PULSES, WAVES AND PHASES

An analysis of Steve Reich’s

Music for Eighteen Musicians

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Introduction

It sometimes occurs that opposite sides of a debate through independent study and investigation reach the same conclusion. The debate on how music should be composed in an age of technology is one where Milton Babbitt, as a leading serialist composer in America, could easily represent one side. When he wrote in 1962 about the revolution that had taken place in music composition due to the birth of the electronic medium, Babbitt emphasized that it was no longer necessary for musical composition to be limited by abilities of human performers and sonic range of non-electronic media. These limits could be expanded to the “perceptual and conceptual capacities of the human auditor.”¹

Unfortunately, he noted, our knowledge of the nature of these capacities is limited and so it is still necessary to turn to the past for guidance. Babbitt argued that if each composition is thought of as an experiment and if successful experiments have been undertaken using traditional methods of composition, then future music should use these traditional methods while developing new ones. He went on to suggest that we should explore the nature of our perceptual and conceptual capacities by incorporating traditional methods into electronic compositions and validate instances of nontraditionalism against the older methods. Importantly, Babbitt said that rhythm could be treated in much the same way that pitch had by using integers from 0 to 11 to represent the metric location of an event attack. This geometric approach differed from the Darmstadt method on the other side of the Atlantic, which applied the integers modulo-12 rather to event duration.

In Babbitt’s revolution, the implications for time-related attributes of musical events were among the most noticeable in the new music:

Surely it is in the domain of temporal control that the electronic medium represents the most striking advance over performance instruments, for such control has implications not only for those events which are normally and primarily independent areas: speed and flexibility of frequency succession, time rate of change of intensity, and important components of what is perceived in conjunction as tone-color, such as envelope… and deviations of spectrum, frequency, and intensity during the quasi or genuinely steady-state.²

On the other side of the fence from Babbitt is Steve Reich, whose output up to and including the work *Music for Eighteen Musicians* (1976) has been labeled as “minimalist” by

1 Babbitt, 1962, p. 49.
many. Reich spent the better part of the decade after the publication of Babbitt’s article experimenting with ideas that were “indigenous to machines” and exploring the common ground between his technique of phase-shifting and the more traditional method of canon. Reich was by the end of the 1960’s moving away from the idea that a composer could construct a pattern and set it in motion without any need of further intervention. In contrast to Babbitt however, Reich’s interest lay precisely in the limitations of the human performer and to what degree those performers could “imitate a machine while playing live music.”³

Reich’s treatment of time has confounded attempts to codify his works using traditional techniques of analysis and has caused some critics to label him as outside of the Western musical tradition for which these techniques were developed.⁴ That Reich composed outside of the Western paradigm was a notion that was first suggested by the composer himself, but frequently recanted over the rest of his career.⁵ It is the intention of this study to show how Reich’s work can be analyzed according to traditional methods and how an investigation of his rhythmic technique is central to this analysis. To accomplish this, the example of *Music for Eighteen Musicians* will be used. Note that not all of the sections of the work are examined in detail. The basic rhythmic material for many of the sections is related, and so this study will only mention examples where new and relevant information is introduced.

⁴ Cohn, 1992.
⁵ Reich, 2002.
**Music for Eighteen Musicians**

*Music for Eighteen Musicians* is generally positioned at the acme of Steve Reich’s minimalist period due in part to the use of a wide variety of techniques developed in the composer’s work up to that point and the inclusion of some new innovations. One such innovation is the expanded instrumentation from Reich’s previous pieces: two B-flat clarinets doubling on bass clarinet, a vibraphone, 2 xylophones, 3 marimbas, 4 pianos, 4 female voices, a violin and a violoncello.

A further innovation is clear in the piece’s harmonic development, of which Reich remarks in the program notes for the piece:

> There is more harmonic movement in the first five minutes of *Music for Eighteen Musicians* than in any other complete work of mine to date. Though the movement from chord to chord is often just a re-voicing, inversion, or relative minor or major of a previous chord, usually staying within the key signature of three sharps at all times, nevertheless, within these limits harmonic movement plays a more important role in this piece than in any other I have written.\(^6\)

The example below shows the cycle of chords from *Music for Eighteen Musicians*. The chords are based on a mode of seven pitches and are constructed from overlaying fourths and fifths.

