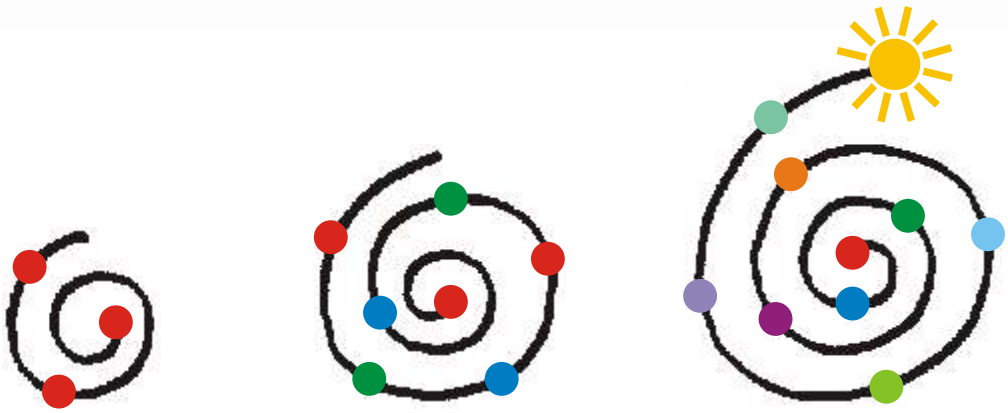
Arts become Therapy

AUTOMUSIC

Building Bridges with ABT

Techniques of Voice, Rhythm & Melody



WCCL Foundation

AUTOMUSIC

ACKNOWLEDGMENTS:

This booklet is about music and autism. It examines the neurological basis of autism and how music can be used as a step by step approach. It is primarily meant as a guide for ABT Practitioners who are working with autistic children.

All ABT Practitioners who are working with groups having communication, expressive, cognitive and motor difficulties will also find the tools and techniques very useful.

The booklet is dedicated to parents-teachers, who have to become extra-ordinary so that they can connect to their children who do not tolerate the ordinary.

WCCL Foundation would like to thank and acknowledge the support of Sir J.R.D. Tata Trust, Mumbai (http://www.dorabjitatatrust.org) for their valuable financial support, Prasanna Autism center (www.prasannaautism.org), for its sincere commitment towards serving children on the autistic spectrum.

On a personal level, we would like to thank Mrs. Jasmine Pavri, Mrs. Padmaja Godbole, Mrs. Sadhana Godbole, Mrs. Kishori Putli, Mrs. Mrunal Dhole, Mrs. Nafeeza Rao, and the children at Prasanna Autism Centre, who continue to guide us on the importance of being in the moment.

This Booklet is created by Zubin Balsara, an ABT Practitioner who has been working in the field on a one-year action research project. We have acknowledged research material from other sources, and would like to thank all the contributors for their knowledge.

1. THE BIG PICTURE

Before we begin, I would like to take you on a 'big picture' journey. This journey explores some myths and takes you to another place from where you can see things differently. When you will see things differently, you will act differently.

Before looking at autistic children and their “pathology” let us look at ours first. We live a regular existence, meet regular people and do regular things. As we have grown older, our cognitive system has been conditioned to accept a common 'consensual' reality - a reality, which everyone agrees upon!

I was given a name, and raised on a strong dose of religion, patriotism, education, relationships, duties and boundaries. As I grew up, I accomplished ordinary tasks and my ordinariness was celebrated. I do all the small tasks that thousands of other eager young men do all over the world. I am a part of this huge system, which thrives on people who follow rules. This system tells us how we should behave; talk, dress, work, love and most importantly “survive and reproduce”.

This system boils down to security, survival and reproduction of the species. No matter what cute words are attributed to this system (e.g. social system, family, status, success), the truth is that we are living in a structure, which has evolved for human beings to survive and reproduce. In that sense, this has been an excellent education for me. I have learnt how to make money, how to behave in public, how to mate and not get killed (not necessarily in that order)

Somewhere in this race for security and survival, the system ignores higher potentials, which do not directly contribute to the winning spot. This has led to many rich men scratching their head and wondering “why am I not happy?”

If you are standing and looking at ordinary human beings from my standpoint, you will see that our pathology is far more debilitating than autism. Our prognosis is even worse. In the next 50 years, UN has reported that we will wipe out most marine species due to over-fishing. We will soon be fighting over fresh drinking water. Our technology will enable us to create artificial environments where we will survive, but only the rich will be able to afford it, and we will all definitely die one day.

With this sobering context, I urge you to have a perspective of balance. This perspective encourages multiple realities and interacts with various dimensions of human beings. Autistic children have a different perception of reality as compared to us. Given the current human understanding (or lack of it) about reality, life and death, we cannot afford to be so rigid about our reality.

Is it possible to build a bridge between the two realities?

There is a wonderful space of possibility called ART. A space where there are no fixed limits and boundaries. There is magic, play and freedom. You can become whatever you want; you can connect to autistic children in domains, which are familiar to them. You can release yourself from the mental prison of ordinary by singing your own song, and your voice will give you wings to fly into other worlds where there is no judgment, only communion.

You can build a bridge.

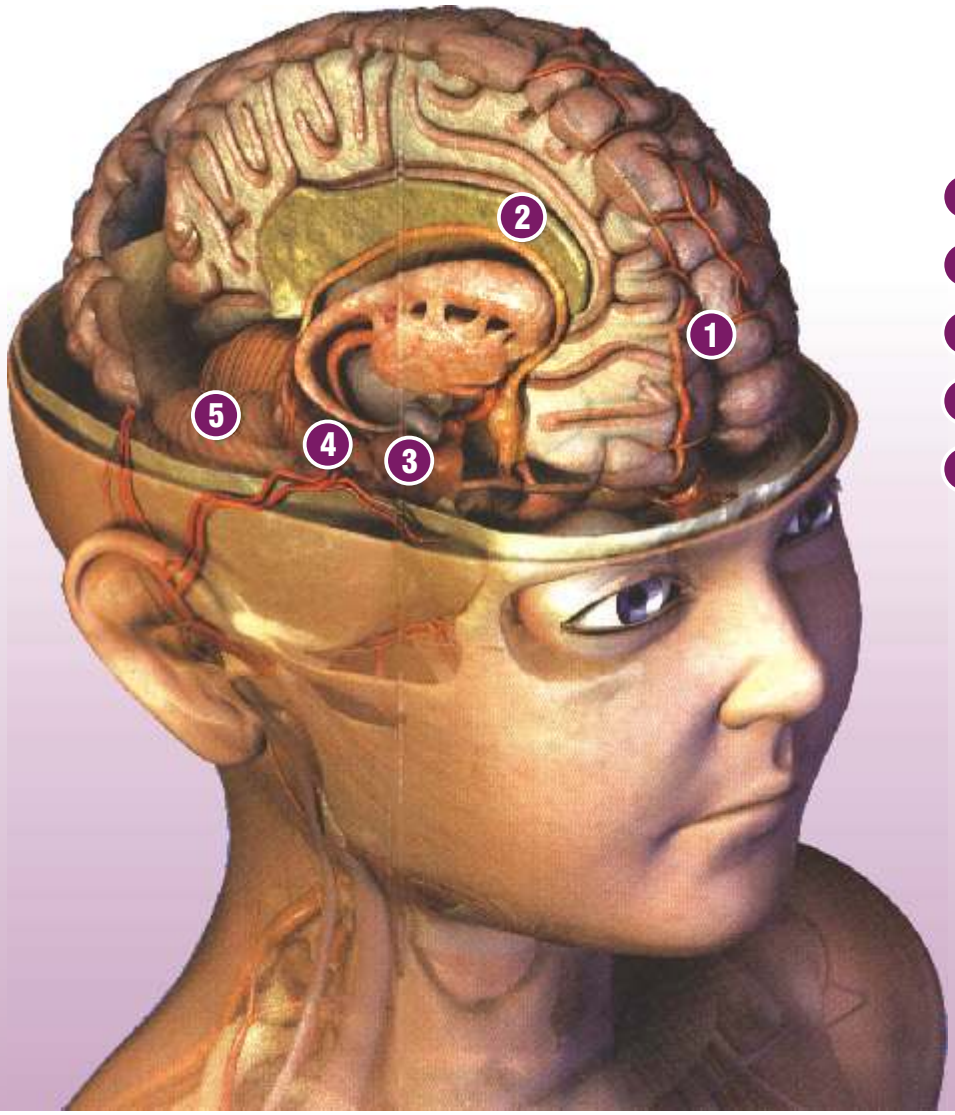
DEFINITION:
ABT is defined as the evidence-based use of art forms (music, drama, and visual arts) to accomplish individualized goals within a therapeutic relationship. It is practiced by a credentialed professional who has completed the ABT Certificate Course.

"Try to see you are very small and life goes on within you and without you"
-The Beatles

2. NEUROBIOLOGY OF AUTISM

An increasing body of evidence suggests that autism is a neurobiological condition (Carter 2000). There are observable differences in the brain of an autistic child as compared to the brain of a regular person. These differences in brain structure explain why they perceive reality differently as compared to regular people. The most notable differences are as follows

- Overall brain size of an autistic person is 10% larger than average brain size
- Frontal lobes are enlarged due to excess white matter. Current scientific conclusion is that white matter in the brain is responsible for maintaining connections between neurons. They are like wires in an electrical circuit. In the case of autistic children there seems to be excess connectivity (tangled wires), which leads to a neural traffic jam, unlike a symphony of an average frontal lobe.



