Formal Design, Textural Profile, and Degree of Endogenous Harmony as modeling factors

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Abstract. *This paper describes the methodological steps taken for the compositional planning of a new work for violin, clarinet, and piano, from the systemic modeling of a musical intertext: Guarnieri's Ponteio No.7. The model, i.e., the hypothetical compositional system for Guarnieri's piece resulted from the analysis of the intertext with focus on formal design, textural profile (identified through partitional analysis), and degree of endogenous harmony.*

Keywords*: Systemic modeling, compositional systems, endogenous harmony, partitional analysis.*

Resumo. *Este artigo descreve os passos metodológicos para o planejamento composicional de uma nova obra para violino, clarinete e piano, a partir da modelagem sistêmica de um intertexto musical: o Ponteio No.7 de Guarnieri. O modelo, isto é, o sistema composicional hipotético para a peça de Guarnieri resultou da análise do intertexto com foco na forma, no perfil textural (identificado através de análise particional) e do grau de harmonia endógena.*

Palavras-chave*: Modelagem sistêmica, sistemas composicionais, harmonia endógena, análise particional.*

1. Introduction

This paper describes the methodological procedures for the systemic modeling of Guarnieri's *Ponteio No.7* with focus on three parameters: (1) formal design, (2) textural profile, and (3) degree of endogenous harmony. Section 2 presents a detailed examination of the theoretical framework employed in this research. In Section 3, the main part of the paper, the systemic modeling of Guarnieri's *Ponteio No. 7* is carried out producing as a result a compositional system (or model), from which, in Section 4, a new work, for violin, clarinet and piano is planned and composed.

2. Theoretical Framework

The following concepts are fundamental to the development of this work: (a) Compositional system, (b) Intertextuality, (c) Systemic modeling, and (d) Degree of endogenous harmony.

A compositional system is a set of relations applied to generic musical objects (pitch-classes, durations, contour-points, etc.) and associated with a specific set of parameters (pitch, rhythm, contour, etc.). Formally, a system is described by Klir (1991), through the expression $S = (O, R)$, in which O stands for the objects and R for the relations amongst these objects. It represents the deepest level or the archetype of a musical work and it is the starting point (rationally or intuitively) for compositional plannings. The concept is derived from the general systems theory (Bertalanffy 1968), more specifically related with symbolic systems (language, music, painting, etc.), which Bertalanffy associates with algorithms of symbols or "rules of the game". Lima (2011:65) defines compositional system as "a set of guidelines, forming a coherent whole, which coordinates the use and interconnection of musical parameters, in order to produce musical works". xxxxxxxxxxx (2015:69) updates this definition by adding the possibility of using unmodified musical materials besides musical parameters. This addition becomes particularly necessary in the case of intertextual systems, in which musical materials may be employed without substantial modifications. A compositional system is designated in the form of definitions, diagrams, or computational algorithms. Tables containing data are also important tools for the description of a Compositional System, especially, as we will see later, in the case of modeled systems.

The system shown in Table 1 has four definitions. The first one says that A, B, and C are unordered pitch-class sets presented in a specific order; the second definition says the system is formed by the sets of definition 1 and by two operations, x and y; the third definition says that all the sets have the same prime form[1]; and, finally, the fourth definition says that operation x applied to set A yields set B and operation y applied to set B yields set C. Based on these definitions, which express relationships between generic musical objects, more specifically, generic pitch-class sets, one can assign specific values and also define other parametric properties not covered by the system (such as rhythm, dynamics, timbre, etc.). These two actions are called respectively particularization and complementation and are part of compositional planning, in the perspective of the theory of compositional systems. Figure 1 has two parts. The upper part is the compositional planning of the pitch specifications according to the systems' definitions, i.e., sets (789), (A12), and (145), which have the same prime form, [014], are interconnected through operations x (T_9I) and y (T_3). Lower part shows the musical realization of the planning and the additional parametric complementation (arbitrary selection of rhythmic figurations, timbre, dynamics, articulation, and tempo).

Table 1: Example of a Compositional System

Definition	Description
1	A, B, C = unordered pitch-class sets presented in a specific order
2	S = ((A, B, C), (x, y))
3	[A]=[B]=[C]
4	x(A)→B, y(B)→ C

[1] In this paper, normal forms are represented inside parenthesis and prime forms are represented inside brackets.

