Bulletin of the *Transilvania* University of Braşov
Series VIII: Performing Arts • Vol. 6 (55) No. 1 - 2013

SPECTRAL ANALYSIS IN MUSIC AND ITS IMPLICATIONS IN MUSIC THERAPY STUDIES (THERAPY THROUGH MUSIC)

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"Every disease is a musical problem; and every cure is a musical solution."
Novalis

Abstract: *Music therapy probably is among the oldest and most unsystematic disciplines or practices. Therapeutic practices are old ever since Orpheus tried to tame or heal the fallen Creation (Genesis) with his song. Today, music therapy has still remained an exploratory field of uncertainties, although some systematisable results have been profiled. In the horizon of these explorations, eclecticism cannot be bypassed, as any practice sends us back to the depths of social and individual psychism. I'll mention some known practices, with a plus of clarity; I connect the therapeutic issue to the composing act, especially for Classicist music. It seems alarming to me and I mention that the effects expected from music therapy grow ever feebler under the circumstances of artistic and non-artistic sound pollution, which troubles and alienates the normal edifice of present-day man's psychogenesis. I also underline that the essence of music therapy is the transfer (mutation) between interchangeable psychical dominants. Today's successes in music therapy envisaging some music genres from the pre-Classicist and Classicist epoch (see the "Mozart" effect) are also due to spectral analysis, namely to low-frequency spectra, to the discovery of the distribution of 1/f sound frequency, naturally contained in certain sound manifestations of music.*

Keywords: *Doru Ursuţiu, music therapy, fractal analysis, spectral characteristics of sound, reception.*

1. Introduction

Without seeking to slide on a beaten path, nor on one which deeply investigates the domain of music therapy on diverging directions, I will here bring to discussion a few questions I asked myself and some answers I have reached following my own research or repeated discussions with specialists in the field. Starting from the

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above motto, we acquire an important idea in my opinion, namely that any disease institutes a disharmony which starts from the macrocosmic to the microcosmic level of the human being (from universe to individual), that the positive resonance of the individual is *music*, and disease troubles this resonance. It is therefore natural that a therapeutic attitude be able to restore the individual's harmony. On the other hand, it seems interesting to notice that most people who deal with music therapy, be it empirically or clinically, admit that they themselves have had a precarious psychical equilibrium, in a passing manner; and sometimes those who have been ill at least once generally also become experts in music therapy; these never issue generally valid diagnostics, but, like psychiatrists, conduct synergic experiments and research at several levels, then comment on the disease, attempting to discover its source, its core.

