

Hidden Complexity:
Rhythmic Processes in Ligeti's *Arc-en-ciel*

Jessica Rudman
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In his articles “Voice Leading as a Spatial Function in the Music of Ligeti” and “Inaudible Structures, Audible Music: Ligeti’s Problem and His Solution”, Jonathan W. Bernard paints a compelling picture of György Ligeti’s compositional career representing a gradual reclamation of elements found in traditional tonal practice. Rejecting serialism on the grounds that the unity implied by its methods had little or no relevance to the resulting auditory experience, Ligeti sought a way to create strictly controlled deep structures that have a noticeable effect on the musical surface though they may not necessarily be audible themselves. At first, Ligeti abandoned pitch as the basic element of music and instead turned to the idea of space: since register and density were the most salient features of much music created by serialists, he chose to focus on those directly rather than on traditional musical aspects such as melody, clear harmony, and distinct rhythms.

Ligeti’s need for a strong organizing system was first filled by the technique of micropolyphony: the creation of intricate contrapuntal (and often canonical) textures made up of numerous voices whose individual motion served only as an element within the composite sonority. Strict yet personalized rules of voice leading governed the motion of each part and the vertical combination of lines, yet the overall result was a mass of sound. Ligeti felt strongly that despite the inability of the listener to pick out individual lines, the tightly controlled counterpoint did make its effect known in subtle ways: mainly, creating unity and direction in the music. This technique allowed him to reclaim the traditional concept of musical line (and in a certain sense, harmony) while creating a distinctive musical expression.

Throughout the rest of his life, Ligeti refined that and other practices, allowing him to incorporate other traditional elements previously abandoned. The *Etudes pour Piano*, a series of late compositions, focus on rhythm as an aspect of music whose role could be reinterpreted much

in the way that that line was revitalized through micropolyphony. In the article “On My *Etudes* for Piano”, the composer describes his intention to merge “meter-dependent hemiola as used by Schumann and Chopin and the additive pulsation principle of African music” into something wholly his own. He later expands the concept of ‘hemiola’ to relationships such as 5:3 or 7:5 as well as multi-tiered relationships (7:5:3), none of which rely on preserving barlines.

This use of the term ‘hemiola’ quickly brings to light a large problem in rhythmic analysis: confusion over definitions of frequently used terms. In order to discuss complex rhythmic structures, it then becomes essential to define some important concepts. For the purposes of this paper, meter will refer to a temporal framework that (once established) will remain in the listener’s mind. Rhythms are the actual auditory phenomena that sound in conjunction or disjunction with that framework. Polyrhythms thus occur when two or more rhythms with dissimilar subdivisions are sounded simultaneously (ex. triplet eighth notes against straight eighth notes, a quintuplet against a triplet, etc.). This differs from hemiola, which is a specific effect where three beats are sounded in the space of two beats (or vice versa), creating a sense that time has either sped up or slowed down. Ligeti’s use of the term actually seems to refer to polyrhythm or polymeter, which occurs when two or more temporal frameworks are notated (or implied) in the music for an extended period. Though the effects of polyrhythm and polymeter can be similar, polymeter occurs on a different hierarchical level and will continue long enough for the independent layers or their composite to be absorbed by the listener as an ongoing frame of temporal reference.

Depending on the relationship of the different meters to each other, three different categories of polymeter exist: measure preserving, tactus preserving, and subdivision preserving.

Previously described by theorists such as Steve Larson and Keith Waters, the first two types can be seen in examples 1 and 2 below.



Ex. 1 Measure preserving polymeter: beats are not aligned, but barlines are¹



Ex. 2 Tactus preserving polymeter: beats are aligned, but barlines are not

While useful categorizations, these definitions do not represent the complete spectrum of polymetric possibilities. For example, a polymeter consisting of 3/4 and 9/8 where the eighth note is consistent does not really fit into either of the above categories (see example 3 below). The barlines will meet after three measures of 3/4 and two measures of 9/8, so it is clearly not measure preserving. The beat in 3/4 is the quarter note, while it is the dotted quarter note in 9/8. Though this polymeter is therefore not tactus preserving either, the shared eighth note subdivision creates a clear relationship. Such examples would call into a third category: subdivision preserving polymeter. Though this type of polymeter could be measure preserving (for example, 3/4 and 6/8 with a constant eighth note) and some tactus preserving polymeters will also be subdivision preserving (3/4 and 4/4 with a constant quarter note will thus have a

¹ For an example of this, see Igor Stravinsky's *Petrushka* (2 bars after R3, R4, etc.).

constant eighth note subdivision though 3/4 and 12/8 where the quarter note equals the dotted quarter note will not), this additional category is necessary because of the greater specificity it offers in regards to analyzing combinations of simple and compound meter² like that encountered in Ligeti's fifth etude, *Arc-en-ciel*.



