A Whale of a Sonata – Zoomusicology and the Question of Musical Structures

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ABSTRACT

The present article deals with the question of musical universals, as analysed from a zoosemiotic, and zoomusicological in particular perspective, focusing on a specific portion named "structures". By structures are meant the musical traits in themselves, as distinguished from the para-musical aspects – that is behavioural patterns *related* with music - and the whole psycho-emotional dimension of music. Analysis of this structural level implies specific attention to notions of musical organisation, form, rhythm, timbres, repetition, compositional conventions etc. The argument implied in this analysis is that certain 'universal' musical features most of them, in fact, which I call transpecific traits, are not limited to thresholds of human music. A zoomusicological perspective shows that any qualitative distinction between the aesthetic use of sounds in human and in other species is in principle begging the question, and appears to be the result of a strictly behaviouristic (when not mechanistic) interpretation of animal behaviour. Since ethnomusicology has yet to take the animal issue into account, zoomusicology, as recent efforts in the whole biosemiotic area, are clearly challenging both the behaviourist and the ethnomusicology records.

1. INTRODUCTION

The goal of this article is to analyse a specific portion of the enormous area of musical universals, from a zoosemiotic (and zoomusicological in particular) perspective, i.e., starting from the hypothesis that certain 'universal' musical features—which I call transpecific traits—are shared within a zoological domain, rather than simply the human one. Cetaceans, humans, birds, canidae, insects and so on display an impressive reciprocal resemblance in their musical behaviour, and this is already a start. Through the comparison between human and other animals' musical activities many of these similarities come out, allowing me to attempt to pinpoint my attention on all those elements that recent musicology, although in a very heterogeneous way, has named "universals", and compare them with zoomusicological issues. The overriding question is: Are universals to be detected only at the anthropological level, or does the concept of universality go beyond the threshold of human music?

The idea of zoomusicology, in the modern sense of the term, originated with François B. Mâche, in his fundamental *Musique, Myth, Nature*. He announces that zoomusicology is "not yet born", but in actual fact establishing its birth. Briefly put, Mâche aims to "begin to speak of animal musics other than with the quotation marks". His book first came out in 1983, thus one can understand how little has been said until now about the subject, and how much remains to be said. Very generally speaking, zoomusicology studies the "aesthetic use of sound communication among animals". With such a definition, one avoids the use of the dangerous word, "music", a concept that must be handled with extreme care, even when related to human activity, but, at the same time, includes another dangerous word, "aesthetic". This is not only because modern ethology tends to acknowledge an aesthetic sense in animals, but also because aesthetics represents a methodological presupposition supporting our real theoretical goal, i.e., music. In other words, a specific discourse on non-human music is better if backed by a more general discourse on non-human aesthetics. "Aesthetics" is a fundamental—though not exclusive—presupposition for defining music.

Zoomusicology approaches "non-human animals" from the direction of human sciences, and music from the direction of biological sciences. Its basic innovation is the assertion that music is not an exclusively human phenomenon, but rather a zoologically-based one. Hence, to adopt the zoomusicological paradigm means to question present definitions of music, starting from its strongly anthropocentric connotations. Secondly, by saying "animals", rather than "non-human animals", one leaves open the possibility of including *homo sapiens* in zoomusicological research. It is important to make clear that zoomusicology is not 'opposed' to anthropomusicology, but actually includes it. If the analysis of human behaviour can fall into the ethological domain, then human music can also fall into the domain of zoomusicology. Such an approach, in a specific ethological and slightly anti-transcendentalist way, yields the expression "aesthetic *use.*"

Furthermore, zoomusicology strongly suggests that the whole conception of a nature-culture dichotomy needs to be revised. One should wonder in the first place if we really have to consider nature-culture as a dichotomy—as Charles S. Peirce already did in speaking of synechism. By speaking of "sound communication," one explicitly takes zoomusicology into the domain of semiotic analyses of the musical phenomenon. However obvious that may sound to readers familiar with semiotics, musicologists for a long time (nowadays, in part) have refused to consider music as an exteroceptive phenomenon, regarding it purely and exclusively as an aesthetic expression 'closed in' on itself.

1.1. THE QUESTION OF UNIVERSALS

At the end of his essay on whale song, Roger Payne (1996: 78) wonders about the existence of a "musical Platonism"[1], i.e., a great universal musical archetype constituting the basis for each animal musical culture (in animal studies the notion of 'culture' has been ascribed to non-human beings for quite some time)[2]. We do not have enough information to establish how ancient music is, human or not, but, says Payne, if it is *really* ancient, atavistic one might say, then maybe we would understand

why we find so much emotional and intellectual significance in music, without knowing why. If such a basic aspect of our life as music is so indefinite and vague, possibly its roots are much closer to the brain of our reptile ancestors than to that of *Homo sapiens*. Possibly music is something that precedes rather than follows language.

The problem of musical universals deeply interested several philosophers of the past (viz. Kircher's *Musurgia universalis*), because of its cosmological references and because of a strong wish to trace the origins of the musical phenomenon. The question arose again in the 1970s mainly within the field of ethnomusicology, in strictly scientific and systematic terms, and in its uniquely human dimension. It is thus important to remark that a fundamental goal of this essay is to prove that theories conceived solely for human musical cultures are not either in principle or in practice, inapplicable to non-human music.

The urge to investigate the universal characteristics of music went hand in hand with an interest in the "other", i.e., non-western musics. An overall wondering about the universality of music leads in turn to wondering about music itself. Thus:

> It seems to us that there are reasons why ethnomusicology is concerned with the question of the universals of music: first of all, because this discipline … contains an essential comparative dimension; this being the case, ethnomusicologists do not seem yet to have encountered any civilisations without music and are thus led to pose the question: 'What is music as a universal phenomenon?', which, in itself, could constitute a first universal feature of music (Nattiez 1977: 92-93).

Universals in ethnomusicology constitute a theoretical problem that is far from having one single solution. Various scholars discuss the possible existence of archetypical musical structures, and even whether such a question make sense. Indeed, most of the theoretical material that I illustrate from now on is under constant revision or discussion, since any search for musical universals can lead to controversial results

Any search for universals in music poses a crucial philosophical question: What is required of a musical element in order to define it as universal? In principle, ethnomusicologists have distinguished between two main possibilities:

1) A non-contradictable coherence of given musical traits across all communities: Thus, "[...] for an element to qualify as universal, one must prove that it can clearly be found everywhere and that no contradictory examples are to be found. To the extent that such a demonstration has not been made, the elements should be considered as *hypothetically* universal, with a more or less strong coefficient of chance. In some ways, one can affirm that any element presented as universal is always hypothetically so, for the knowledge of the musical civilisations of the world is not exhaustive" (Nattiez 1977: 98)
2) A continuity at the pragmatic level, i.e., in the way those musical traits work, or in the principles that motivate their appearance within certain—not necessarily all—communities. Thus: "what

we should ask about, when considering the problem of universals, is not whether the data itself is common to different cultures—any more than we decide whether there are scientific laws on the basis of particular physical events. What we should ask is whether, beneath the profusion of diverse and divergent particulars, there are any universal *principles of functioning*" (Meyer 1971: 271).

