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A Metrical Analysis and Rebarring of Paul Creston's
Sonata for Alto Saxophone and Piano, Op. 19

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A METRICAL ANALYSIS AND RE-BARRING OF PAUL CRESTON'S
SONATA FOR ALTO SAXOPHONE AND PIANO, OP. 19

by

C. Kyle Sweitzer

A THESIS

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A METRICAL ANALYSIS AND RE-BARRING OF PAUL CRESTON'S

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Christopher Kyle Sweitzer, M.M.

University of Nebraska, 2010

Advisor: Gretchen Foley

The Sonata For Alto Saxophone and Piano Op. 19 is one of the most popular pieces in the saxophone literature, commonly played by professional saxophonists during their training. It features exciting rhythmic devices like irregular and mixed meter, the notation of which is the main focus of this paper. Although Creston often used irregular and mixed meter in his compositions, he rarely specifically notated them, choosing instead to use accents, beams, slurs, and other phenomenal cues at the musical surface to create the effect of these metric plans. Time signatures often remained constant throughout entire movements. Creston believed this would ease performers reading burden by using the barlines as nothing more than measured markers of the underlying pulse stream, leaving them free to focus on more pertinent aspects of the music. I have termed this idea as meter-as-measure, and is central to Creston's rhythmic theories. Contemporary theories of rhythm and meter based in cognition do not support the meter-as-measure hypothesis, however, and publishers typically show irregular and mixed meters through notation of changing time signatures.

The main purpose of this thesis is to create a new score of the Sonata to reflect the meter inherent in the phenomenal cues of the musical surface, thereby restoring the power of the barline to convey the metrical structure of the work to performers. Lerdahl
and Jackendoff’s theory of metrical structures from *A Generative Theory of Tonal Music* is used as a basis for parsing the rhythms at the musical surface, providing a theoretical framework for the rebarring. Many passages with difficult-to-interpret metrical structure are discussed in detail and reproduced as examples.
# Table of Contents

Introduction .......................................................................................................................... 1

Chapter 1: Theories of Rhythm
  - Paul Creston .................................................................................................................... 4
  - Lerdahl and Jackendoff ................................................................................................. 10
  - Justin London ................................................................................................................ 16

Chapter 2: Tactus ............................................................................................................... 21

Chapter 3: Parallelism ........................................................................................................ 34

Chapter 4: Syncopation, Hypermeter, and Polymeter ....................................................... 55

Conclusion ......................................................................................................................... 77

Appendix A: Metrical Well-Formedness Rules and Metrical Preference Rules ............. 80

Appendix B: Metric Plans .................................................................................................. 82

Bibliography ............................................. 86
<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 2.1</td>
<td>24</td>
</tr>
<tr>
<td>Figure 2.2</td>
<td>29</td>
</tr>
<tr>
<td>Figure 2.3</td>
<td>32</td>
</tr>
<tr>
<td>Figure 3.1</td>
<td>38</td>
</tr>
<tr>
<td>Figure 3.1 continued</td>
<td>39</td>
</tr>
<tr>
<td>Figure 3.2</td>
<td>41</td>
</tr>
<tr>
<td>Figure 3.3</td>
<td>44</td>
</tr>
<tr>
<td>Figure 3.4</td>
<td>46</td>
</tr>
<tr>
<td>Figure 3.5</td>
<td>48</td>
</tr>
<tr>
<td>Figure 3.6</td>
<td>52</td>
</tr>
<tr>
<td>Figure 3.6 continued</td>
<td>53</td>
</tr>
<tr>
<td>Figure 4.1</td>
<td>57</td>
</tr>
<tr>
<td>Figure 4.2</td>
<td>59</td>
</tr>
<tr>
<td>Figure 4.3</td>
<td>61</td>
</tr>
<tr>
<td>Figure 4.4</td>
<td>63</td>
</tr>
<tr>
<td>Figure 4.5</td>
<td>67</td>
</tr>
<tr>
<td>Figure 4.6</td>
<td>70</td>
</tr>
<tr>
<td>Figure 4.7</td>
<td>73</td>
</tr>
<tr>
<td>Figure 4.8</td>
<td>76</td>
</tr>
<tr>
<td>Figure B.1</td>
<td>83</td>
</tr>
<tr>
<td>Figure B.2</td>
<td>84</td>
</tr>
<tr>
<td>Figure B.3</td>
<td>85</td>
</tr>
</tbody>
</table>
Introduction

The terms rhythm and meter are familiar to many people, musicians and non-musicians alike, and are typically used with little confusion when writing and speaking about music. Colloquially, they refer to the time component of music, dance, and poetry. More specific definitions of these terms, however, have been elusive. As humans, we all share to a certain degree an innate ability to perceive and entrain\(^1\) to patterns of periodic stimuli. Most people have no trouble tapping their feet or hands along with a beat. Dance and music are ubiquitous among human cultures. However, writers on music throughout history have tried to elucidate the concepts of rhythm and meter, and despite their shared human experience, their attempts rarely agree with each other and sometimes are even in direct opposition.

Why has this been the case? Historically, definitions of rhythm and meter had been confined to philosophic discussions of proportion and poetic meter, or crude parallels to physiological traits like heartbeat, breathing, or walking pace. Without the rigors of scientific study, these writers could only make claims based on personal observation, anecdote, and opinion. Today, with the help of science, we can scrutinize these claims made by past writers. A growing body of research in music cognition has helped downplay the importance of philosophic discussions of proportion by showing that rhythm and meter have a physiological basis in the brain.

A passage in the Grove Dictionary of Music's section headed “Rhythm”, authored

\(^1\) London, Justin. *Hearing in Time: Psychological Aspects of Musical Meter*, (Oxford: Oxford University Press, 2004), 12. The term entrainment is appropriated by London from research by Glass and Mackey: “in response to a periodic input, a physiological rhythm may become entrained or phase-locked to the periodic stimuli.”
by Justin London, defines both terms and will be used in this discussion:

Rhythm involves the pattern of durations that is phenomenally present in the music, while meter involves our perception and anticipation of such patterns. In psychological terms, rhythm involves the structure of the ‘temporal stimulus’, while meter involves our perception and cognition of such stimuli.²

The reason this definition is chosen over others is twofold. First, it emphasizes a physiological basis of rhythm and meter, relying on the listener’s experience of phenomenal cues as the basis for its rationale. Second, it defines rhythm as the absolute property of phenomenal cues, while meter is the perception of their organization by the listener. This is an important distinction because it implies that meter is a product of the listener or performer perceiving patterns of phenomenal cues in real time, and not an abstract quality of timing or notation provided by the time signature.

Paul Creston also used the listener’s experience of phenomenal cues as the basis of his rhythmic theories, but his conception of rhythm and meter were unique. Creston’s theories led him to adopt a strict metric notational style that used equally spaced barlines, even in mixed, irregular, and multi-metric passages. Composers during the early twentieth century frequently used this style of notation, since performers and conductors favored scores with regularly recurring barlines over irregular and multi-metric notation. This practice has since fallen out of favor as performers have become familiar with these varied metric organizations.

The following thesis, then, is an attempt to reconcile Creston’s original musical intentions with current practices of notation, informed by current conceptions of rhythm and meter. His piece, the Sonata for Alto Saxophone and Piano, Op. 19 is the focus of the

thesis, concentrating on the development of a new edition of the score by re-barring the music to reflect the metric structure of the piece. A full edition of the Sonata including the new barring is not included in the thesis, but many examples of the process are discussed in detail, tracing the methodology used to generate the new barring. Analytical tools from Lerdahl and Jackendoff’s Generative Theory of Tonal Music are used as a basis for the re-barring, along with modifications to well-formedness rules proposed by Justin London in his recent work, Hearing in Time. Appendix A provides a full representation of the Sonata’s metric structure, shown in slash notation. Performers interested in reconstructing their own performance edition are encouraged to do so by transferring the new metric structure shown in the appendix to their own copy of the Sonata.
Chapter 1: Theories of Rhythm

Paul Creston’s Theory of Rhythm

Creston held a great respect for tradition, and spent countless hours studying the music and writings of past composers and theorists. He believed the role of the modern composer was to be a part of and help expand musical tradition rather than to rebel against it, as he felt was the case with many of his contemporaries. The act of writing new music was to be an exercise of balancing intelligibility and innovation; he wanted to compose music that was harmonically and rhythmically interesting without abandoning the musical traditions of previous generations. Creston placed great value in the audience’s ability to access and understand the music they were hearing, and a love for dance combined with his conservative attitude toward composition led Creston to focus on rhythm as an outlet for musical innovation. The result was a consistent focus on rhythm in his compositions, and two monographs espousing his ideas for any who would wish to read them.

Creston felt that composers during the Common Practice Era let the rhythmic interest and complexity of Renaissance music fall by the wayside, and he wanted to restore it as a meaningful compositional tool alongside melody, harmony, and orchestration. Creston believed rhythmic organization was to be the novel frontier to be sought by the new generation of composers. During his study he had lamented what he saw to be music theorists’ lack of attention to rhythm, and decided to write a textbook outlining his ideas for young composers. This led to the publication of Principles of
Rhythm in 1964 where he first presents his theories of rhythm and meter. While intended for composition students, the book was not merely suggestions or compositional exercises. It was a complete theory of a hierarchical framework of rhythmic organization meant to be applicable to all music. Creston was completely self-taught, gradually developing his own ideas of harmony, rhythm, and composition over many years of studying theoretical writings, scores, and recordings. In 1978, He repeated the effort of Principles of Rhythm by publishing Rational Metric Notation, which was intended to focus more on the written notation of meter, rather than its underlying theoretical framework. Creston repeated and expanded on many of the ideas first put forward in Principles, and the two books together constitute a complete theory of rhythm by Creston, devised from the ground up.

He saw his efforts in these two monographs as a formidable theoretical treatment of rhythm, but fellow composers or theorists seemingly did not share such a sentiment, and his works fell in to obscurity. Principles was published just after a much more recognized work in the field, Meyer’s and Cooper’s The Rhythmic Structure of Music, which first appeared in 1960. The popularity of this rival publication may have played a role in the obscurity of Creston’s ideas, and while Creston formulated a novel theory of rhythm in many ways superior to Meyer’s and Cooper’s, his ideas were ignored.

Creston’s theory was based primarily on the notion that meter played a limited role in rhythm, to measure out regular groupings of durations. He assigned little value to meter other than that of a musical yard-stick, marking off groups of pulses in the time-space of the music. As a result, he did not recognize the time signature’s ability to help listeners perceive, entrain, or most importantly, anticipate meter. Some aspects of
Creston’s theory seem to clearly take for granted that listeners can entrain to metric structures, but he views this as a property of the all inclusive category of “rhythm,” of which meter is only a part, along with other aspects like tempo and accent.

This unique treatment of meter can be called _meter-as-measure_, and is a variation of the notion of divisive rhythm. Meter in divisive rhythm is a product of dividing regular marked time intervals into smaller units, based on the proportion rules in effect at that moment in the piece. Creston believed meter was a framework for marking out time, with barlines giving the boundaries in which to make equal or unequal divisions. His theory of rhythmic structures outlined in *Principles* described the different organizations possible of divisions within the barline, and broke them into five categories depending on their specific plan of division. The first two structures looked at divisions within a single measure; the first structure denoted a measure whose duration was divided evenly, while the second structure described an unequal division of a single measure. Structures four and five are identical to structures one and two, except that they describe the division of a group of two or more measures, with the fourth structure describing equal divisions and the fifth structure, unequal divisions. The third structure is different in that it does not use a divisive plan. It is reserved for mixed metric structures, where durations between strong beats do not follow a set plan. Taken together these rhythmic structures and the concept of meter-as-measure constitute the basis of Creston’s rhythmic theory.³

Creston's understanding of meter led him to notate his music in a specific way: he used a single time signature throughout a movement or work, regardless of its metrical

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³ It is not necessary for the reader to be completely familiar with Creston's theory, this outline of the rhythmic structures is included only to better illustrate how Creston aligned his theories with the divisive rhythm used during the Renaissance.
complexity. He then would shower the text with accents, slurs, beams, and dynamic markings, controlling every expressive aspect of the musical surface for the performer. If played precisely, these visual notational guides would create phenomenal cues interpreted by the audience, revealing Creston’s rhythmic structures. This seemed to Creston to be a novel and interesting approach to the organization of rhythm, and provided the balance of innovation and tradition he was looking for.

