

Liminality as a Framework for Composition: Rhythmic Thresholds, Spectral Harmonies  
and Afrological Improvisation

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## ABSTRACT

### Liminality as a Framework for Composition: Rhythmic Thresholds, Spectral Harmonies and Afrological Improvisation

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This paper will examine the ways in which involvement with both French spectral music and Afrological forms of improvisation has informed my current work as a composer. I present a brief overview of the major concerns and preoccupations of both musics as well as an account of the overlapping histories of spectral music and Afrological improvisation, with particular attention to the concepts of liminality and rhythmic thresholds in the light of recent music perception research. Finally, through an in-depth analysis of two of my recent compositions, *Echoes* (2008) and *Baltimore/Berlin* (2008, rev. 2011), I show how this ongoing inquiry allows us to think about composition in new and fruitful ways.

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## Prefatory Remarks

After years as a performer and composer of improvised music, I first became aware of spectral music in 2001, while studying for an M.A. in Music Composition at Wesleyan University. Since then, much of my intense involvement with contemporary Western art music, and with spectral music in particular, has been supported and encouraged by academic institutions like Wesleyan, Columbia University, The Paris Conservatory (CNSM), and the Institut de Recherche et Coordination Acoustique/Musique (IRCAM), and through my collaborations with new music groups like the International Contemporary Ensemble and the JACK quartet. In June 2009, when my CD recording *Travail, Transformation & Flow* was released on Pi Recordings, I began to receive a steady stream of inquiries about my synthesis of spectral harmony, highly structured rhythmic materials, and improvisation. Colleagues, mentors, critics, serious listeners and students reached out, wanting to know more about this particular aspect of my work.

I hope to respond to those inquiries more fully in this paper by examining the ways in which involvement with both French spectral music and Afrological forms of improvisation has informed my current work as a composer. I present a brief overview of the major concerns and preoccupations of both musics as well as an account of the overlapping histories of spectral music and Afrological improvisation, with particular attention to the concepts of liminality and rhythmic thresholds in the light of recent music perception research. Finally, through an in-depth analysis of two of my recent compositions, *Echoes* (2008) and *Baltimore/Berlin* (2008, rev. 2011), I show how this ongoing inquiry allows us to think about composition in new and fruitful ways.



## Spectral Music

In spectral music<sup>1</sup> the physics of sound informs almost every compositional decision. Timbre (attack, decay, overtone structure) provides the source material for orchestration, harmony, duration and musical form. The most prominent overtones of a given sound – a clarinet or a church bell, for example – are used to create a rich harmonic framework that is organized according to frequency relationships, as opposed to the intervals of a musical scale. This can be particularly useful when working with the harmonic series, where the interval structure is fairly complex, but the frequency structure is rather simple. In addition, individual overtones are assigned to specific instruments in an ensemble, and blended together to create new harmonies derived from the physical structure of the original sound source. This collection of compositional techniques, often referred to as “orchestral synthesis” or “instrumental synthesis,” draws symbolically from the idea of additive synthesis, in which simple sounds (traditionally, sine waves) are combined to create more complex aggregates. The advent of computer music programs, digital synthesis, and digital sound analysis in the early 1970s was instrumental in the development of spectral music and provided composers with powerful new tools, capable of handling the considerable computational strain associated with the detailed analysis and synthesis of complex sounds.<sup>2</sup> Following these compositional techniques, both timbre and harmony are conceived of as the composite of more elementary sounds, and the elision of these two musical categories may be the most important and durable idea to have emerged from the spectral movement.

My own engagement with spectral music has been especially influenced by the work of Gérard Grisey, and Tristan Murail, who became an important mentor for me at Columbia University. While these are the two composers most closely associated with the spectral movement, this music has developed in the historical context of earlier proto-spectral

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<sup>1</sup> Spectral music and spectral techniques represent an extensive collection of ideas about harmony and orchestration and about composition in general. As a result, a comprehensive overview of the spectral movement and the various organizing principles of the music would be well beyond the scope of this paper. Fortunately, there already exists a good amount of excellent scholarship devoted to the basic compositional techniques of spectral music (Fineberg 2000, Moscovitch 1997, and Rose 1996), and the cultural and historical context in which the music first emerged (Drott 2009 and Anderson 2000).

<sup>2</sup> See Dodge and Jerse (1997) for a comprehensive overview and history of additive synthesis techniques.

composers like Debussy, Scriabin, Varese, Messiaen, Scelsi, Ligeti, and Stockhausen. There are also parallel streams, such as the Romanian spectral school, which includes Dumitrescu, Radulescu and Avram. But the emergence of the French spectral movement in the 1970s, and its subsequent evolution, seems to represent a particularly important point of definition in the last forty years of contemporary Western art music.

In the context of this brief overview of spectral music, it is important to note that both Murail and Grisey have expressed reservations about the idea of an all-encompassing “spectral school” of composition, and have been hesitant to reduce their music to a finite collection of compositional techniques. Both composers have instead sought to define the spectral movement more broadly, as a collection of ideas and attitudes about composition, placing particular emphasis on the phenomenology of perception and the central role of hybrids and thresholds in their music. Here is Murail in 2000:

For me, this fascination with transforming objects and creating hybrids was always there: it’s almost congenital. I think retrospectively that this idea, coupled with the importance I (and others) place on working with harmony in a way that completely controls it – giving strength to the formal construction – were the basic ideas of spectral music. (Murail 2000)

## **Afrological Improvisation**

Like the French spectral movement, Afrological forms of improvisation do not represent a specific musical style or collection of techniques. In his 1996 article, “Improvised Music After 1950: Afrological and Eurological Perspectives,” composer/theorist George E. Lewis describes the terms Afrological and Eurological as referring “metaphorically to musical belief systems and behavior that...exemplify particular kinds of musical ‘logic.’” Lewis compares and contrasts Afrological and Eurological modes of improvisation and argues that Afrological improvisation can be defined by the following tendencies (Lewis 1996):

- An understanding of improvisation in which careful preparation, formalism, and intellectual rigor are as privileged as spontaneity and real-time decision making
- A collaborative model in which the internalization of alternative value systems is supported and encouraged
- A preoccupation with the articulation of personality and the assertion of individual agency through sound
- An emphasis on the social instrumentality of sound and the potential for improvisation to resist perceived restrictions on expression.

My own use of the term Afrological is also intended to be understood in a larger context of African-American musical aesthetics, which includes improvisation, but also extends beyond it. Composer/theorist Olly Wilson (1974) cites the following conceptual tendencies, among others, as characteristic of African-American music across a wide variety of artistic genres:

- Metronomic Sense: Musical pulse that is perceptually salient and encourages a psycho-physical response to music
- Rhythmic Contrast: Polyrhythm and/or the off-beat placement of melodic accents
- Dominance of Percussion: A percussive approach to instrumental practice and a preoccupation with percussion as an expressive musical element

- A heterogeneous sound ideal that privileges a diverse collection of instrumental timbres and musical perspectives

In my view, Lewis's notion of Afrological improvisation and Wilson's analysis of African-American musical aesthetics can complement and reinforce one another. In particular, Lewis's notion of the internalization of alternative value systems in improvisation seems to echo Wilson's concept of "a heterogeneous sound ideal" in African-American musical practices.

As a composer/performer deeply engaged with Afrological forms of improvisation, I view my own work as part of a lineage of American creative music that includes, among many others, Charlie Parker, Bud Powell, John Coltrane, Jackie McLean, Betty Carter, Andrew Hill, Henry Threadgill, Anthony Braxton, George Lewis, Evan Parker, Mark Dresser and Greg Osby.<sup>3</sup> Despite representing a vast array of ideas about music and improvisation, all of these musicians have produced influential and highly personal bodies of work that remain rooted in the constellation of Afrological and African-American music as understood by Lewis and Wilson. Furthermore, they have all pursued creative strategies that foreground the role of the composer/performer and privilege a collaborative model in which the exchange of ideas with performers in an ensemble is an essential component of the compositional process. In fact, for many of these musicians, the careful selection of collaborators is viewed as a crucial *compositional* decision. These ideas play a central role in my own understanding of Afrological forms of improvisation, and of establishing a highly collaborative musical environment driven by performer agency – what music historian and cultural theorist Samuel A. Floyd (1995) has referred to as "individuality within the aggregate."

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<sup>3</sup> Having pursued formal studies with Braxton (Wesleyan University), Lewis (Columbia University), and McLean (Hartt School of Music, University of Hartford), I have been particularly influenced by the musical perspectives of these three composer/performers. See Lehman (2005) on Braxton and Lewis and (2008) on McLean.

## Spectral Music and Improvisation

In terms of socio-cultural context, geography, and institutional affiliation, spectral music and Afrological forms of improvisation could hardly be more distinct. Yet, these two musical histories do overlap, often in very meaningful ways that reveal an important set of shared attitudes and ideas about music.

The Duke Ellington composition *Daybreak Express* (1933) provides one of the earliest and most compelling examples of the intersection of spectral techniques and Afrological forms of improvisation. Ellington's densely-packed, three-minute work makes use of an acoustic big band to recreate the sounds of a speeding train; in one of the piece's most remarkable passages, the brass and woodwind harmonies fuse together to imitate the wail of a train whistle [Fig. 1]. Combining individual instrumental sounds to create a more complex composite, Ellington's writing in this portion of the piece clearly seems to intend an instrumental synthesis. Though *Daybreak Express* was written at least forty years before the emergence of the French spectral movement, Ellington's use here of orchestral synthesis to recreate real-world sounds certainly foreshadows many of the fundamental concerns of composers like Murail and Grisey.<sup>4</sup>

More recently, the work of John Coltrane and Thelonious Monk has been theorized in terms of the harmonic series, a central concept in early spectral pieces like Gérard Grisey's *Partiels* (1975). Music historian Bill Cole ([1976] 2001), for example, views Coltrane's improvised use of multiphonics and unorthodox fingerings, in compositions like *Om* (1965), as a real-time manipulation of the harmonic spectrum of the saxophone.<sup>5</sup> Pianist and composer Vijay Iyer (2010) has also argued that the harmonic series and the physical properties of sound are at the heart of Thelonious Monk's singular approach to the piano.

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<sup>4</sup> Like Ellington, Charlie Parker is another Afrological improviser connected to the prehistory of spectral music, in Parker's case through his collegial ties to the expatriate French composer Edgar Varese. Varese and Parker had arranged to work together and had it not been for Parker's untimely passing in 1955, it seems likely that he would have pursued formal studies with Varese (see Desmond, McClellan and Parker (1954)).

<sup>5</sup> Coltrane has also used saxophone multiphonics as a compositional premise. See Coltrane's "Harmonique" and his arrangement of the George Treadwell composition "I'll Wait and Pray" as documented on the 1960 recording *Coltrane Jazz*.

The image displays a musical score for Duke Ellington's *Daybreak Express*, specifically a section titled "D" starting at measure 33. The score is arranged for a large ensemble, including vocalists and various instruments. The vocal parts (Soprano Alto, Alto, Clarinet Tenor, Baritone Alto) feature melodic lines with dynamic markings (*mp*, *mf*, *p*) and performance instructions like "bend" and "gliss." (glissando). The brass section (Tpt. 1-4, Trb. 1-2) also includes glissando markings and dynamic changes. The piano part features a rhythmic accompaniment with chords, while the guitar, bass, and drums provide a steady groove. The score is published by Jazz Masterworks Editions.

Fig. 1: Imitation of a train whistle in Duke Ellington's *Daybreak Express*

For Iyer, Monk's strategic use of chord voicings that span several octaves is directly related to his intimate knowledge of the piano's acoustic properties and overtone structure. Monk's then unorthodox use of chord extensions like the sharp four, the flat nine, and the simultaneous use of the dominant and major sevenths, can, in fact, be viewed as a means of approximating the upper partials of a fundamental frequency [Fig.