Kwabena Nketia (Nketia, 1984: 15) has tried to incorporate both hypotheses within his discourse on so-called *absolute universals* ("unrestricted, unconditional universals") and *universal consequents.* Yet his approach to universality is empirical rather than general and speculative. As he points out, "tuning, tonal and metric systems, for example, developed in music through time and cross-culturally, are myriad, but that does not mean that the musical working-out of the consequences of such properties will also be myriad in number. Consequential relationships of a universal nature imply common tendencies in both the response to and development of musical materials, not a commonality in the choice of the material themselves". Further, he observes that an artistic world-view of music is of qualitative, rather than quantitative type. Diversity is certainly inevitable in music, but "it is accommodated in creative and conceptual terms through 1) the postulate of an archetypical source; 2) the concept of music as a world-wide art of which individual cultures are particular expressions; 3) the notion of complementarity and alternative modes of expression; and 4) the universality of aesthetic experience" (Nketia, 1984: 6).

There seem to be good reasons to back this position. We shall not call universal only those musical traits displayed by every single musical culture, human and non-human, otherwise the search for universality in music becomes quite a hopeless task. As Mâche reminds,

> It is all too easy to show that music is not a 'universal language', since the learning of its diverse dialects is always laborious: it involves passing from excessive ethnocentricity to an accepted and perpetuated anarchy. No one has ever imagined … that all musics are alike. It is not essential for data to match up in every detail, without exception, for them to be qualified as universal. It is enough that they should appear in independent contexts, and that their functioning presents analogies too precise to be put down to chance (Mâche, 1992: 42).

Perhaps this is the right way for zoomusicology to proceed. We cannot be 100% sure, but it is very likely that *Homo sapiens* and, for instance, *Megaptera novaeangliae* constitute "independent musical contexts". According to Roger Payne, during the 53 million years separating pre-historical from modern cetaceans, there is no possibility for a significant acoustic contact to have occurred between humans and whales (Payne, 1996: 177). At the same time, it is not in principle problematic that a musical trait shared by humans and humpback whales is not also shared by nightingales.

In classifying universals, zoomusicology adopts the same basic and well formulated tripartition proposed by ethnomusicologists.

1) *Structures*. The musical traits in themselves. Analysis of this level implies a large use of sound material, such as recordings and spectrograms, and aims to define the organisation of sounds in

the species observed; e.g., range of sounds covered, recurrent intervals, timbres, and so on. Mâche (1992) proposes exactly this typology of research.

2) *Processes*. Acts and behavioural patterns related to the structures, in the fields of emission and reception. This is the realm of the para-musical, and it includes the whole cultural dimension of making music, with its rituals, social rules and so on. In zoomusicology, this level constitutes the best-known part of the research, with many of its aspects having already been investigated by ethology. A type of analysis based on processes can be found in Sebeok's Play of Musement (Sebeok, 1981), in the chapter entitled "Musical Signs."
3) *Experience*. This is the level that musicologists like Stefani (1998), Delalande (1991), and Tagg (1987) have proposed in their discussions about musical universals. Since musical experiences may be considered a general experience that takes place between a subject and an object (musical event), they advanced the idea that a universal feature in each experience is the restatement of particular conducts and competences. This view may be used for zoomusicological purposes with similar presuppositions. If the first level (structures) was that of the objective, and the second (processes) of the cultural, the investigation of music as an experience lived by an individual is surely the level of subjectivity, although it is clear that many of these experiences follow general rules.

2. THE MUSICAL STRUCTURES

The level in this tripartition that I intend to analyse in the present article, and to apply to the zoomusicological case, is that of structures. The universal structure par excellence is undoubtedly singing. As Boiles pointed out, to vocalise is one of the principle learned behaviours that is universal among humans who can speak. Formants, stops, releases, timbre, and suprasegmental phenomena are combined with pitch inflexions and prosodic cadences to form the oral expression of each cultural enclave (Boiles, 1984: 60). It goes without saying, singing, i.e., using one’s vocal apparatus to create and perform music, is by any and all means a transpecific feature. Although some species display musical cultures founded on non-vocal use of sounds, singing remains the most universal form of musical activity.

A very transpecific characteristic of singing is its relative independence, as a communication system, from so-called ordinary communication. Very often events, contexts, behavioural patterns which cause or follow singing, occur always and only on a particular occasion, and on these particular occasions are not extra-musical activities. This already points out an important issue: however one may define it, as music or not, singing is a very defined event in animal life, i.e., something involving a series of precise and codified actions or ritual. That I call this ‘ritual’ emerges from at least four observations. First, in non-human animals, singing is a different activity from other types of vocal communication, just as, in humans, singing is different from speaking[3]. Singing in all animals differs from other communicative forms in terms of complexity, acoustic frequency, timbres, contexts, subjects involved, reactions and so on. Secondly, in many cases singing consists in long

and complex elaborations that singers may perform alone. Thirdly, in some cases only male specimens sing, though of course both males and females communicate. Finally, many species devote only a part of the year to singing. Moreover, in periods when detailed interpersonal communication is necessary, they do not sing. For instance, some cetaceans do not sing during the feeding season, in which krill hunting (performed in groups) requires a remarkable exchange of information.

Singing, as universal, presents few, if any, theoretical problems. The same cannot be said for other structural elements in music. Indeed, singing should be considered a special type of structure, starting from the fact that it cannot obviously be referred to as *only* a structure. Therefore, one might ask, what credibility can be given to pursuing other musical structures? Again, as we have seen, any search for universals in structures in music can lead to quite controversial results, and thus data must be handled with care. As Frank Harrison points out (Harrison 1977: 32):

> Common structural features cannot of themselves be evidence of actual or incipient 'universalism'. […] Similarity, even approaching identity, of music structure features does not in itself argue for anything more than its own existence, which may well be coincidental (while observing that timbre is part of structure, we must leave out of discussion here the important subject of comparative organology which in terms of our present subject is an aspect of use). Structure as a 'universal' begins to have significance when the area of meaning (i.e., that of use and function) is brought into discussion.

Another, zoomusicologically-specific, limitation to studying universals in structures concerns the frequencies emitted by some species, which the human ear is not able to hear. For instance, humpback whales typically sing at sound frequencies of between 20-3000 Hz and occasionally produce frequencies as high as 8000 Hz and lower than 20 Hz. The average human ear can sense between 150-16000 Hz, so many of the very low frequencies are out of our range of hearing. Similar considerations apply to many mammals, insects and fishes. It is thus important to underline that all reflections proposed here or elsewhere are approximate. In the case of humpback whales, the approximation consists of 130 Hz which the human ear is not able to perceive[4]. What we hear in whale songs are sounds lacking their lowest frequencies. It is like listening to and analysing Ravel's *Bolero* without hearing the lowest sounds of the second theme. Surely, the whole piece would be recognisable anyway, but much of its charm would probably be lost.