Ex. 3 Subdivision preserving polymeter: neither the beats nor all of the barlines are aligned, but there is a shared subdivision pulse

The etude is written in a subdivision and measure preserving polymeter: 3/4 in the right hand with 6/8 in the left hand, where the eighth note and sixteenth notes are consistent but the beats are not. Ligeti's previously quoted intentions regarding hemiola and the additive rhythms of African music are directly embodied in this metric structure. The three against two patterning is articulated for almost the entire movement and acts as a framework against which irregular groups of sixteenth notes are expressed by accents, beaming, register, and other means. These rhythms represent Ligeti's absorption of African music and create another layer of complexity above the polymeter.

However, while the concept behind the music is quite sophisticated, the effect is very natural. Like Ligeti's micropolyphonic music, there is a distinct gap between the notation and the auditory effect of *Arc-en-ciel*. The extremely slow tempo (sixteenth note = ca. 84) and the instruction that "the metronome mark represents an average, the semiquaver movement

² This could also have applications in describing more complex polymeters, such as 5/8 against 11/8 (constant eighth note).

fluctuating freely around this average tempo as in jazz” make it so the music will never be felt the way it looks on paper. Indeed, without even taking the tempo fluctuations of *Arc-en-ciel* into account, the tempo itself greatly limits the manner in which the music can be perceived.

In his article, “Mapping Metrical Particularity: Some Hierarchical and Psychological Considerations”, Justin London discusses how various limits of perception will effect the likelihood that certain metric patterns will be perceptible. He states the psychological present is approximately 6 seconds while the longest possible span between two points that can be heard as consecutive beats is only about one and half to two seconds. Given the tempo and notated meters of *Arc-en-ciel*, one measure of music lasts about nine seconds while each quarter note has a duration of about three seconds and each dotted quarter note of about four and a half seconds. The notated measures thus last one and a half times the psychological present, while the beats are two to three times greater than the longest perceptible span between successive beats!

According to London’s argument, such a meter would not be tenable, and in reality, the etude’s rhythmic surface does not project the quarter or dotted quarter note as the beat, but rather the shared sixteenth note subdivision. The speed of this note value is much closer to the range of maximal pulse salience (or the range of tempos most likely to be perceived as the beat) and creates a level of continuity throughout the piece than cannot be felt as anything other than the true beat. The quarter and dotted quarter notes will in turn be felt as regular groupings of beats (ie. measures) rather than beats themselves. Ligeti’s subdivision preserving polymeter will be felt as tactus preserving, and the overall effect will be of a diffuse field of shifting metric and rhythmic accents.

The composer further obscures the polymeter through the technical demands placed on the pianist. The texture of the etude is generally notated as four separate lines, one melodic part

and one harmony part in each hand.³ The performer is faced with the challenge of bringing out those two melodic lines, despite the long span of time between successive notes in those parts, the limited sustain of the piano, and the complex texture. He/she must also execute the notated accents (usually though not always expressing the polymetric structure) and phrasing even when other musical parameters such as melodic shape express conflicting groups. In the left hand of the first measure (example 4), the player is asked to bring out the line E-C-D-Bb-Db (stems down) while the musical surface suggests a different interpretation: consistent groups of three sixteenth notes forming a sequential pattern (example 5). The shape of the pitches creates an alternate melodic line and rhythmic grouping that is arguably more perceptible than the one emphasized by the notation. Similar examples of disagreement between pitch patterns and the rhythms or lines Ligeti denotes as most important occur throughout the etude, adding further richness to the music.



