Performing Rhythmic Dissonance in Ligeti’s Études, Book 1: A Perception-Driven Approach and Re-notation

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by

IMRI TALGAM

A dissertation submitted to the Graduate Faculty in Music in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

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Imri Talgam

This manuscript has been read and accepted for the Graduate Faculty in Music in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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Abstract

Performing Rhythmic Dissonance in Ligeti’s Études, Book 1: A Perception-Driven Approach and Renotation

Imri Talgam

Interpretive approaches to the Études have been limited by Ligeti’s choice of notation, which creates several layers of difficulty in the presentation of complex rhythms. In order to resolve some of these difficulties, this dissertation includes a complete re-notation of four Études, using a methodology based on research in cognition and perception of rhythm.

Based on this new score, the notion of rhythmic dissonance is developed as an analytical tool to investigate in-time perception of rhythmic complexity, drawing on existing work on metric entrainment and metric dissonance. Different compositional strategies for the production of rhythmic dissonance are shown to have a decisive formal function on both the micro- and macro-levels. The relation between perception of rhythmic patterns and the influence of other musical parameters is explored, using concepts from information theory, and auditory scene analysis.

Using this conceptual framework, I argue for the need to open a new space for interpretation based on analysis of rhythmic perception and re-notation of the score. This is demonstrated using detailed analyses of Automne à Varsovie and Fanfares, with discussion of various alternative re-notations and their influence on performance.
Finally, I suggest a model for maximizing listeners’ experience of rhythmic dissonance by performers. Using knowledge of the most perceptually salient polymetric layers, performers can modulate the relative prominence of each layer in order to create a maximally differentiated musical texture. This model can be extended to other Ligeti Etudes and related repertoire, as well as other types of notated, rhythmically complex music.
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Introduction

The work of re-notating the first book of Ligeti’s Etudes has both a practical as well as a theoretical goal. Having performed the Etudes many times in recent years, I often found myself resorting to counting strategies strongly at odds with Ligeti’s choice of notation in order to realize the polyrhythmic and polyphonic quality of the music. Often, the music is notated in a traditional meter such as 4/4, while actually only articulating pulsations that are in contradiction with this notation. Such “virtual” meters obscure the interaction of rhythmic layers in the music, creating considerable cognitive strain for the performer. More generally, the groupings implied by the notation often conflict with the most likely metric interpretation of the music for both performers and listeners, making access to the musical structures unnecessarily opaque.

These conflicts between notation and perception are evident in multiple idiosyncrasies of the notation. The inadequacy of traditional metric grids in polyrhythmic music is reflected in the systematic use of beaming over the beats of the written meter (reinforcing anti-metrical pulses and groupings), as well as unmetered notation (in Etudes 1, 2, and 3). While some performers might not see the need for such re-notation and rely on the notated meters for their counting strategies, repeated performances convinced me that many difficulties could be resolved by re-writing the music with alternative groupings and meters. As I argue, the change in notation is not merely a more efficient way of conveying the same information to the performer, but rather proposes a different approach for the communication of complex polyrhythmic structures to the listener. The practical goal of this dissertation is therefore to resolve
some of these difficulties by re-notating the Etudes, in the hope of maximizing the potential for communication of polyphonic and polyrhythmic organization of the music.¹

Separating these interrelated questions of perception, notation, performance, and aesthetics when the score itself is subject to revision in the process creates some difficulties. In order to untangle these issues, I have chosen to start with concrete issues tackled in performance of the written score, while gradually expanding into the more complex questions behind these difficulties. Chapter 1 deals with the problem of notation at length, with the advantages and problems of Ligeti’s notation reviewed historically and practically. Chapter 2 formulates a general set of preference rules for my re-notation, with specific examples of each rule.

In addition to this practical goal, I also attempt to clarify some of the issues involved in the listener’s perception of rhythmic complexity, and how it can be influenced by performers. For this purpose, Chapter 3 develops a notion of rhythmic dissonance that draws on empirical work in order to create new analytical concepts for performance. Through analysis of perceptual constraints and possible listening strategies, I suggest a model for maximizing rhythmic dissonance in both composition and performance of complex music.

Following these methodological chapters, I proceed to analyze Fanfares and Automne à Varsovie in detail. These Etudes were chosen for their especially systematic character, and the corresponding improvement offered by the re-notation. Of the other

¹ There are many precedents for re-notation for practical purposes of rhythmically difficult music; for example see Koussevitzky’s re-barred version of the Rite of Spring, or Yvar Mikhashoff’s transcription of Nancarrow’s Tango? (both scores are unpublished).
four Etudes in Book I, two are relatively unproblematic in terms of performance and notation, because of their slower tempi (n.2 and 5), while the notation of Désordre can be improved with a simple alteration, as I explain in the appendix; Touches Bloquées presents a special case, which I discuss in Chapter 3.

The analysis of Fanfares in Chapter 4 begins with a discussion of the choice of re-notation, with alternatives and discarded possibilities serving to demonstrate the benefits of the final choices. I then proceed to analyze the creation of large-scale form through rhythmic organization from a compositional standpoint. Based on this preliminary analysis, I re-introduce issues of perception and rhythmic dissonance and apply the analytical model developed in Chapter 3 in particularly interesting passages.

Chapter 5 reverses the order of presentation, and begins with an analysis of the main rhythmic techniques of Automne à Varsovie, before considering questions of perception and performance. This difference in approach is dictated by the polyphonic quality of the music, which provides many more alternatives for re-notation. As I argue, the re-notation in this case is a type of composed interpretation informed by analysis. Furthermore, the specific difficulties raised by different passages require a highly contextual approach to re-notation, as I discuss at length. Finally, one the most complex passages is presented as a puzzle for interpretation, allowing for application the different concepts developed throughout the dissertation.

Rather than trying to exhaust the material, the discussions focus on moments that present both analysis and performance with special challenges; the analysis of other passages can be inferred from the re-notation and preference rules. Lastly, the
new score is provided in the appendix; many of my interpretative ideas can also be read through a comparison (or performance) side by side with the original.
Chapter 1: The Need for a Re-notation

Introduction

This chapter opens with discussion of the practical difficulties created by Ligeti’s notation for performers. The argument I make about the benefits of a re-notation applies to most Ligeti Etudes, despite considerable differences in their rhythmic organization and corresponding metric notation. For the simplicity of presentation, I only present excerpts of Automne à Varsovie here, rather than try and demonstrate the ideas using several Etudes. However, the same principles hold for many other works in book II and elsewhere (especially Galamb Borong, Der Zauberlehrling, Entrelacs, Vertige and L’escalier du Diable).

After presenting the difficulties, I review the principles behind the original notation and their relation to the work’s genesis with reference to comments by the composer. Having reviewed Ligeti’s performance ideal, I propose an alternative approach to its realization in performance, using a different approach to notation.

In exploring the perceptual and cognitive difficulties underlying performance of rhythmically complex music from the performer’s perspective, the relation between notation and metric entrainment emerges as the central issue for re-notation. Drawing on empirical experiments, I propose as an alternative model for performance of rhythmically complex music, using a single meter to integrate the various rhythmic layers. Finally, different types of rhythmic listening are considered in relation to rhythmic organization and notation, which I explore in detail in subsequent chapters.
Difficulties in Ligeti’s Notation

Notation of any complex polyrhythmic music is bound to create practical difficulties for performers: if nothing else, certain pulses will always be easier to accommodate within the written meter than others, which will appear as syncopations. The most immediate difficulty created by Ligeti’s notation is the rift between the notated meter and the pulses actually articulated in the music. Rather than reflecting and supporting the rhythmic organization, the notated meters of most Etudes serve as merely ‘virtual’ grids for coordinating different pulse trains. Often, Etudes are presented in a traditional meter (such as 4/4, 12/8 etc.), although the meter is never articulated in the music, nor related to its means of organization. The logic behind this seems simple at first: given the complexity of rhythmic processes, Ligeti decided to simplify the appearance of the music by giving the performer a standardized yardstick. This has the benefit of providing a ‘neutral’ environment for the presentation of conflicting polyrhythms, in which no single pulsation is dominant, while allowing for the synchronization of different layers using the visually apparent common denominator. While this strategy provides a means of verifying the correct alignment of different layers, it overemphasizes the common denominator, which should not be acoustically and perceptually salient.

In Figure 1.1, the music is notated in 4/4; however, the problem with this notation is visually reflected in the anti-metrical beaming in the left hand, which constantly contradicts the division into beats and measures. For a pianist performing
the work, this is a source of difficulty both during the learning process as well as in real
time performance:

![Figure 1.1: Clash between 4/4 meter and G3/G5 pulse layers (mm. 17-20 of Autumne à Varsovie).](image)

As shown in Example 1.1, two distinct pulse trains occur at a speed of five
sixteenth notes in the right hand (G5) and (less consistently) three sixteenth notes
in the left hand (G3). Curiously, even the accompaniment created by G4 (indicated
by the beams) is not aligned with the notated meter in this passage. As a result,
counting in 4/4 forces the pianist to perform both these different metrical layers as

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2 I refer to polyrhythms using the standard terminology proposed by Krebs (1999). The cardinality refers to the groupings created by accents expressed in terms of the shortest given note value. Hence G4= grouping created by accents every four sixteenth notes.
syncopations, rather than treating one of them as the primary pulse and the other as a related polyrhythm. This difficulty can be interpreted in light of experimental work on perception of rhythm, as I show below.

**Reasons for Ligeti’s Notation**

While Ligeti’s insistence on traditional meters might seem odd from a practical standpoint, it can be related to the Etudes’ genesis. The influence of Conlon Nancarrow’s player-piano studies on Ligeti’s music in the 1980’s was acknowledged by the composer and is well-documented by various scholars.³ Ligeti’s Etudes react to the exploration of complex temporal relations in Nancarrow’s studies, and can be understood as an attempt to make such complex polyrhythms performable by a single player. In the case of Nancarrow’s studies, complex polyrhythms could be executed directly on a player-piano by punching holes in the rolls at precise points. In order to do this, Nancarrow used a milimetric grid for measuring the positions of holes punched into the player-piano rolls.⁴ While this grid remains unarticulated in Nancarrow’s studies and only serves to calculate the common denominator of the different parts, almost all of Ligeti’s Etudes feature uninterrupted rhythmic motion articulating the smallest common denominator of the different polyrhythmic strands.

The constant presence of the common denominator has two practical benefits. First, the visual salience of the common denominator makes it possible to

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³ Richard Steinitz, *György Ligeti* (Faber & Faber, 2003), 269.
realize the complex rhythms of the player-piano by a live pianist. If the common denominator (the sixteenth notes in the example above) were missing, it is easy to imagine how the complex and irregular attack pattern of the combined layers would be distorted beyond recognition; by making the grid present, the possibility of error in calculation or synchronization is avoided. Moreover, Ligeti was interested in the possibility of creating an illusion of multiple concurrent tempi arising from different groupings of the common denominator:

I have also been concerned with acoustical illusions, especially in my more recent pieces, the Piano Études and the Piano Concerto. In these compositions, we hear melodies which have not been played, which are created out of the interaction of different instruments. Or, a single performer, the pianist, might play in several tempos at the same time. In reality, he plays in one tempo, but creates an acoustical illusion.5

This technique has been described as 'linear extraction' (Pace, 2012) or as systematic use of hemiolas (Taylor, 1997), and has a strong basis in the nineteenth century tradition of piano writing. Remarkably, most Ligeti Études rely entirely on this technique in which different tempi are created by accentuating groupings of different length, with a constant motion at a regular speed underlying the emerging meters (see Figure 1.1 above).

Unfortunately, the safety net provided by the presence of the common denominator also provides the single greatest obstacle to an adequate polyphonic performance of the études, in which all metric layers are transparently played. From the performer's perspective, it requires an extreme differentiation in dynamics and

timbre in order to separate the foreground layers from this constant background
movement and avoid cross interference between the foreground (pulse layers) and
the common denominator background; similarly, the listener then has to extract the
different pulse strains from the piano’s constant stream of sixteenth notes. Because
of the timbral uniformity of the piano’s sound, this process of encoding and
decoding the metrical message makes the polyrhythmic relations less immediately
apparent.

While the presence of the common denominator is part of the identity of
these works and cannot be changed, the task of differentiating between the different
rhythmic layers would be greatly aided by re-notating the groupings of sixteenth
notes to correspond to the actual pulses. This presents us with another question:
why did Ligeti knowingly choose to notate the music in a generic meter regardless
of the specificity of the music? In a performance note to Fanfares, he makes the
following comment:

From here onwards until the end of the piece the bar-lines serve only to help
synchronize the two hands. The articulation of the motif does not depend on
the bar division (the ostinato, however, continues to be accentuated as
3+2+3, independently of the motif).\(^6\)

Similar comments appear in other etudes, especially in Book II. This could be
explained by practical aspects of notation that first came up in the horn trio of 1982,
the first piece in Ligeti’s new polyrhythmic style. In that work, despite the

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independence of the different layers, the use of a virtual meter remains the easiest means of coordinating the different tempos between the three players. However, in the Etudes synchronization between players is no longer a consideration, and hence provides no benefit; this suggests that the metric notation could be an attempt to influence the interpreter’s perception of the rhythm. By avoiding the correspondence of meter and accent patterns, the notation’s use of ‘virtual’ meters prevents any single pulse layer from dominating the texture, or being perceived as the primary meter of a passage. In this way, Ligeti communicates the idea of polyrhythmic multiplicity to the performer through the avoidance of hierarchy in the score; all actual meters are equally removed from the underlying grid.

Without yet formulating the principles behind the re-notation, let us illustrate its approach. In opposition to virtual meters, the re-notation uses the changing groupings present in the music to determine the meter. Figure 1.2 presents a re-notation of measures 17-20 (fig. 1.1) in which the left hand pulse is identified with the meter, thus reducing the syncopation to the remaining pulse in the right hand.
Fig. 1.2: Alternative notations of Automne à Varsovie. (A) Original notation. (B) Re-notation with meter derived from left hand pulses (G4 and G3).
For now, it suffices to see how the choice of notation radically changes the difficulties faced by the performer. On a first impression, the changes of meter might seem more complex, or otherwise redundant. However, the discussion of the rules and methodology below shows how this re-notation actually simplifies the situation.7

**Rhythmic Dissonance and Polyphony**

Rhythmic complexity in the Ligeti Etudes is closely related to polyphony and the differentiation of simultaneous voices or pulse layers; as we've seen, a successful performance is one that manages to convey this multiplicity with the greatest differentiation. In Chapter 3 I define the relation of rhythmic dissonance, complexity, and polyphony at length. For now, let us adopt a working definition of rhythmic dissonance relevant for the discussion of the relation of notation and performance. Let us define rhythmic dissonance as the simultaneous coexistence of at least two competing pulse trains that exhibit some degree or regularity, allowing the listener to entrain to either of the different meters and grouping of accents suggested by each. In Figure 1.3, rhythmic dissonance is produced by the conflict between G5 in the right hand, and an alternation between G3 and G4 in the left hand.

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7 An apparent inconsistency appears in Fig. 1.2 (B), measure 23. Although it would be more literally consistent to notate measures 22-23 in a meter that reflects the irregular grouping (3,3,3,4,5), this has undesirable consequences, as I show in Chapter 2. In this case, the metric economy rule (rule 4) justifies the deviation (see Chapter 2 below).
This type of grouping conflict is usually described as a polyrhythm (in this case, 5:3 and 5:4), or sometimes as a polytempo, as in Ligeti’s comment above.

Figure 1.3: Rhythmic dissonance produced by pulse layers with independent grouping (re-notation by the author).

In order for the rhythmic dissonance in Figure 1.3 to be perceived as such, a performance has to satisfy two conditions. First, the accents in both hands have to be dynamically separated from the continuous stream of sixteenth notes; second, the accent patterns of the two hands should be differentiated from each other. In other words, the separation of the texture into two polyphonic parts (or streaming,
in the terminology of auditory scene analysis) is required for the perception of rhythmic dissonance, a phenomenon that I discuss at length in the analysis Automne à Varsovie.

In light of this, let us consider the implications of Ligeti’s comment: a successful performance is one in which the impression of independent tempos (or pulse trains) emerges, allowing for perception of the polyphonic relations between the parts. In this relation, neither part is thought of as metrically primary; if there were a pre-established hierarchy, the music would no longer be fully polyrhythmic, but would simply feature anti-metrical, or syncopated elements. In order to convey this, Ligeti chose the metric notation closest to a level playing field, in which the rhythmic definition of each part would be the sole reason for its claims on the performer’s attention. In other words, this notation suggests that at the heart of the Etudes’ aesthetic is a struggle for metric dominance by the different parts or conflicting rhythmic groupings, out of which musical form is born. In what follows, I will show why precisely this ideal is better realized using the opposite principle of notation demonstrated in Figure 1.2 (B). In other words, I propose to clarify the aesthetic effect Ligeti seeks precisely by contradicting his own rhythmic notation.

**Entrainment and Meter**

If the avoidance of hierarchy is central to Ligeti’s aesthetic, strong reasons are required to justify reversing the notation that conveys it. Let us examine in detail some of the cognitive problems that arise from the idea of non-hierarchy and consequent use of virtual meter.
Attending to a musical meter or pulse is generally described as process of entrainment, in which the listener ‘tunes in’ to a pre-existing regular pulse and anticipates its continuation by projecting the next beats. After a multiple pulses have been played, most listeners will be able to predict the timing of the next beat with ease within a broad range of tempos, even without musical training. London (2012) argues for the primacy of entrainment in musical experience while reviewing the experimental literature on the topic.\textsuperscript{8} Many bodily mechanisms other than the auditory system cooperate to produce entrainment, including sensorimotor synchronization and neural network activity. The response of these mechanisms is dependent on the interaction of patterns created by the interonset intervals (IOI) between sound events, but also on a prior sense of metrical expectation; the interaction of the two is highly context dependent. The power of these mechanisms is greatest when the musical signal displays a high degree of regularity, allowing for confirmation of our metric expectations. Conversely, our ability to entrain decreases when faced with irregularity or ambiguity; to simplify, the power of entrainment corresponds to the degree of regularity.

When the pulse displays a higher-level regularity that allows prediction or entrainment to the grouping pattern of multiple beats, a metric framework is created.\textsuperscript{9} In Western art music, most meters are associated with certain characteristic accentuation patterns manifested in phenomenal accents. Ligeti’s

meters (like many other contemporary composers), however, do not carry such meanings, but are only technical means for synchronization.

Still, regardless of the added cultural associations and implications of a metric pattern or the lack thereof, the meter still determines the tactus used by the performer. A tactus is normally defined as the most stable pulse present in the music, in relation to which we perceive other speeds of motion (for example, a quarter note in 4/4 or 3/4). While a tactus is required for a meter, it is not in itself sufficient; a pattern that organizes pulses into a higher regularity is required. However, the choice of tactus is decisive in the grouping together of various rhythmic events. This explains the difficulty caused by performing an anti-metrical pulse, where a rift is created between stimulus-based attention (sound events) and expectancy-based attention (the result of metrical expectations)\(^\text{10}\). This is line with observations about the connection between phenomenal accents and meter found in *Generative Theory of Tonal Music*, in the requirement of metric preference rule 3.\(^\text{11}\)

In Figure 1.1, the tactus given in the notation contradicts the low-level grouping: each beat in the notated meter is four sixteenth notes long (G4), while the accents create groups of three and five (G3 and G5). On a higher grouping level, the metric organization of this tactus into units of four pulses also does not correspond to the music, as the beginning of each bar is not marked as such. In this way, Ligeti’s virtual meters produce a cognitive dissonance: the performer is required to count according to the score, while fighting against the natural entrainment to the accent

\(^{10}\) London (2012), 48.  
\(^{11}\) See Lerdahl and Jackendoff (1987), 76; For an extended discussion, see Chapter 2 below.
patterns. The conflict between these contradictory forms of metric organization is counterproductive, leading to many inaccuracies in most performance. Remarkably, these often occur in passages where the conflict between notated meter and articulated pulsation is strongest.\textsuperscript{12}

**Can Musicians Track Two Beats Simultaneously?**

So far, the difficulties in notating polyrhythmic music have been shown to emerge from the conflict between different aspects of entrainment, or the conflict between the entrainment to one pulse against the framework of another. Perhaps the fault lies with the insistence on using a meter to co-ordinate polyrhythmic music through a single metric grid: why not abandon traditional meter altogether, and have performers simply divide their attention between two independent pulses equally?