![Example 1. *Music for Eighteen Musicians*, cycle of chords](image)

These chords are played at the beginning of the piece and are held long enough for the wind instruments and voices to inhale and exhale twice. Each chord is then stretched out as a pulse for each of the eleven middle sections in a way that Reich intended as “a cantus firmus, or chant melody of 12\(^{th}\) century organum by Perotin [that] might be stretched out for several minutes as the harmonic center for a section of the organum.”\(^7\)

The overlaying of fourths and fifths in the dyads of the bass register suggests a progression of root and second inversion chords that would yield a progression of iv–iv–i–i in F\# minor followed by a iv–i–vi–vi–i–iv–iv in A major. On the other hand, if the

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\(^6\) Reich, 2002, p. 87.

\(^7\) Reich, 2002, p. 89.
fourths are taken as suspended fourths and not inversions, we could read the progression as i–iv–v–i in F# minor followed by a iv–i–iii–vi–iv–i in A major. This ambiguity with regards to the functionality of the chord progression is used to great effect in the opening and closing sections of the piece.

The following example shows the chords from the work in their most condensed position, which enables us to analyze the pitch-class sets of each of the chords.

Example 2. Pitch-class sets used in the chords of Music for Eighteen Musicians

Some general patterns may be noticed from the chords, such as three movements toward consonance (in chords iii, vii and xi), which have only four pitch-classes each. We can also see two different types of change between chords in the progression, either between inversions of the same chord or between chords of slightly differing content. Most interestingly, the pitch-class set [024579] is quite prominent here, appearing in chords VI and IX, and subsets of this pitch-class set are found in many of the other chords.

As mentioned, Music for Eighteen Musicians has eleven sections other than the introduction and epilogue, each of which is based on one of the chords in the sequence. These sections are based either on an arch form (ABCDCBA) or a gradual process where beats are systematically substituted for rests until the process is completed.

Often, elements of the composition reappear in the work with changed instrumentation or harmony. An example of this changing instrumentation can be seen as the pulsing chords are accomplished first by the pianos and marimbas in sections I and II, later by the marimbas and xylophone in section IIIA, and later still by the xylophones and maracas in sections VI and VII. The process of building up phase-relationships between instruments also changes instrumentation throughout the piece. In his program notes to the work, Reich described these changes as being analogous to the “resemblances between members of a family. Certain characteristics will be shared but other will be unique.”

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9 Reich, 2002, p. 89.
Gradual Processes

In 1968, Reich issued a statement of his core aesthetic ideals with the collection of aphoristic statements, “Music as a Gradual Process”. Elaborating on these ideals in an interview with the composer Michael Nyman two years later, Reich emphasized the role that rhythm played in his musical processes:

My preoccupation with gradual processes – which don’t affect the timbre or dynamic of the sound, but only its rhythmic and durational values – means that you can begin to take an interest in things that in older music were just details. In baroque music, you might hear a few harmonics in a certain passage that stays within one chord, or you might begin to hear all kinds of details, but by the action of a keyboard instrument. These are merely incidental details, but by isolating them you can legitimately use them as your basic musical material.10

Rhythm is a dominant parameter in Reich’s music and we see that Reich is firmly grounded in the Western tradition in his use of augmentation and canon. Some analyses, including those by the composer himself, have gone so far as to classify his early tape works – *It’s Gonna Rain* (1965) and *Come Out* (1966) – as infinite canon with variable imitation. The following quotation from Reich’s own writings brings to mind Babbitt’s earlier comments about the use of traditional composition methods in new music:

I understand the process of gradually shifting phase relationships between two or more identical repeating patterns as an extension of the idea of infinite canon or round. Two or more identical melodies are played with one starting after the other, as in traditional rounds, but in the phase shifting process the melodies are usually much shorter repeating patterns, and the time interval between one melodic pattern and its imitation(s), instead of being fixed, is variable. Nevertheless, that this new process bears a close family resemblance to the thirteenth century musical idea of round seems to give it more depth. Good new ideas generally turn out to be old.11

*Music for Eighteen Musicians* has several different levels of rhythm that occur simultaneously providing a unique perspective of time in the work. First, there is a steady pulse that opens the work in the pianos and marimbas. This pulse continues throughout the composition moving among the instruments. Second and new to Reich’s music is the use of human breath to set the duration of certain instruments. This is most obvious in the opening and closing sections where the performers use their breath to determine how long they hold a note. Reich intended for these pulses to give a rising

10 Reich, 2002, p. 54.
and falling pattern to the music, “gradually washing up like waves against the constant rhythm of the pianos and mallet instruments.”