Meter-as-measure also served another purpose besides providing the framework for Creston’s rhythmic structures. Creston believed that performers would have less trouble interpreting his notational style since meter-as-measure used the familiar metric plan of regularly recurring barlines and few time signature changes, and advocated it as a way to ease the reading burden during performance. During the early twentieth century, composers writing in mixed or irregular meters were met with resistance by performers, who were not accustomed to playing in such metric plans. Aaron Copland, in his tome *On Music*, recalls his early experiences with this resistance from performers and conductors to these metric plans in a section titled “Shop Talk: On The Notation Of Rhythm.” The essay is a concise explanation of the debate between two notational styles, one similar to Creston’s meter-as-measure where barlines were more or less equally spaced, and a newer style where the metric structure is mostly conveyed through changing time-signatures and barlines. Copland suggests that in his experience, the different notations each serve a different purpose depending on the size of the performing group; large ensembles tend to benefit from meter-as-measure notation, while solo or small ensemble pieces might be better served by the newer notational style.⁴

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⁴ Copland, *On Music*, (New York: W.W. Norton & Company, 1963), 273-280. Copland invites the reader to compare the original score of *El Salon Mexico* and its arrangement for piano, which have alternate
however, firmly believed that meter-as-measure should be used regardless of the size of the ensemble, since in his theory the time signature was only a measurement device.

One problem with meter-as-measure concept, however, is that it does not take into account the physiological basis of meter, especially the cognitive limits on its perception. Using regularly occurring barlines to express mixed or irregular meter is fundamentally difficult for performers to read, because it conflicts with their ability to predict or anticipate the future metric structure. The performer is left trying to reconcile two conflicting sources of metric information, that of the written time signature and barlines, and that of the phenomenal cues created by the carefully placed accents, slurs, and beams.

Ironically, Creston recognized this difficulty. During performances his pieces, he noticed that performers would incorrectly interpret the rhythmic structure that had been intended, favoring the written time signature and barlines instead of his carefully placed articulations. Creston termed this phenomenon the “tyranny of the bar-line”,5 blaming its cause on philosophical sentimentality for the four-square rhythms of yore, rather than the performer’s anticipation of metric structure as shown by the time signature. Even though he frequently confronted the problem of the tyranny of the bar-line, Creston still firmly believed performers were better able to read and interpret music notated without constant

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5 Creston, Principles of Rhythm, (New York: F. Columbo, 1964), 9. This term is not Creston’s own, but possibly taken from a passage from Walter Piston, quoted by Aaron Copland in On Music, p. 275:

“The overemphasis on the musical significance of the barline and the attempt to make meter and rhythm synonymous should perhaps be laid to the influence of Stravinsky and Bartók. After the Sacre our young composers fell under a tyranny of the bar measure quite as strict as that which held sway during the nineteenth century, forgetting that the bar-line in music is only a convenience for keeping time and that it indicates rhythmic stress only by accident and coincidence.” The language used by Piston here returns numerous times in Creston’s two monographs, especially the phrases “tyranny of the barline” and “attempt to make rhythm and meter synonymous.”
Interestingly, it is likely that performers of the early twentieth century actually did struggle with the complexity of irregular and mixed meters when compared to performers today. Research by Erin Hannon and Sandra Trehub has shown that test subjects raised in cultures that frequently use irregular and mixed meters are more successful at identifying grammatical errors in musical excerpts using these metric plans than subjects raised in cultures that do not frequently use them.\(^6\) This research also shows that infants from both cultures perform equally well at identifying grammatical anomalies in irregular and mixed meters, suggesting that the ability to entrain to these metric plans is one that is lost rather than gained through enculturation.\(^7\) It is likely that performers in the early twentieth century, having only been exposed to the more simple metrical structures of common practice Western music, had legitimate difficulty perceiving or performing meters judged to be only mildly complex by today’s standards.

A full discussion of Creston’s theories of rhythm and meter is not included in this thesis beyond the basic introduction provided above. An analysis of the Sonata using his theories is not directly important to the task of re-barring the piece, since they are based on arbitrary placement of barlines within the metric structure. However, Creston’s extensive use of accents, slurs, and dynamics provide phenomenal cues that govern the input to the metric analysis techniques developed by Fred Lerdahl and Ray Jackendoff in their influential monograph, *A Generate Theory of Tonal Music*. The analytical tools provided by their theory allow Creston's phenomenal cues to be used to generate a new

\(^6\) “Grammatical” here is used in the way appropriate to the field of music cognition, and shows reference to the influence on music cognition from the field of linguistics.

barring, providing performers with a score that visually reflects the metric structure of the music.

* * *

**Lerdahl and Jackendoff’s A General Theory of Tonal Music**

In *A Generative Theory of Tonal Music (GTTM)*, Fred Lerdahl and Ray Jackendoff seek to present a theory of music from a cognitive approach, describing how our musical intuitions help us to perceive music specifically from the western, common practice style.⁸ Their theories on grouping and metrical structure mirror those of other cognitive disciplines, such as vision and linguistics, and help to describe how the experienced listener in the western idiom parses the musical surface. The grouping and metrical structure aspects of the theory were originally intended as the foundation for GTTM’s arguments about pitch reduction, but here it will be used to provide support for the metrical analysis and re-barring of the *Sonata*.

*GTTM* has been influenced greatly from the field of linguistics; specifically by Noam Chomsky’s theories of “deep structure” (which form the basis of the modern linguistic theory, called the *Generative Theory of Language*, from which *GTTM* takes its name). Lerdahl and Jackendoff’s theory was devised in much the same way, through reverse engineering of our own particular “musical language” – the music of western culture in the common practice era, from 1750 C.E. to the present. The goal of *GTTM* is to find the processes behind the “preferred hearing,” or the experience of the “perfect” listener in the western tonal idiom. Because of this approach the theory excludes much of the world’s past and present music, namely, anything without the particular grammar of

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western tonal music. The aim of the theory is not to describe the universal grammar of music found in all humans, but it does make a few claims about parts of the western music grammar that may be universal.\(^9\)

It is important to make a distinction at this point. Lerdahl and Jackendoff do not claim that Chomsky’s theory of language is applicable to music, or that music has a universal deep structure, only that musical intuition consists of some of the same basic components: recursiveness, universality, and well-formedness.\(^{10}\) Many terms used in \(GTTM\) are borrowed from their close counterparts in Chomsky’s theory, but these similarities between \(GTTM\) and linguistics are mostly superficial, and many new concepts (such as preference rules) were invented and named by Lerdahl and Jackendoff to describe the unique characteristics of music and the intuitions humans use for its parsing.

Well-formedness, preference, and transformational rules form the core of the theory. These rules take the form of statements which describe the possible ways in which grammatical musical structures may be organized. In music cognition, as in linguistics, grammar refers to the rules which control the type and order of events, which when strung together in sequence, produce a recognizable or meaningful mental entity.\(^{11}\) In language, grammar controls the order and structure of words to form meaningful sentences. In music, it controls the sequence and structure of musical events – pitches, rhythms, harmonies, meter – into a perceivable musical surface that is recognizable as a certain musical idiom, in the case of \(GTTM\), the western music idiom known as the

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\(^9\) Lerdahl and Jackendoff 1-4.
\(^{10}\) Lerdahl and Jackendoff, 5-6.
\(^{11}\) Lerdahl and Jackendoff, 4-6.
“common practice era.”

**Well-formedness** rules are the constraints by which strings of musical events may be generated. However, these rules are capable of generating many musical strings which are not recognizable as idiomatic to the western style, or provide for different valid interpretations of the same musical string, necessitating a further set of constraints. These are called **preference rules**, and provide a way to limit the possible generations of the well-formedness rules to only those permissible in the western music idiom. They also serve to choose between different valid interpretations of musical strings.

**Transformational** rules, while a fundamental part of linguistic theory, play only a small role in **GTTM**. They do not generally pertain to grouping or metrical theory, and are beyond the scope of the present discussion.

**GTTM** deals only with the formalization of the hierarchical aspects of music, including pitch, harmony, grouping, and meter. Other aspects such as dynamics, timbre, and motivic-thematic processes are not formalized, although they do play an important role in the perception of the musical surface, in that they help to delineate grouping structure. Discussions of pitch and harmonic reductions form the main part of Lerdahl and Jackendoff’s theory, but they will not be discussed here as they do not pertain to the process of re-barring the *Sonata*. However, to provide a foundation to these reduction theories, Lerdahl and Jackendoff first had to devise new theories of grouping and meter, which they termed **Grouping Structure**, and **Metric Structure**.

**Grouping structure** controls the reduction of the musical surface into its constituent parts through well-formedness, preference, and transformational rules.

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12 Lerdahl and Jackendoff, 9.
Groups commonly described in musical literature include: motives, themes, phrases, periods, theme-groups, sections, and the entire piece. The authors posit that grouping is the most basic form of music understanding in humans. Indeed it is a phenomenon found in many areas of cognition and perception, including vision and linguistics. It is recursive, meaning that it is possible for a piece of music to have any number of groups and that the same rules hold at all hierarchical levels. Groups are limited to include adjacent events only; events that show similarities that are not contiguous at the musical surface are called “associational structure,” and are not a part of group structure. Overlapping of groups is permissible only in specific situations. Slur notation is used to denote groups in analysis, with the hierarchical structure shown with layers of slurs. Grouping structure is seen by the authors to represent a more universal human trait of musical experience than metrical structure.

**Metrical structure** is a theory of reduction of the continuous series of pulses present in most music, through which the listener can relate the individual musical events. It is hierarchical and recursive, as in grouping structure, and is also described through a series of well-formedness, preference, and transformational rules. Metrical Structure seeks to describe the process through which we perceive meter, or how we measure the flow of time in music. Unlike grouping structure, metrical structure may or may not be present in a given piece of music. To have a metrical structure, music must

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13 Compare this with p. 1 of Creston’s *Rational Metric Notation*. “In a single measure, the pulses... are the units of duration; in a phrase, the measures themselves are considered the units; and in an entire composition, the formal sections are the units.”

