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MUSICOLINGUISTICS – FROM A NEOLOGISM TO AN ACKNOWLEDGED FIELD

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Mihailo Antović

Department of English, Faculty of Philosophy, University of Niš

Abstract. *This paper aims to give an overview of the expanding interdisciplinary branch of cognitive science in which music psychology and cognitive / generative linguistics overlap. The field, sometimes labelled 'musicolinguistics', aims to describe a number of phenomena in music perception within the linguistic epistemological framework and methodological apparatus. The discussion first introduces the precursors of the discipline, from the earlier musico-theoretical, aesthetic and psychological schools, such as Schenker, Cooke, or Langer. Further text covers the research of properties common to language and music dominant in the period of the Chomskyan revolution of the late twentieth century. Approaches of Bernstein, Keiler, Lerdahl and Jackendoff are analyzed, followed by attempts at empirical confirmation – psychological and neurophysiological. The final section of the paper concentrates on present dilemmas in the domain, where the issue of biological foundations of music and language is once again raised. The conclusion points to a possible reconciliation within the new approach in cognitive science applicable to both language and music, known as optimality theory.*

Key words: *music, language, musicology, linguistics, cognition*

1. INTRODUCTION. PRECURSORS.

Music and language have been compared for centuries. Reasons for this are a matter of common sense: both systems are physically manifested as sounds; they extensively utilize the human vocal apparatus (language is primarily spoken, and music got its first exclusively instrumental realizations only towards the end of the Middle Ages); both are expressible by means of written representations, whether letters or notes; both evoke psychological reactions in listeners (cognitive or emotional/affectual); both may be used for ritual purposes or as a source of aesthetic pleasure; both need to conform to certain internal rules in order to be at all comprehensible by listeners: if this were not the case, constructs such as 'language' or 'music' would not exist at all – they would be lost in the

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myriad of inarticulate sounds with no internal or external significance. For these reasons and others, some sort of comparison between language and music has remained the focal point of a number of researchers for centuries – from Plutarch to the present day. The aim of this paper is to provide a short conceptual overview of such approaches with special emphasis on and critical consideration of the school tackling musical phenomena within the methodological framework of cognitive science and generative linguistics, which originated in the United States in mid seventies, and still has major proponents today.

Through history, the comparison of language and music has been most common in philosophical discussions, where the usual stumbling block is the problem of musical meaning. Formal schools have denied anything in music "but itself" and claimed it should be studied on the basis of its internal, inherent structural relationships, with no reference whatsoever to the external world. This approach reached its peak after the fall of Romanticism and remains very influential in the postmodern period, both with musicians and theorists (Bernstein, 1976; Focht, 1980; Dempster, 1998). Referential schools, on the other hand, have claimed that any purposeful approach to music must acknowledge the vast influence it has on the extramusical domain. On this view, music should be studied through what it sparks outside itself, where targets of the impact have been diversely identified: music is thus explained through human affectual reaction, where what is heard evokes or even contains emotions (Cooke, 1959; Peretz et al, 1998); it is seen as a protosymbolical system with strong implications on the perception of other art forms (Langer, 1964/1990); as a grand signifier capable of conveying meaning through subtle semiotics (Seeger, 1960; Tagg, 2005); in the recent period, as a form that most strikingly triggers metaphorical representations in the human conceptual system (Zbikowski, 1998; Spitzer, 2004). Whatever approach is taken, some relevance to modern linguistics may be found: music as a self-referential system has been of interest to the generative schools of the last three decades, while music as a vehicle for transferring some kind of meaning has attracted semanticists from diverse schools, with varying success.

The second major historical problem in the comparison of language and music is that of there being a grammar in both forms. While the existence of grammar in language goes by definition, the striking thesis is the claim that music too has properties definable as grammatical. Historical usage of the phrase 'grammar of music' can be tracked back to the early modern period, where it was taken as a mere analogy, especially useful in music education: if language is a system based on a clearly defined set of strict rules that need to be learned, practised, and maintained, then there is some relevance to the concept in music, too – in particular if one needs to explain to a young performer how difficult a task it will be to master all the skills on her instrument. The phrase was therefore coined for pedagogical purposes (for instance, Diletski 1723/1970), and it opened the way to introducing other terms usually used in the language science into music theory: with concepts such as "sentence", "period" and "syntax" as the obvious examples. Naturally, this 'prescriptive' view of grammar, be it linguistic or musical, is all but abandoned today. In its modern usage, the term presupposes a 'descriptive' approach, where no conscious instruction is favoured, or needed, and where the task of the grammarian is just to observe and classify phenomena and reach conclusions on the nature of the system lying behind the surface manifestations. Such a view of grammar in language has been taken as standard since the times of de Saussure, in the structuralist, and later particularly cognitivist periods. In musical grammar, it originated during the mid phase of the Chomskyan revolution, in the seventies.

The questions of musical meaning and musical grammar have remained the common ground of linguistic and musicological theories to the present day. Although approaches remain numerous (with sometimes vacuous and still protoscientific analogies at hand), cognition-oriented studies, probably at their peak as this text is being written, seem to provide the most promising results. The mind and its capacities, vastly studied in the multidisciplinary endeavour broadly known as cognitive science, are therefore the venue where a new discipline is emerging: musico-linguistics.

2. The Rise of the New Field.

At the first Conference on Interdisciplinary Musicology, held in Graz, Austria, in 2004, an entire session was devoted to the problem of music / language interrelationship. This was a natural continuation of the tradition that started at the Massachusetts Institute of Technology, where in 1974 there was the seminar on music, linguistics, and aesthetics. The old protoscientific or rather speculative link between music and language, hence musicology and linguistics, is today no longer considered alternative, and is commonly found in the work of numerous musicologists, psychologists and linguists of cognitivistic background (R. Jackendoff, F. Lerdahl, J. Sloboda, I. Cross, C. Palmer, B. Aarden, I. Peretz, D. Schon, J. Pearl and numerous others). Stemming from the cognitive science of the seventies, the school studying connections between music and language cognition became reputable in psychological circles in the eighties and nineties. However, regardless of the status of "scientific field", which today it certainly assumes, the discipline still gathers a relatively small number of researchers, located in a few centres in the USA and Europe (Massachusetts Institute of Technology, Brandeis University, Ohio State University, Marseilles Research Centre for Cognitive Neurosciences, Leipzig Max Planck Institute, Keele University in England, Groningen University). For this reason, as is the case with numerous other small projects in cognitive science, the music/language endeavour is still not classified as a research field nor study program at western universities. Hence the exclamation of one of the researchers mentioned above, J. Pearl of the University of Santa Barbara in California, pronounced at the Graz conference, that "we [pursuing the music and language issue] still do not have a field!"

