

Music, Brain, and Physiologic Function: How does my brain process sensory information? What does my brain do with music? Why?

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To study the human brain is to study ourselves (Can the brain study itself?).

To study ourselves is to understand ourselves as *emotional* animals (LeDoux, Damasio, Gazzaniga, Schneck and Schneck, et al).

To understand ourselves as *emotional* animals we must understand how we receive and process information as one complete physiologic unit involving simultaneous interaction of *all* the systems of the body towards one common goal: survival!

We music therapists enjoy referring to our clinical profession as being “*holistic*”, or client-centered. Do we fully understand what ‘holistic’ and ‘client-centered’ really mean in terms of human physiologic function? It is not just something psychological or sub-cortical or cortical or cognitive. To understand the profound meaning of ‘holistic’ and ‘client-centered’ is to understand human (client) physiologic function as being the *sum total function of a complete unit* — *whole-brain/whole-body simultaneous function*; a complete system at work, not just cognition and thought processes. In this case the whole, indeed, is greater than the sum of all of its parts!

Long before the neocortex became enlarged for cognitive (conscious) processing of information, humans responded to sensory stimuli for the sole purpose of *survival*, both individual and as a species. Long before “cognition” and “psychology” became the buzz words for analyzing and defining the human experience, human systems responded (and continue to respond) as a result of *emotional* intuitive evaluation of perceived events. It is this *emotional instinct* — *the instinct for survival in the face of perceived threats (real or imagined) to that survival* — that drives human physiology. “*Thought*” is a luxury that we control after the fact, so “thought” should more aptly be termed “*after-thought*,” a physiologic process that we can turn on and off only after the response has already taken place instinctively. *Thought* (or, more accurately, an *awareness* of internal and external events) happens long after an emotional event. *Instinct* is an immediate tool for survival, a requirement for perpetuation of the species! It cannot be turned on and off. It is an integral part of physiologic function, hard-wired into our being, passed on automatically from generation to generation.

In the book *Synaptic Self: How Our Brains Become Who We Are*, Joseph LeDoux (2002) eloquently reminds us that: “*What a person is, and what he or she thinks, feels, and does, is by no stretch of the imagination influenced only by consciousness. Many of our thoughts, feelings, and actions take place automatically, with consciousness only coming to know them as they happen, if at all.*” Furthermore, “*...many things that the brain does ... are not available to consciousness.*” And, he goes on to say, “*Most of the time, consciousness is informed after the fact.*” (p.10-11)

So, **knowing** is not the precursor to behavior. **Feeling** is. The commentator of a recent TV program about the brain stated that ‘... *humans are not thinking machines. We are feeling machines that think!*’ To believe otherwise is to exhibit a naive understanding of the most basic of physiologic processes. Neuroscientist Joseph LeDoux (1998) and others tell us that **fear** could well be the underlying emotional thrust driving human behavior. It is irrelevant to the brain whether we **cognitively** (consciously) **recognize** (are aware of the presence of) fear. For, by the time the information comes to realization through processing in the cognitive centers of the neocortex, the sub-cognitive paleoencephalon has already assessed and elicited responses to what it perceived as a threat to its survival (fear factor). And one might not ever be fully “cognizant” of the fact that it was *fear* that caused the response. (“Love” could even be a kind of ‘fear’ response...a primal ‘hunger’ that must be satisfied for ‘fear’ of self-destruction and extinction of the species. In many ways, one could also argue that “Religion” derives from fear; and the list goes on).

A paradox is expressed in the following equation:

fear \equiv ***stress*** \equiv ***response*** (sub-cognitive) \equiv ***desirable result*** (safety, comfort, survival...)

Consciously, we can reduce stress only after the fact in most instances, by preparing the system to modulate quickly (adapt) from stress to restorative stressless function, thus minimizing or eliminating completely the same response to the same input (fear). Indeed, that is probably one of the ways in which our organism has managed to survive to date; but in order to understand this, we must understand the physiologic unit of humans as an engineer understands the mechanics of a machine.

Psychologically, we could say that stress becomes a conditioned *attitude towards ‘fear’* once the fear-factor reaches our cognitive state of interpretation. It is the (cognitive) *attitude* about fear that then nurtures the conscious stress response. Cognition has stepped in (after the fact) and taken over (in an attempt to explain) those responses that were originally the result of *sub-cortical* instinct (much faster), and the responses become ‘learned’ and repeatable later, without the presence of the original stimulant – like the famous “Pavlov’s Dog” explanation of conditioned reflexes.

