A Linguistic Approach to the Syntax of Early Music: Representation of the Hexachord System by X-Bar Method as an Excavation Tool

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Abstract. In their pioneering Generative Theory of Tonal Music (1983, 'GTTM'), Lerdahl and Jackendoff attempted to apply Chomsky's Transformational Generative Theory method to music, with the aim of explaining the musical structures as a language. Their insight has been further developed by Katz and Pesetsky's "Identity Thesis" within the framework of the Minimalist Program of linguistics. While those studies are concerned with the "common practice" period in music, the aim of the present study is to point out that while GTTM and Identity Thesis are genuine approaches to music in tonal tradition, they do not address the issue of early periods (pre-tonal period). To answer this question, this study uses Generative Theory's X-Bar approach to analyze "early music" repertoires and associate it with Foucault's archaeological approach to the historical documents. It proposes hierarchical relationships within the intervals of hexachord system as an approach to the theory of early music and applies its output to the "Annus Novus versus" of Aquitanian Polyphony.

Keywords: Archaeology of knowledge · Linguistics · Generative theory · X-Bar · Early music · Hexachord system · Gamut · Deep structure · Surface structure

1 The Problems, Background and Method

Was there any period in history when music had been treated as a language? Could there be any continuity in music as a natural substitution of language as interdependent relationships with their features and constituents? This study investigates to find evidence in the light of the studies of musicology and to answer these questions in Modal Period of Early Music by representing them within the Generative approach in linguistics. Finally, it calls this synthesis an excavation tool to collaborate with Foucault's approach in the "Archaeology of Knowledge".

In order to find out a consistent evaluation scheme for the early music, there have been numerous endeavors for decades. In this respect, the studies which came down to us by Treitler and Fuller have been lightening the trajectories of the duration of the medieval music, while they were contemplating about the term to transform the

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paradigm to a progressive level. Accordingly, Margaret Bent criticizes the anachronistic approaches of "presentist" scholars and encourages those people who may make studies which may be able to analyze the individual pieces of the term in an analytical manner in line with Lerdahl and Jackendoff's GTTM [1: 23].

So GTTM still expects the value it deserves, one case of which is the recent study of Pesetsky and Katz, which, as in the verbal realm, seems to bring about sufficient answers to these needs which have kept the hopes of the researchers alive [2]. However, Cohen draws the boundaries of this realm; "… the systematic borrowing of grammatical terms in the Middle Ages, beginning with the Carolingians, was of crucial importance for the history of western music theory. Grammatical discussions of such matters as the nature of the voice, the elements of language, the articulation of a text by means of punctuation and pauses, the correct rendering of verbal accents and syllabic quantities, and the correct writing of the graphic symbols for accents provided the Carolingian cantors with a variety of terms and verbal strategies for the description of melodic events" [3: 314].

Finally, while Harold Powers revealed that "Given my present belief in the much greater range of variability as to both order and kind of complexity in the world's musics versus the world's languages, I can hardly imagine how a model developed really satisfactorily for the detailed structural explanation of one musical language is so easily to be modified to another, and all the more so if the original model be evolved from linguistics rather than from the musical disciplines" [4: 48][1]. Blair Sullivan claims that early grammar studies in the Carolingian Era projected their own characteristics into musical structures and he states his aims in his work; "The investigation is conducted in two fundamental intellectual terrains: grammatical theory and harmonic theory, …. A large collection of treatises has been read with a single purpose: the location of materials pertaining to the written representation of sound and the exploration and comparison of the underlying assumptions that produced Greek pitch notation and neumatic systems" [5: viii].

1.1 Traces of Word Segmentation and Phonologic Analogy

7By the time of the first political unity of Europe under Charlemagne (who paid special attention to cultural and educational organizations in his famous palace school Aix-La-Chapel), the most important art in the traditional seven arts of the medieval period was grammar. These studies, organized under Alcuin, an influential scholar of the period, offered his successors what could be considered the musical counterparts of the essentials of language to music. For highlighting these endeavors, Sullivan's dissertation is especially important. In his dissertation, Sullivan refers these studies as "A tightly woven net of circumstances-music historical, socio linguistic, and socio-political direct the focus of the investigation toward the Carolingian culture and writers such as Hrabanus Maurus, Alcuin, Johannes Scottus, Aurelian of Reome, Hildemar of Corbie,

[1] Same quotation takes place in [1]. The citation is taken from the original source.

Hucbald of St.-Amand, Regino of Prum, Remigius of Auxerre, and the theorists of Musica enchiriadis, Scolica enchiriadis, and Commemoratio brevis" [5: ix].

In this study, we will refer to two principles which show the strong linguistic characteristics of medieval music. The first one of the principles is the Frankish treatise of early medieval music presented by Sullivan that refers to Peter Wagner's "Un piccolo trattato sul canto ecclesiastico in un manuscritto del secolo X XI" and indicates the phonologic background:

Principal 1 (Phonologic Analogy). "What is chant (song)? It is skill in the musical art, inflection of the voice, and melody…. Its source and composition are revealed by the accentuations of tone and the metric patterns of syllables. Indeed, it is described by acute, grave, and circumflex accentuations of tone…. The musical note known as neuma originated from the accentual patterns of the tones" [5: 103].

The second principle indicates the syntactical analogy which Sullivan refers to as Aurelian's Musica Disciplina.

Principal 2 (Word Segmentation). "The tone is the basic element of music, in addition to being a rule, just as the basic element of grammar is the letter and the basic arithmetical element the unit. In the same way that speech arises from and is guided by letters, and that large numbers arise from and are guided by units, so every melody is governed by the limits of its sounds and its tones" [5: 34].

These are the essential principles of our study. After describing the X-Bar method and Excavation approach, by using the X-Bar method of Generative theory, we will demonstrate that we can use an analytical tool which we develop through this study to parse and analyze to the individual scores of the manuscripts in the medieval era. We consider this technique as an excavation into Foucault's approach.

1.2 X-Bar Method[2]

In 1970, Chomsky introduced to first appearances of the X-Bar method to the linguistics discipline with his "Remarks on Nominalization" [6]. The system he developed was to become the main analytical representation tool of the Generative theory in the following years. In this study, Chomsky discusses how a nominalization process works in our minds with respect to two categorizations: Gerundive nominals and derived nominals. In the study he gives forty examples to analyze their transformations. He also specifies the representational levels of his approach: "Deep Structure" and "Surface Structure". "The context-free grammar generates phrase-markers, with a dummy symbol as one of the terminal elements. A general principle of lexical insertion permits lexical entries to replace the dummy symbol in ways determined by their feature content. The formal object constructed in this way is a deep structure. The grammar contains a system of transformations, each of which maps phrase-markers. Application of a sequence of transformations to a deep structure, in accordance with certain universal conditions and certain particular constraints of the grammar in question,

[2] Many special thanks to A. Sumru Özsoy who has helped me to understand the compelling topics in Generative Theory.

determines ultimately a phrase-marker which we call surface structure" [6: 12]. On the other hand, we can present the introductory description of the X-Bar Method as "In generative syntax …, X-bar theory is the module of the grammar that regulates constituent structure. It aims at characterizing a possible syntactic configuration. In interaction with the other principles of the grammar, X-bar theory determines structural representations" [7].