Before we can answer this as a performance technique, it is necessary to articulate the conditions of this type of listening. After all, in order to equally attend to two or more polyrhythmic parts, a performer has two be able to follow them as a listener, at least in order to monitor their precision. The question then becomes whether it is possible for musician-listeners to entrain to two independent pulsations simultaneously.

\textsuperscript{12} Generally, problems tend to occur whenever the pulse layers in *Automne à Varsovie* feature some irregularity. For a particularly telling case, compare measures 13-15 of *Automne à Varsovie* in many performances. Almost all performers rush in this phrase, probably as a result of using the left hand pulsation as a meter and distorting it (in order to preserve this metric function), in spite of its gradual augmentation.
A recent experiment by Poudrier and Repp (2012) tested the ability of musicians to track two beats simultaneously, which the authors refer to as polymetric perception.¹³ Participants (who were classically trained musicians) were presented with a series of tracking tasks in which two different meters (2/4 and 6/8) were played simultaneously. In order to gauge metric perception, participants were asked to judge whether a particular probe coincided with a beat in one of the rhythmic parts. To summarize the results, participants were able to track two pulses well under a selective attention condition (in which they only followed one of the lines), whereas under the divided attention condition with more complex rhythmic configurations (such as out-of-phase polyrhythms), participants’ abilities did not differ considerably from chance. This result suggests that participants relied on a strategy of composite accent pattern to determine the metrical position of the probe; under the terms defined by the experiment, this does not constitute polymetric perception, as it is based on a single, unified metric framework.

In this listening strategy, the listener entrains to one of the pulse layers (or tempos), effectively making it the meter for events in the other pulse layer. Figure 1.4 shows the two ways simple 2:3 and 3:4 polyrhythms can be perceived—either as two independent pulsations (bottom row), or alternatively as a single attack pattern. The two different pulsations are represented by black and white squares; the bottom row represents the theoretical possibility of independent pulse

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perception, while the top row presents the result of their combination in a composite attack pattern:

![Polymetric and composite rhythms](image)

**Fig. 1.4:** Polymetric and composite rhythms. 2/3 and 3/4 polyrhythms under condition of streaming (bottom row), representing possible polymetric hearing; in the top row, the composite attack pattern. Reproduced from Beauvillain, (1983).

This constraint on our perception could be turned into a rule for simplifying the notation, assuming a strategy of compound attack patterns is absolutely necessary. In this way, one of the regularly articulated pulses in the music has to serve as the metric grid, against which the other voices are measured.

However, this runs the risk of reducing the polyphonic perception of the texture. Figure 1.4 points out that in order to perceive two distinct pulses, it is necessary to dissociate adjacent sound events from each other. Auditory scene analysis describes the many factors involved in the perception of distinct layers, known as stream segregation. Such stream segregation is influenced by multiple factors, and can be supported by differences in timbre, register or spatialization; however, it can also be influenced by a listener’s attempt to hear it one way or
another. Consciously choosing to combine the pulses into a single attack pattern runs the risk of fusing them into a single line, thus preventing the differentiation of layers; this risk is particularly great given the uniform timbre of the piano.

This presents the re-notation with a dilemma. If this zero-sum game between rhythmic precision and polyphonic perception is unavoidable, every notational solution would generate a problem. This would make an adequate re-notation strategy for the Etudes impossible, or at the very least produce equally bad alternatives. While polyrhythms remain challenging, I believe the use of dynamics to differentiate between the voices can compensate for the tendency towards fusion in metric notation that relies on compound accent pattern. Reconciling compound accent strategies and polyphonic differentiation is possible if the performance of rhythm can be uncoupled from the use of dynamics. In other words, although using a compound accent pattern highlights the similarity and proximity of events that should not be integrated (since they belong to different layers), a careful performance can conceal the performer's use of a compound attack pattern. If the dynamic differences are performed clearly enough, listeners will still be able to perceive the polyphony. Although it might be counter-intuitive, mastering this contradiction between streaming and compound accent pattern is still easier than the conflict created by disruption of the normal relationship of accents and meter required by virtual meters.

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15 See Chapter 5 for further discussion of this topic.
Hierarchy, Tactus Choice, and Listening Strategies

If tracking and performing two pulses without a unified metric framework is unreliable, creating metrical hierarchy is necessary for a controlled performance. This leads us to the question of how to choose a tactus from the manifold rhythmic layers present at any given point. Some tactus choices offer an immediate benefit to rhythmic stability, but might over-emphasize an already salient element, making others unintelligible; others will seem counter-intuitive, but are ultimately better for the overall clarity of the polyphony. The choices for each passage are highly contextual and dependent on the concept of rhythmic dissonance developed in Chapter 3; Chapter 5 demonstrates the interpretative benefits of a systematic approach to tactus selection. For now, let us simply assume that there are reasons for changing the tactus in the course of an Etude and analyze the principle active in transitions.

Imbrie (1973) speculated that listeners can listen to rhythmically ‘problematic’ or ambiguous passages in one of two ways, which he identifies as radical and conservative. A conservative listener is one who maintains the previous metric framework in spite of contradiction by changes in the music, while a radical listener chooses to adjust the metric framework immediately in order to

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16 In Book I, this applies most strongly to the polyphony of Automne à Varsovie, but can be applied to other Etudes, especially n. 7,12,13 in Book II.
accommodate the new events and accent patterns (see example 1.5 below). Imbrie’s distinction originally referred to the listener’s perspective, but it is equally useful as from the performers’. In our case, the two necessarily differ, as will become clear in the discussion of re-notation rules.

In choosing how to deal with a complex polyrhythmic situation that allows for multiple metric perspectives, our primary decision in dealing with a change in relations between pulses is whether to react ‘radically’ or ‘conservatively’ to changes in the musical signal. For example, the following passage from Automne à Varsovie involves the entry of a new voice at a faster speed (the tactus is G7). At the entry, a conservative notation would ignore the accentuation of a metrically weak spot and maintain the same tactus. For a radical re-notation, the same event would trigger a change in the metric organization and length of tactus, changing it to suit the new attack pattern. Figure 1.5 presents conservative and radical versions of the same passage:

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18 I believe the significance of this distinction for analysis of rhythmically complex music has been overlooked; Chapters 3 and 5 develops this by describing the factors that influence listeners’ choice of transition from one type of listening to another.
Fig. 1.5: Conservative and radical notation (both by the author). (A) Conservative notation. (B): Radical notation.
The important thing to bear in mind at this point is the difference between the perspectives of the listener and the performer. A listener is free to respond to the change spontaneously; in order to be precise, a performer has to practice a certain metric pattern in advance, be it radical or conservative. In the analyses offered in Chapters 4 and 5, I trace the divergence of the two in specific passages and consider the implications for interpretation.

Summary

This chapter began with the difficulties created by Ligeti’s use of virtual meters from a performance perspective. The core of the problem is the lack of correlation in this notation between stimulus-based entrainment (the metric pattern suggested by phenomenal accents) and expectancy-based entrainment (the use of tactus as means of synchronization). In order to avoid this difficulty, it was proposed to relate the polyrhythmic parts directly to each other without the mediation of a meter; however, this possibility is ruled out by the impossibility of tracking two pulses independently. As an alternative to using independent pulses, the strategy of using compound accent pattern is proposed, based on a unified metrical framework. The possibility of manipulating this framework (and the choice of tactus) is discussed with reference to radical and conservative listening modes.

The outcome of this argument is paradoxical. The only way to realize the ideal of polyphonic/polyrhythmic independence and perfect synchronization in performance is to accept the need for a hierarchical ordering of the rhythmic layers.
that inherently favors one layer over another. In order to counteract this effect, the choice of metric re-notation has to maximize rhythmic dissonance systematically, as I will show in the discussion of each Etude. Some strategies for mastering this contradiction can be proposed, but many aspects are still context-dependent. In the section that follows, I present the most general guidelines for the re-notation implied by these considerations more formally, in the form of preference rules.
Chapter 2: Re-notation Principles

Introduction

This re-notation generally follows Grouping Preference Rules (henceforth GPRs) and Metric Preference Rules (henceforth MPRs) proposed by Lerdahl and Jackendof in *Generative Theory of Tonal Music*. GTTM describes rules for cognitive organization of tonal music and the meters listeners are likely to infer, or that allow for partitioning the musical signal in the simplest way. While some of these rules are rooted in tonal style, they can be used with adaptations for other styles of music. In this work, the status of these rules is not prescriptive or strictly hierarchical – that is, they are not used to make the case that one interpretation is more correct than another or that certain analytical descriptions are invalid. Instead, they are understood as a formalization of widespread musical intuition that is useful in determining how complex musical objects are most likely to be parsed and grouped in a simple way.

The tonality-specific rules presented there are obviously not used, except in cases where the music exhibits some features of traditional tonal organization. The following is a brief recapitulation of GPRs and MPRs from GTTM relevant for this re-notation, with slight paraphrase of the original formulation.

General Preference Rules

GPR 1

Avoid analyses with very small groups - the smaller, the less preferable.

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**GPR 6 (Parallelism)**

Where two or more segments of the music can be construed as parallel, they preferably form parallel parts of groups.

**MPR 1 (Parallelism)**

Where two or more groups or parts of groups can be construed as parallel, they preferably receive parallel metric structure.

**MPR 2 (Strong Beat Early)**

Weakly prefer a metrical structure in which the strongest beat in a group appears relatively early in the group.

**MPR 3 (Event)**

Prefer a metrical structure in which inception of pitch events coincide with the strong beats.

**MPR 4 (Stress)**

Prefer a metrical structure in which stressed beats coincide with strong beats.

**MPR 5 (Length)**

Prefer a metrical structure in which a relatively strong beat occurs at the inception of either

- a. a relatively long pitch-event,
- b. relatively long duration of a dynamic,
- c. relatively long slur,
- d. a relatively long pattern of articulation.
These rules describe the most likely interpretations of a metric structure by a listener, or a set of default rules for listening, and serve as the starting point of my analysis of rhythmic dissonance. The number of choices in my re-notation, however, is already limited by Ligeti’s unequivocal delineating of groups using accents and slurs, creating clear boundaries in accordance with the principles above. To these preference rules I add another type of preference rules for preferred hearing by the performer, which also serve as the basis for the re-notation.

Notation Preference Rules

1. Metric Regularity Rule

*Strongly prefer a metric notation based on the most rhythmically regular layer.*

For instance, prefer an isochronous meter based on accent pattern with equally spaced attack points to a non-isochronous meter. This rule attempts to maintain correlation between the most salient and regular metric element and the metric grid.
In Figure 2.1, prefer the second example (B), in which the meters implied by the right-hand material dominate. The complex cross-accentuation of the hands becomes easier to realize in the second notation because of the ability to infer each metric position more easily in relation to isochronous pulses. For an illustration of this, see Chapter 4, Figure 5.

2. Motoric Attention Rule

*Strongly prefer a meter that corresponds to the grouping of the most technically difficult element of the texture.*
The task of executing complex motor sequences is related to rhythmic entrainment, which is itself based in sensorimotor synchronization. More intuitively, execution of complex motions is made easier when they can be easily assimilated to the metric framework used by the performer, or when most of its group beginnings coincide with a metrically accented position.

Figure 2.2 (A) shows measures 82-83 in the original notation of *Automne à Varsovie*, in which the right hand plays groups of three sixteenth notes with each group displaced by an octave (G3), while the left hand plays two slower-moving voices without any figuration (G5 and G7). Given both the greater speed and the complex movements required for the right hand figuration, it is inevitable that a performer will have to concentrate on it. In the original notation the 4/4 meter does not correspond to any of the pulse layers actually present at this point, which articulate groups of three, seven, and five sixteenth notes. In this notation, performing the 3/16 grouping in the right hand while counting in 4/4 yields a 4/3 polyrhythm; in addition to this, the polyrhythms created by the other layers have to be counted against the ‘virtual’ (unarticulated) 4/4.

This difficult situation can be greatly simplified by changing the meter to 12/16 (divided into four groups of 3/16 as in Figure 2.2 (B)). In this way, attention can be focused on the right hand, while the other pulse layers in the left hand can be played in relation to the 12/16 meter.
Figure 2.2: Motoric attention in notation. (A) Original Notation in 4/4. (B): Re-notation in 12/16, based G3 in the right hand.

3. Metric Anticipation rule

   Weakly prefer a notation in which a new metric pattern is anticipated at the onset of the first strong signal. Alternatively, prefer a notation that assumes the metric patterns of a radical listener.
This rule requires some explanation. Obviously, not all strong phenomenal accents (whether dynamic, registral, durational or other) cause our perception to shift the metric framework immediately and interpret it as the beginning of a new group. In other words, we are not naturally hyper-sensitive radical listeners, as this would deprive us of predictive frameworks altogether. Therefore, ‘radical’ notation must not be confused with the listener’s experience of rhythmic dissonance. While the re-notation also serves an analytical goal, it ultimately serves to facilitate performances in which all accent patterns are equally respected, resulting in the richest and most differentiated musical surface.

A certain disagreement between rhythmic notation and its perception is inherent in all complex scores, allowing for different hearings. However, in this case, the re-notation intentionally and necessarily produces the difference between the perception of the performer and that of the listener, by making metric decisions that anticipate further developments based on prior knowledge of the music. This divergence is further discussed in specific etudes in the following chapters. Generally speaking, the rule can be understood as a preference for ‘radical listening’ on behalf of the performer, in order to allow the listener a more complex and ambivalent experience of getting momentarily lost.

Figure 2.3 shows the original notation of measures 138-142 of Fanfares, followed by a re-notation according to the metric anticipation rule. The original notation retains the ostinato meter throughout, reflecting the most probable interpretation by a conservative listener until measure 4 of the excerpt. The extreme dynamic contrast of the sudden fortissimo would probably prompt even
the most insistent listener to consider this event as a change of meter, with a new
downbeat on the fourth eighth-note.
Fig. 2.3: Radical notation trigger. (A) Measures 138-142 of *Fanfares* in original ‘conservative’ notation. (B): Radical Re-notation triggered by sudden *ff.*
The conservative interpretation reflected by this notation captures the ambiguity of actual experience up to the fortissimo, in which the motivic material in the right hand can be interpreted as syncopations within the ostinato’s meter. However, after the fortissimo the notation is less likely to correspond to a listener’s intuition and only reflects the composer’s decision on the communication of the rhythm to the performer.

In contrast to this, the radical interpretation of the second notation reflects an unlikely fast rate of adjustment to metric changes, adopting new meters before they could be established with sufficient repetition for the listener to recognize this. Such a notation necessarily reflects a learned interpretation of the score based on prior knowledge; it intentionally purges the ambiguity of listening in favor of an imposed metric organization. However, it corresponds to actual experience by amplifying all the rhythmic events that could prompt an adjustment of the listener’s metric interpretation. Occasionally, however, it is closer to the listener’s experience than conservative notation, as in the case of the fortissimo discussed above (measure 152 in the re-notation). The practical benefit of radical notation in this passage is its aid in synchronizing the hands after long notes in the right hand, further discussed in the Fanfares chapter.

Inevitably, any single kind of notation is insufficient to capture the manifold metric interpretations of an actual listener, who most likely responds differently on repeated listening. Notwithstanding this issue, it is important to remember that the change in notation reflects a change only in the performer’s metric strategy, while
leaving the rhythmic proportions unchanged, and as such does not influence the listener’s strategy.

4. Metric Economy Rule

Avoid frequent meter changes if these are not essential to the synchronization of the parts or to the clarity of the texture.

This rule can be interpreted as a constraint on the metric anticipation rule, which encourages frequent metric changes. However, if the phenomenal accents that suggest metric changes do not form metric patterns involving repetition or parallelism, a regular isochronous meter is preferred.

For example, the augmentation process in Fanfares (measures 206 onwards) can initially imply a series of changing meters; however, the additive nature of the process does not create a regular pulse. Figure 2.4 shows a rejected re-notation of this passage, in which every left-hand chord is interpreted as a downbeat, followed by the original notation, in which the original 3+2+3/8 meter prevails.
This example makes clear that the benefits of ‘radical’ re-notation are context-dependent. Whereas the re-notation discussed in Figure 2.2 helped synchronizing the hands while playing the complex cross-accentuation, Figure 2.4 shows the benefits of a ‘conservative’ meter. In the rejected re-notation, the ostinato accents in the right hand in the third and fifth measures pose a synchronization risk that is easier to tackle in the opposite way, by playing the chords as syncopations in the 8/8 meter. This example also illustrates the motoric attention rule: a key factor in making the re-notation awkward to perform is the contrast between the constant rhythmic activity in the right hand compared to the slow pulse of the left hand.
Concluding Remarks

The set of rules presented above by no means accounts for all difficulties involved in performance and notation of the Etudes. However, it provides a template with which the usefulness of any alternative notations for performance can be interrogated. For each possible notation of a passage, it is useful to ask how which rules are observed and which are violated. Often, it is impossible to satisfy all of these at once, as the rhythmic complexity of the music must manifest itself in a contradiction between different principles. In such cases, it is best to decide based on the musical priorities of each Etude; to this end, the analytical chapters discuss specific choices of notation.

Finally, different solutions offer distinct benefits that can be utilized by performers at different stages of the practicing process. Each notation highlights certain elements, while pushing others into the background, allowing the performer to focus on a different aspect of the music. Ideally, such rhythmically complex works could be published digitally using ‘open’ format that allows for metrical adjustments by performers; evidently, practicing using different notations is the best training for rhythmically complex patterns.
Chapter 3: Analysis and Performance of Rhythmic Dissonance

Introduction

In chapter 1, I’ve discussed the problems with Ligeti’s notation from a practical standpoint, while chapter 2 proposed a set of alternative principles for a re-notation. Various issues involving the perception of polyrhythm and metric entrainment helped to explain the difficulties that result from different types of notation. This made it possible to simplify the relation of score and auditory perception by creating a unified metric framework, while intentionally reducing polyrhythmic complexity to a single compound accent pattern. The compound accent pattern was supported by meters derived from the most salient pulse layer, as described in the re-notation preference rules.

While this strategy reduces polyphonic differentiation and multiplicity, it was shown to be a necessary step in improving the precision of synchronization between different rhythmic layers. In this chapter, I’ll explore the ways in which polyphonic and polyrhythmic independence can be restored and maximized by the performer using this re-notation. This first requires a definition of rhythmic dissonance and the ways in which a performer could influence listeners’ perception. Multiple studies have analyzed the rhythmic complexity of the Etudes in terms of conflict between polyrhythmic ratios and attack points, while largely divorcing rhythmic grouping accents from other types of grouping structures that affect our perception of the
accent patterns.\footnote{See for example, John Cuciurean, “A Theory of Pitch, Rhythm, and Intertextual Allusion for the Late Music of György Ligeti” (Ph.D. diss., State University of New York at Buffalo, 2000).} While these are necessary descriptions of Ligeti’s compositional system, this omission of non-rhythmic elements prevents analysis from tackling our perception of these grouping conflicts. In order to better understand the interaction between rhythmic organization and perception, I explore the interrelationship between rhythmic dissonance, grouping structure, and performance. The argument presented here is ultimately meant to create a set of concepts that informs the interpretative choices of performers, so that the complexity of the music can be manifested in the fullest differentiation and articulation of the conflicts involved.