As LeDoux (1998) points out in his note about anxiety attacks, a fear event may have once occurred without the person ever being aware (cognizant) of it having happened, but the system (Amygdala, Hypothalamus, et al) has permanently programmed the response to that original fear, to the point where the slightest event, consciously or unconsciously recognizable, can trigger hyperventilation and a state of agitation common to a fight-or-flight response. This, then, would be the ‘attitude’ factor (in our theory), which asserts, in this case, that conscious fear is a learned response, such that the equation now reads:

Fear \equiv ***perceived stress*** \equiv ***instinctive response*** \equiv ***cognitive recognition*** (*memory, learned response*)/***attitude*** \equiv ***fear*** \equiv ***perceived stress*** \equiv ***instinctive response*** \equiv

An infinite, cyclic “do-loop,” or even worse, a *spiral*, that becomes difficult to redirect once “thinking” becomes an integral part of the process. One major way to break the loop is to *reprogram* the system’s response to perceived threats (fear) thereby redirecting the thinking (attitude) process. Only when the system is placated can ‘thinking’ improve.

So bring in the pipers! How does music change the equation, altering physiologic responses to help develop “functional adaptation” – *functional accommodation* that will redirect ‘attitude’ and physiology to truncate the fear spiral? For starters, music does not need the ‘thinking’ brain, so it is not constrained by cognition! It can thus bypass the cognitive “*attitude toward*” problem. We music therapists have sought, and continue to seek, anecdotal research studies indicating “what” music does to the human physiologic unit! But, are we asking the right questions??

Will proving that music does do something, and describing *what* music does, bring about a global understanding of “*why*” and “*how*” music does it? That is to say, *why* and *how* physiologic (instinctive - emotional) changes and accommodations occur through music therapy interventions? In fact, *why* is music even on the planet? What will “taking two CDs and calling in the morning” do to influence ‘functional adaptation’?

Based on what we know about the brain/body *unit* that operates as one singularly complete physiologic machine, we can begin to theorize that certain applications of carefully analyzed, well-thought out *music* interventions, for any type of population from Autism to Alzheimers, from psychotic to ‘normal’ high functioning, can influence physiologic function that can bring about a state of sensory balance — *cenesthesia* — a state in which the system can quickly modulate from toxic stress chemicals (physiologic “*dissonance*”) to therapeutic ones pushing the system towards a functional equilibrium (physiologic “*consonance*”).

Good. So what, then, do we Music Therapists need to know? We need to know what, physiologically, we are looking at when we meet a client: is the sensory system creating the emotional upheaval, or is the emotional upheaval creating sensory imbalances? We need to understand how the whole brain receives and interprets incoming sensory information, *not just the cognitive areas* of the neo-cortex, which really enter the response process much later (physiologically speaking). We need to fully comprehend the whole brain — from the paleoencephalon to the neo-cortex; we need to understand the brain/body as one complete operating system. Only then can we try to comprehend whether the *whole-brain* knows what the *mind* is thinking! Because “thinking”, as stated earlier, is only a small percent of the whole-brain activity, and actually comes much later in the scheme of cerebral information processing. Remember, our bodies can still function without ‘*mind*’ (e.g., sleep states, comas, strokes, autism, cerebral palsy, etc.).

Above all, we music therapists must understand the materials we are applying —

the six basic elements of music — and how these might contribute to physiologic function. In order to know that, we must understand the basics: the interdependency of the sensory systems -- the brain’s major source of incoming information. What does music have to do with ‘proprioception’? What does ‘vestibular’ mean, and what does that have to do with the visual or auditory sense? What is ‘sensory integration’? What is ‘synesthesia’ (as opposed to ‘cenesthesia’)? Especially, we need to understand the auditory system since our work involves this important sensory system. BUT – we must NOT neglect how the auditory system functions as a member of a TEAM – the body’s other sensory and motor systems – all trying to accomplish the same mission: survival! And, we need to learn not to make possibly erroneous assumptions about hearing and listening, how that interacts with other sensory units, and that rather than ‘warm fuzzies’, music might actually evoke negative or disturbing responses if not prescribed in accordance with the known anatomical/physiological bias of the ‘client’.

We are only at the beginning of thinking about or understanding our brains. And we have barely scratched the surface in our understanding of the role of Music in human adaptation. What is “adaptation”? Earlier we asked why music exists in the first place. Can it really be that the human brain, in all its lauded efficiency, would invent something completely unnecessary? “Cheese cake”, as was once suggested? Why has verbal language and cognition come to be so important, when human beings evolved for millions of years without it? Could it be, in fact, that Music, or rather, intoned inflective sounds linked together in long stretches, actually preceded language by millennia?

Anthropologist friends, in conversation, have speculated that music might have had a biophysical significance for a wider variety of species than we might think. For instance, DNA is now showing that Homo Sapiens and Neanderthals apparently did not inter-breed. Yet, a 90,000 year old, playable, bone flute was discovered to have been of the Neanderthal period. So Neanderthals may have already reacted to the need for artificially created forms of expression through ‘musical’ elements and implements — expressions beyond their bodily capacity to produce those extended communicative-linked sounds. In fact, why do we need “instruments” altogether when birds are perfectly happy simply using their voices? And how did the later-arriving Homo Sapiens and musical instrumental forms develop to fit the scenario and satisfy some obvious need?