2]. In some ways, the spectral nature of Monk's characteristic chord voicings and sound clusters is reminiscent of Olivier Messiaen's "chord of resonance," in which targeted

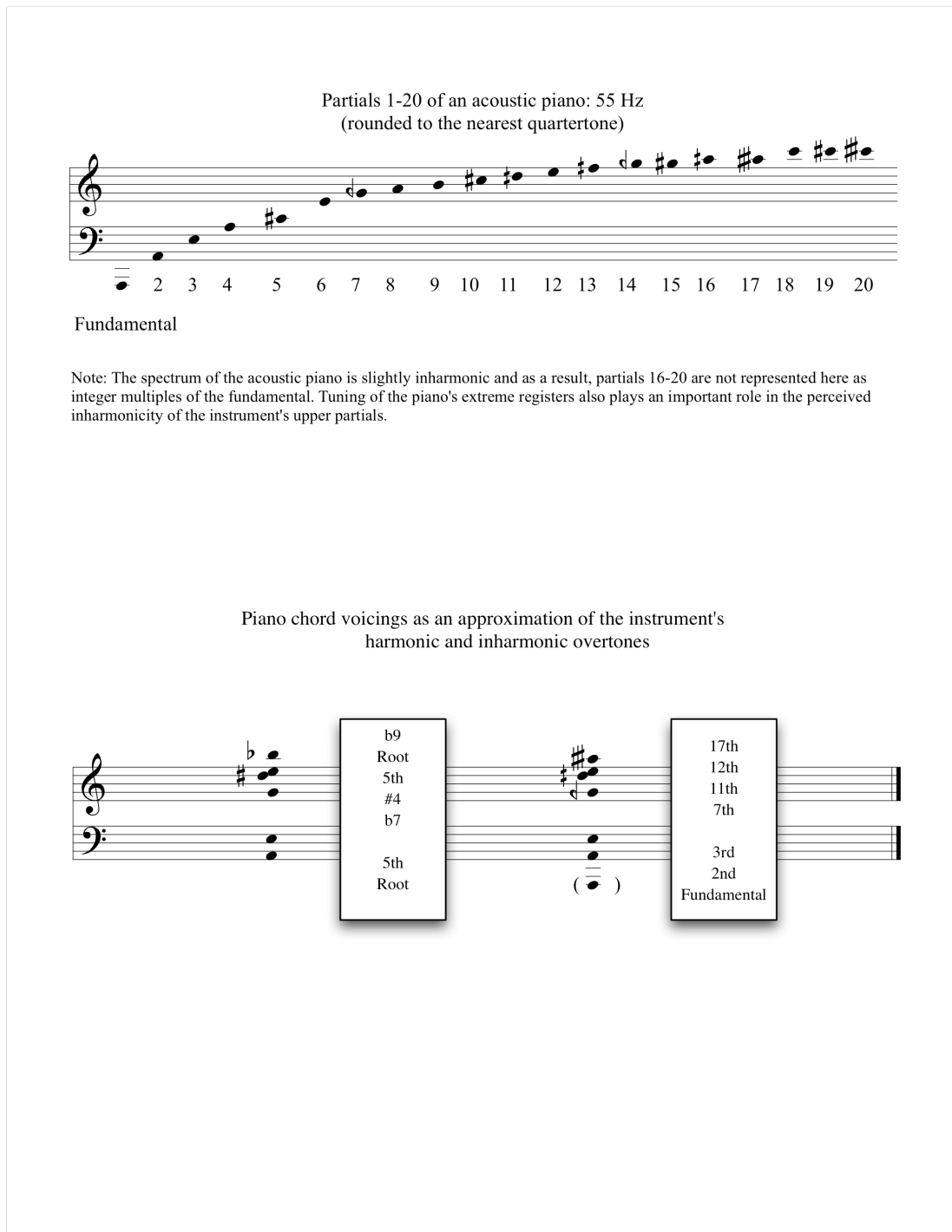


Fig. 2: Chord voicings in relation to the overtone structure of an acoustic piano

piano voicings are used to approximate partials 4 through 15 of the harmonic series.<sup>6</sup> However, as Anderson (2010) has pointed out, Messiaen's "chord of resonance" is, in fact, a middle-register compression of harmonics 4 through 15, in which the approximation of a harmonic spectrum is contained within the span of two octaves. In this sense, Monk's highly resonant piano voicings may be more closely connected to the proto-spectral harmonies employed by Henri Dutilleux in his orchestral work *Métaboles* (1964), in which chords modeled off of the frequential structure of the harmonic series span several octaves.<sup>7</sup>

Just as some improvisers have used spectral techniques, improvisation has played an important, if little documented, role in the music of French spectral composers like Murail, Grisey and Philippe Hurel. Grisey, in particular, made regular references in the 1980s to the influence of American jazz musicians on his concept of rhythm and fluid pulse/periodicity (Grisey and Lelong 2008). Grisey taught at UC Berkeley from 1982 to 1986, and many of the major works he composed during and after this period – *Talea* (1986), *Le Noir de l'Etoile* (1990), and *Vortex Temporum* (1995) – bear witness to a new preoccupation with musical rhythm. The influence of jazz and other forms of Afrological improvisation is also deeply felt in the music of Philippe Hurel. Like Grisey, Hurel points to jazz as a direct influence on his conception of the rhythmic, rather than the durational aspects of musical time (Dénut and Hurel 2001). In chamber works like *Six Miniatures en Trompe l'Oeil* (1991) and *Kits* (1995), Hurel calls upon the ensemble to perform complex polyrhythms while remaining connected to the underlying pulse, which he considers to be a rhythmic concept derived from contemporary forms of jazz.

It is also interesting to observe that, like many Afrological improvisers, French spectral composers initially succeeded in gaining international recognition for their work through their own efforts as composer/performers. Grisey and Murail co-founded Ensemble l'Itineraire in 1973 with composers Hugues Dufourt, Roger Tessier and Michael Levinas

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<sup>6</sup> See Messiaen (1944) and Mittelstadt (2009) for a discussion of Messiaen's use of the "chord of resonance" in his piano writing in the compositions *Poemes pour Mi* (1936) and *Quatuor pour la Fin du Temps* (1941), for example.

<sup>7</sup> See Anderson (2010) for a comprehensive discussion of proto-spectral harmonies and formal organization in Henri Dutilleux's *Métaboles* (1964).



and regularly performed their own electro-acoustic<sup>8</sup> works (Cohen-Levinas [1991] 1998). Murail and Grisey would both eventually move away from such do-it-yourself methodologies, towards compositional techniques reliant on cutting-edge technology and generous institutional support.

In a letter written to composer Hugues Dufourt in 1980, Gérard Grisey expressed his frustration with the term “spectral music,” finding it too vague and inclusive.<sup>9</sup> Instead, he proposed the term “liminal music” as a more apt description of the foundational concepts in his work (Grisey and Lelong 2008). I would argue that this clarification may, in fact, point to the most significant link between French spectral music and Afrological forms of improvisation. Both of these musical traditions are built around thresholds of transition and becoming, where the exploration of a liminal terrain between two fixed identities can lead to a transcendent musical experience. Musical boundaries are central to spectral music: the lines between harmony and timbre, pitch and noise, electronic and acoustic, and rhythm and duration. In Afrological forms of improvisation, inquiry into such musical boundaries is further reinforced by the traditional and fundamental nature of improvisation as a creative practice situated at the thresholds of structure and disorder, individuality and community, understanding and mystification, and the known and the unknown.<sup>10</sup>

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<sup>8</sup> Tristan Murail has made several references to the improvisational nature of realizing and performing works involving live electronics during the early 1970s (Murail 2010 and Cohen-Levinas [1991] 1998).

<sup>9</sup> The term “spectral music” first appeared in Hugues Dufourt’s 1979 article “Musique Spectrale: Pour Une Pratique des Formes de l’Énergie”, published in 1981.

<sup>10</sup> See Ruud (1995), for example, for a discussion of jazz improvisation as a liminal experience, and its application in a variety of music therapy techniques.

## Rhythmic Thresholds and Music Perception Research

*Je pressens cependant qu'il existe quelque part dans notre perception une limite, un degré zéro en deça duquel il est impossible de transgresser sans sombrer dans l'absurde. C'est de ce seuil que je parle; c'est à partir de ce seuil que devrait s'organiser toute musique.* (Gérard Grisey [1978] 1986)<sup>11</sup>

Beginning in the late 1970s, Gérard Grisey devoted more and more of his creative energy to the compositional precept of rhythmic thresholds, placing particular emphasis on the idea of fluid periodicity in works like *Tempus Ex Machina* (1979).<sup>12</sup> In many of these pieces, Grisey seeks to establish a kind of compositional homology between the harmonic (harmonicity/inharmonicity) and durational (periodicity/aperiodicity) aspects of his music. Later works, such as *Vortex Temporum* (1995), expand on these ideas and demonstrate a unique set of rhythmic strategies which music theorist Jean-Luc Hervé (2001) describes as “situated on the narrow crest where the rhythm falls neither into the anesthetizing repetition of a simplistic pulsation, nor into a rhythmic complexity that loses its way with all sensation of pulsation.”<sup>13</sup> Composer/theorist Fred Lerdahl (1988) has also commented on these types of rhythmic phenomena, noting that “constant change doesn’t give rise to salient and distinctive transitions and neither does no change at all. Babbitt and Reich have something in common after all.”

In the opening passage of *Vortex Temporum*, Grisey uses repetition, shifting rhythmic periods, and an accelerating progression of registral changes to gradually transform his musical material [Fig. 3]. The opening gesture of the piece, a rapidly repeating arpeggio, evolves into a much longer musical action, where quick shifts in register mimic the shape of the original arpeggio.<sup>14</sup>

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<sup>11</sup> “I sense, however, that somewhere in our perception there exists a limit, a degree zero, beneath which it is impossible to pass without sinking into absurdity. It is of this threshold that I speak; it is beginning with this threshold that all music should be organized.” Translation by the author.

<sup>12</sup> See Chen (2010) for a detailed account of *Tempus Ex Machina* and its rhythmic structure.

<sup>13</sup> “Situé sur l’étroite crête où le rythme ne tombe ni dans la répétition anesthésiante d’une pulsation simpliste, ni dans la complexité rythmique perdant pied avec toute sensation d’une pulsation.” Translation by the author.

<sup>14</sup> See Hervé (2001) for a comprehensive analysis of *Vortex Temporum*.

The image shows a page from a musical score for Gérard Grisey's *Vortex Temporum*. It features six staves: Flute (Fl.), Clarinet (Cl.), Violoncello (Vno), Viola (Vla), Violon (Vc), and Piano (Pc.). The Flute and Clarinet parts have complex, rapid rhythmic patterns with dynamic markings like *f*, *mf*, *p*, *pp*, and *ff*. Above the Flute staff, there are circled numbers 13 and 16, and a circled 4 above the Clarinet staff. The Violoncello and Viola staves are mostly empty, with a '3° C.' marking above the Violon staff. The Piano part has a rhythmic pattern with dynamic markings and a 'Ped.' marking at the bottom. The page number 'R 2714' is at the bottom center.

Fig. 3: Repetition and rhythmic shifts in Gérard Grisey's *Vortex Temporum*

To a certain extent, the rhythmic structure of *Vortex Temporum* may be directly related to a kind of “eureka” moment that Grisey experienced in 1984, while attending a rehearsal of Tristan Murail's *Désintégration* (1983):

Despite the extreme rigor of thought and the completely new treatment of sound that Murail puts forth so abundantly, I am discovering to what extent it is time for me to add rupture and rapidity to the obsession with continuity and slowness of process. Is this the influence of African music, or of the jazz I discovered during my stay in California? Is it the discovery of Conlon Nancarrow – the greatest rhythmic composer since Stravinsky...? (Grisey [1984] 2008)<sup>15</sup>

Grisey's reflections about his own compositional processes may indicate a desire to anchor his use of rhythmic thresholds to a more comprehensive understanding of human

<sup>15</sup> “Malgré l'extrême rigueur de la pensée et l'aspect a proprement parler inouï du traitement des sons que Murail dispense a profusion, je decouvre a quel point il est temps pour moi d'ajouter rupture et rapidité a l'obsession de la continuité et a la lenteur du processus. Est-ce l'influence de la musique africaine ou du jazz decouvert lors de mon séjour en Californie? Est-ce la decouverte de Conlon Nancarrow – le plus grand rythmicien depuis Stravinsky...?” Translation by the author.

perception. But in contrast to his work with harmony, which benefitted from considerable familiarity with the science of psychoacoustics, any inquiry into the nature of rhythm perception seems to have been based largely on intuition and personal experimentation.<sup>16</sup> In my own efforts to move towards a more thorough understanding of the concept of rhythmic thresholds present in French spectral music and Afrological forms of improvisation, and to adapt these concepts to my own work, I have found a more systematic review of the field of music perception to be useful, and here present a brief overview of the relevant current research.

### Cognitivist Research on Rhythmic Thresholds

In his article “Cognitive Constraints on Metric Systems: Some Observations and Hypotheses,” music theorist Justin London (2002) provides a useful summary of the rhythmic phenomena which have been studied in the field of music perception. Among the categories of research listed by London, several relate directly to the concept of rhythmic thresholds:

- The range of spontaneous tempo: the longest and shortest periods in which we are able to produce a steady beat
- The values of preferred tempos: the rate at which we are most comfortable producing a steady beat
- Our sensitivity to changes of tempo at different initial rates and in different contexts
- Our sensitivity to differences of duration relative to the magnitude of the durations involved
- The shortest and longest durations musicians tend to produce in rhythmically palpable patterns
- The extent and limits of the psychological present

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<sup>16</sup> See Grisey (1987) and (1998) for additional examples of the composer’s written reflections on the perception of musical rhythms.

Music perception studies on these topics suggest that there are perceptual and cognitive limits on our ability to hear, understand, and reproduce musical rhythms. But as London is careful to point out:

It is impossible to determine hard and fast values for the various temporal thresholds.... Moreover, this research has shown that the various thresholds, acuities, and so on are heavily dependent upon task, stimulus, context, and so forth.... Thus with the understanding that proposed thresholds may be fuzzy, or shift according to context, such thresholds nonetheless exist (London 2002).