2. Music Therapy Yesterday and Today. A Brief Overview

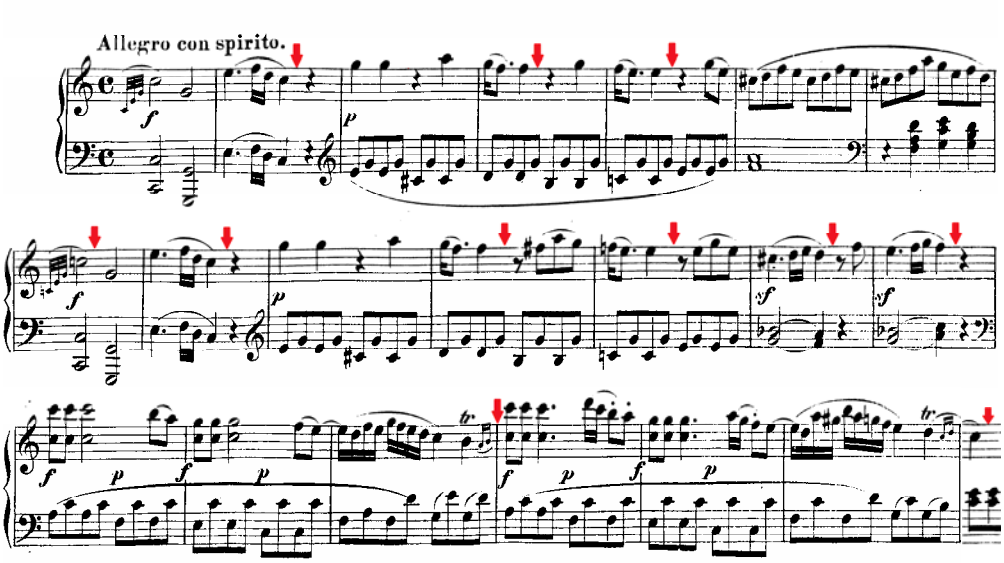
Music therapy as a domain was first born as a spontaneous phenomenon, then as a clinical experiment, and it finally tackled sound through scientific methods, analysed it from the point of view of its spectrum and intimate harmony (see the considerations regarding the fractal analysis of a sound (sound constellations) with applications in psychology/ psychoanalysis further on). Today, these methods tend to gather together, achieving multiple connections to stimulate using music to therapeutic aims. For instance, music therapy brings to discussion some experiments from the new sciences, like those in bioacoustics – from what is understood as neuromusical thresholds –, those regarding mental energy fields and inborn, biological musicality. Likewise, the presence of conscience (of the individual emotional life) in images, not in verbal forms, is highlighted, which allows us to also accept various fields of musical inspiration (even if we do not understand them). I also mentioned on other occasions that the grammar of natural language does not match the musical grammar. Therefore, there are no real similarities between musical syntax and the syntax of linguistic texts. There only exist approximations, correlations that pertain to finding and testing certain methods to analyse music (using the known, conventional links between phenomena). When we talk of musical inspiration, we do not think of therapy yet: obviously, these two entities have different features at a first glance. Even if there is a clear distinction between musical composition – the inspirational nucleus of which it was born – and therapy (as a practice), inspiration in itself (the first level of composition) has a therapeutic motivation. The composers write music under the influence of aims, like that of setting himself free of all the ramblings of his brain, relieving him of certain psychical states which are pressing him and from which results the very idea, the core of creation. If we take a retrospective look into history, once with the early Renaissance epoch, music was no longer conceived for therapeutic aims, as it happened in the (very) ancient cultures (it is known that the therapeutic function of music has existed since time immemorial, when shamans (thaumaturges) associated dancing around the sick with their more or less improvised incantations – beside certain herbs with healing powers; where

rituals were expected to bear a positive psycho-physiological influence on the sick. The history of music proves that the composer of the last centuries has been creative, has orders for the immanent need of religious cults, for secular events, for nobility or folk festivities, with a character lying outside the deep interiority of the soul. On the contrary, healers did not make incantations to spirits, as the idea of *approach*, nor that of musical composition existed then. Musical composition appears with the emerging of scores, written forms which encode musical states through serigraphic conventions. A composer (score „maker") is endowed with multiple spiritual valences; he could be a scientist, literate or philosopher at the same time. Beethoven said that music was a revelation above all wisdom. When we deal with revelation, it is perceived – according to an unwritten rule – beyond current judgement. It, the revelation, is an intuition of the absolute existential truth, higher intellective ability, generating transformations in the personality of him who comes upon it, a solving of an ever vivid curiosity. In music, I think, one can encounter higher achievement in accomplishing one's personality through *revelation*. By addressing the psychical, cognitive and emotional functions, music therapy, in its modern sense, relies on sound exploration studies, and on the link established between music and the human brain. Each person is touched by music through different and specific paths; likewise, each person partakes in and perceives a distinct modality of music therapy with each own experience, and this modality offers him/her diverse learning opportunities (adapting to new understandings, to catharsis experiences), creativity in varied horizons, but also flexibility in expression (reception), which can be noticeably differentiated in traditional education, but also in the current one. A child – a young person initiated in music – has improved traits of character and is capable of rich abilities. As a novelty and also peculiarity, the Secretary of State in Edinburgh decreed in 2013 that every newborn in Scotland shall receive a CD with Classicist music pieces at birth, in the hope that, thus, the love for music will be cultivated in each child, which can have positive impact on the cognitive development of children and strengthen bonds between these and their parents, by encouraging families to use music for consolidating informal education [1]. As I also announced in the introductory part, this study does not envisage a systematic approach of the music therapy domain; it does under no circumstances deal with a healing therapy in the case of a malady. I attempt to explain some indices which can, in the case of certain music, certify its healing valences through certain (selective) determinations related to acoustics, mathematics, (higher) theory of music, at a prospective (introspective) interdisciplinary level.

