

The Traditional Music Genres of Puerto Rico: Elements and Analysis of Polyrhythm, Book I

(Compendium of my treaty to be published later. Previous works of mine on the same subject are the doctoral dissertation of 2005, the edition of 2010 and two presentations from 2015 and 2017.)

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Introduction

This presentation classifies, enumerates and itemizes the five elements of polyrhythm, which constitutes the theoretical framework for the polyrhythmic analysis of the traditional genres of Puerto Rico –from the micro to the macrostructure.

Elements

- 5) Variation Techniques
- 4) Forms
- 3) Phrasing
- 2) Rhythms
- 1) Pulses

Genres

- 6) *Plena*
- 5) *Danza Puertorriqueña*
- 4) *Guaracha*
- 3) *Seis*
- 2) *Aguinaldo*
- 1) *Bomba*

The polyrhythmic analysis of the traditional genres of Puerto Rico is based on the *tresillo* (3+3+2), whose rhythmic cells conforms the phrases, which at the same time conforms the musical forms that are molded by the variation techniques.

Primary Pulse

I called the inferior pulsating level, the most narrow, the primary level, whose pulse represents the inferior subjective reference that can not be divided further, the primary pulse². In the traditional genres, this pulse is always equivalent to the sixteenth note.

The primary pulses are indistinguishable from each other because they are equidistant, unaccented and isomorphous³, as well as all of the pulses from their respective pulsating levels. Also, due to their subjective nature, it is unnecessary to play them during the performance.

The importance of the primary level is that it creates a spatial grid⁴ where all the durations are positioned. The example below shows the “Cheki Morena” rhythmic pattern on a single spatial grid.



Therefore, the pulses are required to transcribe, analyze and perform the traditional genres of Puerto Rico.

Pulsating Levels Table

Whole Note 1/1



Halve Note 1/2



Quarter Note 1/4



Eight Note 1/8



Sixteenth Note 1/16



The example below shows the first phrase of the refrain from the *plena* “Cortaron a Elena” (“They Cut Elena”) notated in the primary level and the eight note level.

The image displays two staves of musical notation for the first phrase of the refrain from the *plena* "Cortaron a Elena". The top staff is in the primary level, and the bottom staff is in the eighth note level. Both staves include a tempo marking of quarter note = 120.

Golpe

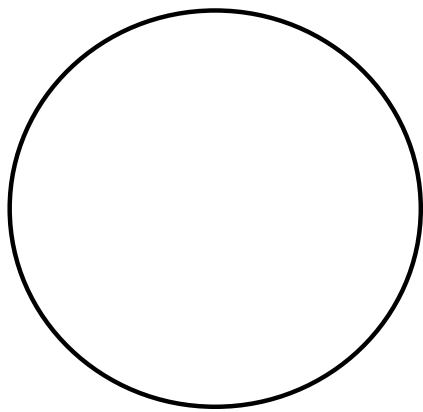
I called *golpe*⁵ (strike) the act of singing or playing an (in)definite sound on a primary pulse whose sonorous and/or silent prolongation through one or more primary pulses, if any, lasts until the next *golpe*.

The quantities of these temporal, unequal and objective units equate the terms of the arithmetic progression⁶ with common difference 1 ($A+C=B^2$), e.g., 1 (+1 =), 2 (+1 =), 3 (+1 =), 4, etc.; which is analogous to the the measures of the units from the metric system based upon powers of ten. Hence, the first term and its multiples are commensurable. The first term is paired with the sixteenth note, which is equivalent to primary pulse.