We can ascribe quite variable meanings and functions to structures to animal musical cultures (see references to the term 'cultures' in Endnote 2) as with humans. Songs, instead of being of simple duration, vary in abruptness of beginning and ending, repetitiveness, in rate, in rhythm, and in other subtleties of sequence. Instead of simple pitch, they vary in timbre or tone quality, in vowel quality, in approximation to noise, in noise quality and in changes of all these in time. Instead of simple loudness they vary in the dimensions of loudness, the rate of change of loudness and the rate of change of change of loudness. In meaningful sounds these factors can be combined to yield higher order variables of staggering complexity (Thorpe, 1972: 164).

What *is* more "universal" in animal music is the regulation, forms, and conventions of such structures. In short, there are thousands of diverse musical scales in all species, *but all of them are scales*. In general, there are two main modalities of structural categorisation in animal musics, one is related with the quality of sounds, the other with their organisation. I shall sub-divide these two macro-wholes into five main parts: 1) organisation and form, which deal with organisation modalities of musical phenomena, basically a game of rules; 2) repetition and variation, a dichotomy that concerns the important distinction between musical and "ordinary" language; 3) intervals and scales, which deal with musical structures par excellence, i.e., the primary and most immediate form of sound organisation; 4) rhythm and tempo, which deal with everything related to musical phenomena as horizontal, temporal entities; and 5) sounds and timbres, which deal with the quality or colour of sounds.

3. ORGANISATION AND FORM

To deal with form and organisation in music principally means to accept the concept that music is a game of rules. Such rules may be universal, cultural or individual, but still they are rules. Many arise from conventions or habits within a given community; others derive from social and historical interaction; others, perhaps most of them, are related with instinctive and emotional causes:

> In all cultures, musical utterances tend to descend in pitch at the end although they are not similarly uniform at their beginnings. All cultures make some use of internal repetition in their musical utterances; and all contain the component of variation, although it may not be recognised or accepted […]. All have a rhythmic structure which depends on distinction among note lengths and among dynamic stresses. These are universals in the sense that they exist everywhere, but also in another sense: they would *not* have to be present in order for music to exist, and thus are *not* simply a part of the definition of music. In other words, it is conceivable for a music to come into existence using only major thirds, or having all of its notes of equal length. Evidently, then, mankind has not only decided to make music, but to make it in a particular way, and this despite the vast amount of variation among the musics of the world (Nettl , 1977: 5).

Pace Nettl, it is in fact not only human to decide to make music “in a particular way”. A demand for *organising*, controlling, measuring, pitching, etc. music is present in practically all species, each with its own characteristics and degrees of complexity. The following sample of a song performed by a Superb Lyrebird should prove the point quite clearly (link to sample 1). Even humpback whales, possibly the species that produce the most complex singing, create quite precise structures: “On first hearing humpback vocalizations, one has the impression of an almost endless variety of sounds. Spectrographic analysis shows, however, that “all prolonged vocalisations occur in long, fixed sequences and are repeated with considerable accuracy every few minutes” (Payne and McVay, 1971: 590).

Two main levels of musical organisation can be distinguished: a primary level, which concerns the organisation of simple and basic sounds; and a secondary, more complex level, which deals with the organisation of sound wholes. In other words, not only do musical cultures create rules for sound functioning, but they also create sorts of geographical maps in order to manage the musical mass. As for the primary level, Francesco Giannattasio (1998: 129) remarks that all forms of musical activity, in practically all human cultures, imply the presence of three kinds of rule. These three basic rules constitute the point of departure for musical organisation:

1. Discreteness of the sound continuum (intervals, scales, timbres, etc.);
2. Hierarchy of values and functions of sounds belonging to the diverse ranges, which determines the "modes" for melodic construction, in relation to
3. Intensive (piano/forte, dynamic contrasts, stresses) and temporal (rhythmic) organisation of sounds, generally measured in relation to a periodic point of reference (beat, metre).

As will become clear in the next sections, these rules are widely used in most animal species, with very few exceptions.

There is also a secondary level of musical organisation, i.e., another set of generally cultural conventions, which concern the so-called “form” of a musical piece. Such conventions deal with groups of sounds that are already organised within each group, and thus can regulate the final structure, the architecture of the piece. Such an aspect is particularly overt in Western music, but present in all musical cultures and quite evident in non-human music as well. Indeed, musical organisation (in birds, mostly),

> …encourages us to credit the animal with a sense of sound architecture […] . If the bird has the sense of balance between non variation and variation at the level of syntax of sequences, it can also manipulate with order, at the higher level, the temporal proportions of sequences or of the strophes between them. To know if this architecture is itself innate or if it forms part of individual learning, we would need to study for each species a large quantity of analyses which are still far from being achieved. From what I have been able to establish about larks, it seems that the role of ontogenesis, of individual development, may be considerable (Mâche: 1992: 141).

A summary of the numerous features of musical form goes as follows:

3.1. THEMATIC ORDER AND STROPHE-REFRAIN STRUCTURE.

Musical cognitive categories that correspond to what we design as parts (introduction, theme, ending, etc.) can be easily traced in several species. Olavi Sotavalta (1956: 7-8) found that songs of the sprosser nightingales (link to sample 2) are usually organised into six main parts:

a. *Introductory*: a starting sound repeated twice in a basic duple metre, and another sound a half-tone lower, still in duple time, but more complex, which links to the second part.

b. *Antecedent*: this part is optional, and the bird may every now and then skip it, proceeding directly to the next part. When present, the antecedent consists of only one, relatively low-pitched, repeated sound.

c. *Characteristic*: this is one of the main and most melodious parts. It consists of "successive single notes of different pitch, or of two-note chords of a certain interval. The rhythm can be duple or triple, in eighth- or sixteenth-notes" (Sotavalta, 1956: 7). Rhythmic patterns constantly change (no less than 10 or 11 times), and the melodic line contains quite large intervals.

d. *Postcedent*: it normally consists of only one relatively low-pitched, "flute-like" repeated sound, but the rhythmic pattern may change (it is usually duple, but sometimes triple).

e. *Finale*: "The finals showed a remarkable uniformity in tonality and partly also in rhythm. As a rule, the finals were chirpy, xylophone-like, repeated chords; the commonest final was the minor sixth F# - D, or the same inverted, embellished with auxiliary notes and sometimes with acciaccatura. Tonally different finals were very rare" (Sotavalta, 1956: 7). Rhythmical patterns are usually duple.

f. *Cadence*: it usually consists of a simple "tambourine rattling" in duple time, but it can also be more complex. Sometime it is absent. Occasionally, and usually between any two successive sections, the so-called *bridges* and *links* may appear. Links are short, single or double whistles of high pitch; bridges are made up of more than one link, interspersed with low-pitched notes, shakes or clicks. Rhythmical patterns are variable.