This pessimism seems to be unwarranted, after all. Although it is true that the name of the field is still a matter of some dispute, one cannot deny that language and music have indeed been compared for centuries. While such approaches were common in philosophical and pedagogical disputes of the earlier times, the true rise of the new discipline came with the overwhelming influence of psychology on all social sciences – realized through the behaviourism of the forties and fifties, and particularly cognitivism of the sixties and later. The "new" theory of western music, based essentially on the analysis of H. Schenker of the early twentieth century, aimed at describing the musical system as cognitive in nature. The old music theory analyzes tones and their interrelations, and these are definite – a higher octave is made by shortening the vibrating chord to its half length. This is all there is to the music science. The new theory, however, attempts to go deeper than this, to reach the psychological reality of the events that register certain musical relations – rhythmic, metrical, melodic, and, to a lesser extent, harmonic: in other words, the issue is *why* the 2:1 wavelength ratio is *intuitively* perceived as the same tone by *native listeners* (idealized agents analogous to linguistic native speakers). Although the comparison between language and music is by no means the only task of this discipline[1], one should not be surprised to learn that the formal framework for the field was found in the generative linguistics of the seventies. First of all, at that time, generative linguistics was dominant in all social science, so that it was taken by many to be the leading discipline in cognitive psychology, more important than the very psychological approaches. In this respect, many of its claims, from the most popular deep/surface structure distinction to technical issues such as transformations found its way to other domains, musicology included. The choice of a linguistic methodological framework in the "new" music description is logical if one also bears in mind the actors themselves, i.e. the academic background of the researchers involved in the early program: Leonard Bernstein was a friend and intellectual follower of Noam Chomsky; Fred Lerdahl his Harvard colleague, composer and theorist interested in generative theories; Ray Jackendoff was and still is the most famous Chomsky's student, founder of interpretive semantics and x bar theory – an influential linguist and educated clarinettist; Alan Keiler was Jackendoff's colleague from Brandeis, with a doctorate in linguistics from Harvard and subsequent orientation towards music theory, a leading authority on Heinrich Schenker then and now; John Sloboda is an influential cognitivist music psychologist with some linguistic education, too. Such people, sometimes independently of one another, seemed to have no choice but develop a metalinguistic music theory in the late seventies and early eighties, which provided the setting for subsequent empirical studies of properties common to music and language cognition.

The name of the field, however, still remains somewhat elusive. There is much confusion in the literature regarding the title and classification of the discipline. Numerous conventions have defined it as a metalinguistic branch of music psychology, cognitive psychology of music, music perception theory, as the music-language science, the blend of musicology and linguistics, etc. I hold that *musicological linguistics* or *linguistic musicology* (depending on which of the two disciplines the particular researcher feels to be central to her purpose) would be the best name for the field. However, the term 'musicology' has two senses, similar to those of 'anthropology': it may be regarded as the broadest science of music, but it is usually taken in its narrower sense, denoting the study of the music of primitive communities. Unfortunately, in our country in particular, musicology is rarely taken to be an essentially psychological approach to the study of music. For this reason, not without some apprehension, I shall stick to the term *musicolinguistics* (coined by Bernstein, 1976: 53), as the concept to cover the research field in which music and language capacity are compared in the cognitive or generative epistemological framework.[2]

[1] Today mostly known as *music perception theory*, with its own influential journal *Music Perception*, or *cognitive psychology of music* with societies such as ESCOM (European Society for the Cognitive Sciences of Music) and journals such as *Musicae Scienciae*.

[2] As linguistics is the field, and music the object of study, rather than discipline, *musicolinguistics* may sound like an unnatural blend. This is less so in English, but may pose translation problems, and hence my misgivings. As for etymology, there are indications that Bernstein himself took the term over from the Indian-American author Anoop Chandola. However, this early usage had no connections with the Chomskyan program, for which reason I keep Bernstein as the originator of the term in the generative sense.

3 BASIC CONCEPTIONS OF MUSICOLINGUISTICS.

Musicolinguistics may be defined as a branch of cognitive science which attempts to describe music perception phenomena by means of linguistic methodology.[3] Conceptually, it aims to draw clear parallels between the two types of cognition. Practically, this usually means that terms from the language science are "borrowed" and adapted to the musicological framework.

As already pointed out, the very phrase "grammar of music" is rather old. In the modern generative sense, it mirrors the dualism of the language grammar: first, the phrase denotes a mental capacity – the set of unconscious tasks that the mind effortlessly resorts to in order to comprehend a series of sound stimuli as "familiar", acceptable for musical intuition. Additionally, in the descriptive sense of the word, musical grammar is also a formal theory – it uses the appropriate symbolical system to describe the postulated mental processes occurring during native-idiom music perception. In this sense, the grammar of music is, to use the theory's internal metaphor, a 'daughter' of generative linguistic theories, as these, in principle, may be applied to any kind of cognition.