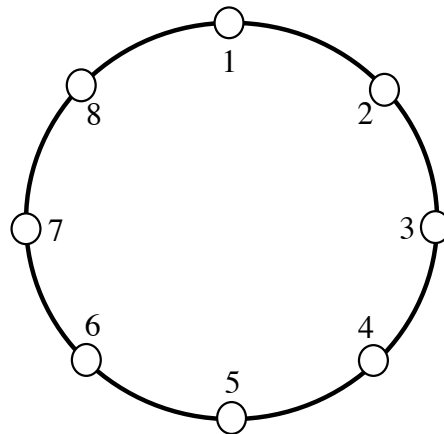
In musical notation: $\text{♪} (1) + \text{♪} = \text{♪} (2)$, $\text{♪} + \text{♪} = \text{♪} (3)$, $\text{♪} + \text{♪} = \text{♪} (4)$, etc. With respect to the pulsating levels the musical notation is $\text{♪} (1) * \text{♪} = \text{♪} (2)$, $\text{♪} * \text{♪} = \text{♪} (4)$, $\text{♪} * \text{♪} = \text{♪} (8)$, etc.

Rhythms

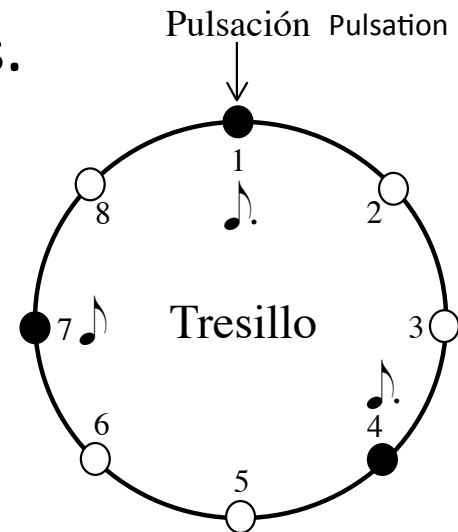
Rhythm is perceived when the division of the primary pulses by actions of the *golpes* adopts an determined order with respect to the pulsation, for not every pulsating organization is rhythmic⁷. In this way, the division of any of the pulsating levels through certain disposition of the *golpes* conforms a rhythm. I called this disposition morphology, whose quantities are expressed in natural numbers, e.gg., 1+1+2, 3+3+2, etc. There are three types of rhythms: the meters, the claves and the cells.



Continuous
Temporal Space



Division of the
Temporal Space by
the Primary Pulses



Division of the
Primary Pulses
by the *Golpes*

Meters

Meters are constructed based on simple ratios, which represents significant similarities with the metrical feet of the lyric poetry from ancient Greek.

ratios simples	1 : 1	3 : 2	2 : 1	4 : 3
metros				
Common meter in infant songs	Metro Común en Canciones Infantiles			
claves y células				
	cr5b1			<i>Rachenitsa</i> (Bulgaria)
ratios simples	3 : 1	2 : 1	3 : 2	1 : 1
metros				
claves y células				
	Clave son (Cuba) Highlife (Ghana) Salsa (Circuncaribe)		"Take Five" (Brubeck Quartet)	Campana Adowa (Akan) Campana Agbekor (Ewe) (2+2+1+2+2+2+1)

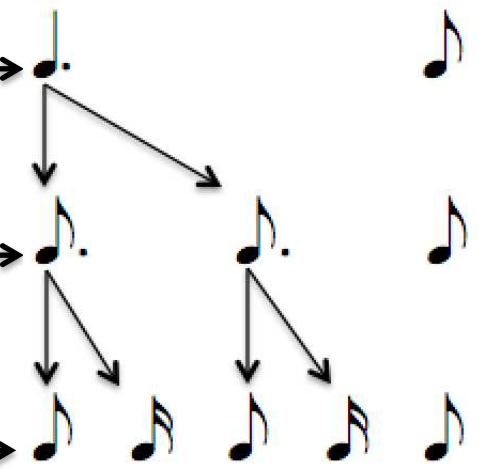
Meters (Cont.)

Each ratio term is divided into two or three equal or unequal *golpes* that configure the meters. If the division is ternary the *golpes* are always equals, if there is not division at all the term becomes a single *golpe*. The *golpes* conforms two types of meters: the ones that contain 4, 6, 8, 12 and 16 primary pulses –factors of 12 and 16–; and the ones that contain 5, 7, 9 and 10 primary pulses –factors of much larger numbers. The Circum-Caribbean dances with the first group of meters, while other regions dance with the second group of meters. Therefore, the meters organize the morphology of their rhythms, not of their pulsating levels. The next example explains the division of 3:1 ratio.

