An integrated perspective of education: The role of Art and Science and the contribution of Music Psychology

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Resumo: O principal objetivo deste trabalho é promover a interface de conhecimento entre arte e ciência. Pretendemos introduzir o leitor para o campo da psicologia da música e destacar as contribuições dessa área para o desenvolvimento de uma educação integrada.
Palavras Chave: Educação, Arte, Ciência, Emoção e Psicologia da Música.

Abstract: The main goal of this work is to promote the interface of knowledge between art and science. We aim to introduce the reader to the field of music psychology and highlight its contribution to the development of an integrated education.
Keywords: Education, Art, Science, Emotion and Psychology of Music.

Introduction

"How do sounds, which are, after all, just sounds, have the power to so deeply move those involved with them?" (Reimer 2003, p. 73).

This work emphasizes the crucial role of art, including *music*, in education. This role is not only from the viewpoint of persuading artistic creation as a transversal theme or a supplement to enrich the education of a person, as most researchers and professionals of education understand but, in particular, also as an intrinsic component of human evolution. In this perspective, art is the actual and genuine representation for a phenomenal approach in the cognitive advance of humankind, showing the capability to completely fuse different cognitive areas. Hence, art (including music) should be seen as a fundamental content in both individual and collective development and, therefore, as a key school discipline.

According to Read, art education should not be considered as "arts education" in the sense of training technical aptitudes only, but more as an *aesthetic* education. In this regard, art stimulates, instructs and develops the faculties, an aesthetic and emotional personal sense, so becoming a "far reaching methodology to comprehend reality" based on awareness, discernment and judgment (Read, 2001). In this perspective, art education should not be just another discipline carelessly framed in a scholar's curriculum, but has to be one of the pillars that forms the basis of the entire educational process.

In this sense, as in any other area of education, the practice of music education should consider the influence of psychological factors related to both the practical didactics (classroom) and the subject of study (relationship between psychology and *musical phenomena*). From this perspective, *music psychology* through studies of psychological processes involved during music experience, has tried to answer questions about how music changes moods and emotions, what the importance of

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music in perceptive processes, what its influence for the social context of listeners, among others.

Therefore, in this study, we aim to emphasize the implications of music psychology for the educational process, by (re) integrating art and science, to obtain safe methods to determine and investigate the relationship between music and the individual *experience* and *perception* of it. To illustrate the importance of an integrated educational perspective between art and science, we will first provide a brief historical of the ontogeny of these areas:

(Re) Integrating Art and Science

A great deal of what defines the western culture in philosophy, science, and art is in the ancient *Greek* civilization. The first historical record involving mathematics and music is attributed to Pythagoras, through experiments with the Monochord and the Greek musical instrument known as Lyre. With these experiments Pythagoras performed one of his most beautiful discoveries, giving birth to (as considered by the Pythagoreans) one of the fourth branches of the "divine" science of mathematics: the *music*.

One of the most important find of Pythagoras was the intrinsic mathematical relationship between the perceptive experience of sounds and the ratio of lengths of the vibrating strings. He observed that two strings with fixed length L vibrating in its starkest form have the same pitch and sound "good" or *consonant* when they are played together. Pythagoras observed that reducing the length of one of the strings to a half, three or in four *equal* parts (but keeping the same tension and thickness of the other string), the sound of each proportion has different pitches in comparison with the string with length L, but the auditory sensation of each of them when played together with the original string continue to sound consonant. The most significant observation is that the lengths of the strings need to be in a certain integer proportion. This simple relation highlights a deep connection between human perception and abstract mathematics. What seems to be a subjective judgment, this sounds "good" (consonant) or "bad" (dissonant) could be remarkably predicted by using abstract mathematics.

Also in Ancient Greece, it is attributed to Aristotle the first effort to make a systematic cosmology grounded in physical theory. Aristotle developed a theory of motion which was entirely connected to his philosophical framework. To Aristotle, the world was completely occupied with matter since the idea of vacuum, i.e. the existence of anything was self-contradictory for him. Moreover, since his philosophy also rejected the existence of an infinite material extension, his cosmology is then featured by a finite universe in which was possible to set a static center of all "natural motion", where Aristotle placed Earth (see Hawley et al., 2005, for more details).

The cosmological model of Aristotle was improved by Ptolemy in the second century and prevailed for nearly fourteen centuries when this geocentric view began to be severely questioned in the Renaissance. During this period, artists and craftsmen have carried along a key influence in the new thought that prepared the scenario for the great scientific revolution of the seventeenth century.