In research focused on sensitivity to change in tempo and duration, perceptual thresholds are usually referred to as the “just noticeable difference” or JND (normally represented as percentage change). Much of the recent research dealing with cognitive constraints on rhythm and tempo perception is predicated on the early work of Paul Fraisse, which helped to establish a connection between rhythm and the structure of the body, and posited several key categories of duration, including: (1) short durations: 400 milliseconds or shorter; (2) long durations: 600-2000 milliseconds; (3) the indifference interval: 400-600 milliseconds, and (4) the perceptual present: 3-8 seconds (Fraisse 1963 and 1987). As music theorist Eric Clarke (1999) has noted, for Fraisse these categories of duration “are not only quantitatively but also qualitatively different,” and it is now widely accepted that the manner in which listeners process physical input is strongly affected by these durational categories.

## Tempo

Fraisse’s “indifference interval,” which he defines as the span of time for which a listener’s estimate of duration is most accurate: 400-600 milliseconds (Fraisse 1978), seems to have a direct effect on the manner in which we perceive and entrain to various tempi. Richard Parncutt (1994) has done research that suggests that listeners prefer to hear tempos in the range of 100-120 BPM, or at an isochronous pulse rate of 500-600 milliseconds, which is well within the range of Fraisse’s indifference interval. Parncutt also suggests a standard tempo range of 67-150 BPM, finding that listeners stop hearing durations as regular pulses below 33 BPM (1800 seconds) and start grouping individual

pulses into larger units above 300 BPM (200 milliseconds). Parncutt's proposed limits on the perception of tempo (200-1800 milliseconds) can also be directly related to a listener's physical ability to reproduce isochronous durations. Bruno Repp (2005) has cited 100 milliseconds as the shortest physically reproducible duration and 1800 milliseconds as the longest such duration. 1800 milliseconds (33 BPM) corresponds to Parncutt's lower limit of tempo perception and the duration of 100 milliseconds, is half the value of Parncutt's upper limit of 200 milliseconds.<sup>17</sup> For many music theorists, the very notion of tempo is contingent upon the ability to perceive symmetrical divisions of a regular pulse, usually in ratios of 2:1 or 3:1. Given our apparent inability to reproduce, and perceive regular sub-pulses shorter than 100 milliseconds, Parncutt's upper limit of tempo perception (200 milliseconds) can be viewed as a logical threshold.

### The Psychological Present

The upper limits of tempo perception may also bear witness to another important rhythmic threshold normally referred to as the "psychological present" or the "specious present." Michon (1978) defines the perceptual present as "the time interval in which sensory information, internal processing, and concurrent behavior appear to be integrated within the same span of attention." Fraisse (1982) cites 2 to 3 seconds as an average range for the psychological present, acknowledging that it can last as long as 5 seconds depending on context. This roughly corresponds to 33 BPM as a lower limit on tempo perception. Michon's (1978) findings are similar, though he places the upper limit of the psychological present at 7 to 8 seconds. Reflecting on the relationship between tempo perception and the threshold of the psychological present, London suggests that:

If 2 seconds seems to be the limit for hearing successive events as temporally connected outside of a metric hierarchy, then it makes sense that the absolute value for a measure might be from about 4 to 6 seconds (i.e., twice or three times the length of the "slowest possible beat" [*sic*]), (London 2002).

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<sup>17</sup> In assessing the longest physically reproducible duration, it is often difficult to determine when listeners begin sub-dividing long durations into smaller groups in order to reproduce them more accurately (Repp and Doggett 2007).

Building on this idea, it seems reasonable to conclude that the boundaries of the psychological present correspond to a qualitative shift in our perception of rhythm and musical time. For example, Francoise Maçar (1985 cited in Kramer 1988) has found that listeners are much less sensitive to changes in duration for time spans lasting 4 seconds or longer.

### Just Noticeable Difference (JND)

The concept of “just noticeable difference” (JND) in music perception research can also provide valuable insights into the nature of rhythmic thresholds. JNDs represent the smallest amount of detectable difference between two sensory inputs. In the case of rhythm perception, duration and tempo-rate (interonset interval) are the stimuli that are most commonly studied. Dowling and Harwood (1986) cite a JND ranging from 2% to 3% for listeners tapping along to a steady beat and a JND between 5% and 10% for (passive) listening estimations. In other words, a change in duration for a pulse lasting 1 second (1000 milliseconds) – a quarter note at 60 BPM, for example – might only be detected once it reached the JND threshold of 900 milliseconds (10% decrease) or 1100 milliseconds (10% increase). As noted in the previous section, Maçar (1985 cited in Kramer 1988) has found that the JND increases significantly for durations lasting 4 to 30 seconds, citing 16% as an average JND for those time-spans. With regard to sensitivity to changes in tempo, Mark Ellis (1991) has found that the JND can vary considerably, depending on tempo range. In particular, Ellis argues that it is harder to detect increase in tempo at a range of 48-84 BPM and, likewise, slightly more difficult to detect decreases in tempo at a range of 192-228BPM. His findings are summarized below:

Tempo Rate (BPM)	JND (Decrease in Tempo)	JND (Increase in Tempo)
48	6%	13%
84	6.5%	9%
120	7%	7%
156	7%	7%
192	8%	6.0%
228	7%	5.5%

## Ecological and Categorical Perception

Traditional cognitivist approaches to rhythm perception provide a useful foundation for the understanding of rhythmic thresholds. As previously suggested, the overview of perceptual thresholds presented here is best understood as a collection of “fuzzy” data that can vary, in significant ways, depending on the broader musical framework. Nevertheless, many music theorists have criticized research in the field of music psychology for relying too heavily on the analysis of abstracted and simplified musical tasks that are taken out of context. Drawing on the work of psychologist James Gibson, Eric Clarke is one music theorist who has proposed an ecological model of music perception:

Rather than considering perception to be a constructive process, in which the perceiver builds structure into an internal model of the world, the ecological approach emphasizes the structure of the environment itself and regards perception as the pick-up of that already structured perceptual information....What is important is to consider what is *directly specified* [*sic*] by environmental information – not what a perceiving organism can interpret in or construct from, a stimulus. (Clarke 2005)

With regard to rhythm perception in particular, Clarke (1987) has suggested that it “can be viewed as [the process of] finding solutions in a three-dimensional space” that includes meter, beat sub-division, and expressive transformations. Building on this conceptual premise, Clarke has argued for a categorical approach to rhythm perception in which small whole number ratios of duration function as perceptual categories.<sup>18</sup> According to Clarke, once the temporal information for rhythm has been perceptually categorized into ratios of 1:1 or 2:1, for example, any duration that deviates from those categories is considered to be either expressive or accidental. Placing emphasis on the potential shift from one perceptual category to another – in place of the more traditional notion of a JND – this view of rhythm perception has a direct effect on the concept of rhythmic thresholds. In one experiment, listeners were presented with a short musical sequence in a triple meter (6/8) and asked to identify targeted two-note phrases as

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<sup>18</sup> Fraisse helped to establish the foundational nature of whole number ratios in rhythm perception, particularly 1:1 and 2:1, which he views as closely tied to the motor properties and the symmetrical structure of the human body (Fraisse 1963).



belonging to either a 1:1 or 2:1 perceptual category. The total duration of the two-note phrase remained constant at 960 milliseconds and the individual values of each note were systematically varied between a ratio of 1:1 and 2:1, with several intermediate values. His findings are summarized below (Clarke 1987):

Note Values (Milliseconds)	% of Listeners Identifying as 2:1 Ratio
640/320 (Perfect 2:1 Ratio)	100%
560/400	80%
540/420	50%
480/480 (Perfect 1:1 Ratio)	0%

As Clarke's data indicates, in the context of a triple meter, half (50%) of the listener continued to categorize the ratio of 540/420 milliseconds as 2:1. Compared to the perfect 2:1 ratio of 640/320, the 540/420 ratio represents a 15% change in the long value (640 to 540) and a 31% change in the short value (320 to 420), which is a far cry from a JND for duration of 5-10%.

Like Clarke, Repp (1992) has also employed ecological models of rhythm perception in his research. In a study on expressive timing, Repp suggested that a listener's expectation at key structural moments in a composition has a direct effect on his or her ability to detect small changes in duration. Repp's findings showed that if listeners expect to hear an expressive ritard – at the end of an important musical phrase or section, for example – they are much less likely to classify the music as slowing down. Thus, a temporary shift in tempo, as implied by the structural context of a composition, can obscure the perception of rhythmic change if it doesn't represent a deviation from stylistic norms of performance practice. As both Repp and Clarke's research strongly suggests, it seems likely that a thorough understanding of rhythmic thresholds must also account for the methodological paradigm of ecological perception as it relates to compositional structure and categorical boundaries.

## Embodied Cognition

Drawing in part from research done by Fraisse, which suggests a close correlation between the structure of the human body, motor functioning, and rhythm perception, Neil Todd, Vijay Iyer, and others have proposed a model of rhythm perception grounded in the concept of embodiment. Citing Varela, Iyer describes the paradigm of embodied cognition in the following manner:

The viewpoint known as *embodied* or *situated* [*sic*] cognition treats cognition as an activity that is structured by the body and its situatedness in its environment -- that is, as embodied action. In this view, cognition depends upon experiences based in having a body with sensorimotor capacities; these capacities are embedded in an encompassing biological, psychological, and cultural context. Sensory processes (perception) and motor processes (action), having evolved together, are seen therefore as fundamentally inseparable, mutually informative, and structured so as to ground our conceptual systems. (Varela 1991 in Iyer 1998)

Contributing to this methodological point of view, Todd (1994), for example, has proposed a model of rhythm perception based around the idea of a sensory-motor filter, where our ability to feel and recognize rhythms is defined by our motor capacities. Todd cites 600 milliseconds as the center frequency for the sensory-motor filter, and the rate at which it is easiest for listeners to perceive a regular tempo (100 BPM). Not surprisingly, the rate of 600 milliseconds also corresponds to Fraisse's "indifference interval" -- the span of time for which a listener's estimate of duration is most accurate.

Expanding on Todd and Fraisse's research in similar areas, Iyer (2002) has proposed a table of rough musical correlates to bodily motion which is summarized here:

Body Motion	Approximate Duration	Musical Correlate
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Breathing, Body Sway	1 to 10 Seconds	Musical Phrase
Heartbeat, Walking, Sexual Intercourse, Head Nod	333 to 1000 Milliseconds	Musical Tempo
Speech, Lingual Motion, Digital Motion	100 to 333 Milliseconds	Fast Notated Rhythm, Smallest Salient Subdivision of Musical Pulse

With regard to rhythmic thresholds, Iyer's table seems to suggest a categorical model of rhythm perception in which different types of body movement help define perceptual categories. And, as one might expect, the approximate boundaries separating breathing, walking, and speaking in Iyer's table correspond rather well to Fraisse's categories of duration.

Bodily Motion Category (Iyer)	Approximate Duration	Perceptual Category (Fraisse)	Approximate Duration
Breathing	1 to 10 Seconds	Psychological Present	2 to 8 Seconds
Walking	333 to 1000 Milliseconds	Indifference Interval and Long Duration	400 to 2000 Milliseconds
Speaking	100 to 333 Milliseconds	Short Durations	100 to 400 Milliseconds

Given the wealth of music perception research pointing to the fundamental relationship between rhythm and human movement<sup>19</sup>, it seems reasonable to conclude that a comprehensive understanding of rhythmic thresholds must also account for thresholds of embodiment as they have been defined in the field of embodied cognition.

<sup>19</sup> See Clarke (1999) for a summary of current research on rhythm, timing, and movement in the field of music perception.

## Concluding Remarks on Rhythmic Thresholds

Reflecting on the nature of heuristics in music perception, Albert Bregman writes:

Having evolved in a world of [sound] mixtures, humans have developed heuristic mechanisms capable of decomposing them. Because the conditions under which decomposition must be done are extremely variable, no single method is guaranteed to succeed. Therefore a number of heuristic criteria must be used to decide how to group the acoustic evidence. These criteria are allowed to combine their effects in a process very much like voting (Bregman [1990] 1994).

I propose that the music perception research discussed here be viewed not as the basis for a theoretical model of rhythmic thresholds, but as a collection of heuristics that may provide useful and meaningful approaches to rhythm in music composition. In my own music, I have tried to draw from current research in the field of music perception, and tend to believe, as Fred Lerdahl (1988) has stated, that “the music of the future will emerge less from twentieth-century progressivist aesthetics than from newly acquired knowledge of the structure of musical perception and cognition.” I also believe that twenty-first century musical forms and other new modes of creativity will provide us with crucial and unforeseen insight into the structure of the mind and how it processes musical activity and information.

## *Echoes*

My composition *Echoes* (2008), one of eight works comprising the cycle *Travail, Transformation and Flow*, provides a useful example of the integration of spectral techniques and rhythmic thresholds with Afrological forms of improvisation.

Commissioned by Chamber Music America in 2007, *Echoes* is written for an eight-piece ensemble that includes trumpet, alto and tenor saxophones, tenor trombone, vibraphone, tuba, acoustic bass, and drum set.

### Formal Structure

*Echoes* is approximately five minutes long with a compositional form comprising three sections: exposition (mm. 1-25), interlude (mm. 26-38), and drum coda (mm. 39-45). The exposition (mm. 1-25) is played twice, with the alto saxophonist performing an improvised solo during the second repetition. The interlude (mm. 26-38) is performed as written and the drum coda (mm. 39-45) is repeated four times. During all four repetitions of the drum coda, the drum set player performs an improvised solo.