Four eighth notes in a simple ratio of 3:1. —————→

The first term is divided into two dotted eighth notes and the second term, by not dividing it, becomes a single *golpe*, which conforms the *tresillo* of eight sixteenth notes. —————→

Each of the first two *golpes* of the *tresillo* are divided in one eighth note and one sixteenth note, while the third one is not divided, which conforms a cell of five *golpes*. —————→






Tresillo

The rhythm that regulates the cellular morphology of the traditional genres of Puerto Rico and other genres from the Circum-Caribbean is known as the *tresillo*. The three *golpes* (3+3+2) coins its name. It is also known as the mother cell.

Three characteristics of the *tresillo*: (1) It exerts the function of meter, (2) the cells are derived from it, which explains the unequal *golpes* in all of them, and (3) it is *performed in the traditional genres*, in which, on occasions, it becomes periodic.

The example below shows the most common notations in which the *tresillo* is represented .

3			3			2	
							
X			X			X	
●			●			●	

Claves

The rhythm that regulates the morphology of the phrasing in some genres of the Caribbean is known as the clave. In Indian music, the word *tāla* is related to basis, since the song, the musical instrument and the dance rest on this base⁸. The function of *tāla* is similar to the clave.

I called clave *criolla* (3+3+2+4+4) the clave that stands out in the traditional genres of Puerto Rico and I called the clave *tresillo* (3+3+2+3+3+2) the one that follows in importance. Each one has its own variants.

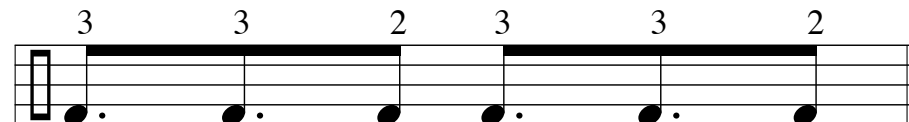
I defined *cruzao* as the unbalance caused by the *golpes* of the phrasing that get off their corresponding primary pulses because they fall behind or overtake the *golpes* from the clave.

Clave *Criolla*



16 Pulsos ·
5 Golpes ·
Simétrica ·
Ciclo ·

Clave *Tresillo*



16 Pulsos ·
6 Golpes ·
Simétrica ·
Ciclo ·

Cells

The rhythm whose function is relative to its position is known as a rhythmic cell or simply as a cell. The Circum-Caribbean rhythmic palette shows the economic morphology of the cells –compact, compressed and compatible– in an “inventory of theoretical possibilities”⁹. Its alphanumeric nomenclature emphasizes the rotational properties of the cells. For example, 3+1+2+2 (4a1) rotates to 1+2+2+3 (4a2).

The image displays a grid of musical notation for rhythmic cells, organized into six rows and five columns. Each cell is represented by a short musical staff with notes and rests, and an alphanumeric label above it. The labels are as follows:

- Row 4a: 4a1, 4a2, 4a3, 4a4
- Row 4b: 4b1, 4b2, 4b3, 4b4
- Row 4c: 4c1, 4c2, 4c3, 4c4
- Row 5a: 5a1, 5a2, 5a3 palíndromo, 5a4, 5a5
- Row 5b: 5b1, 5b2, 5b3 palíndromo, 5b4, 5b5
- Row 9a: 9a1, 9a2, 9a3, 9a4, 9a5 palíndromo palíndromo
- Row 9a (continued): 9a6, 9a7, 9a8, 9a9

The notation uses a single staff with a common time signature. Notes are represented by stems with flags, and rests are indicated by vertical lines. The alphanumeric labels use numbers 1, 2, and 3 to denote note values, with underlines indicating specific features or rotational properties.

Cells (Cont.)

Each set contains cells with the same number of *golpes*, whose permutations segment the set into collections and whose rotated *golpes* segment the collections into cycles. For example, the set 4, the collection 4a and the cycle 4a1. In other words, the number 1 indicates the cycle, the letter a indicates the collection and the number 4 indicates the set.