14 Lerdahl and Jackendoff, 13.

15 This is limited on the small end to a single note, and on the large end to the entire piece.

16 Similarities here refers to such qualities as texture, timbre, motivic, range, or other musical features.

17 Lerdahl and Jackendoff, 18.

18 Lerdahl and Jackendoff, 18.
have pulses, or beats, which are grouped into hierarchical structures according to their pattern of stress and periodicity. Beats do not possess a time value, but are instead considered specific points in time, to be counted and grouped into patterns. In order to produce a perceivable meter, beats must be equally spaced, or periodic, and they must imply at least two hierarchical levels; one level subsuming the other level at a pattern of either two or three beats to a group. Like grouping hierarchy, metrical hierarchy uses the principles of adjacency and recursiveness, and allows overlapping only under special circumstances. Five to six levels of metrical hierarchy can be perceived in a typical meter, with the tactus level\textsuperscript{19} typically represented at a middle level. Listeners lose the ability to perceive the metric structure at levels larger than a few measures.\textsuperscript{20}

At larger levels, metrical structure is taken over by grouping structure, with the boundary between the two structures often interacting to produce interesting rhythmic textures, such as syncopation. Syncopations occur when the grouping structure of the musical surface does not align with the previously established metrical structure. Although both grouping structure and metric structure use the same phenomenal cues for their input, they remain separate perceptual phenomena, with their own separate well-formedness and preference rules. Lerdahl and Jackendoff are careful to point out that groups described by grouping structure do not receive metrical accent, and likewise beats do not possess any inherent grouping.\textsuperscript{21}

Both grouping and metrical structures are hierarchical in nature, meaning that the musical surface can be grouped into different levels organized by the listener, with some

\textsuperscript{19} The tactus is considered by Lerdahl and Jackendoff to be the level at which beats are counted, i.e. the tap of the foot, the conductor’s baton, and so on. Lerdahl and Jackendoff, 21.
\textsuperscript{20} Unless the tactus level represents a single measure, as in a fast 3/8.
\textsuperscript{21} Lerdahl and Jackendoff, 4.
groups being subsumed into other, larger groups. These multiple recursive levels are limited in scope only by the bounds of our perceptual abilities. Hierarchical levels in grouping and metrical structure are perceived mainly through the proximity and similarity in a string of musical events. This string may include the use of articulations, dynamics, timbre, accent, rhythm, or any other event that can exhibit parallelism with the surrounding musical stream. The natural propensity of the listener to perceive parallel events is the basis for grouping and metrical structure.

Accent is of particular importance to the hierarchical parsing of the musical surface. Lerdahl and Jackendoff identify three types, phenomenal, structural, and metric.\textsuperscript{22} A \textit{phenomenal} accent consists of any quality of an event that sets it apart from other events. These qualities include attack-points, local stresses, sudden changes in dynamics of timbre, long notes, leaps to relatively high or low notes, or harmonic changes. \textit{Structural} accents are accents caused by melodic or harmonic points of gravity in a phrase or section, especially at a cadence. \textit{Metrical} accents consist of any beats that are relatively strong in their metric context. Lerdahl and Jackendoff posit that only phenomenal accents work to provide the necessary pattern and periodicity that interact to produce meter, with structural accents relegated to larger scale phenomenon. Metric accents are created by an expectation of stress, set up through the metric framework implied by the surrounding phenomenal accents.

Grouping and metrical structures are powerful tools for parsing the musical surface of tonal music, and provide the foundation for the reduction theory that occupies the core of \textit{GTTM}. However, \textit{GTTM}'s well-formedness and preference rules only describe

\textsuperscript{22} Lerdahl and Jackendoff, 17.
the regular, periodic groupings and meters found in common practice tonal music, and cannot parse the non-periodic groupings of irregular and mixed meter within much of the music of the twentieth century or non-western cultures. Creston's extensive use of mixed and irregular meter necessitates an extension of the analytical tools of GTTM in order to parse the metric structure of the Sonata. This extension is provided by Justin London's Theory of Metrical Cycles.

* * *

Justin London’s Theory of Metrical Cycles

In his book Hearing in Time (2004), Justin London updates the metrical structure theory put forward in GTTM to a universal set of well-formedness constraints that seeks to describe the experience of rhythm in humans of all times and places. In his effort London brings together research in both cognitive science and music theory to support his findings. He introduces the theory of beat-cycles to describe the different types of possible metrical entrainment behaviors, and establishes new terminology and graphic notation to describe his ideas visually.

The main thesis in Hearing in Time is that meter is a type of entrainment behavior inherent in all humans, which can be developed through practice to a high degree. London defines meter as “the anticipatory schema that is the result of our inherent abilities to entrain to periodic stimuli in our environment.”23 He bases his definition on research in music cognition, to provide a firm scientific footing for his claims. London focuses on the listener's ability to impose a sense of organization of the musical events

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23 London, Hearing, 12.
being heard. Meter is not a product of the composer’s choice of time signature or notational style, but of the organization of the actual musical events as perceived by the listener. Also, London recognizes meter as an inherent ability or behavior of all humans; one of the major claims of cognitive based theories such as GTTM and London’s beat-cycles is the universal nature of human cognitive abilities. Evolution is a very slow process in comparison with the time-scale of human history, thereby suggesting that all humans have evolved basically the same potential cognitive abilities, including the abilities of language and music. A definition of meter should then be universal among all cultures past and present, and a true theory of meter should also be able to describe the varying metrical practices encountered throughout the world.

Because meter is made possible through cognitive processes in the brain, it is subject to limits in its organizational plans by the physical limitations on human perception. London describes an upper and lower temporal boundary within which we are able to metrically entrain a string of events. The lower boundary occurs around 100 milliseconds (ms) between inter-onset-intervals (IOI), below which we lose our ability to distinguish separate events or perceive temporal displacements of periodic stimuli. This limit has implications for the subdivisions of the tactus beat level, because the subdivisions cannot be faster that 100 ms. This places the lower limit of tactus tempo at 200 ms for simple meters and 300 ms for compound meters. The upper boundary occurs around 2.0 seconds (sec) IOI, where we lose the ability to hear events as a group or a

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24 Inter-onset interval (IOI) is London’s term for the time interval between successive relevant stimuli. It is measured in milliseconds, from the onset of one event lasting through to the onset of the next event. IOI is typically used only for periodic stimuli.
whole, and begin to perceive them as separate entities in time. This places an upper limit of tactus tempo around 5.0-6.0 sec, given that the subdivisions have a 2.0 sec IOI. Above the 5.0-6.0 sec range we tend to lose our ability to predict when the next tactus event will occur. In between 100 ms and 2.0 sec, around 500-700 ms, is the preferred range for the tactus IOI. Beginning with these cognitive limits, London describes a set of well-formedness constraints to describe the possible metrical entrainment behaviors. The term well-formedness constraints is used not only to differentiate his theory from the well-formedness rules of Lerdahl and Jackendoff, but also to imply that they are a product of the constraints of our perceptual abilities, instead of rules which may be arbitrary. Non-perceivable meters are those that fall outside of the constraints of our brain’s entrainment behavior mechanisms.

The main difference in the theories of metrical well-formedness of London and those of Lerdahl and Jackendoff is that London’s theory allows for aperiodic tactus, creating what London terms non-isochronous meter. Lerdahl and Jackendoff’s well-formedness and preference rules prohibit non-isochronous (irregular) meters by limiting the tactus level of the metrical grid to a periodic string of time-points (though aperiodicity is permitted at hypermetric levels). London’s theory allows for an aperiodic tactus within certain bounds, described by his well-formedness constraints, which in turn allows for irregular meter. The ability to capture and describe the irregular meters found outside of the Western common practice era is what makes London’s theory universal, and also

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25 Isochronous, from Greek, literally means “equal time.” It is used in this context to refer to the equal IOI’s of attentional peaks or time-points. In this thesis, the term “irregular” will be used in place of London’s term, “non-isochronous.”
establishes it as an important extension of Lerdahl and Jackendoff’s original theory.

*   *   *

This thesis is related directly to a concept that Creston deemed important, the performer’s ease in reading their part. Re-barring the piece can give performers access to the preferred metric structure without relying on memory, and still creates the sense of rhythmic interest and metric ambiguity in listeners. Listeners have the ability to find and entrain to the metric structure of the music in real time, but music without any discernible patterns in strong/weak beats prevents this behavior. Performers, however, have full access to the future of the metric structure of the work, both through the notated score and through memory from repeated performances. This provides a marked difference in the experience of meter between listeners and performers. Since performers can interpret the music’s metric structure through its notation, they can anticipate any changes to a regular metric structure and will unconsciously provide subtle expressive timings (grouping and intensity cues) that are intrinsic to those changes. Listeners, however, can only take in what they hear, and must make decisions about the metric framework only after hearing it.

The goal of this thesis is not to lock in the metric entrainment of performers and listeners, but to provide the performer with the metric structure of the music. Listeners, without a score or previous experience listening to the music, will be unlikely to entrain to music that does not contain a simple pattern of repetition, like that with irregular or mixed meter. Likewise, performers with a score that obscures (or, as in Creston's case,
leaves out entirely) the metric structure of the music will also be unlikely to produce the
meter correctly, since they have little evidence with which to produce the its correct
expressive timings except the memory of previous performances. The more encounters
listeners have with the music the more likely it is that they will discover and anticipate
the actual metric structure. Providing performers with a score notated to show the metric
framework as best as possible can help them correctly interpret the expressive timings
crucial for the metric entrainment of listeners.

The following analysis will include ideas introduced by the work of both Lerdahl
and Jackendoff, and Justin London. London’s well-formedness constraints will provide
the basis for possible metric organizations, and Lerdahl and Jackendoff’s metrical
preference rules will provide the basis for segmentation into strong and weak beats.
Musical passages found in the examples are analyzed in the style of Lerdahl and
Jackendoff’s dot analysis, and show the metric hierarchy of the music in the passage,
along with the barring that this analysis suggests. Chapter 2 looks at the different ways in
which Creston introduces the tactus to the listener, and how he manipulates the listener’s
perception of the tactus to help obscure the metric structure. Chapter 3 discusses
instances where parallelism helps to control the metric structure through motivic and
thematic transformations. Chapter 4 looks at other examples where the metric structure is
ambiguous, where the listener has a choice between different metric structures, such as
during areas of hypermeter and polymeter.
Chapter 2: Tactus

One of the many ways that Creston creates rhythmic variety in the Sonata is through his use of the tactus beat level (labeled in the following several analyses as level \(L_0\)). The tactus is the most important beat level in Lerdahl and Jackendoff’s hierarchical model of meter; it is the level that corresponds with what is colloquially called the “beat” in music, where listeners are most likely to tap their feet, or what conductors show with the wave of their batons. This beat level is both subdivided and grouped by listeners into hierarchically adjacent beat levels, called subtactus and supertactus levels, respectively.

The first subtactus level is given the label \(L_{-1}\), and subdivides the tactus (\(L_0\)) into either two (binary) or three (ternary) equal time-spans. The first supertactus level is labeled \(L_1\), and groups tactus beat level events to produce binary, ternary, octal, or higher groupings. These three beat levels together produce the qualities that differentiate the common simple/compound and duple/triple/quadruple distinctions used in current rhythmic terminology. The simple/compound distinction corresponds to the binary or ternary subdivision of the tactus to produce the subtactus, while the duple/triple/quaduple distinction corresponds to the binary, ternary, octal and higher groupings of the tactus to produce the supertactus beat level.

This plan of subdivision and grouping is recursive, extending into beat levels with smaller and smaller subdivisions and beat levels with larger and larger groupings, until they pass out of listeners perceptual abilities (about 100ms between IOI’s at the short end
and 5-6 secs at the long end). Beat levels above the supertactus ($L_i$) receive a label consisting of the character $L$ plus a subscript numbering in ascending order from, $L_1$, $L_2$, $L_3$, $L_4$, and so on until grouping structure begins to take over for metric structure. Levels below the tactus are denoted with negative subscript numbers, $L_{-1}$, $L_{-2}$, and so on until it passes below the 100 ms lower perceptual boundary. The subtle differences between meters are a result of changes in the relationship between the tactus and its surrounding beat levels.