The present study uses the X-Bar method of the Generative Theory and applies it to Foucault's Archaeological approach as an excavation tool. At this point, one of the main differences needs to be emphasized; when Chomsky says that "I will assume that a grammar contains a base consisting of a categorical component (which I will assume to be a context free grammar) and a lexicon. The lexicon consists of lexical entries, each of which is a system of specified features" [6: 12], he points out two properties of the language competence: categorical components and lexicon. However, Katz and Pesetsky emphasize the differences and also similarities of music and language, "… language, unlike music, makes use of a lexicon. So many other details of music and linguistic structure will turn out to be identical that the two domains might quite reasonably be viewed as products of a single cognitive system" [2: 2]. Accordingly, in the light of this evidence, the properties of music and language are identical, although the lexical properties of the language are locked out in music. In this paper, we propose a new phrase-markers tool which consists of intervals of the music as the deep structures which generate the individual surface structures of the musical phrases. The main justification of the intervallic deep structures takes its essentials from Patel's observation. In his relatively recent study, Patel has given musicology new insights about the cognitive properties of music. Patel divides the pitch intervals to four categories [8], and especially with respect to the categorical perception he points out their identification and distinction. "CP (categorical perception) refers to two related phenomena. First, sounds that lie along a physical continuum are perceived as belonging to distinct categories, rather than gradually changing from one category to another. Second, sounds of a given degree of physical difference are much easier to discriminate if they straddle a category boundary than if they fall within the same category. CP is thus studied using both identification and discrimination tasks" [8: 24]. In the same section, Patel alerts the interested scholars, to how music may be related to the realm of neuroscience; "The question of interest is if the size of the MMN [9] simply grows linearly with frequency difference, or if there is a jump in MMN size as the interval crosses into a new category. If so, this would be neural evidence that pitch intervals were acting as sound categories in perception" [8: 28].

When we exclude the lexical properties of language from the representation process of Generative theory, those representational tools of categorical components of language as Noun Phrase (NP), Verb Phrase (VP), Adjective Phrase (AdjP) etc. could be replaced with the new categories in our study: Diapason Phrase (DpasP), Diatesseron Phrase (DtesP), Diapente Phrase (DpenP) etc. Finally, we represent our categories with the five essential structural relations of Generative theory: Daughter, Sister, Adjunct, Complement and Specifier relationships.

Daughter. If one node is immediately dominated by another node, it is the daughter of that dominating node. Determiner Phrase (DP) and Determiner (D') that are the first binary branches of maximal projection DP are also its daughters in Fig. 1).

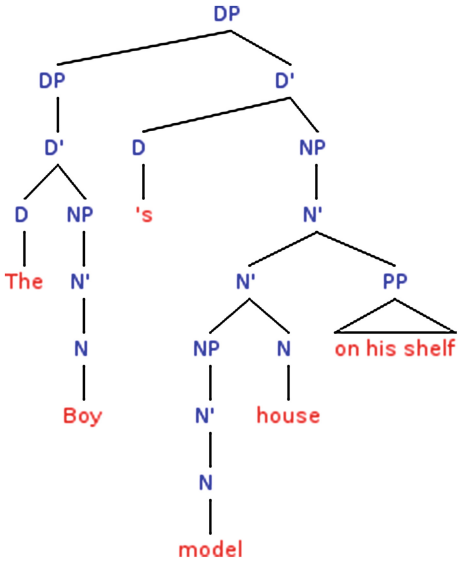

Fig. 1. Daughter relation

Sister. If two components are adjacent to each other, it is a sister relationship. The nodes which are denoted in the rectangle are sister relationships in Fig. 2.

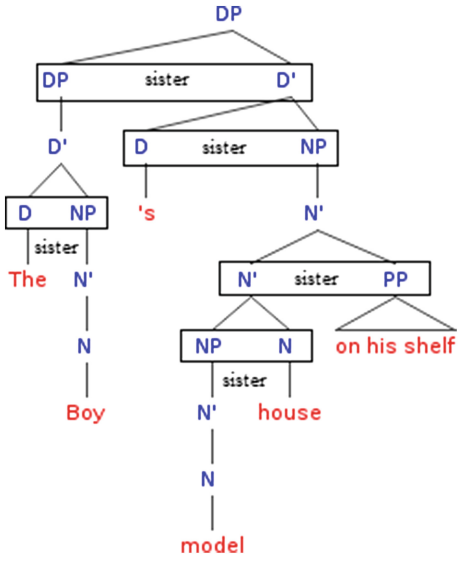

Fig. 2. Sister relation

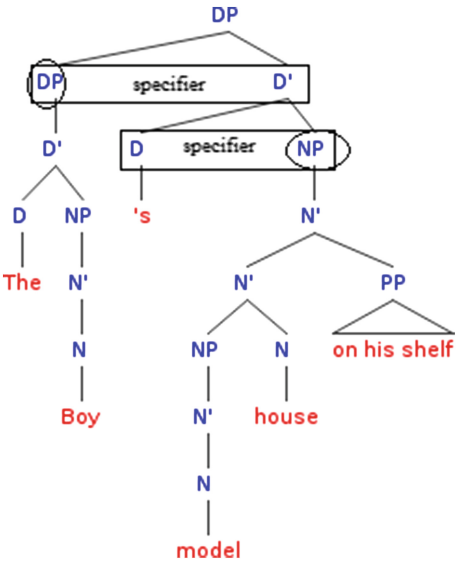

Fig. 3. Specifier relation

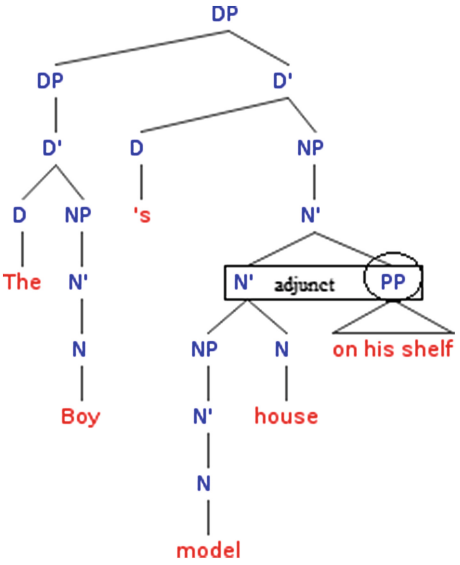

Fig. 4. Adjunct relation

Specifier. It is a "Sister to X', daughter of XP" [10: 186]. In this sense, DP is a specifier (Spec) position of first DP and NP is the second specifier of maximal projection, DP in Fig. 3.

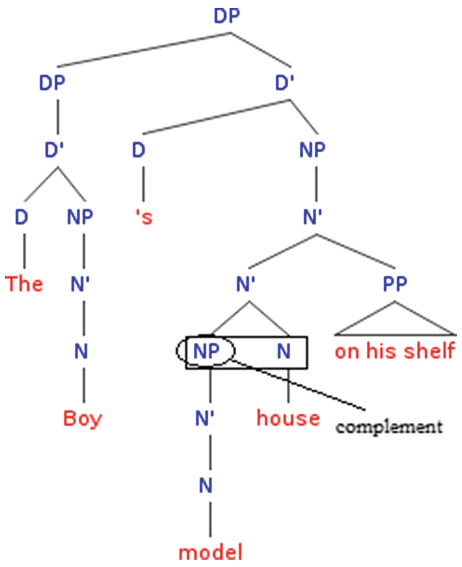

Fig. 5. Complement relation

Adjunct. If one XP is adjacent to a bar node (at the right or left of the bar) and is the daughter of another bar node, it is an adjunct relationship. In verbal, when we consider "on his shelf" part, it is an adjunct of the NP.

Complement. If one XP is adjacent to a head level, it has a complement relationship. Verbally, when we consider "model house", first noun "model" is a complement of the head of NP.

In the description process of five functions, we used the linguistic representation. At the end of this study, we will examine these functions with the musical segmentations.

1.3 Archealogic Approach

In his Archaeology of Knowledge, Foucault describes his approach to the episteme; "By episteme, we mean, in fact, the total set of relations that unite, at a given period, the discursive practices that give rise to epistemological figures, sciences, and possibly formalized systems; the way in which, in each of these discursive formations, the transitions to epistemologization, scientificity, and formalization are situated and operate; the distribution of these thresholds, which may coincide, be subordinated to one another, or be separated by shifts in time; the lateral relations that may exist between epistemological figures or sciences in so far as they belong to neighboring, but distinct, discursive practices" [11: 191].