The *golpes* of each cell from the same set maintain equal durations (length), velocities (size) and number; the difference lies in their order. Each one of the previous meters creates its own rhythmic palette, all exhibiting these properties.

Collection 4a

Set 4

Cycle 4a1

4a1 3 1 2 2

4a2 1 2 2 3

4a3 2 2 3 1

4a4 2 3 1 2

4b1 2 1 2 3

4b2 1 2 3 2

4b3 2 3 2 1

4b4 3 2 1 2

4c1 2 1 3 2

4c2 1 3 2 2

4c3 3 2 2 1

4c4 2 2 1 3

Phrasing

“The musical phrase is an indivisible conceptual totality. It encloses a complete thought but interdependent, relatively or absolutely conclusive”¹⁰.

Contrary to the static morphology of the *tresillo* (meter) and the claves (normative phrasing), the dynamic morphology of the cells is expressed in four types of phrases:

- (1) simple/compound
- (2) a/symmetric
- (3) equidistant/unequal
- (4) in/commensurable

The period is the motion, delimited by a fixed number of pulsations, of one to four phrases whose periodic positions are reiterated with or without variations.¹¹ These types of phrases are organized by the period. “Each consecutive and equal time period in the rhythm is called a cycle”¹².

Phrasing (Cont.)

The compound phrase is divided in cells, the simple in *golpes*; the symmetric phrase is divided by half, The asymmetric is not; the equidistant phrase contains equal number of pulsations, the unequal does not; and the commensurable phrase is based on the geometric progression of reason 2 with the first term equal to 2, the incommensurable phrase is based on another progression and/or another term. In this case the incommensurable phrase maintains the said progression, but with the first term equal to 3.

The image displays eight musical phrases on a single staff, each with a label above it and a bracket underneath indicating its structure. The phrases are:

- Frase Compuesta Compound:** A phrase of 10 notes divided into two groups of 5 notes each.
- Frase Simple:** A phrase of 6 notes divided into two groups of 3 notes each.
- Frase Simétrica:** A phrase of 10 notes divided into two groups of 5 notes each, with a central vertical line.
- Frase Asimétrica:** A phrase of 10 notes divided into two groups of 5 notes each, with a central vertical line.
- Frases Equidistantes:** A phrase of 10 notes divided into three groups of 3, 4, and 3 notes.
- Frase Desigual Unequal:** A phrase of 10 notes divided into three groups of 3, 4, and 3 notes.
- Frase Commensurable:** A phrase of 10 notes divided into two groups of 5 notes each.
- Frase Incommensurable:** A phrase of 10 notes divided into two groups of 5 notes each.

Periodic Accent

The phrase has one or several pulsations and, also, one lone periodic accent. Each periodic accent or “«spiritual» accent or accent of understanding”¹³ (1) accentuates the *golpe* or the rest with which the phrase begins, (2) delimits the phrase, thus, its length and (3) accentuates the starting over of the period, whether consecutive or not, when all the phrases become superimposed in the first pulsation.

The phrases 3a1 y 5b1, superimposed in one period of two pulsations, are clearly similar, but not equal. When the fourth *golpe* of the phrase 5b1 is subdivided (after the discontinuous line) they become identical. However, their periodic accents distinguish them.

Periodic Accent

Frase 3a1
AP AP AP AP AP AP AP AP

Frase 5b1
AP AP AP div. AP div.

Periodic Accent (Cont.)

The refrain of the plena “Cortaron a Elena” has a period of sixteenth pulsations and, thus, 64 primary pulses. The periodic accents position in the first, fifth and ninth pulsations section the refrain in two simple phrases and one compound phrase. Those are equidistant and symmetric, this one is equal and asymmetric. Nevertheless, the three are commensurable. This disposition of phrases, ubiquitous in the plena, is known as sentence form.