### Harmonic Structure

The harmonic language of *Echoes* is loosely based on the sound spectrum of a vibraphone, which produces a very clear sense of pitch despite the presence of some inharmonic partials, as well as a relatively loud 15<sup>th</sup> partial which sounds three octaves and a major seventh above the fundamental.<sup>20</sup> In the first measure of the piece, for example, the written harmony is derived from the harmonic spectrum of the vibraphone note E-1 (41.2 Hz): the tuba and the acoustic bass play the second harmonic (E – 82.4 Hz), the tenor saxophone sounds the seventh harmonic (C  $\frac{3}{4}$  Sharp – 285.3 Hz), the alto saxophone and the trombone play the ninth and tenth harmonic (respectively F# – 370 Hz and G# – 415.3 Hz.), the trumpet sounds the eleventh harmonic (A  $\frac{1}{4}$  Sharp – 452.9 Hz),

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<sup>20</sup> It is important to note that though the harmonic series and the overtone structure of acoustic pitched instruments are often discussed in the context of spectral techniques, it is actually more common for composers like Murail and Grisey to use inharmonic spectra as foundational elements in their music (see Moscovich (1997) on Murail's *Gondwana* (1980), for example).

and the vibraphone plays both the fifteenth and the thirty-second harmonic (D# – 622.3 HZ & E – 1318.5 Hz). The notated pitches in this measure are, of course, only approximations of the exact frequential structure of the harmonic series. In a practice commonly associated with spectral harmony, each note in the chord is rounded to the nearest quartertone in an effort to keep the underlying frequency relationships intact [Fig. 4].

**Echoes**

♩ = 120

The musical score for "Echoes" consists of two measures of music. The first measure is marked with a tempo of 120 and a key signature of one sharp (F#). The second measure is marked with a key signature of two sharps (F# and C#). The instruments and their parts are as follows:

- Trumpet in Bb:** Plays a half note in the first measure and a half note in the second measure.
- Alto Sax:** Plays a half note in the first measure and a half note in the second measure.
- Tenor Sax:** Plays a half note in the first measure and a half note in the second measure.
- Trombone:** Plays a half note in the first measure and a half note in the second measure.
- Vibraphone:** Plays a half note in the first measure and a half note in the second measure. The notation includes dynamic markings such as *f* and *mp*.
- Tuba:** Plays a half note in the first measure and a half note in the second measure.
- Acoustic Bass:** Plays a half note in the first measure and a half note in the second measure.
- Drum Set:** Plays a half note in the first measure and a half note in the second measure.

The score includes dynamic markings such as *mf*, *pp*, *f*, and *mp*, and articulation marks like accents and slurs. The vibraphone part is specifically noted with "Motor: Medium Speed".

Fig. 4: Harmony and frequential structures in *Echoes*

The loud percussive attack of the vibraphone and the crash cymbal at the beginning of the measure also contribute to the auditory sensation of spectral fusion. By masking the individual attacks of the brass and woodwind instruments, the vibraphone and the crash cymbal function somewhat like attack transients, creating a kind of composite ensemble attack. As a result of these compositional techniques, the individual pitches in the chord seem to fuse together, much like the harmonics of a single note on the vibraphone.

The harmonic rhythm of *Echoes* is fairly slow, with strategic shifts in orchestration and metric structure, rather than frequent root movement, used to create compositional change at the local level. The second measure of the piece, for example, is almost identical to the first, except that the pitches originally played by the alto saxophone, tenor saxophone, and tuba have been removed. The second measure is further transformed by changes in dynamics and a metric shift from 6/4 to 5/4. By means of these somewhat subtle shifts in color and texture, the second measure of the piece is meant to function as a kind of reflection or echo of the first. Measures five and six share a similar relationship, but here the written harmony is based on the harmonic spectrum of C-1 (32.7 Hz). The A  $\frac{1}{4}$  Sharp (452.9 Hz) sounded by the trumpet in these measures is an approximation of the fourteenth harmonic of C-1, whereas in measures one through four it had functioned as the eleventh harmonic of E-1. This change in virtual fundamental functions as a kind of common tone modulation, revolving around the hub of A  $\frac{1}{4}$  Sharp [Fig. 5].

### Rhythmic Structure

The rhythmic structure of *Echoes* is organized around groupings of four, five, six, seven, and nine beats. Each grouping is subdivided into four parts of equal duration, accented to varying degrees by the alto and tenor saxophones, trombone, tuba, acoustic bass, and drum set.<sup>21</sup> As a result of these phenomenal accents, each measure-length acquires a distinctive polyrhythmic identity that remains unchanged throughout the entire piece. The division of each measure into four equal parts also creates a very specific kind of

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<sup>21</sup> The 6/4 measures (mm. 1, 3, 6, 12, 15, 22, 26, 39) are actually divided into eight equal parts by the alto saxophone, trombone and drum set. However, these measures can also be viewed as a continuous sequence of two 3/4 measures divided into four equal parts.

rhythmic ambiguity with regard to pulse. Particularly in the measures of 5/4, it is possible for a listener to entrain to groupings of five sixteenth notes and perceive them as a new, slower tempo of 96 BPM.

The image displays a musical score for a piece titled "A (H8-H16)". The score is organized into two systems, each containing eight staves. The instruments and parts are: B♭ Tpt., A. Sx., T. Sx., Tbn., Vib., Tuba, A.B., and D.S. The time signature changes from 4/4 to 5/4 and back to 4/4. The score includes various musical notations such as notes, rests, and dynamic markings (pp, mf, f, p, mp). The first system covers measures 5 through 8, and the second system covers measures 9 through 12. The modulation is achieved through common tones between the 5/4 and 4/4 sections.

Fig. 5: Common tone modulation in *Echoes*



In the measures of 7/4 and 9/4 this phenomenon is still present, though less prominent due to the increased disparity between the notated quarter-note tempo of 120 BPM and the tempi that emerge with the groupings of seven sixteenth notes (69 BPM) and nine sixteenth notes (53 BPM). In the 6/4 measures of *Echoes*, for example, listeners and performers often feel the groupings of three sixteenth notes as a new, faster tempo of 160 BPM – one that is easier to entrain to than the slower notated quarter-note tempo of 120 BPM. Peters and Schwarz (1989 cited in Summers and Rosenbaum 1993) have shown that when asked to entrain to a simple polyrhythmic pulse comprised of two parallel tempi, both musicians and non-musicians found it much easier to consistently execute the faster of the two pulse-trains.

Handel (1984), however, has suggested that while listeners do tend to favor the faster of two pulse-trains in the perception of polyrhythms, they also consistently gravitate towards tempi that are physically easy and comfortable to execute. Given Parncutt's (1994) previously cited "preferred tempo range" of 100-120 BPM, it may follow that polyrhythms comprised of two pulse-trains within the range of 100-120 BPM are most likely to evoke the perception of a rhythmic threshold between two discrete tempi. In *Echoes*, then, the measures of 5/4 may be most effective in provoking the sense of two simultaneous tempi, precisely because the listener is presented with two pulse-trains that fall roughly within Parncutt's preferred tempo range: the quarter-note tempo (120 BPM) and the tempo which emerges as a result of the four equal groupings of five sixteenth-notes (96 BPM).

## Improvisation

The central framework for Afrological modes of improvisation in *Echoes* is provided by its spectral chord changes. In measures one through four, for example, the alto saxophonist is asked to improvise based on a musical scale comprised of harmonics eight through sixteen of E1, rounded to the nearest quartertone. This chord-scale relationship is marked in the score as "C# (H8-H16)" with the E transposed to C# for the alto saxophone [Fig. 6]. In measure 5, when the harmony shifts to reflect the change in the virtual fundamental from E1 to C1, the chord symbol notation also changes and is marked as "A

(H8-H16)”. As is the case with any system of chord changes, many of the decisions regarding pitch choice and octave transposition are left to the improviser.

### **C# (H8-H16):**

The chord symbol notation (H8-H16) indicates that the soloist is to improvise using those pitches, rounded to the nearest 1/4 tone, which correspond to the 8th, 9th, 10th, 11th, 12th, 13th, 14th, 15th and 16th harmonic of a given note. In the case of C# (H8-H16) this gives the following:



Fig. 6: Chord symbol notation for improvisation in *Echoes*

In my own experience, I’ve found that in negotiating the spectral chord changes of *Echoes* I tend to emphasize harmonics nine, eleven, twelve, and fourteen in addition to incorporating pitches derived from other scales when the musical context calls for it.

Each measure of music in *Echoes* is conceived of as a unique sound object: a composite of harmony, rhythm and ensemble texture. As a result, the improvisational precept of “changes” is expanded to include all three of these elements. In measures four and five, for example, the alto saxophonist is expected to construct an improvisation informed by (1) the metric shift from 5/4 to 7/4, (2) the change in texture brought about by the tenor saxophone and the tuba, and (3) the modulation of the virtual fundamental from E1 to C1. As a framework for Afrological improvisation, the compositional structure of *Echoes* can be difficult to internalize. However, many of the challenges presented by the piece also provide opportunities for creative approaches to improvisation. An improvised solo on *Echoes* can be built around the microtonal pitch content of the spectral chord changes, but it is also possible to imagine an improvisation that uses the piece’s rhythmic, textural, and dynamic changes as its foundation. For example, the drum coda at the end of the piece (mm. 39-45) can be seen as a platform for improvisation that privileges both rhythmic and textural variation. In lieu of chord changes, the percussionist is asked to negotiate a set of “dynamic changes,” which are the result of rapid shifts in the number of

accompanying players from seven (m. 39) to three (m. 40) to two (mm. 41-42) to five (mm. 43-44) to one (m. 45) [Fig. 7].

4X

The musical score is divided into two systems. The first system covers measures 39 to 42, and the second system covers measures 43 to 45. The instruments listed on the left are B♭ Tpt., A. Sax., T. Sax., Tbn., Vib., Tuba, A.B., and D.S. The score shows dynamic markings such as *mf*, *p*, *f*, and *mp* across the staves. The D.S. staff (Drum Solo) shows a complex rhythmic pattern with many notes and rests. The Vib. staff shows a series of chords and single notes. The Tuba staff shows a series of notes and rests. The A.B. staff shows a series of notes and rests. The Tbn. staff shows a series of notes and rests. The T. Sax. staff shows a series of notes and rests. The A. Sax. staff shows a series of notes and rests. The B♭ Tpt. staff shows a series of notes and rests. The score is written in 4/4 time and features a variety of musical notations including notes, rests, and dynamic markings.

Fig. 7: Dynamic changes in the drum coda in *Echoes*

## ***Baltimore/Berlin***

Written for a mixed quintet that includes Bb clarinet, trombone, piano, acoustic bass and drum set, *Baltimore/Berlin* (2008, rev. 2011) is one of four compositions in the evening-length cycle *Impossible Flow*, which was commissioned by the International Contemporary Ensemble in 2010 and premiered on April 17, 2011 in New York City. In the following analysis of *Baltimore/Berlin*, I present a brief overview of the composition's formal structure and harmonic underpinning before moving through a more detailed and comprehensive account of the piece's rhythmic structure, placing special emphasis on the ways in which I have sought to incorporate rhythmic thresholds into a work for a small chamber ensemble.

### Formal Structure

In *Baltimore/Berlin*, expressive timing, compound meter, rubato phrasing, changing tempi, polyrhythm, instrumental gesture, and memory are treated as a seamless continuum designed to explore the psychology of musical time and its connection to musical meaning. The piece is approximately eleven minutes long and comprises six sections: first passacaglia (mm. 1-22 [3']), first rhythmic interlude (mm. 23-39 [2']), piano interlude (mm. 40-48 [1']), second rhythmic interlude (mm. 49-59 [1']), rubato interlude (mm. 60-81 [2']), and second passacaglia (mm. 82-92 [2']). Each section is conceived of as a compositional "scene" which examines the rhythmic premise of *Baltimore/Berlin* from a unique vantage point. As a result, the work demonstrates a kind of kaleidoscopic formal logic, in which distinctive melodic motifs, instrumental gestures, and chord voicing are presented to the listener in a variety of compositional contexts. There are, however, several instances in *Baltimore/Berlin* in which compositional material is transformed and developed in a more linear manner. The recapitulation of the passacaglia in m. 82, for example, can be understood both as a more traditional formal device and as a means of exploring the nature of long-term memory in the manifold of rhythmic structures driving the piece.

## Harmonic Structure

The harmonies in *Baltimore/Berlin* are derived from the physical properties of an acoustic piano; the sound spectrum of the piano is slightly distorted, which results in inharmonic overtones, starting with the 16th partial. The lowest octave of the piano is also defined by the fact that, in many cases, the second harmonic has a higher amplitude than the fundamental frequency. Throughout *Baltimore/Berlin*, the sound of the piano and its physical structure provide a symbolic foundation for an array of harmonic devices.

In the opening measures of the piece, the natural resonance of the piano assumes a harmonic role. In order to reinforce the acoustic properties and overtone structure of the piano, the first passacaglia is written in the instrument's lowest register, allowing a greater number of the overtones to fall within the range of human hearing. The pianist is also asked to keep the sustain pedal depressed throughout the entirety of the first section in order to further reinforce and prolong the natural resonance of the piano's upper partials [Fig. 8].