1. Frontal Lobes
2. Corpus Callosum
3. Amygdala
4. Hippocampus
5. Cerebellum

- Temporal lobe - the amygdala is enlarged. The amygdala plays an important role in the limbic system. It is the part, which is most active in 'sizing threat' in the environment and this threat is responded to by 'fight or flight'. An amygdala response can occur at the sub-conscious level. A common example is : suppose you are walking down a street in the night. It is very deserted and you hear footsteps in the dark. These footsteps seem to be approaching you, immediately your amygdala sends signals to your body and your heart rate increases, excess glucose is pumped into your body to get you to fight or flee the supposed threat. However, on closer inspection, you realize, that the footsteps are of a policeman patrolling the area and your conscious reasoning frontal lobes suggest that it is safe to have policemen around in the night and you start to relax and get back to your original walking metabolism. In the case of autistic children, since the amygdala is oversized, it is inferred that the autonomic nervous system is in a constant excitory/inhibitory state and hence they feel anxious/indifferent to new situations and people.
- Temporal Lobe - Hippocampus is also enlarged. The hippocampus plays an important role in laying down memory. This seems to explain why autistic children have such excellent rote memory. They process all information on memory level.
- Parietal lobe - Corpus Collosum is undersized. The corpus collosum acts like a bridge between left hemisphere and right hemisphere of the brain. In the case of autistic children, since it is undersized, it is inferred that they have problems processing inter-hemispheric information thereby accounting for generalization problems, and difficulty with coordination.
- Occipital Lobe - cerebellum is enlarged (overloaded with white matter like the frontal lobes). This excess debris of white matter is accountable for poor functioning of the cerebellum, thereby leading to poor motor coordination, motor planning, and inability to anticipate events.

It is also recommended that readers revise musical concepts like pitch, tempo, tone, melodic contour, rhythm, velocity, and duration. All these definitions are available at www.wikipedia.com

3. CANT YOU HEAR WHAT I SAID?

There are many autistic children who do not seem to 'hear' us. They are unable to make sense of speech. Improper hearing may, in itself lead to weaknesses in all the language tasks viz. vocabulary, comprehension, speech, reading, and writing. In order to understand speech, they must be able to differentiate rhythm, tone, emphasis, and melodic contour. These elements are common components of musical expression too and they are processed in the auditory cortex of the brain.

In case of a regular person, the primary auditory cortex has a well-developed network of neurons. These neurons connect together to form brain maps. When we hear a particular pitch (e.g. Sā) the brain map for 'Sā' will light up and it will also identify the volume of incoming signal.

When we are born, our brain maps are often 'rough drafts', lacking details, undifferentiated. In the critical period after birth (years 1-3) these brain maps get differentiated, detailed and reinforced.

The theory proposed by Dr. M. M. Merzenich (Doidge 2007) states that in the case of autism, certain factors affect the neural circuits, forcing the critical periods to shut down early, before the brain maps are fully differentiated. These brain maps remain undifferentiated. If they hear one frequency, the entire auditory cortex starts firing. This cause difficulty in paying attention. When asked to focus on one sound/pitch, the child will be bombarded with booming buzzing confusion. This could be one reason why they withdraw from the world.

Dr. Merzenich also demonstrated that with training, these **brain maps could be differentiated** so that they can identify selective tones and only relevant brain maps fire when a particular tone is heard.

Once the brain maps are differentiated, the second task is to **process sound patterns in real time.**

Normally, after one tone is processed, neurons are ready to fire again after a 30-millisecond rest. But Paula Tallal at Rutgers University, studied that eighty percent of language impaired children took at least three times that long, so they lost large amounts of information (Doidge 2007). This slow firing of neurons in the auditory cortex makes it difficult for autistic children to recognize two sounds if they occur together fast, they may be unable to differentiate which sound occurred first and which was second. Often, they don't hear the beginnings of syllables or the sound changes within syllables. As Dr. Merzenich says, “when the neuron-firing patterns were examined, the signals weren't clear. They were muddy in, muddy out.”

Reference - The Brain That Changes Itself - Norman Doidge M.D.

3.1 TOOLS & TECHNIQUES FOR SOUND COMPREHENSION

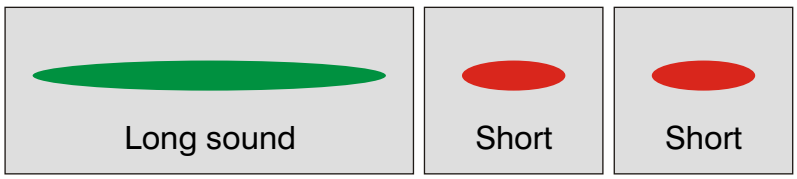
"Human speech perception pushes the auditory system to its limits of acoustic interpretation."
Dr. Dale B. Taylor

Possibility 1:

The simplest way to differentiate the auditory cortex brain maps is by exposing the child to simple tones, one at a time. This can be done by playing 'Sā' on the keyboard, and singing the same. Use different tempo and see the response. Start from a long drone and eventually, play small pips (short durations) of the same note. Repeat the exercise for all other notes (Ré, Gạ, Mạ, Pạ…).

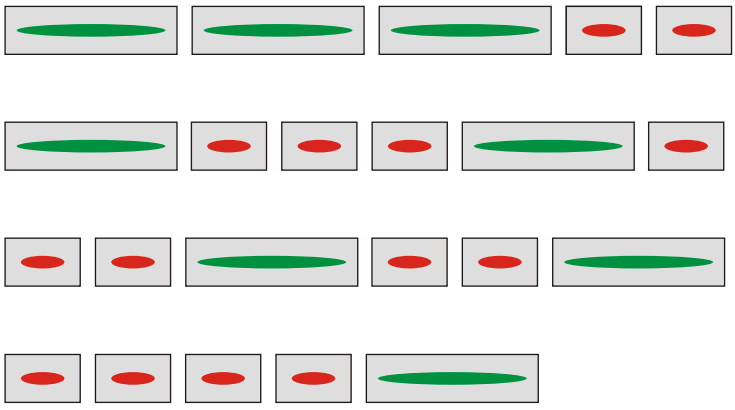
Possibility 2:

Train children to distinguish between long sound and short sound. This can be done by the following graphics flash card:



Keep the key pressed for long time and press it two times for the short one. You can do this exercise with a drum wherein you play a long beat wait and play two fast beats.

Play with various patterns of long and short sound

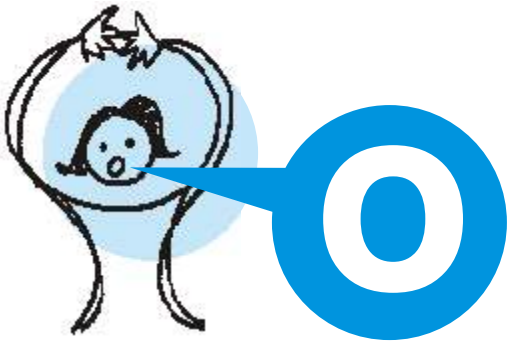


Possibility 3:

Sing vowels first. Using a hand drum and your voice, create melody, which can be sung using vowels. The vowels will determine the melodic contour of the piece. Whenever possible, build a context around the melody by integrating it with visual, tactile, olfactory, vestibular or proprioceptive sensory systems.

Look for signs of babbling, and encourage gibberish vocalization.

A new imaging study (Science Daily 2007) shows that when we learn a new action with associated sounds, the brain quickly makes links between regions responsible for performing the action and those associated with the sound. When you see an action, your brain will remember the corresponding sound, and vice versa.



Possibility 4:

Sing commonly occurring vowel-consonant* combinations like MA MA, DA DA, BA BA, AAEE, SA, RE, GA, MA, PA, DA, NI, etc. Preferably, use Hindi or regional language because they have more subtly differentiated vowel sounds like

अ आ इ ई उ ऊ
ए ऐ ओ औ अं अः

Detailed guide:

- Initially select the following consonants P, B, M.
- Move on to T, C, D, G, W & N
- Take a hand drum and play a pulse at about 60 beats per minute (use your wrist watch to keep time, or you can purchase a metronome$^{\Delta}$). Encourage the child to play along too, if you feel it is appropriate.
- Select a vowel-consonant combination e.g. - Mā. Sing this combination slowly over the beat, which is being played on the drum. Make the combination two syllables long Mā Mā

* Vowels in English are A E I O U and consonants are all the other alphabets other than vowels B C D F etc.