Prior to discussion of performance, it is necessary to consider how composers set up such perceptual conflicts in their music, as well as how complex rhythmic structures are experienced by listeners. In order to analyze the ways listeners experience rhythmic complexity, I develop the concept of rhythmic dissonance, which I previously defined simply as the conflict created by the existence of two independent pulses in a polyrhythmic context. Before considering how composers can use rhythmic dissonance in organizing musical form, three questions have to be answered:

1. What is the aesthetic significance of rhythmic dissonance/complexity?
2. What is the relation between rhythmic complexity and rhythmic dissonance?
3. What is the cognitive basis of rhythmic dissonance?

**Aesthetics of Rhythmic Complexity**

It is a commonplace notion that the twentieth century saw a great expansion in rhythmic complexity, following a relative lag in comparison with the development of complex pitch organization during the nineteenth century. Much like Schoenberg’s emancipation of dissonance, the emancipation of rhythm from its metric form was a key element in the shock tactics of the musical avant-garde. This process of greater rhythmic differentiation has created vast new possibilities for musical organization, but also new difficulties for performers, listeners and analysts.

The most common concern of many twentieth century approaches to rhythmic complexity is the ‘problematization’ of the listener’s metric perception. Whereas most eighteenth and nineteenth century music used a unified metric framework, in which most rhythmic events can be intuitively related to an underlying regular pulse, works from around 1910 onwards challenge the listener by presenting many events that require listeners to constantly adjust their metric expectations. Starting with Ives and Stravinsky, clashes between simultaneous and independent musics coming from different directions in space are common; some works make such conflicts into their primary narrative device, such as Ives’ Fourth symphony or the last tableaux of Stravinsky’s *Petrushka*. Other composers such as Varèse or Antheil overwhelm the listener by the sheer amount of unsynchronized rhythmic events, making any perception of metric unity unstable and highly
subjective. While these developments of rhythm take very different directions, they all exploit rhythmic uncertainty as an explicit force.

This qualitatively new type of rhythmic complexity creates conflict for the listener, who is forced to choose her way of listening to this chaotic multiplicity. Attempts to focus on a single pulse layer or type of music are constantly interrupted by other types of music competing for metric attention; a synthesis of the complex relations between the parts are often not possible to grasp in initial listening without the study of a score. In extreme cases, the destructive interference of different rhythms results in the perception of noise rather than musical structure. Composers who use rhythmic complexity have gone further by assimilating the possible responses of listeners into the form of their works; in other words, resistance to listening becomes not just a result of complexity, but an integral component of the form.

In this context, we can think of rhythmic organization using a continuum between rhythmic order and complexity. Rhythmic order exists when all rhythmic events can be interpreted in relation to a single meter or common pulse, while complexity is characterized by a high degree of syncopation or competition between simultaneous independent pulses for listener’s attention. By varying the degree and type of rhythmic complexity, composers can create musical form driven by the rhythmic conflicts that the listener experiences in two possible ways. On the one hand, composers seek to push the boundaries of rhythmic perception, making listeners perceive and differentiate rhythmic structures ever more precisely; on the

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21 See discussion of Grisey’s ideas below.
other, composers seek to overwhelm and interrupt the listeners’ ability to
synthesize rhythmic information into a coherent whole. As we’ll see, these conflicts
can form local structures (micro-level), such as the relation between metric
organization of measures, as well as the overall form of a piece and the relation
between different sections (macro form).

Alongside the benefits of this new formal parameter, rhythmic complexity
brings about the risk of a loss of compositional control and communicative capacity
by consistently exceeding listeners’ perceptual abilities. This does not imply that
there should be aesthetic constraints on rhythmic complexity, but rather that it is
necessary to clarify the relation between compositional organization and rhythmic
perception. In order to distinguish effective and ineffective types of rhythmic
complexity, we have to describe the conditions that make it possible to maintain the
listener’s interest over time; as we’ll see, this requires a certain rate of change in the
degree of predictability (or complexity). In other words, the concept of rhythmic
organization of form should be extended to include the way rhythmic organization
creates transitions between different types of listening, corresponding to the
problems set up by the composer.

In order to explain the constructive use of rhythmic complexity, theorists
have mobilized older notions of the sublime used in classical philosophies, such as
those of Kant (Critique of Judgment) and Burke (On the sublime), or later authors,
such as Lyotard (The Inhuman).\footnote{22} Without entering this discussion, we can note that

\footnotetext{22}{See for example, Immanuel Kant and Paul Guyer, \textit{Critique of the power of judgment} (Cambridge, UK; New York: Cambridge University Press, 2000); Jean-François
Lyotard, \textit{The Inhuman: Reflections on Time} (Stanford, Calif.: Stanford University}
rhythmic complexity has the capacity to overwhelm, but also to create a sense of wonder and enjoyment by enabling an expansion of the scale of the aesthetic experience. By alternating between these types of responses, rhythmic dissonance possesses the capacity to make the listener reflect on her way of listening, as well as the limitations of her perception. In what follows, I address the concrete issues for analysis and performance raised by this phenomenon within this existing aesthetic framework.

Rhythmic Complexity or Rhythmic Dissonance?

Until now, the terms rhythmic complexity and rhythmic dissonance have been used interchangeably, based on the general reliance of both on conflict between accent patterns. However, I believe a distinction between the two is essential, as it articulates a difference often overlooked in analysis.

Analysis of rhythmically complex music is faced with a conundrum. Given an abundance of rhythmic detail, the initial tendency is to attempt to uncover a hidden structural coherence that is the product of the composer's techniques or generative strategy. By uncovering such principles or techniques, most analyses of rhythmically complex works attempt to demonstrate a coherent and rational control of the overwhelming amount of information on the surface of the music.23 In this process, a necessary reduction of multiplicity is carried out in order to create some kind

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larger analytical narrative for the piece; considering each detail independently would bring about an atrophy of thought, reminiscent of Borges' *Funes the Memorious*. Analysis of complexity therefore requires the creation of categories under which multiple musical details are grouped together, without overlooking the special significance of specific events. To do this, analysis of rhythmic complexity requires the construction of criteria specific to each work, so that the decisive elements of its formal processes can be recognized.

While such categories are indispensible for analysis, they do not necessarily correspond to the experience of listening to such complexity in real time. In other words, analysis tends to relegate complexity to description of the scores, using the advantage of outside-time descriptions involving the score. As a result, most analysis focuses on the poietic process (the composer’s organization of the material) while largely avoiding the esthesic process (in which the listener reconstructs meaning). A full discussion of the issues involved in this distinction is beyond this work; however, much of the difficulty in analysis of rhythmic complexity is created by the fundamentally different temporalities of the analyst and listener, both of which are indispensible. While an analyst is free to make connections and categories outside of time, thereby tracing the work of the composer more closely, the listener has to process the information in real time and is subject to cognitive constraints on

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24 See Jorge Luis Borges, *Labyrinths: Selected Stories & Other Writings* (New Directions Publishing, 1964). In this allegorical story, Funes sustains a head injury following an accident, which leaves him unable to forget any past experience or perception. As a result, he is able to remember his experiences precisely, but unable to formulate any general ideas or concepts.

his/her perception. A theory of rhythmic experience has to mediate between the two by using the differentiation possible in score-based analysis outside time, while considering the tendency of real-time perception to generalize and approximate the complexity of the music. The term rhythmic dissonance therefore defines more precisely the aspects of rhythmic complexity that have a bearing on in-time perception by listeners, and will be used subsequently.

**Rhythmic Dissonance**

In order to develop our understanding of the way rhythmic complexity is experienced by listeners, I propose to use the term rhythmic dissonance, which re-orient our thinking towards difficulties that are created for listeners. The term rhythmic dissonance has been used by Yeston (1976) and Krebs (1987); Conlon Nancarrow used the term ‘Temporal dissonance’ to describe a closely related phenomenon. As Krebs suggests, rhythmic dissonance can be interpreted etymologically: consonance means sounding together, whereas dissonance results from many rhythmically strong events that do not coincide.

In the context of the Ligeti Etudes, I define rhythmic dissonance as a process/formal principle, in which initially stable metrical structures are gradually destabilized, creating a disorienting effect on listeners. This effect is not

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26 See discussion in Chapter 5.
28 It is certainly possible for composers to employ rhythmic dissonance without first establishing an unproblematic meter. The decisive point here is the that rhythmic dissonance is a formal category, in which varying degrees of dissonance serve to differentiate and develop musical form through rhythmic process.
adequately captured by the mere concept of irregularity, but is the result of alternation between states of varying periodicity and predictability of the metric organization. Rather than simply describing the complex rhythmic organization, my goal is to describe the most likely responses to these in real time listening, thereby connecting the composer’s organization with the dissonance experienced by listeners.

While this concept of rhythmic dissonance can be applied more broadly for different types of repertoire, Ligeti’s Etudes explore this phenomenon precisely and thematically as their defining aesthetic problem. Rhythmic dissonance is thematic in the Etudes in two ways. From a compositional perspective, both local rhythmic structures and macro-form can be interpreted in reference to rhythmic dissonance; for the listeners, the segmentations of musical surface through devices such as contrast in dynamics and register are strongly correlated with the rhythmic development, as chapters 4 and 5 show in detail.

In these analyses, I trace the difficulties created by the interplay between the periodic rhythms that afford metric perception and elements that erode and challenge metric perception. As a preliminary simplification, these conflicts can be thought of in the terms of interaction of metric and anti-metrical material (or ‘rhythmic noise’) familiar from tonal music; however, much of the interest of the Etudes is due to the refusal of such hierarchical categories of meter in favor of tension between different simultaneous meters, as I explore in chapter 5. However, the difference between rhythmic dissonance and metric dissonance in tonal music is not only a matter of degree; rhythmic dissonance is qualitatively different in that the
resistance to listening persists regardless of the listener’s rhythmic strategy, and the strength of metric organization is constantly in flux.

**Limits to Perception of Complexity**

There are several reasons to avoid equating the complexity of a score with the complex perception of rhythm that results from listening to it. Perception simplifies certain aspects of the music, but also amplifies the significance of certain relations that might not seem central in the score. Therefore analysis of rhythmic dissonance is concerned with the weighting of the relative significance of different events, based on their prominence for listeners. This means that it requires both a reductive procedure, but also the detection of the particularly salient details. The difficulty consists of defining criteria for deciding on the relative importance of detail for perception, especially when the interaction of multiple musical parameters is involved.

As a first step, it is necessary to consider the cognitive and perceptual limitations on the communication of complex organization. Lerdahl (1992) and London (2009) have presented critiques of twentieth century compositional systems based on cognitive constraints on the organization of rhythm and pitch. The benefit of this approach lies in the ability to define what aspects of the composer’s organization of the material are accessible to listeners, and which aspects are transformed or lost in listening.29 Using these constraints, we can reduce the

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29 Admittedly, different listeners vary in their abilities and perception, making it difficult to theorize listening without considering who the listener is and under what
analytical effort to identify aspects of the score that have the potential to affect our
listening, while bracketing types of organization that are cognitively opaque.30

As London (2009) argues, our perception of rhythm necessarily involves
generalizing and filtering the musical signal in order to extract regularity and
recognize patterns. In this filtering process, the imperfections of actual rhythmic
performance (including expressive timings and other deviations) are perceived
categorically as being ‘the same’ within a certain contextually defined range. This
range is defined by perceptual psychology using the concept of ‘just noticeable
difference’ (JND), or the minimum amount of change in stimuli required for
perception of the difference. The JND in rhythmic perception is highly dependent on
metrical context, becoming more acute in reference to a steady pulsation.31
Furthermore, differences of duration are not perceived absolutely but categorically,
with listeners often ‘normalizing’ differences to produce durational categories, as
noted by Desain and Honig (2003). In this way, the listener’s ‘subjective’ experience
of duration assumes an ‘objective’ role in determining perception.

30 Fred Lerdahl, “Cognitive Constraints on Compositional Systems,” Contemporary
31 London, Justin. "Temporal Complexity in Modern and Post-Modern Music: A
Critique from Cognitive Aesthetics." Unfolding Time: Studies in Temporality in
Consequently, analyses that consider all rhythmic information as equally important quickly lose the ability to distinguish between poeitic and esthetic complexity; to recall an old trope, they ‘confuse the map with the territory’.\textsuperscript{32} It follows from this that an analysis of aesthetic complexity requires criteria for deciding which events/nuances are decisive in any given moment, or how listeners filter information in specific contexts, with variable JND values.\textsuperscript{33} I offer an outline for such a theory below, in the discussion about grouping conflicts and perceptual rewards.

**Rhythmic Dissonance, Information Theory, and Form**

Returning to the parallel between the emancipation of dissonance and the emancipation of rhythm, we can pursue the implications of the metaphor on several levels of musical form. On the micro level, the rhythmic regularity of a sound wave produces frequency and the perception of pitch (acoustic consonance), whereas noise (acoustic dissonance) is produced by sounds. However, the periodicity of pitch is not experienced as rhythm, due to its micro time scale. On a scale closer to ordinary musical experience, our expectations of consonance and dissonance also have aspects of rhythm. For example, the consonant/functional harmony of common-practice music is highly predictable, with consonant chords occurring

\textsuperscript{32} “A map is not the territory it represents, but, if correct, it has a similar structure to the territory, which accounts for its usefulness.” See Korzybski (1996).

\textsuperscript{33} Such criteria are particularly important in analyses of works of ‘new complexity’, where a great emphasis is placed on the intricacy of the notated score; for some comments, see Pace (2009).
more often that dissonant ones. In contrast, dissonances are often understood as surprising deviations from standard practice. Similarly, rhythmic dissonance can be recognized by surprises that interrupt the normal metrical and hypermetrical norms of common-practice styles.

A possible way of formalizing these phenomena and doing away with the metaphorical use of dissonance is offered by information theory. Originally formulated in 1948 as a mathematical theory of communication by Claude Shannon for the sake of efficient signal processing in communication systems, it has since been taken upon by numerous authors and composers in attempts to formalize aesthetic experience.\textsuperscript{34} Among these, the most important classic text is Moles’s \textit{Information Theory and Esthetic Perception},\textsuperscript{35} where music features most prominently. Interestingly, the influence of information-theory concepts is evident in the writings of Stockhausen, Xenakis, and Grisey (see below) with various degrees of rigor and adaptation.\textsuperscript{36}

Information theory conceptualizes complexity by treating information as a quantity and following the changes in the rate of information at different points, based on the degree of entropy (unpredictability involved in the message, to simplify) and the number of symbols in the repertoire of the communication. The

\textsuperscript{34} For an introduction, see John R. Pierce, \textit{An Introduction to Information Theory: Symbols, Signals and Noise} (Courier Corporation, 2012).
\textsuperscript{36} See in particular Stockhausen's \textit{Structure and Experiential Time} (Stockhausen 1958), as well as Xenakis' \textit{Formalized Music} (Xenakis 1992). Both composers were personally acquainted with Moles through Pierre Schaeffer and the GRM. A fuller study of the influence of information theory on post-serial music would be beneficial, considering the decline of its influence on music.
reduction of various aspects of music to uniform 'bits' of information has raised various objections, from theories of ecological perception (see below) to aesthetic critique of the mathematical paradigm and the concept of ‘message’. While a full discussion of these issues is outside the scope of this work, we can nonetheless note some of the affinities and useful distinctions offered by information theory for the study of rhythmic dissonance.

According to Moles, an increase in the rate of information is synonymous with greater complexity, which results from the number of symbols or elements and the rate of transmission involved. However, the amount of information varies depending on the originality it contains, which is defined by quantization of redundancy and entropy. Redundancy exists when some of the information is not needed for the receiver to understand the message, and it can be deciphered despite possible distortion of the signal; the missing information can be inferred from the rest of the message. In contrast, surprises increase the element of originality/unpredictability (entropy) and make further prediction more difficult. Under these conditions, any distortion (or failure to process some of the information) can render the message impossible to decipher.

Taking rhythmic organization, we could use the following example (Fig. 3.1). A completely regular sequence of measures in 4/4, with every quarter note beat articulated and equally accented, contains a high degree of redundancy; the 4/4 meter could be articulated less redundantly by rhythm that contains some variation. Fig. 3.1(B) presents the same melodic line in a version that contains too much variation for articulating the 4/4 meter.
We could see this by considering an omission of a note in either case; whereas in example A this would not effect the expectation of continued of metric regularity, in (B) this could cause momentary confusion, given the already syncopated articulation of the meter. The same phenomenon can be observed with regards to rubato, as Temperley shows.\textsuperscript{37}

In comparison, non-isochronous meters involve more information in comparison to an isochronous, hierarchical meter (such as 4/4 or 2/4). For the sake of simplification, lets us assume that both meters feature only rhythmic events that coincide with the beats. For example, a 2/4 metric cycle features only isochronous attacks; after an initial period, we could still know the timing of the second beat even if it were not articulated. In contrast, a 5/8 meter allows for two types of articulation into 2+3 or 3+2. Therefore knowing the length of the cycle (five eighth-notes) does not tell us about its internal division which remains unknown- more information is required in order to specify this: 5/8 could be said to contain more entropy (Fig. 3.2).

(A)

Little information lost by omission

(B)

More information lost by omission

(Or: ?)

Fig. 3.2: Metric complexity and entropy. (A) Redundancy reduces impact of information loss. (B) More metric complexity leads to greater loss of information in omission.
Crude as these examples are, they illustrate the connection between periodicity, isochronicity, redundancy, and predictability. Generally speaking, periodicity makes metric predictions stronger, but if it continues too long it becomes redundant, leading listeners to focus on other parameters. In contrast, rhythmic dissonance is created by alternation in the degrees of predictability.

This view of rhythm is proposed by Grisey in his article “Tempus ex Machina: A composer’s reflection on musical time.” Grisey presents a continuum of rhythmic complexity implicitly based on Moles’ adaptation of information theory for musical perception, as an alternative to structuralist dichotomies used to think about rhythm (measured/unmeasured, symmetrical/asymmetrical, etc.). In this case, order is represented by periodicity, which allows for metric prediction, while various degrees of disorder are created through distortions of periodicity.

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Among the possible objections to the application of information theory to esthetic perception is the quantization of information it demands. Furthermore, the different weighting of events (discussed at the opening of the Chapter) requires some type of qualitative criteria; these would have to engage with the cross-influence of different parameters (see discussion below).

This redundancy can have a constructive effect: for example, the opening of Grisey’s Tempus Ex Machina uses this strategy (rhythmic redundancy) to emphasize the otherwise overlooked harmonic spectrum of the Gran Cassa.

These categories could be applied on various levels, from the periodicity of a single measure to the organization of repetition in macro form (for example, the periodicity of ABAB). Grisey’s categories allow us to think of rhythmic dissonance on these different levels, rather than locally, by allowing form to be differentiated by rhythmic process. Moreover, it is clear that there is great fluidity in the transition between categories, providing composers with an opportunity to influence perception by moving between different categories. In the example from *Touches Bloquée* below, an initially periodic (metrical) structure is slightly distorted, in such a way that the periodicity is fuzzy but still apparent; this fuzzy periodicity can then be distorted further and destroyed, or altered to produce a new metric pattern. In this way, the liminal rhythmic spaces in which multiple interpretations are possible...
help to harness the power of rhythmic perception into the formal process of the work.

