devoted to just the Hemi-Sync Process

from a purely objective point of view. Rather, the 'real' information is an entanglement in a web of glitter and glamorous colour images. There is a webpage called Hemi-Sync <http://www.hemi-sync.com> but this is more a secondary product page and contains less information than the official website. The Monroe Institute site <http://www.monroeinstitute.com> would be considered the first port of call and contains more data than the specific Hemi-Sync site. It was surprising that there was no 'scientific' site dedicated to the raw data, but that it was as I have stated an entangled 'web' of marketing and advertising. Therefore the validity of the Process at the Monroe Institute becomes very subjective in attempting to trace back 'real' data.

Monroe Institute Brochure

On examination of the Monroe Institute's 'official brochure', the content deals with who, what, where and how in relation to the Institute's official role (Monroe 2003). Specifically, it covers its aim, and when and where its research and products comes from. It is appropriate to address what areas the brochure canvasses because, aside from the website, it would be a good first port of call for serious researchers to begin also to follow a research path to the Monroe Institute. The brochure opens with an image of tall pine trees set amongst a pink-blue haze in what look like a mountain range. The images reflect symbolically anything from a peaceful retreat to an academic environmental report. The corresponding quote states 'dedicated to the exploration of human consciousness'. This in no way suggests that there is any activity being carried out in relation to the exploration of sound or about specific impacts on brain waves. This is interesting because the purported basis of the Monroe Institute is considered to be the Hemi-Sync Process which incorporates, as will be shown, the unification of consciousness with sound technology.

The brochure has four main sections:

1. Beginnings about the Hemi-Sync Process, Centres and Retreats
2. The Science of Sound
3. Different Programs offered
4. Memberships and Advisors

Thus it can be seen that sound and the Hemi-Sync Process appear to feature as the main key subjects in the brochure and then we read a second quote which states:

Focused consciousness contains definite solutions to the questions of human experience. Greater understanding of such consciousness can be achieved through coordinated research efforts using an inter-disciplinary approach.

The primary concept of an inter-disciplinary approach seems to be the key area in the work of the Monroe Institute and therefore focused consciousness, which can include brain wave effects, medication and focus. It is clear in studying and working with the Hemi-Sync Process that the medical, physiological, psychological and musical domains need to be related to one another to understand and develop the Process further. It is apparent in the suggestions for the use of the Hemi-Sync Process that the physiologic and psychological domains in the human subject might be useful for therapeutic effects. What is evident is that the focus on related consciousness studies does extend beyond the accepted scientific paradigms, by implying that 'para-sciences' are involved in making the Hemi-Sync Process a success. The following opinion seems to sum up the direction and aim of the Hemi-Sync Process:

Conventional scientific procedures are employed whenever feasible, but research is not limited to such processes. With the use of two systems of measurement, conventional and non-conventional, it is possible to validate much of TMI's methods and techniques by standards of interest to the conventional scientist and researcher (Monroe 2003).

This is where the scientific community would differ because if a new field were to be accepted, the testing used would have to be of strict observance of the whole process.

Also listed in the brochure are very influential thinkers and professionals who would add to the validity of research. Some of these include George D Carroll, PhD, Professor of Music; Raymond Waldkoetter, EdD, Research Psychologist; Helene Guttman, PhD, Biomedical Research Consultant (Monroe 2003).

These professionals work in the control laboratories set up on Monroe Institute locations mentioned in the brochure and employ testing and evaluation in their own academic/ establishments and the

author finds the calibre of these people impressive. Research into their credentials shows a knowledge base that is both relevant to the work of the Monroe Institute and, from their viewpoint, would reflect a positive image of the Hemi-Sync Process onto the scientific community. Their work and others of professional status commonly publish their experiments in what the Monroe Institute has called the *Hemi-Sync Journal*.

Hemi-Sync Journal

The *Hemi-Sync Journal*, a publication of the Monroe Institute, an educational and research organization dedicated to exploring and developing the uses and understanding of human consciousness, offers current reporting on research and application of the Hemi-Sync technology in a variety of professional fields (Monroe 2007c).

The *Hemi-Sync Journal* would not be considered an official academic journal but rather can be seen as an 'in-house' publication that reflects the work and insight of advisors and professional members associated with and working with the Monroe Institute. Once again, the idea of consciousness is brought into the equation and may suggest to the audience a broader range of ideas and experiments that are being brought into the journal's criteria. The author does not intend to analyse the journal from a case study point of view but rather undertake a critique of the entire ascetic layout together with the idea and aim it is attempting to portray to the scientific community.