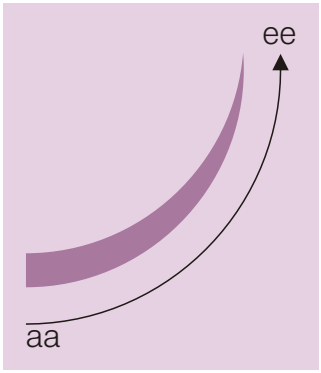
Δ metronome digital device that beeps and keeps time in the unit BPM (beats per minute)

Vowel-Consonant Matrix

	B	P	M	T	C	D	G	W	N	F	H	J	L	Q	R	S	Y	Z
A	BA	PA	MA	TA	CA	DA	GA	WA	NA	FA	HA	JA	LA	QA	RA	SA	YA	ZA
E	BE	PE	ME	TE	CE	DE	GE	WE	NE	FE	HE	JE	LE	QE	RE	SE	YE	ZE
I	BI	PI	MI	TI	CI	DI	GI	WI	NI	FI	HI	JI	LI	QI	RI	SI	YI	ZI
O	BO	PO	MO	TO	CO	DO	GO	WO	NO	FO	HO	JO	LO	QO	RO	SO	YO	ZO
U	BU	PU	MU	TU	CU	DU	GU	WU	NU	FU	HU	JU	LU	QU	RU	SU	YU	ZU

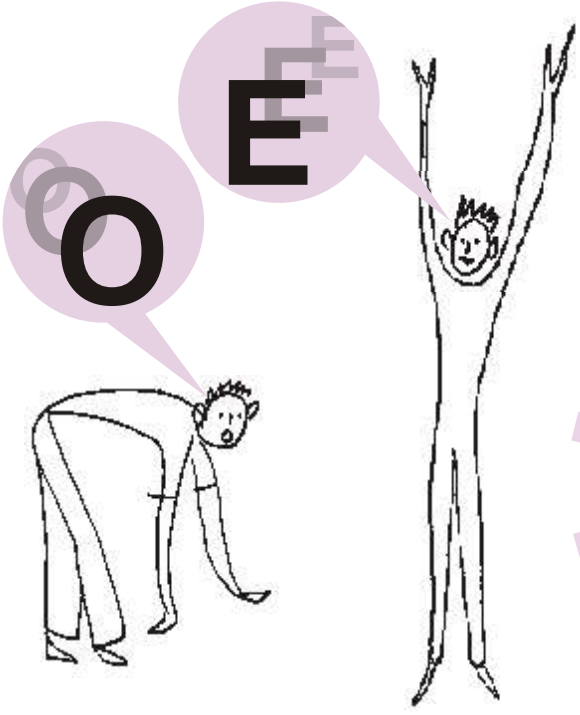
Possibility 5:

Raise the pitch of vowel-consonant sounds. This is a crucial factor in understanding tone and emotions. When we ask a question, we raise the pitch of our words towards the end, isn't it? This variation in pitch gives 'inflection' to our speech. Without that, our speech would be robotic. Musically, one can play with pitch in many ways



Detailed guide:

- Press one note on the keyboard and use the 'pitch bender' function to raise the pitch of that note. You can ask the child to do it, and simultaneously, you can represent the increasing pitch by drawing a graph on paper.
- Stand with your palm open and hand at waist level, bend down so that your hands are almost touching the ground, and mark that position with a low pitch vowel sound, slowly raise your hands and increase the pitch of the sound as your hand moves up upto your head height. Metaphor : first you sound like Amitabh Bacchan when your hand is low and then you sound like Lata Mangeshkar when your hand is high.
- Deliberately choose songs that have a pitch bend : Kishore Kumar's yodel, Saawariya, etc.
- Using the hand drum, play a rumble*, and modulate the volume of rumble from low to high while using your voice to modulate the pitch from low to high.



* rumble- playing the drum very fast with both hands towards a crescendo

Possibility 6:

Creating **Sound Templates** and asking the child to fill-in-the-blank

- You can start by playing Sā, Ré, Gạ, Mạ, Pạ, Dhạ, Nī, Sā on the keyboard. This is your sound template. Once the melody has been repeated sufficiently, it will be retained in the child's memory.
- Once you are certain that the child can recollect this melody line, sing the melody line, but deliberately miss out one or two notes in between. Encourage the child to sing the missed out notes. Give ample time to the child. The missing notes should 'spontaneously' flow into the gaps. Do not pressurize the child.
- This exercise is to be done with the same slyness with which advertisement jingles are targeted at consumers. Before you know it, the tune for Nirma detergent powder is slipped into your head and if someone sings “washing powder Nirma…..” , then you can complete the rest of the song even though it has been years since you heard the jingle.

Simple melodies get “stuck” in our heads easier than more complex ones. Evolutionary biologists theorized that simpler tunes helped the ancient profession of the bard sing and remember oral histories. It has been shown that the more predictable the tune, the easier it is to get stuck in the head (Shouse, 2001).

Many children like the music of Himesh Reshamiya or film music from movies like dhoom because the melodies are repetitive, they have a strong rhythmic structure and they are predictable.

CONCLUSIONS:

As you play with the child, you will come across some musical activity, which he/she likes. It could be a favorite song, or a funny sound that makes him laugh. Make a note of these. Whenever a goal is achieved, play that musical piece or event so that it gets the child's attention. In order for the brain to secrete dopamine and acetylcholine (neurotransmitters which consolidate the map changes he has just made), it is important to set up this system of 'reward' for both of you. Have fun and let go of all expectations. Surrender to the will of the spirit.

4. CALM DOWN!

As a person who is working with autistic children, your instinctive response is to get the child to calm down. The flapping of hands, jumping, twirling, finger movement, or vocalization gets irritating. An ABT Practitioner never listens to instinct. Instead s/he follows intuition. What one must remember at all times is that the behavior is originating from a neuro-physiological source. There is a reason for it. The child is 'feeling' sensations, which you do not feel.

To try and give you a clue, I suggest the following -
On a cold morning, stand under a cold shower. As the chilled water pours over your body, some of you may utter sounds involuntarily; you may move your hands and shake your neck. Observe the involuntary urge to vocalize or move in a particular way to compensate for the sudden sensory surge. Now, imagine feeling this way all the time.

In case this doesn't work for you, get some friends to help you set up an experiment. Do something whereby you experience fear. Observe your bodily reaction to fear. You will catch yourself doing some stereotype motility or expressive action.

Why children behave the way they do, is a subject of much research :

A study by **William Hirstein, V. S. Ramachandran*** and **Portia Iversen**[Δ] indicates that autistic children indulge in **self-stimulating behavior** in order to calm down the hyperactive - sympathetic (`flight or fight') branch of the **autonomic nervous system**. The hyperactivity is attributed to the grossly **oversized amygdala** structure observed in autistic brain.

Behavior is the final manifestation represented by movement of muscles in response to a certain stimuli. Behavior allows us to peek into the individual's emotional makeup.

Autonomic responses provide the energy required to facilitate the behavior.

The sympathetic branch of autonomic system regulates the following:

1. Heart rate
2. Dilation or constriction of blood vessels in order to circulate blood towards skeletal muscles and away from digestive system
3. Pupils dilation
4. Sweating of the palms produced by the eccrine system.

The **amygdala** has what is thought to be an excitatory role in producing autonomic responses, such as pupil dilation, sweating of the palms and decreased gastric motility, via its connections with the lateral hypothalamus (Lang et al. 1964).

* Center for Brain and Cognition, University of California, San Diego, LaJolla, CA 92093, USA

Δ The Cure Autism Now Foundation, 5455 Wilshire Boulevard #715, Los Angeles, CA 90036, USA

Common sense suggests that if sensory input is targeted to the amygdala and its responses are modified, then we can affect the autonomic system. This will cause the same effect as self-stimulating behavior.

The question is what is the role of music in targeting the amygdala? The answer comes in the form of another study done by Dr. Joseph LeDoux (2003). It shows that music (sound) signals reach the amygdala and hypothalamus even before they reach the primary auditory cortex. **This means that sound is processed at a sub-conscious level even before you are aware of it.**

In his brilliant book *The Emotional Brain*, Dr. LeDoux demonstrates the neural pathway for generating fear reaction using auditory cue. A simplified brain map for the same is given below