Other typical generative linguistic concepts also found their way into musicolinguistics, although some of them are to be taken with caution: *musical idiom* is analogous to a mother tongue, defined as a particular musical style accepted as "one's own" or recognizable by members of a nation or, more commonly, by people from a broader geographical region; *native listener* is akin to a native speaker: not a concrete person, but an abstraction: an idealized agent who by definition possesses full unconscious knowledge of the idiom and is able to parse musical phrases according to internalized rules; this agent develops *musical intuition*, again taken in the generative sense of unconscious knowledge: any music she hears will be automatically compared with this knowledge, on basis of which the line will be assessed as acceptable ('grammatical'), unacceptable ('ungrammatical') or *ambiguous* – where two interpretations are possible due to the discrepancy between the *underlying* and *surface* structures, usually on metrical or harmonic levels. Ambiguity is the key concept of all cognitive science, relatively easily testable in music (e.g. Maess et al, 2001). It points to a clear distinction between the physical and the psychological reality of the signal processed – showing that the soundwaves heard are constantly compared with internal mental representations, a trait crucial to the generative description of language, as well. The goal of musicolinguistic description is thus equivalent to its linguistic counterpart – *predictive* and *reductionist*. It strives to explain how the perception of a seemingly endless set of meaningless stimuli may formally be reduced to the cognition of basic structural relations, in language and music based mostly on domination. If one shows that the entire musical flow of a complex piece, such as a Beethoven sonata, can be reduced in principle to the relationship found in the basic cadence or even tonic chord, this kind of music psychology may rightfully be called generative, or metalinguistic.

Based on such postulations, musicolinguistics sometimes goes even further in drawing parallels. Hence its subject matter is occasionally studied through pseudolinguistic subsidiary branches, such as *musical phonology, syntax,* and *semantics* (again first in-

[3] While linguistic theories seem to be equally interested in perception and production, musicolinguistics usually constrains its interest to perception only. As discussed by Sloboda (2000), reasons for this are western prejudice which views musical abilities as skills available to talented professionals only, and the impossibility of precise empirical testing of generative processes in musical performance.

voked in Bernstein 1976); and there are even attempts at introducing *musemes* as basic units of musical expression, at least in principle comparable to linguistic *morphemes* (Seeger, 1960: 244, the term is today popular in semiotic schools, e.g. Tagg, 2004). However, excessive analogies, even when explicitly intended as metaphors, have often caused only harm. This is why musicolinguistics should be viewed as a discipline of cognitive science, whose purpose is to study the human mind via musical phenomena: if seen this way, and not as a branch of either linguistics or musicology, it stands a chance of being taken seriously in future theoretical and empirical endeavours. To use a functionalist metaphor, the ultimate subject matter is the mind as hardware, while music and language are only the software helping us to reach its secrets.

4 The Modern History.

The first book on musicolinguistics was published in mid seventies in the United States: it comprised six popular lectures given by the composer Leonard Bernstein to students at Harvard in autumn 1973 (Bernstein, 1976). For five consecutive evenings, with TV cameras recording all sessions, the maestro gathered students from different departments, mostly non-musicians, and attempted to explain to them all the complexity of the musical system using the constructs of the early generative linguistic theory. Naturally, this approach was not really scientific and the methodology was somewhat dubious. However, it turned out that this book, in its attempt to respond to the *unanswered question – whither music*, would give a serious boost to the birth of the new cognitive discipline.

In addition to christening the new field, Bernstein dealt with numerous tricky issues of any music theory. The relationship between musicality and language in his view comes from what linguists today would call *affective prosody* – the ability of speakers to produce their linguistic material with varying intonations, significantly altering meaning. Question making, confirming, negating, reprimanding – are some variables enabling the same phrase to be expressed in different ways, almost literally 'sung'. Bernstein was particularly interested in the musical interval known as the minor third sung downward, which seemed to exist in nursery rhymes from numerous cultures. Claiming this was a *substantive universal*, more easily reached in music than in language, Bernstein believed that the system of tone scaling, i.e. the construction of keys, should be the subject matter of a *musical phonology*. Within the basic interval we today call the octave, manifested in the 2:1 wavelength ratio, there are smaller intertonal distances perceived as either gradually more consonant or dissonant. The construction of all key systems in any world music, believes the composer, is possible due to the unconscious perception of the *overtone series*, a number of frequencies produced by any natural tone which are not consciously registered, but float above the fundamental frequency (perceived as the pitch/height of the tone) and contribute to the overall quality of the sound heard (among other things, timbre). The theory of overtone series as the cornerstone of musical phonology has found numerous proponents and opponents in the last thirty years. Unfortunately, empirical research has so far been unable to prove that keys and the sense of tonality originate from this construct (Jourdain, 1997: 35, 69; Jackendoff and Lerdahl, 2004: 14). The thesis of the minor third as a substantive universal is also abandoned today. However, the phrase musical phonology has been preserved, and it is now used for the connection between the emotional colour given to pronounced words – affective prosody – and musicality. There are even indications that the processing of both events is the responsibility of the same mental processor (Jackendoff, 1994: 63-4). Connections and differences between brain cortex zones responsible for linguistic and musical tasks in sound processing are a matter of present interest in cognitive neuroscience, too (e.g. Patel and Danielle, 2003).

Apart from musical phonology, Bernstein insisted on the construct of musical syntax, a theory in which linguistic units larger than words and musical phrases, sentences, and ultimately movements (in German: *Satz*) are compared. In spite of the composer's effort and long tradition in which musical syntax, sentences, phrases and periods have been taken as standard terms, one finds little connections between the concept of the sentence in music and language. If anything, the key trait of a linguistic sentence is the clear-cut division between the subject and the predicate, a notion ultimately lacking in musical understanding. Numerous references to musical syntax in research papers, most notably from cognitive neuroscience (e.g. Koelsch et al, 2000; Maess et al, 2001;) should therefore be taken with caution as musicolinguistic theories have since Lerdahl and Jackendoff (1983, see below) denied the plausibility of this construct. Much more successful was Bernstein's treatise of musical semantics: as a strict formalist, he loathed any interpretation of music by means of the extramusical, insisting on a music listening which would rely solely on internal musical relations – movements, transformations, tensions, relaxations, rather than external references, emotional, affectual, or cognitive. In the treatment of the problem, however, he insisted on music being 'metaphorical' in nature. His understanding of the term, a key concept in cognitive linguistics then and now, implied a twofold interpretation: on one hand, there is an 'intrinsic' musical metaphor, in which the repetition of musical motives with a slightly changed metric, melody, or harmony is the instance of intramusical metaphoricity; on the other, there is also an 'extrinsic' metaphor in music – the reference to the extramusical, with terms such as 'scale', 'chord', 'high pitch', 'low resonance', but also 'dark melody', 'female minor', 'sad tune'. Bernstein considered only the former of interest to musical semantics, but more modern theorists have incorporated the latter into legitimate musicolinguistics, too (e.g. Kuczenski, 1998; Spitzer, 2004).