The image displays two staves of musical notation in treble clef, illustrating the periodic accents and phrase structures of the refrain. The first staff, labeled 'Acento Periódico' and 'Frase Simple', shows the first 32 primary pulses. The second staff, also labeled 'Acento Periódico' and 'Frase Compuesta', shows the remaining 32 primary pulses. The notation includes notes, rests, and bar lines, with periodic accents marked above the notes. The primary pulses are numbered from 1 to 64.

Acento Periódico
Pulsación Frase Simple

Pulsos primarios 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

Acento Periódico
Frase Compuesta

33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64

Therefore, a cell or the juxtaposition of two to four cells with respect to the periodic accents is called phrasing.

Form

The phrases are organized in two ways: (1) the fixed group and (2) the variable group. The phrases of the fixed group “are maintained essentially unchanged throughout the duration of the piece”; while the phrases of the variable group are improvised “throughout the duration of the piece”¹⁴.

Because the superimposition of both groups exhibits a sectional periodicity, the three forms of the traditional genres from Puerto Rico circumscribes to it: (1) The responsorial form alternates between the refrain and the stanza, (2) the poetic form alternates the *decimilla* or the *decima* with the instrumental interlude and (3) the prosaic form contrasts the themes (A, B, C, etc.).

Responsorial	Poetic	Prosaic
Refrain and Stanza	<i>Decimilla</i> or <i>Décima</i> and Interlude	Contrasting Themes
<i>Bomba, Plena</i> and <i>Guaracha</i>	<i>Aguinaldo</i> and <i>Seis</i>	<i>Danza Puertorriqueña</i>

Form (Cont.)

The form is perceived when the division of the periodicity by actions of the phrases adopts an determined distribution. “[F]orm is rhythm in the long span”¹⁵.


Just as in anatomy the cells are juxtaposed to conform superior elements until culminating with the body, the juxtaposition of rhythmic cells conforms superior elements that culminate in the form. This type of hierarchy is inherent in the fine arts.

Elements of Anatomy, Polyrhythm and Poetry

Anatomy	Polyrhythm	Poetry
Body	Piece	Poem
Apparatus	Variation Techniques	<i>Décimas</i>
Systems	Form	Couplets
Organs	Phrasing	Verses
Tissue	Rhythms	Words
Cells	Pulses	Syllables Letters

Variation Techniques

The variation techniques operate together, although some stand out more in certain genres than others. These techniques act upon the *golpes* of the phrases during the performance with the only purpose to generate affect. It is important to highlight that these possess subjective properties, causing their positions to be aperiodic.

The following list names nine variation techniques¹⁶ and their four categories. To facilitate the understanding of these techniques, the ubiquitous cell  illustrates each one of them, which are located under their corresponding categories: length, size, density and perspective.

Length: The duration of the *golpes* determines the extension of the phrase with respect to the pulsation:

Expansion



Reduction



Variation Techniques (Cont.)

Size: The velocity of the *golpes* determines the pulsating level of the phrase with respect to the pulsation:

Augmentation



Diminution



Density: The number of *golpes* determines the volume of the phrase with respect to the pulsation:

Subdivision



Substitution

Combination



Perspective: The reordering of the *golpes* determines the cell or cells of the phrase with respect to the pulsation:

Rotation



Permutation



Polyrhythmic Analysis

I called arboreal cell the conductive thread that regulates the variation of the principal melodic phrases through the variation techniques. Only one arboreal cell, with rare exceptions, binds all the phrases rhythmically, although in a few occasions two arboreal cells divide a piece in two sections.

What characterizes the variations and makes them comprehensible to the perception is the arboreal cell. The quantity to the variations enhances the cohesion of the rhythmic structure and the quality of them determines the affect.

At the top of the following three examples, in the reduced staff over the alphanumeric nomenclature, is located the arboreal cell, from where the principal melodic variations are derived. These variations are the only ones which are transcribed in the musical examples, except the *danzas puertorriqueñas*, which are already notated. The other instruments are transcribed with their respective normative patterns.

Polyrhythmic Analysis (Cont.)