**Baltimore/Berlin**

$\text{♩} = 96$   
Organic with Great Rhythmic Precision

Piano

Pno.

D. S.

pp

mp

pp

Soft Mallets

Crash

pp

Fig. 8: Opening passacaglia in *Baltimore/Berlin*

In mm. 14-15, the upper harmonics of the piano are reinforced by the clarinet and trombone. The piano plays a D#1 (38.9 Hz), which functions as a fundamental frequency, while the trombone sounds a rough approximation of the eleventh harmonic (A – 440 Hz) and the clarinet plays the fourteenth harmonic (C ¼ Sharp – 538.6 Hz). The quiet noise of the cymbal roll in mm. 14-15 and the mezzo-piano attack in the piano (with the damper pedal removed) help to mask the entrance of the clarinet and trombone and allow those instruments to fuse more easily with the natural resonance of the piano [Fig. 9].

Fig. 9: Approximation of upper piano harmonics by the clarinet and trombone in *Baltimore/Berlin*

The harmonies in the second rhythmic interlude (mm. 49-59) are also modeled after the slightly distorted spectrum of the piano. In the beginning of m. 49, for example, the acoustic bass and the piano sound pitches derived from the overtones of a virtual fundamental sounding at C-0 (16.4 Hz). The acoustic bass plays the second partial (C – 32.7 Hz) and the piano approximates the eleventh and fifteenth partials (F# – 185 Hz & B – 247 Hz), as well as the 16 partial (C# – 277.1 Hz), which is slightly inharmonic.

Throughout the second rhythmic interlude (mm. 49-59), the harmonies are constructed in this fashion and make frequent use of perfect fourth and perfect fifth intervals. Demonstrating qualities of quartal harmony in a spectral context, the chords sounded by the piano and acoustic bass in this section take on a distinctive character [Fig. 10].

The musical score for measures 49-59 of *Baltimore/Berlin* is presented for five instruments: B♭ Clarinet (B♭ Cl.), Trombone (Tbn.), Piano (Pno.), Acoustic Bass (A.B.), and Drums (D. S.). The score is written in 4/16 time, with a key signature of one sharp (F#). The tempo is marked as 'Just Loud Enough to Color the Ensemble Texture...'. The B♭ Cl. part begins with a *ppp* dynamic and features a melodic line with a 'Remove Mute' instruction. The Tbn. part starts with a *mp* dynamic and includes a 'w/Drums' instruction. The Pno. part begins with a *mp* dynamic and features a complex harmonic structure with a *pp* dynamic. The A.B. part starts with a *f* dynamic and includes a 'Closed Hi-Hat' instruction. The D. S. part begins with a *mf* dynamic and includes a 'w/Trombone' instruction. The score is divided into measures 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, and 59.

Fig. 10: Mixtures of quartal harmony and spectral pitch organization in *Baltimore/Berlin*

## Rhythmic Structure

The rhythmic structure of *Baltimore/Berlin* explores the concept of rhythmic thresholds from multiple perspectives. Using a unique and meaningful approach to rhythm rooted in the nature of human cognition, each section of the piece explores a specific facet of rhythm perception.

In the first passacaglia (mm. 1-22), the notated tempo of eighth-note = 96/quarter-note = 48 places the temporal flow of the music at the lower threshold of Parncutt's "normal tempo range" (67 BPM) and at the tempo rate which both Parncutt (1994) and Repp and

Doggett (2007) have cited as the point at which listeners are unable to perceive/anticipate a regular pulse (33 BPM). As a result, the opening section of *Baltimore/Berlin* demonstrates a kind of “fuzzy periodicity,” even when the pianist is asked to play several consecutive notes of equal length. The notated durational shifts in the opening passacaglia also contribute to this phenomenon and further complicate the notion of pulse salience in this section of the piece. Centering the first passacaglia around the quarter-note value of 48 BPM and making frequent use of sixteenth-note groupings of 3, 5, and 6 to foster an asymmetrical pulse is intended to create a compositional tension between the perception of discrete changes in duration and the human preference for and propensity to hear temporal ratios of 1:1 (See Fraisse (1963) and Clarke (1987), among others) [Fig. 11].

Organ with Great Rhythmic Precision

♩ = 96

Piano

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

Fig. 11: Fuzzy periodicity in the opening passacaglia of *Baltimore/Berlin*

The first rhythmic interlude (mm. 23-39) is largely defined by the introduction of the drum set as a rhythmic instrument. The unison phrase played by the acoustic bass and drum set at the end of m. 22 situates the opening passacaglia within a more explicit



rhythmic structure, introducing a fragmented and asymmetrical sense of pulse that nevertheless remains highly synchronized. The material in this section of the composition explores the extent to which rhythmic unisons and synchronized attacks can influence the perception of musical pulse. Though the literature on this area of music cognition appears to be virtually non-existent, I believe that this kind of inquiry is crucial to a comprehensive understanding of rhythm perception. In *Rai* (2006), for example, I make use of a seemingly random row of durations, which increasingly evokes the sense of an underlying cognitive grid with notated unison attacks [Fig. 12].

The image displays a musical score for Piano and Drum Set, consisting of three systems. Each system has two staves: a Piano staff (treble and bass clef) and a Drum Set staff (single line with a double bar line). The score is written in 4/4 time, with a key signature of one flat (B-flat). The first system shows the Piano playing a series of chords and the Drum Set playing a complex, asymmetrical rhythm. The second system continues this pattern, with the Piano playing more complex chords and the Drum Set playing a more complex rhythm. The third system shows the Piano playing a series of chords and the Drum Set playing a complex, asymmetrical rhythm. The score is marked with '5' and '9' at the beginning of the second and third systems, respectively, indicating measures 5 and 9. The score is titled 'Fig. 12: Unison attacks of asymmetrical rhythms in Rai'.

Fig. 12: Unison attacks of asymmetrical rhythms in *Rai*

In *Baltimore/Berlin*, the meticulous alignment of musical materials is also reinforced by the extensive use of the bass and snare drum. Though it may seem self-evident that percussive timbres, in and of themselves, can contribute to a sense of pulse and rhythmic

stability, here again there is little psychological literature on the topic.<sup>22</sup> In measure 31 of *Baltimore/Berlin*, a rapidly shifting and highly asymmetrical organization of musical time is made to sound more rhythmic as a result of unison attacks shared by the piano, acoustic bass, and drum set, and densely notated material executed by the bass and snare drum. As evidenced by the material in this measure, the first rhythmic interlude in *Baltimore/Berlin* is intended to explore the relationship between timbre, alignment, and the rhythmic threshold separating the perception of rhythm and pure duration [Fig. 13].

The figure displays a musical score for measure 31, featuring five staves. The top staff is for B♭ Clarinet (B♭ Cl.), followed by Tuba (Tbn.), Piano (Pno.), Acoustic Bass (A.B.), and Drum Set (D. S.). The piano part is characterized by a series of unison attacks with dynamic markings: *pp*, *pp*, *mf*, *f*, *mp*, and *pp*. A 'Xeo' label is placed below the first two *pp* markings. The acoustic bass and drum set parts also contribute to the unison attacks. The drum set part includes a triplet of eighth notes and a 3:2 ratio marking. The entire measure is marked with a *mf* dynamic.

Fig. 13: Unison attacks in a rapidly shifting rhythmic context in *Baltimore/Berlin*

In the last four measures of the first rhythmic interlude (mm. 37-39), the listener is presented with a rapidly shifting constellation of simultaneous pulse-trains. As Lerdahl (1988) has noted, simultaneous tempos can compete for attention and obscure the underlying rhythmic structure of a composition. Perkins and Howard (1976) have found

<sup>22</sup> Writing on the nature of ecological perception in music, Vijay Iyer (2002) has noted that “we connect the perception of musical motion at the ecological level to human motion.” From this point of view, the very sound of a snare drum, for example, may evoke the feeling of a human action (the striking of a drum) that culturally, we associate with rhythm.

that when presented with multiple tempos, listeners will attend to the rhythmic structure in one way while remaining aware of alternate possibilities for entrainment, in some cases moving back and forth between two or more options. In mm. 37-39 of *Baltimore/Berlin*, the simultaneous presence of multiple pulse-trains is intended to create a compositional tension between serial and segregated modes of listening [Fig. 13 and 14]. Jones and Jagacinski (1995) define serial listening as a mode of attending in which two or more rhythmic textures are perceived as part of one sequential stream of information. Segregated listening, or streaming, on the other hand, occurs when a rhythmic sequence is perceived as two or more segregated streams.

The musical score for measures 37-38 of *Baltimore/Berlin* is presented for five instruments: B♭ Clarinet (B♭ Cl.), Trombone (Tbn.), Piano (Pno.), Alto Saxophone (A.B.), and Double Bass (D. S.). The score is written in 2/4 time and includes various musical notations such as dynamics (pp, mp, p, mf), articulation (accents, slurs), and rhythmic markings (7:4, 4:3, 3:2). The B♭ Cl. part features a complex melodic line with a 7:4 ratio marking. The Tbn. part has a rhythmic pattern with 4:3 and 3:2 ratio markings. The Pno. part includes a bass line with a 7:4 ratio marking and a treble line with a 3:2 ratio marking. The A.B. part has a simple melodic line. The D. S. part has a rhythmic pattern with a 7:4 ratio marking.

Fig. 13: mm. 37-38 of *Baltimore/Berlin*

The musical score for measures 39-40 of *Baltimore/Berlin* is presented for four instruments: B♭ Clarinet (B♭ Cl.), Piano (Pno.), Alto Saxophone (A.B.), and Double Bass (D. S.).

- B♭ Cl.:** Measures 39-40. The melody consists of quarter notes: C4 (sharp), D4, E4, F4, G4, A4, B4, C5. Dynamics: *mp*.
- Pno.:** Measures 39-40. The right hand plays quarter-note triplets of G#6. Dynamics: *pp*, *mp*, *mf*, *f*, *mf*, *p*. The left hand plays groups of five sixteenth notes alternating between G2 and A#1. Dynamics: *p* to *mf*.
- A.B.:** Measures 39-40. The melody consists of quarter notes: C4 (sharp), D4, E4, F4, G4, A4, B4, C5. Dynamics: *mf*.
- D. S.:** Measures 39-40. The bass line consists of quarter notes: C4 (sharp), D4, E4, F4, G4, A4, B4, C5. Dynamics: *mp*. A box labeled "Mallets" is present above the staff. A "Ride" symbol is present above the staff.

Rhythmically Precise with Crescs. (!)

Fig. 14: m. 39 of *Baltimore/Berlin*

Bregman (1990) has suggested that periodic rhythms can reinforce the perception of an auditory stream, and has also proposed that simultaneous pulse-trains separated by more than 3 to 4 semitones encourage segregated modes of rhythmic attending (streaming). In measure 39 of *Baltimore/Berlin*, the listener is presented with three separate isochronous pulse-trains spanning several octaves: the clarinet plays a C  $\frac{3}{4}$  Sharp, just above C4, in a steady quarter-note pulse; the right hand of the piano sounds G#6 as quarter-note triplets, and the left hand of the piano alternates between G2 and A#1 in groupings of five sixteenth notes. Establishing multiple pulse-trains that compete for attention across a wide registral span, I hope to evoke a perceptual threshold in the listener, simultaneously encouraging segregated and serial modes of listening.

The rhythmic structure of the piano interlude (mm. 40-48) is oriented around the boundaries of the psychological present. In mm. 39-40, the duration of the repeating motif in the bass clef of the piano part is expanded from a regular pulse of five sixteenth-

note groupings to a pulse of half notes and dotted half-notes. At the written tempo of quarter-note = 48, groupings of five sixteenth-notes last approximately 1.5 seconds and half notes and dotted half notes last about 2.5 seconds and 3.75 seconds respectively. Given the average range of the perceptual present – 2 to 3 seconds, as defined by Fraisse (1982) – the expansion of the piano motif in mm. 39-40 can be understood as a strategic shift which places the musical material in a new perceptual framework. In measure 42, the duration of the piano motif is expanded further to include a whole-note with a duration of approximately 5 seconds – Fraisse’s upper limit for the psychological present. Having reached a perceptual threshold in m. 42, the musical material in mm. 43-44 is intended to create a symbolic link between the psychological present and a more expanded notion of short-term memory. The repeated G#6 played by the piano in m. 43 is an allusion to m. 39, where G#6 also figures prominently in the notated piano part. In measure 44, the piano makes a veiled reference to the piece’s opening passacaglia, which is expanded in mm. 45-46 [Fig. 15].