Of course, one may ask if such organisation is really significant to the bird. Mâche attempts to answer this question as follows:

> Whether these variations are conscious and voluntary, in the animal, or whether they are as insignificant as the number of bounces of a ball, everything happens as if, on a deeper level than that of acoustic characters, a *grammar* was acting to organise the sequence locally. Sometimes one has the impression that a concern for development governs the oppositions evoking the alternating couplet-refrain: AA BB C D E F EE AA BB C D G E F C E F E A BBB […]. To a certain extent ABCD plays the role of a refrain, shortened on its third repeat, which embraces two couplets, of which the second is, however, slightly developed (Mâche, 1992: 130-131).

3.2. REDUCTION AND SYNTHESIS OF THEMES.

A widely used practice in musical cultures, especially in Western music, is the connecting of the main themes of a piece, in a sort of narrative framework, as if the material consisted in more and less important elements, so that, at some stage in the song, things can be summed up. That may go through recapitulation (i.e., reduction to one or few units of material that was multiply exhibited, as shown in Fig. 1), or sheer elimination (i.e., deliberate exclusion of parts that do not play a significant role within the whole performance).

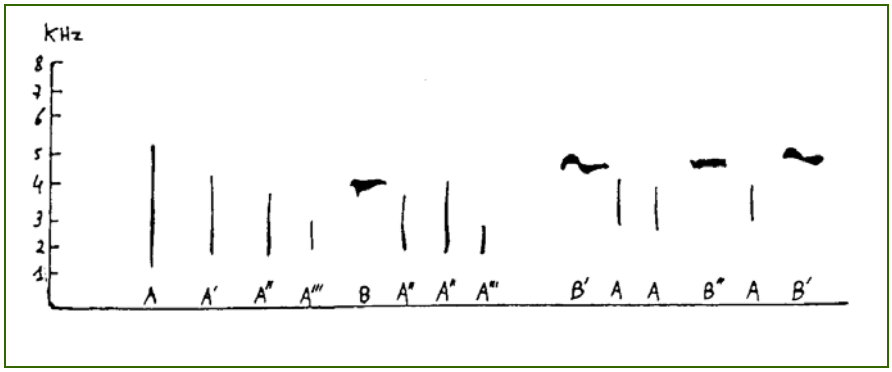

Figure 1: An example of theme reduction in birdsong.

3.3. SENSE OF THE TONIC.

As David McAllester suggests, “almost everywhere there is some sense of the tonic, some kind of a tonal centre in music. Almost everywhere music establishes a tendency. It seems to be going somewhere, whatever its terms are, and the joy that the performers of that music feel has to do with the way in which that tendency is realised” (McAllester, 1971: 379-380). Similar considerations may be applied to several species, with possible emphasis on birds and mammals. Birds are very well known for the regularity and humanly intelligibility of their pitch. In canidae the presence of a sort of *bourdon* is evident, whereas humpback whales and orcas include several *points of relaxation* (usually constituted by the same, often long, sound) in their most complex elaborations, as if they really needed a "tonic" as a point of rest.

3.4. ORGANIZATION OF SOUND WITH MOVEMENT

Music is even more a game of rules when associated with dance, where sounds and movements are coordinated according to a set of conventions established between the performers. Long-tailed manakins, observed by ornithologist Paul Slud are an interesting example:

> […] the birds stand on the vine or branch lengthwise, both facing in the same direction but with one behind the other, […] spaced more than a foot apart. The first bird, uttering his *miaow-raow*, rises straight into the air, where he then hangs momentarily suspended. As he reaches the top of his leap, the rear bird, crouched, his eyes fixed upon the bird in the air, with rapidly flicking wings and arched tail hitches himself forward to the accompaniment of a low ticking, *pk-pk-pk-pk-pk* etc., to a point on the branch directly below the suspended bird and identical to the one from which the first bird rose. The bird in the air now falls diagonally backward to the very spot from which the bird began his ticking, wing-quivering creep. As he alights, the second bird, now in the forward position, rises into the air. At the same instant the first bird, fallen to the rear position, hitches himself forward in his turn. Like balls in a juggling act, the birds replace one another with cyclical regularity. The individually uttered *miaow-raow’s* accent the recurrent rhythm and the underlying ticking goes on almost without interruption. The tempo may be increased but the performance does not become disorganised […]. The dance ends suddenly and the birds float 'butterfly-like' on the sidelines (Slud, 1957: 337-338).

4. REPETITION AND VARIATION

Although in clear opposition with each other, repetition and variation are nevertheless in a reciprocal relation a typical example being the pragmatic interaction among strophes, refrains and middle-eights in popular music, all of which one can easily read in Peircean terms. For example refrains are the reassuring redundancy that is doomed to catch the listener’s attention, and therefore has clear ‘firstness’ qualities. Strophes – the ‘secondness’ dimension – provide the narratives, the develop-

ment and the evolution in a song, enabling the listener to perceive the thematic environment of the song. The middle-eight, generally appearing just once in the song, provides a strong variation - both musical and lyrical - and is often offered on a different musical key. The art of song-writing must always keep this difficult balance between storytelling, qualities and charming repetition. One is a justification, when not a direct cause, for the other. In the case of non-human animals the category of repetition and redundancy are definitely more prevalent than that of variation.

4.1. REDUNDANCY

The concept of redundancy is often used by specialists as a wide behavioural category to explain several forms of sound organisations that are otherwise hard to classify in extra-musical terms. (Mâche, 1992: 114) points out:

> When, for example, we define the repertoire of the blackbird by saying that it possesses seven calls and one song, that of the robin six sound signals, the rock partridge fourteen cries etc., the only criterion used, that of behaviour, in no way acknowledges the extreme variety of the motifs of the robin's song. In this case, zoologists are currently satisfied with noting that *redundancy*, defined by the same reactions produced by different signals, is very large, which assures a wide intelligibility of the signal. But the same intelligibility is still better obtained with totally stereotyped signals, like that of the gecko or the quail; simply, this apparent waste of energy and imagination does not enter into the behaviourist schema of utilitarian explanation. With the term *redundancy* one glosses over an extraordinary diversity, which would only cease to seem a waste if we recognised in music, i.e., in aesthetics, the fundamental character of a partly autonomous biological function.

In other words, redundancy does not stand for mere repetition. Its biological value goes far beyond any interpretation of "Morgan's Canon."[5] . In fact, the idea that animal species, birds in particular, perform just one or two kinds of song is not true. More than 70% of bird species have repertoires consisting of several different songs. Mammals are anything but repetitive singers and the astounding case of humpback whales is prototypical in this sense. Finally, repetition and variation are wide-spread musical practices among insects, too. To non-specialists, what the choruses of crickets and cicadas display is pure and endless monotony, but more careful - and not necessarily specialist attention - reveals much rhythmical creativity, up to sheer anticipations and *rubati* (link to sample 3).