In order to examine the rhythm technique in more detail, the main structural material for section I of *Music for Eighteen Musicians* must be considered. As with most of the sections of *Music for Eighteen Musicians*, section I uses a rhythmic figure that Reich used previously in *Clapping Music*, the metric flexibilities in its modulo-12 bar being very attractive to the composer. This rhythm is also used in sections II – IV.

Example 3. **Basic rhythm unit from Clapping Music**

This pattern as it appears in *Music for Eighteen Musicians* is shown in the second image below. This basic unit is then expanded to two bars and doubled with parallel fourths in the second clarinet and two of the voices (see Ex. 3c).

Example 4. *Music for Eighteen Musicians*, Section I: a) basic chord; b) versions of the *Clapping Music* pattern played by Marimba 3 and Piano 3, R97; c) melody from *Clapping Music* pattern in Clarinets and Voices 1 & 2, R103-4.

These elements are then combined with another type of duration. As the melody rises in pitch, the basic chord is extended using alternating B minor and F#7 chords that contribute to the ambiguity in the downbeat.

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12 Schwarz, 1982, p. 246.

This is a technique that Reich first developed in *Four Organs* (1970), where tones “begin in unison in a pulsing chord, and then gradually extend out like a sort of horizontal bar graph in time.”¹⁴ The progression in this case has a total of twenty-two beats, which altered from 3+3, 4+2, 3+3, 2+2 (shown above) to 6+6, 3+3, 2+2 in Example 5 below.


Writing about this technique in the program notes to *Four Organs*, Reich draws another connection with early music:

>This process of augmentation was suggested by the enormous elongation of individual tenor notes in *Organum* as composed by Perotin and others in the twelfth and thirteenth centuries in Paris at Notre Dame Cathedral. Tenor notes that in the original chant may have been equivalent to our quarter- or half-notes can take several pages of tied whole-notes when augmented by Perotin or Leonin.¹⁵

When this augmentation technique appears in the melody and accompaniment in the voice parts of section IV, its effect is mesmerizing.

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¹⁴ Reich, 2002, p. 45.
¹⁵ Reich, 2002, p. 50.

The second voice continues to sing a variation on the Clapping Music pattern, while Voices 3 and 4 sing a shifting accompaniment between the dyads of B F# and C# G. While this system is playing, the perceived length of the melody depends greatly on whether the listener takes the first or the second dyad as the downbeat, an ambiguity made possible by the use of repetition in the work. The different lengths of the accompanying dyads have been marked into the image above to indicate some of the ways that this system can be perceived. In other words, we can hear a shifting meter in Voices 3 and 4 between 7/4 and 5/4 against a meter of 12/8 in Voice 2. Overall, this lends a surprising amount of variety to what looks, on the surface, to be very repetitive material.

Further investigation reveals another level to the rhythmic activity of the work. In a study of Reich’s previous works, Phase Patterns and Violin Phase, Richard Cohn shows how the structures of metric cycles could be analyzed using terms developed for pitch-class sets:

A metric cycle consists of \( n \) beat-classes, arranged into a mod-\( n \) system and labeled from 0 to \( n-1 \), with 0 representing the notated downbeat. The rhythmic material consists of one or more beat-class sets… Like pitch-class sets, [beat-class] sets have an interval content, bear properties such as invariance or cycle-generability, and enter into equivalence, similarity, and inclusion relations with each other. Consequently, much of the technology developed for atonal pitch-class analysis is transferable to the rhythmic domain, mutatis mutandis.\(^\text{16}\)

In phase-shifting sections of Music for Eighteen Musicians, the repetition of a beat-class set is complemented with another statement of the set at some temporal interval. This temporal interval of canonic imitation changes additively as the full set is constructed note by note. Reich refers to this process as “building-up”, whereby an entering voice assembles a completely beat-class transposition of the original pattern.

\(^{16}\) Cohn, 1992, p. 149.
When extending and advancing the theories of Cohn to more recent works, Roeder emphasizes the role of accents in these processes arguing that not all attacks in a beat-class set should be treated as equal. Furthermore, he suggests a typology for accents.

