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Beat-Class Tonic Modulation as a Formal Device in Steve Reich's "The Desert Music"

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I am submitting herewith a thesis written by Liahna Rochelle Guy entitled "Beat-Class Tonic Modulation as a Formal Device in Steve Reich's "The Desert Music"." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Music, with a major in Music.

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Abstract

Beat-class analysis is a model of rhythm employed by Richard Cohn and John Roeder to analyze textural form in the compositions of Steve Reich (Roeder 2003, 275). Rhythmic attacks are regarded based on the modulus analytically assigned to a particular section (eighth note, sixteenth note, etc.). This paper will offer an in-depth analysis of beat-class modulation and transposition in Steve Reich's *The Desert Music*, with a focus on the third movement. Applying this analytical technique to *The Desert Music* (a piece never before analyzed using beat-class analysis) proposes a fresh analytical approach to Reich's 1984 piece. This perspective will show that the transpositional relationships found among beat-class tonics serve to generate a sense of form within *The Desert Music*. It will be shown through the use of beat-class analysis, that small and large formal implications within the movement are present. As a result of research and analysis, multiple transpositional relationships (t_n relationships) and instances of beat-class tonics can be seen. Reich establishes multiple t_n relationships between beat-class tonics and individual strands of phrasing. Each t_n relationship and beat-class tonic modulation revolves around the numbers two and four, which will be shown to have significance in *The Desert Music.* Terminology from the research of Cohn and Roeder will be adopted and modified as necessitated by the music.

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Chapter 1: Introduction

Beat-class analysis a system of analysis used to study the effect of rhythmic attacks on the formal composition of a piece of music. This paper will make use of this analytical technique and propose a series of beat-class modulations and transpositions in Steve Reich's *The Desert Music,* with a focus on the third movement and the transpositional relationships found between beat-class tonics. By applying this analytical technique to *The Desert Music,* I will demonstrate how beat-class tonic modulations serve as a formal device in Reich's 1984 piece.

History of Beat-Class Analysis

It was in the context of twelve-tone composition (1962) that Milton Babbitt first proposed conceiving rhythm analogously to pitch by using the "integer residues" modulo 12 (mod 12) to represent the metric location of event attacks (Roeder 2003, 275). In 1992, Richard Cohn advanced Babbitt's method of perceiving mod 12 organized rhythm by describing in detail the technique of bc (beat-class) analysis. Similar to pitch-class analysis in that the technique relies heavily on a modular system of some kind (like mod 12 in pitch-class analysis), bc analysis consists of a "metric cycle consisting of *n* bcs, arranged into a mod *n* system and labeled from 0 to *n*-1, with 0 representing the notated downbeat," (Cohn 1992, 149).

Cohn and John Roeder's pursuits have helped elucidate Reich's unique rhythmic voice. According to Cohn,

> "Given the relative poverty of our rhythmic terminology, the challenge for the theorist is to discover a means to characterize this material that is not only descriptively adequate, but also allows for exploration of its properties, its behavior under transformation, and its relations to other potential material," (Cohn 1992, 149).