There are possibly three main analytical categories pertaining to musical repetition:

1. *Presence of refrains*. As Sotavalta (1956: 14) notices in sprosser nightingales, "a certain characteristic as a significant motive, and in most cases a whole period, recurred sooner or later, thus giving the song a cyclic impression". The same elaborations can be found in practically all songbirds and in many mammals, as in the following case of humpback whales (hear a very clear refrain at the beginning and at the end of the sample) (link to sample 4).
2. *Repetition of certain patterns.* "No regularly recurring fixed cycles of succession were found in the song of the bird, but shorter or longer 'semicycles', regular patterns of succession of certain

characteristics were common" (Sotavalta, 1956: 16). To mention another peculiar example, song thrushes (*Turdus philomelos*), display a clear tendency to double most parts of song motifs, "just like Debussy" (Mâche, 1992: 115). A master of minimalistic redundancy is certainly the bou-bou shrike (link to sample 5);

3. *Continuous melody*. Several species do not isolate their musical elements as separate entities, but rather tend to practice a kind of continuous melody. It is the case with some canidae, primates and cetaceans, but also – unpredictably enough – with some birds, such as the grasshopper warbler or the nightjar of Europe. This, Mâche remarks (1992: 105), does not imply "either the monotony or aleatoric disorder that one might expect".

a) VARIATION

As for the concept of variation, I shall report on what I consider the "mother of all examples" - humpback whales' variations, but first I will mention the various interpretations on the issue, provided by scholars writing from within both evolutionary and non-evolutionary frameworks. The point, predictably, is that variation is not easily framed within any reductionist theoretical scheme.

Within an evolutionary framework, variations in singing are considered a useful advantage in natural selection, especially in mating-related contexts. For sure, there are examples of preferences for behavioural novelty in animal courtship displays. Bird song is a typical case, being evolved through female choice and showing a rather high degree of complexity and diversity. In several species, females prefer males that demonstrate larger and varied song repertoires. Novelties in bird songs are generally introduced from time to time. The novelties attract the attention of the female and spread through populations of males in patterns of appropriation, modification and diffusion, in a similar manner as in human musical, or linguistic, or oral traditions. Rather importantly, songbirds' brains are about twice as big as non-singing species: this is possibly because both sender and receiver of the song - generally, the male being the former, and the female the latter, although this is not a rule - must be able to process a higher amount of information as compared to non-singing species. The presence of variations makes this information not the easiest one to codify and decode.

Variation in courtship displays is not limited to birds. I have cited the case of humpback whales. Among humpbacks, songs are enormously long, complex, and with a very high degree of variation and their songs occur not only during courtship displays. Among dolphins, too, courtship includes complex sound elaborations. Finally, variation does not pertain to intrinsic musical display, but also to para-musical patterns like dance. Most animals perform particular and complex movements during courtship.

The evolutionary conclusion to these observations is that courtship displays in some birds and mammals are driven by an intrinsic perceptual bias in favour of complexity and novelty. As for non-evolutionary interpretations, I shall once again quote Mâche:

> Whatever the motivations which cause an animal to sing, it is apparent that it operates [by] instantaneous choices from amongst the formulae of its repertoire, or instantaneous realisations of one of its operative models, and that for whatever reason certain species, those that we consider to be the best singers, tend to prefer the law of maximum variety (compatible with the affirmation of the species) to that of the least effort. The musician's imagination works the same way: the desire to establish the identity of a sound proposition (of an 'idea') is normally accompanied by the opposing concern to bring into play diverse variables of this proposition. Among all the possible solutions, whose number is probably not infinite, a composer can encounter those which one or more animal species frequently apply (Mâche 1992: 124).

Such a process, to which anyone who has ever composed some music can easily relate, is both witness of the important role played by variations in animal music, and yet another confirmation of the basic differences between music and ordinary types of communication.

In any case, there is no doubt that the maestro of the musical variation is the humpback whale, *Megaptera novaeangliae*. Humpback whales are passionate manipulators of their compositions, and at least form a human point of view, provide the most outstanding examples in the whole of zoomusicology, They provide their songs with continuous variations, so that, after about five years, they sing a totally new song and, as far as scholars could notice, they never come back to the original version. Variations occur during the mating season: a phrase may be shortened or suddenly interrupted and replaced with a new one. A theme may be enriched with new sounds and then inserted into the whole context, or a part of it can be changed in sequence. Every whale 'updates' and includes new melodies on its song. They are performed faster and the variation is kept within the song until the next mating season. Then, old songs are reprised at the very point they had been left last year.

The latter peculiar characteristic was discovered by Payne and McVay (1971), who observed this work-in-progress compositional process in several whales (see Fig. 2). The picture shows two different song patterns from one whale: quite clearly the phrases are in continuous evolution (going from up to down). Comparing one pattern at the top with one at the bottom, one can really see how, if some passage is skipped, diverse phases do not really look like each other. The process is also illustrated by the following sound-sample (link to sample 6).

A crucial and typically musical aspect of this behaviour is that variations obey a codified set of rules, which are easily comparable to our compositional conventions. For example, a strictly followed convention in humpback whales is to sing a new phrase very fast (as we used to do at school when memorising poems), and then start manipulating it. Geographical location is also relevant, for once again it recalls human musical culture. Earle reports (Earle, 1979: 19):[6]

> Although songs of the same year in Hawaii and Bermuda are different, it is intriguing that they obey the same laws of change, and have the same structure. Each song, for example, is composed of about six themes-passages with several identical or slowly changing phrases in them. Each phrase contains

from two to five sounds. In any one song the themes always follow the same order, though one or more themes may be absent. The remaining ones are always given in predictable sequence"

For instance, if a song contains some descending sounds in glissando, these may be performed slower and slower and end up being divided into series of small descending notes. Time after time, some of these notes may disappear, and the continuous glissando may turn into a discrete arpeggio based on intervals of a third. Then, the sounds in the middle may disappear, up to producing an octave interval. Both the sounds of this octave may be doubled, and a longer sound may be added at the end. This latter may be augmented in volume and be repeated several times before the octave interval. We now see that we started with descending sounds in glissando, and we ended up with an octave interval with prolonged sounds (see Payne, 1996: 159).

Totally elaborated, this process may last for months or years, and it is intriguing that, if we compare the very first with the very last version, we hear two totally different songs[7] yet when we follow every step, the miniscule variations are hardly detectable. It is something like the difference between seeing somebody after twenty years and growing old beside him/her. The only aspect which keeps more or less its original structure is the sequence of themes. According to Cousteau and Paccalet, if the departing theme sequence is, for instance, *a b c d e f*, and one of themes – say *c* – is deleted or totally transfigured, the whole sequence is not affected, thus the order will be *a b d e f* (Cousteau and Paccalet, 1987: 237).