Information theory makes a crucial point about limits to communication in extreme cases. Where there is too little information (excessive redundancy), nothing is communicated (the stimulus is not perceived as primarily rhythmical); where there is too little predictability (high degree of irregularity), metric predictions cease after a while. The perception of rhythmic dissonance cannot be sustained over time, as the listener tends to tire of situations of zero predictability. This point deserves some emphasis, as it is a key to understanding the relation between rhythmic dissonance and form in the Etudes.

In Grisey’s continuum of rhythmic predictability, we notice that predictability decreases with the growth of complexity and disorder, reaching zero predictability in the case of statistical (random) durations. However, an extended state of zero predictability also entails the loss of rhythmic expectation. Rhythmic dissonance, therefore, does not progress linearly in the same way; in other words, it does not directly correspond to rhythmic unpredictability. Rather, rhythmic dissonance is the result of the changes between different degrees of predictability/unpredictability. As we’ll see, these changes in the degree of predictability can lead listeners to adopt different strategies in an attempt to anticipate further rhythmic events.

**Influence of Other Parameters: Complexity and Reductionism**

Until this point, we’ve been using a rather simplified model of rhythm, where only attack patterns of abstract beats were considered. However, in trying to
describe listeners’ experience of rhythmic dissonance in real time, music theory runs into great difficulties given the number of factors involved and the inherent ambiguity of ‘in-time’ rhythmic experience. One approach has been to magnify the ‘present’ moment, by tracing the process of metric interpretation using phenomenological tools, most extensively by Hasty.\textsuperscript{41} Although this approach can make us more sensitive towards certain elements, it quickly becomes too complicated in itself to be helpful in tackling already complex music.\textsuperscript{42}

An alternative approach would be to rely on empirical knowledge in perception and cognitive psychology in analyzing the experience of rhythmic complexity. In this case, knowledge of the separate factors involved (metric entrainment, polymetric perception, grouping principles, and so forth) could be used to determine our experience of individual parameters. This approach is useful in defining the limitations of our perception in specific cases. Such a practical application was our use of Poudrier’s experiment on polymetric tracking in Chapter 1, which helped in creating a notation that acknowledges the limitations of performers.

However, trying to use empirical knowledge of a specific perceptual phenomenon in analysis of an actual piece of music creates considerable difficulties, because of the complex interaction of the different musical parameters. This

\textsuperscript{41} Christopher Hasty, \textit{Meter As Rhythm} (Oxford University Press, 1997).
\textsuperscript{42} Generally speaking, Hasty’s project of teasing out micrological ambiguities in real-time experience of rhythm seems most useful for repertoires that have hierarchical metrical structures. Given the high degree of ambiguity that most metric structures in contemporary music contain, the more useful task would be to describe the most common and likely way of perceiving complex metric structures.
methodological problem is often described as the complexity/reductionism problem, as Roads (2015) points out. In tackling a complex phenomenon, the scientific study of rhythm breaks it down into isolated parameters, which are then investigated under controlled conditions in laboratory, with the goal of eliminating influence by other factors. This type of reductionism is required in ordered to produce empirically reliable data, but makes the results of limited use in application to analysis of actual works. As London puts it:

The values reported are largely from experiments that used nonmusical (or perhaps “quasi-musical”) stimuli and contexts; for the most part, this research lacks ecological validity relative to real-life listening situation. Moreover, this research has shown that various thresholds, acuities, and so on are heavily dependent upon task, stimulus, context, and so forth.43

The term ecological validity used here refers to the occurrence of the stimuli in a musical context that features many interacting elements, as Nattiez points out.44 The goal of such experiments is to produce data that can in turn serve future experiments, gradually bringing about a synthesis of the various isolated data in a new conceptual framework; currently, however, knowledge of the interaction of different musical parameters on perception is limited.

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The problem of ecological validity can once more be illustrated in reference to the Poudrier and Repp experiment discussed in Chapter 1. In that experiment, participants’ tracking of two independent pulses was facilitated by a strong separation in register, so that they formed two distinct streams regardless of the success of metric training. Such stasis in the pitch and register domains hardly exists in most polyrhythmically organized works; at almost any given time, both streaming and metric perception are influenced by changes in other parameters, which can bring the relation into relief or obscure it. In fact, much of the compositional potential of rhythmic dissonance comes from the cross-influence of other parameters on the perception of meter.

Part of the difficulty in applying the results of experiments arises for the tasks used in measure rhythmic perception. Many experiments track participants’ tracking abilities as measured by tapping, implicitly equating metric perception with the ability to reproduce it. However, it is certainly possible to recognize a rhythmic pattern in listening even without being able to reproduce it, especially when metric organization is influenced by other parameters. Treating rhythmic organization (defined by interonset intervals) as one type of grouping cue interacting with grouping cues generated by other parameters provides a possible way of incorporating empirical data while maintaining ecological validity.

**Meter and Grouping Cues**

Since defining the cross-influence of different types of grouping cues empirically is neither feasible nor necessarily advantageous, it is best to avoid assuming the primacy of one parameter over another and instead examine their interaction. The complexity/reductionism problem can be avoided through a description of the factors involved, while avoiding analysis of their interaction in strictly empirical terms. In this way, empirical data is ‘mobilized’ in the construction of theoretical analysis without limiting its predictions to the available data and contemporary research paradigms.

As various authors have shown, the perception of meter is closely related to grouping structure, which is itself supported by other musical parameters.\(^{47}\) In order for metric organization to exist, grouping cues must be coordinated with other musical parameters. Think for example of a waltz accompaniment figure, with its correlation of register and metric position, or the regular changes in instrument used in drum riffs: in both cases, the perception of meter is created not just by regular interonset intervals (IOIs) or the equal length of cycles, but by the rhythm of change in different musical parameters (register and timbre in the example above, respectively).

Narmour (1984) sees the influence of other parameters on metric perception even more radically: ‘Meter is a summarizing result of all parameter interactions [...]’

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rather than the cause of them.’

This is an important reminder for analysis, which often takes the perceptual independence of metric of organization as a given fact. Without the normative expectations created by the tonal system, metric organization itself has to be produced first by some identifiable correlation of rhythmic events and other musical parameters. By maintaining a constant coupling of rhythm with another element, a relation of invariance is created, which orients and determines the response to changes in rhythm.

**Listening Strategies and Invariants**

Before engaging with the considerable rhythmic complexity of the Ligeti Etudes, it is useful to consider the simpler form of rhythmic dissonance in earlier modernist music. This will help demonstrate the connection between grouping cues, listening strategies and rhythmic dissonance.

In Chapter 1 I discussed questions of notation in light of Imbrie’s distinction between ‘radical’ and ‘conservative’ listening. To recapitulate, a radical listener is one who adjusts her metric expectations at the first strong cue of a shift in meter, whereas a conservative listener attempts to hold on to the previous metric framework even in the face of contradicting signals.

While Imbrie’s distinction was

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49 This formulation simplifies more complex processes involved in perception of rhythm that have been since investigated. On the one hand, metric perception is the result of extraction of regularities from the signal itself (a bottom-up process); on the other, it involves making predictions based on previous metric patterns and interpreting subsequent events in light of this. Given the complexity/reductionism
intended to suggest the different ways a listener might interpret a tonal piece with a high degree of ambiguity, it can be expanded to refer to compositional strategies. Roughly put, composers organize the music in ways that rewards one type of listening more than another, thereby making sure that listeners choose the more 'effective' strategy for the music in question.

Generally speaking, a listening strategy is rewarded by confirmation of its power to predict future events, or when subsequent events match our expectations to some degree. A simple example is the traditional use of syncopation, in which the listener is rewarded for conservative listening by the re-alignment of the accent pattern with the former pulse; a radical listening to the same syncopation sequence would not be able to predict this. A different type of reward is provided by the use of invariants. As Clarke (2005) has shown, perception relies on invariant or structured elements of its environment. The structure and repetition provided by invariants provide a 'grid' for perception, with other types of information organized around it. The invariant element can be provided a repeating attack pattern (defined by interonset intervals), or by the repetition of pitch group or sonority. In either case, perception resonates with the most saliently regular element, whether it is pulsation or repetition pitch constructs, with other musical elements perceived against that background. From an information-theory perspective, invariants could

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problem described above, I find the simplified question that Imbrie suggests is still useful.
be said to minimize the amount of information and maximize redundancy, thereby assuring the intelligibility of the ‘message’ (or metric structure).\(^{50}\)

To illustrate this interaction between rhythmic listening strategy and invariants, consider the following passage from Stravinsky’s *Rite of Spring*, an iconic example of rhythmically dissonant metric shifts (Figure 3.4):

![Fig. 3.4: Invariance rewards radical listening. NI Metric Structures alternating with Isochronous Structure.](image)

\(^{50}\) I am intentionally pointing out these similarities between the opposing approaches of ecological perception and information theory. Information-processing models generally discuss the ways in which regularity is extracted from the ‘chaotic’ signal through cognitive processes, whereas ecological perception emphasizes the already-structured aspect of the environment. See Eric Clarke, *Ways of Listening: An Ecological Approach to the Perception of Musical Meaning* (Oxford University Press, 2005).
The remarkable metric irregularity of this passage is produced through the alternation between non-isochronous beats (two and three eighth notes in length). The 2+3 pattern is repeated in the first two measures, reinforcing the non-isochronous meter. Subsequent changes in meter play on the expectation established by this pattern; for example, the use of normally consonant isochronous beats in the third measure is made dissonant through juxtaposition with the first measures.

Underlying our immediate intuition that this passage requires radical listening is a set of grouping cues in other musical parameters that generate the accent pattern; the real incentive for radical listening is provided by the repetition in the organization of pitch and timbre. For example, the onset of each beat (smallest group) is marked with an A in the bass, while the three-eighth group is marked with a low A in the timpani. These grouping boundaries are further coupled with registral contrasts and melodic forms, producing a great degree of invariance in the repetition of the material.

This invariance leads the listener to strongly associate the recurrence of these events withmetrical accent, regardless of varying lengths of phrases and meters. In this way, Stravinsky makes radical listening the only viable strategy for this passage; there are almost no cases in which conservative listening is rewarded by a re-alignment with the pulse.

The strategy for production of rhythmic dissonance here is relatively easy to analyze, since it maintains an identity between the objective rhythmic proportions of the score (chronometric time) and the resulting perception (subjective or
experienced time). Following the initial segmentation of these unambiguous patterns, analysis proceeds to show the points at which listeners are required to adjust their metric expectations and revealing the larger patterns that these create.

A diametrically opposed compositional strategy is the use of isochronous beats, allowing the listener to easily anticipate the continuation of a rhythmic layer. In this case, the invariance is provided by IOI regularity, while changes in other parameters occur (Figure 3.5):

![Fig. 3.5: Polymeter created by two isochronous pulse layers (G5/G3). Re-notation by the author.](image)

In this example from *Automne à Varsovie*, both melodic lines use entirely isochronous beats, each moving at a different speed (three sixteenth notes in the bass and five sixteenth notes in the soprano). In addition to this regular attack pattern, each uses enough stepwise intervals to make their continuation predictable; thus conservative listening to each line is rewarded. In this case, the dissonant element resides in the dissonant relation of the two lines (a 5:3 polyrhythm), and the competing demands for metric entrainment by each line.
Needless to say, while the two compositional strategies rely on fostering different kinds of listening, the two are not mutually exclusive on an aesthetic level; alternating between encouragement of radical listening and conservative listening can contribute towards large-scale differentiation, as we will see in the analysis of *Fanfares*. However, the first two types are mutually exclusive on the local level. The mutually exclusive aspect of compositional encouragement to radical and conservative listening strategies consists in the need to choose a single invariant element at any given time. It is easy to see that invariance in several parameters yields redundancy and predictability, while no invariance deprives perception of any structure, resulting in the atrophy of attention and perception of dissonance altogether. Locally, these two possibilities present a zero-sum game: the more irregular the metric construction, the greater regularity in other parameters required for its recognition as dissonant; the more differentiated other musical parameters are, less variation in metric construction is possible.

Rhythmic complexity, then, cannot be interpreted through descriptions of rhythmic patterns and proportions in isolation from other types of grouping cues that effect listener strategies. In the Stravinsky example, invariance in timbre and register determines the radical mode of listening; in *Automne à Varsovie*, the polyrhythmic dissonance is supported by isochronous (invariant) beats. In both cases, metric perception is the result of interaction between invariance in one musical parameter and variation or irregularity in another.
Rhythmic Techniques of the Etudes

Based on this difference in the use of invariants, we can distinguish between two main strategies for the production of rhythmic complexity in the Ligeti Etudes:

1. ‘Radical’ music that emphasizes constant metric irregularity and change in the pulse itself, with durations derived from additive use of rhythmic cells. The irregularities in the metric organization are often brought into relief through other clear signals (see the example from Touches Bloquées below). In order to maintain sufficient clarity in these signals, a considerable amount of repetition in the material is necessary.

2. Polyrhythmic music that features conflicts between different simultaneous tempos, in which each part appears independent of the others rhythmically. Given competing metrical layers, the listener is faced with multiple ways of listening to their relation, depending on the layers they choose to entrain to.

Based on this division, we can place Etudes 2, 3, and 4 in the first group, while the second includes the polyrhythmic-based 5 and 6. Remarkably, every Etude in Book I explores a single rhythmic technique; mixture between metric irregularity

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51 Désordre uses a far less common form to produce rhythmic dissonance, through the use of a chaotic phasing technique between two voices playing an initially identical talea. Given the many analyses of that piece, I focus on clarifying the techniques of the two categories described above.
and polyrhythm is largely avoided.\textsuperscript{52} While there is nothing to prevent mixture of the two techniques (such as the use of a single rhythmic talea played in different tempos in the first movement of the piano concerto, for example), limiting each Etude to a single technique lends the Etudes in Book I a remarkable synthesis of complexity and clarity.\textsuperscript{53}

All of the Etudes create rhythmic dissonance through the consistent use of polyphony, in which each voice or part presents groupings that conflict with those of the other parts. By assigning a distinct rhythmic definition to each part, as well as maintaining differences of register and dynamics, the polyphony articulates the rhythmic clashes consistently. The streaming of pulse layers into independent lines is deliberately interrupted locally, most notably in Etudes 2 and 6.\textsuperscript{54}

The difference between the two categories is most immediately evident in the degree of variation in the metric organization of each layer, but also influences the degree of polyphonic complexity. The radical metric adjustment required by use of non-isochronous meters is only effective when attention is focused on a single line; in other words, in order for changes in grouping and metric organization to become dissonant, the listener needs to be able to project their continuation, requiring focus on a single line. Constant metric changes in multiple layers are likely to make excessive demands on the listener, thereby weakening the ability to project

\textsuperscript{52} Several Etudes in Book II (especially Galamb Borong, L’Escalier du Diable and Entrelacs) attempt to mix these two techniques, resulting in more ambiguous metric structures. While it would be instructive to analyze their occasionally opaque processes, this is outside of the scope of this work.
\textsuperscript{53} This can be understood in reference to the notion of communicative pressure presented by Temperley (2008).
\textsuperscript{54} See Chapter 4 for a discussion of streaming and fusion in Automne à Varsovie.
the continuation of each; while this can produce rhythmic dissonance locally, it soon leads to the attenuation of rhythmic listening. As a result, the Etudes in the first group are less polyphonic, often reducing the complexity and consistency of one of the parts (for example, the ostinato in Fanfares or the staccato interjections in Touches Bloquées).

In contrast to this, polyrhythmic music (second group) based on isochronous pulse layers allows the listener to choose which pulse train or voice to identify as the dominant meter, provided the parts are well differentiated. In this sense, polyrhythmic music is similar to more traditional polyphonic music, with the non-synchronous attacks of different layers providing a support for polyphonic perception, by preventing the fusion of two simultaneous accents into a complex sonority. This leads to the division of attention between the pulses of different speeds, with constant challenges to the listener’s choice of meter (based on the pulse layer entrained to) resulting from the appearance of accents in other parts at unforeseeable points.

Finally, while this distinction serves as the basis of much of the subsequent analysis, it is a deliberate simplification. Much of the interest and complexity of the Etudes results from the quick alternation between these two basic modes. In subsequent chapters I analyze one Etude from each category (Fanfares and Automne à Varsovie) and engage the way alternation between the two strategies creates levels of dissonance that exceed the clear-cut examples presented above.
**Metric Expositions**

Like the definition of harmonic dissonance, rhythmic dissonance is easier to define in the context of the tonal system, given the high degree of standardization and the resulting sense of normative expectation on behalf of the listener. In traditional tonal music, rhythmic dissonance is a relatively isolated phenomenon, and can be adequately described as the result of conflicts between groupings and the normative meter. Krebs describes these types of interactions between local groupings (created by phenomenal accents and harmonic changes) and meter, resulting in a typology of metric dissonances.\(^5^5\) While these are useful for our purposes, much of Krebs's framework relies on the primacy of the basic meter of the piece: all rhythmic dissonances in tonal music owe their power to the negation of normative rhythmic expectations. In this sense, the primary meter functions somewhat like the tonic of a piece.

In post-tonal music, rhythmic expectations are much more context-dependent, given the tendency towards frequent metric changes and the use of irregular rhythmic patterns. This does not mean that listeners are not able to extract metric frameworks from the complex signal, but rather that one more stage is added to the process of listening and analysis. First, an initial sense of metric organization has to be established, which then can be challenged by subsequent events; in other words, rhythmic dissonance requires at least a minimum degree of regularity, as well as initial correlation between different types of grouping cues and invariants.

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\(^{55}\) See Krebs, *Fantasy Pieces*, Chapter 4.
This minimum of regularity is ensured in the Etudes through the use of tonal formulas in voice leading and harmonic organization, giving listeners a chance to employ listening schemata used in traditional tonal music. Interestingly, this is the case in Nancarrow’s studies as well, with their use of jazz and popular music; both could be described as ‘not-atonal’, with extensive use of traditional categories of melody, harmony, counterpoint and the resulting segmentation of the musical surface.

With no a-priori conventions for the alignment of grouping cues, post-tonal works need to create an initial set of ‘rules’ or perceptual environment in which rhythmic dissonance can unfold. Ligeti deliberately counters this through the systematic use of metric expositions, in which the identity of the rhythmic material is initially established through presentation of the primary material in a rhythmically consonant setting. This allows the listener to recognize the relation between pitch-based grouping signals and metric organization. Once the listener has entrained to the pulse resulting from the interaction of the two, subsequent changes in the relation between grouping and meter become more distinct. In this way, rhythmic dissonance is created by the process of change between the listener’s initial metric perception of the material and its later transformation. In Ligeti’s rhetoric of rhythmic dissonance, the initial alignment of grouping cues is gradually interrupted, causing the listener a conflict in choosing which ones to stay attuned
The opening of Désordre provides an example of alignment of various grouping cues, as shown in Figure 3.6:

![Alignment of grouping cues in Désordre](image)

In this example, three types of grouping cues occur together, creating a strong perception of distinct beats. All changes in the direction of melodic motion in the eighth-notes coincide with a dynamic accent, as well as an octave doubling (supporting the grouping through contrast in timbre). A higher grouping level is created by the introduction of new pitches in the thematic (octave) line every eight attacks (or every two groups), creating the immediate impression of metric organization of the smaller groups into distinct measures.