The recursive nature of Lerdahl and Jackendoff’s metric theory allows listeners to perceive five or six discrete beat levels simultaneously, with one level in the middle of these being perceived as the tactus ($L_0$). Depending on musical context and tempo there may be more than one beat level that is a candidate for the tactus. Typically, the IOIs of the tactus beat level will be between 500ms and 1 sec, but can be faster or slower depending on the context of other levels. Lerdahl and Jackendoff do not allow for an aperiodic tactus in GTTM because it is extremely rare in the music of the western common practice era, but they do not claim that irregular meter cannot exist. For their theory to be applied to irregular meter, the fourth Metrical Well-Formedness Rule (MWFR) (tactus and immediately adjacent beat levels music must be periodic) must be changed. London abandons part of this requirement in his theory, and allows for aperiodicity at all levels except for the fastest beat level. This important extension by London allows the Sonata, with its numerous areas of irregular and mixed meter, to be analyzed with a Lerdahl and Jackendoff-style dot analysis.
Creston uses different strategies to toy with the listener’s perception of the tactus in each movement, finding clever ways to obscure the metric framework and provide rhythmic interest. The first movement has the most conservative use of the tactus, with regular beat levels present at the tactus (L₀), and its subdivisions and groupings at the subtactus (L₁) and supertactus (L₁) beat levels. The second movement creates interest by alternating between binary and ternary subdivisions of the tactus, in a rhythmic plan Creston termed “combinative” meter.²⁶ The third movement makes the most use of the tactus as a device for rhythmic interest by using a non-repeating, aperiodic tactus combined with aperiodic higher beat level groupings. Most re-barring decisions in the third movement are based on helping the performer to identify the tactus, since Creston obscures the movement’s irregular and mixed meter framework within a 4/4 time signature.

*   *   *

Creston makes use of a binary, periodic tactus (L₀) and subtactus (L₁) in the first movement. Higher beat levels (L₁, L₂, etc.) are also mostly periodic and binary, making the metric framework of this movement the most accessible of the three movements to parse for the listeners. However, the beginning of the movement provides some metric ambiguity by obscuring both the tactus and the first downbeat of the metric structure. The first few measures of the movement are shown in Figure 2.1 (mm. 1-4).²⁷ The opening

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²⁶ Creston used this term to describe music in which the subdivision of the tactus alternated between a binary and ternary division, or used both divisions simultaneously in two different parts.

²⁷ Measure numbers shown in Figures 2.1 and following are those given in the original score. Barrings and time signatures in Figures 2.1 and following reflect the proposed change in barring. Measure numbers do not appear in the figures because they conflict with those in the original score.
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saxophone figure and piano chords provide a difficult entrainment task for listeners, with many conflicting phenomenal cues for both the tactus beat level and the first metric downbeat. Listeners first encounter the saxophone's opening sixteenth-note figure, consisting of events 1 through 5. The beat level described by these note's attack points is probably too fast to be the tactus, since at $\mathcal{Q} = 126$, the IOI between the notes is very small at roughly 125 ms. A composite rhythm of events 5, 6, and 7, the D♭ in the saxophone melody along with the piano’s first two chords, groups the previously heard beat level decisively into twos, giving the opening saxophone figure some metric context. This new beat level is a better candidate for the tactus since the IOI here is 250 ms (closer to the ideal IOI of 600 ms), but is still quite fast. The events already described also reveal an even larger beat level, a binary grouping consisting of events 5 and 7 alone, the D♭ in the saxophone and the second eighth-note piano chord. This level, with an IOI of 500 ms is listeners most likely candidate for the tactus, despite the fact that it contains only two audible events. Between events 7 and 8, a sixteenth-note figure in the saxophone focuses listeners attention away from this new level, and it is not until the following written measure that the tactus is made apparent and reinforced by the piano chords in events 8 – 12.

Along with a relatively ambiguous tactus at the beginning of the piece, Creston also obscures which event constitutes the first downbeat of the movement. The first note in the saxophone at event 1, the D♭ quarter note in the saxophone at event 5, the second of the piano’s opening two chords at event 7, and the piano’s following chord at the
beginning of the second written measure at event 8 are each candidates for the first metric
downbeat, with each successive event likely a better candidate for the first metric
downbeat than the one before it. First, the sixteenth-note/quarter-note opening figure in
the saxophone (events 1-5) places a conflict between Metrical Preference Rule (MPR) 2
(strong beat early) and MPR 5a (length/note).\textsuperscript{28} The saxophone note at event 1 could
receive metric stress due to MPR 2 (strong beat early) as the first note of the piece, and
the D\textsubscript{4} quarter note at event 5 might receive metric stress for MPR 5a (length/note) since
it is relatively longer than the previous events. Since event 1 and event 5 both receive the
same dynamic marking and accent, event 5 here receives a greater stress due to its greater
length, shifting the listeners perception of the metric structure to begin at this point and
giving the opening sixteenth-note group the feeling of a one-beat anacrusis to event 5.

This interpretation, however, is immediately challenged by the piano’s first two
chords at events 6 and 7. The attack points of events 5, 6, and 7 introduce a new beat
level, $L_{-1}$, one level above the saxophone's opening sixteenths. These weak or strong
status of these events is ambiguous, due to conflicting preference rules between MPR5a
(length/note) on the D\textsubscript{4} quarter note in the saxophone at event 5 and MPR 4 (stress) on
the piano chord at event 7. The stress created by the thick texture and strong $\text{forte}$
dynamic marking of the piano favors event 7 as the first downbeat when compared to the
weaker, single note of the saxophone at event 5, shifting the listener's perception of the
first metric downbeat once again, although not for the final time.

The opening saxophone sixteenth-note figure now returns, developed to last two

\textsuperscript{28} A summary of Lerdahl and Jackendoff's MWFR's and MPR's can be found in Appendix A.
beats, and culminates at the D♯ at the beginning of measure two at event 8, providing yet another choice for listeners as the first metric downbeat. Both events 7 and 8 are similar in dynamic marking and texture, but MPR 5a (length/note) allows listeners to prefer event 8 over event 7 as strong. The quarter-note piano chords on events 9-16 serve to reinforce the tactus level, solidifying for listeners the quarter-note tactus. However, this does not have the effect of listeners perceiving the first metric downbeat at event 8, but at event 1! Each event in question provides enough phenomenal evidence to feel a downbeat, but is thwarted by conflicting phenomenal evidence presented by the next event. When the listener has finally reached event 8, it is evident only in retrospect that the piece does not open with an anacrusis, and that the very first note is also the first metric downbeat.

* * *

Many re-barring decisions in this movement are controlled through its harmonic rhythm. The metric framework is much more irregular, making it harder for listeners to develop an anticipation strategy. The tactus (L₀) is the only periodic beat level in this movement; its subdivisions (L₁), however, alternate between duple and triple, and its groupings (L₁) make up a non-repeating, mixed-meter framework. This focuses listeners attention on the quarter-note pulse, since the immediate adjacent levels change freely and discourage them from developing an anticipation strategy. The slow tempo at $\frac{1}{4}=66$ provides a long interval between downbeats, helping to soothe the mixed metric structure for listeners since many measure-level groupings are at the longer end of the IOI
perceptibility window.

Figure 2.2 (mm. 1-4, beat 4) shows the first several beats of the second movement. The opening piano notes are deceptively complex rhythmically, with the quiet dynamic and simple homophonic texture hiding a mixed metric structure. Two beat levels are established in listeners immediately, that of the chords in the left hand and the melody in the right hand, with the right hand beat level dividing the left hand beat level exactly in half. However, there is scant phenomenal evidence to help listeners group the left hand beat level, and the slow tempo allows for both beat levels to be considered candidates for the tactus. The initial tempo indication for the quarter-note is 66 bpm, which gives a value of 909ms between IOI’s. This is longer than the preferred 600ms tactus IOI, but is still an acceptable tactus IOI for listeners. Creston later encouraged performers to take an even slower tempo closer to 50-54 bpm, however, which places the tactus at an even slower 1100-1200ms. The mixed meter framework discourages the listener from forming predictions about grouping of the tactus at this level, leaving the listener with the curious ability to predict the timing of the next tactus pulse with great accuracy, but not if it will be strong or weak in the metric structure. If the listener were to choose beat level L_{1} as the tactus, the IOI would drop to 550-600ms, corresponding exactly with the median preferred tactus IOI, and would give the entire movement a \( \frac{3}{4} \) metric framework. This provides a regularity for listeners previously struggling with the uncertainty of strong and weak pulses in a mixed-meter framework. One difficulty listeners may have

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29 600ms is the median tactus IOI; 66bpm is equal to 909ms
30 Mauk, Steven. “Master Lesson on Paul Creston’s Sonata.” Ithaca College. faculty.ithaca.edu/mauk/docs/creston (retrieved November 7, 2010).
Figure 2.2

Corresponds to mvt II, mm. 1-3 (beat 4) in orig. score

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with this interpretation, however, comes through Creston's use of combinative meter. Throughout the second movement the piano chords rarely move in subdivisions, with the saxophone constantly shifting between eighth notes and triplets. This makes beat level \( L_0 \) the only regular beat level in the movement and focuses the listener’s attention for the tactus here, although it is reasonable for listeners to interpret the compound subdivisions of certain beats as syncopations using quarter-note triplets.

The opening music also provides listeners with more than one location for the first downbeat in the metric structure. The first phenomenal evidence for grouping of beat levels comes in the first notes in the melody, a rising eighth note figure followed by a descending eighth-two-sixteenth figure at events 2-5. The apex of this figure, the \( C_\sharp \) at event 5, doesn’t immediately stand out as strong, but as the figure descends for three beats towards the first harmonic change at event 8, this \( C_\sharp \) is heard retrospectively as the downbeat. The event’s place as the highest note in the figure approached from below and then descending towards a prominent harmonic change marks the position within the metric structure as a point of attention, through structural accent. The first note of the figure, \( G_\flat \), begins on a subdivision of the tactus and constitutes the leading tone in the key, unlikely to be the downbeat. The second note, \( A \), occurs on a tactus event and is the tonic pitch, which could be argued to be stressed over the \( C_\sharp \) because of its obviously more important harmonic status, but the position of the \( C_\sharp \) as the melodic apex outweighs this aspect. In my interpretation, the beginning is re-barred to include a 2 beat anacrusis at \( L_0 \), though given the highly varying metric framework it could easily be interpreted as
a \( \frac{3}{4} \) measure. This interpretation would place the first downbeat at the beginning of the movement, however, robbing some emphasis from the \( C_4 \) at event 5.

* * *

The third movement differs from the preceding movements mostly by using an aperiodic tactus. This makes for an extremely difficult reading task for performers when written in Creston’s meter-as-measure notation, since the metric structure is hidden from them in lieu of a periodically repeating barline. It is important that performers have access to the metric structure in order to impart its inherent expressive timings. Many re-barring decisions in this movement will be based around identifying the tactus, and others will reflect the irregular mixed-meter framework itself.

Figure 2.3 shows the opening measures of the third movement. Beat level \( L_{-1} \) is the only level in this movement that is consistently periodic, but it is too fast to be the tactus level. The initial tempo marking given by Creston is \( \frac{3}{4} = 160 \), although he later suggested that \( \frac{3}{4} = 144 \) may be a more appropriate tempo.\(^{31}\) This places the IOI between eighth notes at roughly 200ms, well outside the optimal 600ms-1000ms tactus IOI range. The beat level immediately above this, \( L_0 \), is then the next best candidate to be the tactus, but it is grouped aperiodically. Events at this level alternate between 400ms and 600ms IOI, which is much more comfortable as a tactus for listeners, except for the difficulty the aperiodicity poses for listeners in creating an anticipatory schema. Events 1 and 2 are the first notes heard by the listener, but they are followed by the entrance of the piano and the

\(^{31}\) Mauk, Steven. “Master Lesson on Paul Creston’s Sonata.” Ithaca College. faculty.ithaca.edu/mauk/docs/creston (retrieved November 7, 2010).
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Figure 2.3

Corresponds to mvt III, mm. 1-6 in orig. score
longer, accented, and ornamented note in the saxophone at event 3. The accent in the score on event 3 triggers MPR 4 (stress), and the relatively long length of the saxophone quarter-note D, triggers MPR 5a (length) converging to give the note at event 3 preferred status as strong over events 1 and 2, giving them the feel of an anacrusis to event 3.