The journal dates back to 1990 according to the Monroe Institute's website. Two editions will be used as a basis for analysis – Vol. XIV Summer/Fall 2006 Nos 3 & 4 and Vol. XV Winter/Spring 2007 Nos 1 & 2 (Monroe 2007d & 2007e).

It is obvious that the journals allow a creative outlet for professional and practising members as is apparent from the inclusion of case studies and this could possibly allow for future development for peer-reviewed experiments because serious researchers may see some validity in the direction of these studies. For example, the work of Viktoria Mandlin presented in the XIV Summer/Fall 2006 Journal found that adding Hemi-Sync to the treatment regime makes a noticeable positive difference with her patients in practice. Likewise, Kude and Flemming in Vol XV Winter/Spring 2007 used the Hemi-Sync technology in place of contemporary music to add an additional factor to their treatment

regime for added therapeutic benefit. It seems evident that Hemi-Sync is being used to augment the experimenters' field work.

The layout of the Journal reflects a professional design. This is reflected in the simple and straight forward approach of the presentation of the case studies. There does not appear to be any advertising of the Hemi-Sync Process or associated programs or music provided at the Monroe Institute.

After examination of a cross section of the journals and related examples it can be concluded that the case studies reflect a direct professional experience and application of the Hemi-Sync Process. The studies use the Hemi-Sync Process as a complementary theory that aids in the greater research of the associated work of the Institute. Finally the journal is clear in its aim which is 'reporting on research and application of the Hemi-Sync technology in a variety of professional fields' and, from this standpoint, it has achieved its mark.

In the overall context of the Monroe Institute attempting to establish an academic profile, it states:

The Institute's research includes three distinct domains: clinical and applied research done by the Institute's professional membership, research done at universities and hospitals, and technical research done at the Institute's facilities in Virginia. Ultimately, the goal of said research is to enable the enhancement of the Institute's educational curriculum (Monroe 2007b).

It is stated that even though they endorse the research developed externally, it is evident from the statement that the Institute focuses on developing its own educational curriculum which then, from a marketing viewpoint, would need to primarily focus on their own staff in order to sell products.

Conclusion of this Chapter

It can be agreed that the whole experimentation and future exploration of the Hemi-Sync Process will remain as a primary focus in this 'new' field of questionable research and the hard scientific studies will come when other researchers work through the advertising and gloss campaigns. It can be assessed that the commercial activities of the Monroe Institute would have a negative impact on the scientific evaluation of the Hemi-Sync Process. That is not to say it will not discourage the

continuation of serious research and development in the use of binaural beats but rather researchers, in attempting to test certain hypostasis, will have to understand the complex interplay of other mind-body factors that have been noted as key aspects for the Hemi-Sync Process to function.

CONCLUSION

This thesis has attempted to provide a critical examination of the primary areas of research into binaural beats and their effect on brain waves. An analysis of how this has been put into practice was examined and presented across many research disciplines with particular focus on the Hemi-Sync Process as developed at the Monroe Institute. The deeper probing of this field has exposed the issues and problems surrounding the use of binaural beats in research and therapeutic applications. Certain psychological and physiological conditions were found to be major contributing factors to the success of the whole application of binaural beats affecting brain waves.

The idea that binaural beats can affect brain waves through entrainment is not new, for example research into meditation has evidence to suggest that entrainment of the brain waves can occur through other complex factors. These factors involve certain physiological and psychological cues in order to make the human subject susceptible to change. This seems also to be the case when utilising binaural beat frequencies, though more research is needed.

Examination of the marketing and advertising of the Monroe Institute's Hemi-Sync Process shows a propensity towards a potential negative impact on past and future research and testing. This is important as the Hemi-Sync Process has a potential positive therapeutic application if the issues of the other complex factors are taken into account by serious investigators.

The organisation of the Monroe Institute would be considered by some serious academic professionals to border on fringe science as it journeys into the realms of consciousness studies. The Institute is clear in stating this and holds no excuse. It proposes the mind-body connection needs to be included in its Process in order for it to be an effective system. It is clear by analysis of the Hemi-Sync Process that inter-disciplinary connections would be vital if further testing is to be undertaken by this researcher or other academic researchers to validate the Process. Binaural beats on their own as a core audio process may not offer much success in the way of brain wave entrainment. On the other hand, the complex workings of the Hemi-Sync Process may, if tested fully, offer other explanations for brain wave entrainment or allow binaural beats to work more effectively in affecting brain waves. In examining this field the author considered the medical and biological aspects in this field a challenge, as there are many factors that could account for the alteration of brain waves.