Cohn and Roeder's analyses have helped us better conceptualize Reich's rhythmic processes by modifying Babbitt's notion of mod 12 integer residues in bc analysis. After all, Babbitt's conception of the time-point system – or the construction of rhythms through these integer residues' metric locations – was spurred by his desire to consider it independent but analogous to pitch relations. Perhaps fellow serial composer Charles Wuorinen's explanation of the time-point system can provide further clarification. In his 1979 text, *Simple Composition*, Charles Wuorinen states, "time and pitch have one critical element in common: they are both continuums which are divided up for musical purposes by *intervals,*" (Wuorinen 1979, 131). According to theorist Brendan McConville, "Although the two domains are not inherently isomorphic, a composer may posit an isomorphism by dividing the time continuum in a manner analogous to pitch, with twelve equal divisions correlating one-to-one with the twelve pcs of the equal-tempered octave," (McConville 2011, 159). Wuorinen explains the connection between pitch interval and time interval: as a "pitch interval is the distance between two pitch classes," a "time interval is the distance between two *time points*," (Wuorinen 1979, 131). Wuorinen defines a time point as "simply a *location* in the flow of time," (Wuorinen 1979, 131). Figure 1 provides an illustration of an isomorphism created between the pitch and time domains. In this figure, Charles Wuorinen's pitch series is [A, C, B, C#, D, Bb, Ab, F, F#, E, Eb, G] whose integer residues are then transferred 1:1 into time-points in the temporal dimension. The integers above the example indicate the amount of time between rhythmic attacks. This pitch series yields the ordered pc-interval sequence "i <9, 0, E, 1, 2, T, 8, 5, 6, 4, 3, 7> = [3, 11, 2, 1, 8, 10, 9, 1, 10, 11, 4, 2]" (McConville 2011, 159). In this way, "durations between time-points correspond one-to-one with the series' ordered pc-interval sequence," (McConville 2011, 159-160).

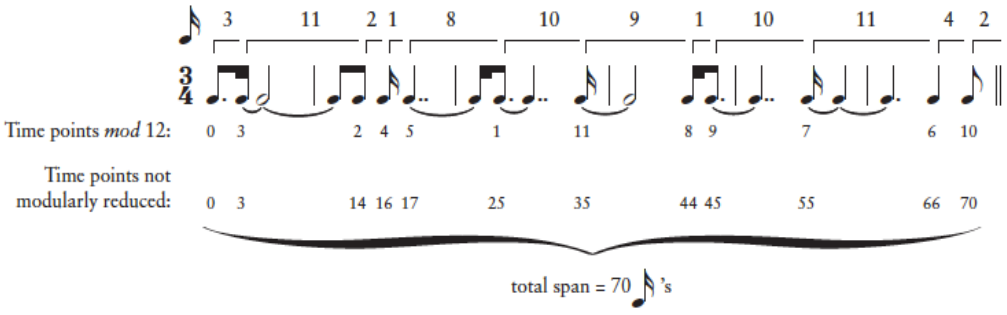


Figure 1: Annotated example from Wuorinen's *Simple Composition:* Isomorphism created between the pitch and time domains

Source: McConville 2011, 159.

Thus, bc analysis is not necessarily concerned with twelve-tone music, but it does draw from analytical nomenclature of twelve-tone theorists. Illustrations such as Figure 1 help theorists perceive the location of event attacks in a mod 12-controlled canvas.

Twelve-tone theorist Andrew Mead has also been helpful in illustrating integer residue mapping. Mead says, "The octave is translated into a fixed time-span called the *modulus*. This in turn is subdivided into twelve units of equal length," (Mead 1987, 183). This subdivision of a modulus can be seen in Figure 2. Mead explains that a time-point row consists of a specific ordering of the twelve elements, and is projected across as many connected moduli as necessary (Mead 1987, 183).

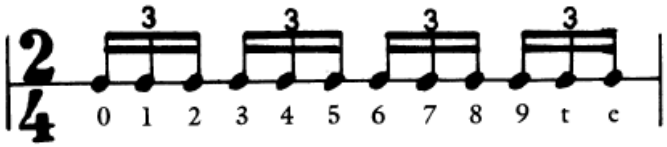


Figure 2: The octave translated into a fixed time-span, then subdivided into twelve units of equal length

Source: Mead 1987, 183.