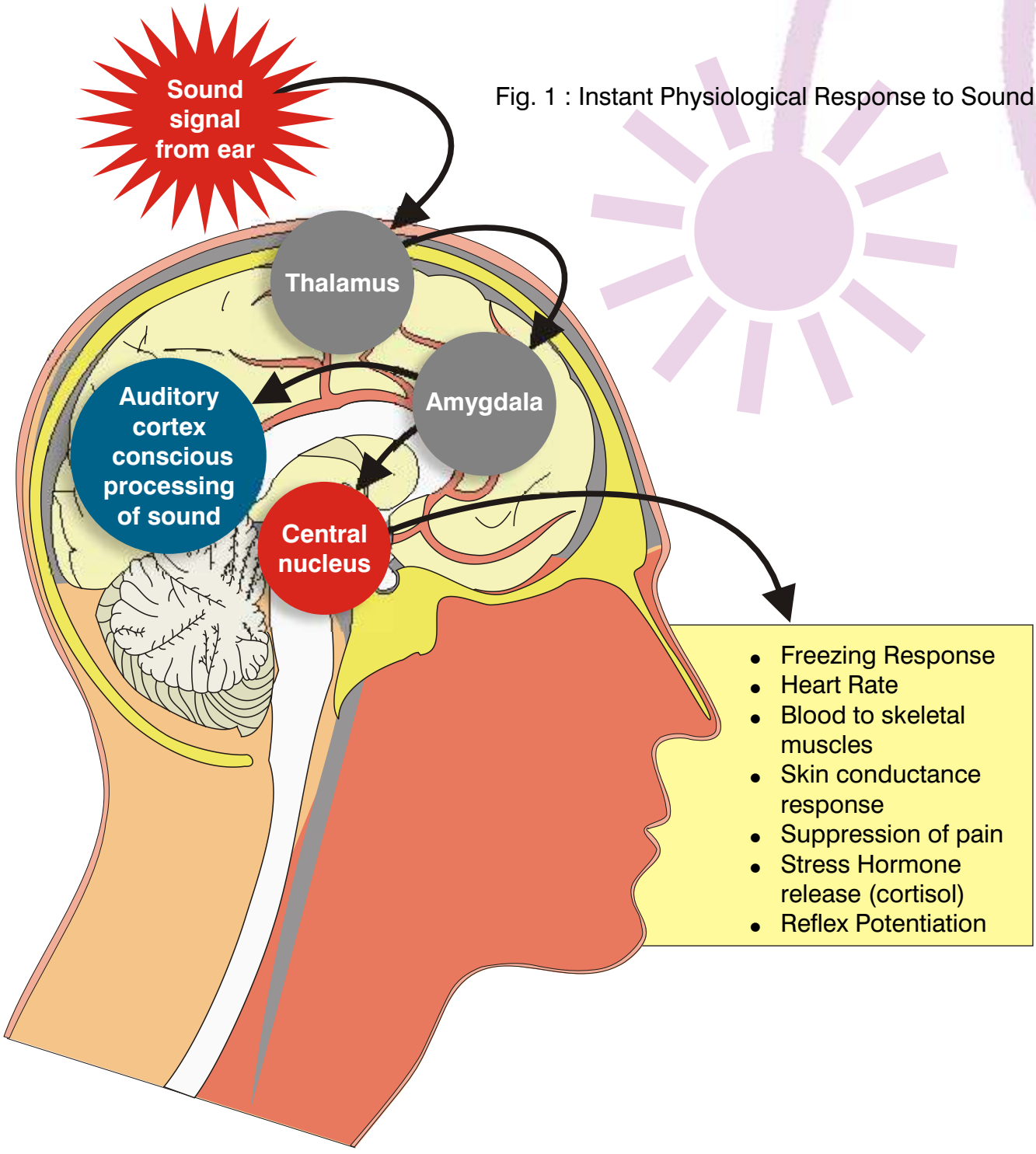


Fig. 1 : Instant Physiological Response to Sound

Refer to fig. 1 and notice that the sound signal travels from the ear to the thalamus. From there, it is sent to the *amygdala* where an *auto response* is generated and to the *auditory cortex*, where a *conscious response* is generated. This neural pathway indicates that when music is received by human beings, it travels directly to the amygdala and the autonomic response to it is generated before you are consciously aware of the music or its source.

e.g. Father shouts at child as soon as a glass falls down

From sound to physiological response in 5 milliseconds* -

Calming musical impulses can reduce the neuronal activity in the central nucleus of the amygdala.

There are corresponding reductions in the signals being sent out through its projections to other parts of the brain that respond to aversive situations, such as the hypothalamus.

The hypothalamus in turn reduces its level of stimulation of the pituitary and endocrine glands including the adrenal medulla, which secretes epinephrine and norepinephrine, and the adrenal cortex, which secretes cortisol, a steroid stress hormone. Resultant behaviours that can be adapted are anger, aggression, feeding, escape reaction, drinking and sleeping

The impact of music on eating and drinking habits of human beings has been the focus of many restaurants and bars. Owners of these establishments spend lot of money on expensive music systems, because people tend to eat and drink more when they are stimulated with loud music. The same goes with color, wherein the colors orange and red are used to stimulate hunger.

Various studies have shown that music can affect autonomic nervous system. The heart rate is easily altered in adults and infants. In fact, even in the mother's womb, the fetal heart rate shows change when headphones are placed on the mother's womb. At 38 weeks, Fetal Heart rate accelerates and limb movements occur reliably (each time) in response to piano and choral music (woodward et al., 1992).

* Excerpted from Biomedical Foundation of Music as Therapy, Dr. Dale Taylor

4.1 STEPS TO ALTER AUTONOMOUS RESPONSE

Given this encouraging insight, ABT practitioners must make use of of the knowledge that "Music has the ability to directly affect neuronal activity in the autonomic nervous system through pathways in the midbrain and brain stem."

In order to reduce hyperactivity of the Autonomic Nervous System using music, we will divide our approach into three steps in order of priority

i. Reduce anxiety, promote feeling of familiarity
ii. Get child's attention, offer something surprising, valuable & novel
iii. Immerse in music
iv. Motivation

i. REDUCE ANXIETY:

With an enlarged amygdala, the child is constantly facing neurological fear and anxiety. Everything can be perceived as a threat. There is a surge in autonomic response whenever encountering new situations. The child will contain this surge by indulging in overt behavior (self-stimulation).

The ABT Practitioner must focus on the following goals :

a) Create a ritual melody/song. Repeat this melody or song at the beginning of every session. The melody must be simple. This will ensure that familiar melody will calm the neuronal activity in the central nucleus, allowing for reduction in stress and anxiety.

b) Get the child to select a melody or song. By doing so, you give the power of choice to the child. Be sensitive to the child's favourite song. No matter how much we codify music and brain, it will always be a very personal experience. There can never be a standard prescription for music. Claims that certain kind of music is therapeutic are not entirely true. Many children will enjoy rhythmic songs, simple melodies far more than meditative music. Be truly open to all kinds of music and respect the child's choice.

c) Personal experience will lead you towards certain type of music. I have found that children respond very favorably to songs which have a 'shuffle' rhythm (shuffle rhythm used in songs like *pal pal pal* from Lage Raho Munnabhai or *kaisi paheli hai yeh zindagani* from Parineeta) or a song with a strong rhythm motif (songs like dhoom have a rhythm which is enforced by the melody as well). ABT practitioners must be updated with

- Nursery rhymes
- Current Hindi film music
- Certain western classical music and
- Prayers & mantras

This is what most children listen to in their environment.

d) Parents must expose children to different type of music and note songs which children like. These songs must be given to teachers so that children can listen to them in school. Each parent contributes valuable information about the child. I have received all my basic music templates from parents.

e) Ensure that all your ABT sessions are conducted in the same space. Ensure same position of chairs. Keep your instruments ready and in the same position as always.

ii. GETTING CHILD'S ATTENTION :

There is a part of our brain which says “hey! Pay attention, this is important”. This part of the brain is the **nucleus basalis**. In childhood, we all learn language and countless other skills in a “critical Period” of 1 to 5 years. This is because our brain has switched 'ON' the nucleus basalis continuously!!! After a few years, the nucleus basalis and the attention system is switched off. After that we cannot learn a new language effortlessly. We have to study the 'foreign language' by paying attention.

***Important Note For Educators*:**
most students complain that their teachers are boring. If the teacher cannot create Surprises, Importance and Novelty in their teaching methods, then the nucleus basalis will not get activated. Resulting in less attention from students.

***From here onwards, the nucleus can be activated only when something* Surprising, Important, Novel *occurs or we deliberately pay close attention*.**

So here is a classical dilemma for ABT Practitioners working with children :

- Autistic children don't like surprises
- They don't seem to attach importance to many things which we find important, and
- They find novelty in details, and they don't mind going through those details again and again.

In such a scenario, how do you get their attention??

The solution lies in **STRUCTURE & IMPROVISATION**
In order to reduce anxiety, we have developed a STRUCTURE. This includes rituals, finding their songs and creating a familiar environment. But in order to get their attention, the same structure must incorporate moments of surprise, value and importance to them.

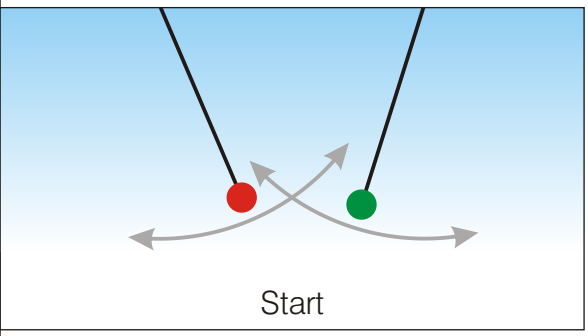
Artists do this all the time. When playing for an audience, the artist must take a familiar subject and add twists to it. A balance of ritual and risk is important for getting the audience interested. In music, we would work with a signature tune something which will be structured and then improvise over it. Free form jazz or Hindustani classical music goes over the head of lay person because s/he cannot find any structure in the barrage of notes that are played. Popular music styles use formula so that listeners can place them in a genre or category.

As an ABT Practitioner, we have the creative option of playing with a structure. Here is one example:

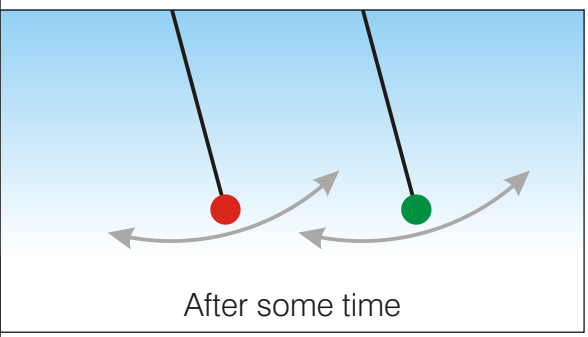
- If a child likes 'London bridge is falling down', start with singing this song
- Introduce a drum instead of singing the song, hit the drum for every syllable i.e. tata tata tatata tatata tatata
- Introduce new lyrics in the same melody "drumstick is falling down, falling down falling down…./my dear abhay"
- Break up the song into two parts for doing a sawaal jawaab (call and response) you sing "London Bridge"/child sings "falling down"
- Introduce a slight variation in the melody, by changing one note in the tune.
- Introduce another rhythm play London bridge in dandiya style!
- Play with the tempo (the speed) of the song.
- Introduce different emotional tones by using minor key (black key/kaali patti) variations to depict scary tone, white keys to depict happy tone, different voice styles to depict different emotions.

ABT Practitioners are often faced with situations wherein children react to certain situation and the session has to be totally altered to deal with such a response. For example, you may want to work with the child on language skills today. You have planned a session on vowel-consonant combinations using some songs. But the child walks into class and starts jumping. As an artist, your response to this jumping must be spontaneous, intuitive and playful. Here are a few suggestions :

- Jumping is a rhythmic activity. Find the rhythm of the jumping.
- Create music which supports the jumping activity. By doing so, you have created a structure which is comfortable for both child and yourself.
- Use claps along with jumping, hold hands, clap each others hands
- Give the child a pair of sticks and ask him to hit the drum while jumping
- Play with the tempo of the jumping. Given strong auditory rhythmic stimulus, the brain, body, and spirit of the child will synchronize with the speed of the rhythm. This is a fact of physics called "entrainment". A little bit about entrainment when two systems in motion are placed in close proximity to each other, they will entrain to a common motion. The most famous experiment in entrainment is beautifully simple too. Take two pendulums, set them in motion (swinging side to side). Place them near each other. After a while, they will be swinging in the same direction. When you listen to a strong beat in the discotheque, or Ganesh Mandal, automatically, your body starts moving to the rhythm. When a group of humans clap their hands, they clap together as if they have all decided on the speed, and rhythm of the clap. Rhythm does bring togetherness!