Bernstein's most important contribution to cognitive science, however, lies in his deep understanding of the importance of ambiguity: this key compositional device in music lies at the basis of this composer's new materialistic aesthetics. The essence of art is no longer in the unity of mind and matter, the ungraspable duality produced via physical tones; rather, it is an issue psychological in nature – aesthetic pleasure is experienced due to the composer's skilful play with the listener's expectations – subconscious, effortless mental anticipations that unmistakably await a particular chord or progression once the previous part of the sequence has been heard. Ambiguity plays games with the mind. Since it often occurs in language and music, it proves that the physical stimulus is reduced to a mental representation. This in turn opens up the way to a generative theory of music perception.

The second major name in musicolinguistics of the seventies is Alan Keiler. This researcher furthered Bernstein's theses on generative nature of musical processes in search of a full analogue between musical and linguistic syntax (for instance, Keiler, 1977). The parallel, along with a number of transformational procedures proposed in line with the generative program, turned out vacuous and superficial. However, Keiler's influence on musicolinguistics came after his profound interest in the work of the classical theorist today considered precursor to musical generative grammars: Heinrich Schenker (1868-1935). The concepts of domination, recursion, and reduction in musical understanding are ultimately attributable to this scholar, who devised ideas on the basic element of musical expression, the so-called *Ursatz*, and numerous hierarchical levels of tonal organization, ultimately reducible to the harmonic triad. The revival of Schenker's ideas prompted a new theory of classical western tonal music based on generative principles.

The first methodologically rigorous description of the perception of western tonal music which used the formal devices of generative linguistics was developed in the early eighties as a collaborative effort of a musician and linguist, Fred Lerdahl and Ray Jackendoff. One of the most influential theories in modern music psychology, and certainly the key book to all musicolinguistics, came to be known as the generative theory of tonal music (GTTM, Lerdahl and Jackendoff, 1983). According to its subject matter, epistemological framework, and methodological preferences GTTM is a classical metalinguistic theory: it takes musical grammar to be the ability of the listener to recognize any musical piece she hears as belonging (or not) to her native idiom, for which process she utilizes a set of deeply wired, perhaps inborn, perceptual intuitions. These intuitions reduce the musical signal to a set of relations, with some musical elements being more dominant than others on a number of levels in the hierarchy. The goal of the theory is, therefore, to predict what the relatively dominant elements and interrelations will be in any novel piece of the native idiom that the speaker might be confronted with, and, based on such intuitions of dominance, how the listener will subconsciously parse / affectually respond to the new music she hears.

A formal theory, GTTM postulates abstract structures and operations to manipulate them. The four basic structures are metrical, grouping, time-span, and prolongational structure. Metrical structure describes the intuition of native listeners on the succession of relatively marked and unmarked segments in the music they are exposed to, on a number of levels. Grouping structure points to the tendency of native listeners to experience some melodic combinations as more close, i.e. to classify series of tones they hear into psychologically real wholes based on Gestalt principles. The last two structures are reductional: time-span structure divides the musical piece heard into major wholes in accordance with domination principles, in effect, though not by program, mainly stemming from western tonal harmony. Finally, prolongational reduction, as the most abstract and by now most doubted construct relates to the intuition of listeners that the musical flow may, based on the succession of tension and relaxation, continuity and progression, be reduced to simpler structures which indirectly induce affectual reaction in the parser, i.e. the listener's sense of music invoking emotions.

Structures so defined are subject to three types of formal operations, called rules after the generative linguistic theory: well-formedness rules, as occurring in all computational science, which define the conditions that need to be satisfied so that a particular musical constituent can be built at all. For instance, in order for a group to be made, it must consist of an uninterrupted whole in the musical flow so that the rule reads that only neighbouring elements may form a group. Apart from these, there are transformational rules, which do not really mimic major syntactic movement as Bernstein and Keiler once wanted them to, but rather represent surface phonological phenomena, the fine tuning of the finished musical product, realized through processes such as elision and deletion. Finally, preference rules, revived in this theory from the early period of Gestalt psychology and some pioneering work in pragmatics (Wertheimer, 1923; Grice, 1975) were the real novelty to cognitive science at the time. They sharply distinguished music perception from its language counterpart, as they enabled subtle non-binary choices to be made in selecting the moist plausible interpretation of any part of the musical flow. These were not inflexible choices, but a consequence of the parser's free options among a number of equally acceptable alternatives. Such rules were presented in the theory via conditionals and superlatives: e.g. *if two groups are perceived as parallel, it is best to ascribe them parallel metrical structures*. "If" and "it is best" point to the impossibility of computation: this type of rule undermines the formality of the theory, since it incorporates free choice of the listener, conscious or not, and introduces an amount of "subjectivity" into music perception, which was by then avoided in cognitive theories by definition.

Jackendoff's decision to borrow the long-forgotten preference rules from visual cognition theories and incorporate them into GTTM turned out to be a visionary move. Renamed as 'constraints', cognitive preferences have in the following twenty years found their way into many non-musical branches of cognitive science, including linguistics: they have been taken as standard by Chomsky and followers since the early days of government and binding theory (Chomsky, 1981), are found too in the present-day approach to generative linguistics known as the Minimalist Program (Chomsky, 1995), while their application is pushed to the edge in the computational and linguistic school especially fruitful in the domain of suprasegmental phonology, Optimality Theory (OT, Prince and Smolensky, 1993). In addition to this, Jackendoff and Lerdahl's system pointed at striking connections between musical and linguistic metrics (following Lieberman, 1975 and Selkirk, 1982) and Gestalt conditions of proximity, similarity and figure-background, relating the visual and the musical domain (as first defined in the work of the prematurely deceased British psychologist David Marr, 1982). Preference rules in music psychology and linguistic theory, common metrical relations in music and language perception, and Gestalt principles applicable to musical and visual cognition became the cornerstones of musicolinguistics in the twenty years to follow. The discipline was born.