This alignment of grouping cues demonstrates Narmour’s claim about the emergence of meter as the result of the interaction of other parameters. In Désordre,

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56 Needless to say, other strategies for articulating rhythmic dissonance are possible, as one can recognize in the works of Nancarrow and Varèse, for example. It would be particularly instructive to create formal typologies of their works using these criteria of the relation between initial creation of metric contexts and the presentation of thematic material.
this allows even the brief opening measures to project an unequivocal metric organization, so that the process of de-synchronization and rhythmic dissonance can begin immediately. A similar alignment of grouping occurs in the ostinato of *Fanfares*, ensuring its immediate recognition despite subsequent clashes with the thematic part (Figure 3.7):

![Fig. 3.7: Alignment of metric structure and change in direction of motion.](image)

As both these examples show, Ligeti takes cares to establish metric perception before introducing contradictory grouping cues. The relative length of these metrical expositions (before the introduction of rhythmic conflict) in each Etude varies greatly, from a mere four measures in *Désordre* to fifty iterations of the ostinato in *Fanfares*; nevertheless, all the Etudes in Book I observe the principle of gradually increasing rhythmic dissonance, never starting from a strongly dissonant situation.\(^{57}\)

\(^{57}\) It is tempting to ask whether Ligeti first composed the rhythmic durations and proportions of the material prior to the specification of other parameters of pitch and harmony. Closer study of the Etudes’ manuscripts and sketches could
De-synchronization of Grouping Cues: An Example

The opening of *Touches Bloquées* presents an interesting metric exposition, in which an initially clear periodicity is gradually distorted. In the initial process of metric establishment, several grouping cues are aligned, creating a slightly asymmetrical rhythmic cycle of fifteen eighth notes, divided as 7+8; alternatively, this could be described as a non-isochronous meter divided 3+2+2/2+2+2+2 (see Figure 3.8 below). This metric pattern is articulated in the right hand part by playing a continuous chromatically descending and ascending scale; because of the keys held silently by the left hand (notated by diamond shapes), only some of the keys attack the strings, producing the rhythmic pattern perceived by the listener (indicated in the score by large note-heads). The periodicity is indicated in Figure 3.8 by square brackets:

potentially shed light on this question, although it is of little consequence for the purpose of the analysis presented here.
Two grouping cues articulate this periodicity: each two measure period begins with a longer group (two consecutive eight notes), while changes in the direction of melodic motion occur every seven and eight notes, creating a clear contour. The repetition of this pattern multiple times makes it assume a clear metric function, resembling an ostinato. Given the rapid tempo of this Etude (vivacissimo, ca. 100 for the whole note in most performances), it is possible for a perception of slightly lopsided symmetrical perception of pulse at the level of measures to emerge, where every first beat feels slightly ‘rushed’.

In contrast to the alignment of grouping cues in the right hand pattern, the left hand consistently produces ‘rhythmic noise’, through attacks at metrically weak (unarticulated) positions with regards to the right hand pattern. In particular, the
echoes of the two-note group (initially Gb-F) at points unarticulated in the right hand obscures the clarity of the pattern. Through differences in articulation (the echoes are always staccato in contrast to the legato pattern in the right hand), a minimal difference in timbre emerges that allows the two lines to be differentiated by the listener; if the two lines are collapsed into a single perceptual entity, the perception of meter becomes much weaker, as shown in Figure 3.9:

\[ \text{Fig. 3.9: Re-notation of Touches Bloquées as an integrated line.} \]

This type of integrated perception is less clear metrically, given the frequent variations in the attack pattern. In order to perceive the metrical pattern here, the listener has to decide once more which grouping cues are most significant; in the case of integrated perception, the longer groups of four notes become a strong cue.

From the very beginning, then, the listener is faced with a grouping conflict that hinders the ability to predict this relatively simple pattern and requires filtering out information, or deciding on a way of making sense of this fuzzy periodicity.

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58 Unlike other re-notations presented throughout, Fig. 3.9 only serves to illustrate the possible perception of fusion, rather than a performance strategy.
As the Etude progresses, this relatively mild conflict is amplified and becomes thematic through a de-synchronization of the grouping cues. At first, the metric pattern is interrupted by the top note of the pattern entering one eighth note too early (D in measure 14 below). As a result, the original synchronization of top notes with the onset of longer groups is decoupled, jolting the listeners out of their relatively reliable sense of metric expectation. Figure 3.10 shows this moment with its resulting disorientation; note that the meters and barring in my re-notation choose to follow the onset of longer groups as indication of the downbeat, rather than the top notes:
Fig. 3.10: Interruption of periodicity and conflict between grouping cues.

In addition to this conflict, two other elements are added that de-stabilize the grouping structure even further. Starting in measure 18, some of the left hand’s
interruptions are sustained, introducing a prominent new element to the texture that suggests metric accent. At the same time, 3/8 groups (marked by triangles in the example above), previously reserved for the start of every metric cycle only become more frequent. By the end of the passage, the different elements become so confused that any interpretation of cyclic or additive meter would be highly contestable. Having exhausted the initial metric energy, the Etude restarts in the next measures with the hands changing roles.

Despite the manifold details, the overall trajectory of this opening section is quite clear. Starting from a periodicity established by the agreement of several grouping cues, the five iterations of the fuzzy periodicity (the 7+8 pattern) featured various interruptions and false cues from the left hand. Following this, the different grouping cues are de-synchronized, leading to a state in which listeners are forced to choose between the length of groups and their contours. The result of this is a zone of minimal predictability, or high intensity rhythmic dissonance, in which both metric perception and grouping become highly problematic. After the complete abandonment of the previous metric paradigm, the listening process begins anew: instead of relying on the previous coupling of grouping cues, listeners start to extract new regularities and possible groupings ‘from below’. If the groupings are clear and regular enough, she can form a new metric framework.

The state of maximum rhythmic dissonance differs qualitatively from simpler examples of metric irregularity, such as the Stravinsky example above. In that example, radical listening seemed to provide a sure way of adjusting to the constant metric changes, thereby making the perception of different listeners similar. In
*Touches Bloquées*, however, each listener might choose to hold on to one cue or another as a means of predicting the continuation of the music and extracting regularity from it; consequently, they are all bound to experience rhythmic dissonance as a result of their failure to apply the previous scheme successfully. Unlike the Stravinsky example, the multiplicity of hearings that results is irreducible – there are always at least two ways of hearing a complex passage. While these ways of listening can be interrogated using the conservative/radical distinction, their reliance on more specific types of grouping cues requires the further analysis of possible listening types.

**Performance and Grouping Cues**

Let us now consider how a performer could influence the perception of rhythmic dissonance in the excerpt from *Touches Bloquées*. While the use of agogics is out of the question, there are still several parameters that can be manipulated more freely to influence the perception of grouping conflict. These include accentuation, articulation, dynamics, and the balance between the hands. Rather than considering all the possible combinations of these, it would easier to consider the effect such manipulation can achieve.

The performer can influence the perception of metric structures in two ways. On the one hand, she can clarify the metric structure by emphasizing the periodicity— in this case, through accentuation of the metrically strong spots. On the other hand, she can also amplify the conflict between the periodicity of the right
hand and the rhythmic noise in the left hand, thus making even the relative stability of the opening measures disappear.

However, the performer's role becomes more interesting once the grouping cues are no longer aligned. Once the listener is forced to choose which of the grouping cues to take as a sign of the downbeat (in this case, the conflict between high notes and metric pattern), the performer's function becomes crucial. By emphasizing one or the other, the transition from the initial periodic state to the dissonant state can be perceived in different ways—either as a clear break, or as an almost imperceptible shift.

The profound influence such interpretative choices can have on the perception of form and process in the Etudes stands in contrast to Ligeti's notation and performance instructions, which tend to reduce the performer to an executor of meticulously predetermined instructions. However, given the complexity of the relation between score, performance, and perception, it is impossible to specify the influence of performance on perception in a fixed way. At best, we can define the conditions within which rhythmic dissonance can be produced by compositions, while leaving the specific interaction of factors in concrete situations to an experimental game played by the performer. In the analytical chapters that follow, I investigate some of the ways that performers can apply this type of analysis in particularly difficult passages.
Chapter 4: Fanfares

Rhythmic Difficulties and Notation

Fanfares is based on an ostinato played in the background throughout the piece that articulates a non-isochronous 3+2+3 meter. Against this background, a motivic part presents variable metric groupings that interact with the ostinato in various ways; analysis of the piece naturally focuses on the changing relation of their respective meters. The complementary roles of the hands are maintained throughout the work; the ostinato is always present in one hand, while the other hand plays an independently evolving motivic part. The performer’s challenge is to make the accentuation and grouping of both parts intelligible, without the accents in one part interfering with the pattern of the other. As I’ll show in this chapter, the difficulty of this task is largely determined by the choice of metric notation, with different types of metric organization providing different benefits.

The original metric notation of Fanfares follows the ostinato throughout, even when the motivic groups no longer correspond to the 3+2+3 meter. In order to suggest the independent rhythmic structure of the motivic part, Ligeti uses beams that cross the bar line, creating a visual and cognitive clash for the performer (Figure 4.1). This is explained in a performance note:

From here onwards the barlines are only meant to help the synchronization of the hands. The articulation of the motifs does not depend on the bar-
division (the ostinato, however, continues to be accentuated as 3+2+3, independently of the motifs).\textsuperscript{59}

![Image of sheet music]

Fig. 4.1: Clashing beaming in original notation of \textit{Fanfares} (mm. 46-48).

This unusual clashing beaming has the advantage of visually conveying to the performer the need for an independent accentuation pattern in each hand, with the goal of creating two distinct rhythmic strands. A further advantage of this notation is the uniformity of the meter, which allows the changing and irregular groupings that occur in the motivic part to rely on the ostinato’s metric stability.

However, despite its clear communication of the performer’s task, Ligeti’s notation of the independent and clashing patterns produces practical difficulties. The first of these is the synchronization of the hands, which have to play note against note while articulating independent accent patterns. My personal experience shows that there is considerable difficulty in performing \textit{Fanfares’} complex cross-accent patterns without risk of a complete de-synchronization of the eighth-notes themselves between the hands. This difficulty can be explained by research on the relation of sensorimotor tasks to rhythmic entrainment, which shows that metric

entainment is based on sensorimotor synchronization; we may reasonably conclude that execution of complex motor sequences depends on the metric organization imposed on them by the performer.\textsuperscript{60} This phenomenon can also be explained in reference to metric preference rules, as I suggest below. Consequently, changing the metric notation (while keeping the patterns identical) could help resolve some of the technical and rhythmic difficulties involved in executing independent accent patterns, as I show below.

In trying to perform \textit{Fanfares}, the problem seems to be a zero-sum game between synchronization and independence of accentuation: performing the motivic accents while counting with the ostinato generates considerable cognitive overload for the performer. This difficulty can be interpreted as a violation of GTTM's MPR 5,\textsuperscript{61} which states that listeners tend to prefer metric interpretations in which accents and long notes appear on the beat.\textsuperscript{62} In Figure 4.2, long notes (in this case all durations longer than an eighth note) appear in positions contradicting the accents of the ostinato. Furthermore, synchronization difficulties arise from the eighth-note offsets between the accents, marked by diagonal dashed lines. In \textit{Fanfares’} rapid tempo (63 for the whole note), an offset of one eighth-note between accents causes considerable synchronization difficulties, because of the natural tendency to synchronize the hands at metrically strong spots. The difficulty is compounded by the quick changes in the order of accents between the hands. In this example, the first two accents are played together, while the next three left hand

\textsuperscript{60} London, \textit{Hearing in Time: Psychological Aspects of Musical Meter.}
\textsuperscript{61} See Chapter 2.
\textsuperscript{62} Lerdahl and Jackendoff, \textit{A Generative Theory of Tonal Music.}
accents precede the right hand accents; immediately afterwards, the order is reversed, with the right hand anticipating the left hand accents (Figure 4.2).

Fig. 4.2: De-synchronized accents patterns create synchronization difficulties.

The zero-sum game between accent clarity and synchronization in this example can be noticed in most performances, either in the form of a blurring of the accent patterns or through a momentary but noticeable de-synchronization of the hands, in which the eighth notes are not played together by the two hands.

Given the central role of the score in the learning process, the notated meter determines the cognitive assimilation of this complex material. In this case, learning the motivic part as syncopated against the background of the ostinato’s meter makes the ostinato even more prominent. As a result, attempts to perform Fanfares with the prescribed dynamic balance (in which the motivic part always dominates) feel self-contradictory, as if pulling with one hand while pressing with the other. This leads to a paradoxical effect: while Ligeti’s meters follow the ostinato in order to emphasize the anti-metrical nature of the motivic part, this results in the assimilation of the latter to the ostinato, thus weakening the grouping conflict.

Rather than allowing for independent accentuation of the motivic part, the meter
assures the dominance of the ostinato, bringing it into relief and making it redundant in relation to the constantly changing motivic part. Performing the cross-accents becomes considerably more difficult; later on in the piece, this has dire consequences in passages of motivic double notes, which become unstable when counted against the background of the ostinato meter.

A possible solution would have been a notation with different bar lines for each hand, depending on the meter of the motivic part. This would clearly convey the idea of independent accentuation patterns without the risk of assimilation to the ostinato (Figure 4.3).

![Fig. 4.3: Alternative notation with independent barlines in each part.](image)

This type of notation was Ligeti’s choice in *Désordre*, where it serves to show the formal process created by rhythmic mutations. While this notation has the advantage of visually communicating the independent groupings of both parts, it is rather impractical in performance. As discussed in the Chapter 2, a performer is unable to count in two separate meters simultaneously; for the sake of measuring complex rhythms, entrainment to a single pulse is indispensable. While this notation allows the performer to choose her notation for each passage, it still requires a
decision on which metric layer dominates in each passage in order to ensure the synchronization of the eight notes, as shown above. In the case of Fanfares, given the redundancy of the ostinato, such notation seems to be an unnecessarily complex solution.

For these reasons I’ve decided to reverse Ligeti’s notation by re-notating the entire etude following the changing motivic meters, so that the groupings and implied meters of the motivic part dominate throughout (with one exception discussed separately). Figure 4.4 (A) presents Ligeti’s notation of measures 46-48, followed by my proposed re-notation (B).

(A)

(B)

Fig. 4.4: Isochronous re-notation. (A) Ligeti’s original notation in 8/8 (mm.50-53). (B) Re-notation in 12/8.

It may initially seem that reversing Ligeti’s metric notation would lead to similar results and difficulties in inverted form. However, there are several factors
that make the re-notation easier to perform. First, the problem of long notes on metrically weak positions (the violation of MPR 5 shown in Figure 4.2) is now eliminated, as all long notes appear only in the motivic part. Second, the repeating motor sequence of the ostinato is easier to perform than the more irregular and demanding sequences of the motivic part; by focusing the performer’s attention on the latter, their realization is made easier. Lastly, this corresponds to the prescribed dynamics, in which the motivic part always dominates.

This notation also reveals surprising metric regularities in the motivic part that are easily overlooked in the original notation. Following Ligeti’s slurs, the motivic part can suggest a meter of 6/8, or even 12/8, based on the longer last group. The momentary establishment of isochronous pulses against the background of the ostinato is a key factor in producing rhythmic dissonance, especially in otherwise non-isochronous metric environments (see discussion below).

In this passage, the 12/8 meter supports the realization of the more challenging motivic part, while requiring that the ostinato’s accents be interpreted as off-beats in this meter. At points of coincidence between the two parts, the ostinato accents are unaffected, whereas ostinato accents that do not correspond to the 12/8 meter may indeed become more challenging and are perhaps somewhat obscured. However, the invariance of pitch and rhythmic pattern in the ostinato makes it a salient feature even in the background; considering the goal of achieving the illusion of two independent rhythmic strands, the resulting balance between the parts allows for perception of both.
For comparison of the greater ease of playing from the re-notation, consider the difficulty of performing the same accentuation pattern in the two different notations, shown in Figure 4.5. Above the score is a representation of the stressed attack points in each hand. Because of the louder dynamic of the motivic part, all eighth notes are notated as elements of the rhythmic pattern, while only the ostinato’s accented notes appear below.
Performing the accent patterns is much easier in the latter notation, given an isochronous metric framework. In other cases where both parts are non-isochronous, the re-notation brings about little rhythmic simplification but still remains helpful for motoric synchronization, for the same reasons discussed above.
Lastly, shifting the meter according to the motivic part causes a cognitive clash between the invariant association of pitch and meter in the ostinato before; in other words, the same pitches now appear metrically displaced with regards to the new downbeat, assuming the listener entrains to the motivic part. In this way, the ostinato’s pitch contributes to the effect of rhythmic dissonance throughout the etude, instead of obscuring the metric organization of the motivic groups.

**Rhythmic Dissonance and Form in Fanfares**

Prior to the discussion of the perception of rhythmic dissonance in *Fanfares*, it would be useful to analyze the grouping and rhythmic development revealed by the re-notation. In particular, areas of regular motivic meters are more immediately apparent and suggest previously overlooked aspects of formal process. The degree of consistency of the transformations of the meters in the motivic part suggests that the form of *Fanfares* is made of distinct sections, each of which has its own principles of metric organization in the motivic part. As in the other Etudes in the set, strong contrasts in register and dynamics provide strong cues for the transition from one section to another.

The systematic conflict between ostinato and motivic meters creates the greater formal structure of the piece. It is articulated through alternation between ostinato-dominated areas and more dissonant episodes with independent metric structures in the motivic part. This form brings rhythmically dissonant episodes into relief, while also preventing constant irregularity and the attenuation of metric expectations that would result from constant rhythmic dissonance.
The segmentation is strongly supported by Ligeti’s choice of dynamics, register, and texture; almost every transition is marked by a strong contrast in one or more of these parameters. Interestingly, harmonic or pitch collection differences do not seem to figure at all among the means of delineation, perhaps because of Ligeti’s concern with a constant production of triadic sonorities through smooth voice-leading. I offer an outline of this segmentation below, with the initial measures of each section illustrating the metric organization that distinguishes it. Accented notes are highlighted in red to emphasize the different levels of synchrony/conflict between the parts.

1. Exposition (mm.1-45) establishing the ostinato and meter. In this section (Figure 4.6) all accents in the thematic part coincide with one of the ostinato beats, creating a mild grouping dissonance through systematic variation in the offset of motives from the downbeats of the ostinato (see discussion below).

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64 All measure numbers and examples below refer to the re-notated version (see appendix).
Fig. 4.6: Metric exposition. Opening measures establish 2+3+2/8 meter.

2. First dissonant episode (mm.46-63, Figure 4.7), announced by a break in the surface texture (sudden eights note movement in the motive). The meter is challenged, through initially irregular accentuation patterns. Later, other isochronous meters are momentarily established in the motivic part (12/8 in mm.51-53 and 9/8 in mm.59-62).
3. Reinstatement of the ostinato meter in the motivic part (m.65-87, Figure 4.8), emphasized by the return to a chordal texture. In contrast to the dissonant groupings of the previous section, the initial ostinato meter is reasserted.
4. Second dissonant episode (m.90-123, Figure 4.9), characterized by extensive use of displacement dissonances and gradual derailing of material derived from the ostinato meter through variation in the length of motives. Note the initial agreement of the motivic part with the ostinato meter, followed by an eighth-note displacement in measures 94 and 96. No strict systematic organization of the motivic part is apparent in the section, lending it an improvisatory quality.
Fig. 4.9: Gradual displacement of motivic material from ostinato.

5. Establishment of a repeating 7/8 meter in the motivic part, producing a phasing polyrhythm with the ostinato (m.124-142, Fig.4.10). In contrast to the irregular interruptions of earlier parts, this section maintains the new meter for a considerable time. The systematic quality of this section is evident in its symmetrical design, allowing the completion of each cycle after seven measures, while switching the parts between the hands at the synchronization point.
Fig. 4.10: Systematic grouping conflict (G8/G7). Hands switch roles at the end of the first cycle (measure 132).

6. Dissolution of the 7/8 meter and momentary restoration of 3+2+3 in the motivic part (m.144-150, Figure 4.11). Although much shorter than section 3, it serves a similar function of restoring metric unity.
Fig. 4.11: Dissolution of 7/8 meter and restoration of original meter (mm.144-146).