Plena “Cortaron a Elena”,
music transcribe by the author,
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“Cortaron a Elena” (plena); (1)
Arboreal cell: 9c3; (2)
Prominent categories: length,
density and perspective; (3)
Ratios: 2:1, 4:1 y 8:1;
(4) Phrasing: sentence form, the
compound phrase maintains a
proportion of 2:1, 4:1 y 8:1 with
respect to the *panderetas* 1, 2 y
3, respectively.

Clearly the four instruments
constitute a polyrhythmic
texture: two or more
superimposed periods at the
same pulsating level or two of
them, being delimited by an
equal number of pulsations.

The musical score is divided into two systems. The first system includes:

- Arboreal Cell:** A top staff with a repeating rhythmic pattern.
- Vocal Line:** Labeled "Estrillo Estrofa", it contains the lyrics "Cor - ta - ron a E - le - na," and "cor - ta - ron a E - le - na,". Above the notes are labels: "Frase Simple", "Estrillo 9c3", "Refrain", "Fraseo Horizontal", and "Frase Simple".
- Variable Group:** A bracketed section containing the vocal line and the first pandereta part.
- Pandereta 1:** Labeled "Cuatro Pulsaciones 1:1", it shows a rhythmic pattern with a 9c3 ratio and a "com. 2:1" label.
- Fixed Group:** A bracketed section containing the second and third pandereta parts.
- Pandereta 2:** Labeled "Dos Pulsaciones 1:1", it shows a rhythmic pattern with a "Fraseo Horizontal" and "sim." label.
- Pandereta 3:** Labeled "Una Pulsación 1:1", it shows a rhythmic pattern with a "Fraseo Horizontal" and "sim." label.

The second system includes:

- CT:** A top staff with a repeating rhythmic pattern.
- Vocal Line:** Labeled "Estrillo Estro.", it contains the lyrics "cor - ta - ron a E - le - na y se la lle - va - ron al hos - pi - tal." Above the notes are labels: "Frase Compuesta (exp.)", "red.", "7b2", "div.", "7b1", "red.", "per.", "per.", "Fine", "com.", and "1:1".
- Pan. 1:** Labeled "Fraseo Horizontal", it shows a rhythmic pattern with a 2:1 ratio.
- Pan. 2:** Labeled "V e r t i c a l", it shows a rhythmic pattern with a 4:1 ratio.
- Pan. 3:** Labeled "V e r t i c a l", it shows a rhythmic pattern with an 8:1 ratio.

Polyrhythmic Analysis (Cont. II)

Guaracha “¡Ay! Choferito”

“¡Ay Choferito” (guaracha); (1) Arboreal cells: 9b4 y 8a5; (2) Prominent categories: length and perspective; (3) Ratios: 1:1, 2:1; (4) Phrasing: equal and unequal phrases, the first phrase maintains a proportion of 2:1 with respect to the guitar and *güiro*.

Due to space constraints, the third system of the refrain is omitted (almost an exact copy of the second one).

The arboreal cell 9b4 regulates the variations of this period (refrain) of twenty-four pulsations, of which phrases are equal and unequal.

The arboreal cell 8a5 regulates the variations of the stanza of sixteenth pulsations, of which phrases are exclusively equal.

Both arboreal cells regulate the variations of their themes and, hence, section the piece rhythmically.

First system of the refrain. It includes staves for Célula Troncal, Estribillo Estrofa, Guitarra, and Güiro. The Estribillo Estrofa staff shows the vocal line with lyrics: "¡Ay! cho - fe - ri - to, pre - pá - ra - te ¡ay! cho - fe - ri - to, pre - pá - ra -". Above the staff, the arboreal cell 9b4 is indicated. The guitar and güiro parts are marked with 4a1.