Creston's notation shows events 1 and 2 as an anacrusis, which is very odd at first look considering Creston’s approach towards meter. His argument against the “tyranny of the barline” was based on the assertion that the barline gave no information to the performer on which notes were to be stressed. Here, Creston's decision to use a barline to provide the feel of an anacrusis to the performer is a contradiction to his claims about the ability of the bar-line to provide stress. Part of Creston’s theory, however, included classifications of strong and weak notes in the beginning passages of a composition. Called the “initial species,” the classifications described rhythmic patterns commonly found in opening passages, and divided them into classes either with or without an anacrusis.32 This part of the theory was likely included to mitigate the contradiction between the existence of anacrusis measures and the supposed lack of metric stress supplied by barlines. A more in depth look at the metric structure of this passage will be discussed in chapter three, since parallelism plays a prominent role in defining the continuing metric structure.

Chapter 3: Parallelism

The Sonata is a good example of the small melodic motives Creston uses as the basis for many of his compositions. He presented the motives at the beginning of each movement, that are then developed and woven throughout the piece much like the Fortspinnung technique of the Baroque. These motives are so prevalent at the musical surface and readily perceivable to the listener that their placement and transformations may be used to easily manipulate the metric structure. Listeners assign a metric structure to these motives and themes the first time they are encountered, and expect to hear the same metric structure during repeat occurrences unless new phenomenal evidence suggests that listeners re-contextualize the theme or motive in a new meter. This effect is the basis of the metrical preference rule for parallelism (MPR1), which prefers parallel metric structures between similar or repeated motives, themes, or sections. Motives and themes can be thought of as single abstract phenomenal chunks which can be identified by listeners, even if they undergo slight manipulation by the composer through ornamentation or simplification. Lerdahl and Jackendoff identify similarities of rhythm, internal grouping, and pitch contour as important to identifying particular motives and themes as parallel. As long as they retain enough characteristics similar to the original phenomenal chunk, listeners will still hear them as the same abstract unit, although the degree to which a motive or theme can be transformed before it loses its identity to the

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33 Lerdahl and Jackendoff, 52-53. The authors also propose here that a separate set of preference rules specifically for parallelism should be devised, and criticize their failure to do so as a “serious-gap” in their efforts.
listener is quite contextually sensitive.

Motivic and thematic parallelisms play a role in defining the metric framework of the *Sonata*, and are used slightly differently in each movement. Motivic and thematic transformations control many of the meter changes in the first movement, shortening or extending passages to effect the placement of downbeats. The second movement is controlled mainly through its harmonic rhythm, grouping adjacent tactus events by their harmonic content. The third movement uses accents, slurs and other articulations to help create an irregular tactus, which is reinforced by melodic parallelisms as the opening motives return throughout the movement.

*   *   *

The first movement’s strong metric framework results from the regular tactus with both binary subdivisions and groupings and provides listeners a resistance to change their metric anticipatory schema. The tactus beat level is mostly regular in the first movement, but some passages have slightly longer or shorter groupings based on parallelisms created by transformations of previously heard motives. When listeners encounter a motive or passage for the first time, they take cues about the metric structure so that if the motive or passage were to return, listeners would expect to hear the same metric structure applied. If the metric structure is different in some way, listeners are presented with a choice to either accept the new structure as false, creating a sense of syncopation, or to adjust their metric anticipatory schema to match the new evidence.

Measures 42-56 of the first movement are shown in Figure 3.1. This passage
Figure 3.1

Corresponds to mvt I, mm. 42-56 in orig. score

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Figure 3.1 Cont.

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incorporates the first occurrence of motivic parallelism, resulting in an ambiguous metric structure. Until this point, the grouping of the tactus beat level has been periodic and binary, easily grouped into measures of $\frac{4}{4}$. The melodic run in the saxophone beginning on event 1 appears to end four beats later at event 2, but its climax is postponed until the accented G quarter note at event 3. Event 2 may be heard as a downbeat by the listener, but the sense of arrival at event 3 – created by the written accent, melodic climax, and relatively long duration – suggests that Creston intended this note for stress, and that $\frac{5}{4}$ might be a better barring. The climax note and its sixteenth-note anacrusis is marked $x$, and is used many times in the remainder of the passage to provide metric downbeats, giving repeat listeners more evidence to hear event 3 as strong compared to event 2. A subtly altered version of motive $x$ is introduced at event 6 by shortening the original long second note to an eighth-note. This motive is called $x'$, and is used with motive $x$ to extend the metric structure of many measures during this passage. Because listeners cannot distinguish between the motives $x$ and $x'$ until the second note is either held as the dotted-quarter note of $x$ or cut short as in $x'$, Creston is able to manipulate the metric structure of the section through motivic parallelism by placing instances of $x'$ before the downbeat of motive $x$ in order to lengthen the metric structure. Specifically, this is observed at events 6, 8, 12, 14, 15, 17, 18 and 19, controlling the downbeats of the measures beginning at events 7, 9, 13, 16, and 20 respectively. Not all instances of motive $x$ infer a metric downbeat, since at events 4-5 and 10-11 two instances of motive $x$ occur adjacent to one another (prohibited in GTTM), but the second instance in each case
delineates the secondary strong beat of the measure.

A similar process is used at events 20-32. Motives $y$ and $z$ are shown at event 20 in the continuation of Figure 3.1. The first motive $y$ has the strong beat on the first note at event 20, marked by a written accent, while $z$ begins at event 21, and leads to a stress on the last note of the group through agogic accent at event 22. The first instance of $z$ does not end with downbeat because Creston immediately repeats the motive, also repeating the expectation of stress at the end of the motive at event 24. Here, listeners are met with another instance of $y$, suggesting through parallelism that event 24 should be the next downbeat, creating a $\frac{4}{4}$ measure. The elision of motives $z$ and $y$ at event 29 also creates a $\frac{4}{4}$ measure, before breaking the motivic pattern and closing the passage with an augmented modification of motive $y$.

* * *

The metric structure in the second movement is informed mainly through its harmonic rhythm. Other forms of rhythmic interest such as syncopation and irregular meter are absent, leaving the listener with little other phenomenal evidence with which to entrain to the meter. The harmonic rhythm becomes the listener’s focus for making tactus-level groupings, even though adjacent harmonies rarely last for the same number of beats. These groupings are reinforced by parallelisms in the saxophone melody, whose recurring motives usually exhibit metric structures that concur with those given by the harmonic changes. The typical plan of the movement is to have one chord per measure, with some measures changing chords more often, usually on each beat. Structurally
important melody notes reinforce the metric structure provided by the harmonic rhythm. As the melody’s themes and motives recur, listeners remember the metric structure present in previous hearings and anticipate that these new instances of the themes and motives will share the same metric structure. These two factors, the harmonic changes in the piano and the motivic parallelisms in the melody, are the main characteristics that guide the metric structure in the second movement. The task of re-barring would be made quite difficult if the melody did not align with the harmonic changes in the piano as frequently as it does; instead these two aspects of the musical surface work together, reinforcing the metric structure for the listener.

Figure 3.2 shows mm. 14, beat 4 – 23 of the second movement. The arch-like contour of the piano figure that begins here helps the harmonic rhythm provide metric stress, reinforced by motivic parallelisms in the saxophone melody. Motive $x$ is the opening fragment of the main melodic theme of the movement, introduced by the piano in the first measure. It consists of a four-note rising eighth note pattern, beginning on an offbeat and ending with a metric stress on the last note. The $y$ motive is also part of the main theme, describing the melodic motion leading to end of the theme, consisting of a melodic encapsulation of a metrically strong note with three shorter anacrusis notes.

Parallelism governs aspects of the metrical structure with a combination of phenomenal evidence from both the piano and saxophone. The piano’s use of parallelism comes with the use of the arch figure in the left hand, shown with a dashed bracket and label $z$. The repetition of this figure, especially with its lowest note at the beginning of the
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group, triggers both MPR 6 (metrically stable bass) and MPR 1 (parallelism), thereby preferring the beginning of this figure as a metric downbeat. These downbeats are also reinforced through the saxophone melody, with each instance of motive $x$ or $y$ (or their modified forms, $x'$ or $y'$) receiving metric structures parallel to their earlier appearances. In each case, the final note of the figure coincides with the downbeat of figure $z$, adding MPR5a (length) and another instance of MPR1 (parallelism) to the list of preference rules governing the metric structure here. Creston also used parallelism to trick the listener into expecting a downbeat where there isn’t one. At event 10, Creston elided motives $x$ and $y$, confusing the stress pattern for the listener, since the elided note is strong with respect to $x$ but weak in respect to $y$. The listener expects a strong beat at event 10 through motivic parallelism with $x$, but this interpretation is weakened because it does not coincide with the arch figure $z$ in the piano. The listener is immediately met with motive $y$, whose metric structure does coincide with figure $z$, moving the listeners sensation of the strong beat to event 11.

The $\frac{1}{4}$ measure beginning at event 13 is similar, only the measure grouping suggested by the piano’s $z$ figure is outweighed by the motivic parallelisms of the saxophone. Motive $y'$ is used along with an instance of figure $z$ to denote event 13 as strong, beginning a new measure. The $z$ figure repeats, creating an expected measure of three beats, but $y$ returns early to produce an expected strong beat in only two beats, at event 14. The arch figure continues to its expected strong beat at event 15 that provides conflicting evidence to the listener of which beat is strong in the structure. Motive $y'$ then
repeats again, placing an expectation of stress at event 16. This has the effect of producing three potential events for the next downbeat, events 14, 15, and 16. The agogic accent of event 16 triggers MPR5a (length/note), preferring it as strong over events 14 and 15, with event 14 receiving stress as the secondary strong beat in the measure. Event 15, though stressed through parallelism, is not considered strong in the structure through the prohibition of consecutive downbeats. Figure z begins anew at event 16, and suggests the next downbeat to be at event 17, where z repeats in full once again. These downbeats are reinforced by instances of motive y in the saxophone, as they had been at the beginning of the passage.

Another instance where parallelism is used to control the metric structure is presented in Figure 3.3, showing mm. 40 (beat 4) – 45 of the second movement. The main theme of this movement reappears here, being transformed through augmentation to help gradually slow the rhythmic structure before the end of the movement. The main theme is constructed of three components, the initial rising figure x, the final ending figure y, and small melodic fragments m in between to serve as a bridge. Through parallelisms with earlier occurrences of these motives, listeners will likely prefer downbeats at events 1 and 4 with two instances of melodic fragment m elided in a chain to connect the outer motives. Event 4 is also preferred as strong through MPR 5a (length/note) and MPR5f, (length/harmony), from the saxophone’s dotted-half note and the change in harmony in the piano. Creston repeated the theme two more times, during events 5-9, and again at events 10-15. He transformed the main theme during each
Figure 3.3

Corresponds to mvt II, mm. 40 (beat 4) - 45 in orig. score

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repetition by omitting the opening $x$ motive, and by adding an instance of melodic fragment $m$ in front of motive $y$. Although the $x$ motive is absent, listeners still recognize these instances as the main theme, and feel a strong beat at the first instance of melodic fragment $m$ as in the original thematic statement. Creston extends the metric structure during each thematic statement through parallelism by adding an instance of melodic fragment $m$ in each theme statement. These parallelisms are reinforced in the piano accompaniment through instances of MPR 5f (length/harmony), providing the listener with ample evidence from which to derive the metric structure.