Start



After some time

iii. IMMERSE IN MUSIC:

When you follow a structured process, you enable the brain to make predictions, pay attention and update the event in memory.

It is very important that the ABT Practitioner follows the session structure and works with a clear beginning, middle and end. Besides this, the ABT Practitioner must make use of “transitions” in the musical movement. It is advised to create shorter musical pieces with clear-cut changes after every few bars. This lends an element of “surprise “ within the musical piece and makes the brain pay attention. Some transitions, which the ABT Practitioner can work with, are:

a) Stop cuts the melody line takes a clear break after every eight bars of music.
b) Accent Jumps after a few bars, the ABT Practitioner accents on the same notes over and over again. E.g. dhoom dhoom (from the song Dhoom Again)
c) Volume Dynamics moving from soft melody to loud
d) Rumbles using rumbles in melody/rhythm after every few pre-determined bars.

Stanford University School of Medicine research team showed that music engages the areas of the brain involved with paying attention, making predictions and updating the event in memory. Peak brain activity occurred during a short period of silence between musical movements - when seemingly nothing was happening.

"In a concert setting, for example, different individuals listen to a piece of music with wandering attention, but at the transition point between movements, their attention is arrested," said the paper's senior author Vinod Menon, PhD, associate professor of psychiatry and behavioral sciences and of neurosciences.

The team used music to help study the brain's attempt to make sense of the continual flow of information the real world generates, a process called event segmentation. **The brain partitions information into meaningful chunks by extracting information about beginnings, endings and the boundaries between events.**

iv. MOTIVATION:

The advantage in using art forms is that children are 'motivated' to explore it. In animal therapy program run by Animal Angels, an NGO based in Pune, the pet therapist works with children using the dog as a motivational factor. The dog is trained and interacts with children by playing catch, allowing them to stroke its fur, eating from their hands, etc. The child is inherently 'motivated' to interact with the dog, and the therapist uses this to forward learning objectives.

When a child performs a successful social interaction, there is a definite feeling of satisfaction. The brain releases dopamine (the reward neurotransmitter) thereby strengthening the stimulus response and creating a brain map for the activity. If the ABT Practitioner senses that the child is not motivated by music, then he/she should take the hint and stop trying for a while. It is not advisable to push any child towards any therapy. The appropriate time will be decided by the child.

5.0 MUSIC AND LANGUAGE

Art forms are a language of the soul. When you interact with a child musically, you are communicating with him/her at a subtle level. There is no need for words, but a higher order of communication structure is present. Simple communication procedures like listening, taking turns, understanding context, pre-empting future action, planning a response, are interwoven in a musical web.

The child and practitioner are connected to each other through this web of music. In the case of language, researchers at Georgetown University Medical Center (2007) have found evidence that the processing of music and language do indeed depend on some of the same brain systems.

ABT Practitioners can use music as the structure for teaching basic communication. Possibilities are endless, but to start somewhere, let us assume that we start by teaching vocalization (the ability to make sounds). As seen in the previous chapter, we can start by working on basic vocalization using the vowel-consonants. If a child is able to vocalize, then you can take the process to the next stage.

5.1 CREATING MUSICAL DIALOGUES:

When two persons play music (using musical instruments/voice), they interact with each other. Their interaction evolves on the basis of a common rhythm, common melodic contour, common melodic scale and common tempo. Based on this agreed structure, the two musicians will improvise and add their unique contribution, thereby making the musical dialogue richer and exciting.

This musical interaction is extremely important for building pre-verbal communication skills amongst children with communicative disorders. The musical interaction must be tightly coordinated. In order to encourage interaction, the following parameters are to be considered:

a) As mentioned in the previous chapter, ABT Practitioner must provide ORDER. The practitioner must create situations with regularly returning elements and rituals in the musical play with the child. By giving order to musical parameters like rhythm, melody or musical form, the child will find it easier to process the interaction, as well as participate in joint attention activities which are familiar.

b) ABT Practitioner must discover INTER-CONNECTEDNESS. The practitioner must be in resonance with the child. By connecting with the child, the practitioner will be able to provide a sound feedback for every outer and inner movement of the child. This may be in the form of supporting the child in a song, or playing the child's vocalization on the keyboard, or sometimes just reflecting the child's emotional state by playing music on the Qchord. If the practitioner can accurately represent the child's inner and outer movements musically, then the child is enabled to express her/his self through emotional signalling.

c) ABT Practitioner must CO-CREATE NEW REALITY. By providing an environment of musical turn taking, the practitioner must enable the child to regulate his/her own behaviour as well as the behaviour of the practitioner. The question-answer mode of music making encourages children towards intentional communication and social referencing which represents an effective preverbal medium for behavioural regulation.

5.2 COMMUNICATION SONGS

Communication songs have a familiar melody and contain simple sentences which convey basic communication. In order to understand the significance of the above methodology, let us reflect on the underlying mechanisms.

The Human brain processes words (and their meanings) and familiar melodies in the same region of the temporal lobe. When you listen to a familiar melody, automatically, you will recall the lyrics and the context of the melody. As a child, each person is taught rhymes, ABCD, prayers etc through familiar tunes. These tunes stick in the head and ensure that you never forget the words. In India, Brahmin priests can memorize immense amount of scriptures by reciting them in a particular tone and rhythmic meter. Many indigeneous cultures which did not have written tradition, would make use of chanting songs and pass down information from one generation to another. Human beings have an immense capacity to remember words (and their meanings) in this way. One interesting story, which I believe is true, goes that

Genghis Khan, the great Mongol emperor ruled a kingdom from Russia to India including Persia and China. In order to send messages, he had created a chain of horsemen who would be posted at distances of 10 kilometres. They would ride at top speed from one post to the other and relay the message to its final destination. The problem was how to make sure that the original message would remain intact when passed on from hundreds of horsemen? This was solved by creating a standard chanting melody, and rhythmic meter. The horsemen were trained to memorize information in a sort of poetic telegraph. This was sung from one horseman to another, thereby ensuring that the original message “The King is going out” would remain the same and not transform into “the king is out”.

In today's world, advertisements use small melodies called as “jingles” in order to place their product's name and features squarely in your head. The recall value of the jingle is immensely powerful, thereby ensuring that prospective customers think about the product when they hear the tune.

In India, we all learn mathematics tables in a kind of hypnotic trance. Thereby mugging up the multiplied numbers and sometimes, one has to say the entire table in order to figure out a particular value.

Given this background the ABT Practitioner can device communication songs and structure it as follows:

1. Make a list of basic communication which you want the child to learn
   a. Hello _____ How are you?
   b. Please give me _____
   c. I want _____
   d. Bye Bye thank you
   e. No! I don't want _____
   f. Im angry
   g. Can I have some more
   h. Please stop, I want to _____
   i. Where is _____
   j. Where are _____
2. Put them to a familiar tune. The tune should be simple and easy to recall (For you and the child)
3. Sing the tune, and add coherence and context by singing the tune and performing the action.
4. Once the song is memorized, and the child can sing along with you, then create dramatic simulation/situational simulation of the same.
5. Contextualize the song by asking the child to sing the relevant song whenever s/he wants something.

How often do you have to do this? Does this mean that you will have to keep singing? There is relief for the ABT Practitioner because as you do the above, another brain system situated in the frontal lobe , helps us unconsciously learn and use the rules that underlie both language and music, such as **the rules of syntax in sentences**, and the **rules of harmony in music** (Georgetown University, 2007). In sometime, the brain will learn and start making the sentences on its own. This is one of the fundamental premises of neuroplasticity.

SUMMARY :