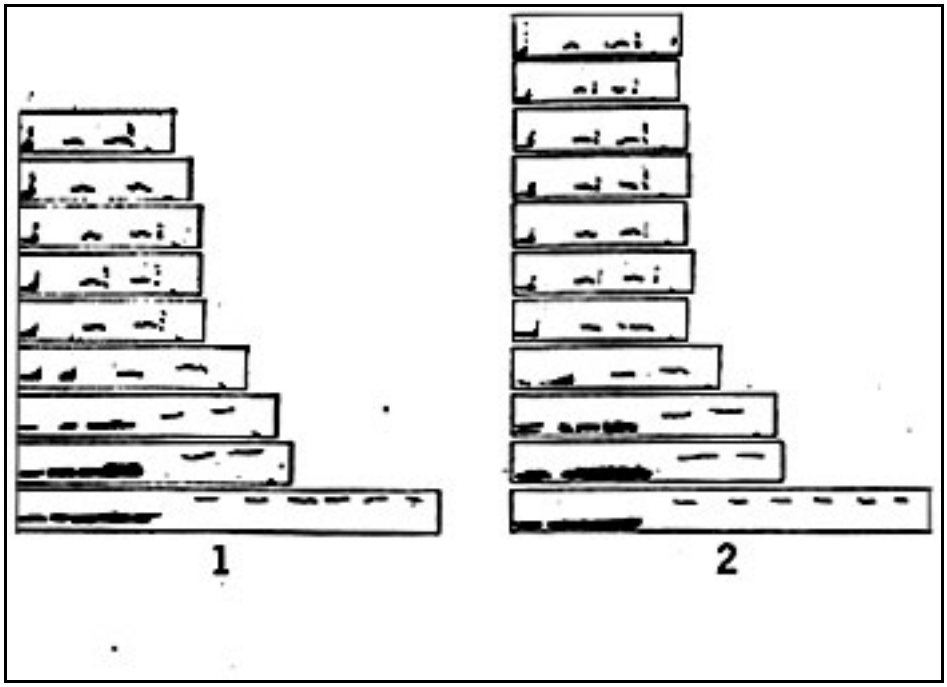

Figure 2: *Work-in-progress composition in two song patterns from the same whale*

This game of improvisation is almost endless. There is no point at which the whale stops manipulating its song. He stops singing for a while during the mating season, but after summertime picks it up from the same point. This is another reason why some scholars believe that singing is

more like a self-rewarding game. The aim is pleasure and satisfaction. There are no transitional stages; each phase has a complete musical sense. As Payne suggests, if whales were able to speak human language and we listened to a specimen singing the same verse after five years, we would hardly suppose there to be a relation between the two versions. However, if we listened to that verse over all the five years, not only we would realise that they are related, but we would also see that the transitional stages all obey syntactical and semantic rules (see Payne, 1996: 158-159).

In order to clarify this point, I shall propose a little game. We take two rather different words, such as *song* and *whale*, and - in very little time (whales' variations are very fast) - we turn from the former into the latter, just by changing, adding or deleting a single letter, such that every word in between still makes sense. For instance:

> **SONG** > (O to I) SING > (S to W) WING > (+ S) SWING > (G to E) SWINE > (- S) WINE > (+ H) WHINE > (N to L) WHILE > (I to A) **WHALE**

The question of cultural transmission, too, poses some interesting problems. Every whale, on the basis of the musical material available in its stock, creates its own personal song and performs it to the others. As Cousteau and Paccalet (1987: 238) underline, one can speak of sheer *hits*, i.e., songs more charismatic than others, songs which the group takes as a point of reference for the revisions that follow. Songs thus seem to follow the same rules of human culture, where words like "hit", "trend" and "fashion" play a relevant role in our musical choices. For instance, a new musical trend does not last for long if it does not become very popular. As Katy Payne, Peter Tyack and Roger Payne (see Payne, 1996: 167) discovered, the same applies to whale songs. If new elements are not displayed by all the specimens within the same area, they are soon forgotten. But once every whale incorporates them into their own songs, then the novelty will last for a long time. This means that males can realise the success of a modification according to its popularity.

So, songs within the same stock resemble each other and all resemble the hit of the moment. Yet, I previously described the songs as continuously-in-progress. *Thus, the question is: how we define resemblance and how we define difference*. Indeed, in order to speak of leit-motif, one should be perfectly aware of what constitutes a significant difference between two or more songs. In the case of humpback whales – we do not at present know. Referring this issue to human parameters therefore: two songs are defined as resembling each other (or being two performances of the same song) if they include the same themes in the same order, even when the number of repeated phrases within each theme is different, and when some version lacks one or more themes. If we look for each theme to be present and for the number of phrase repetitions to be constant, very rarely will we find two whales performing the same song. But is it not the case with human music, too?

At this point we may think about common musical competence Take a song that everybody knows and ask some people, one by one in different time and places, to sing it. During my early days of zoomusicological research, while in Bologna, I made this little survey with Lennon-McCartney's "Yesterday", possibly one of the best-known songs ever written. The different per-

formances were quite interesting. Firstly, the starting key was rarely the same in each version, and in the case of not-very-good singers, it would typically change *during* the performance, sometimes just by a matter of commas. Someone would know and sing the lyrics; someone else would just sing the word “Yesterday…” plus a varying amount of Nah Nah Nahs. Some would start from the beginning, some from the refrain. Some would sing an instrumental part (the acoustic guitar intro, string-quartet phrases, etc.). Some would enrich the melody with pseudo-bel canto embellishments (I was in Italy), ironically pitching his/her voice as would an opera singer, and so forth. Despite all this heterogeneity, all of the songs I heard were clearly and undoubtedly "Yesterday". Why should we expect more precision and perfectionism in whale songs?

If anything, we have another methodological task: we should take into account that subtle differences between two songs can be significant to whales, and thus we should not exclude the possibility that minor differences have a relevant role, so that songs carry more complicated messages, that goes beyond the simple remaking of other songs. But this, I am afraid, is a question too difficult to answer at this stage of zoomusicological research.

5. INTERVALS AND SCALES

Not only is it wrong to ascribe solely to human beings the capacity and need to classify sounds in discrete fashion, by degrees., we should also realise that such a capacity is systematically operative in most species. A cognitive psychologist, Dane Harwood (Harwood, 1976: 526), reminds us that:

> …all musical systems which use pitch distinctions to generate melodies show the use of clear and discrete pitches. That is, scales are comprised of pitch categories which seem not to overlap. This is so even though interval sizes and number of pitches per scale vary across and even within musical traditions. The psychological basis of this phenomenon is strongly perceptual and cognitive: scales seem to be the basic cognitive framework on which are 'hung' pitches and pitch relations the performer of a tradition considers meaningful. These 'frameworks' are representations in memory, and serve to reduce perceptual ambiguity in a perceived musical stimulus. The general process involved, which many psychologists call 'categorical perception', in this case, uses discrete pitches as a means of imposing on incoming sound a set of meaningful conceptual categories and relations between them. Pitch scales thus seem to be the result of a universal 'chunking' of tonal information about pitch into a few selective categories, categories which are mapped repeatedly and systematically onto successive octaves.