* * *

The third movement relies on motivic parallelism along with carefully placed articulations to help create a highly irregular metric structure. Consider Figure 3.4, showing mm. 1-15 in the original score. The opening saxophone figure is marked as motive $x$, and is the main motive of the movement, usually occurring along with motive $y$, a five-note arch figure in the left hand of the piano. MPR4 (stress) and MPR5a (length) prefer event 1 as strong in both motives $x$ and $y$, creating an expectation of stress in listeners at this point in both motives. Though slightly out of phase with motive $x$, the metric structures of the piano and saxophone motives align to prefer the same strong beats in each beat level. The two motives immediately repeat, and listeners expect to hear parallel metric structures between the first instance of the motive and its repetitions. Creston placed accents judiciously during this movement to help show performers the correct meter, and the parallelisms created through repetitions of these two motives help
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transfer the \( \frac{5}{8} \) metric structure to listeners. The pattern of repetition of motives \( x \) and \( y \) breaks at event 2, with written accents taking over much of role of defining the metric structure throughout the rest of the main theme, until motives \( x \) and \( y \) return at event 6. Strong beats during this section are informed mainly through MPR4 (stress) and MPR5a (length/note), but grouping the strong beats into measures is a task not suited well to \textit{GTTM}, because of the aperiodicity of both the tactus beat level and its groupings.

Ironically, Creston used the opening of the third movement as an example in his \textit{Principles} of how his notational concept of meter-as-measure could be beneficial to performers for irregular and mixed meters, annotating his published score with barlines and time signatures to reflect his intended rhythmic structure. He includes the excerpt as part of an explanation of his rhythmic structure (third structure), reserved for non-repeating mixed meters that describe a situation where the phenomenal evidence does not suggest any regular pattern of strong/weak groupings at the measure-level. Although this structure does not fit the pattern of the other four rhythmic structures, namely subdivisions of measures or groups of measures, Creston includes it as a legitimate metric plan, and still advocates for meter-as-measure notation as the best representation of the metric structure for performers. His inclusion of this passage gives us a glimpse into Creston’s intentions of what time signatures he might have chosen if he had not dogmatically used his ideas about meter-as-measure notation. Figure 3.5 reproduces the same passage shown in Figure 3.4, but is shown with the barring Creston claims he intends for this passage.\footnote{Creston, \textit{Principles}, 103.} The metric analysis in Figure 3.5 is identical to the one shown
Inconsistencies between this interpretation and the present analysis.

Figure 3.5
Corresponds to mvt III, mm. 1-15 in orig. score

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in Figure 3.4, with added commentary on the differences between Creston’s interpretation and my own, so the reader may compare directly the two proposed metric structures. In the example, Creston shows the anacrusis beat and the first two $\frac{8}{8}$ measures, but his interpretation differs from my re-barring in the third measure, which he interprets as $\frac{7}{8}$ . I do not interpret this measure this way for several reasons. First, listeners have heard motives $x$ and $y$ in immediate repetition, and this measure starts with a third repetition of these motives that are presented in their entirety. Through parallelism listeners expect a downbeat at event 1 unless other preference rules interact here to intervene. The quarter note in the saxophone at event 2 provides an instance of MPR4 (stress) that Creston intends to extend the metric structure of this measure by two eighth notes. However, it would be unlikely for listeners to reject the established metric structure of the motive, and interpret the metric structure in this way. The conflicting structures are shown in the metrical analysis of Figure 3.5 at event 2. Working against Creston’s interpretation is the fragment of motive $y$ that occurs at event 1, providing evidence to the listener that motive $y$ is beginning again, triggering another downbeat. Although event 2 is stressed through MPR5a (length) and MPR4 (accent), the listener has already inferred a downbeat at event 1, giving event 2 the feeling of a syncopation.

This also has an effect on the stress of events 4 and 5. Event 4 is considered weak in Creston’s interpretation because it occurs within the dotted-quarter note downbeat of the $\frac{8}{8}$ measure beginning at event 2. I have interpreted event 4 as strong, although there is very little phenomenal evidence here to guide the listeners to prefer Creston’s structure.
to my own, or vice versa. Evidence for which event should be strong (event 2 or 5) must come from the context of the surrounding metric structure. Creston uses an accent at the saxophone quarter note at event 2, intending it to provide the stress needed to create a downbeat. However, motives \(x\) and \(y\) have broken away at event 1, weakening the \(\frac{5}{8}\) structure set up through melodic parallelism in the opening measures, though event 1 still receives an expectation of stress through the repetition of motive \(y\). Listeners expect event 1 to be strong, but when juxtaposed to the accented quarter note at event 2, a conflict arises between which event should be strong because MWFR 3 prohibits adjacent strong beats within the same beat level. The 3+2 pattern of strong beats presented in the first two measures is broken at event 2, suggesting a \(\frac{3}{4}\) interpretation. Because listeners are expecting a new \(\frac{3}{8}\) measure, they will likely feel event 1 as stronger than event 2 making the accent at event 2 feel like a syncopation. Also, Creston’s \(\frac{7}{8}\) interpretation would suggest a strong beat at event 5, but hearing this would be difficult in context because listeners would have no reason to expect a three-eighth note grouping for this beat, especially with the onset of the saxophone melody notes at event 4 that trigger a weak instance of MPR2 (strong beat early).

The remaining analysis of which events are strong or weak is identical to Creston’s, but I have chosen to bar the music slightly differently, based on the progression of the \(L_1\) beat level of the passage. Throughout the theme, the \(L_1\) grouping is consistently binary, (with one exception at measure encompassing events 6, 7 and 8), producing a duple meter with irregular beat-lengths. This configuration of irregular beat
lengths may be represented by the label SQ, denoting a duple meter with one slow beat and one quick beat.\textsuperscript{35} Creston bars the music based on groupings of written accents, sometimes including measures of $\frac{5}{8}$ next to measures of $\frac{3}{8}$, which would also place consecutive downbeats on the same beat level. Instead, I have barred the music to minimize conflicts with MWFR 4,\textsuperscript{36} distributing the strong beats of L\textsubscript{1} more evenly throughout the passage. The separate $\frac{5}{8} + \frac{3}{8}$ measures grouping events 9 and 10 are subsumed into a single QS measure, corresponding to $\frac{5}{8}$. Events 12 and 13 subsumed into a SS measure through the same process, corresponding to a $\frac{5}{8}$ measure instead of two $\frac{3}{8}$ measures, and minimizes the marked difference in length between strong beats at beat level L\textsubscript{1}. Likewise, the grouping of events 6, 7, and 8, which are grouped into a triple SSQ configuration (corresponding to a $\frac{4}{8}$ measure with a 3+3+2 eighth-note grouping), is also done for this purpose.

Parallelism may also play a role in governing the perception of strong/weak relationships at beat levels higher than the tactus and supertactus. Consider the passage presented in Figure 3.6, showing mm. 138-156. The regularity of the present beat levels in this section of music, combined with a fast IOI, gives rise to the effect of hypermeter (to be discussed in depth in the next chapter). Motive $x$, first shown in the piano right

\textsuperscript{35} Lerdahl and Jackendoff, 98. This labeling system is shown in GTTM as an example of alternatives to MWFR 4. $S$ denotes a slow beat and $Q$ denotes a fast beat, with the proportion of $S$ to $Q$ being 1.5 to 1. The order and number of S’s and Q’s in the label denote the arrangement of the slow and quick beats in the meter it is describing. This terminology may be used to denote irregular beat groupings of eighth notes that occur in irregular meters such as $\frac{5}{8}$, $\frac{3}{8}$, and $\frac{1}{8}$ (grouped 3+3+2), and so on. The terminology is credited by Lerdahl and Jackendoff to the work of Alice Singer.

\textsuperscript{36} “The tactus and immediately larger metrical levels must consist of beats equally spaced throughout the piece. At subtactus metrical levels, weak beats must be equally spaced between the surrounding strong beats.”
Figure 3.6

Corresponds to mvt III, mm. 138-156 in orig. score

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Figure 3.6 Cont.
hand at event 1, consists of a pair of dotted-quarter/eighth-note rhythms, leading to a relatively long note on a downbeat. Through parallelism, listeners expect strong beats at both the initial and final note in motive $x$ that is fulfilled at events 3 and 4. However, the $x$ motive beginning at event 5 has a thwarted conclusion at event 6, where the expected strong note (which is usually relatively long) is replaced with a rising quarter-note triplet figure reminiscent of the three anacrusis quarter notes before the $x$ motive at event 3, and is followed by another instance of motive $x$ at event 7. This parallelism creates a measure of three hyperbeats instead of two, extending the hypermeasure by one hyperbeat. The statement of motive $x$ beginning at event 9 is interrupted by another instance of motive $x$ at event 10, that is in turn interrupted by a two quarter note rising figure, again extending the hypermeasure to three hyperbeats. The two quarter note figure is the beginning of a modified statement of the main theme of the movement, marked here as $y$. The exact motive appears at event 13, and the others are modified through augmentation. Listeners remember the metric structure of this motive through parallelism, with the long middle note receiving stress as a downbeat. Creston transformed the motive here as necessary to match the prevailing hypermeter, further reinforcing the downbeats of each hypermeasure. He also uses motive $y$ to create one more triple hypermeasre, beginning at event 18, and uses a fragment of $y$ to end the melodic line, with the important middle note receiving its expected status as a downbeat.
Chapter 4: Syncopation, Hypermeter, and Polymeter

Change of meter, like change of key, relies heavily on the surrounding musical context to identify. Most listeners can entrain to a given meter fairly quickly, but changing that entrainment to a different meter happens at different rates with different listeners. Some listeners will detect anomalies and readjust with only minimal evidence, maybe as fast as within the immediately following measure. Others will hold on to the entrainment, trying keep the original metric structure aligned with the new, conflicting evidence. If a metric structure changes often, listeners will give up trying to predict the structure at all. These two listening strategies are referred to by Lerdahl and Jackendoff as radical and conservative, respectively.\textsuperscript{37} This effect is largely governed by the scope of the unexpected phenomenal evidence in comparison to the entire piece, and may be seen as analogous to tonal regions versus change of key in harmonic theory. A new metric structure might be perceived in as little as two repetitions by an experienced radical listener, while conservative listeners will hold on to the previous metric structure for many measures, only relenting in the face of extraordinary contrary evidence.

Some sections in Creston’s Sonata are clearly in a specific meter, with long stretches of a stable metric structure easily discernible through periodicity. Others are much less so, with conflicting and surprising phenomenal evidence to provide rhythmic variety. Individual listeners will hear metrically ambiguous sections in the Sonata

\textsuperscript{37} On p. 22 of GTTM, Lerdahl and Jackendoff credit the creation of the terms radical and conservative to Andrew Imbrie.
differently; conservative listeners will usually suffer their way through the conflicting cues, until the original metric structure returns. Radical listeners will be less willing to contradict the new evidence, and will adjust the metric structure to fit the new evidence. The following examples show places in the *Sonata* where decisions between metric structures can be specific to individual listeners, such as during areas of syncopation, hypermeter, and polymeter, and the process listeners and performers use to parse these sections.

* * *

The periodic tactus of the first movement, with both binary subdivisions and groupings, supports the listeners resistance to change the metric structure in the face of conflicting evidence. If the metric structure has been mostly predictable to this point, listeners are likely to conclude that unexpected phenomenal evidence is intended only to provide rhythmic interest, not constitute a change in the metric framework. Unpredictable metric frameworks have less of a contrast between expected and received phenomenal evidence, making syncopations feel more like the rest of the music, softening its striking rhythmic character. The scope of the unexpected phenomenal accents also plays a role, but must be balanced against the predictability of the underlying metric framework.

Figure 4.1 shows a measure 110 from the original score, and is an example of a small scale syncopation that is not large enough to bring about a change of meter in most listeners. The dotted-quarter note rhythm produced by the piano, with chords at events 1 and 3, along with the slurred saxophone sixteenth note groups suggest event 3 as the best
Figure 4.1
Corresponds to mvt I, m. 110 in orig. score

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candidate for strong beat in its level, with MPR’s 4, 3, and 1 applied. If this passage were to appear in the irregular and mixed metric framework of the third movement, it would be more likely for a listener to warrant a change to an irregular tactus. However, the scope of the change is small in comparison to the surrounding context, such as a consistently regular tactus throughout the movement, and listeners will likely hear the measure as a syncopation within the regular $\frac{4}{4}$ metric structure. Also, this particular syncopation is very common in jazz and pop, and may influence the entrainment of listeners familiar with these idioms.