Second system of the refrain. It includes staves for CT, Estri. Estro., Guit., and Güiro. The Estri. Estro. staff shows the vocal line with lyrics: "te por - que yo quie - ro que tú me lle ve, ¡ay Dios! a - la ba - hí a 'e San". Above the staff, the arboreal cell 9c9 is indicated with "exp." and "per." markings, and the ratio 8f2 is shown. The guitar and güiro parts are marked with "com." and "red." markings.

third system omitted

Stanza section. It includes staves for CT, Estri Estro., Guit., and Güiro. The Estri Estro. staff shows the vocal line with lyrics: "Juan. Un mu - cha - cho se ca - yó de la to - rre de_u - na i - Cuan - do, un po - bre se, e - na - mora y un ri - co se le atra -". Above the staff, the arboreal cell 8a5 is indicated with "Fine com." and "com." markings.

Polyrhythmic Analysis (Cont. III)

Danza Puertorriqueña “El Coquí” por Quintón

“El Coquí” (danza); (1) Arboreal cell: 5a4; (2) Prominent category: density; (3) Ratio: 1:1; (4) Phrasing: equal phrases, The phrasing of the principal melody maintains a proportion of 1:1 with respect to the left-hand piano, although both show a phase difference.

The two danceable themes exhibit two arboreal cells that sections the piece rhythmically.

In this case a rhythmic modulation occurred. The arboreal cell 5a4 modulated to the arboreal cell 8e1 through the combination and substitution of *golpes*.

The third and fourth *golpe* from the first ct5a4 are combined into a dotted eight-note and the first three *golpes* from the next ct5a4 are substituted by two eight-notes.

CT

Theme A

10

gracioso

9a7

5a4

8va com.

5a4

8va com.

9a4 sus. div.

3

Pno.

CT

14

8va com.

5a4

5a4

8va com.

9a4 sus. div.

3

simili

Pno.

various systems omitted

CT

Theme B

26

espressivo

8va

8e1

8va

8e1

Pno.

Conclusion

Rhythm is the only musical parameter that unifies the traditional genres of Puerto Rico. The polyrhythmic structure is present in all of them, although it is more prominent in certain traditional genres than in others.

This unification is sustained by the five elements, whose process from the micro to the macro structure enables the manifestation of the polyrhythm.

All the rhythms are positioned in the primary level. From those, the cells are the ones that conform the phrases, which at the same time conform the forms, whose structure is molded by the variation techniques.

The arboreal cell regulates the variations of the principal melody in the variable group, which is superimposed on the fixed group. Together they generate affect, as long as the first group is dynamic and the second one static. All depends on how the improvisation is managed.

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Appendix A

Rhythmic Palette: Cells Derived from the *Tresillo* (♩.♩.♩ = 3+3+2)

The image displays a series of musical staves, each containing rhythmic cells derived from the *Tresillo* (3+3+2). The cells are organized into groups labeled 4a, 4b, 4c, 5a, 5b, 9a, and 9b. Each cell is represented by a sequence of notes on a staff, with fingerings (1, 2, 3) indicated above the notes. Some cells are labeled as palindromes.

4a

- 4a1: 3 1 2 2
- 4a2: 1 2 2 3
- 4a3: 2 2 3 1
- 4a4: 2 3 1 2

4b

- 4b1: 2 1 2 3
- 4b2: 1 2 3 2
- 4b3: 2 3 2 1
- 4b4: 3 2 1 2

4c

- 4c1: 2 1 3 2
- 4c2: 1 3 2 2
- 4c3: 3 2 2 1
- 4c4: 2 2 1 3

5a

- 5a1: 1 2 2 1 2
- 5a2: 2 2 1 2 1
- 5a3 palíndromo: 2 1 2 1 2
- 5a4: 1 2 1 2 2
- 5a5: 2 1 2 2 1

5b

- 5b1: 2 1 1 2 2
- 5b2: 1 1 2 2 2
- 5b3 palíndromo: 1 2 2 2 1
- 5b4: 2 2 2 1 1
- 5b5: 2 2 1 1 2