Ex. 4 Left hand of m. 1 as notated

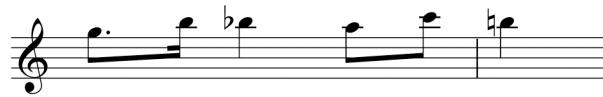


Ex. 5 Left hand of m. 1 with groupings rewritten to reflect pitch contour

In addition to such issues of perception created by voice overlap and voice crossing, there are lines notated in the score that can never truly be performed as written since certain keys will

³ Generally, each hand's music could be reduced to three or four part tertian harmony with clearly controlled stepwise voice leading. The non-functional tertian harmonic language of the piece can be viewed as another element of traditional practice that Ligeti has reabsorbed by this point in his career.

need to be restriking by another voice. In the right hand of the first measure, the melody is indicated as in example 6 but will instead be heard as example 7 since the pianist must lift off the Bb in order to restrike it as part of the inner voice. This occurs again on the high B's and D's of the second measure and at other places in the piece. The perceived melodic line thus differs from the notation in an inescapable fashion.



Ex. 6 Right hand upper voice of m. 1 as notated



Ex. 7 Right hand composite melody of m. 1 (notes in parentheses are from the inner voice)

Still, the right hand melody (with a few notes from the harmony voice contributing to the line) is a guiding force in the piece. While the natural tendency for the ear to pick out the upper voice as most important is a factor in this primacy, Ligeti's care in shaping the line gives it a crucial role in both the rhythmic and pitch structure of the etude. The melody begins with dotted eighth – sixteenth rhythms (notated on the first beat and perceived on the second beat), which foreshadow the groupings of three sixteenth notes that later become important.⁴ On the third beat of the melody, the change to eighth notes (or groups of two sixteenth notes) embodies a subtle acceleration of activity, preparing the listener for mm. 3 – 5 where a more elaborate version of this process occurs. The first phrase ends on the downbeat of m. 2, yet the B-natural

⁴ The left hand patterning at the beginning of the first measure underscores that rhythmic grouping as well.

is restructured by the inner voice creating the impression of a dotted eighth – sixteenth rhythm that propels the music into the next phrase.

Here, a characteristic motive of Ligeti's style that was hinted at in the opening comes to the fore: a chromatic descent often referred to as the lamento motive. The first phrase includes the pitches B-Bb-A in the melody while the next note of that descent, the Ab, is transferred to the right hand harmony voice on the last sixteenth note of m. 1. This manner of hiding the end of the descent occurs frequently in the piece and creates the impression of a subtle Shepard scale where the notes are always descending yet never really abandon their original registral space. In fact, the chromatic descents begin on successively higher pitches (Bb for the first phrase, D for the second, E for the third, F for the fourth, F# for the fifth, etc.) and span larger registers each time. This motive strongly influences the surface pitch material for a majority of the work and creates a clear (almost Schenkerian) structural framework.

The second phrase is also important in establishing another level of the work's metric architecture. Like the opening phrase, the second lasts four quarter notes and uses a similar rhythm to strongly express that grouping. By repeating such a clear structure, Ligeti is adding another layer of rhythmic complexity: the implication of 4/4 over the notated polymeter of 3/4:6/8. As listed in example 8 below, the lengths of phrases in the melody generally span between two and eight quarter notes, a fact probably due in large part to the limits of perception imposed by the slow tempo as discussed above. Of the seventeen melodic phrases, five last exactly four quarter notes, while another three are slightly more or less than 4 quarter notes. One extended phrase is eight quarter notes and two different pairs of adjacent phrases add up to 8 quarter notes. This frequency of durations based on four quarter notes gives the melody a sense of an improvisatory 4/4 time freely floating over the main polymeter.

<u>Measure #s of Melodic Phrases</u>	<u>Length in Quarter Notes</u>
1 – 2.1	4
2.2 – 3.2	4
3.3 – 5.1.25	4.5 (grouped in dotted eighths)
5.1.5 – 6.1	2.75 (grouped in eighths)
6.1.25 – 7.1	3.75
7.2 – 8	5
9 – 10.3.33	5.33
10.3.66 – 11.2	2.66
11.3 – 12.2	2.25
12.2.25 – 13.2	3.75
13.3 – 14	4
15	3
16 – 17.1	4
17.2 – 19	8
20 – 21.1	4
21.2 – 22.1	3
22.2– 23	5

Ex. 8 Length of Phrases in Right Hand Melodic Voice

As shown above, the piece is divided into three sections, the first of which ends at a place where the implied 4/4 and the notated 3/4:6/8 polymeter meet. Though none of the melodic phrases in the second and third sections are strictly aligned with the original 4/4 framework set out by the opening, that background structure does have a lasting effect on the musical surface. A number of important events happen on downbeats of the projected 4/4: the arrival of the 6:4 polyrhythm in m. 7 (that begins on the highest note of the first section), the first appearance of the loudest dynamic of the piece in m. 11 (*fff*), and the point in m. 18 where the sixteenth note pulse completely disappears. Even the final empty measure of the etude can be explained as a resolution of the 4/4 vs. 3/4:6/8 cycle.