Of all singing animals, birds seem to possess this “categorical perception” in the most evident way:

> Many birds […] possess the ability to follow a train of changing pitches, like a scale, and to distinguish it from another train proceeding simultaneously but at a different speed or in a different direction. In other words, these birds appear to have solved what [has been] designated as the 'cocktail party problem', the essence of which I take to consist in the capacity to select one particular acoustic

> string, *viz.*, a tune, from its accompaniment or to distinguish it from another string proceeding at the same time (polyphony). (Sebeok, 1981: 224)

There are species, like the canon wren, which base most of their compositions on scale performances, up and down, by discrete unities and gradual order, in arpeggios, and so on, like in the following sample (link to sample 7).

As for intervals, their universal character seems to be in the seconds and thirds, not necessarily tempered-scale kinds of intervals, but small successive intervals, brief distances between one sound and another. As Bruno Nettl says, (Nettl, 1977: 4-5):

> in all vocal musics, the chief melodic interval appears to be something in the general area of the major second (we are not speaking, of course, about accuracy in tuning, distinguishing a tempered second from other types). But intervals roughly in that area, and including anything up to five-quarter tones and down to three-quarters, surely make up the bulk of the world's melodic progressions. And there are no cultures, to my knowledge, in which many pieces progress exclusively by half or quarter tones, or, for that matter, by thirds and fourths".

Harwood herself reinforces the concepts when noticing that while scales are composed of intervals and pitch categories that are different from culture to culture, "we find that in most musical traditions melodies are constructed of small successive intervals, usually no greater than 3-4 semitones" (Harwood, 1976: 526).

In the case of non-human animals, not only do we find the same tendency to perform within a limited intervallic area. Rather, with significant frequency most animals display a preference for very small intervals, in particular, minor and major seconds, plus some thirds, as illustrated in the following short sample of a loon – (link to sample 8). This is even more interesting when applied to species such as cetaceans, all of which can cover a huge range of sounds. It seems that all animals prefer simple and closely-connected types of melodic articulation. Arpeggios, both in legato and staccato, should possibly be interpreted within this framework.

6. RHYTHM AND TEMPO

One of the least arguable universal forms of musical organisation in non-human musical manifestations, is the presence of rhythmical elements, and these are widely documented in most species. Temporal scansion is at the basis of rhythmic movements, and these can be easily found in pre- or pseudo-musical performances, such as playing or ritual courting. Fisher records that on a number of occasions primatologist Wolfgang Kohler entered the chimp enclosure in a primate research centre to find a group of males and females trotting in 'a rough approximate rhythm' around and around a pole. Kohler said the animals wagged their heads as they swung along, each leading with the same foot. Chimps sometimes sway from side to side as they stare into one another's eyes just prior to copulation too. In fact, nothing is more basic to courtship in animals than rhythmic movement. Cats

circle. Red deer prance. Howler monkeys court with rhythmic tongue movements. Stickleback fish to a zigzag jig. From bears to beetles, courting couples perform rhythmic rituals to express their amorous intentions (Fisher, 1992: 31).

Most creative birds, such as nightingales, usually display a wide range of rhythmical patterns. Figure 3 shows 11 models performed by the sprosser nightingale, as classified by Sotavalta (1956: 4). They consist of seven cases of duple time and three of triple time. The eleventh model is a sort of unclassifiable trill.

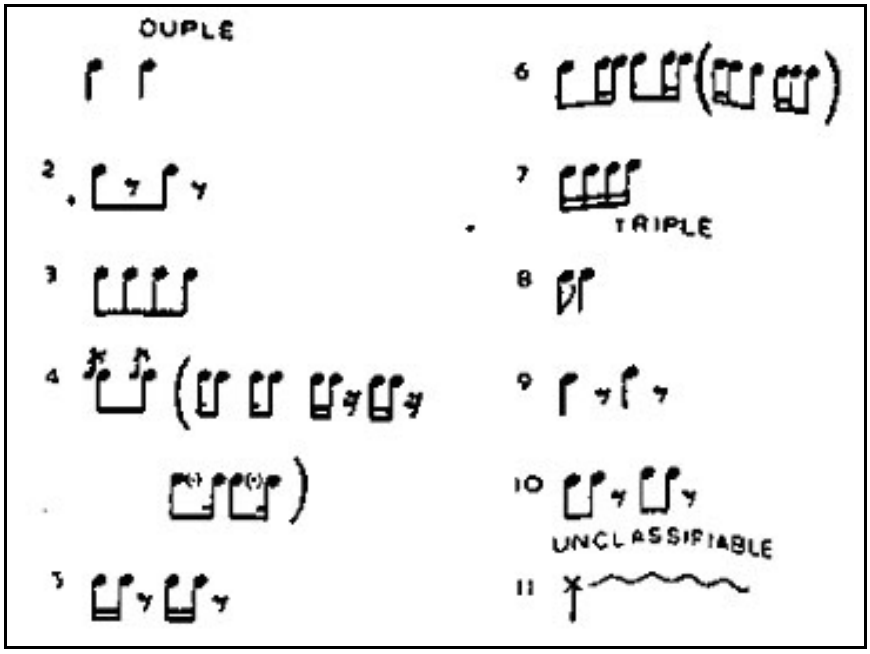

Figure 3: Rhythmic patterns displayed by the Sprosser nightingale

Another interesting example is provided by Sebeok, one which emphasises not only the existence of rhythmic patterns in animals, but also a truly rhythmic musical mind. In this case its perceptual bases can be detected empirically:

> Rhythm is the basis of form in birdsong, as in all music […]. An important series of experiments bearing on this point was carried […] with jackdaws (*Corvus monedula*). After being conditioned to distinguish certain rhythmic acoustic signals, the jackdaws were able to identify them even when played by different instruments, that is, with a different timbre, or when the tempo, pitch, or interval was transposed. They could also distinguish between two-four time and three-four time. The birds could perceive acoustical patterns differing in intensity and duration of tone, and recognised a great many variations. In sum, they did not depend on absolute clues only but, as we ourselves do in the perception of phonemes, on relative ones (Sebeok, 1981: 223-224).

To say rhythm is also to say dance. Although a whole other article should be dedicated to kinaesthetic signs, it is worth reporting here an example of dancing performance of the birds *Pipridae*, in which rhythmic coordination seems to be the fundamental aspect:

> Upon a bare branch which overhung the trail at a distance of about four feet from the ground, two male 'Bailadors' were engaged in a 'song and dance' act that simply astounded me. The two birds were about a foot and a half apart, and were alternately jumping about two feet into the air and alighting exactly upon the spot whence they jumped. The time was as regular as clock-work, one bird jumping up the instant the other alighted, each bird accompanying himself to the tune of 'to-lé-do, to-lé-do, to-lé-do', sounding the syllable 'to' as he crouched to spring, 'lé' while in the air, and 'do' as he alighted (Slud ,1957: 333).