Bc analysis evolved from both pitch class analysis and the study of time-point compositions. First, in bc analysis, duration is the measure of *temporal* distance between time points, just as interval is a measure of *pitch* distance between points in pc analysis. The pitched interval distance is interpretable as "the point of initiation of a temporal event, that is, as a time-point number," (Babbitt 1962, 63). Second, according to Babbitt, "The rhythmic system, as opposed to the pitch-class system, is closed, and as its structure is independent of pitch clarification, it can be applied as independently as the pitch system," (Babbitt 1962, 72). Therefore, "a time-point of a set can represent various things, be it the point of initiation of a single pitch, the repetition of a pitch, or a pitch simultaneity," (Babbitt 1962, 72). Third, "though the pitch system suggests the number twelve (numbers 0-11) through its use of mod 12 (because there are 12 equal tempered pitches in an octave), the time-point system is applicable to any number of set elements, and has been applied compositionally to a smaller number," (Babbitt 1962, 72). Next, as the progenitor of bc analysis, Babbitt created terminology that theorists Richard Cohn and John Roeder later adopted and developed. This terminology for bc analysis and the terminology for time-point analysis share certain characteristics. Babbitt's *time-point set*, "a serial ordering of time-points with regard to "<", where "<" refers to temporal precedence, and ">" refers to temporal antecedence," (Babbitt 1962, 63) is similar to Cohn's *bc set*, "a set of integers representing rhythmic attacks instead of pitch-classes," (Roeder 2003, 288). Furthermore, Babbitt defined transposition as "preserving the duration class succession, while effecting a particular permutation of the twelve time-point classes. It may also be thought of as a translation of each time-point. The result is a metric reorientation of the set," (Babbitt 1962, 65). This idea of transposition is similar to Cohn's *bc modulation*. A note to the reader: though

complete definitions of bc terminology will be used and explained in Chapter 3, I have included several here, where necessary, to provide a historical context for the analytical technique.

Chapter two addresses previous scholarship on and relevant terminology for bc analysis, as set forth by Richard Cohn and John Roeder. In order to understand the terminology, each must be presented in the context of a musical example. The appendix contains a list of complete bc terminology. Examples from Reich's music (other than *The Desert Music*) will be examined for points of departure between Reich's early phase pieces, *The Desert Music*, and his later phase pieces. Chapter three contains a discussion of the evolution of Reich's music from a bc perspective. The comparison will span from the late 1960s (*Piano Phase*), to the early 1970s (*Clapping Music*), 1980s (*Vermont Counterpoint*), 1990s (*City Life*), and to the 2000s (*Three Tales* and *2x5*). Bc analysis, as well as an analysis of phasing patterns will accompany the discussion where appropriate. Chapter four will focus on the application of bc analysis to the third movement of Reich's *The Desert Music*. This chapter will include a discussion of the transpositional relationships found between bc tonics and the role they play in bc tonic modulations.

Chapter 2: Beat-Class Analysis Scholarship

By exploring existing scholarship, I will provide examples of bc analysis in Reich's earlier works. These examples will concurrently offer definitions for relevant bc analysis terminology. Cohn and Roeder have laid a clear analytical foundation for bc analysis; I will later draw on their research for my analysis of *The Desert Music*.

Richard Cohn

In his 1992 article "Transpositional Combination of Beat-Class Sets in Steve Reich's Phase-Shifting Music," Cohn analyzes two of Reich's phasing pieces using bc analysis. A quote from Reich's 1968 essay "Music as a Gradual Process" serves as the starting point for Cohn's analytical approach: "Material may suggest what process it should be run through (content suggests form) and processes may suggest what sort of material should be run through them (form suggests content)," (Cohn 1992, 148). Cohn adopts a formal language in order to explore the interaction of form and process, content, and materials in *Phase Patterns* (1970) and *Violin Phase* (1967) (Cohn 1992, 148). According to Cohn, "This exploration will lead to insights about the composer's internalized, "out of time" knowledge of his craft, and about the "in time" experience of the listener in the presence of this music. In short, this exploration will lead to *analysis* of the music at hand" (Cohn 1992, 149). A stylistic and aesthetic reevaluation of Reich's phase-shifting music is undertaken in the final part of Cohn's essay (Cohn 1992, 149).