Returning to the small-scale rhythmic structure of the right hand melody, the third phrase begins on the anticipated downbeat of the implied 4/4 meter and starts with the same dotted rhythm as the previous two phrases. Here, however, Ligeti uses the expected attack on the sixteenth note of that figure as a pivot to a new rhythmic grouping of three sixteenth notes rather than four, causing the implied quarter note beat to accelerate and become a dotted eighth note beat. This change was prepared by the emphasis on groupings of three sixteenth notes present in the first measure of the etude, a connection that is emphasized by the similarity of pitch material: the upward arpeggios of the left hand at the beginning are mirrored by the downward arpeggios of the right hand in the third phrase.

In m. 5, another rhythm pivot foreshadowed by the opening measure occurs. The next attack expected in the pattern of three sixteenth notes comes on the third sixteenth note of beat 1 but the rhythm then continues in eighth notes.⁵ This process of acceleration from groupings of four sixteenth notes to three to two reflects Ligeti's beliefs about the perception of polymeter and polyrhythm. In "On My *Etudes* for Piano", he writes:

"The ratio 5:3 is of course arithmetically simple, but perceptually very complex. We do not count the pulses but rather experience two qualitatively different tempo levels."

Leaving the question of whether the polymeters in *Arc-en-ciel* are actually perceived as different tempi, it is clear that the rhythmic process in the melody of mm. 1 – 5 is thus one of an actual tempo shift in Ligeti's mind. The presence of the shared sixteenth note subdivision between the three different speeds creates the effect of a very explicit metric modulation in the right hand. The left hand continues in its original temporal space, but at times takes over the groupings of four sixteenth notes that were originally the property of the right hand. Thus it continues the 3/4:6/8 polymeter while the right hand creates a sense of acceleration above.

⁵ It is interesting to note that the change comes on the first expected melodic attack after the downbeat of the original implied 4/4 meter.

That composed out *accelerando* ends on the third beat of m. 5, where Ligeti introduces the first true polyrhythm of the piece. That process heightens the expressive effect of the polyrhythm: the music gets more agitated and intense as the acceleration occurs, finally culminating in the previously discordant but still interlocking rhythmic layers being pulled apart completely. The 5:4 polyrhythm brings a new level of rhythmic dissonance to the piece, which later builds to an even greater climax before resolving at the end of the first section.

In m. 6 and 7, the motion from eighth note groupings to polyrhythm is repeated and intensified. The eighth note groupings are continued for a longer amount of time and build to their own dynamic climax (third beat of m. 6) and then die out before the polyrhythm arrives on the second beat of m. 7. Here, the 5:4 polyrhythm reawakens the music and propels it toward the end of the section. The 5:4 rhythm accelerates into a 6:4 figure, which is repeated three times as it crescendos. This 6:4 polyrhythm, as mentioned previously, begins on a projected downbeat of the 4/4 framework and is the first introduction of eighth note triplets, a rhythmic pattern that becomes crucial in the second and third sections of the piece. Once a climax is reached on the last beat of m. 8, the polyrhythm seems to continue, but the triplet sixteenths then move to thirty-second notes. Ligeti thus continues the process of acceleration in such a way that the rhythmic pulse of the right hand becomes realigned with that of the left hand. A sort of temporal resolution sneaks in, and the volume of the music drops off as abruptly as the rhythmic tension.

The second section of the piece (m. 9 – 15) is developmental in nature. The lamento motif remains an important element of the right hand melody, though now whole tones disrupt the chromatic flow. The rhythms of this section are more variable as well: groups of two and three sixteenth notes occur in a non-retrogradable rhythm during the first phrase, while the second phrase features intense polyrhythms leading up to the loudest part of the piece. Here, the

music crescendos to *fff* on the beat 3 of m. 11 (another downbeat of the implied 4/4 framework) for a reappearance of the important eighth note triplets. After the 3:4 polyrhythm of that dynamic climax, Ligeti uses another composed out accelerando: the triplets move to a grouping of three sixteenths and then groups of two sixteenths. The expressive tempo changes indicated in the score enhance the composed out temporal shifts and create a strong build-up of tension going into the false recapitulation at m. 13.3.