4. EMPIRICAL FINDINGS

Contrary to the purely linguistic generative program, notorious for changing approaches, methodology, and jargon every few years, the world of musicolinguistics remained under the influence of GTTM for almost two decades. This development induced a series of criticisms – negative, claiming that the lack of new theories proved the very concept of musical grammar was erroneous (Dempster, 1998; deBellis, 1999), and positive, ascribing GTTM major importance in all cognitive science (Sloboda, 1985; Raffman, 1993; McAdams, 1996)[4]. Wherever the truth may lie, in the late eighties and all of nineties, musicolinguistics ceased to be a theoretical discipline. Researchers rather attempted to substantiate its claims empirically. Some such endeavours were computational: although preferences rules made this extremely difficult, programmers ventured into making algorithms which would parse music according to (usually slightly adjusted)

[4] Not that there were no real alternatives: Lerdahl (2001a) devised a model of GTTM hierarchies interfacing poetry and music; Narmour (1990, 1992) proposed the well-accepted model of sixteen archetypes in music cognition; Bod (2001) introduced the probabilistic computational approach. However, none of these had as strong connections with generative linguistics as Jackendoff's contribution did, and none can therefore be taken as a fully musicolinguistic theory.

GTTM principles (Temperley, 2001; Ida, 2002). Most approaches, however, were either psychological or neurophysiological in nature and took the form of experiments carried out on subjects of flesh and blood, some musically educated, some gifted laymen, and some even tone deaf.

Psychological experiments testified to lower structures in the hierarchy being well described in GTTM: Deliege (1987) remains the most convincing substantiation of grouping hierarchies as defined in the original theory (although Deliege proposed some alterations to the model, a tendency followed by many ever since); metrical structure was well represented in the experiment by Large and Palmer (2002). Complex reductions from GTTM have not really been seriously experimentally verified: partial results were achieved in experiments with jazz pianists (Large et al, 1995) and in perceptual tests with sequences of short chords (Bigand et al, 1996). Other research projects did not aim at confirming or denying GTTM postulations, but strived to prove the psychological reality of elementary musical relations, rhythmic, melodic, or harmonic. However, these experiments usually tangentially related to GTTM, too: in harmony, this was done by Krumhansl and her students (Krumhansl, 1990), in the domain of melody or "pitch hierarchies" by Cuddy (1994), Bharucha (1994) or Cross (1997), and in the scope of rhythm by numerous researchers (Rothstein, 1989; Parncutt, 1994; Roberts, 1996; Hasty, 1997).

Even more interesting are modern neurophysiological and brain imaging experiments. Although methodology has progressed since the pioneering work connecting psychological introspection and neurological reactions in the brain in the seventies, results of these endeavours should still be taken with caution. Contemporary cognitive neuroscience has found its way to music cognition as well, and the issue of connections between music and language on the neural level is of great interest at present: joint neural activation has been detected in numerous activities mixing language and music perception, on phonological, syntactic and semantic levels, with pronounced excitation of a number of brain zones, Broca in particular (emotions in music – Peretz and Hebert, 2000; Blood and Zatorre, 2001; common underlying structures for language and music – Peretz et al, 1998; Zatorre et al, 2002). One should point out here the research of M. Besson and D. Schon of the Institute for Cognitive Neurosciences of the Mediterranean in Marseilles, France, whose event-related potential research (Besson and Schon, 2001) suggested a number of neocortex locations responsible for music and language processing. New studies of this group utilize the most advanced technique known as functional magnetic resonance imaging where additional results are currently expected. Similar techniques are used by the Max Planck Institute group from Leipzig, Germany, where the role of Broca's zone in music and language ambiguities was studied in the recent past (Koelsch et al, 2000; Maess et al, 2001), while semantic processing in music and language is inspected at present (Koelsch et al, 2004). In the opposite direction, from practice to theory, empirical findings of common localizations for some musical and linguistic tasks currently threaten to undermine a number of fundamentals in cognitive science: among others, Chomsky's claim of the absolute specificity of language in the cognitive system (as defined, for instance in Chomsky, 1975) and the strict variant of Fodor's modularity theory (Fodor, 1983).

Interesting endeavours in musicolinguistics have also been presented at two conferences on interdisciplinary musicology organized in Graz, Austria, in April 2004, and Montreal, Canada, in April 2005. The first of the two hosted a separate session devoted to music-language issues, where the problems of musical semantics (Antović, 2004) and in particular musical phonology and its consequences for music therapy were discussed (Deutsch and Beiß, 2004; Mogharbel et al, 2004). The second conference, largely dedicated to the problem of timbre in music, saw a number of papers inspecting the influence of this perceptual entity on the controversial notion of musical meaning (Rogers, 2005; Darke, 2005; Zagorski-Thomas, 2005). It is quite true today that musicolinguistics is a propulsive experimental discipline, gathering researchers from diverse fields. However, the latest developments point to new theoretical contributions as well, from old authors and new.

5 The Present

Musicolinguistics today reflects the tendencies of modern cognitive science. One of the pressing issues in the cognitive world now is the question of the complex interrelationship between the inborn and the acquired in any mental capacity. The old psychological paradox, widely known as the 'nature/nurture issue' (Jackendoff, 1994; Pinker, 2002) seems to attract numerous researchers, where the accent today is largely put on the 'natural', 'prewired', or genetic side of the problem. In other words, most researchers tend to believe that both musical and linguistic competence are a consequence of evolutionary development. In linguistics, the Darwinian view, according to which language must be a product of natural selection is dominant among the younger and middle generation of scholars, although major authorities still express their misgivings (Pinker and Jackendoff, 2005 contra Fitch, Hauser, and Chomsky, in press). In the domain of music cognition, the view of music as being largely a form of evolutionary adaptation is reviewed in McDermott and Hauser (2005). Most cognitively oriented researchers today tend to believe that music is species-specific, like language, so that musicality, taken in the broadest sense of the word, is only found in humans. The conclusion that music must have been somehow important for the preservation of the human species sounds reasonable in such a milieu. In this respect, one line of scholars believes that, although its functions are today perceived as merely ritual or aesthetic, music must have originally had a strong social purpose, since it was a powerful means available to induce in humans a stronger sense of belonging to the group (Cross, 2001; Huron, 2001); others contend that music is an accidental, having developed spontaneously and purposelessly from other faculties, most notably language (Pinker, 1997); still others tend to think music capacity is not a subform of language competence, but rather equal to it in a wider imitational, or 'memetic' symbolical system (Vaneechoutte and Skoyles, 1998). Whichever position one might embrace, the problem of biological foundations of music and this faculty's interdependence with language induces numerous studies today, especially in cognitive neuroscience (Peretz and Zatorre, 2005).