The first piece analyzed in Cohn's article, *Phase Patterns* (1970), was written for four electric organs (Cohn 1992, 148). Unlike many of his pieces, which Reich says he composes

with metric cycles of twelve beats[1] (Reich 2002, 130), *Phase Patterns* is written with a metric cycle of eight beats (mod 8) partitioned into two sets of four (Cohn 1992, 149). Cohn shows that *Phase Patterns* contains "only one principle bc set and only five prolongational regions," (Cohn 1992, 165). His term *bc set* was probably best defined by Roeder. Roeder defined a bc set as "a set of integers representing rhythmic attacks instead of pitch-classes," (Roeder 2003, 288). Cohn defines a *prolongational region* of a composition as "lockings in," which "form canons at various transpositions in beat space," (Cohn 1992, 152). In simpler terms, a prolongational region is a gradual manifestation of a completed musical idea. "Each 'prolongational region' features a new bc set that results from a combination of transpositions of the original set," (Cohn 1992, 153). Cohn's bc divisions of *Phase Patterns* are shown in Figure 3.

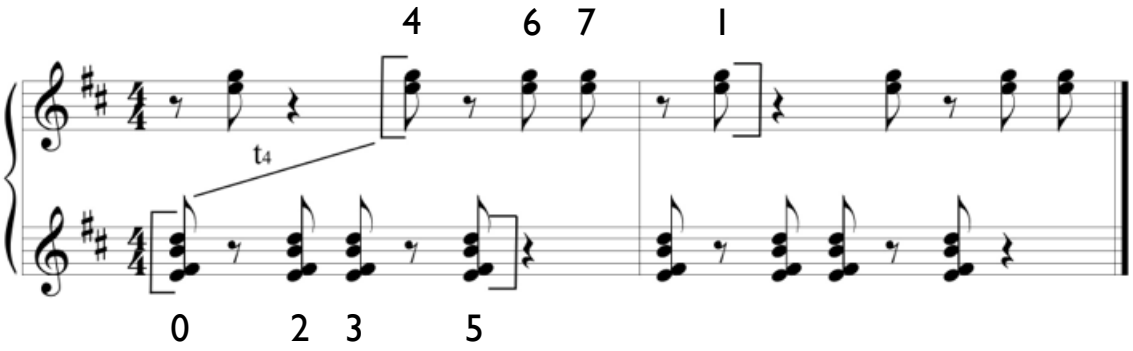


Figure 3: Basic Pattern of *Phase Patterns*, annotated

Source: Cohn, "Transpositional Combination of Beat-Class Sets," 150.

[1] "Very often, I'll find myself working in 12-beat phrases, which can divide up in very different ways; and that ambiguity as to whether you're in duple or triple time is, in fact, the rhythmic life-blood of much of my music. In this way, one's listening mind can shift back and forth within the musical fabric, because the fabric *encourages* that," (Reich 2002, 130).

In Figure 3, the partitioning of the notes in the right hand occurs at attack points 1, 4, 6 and 7 in a 0 – 7 (eighth note) modulus. Cohn's bc set representation of this rhythm is thus {1467}[2]. The left hand creates set {0235}. The two bc sets are equivalent under transposition (t), mapping into each other at t_4, mod 8 (Cohn 1992, 150). The transformation t_n signifies "time transposition" (or delay) by *n* beats (Roeder 2003, 278). Cohn used this example to show the transposition of certain bc sets across the multiple lines of the music. In fact, this excerpt is emblematic of Reich's larger fascination with transporting multiple short rhythmic attack groupings across several lines of music.

Cohn also analyzes Reich's *Violin Phase*, which uses a twelve-beat cycle. His analysis showed that, "As in *Phase Patterns*, it is the registral groupings of the constituents that produces the most significant bc sets," (Cohn 1992, 150). Three important bc sets emerge through the registral segmentation (Cohn 1992, 150). These groupings are found in Figure 5 in three active registers: the low $C\#_4$, the high E_5, and the four pitches between $F\#_4$ and B_4. Reich considers the highest and lowest registers to possess strong individual identities (Cohn 1992, 150). The basic pattern of *Violin Phase* is seen in Figure 4.