3. The „Mozart Effect" and the Fractal Dimension in the Analysis Proposed by Prof. Dr. Doru Ursuțiu

According to some authors, the issue whether, in a certain sense, Wolfgang Amadeus Mozart was more musical than the "baker next door" or whether he just was far more creative, still remains a mystery[2]. It is clear that not only Mozart, but even the baker came into this world

with his own musical endowment. Yet, it is not both persons who erected a foundation stone for the universal culture. In this respect, I consider that Noam Chomsky's assertion[3], which postulates the existence of innatism – inborn psychical structures which do not „evolve" through experience and accumulations, but exist already (like the liver or any other organ of a baby – which only has to consume its growth time for one and the same functionality during the entire life) – is illuminating. Innatism as a scientific icon allows measurability, noticing the oscillability, variants and invariants between the different cognitive structures of individuals. The research of the human brain has brought forth significant insights, as varied regions of the brain work together. This process of working "together" at the level of synapses is definitely the one that ensures the human being's potential for creativity. Discoveries based on musical and clinical considerations (until the present) affirm the thesis that *every* human being is *musical* to a higher or lower degree, that *every* human has *musical* knowledge [4]. Wolfgang Amadeus Mozart was probably more musical than the baker next door, as he was marked by musical sounds, by types of music along his family tree and even in his intrauterine life. I do not bring to discussion his musical education here, the relentless work, him being constantly stimulated by his father and his entire experience, confirmed by an immensely prodigious creation. It is also known that the generations of instrumentalists and fiddlers bear offspring with higher musicality potential than ordinary people. In the empirical musical practice (more ancient or newer), by singing and playing they took over the suffering of him who hired them, they shared their compassion with him. A fiddler achieved a *passing-over* to quite an extent, actually the passage to another psychical dominant – as certain people suffering from depression were encouraged to travel to other lands in the old days; Romanian fairytales depict this aspect; as we know, all young ladies (emperor daughters) in love with the wrong guy were forced to leave on journeys or exiled in order to overcome the psychical dominant they were bound to. Today, the "Mozart effect" is a certainty, a success of therapeutics. There are studies referring to structures with a low-frequency characteristic of the 1/f type, present in his musical compositions, which can be – and have been – correlated to the positive effects of therapy through music. This type of harmonic analyses, resulting in raising spectra with a low-frequency characteristic (structures of the 1/f type), have been made by Professor Dr. Doru Ursuțiu within the Laboratory for *Medical Acoustics* at the *Transilvania* University in Braşov, with the aid of the computer. Affirming my viewpoint, he ascertains that the specific form of Mozartian creativity itself generates this effect. The simplicity of the melody, harmony and orchestration, as well as that of the short musical phrases – with frequent closes (cadenzas) – stimulates in its listeners the frequency of releases (relaxing of emotional tensions).



Example no.1
(Mozart – Piano Sonata No. 7 in C major, K. 309)

In the example of the main theme in the 1st movement from the sonata no. 7 K. 309 by Mozart, one distinguishes closes (cadenzas) which parcel the discourse with greater or lesser weight as to its hardness compared with the relations established between harmonic functions, in a highly frequent distribution in time – every two bars. Thus, the structure's *initium* (built through a rhythmic and melodic unison) marks a first cadenza in C major (tonic-dominant-tonic) at the end of the first two bars. In the phrase starting with bar 3, the flow is short-circuited ever more "hurriedly" at the level of one and a half bars, up to half a bar (see the marks with vertical arrows). In bar 6, instead of the expected "military" cadenza, we witness a statism on the subdominant's function (2nd degree), which does nothing more than "put our nerves on edge", deceive the initial psychical dominant, compelling us to wait for the cadenza; yet, this moment vigorously appears in the next bar of the structure. In bars 13 and 14 (for instance), these cadenza cuts grow ever more frequent: it is the so-called – by musicians – *development through elimination*, a composing procedure in which the author envisages this very aspect. Consequently, until the Mozart theme (of 21 bars) is completed, we assist to no less than 11 such (melodic/ harmonic) "haltings", and I only marked the most obvious ones.