7. Dissonant episode using additive meters (m. 151-159,) and 6/8 (m.160 onwards, see Figure 4.12 for both), with systematic displacement of every subsequent phrase from the established pulse (see discussion below).
Fig. 4.12: Additive meters showing repetition of a metric formula (5/8, 5/8 9/8).

8. Establishment of successive isochronous pulsations lasting two and three eighth notes (mm. 186-205), creating a dissonance between subsequent phrases.
Fig. 4.13: Isochronous pulses at different speeds.

9. Gradual augmentation in the motivic part, leading to a destruction of its rhythmic quality, followed by the re-emergence of the ostinato meter. (mm. 206-218, Figure 4.14)
Fig. 4.14: Conflict between ostinato meter and an augmentation in the motivic part.

10. Coda (m.219 to the end, Figure 4.15), recalling the materials and groupings of episode 7. The ostinato is ‘evaporated’ through a gradual change in registers, from the lowest notes on the keyboard to the highest, while the motivic part descends to the bottom of keyboard. This crossing complements the rhythmic dissonance of the parts with a registral one; under this double pressure on musical coherence, the piece finally breaks down.
As I suggested above, the episodic structure could be described as a process in which the motivic material gradually becomes more complex and independent of the ostinato through the establishment of competing meters, culminating in the sustained 7/8 meter of episode 5. This process is punctuated by sections dominated by the ostinato (3,6,9) that serve to reinforce the listener's original entrainment to
the ostinato meter, thus intensifying the dissonant effect of rhythm on the overall form.

In the language of information theory presented in Chapter 3, this alternation can be considered as a contrast between sections containing high redundancy (synchronization of motivic part with ostinato) and greater entropy (various types of rhythmic dissonance). However, rather than trying to quantify the rhythmic dissonance that results from each metric organization, it would be more helpful to classify the different types according to their perceptual results.

In trying to distill the great variety of additive and irregular metric structures in _Fanfares_, three main types can be distinguished: grouping dissonance, displacement dissonance, and a competing isochronous pulse dissonance. An example of each type is discussed below; these categories can be applied in various combinations for the rest of _Fanfares_.

**Grouping Conflict**

The very opening (and relatively consonant) measures already present a systematic grouping dissonance, in which the groups of three pulses in the ostinato conflict with the motivic grouping of five pulse units in the right hand. Figure 4.16 shows the different groupings (length indicated by number of NI pulses) creating a larger-scale 5/3 polyrhythm. While the motivic material is entirely synchronized with the underlying meter, groups onsets are not synchronized with the ostinato’s downbeats; in this way, some metric independence is given to the motivic part.
Given the systematic nature of this conflict, it brings the two hands into alignment every five repetitions of the ostinato, or three motivic groups. While all attacks in the motivic part coincide with an ostinato pulse, the beginnings of groups (accentuated by the preceding break) coincide with ostinato downbeats only every five measures. The opening measure further intensifies the metric conflict, by allowing the listener to entrain to the ostinato pattern first; against this background, the grouping conflict is more effective.\textsuperscript{65}

While the right hand part can be easily interpreted within the ostinato’s metric framework, the conflict nonetheless creates some difficulty in recognizing the larger-scale grouping patterns in the right hand. The result is a mild type of grouping dissonance, which disturbs the partitioning of the music into unambiguous

\textsuperscript{65} This technique is found elsewhere in Ligeti’s work from 1985 onwards. For example, see the openings of \textit{Automne à Varsovie} and the Piano Concerto’s third movement.
phrases in real time. As the piece progresses and introduces eighth-notes in the motivic part, the level of dissonance shifts from grouping conflict utilizing a common metric grid (the ostinato’s $3+2+3$), to rhythmic dissonances between adjacent eighth-note attacks.

The same $5/3$ grouping conflict is maintained in the beginning of the first interruption episode, which can be interpreted as a variation using diminution of the original grouping of five NI pulses. In this variation, each chord is divided into two or three notes corresponding to its original length (a quarter note or a dotted quarter note), while maintaining the larger groupings.

Fig. 4.17: Preservation of the previous grouping with diminutions of each pulse in the motivic part.

Such grouping dissonances between the two hands—essentially desynchronized, strongly accented group beginnings—continue throughout *Fanfares*
in a less systematic fashion, and are an important device in ensuring the musical flow despite the static repetition of the ostinato.

**Isochronous Competing-Pulse Dissonance**

The same passage introduces the first competing pulse dissonance - a technique by which a new regular pulse is established independently of the ostinato meter, creating a simultaneity of two meters. I define a competing pulse as series of isochronous pulses with sufficiently sustained regularity to compete with the ostinato for the listener’s metric attention. In a rhythmic environment based on NI meters, the appearance of an isochronous pulse is particularly powerful, creating an increased effect on the listener’s attention. The example below traces the emergence of such a pulsation in the right starting in m. 46, using color notation to express the competition for the listener’s metric attention that arises from different cues. All accents are marked red, with the listener’s most likely metric organization of the motivic layer notated in the note durations above the staff in red. Black note durations indicate a frustrated continuation of a previous metric projection, contradicted by the actual attack pattern, which appears above the projected continuation of the previous one (Figure 4.18).
Fig. 4.18: Gradual emergence of a competing pulse (marked in red dotted quarter notes).

Starting from an accentuation pattern derived from the ostinato, the right hand deviates from the ostinato’s accents in measure 49 to produce the first hint of
a competing isochronous pulse, notated as four consecutive dotted quarters above the right hand staff. The projected continuation of this pulse is avoided while the accents in the right hand revert to an NI pattern. However, the same dotted-quarter pulse is taken up again in measure 52, this time for eight pulses, allowing for a full entrainment by the listener to the new meter. The same process occurs immediately afterwards with the hands’ roles reversed, confirming the deliberateness of the procedure (Figure 4.19).

Fig. 4.19: Emergence of the same competing pulse in the left hand.
The series of four isochronous pulses in measure 56 parallels measure 48, and provides sufficient regularity for entrainment to the new pulse. Once again, the continuation of this pulse is blocked by several NI groupings, before taking up the same dotted quarter pulsation for eight pulses.

The rhythmic process here could be conceptualized as follows. Starting from a unified NI metric framework (of the ostinato), a regular counter-pulse is established for a minimum duration required for entrainment (four pulses). This new metric framework is contradicted as soon as it has been established through NI groupings that partially conform to the ostinato, resulting in a momentary suspension of both metric frameworks. Finally, a prolonged counter-meter of eight pulses appears, followed by a return to the ostinato framework.

While the shift back to the ostinato meter is abrupt and supported by dynamic and texture breaks (an example of Krebs’ “indirect dissonance”), the process of establishing a regular counter-pulse is more gradual, bearing some resemblance to a harmonic modulation. The four-pulse series anticipates the actual metric shift, somewhat like the premature appearance of a leading tone of the modulation’s goal key, with the longer eight-pulse group as the cadence that establishes the identity of the new meter or tonality.

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Two Dissonant Listenings

The rhythmic dissonance in this passage can be described from two perspectives, corresponding to radical and conservative listening models. A conservative listening would hold on to the ostinato meter, despite the manifold contradicting accents and groupings in the motivic part; this maintains a unified metric framework, but in which most events contradict the sense of pulse. Such a listening is conveyed by Ligeti’s original notation (see Figure 4.1 above). In this case, the dissonance arises from the inadequacy of the metric grid to predict the actual events, recalling the conflict between stimulus band prediction-based entrainment. The mental metric framework is maintained at the cost of correspondence to the specificity of events in the music.

On the other hand, a radical listening that adopts new groupings at the slightest deviation from the preceding meter runs the risk of producing many unfulfilled projections that are contradicted by the actual phenomenal accents. This results in a process of constant re-adjustment, with no stable metric and mental framework with which to make sense of the events. In the previous analysis, this process is indicated by areas with overlapping pulse layers - projected pulses in black, actual ones in red. While these conflicts of projection and actual events last only last a split second, their disorienting effect on further metric projections can hardly be denied.

This suggests an interesting hypothesis: rhythmic dissonance is experienced at the points of transition between two types of listening or at the shift from one metric
framework to another. Given that both listening strategies are contradicted by some of the information, the result is bound to be a change in the mode of listening. In order to maximize this effect, it is important that each possible metric framework is established with sufficient consistency before being challenged; if the rate of change is too quick, the result can be an attenuation of rhythmic expectation rather than a dissonance between different interpretations.

This hypothesis leads to a new definition of rhythmic dissonance. While we usually think of grouping conflicts as simultaneous rhythmic groups, the actual experience of listening to them involves a process of switching metric attention from one part to another, as well as from one listening strategy to another. The efficiency of rhythmic dissonance depends on each part forming a clear metric construction that listeners can entrain to if they choose to do so— a requirement of minimum predictability. On the other hand, maximization of potential rhythmic dissonance (as opposed to surface complexity) requires juxtaposition of these minimally regular metric patterns without producing a predictable alteration of the two, or a higher-level regularity. This functional relation between micro-regularity and a larger-scale irregular rhythmic organization is an important critical tool in assessing the success of rhythmic dissonance, as was also demonstrated in the analysis of Touches Bloquées in Chapter 3.

**Competing NI Metric Dissonance**

It is useful to compare the passage discussed above with an example of an NI competing pulse later in the piece (section 5), starting in measure 124 (Figure 4.20).
In this case the grouping dissonance is made systematic, with the cycle of the thematic part lasting seven eighth notes against the ostinato's cycles of eight. The result is a phasing of the two patterns, completed after seven repetitions of the ostinato (measure 130):
Fig. 4.20: Systematic grouping conflict (G8/G7) between the ostinato and the motivic part.

Unlike the previous example, the dissonance in this example is more ambiguous precisely because of its systematic use of two NI meters. Because of the static and repetitive character of both parts, a listener might choose to focus on either of them; since neither offers the ease of entrainment provided by an
isochronous pulse, both are possible metric frameworks. However, the dynamics counter this effect, bringing the motivic part into considerable relief at times. It is also highly possible that such a situation would lead to an attenuation of metric expectations rather than a dissonant clash with them, certainly after a multiple of repetitions. The problem of the efficacy of multiple NI meters is a central question in book II of the Etudes, requiring separate analytical treatment.

**Displacement Dissonance**

Krebs (2003) points out a type of dissonance in Schumann’s music, in which the metric framework appears shifted, with groupings producing an effect of a shift of the downbeat to another part of the measure.67 A development of this type of dissonance can be seen in the following passage, where each subsequent phrase is shifted by an increasing amount. In the following passage (Figure 4.21), the dotted-quarter note pulse is shifted by various durations, forcing the listener to adjust her expectations accordingly.

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67 Krebs, 34.
Fig. 4.21: Progressive displacement of the pulse in every phrase (marked in X).

In this example, the dotted quarter note pulsation is stable enough to produce a higher-level grouping into groups of 6/8, indicated by square brackets. Measure 161 shows an interruption to this regular pulsation when the next group fails to begin on the last eighth note of the bar (marked here with an X). Instead, the same pulse resumes on the next eighth note, thereby shifting the pulse by an eighth
note. The repetition of the same rhythmic pattern in the next phrase makes it easy enough for the listener to shift the metric framework immediately; in this passage radical listening provides a strong benefit, and is the most likely hearing of the second and third phrases of this sequence. Furthermore, given the rapid tempo of this passage (the duration of a single eighth note is approximately 120 ms), a deviation of a single eighth note can be accommodated easily by our hearing.\footnote{London, Hearing in Time: Psychological Aspects of Musical Meter, 122.}

This initial grain of sand in the machine causes great problems still. In measure 165, the same type of interruption occurs, weakening the perception of the dotted quarter grouping. While the previous quarters can still be interpreted as a triplet within the two-meter, the next group starts “too early” after four eighth notes. In measure 167, the break is doubled once more, resulting in a possible continuation of the 6/8 grouping.

Once again, rhythmic dissonance appears as result of a process that forces the listener to adopt different listening behaviors in seemingly parallel phrases. While the best solution in the first phrase (158-161) is to ignore the extra eighth note, this proves problematic for the next interruption (m.165), which acquires a more disorienting effect as a result. In a humorous turn of events, the last interruption (m. 167) turns out to be no interruption at all, but a smooth continuation of the same pulse.

A comparison with the Stravinsky excerpt analyzed in Chapter 3 reveals an important difference in technique (Figure 3.4). Whereas Stravinsky’s invariant coupling of pitch, orchestration, and metric structure strongly rewards radical
listening, Ligeti’s cues to the listener about the metric organization are deliberately ambiguous. This results in greater difficulty in parsing the grouping and relations between successive phrases in the motivic part, as well as in cases where two roughly parallel phrases are treated differently.

**Large-Scale Rhythmic Dissonance and Form**

A trope of Ligeti’s forms is the moment of catastrophe, in which the piece collapses under the power of its own processes. In *Fanfares*, the constant struggle between the two types of pulse units used throughout—two and three eighth notes, or a quarter note and a dotted quarter note—is brought to a boiling point, shown in Figure 4.22. The conflict unfolds on two levels: superficially, in the alternation between quarter notes and dotted quarter notes, and more interestingly in the larger groupings they form. For example, the three quarter notes in measure 190 form a total grouping of six eighth notes, and can be related to either the groups of four (by their attack onsets) or to the longer six groups (by the group duration, as triples). The eventual result of this is both the de-stabilization and augmentation of the metric framework by steps; perception of the exact proportions of groups is replaced by a categorical perception of longer and shorter duration.

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69 See for example, *Désordre*, page 6; *Automne à Varsovie*, last page; Chamber Concerto, last movement, etc.
Fig. 4.22: Juxtaposition of metric groups of varying lengths, creating maximum discontinuity between phrases.
This process leads to a linear augmentation of the motivic part, initially augmenting the duration of every third chord by an eighth-note. The repetition of each duration is abandoned from durations of six eighth-notes and above, presumably in order to retain the illusion of slowing down the same initial pulse. Parallel to the slowing down of the tempo of the motivic part, the ostinato carries on in its own tempo (Figure 4.23).

Fig. 4.23: Gradual augmentation of the motivic part.
The result of this process is the destruction of metrical organization of the motivic part, having exhausted all forms of rhythmic dissonance in the course of the piece. The momentary metric vacuum is filled by the reemergence of the ostinato meter, creating the most polarized juxtaposition of the two metric frameworks.

**Conclusions and Questions for Further Research**

This analysis points to a few intersections between the analysis of rhythmic complexity and current empirical research in cognitive psychology. First, investigation of listening and tapping strategies for rhythmically complex music could help determine the empirical basis of the distinction between radical and conservative listening in response to NI meters. More specifically, the response of radical listeners to the appearance of a new isochronous pulse could be monitored in order to establish the number of pulses required for a shift of metric expectations. An intuitive response to this question suggests that three pulses is the bare minimum (producing two interval durations), with four as a more likely figure. This probably varies contextually, but could nonetheless be investigated in different situations.

This raises the further question about the relation between the number of isochronous pulses and subsequent metric expectations and projections. It has been shown that the longer the appearance of a regular pulse, the stronger the entrainment and subsequent expectation of its continuation will be. However,

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there might be a critical threshold for this phenomenon after a certain number of pulses, which could assist both composers and performers in assessing the communicability of metric complexity.

Also, my analysis suggests that the initial entrainment to the counter pulse (in its short four-pulse appearance) makes the entrainment to its subsequent longer version more immediate, as the listener can associate the two. Investigating this phenomenon would help in establishing how metric attention is divided in such complex environments.

In analyzing conservative listening, the maximum amount of contradiction to a given metric framework should be defined more precisely. In other words, the maximum number or contradicted projections that still allows the listener an option to maintain the previous pulse could be tracked, along with preferences for eventual adjustment.

Finally, displacement dissonances raise related questions about our willingness to ignore a certain margin of deviation and other adjustment strategy. While some margin of error is possible, adjusting the metric framework seems to be beneficial beyond a certain threshold. Once again, this would be contextually variable, but could reveal some connections between tempo and metric strategies.
Chapter 5: *Automne à Varsovie*

**Introduction**

The analyses presented in previous chapters are focused on listeners’ responses to metric irregularity and processes of rhythmic destabilization in *Fanfares* and *Touches Bloquées*. In both Etudes radical listening is described as a process of adjustment of metric expectations in response to conflict between different grouping cues, resulting in conflict with previous metric expectations, and the momentary suspension of metric perception. The largely homophonic textures and extensive use of variable non-isochronous (NI) meters make it possible to identify challenges to metric entrainment, while treating the most salient pulse level as the basis of metric perception. Moreover, the clear breaks between sections using different groupings in both Etudes make it possible to recognize metric shifts with relative clarity.

In contrast, *Automne à Varsovie* is a polyphonic piece in which isochronous pulses in different layers interact in continuous multi-layered processes, causing the listener’s metric attention to be divided between the various pulse layers. Rather than challenging a single meter through the use of non-isochronous beats of varying lengths, *Automne à Varsovie* makes use of polyrhythmic relations between pulse layers to create polymeter (or polytempo) throughout. Furthermore, Ligeti’s conception of a tempo fugue (discussed below) deliberately avoids establishing a stable hierarchy between the various polyphonic parts; much of the interest in the music stems from the struggle for perceptual prominence between the different
pulse layers. This requires a different analytical approach, in which categories of interaction between pulse layers are the primary focus, while acknowledging the division of metric attention between the different tempos, or different polymetric layers.

The goal of this chapter is to analyze the perceptual difficulties created by this rhythmically dissonant polyphony for both listeners and performers, in order to formulate a strategy for realizing the rhythmic complexity of Varsovie in the most lucid way. In order to do so, I argue that it is necessary to incorporate interpretative aspects into the re-notation; consequently, the discussion combines analysis of the music with performance and notation issues. Unlike the re-notation of the other Etudes, in which we could proceed according to a set of general preference rules in order to facilitate performance, the polyphony of Automne à Varsovie requires integrating an analysis of listener expectations into the re-notation, in order to help maximize the differentiation of the rhythmic structure by the performer. In this sense, the re-notation is even more a “composed interpretation”, in which a particular interpretation of the rhythm and polyphony is hard-wired into the choice of metric structures.

In order to untangle the complex relation between analysis, perception, and re-notation, this chapter will proceed in several stages. In the first part, a general analysis of the rhythmic structures and overall form is provided. In the second part, I proceed to analyze the factors that influence perception of the rhythms, drawing on principles from Auditory Scene Analysis. In the last part, I suggest how perception of the polyphony could be manipulated to produce a performance that is
both lucid and maximally dissonant, with one particularly dense passage examined in detail.

**Materials and Rhythmic Techniques**

Many analyses of *Automne à Varsovie* are available, probably because of the remarkably systematic organization of certain elements; there is wide agreement about the underlying principles and materials.\(^{71}\) Therefore, instead of providing an entire analysis of the piece, I present a summary of the rhythmic techniques and the various analytical concepts that have been applied to them in order to explore questions of rhythmic dissonance and performance.

*Automne à Varsovie* is the most polyphonic Etude of the entire set, and the only one to make systematic use of polyrhythms. When the same thematic material is played at these polyrhythmic ratios simultaneously, the illusion of multiple tempos emerges; Ligeti has described this as a “tempo fugue”, as have many later commentators.\(^{72}\) As in a traditional fugue, all voices share the same subject, often described by commentators as a “Lamento” motive and used in several other works of the 1980's, including the Piano Concerto and the Horn Trio. Unlike a traditional fugue, however, there is no countersubject or secondary material, with all motivic

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figures derived from the Lamento. While much has been said about the
cultural/historical references of the lamento motif, it is worth emphasizing the
qualities that make it particularly well-suited to the presentation of conflicting
temporal relations from a perceptual standpoint. First, the melodic stepwise descent
articulated by isochronous beats produces an easily recognizable gestalt, as well as
producing a strong illusion of virtual motion. These qualities make the thematic
material particularly useful for projecting a tempo, as the listener can anticipate the
continuation of the melody almost immediately. (Fig. 5.1):

73 Steinitz, Richard, György Ligeti.
74 Robert O. Gjerdingen, "Apparent Motion in Music?," Music Perception: An
Fig. 5.1: Isochronous pulse in lamento line facilitates metric entrainment. Mm. 1-3.