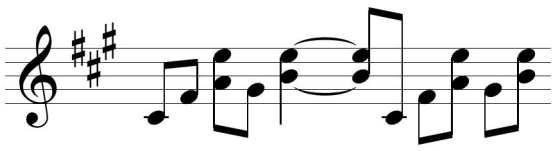


Figure 4: Basic Pattern of *Violin Phase*

Source: Cohn, "Transpositional Combination of Beat-Class Sets," 150.

[2] Cohn used braces { } in the identification of bc sets. This paper also uses these braces.

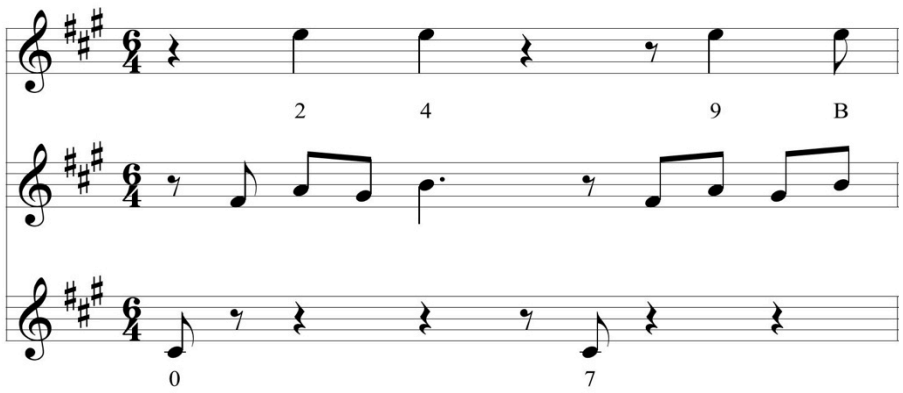


Figure 5: Principal Bc Sets of *Violin Phase*

Source: Cohn, "Transpositional Combination of Beat-Class Sets,"151.

Cohn identifies one bc set {07} as formed by the low C# attacks. Likewise, the high E attacks generate a second bc set {249B}. He also shows a third bc set that considers the union of the two registers, or {02479B} (Cohn 1992, 150). The letter A represents the integer 10, and the letter B represents the integer 11. According to Cohn, "Reich considers the highest and lowest registers to possess strong individual identities as 'psycho-acoustic byproducts,' a view which has been strongly corroborated by recent experimental work in perception and cognition," (Cohn 1992, 150). Cohn's analysis of rhythmic attacks provided insight into the construction of *Violin Phase*, as his analysis of transposition levels (t levels) shed light on the various structural levels.

Through Cohn's bc analyses of these two works, we can identify consistencies in Reich's compositional phasing design. *Phase Patterns* begins in rhythmic unison, and alternates progressions (phase shiftings), and prolongations (marked by the introduction of resultant patterns) until the second voice has moved – or phased – four beats ahead of the first (Cohn 1992, 153). The first half of *Violin Phase* consists of the same series of prolongational regions. However, in the second half of *Violin Phase*, the initial two voices remain fixed at t_0 and t_8, while a third voice is cloned from the second and eventually reaches t_4 after progressing through

a series of prolongational regions (Cohn 1992, 153). The plans for the two pieces (*Violin Phase* and *Phase Patterns*) are similar in that the t_4 progression occurs at the highest levels (Cohn 1992, 153). They are also similar to *The Desert Music* in that the levels of transposition are *often* t_4, though sometimes t_2, t_6, t_8, and t_{10}. As we will see in chapter 3, *The Desert Music* likewise makes use of even-numbered t levels. In fact, it will be shown that t_2 and t_4 serve as progenitors of the various transposition levels, and both play a part in constructing small and large-scale formal designs.

John Roeder

In his 2003 article, Roeder develops terminology and concepts created by Cohn, and applies them to two of Steve Reich's phasing pieces, *Six Pianos* (1973) and *New York Counterpoint* (1985).