The present study extends the boundaries of the archeological approach to the individual music pieces and collaborates its analysis to the various recursive musical figures. In this sense, through the analysis of this study's approach, we will present the epistemological figures–such as melismas, differentiae, tonaries, psalm tones, modes

etc. - which have discursive characteristics but are also recursive. And at a given period - 12th century, 13th century etc. - we will try to understand what are the total set of relations – common properties of the corpus or collections - that unite those characteristics, for example consonance-dissonance treatment, sequences of the intervals, rhythmic properties, transformations of note against note treatment, etc. By this analysis, we see the transformations of a simple structure to conceptualization of that structure (e.g. which period call the some recursive structures from piece to piece) as 1st species that once upon a time were called simply organum style, when a simple recursive feature began to be called "directed progression", "cadence", or "occursus" and what were their origins unintentionally or without any conceptualizations took place in the pieces etc. We hope this analytical system will bring the formal units of music a new perspective as referred to in Foucault's "Recurrent redistribution", "Recurrent redistributions reveal several pasts, several forms of connection, several hierarchies of importance, several networks of determination, several teleologies, for one and the same science, as its present undergoes change: thus historical descriptions are necessarily ordered by the present state of knowledge, they increase with every transformation and never cease, in turn, to break with themselves…" [11: 5].

After all, this system that develops a mathematical model locks out all the speculative tradition for the term for a while, but then after some analytical organization to the early music pieces, it will apply syntactic organization as the provider of their grammaticality at a given period and it will detect transformations of their grammaticality between three discontinuities and two continuities placed between them. We apply the terms Discontinuity and Continuity concepts of Foucault to the external phrases in our approach. In Foucault's words, "… the notion of discontinuity assumes a major role in the historical disciplines. For history in its classical form, the discontinuous was both the given and the unthinkable: the raw material of history, which presented itself in the form of dispersed events - decisions, accidents, initiatives, discoveries; the material, which, through analysis, had to be rearranged, reduced, effaced in order to reveal the continuity of events" [11: 8]. Consequently, we hope to hear a voice crying in the wilderness in the ruins of the ancients by these methods of present study.

2 Practical Aspects

In this part, we will demonstrate the two principles of phonological and syntactical analogies which refer to sentences represented in Sullivan's dissertation. However, before further investigation, we will clarify three concepts: Phrase, Bar and Head, used in X-Bar method. In order to understand their differences in musical meanings, we will clarify some complexities about the conceptualizations which coincide with the concepts of music discipline with the linguistics.

Phrase (Music). "A term adopted from linguistic syntax and used for short musical units of various lengths; a phrase is generally regarded as longer than a Motif but shorter than a Period. It carries a melodic connotation, insofar as the term 'phrasing' is usually applied to the subdivision of a melodic line. As a formal unit, however, it must be considered in its polyphonic entirety, like 'period', 'sentence' and even 'theme'" [12].

Phrase (Linguistics). "The term Phrase is used to mean simply a set of elements which form the constituent, with no restriction on the number of elements that the set may or must contain" [13: 85].

Bar (Music). "A line drawn vertically through a staff or staves of musical notation, normally indicating division into metrical units (of two, three, four beats, etc.); now also the name for the metrical unit itself, the line being commonly called a 'bar-line'. American usage, however, normally reserves the term 'bar' for the line itself, describing the metrical unit as a 'measure'" [14].

Bar (Linguistics). "A Bar in linguistics is an intermediate projection between phrase and head nodes" [10: 186].

Head (Music). The head concept for the music was used first time in the GTTM. While its description gives cue to the problems what about the phrase-markers which generate those heads, it is important it stimulates such questions. Although, there is no literal description of the head in GTTM, we understand from a lots of example of which it proceeds, it is the "… a single event is chosen as the most important event…" [15: 120].

In our study, the head is a music unit indicated by interval phrases, and described as word initials and word endings by the way of the segmentation principles which we describe them in the present study.

Head (Linguistics). "The word that gives its category to the phrase" [10: 186]. Now, we will see the main categories of the practical aspects. They include four parts: External Phrases, Hexachordal Features as the Phonological Analogy, Internal Phrases and Textural Segmentations.

2.1 External Phrases (Maximals)

An external phrase is not placed in the realization of musical pieces, however as the main projections, they direct the cognitive properties of the performers as the deep structures. They are;

Time Phrase (TP). As a maximal projection, TP dominates all the branches as the feeling of the beats in a bar. The bar concept is used in the sense of X-Bar method rather than notation of music. Feeling can change from one point to the other, and these cognitive transformations in the feelings of the performers indicate the place of the piece in time. Accordingly, in a study which published in 2009 could be strong supporter of this approach "We show that newborn infants develop expectation for the onset of the rhythmic cycles (the downbeat), even when it is not marked by stress or other distinguishing spectral features. Omitting the downbeat elicits brain activity associated with violating sensory expectation. Thus, our results strongly support the view that beat perception is innate" [16].

Discontinuity Phrase (DiscP). Discontinuity is a major event in the piece (e.g. beginning of the sentences, transformation of the modes). It takes its source from Foucault's Archaeological approach. DiscP is usually placed in specifier position (Spec) of the TP. It means the beginning of the piece by a DiscP gives first impressions

of the beats which direct the perceptual trajectories of following constituents. Because of this fact, it has a special importance. On the other hand, as an external phrase DiscP is not placed on the realization of the music; however it is specified by first Dpas1s and Dpas1s subordinated constituents under its head. This fact gives a cue that the "Spec CP" position in Generative Linguistic can functionally be applied to the present music representation and analysis system. In the future studies, we assume that the Byzantine Octoechos and Intonational formulas, psalm tones of the medieval music could be able to have strong relationships to perceive music of the medieval peoples which specify the direction of the music perception. We expect to associate them to Spec MCP (Specifier Music Clause Position).

Continuity Phrase (ConP). The time span which extends from first DiscP to the last one in the ConP Region. It takes as its source Foucault's Archaeological approach. ConP is the complement of TP. It means the rhythmic determination specified by DiscP in the TP is tried to be constant through the ConP. However, unless a metronome indicates what a certain tempo is, it is almost impossible staying consistently in the certain tempo marker. Accordingly, the Dpas1s specify these slight tempo transformations through the ConP region. Therefore, the first Dpas1 is Spec position in the region[3] except for last Dpas1 which is the starting dyad of the ConP and it is functioned as the complement of the ConP. And the Dpas1s which places between Spec MCP and complement of the ConP are adjunct to ConP. Finally, in the representation process, *Hierarchically Dpas5, Dpas4, Dpen1, Dpen5, Dpen4 and Dtes1, Dtes5 and Dtes4 are adjunct to Dpas1. All other intervals are complement of aforementioned intervals and complements with each other.* The last underlined sentence will be called as the hierarchical formula through the study.

DiscP Region. It is the boundaries of the Specifier Music Clause Phrases (Spec MCP) position from first Dpas1 to second Dpas1 (from left to right in DiscP Region). Its features are head initial. The hierarchical formula is also valid for this maximal.

ConP Region. It is the boundaries of the Spec MCP position from first Dpas1 to last Dpas1 in ConP (from right to left in ConP Region). Its features are head final. The hierarchical formula is also valid for this maximal.

2.2 Hexachordal Features as the Phonologic Analogy[4]

The features which are explained in this part stem from the order of the Hexachord system. They are;

Realm. Indicates where the individual notes take place as Grave, Acutae and Super Acutae in the hexachord system.

Loca. Denotes the particular point of an individual realm in the Loca. For example G is the 8th point of the Grave realm.

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[3] In future studies, we will assume that "differentia" parts of the medieval music could be associated by this conceptualization.

[4] [17] is a well-organized website to basic knowledge for hexachord system.

Syllables. Indicates the Ut, Re, Mi, Fa, Sol and La notes. Their successive intervallic characteristics collaborate with Loca points and transform them.