Anthropology colleagues suggest that perhaps migration produced a need to communicate over greater distances, thereby requiring acoustic extensions of linked communicative sounds (necessity is the mother of invention!). This would have required more resonant and repetitious messaging systems such as rhythm and extended tones from flutes and whistles. And perhaps accidentally, this form of communication was also found to appease and be amusing to the brain, perhaps, also, somehow altering physiology? And perhaps as Homo Sapiens gathered in colonies, the brain, in its efficiency and need to condense information into patterns and groups, developed a sort of ‘short-hand’ abbreviated form of ‘music’, ultimately reducing extended inflections and wails into “words” -- grunts and lingual interruptions of longer sounds?

The mystery continues, and we may never really know all of the details for sure. What we do know right now, however, is that the human “machine” is emotional and processes sensory information in defined ways that derive from its two primary needs: (1) to survive as an individual, and (2) to survive as a species. And we, Music Therapists, *must* learn about the whole brain/body, and about systemic physiologic responses — rather than focusing so obsessively on “cognition”, which is but a small, anatomically isolated part of the human operating system, a system deliberately designed to operate much faster *without* thinking; a system in which the effects of music do not rely on ‘thought’.

Finally, Music Therapy is a relatively young profession that must now develop on its own merits, as clinical intervention for the betterment of physiologic, psychologic and cognitive function. This development should not, necessarily, be predicated on knowing all there is to know right up front. Indeed, modern medicine STILL does not really know the mechanism of action in an aspirin, yet aspirin has been around for decades and is used extensively as an analgesic and anti-inflammatory medication. Why? Because it works! Remember also that an entire and well-respected profession — that of Psychology — is based on *theory* that defies scientific proof. Have Freud’s theories ever received rigorous scientific explanation? For that matter, has any other psychology theory?

Let us be reminded as well that *religious beliefs* have never been put to the rigors of scientific justification! Yet religion is a universal practice in humankind, and we know the power of

prayer in the healing process. Indeed, in the same way that religion evolved to satisfy the third of our most fundamental human needs — the need for spiritual fulfillment — it is not beyond reason to theorize that music evolved precisely to satisfy our need for cenesthesia as a means for survival through consonant physiologic function. And, in the same sense as we accept the former (religion) on faith alone (none of the basic tenets of any of the world’s religions can be rigorously proven by strict scientific investigation), we might likewise accept the latter (the evolution of music) as an axiom of reality in our attempts to understand the human experience -- an axiom being something taken to be true without proof, simply on the grounds that it works and no “exceptions to the rule” have been successfully identified.

So, why this obsession to “prove” that music works? Can our profession not yet fully explain itself as an *independent modality that operates according to its own, uniquely defined paradigms*? In trying to infuse ourselves into areas other than music — education, medicine, psychology, recreation, entertainment — in an attempt to “blend in” with, duplicate and be accepted by other recognized and more readily approved forms of human endeavors, have we inadvertently *impeded* the development and growth of music therapy treatment as being *equally* legitimate? It seems essential to promote our clinical work more through *our own understanding and teaching of how*, from the physiologic point of view, music means getting “back to basics!”. Once Music Therapy stands *on its own merits*, as its *own* profession (rather than simulating others) for what music itself *is*, and *why* and *how* it can achieve, in and of itself, its potent impact on human adaptation, our language and paradigms might be more understandable, acceptable, and less preoccupied with ‘proof’ scrutiny. Perhaps we should demand *disproof* of its efficacy?

We do not so much need to prove that music works as we *need to know how to explain* why and how it can work to affect us *systemically*. Is music “entertaining” and “educational” and “medicinal?” Of course it is! But music is more than just a tool for achieving high marks in school! *It is a physiologic tool for functional adaptation*. And we must be able to *explain* this. It may well be that, as an intervention, its efficacy will not be entirely “provable” (or *disprovable*), at this point in time. But like prayer, aspirin and Freudian dream analysis, we know it works and, incidentally, none of the latter can be proven, either! (Imagine where the psychology practices of Freud would be today, were he forced to “prove” his theory every inch of the way! What he did understand was *how to explain* it!) We clinicians require accurate language, and strong commitment to *our own understanding* of the role of music in human adaptation – from the *physiologic*, not just the cognitive, psychologic perspective.

Our workshop expands upon some of the ideas presented briefly herein, providing much more anatomic/ physiologic information, together with some examples of music elements that could influence or alter sensory perception and adaptation. Discussed will be basic information on the brain, sensory systems, physiologic information processing, aspects of sensory integration; elements of adaptation and whole-brain/whole body mechanics; “audition” – elements of Dimensional Hearing and Listening; six elements of music and sensory adaptation; suggested areas of observation for the Music Therapist to consider. Once we Music Therapy professionals absorb this kind of physiologic information and begin using important technical terminology displaying an understanding of the working mechanics of the human system — the *what*, *why* and *how* of music — we will not necessarily need to “prove” its effectiveness which, as stated, may not ever be entirely “provable”. We will be able to share the podium with doctors, physiologists, psychologists, and other professionals, as equals to the task of bettering the human condition. This, perhaps, is where the 21st Century will lead us, as long as we set out to learn and

understand everything there is to understand (to date) about the human system, and about the role of music in human adaptation.

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