The image displays two systems of musical notation for measures 41-44 of the piece *Baltimore/Berlin*. The top system covers measures 41 and 42, while the bottom system covers measures 43 and 44. Each system includes a piano (Pno.) part on a grand staff (treble and bass clefs) and a double bass (D. S.) part on a single staff. The piano part in measure 41 features a rapid, articulated passage marked 'Very Fast & Very Well Articulated...' and 'pp'. In measure 42, the piano part includes a whole note with a duration of approximately 5 seconds, marked 'pp'. The double bass part in measure 41 has a 'pp' marking and a 'p' marking. In measure 42, it has a 'p' marking and a 'pp' marking. The bottom system (measures 43-44) shows the piano part with a 'p' marking in measure 43 and a 'pp' marking in measure 44. The double bass part has a 'pp' marking in measure 43 and a 'pp' marking in measure 44. The notation includes various musical symbols such as notes, rests, and dynamic markings.

Fig. 15: Rhythmic structure in relation to the psychological present in *Baltimore/Berlin*

The second rhythmic interlude of *Baltimore/Berlin* (mm. 49-59) demonstrates the most prominent and consistent sense of pulse, where the tactus is felt at approximately 96

BPM, at the eighth-note level. The notated drum set part in this section of the piece establishes a semi-consistent temporal flow that is disrupted repeatedly at short intervals, by the asymmetrical subdivision of the pulse. In this rhythmic context, compound meter serves both to create segmentation and to prescribe a rough hierarchy of rhythmic emphasis. Winold (1975) has suggested that the use of mixed meters, particularly those that result in unequally timed beats, will bring about a strong sense of irregularity and disruption in rhythmic structure. However, given the human preference for temporal ratios of 1:1 and 2:1, a feeling of disruption at the phrase level can often be difficult to achieve. Repp (1992), for example, has shown that listeners are often very good at detecting small changes in duration at the pulse level, and much worse at the phrase level. Repp has also suggested that this may, in part, be due to the fact that expressive deviations in timing in Western Classical music tend to be lengthenings, as opposed to shortenings, with the former often occurring at phrase boundaries. Following Repp, the strategic use of compound meter to shorten individual pulses in the second rhythmic interlude of *Baltimore/Berlin* can be understood as a means of provoking at the phrase level a sense of rhythmic unbalance that is more likely to be perceptually salient. This compositional effect is reinforced by the fact that shortened pulses in this section of the piece are systematically followed by unison attacks in the piano, acoustic bass, and drum set, which mark important phrase boundaries. The manipulation of rhythm to postpone and anticipate listener expectation has long been understood as a kind of phenomenal accent in music.<sup>23</sup> Indeed, the rhythmic structure of *Baltimore/Berlin* in mm. 49-59 is intended to create a heightened sense of compositional tension by simultaneously manipulating expectation at both the beat and the phrase levels. Structuring my rhythmic materials in this way, I hope to achieve a careful compositional balance where the impression of a steady pulse is constantly deconstructed and transformed, without being completely obscured [Fig. 16].

In stark contrast to the second rhythmic interlude, the rhythmic structure in the rubato interlude (mm. 60-81) is intended to promote a sense of what Pierre Boulez (1960) has referred to as “smooth time,” where the listener is unable to perceive the presence of a musical pulse.

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<sup>23</sup> See Cooper and Meyer (1956), for example, on rhythmic postponement.

The image displays a musical score for measures 51 through 55 of the piece *Baltimore/Berlin*. The score is written for five instruments: B♭ Clarinet (B♭ Cl.), Trombone (Tbn.), Piano (Pno.), Acoustic Bass (A.B.), and Drums (D.S.). The time signature is 2/4, with a 16-measure bar line. The key signature has one sharp (F#). The score features a variety of musical gestures, including tremolos, glissandi, and complex rhythmic patterns. The B♭ Cl. part starts with a *ppp* dynamic. The Tbn. part includes a *mf* dynamic and a glissando. The Pno. part features a *mp* dynamic and a tremolo. The A.B. part starts with a *f* dynamic. The D.S. part includes a *mf* dynamic and a complex rhythmic pattern. The score is annotated with various musical notations, including slurs, ties, and dynamic markings.

Fig. 16: Mixed meter and rhythmic disruption in *Baltimore/Berlin*

This effect is achieved through the use of musical gestures which do not demonstrate a discrete beginning or end, and are thus more difficult to situate within a rhythmic context: piano tremolos with the sustain pedal depressed; quiet glissandi in the trombone and acoustic bass, and cymbals rolls in the notated drum part. Here again, the distinctive repetition of G#6 in the upper register of the piano is intended to reference mm. 39 and 43 where the G#6 is first introduced. In this context, the G#6 can be viewed as a symbolic compositional gesture, evoking the role of long-term memory in the rhythmic framework of the piece. In measure 65, the notated tremolo in the lower register of the piano is transformed into a more rhythmic gesture, which suggests a distinct feeling of pulse that remains largely obscured as a result of the notated register and the consistent use of the sustain pedal [Fig. 17].





## Conclusion

When I first encountered the music of Tristan Murail and Gérard Grisey in 2001, I was profoundly moved by the unique, otherworldly nature of their harmonic language, and I began to think about ways to integrate spectral harmony into my work as an improviser. Eleven years after my initial introduction to Murail and Grisey's music, I am still exploring the relationship between spectral music and Afrological improvisation and continuing to make new connections and new musical discoveries.

Initially, my synthesis of spectral harmony, Afrological improvisation, and highly structured rhythmic materials was essentially intuitive and guided by a rough set of aesthetic precepts. In the process of working towards a more comprehensive understanding of these musical practices, however, I have been able to construct a rich conceptual framework for my work as a composer/performer. In particular, by focusing on the dual concepts of liminality and perceptual thresholds as they relate to the harmonic, rhythmic, formal, and improvisational aspects of my music, I hope I have been able to further reinforce some of the important correspondences between the distinct musical traditions informing my work. My exploration of the music cognition literature and, my investigations of its application to my own music, has been one means towards this end.

In both improvised and fully notated formats, my compositions reflect and extend Afrological notions of collaboration and a heterogeneous sound ideal that is capable of sustaining alternative value systems and diverse musical perspectives. Both *Echoes* and *Baltimore/Berlin* are compositions that can pose new challenges for performers because of their highly collaborative nature. The first performances of *Baltimore/Berlin*, for example, were realized with a carefully selected group of musicians, who were intimately familiar with my previous music and my highly personal repertoire of rhythmic devices, and were thus capable of contributing to the piece in meaningful ways. In my future research, I hope to explore the ways in which the concept of liminality can be extended to the nature of composer-performer interaction, resulting in a collaborative model that is at once hierarchical and non-hierarchical.

The act of composing music of meaning and substance continues to be a mysterious process for me in many ways. My hope is that this paper will contextualize some of the key ideas that have contributed to my recent music and encourage others to extend my research and experimentation in these areas.

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# ECHOES

For Mixed Octet

Steve Lehman (2008)

## Performance Notes

Bb Trumpet  
Alto Saxophone  
Tenor Saxophone  
Tenor Trombone  
Vibraphone  
Tuba  
Double Bass  
Drum Set (Kick Drum, Snare, Hi-Hat, Crash Cymbal, Ride Cymbal)

**General:**

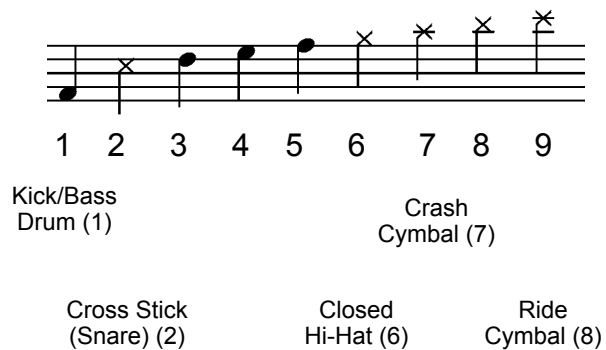
Accidentals apply only to the note-heads which they precede and do not carry through the measure.

The one exception to this rule applies to consecutive articulations of the same pitch in which case only one accidental is used for all sequences of two or more identical pitches.

Quarter-tone, Half-tone, and Three-Quarter-Tone Accidentals are notated in the following manner:



### Percussion/Drum Set:





# Echoes

$\text{♩} = 120$

Trumpet in B $\flat$  *mf* *pp*

C# (H8-H16)

Alto Sax. *mf*

Tenor Sax. *mf*

Trombone *f* *p* *mf*

Vibraphone *f* Motor: Medium Speed *mp*

Tuba *f*

Acoustic Bass *f* *mp*

Drum Set *f*

B $\flat$  Tpt. *mf* *pp* *mf*

A. Sax. *mf*

T. Sax. *mf*

Tbn. *f* *p* *mp*

Vib. *f* *mp*

Tuba *f*

A.B. *f* *mp*

D. S. *f*

5

B♭ Tpt. *pp* *mf*

A (H8-H16)

A. Sx.

T. Sx.

Tbn. *f* *p* *mf* *f*

Vib. *f* *mp* *f* *f*

Tuba

A.B. *f*

D. S.

9

B♭ Tpt. *p* *mf* *pp* *mf*

A. Sx.

T. Sx.

Tbn. *p* *mp* *f* *p* *mp*

Vib. *f* *f* *f* *mp*

Tuba

A.B. *f* *mp*

D. S.

13

B♭ Tpt. *mf* *p* *p* *mf*

A. Sx. *mf* *mf*

T. Sx. C# (H8-H16) A (H8-H16) *mf*

Tbn. *f* *p* *mp* *p* *mf* *f*

Vib. *f* *f* *f* *f*

Tuba *f* *f*

A.B. *f* *mp* *mp* *f*

D. S. *f* *f* *f* *f*

17

B♭ Tpt. *mf* *mf* *p* *p*

A. Sx. *mf* *mf* *mf*

T. Sx. *mf* *mf* B (H8-H16)

Tbn. *f* *mf* *p* *mf* *p* *mf*

Vib. *f* *f* *mf*

Tuba *f* *f*

A.B. *f* *f* *mp* *mp*

D. S. *f* *f* *f* *f*

21

B♭ Tpt.

A. Sx.

T. Sx.

Tbn.

Vib.

Tuba

A.B.

D. S.

*mf*

*mf*

*mf*

*f*

*mp*

*f*

*f*

*f*

*mp*

24

B♭ Tpt.

A. Sx.

T. Sx.

Tbn.

Vib.

Tuba

A.B.

D. S.

*mf*

*mf*

*mf*

*mf*

*f*

*f*

*f*

*f*

*mp*

*p*

*mf*

*mp*

26

B♭ Tpt. *mf*

A. Sx. *mf*

T. Sx. *mf*

Tbn. *f*

Vib. *f* *mf* *f*

Tuba *f* *8va*

A.B. *f* *mp* *f*

D. S. *f*

29

B♭ Tpt. *mp*

A. Sx. *mf*

T. Sx. *mp* *mf*

Tbn. *f*

Vib. *f*

Tuba *f*

A.B. *mp*

D. S. *f*

32

B $\flat$  Tpt. *mf* *mf* *mp*

A. Sx.

T. Sx. *mf* *mp* *mf*

Tbn.

Vib. *f*

Tuba

A.B. *f* *mp* *f*

D. S.

36

B $\flat$  Tpt. *mp*

A. Sx.

T. Sx. *mp* *mf*

Tbn.

Vib.

Tuba

A.B. *mp*

D. S.

# 4X

39

B♭ Tpt. *mf* *p* *mf*

A. Sx.

T. Sx.

Tbn. *mf* *p* *mf*

Vib. *f* *mp* *f* *f*

Tuba *f*

A.B. *f* *mp* *mp* *mp*

D. S. *f*

43

B♭ Tpt.

A. Sx.

T. Sx.

Tbn.

Vib. *f* *f*

Tuba *f*

A.B. *f*

D. S. *f*

# Baltimore/Berlin

For Mixed Quintet

Steve Lehman (2008, rev. 2011)



## Performance Notes

Bb Clarinet  
Tenor Trombone with Bucket Mute  
Piano  
Double Bass with C Extension and Amplifier  
Drum Set (Kick Drum, Snare, Piccolo Snare, Hi-Hat, Crash Cymbal, Taped Splash Cymbal, Ride Cymbal)

### General:

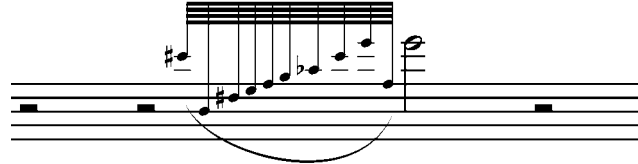
Accidentals apply only to the note-heads which they precede and do not carry through the measure.

The one exception to this rule applies to consecutive articulations of the same pitch in which case only one accidental is used for all sequences of two or more identical pitches.