Deductio. The cluster of the syllables as Hard, Natural and Soft.

Phonologic Relationship. In phonology, we see two main categories: Consonant and Vowels. Consonants are represented by three features - manner, place and voice, and vowels are represented by two features - monophthongs and diphthongs. Consonants' three features have some sub features as the following; Manner sub features are stop, fricative, affricate, nasal, liquid, glide; Place sub features are bilabial, labiodentals, lingua-dental, lingua-alveolar, lingua-palatal, lingua-velar, glottal and Voice sub features are voiced and voiceless. When we observe the vowel subcategories, a monophthong has three sub features as front, central and back and diphthongs has only one feature. Table 1 represents these characteristics.

Table 1. Phonologic features

Consonances			Vowels	
Manner	Place	Voice	Monophthongs	Diphthongs
stop	bilabial	Voiced	Front	Diphthongs has only one feature
fricative	labiodentals	Voiceless	Central	
affricate	lingua-dental		Back	
nasal	lingua-alveolar			
liquid	lingua-palatal			
glide	lingua-velar			
	glottal			

Since we do not need to further investigate why the features of the hexachordal system are completely different, we will not give examples of the representation of these phonological features. What we try to denote is to show the analogies of parsed hexachord system to these distinctive features of the phonetic properties that humans can produce. For further investigation, [18] is a well-organized website to study these features.

Referring to Katamba's explanation regarding the generative approach's interpretation of distinctive features, he states that "Chomsky and Halle (1968) in their book The Sound Pattern of English (henceforth SPE) proposed a major revision of the theory of distinctive features. They replaced acoustically-defined phonological features with a set of features that have, in most cases, articulatory correlates. Furthermore, the number of features was also substantially increased. … SPE features remain binary. They have only two coefficients or values, plus (+) indicating the presence of a feature and minus (—) its absence, so that, for example, among other things, a sound like [p] is said to be [—voice] and [— nasal] while [m] is [+voice] and [+nasal]" [19: 42]. In the following section, representation of the present study's hexachord system collaborates its own features (represented in the preceding part) as an analogy to that of the generative approach.

Hexachord System and Features of Deductios. By synthesizing the Musica Enchiriadis, Musica Scholarum, and Alia Musica compilations, Benedictine monk Guido Arezzo devised a new analytical system for music in the beginning of the 11th century.

In Guido D'Arezzo's approach, three components have the main functional categories in the system: Syllables, Loca and Deductios.

In the Table 2, it presents the all the individual notes unique features. The brackets are organized in the following order;

Table 2. Hexachordal features

GENERATIONS OF THE DEDUCTIOS (FEATURES)				
LOCA	**Feature1**	**Feature2**	**Feature3**	**Notes**
e'	[+Sac, +e', +la, +Hard]	[+Sac, +e', +mi, +Nat]		E5
d'	[+Sac, +d', +sol, +Hard]	[+Sac, +d', +re, +Nat]	[+Sac, +d', +la, +Soft]	D5
c'	[+Sac, +c', +fa, +Hard]	[+Sac, +c', +do, +Nat]	[+Sac, +c', +sol, +Soft]	C5
b'	[+Sac, +b', +mi, +Hard]	[+Sac, +b', +fa, +Soft]		B4
a'	[+Sac, +a', +re, +Hard]	[+Sac, +a', +la, +Nat]	[+Sac, +a', +mi, +Soft]	A4
g	[+Ac, +g, +do, +Hard]	[+Ac, +g, +sol, +Nat]	[+Ac, +g, +re, +Soft]	G4
f	[+Ac, +f, +fa, +Nat]	[+Ac, +f, +do, +Soft]		F4
e	[+Ac, +e, +la, +Hard]	[+Ac, +e, +mi, +Nat]		E4
d	[+Ac, +d, +sol, +Hard]	[+Ac, +d, +re, +Nat]	[+Ac, +d, +la, +Soft]	D4
c	[+Ac, +c, +fa, +Hard]	[+Ac, +c, +do, +Nat]	[+Ac, +c, +sol, +Soft]	C4
b	[+Ac, +b, +mi, +Hard]	[+Ac, +b, +fa, +Soft]		B3
a	[+Ac, +a, +re, +Hard]	[+Ac, +a, +la, +Nat]	[+Ac, +a, +mi, +Soft]	A3
G	[+Gr, +g, +do, +Hard]	[+Gr, +G, +sol, +Nat]	[+Gr, +G, +re, +Soft]	G3
F	[+Gr, +F, +fa, +Nat]	[+Gr, +F, +do, +Soft]		F3
E	[+Gr, +E, +la, +Hard]	[+Gr, +E, +mi, +Nat]		E3
D	[+Gr, +D, +sol, +Hard]	[+Gr, +D, +re, +Nat]		D3
C	[+Gr, +C, +fa, +Hard]	[+Gr, +C, +do, +Nat]		C3
B	[+Gr, +B, +mi, +Hard]			B2
A	[+Gr, +A, +re, +Hard]			A2
I	[+Gr, +G, +do, +Hard]			G2

[Realm, Loca, Syllables, Deductio]. On the left side the locas denote the places of the syllables. Some locas take one, two or three syllables depending on which deduction they belong to. Dark grey highlights show the hard deductios, grey natural and light grey soft deductios. For example, the "d" loca refers to three distinct syllables which belong to hard, natural and soft deductios. At the most right it denotes the places of modern notational system.

2.3 Internal Phrases (Step and Interval Hierarchy)

These are the intervallic features which are also deep structures. They are associated with divine origins, according to the Pythagorean Tradition of The Harmony of the Spheres and are doctrinized by those conceptualizations of Musica Mundane, Musica

Humana and Musica Instrumentalis as Macrocosms and Microcosms by, 6th century scholar Boethius. Now, we will see their hierarchies:

Step Hierarchy. The Direction Phrase (DirP) which shows the linear and vertical ways of the lines is the maximal projection. Step Hierarchies are dominated by linear ways which we call Melody Phrase (MelP)[5] and it c-commands the Vertical Phrase (VerP) of the Intervals. The"-"means step.

1-P. Indicates the 1st step of the modes and depending on the modes its first step takes those notes respectively: D, A, E, B, F, C, G, D. The first step of the modes therefore specifies the other steps' numerical characters which is the most important step.

5-P. The second most important step which has transformative character depending on the first note.

4-P. In the third order of the hierarchy tree and it has a transformative character depends on the first note of the mode.

DPP. (Directed Progression Phrase) takes its essential from Fuller's [20]. It consists of 3-P and 6-P. These steps are evaluated under this phrase in order to provide consistency to the binary system of the X-Bar Method. DPP is a non-head phrase as an exocentric construction (Fig. 6).

3-P. Immediately dominated by 4-P and also occurs preceding step phrase. It has transformative character depends on the first note of the mode.

6-P. The sister of the 3-P and shares the same features as 3-P.

DisP. DisP takes its essence from the steps in question are evaluated as the main dissonance steps in music theory. It is evaluated under this phrase since it provides consistency to binary system of the X-Bar Method. DisP is non-head phrase as an exocentric construction.

2-P. Dominated by 3-P and it c-commands the 7-P. It has a transformative character dependent on the first step of the mode.

7-P. Dominated by 6-P and it c-commands the 2-P, It also has a transformative character dependent on the first step of the mode it belongs to.

Interval Hierarchy. Interval Hierarchies belong to VerP and are dominated by LinP and c-commanded by every individual step, but do not c-command the LinP and its sub-branches;

Dpas (P1st and P8th). The most important interval by the words of Marsilio Ficino "The Ratio 2 to 1… fills the ears with wonderful pleasure by means of octave" [21: 165]. It dominates all the intervals.

Dpen (P5th). Dpen is the second important interval in the medieval period together with Dtes. They are dominated by Dpas and dominate the rest of the intervals.