It defines accent as a perceived emphasis, at a point in time, that may arise in at least three distinct ways: from perceived changes in pitch, duration, loudness, and in more complex musical processes of harmony, timbre, and texture; from expectations of regularity such as meter; and from the perceived function of the events at that timepoint in the structure of melodic and harmony segments.\(^{17}\)

This typology as it can be found in Reich’s music includes accents of: \textit{climax}, when the pitch of an event is higher than those before and after; \textit{nadir}, when the pitch of an event is lower than those immediately before and after; \textit{duration}, when an event is longer than the event before or there is a relatively long interval until the next event; and \textit{pulse}, when regularly repeating accented events imply further accents at the established temporal interval. As we will see in the following examples taken from section V of the work, these accents are coordinated to create large-scale rhythmic processes.

Section V of \textit{Music for Eighteen Musicians} is marked by a change in the key signature to four sharps, with the new pitch (D\#) fitting into the C\#-minor tonality that the section starts in. The chord for section V is altered to the following:

Example 8. Chord V as it is altered for section V of \textit{Music for Eighteen Musicians}

\[\begin{array}{c}
\text{Example 8. Chord V as it is altered for section V of Music for Eighteen Musicians}\\
\text{[Diagram of chord]}\\
\end{array}\\
\]

The pitch-class set of this chord is [024579] in prime form. The significance of this pitch-class set becomes clear when investigating the beat-class sets in this section. Section V is the first part of the work to use a pattern unrelated to the basic unit of \textit{Clapping Music}. The basic rhythmic material for the pianos in section V is the same as the one used in \textit{Violin Phase}, transposed down a perfect fourth. It is shown in the example below.

\(^{17}\) Roeder, 2003, p. 276.
Example 9. Basic Pattern of *Music for Eighteen Musicians* (V)

![Diagram of a basic pattern for Music for Eighteen Musicians (V)](image)

Ten of the beats are attacked in this modulo-12 system basic pattern. This pattern is actually a nesting of three repeating figures that can be broken down according to three registers (from lowest to highest – G#3, the group of notes from C#4 to and F#4, and B4) to yield the following principal beat-class sets.

Example 10. Principal beat-class sets of *Music for Eighteen Musicians* (V)

![Diagram of principal beat-class sets for Music for Eighteen Musicians (V)](image)

Through analysis of the beat-class sets formed by accented beats and combinations of these sets, some interesting parallels with the pitch-class materials of this section emerge. The beat-class set formed by the low G# notes is \{07\}, which in prime form is [05]. We can refer to this as the \(N\) beat-class set (for nadir). The high B tones form a beat-class set of \{249B\}, or prime form [0257], and can be labeled the \(C\) beat-class set. Note also that this set includes the only accent of duration, which arrives on beat 7 in the prime form of the set. The combination of the \(C\) and \(N\) beat-class sets yields a third beat-class set \{02479B\}, which has the prime form [024579]. As Cohn showed in his study of *Violin Phase*, each of these sets “is cyclically generated by the smallest nonunit prime interval (i.e. the smallest prime interval greater than 1) in its modular system.” In the case of the beat-class set [024579], the smallest prime interval greater than 1 is [05].

This is important for several reasons. First, we can see that the prime form [024579] is also the source of the pitch materials for this section of the piece. We can infer that this is an intentional connection considering that Reich changes the pitch material to include D# at the beginning of the section since the pitch material from the introduction would have generated the prime form [024679]. Also, this cyclic generability has been shown to
be important in much of the West African music to which Reich was exposed on his trip to Ghana in 1970.\(^\text{18}\)

In *Music for Eighteen Musicians* (V) as with other “phase-shifting” pieces of Reich’s, a repeated pattern such as the basic pattern for section V is combined with another statement of the same pattern with some temporal transposition. This second statement in another voice often begins with one attack and adds attacks with each repeated segment until a complete beat-class transposition is assembled in that voice. The beginning of one such process of a “build-up”, as Reich himself calls it, is shown in the example below.

Example 11. Building up a beat-class transposition on beat-class 5, R350-3.