In the limited success of the Hemi-Sync Process, it would be interesting to explore if this Process creates a sustainable and lasting result. For it may become apparent that in the absence of not listening to the Hemi-Sync recordings there may be found no sustainable change occurring in brain wave states, by potentially reverting the listener's brain waves back to their previous physiological and psychological state. In the greater context it must be addressed what positive brain wave states are desirable for therapeutic results. These questions need to be addressed if the whole field were to be considered a serious therapeutic application in the medical domain.

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APPENDIX I: INTERVIEW

- Hi Barbara, I am glad you could join me for an interview on the topic of sound healing/therapy. Please tell me a bit about your background and current focus?

I have been a music therapist for 30 years and a music therapy educator since 1977. My clinical experience was primarily with emotionally disturbed adolescents. I have my Bachelor's and Master's degrees in music therapy from Michigan State University and am a Music Therapist-Board Certified. I am a past president of the National Association for Music Therapy and was Executive Director of the Rhythm for Life Project. I also have an interest in sound healing and have participated in a number of sound healing conferences and colloquium over the years.

- Are music therapy and sound healing/therapy connecting? If so how?

At this point there is no formal connection between these two related but different disciplines. Many music therapists are interested in sound healing practices and one European form of music therapy, Dorion Music Therapy, emphasizes the direct, physical impact of tones and intervals on the body. I think there is dialogue occurring between various music therapists and sound healing practitioners, but no contact on a discipline basis.

- What do you see as being the major research issues in sound healing/therapy?

As I explored in my book, I feel the real challenge is finding the right research methods to substantiate the complex interaction of the complex input that sound and especially music is with complex human functioning. Clearly, reductionistic, double blind studies just doesn't work to show how the complex information input of sound and music impacts an area of human functioning. I think some of the research methods from complexity science that shows the effects of input on a complex system in motion may have some potential.

- What are your feelings and views regarding progress of sound healing/therapy within the scientific community of the last 2-3 years since writing 'Music and Soul Making'? That is,

have there been major research advancements or has there been more of a sceptical approach?

Since my book was about music therapy, I feel it has had little effect on the whole area of sound healing. Medical settings and researchers who are open to 'complimentary' medicine practices have expressed some interest in researching various aspects of sound healing but these efforts are limited and highly localized.

- In your research are there any useful applications of 'binaural beat frequencies' in the field of 'frequency medicine'? If so what do they promise or help?

I'm not sure what you mean by 'frequency medicine'. I know of applications of binaural beat frequencies in accelerated learning, producing altered states of consciousness, and stress reduction through synchronization of neural discharge patterns between hemispheres.

- The following key concepts of: resonance, entrainment and sonic neurotechnologies are vital principles within sound healing/therapy. How do you view these and see them being applied?

I think the big problem in applying these is that there are so many factors affecting how these might impact on an aspect of human functioning that the specific tone or rhythm pattern or whatever will vary from person to person and within one individual under different circumstances. I have never believed that music/sound could be 'prescribed' to meet a particular need. In issues like resonance, I think the first question to answer is, 'Is it, in fact, positive or beneficial to resonant a body structure?' I'm not sure it is. I think there has been a great deal of assumption that resonance and entrainment are 'good things' without any real understanding of the underlying principles.

- In your book you discussed the theories of the 'new physics' that need to be applied to deal with the immense complexity of the human functioning. What are the recent developments, understanding or application within music/sound therapy field?

At this point, not much. I don't think my book has had that wide a circulation to influence practice at this point. As I mentioned above I think we need new research paradigms to really see how music/sound is influencing the dynamical system of human functioning.

- With the idea of interdisciplinary research, that is, biology with music or music with physics etc., what do you envision as a professional research/teacher?
 - a) In regard to the future for academic institutions like university?
 - b) In the greater application by the scientific community?

I really think we need research teams of music therapists, sound healers, complexity science researchers, neurophysiologists, etc. I don't any one person can bring all the knowledge and skills to the extensive research that needs to be done. I would hope that cross-disciplinary collaboration and research could be accepted and embraced by universities and research labs.