Six Pianos was written in the middle of Reich's compositional career, as Reich was transitioning out of his phasing period (Roeder 2003, 275-278). According to Roeder, "the role of accent in large-scale process is evident from even a cursory listening to Reich's transitional pieces" (Roeder 2003, 278). Roeder labels his bc sets as Q1, Q2, Q3, etc.[3] Figure 6 shows a representative excerpt of bc modulation from *Six Pianos* and illustrates a moment in the music where all of the pianos are sounding and the pitch and rhythmic relationships among them become evident (R55). As shown in Figure 6, Pianos 1, 2, and 3 repeat eight-beat patterns, labeled Q1, Q2, and Q3 respectively. Piano 4 plays the same pattern as Piano 3 (Q3) but is shifted one eighth-note beat later (also referred to as a t_1 transposition. Piano 5 can also be perceived as a t_6 transposition of Piano 1 (Roeder 2003, 278). Roeder's bc analysis of *Six Pianos* reveals the manifestation of Reich's original pattern at coordinated, stratified time points within

[3] Through correspondence with Roeder, it was determined that Q is an arbitrary label.

the modulus. The staggered pattern-entrances create a pulsing effect, where the listener perceives an echo.

Bc modulation "arises from changes in the membership of the bc collection itself, or from changes in the types, strength, and placement of accent within a continuing collection," (Roeder 2003, 289). "Changes in tonic or mode," which Roeder calls, "bc 'modulation,'" generates "large-scale contrast, progression, and return, analogous to processes of pitch-class tonality," (Roeder 2003, 289).

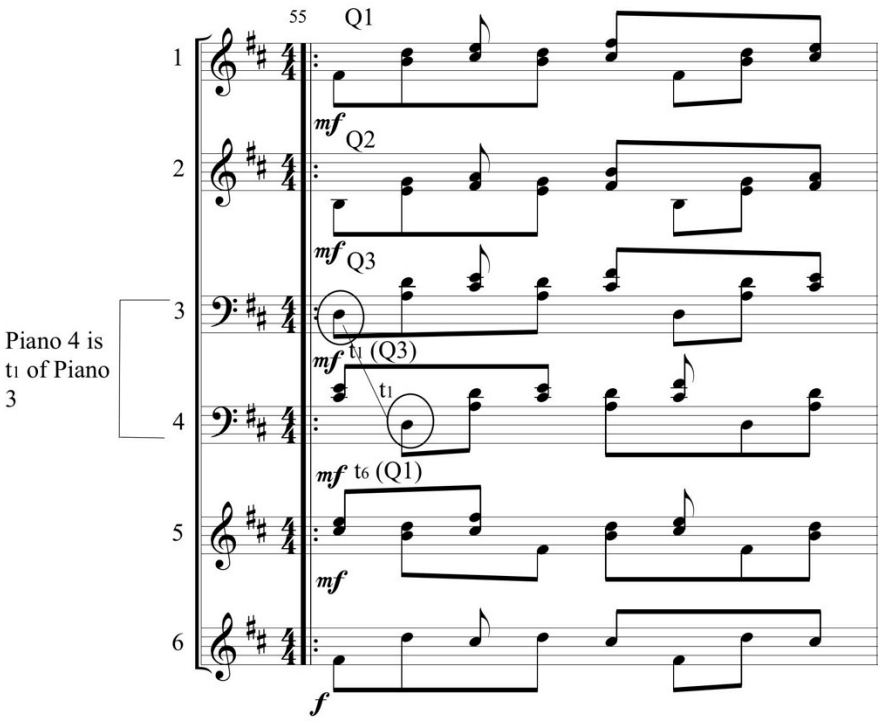


Figure 6: Bc sets in *Six Pianos*, R55

Source: Roeder, "Beat-Class Modulation in Steve Reich's Music," 276.

Roeder's analysis of *New York Counterpoint* (R3-R22) shown in Figures 7a and 7b contains a passage that occurs during the first movement of *New York Counterpoint*.