[5] Many thanks to Professor A. Sumru Özsoy who suggested this for representation.

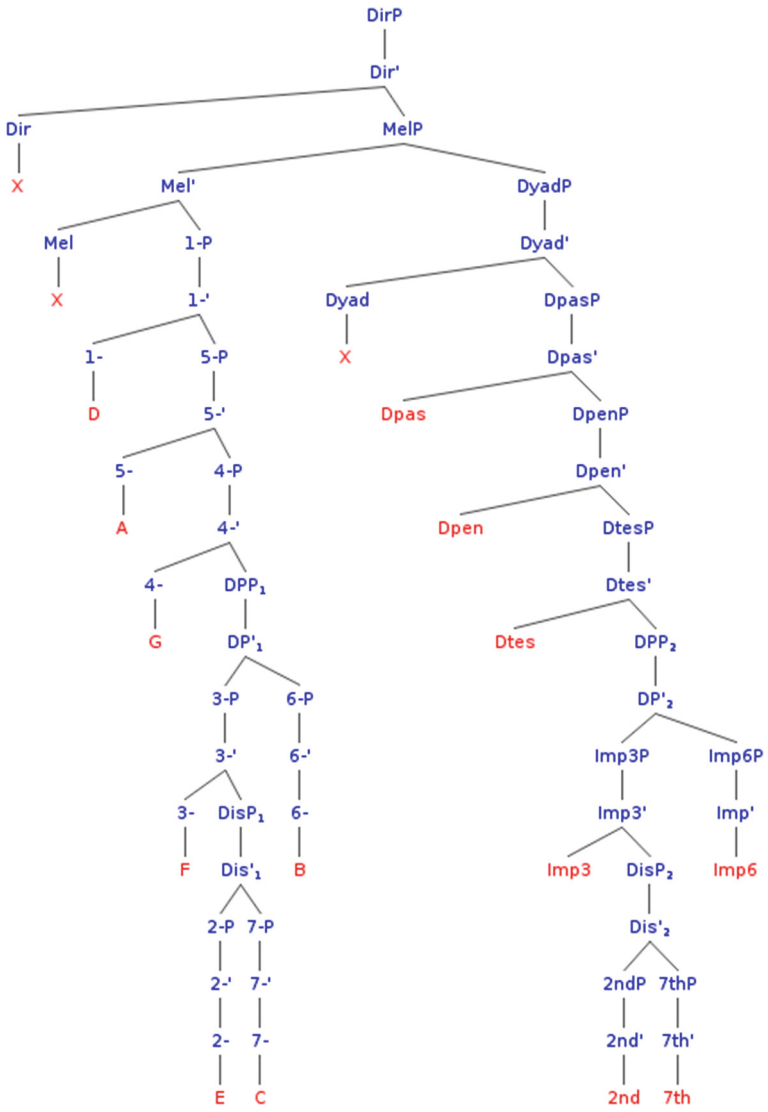


Fig. 6. Step and interval hierarchy

Dtes (P4th). Dominated by DpenP, DpasP and DpenP immediately dominates the DtesP and respectively dominate the rest of the intervals.

DPP. (Directed Progression Phrase), As in DPP in the section of the step hierarchy, this takes its essential from Fuller's [30]. It consists of 3-P and 6-P. These intervals are evaluated under this phrase in order to provide consistency to binary system of the X-Bar Method. DPP is a non-head phrase as an exocentric construction.

Imp3 (m3 and M3). Intervals of the Imp3 are sisters of the intervals of the Imp6P. They are immediately dominated by DtesP. Imp3P and Imp6P mutually c-command to each other's domains.

Imp6 (m6 and M6). Intervals of the Imp6 are sister of the intervals of the Imp3P. They are immediately dominated by DtesP. Imp6P and Imp3P are mutually c-commands to each other.

DisP. As in DisP in step hierarchy section, takes its essential from the steps in question which are evaluated as the main dissonance steps. They are evaluated under this phrase in order to conform to the binary system of the X-Bar Method. DisP is non-head phrase as an exocentric construction.

Second (m2 and M2). Regarded as dissonances. They are immediately dominated by Imperfect sonorities and respectively c-command each other's domains.

Seventh (m7 and M7). Regarded as dissonances and they are immediately dominated by Imperfect sonorities and respectively c-commanded by DpasP, DpenP and DtesP.

Second (m2 and M2). Regarded as dissonances. They are immediately dominated by Imperfect sonorities.

Seventh (m7 and M7). Regarded as dissonances and they are immediately dominated by Imperfect sonorities.

Diabolus in Musica (DMP). The interval not used in chant repertoires, therefore not represented in the tree, and even if rarely used, includes the detailed treatment in the counterpoint of the discantus. It is placed in the lowest part of the hierarchy.

2.4 Textural Structures and Segmentation Principles

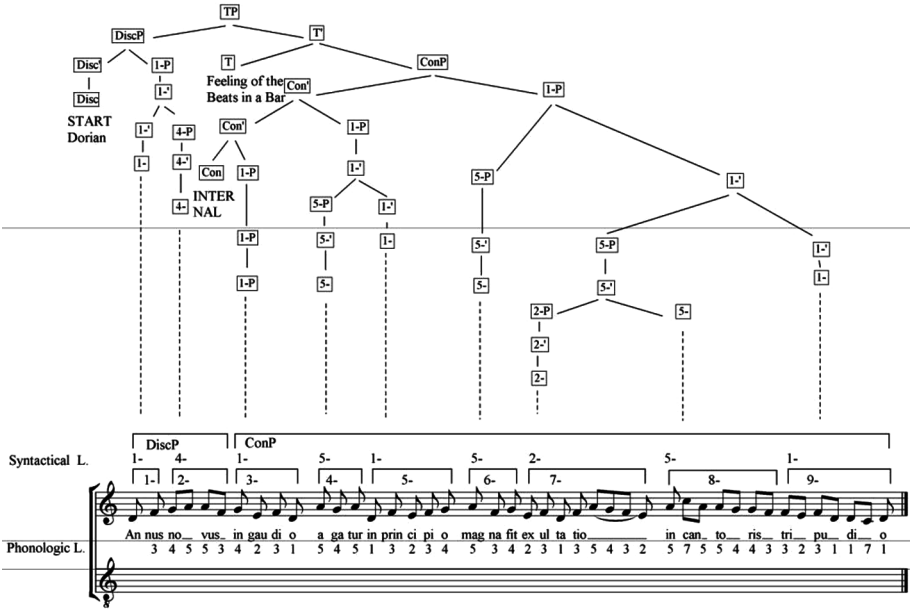
There are three species of textural segmentation processes: Monorhythmic (MRS), Homorhythmic (HRS) and Florid (FS). And there are two levels of each of the segmentations: Phonologic Level (PL) and Syntactical Level (SL).

Monorhythmic Segmentation (MRS). MRS is analyzed in the two levels PL and SL.

PL. PL level of MRS is determined by word boundaries of the relevant text and all articles, prepositions, and conjunctions are evaluated in the following words they belong to. The intervallic characters of every step (this is the only differences between MRS and HRS analysis) indicate the prosodic accentuations.

SL. SLS level of the MRS is determined by the steps which specify the beginning and ending of the words. Depending on the step hierarchy, the dominant step gives its own name to the segmentation. At this point, we need to say that since close interdependency exists between intervals and steps, the hierarchical formula which takes its essential from intervals is considered in line with steps in MRS. Accordingly, the hierarchical formula (Henceforth, "I-Formula" Interval Formula) *Hierarchically*

Dpas5, Dpas4, Dpen1, Dpen5, Dpen4 and Dtes1, Dtes5 and Dtes4 are adjunct to Dpas1. All other intervals are complement of aforementioned intervals and complements with each other is changed by that principle as we call "S-Formula" (Step Formula). *Hierarchically 5th, 4th, adjunct to 1st, All other steps (2nd, 3rd, #4th, 6th and 7th) are complement of aforementioned intervals and complements with each other* (Score 1).