During the Middle Age probably the entire art was a reflection of the "God-man" relationship, art being a religious act of communication with god. In this theocentric view, God was the ponderous theme, and music like all artistic creation was the reflection of a correspondence between God and human beings. One of the main songs of this period, the *plainsong*, established by the western Roman Catholic Church with the Gregorian chant repertoire. The plainsong, as a qualitative form of collective existence, was made to minimize the individual and emphasize the community. This attribute is apparent in the vocal expression, free of ornaments and musical instruments. The main features of plainsong are unison melodies (monodic), strictly homophonic, without rhythm and compass, based only on accentuation and phrasing.

In the twelfth and thirteenth centuries, music started to change, influenced by the formation of small villages around the castles, the "boroughs". These villages were marked by the predominantly collective and corporate work of its inhabitants and especially by the mercantilist economy. One of the main features of the transforming urban music in that time is the *organum*, that adds another voice to a melody song, starting the rudimentary *polyphonic* (music with many voices).

The Notion of "space" in music have spawned only in the High Middle Age, with the emergence of a technique in which two or more musical parts are made to take into account the musical profile of each of them, as well as the intervals and harmonic relations generated by the superposition of them. This technique is called *counterpoint*. It is the design of the horizontal and vertical musical space at the same time, while Gregorian chant is evident in only one dimension. The notion of counterpoint applies to lines that develop from a main line given, called *cantus firmus*. From the cantus firmus, one can establish various melodic lines in relation to the principal one. A counterpointal line therefore acquires all of its importance in the horizontal direction, albeit being controlled vertically (Boulez, 1995).

Although the greatest renascentist music were made to the church, in a style described as *choral polyphonic* (a counterpointal music for one or more choirs with several singers in charge of each vocal section), the composers now began to show much more interest in profane music and also in writing musical compositions for instruments. A keen student and admirer of the polyphonic composition was *Nicholas of Cusa*, who was not only one of the greatest philosophers of the fifteenth century, a reformer before the reformation and a herald of Copernicus, Giordano Bruno and Leibniz, but also a trained and talented artist (see Meyer-Baer, 1947, for more details).

In cosmological terms, as recognized by Koyré, Nicholas of Cusa was the first to introduce a new philosophical movement in Renascence aiming to "destruct" the Aristotelian cosmology that has reigned during the Middle Age (the cosmological vision that established the geocentric system of a hierarchical and closed universe). Likewise, according to Koyré, Nicholas of Cusa was the first thinker to cast on the same ontological plane the earth and heaven realities. To Nicholas of Cusa is commonly ascribed the qualification of the universe as being infinite (see Koyré, 1986, for more details).

It is important to note the fundamental relationship between the philosophy of Nicholas of Cusa and the concept expressed by the artists of his time, i.e. "*perspective*". Perspective is not barely a picture-technique of painting, but a fundamental philosophical concept that art expresses figuratively through the knowledge of geometry (Meyer-Baer, 1947). This is well observed in the 'Supper' by Leonardo Da Vinci and 'Transfiguration' by Raphael Michelangelo, where the reappearance of the representation of space and volume through the technique of perspective creates a visual realism which was ignored in painting since antiquity.

The Renaissance is marked by a transformation in music that turns over a speculative arithmetic design founded on the Pythagorean tradition, to bring along a new mathematical-empirical approach, whose great representative was Vincenzo Galilei, father of Galileo Galilei, who started groundbreaking studies on musical intervals (see Abdounur, 2003, for more details).

Analogously with this novel concept of "space" established in music and painting, in physics, Galileo Galilei consolidates the apprehension of space, through the discovery of the telescope as a scientific instrument of observation.

Galileo constructed the telescope to prove that Earth was not the only center of motion in the universe. Galileo discovered the four largest satellites of Jupiter, now named the *Galilean moons*, thus refuting one of the most important tenets of Ptolemaic-Aristotelian cosmology and physics. These new observations challenged the Aristotelian notions of motion and were the key for the overthrow of the Aristotelian thinking and building of a new science through unification of the laws of motion for both the terrestrial and celestial world.

Johannes Kepler and Galileo Galilei turned out the possibility to construct a mathematical physics to deal with material objects, but it was not just an abstract and formally correct discourse. Galileo realized that motion is *relative*, this means it is possible for us to be on a moving Earth without perceiving its motion. Galileo never succeeded working out the full laws of motion. However, a couple of months after Galileo's death, Isaac Newton was conceived for a life that would complete this scientific revolution. Newton established the rise of modern physics with the development of the fundamental laws of motion and gravitation.