9a

- 9a1: 1 2 2 2 2 2 1 2
- 9a2: 2 2 2 2 2 2 1 2 1
- 9a3: 1 2 2 2 2 2 1 2 1 2
- 9a4: 2 2 2 2 1 2 1 2 2
- 9a5 palíndromo: 2 2 2 1 2 1 2 2 2
- 9a6: 2 2 1 2 1 2 2 2 2
- 9a7: 2 1 2 1 2 2 2 2
- 9a8: 1 2 1 2 2 2 2 2 2
- 9a9: 2 1 2 2 2 2 2 2 2 1

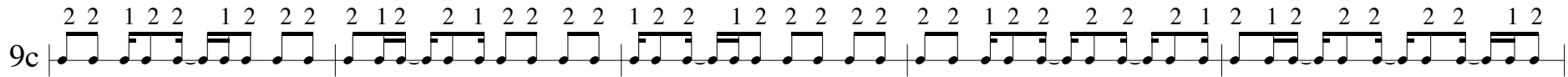
9b

- 9b1: 2 1 2 2 2 2 1 2 2
- 9b2: 1 2 2 2 2 1 2 2 2
- 9b3: 2 2 2 2 1 2 2 2 1 2 2
- 9b4: 2 2 2 2 1 2 2 2 1 2 2 2
- 9b5 palíndromo: 2 2 1 2 2 2 1 2 2 2 1 2 2
- 9b6: 2 1 2 2 2 1 2 2 2 2
- 9b7: 1 2 2 2 1 2 2 2 2
- 9b8: 2 2 2 1 2 2 2 2 1 2 2
- 9b9: 2 2 1 2 2 2 2 1 2 2 2 2 1 2

Appendix A (Cont.)


9c1 9c2 9c3 9c4 9c5 palíndromo

2 2 1 2 2 1 2 2 2 2 1 2 2 1 2 2 2 2 1 2 2 1 2 2 2 2 2 2 2 1 2 2 2 2 2 1 2 1 2 2 2 2 2 1 2



9c6 9c7 9c8 9c9

1 2 2 2 2 2 1 2 2 2 2 2 2 2 1 2 2 1 2 2 2 2 1 2 2 1 2 2 2 2 1 2 2 1 2 2




8a1 8a2 8a3 8a4

3 1 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 3 1 2 2 2 2 2 3 1 2



8a5 8a6 8a7 8a8

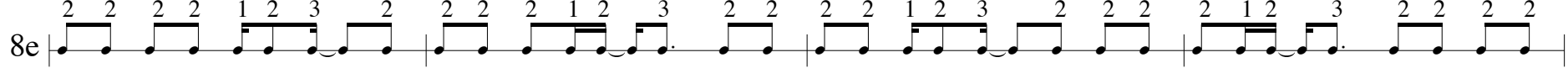
2 2 2 2 3 1 2 2 2 2 2 3 1 2 2 2 2 2 3 1 2 2 2 2 2 3 1 2 2 2 2 2



The collections B, C and D from set 8 are omitted.


8e1 8e2 8e3 8e4

2 2 2 2 1 2 3 2 2 2 2 1 2 3 2 2 2 2 1 2 3 2 2 2 2 1 2 3 2 2 2 2



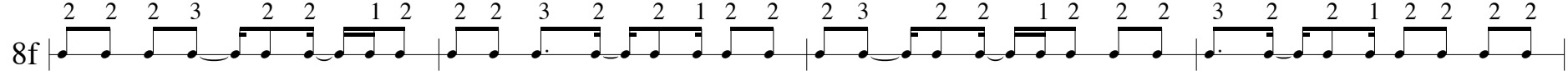
8e5 8e6 8e7 8e8

1 2 3 2 2 2 2 2 2 3 2 2 2 2 2 1 3 2 2 2 2 2 1 2 2 2 2 2 2 2 1 2 3



8f1 8f2 8f3 8f4

2 2 2 3 2 2 1 2 2 2 3 2 2 1 2 2 2 3 2 2 1 2 2 2 3 2 2 1 2 2 2 2



8f5 8f6 8f7 8f8

2 2 1 2 2 2 2 3 2 1 2 2 2 2 3 2 1 2 2 2 2 3 2 2 2 2 2 2 3 2 2 1