7. SOUNDS AND TIMBRES

The final structural category, to be discussed only briefly here, is the so-called area of musical colour. To act musically means also to choose sounds from among all those available to, and producible by, a given subject. Such a selection occurs first of all in the domain of timbres, but dynamics and intensity are also relevant. Although humans are possibly the species provided with the most and widest variety of sounds - mostly with, but also without the help of various technologies, all animal species are capable of producing a more or less differentiated range of timbres and dynamics. What is common, and thus universal, in most of them is a selection from among the following:

1. *Musical* and *non-musical sounds*. For instance, among cetaceans the sound repertoire consists of a very wide range of sounds, to name which scholars have used the most diverse terms and metaphors: *moans, growls, shrieks, ratches, motor boat noises, chortles, chuckles, whinnies, snarls, whoops, caterwauls, howls, sighs, bawls, brays, wails, roars, bellows, trills, toots, whistles, barks, yaps, yelps, yips,* and so forth. Surprisingly enough, many of these sounds are not employed in musical performances, and - either by coincidence or by an impressive aesthetic convergence - the remaining ones are usually those most pleasant for a human to hear.
2. *Sounds to be performed in certain parts of the song* and *sounds to be performed in others*. For instance, Sotavalta noticed that:

> …pure tones as well as noises and mixed sounds appeared in the figures of the Sprosser. Pure tones could be whistling, piccolo-like, dull, like a low flute, metallic, celesta-like or chippy, like a xilophone, long or short. The commonest type of noise appeared in the cadence and resembled the rattle of a tambourine; another was a simple click of relatively low, indifferent pitch. These are marked on the stave with larger crosses. The mixed sounds were clicks with an approximate pitch, which are marked with a smaller cross at the proper place of the pitch […], or rolling R-shakes with a definite, low pitch, which are marked with shake intervals (seconds). The tones of the chords were, strictly taken, not simultaneous, but quick arpeggio-like upwards or (usually) downwards (Sotavalta, 1956: 5).

3. *Sounds to be performed in certain contexts* and *sounds to be performed in others*. For instance, several species of birds have two different versions of the same songs. A more intense one is usually performed in cases of territorial dispute, or better *before* territorial dispute, and signals that the performer (or performers, if it is a chorus) is ready to fight. A second version, definitely softer in volume, may be addressed to the partner or the offspring, and display a very friendly attitude.

8. CONCLUSION

This article gives an outline of one of zoomusicological research's most important topics, musical universals. It promotes the hypothesis that ethnomusicological theories on the subject are easily applicable to the non-human area as well. The article then focuses on the most problematic area of interest within universals, the so-called structures, i.e., those intrinsically musical elements (form, scales, intervals, rhythm, timbres, etc.) that are more difficult to detect as emerging in independent contexts. The thesis defended in this article is that of the universality of rules, rather than specific cases, and is the same sort of universality applied to the human case by many ethnomusicologists. Several zoomusicological cases were provided, with major emphasis on bird and cetacean species.

In the introduction, I mentioned that one of the main theoretical consequences of zoomusicology is that the concepts of nature and culture now appear more blurred and less of a dichotomy, than how we normally used to describe them. Since Eco's metaphor of the semiotic threshold as culture and codes (back in 1976), the dominant idea has been that biological or physical domains had to be excluded from semiotic investigation. During the last years, however, the birth of biosemiotics and the reinforcement of zoosemiotics (plus a general growing tendency to replace semiological approaches with semiotic ones) have led to a remarkable reconsideration of Eco's threshold.

Peirce was never persuaded by the dualism between mind and matter. Through his idea of synechism, he promoted the principle of continuity between the two aspects. Among the entities involved in semiosic processes, Peirce predictably mentioned animals, but microorganisms, plants, and intelligent machines were described as being involved in quasi-semiosic actions, not to mention processes of "thought," occurring even "in crystals, and throughout the physical world" (CP 4.551).

After the strong affirmation of Peircean and Peircean-based approaches, a process that certainly went hand in hand with the birth and the growth of biosemiotics, it became clear that semiotics could no longer be concerned with signs based exclusively on culture and codes. Thanks to Sebeok's pioneering work dating back to the 1960's, semiotic processes whose agents are animals and micro-organisms became included in the semiotic sphere. This was after all not so surprising, for the question was indeed raised whether precursors of semiosis should be traced in the inanimate world and whether semiotics should also include fields of physicosemiotics, and others of – so to

say – a protosemiotic type. In addition, a further challenge to Eco's semiotic threshold came from the domain of machines, computers and artificial intelligence.

The current status of the art of biosemiotics makes it however clear that the study of life semiosis is not a just challenge anymore, but a mere reality within the semiotic world. My contribution in this article is to show that from a zoomusicological perspective that any qualitative distinction between the aesthetic use of sounds in human and in other species is in principle begging the question, and appears to be the result of a strictly behaviouristic (when not mechanistic) interpretation of animal behaviour.

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ENDNOTES

1. Payne is referring to mathematical Platonism, a theory postulating the existence of universal mathematical structures yet to be discovered.

2. In animal studies, the notion of ‘culture’ has been ascribed to non-human beings for quite some time. For more information, please see Thorpe (1961 and 1963), Gardner et al. (1994), Bonner (1980), Bekoff and Jamieson (1990), Cimatti (1998), Hamilton and Marler (1966), Mainardi (1975), Box (1973), Armstrong (1963), Sebeok (1968), and Payne (1996).

3. With the possible exception of some rap, which anyway is meant as a musical gesture, thus contextualised and codified according to a specific set of characteristics.

4. The problem of actually hearing those sounds can technically be overcome by digital re-editing, by simply increasing the pitch rate of the sample. However, the problem here does not lie on the accessibility of a given musical phrase, but rather on the role that a specific frequency plays within a given soundscape, and – consequently – within the very Umwelt (see Uexküll, 1956) of the species in question. The issue is evidently not a marginal one.

5. Morgan's Canon: "In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of one which stands lower in the psychological scale"

6. A human example corresponding to this is easy to illustrate. If we consider the rock'n'roll repertoire of the 1950s, we could notice, for instance, that a *rock-blues* performed by the American singer Elvis Presley was in principle different from one performed by the English singer Cliff Richard (at that time, he was known as the English *Pelvis*). However, stylistically speaking, both the songs witness very clearly the contact between the American and the British musical culture: Twelve-bars blues, sequence Tonic-Subdominant-Tonic-Dominant-Tonic, an electric guitar solo, pentatonic melody, and so on.

7. "For example, the songs we taped in 1964 and 1969 […] are as different as Beethoven from the Beatles" (Earle, 1979: 19).