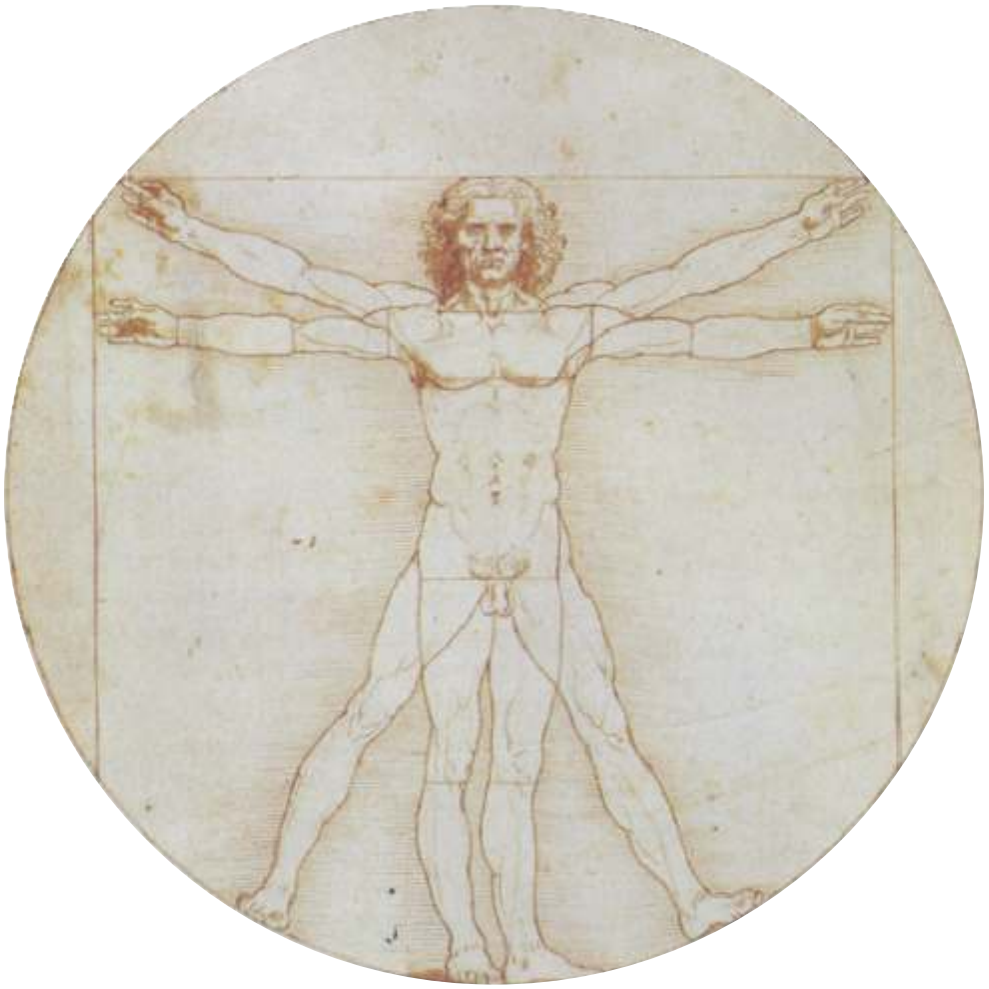
Music can be used to teach rules of language as they rely on the same brain system. Memorized information in language and memorized melodies in music use the same brain system, hence the impact of music on memory.

6.0 MUSIC IS A MULTI-SENSORY 'integrated' PROCESS

In the case of 'pervasive development disorder', it is vital that therapies provide 'pervasive developmental order'. Music provides a multi-sensory integrative input to the child. The experience of active music playing literally “immerses” the child into an orderly energy field. There is a certain underlying harmony; a mathematical cohesiveness, and a universal order in art forms. They appear aesthetic to us because of this underlying pattern, and stability.

The brain is always drawn towards objects/events/beings who display this order. Mathematicians are constantly uncovering the mathematical order in natural aesthetic objects. A TV Series on Discovery channel showed how everything that appeals to us aesthetically has an underlying mathematical precision which attracts us unconsciously.

For example, a fern stem is arranged in such a way that the position of each individual leaf follows the Fibonacci Series. Leonardo DaVinci showed us how the physical body (which in most cases is very aesthetically appealing) is proportioned in the ratio of 'Pi'. The ratio of shoulder-elbow length & elbow-wrist length will always be 3:4



Today, plastic surgeons use mathematical proportions to craft a perfect face.

The entire universe is striving to achieve order, integration and harmony. If this is offered to human beings in any form, it will be received with grace.

6.1 HARMONY & RESONANCE:

When we look at auditory stimulation, music is foremost in simulating order, aesthetics and harmony. In fact, most scientific theories about the cosmos are using music as the metaphor. A new scientific theory called as “String Theory” propounds that the universe is made up of tiny 'strings' of energy which vibrate at various frequencies just like a string on a violin, and their different frequencies give rise to different forms just like a violin string will emanate different tones. In the Hindu Scriptures, the entire universe has its origins in the subtle vibrations of OM. In the Bible, the origin of the universe is ascribed to “The Word” (' and the word was with God').

There is no doubt that music represents a structure of sounds, which are arranged in a pattern. This orderly pattern is inherently appealing to the human brain. When a person is “Immersed” in a music experience, his/her brain entrains with the underlying order of music. This has an instantaneous influencing effect on the person's physiological system, emotional system, spiritual state and relationship with the environment.

If we ask the question “how does music integrate all the diverse brain activities into one unified response?” Then we must open our mind to the fascinating world of the hologram.

Roederer (1985) propounded the hololologic mode of storage and recall of music. The “hololologic representation” theory was first proposed by Karl Pribram (1971).

6.2 HOLOGRAPHIC REPRESENTATION:

A hologram contains all information of an image in every point. Metaphorically speaking, each cell of your body has the genetic information required to create an entire human being. Similarly, if you take a holographic image of an apple, and then cut the image into half, it will still contain the entire image of the apple. When you break a piece of magnet, it will become two magnets. Pribram suggests that the brain is also organized holographically. One area of the brain can simultaneously affect all areas of the brain. If one area of the brain is stimulated, it will reach out to the entire brain in order to facilitate storage and recall.

This approach makes sense when you consider that you only have to impact the auditory cortex in order to create subsequent changes in the limbic system, motor cortex, visual cortex, and all other parts of the brain. If I listen to a piece of music, which appeals to my taste, the music will trigger off the following responses

a) My body will **move** to it, feet will tap, hands clap, head moves etc.
b) I will **remember** the entire sequence of melody, lyrics and rhythmic structure to the song.
c) I will **experience imagery** related to the song's lyrics, or my interpretation of the music.
d) I will **experience the same emotional landscape** that I was in when I first heard the music
e) Consequently, my body will **relax/get excited**, depending on the music.

As soon as the auditory cortex 'hears' a sound, it sends all the information about the sound (pitch, localization, timbre, duration, loudness etc) to all parts of the brain. Each part of the brain receives it and responds according to its primary function.

Each time a familiar musical activity is introduced, neural networks are formed through out the brain. The next time, just one small part of the musical activity will be enough to trigger the entire neural pathway related to the entire activity (Roederer, 1985 : p.76).

6.3 RHYTHM IS ORDER :

A dynamic system which is in order, possesses a rhythm. Chaos is lack of rhythm. According to Hindu beliefs, the Lord Nataraja is the divine deity for dance. He embodies the divine cosmic dance. It is said that destruction will begin when Nataraja dances his dance of destruction.

Every ordered phenomenon has a rhythmic pattern. The planets are in orbit in a particular rhythm, which gives us our cosmic rhythm, the earth travels round the sun and we get the daily rhythm of day and night. Our own bodies are in synch with this rhythm of night and day, it is called 'circadian rhythm'. When we experience 'jet-lag' it is because our circadian rhythm has experienced a dissonance. Your body is a live symphony of rhythmic heartbeats, pulse rate, brainwaves (measured by EEGs), muscular rhythm (EMG), lung functions, hunger signals, digestive & excretory process, lymphatic system, endocrine system etc. if any of the process were not in rhythm, there is a dis-ease.

Ordered motion and movement arises from rhythm. This is evident even in the way modern machines work. In a car, the engine fires in a certain rhythm where the six pistons in each cylinder fire in successions. There is a tuning and timing for your car which the mechanic performs during maintenance.

Movement and motion are not the only phenomenon which require rhythm, in fact even e-motions & human social interactions require it. Human relationships are dependent on a matching of rhythm. For a successful relationship, human beings have to adjust to the pace of their partner. If there is no synchronicity between them, the relationship gets strained. In order to build rapport with one another, human beings are constantly striving to match pace with each other's emotional states. Extremely happy guy cannot sit besides an extremely sad woman. (especially when she blames him for it!) Somewhere along the line the states have to synchronize.

This need for rhythm comes from our inherent comfort with order. Not always is a system in perfect order and not always is it necessary that we have a simple rhythm. The universe is a vastly complex array of rhythmic entities who seem to choose a possibility from the chaos, play with that possibility for a while and then split up to find other possibilities. This is most elegantly denoted in the Hindu scriptures wherein Brahma is the creator, Vishnu is the maintainer and Shiva is the destructor of the universe.

Many autistic children have difficulties with motor planning, fine motor movements (including speech musculature), limbic coordination, inter-hemisphere coordination. These can be worked upon by using the natural “kinetic melody” of the body. The instinctive use of physiology whilst playing a rhythm instrument allows children to create new neural networks which enable them to coordinate motor activities with ease.

6.4 ORDERED MOVEMENT = KINETIC MELODY!

While giving a drum to child, observe the drumming and prepare a profile of the child based on his/her drumming style. That will give you evidence of the child's motor movements and capacity.

An example of a rhythm chart is given below

VERY HARD FORCE (Hits very hard)

CHAOTIC - Uses full weight of arms

STEADY & RIGID - Face is stiff, both hands hit together, same pattern repeated.

SHORT BURSTS - Short Bursts of frenzy, and then stop!

RH-LH COORDINATION

1. Uses only one hand at a time
2. Uses Alternate hands but cannot coordinate the height, direction & force
3. Can Coordinate RH & LH, but has to play very slow. Looses interest soon.

NORMAL FORCE

STEADY & RIGID - Rhythm is only one pattern played again & again.

CHAOTIC PHRASING - Cannot maintain a steady beat, but initiates rhythmic phrases or follows them when therapist initiates it.

RH-LH COORDINATION

1. Uses only one hand at a time
2. Uses Alternate hands but cannot coordinate the height, direction & force
3. Can Coordinate RH & LH, but has to play very slow. Looses interest soon.

NO FORCE (Hits very softly)

CHAOTIC - Sounds like 'mumbling', not clear rhythm, plays fast and slow.

NOT INTERESTED - Needs 'kinetic push' to start playing, body is slouched and hands look limp.