Darren Curtis

APPENDIX II: GLOSSARY

Binaural Beats – Auditory beats in the brain, created by sending separate distinct tones to each ear which produce a third ‘phantom’ beat which is perceived by the brain as real.

Brain Waves - Electrical activity emanating from the brain is displayed in the form of brainwaves categorised by 4 to 5 main power spectrums – Alpha, Beta, Delta, Theta, Gamma.

EEG – Electroencephalogram measures and records the electrical activity of your brain which uses electrodes.

Entrainment – Two or more close frequencies locking in rhythm with each other.

FFR – Frequency Following response - theory of brain wave entertainment whereby binaural beats can affect brain waves (EEG) by reproducing the stimulus response.

Hemi-Sync - Hemi-Sync® is an audio guidance technology (developed by the Monroe Institute) that works quite simply by sending different sounds (tones) to each ear through stereo headphones (Monroe 2007h).

Hertz – A measurement of frequency 1 Hz = 1 cycle per second (Abode 2004a).

Monroe Institute - The Monroe Institute is a non-profit, educational and research organisation dedicated to the exploration of human consciousness, and is internationally known for its work with audio sound patterns that can have dramatic effects on states of consciousness (Monroe 2007h).

Psychoacoustics - Psychoacoustics is concerned with the relationship between the physical characteristics of sound and what is actually perceived by the listener (Moore 2006).

RAS - Reticular Activating System - The RAS is located in the brainstem and helps to maintain homeostasis or internal stability.

Sine Wave – Sine wave forms are fundamental with no harmonics, a 'pure tone' (Abode 2004b).

Superior Olivary Nucleus - Part of the olive, an organ that lies behind the brain stem, binaural beats have been traced to this location.

APPENDIX III: CD-ROM

Audio Example 1

- a) Simple Binaural Beat 400 Hz - Left Ear
- b) Simple Binaural Beat 410 Hz – Right Ear
- c) Binaural Beat 10 Hz (Curtis 2007b)

Audio Example 2

- a) 398 Hz, 498 Hz, 598 Hz, 746 Hz – Left Ear
- b) 402 Hz, 502 Hz, 602 Hz, 754 Hz – Right Ear
- c) < 398 Hz to 402 Hz = 4 Hz Modulation > <498 Hz to 502 Hz = 4 Hz Modulation>
<746 Hz to 754 Hz = 8 Hz Modulation > (Curtis 2007c)

Audio Example 3

Hemi-Sync - Complex binaural beat patterns (Taken from Human Plus series Hemi-Sync PREP Side 1 – No other information is present) (Interstate 1988a)

Audio Example 4

Hemi-Sync - Pink noise masking binaural beats (Monroe 1999a)

Audio Example 5

Hemi-Sync - Verbal suggestion (Interstate 1988b)

Audio Example 6:

Own composition - Transcendent beats

Sine wave generators:

- 1 = 210 Hz(±) @ 7 Hz Moving to 660 Hz @ 4 Hz(±) (in 2 sec out 40 sec ramp 5 sec).
- 2 = 420 Hz(±) @ 5 Hz Moving to 330 Hz @ 7 Hz(±) (in 10 sec out 45 sec ramp 10 sec).
- 3 = 500 Hz(±) @ 8 Hz Moving to 440 Hz @ 5 Hz(±) (in 15 sec out 50 sec ramp 15 sec).
- 4 = 480 Hz(±) @ 2 Hz Moving to 360 Hz @ 4 Hz(±) (in 20 sec out 50 sec ramp 14 sec).

Background sound:

Pink noise - panning at 0.04 Hz and Thunder panning at 0.08 Hz (Curtis 2007d)

With comparison of Hemi-Sync – ‘Sleeping Through the Rain’ by Monroe Institute (No other information present) (Monroe 2004).

Movie Example

Introduction to the Hemi-Sync Process (Monroe 2007f)

Journal Example 1

Hemi-Sync Journal – Vol. XIV Summer/Fall 2006 Nos 3 & 4 (Monroe 2007d)

Journal Example 2

Hemi-Sync Journal – Vol. XV Winter/Spring 2007 Nos1 & 2 (Monroe 2007e)

Brochure Example

The Monroe Institute Brochure (Monroe 2003)

Website Example

Monroe Institute Front Page <http://www.monroeinstitute.com> (Monroe 2007h)

Patent Example 1

Method of inducing and maintaining various stages of sleep in the human being (Monroe 1975)

Patent Example 2

Method of and apparatus for inducing desired states of consciousness (Monroe 1994)