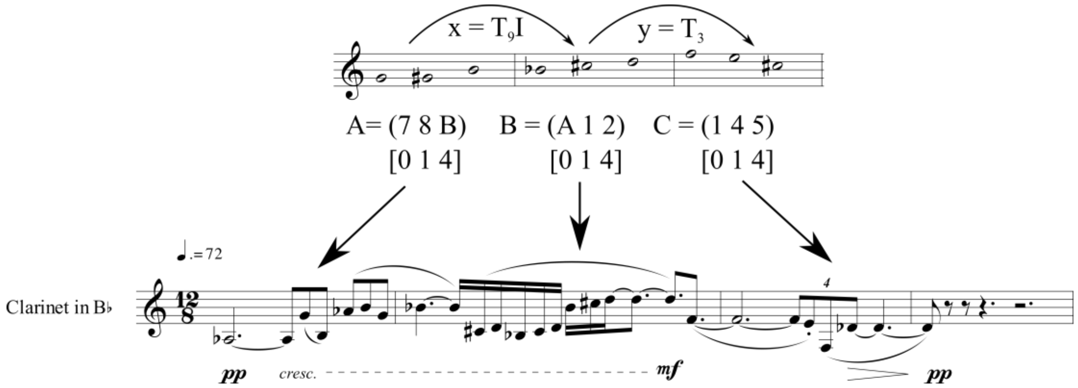


Figure 1: Compositional planning and musical realization of the system presented in Table 1

Intertextuality in music has been extensively studied by Klein (2005) and Korsyn (1991). The latter provides the first attempt to translate Bloom's revisionary ratios to the musical field. The concept of intertextuality was proposed by Kristeva: "any text is constructed as a mosaic of quotations; any text is the absorption and transformation of another" (Kristeva 1980:66). If the intertext is used in its original state and it is clearly recognizable we say that it is a case of literal intertextuality; if, on the other hand, only deep aspects of the intertext are used, an abstract intertextuality is taking place. Several compositional techniques are associated with intertextuality: collage, quodlibet, medley, potpourri, centonization, borrowing, paraphrase, parody, allusion, pastiche, contrafactum, variation, and modeling. In order to give an example of one of these techniques, we can mention the third movement of Berio's *Sinfonia*, as an illustration of collage. This piece is constructed taking the entire third movement (with some modifications) of Mahler's *Second Symphony* that is juxtaposed with quotations from several works by other composers.

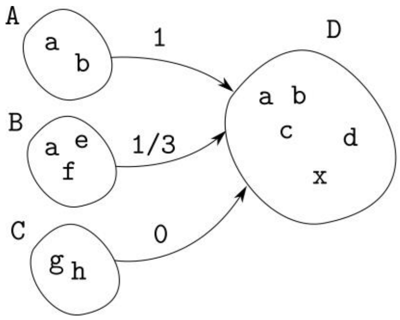
Systemic modeling is a type of abstract intertextuality focused only in the relationships that coordinate the interaction of musical objects under specific parametric perspectives. It inherits also methodological traits associated with compositional systems, especially with respect to the formal description of parameters, objects, and relationships. Thus, the methodology of systemic modeling is an epistemological convergence of the theory of compositional systems and the theory of intertextuality, more precisely in its abstract fashion. It is accomplished in three phases. In the first phase – parametric selection – a prospective analysis of the intertext is conducted in order to identify the parameters best suited for the task. The second phase – analysis – is the core of the procedure and provides a vast amount of information about the piece, in the perspective of the selected parameters. The last phase – parametric generalization – is the key of the process: it focuses on the relationships and disregards the particular values of the musical objects, producing, as a result, a model, which is a hypothetical compositional system for the intertext[2]. We should emphasize three aspects: (1) A model in the context examined in this paper, i.e., a Compositional System produced through systemic modeling, is exclusively connected to one particular work and does not have as a goal to summarize the complete output of a composer; (2) In Model Theory, and as a consequence, for systemic modeling applied to musical

[2] If, however, the model is in itself a very abstract structure, completely distant from the surface level, this phase may be disregarded or simplified.

composition, a model is always a partial representation[3] of the examined work – this means that a model is not an exhaustive description of the original[4]; and (3) A model is always hypothetical because it is a partial[5] investigation of a piece and, furthermore, because we are not aware of the composer's intentions.

The last concept in the scope of this theoretical framework is the degree of endogenous harmony. The word endogenous is related to something derived internally. This is the opposite of exogenous, which means something derived from outside. Given two unordered pitch-class sets, A (corresponding to an arbitrarily chosen layer and labeled melodic set) and B (corresponding to the remaining layers of a musical passage and labeled harmonic set), within a specific window of observation, we define degree of endogenous harmony (*deh*) between these two pitch-class sets, A and B, as the ratio of the cardinality of the intersection between them and the cardinality of set B (harmonic). In other words, *deh* is the relationship between the macroharmonic[6] components of a melodic and a harmonic layer that describe quantitatively their degree of pertinence.