The clarity of individual lines is particularly important in dense passages that present the theme in multiple tempos, as it facilities immediate recognition and entrainment to new pulse layers. Furthermore, the avoidance of bigger leaps in the melodic lines prevents overlap between the different voices, with a few intentional
exceptions discussed below. Finally, the clear segmentation into phrases and repetition of the motif at the opening of the piece facilitates recognition and memorization of melodic structure.

*Automne à Varsovie* is thus based on an opposite strategy from *Touches Bloquées* and *Fanfares*, in which metric perception was constantly challenged by irregular groupings from the outset. Starting with relatively predictable and regular material, the addition of new voices at different tempos gradually becomes overwhelming, despite the deterministic and predictable quality of the melodic material itself.

While this gradual growth in complexity might suggest a connection with earlier orchestral sound-mass pieces, it also differs from them in crucial ways. Rather than integrating micro-processes (or melodic motion in individual voices) into a single sound mass, the single lines maintain polyphonic clarity and independence throughout most of the piece. However, at key points this clarity is intentionally destroyed, creating the momentary effect of an integrated sound mass. In this analysis, I'll focus on the interaction between the perception of polyphony and meter, as it is problematized in particularly dense passages. As we'll see, the performer has a crucial role in presenting the interplay of rhythmic dissonance, polyphony, and textural clarity creates the formal drama of the work.
**Hemiola, Polyrhythm, and Polytempo**

Let us now examine the ideas behind the concept of a tempo fugue more closely, and the possible ways of describing it. Ligeti has explained the idea of a tempo fugue as a systematic extension of the traditional concept of hemiola:

One often arrives at something qualitatively new by unifying two already known but separate domains. In this case, I have combined two distinct musical ideas: the hemiola of Schumann and Chopin, which depends on meter, and the additive pulsation principle of African music. The hemiola arises from the metric ambiguity posed by a measure of six beats, which can either be divided in three groups of two or in two groups of three. . .The shimmering effect of dividing the bar simultaneously into two and three produces the metric tension which is one of the most seductive attractions of the music of Chopin, Schumann, Brahms, and Liszt.\(^{75}\)

While this description clarifies the link with traditional practices of metric dissonance, it is not sufficient as an analytical approach. In traditional uses of hemiolas, the priority of the notated meter and tempo, as well as the division into measures, are the background against which hemiolas are perceived; only rarely is the meter entirely obscured by anti-metrical accentuation. In *Automne à Varsovie*, on the other hand, the notated measures and meter are only a notational practice, rather than an indication of metric structure.\(^{76}\) The term hemiola would be somewhat misleading in this case, unless it is extended beyond its historical meaning.

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\(^{75}\) Quoted in Taylor (1997).

\(^{76}\) See Chapter 1 for a full discussion of this issue.
However, a parallel to the role of traditional measures can be found in the prominence in polyrhythmic cycles. For example, a grouping conflict between a voice accentuating every fifth sixteenth note (G5) and another accentuating every third sixteenth note (G3) produces a polyrhythm of 5:3, with a coincidence every fifteen sixteenth notes (Fig. 5.2):

Fig. 5.2: G5:G3 Cycle produces a convergence point every 15 sixteenth notes.

In both the perception and notation of such polyrhythms, the cycles serve a role analogous to measures; the coincidence of attacks at the beginning of a cycle can support the perception of a downbeat. Although all polyrhythmic cycles in *Automne à Varsovie* are aligned (that is, their beginnings are synchronized), they are not particularly salient: for instance, higher ratios like 5:7 only coincide every thirty-five sixteenth notes. Finally, coincidence points where three or four voices synchronize are even more rare, as Cuciurean shows.77 While this index of complexity is useful for orientation, it tells us little about the dissonance produced

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77 Cuciurean (2000), 74.
by these ratios for perception, which is intimately tied to interaction with other parameters.

In spite of the constructive role played by these cycles in *Automne à Varsovie*, they are not intended to be perceived as such. Ligeti systematically conceals the cycles at the opening by obscuring the simple 4:5 polyrhythm; this leads to heightening the illusion of independent tempos (see example 5.5 below). Thomas (1988) suggests that this is one of the ways in which a simple polyrhythm can be made into a polytempo. She illustrates the difference between polyrhythm and polytempo in Nancarrow’s studies (widely acknowledged as a strong influence on Ligeti’s Etudes) using the following scheme (Fig. 5.3):

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FIG. 5.3: POLYRHYTHM AND POLYTEMPO. REPRODUCED FROM THOMAS (2000).

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In this figure, the simple 4:3 ratio is obscured in (b) by grouping the lower line in units of four notes; in this way the coincidence points (henceforth CP’s) are obscured and listeners’ attention drawn to the independent beginning of groups in each of the voices.

**Talea and Local Rhythmic Dissonance**

*Automne à Varsovie* constructs a polytempo in the opening by using a talea (or rhythmic series) in the thematic part, which guarantees that the cycle produced by the 4:5 ratio is not perceived, in spite of occasional articulation of the beginning of cycles in both parts. The talea is based on a distinction between short and long beats (five and ten sixteenth notes long, respectively). The pattern of alternation between short and long beats (marked S and L below) yields three distinct phrases, with longer durations serving to delineate the phrases (Fig. 5.4):
Fig 5.4: Talea pattern alternating short and long durations creating division into phrases.

Figure 5.5 below demonstrates how the talea has the effect of concealing the beginnings of G5:G4 cycles. X’s mark beats which are not articulated because of ties sustaining the longer note; cycle beginnings are marked with square boxes.

Although some CP’s are articulated, they do not coincide with the talea’s phrase beginnings (except for its initial entry). The result is a “magical” situation, where the systematic avoidance of accenting CPs prevents the listener from recognizing the ratio of the polyrhythms, while still keeping the cycles synchronized and relatively easy to perform.
Fig. 5.5: Talea in the opening of *Automne à Varsovie* prevents articulation of convergence points
This talea is repeated twice more, creating a clear division into three sections in the opening pages. Interestingly, the talea does not continue throughout the piece systematically, but is abandoned with the entry of subsequent voices and greater complexity; this is probably because of the tendency towards more frequent crises and shortening of sections, which would not permit full statements of the talea (see next section of discussion). The return of the talea following the first great crisis of the piece establishes a parallel with the opening, giving the piece a distinct two-part form; however, it is once again abandoned and replaced by simple polyrhythms.

Lastly, the talea itself produces a local type of rhythmic dissonance through its unpredictable changes between short and long beats, or rather the number of short beats that appear before the next long beat (since there are no consecutive long beats within a single phrase). The listener entrains to the pulsation of the short isochronous beats; however, the variable number of short beats before a long beat prevents listeners from predicting the grouping patterns and perceiving it as a recurring meter.

**Form and Rhythmic Processes**

So far our analysis has proceeded from the bottom up, tracing the initial forms produced by the talea. Taking a top-down approach now, we can note the interaction of local rhythmic processes with the macro-form. The most important type of middle-ground processes in *Automne à Varsovie* is the buildup of rhythmic complexity through the gradual introduction of additional pulse layers. Each section starts with either a single pulse layer or a polyrhythm of two layers and proceeds to
add more pulse layers until the texture reaches a highly complex and rhythmically unpredictable state. In several passages, the density becomes so high that the perception of independent lines becomes problematic, further reducing the degree of rhythmic predictability, as I'll show below. This state of saturation is used sparingly: as soon as maximum density has been reached, Ligeti restarts by abrupt changes in density, register, and dynamics, as in the other Etudes. The resulting form is a series of catastrophes, in which the music repeatedly collapses under its complexity. This tendency prevents extended stretches of music with a high degree of complexity/rhythmic unpredictability (in which metric prediction would be attenuated); this confirms Ligeti’s careful use of entropy discussed in Chapter 3. 79

Taylor (1997) identifies seven climaxes in total, corresponding to these abrupt changes in dynamics. The resulting segmentation articulates a large-scale form, which he identifies with a fugue and a binary form (Figure 5.6): 80

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79 See Chapter 3 for the concepts of information theory and entropy.
80 This description is largely correct, despite a probable misreading of the dynamics in measure 20, where no stark contrast is found if the pp applies only to the left hand. Also, the portrayal of all climaxes as equally significant is somewhat misleading: only the climax of measure 50 matches the extremity of the climaxes found in the second half of the piece.
The repeated dynamic contrast of crescendo followed by *subito* 
piano/pianissimo provides a strong cue for listener’s segmentation of the music, 
drawing on well-established rhetorical use in traditional classical music. Given the 
unequivocal segmentation provided by dynamic contrasts, parsing the polymetric 
textures is made much simpler; simply put, most abrupt metric shifts (from one 
pulse layer to another) occur following a *ff/p* contrast.

The overall tendency of the piece, then, is a gradual destabilization and 
intensification, in which each “crisis” destroys the previous metric organization 
locally; globally, the destabilization escalates in the second part of the piece.

If this pattern of growing complexity and crises defines the interaction of 
local process and form in the piece, the performer’s main task is to convey this 
interaction with the greatest clarity and drama. Consequently, the analysis 
presented here will be concerned with the gradual build-ups of rhythmically 
dissonant relations between voices, with emphasis on the effects of texture on the

Fig. 5.6: Segmentation of form using dynamic contrasts. Reproduced from 
Taylor (1997).
clarity of these processes. As we’ll see, rhythmic perception is related to the clarity of polyphony: generally speaking, even dissonant rhythms can be made intelligible by textures that facilitate polyphonic perception, while textures that use overlapping registers create perceptually chaotic situations. Consequently, the (con)fusio of individual lines into sound masses is the chief means of bringing about crises.

In order to trace these processes, it is necessary to correlate between the build-up of polyrhythmic cycles and the influence of texture on the perception of polyphony. While the polyrhythmic cycles can be traced relatively easily, the role of texture and register in changing the predictability of events requires us to introduce some basic concepts taken from Auditory Scene Analysis.

**Streaming/Fusion and Metric Perception**

Auditory Scene Analysis (henceforth ASA) is a model proposed for study of listeners’ ability to extract groupings of frequencies from a complex sound wave in order to identify its different components. ASA identifies two primary types of processes involved in the analysis of complex sound wave. Integration is the process by which multiple frequencies are interpreted as a single entity (such as the multiple frequencies of a piano chord perceived as a single “color”); in contrast, stream segregation involves separation of simultaneous events into independent streams, each of which exhibits some type of regularity in its sequence. The preference for one type of perception over another is the result of competitive

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81 Bregman, *Auditory Scene Analysis.*
grouping, in which degree of similarity and difference between different elements is constantly re-assessed and re-grouped differently. A greater degree of similarity between two events causes them to be grouped together and form a stream; their perceived similarity is the result of input by different factors.

There are multiple factors that influence the phenomenon of streaming, or the recognition of separate voices required for perception of polyphony. These include the (de)-synchronization of attacks, tonal fusion (where multiple frequencies are interpreted as a single complex sonority such as chord), spatial location and differences in the timbre of complex sounds (once each has been grouped together from separate frequencies).

The last two are not relevant for our analysis, given the piano’s nearly uniform timbre and the production of all sound by a single source in space. However, because of the uniformity of timbre and registral proximity of the polyphonic lines, adjacent attacks in different voices are in constant risk of being grouped together rather than streamed; throughout the piece, the streaming/fusion boundary is in flux. This tendency becomes stronger as voices overlap in register for an extended period; this results in perception of the compound accent pattern, as we’ll see below.

Figure 5.7 shows measures 41—44, in which two voices articulating the 5:3 polyrhythm are presented in two contrasting textures. In measures 41—42, each voice presents a pulse layer in a distinct register, resulting in a natural perception of two streams; despite the articulation of convergence points, no risk of fusion is present. In measures 43—44, however, an abrupt leap in the G3 voice from the bass
to alto register brings the two voices in close proximity. This results in a destructive interference, where attempts to entrain to either voice are constantly interrupted by the accents of the other, yielding an unpredictable attack pattern. The contrast in register in the previous two measures allowed the listener to entrain to either one of the pulses, while relegating the attacks of the other to an anti-metrical status. With the loss of polyphonic differentiation, the ability to anticipate subsequent rhythmic events based on the continuation of one of the isochronous pulses is strongly diminished: the isochronous pulses disappear behind the palindrome of the combined accent pattern.
Fig. 5.7: Streaming and fusing textures. (A) Measures 41-43. Transition from streaming texture to fusion texture. (B) Perception of fused G3/G5 in mm. 43-44.

Measures 43-44 mark the first break from the relation of texture to rhythmic structure used up to this point in *Automne à Varsovie*, in which streaming preserved the identity of individual voices despite the growing complexity. The fusion of pulse layers in measures 43-44 creates a palindrome attack pattern, which contrasts with the previously all-isochronous lines; this sets off the destabilization process that
ultimately brings about the first major climax of the piece. It is significant that this break with the previous procedure is not marked as such: while it has a determinate effect, it is not immediately recognizable for the listener, until its consequences have unfolded in the next measures.

A model for thinking about this type of interaction between polyrhythm and problems of streaming fusion relations created by texture has been proposed by Poudrier (2008). She identifies three types of relation between texture and underlying polymetric structures, in which each voice’s prominence in relation to the polyphonic texture is the basis of metric attention. A balanced polymetric structure features equal prominence by two competing layers, as in measures 41-42, allowing the listener to choose pulse to follow and base their metric expectation on. By contrast, an integrated polymetric structure is one in which the distinction between pulse layers is eroded, as in measures 43-44 above. Finally a polarized metric structure is one in which one layer dominates the texture, due to greater consistency (articulating consecutive beats) or prominence (owing to dynamics, for example). As Poudrier notes, transitions between modes can be controlled by composers to some extent, through use of strong differentiation/preference or their absence. However, the perception of the same texture in one way or another ultimately depends to some extent on the performance.

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Polymetric Modes and Performance

The degree of rhythmic dissonance produced by polymeter is thus not constant for any specific tempo ratio between voices; rather, it varies with changes in the texture's density, the perceived hierarchy between voices, and the performer's ability to negotiate the various factors in real time. With these categories of interaction between texture and polymeter in place, we can now formulate different strategies for the realization of rhythmic dissonance in performance.

As we've seen, the exposition of the material in *Automne à Varsovie* projects a mostly polarized polymeter, with G5 maintaining priority over the other voices throughout measures 1-24, despite the growing prominence of anti-metrical layers articulating that imitate the lament motif at different speeds. The first important transition between polymetric modes occurs at the end of measure 24, when the G5 and G3 layers exchange registers: G3 becomes the top voice, with the G5 moving to the bass (Fig. 5.8). This transition can serve as an example for the strategies a
performer might use.

Fig. 5.8 Register Switch between G3 and G5 Pulse Layers in mm. 24-26.

As a result, the perceptual salience of G3 grows significantly, as Drott observes.\textsuperscript{83} This increase in prominence is likely to attract the listener's attention and prompt a radical listening response, taking G3 as the new metrically dominant element. Furthermore, it is likely that the listener will choose to continue entraining to the soprano line, hitherto the most metrically indicative pulse layer. Such a listening is

\textsuperscript{83} Eric Austin Drott, "Agency and Impersonality in the Music of György Ligeti" (Yale University, 2001), 334.
indeed rewarded in the following passage (measures 26-36): the G3 soprano line
becomes most prominent through the separation in register, chordal texture and the
use of dynamic accents; listener adjustment to this dominant new pulse is almost
inevitable. On the other hand, the previous strong entrainment to G5 makes it
possible to follow it as well; the articulation of the polymeter is now balanced.

Another important factor encouraging radical hearing of this passage is the
shift from a slower-moving grouping G5 to the faster G3. The faster speed of the new
pulse means that its subsequent beats anticipate those of G5, diverting the listener
from the continuation of the projected G5 continuation. It is likely that an opposite
transition from a perceptually fast pulsation to a slower one would not trigger an
immediate shift in metric perception.\(^8^4\) Interestingly, most polymetric expansions in
Automne à Varsovie start with slower pulses and add faster ones, allowing new pulse
layers to be recognized even against already complex backgrounds. By contrast,
there are only two instances in the piece in which a slower pulse is added to the
texture: G7 added to G3 and G5 in measure 44,\(^8^5\) and G5 added to G3 and G4 in
measure 89. This preference for diminution corresponds to the traditional
association between faster tempos and intensification; in comparison, the addition
of slower moving pulses is perhaps less immediately apparent, yet ultimately more
unusual and disorienting.

The performer can intervene in this transition in two ways. One can see it as
a transition from one polarized polymetric situation to another: in both measures 1-

\(^8^4\) To the best of my knowledge, this specific question has not been empirically
investigated.

\(^8^5\) See discussion at the end of this chapter.
24 and 24-36, the pulse articulated in the top voice is the most prominent, and likely the basis for metric entrainment and prediction. In that case, the shift by a radical listener to a new pulse (in this case, from G5 to G3) provides the best response to the new polymetric situation. However, this shift in entrainment coupled with the obstructions to the G5 layer by the accompaniment result in the weakening of polymetric perception altogether—a problem that is also evident in most performances of this passage (Fig. 5.9).

Fig. 5.9: Greater salience of G3 over G5 in mm. 26-29.

Acknowledging the risk of diminishing the polymetric balance inherent in this tempting radical hearing of the transition, we could argue for the benefits of a conservative approach on behalf of the performer. By emphasizing G5 throughout the transition, the performer takes this new polarized polymeter (in which G3 is
emphasized by phenomenal accents) and brings it closer to a balanced polymeter. While the term “balanced” might suggest a rhythmically simpler perception, the outcome is likely the opposite. If the G5 can be brought out enough in performance to compete with the G3 for the listener’s attention (this proves very difficult given acoustic and pianistic constraints), the transition is bound to be more difficult to adapt to. In other words, if the appearance of G3 in the soprano is performed in more subdued manner, the shift to G3 as the most prominent layer can be delayed, creating more of a sense of competition between the pulses. As we have seen in chapter 1, precisely this effect of pulse layers fading in and out of perceptual prominence distinguishes Ligeti’s work from earlier types of metric dissonance, where the primacy of a single layer throughout extended sections is fundamental.

This interpretive dilemmas illustrated here arise from this unique device of metric flux, in which multiple factors influence the relative prominence of each layer. The example presented above can serve as a template for metric transitions elsewhere in Automne à Varsovie and other Ligetian tempo fugues; while the range of interpretative possibilities is narrowed down by the composer’s dynamic indications, these by no means exhaust the possible ways of communicating these transitions.86

86 Although Ligeti’s performance indications are typically prescriptive (both voices in this case are marked piano), they arguably do not do justice to the complexity involved. It is not entirely clear whether they describe the action (investing the same energy on behalf of the performer) or the perceived result (equal dynamic level in both parts). In either case, my subsequent claims about re-notation choices and performance issues rest on the legitimation of this type of interpretative discourse, in which the authority of the composer is not taken in a prescriptive sense, allowing for the participation of the performer in these crucial aspects of rhythmic perception.
Radical, Conservative, Progressive?