ANXIOUS - seems disturbed by the noise

RH-LH COORDINATION

1. Uses only one hand at a time
2. Uses alternate hands, but with no coordination
3. Can coordinate RH & LH

DYNAMIC FREEDOM

Is able to play loud & soft

Is able to play fast & slow

Is able to coordinate rh & lh to play rhythmic patterns

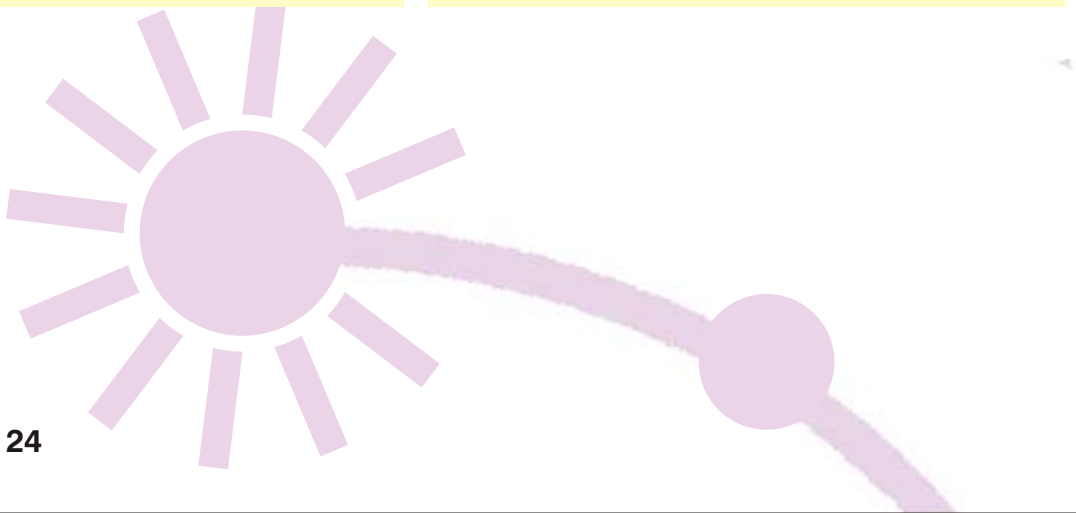
Is able to coordinate a response to musical stimulus

Is able to coordinate playing two-tone rhythms (bass & tone)

Is able to play rumble

Stop & start on cue

Imitate rhythms



APPENDIX 1: SCOPE OF APPLICATION OF MUSIC

The Following table will detail the 'Scope of Musical Applications'. ABT Practitioners can use this table to understand the depth at which processes occur in the brain when it is exposed to musical input. ABT Practitioners can also use the table to direct their musical activity towards specific neurological areas.

Table 1 : FETAL BRAIN DEVELOPMENT

Shows early formation of auditory receptors	The auditory tract may well be the fetal brain's primary source of stimulation	Auditory Stimulation results in formation of cognitive structures, which are useful after birth.
	Conscious introduction of soothing music and voice shows positive results.	Auditory evoked response in the fetal brain shows that the stimulus is transmitted to the brain where it can be perceived & stored in memory (Shetler, 1990)
		Panthuraamphorn (1993) reported that newborns who have been sung to prenatally appear calm, attentive and highly alert to their new environment after birth.
	Introduction of inappropriate sound (white noise) shows negative results	Study shows that the closer children lived to the noisy airport in Frankfurt, Germany, the lower their intelligence was.
		Similar study, on children in public housing high rises above the Dan Ryan Expressway in Chicago, found that the closer their floor was to the highway, the lower their intelligence.

Table 2 : **FETAL BRAIN DEVELOPMENT**		
'White Noise' consists of many frequencies and is very stimulating to the auditory cortex.	Infants are reared in more noisy environments. White noise is everywhere now fans in electronics, air conditioners, Mobile Ring tones, Car Engines, Refrigerators, Inverters, Background Television etc.	When rat pups are exposed to continuous pulses of white noise during their critical development phase, their auditory cortices are devastated (Zang, Bao & Merzenich, 2002). The animals are left with undifferentiated brain maps. There will be indiscriminate neural firing (entire auditory cortex) each time they were exposed to any sound frequency. Similar undifferentiated brain maps are observed in autistic children. If they hear one frequency, the whole auditory cortex starts firing (Rubenstein & Merzeovich, 2003).
	External white noise is not the only cause of diffused auditory brain maps.	Dr. Merzenich believes that many inherited conditions interfere with the ability of neurons to make strong clear signals that stand out against the background of the brain's other activities, creating the same effect on a brain as white noise. He calls this problem *internal* noise (Doidge 2007).
	Undifferentiated brain maps can be normalized	Using white noise, Merzenich and his team first differentiated the auditory maps of rats. After the damage was done, they normalized and redifferentiated the maps using *very simple tones*, one at a time. With training, they brought the maps to an above-average range. They are trying to do the same with autistic children (Baoetal, 2003).

RESPONSE TO ORGANIZED SOUND (MUSIC)

Table 3 : MEMORY

Auditory stimulation continues to form and reshape cognitive structures (related to memory) in the brain	The neural network is shaped by the auditory input. When the auditory cortex hears one sound, it relays the information 'holographically' to the entire brain.	If an ABT Practitioner introduces the initial melody of a familiar song, the client can sing the remaining song. This is accompanied by strong positive emotional reactions which are very motivating and reinforcing

Table 4 : ANS (Autonomic Nervous System)

Music reaches the amygdala, which sends axons to the following -	*Hypothalamus* musical stimulus have a strong effect upon its neurological firing patterns (Taylor 1997:27)	Stimulating the hypothalamus can affect the *autonomic nervous system*. Specific *behavioral responses* which can be elicited or inhibited via hypothalamus • Anger and aggression • Feeding and satiety • Escape • Drinking • Sleeping • Reproductive reactions involved in mating. • Blood pressure
		Stimulating the hypothalamus can affect the *endocrine system.* Specific *hormonal activities* which can be elicited or inhibited via hypothalamus are: • Stimulation of Pituitary gland • Stimulation of adrenal medulla which secretes epinephrine and norepinephrine. • Stimulation of adrenal cortex, which secretes *cortisol*, a steroid stress hormone.
		Ruud (1978) describes that patients who are inattentive, distractible, confused, depressed, hallucinated or in anxiety state cannot initiate or sustain verbal contact. Music makes contact through the amygdala, hypothalamus and other limbic brain structures. It reaches emotional centers without prior need for higher cortical analysis of the sensation.

Table 5 : **EMOTIONS**		
AMYGDALA	Auditory stimulation activates response in amygdala	Results display bilateral amygdala activation in response to emotional auditory stimulation. This result was observed for both positive emotions (happiness, pleasure) and negative emotions (fear, sadness) (Fecteau, 2007)

Table 6 : **INTER-HEMISPHERIC ACTIVITY**		
Brain trained in music exhibit enhanced structures connecting right & left hemisphere.	Musicians have longer anterior corpus callosum.	Schlaug (1995) demonstrated that the anterior corpus callosum was significantly larger in adult musicians than in adult non- musicians and that the difference was attributable to the subgroup of musicians who began training before age seven.
	Musicians have larger cerebellum.	*Cerebellum*. The cerebellum is involved in motor skill acquisition and performance through error feedback. Right-handed male musicians have a larger cerebellum relative to total brain size than do non-musicians. Relative cerebellar size also correlated positively with duration and intensity of training and practice, as well as an early age of commencement (Hutchinson, 2001).
		Conventional wisdom suggests that the principal role of the cerebellum relates to coordinating motor movement. But research by Levitin is consistent with studies by Jeremy D. Schmahmann, M.D., and Janet Sherman of Harvard Medical School that point to a much broader role for the cerebellum, including tracking the beat and distinguishing familiar from unfamiliar music. Perhaps most surprising is that the cerebellum plays a role in musically evoked emotions and in the formation and expression of musical taste. These discoveries are consistent with anatomical studies from the 1970s that found direct neural connections between the cerebellum and the hearing organ with-in the cochlea, which converts sound vibrations into nerve impulses.

Table 6 : **INTER-HEMISPHERIC ACTIVITY**		
		correlations have been found between the size of the corpus callosum and the extent of activation of the supplementary motor area, cingulate cortex, primary motor and premotor areas, prefrontal cortex, and temporal cortex during bimanual finger movements (Stancak, Lucking, Kristeva-Feige 2002).
	Bi-Manual motor movement is improved by music practice.	The finding of rapid increases in corpus callosum size during early childhood complements other studies in establishing that the corpus callosum plays an essential role in the execution of bimanual motor movements (which are of course essential in playing an instrument). Considering that both corpus callosum size and finger development show their most rapid gains between the ages of four and eleven, the most probable cause for increased corpus callosum size in musicians beginning training before age seven would be that there is a large amount of use-dependent plasticity involved in development of the corpus callosum as well as in other cortical areas. If so, then “environmental” factors, such as bimanual motor training, would determine corpus callosum size.
		Evidence comes from studies which indicate that the corpus callosum continues to grow well into adolescence, experiencing its greatest gains between the ages of four and eleven (Geidd, et al 1996). This would make it likely that the growth of the corpus callosum is due largely to 'environmental' factors such as music training

Table 7 : **SPEECH**		
Speech area	In the case of musicians, increased volume of gray matter in Brocas region is observed.	A positive correlation between gray matter volume and musicianship was also found in the left inferior frontal gyrus in the Broca's region of orchestral musicians. Broca's region is commonly associated with speech production. However, many of the requirements for music, such as monitoring and adjusting motor function based on analysis of auditory sequences, are similar to those required by speech, as indicated by the above structural evidence (Sluming, et al 2002).