On a more narrowly musicolinguistic level, one finds today two approaches extending the original generative music theory. The first one is presented as the revived interest of the theory's originators in the problem of music, as outlined in Jackendoff and Lerdahl (2004). Principal questions asked by the two authors in this paper are the true questions of musicolinguistics: what cognitive structures are evoked in the listener's mind/brain as she listens to music from the native idiom; what are the unconscious principles in accordance with which the native listener constructs experience based on the music she hears (i.e. what is her musical grammar); how does the native listener acquire a musical grammar based on limited exposure to pieces from the native musical idiom in childhood; what are the physiological resources that the mind/brain utilizes to manipulate these stimuli; finally, how much of musical competence is a consequence of the general cognitive capacity, and how much is specific in cognitive organization. Jackendoff and Lerdahl provide tentative answers to these questions by still resorting to the well-known descriptions of metrical and grouping structures, time-span reductions, and prolongations. Some differences from the original model are visible, though. First, along the line of new approaches to linguistics, mainly optimality theory, preference rules are today largely defined as *constraints*. Second, the "harmonicentricity" of the original model gives way to a much simpler analysis of tonal hierarchy, in principle applicable to some non-western musical idioms as well, however still based on the general psychological importance ascribed to the tonal centre in any pitch system. A new, and interesting, hypothesis on the sense of tonality is found in the explanation offered on why interval relations in most western and non-western musical keys are imperfect: the dominant is not really located in the middle of the scale, but a bit above; half steps are differently ordered in different keys, but always a bit asymmetrically; while fully symmetric whole-step scales are an exception and do not occur in natural musical idioms. The reason for this seems to be the cognitive system's need to perceive the entire key as a Gestalt, to use small systemic imperfections in order to better orient itself in the given tonality at every given moment of perception. The third novelty in the theory is additional importance ascribed to the relative stability of pitches in the melody, earlier described on Schenkerian reductionist principles and generative trees. These are today elaborated in the theory of pitch spaces (TPS, Lerdahl, 2001b), whose purpose is to develop a quantitative model of perception of relative tonal and harmonic relations in native listeners. The analysis of this kind results in interesting parallels between metrical and tonal structures, not present in the original GTTM: melodic tension and relaxation are here also hierarchically represented, which wants a system of unstressed, relatively stressed, and strongly stressed tensions and resolutions, symbolically similarly represented as the metrical structure. Yet, all these changes irrespective, GTTM remains a formidable model of dominance relationships in music perception, whose postulations still need to be empirically tested.

Finally, in the last few years a new tendency in musicolinguistics emerged from the expanding approach to language called optimality theory (hereinafter: OT, Prince and Smolensky, 1993). This theory fully rejects the old generative notion of inflexible binary rules and introduces a 'network-based' approach to creating acceptable ('optimal') forms on all levels of linguistic analysis, most notably in phonology: the surface structure form (called simply 'the output' in OT) emerges as a result of the struggle of potentially conflicting, violable universal constraints. The approach owed a lot to Lerdahl and Jackendoff (Prince and Smolensky, 1993: 2-3), while today the influence in the opposite direction is also acknowledged (Lerdahl, 2001b: 7; Jackendoff and Lerdahl, 2004: 5). In particular, the insistence of GTTM on preference rules provided the room for an introduction of constraint-based approach to the perception of some musical phenomena. In Gilbers and Schreuder (2002), it is proposed that every form of temporal behaviour might be mentally mapped in the same way, which is best seen in the almost identical analysis of metrical phenomena in music and language. Examples from Dutch and the famous A major Mozart sonata show that the notions of segmental and positional markedness, as introduced in OT, closely mimic tonal and metrical hierarchies constrained by GTTM preference rules. In addition, boundary markers, present in some instances of uninterrupted speech, may be explained via constraints imposed on musical phenomena as well. Finally, music analysis seems to be instrumental in explaining rhythmic variability in speech as systematically phonological, rather than superficially phonetic in nature, a matter still regarded as unsettled in the phonological literature. Along the claims of this paper, van der Verf and Hendriks (2004) introduce the notion of constraints into musical grouping as well. Accepting the GTTM claim of generalized Gestalt principles of proximity in the perception of musical groups, these authors first reinterpret GTTM grouping preference rules as OT constraints, and then go on to create a computational model of dissecting short musical sequences into groups in the computer language Prolog. The model was tested on the sample of 10 human subjects, and the results were promising: it turned out that musical parsing could be represented as governed by constraints, that those could be violated, and that they also differed in strength. Optimality theory, therefore, remains a promising tool for further ventures in musicolinguistics.

5 Conclusion

The aim of this paper was to provide an overview of the small but expanding enterprise in cognitive science bordering on linguistics and cognitive psychology of music. I hope to have shown that the ancient music/language analogy is no longer to be interpreted as a poetic metaphor or remnant of prescientific thinking. Rather, it seems that musicality and capacity for language indeed use at least some identical resources in our cognitive system. Disentangling the shared and the separate domains for music and language in the mind/brain will thus be the most important task in musicolinguistics in the future.