Another effect of the strong metric structure of the first movement is that it can create moments of attention during times when no phenomenal evidence is present. Figure 4.2 shows a passage from mm. 97-101, and contains an example of an “accented rest,” or a strong beat in the metrical structure that occurs during silence. This passage is in $\frac{4}{4}$, with a strong binary grouping of the tactus set up through parallelism by recurring instances of motive $x$. This motive is stressed at its final note, providing emphasis on the half note beat level grouping at events 1, 2, 3, and 4. The pattern is completed at event 5 with a modified version of the opening motive, labeled $y$, receiving metric stress parallel to what it had received previously. With the previous emphasis on the half-note beat level, listeners expect another stress at event 7, but this expectation is not met with any events in either the piano or the saxophone. Even though there is no event to correspond with the moment of attention, the space is heard as accented, or given weight, and perceived by listeners as strong in the metric structure. Event 6 could be considered a
Figure 4.2

Corresponds to mvt I, mm. 97-101 in orig. score

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strong beat through MPR5a (length/note), except for motive z, which is also from the opening theme, emerges after the accented rest on event 7. Consistent with its earlier appearance in the main theme, motive z’s final note is accented as a downbeat, and its position in the measure ending on event 8 assures that the metric structure remains in $4$. Although Creston did not believe that meter could inherently provide stress to beats, he mentioned the accented rest in *Principles* during the discussion of accents. Although he ascribed the “accent” of the rest as having an agogic quality, his inclusion of the accented rest in his list of accents indicates his awareness of the ability for stress to be present in the absence of phenomenal cues.

* * *

The second movement’s periodic tactus, slow tempo, and uniform articulations provide little phenomenal evidence for listeners to use for metric entrainment. The most salient feature of the musical surface to provide grouping decisions for the listener becomes its harmonic rhythm. The slow tempo assures that the harmonic rhythm is in the 3-6 sec range for most of the movement, placing the measure level grouping at the far end of the listeners perception window for metric structure. Although the movement is primarily in mixed meter, the long interval between metric downbeats helps to provide a veneer of regularity.

Placing barlines in some parts of this movement are relatively easy given the harmonic motions and parallelisms present, but some areas remain make specific decisions of barline placement difficult. The passage shown in Figure 4.3 (mm. 1-8) is an

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Corresponds to mvt II, mm. 1-8 (beat 2) in orig. score

Figure 4.3

Corresponds to mvt II, mm. 1-8 (beat 2) in orig. score
area where exact barline placement is ambiguous. The structure here is controlled mainly through instances of MPR5f (length/harmony), since little else is present to provide stress. Melodic motive $m$, previously discussed in chapter one, is also used here to cue listeners to downbeats. A strict $\frac{3}{4}$ interpretation could be made of this section, which is shown by the dotted vertical lines in the metrical analysis. Excluding the anacrusis notes, the piano introduction consists of 36 beats, which divides evenly by three into twelve $\frac{3}{4}$ measures. Phenomenal evidence supports this interpretation at most instances, with the exception of three places: at events 3-4, 7-8, and 9-10. Although event 3 shows where the downbeat should be in the $\frac{3}{4}$ interpretation, event 4 contains a change of harmony and melodic fragment $m$, which serves to strengthen and prefer it over event 3 as strong through parallelism. Event 5 is marked for stress through MPR5a (length/note) and 5f (length/harmony), making this measure only two beats long. This measure combines with the previous one, creating a $\frac{3}{4} + \frac{1}{4}$ metric structure. Since this two-measure group is six beats long, listeners also have the choice of a $\frac{3}{4}$ interpretation of the metric structure. The same preference rules in force at events 3-4 govern the downbeat of events 7-8, producing the same two measure pattern of $\frac{3}{4} + \frac{1}{4}$. The structure around events 9-10 are similar, but this time with a $\frac{1}{4} + \frac{3}{4}$ configuration. MPR’s 5f (length/harmony) and 5a (length/note) suggest a stress at event 9, and is reinforced by the harmonic and melodic resolution of the melody line.

Chapter 2 discussed Creston’s use of a slow tempo during this movement to obscure the tactus level for listeners. Figure 4.4 (mvt. II, mm. 23 beat 4 – 31) shows the
Figure 4.4

Corresponds to mvt II, mm. 25 (beat 4) - 31 in orig. score

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passage with the best opportunity in the movement for listeners to abandon the quarter-note beat level as the tactus, and instead choose the eighth-note beat level (L_{-1}). Here, the texture created by the piano’s septuplet flourishes and rolled chords de-emphasize the quarter-note beat level (L_{0}) as the tactus. Also, just before the arrival at event 1, Creston instructs the performers to “retard” (sic) and play “a little broad.” The slower tempo indication and eighth notes of the saxophone melody focus listener’s attention to L_{-1}, especially when considered along with the rhythmically imprecise piano texture and the thirty-second-note divisions at the end of the saxophone melody. Tension that had existed between these two conflicting tactus levels is released here, as listeners are encouraged to migrate the tactus to the eighth-note level (L_{-1}).

The saxophone melody is constructed from the opening motive, marked here as x, that imparts parallelisms of the quarter-note level (L_{0}) from its previous appearances and helps to control the half-note beat level (L_{1}) grouping. Event 2 is marked as strong with motive x, helping to show the 3 + 2 grouping of this and the following two \( \frac{5}{4} \) bars. the metric structure is highly ambiguous at events 8 and 9, where parallelisms of the x and m motives producing two consecutive downbeats at the half-note level. Motive x, which has appeared in pairs several times up to this point in the previous few bars, has a strong parallelism guiding listeners to hear a downbeat at event 8. However, this motive’s strong ending note is elided with melodic fragment m, which also comes from the main theme. Melodic fragment m appears on the downbeat of the measure and leads to an agogically accented downbeat, very similar to an earlier motive interpreted as y in Figure 3.3,
modified slightly by using thirty-second notes as the descending gesture instead of
sixteenth notes. Because of this parallel to the earlier motive, listeners recognize the long
melody note at event 9 as strong. If listeners chose the faster, eighth note tactus level, the
consecutive downbeats created between events 8 and 9 would exist at a hypermetric
level, for which GTTM makes an exception.

Showing the tactus migration for hypermetric structures with re-barring is not
always necessary, since it is only the listener’s perspective of the tactus that changes
when the tactus migrates between beat levels, not the metric structure itself. Listeners
will have a different metric entrainment depending on which beat level is the tactus, in
this case a shift from \( \frac{5}{4} \) to \( \frac{1}{4} \) with a \( \frac{3}{4} \) hypermeter imposed on top. Because the metric
framework is the same, however, listeners still have a successful anticipation strategy for
the upcoming strong and weak beat relationships. This is not true in instances of irregular
or mixed meter, where listeners do not have access to an anticipation strategy, even when
the tactus level is obvious.

*   *   *

The third movement uses both an aperiodic tactus and a non-repeating, irregular
and mixed meter framework to provide rhythmic variety, but is punctuated occasionally
by stretches of regular \( \frac{5}{4} \) or \( \frac{1}{4} \) meter. These sections of multi-leveled periodicity provide
listeners a much more familiar opportunity for entrainment. Some of these sections also
suggest a hypermetric beat level, though Creston does not indicate in the score that the
music should be played in a half-time feel.
The opening structure of the third movement is discussed in detail in Chapter 3, but one passage from the opening measures provides a good example of preference rules pointing to a syncopation rather than change of meter. For this example, please refer to Figure 3.4, events 3-7. Here, the saxophone’s sixteenth-note figure is grouped by three’s, supported by the chords in the piano right hand. These groups create a polyrhythm against the steady succession of eighth notes in the piano left hand, giving listeners two alternate parsings for which events in the measure should be strong. Radical listeners may have the ability to feel the tactus move to the events described by the right hand piano grouping, but the brisk tempo of the third movement places the IOI’s of the sixteenth-note level at 150ms, near the limit of perceptibility for grouping, making this less likely.

The steady eighth notes in the piano left hand continuing underneath the upper voices also weaken this interpretation, since it reinforces the original tactus.

The irregularity of the opening section soon gives way to a more familiar metric framework. Figure 4.5 shows mm. 106-121 (see also Figure 3.6). Here, the theme in the saxophone changes to a primarily quarter note rhythm, a marked shift from the eighth and sixteenth note rhythms that have dominated the melody to this point. The broadening of note values in the melody is matched in the piano, creating the effect of a slower moving texture, while parallelisms in the sax melody and piano accompaniment suggest another beat level in the metric structure. At event 1, the piano begin a four-beat pattern in the left hand that will continue throughout the section, marked as \( x \), changed slightly with each repetition. The beginning of each four-beat pattern is marked for stress as the lowest note
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in the texture, triggering MPR6 (metrically stable bass) and follows a consistent arch-like contour, triggering MPR1 (parallelism). The right hand is less regular, moving only in quarter and half notes with the occasional quarter/dotted-eighth rhythm. The piano matches the broad feel of the saxophone melody, and occasionally echoes the saxophone’s line in hocket. The instances of MPR6 (metrically stable bass) and MPR1 (parallelism) provided by the bass note in the piano left hand during this pattern, combined with melodic points of arrival, work to introduce a new metric level at the whole note (L_{2}). The half note beat level (L_{1}) is reinforced as well, through the use of dotted-quarter/eighth note and quarter note triplet rhythms in the sax melody. These two-beat melodic figures emphasize the half note beat level, with the quarter note triplet rhythm reminiscent of the “combinative” meter prevalent in the second movement.

These properties provide some cues for listeners to have the option to shift their tactus from the quarter note level (L_{0}) to the half note level (L_{1}), but the best evidence comes from the tempo itself. With Creston’s revised tempo of \( \frac{\text{q}}{\text{= 144}} \), the IOIs of the half note tactus are around 800ms, in the middle of the 600-1000ms optimal tactus range for most listeners.

Three choices of time signature are appropriate to re-barring this section. The first is to notate the section in a true half-time \( \frac{2}{3} \) time signature. This choice would highlight the change in tactus from the quarter note level (L_{0}) to the half note beat level (L_{1}). The second choice would be to leave the section in Creston’s \( \frac{4}{3} \) notation, but this choice fails to capture the subtleties of the phenomenal cues presented, namely, the new beat level
introduced at the whole note. The broadening note values, thinner texture, and melodic parallelisms are markedly different from chaotic nature of the music up to this point. An compromise between these two positions, notating in $\frac{4}{4}$, would allow for listeners and performers to recognize the parallelisms and broadening texture without being forced to feel the section in half time, and give them the choice to feel the tactus at the half note beat level or the quarter note level. Even if Creston explicitly did not intend for the tactus to change here, listeners and performers could still choose to interpret the music in that way, given the evidence provided by phenomenal cues throughout the section.

This is not the case for all of the regular sections of the third movement, however. Figure 4.6 (mm. 202-223) shows a passage with an extended regular metric structure where a hypermetric tactus may not be the best interpretation. As with the previous example, this section’s metric hierarchy is periodic through multiple beat levels, but there is little phenomenal evidence supporting the migration of the tactus to the half-note level. The saxophone melody makes use of a wide range of durational values during this section, from sixteenth-note-triplets to tied half notes. The rhythms here are broader than in the main theme, but less so than in Figure 4.5. Creston varies the subdivisions of the quarter note, including a few quintuplet figures, making it very difficult for performers to feel the section in half-time because they must actively keep the quarter note pulse in order to subdivide it successfully. A triplet figure in the melody, motive $x$, is present throughout the example but recurs too far apart in time to trigger a larger beat level with parallelisms. Also, the piano’s “boom-chick” stride rhythm helps keep the tactus
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decidedly at the quarter note, and does not provide the parallelisms of the arch figure in
the previous example. The $\frac{3}{4}$ time signature here is adequate to represent the metric
structure during this passage.