APPENDIX 2: TYPICAL DEVELOPMENT OF MUSICAL BEHAVIOR* :

A rough road map for ABT Practitioners will illustrate what behavior to look for whilst planning a musical intervention. This is a form of diagnosis based on the child's musical responses. By understanding the musical behavior, the ABT Practitioner can assess the level of development and correlate it to therapeutic objectives.

Cognitive structures for appreciation and expression of music are developed in a certain pattern. Although these patterns vary, the resultant musical behavior can prepare the ABT Practitioner to asses the stage of development of the child's musical behavior.

Stage I :

A prerequisite for acquiring musical behavior is forming stable concepts of melody, rhythm, harmony and form. This can happen when their capacity to 'listen' to music is encouraged.

At this stage, the ABT Practitioner is primarily concerned with exposing the child to various forms of - **melody**, **rhythm**, **harmony** and **form**.

An ABT Practitioner must have a diverse range of musical ability for expressing:

a) Different colors of melody
b) Different rhythmic structures
c) Improvising with harmonies and
d) Providing different forms of music which are relevant to the cultural context of the child's environment.

At this stage, the ABT Practitioner is intently looking for responses from the child. From the response, the ABT Practitioner can watch out for & assess the following:

1. Which melodic lines attract the child's attention?
   When the ABT Practitioner tries out different melodies, s/he can start with simple melodic patterns, but there is no need to restrict the melody to simple progressions. Children are capable of appreciating a wide variety of melodic progressions. It is worthwhile to explore music which is familiar to the child. Sometimes it may be an ad jingle, or hindi film song.
2. Which rhythms allow for spontaneous physiological response?
3. Does the child display eye contact; especially watch out during the silences between notes (refer to paying attention)
4. Facial expression will tell you whether the child is attentive. Neuro-Linguistic Programming (NLP) states that if the eyes are looking upward (right side) with head tilted to one side then the child is using auditory system to process information.

31. Adapted from Dale B. Taylor, Biomedical Foundations of Music as Therapy, MMB Music Inc. (Pg. 28-29)

5. Watch for pitch matching this will tell you about the functioning of the right hemispheric primary auditory cortex where pitch is perceived. It will tell you if the brain maps for auditory perception are differentiated. It will also tell you about expressive ability, prosody of speech and thereby give a clue about the child's expressive capacity at the moment.
6. Watch for rhythm matching this is a primary function, whose perception originates in the left hemisphere of the brain. Rhythm has a physiological appeal and is expressed via the motor cortex & speech areas. Observing the child's rhythm matching ability will give insight into limbic coordination (left and right side), indicate muscular ability/tension, fine motor and gross motor skills, auditory perception of sound duration (can s/he identify the length of a sound),
7. Watch for vocal reproduction of melodic contour : to what extent can the child reproduce a melody played by the ABT Practitioner? This activity is primarily perceived in the right hemisphere of the brain.
8. Maintenance of tonality is the child able to sustain a particular (e.g. Sa or Ni) note? Tonality is part of an 'Auditory pattern recognition' system. It is primarily a function of the right hemisphere. Receptive as well as expressive maintenance of tonality can be checked.
9. Watch for intuitional logic concerning pattern recognition, response to stimulus the child will not appear to “learn” music, but will be responding musically to the stimulus provided by the ABT Practitioner. At this stage, the child will not be able to perform reversible operations if the stimulus is altered. The child will ask for 'sameness' in order to 'conserve' the musical experience. Conservation of the musical experience can be related to a certain 'flow' of information that is established between the child, practitioner and music medium.

Stage II

At this stage, the child will develop an understanding of the 'underlying pattern' of musical play. With this understanding, the child will be able to perform tasks of musical imitation, improvisations and role-play.

At this stage, the ABT Practitioner can watch out for and assess the following:

1. Ability to imitate tonal patterns vocally : this will inform us about vocal capacity and speech musculature, auditory pattern recognition, whether the brain maps are differentiated to perceive minute tonal changes?
2. Ability to imitate tonal patterns on instruments : This will indicate motor planning, musculature control for fine motor movements, thereby giving clue to speech areas, auditory perception, and attention span.
3. Ability to imitate rhythmic patterns : this will indicate motor planning, gross motor movement, fine motor movement, is there 'kinetic melody' in the body? Ability to recognize auditory sequences (since rhythm always plays in a loop), level of interaction.

4. Perception of durational changes : if a particular group of notes are sustained or shortened, a 'musical phrase' is created. Can the child perceive and reproduce it accurately? The duration of each note will change the musical phrase. This will indicate auditory pattern recognition, tonal differentiation, tempo and time perception.
5. Conservation of rhythm & tempo under melody deformation in a song, the rhythm can be independent of melody line progressions. Natural instinct is to play the rhythm according to the melody, but once the child is at Stage II development, s/he will be able to conserve the rhythm whilst the practitioner improvises with the melody. This will indicate perception of rhythm, ability to integrate two auditory stimuli simultaneously (rhythm of the child and melody of the practitioner), and ability to integrate auditory, visual, tactile, proprioceptive senses to form a Gestalt of the musical piece being played.

Stage III

At this stage, you will begin to notice a musical dialogue, complete freedom of expression, and reciprocity between child and practitioner.

At this stage, the ABT Practitioner can watch out for and assess the following:

1. Conservation of melody under rhythmic changes and pitch transposition : this will indicate skill level of singing or instrument playing, and will determine sensory integration, attention span and conservation ability (the mental capacity most studied by researchers in developmental musicology)
2. Conservation of rhythmic meter and melodic phrases
3. Improved Tonal memory, melodic perception and pitch discrimination
4. Improvisation ability, ability to produce inversions and retrograde.

REFERENCES

Bao, S. Chang, E. F. Davis, J.D. Gobeske, K.T. and Merzenich, M.M (2003) Progressive degradation and subsequent refinement of acoustic representations in the adult auditory cortex, Journal of Neuroscience, 23 (4): 10765-75

Carter, R (2000) Mapping The Mind, London: Orion Books

Doidge, N (2007) The Brain that changes itself: stories of personal triumph from the frontiers of brain science, USA: Viking

Geidd, J., Rumsey, J., Castellanos, F., Rajapakse, J., Kaysen, D., Vaituzis, A., Vauss, Y., Hamburger, S., Rapoport, J. (1996) A quantitative MRI study of the corpus callosum in children and adolescents, Developmental Brain Research, 91: 274-280

Georgetown University Medical Center (2007) Music And Language Are Processed By The Same Brain Systems. Online.< http://www.sciencedaily.com/releases/2007/09/070927121101.htm> (Retrieved November 10, 2007)

Hutchinson, S., Lee, L.H., Gaab, N., Schlaug, G (2003) Cerebellar Volume in Musicians Cerebral Cortex, 13(9), 943-949

Lang, A. H., Tuovinen, T. & Valleala, P (1964) Amygdaloid afterdischarge and galvanic skin response, Electroencephalogr, Clinical Neurophysiology, 16: 366 374

LeDoux, J (2003) The Emotional Brain, London: Phoenix

Panthuraamphorn, C. (1993) Prenatal infant stimulation program in T. Blum (ed) Prenatal Perception, Learning & Bonding (pp.187 220) Hong Kong: Leanardo Publishers

Pribram, K (1971) Languages of the Brain, Englewood Cliffs, NJ: Prentice-Hall

Roederer, J.G (1985) Neuropsychological processes relevant to the perception of music an introduction. in R. Spintge & R. Droh (Eds.), Music in Medicine (pp. 61 86). Basel: Editiones Roches

Ruud, E (1978). Music Therapy and its Relationship to current treatment theories. Saint Louis: MMB Music, Inc

Fecteau, S. Belin, P. Joanette, Y. Armony, J (2007) Amygdala response to non-linguistic emotional vocalizations, Neuorimage

Schlaug, G., Jancke, L., Huang, Y., Staiger, J., Steinmetz, H (1995) Increased Corpus Callosum Size in Musicians, Neuropsychologia, 33: 1047-1055

ScienceDaily (2007) Musician In The Mirror: New Study Shows Brain Rapidly Forms Link Between Sounds And Actions That Produce Them. Society for Neuroscience, Online. Available HTTP < http://www.sciencedaily.com/releases/2007/01/070112155201.htm> (Retrieved November 10, 2007)
Shouse (2001). (Retrieved from <http://en.wikipedia.org/wiki/Music_and_the_brain>)

Shetler D.J (1990) The inquiry into prenatal musical experience in Wilson, F and Roehmann, F (eds), Music & Child Development (pp. 44 62). Saint Louis: MMB Music, Inc.

Sluming, V., Barrick, T., Howard, M., Cezayirli, E., Mayes, A., Roberts, N. (2002) Voxel based morphometry reveals increased gray matter density in Broca's area in male symphony orchestra musicians, Neuroimage, 17: 1613-1622

Stancak, A., Lucking, C., Kristeva-Feige, R (2002) The size of the corpus callosum and functional connectivities of cortical regions in finger and shoulder movements. Cognitive Brain Research, 13, 61-74

Taylor, D (1997) Biomedical Foundations of Music as Therapy, USA: MMB Music, Inc.

Woodward, S.C., Guidozzi, F., Hofmeyer, G.J., Dejong, P., Anthony, J., & Woods, D. (1992). Discoveries in the fetal and neonatal worlds of music, in H. Lees (ed) Music Education: sharing Musics of the World, New Zealand: University of Canterbury, (pp. 58-66)

Zhang, L.I, Bao, S. and Merzenich, M.M (2002) Disruption of primary auditory cortex by synchronous auditory inputs during a critical period. Proceedings of the National Academy of Sciences, USA, 99 (4): 2309-14.