Figure 2 exemplifies three cases of *deh.* In the first case, set A has two elements and its intersection with set D yields two elements. Therefore, *deh = 1.* In the second case, set B has 3 elements and its intersection with set D yields one element resulting in a *deh* of *1/3.* In the last case, the *deh* equals *0* since the intersection between C and D yields no element. Figure 3 shows the *deh* for the first three measures of the first movement of Bartók's *2nd String Quartet.*[7]



$$deh_D^A = \frac{n(A \cap D)}{n(A)} = \frac{2}{2} = 1$$

$$deh_D^B = \frac{n(B \cap D)}{n(B)} = \frac{1}{3}$$

$$deh_D^C = \frac{n(C \cap D)}{n(C)} = \frac{0}{2} = 0$$

Figure 2: Degree of Endogenous Harmony between pitch-class 'melodic' sets A, B, and C and the 'harmonic' set D.

[3] Worobeia and Flämig (2014:880) provide an English translation of the work of Stachowiak (1973) on general model theory, in which he states that models are characterized by three properties: "(1) Image characteristic, i.e. models are always models of something. They are representations of natural or artificial originals that can be models themselves; (2) Reduction characteristic, i.e. in general models do not capture all aspects of the represented original. Only attributes seen as relevant by model creators or users are taken in consideration; and (3) Pragmatic characteristic, i.e. model requirements are derived from the purpose. Models fulfill their function as surrogates for certain subjects (for whom?), within certain time intervals (when?) and restricted to certain mental or physical operations (Why?). The pragmatic characteristic determines the selection of relevant aspects of the represented original."

[4] Such exhaustive description would be meaningless in compositional terms, since the piece is already written. Systemic modeling is a methodology that helps the composer to take the initial procedures in order to create a new work.

[5] Both in the sense of biased and incomplete.

[6] The term macroharmony was defined by Tymoczko (2011:4) as "the total collection of notes heard over moderate spans of time." In our study, we are comparing the pitch-class content of two arbitrarily selected layers in the span of a measure.

[7] The term n/a means not applicable. This is the case in which there is no melodic set.

Figure 3: Degree of Endogenous Harmony in the first three measures of the first movement of Bartok's *2nd String Quartet*

3. A Model for Guarnieri's *Ponteio No.7*

Ponteio No.7 is one of the ten pieces of the *Primeiro Caderno de Ponteios* (First Book of Ponteios), composed by Brazilian composer Camargo Guarnieri (1907-1993), who published five of these *Cadernos* between 1955 and 1970. The piece is in slow movement, with forty-four measures, and the character indicated by the composer is *Contemplativo* (Contemplative). The initial gestures of *Ponteio No.7*, corresponding to phrase a1, are shown in Figure 4. Based on the behavior of thematic materials, textural rhythmic partitioning, and degree of endogenous harmony (*deh*), we propose that the piece has the macrostructure ABA'+Coda (Table 2). A short introductory material is merged inside the first phrase.

Table 2: Macrostructure of Guarnieri's *Ponteio No.7*

Section	Phrase	Measures
A	a1	01—11
	a2	11—18
B	b1	19—22
	b2	23—29
A'	a1	29—39
Coda		40—44

The textural profile of the work was analyzed with *Parsemat*, a computer application created by Pauxy Gentil-Nunes (2009)[8] that can perform a detailed partitional analysis[9] of a MIDI file providing as an output an indexogram[10], a partitiogram[11], and the entire list of partitions. Tables 3 presents the partitions, as well as, the density-number (*dn*) for each measure of Guarnieri's *Ponteio No.7*. The calculation of the *deh* for the entire piece was executed manually and it is also presented in the same table.

Figura 4: The initial gestures of Guarnieri's Ponteio No.7

This table alongside with Table 2 (macrostructure) configure the model for *Ponteio No.7*, exclusively with respect to formal design, textural profile, and degree of endogenous harmony. Based on these tables we will plan a new original work for violin, clarinet and piano.

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[8] Freely available at <http://musmat.org>.

[9] A great deal of publications on partitional analysis has been produced by its creator, Pauxy Gentil-Nunes, and his graduate and undergraduate students at the Universidade Federal do Rio de Janeiro. These publications, as well as additional software dealing with this subject, are freely available at <http://musmat.org>.

[10] According to Gentil-Nunes (2009:238), the indexogram is a "graph where the indexes a and d (agglomeration and dispersion) are plotted in the vertical dimension against a horizontal time, representing the time points. The index d is plotted on the positive side, while the index a is plotted inversely, on the negative side. The indexes are evaluated according to their distance from the zero axis." "The indexogram is a way of representing the evolution of the agglomeration (a) and dispersion (d) indexes, plotted against a temporal axis." (Gentil-Nunes, 2012:49)

[11] According to Gentil-Nunes (2009:240-241), the partitiogram is a Cartesian graph where the indexes (a, d) of the partitions of a musical piece are plotted. The participle is homologous to Young's lattice, and a cartographic characterization is added to it, in which the absolute measures of distance between partitions are significant. In addition, the partitiogram is a phase space, considering that the partitions represent the potential states of the represented application. However, it is a reticulated phase space and, in this sense, different from the standard phase space of physics (continuous).