References

1. Antović, M., (2004), "Linguistic Semantics as a Vehicle for a Semantics of Music", in Parncutt, R. et al., (eds.), *Proceedings: First Conference on Interdisciplinary Musicology CIM04*, Graz, Austria
2. Bernstein, L., (1976), *The Unanswered Question*, Harvard University Press
3. Besson, M. and Schon, D., (2001), "A Comparison between Language and Music", *Biological Foundations of Music,* Annals of New York Academy of Sciences, pp. 232-258.
4. Bharucha, J., (1994), "Mental Tonal Structures", Proceedings: Third International Conference on Music Perception and Cognition, Liege.
5. Bigand, E., et al., (1996), "Perception of Musical Tension in Short Chord Sequences", *Perception and Psychophysics*, 58, pp. 125-141.
6. Blood, A. and Zatorre, R., (2001), "Intensely Pleasurable Reactions in Music Correlate with Activity in Brain Regions Implicated in Reward and Emotion", *Proc. Natl. Acad. Sci*., USA, 98/20, pp. 11818-11823.
7. Bod, R., (2001), "Probabilistic Grammars for Music", *ILLC*, University of Amsterdam online papers
8. Chomsky, N., (1975), *Reflections on Language*, Pantheon Books, New York
9. Chomsky, N., (1981), *Lectures on Government and Binding*, Foris, Dordrecht
10. Chomsky, N., (1995), *The Minimalist Program*, MIT Press
11. Cooke, D., (1959), *The Language of Music*, Oxford University Press
12. Cross, I., (1997), "Pitch Schemata", in Deliege, I. and Sloboda, J. (eds.), *Perception and Cognition of Music*, Hove: Psychology Press, pp. 357-390.
13. Cross, I., (2001), "Music, Cognition, Culture, and Evolution", *The Biological Foundations of Music*, Annals of New York Academy of Sciences, New York, pp. 28-42.
14. Cuddy, L., (1994), "Tone Distributions in Melody: Influence on Judgments of Salience and Similarity", *Proceedings: Third International Conference on Music Perception and Cognition*, Liege.
15. Darke, G., (2005), "Assessment of Timbre Using Verbal Attributes", *Proceedings, Second Conference on Interdisciplinary Musicology CIM05*, Montreal, Canada

16. de Bellis, M., (1999), "What Is Musical Intuition? Tonal Theory as Cognitive Science", *Philosophical Psychology*, 12(4), pp. 471-482.
17. Deliege, I., (1987), "Grouping Conditions in Listening to Music: an Approach to Lerdahl and Jackendoff's Grouping Preference Rules", *Music Perception*, 4, pp. 325-360.
18. Dempster, D., (1998), "Is There Even a Grammar of Music?", *Musicae Scienciae*, 2/1, pp. 55-65.
19. Deutsch, W. and Beiß, T., (2004), "Singing as a Way to Recover Speech", talk presented at the *First Conference on Interdisciplinary Musicology, CIM04*, Graz, Austria
20. Diletski, M., (1723/1970), *Gramatika muzikalna*, Muzična Ukraina, Kiev
21. Fitch, W., Hauser, M., and Chomsky, N., (in press), "The Evolution of the Language Faculty: Clarifications and Implications", *Cognition*.
22. Focht, I., (1980), *Savremena estetika muzike*, Nolit, Beograd
23. Fodor, J., (1983), *The Modularity of Mind*, MIT Press
24. Gilbers, D. and Schreuder, M., (2002), "Language and Music in Optimality Theory", *Rutdgers Optimality Archive,* ROA 571-0103, http://roa.rutgers.edu
25. Grice, P., (1975), "Logic and Conversation", in Cole, P. and Morgan, J., (eds.), *Syntax and Semantics*, 3: 72-91.
26. Hasty, C., (1997), *Meter as Rhythm*, Oxford University Press
27. Huron, D., (2001), "Is Music an Evolutionary Adaptation?", *The Biological Foundations of Music*, Annals of New York Academy of Sciences, New York, pp. 43-61.
28. Ida, K., (2002), *Structural Analysis of the Musical Piece by GTTM with Extended Prolongational Reduction*, master's thesis, School of Information Science, Japan Institute of Science and Technology
29. Jackendoff, R. and Lerdahl, F., (2004), "The Capacity for Music: What Is It and What's so Special about It?", *Cognition* (in press), http://people.brandeis.edu/~jackendo/MusicCapacity.pdf
30. Jackendoff, R., (1994), *Patterns in the Mind*, Basic Books
31. Jourdain, R., (1997), *Music, the Brain, and Ecstasy*, Bard, Avon Books
32. Keiler, A., (1977), "The Syntax of Prolongation", *In Theory Only*, 3(5): pp. 3-27.
33. Koelsch, S., et al., (2000) "Brain Indices of Music Processing: 'Nonmusicians' Are Musical", *Journal of Cognitive Neuroscience*, 12, 520-541.
34. Koelsch, S., et al., (2004) "Music, Language, and Meaning: Brain Signatures of Semantics Processing", *Nature Neuroscience*, 7(3), pp. 302-307.
35. Krumhansl, K., (1990), *Cognitive Foundations of Musical Pitch*, Oxford University Press
36. Langer, S., (1964/1990), *Problemi umetnosti*, Gradina, Niš
37. Large, E. and Palmer, C., (2002), "Perceiving Temporal Regularity in Music", *Cognitive Science,* 26 (1), pp. 28-44.
38. Large, E., et al., (1995), "Reduced Memory Representations for Music", *Cognitive Science*, 19 (1), pp. 53-96.
39. Lerdahl, F. and Jackendoff, R., (1983), *A Generative Theory of Tonal Music*, MIT Press
40. Lerdahl, F., (2001a), "The Sounds of Poetry Viewed as Music", *The Biological Foundations of Music*, Annals of the New York Academy of Sciences, New York, pp. 337-354.
41. Lerdahl, F., (2001b), *Tonal Pitch Space*, Oxford University Press
42. Lieberman, M., (1975), *The Intonational System of English*, Garland Publishing Inc., New York and London
43. Maess, B., et al., (2001), "Musical Syntax is Processed in Broca's Area: an MEG Study", *Nature Neuroscience*, 4, pp. 540-545.
44. Marr, D., (1982), Vision: a Computational Investigation into the Human Representation and Processing of Visual Information, Henry Holt and Company
45. McAdams, S., (1996), "Audition: Cognitive Psychology of Music", in Llinas, R. and Churchland, P., (eds.), *The Mind-Brain Continuum*, MIT Press, pp. 251-279.
46. McDermott, J. and Hauser, M., (2005), "The Origins of Music: Innateness, Uniqueness, and Evolution", in press, *Music Perception*
47. Mogharbel, C. et al., (2004), "Songs without Words: a Case Study of an Autistic Child", talk presented at the *First Conference on Interdisciplinary Musicology CIM04*, Graz, Austria
48. Narmour, E., (1990), The Analysis and Cognition of Basic Melodic Structures, University of Chicago Press
49. Narmour, E., (1992), The Analysis and Cognition of Melodic Complexity: the Implication/Realization Model, University of Chicago Press
50. Parncutt, R., (1994), "A Perceptual Model of Pulse Salience and Metrical Accent in Musical Rhythms", *Music Perception*, 11, pp. 409-464.
51. Patel, A. and Danielle, J., (2003), "An Empirical Comparison of Rhythm in Language and Music", *Cognition*, 87, pp. B35-B45.
52. Peretz, I. and Hebert, S., (2000), "Toward a Biological Account of Music Experience", *Brain and Cognition*, 42, pp. 131-4.
53. Peretz, I. and Zatorre, R., (2005), *The Cognitive Neuroscience of Music*, Universite de Montreal Press
54. Peretz, I., et al., (1998) "Music and Emotion: Perceptual Determinants, Immediacy, and Isolation after Brain Damage", *Cognition*, 68(2), pp. 111-41.