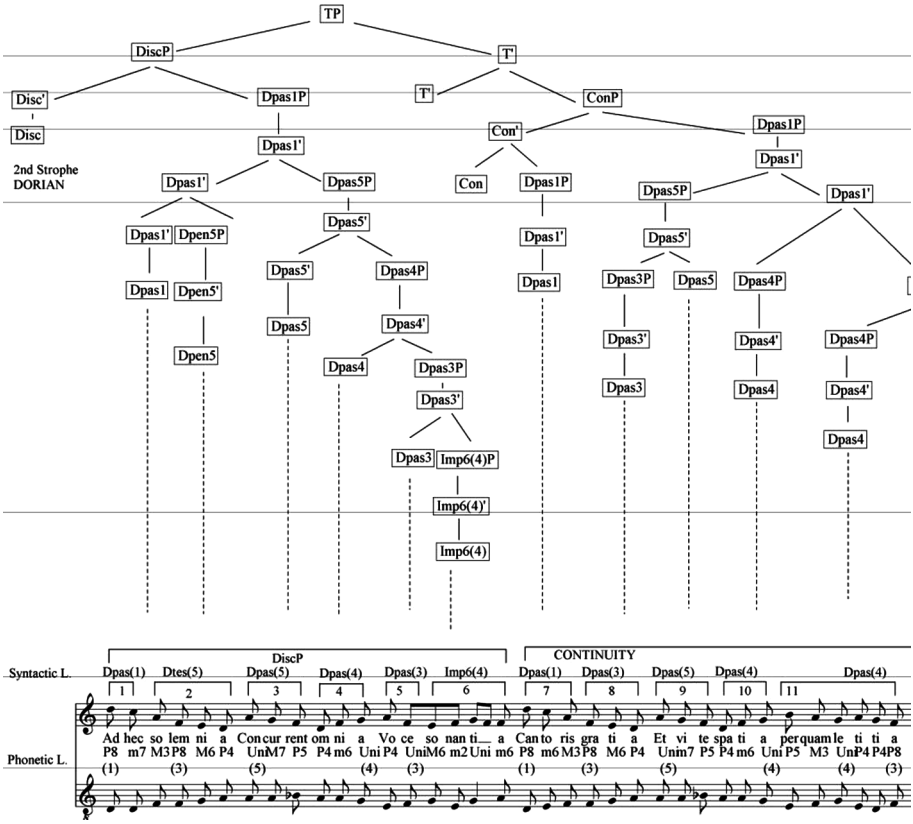


Score 1. Monorhythmic segmentation

Homorhythmic Segmentation (HRS). HRS is analyzed in the two levels PL and SL.

PL. PL level of the HRS is determined by simply word boundaries of the relevant text and all the articles, prepositions, and conjunctions are evaluated in the following words they belong to. The intervallic characters of the every dyad indicate the prosodic accentuations.

SL. SL level of the HRS is determined by the intervals which specify the beginning and ending of the words. And depends on the intervallic hierarchy, the dominant interval gives its own name to the segmentation (Score 2).



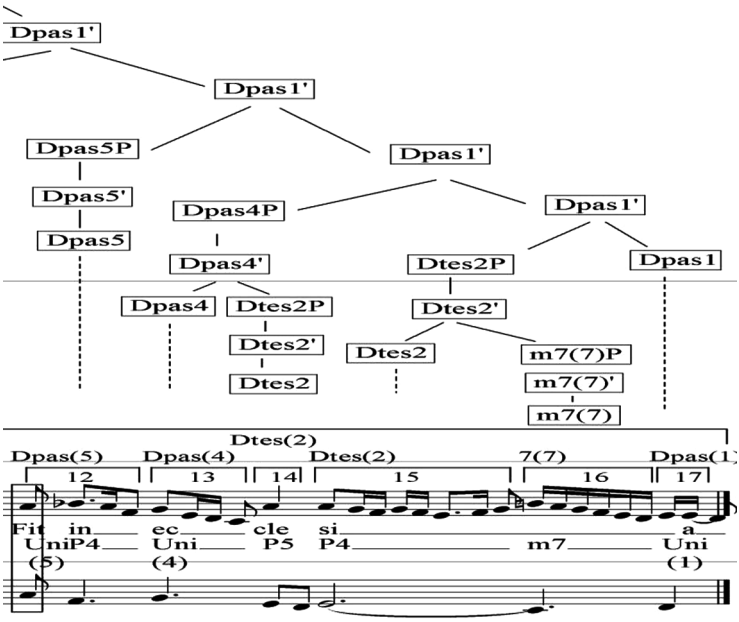
Score 2. Homorhythmic segmentation

Florid Segmentation (FS)[6]. FS is analyzed in two levels PL and SL.

PL. PL level of FS is determined by the long notes which were called tenore in early music generally in the tenor part and occasionally in the other parts of the pieces. In the florid texture, the analysis process breaks down the restriction of verbal and dives into the purely musical representation of its individual language.

SL. SL level of FS is determined by the intervals which specify the beginning and ending of the words. Depending on the intervallic hierarchy, the dominant interval gives its own name to the segmentation (Score 3).

[6] Many thanks to Professor Paul Whitehead acquiring this concept to our study by making me aware of various historical facts as to the period we study.



Score 3. Florid Segmentation

3 Application of the Analytical Principles

Since the middle of the last century, a lot of work as to demystify the Middle Ages music have been practiced and these studies enliven the ways of the new and early researchers who want to develop these accelerations one step more. In this respect, it would be important to refer to the scholars who studied Aquitanian Polyphony: Treitler and Fuller, particularly Fuller's 1969 dissertation [22] and contemplation about early music syntax and Treitler's syntactical explanations as to the essentials of early music have illuminated the way of this study.

Firstly, the exercises we practice are "Annus Novus" piece of Aquitanian Polyphony. "Annus Novus" is the first piece transcribed in Fuller's dissertation, for this term was pointed out by the same quotation in Fuller's dissertation. Treitler's identifications of the maximal segmentation of the piece gives the essential determination of the analysis system: "Groups of phrases usually form balanced units of musical structure that span an entire strophe or outline a rhyme grouping within a strophe. An unflagging sense of melodic direction and balance and symmetry in the large phrase groupings are the prevailing artistic principles of this chant—principles which have direct analogues in the poetic structure" [23]. In this respect, the analysis of Annus Novus is in line with the essentials of Treitler's indication.

3.1 Evaluation of the First Strophe

The first strophe of Annus Novus versus is the monophonic textural structure, so we will examine it in the principles of the relevant texture. When we observe the Score 4, under the lyrics we see that the step numbers of the individual mode is Dorian. These step numbers originate the PL, although in this phase the boundaries of the word segmentation are not indicated. This is the first phase of the representation which will be modified by the next phases. For the representation process, we will indicate the description in the following bullets;