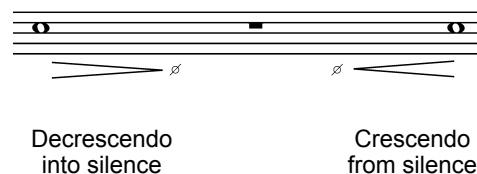
Quarter-tone, Half-tone, and Three-Quarter-Tone Accidentals are notated in the following manner:



Grace-note passages should be executed as fast as possible, albeit in a manner that is extremely precise and well articulated. These passages are notated in the following manner:



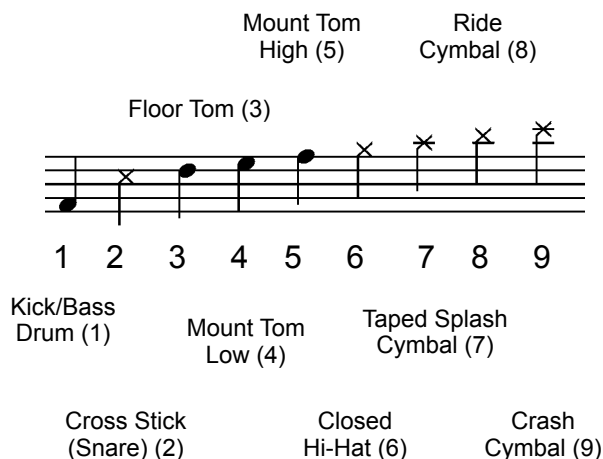
Crescendos arising imperceptibly from silence (no audible attack) and decrescendos fading imperceptibly into silence are notated in the following manner:



## Performance Notes Continued

### Percussion/Drum Set:

The drum set will be scored in the following manner:



Specific drums heads and sizes should be selected according to the notated specifications of the piece. For example, the written score often calls for short and well articulated attacks from the bass/kick drum, which would be easily executed by a small bass drum (possibly with a damper) resulting in a relatively dry and centered sound, capable of being played at several dynamic levels. The percussionist is encouraged to develop/articulate a personal collection of drum set sounds/timbres within the specifications of the piece.

The percussionist may wish to use drumsticks with soft mallet heads at the butt of the stick for passages in which rapid stick changes are called for. All stick changes are notated in the score, with the exception of those changes resulting in brief cymbal rolls/tremolos found in the midst of drum set literature to be performed with drum sticks. All cymbal rolls in the piece should be performed with soft mallets whenever possible and/or practical.

### Woodwinds & Brass:

In some instances, when executing crescendi from silence and decrescendi into silence, the trombonist and/or clarinetist may wish to reinforce the specified dynamic transformation through strategic positioning of the bell of the musical instrument. For example, the clarinetists/trombonist may wish to point the bell of his/her instrument directly at the ground, gradually lifting it towards its normal position, when executing a crescendo from silence (with no audible attack).

# Baltimore/Berlin

♩ = 96

Organic with Great Rhythmic Precision

Piano

*pp*  
Led.  
S

*mp* *pp*  
/S/ S

Pno.

5

Led.

*mp* *pp*  
/S/ S

*pp*  
Led.

Led.

D. S.

5

Crash

Soft Mallets

*pp*

59

# Baltimore/Berlin

8

B $\flat$  Cl.

Pno.

D. S.

8

*pp*  
Led.

*mp* *pp*  
/S/ S

*pp*  
Led.

*mp* *pp*  
/S/ S

*pp*

69

# Baltimore/Berlin

The first system of the musical score for "The Sound of Silence" features five staves. The top staff is for B♭ Clarinet (B♭ Cl.), the second for Trombone (Tbn.), the third for Piano (Pno.), and the fourth for Double Bass (D. S.). The fifth staff is for the Drum Set (D. S.). The music is in 7/4 time, with a key signature of one sharp (F#). The score includes various musical notations such as rests, notes, and dynamic markings. The piano part begins with a *pp* (pianissimo) dynamic, followed by a *mp* (mezzo-piano) dynamic. The drum set part includes a *pp* (pianissimo) dynamic. The score also includes a "Bucket Mute" instruction for the trombone and a "Blend w/Clarinet" instruction for the piano. The system concludes with a *pp* (pianissimo) dynamic marking.

## Baltimore/Berlin

[illegible]

## Baltimore/Berlin

18 Blend w/Trombone

B♭ Cl.

18

Tbn.

Blend w/Clarinet

Pno.

18

A.B.

18

D. S.

# Baltimore/Berlin

22

Pno.

*pp*  
Ped.

22

A.B.

*p* *mf*  
w/Drums  
Ride

22

D. S.

*ppp* *p*  
Sticks  
w/Bass  
*mp*

The musical score is written for three parts: Piano (Pno.), A.B. (likely a vocal or instrumental line), and D.S. (Drum Set). The score begins at measure 22. The Piano part is in the bass clef, with a key signature of one sharp (F#) and a time signature of 3/4. It features a series of chords and single notes, with a *pp* (pianissimo) dynamic and a Pedal (Ped.) marking. The A.B. part is also in the bass clef, with a key signature of one sharp and a time signature of 3/4. It includes a 3:2 ratio marking and a *p* (piano) dynamic. The D.S. part is in the treble clef, with a key signature of one sharp and a time signature of 3/4. It features a series of chords and single notes, with a *ppp* (pianississimo) dynamic and a *p* (piano) dynamic. The score includes various articulations such as accents, slurs, and a 3:2 ratio marking. The D.S. part also includes a 'Sticks' marking and a 'w/Bass' marking.



## Baltimore/Berlin

[illegible]

## Baltimore/Berlin

### Rhythmically Precise with Crescs. (!)

The musical score consists of five staves:

- B♭ Cl.**: Treble clef, 5/4 time signature. Measures 28-31 show melodic lines with dynamics *mf* and *f*. A crescendo hairpin spans measures 29-30.
- Tbn.**: Bass clef, 5/4 time signature. Similar melodic lines to the clarinet, with dynamics *mf* and *f*, and a crescendo hairpin in measures 29-30.
- Pno.**: Bass clef, 5/4 time signature. Features complex rhythmic patterns with triplets and sixteenth notes. Dynamics include *pp*, *mp*, *p*, and *f*. Pedal markings (*ped.*) are present under measures 28 and 30.
- A.B.**: Bass clef, 5/4 time signature. Melodic line with accents (>) and dynamic *mp*.
- D.S.**: Bass clef, 5/4 time signature. Rhythmic accompaniment with eighth-note patterns, accents (>), and dynamic *p*. A crescendo hairpin is shown between measures 28 and 29.

Rehearsal mark 28 appears at the beginning of each staff. Measure numbers 28, 29, 30, and 31 are indicated above the staves. Time signatures change from 5/4 to 3/4+3/16 in measure 29 and back to 5/4 in measure 31.

## Baltimore/Berlin

30

B♭ Cl.

30

Tbn.

Pno.

30

A.B.

30

D.S.

Baltimore/Berlin

31

B $\flat$  Cl.

31

Tbn.

*mf*

Pno.

8

*pp*

*pp*

*mf*

*f*

*mp*

*pp*

A.B.

31

*mf*

3

3:2

D. S.

31

*mp*

3:2

# Baltimore/Berlin

32

B $\flat$  Cl. *mp*

Tbn. *mf*

Pno. *p* *ppp* *mp*

A.B. *mf* *mp* *f*

D. S. *mp*

7+5  
4+16

# Baltimore/Berlin

35

B♭ Cl.

35

Tbn.

Pno.

A.B.

D.S.

70

The musical score for measures 35-40 of "Baltimore/Berlin" is written for five instruments: B♭ Clarinet, Trombone, Piano, Alto Saxophone, and Double Bass. The key signature is one sharp (F#) and the time signature is 7/16, which changes to 6/16 at the end of the page. The score features various musical notations including notes, rests, slurs, and dynamic markings such as *ppp*, *mp*, *mf*, *f*, and *pp*. The Piano part includes a triplet in measure 38 and a 5/2 note in measure 40. The Alto Saxophone part includes a triplet in measure 38 and a 5/2 note in measure 40. The Double Bass part includes a triplet in measure 38 and a 5/2 note in measure 40.

# Baltimore/Berlin

Expressive and Precise as if  
in an Imaginary Folk Idiom...

36

B $\flat$  Cl.

$\frac{6}{4} + \frac{3}{16}$

$\emptyset$   $mp$

w/Drums

Pno.

$\frac{6}{4} + \frac{3}{16}$

$mp$

$p$

36

A.B.

$\frac{6}{4} + \frac{3}{16}$

$mf$

5:2

36

D. S.

$\frac{6}{4} + \frac{3}{16}$

$mp$

$\emptyset$   $p$   $mp$

w/Clarinet

## Baltimore/Berlin

37

B♭ Cl.

37

Tbn.

37

Pno.

37

A.B.

37

D. S.

7:4

4:3

3:2

pp

mp

mp

mp

pp

mp

p

pp

mp

mf

mp



## Baltimore/Berlin

[illegible]

# Baltimore/Berlin

Very Fast & Very Well Articulated...

Pno.

41

*pp*

*pp*  $\varnothing$

*pp* /S/

*pp*  $\varnothing$

D. S.

41

*pp*

$\varnothing$  *pp*

Pno.

44

*p*

*pp*  $\varnothing$  /S/

*pp* /S/

*pp* /S/

D. S.

44

*pp*

## Baltimore/Berlin

47

B♭ Cl.

47

Tbn.

47

Pno.

8

A.B.

47

D. S.

Sticks

# Baltimore/Berlin

Just Loud Enough to Color the Ensemble Texture...

49

B♭ Cl.

*ppp*

49

Tbn.

Remove Mute

w/Drums

*mp*

*mf*

49

Pno.

*mp*

*pp*

49

A.B.

*f*

49

D. S.

*mf*

Closed Hi-Hat

3

5

w/Trombone

# Baltimore/Berlin

51

B♭ Cl. *ppp*

51

Tbn. *mf* Expressive and Precise as if *p* in an Imaginary Folk Idiom... *mf*

51

Pno. *mp* *Red.*

51

A.B. *f*

51

D. S. *mf*

# Baltimore/Berlin

53

B $\flat$  Cl.  $\frac{5}{4} + \frac{1}{16}$  *ppp* *ppp*  $\frac{6}{4} + \frac{1}{16}$

Pno.  $\frac{5}{4} + \frac{1}{16}$  *mp* *Leg.*  $\frac{6}{4} + \frac{1}{16}$

A.B.  $\frac{5}{4} + \frac{1}{16}$  *f*  $\frac{6}{4} + \frac{1}{16}$

D. S.  $\frac{5}{4} + \frac{1}{16}$  *mf*  $\frac{6}{4} + \frac{1}{16}$

# Baltimore/Berlin

54

B♭ Cl. *ppp* *10:8* *ppp* *ppp*

54

Tbn. *mf* *mp*

54

Pno. *mp* *Red.* *f*

54

A.B. *f*

54

D. S. *mf* *13:2*

Detailed description of the musical score: The score is for a piece titled 'Baltimore/Berlin'. It shows measures 54 through 58. The instruments are B♭ Clarinet, Trombone, Piano, Alto Saxophone, and Drums. The key signature has one sharp (F#) and the time signature is 6/4. The B♭ Clarinet part starts with a half note G#4, followed by a quarter rest, then a half note G#4, and ends with a quarter note G#4. The Trombone part starts with a half note G#2, followed by a quarter rest, then a half note G#2, and ends with a quarter note G#2. The Piano part starts with a half note G#4, followed by a quarter rest, then a half note G#4, and ends with a quarter note G#4. The Alto Saxophone part starts with a half note G#4, followed by a quarter rest, then a half note G#4, and ends with a quarter note G#4. The Drums part starts with a half note G#4, followed by a quarter rest, then a half note G#4, and ends with a quarter note G#4. The score includes various musical notations such as notes, rests, dynamics (ppp, mf, mp, f), articulation (>), and performance instructions (10:8, 13:2).

# Baltimore/Berlin

56

B♭ Cl.

*ppp*

*ppp*

56

Tbn.

*mf*

*mf*

Bucket Mute

*p*

56

Pno.

*mp*

*pp*

*pp*

*pp*

56

A.B.

*f*

*mp*

*p*

56

D. S.

*mf*

*mf*

*p*

Ride

5♩:2♩



# Baltimore/Berlin

Creating a Dark, Undulating, Resonant Texture  
with Individual Pitches and Attacks Virtually Imperceptible...

Pno.

58

*p*

*pp*

*ppp*

8

Lead.

S

China

Soft Mallets

Lead.

D. S.

58

*mp*

*mp*

*pp*

*p*

*mp*

As Quiet as Possible with Audible Fragments...  
Point Bell Towards Ground as Necessary...

82

# Baltimore/Berlin

♩ = 92

Tempo Changes Established by Piano and  
Articulated by Conductor

65 ♩ = 96

B♭ Cl.

65

Tbn.

Pno.

8

65

A.B.

65

D. S.

ppp

5:3

Quiet and Rhythmic...

pp

Lead.

p

Baltimore/Berlin

♩ = 88

**Sounding and Feeling Rubato  
While Remaining Rhythmiclly Locked...**

♩ = 84

67

B♭ Cl.

67

Pno.

8

ppp

pp

pp

67

D. S.

p

8:6

∅

8

pp

ped.

Toms should be Played Freer Rhythmically...

Baltimore/Berlin

69  $\text{♩} = 80$

B $\flat$  Cl.

69  $\text{♩} = 76$  5:3

Tbn.

Pno.

A.B.