Amid this historic relation between art and the rise of modern science, where artistic appearances and scientific discoveries reverberated, we can also mention the experience of Albert Einstein, more recently. Einstein was not only the outstanding scientist of the twentieth century, creator of the theory of Special Relativity (which dissolved the Newtonian notion of *absolute* space and time) and the General Relativity (providing a unified description of gravity as a geometric property of space and time, or *spacetime*), but also a gifted and enthusiastic musician. Music was not just a pastime to Einstein, it likewise helped him in his study, as his second wife Elsa, once wrote. "Music helps him when he is thinking about his theories. He goes to his study, comes back, strikes a few chords on the piano, jots something down, returns to his study." (Foster, 2005)

While music played a great influence on Einstein, a counterpoint in the order of influences, Salvador Dali, born in 1904 (one year before Einstein published his first work on the theory of special relativity), was deeply inspired into the new ideas about the nature of the space and time developed by Einstein. This inspiration can be inferred by analyzing one of the most famous enigmatic images of Dali: "The Persistence of Memory", painted in 1931, in which melting watches rest in an eerily calm landscape in a clear allusion to the new conception of relative time.

Back to our time, it is important to acknowledge the placement of Davies (2003, p. 133), who pointed that "the stereotypical view of the objective and analytical scientist and the subjective and intuitive artist is false, and the study of both artist and scientist, requires a mix of objectivity and subjectivity, analytical and intuitive skills working together as a whole."

Therefore, we visualize that music can be used as a tool to build up a unified knowledge, based on the multi-cognitive processes that it stimulates, where its integration with the science of psychology, can indicate us a precious direction to develop the area of education, as we shall discuss in the following.

Introduction to Psychology of Music

The potential of music to alter our physical layout and stimulate our creative and emotional faculties was already noticed by Plato in ancient Greece, which found that music expresses the intrinsic relationships between *musical progressions* and *emotional movements*. (Nasser, 1997).

Many researches that support the idea that music really conjures up *emotions* often disagree over the nature of those emotions and how they are induced. Are musically induced emotions the same as everyday emotions such as happiness, unhappiness, anger, and so on? This debate that can be primarily traced back to Plato and Descartes and centers on the philosophical definition of “emotion”. This also sets a fundamental criterion in the study of emotion psychology once to identify the underlying emotional mechanisms, we need first clearly delimit the phenomena we are attempting to explain.

Most researchers agree that emotion is a subjective feeling, but some expand the definition to include a combination of additional components such as cognitive appraisal, physiological arousal, motor expression and behavioral tendencies (Scherer 2001). Although all of these components can be in principle actuated in response to music, it is very hard to measure precisely the relationship between musical stimulus and perceptual response, as this relation does not follow simple laws due to a large number of variables that may influence the experiments. This makes clear the methodological complexity involved in this type of research, making some behavioral psychologists of the 40 and 50s to believe that studies on emotional responses should not be qualified as "scientific". According to Juslin and Sloboda (2001), this is also due to the way how most of the centers were used to listen and talk about music, in acquisition of excellence in musical performance was always regarded as the main factor in the formation of the musicians, while the scientific work was something nonexistent, denoting thus this huge gap between science and art. And this is true even today.

Gustav Fechner, inspired by experimental results obtained by Ernst Weber, proposed a mathematical relation to map physical magnitudes to perceptual responses. He has developed what is known as the *Fechner's scale* where the subjective response is proportional to the logarithm of the physical stimulus intensity, which is an attempt to connect the publicly observable world with person's privately experienced impression. This content is in his seminal work entitled “*Elements of Psychophysics* ”. The science of psychophysics starts with an apparent paradox: It requires the objectification of subjective experience. Psychophysics has been founded on the premise that the human perceptual organization is a measuring instrument yielding results (experiences, opinions, responses) that might be systematically studied. So, the challenge of psychophysics is to formulate a precise and simple enough experiment to link perceptual experience to physical stimuli (see Ehrenstein et al. 1999, for more details). Since Fechner set the basis for psychophysics, psychology of music started its course as a scientific discipline and Fechner’s original scale have been transformed over the years.

The core of the theoretical and methodological principles of the psychology of music comes from the conjunction of several fields such as psychology, music, philosophy, physics, biology, education, neurology, sociology and anthropology, developing a vast, multilateral field of research. A significant trend in this field has been the emerged by measurement of emotional responses to music by Hevner (1936), who outlined a checklist of adjectives to define and quantify the relationship between musical variables (tempo, time, variations in melody, harmony and rhythm) and affective responses to music (Juslin and Sloboda, 2001).