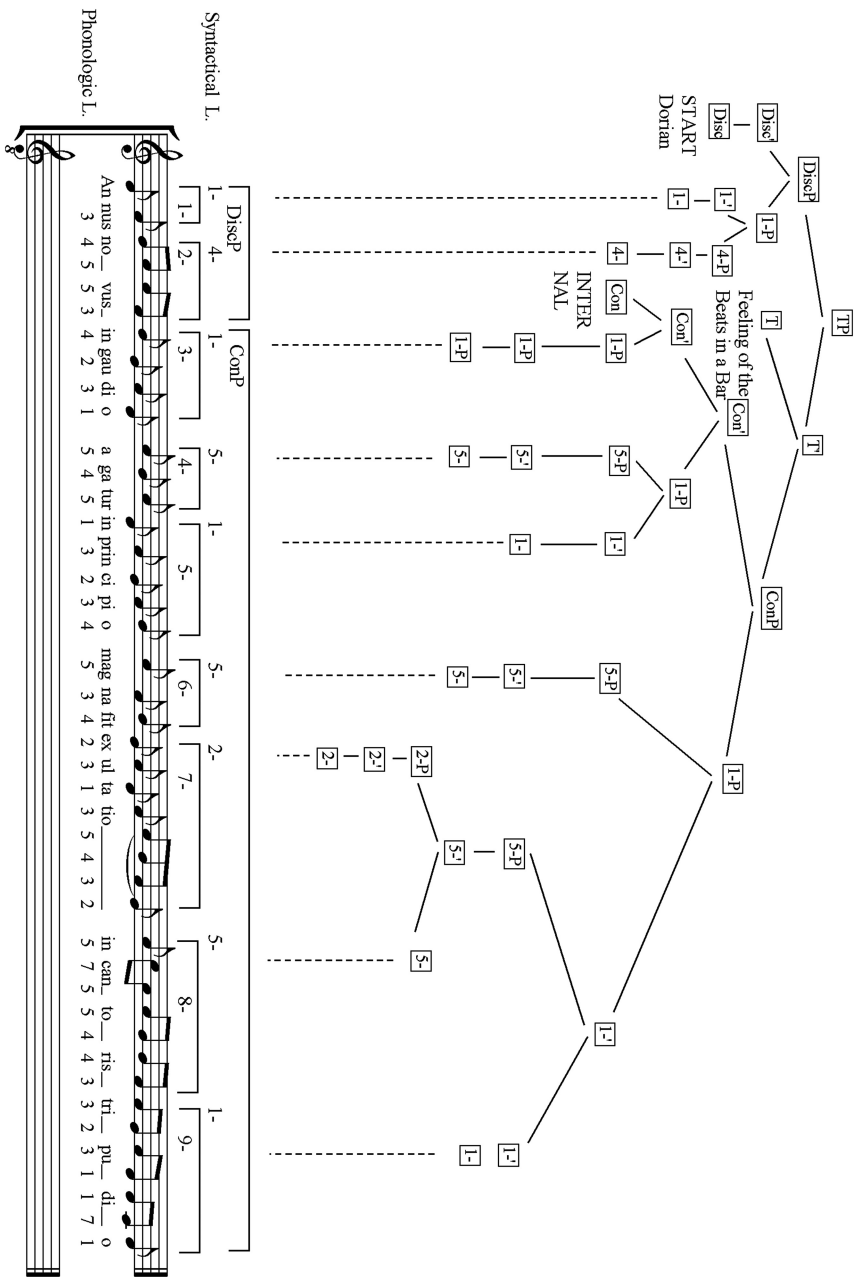
- Above the notes, there are two levels of brackets, one of them denoting the SL and specifying the word boundaries, and therefore modifying the PL. The subject of this phase is SL.
- The second phase of the representation process indicates the SLS level of the MRS determined by the steps which specify the beginning and ending of the words. Depending on the step hierarchy, the dominant step gives its own name to the segmentation.
- The second level brackets above the PL brackets, specify the Maximals that are DiscP and ConP. The subject of this phase is the DiscP.
- The third phase of the representation process is to indicate DiscP which is the boundary of the Spec MCP position from first 1- to second 1-[7]. Its features are head initial in the DiscP. Hierarchically S-formula is valid for MRS representation.
- Now, we will examine the DiscP's internals as Deep Structures. DiscP is a major event in the piece. Accordingly, the head of the DiscP is the Dorian and beginning of the piece. These features are not placed in the realization of the structure, however as a proposal, they are rather intention of the performers or experienced listeners in a performing or listening process. The intention is specified by the 1-P (Segment1) as a Spec position which consists of a adjunct that is 4-P (Segment2). This adjunction is determined by S-Formula[8].

We see another bracket adjacent to DiscP. It is the ConP. In this phase we will examine this maximal by the following levels.

- The fourth phase of the representation process is to denote the ConP, until the end of the musical sentence. It is determined by the strophe while respectively first 1- are specifier of ConP, following 1-s - except the last one which is complement of the ConP - are adjunct of the ConP and S- Formula gives the essential representation.
- As a last section of evaluation of the first strophe of the Annus Novus, we will examine the ConP's internals. ConP is the internal structure of the sentence.
- In the ConP, we see one Spec MCP consisting of two adjuncts and one default complement structure of the ConP.

[7] Numbering is from left to right in DiscP.

[8] In the representation, we see under a single bar level, a sister relationship as 1-'and 4-P. To show the adjunct function of the 4-P to 1-P, we have to draw the tree in this way. On the other hand, the validation of this representation in language could be arguable in Verbal/ Linguistics discipline.



Score 4. First strophe

- The Spec MCP of the ConP is First 1-P[9]. Its head is at the end of the sentence and is the last segment consisting of two adjuncts. From right to left, first adjunct of 1-P is 5-P which has one complement as 2-P and second adjunct of the 1-P is the 5-P.
- The adjunct of the ConP is second 1-P in the middle of the piece which has its own adjunct that is 5-P.
- Finally, the complement of the ConP is another 1-P which is third from right the left.
- In the ConP, the most dominant head which places at the most left because the feature of the ConP is head final.

Detection of the "Mutatios" by Features. In the "Hexachord System and Features of Deductios", the features of the deductios of the hexachord system are denoted. In this part, by showing the unique features of the each voice on the score we will indicate the mutatios[10] -if any- from one hexachord or deductio to another.

In the Score 4, 9 segments are seen; two of them in the DiscP and rest are in the ConP. Now, we will list the segments and their features.

Segments of the DiscP.
[+Ac, +d, +re, +Nat]
[+Ac, +g, +sol, +Nat]
Segments of the ConP.
[+Ac, +g, +sol, +Nat]
[+Sac, +a', +la, +Nat]
[+Ac, +d, +re, +Nat]
[+Sac, +a', +la, +Nat]
[+Ac, +e, +mi, +Nat]
[+Ac, +a', +la, +Nat]
[+Ac, +d, +re, +Nat]

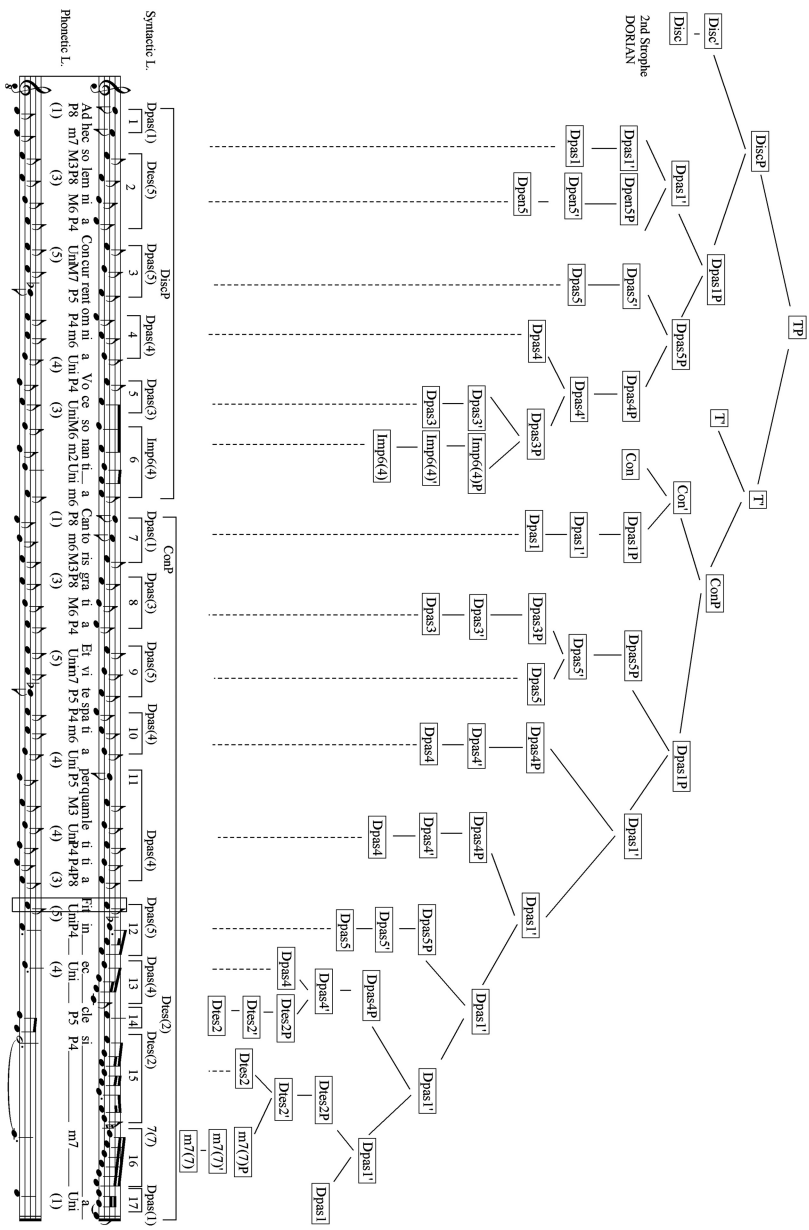
There is no mutation in the features of the segments in the first strophe of versus, and all the segments have the features of the natural deduction.