A comparison of this point with the preference rule advocating radical listening on behalf of the performer presented in chapter 2 is informative. In that case (using an example of metric irregularity in *Fanfares*), the performer is encouraged to adopt an unnaturally radical listening, contrary to the most likely one for most listeners, who are likely to hold on to the previous pattern for longer before adjusting. This hyper-radical listening was shown to be a more effective way of differentiating the different groupings than performing new groupings as anti-metrical events in the pervious meter. In this case, the opposite approach seems more productive: where the listeners are likely to shift their metric attention immediately, we are advocating for the benefits of holding on to the previous pulse.

While all this seems to make a relatively simple transition unexpectedly complex, it highlights the crucial dual role of the performer in making such conflicts come to life. In the discussion of performance of rhythmic dissonance in Chapter 3 we noted the dual role of the performer, who can either clarify (or simplify) rhythmically dissonant situations or create an intentionally obscure metric situation by intensifying conflicts and avoiding a clear hierarchy. In both cases, the starting point of the performance strategy was to identify the listener's most likely mode of listening, using this construct as the basis for interpretation. In order for a listener to have any perception of meter in such complex music, metric perception is necessarily highly selective: the relative significance of certain events is amplified while relegating others to the periphery. The apparent discrepancy between
adopting different listening modes can be explained in light of this principle: in both cases, a performance creates more rhythmic dissonance by supporting and emphasizing the elements that are likely to be filtered out by the listener, provided this “over-differentiation” does not result in the lack of minimal rhythmic recognizability.

To clarify this point, we could think of interpretation and performance as engagement with the text on two levels.\textsuperscript{87} A performance first reproduces these accent patterns somewhat literally as prescribed by the composer; on a more profound level, the relations that emerge can then be manipulated to the benefit of the listener in ever-new ways. While the discussion of the transition in measure 24 above might suggest a reversal of the radical/conservative preference expressed before, in both cases a deeper type of choice is made by the performer to avoid the more “natural” or preferred mode of hearing in order to manipulate the listeners. If listeners tend to simplify or filter some of the rhythmic information to maintain some ability to predict subsequent rhythmic events, the performer must not be tempted to do this as well; to our conservative/radical pair we could add the “progressive” interpreter who recognizes the most likely perception of a passage in order to enhance its complexity.

To summarize this issue, the interpretive process can be broken down into several stages. First, the most likely preferences for “natural hearing” by listeners

\textsuperscript{87} I find the parallel with the Talmudic distinction between \textit{P’shat} and \textit{Derash} readings interesting. \textit{P’shat} refers to the literal meaning of the text, as it is most likely to be interpreted and originally intended; against this background, the \textit{Derash} presents an attempt of the interpreter to add another layer of meaning, sometimes rather remote from the literal sense, according to their interest.
should be described in terms of polymetric modes, radical/conservative responses to transitions, and the relative salience of each pulse layer at each point. Second, the rhythmic elements that are likely to be filtered out by natural listening can be singled out as potential resources for increasing rhythmic dissonance through emphasis in performance. Finally, the performer can decide on the most efficient way of presenting the competing pulse strands, without losing touch of the “naïve” listeners’ perspective. Because the number of factors involved, rather than attempting to formalize this last stage, it is more useful to resort to trial and error. Ultimately, the goal is to communicate a maximally differentiated rhythmic signal, without entirely exceeding the listeners’ capacity, except at strategic points.

The decisive element of this manipulation is the maintaining of a difference between the “natural” entrainment preferences of listeners and the artificially constructed mode of hearing required by performers. By refusing the temptation of “natural” hearing, an interpretive space is opened for the maximal realization of rhythmic dissonance. Although this refusal might seem artificial, it is hardly surprising that communication of such an unusual sensory experience as rhythmic dissonance (which is by default filtered by the listener to become more simple and manageable) requires such a strategy.

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88 This is due to the cross-influence of parameters: see the discussion of the complexity/reductionism problem in Chapter 3.
89 Needless to say, the interpretive procedure described here can be applied in any type of notated polyphonic music, where listeners are confronted with various types of ‘attention-grabbing’ elements from different layers; polymeter merely adds another layer of complexity. The influence of polymeter on polyphonic perception is double edged: on the one hand, focusing on one pulse layer could require ‘ignoring’ others to a great extent. On the other hand, the rare use of simultaneous attacks prevents the tonal fusion of several voices into a single sonority.
Additional Re-Notation Rules

So far, our discussion of performance issues has only considered the ways in which a performer could provide a listener with a maximally differentiated and dissonant presentation of the polymeter. At this point, let us consider a return to the practical difficulties involved in this task. In order to do so, I propose rules for the re-notation that are aimed at this performance ideal. Although these rules attempt to formulate general preferences, they are inevitably weaker than the ones presented in chapter 2, due to the polyphonic nature of the music; often, a helpful notation for one pulse layer generates considerable difficulties in another. In such passages where different difficulties are intertwined, the solutions are contextual and deviate from the proposed rule. This testifies to the complexity of the piece, as well as the inevitable difficulties caused by traditional notation of polymetric music. Generally speaking, these rules prioritize resolution of practical technical and cognitive difficulties over aesthetic considerations in cases of clashes. This is self-evident: addressing these performance difficulties first is a condition for control of the relative salience of different layers in the attempt to influence listeners’ perception.⁹⁰

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⁹⁰ If there is not flour, there is no Torah; and if there is no Torah, there is no flour. (Pirkey Avot, 3:2).
**Tactus Selection Rule**

A. Always choose a tactus articulated by one of the rhythmic layers present at that point. Consequently, the beats should always utilize groupings created by accents in the selected pulse layer, while the number of beats in a measure might vary. The advantage of this strategy is discussed at length in chapter 1. To summarize, this simplifies the relation between score and perception, the synchronization of the hands, and entrainment to the selected pulse layer.

B. Avoid choosing a tactus based on a grouping of more than four attack points on the lowest metrical level, unless it is the slowest pulse at that point.

These rules imply that the tactus should always be based on G3 or G4, and never on G5 or G7, unless one of these is the slowest moving layer. The reason for this preference is the tendency of faster-moving pulses to draw the performer’s attention, thereby creating the basis for entrainment; this can cause unwanted shifts of metric perception, resulting in de-stabilization of the tempo. Furthermore, groups of three and four notes are short enough to be perceived as a single undivided metric unit, whereas groups of five notes and above tend to be subdivided as 2+3 or 3+2. See Fig. 5.10.
Fig. 5.10: Tactus selection. (A) Original notation of 41-42 in 4/4. (B): Rejected re-notation in G5. (C): Preferred re-notation in G3.
The single exception to this rule occurs in measures 24-25. In this case, a notation based on G3 would conflict with two other considerations: the motoric attention rule (due to the repetitions in the left hand), and the preference for support of streaming (due to the difficulty of bringing out G5 in the bass). Consequently, the passage tactus used in the re-notation of this passage is G5 (see Figure 5.8 above).

Polyrhythm Cycle Rule

Strongly prefer metric notation in which articulated coincidence points in a polyrhythmic cycle occur on the downbeat of a measure.

This is derived from the structural function of the polyrhythmic cycles discussed at the opening of the chapter. Although the beginnings of cycles should not be emphasized, each cycle features a similar attack pattern. Consequently, basing the metric division on the number of beats in the cycle yields a repeating compound attack pattern, thus reducing the cognitive difficulty for the performer. In figure 5.11 below, this repeating pattern obscured by the original notation is made explicit. In this case, the two layers in the top stave pulsate every five and three sixteenth notes. Their pulses coincide every fifteen sixteenth notes, occurring here at the downbeat of the measures.
Performance Strategy and Hierarchy of Preference Rules

As the careful reader may have noticed, some of re-notation rules seem to be at odds with the purpose of maximum stream segregation and differentiation. For example, rule 1B above prohibits the use of G5 or G7 as the tactus, despite the fact that these pulse layers are often most in need of emphasis to compete with the prominence of G3 and G4. Also, the polyrhythm cycle rule seems to rely on the prominence of cycles, which Ligeti carefully concealed throughout the opening of the piece.
This apparent contradiction can be explained in reference to the discussion of Ligeti’s notation in chapter 1. In that case, I argued for the benefit of an integrated meter for performance of polymetric music—that is, some unifying framework that initially simplifies the relations of the pulse layer, with the goal of re-differentiating them later. This strategy was more efficient because of the inability to track two pulses independently, as well as the motoric synchronization benefits afforded by notation that is based on entrainment to one of the lines. To put it simply, it seems that motoric synchronization and attention are the overriding considerations in cases of conflict between two rules. The re-notated score does not convey the interpretative ideal perfectly: it serves primarily to resolve some of the most immediate practical technical issues for performance.

**An Interpretative Puzzle**

To conclude this chapter, let us examine in detail the construction one of the densest passages in *Automne à Varsovie* and possible ways of communicating its rhythmic dissonance. This example serves to illustrate the benefits of a perception-based approach to interpretation of rhythmically complex music and to demonstrate the value of analytical categories examined above in more problematic situations.
Measures 43-54 contain the final “crisis” of the first half of the piece, which leads to its collapse and restart. The de-stabilization of this passage is achieved through the introduction of four new elements:

1. Articulation of G7 pulse layer, creating a total of four pulse layers (G3, G5, G7 and a variable layer)

2. The “dynamization” of the accompaniment pedal points through introduction of more pitches and formation of a repeating rising wave contour of increasing length. This process begins as the G3 pattern, and expands through G4, G5 and through G11. In this way the accompaniment becomes a fifth layer of the polyphony, which gradually drowns the others by expanding its register to the range of the entire keyboard.

3. Metric displacement of G3 pulse layer (out of phase polyrhythmic cycle), played simultaneously with an aligned G3 layer. This is the single example in the entire piece of a metrically displaced layer that has no CP with other layers.

4. The use of constant overlap between different pulse layers, creating an area of extended crossing of the fusion/streaming boundary. As a result, two different processes occur: (a) previously streamed pulse layers are obscured by the

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91 Measures 43-54 refer to the original score; henceforth I refer to measure numbers in my re-notation given below.
destructive interference of the wave pitches crossing over, while (b) previously obscured layers re-emerge from beneath the wave (G3 bass in measure 68).

All of the above techniques are illustrated in Figure 5.12 below, using a color scheme for clarification. The new G7 layer (1) is marked in red throughout. Progressive expansion of the wave groupings is indicated by W/G 4, 5 etc (2). The displaced G3 layer appears in blue (3), while the destructive interference of the wave with individual pulse layers (in which the different elements are fused) is indicated by red boxes (4). CPs of the different layers are provided for the beginning of the passage, but are later removed to avoid redundancy.
Expansion of displaced G3 into ‘wave’ contour
Fig. 5.12: Destabilization process with progressive destruction of polyphonic lines by wave figure.

Because of the complexity of the passage, it would be inappropriate to provide a reduction in which these elements are neatly separated: the analytical and interpretative difficulty here lies in conveying the interaction of these processes in all their chaotic detail.

To simplify, the overall trajectory of this passage from relative order to chaos can nonetheless be generalized. Starting with a narrowly spaced G5:G3 polymeter, the addition of G7 creates the most rhythmically complex polymeter in the piece thus far, combined with the greatest amount of difficulty in streaming the texture (due to the proximity in register between the layers). This tension is present under the surface, as it were, by avoiding a corresponding dynamic crescendo until further
destabilizing elements have been added. The major destabilizing force is the introduction of the wave pattern, creating a type of figuration that is entirely new, with the pedal-point ostinatos becoming dynamic rising arpeggios of progressively greater length. As these arpeggios grow in register span and length, they gradually interfere with the “thematic” pulse layers, starting with G3, G7 and finally G5. If this process can be perceived as described here, it carries out a transition from polyphonic complexity to textural/sonic complexity (irregular waves with irregular accentuation patterns interspersed).

92 Several interesting parallels with techniques of electronic music emerge in this passage. First, the expansion of pedal-points in pitch range brings to mind modulation using a LFO slow saw-tooth wave (with a gradual ascent offset by an abrupt drop). Also, the gradual drowning of the pulse layers by the expanding waves shifts the background/foreground relation, leading to a ‘masking’ of one layer behind another common to electronic music.
Performance Strategy

Although the movement from relative order to chaos is built into the score and will be perceived inevitably, the details and logic of the transition are lost in most performances. The major risk involved here is a premature fusion of the layers, leading listeners to abandon metric expectations of any kind early on and focus instead on the generic properties of register expansion and dynamic change. From the point of view of rhythmic dissonance, defined as the maximum communication of rhythmic complexity, this entails a loss of information and a blurring of the message.

This risk is further compounded in most performances by an unintentional acceleration with the expansion of the variable waves; once again, the difficulty might be attributed to the mismatch between the acoustic and motoric salience of the latter and the notated meter (which remains unaffected).

The performer’s challenge, therefore, is to delay the impression of a chaotic state for as long as possible despite the various de-stabilizing elements. Once more, the strategy of resisting the “natural” hearing is required for this—in this case, by emphasizing polyphonic differentiation until it becomes untenable. With this goal in mind, I’ll now present my strategy for conveying this struggle between polyphony and texture; other solutions are certainly possible (although probably less practical).

The first interpretative decision is the metric notation: G3 is used as a pulse throughout, with the exception of measures 61/62. According to the tactus selection
rule, there is a strong preference for G3 over G5 or G7, because of the tendency to subdivide the latter two in this tempo. The G4 based meter in measures 61/62 is used to highlight the transition from G3, and point attention to the process of gradual expansion of the wave groups. The switch back to the original (synchronized) G3 layer in m. 63 is necessary because the changes in group length in the wave layer, which would require constant adjustment of the tactus by the performer, thereby creating more cognitive strain.

The emphasis on G3 in the notation, however, must not obscure the slower-moving G5 and G7. In the original score, G7 is marked by accents, whereas G3 and G5 have tenuto markings only. This hierarchy is obviously required given the lower frequency of attacks in G7, as well as the significance of its appearance for the overall structure of the piece. Throughout the passage, G7 should definitely stand out dynamically, as indicated by the composer, and is left unchanged. Figure 5.13 (A) reproduces the beginning of the passage with the passing notes of the waves reduced, featuring only G3, G5, G7, and the beginning of each wave group:
Fig. 5.13: Polyphonic hierarchy in re-notation. (A) Original notation (mm. 48-50). (B) mm. 62-65 in re-notation.
This seems to leave G5 somewhat in the background. However, it enjoys the benefit of being the highest voice in the texture, with initially little interference from other voices. Therefore, if the G5 pulse is established prior to the entrance of G7, it could still be recognized by listeners with relative ease.  

The result of the hierarchy suggested here is a differentiation of each layer of the texture using a different perceptual accent. G7 is dynamically accented; G5 can be streamed due to separation in register; G3, the most likely layer to be obscured, is supported by the metric notation, facilitating the insertion of discrete accents by the performer. The perceptual emphasis on G5 and G7 corresponds to “natural” hearing; the emphasis on G3 created by the notation is “unnatural”, but provides the only way to maintain this layer as a polyphonic line; without this emphasis, the destructive interference of the layers results in complete fusion of the polyphonic lines.

By measures 67-68, however, attempting a polyphonic differentiation is purely utopian, given the destructive interference of the waves in all polyphonic lines. By this point a chaotic texture is certainly intended; if one insisted on still projecting some rhythmic regularity, this could be done by overemphasizing one the layers over the others.

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93 Incidentally, the clarity of the higher register is also supported by the ‘default’ top-oriented voicing used by most pianists.
Perception and Social Aesthetics of Dissonance

Finally, having engaged at length with truly infinitesimal distinctions in a passage that lasts around twenty seconds, it would be beneficial to take a step back and reflect on the aesthetic values implied by Ligeti’s techniques of rhythmic dissonance from a wider social perspective. In order to do this, I’d like to juxtapose the passage discussed above with an excerpt from Boulez’s Second Sonata (1948), another iconic twentieth work.

Despite the major differences in compositional technique and historical context, both passages pursue a remarkably similar strategy of destructive interference between the voices, in which the combination of register overlap and timbral uniformity create a self-destructive mechanism (Figure 5.14).

![Fig. 5.14 Destructive interference of motives in Boulez’s Second Sonata (Page 12, last system).](image)

In the Boulez excerpt, a stretto made with the same motive (accented eighth note + quarter note) creates a texture so tightly woven that it is no longer perceived as polyphony, but fused into a single stream with constantly accented eighth notes
attacks. Without doubting the aesthetic (and visual) merit of this passage, a
comparison with the Ligeti passage reveals the greater complexity of the latter. The
Boulez excerpt begins in fully fused state, with no change in the degree of
polyphonic clarity throughout; the difference between the polyphonic appearance of
the score and aural perception cannot be bridged. From a social perspective, the
aesthetic is one of refusal to communicate using traditional musical categories: an
unbridgeable gap between “expert” (composer/performer) and layperson (listener)
is posited.\(^94\) The listeners’ disposition of “natural” hearing (in this case equally first
nature and second nature as social construct) is obviously insufficient for
perception of the polyphonic construction of the passage. By resisting parsing of the
texture (even by a professional musician), the avant-garde work celebrates the
denial of communication and its own superior complexity. The avant-garde
aesthetic thus creates a new social hierarchy that does not try to change the
listening behavior and aesthetic perception of listeners, but instead convinces them
that there is “someone who knows better”.

In contrast, the rhythmically dissonant processes carried out by Ligeti engage
in a diametrically opposed aesthetic strategy. By starting out from materials that can
be adequately perceived with a “natural” mode of hearing (in this case, the lament
motive), the disposition of the layperson is affirmed as aesthetically valid. The
gradual change in complexity through the addition of layers makes it possible to
create a continuum of aesthetic experience, in which no absolute boundary

\(^94\) Jacques Rancière, *The Ignorant Schoolmaster / Jacques Rancière ; Translated, with

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separates the layperson from the expert; the listener gradually adjusts to greater complexity, since efforts at hearing with more differentiation are rewarded by the music (unlike the case of the hermetic structure in Boulez), especially given the return to simpler material at various points in the piece.

This is the significance of rhythmic dissonance as an aesthetic category: it forms a continuum between ordinary experience and hyper-complexity of form, allowing both listeners and performers to refine and deepen their experience of rhythm, starting from any level of knowledge. As a medium for communication, it affords a reconciliation of highly specialized musical/technical knowledge (new music) and the possibility of forming a wider community on the basis of shared aesthetic experience. If one can indeed identify Ligeti’s aesthetic credo in the Études and the Piano Concerto, it might very well be this reconciliation of avant-garde complexity with social praxis.
Appendices
Appendix 1:

Étude 3: Touches bloquées

Vivacissimo, sempre molto ritmico

 sempre legato

"stuttering"

senza ped. (sempre)
feroce, impetuoso, poco meno vivace
Appendix 2:

Étude 4: Fanfares

Vivacissimo, molto ritmico, \( \sigma = 63 \), con allegria e slancio

György Ligeti
Re-notation by Imri Talgam

Re-notation by Imri Talgam
György Ligeti

pp sempre
The ostinato slightly "closer"
sub. pp "further away"
"entfernter"

una corda  sempre dim.  ---  ---  ---  ---

loco  m.s.  ---  ---  ---  ---

ppppp  ppppp sempre

(dim.)  ---  ---  ---  ---
Play the grace note with the lower note of the chord.

*
The ostinato remains completely in the background in spite of the ff in the right hand.
senza cresc., sempre pp

cresc. poco a poco (only in the left hand) - - - -

sempre cresc. - - - -

sempre sub. pppp

"da lontano"

una corda

sempre pppp
Étude 6: Automne à Varsovie

Presto cantabile, molto ritmico e flessibile, $\dot{=}$ 132

György Ligeti
Re-notation by Imri Talgam

pp sempre legato
sempre con ped.
mf crescendo poco a poco

(cresc.)

(senza legato)
Bibliography