The relationship between music and emotion has been the main investigated target, which has been studied through varied perspectives (Scherer, 2001). Several studies of emotional responses to music were performed with a manipulation of various musical parameters such as musical intervals, melodic contours, tonal harmonic functions, texture, mode, tempo and rhythm (Scherer and Zentner 2001), (Dalla Bella et al 2001a). Among these various investigated parameters with respect to emotional responses to music, the literature indicates that the *musical mode* shows a satisfactory emotional response. We can highlight the work of Ramos (2011), who conducted a study on the influence of the seven Greek modes (*Ionian*, *Dorian*, *Phrygian*, *Lydian*, *Mixolydian*, *Aeolian* and *locrian*), and their effects on perception of emotion in response to music.

According to Dalla Bella et al. (2001a) these modes are specific organizations of musical intervals, built on a musical scale. The Greek modes are constructed from a fixed set of seven musical notes (C, D, E, F, G, A and B) and hence on specific interval distributions, so that each mode has a musical note acting as a reference. The specificity of each mode is strongly associated with the musical intervals formed between the reference note and the sequence of others musical notes. For instance, in the Lydian mode, the interval between the reference note and the fourth note of the mode is an interval of six semitones. This interval is also called a *tritone*, which is quite jarring to the western ear, having been designated as the "devil's interval" during the history of western tonal music, as the corresponding sound seems to suggest a "diabolical" emotional effect (Wisnik, 2004). Several studies suggest that major modes (Ionian, Lydian and Mixolydian) are associated with “positive” emotions such as happiness or serenity, while the minor modes (Dorian, Phrygian, Aeolian and Locrian) are associated with “negative” emotions such as sadness, fear or anger. Some theorists claim that this is due to the structure of musical interval scale associated to each mode in which each one has different pitch intervals in relation to the first note of the scale. According to Wisnik, these different pitch intervals to the first tone of the mode, allow the obscurity/clarity sensations evoked by the seven modes to be scored in a linear way (Wisnik, 2004). Thus, from lightest (major) to the darkest (minor) mode, they could be ranked: Lydian, Ionian, Mixolydian, Doric, Aeolian, Phrygian and Locrian. This ordering is named *Modal Hierarchy*. Addressing the psychological impact of these modes would help to understand the effect of musical interval structures on the emotional responses of listeners (Ramos, 2011).

The research on the relationship between music and emotions is still in progress, and a large interdisciplinarity is present in such studies. It is now widely believed that music psychology can provide solid *theoretical* and *methodological* basis for educational and therapeutic methods. By focusing on music as a primary research subject, we generate benefits to the society, as *therapy* and *knowledge* through music can offer a full discernment of the role of the individual and, as a consequence, improve human relations in all aspects.

Concluding Remarks

The attributes of arts generate profound implications on its purpose of construction of meanings and knowledge of human experience, and therefore have broad implications on education. Music, specifically, persists in human society also because of the strong emotional responses it evokes. Thus, psychology of music becomes a viable alternative for the investigation of emotional responses. The scientific research through art can allow a constant building of novel methods to assist the development in the areas of education, music and psychology, as well as the interface between them.

Similarly, it is significative to proceed the (re) construction of music education not only as a subject of artistic or musical training included in the scholar’s curriculum, but as an *aesthetic education*, where both student and educator may see and listen or "*listensee*" all the cognitive and affective aspects that this art develops. The possible access to the emotional core and cognitive development of the individual through music education as an aesthetic education, can lead us to novel educational practices guided by affective and cognitive development of pluralities. By eliminating the existing gap among art, science and education and, as a consequence, linking cognitive and affective processes of human development, we will be able to create a very constructive and dynamic relationship throughout the educational process.

The points covered in this work are in resonance with the thoughts of Rudolf Steiner, who proposes that, in art and science, cognition implies an active process of production of the subject, which implies the rise of causality with the needs. Both art and science seek the infinity (Stoltz, 2012). Steiner does not dichotomize reason and emotion, as human affectivity is involved in the act of knowing. The observed depends on the observer, and this is true not only in *quantum* physics and in art, but also in education, where the emotional and affective dimensions are fundamental components for creation of knowledge. The importance of this active participation of the observer in education can be summarized by the expression "knowing the world to change it", and then, be able to be transmuted by it (Bach, 2005). And all this without sweet promises, with the warning that the process is long and arduous.

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