The composer George Enescu (1881-1955) also issued his opinion on this phenomenon (of course, from an empirical perspective – tested, however, by his practice) in some interviews he gave. Therefore, releases at neuronal level must be frequent: here is a subtle idea in formulating a personal viewpoint in composition, with consequences in music therapy. Some researchers consider that Mozart's exuberant, almost unstoppable creativity is a form of combinatory creativity of psychical origin through which he discovers unexpected connections – and yet more than convenient as to their sense – between sound objects. Mozart was famous for his

impulse, jokes and broad innuendos, which would be due to the *Tourette* syndrome – but proof is not unanimously concluding – as Oliver Sacks explained in a 1992 article in *The Britain Medical Journal* [5]. This syndrome manifests itself by an off-balancing of the nervous system, which shows through verbal (or non-verbal) twitches and may emerge during childhood (between the age of 7 and 10), and can be treated and improved over time. Although laborious research has been made, the precise cause of this syndrome cannot be discovered. However, specialists talk about an off-balance in the brain area, which affects the neurotransmitters responsible for communication. This hypothesis for Mozart's creativity was strongly refuted by E. Gleen Schellenberg and others [6]. Yet, the effect of the reproductive and associative thinking due to his early musical training – which acted upon his young, educable brain – remains, indubitably, efficient. Through magnetic brain scans for examining the audition-influenced brain potential, other researchers, like Takako Fujioka, noted surprising changes in the left hemisphere in children, with advantageous consequences for the intellectual development [7]. Interesting music therapy studies certify that there are at least two types of listening to music: *holistic*, emotional, specific to non-musicians – which occurs in the right hemisphere – and *analytical* listening, very close to musicians (through its targeted aims) – which is performed with the left hemisphere. The music structure is first processed in the brain's right hemisphere and then followed, in more detail, in the left part. Even more recent studies ascertain, however, that listening is differentiated according to the types of subjects who come in contact with music, listening which gave birth to *personalising* music therapy, with or without medical assistance, although the collective audition is mainly practiced in hospitals. It has been noted that humans are attracted as by a magnet by music types which are structured spectrally and show characteristics of the 1/f type, as well as by a construction form which coincides with the desired and/ or set psychical content. For instance: it is one thing if I wish to listen to the whole of Beethoven's third symphony – as a composing production that dominates through its aesthetic effect – and an entirely different, more acute thing if something within me calls for listening *especially* to the *Funeral March* (*Marcia funebre*) of the same symphony – or to Mozart's *Requiem* – with great attention and cathartic emotion. I do not under any circumstances wish to gamble on an intellectual result with the *Funeral March*, but I discover deep roots in the individual's psychical life – and this fact is also certified by the presence of the above-mentioned 1/f frequency. In this case, the ritual procedure of "habit cures habit" is practiced (maybe often unsuspected, but with sure impact). In accordance to the facts mentioned above, it is considered that people suffering from depression must often watch comic movies. Therefore, here are the possible intentional nuclei, their influence and dimension.

4. Testing Some Features of "Classicist" Music Types Means Composing Structures with the 1/f Frequency Configuration

One may imagine the configuration of an (automatic) generator, through which sound situations containing spectral structures of the 1/f type could be built; to prove what those music types similar to