Though the music at that point clearly recalls the beginning, it is not a true recapitulation as further development of both the lamento motive and the 6:4 polyrhythm remains. The 6:4 figure reasserts itself in m. 15, here with straight eighth notes articulated in the melody rather than triplets. A brief chromatic descent is stated prominently in that top voice, leading into beat 3 where the sixteenth note triplets transition to thirty-second notes. As at the end of the first section, Ligeti uses a process of rhythmic acceleration to resolve the rhythmic tension created by the polyrhythm. The completion of the 6:4 polyrhythm and the lamento motive on beat 3 of m. 15 mark the conclusion of the second section, an event which again happens on the downbeat of the phantom 4/4 framework.

In m. 16, the music truly returns to the materials of the opening and begins the final section of the piece. Here, the right hand melody emphasizes the decreasing groups of sixteenth notes while the left hand switches to pure eighth notes for the first time in the piece. The pitch patterns of those notes seem to imply a 3/4 meter rather than the notated 6/8, thus introducing a level of uncertainty into the main polymetric structure. Like the opening, the right hand line in m. 16 does articulate a four quarter note phrase, yet it is displaced by a beat from the main 4/4 framework and gradually dissolves into the accelerative process of the inner voice. The next phrase in the melody tries to return more closely to the material of the opening by using a dotted

eighth – sixteenth rhythm, but that again devolves into groupings of three sixteenths. The left hand then imitates the right hand a quarter note after the second phrase starts, destroying any remaining sense of 6/8 in those voices.

At this point, where the notated polymeter is at its weakest, Ligeti uses another rhythmic pivot to create a sense that time itself is slowing down. In the second beat of m. 18, the sixteenth note pulse that has been articulated constantly in at least one voice for all of the preceding measures shifts to a series of eighth note triplets and then to straight eighth notes. Leading up to that point, the right hand has been expressing groups of three sixteenth notes, with the third note of one such group falling on beat 2 of m. 18. That beat also functions as the third beat of the displaced 3/4 implied by the imitation in the left hand. This weak beat (in the notated and perceived meters) acts as the fulcrum from the previous sixteenth note pulse to the slower triplet pulse. By using a weak beat (unlike the previous rhythmic pivots, which occurred on strong beats), Ligeti effectively makes the triplets seem like a natural extension of the phrase as it decelerates. The move from triplets to eighth notes in m. 19 has the same effect, as the eighth notes are grouped in threes and thus feel like a *ritardando* rather than a distinct rhythm. Both the previous use of similar processes functioning in alignment with the sixteenth note pulse and the very incessant nature of that pulse prepare the listener for this moment, allowing it to have an intense expressive effect.

After that stretching of time, the music is finally able to return to the material and structure of the opening. The underlying 3/4:6/8 polymeter is clearly articulated and the melody once again expresses a four quarter note phrase. That phrase is displaced by one quarter note from the original 4/4 framework, but the subsequent phrase lasts three quarter notes, thus realigning the right hand melody with the 4/4 implied by the opening. After the metric

resolution of the melody in m. 22, the music begins to drift off. The distinct voices of the right hand merge into a series of harmonies (some arpeggiated and some not) as the left hand did back in m. 20. The dynamics fade into nothing and the pitches get ever higher until only a chromatic ascent in parallel major seconds remains. The silence of m. 24 implies that the music is continuing even though the listener can no longer hear it, rendering the resolution of the melody's original 4/4 framework imperceptible.

Like his usage of inaudible counterpoint to create direction and unity in his micropolyphonic pieces, Ligeti uses rhythmic and metric processes that range from very perceptible to (arguably) not perceptible at all in order to structure a very free and lyrical work. Those complex rhythmic and metric techniques are the direct cause of the shimmering and shifting musical surface of the etude, yet are masked by their natural and delicate aural result. The tension between the notation, the intricate interpretive demands on the pianist, and the perceptual tendencies of the listener make *Arc-en-ciel* a sophisticated example of Ligeti's reclaimed rhythmic language as well as an intriguing challenge for the performer.

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