![Example 11](image_url)

Generating the beat-class aggregate, in which every beat of the possible twelve is struck, is analogous to uniting transpositions of a particular pitch-class set to generate the pitch-class aggregate. In the example shown below, the build-up from the previous example has been further augmented by another beat-class transposition in a third voice. At measure 372 in section V, this third stage of canon has completed building up resulting in the first of the two images below.


![Example 12](image_url)

\(^{18}\) Cohn, 1992, p. 151.
As can be seen in example 12-b above, we are able to discern the beat-class set of \([024579]\) from only the nadir accents, revealing the design in the composer's choice of these particular transpositions. As shown in the second of the two images in the example above, the events containing G# occur at beats \(\{03578A\}\), which is a transposition of \([024579]\) shown before as relating directly to the pitch-class set of the section.

Following the completion of the third stage of canon, Reich exploits the ambiguity in the downbeat that results from combining the offset layers of identical voices. The consequent multiple downbeats create a complex mix of what Reich refers to as “resulting patterns”\(^{19}\), which are shown in bars 373-4 and are played first by the fourth piano. Once again, this idea is one that was first developed in *Violin Phase*. These patterns are later doubled by the marimbas and women’s voices.

Note that the resulting pattern from this section is very closely related to the *Clapping Music* that is so prominent in the beginning of the work.

With all of these new departures from the previous material, section V is established as the centre of *Music for Eighteen Musicians*. In the sections that follow, Reich returns to material from earlier in the work, however in section VI the material is revisited with less metric ambiguity than before.

Against a constant chatter of the xylophones and pianos, the cello alternates between dyads of DA and EA cutting the duration of the cycle in half with each pass. The effect of this is to reinforce the 12/8-meter and this is perhaps the most unambiguous statement of the meter in the whole work. At the same time, the pitch material in section VI becomes rather uncertain.

Consider the following chord as it appears in this section of the work:

It would seem that the composer intended for either the rhythm or harmonic content to capture our attention but not both at once. The changes in pitch material in these sections of the work, in particular between chords VI and VII, are between more different content than in earlier sections, which were often between inversions of the same chord.

In section VII, Reich brings back the shifting meter in the accompaniment against the now familiar Clapping Music pattern.
The metric ambiguity is never more startling in the piece as when the vibraphone participates in the syncopation of the accompaniment just before bar 535. Since the role of this instrument in the piece is almost entirely to cue the beginning of new material in each of the sections, this out-of-character action of the vibraphone has an ironic effect, removing the semantic security of the signifier (the cue) and creating a tonal paradox.

Section IX, with its complex rhythms on the four pianos, but performed by six players, is likely intended as the climax of Music for Eighteen Musicians. In this section we see for the first time a build-up that does not involve an exact beat-class transposition of a beat-class set.


The first rhythms to emerge start at the beginning of the section and are shown in the middle two instrument above. This single-bar melodic pattern is more noticeable than usual as the piano takes centre stage for this section. While a temporal transposition of the *Clapping Music* pattern is played on the clarinets, voices and strings, player 1 on piano 3 comes in with a matching construction using the building-up method investigated earlier. A third rhythm is then built-up by player 2 on piano 4 and the resulting aggregate of tones is unusually rich in pitch material.

The further sections of the piece serve to complete the harmonic cycle of the work as a whole and do not offer new material in terms of rhythmic technique. The work ends with a statement of the cycle of chords in the epilogue.

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Conclusion

In *Music for Eighteen Musicians*, as with many of Steve Reich’s other works, the “large-scale design expresses intrinsic properties of the small-scale patterns.” A consideration of rhythmic techniques is central to an understanding of Reich’s design in terms of this work. His use of coordinated accents and canon in the phase-shifting sections of the piece and shifting meter in the accompaniment throughout contribute to a high level of variety from remarkably little material. As has been shown, this rhythmic material can be analyzed using technology previously developed for pitches and this analysis, in turn, reveals definite connections with the pitch material of the work.

*Music for Eighteen Musicians* is a statement that, in many ways, sums up the work that Steve Reich had accomplished up to that time, both in its quotation of themes from other pieces by the composer and in its incorporation of techniques developed during his minimalist period. Furthermore, whereas the composer has been thought in the past to be external to Western traditions, it is possible to show that his work has important, demonstrable connections not only to early music, but also to more recent theory of contemporary composition. As a result of this inclusiveness, the work maintains a momentum that has led many to consider it a masterpiece of the twentieth century.

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Bibliography