D. S.

*ppp*

*p*

*pp*

*pp*

Crash

*pp*

Detailed description of the musical score: The score is for a piece titled 'Baltimore/Berlin'. It shows measures 69 through 76. The B $\flat$  Clarinet part has a whole rest in measure 69 and a melodic line in measure 76, marked with a 5:3 ratio. The Trombone part has a whole note in measure 69 and a half note in measure 76. The Piano part has a complex rhythmic pattern in measure 69, marked with accents and a *pp* dynamic, and a similar pattern in measure 76, marked with a *p* dynamic. The Alto Saxophone part has a whole note in measure 69 and a half note in measure 76. The Double Bass part has a whole note in measure 69 and a half note in measure 76, with crash cymbal notation indicated by 'x' marks. Dynamics include *ppp*, *p*, and *pp*. The tempo changes from 80 bpm in measure 69 to 76 bpm in measure 76.

Baltimore/Berlin

$\text{♩} = 72$

71 *ppp*

B $\flat$  Cl.

71 *p*

Pno.

8 *pp*

*Leo.*

71  $\emptyset$

D. S.

*p*

8:6

# Baltimore/Berlin

73

B $\flat$  Cl. *ppp*

Tbn. 73

Loud Enough/Color...  $\emptyset$

Pno. 73 *p*

8 *pp* *Leg.*

A.B. 73 *pp*  $\emptyset$

D. S. 73 *p*

# Baltimore/Berlin

## Sounding More and More Rhythmically Locked...

**Sounding More and More Rhythmically Locked...**

The musical score for measures 75-78 is as follows:

- B $\flat$  Cl.:** Measure 75: Quarter note G $\sharp$ 4. Measure 76: Quarter notes A $\sharp$ 4, B $\sharp$ 4, C $\sharp$ 5, D $\sharp$ 5, E $\sharp$ 5, F $\sharp$ 5, G $\sharp$ 5, A $\sharp$ 5, B $\sharp$ 5, C $\sharp$ 6, D $\sharp$ 6, E $\sharp$ 6, F $\sharp$ 6, G $\sharp$ 6, A $\sharp$ 6, B $\sharp$ 6, C $\sharp$ 7, D $\sharp$ 7, E $\sharp$ 7, F $\sharp$ 7, G $\sharp$ 7, A $\sharp$ 7, B $\sharp$ 7, C $\sharp$ 8, D $\sharp$ 8, E $\sharp$ 8, F $\sharp$ 8, G $\sharp$ 8, A $\sharp$ 8, B $\sharp$ 8, C $\sharp$ 9, D $\sharp$ 9, E $\sharp$ 9, F $\sharp$ 9, G $\sharp$ 9, A $\sharp$ 9, B $\sharp$ 9, C $\sharp$ 10, D $\sharp$ 10, E $\sharp$ 10, F $\sharp$ 10, G $\sharp$ 10, A $\sharp$ 10, B $\sharp$ 10, C $\sharp$ 11, D $\sharp$ 11, E $\sharp$ 11, F $\sharp$ 11, G $\sharp$ 11, A $\sharp$ 11, B $\sharp$ 11, C $\sharp$ 12, D $\sharp$ 12, E $\sharp$ 12, F $\sharp$ 12, G $\sharp$ 12, A $\sharp$ 12, B $\sharp$ 12, C $\sharp$ 13, D $\sharp$ 13, E $\sharp$ 13, F $\sharp$ 13, G $\sharp$ 13, A $\sharp$ 13, B $\sharp$ 13, C $\sharp$ 14, D $\sharp$ 14, E $\sharp$ 14, F $\sharp$ 14, G $\sharp$ 14, A $\sharp$ 14, B $\sharp$ 14, C $\sharp$ 15, D $\sharp$ 15, E $\sharp$ 15, F $\sharp$ 15, G $\sharp$ 15, A $\sharp$ 15, B $\sharp$ 15, C $\sharp$ 16, D $\sharp$ 16, E $\sharp$ 16, F $\sharp$ 16, G $\sharp$ 16, A $\sharp$ 16, B $\sharp$ 16, C $\sharp$ 17, D $\sharp$ 17, E $\sharp$ 17, F $\sharp$ 17, G $\sharp$ 17, A $\sharp$ 17, B $\sharp$ 17, C $\sharp$ 18, D $\sharp$ 18, E $\sharp$ 18, F $\sharp$ 18, G $\sharp$ 18, A $\sharp$ 18, B $\sharp$ 18, C $\sharp$ 19, D $\sharp$ 19, E $\sharp$ 19, F $\sharp$ 19, G $\sharp$ 19, A $\sharp$ 19, B $\sharp$ 19, C $\sharp$ 20, D $\sharp$ 20, E $\sharp$ 20, F $\sharp$ 20, G $\sharp$ 20, A $\sharp$ 20, B $\sharp$ 20, C $\sharp$ 21, D $\sharp$ 21, E $\sharp$ 21, F $\sharp$ 21, G $\sharp$ 21, A $\sharp$ 21, B $\sharp$ 21, C $\sharp$ 22, D $\sharp$ 22, E $\sharp$ 22, F $\sharp$ 22, G $\sharp$ 22, A $\sharp$ 22, B $\sharp$ 22, C $\sharp$ 23, D $\sharp$ 23, E $\sharp$ 23, F $\sharp$ 23, G $\sharp$ 23, A $\sharp$ 23, B $\sharp$ 23, C $\sharp$ 24, D $\sharp$ 24, E $\sharp$ 24, F $\sharp$ 24, G $\sharp$ 24, A $\sharp$ 24, B $\sharp$ 24, C $\sharp$ 25, D $\sharp$ 25, E $\sharp$ 25, F $\sharp$ 25, G $\sharp$ 25, A $\sharp$ 25, B $\sharp$ 25, C $\sharp$ 26, D $\sharp$ 26, E $\sharp$ 26, F $\sharp$ 26, G $\sharp$ 26, A $\sharp$ 26, B $\sharp$ 26, C $\sharp$ 27, D $\sharp$ 27, E $\sharp$ 27, F $\sharp$ 27, G $\sharp$ 27, A $\sharp$ 27, B $\sharp$ 27, C $\sharp$ 28, D $\sharp$ 28, E $\sharp$ 28, F $\sharp$ 28, G $\sharp$ 28, A $\sharp$ 28, B $\sharp$ 28, C $\sharp$ 29, D $\sharp$ 29, E $\sharp$ 29, F $\sharp$ 29, G $\sharp$ 29, A $\sharp$ 29, B $\sharp$ 29, C $\sharp$ 30, D $\sharp$ 30, E $\sharp$ 30, F $\sharp$ 30, G $\sharp$ 30, A $\sharp$ 30, B $\sharp$ 30, C $\sharp$ 31, D $\sharp$ 31, E $\sharp$ 31, F $\sharp$ 31, G $\sharp$ 31, A $\sharp$ 31, B $\sharp$ 31, C $\sharp$ 32, D $\sharp$ 32, E $\sharp$ 32, F $\sharp$ 32, G $\sharp$ 32, A $\sharp$ 32, B $\sharp$ 32, C $\sharp$ 33, D $\sharp$ 33, E $\sharp$ 33, F $\sharp$ 33, G $\sharp$ 33, A $\sharp$ 33, B $\sharp$ 33, C $\sharp$ 34, D $\sharp$ 34, E $\sharp$ 34, F $\sharp$ 34, G $\sharp$ 34, A $\sharp$ 34, B $\sharp$ 34, C $\sharp$ 35, D $\sharp$ 35, E $\sharp$ 35, F $\sharp$ 35, G $\sharp$ 35, A $\sharp$ 35, B $\sharp$ 35, C $\sharp$ 36, D $\sharp$ 36, E $\sharp$ 36, F $\sharp$ 36, G $\sharp$ 36, A $\sharp$ 36, B $\sharp$ 36, C $\sharp$ 37, D $\sharp$ 37, E $\sharp$ 37, F $\sharp$ 37, G $\sharp$ 37, A $\sharp$ 37, B $\sharp$ 37, C $\sharp$ 38, D $\sharp$ 38, E $\sharp$ 38, F $\sharp$ 38, G $\sharp$ 38, A $\sharp$ 38, B $\sharp$ 38, C $\sharp$ 39, D $\sharp$ 39, E $\sharp$ 39, F $\sharp$ 39, G $\sharp$ 39, A $\sharp$ 39, B $\sharp$ 39, C $\sharp$ 40, D $\sharp$ 40, E $\sharp$ 40, F $\sharp$ 40, G $\sharp$ 40, A $\sharp$ 40, B $\sharp$ 40, C $\sharp$ 41, D $\sharp$ 41, E $\sharp$ 41, F $\sharp$ 41, G $\sharp$ 41, A $\sharp$ 41, B $\sharp$ 41, C $\sharp$ 42, D $\sharp$ 42, E $\sharp$ 42, F $\sharp$ 42, G $\sharp$ 42, A $\sharp$ 42, B $\sharp$ 42, C $\sharp$ 43, D $\sharp$ 43, E $\sharp$ 43, F $\sharp$ 43, G $\sharp$ 43, A $\sharp$ 43, B $\sharp$ 43, C $\sharp$ 44, D $\sharp$ 44, E $\sharp$ 44, F $\sharp$ 44, G $\sharp$ 44, A $\sharp$ 44, B $\sharp$ 44, C $\sharp$ 45, D $\sharp$ 45, E $\sharp$ 45, F $\sharp$ 45, G $\sharp$ 45, A $\sharp$ 45, B $\sharp$ 45, C $\sharp$ 46, D $\sharp$ 46, E $\sharp$ 46, F $\sharp$ 46, G $\sharp$ 46, A $\sharp$ 46, B $\sharp$ 46, C $\sharp$ 47, D $\sharp$ 47, E $\sharp$ 47, F $\sharp$ 47, G $\sharp$ 47, A $\sharp$ 47, B $\sharp$ 47, C $\sharp$ 48, D $\sharp$ 48, E $\sharp$ 48, F $\sharp$ 48, G $\sharp$ 48, A $\sharp$ 48, B $\sharp$ 48, C $\sharp$ 49, D $\sharp$ 49, E $\sharp$ 49, F $\sharp$ 49, G $\sharp$ 49, A $\sharp$ 49, B $\sharp$ 49, C $\sharp$ 50, D $\sharp$ 50, E $\sharp$ 50, F $\sharp$ 50, G $\sharp$ 50, A $\sharp$ 50, B $\sharp$ 50, C $\sharp$ 51, D $\sharp$ 51, E $\sharp$ 51, F $\sharp$ 51, G $\sharp$ 51, A $\sharp$ 51, B $\sharp$ 51, C $\sharp$ 52, D $\sharp$ 52, E $\sharp$ 52, F $\sharp$ 52, G $\sharp$ 52, A $\sharp$ 52, B $\sharp$ 52, C $\sharp$ 53, D $\sharp$ 53, E $\sharp$ 53, F $\sharp$ 53, G $\sharp$ 53, A $\sharp$ 53, B $\sharp$ 53, C $\sharp$ 54, D $\sharp$ 54, E $\sharp$ 54, F $\sharp$ 54, G $\sharp$ 54, A $\sharp$ 54, B $\sharp$ 54, C $\sharp$ 55, D $\sharp$ 55, E $\sharp$ 55, F $\sharp$ 55, G $\sharp$ 55, A $\sharp$ 55, B $\sharp$ 55, C $\sharp$ 56, D $\sharp$ 56, E $\sharp$ 56, F $\sharp$ 56, G $\sharp$ 56, A $\sharp$ 56, B $\sharp$ 56

### Rhythmically Precise with Crescs. (!)



**♩ = 88**  
**Seven 32nds = One 1/4th**  
**Following Piano Attacks**

68

## Baltimore/Berlin

82

B♭ Cl.

82

Tbn.

Pno.

82

A.B.

82

D.S.

Lock w/Piano & Drums...

91

# Baltimore/Berlin

Lock w/Piano & Drums... w/Drums

88 *ppp* *mf* *ppp* *mf*

B♭ Cl.

88 *mp* *mp*

Tbn.

Lock w/Clarinet & Drums... Lock w/Clarinet & Drums...

Pno. *pp* *mp* *pp*

88 *mf* *mf*

A.B.

88 *mp* *mp* *w/Clarinet*

D. S.

Lock w/Piano & Clarinet...

Detailed description: This is a musical score for a jazz ensemble. It features five staves: B♭ Clarinet (B♭ Cl.), Trombone (Tbn.), Piano (Pno.), Alto Saxophone (A.B.), and Double Bass (D. S.). The music is in 4/16 and 2/4 time signatures. The B♭ Clarinet part has complex rhythmic patterns with triplets and sixteenth notes, marked with > and mf. The Trombone part has sustained notes with mp. The Piano part has chords and single notes, marked with pp and mp. The Alto Saxophone part has melodic lines with mf. The Double Bass part has a walking bass line with mp. Performance instructions include 'Lock w/Piano & Drums...', 'w/Drums', 'Lock w/Clarinet & Drums...', and 'Lock w/Piano & Clarinet...'. Dynamic markings range from ppp to mf.

# Baltimore/Berlin

91

B $\flat$  Cl. *w/Drums*  
*ppp* *mf*  $\emptyset$

Tbn.  $\emptyset$  *p*  $\emptyset$   
*Lock w/Clarinet & Drums...*

Pno. *pp* *p* *Lead.* *p* *Lead.*

A.B. *mf* *3* *Ride & China*

D. S. *mf* *w/Clarinet* *mf*