Palestrina, Corelli, Vivaldi, Bach, Mozart – that is, those with a 1/f type low-frequency imprint consonance/resonance content – can restore, precisely in order to show the surprising versatility of their model, of the harmony potentiating them. The addition of the structural qualities and multiple meanings they engage is outlined at the junction between Classicist music grammar (mainly diatonic harmony, foreseeable generative melodic forms) and the pressure of our psychical life, wishing to release itself by interacting with its sound. D. Perret affirms this aspect: "I am fascinated both as a musician and as music therapist by the fact that the word "harmony" is a musical term as well as a word used in daily life. Very often the word is used without understanding why the same word pertains to music and to life in general."[8]. Referring again to the music types mentioned, according to studies related to the analysis of a sound configuration, certain parameters can be found (e.g. the fractal dimension) that are specific to these 1/f type spectral distributions, and correlated with certain obvious therapeutic features. This is also the viewpoint of researcher Prof. Doru Ursuțiu, who, dealing with the physical principles of sound, discovers combinatory possibilities of acoustic facts (spectra) through filtering algorithms, also detecting some schematisation levels of sound constitutions (see oscillograms). Following the results of his research, the note that there is a congenital (biological) feature of the being which composes, that this being has *its own* cultural background (with specific and scientific aspects), becomes even more appropriate. These emerge only when the conscience of the author-creator reverberates in that of the receptor – when these psychical coordinates shine through, determine each other, intervening as feedback through the respective spectral structure. It is noted that the sound phenomenon engaged by the above-described structure and frequency characteristic is preceded and foretold by the unceasing practice of established musicians, of geniuses, up to the determination of those students enlisted for the *composition* subject, which, out of passion or amusement, compose in "Bach" or "Mozart" style. The resulting students' works (almost always) confirm some naïve imitations of a considered style, as they cannot be accomplished works from a technical (and aesthetic viewpoint). It remains for the area of computational systematics to fill in the gaps of this – backward – community of young "composers" in the future. However, we cannot leave out the fact that there also exists a category of musically educated subjects with a predilection to improvise in a given style (using the vocabulary and syntax of tonality), in which Corelli, Bach and Mozart shared their areas of "influence". This reflex proves the presence of the 1/f type frequential feature in the improvisation, too. Furthermore, we shall see that, for categorising such music types according to certain measurable spectral features (of which we mention the criterion of the consonant harmony ethos – that is, of the compatibility with the universe on which the neurovegetative activity of humans is built), a specific set of instruments will be used, especially specialised computer programmes like *Labview*. Through this programme, spectrograms (visualisations of complex sound waves) are analysed and spectral events are interconnected. The electro-acoustic determining of the spectra which configure the structure of music becomes a decisive selection factor. A work tool inherent to the described experience is the

drafting of a date file dictionary, which should particularise the plural sound interface with the aim of music therapy investigations. Invoking the necessity to work with a series of subjects who receive such music and react to it almost becomes pleonastic. In contact with a carefully chosen music, a MEG (magnetic brain scan) expertise will be initiated separately for every subject in order to decode the dynamics of effects on synapses at the level of the Broca and Wernicke brain areas. In parallel, spectral features will be determined – for the category of the music types mentioned – (beside some temporal evolution elements) according to the detected acoustic particularities; more precisely, I mean the process through which the correlation together with the fractal analysis will be carried out. Further on, the reactions of subjects coming in contact with the music types for which music therapy effects have been highlighted are detected as precisely as possible – in this concert of possibilities – by monitoring the answer to varied stimuli through adequate measurement systems (quantitatively and qualitatively measured effects). In the inventory of the partly already presented investigative tools, new measurement systems will also be imagined, which can highlight the connection between the brain's left and right hemisphere, but also the arrangement of certain brain waves; it is about highlighting the specific communication circuit between the subject and the respective music, circuit based on measuring some physical parameters and their correlation with the data of the musical structure. Thus, the connection between activity variations produced in the brain (in its different regions) depending on certain music types (namely their melody, harmony, beat) with which the brain interacts will be better understood. The decisive experience is to study attention, memory, vigilance, immediate reactions, all shown by analysing the subject's behaviour to the so varied formulations of spectra which configure the music types based on the above-mentioned property.

5. From the Collective Conscience's Need for a *Refrain* to the Boomerang of Contemporary Sound Pollution

The analysis of spectra provides quantitative information related to the musical structure and contents of music types with 1/f type structures, and the process through which spectra can be decomposed (fractalised) down to the continuum level leads to discovering the components with which a Classicist composer designed his structures to attain the integration of a certain frequency distribution in his music. As compared to lovers of music (intuitive receptors), the composition – practically, a grouping of generative moments – will be received otherwise by specialists (used – maybe out of an "acquired" lack – to only react with cognitive and apprehension reflexes: dividing its medium in parts and managing it by constant restructuring in the mind), who compel the sound flow to match their particularising objectivation model. Lovers of music get its musical answers close to them in a direct manner; its generativism is revealed to them as a phenomenological ambiance, not an acoustic material which leads to the analytical, theoretical, musicological sphere. Maybe that is why students from other faculties generally regard music in more naturally, more lightly and with more aesthetic pleasure as compared to our students, burdened by the obligation to *analyse* it. On one hand we monitor the differences in the attitudes of