Table 3: Textural partitions, density-number, and *deh* for Guarnieri's *Ponteio No.7*

Measure	Partitions	*dn*	*deh*	Measure	Partitions	*dn*	*deh*	Measure	Partitions	*dn*	*deh*
1	**4**	4	n/a	19	**236**	11	2/3	29	**$1^{2}4$**	6	n/a
2					**34^{2}**				**14**	5	
3			1/2		**$2^{2}34$**			30	**4**	4	n/a
	1 4	5		20	**$2^{3}3$**	9	1	31			1/2
4			1/4		**$12^{2}3$**	8			**14**	5	
5			1/3		**134**			32			1/4
6	**1 3**	4	1/5	21	**236**	11	3/4	33			1/3
7			0		**$2^{2}34$**			34	**13**	4	1/5
8			1/4		**236**			35			0
9			0	22	**$2^{3}3$**	9	1/3	36			1/4
10			0		**234**			37			0
11			0	23	**$2^{3}3$**		2/3	38			1
	$1^{3}2$	5			**$2^{2}3$**	7		39			0
12	**$1^{2}3$**		3/4	24	**27**	9	1		**$1^{2}3$**	5	
	$1^{3}2$			25	**15**	6	1	40			0
	$1^{2}2$	4			**$1^{2}3$**	5		41	**13**	4	
	$1^{2}3$	5		26	**123**	6	1		**$1^{2}2$**		0
13	**$1^{3}2$**		1		**$1^{2}2^{2}$**				**13**		
	$1^{2}3$				**$1^{2}23$**	7		42			0
14	**$1^{3}2$**		4/5	27	**124**		1	43			0
	123	6		28			0	44	**134**	8	0
	$1^{2}2^{2}$										
	12^{2}	5									
15	**$1^{2}3$**		1								
	$1^{3}2$										
	$1^{2}3$										
16			3/4								
17	**12^{2}**		1/2								
18	**15**	6	1								
	$1^{2}4$										
	124	7									

4. Compositional planning of *xxxxxxx*

The new piece, created from the model of Guarnieri's *Ponteio No.7* is the second movement (*xxxxx*) of a trio for violin, clarinet, and piano entitled *xxxxxxxxx*.[12] Partitional information as well as density of endogenous harmony are parameters abstract enough, in terms of the melodic and harmonic activity in the musical surface, and, therefore, may be used in raw state, i.e., without further generalization.[13] The new piece, however, will be expanded three times compared with the intertext. In order to accomplish that, each entry corresponding to measure information, in Table 3, will correspond to three measures in the new piece. For example, there will be an introductory material lasting six measures.

[12] The first movement of this piece (*xxxxxxx*) was also designed with the assistance of systemic modeling. In this case Guarnieri's *Ponteio No.6* was the intertext.

[13] We have generalized partitional results in a previous piece, with the use of partitional operations (resizing, revariance, transfer, concurrence, and reglomeration). There is a specific software especially designed to perform these operations. Detailed information on these operation are provided in Gentil-Nunes (2009).

xxxxxxx will be fast (in contrast with Guarieri's *Ponteio No.7*), mostly in 7/8 (the inclusion of new time signatures will serve to contrasting and articulatory purposes only). The pitch material will be predominantly derived from the octatonic scale in its three possible transpositions. The tetrachords that complement the octatonic scales will make it easy to manage the degree of endogenous harmony throughout the piece. Figure 5 shows the first gestures of the new piece. As one can see in this figure, the new piece follows strictly the restrictions shown in Tables 2 and 3, which deals exclusively with texture, form, and degree of endogenous harmony. The remaining aspects are left to the composer's discretion.

Figura 5: The initial gestures of xxxxxxxx

5. Concluding remarks

A comparison of the initial gestures of both scores examined in this paper – Guarnieri's *Ponteio No. 7* and xxxxxxx – will certainly reveal one important conclusion concerning pieces produced with the methodology of system modeling: the aesthetic profile of new works produced from a model, notably in terms of melody, harmony, and rhythm, differ considerable in the surface level from that of the intertext. This observation makes it clear that a compositional system created as a model of a pre-existent work has the property of deflating essential aesthetic characteristics from the new work keeping only the essential features. Thus, a new work created through systemic modeling is similar to the original work only with respect to the deepest structural levels. The most immediate characteristics, the ones easily audible, depend totally on the composer's ability, background, and aesthetic values. We should also add that this methodology has been revealed itself as an important tool for young composers, since it may represent a quick solution for the blank page dilemma, as well as it encourages a close theoretical connection with the works of other composers, from whom it is always possible to learn something important about the art of composition.

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