3.2 Evaluation of the Second Strophe

The second strophe of Annus Novus versus includes HRS from first to 12th segments and FS textures from 12th to 17th. The four phases that were explained in the preceding section are valid for second strophe. In this evaluation of the 2nd strophe, there will be some modifications depending on the textural transformations. In the preceding section, the steps indicated the deep structures, however in this part the intervals will specify the

[9] Numbering starts to begin from right in the ConP Region.

[10] To the transformations between natural, hard and soft hexachords, the most fundamental characteristic of the hard hexachord is the natural b and of soft is bb and of the natural is that it does not include b note.



Score 5. Second strophe

deep structures of the strophe because HRS and FS levels the main characteristics of the organization come from the intervals.

The strophe is the homophonic and florid textural character, so we will examine it in the principles of the relevant texture. When we see Score 5, under the lyrics the interval number of the individual mode Dorian will be seen. As for the representation process, we will indicate the description in the following bullets:

- The first phase of the representation process is to indicate the PL level.
- Above the notes, there are two levels of brackets, one of them denoting the SLs and specify the word boundaries and therefore modifies the PL. The subject of this phase SL.
- The second phase of the representation process is to indicate the SLS level of the HRS and FS determined by the steps which specify the beginning and ending of the musical segments. Depending on interval hierarchy, the dominant interval gives their own name to the segmentation.

Above SL, we see two brackets as DiscP and ConP. In this phase we will examine the DiscP.

- The third phase of the representation process is to indicate DiscP, the boundaries of maximal from 1st segment to 6th segment. Hierarchically, first Dpas1 Spec MCP of DiscP dominates the other constituent of the DiscP and it has two adjuncts, Dpas5P and Dpen5P.
- Then, Dpas5P consists of one adjunct which is Dpas4. Dpas4 has a complement which is Dpas3P and finally Dpas3P has a complement Imp6 (4).
- Another adjunct of the DiscP is Dpen5P.

We have seen another bracket adjacent to DiscP, the ConP. In this phase we will examine this maximal region.

- The fourth phase of the representation process is to denote the ConP from 7th to 17th segment. ConP is until the end of the musical sentence that is specified by the strophe and I-Formula is valid for this representation.
- As a last section of evaluating of second strophe of the Annus Novus, we will examine the ConP's internals.
- In the ConP, it is seen 1 Spec MCP and 1 complement structure. The Spec MCP of the ConP places at the end of the sentence which is Dpas1. The Dpas1 has 5 adjunct and one complement respectively from the last segments to the preceding ones;
- Dpas1's complement is Dtes2 which has one complement: m7(P).
- The first adjunct of the Dpas1 is Dpas4P which has one complement: Dtes2P.
- The second adjunct of the Dpas1 is Dpas5P.
- The third and fourth adjunct of the Dpas1 is Dpas4Ps.
- The fifth adjunct of the Dpas1 is Dpas5P which has one complement that is Dpas3P.
- Finally, the complement of the ConP is Dpas1 which does not consist of any constituent in its bar.

Detection of the "Mutatios" by Features. In the Score 4, it is seen 19 segments; six of them in the DiscP and rest of the segments are in the ConP. Now, we will list the segments and their features.

Segments of the DiscP.

1. [+Gr, +d, +re, +Nat]
2. [+Gr, +f, +fa, +Nat]
3. [+Ac, +a, +mi, +soft]
4. [+Ac, +a, +mi, +soft]
5. [+Gr, +e, +mi, +Nat]
6. [+Ac, +g, +sol, +Nat]

Segments of the ConP.

7. [+Gr, +d, +re, +Nat]
8. [+Gr, +f', +fa, +Nat]
9. [+Ac, +a, +mi, +Soft]
10. [+Ac, +a', +la, +Nat]
11. [+Gr, +f, +fa, +Nat]
12. [+Ac, +a, +mi, +Soft]
13. [+Ac, +g', +sol, +Nat]
14. [+Gr, +e, +mi, +Nat]
15. [+Gr, +e, +mi, +Nat]
16. [+Gr, +c, +fa, +Hard]
17. [+Gr, +d, +re, +Hard]

In the first 6 segments of the DiscP, we see one mutation to the soft hexachord through the middle of the region and it turn back into the natural hexachord.

ConP begins on the natural hexachord and by the third segment starts to waver between natural and soft hexachord, and shows a consistency on the natural hexachord through the middle of the ConP and, finally it ends on the hard hexachord.

4 Conclusion

As a first step to a novel analytical tool for early music which also shows the first implications of a cognitive approach to it, the present study synthesizes musicology and linguistic aspects as applied to the repertory of Aquitanian Polyphony. In conclusion, its main contributions to the relevant studies are the following;

- The study extends the boundaries of the GTTM (Generative Theory of Tonal Music) to music of the 12th century. In this sense, we call it GTMM (Generative Theory of Modal Music).
- X-Bar method of Generative theory is applied to the repertories of the Aquitanian Polyphony of Twelfth Century,
- As the main distinction of present study to Pesetsky and Katz's "Identity Thesis", the conceptualizations of musical structures which take their essential historical

terms of the intervals are described as the "deep structures," and these structures denoted the evidences of the implications of intervallic impacts which are revealed by Patel in his "Music, Language and Brain".
- While musical spaces are described as taking place in two maximals every individual notes are described in a conceptualized domain.

This paper presents a novel approach to early music. This need arose from the fact that though in the evaluation process to the pre-tonal period there have been a lots of subjective interpretation form to discursive pieces, there has not been a tool to provide a consistent understanding for the individual corpus i.e. Aquitanian Polyphony, Montpellier Codex. To provide a contribution to bring a solution about these problems, present study's implications are following:

- All the essentials which are presented through the study are the components of a syntactical tool applied to early music.
- This new syntactical tool may show the cognitive tendencies of the composers of the term, because it takes its essentials from Linguistics, a cognitive discipline.
- Historically, early grammar studies in the Carolingian era and its permeating characteristics into the music structures in the epistemological sense may redefine the compositional process of Western Classical Music by inheriting the mindset of their creators and its evolutionary trajectories.
- A retrospective excavation of the minds of the composers via analyzing the signs that they left could show some new paths to the music analysis generally, and not solely early music repertoire.
- This syntactical analysis tool may be able to be a preset analysis tool for early music repertoires.

Acknowledgment. To my dear mother and sister, thanks to you for always standing behind on my decisions and I am grateful to my dear professors Paul Whitehead in Historical Musicology and A. Sumru Özsoy in Linguistics. If there had not been their guidance and intellects, this study would not exceed a threshold of a positivity but marks time in its myths.

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