both categories of receptors, on the other we also supervise their joint element: the collective psychical conscience, the only one connecting individual perception to the general one. Only with this latter conscience we can represent for ourselves the music of Corelli, Bach or Mozart as among the few with quasi-identical resonances in the psycho-somatic transformation of each individual: "I understand "musicality" to be a product of our unique human way of acting in a sensing the world (Trevarthen 1999), of being conscious of meaning through collective "mimesis" (Donald 2001)."[9] When we discern the interests of a collective psychical conscience, we notice a *forma mentis*, its own dialect. This dialect, like a song born as a *refrain*, springs from an obsession – so frequent in the light music hits. That is why I often heard Mozart's idiom being compared to that of light music: precisely because both formulate *refrains*. The syntagma "entertainment music" means distraction from light obsessions, from the daily stress. We also unveil other forms and faces of obsessions, *refrains*, like the hunger for communication. I consider that the fugue (ricercare) is the abstract expression of *dialogue*, the need for discussion (in society), but also for inner dialogue. This"method" – to prospect our own intimacy – can be somehow compared to the Freudian psychoanalysis (despite the known fact that Freud never referred to the therapeutic capacities of music). A golden rule of music therapy is to abstain from the multitude of brute music types which overwhelm us today, and especially a judicious selection (in optimal, I would say *homeopathic* doses) of those Classicist music types – listened to and retained – in order to consolidate and preserve their uniqueness and symbolic power. Present-day sound pollution – a boomerang set (maybe consciously) against our psychical life – risks diminishing and even undoing what we know as "therapeutic powers". In the past, listening to music was a rare occasion, a spiritual and emotional event, an obvious form of "correcting" the individual's behaviour; this is no longer the case nowadays.

6. Conclusions

The musician's form of address, his ideal (be he a composer or performer) is – after all – the hypostasis as a therapist. For instance, we know of cases of composers like Liszt or Wagner in the history of music: when they reached old age, this subconscious apprehension takes the form of religiously stressed manifestations. It may well be that the most acute and healing therapy be the cultivation of religious experiencing. From this hypostasis, of religiousness, we can take out a practical idea: namely that, in order to have effect, any music therapy action will have to be intensely repeated and rhythmically taken over again and again for a long time (similarly to the prayer ritual, always the same). Evaluating all these coordinates, one might infer that those young people trained, educated in music will be treatable through music therapy for certain conditions later on. The pivot of music therapy shows us that music is associated with the entire range of possible emotions, as their amplitude reaches almost all domains of human knowledge. We might also conclude that the ultimate aim of culture is a therapeutic one, as it conducts a selection of artistic values at a historical scale. The universe which opens up to our prospection combines and tunes diverse perspectives, some more interesting than others. We know that sounds are produced by the intermediation of energy fields that generate resonances, and the latter produce aesthetic emotion through diversified

music ”lessons”, referring to the close universe of childhood (objects, animals), beside progressive auditions, selected as to their level of complication. As I have said, the efficiency of therapeutics is conditioned by the individual's early musical education (see the importance of structuring the curricula) and by shaping the ability to select the music proposed by society. Low-frequency spectral analysis is a universe and method at the same time, which solicits the ability to understand the art of sounds with ideal and emotional potential, reset in the sense in which each audition may gain new meanings for every sound *compositum*. The 1/f type distribution – its related group of spectra – can be analysed in detail with computer programmes, and Professor Dr. Doru Ursuțiu, who created a module of master's courses in music therapy meant for this aim, is the right specialist in this domain. In order to function, the (pre)Classicist (and Romanticist) music samples, carefully chosen, will be evaluated, listed and correlated with the 1/f type low-frequency distribution. Thus, an answer could be glimpsed to *why* this exists to such a small extent in Romanticist and post-Romanticist music types, and to such a great one in (pre)Classicist music types. Associations can be performed, similarities found between the melodies chosen by the composers in the history of music, those compositions which gradually take on this distribution, or, better put, *frequency zone* (to a smaller or greater extent) will be comprised within a hierarchy. It is a universe which solicits the ability to understand the art of sounds in a new way, with an unsuspected potential of ideas and exceptional results, in this intangible network of signs, axiological and predestined, called musical *composition*.

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