Creston also employs polymeter in this movement. Rather than creating metric
ambiguity with an irregular tactus or an irregular metric structure, polymeter
superimposes two different metric structures, one atop of the other. This creates metric
ambiguity because human beings only have the ability to entrain to a single metric
structure. Experienced listeners may be able to perceive that two meters are
superimposed atop of one another, but they cannot experience both meters
simultaneously. In instances of polymeter, listeners will feel one meter as the actual
metric structure, with the phenomenal evidence governing the other metric structure
likely heard as syncopations or ignored.$^{39}$

Although human beings may not be able to directly experience polymeter, it is
recognizable by experienced listeners as a distinct phenomenon from syncopation. This is
because syncopation is what occurs anytime when listeners receive phenomenal evidence
about the metric structure that conflicts with their current entrainment. Although
polymeter creates a considerable amount of syncopation in listeners, polymeter in itself is
not a form of syncopation, but an actual organization of metric structures. Sections of
music containing polymeter will likely result in individual performers and listeners

$^{39}$ Compare the inability of human beings to entrain to more than one meter with their inability to perceive
two key centers at once, such as in compositions that exhibit bitonality. Even though human beings
cannot perceive the tonal relationships of two key centers simultaneously, it would be inappropriate to
say that bitonal works do not exist. Bitonality is a consequence of the organization of pitch in a
composition, and is not directly tied to the listener’s ability to perceive it.
entraining to different meters, depending on which structure stands out to them individually. Performers will entrain to the meter used in their individual part, but listeners can choose to entrain to any of the metric structures present.

The passage shown in Figure 4.7 (mvt III, mm. 39-63) contains a good example of polymeter. The eighth note beat level (L₁) at the beginning of the passage is consistently grouped in threes to form measures of $\frac{6}{8}$, giving the listener the first substantial instance of a periodic tactus in this movement. The saxophone melody is also periodic, but when considered separate from the piano's is clearly in a $\frac{3}{4}$ metric structure. Motive $x$, the tied half-note beginning at event 1, is relatively long and metrically ambiguous. The beginning of motive $y$ creates a new stress through MPR3 (event), grouping the first four beats of level L₀ together. Motive $y$, beginning at event 2, is also a four-beat event with its boundary at event 4 delineated by its repetition. MPR5a at events 3 and 5 outline a binary subdivision of the tactus within the motive, and its adjacent placement with its repetition and the other instances of motive $x$ creates a stress pattern that prefers a $\frac{3}{4}$ metric structure. This differs from the stress pattern of the piano, which suggests a different tactus made apparent also through accent and parallelism. The piano follows a three-beat accent pattern, comprising of a group of three eighth notes instead of two, which Creston shows through notation. He gives each grouping a written accent and beams eighth notes in groups of three, even across barlines. MPR4 (stress) and MPR5f (length/harmony) control the eighth-note beat level (L₁) grouping to provide the tactus, while parallelisms provided by motive $z$ in the piano part suggest a binary grouping of the tactus events,
making 8 the likely preferred metric structure of the piano throughout this section.

Layering these two metric structures atop of one another has an interesting effect on listeners. Since human beings cannot entrain to more than one metric structure at a time, the composite of the differing tactus interpretations creates a large-scale two-against-three polyrhythm, combining the stress patterns of each instrument into a single string of strong and weak events. One metric structure will take over in listeners as the most important, with the other interpreted as a syncopation. In this instance, the listener is likely to favor the metric structure of the saxophone part, since it is the melody.

In sections with mixed an irregular meters, the difficulty of choosing a notation scheme comes in striking a balance between conservative and radical listening strategies. In this polymetric section, however, the difficulty lies in deciding which of the two meters should be shown in the notation. One solution is to show both meters, with different meter signatures and barlines for each part. This solution would show each performer the correct meter for each part, and keep in line with the goal of the rest of the re-barring, namely, to give the performer access to the metric structure of the music. This would be cumbersome to read, however, since the barlines in each part would be out-of-phase, ceasing to coincide. Some instances of polymeter can benefit from this style of notation, especially if the polymeter continues for an extended length, is extended over many parts, or if it is a fundamental idea/motive of the work. Polymeter’s that operate over a smaller length may not benefit nearly as much, due to the increased reading burden by the performers. For this instance of polymeter in the Sonata, the saxophone’s 4 meter
is the best choice for notation, given that the length of the polymeter is small in comparison to the rest of the movement.

Figure 4.8 shows a more brief instance of polymeter. Here, the saxophone presents a shortened version of motive $x$, against a repeating eighth-note pattern in the piano. During previous statements of the main theme, the piano bass figure $y$ was comprised of five notes, and aligned with the $\frac{5}{8}$ structure of the saxophone. In this passage it is shortened to four notes, with the low bass note D in the left hand triggering MPR 6 (metrically stable bass) and MPR 1 (parallelism) from the modified repetition of the figure, suggesting a $\frac{1}{4}$ barring. The right hand plays a modified version of the counter-theme of the main motive, shortened to fit the new length of the theme, but its fast speed and aperiodic grouping do not provide much phenomenal evidence for assigning a metric structure. The saxophone melody, however, uses an unmodified version of motive $x$, which suggests the irregular $\frac{5}{8}$ meter of earlier statements of the main motive. The listener is left to choose between two closely preferred structures, the now familiar five-note main motive, or the four-note pattern of the piano. Parallelism provides evidence for the $\frac{1}{4}$ interpretation in the piano, as motive $y$ had helped define the metric structure each of the previous times it had appeared. The right hand piano also plays the expected counter-theme, leaving only the left hand piano to provide conflicting evidence. The parallelism motive $x$, however, is probably enough evidence for listeners to prefer the $\frac{5}{8}$ structure provided by the saxophone.
Figure 4.8
Corresponds to mvt III, mm. 259-269 in orig. score

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Conclusion

Minus a few aspects, Creston’s theories about rhythm looked forward to many of the current conceptions of meter proposed in Lerdahl’s and Jackendoff’s GTTM. He had rejected the notion of a parallel between musical and poetic meter, preferring instead to base his theories on his own experience and the experience of others. This view placed value on the perception of the listener as a guiding factor in developing his theories. The unit/beat/pulse distinction that governs his rhythmic structures resembles the hierarchical model of GTTM, and attempts to formally describe the interaction of the tactus and its surrounding beat levels. Creston’s description of the different kinds of accent is similar to Lerdahl’s and Jackendoff’s discussion in GTTM, describing different ways accent can be achieved through dynamics, articulations, slurs, and other devices, although he did not recognize that accent played a role in defining meter. Creston even foreshadowed the concept of hypermeter, describing “meters of two or more measures” with their own categories, classified by the number of hyperbeats contained in each hypermeasure. Other ideas from his theories have not quite stood the test of time, however. The most important is probably the notational idea of meter-as-measure. Performers today are expected to play in mixed and irregular meters, and typically have no trouble reading from scores notated in the modern style of changing time signatures.

Creston's other popular works could benefit from a metrical analysis and re-barring as well, since his compositional language almost assures areas of discrepancy
between the notated time-signature and the actual metric framework in his music. Creston’s concertos for “neglected instruments,” including the marimba, trombone, saxophone, and accordion, are played frequently by their respective instrumentalists, and would be good candidates for analysis and re-barring since they are some of his most performed compositions.

Works from other composers written during the early twentieth century could be candidates for re-barring as well. Composers had an interest in notating their music in a way that was inciting to performers to play and conductor’s to program and due to the resistance shown to irregular and mixed meter by performers during the time, some may have chosen to more conservative notational styles. This would necessitate a larger musicological survey of the attitudes of composers, performers and conductors attitudes towards notational style at the time, and could inform the performance practices of many pieces written during the era. Future research in music cognition could study the performer’s perception of a musical passage, looking for patterns of variation in expressive timing and accent between different notational styles, or if these differences were perceptible amongst listeners. This experiment could even be used with the Sonata, comparing performances of scores written in each notational style.

The main purpose of this project has been to provide the performer with a modern edition of the Sonata, re-barred with time signatures to better convey the metric structure visually to the performers. Hopefully, this reduces preparation time and anxiety levels for the performers, who now have more tools at their disposal for a rhythmically precise and
confident performance. It is probable that many readers may not agree with such a radical change to the composer’s original conception of the visual style of the score, but through this rigorous method I hope to persuade readers that the re-barred edition of the *Sonata* accurately reflects the composer’s original musical intention.
Appendix A

• Metrical Well-Formedness Rules (MWFR)
  ◦ MWFR 1 – Every attack-point must be associated with a beat at the smallest metrical level present at that point in the piece.
  ◦ MWFR 2 – Every beat at a given level must also be a beat at all smaller levels present at that point in the piece.
  ◦ MWFR 3 – At each metrical level, strong beats are spaced either two or three beats apart.
  ◦ MWFR 4 – The tactus and immediately larger metrical levels must consist of beats equally spaced throughout the piece. At subtactus metrical levels, weak beats must be equally spaced between the surrounding strong beats.

• Metrical Preference Rules (MPR)
  ◦ MPR 1 Parallelism – Where two or more groups or parts of groups can be construed as parallel, they preferably receive parallel metrical structure.
  ◦ MPR 2 Strong Beat Early – Weakly prefer a metrical structure in which the strongest beat in a group appears relatively early in the group.
  ◦ MPR 3 Event – Prefer a metrical structure in which beats of level $L_i$ that coincide with the inception of pitch-events are strong beats of $L_i$.
  ◦ MPR 4 Stress – Prefer a metrical structure in which beats of level $L_i$ that are stressed are strong beats of $L_i$. 
◦ **MPR 5 Length** – Prefer a metrical structure in which a relatively strong beat occurs at the inception of either:
  ▪ (a) – a relatively long pitch-event,
  ▪ (b) – a relatively long duration of a dynamic,
  ▪ (c) – a relatively long slur,
  ▪ (d) – a relatively long pattern of articulation,
  ▪ (e) – a relatively long duration of a pitch in the relevant levels of the time-span reduction, or
  ▪ (f) – a relatively long duration of a harmony in the relevant levels of the time-span reduction (harmonic rhythm).

◦ **MPR 6 Bass** – Prefer a metrically stable bass.

◦ **MPR 7 Cadence** – Strongly prefer a metrical structure in which cadences are metrically stable; that is, strongly avoid violations of local preference rules within cadences.

◦ **MPR 8 Suspension** – Strongly prefer a metrical structure in which a suspension is on a stronger beat than its resolution.

◦ **MPR 9 Time-Span Interaction** – Prefer a metrical analysis that minimizes conflict in the time-span reduction.

◦ **MPR 10 Binary Regularity** – Prefer metrical structures in which at each level every other beat is strong.
Appendix B

The following pages show the metric structure of the Sonata in abstract, without pitches or rhythms. Figures B.1, B.2, and B.3 show the individual metric structures for movement's I, II, and III respectively. The reader interested in performance of the Sonata is encouraged to compare the barrings found here to those in the original score.
Figure 2.1

Figure 3.1 continued

Figure 3.1

Figure 3.1 continued

Figure 4.1

Figure 4.2

Figure B.1

Movement 1
Figure 2.2

Figure 4.3

Figure 3.2

Figure 4.4

Figure B.2

Movement II
Figure 2.3

Figure 3.4, 3.5

Figure 4.7

Figure 4.5

Figure 3.6 continued

Figure B.3

Movement III
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