55. Pinker, S. and Jackendoff, R., (2005), "The Faculty of Language: What's Special about It?", *Cognition*, 95, pp. 201-236.
56. Pinker, S., (1997), *How the Mind Works*, MIT Press
57. Pinker, S., (2002), *The Blank Slate*, Penguin
58. Prince, A. and Smolensky, P. (1993) *Optimality Theory: Constraint Interaction in Generative Grammar*, Rutgers University Centre for Cognitive Science, Technical Report, 2, ROA 537-0802.
59. Raffman, D., (1993), *Language, Music and Mind*, MIT Press
60. Roberts, S., (1996), Interpreting Rhythmic Structures Using Artificial Neural Networks, Ph.D. diss., University of Wales
61. Rogers, N., (2005), "Verbal Labels Affect Memory for Musical Timbre", *Proceedings, Second Conference on Interdisciplinary Musicology CIM05*, Montreal, Canada
62. Rothstein, W., (1989), *Phrase Rhythm in Tonal Music*, Schirmer Books, New York
63. Seeger, C., (1960), "On the Moods of a Musical Logic", *J. of Am. Musicological Society*, 13: pp. 224-261.
64. Selkirk, E., (1982), *The Syntax of Words*, MIT Press
65. Sloboda, J., (1985), *The Musical Mind*, MIT Press
66. Sloboda, J., (2000) *Generative Processes in Music*, Oxford University Press
67. Spitzer, M., (2004), *Metaphor and Musical Thought*, University of Chicago Press
68. Tagg, P., (2005), "Musical Meanings, Classical and Popular: the Case of Anguish", in Natiezz, J.J. (ed.) *Enzicloppedia della Musica*, Torino (in press).
69. Temperley, D., (2001), The Cognition of Basic Musical Structures, MIT Press
70. van der Werf, S. and Hendriks, P., (2004), "A Constraint Based Approach to Grouping in Language and Music", in Parncutt, R. et al., (eds.), *Proceedings: First Conference on Interdisciplinary Musicology CIM04*, Graz, Austria
71. Vaneechoutte, M. and Skoyles, J.R., (1998), "The Memetic Origin of Language: Modern Humans as Musical Primates", *Journal of Memetics online,* 2
72. Wertheimer, M., (1923), "Laws on Organization in Perceptual Forms", in Ellis, W.D., (1938) *A Source Book of Gestalt Psychology,* Routledge, pp. 71-88.
73. Zagorski-Thomas, S., (2005), "Shouting Quietly: Changing Musical Meaning by Changing Timbre with Recording Technology", *Proceedings, Second Conference on Interdisciplinary Musicology CIM05*, Montreal, Canada
74. Zatorre, R. et al., (2002), "Structure and Function of Auditory Cortex: Music and Speech", *Trends in Cognitive Sciences,* 6/1, pp. 37-46.
75. Zbikowski, L., (1998), "Metaphor and Music Theory: Reflections from Cognitive Science", *Music Theory Online*, 4,1

MUZIKOLINGVISTIKA – OD NEOLOGIZMA DO PRIZNATE DISCIPLINE

Mihailo Antović

Cilj ovoga rada je da ponudi pregled sve razvijenije multidisciplinarne grane kognitivnih nauka u kojoj se preklapaju oblast psihologije muzike i kognitivne / generativne lingvistike. Ova naučna oblast, ponegde poznata kao 'muzikolingvistika', pokušava da opiše više fenomena u percepciji muzike pomoću lingvističkog epistemološkog okvira i metodološkog aparata. U diskusiji se najpre govori o prethodnicima ove discipline, iz ranijih teorijsko-muzičkih, estetičkih i psiholoških škola, poput Šenkera, Kuka ili Langer. Tekst zatim daje pregled istraživanja svojstava zajedničkih jeziku i muzici iz perioda čomskijanske revolucije kraja dvadesetog veka. Analiziraju se pristupi Bernštajna, Kajlera, Lerdala i Džekendofa, a zatim se iznose podaci o pokušajima empirijske provere – psihološkim i neurofiziološkim. Završno poglavlje rada usmerava se ka današnjim dilemama u ovoj oblasti, gde se još jednom ističe pitanje bioloških osnova muzike i jezika. Zaključak ukazuje na moguće pomirenje u okviru novog pristupa u kognitivnim naukama jednako primenljivog na jezik i muziku – teorije optimalnosti.

Ključne reči: *muzika, jezik, muzikologija, lingvistika, kognicija*