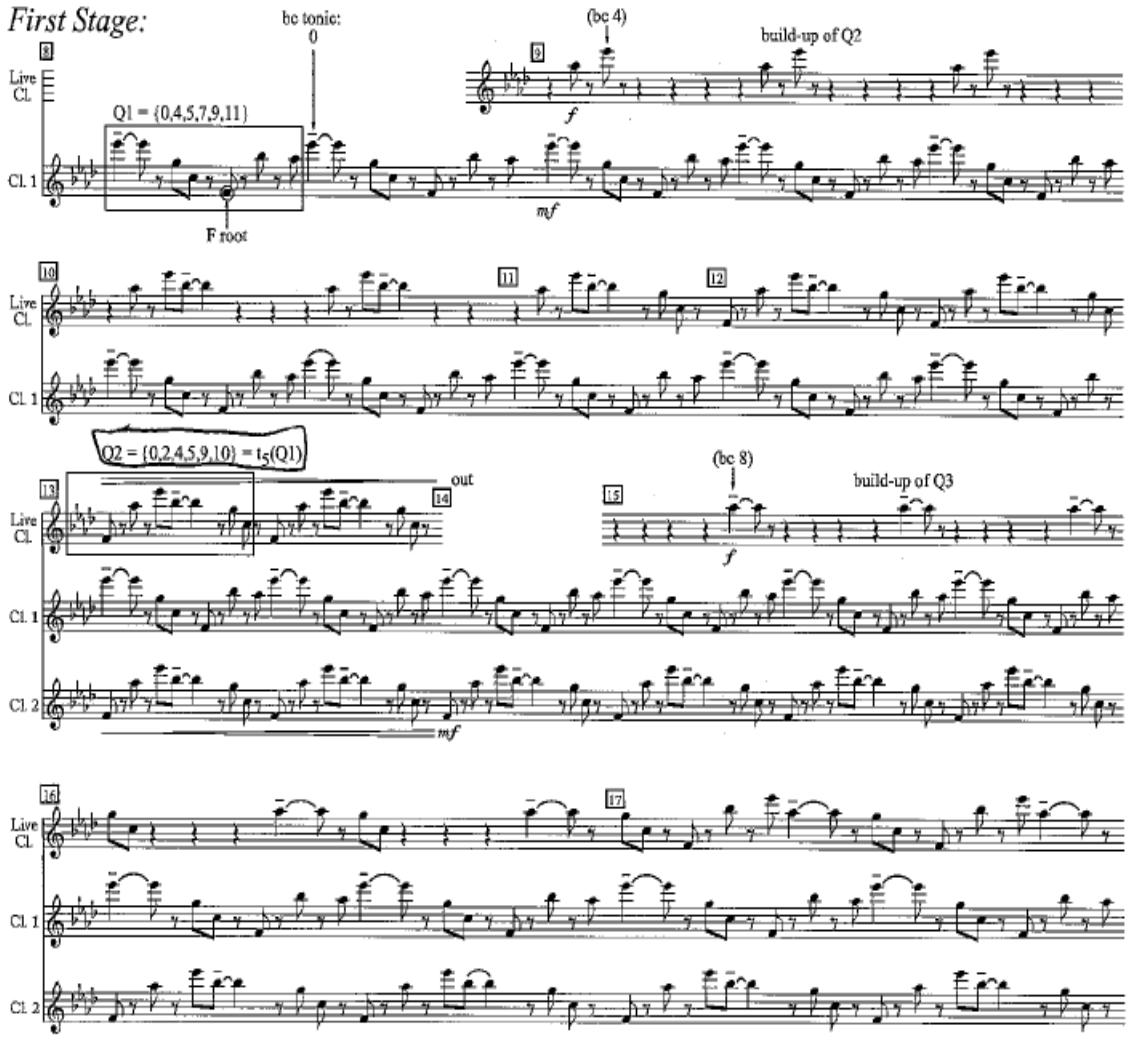
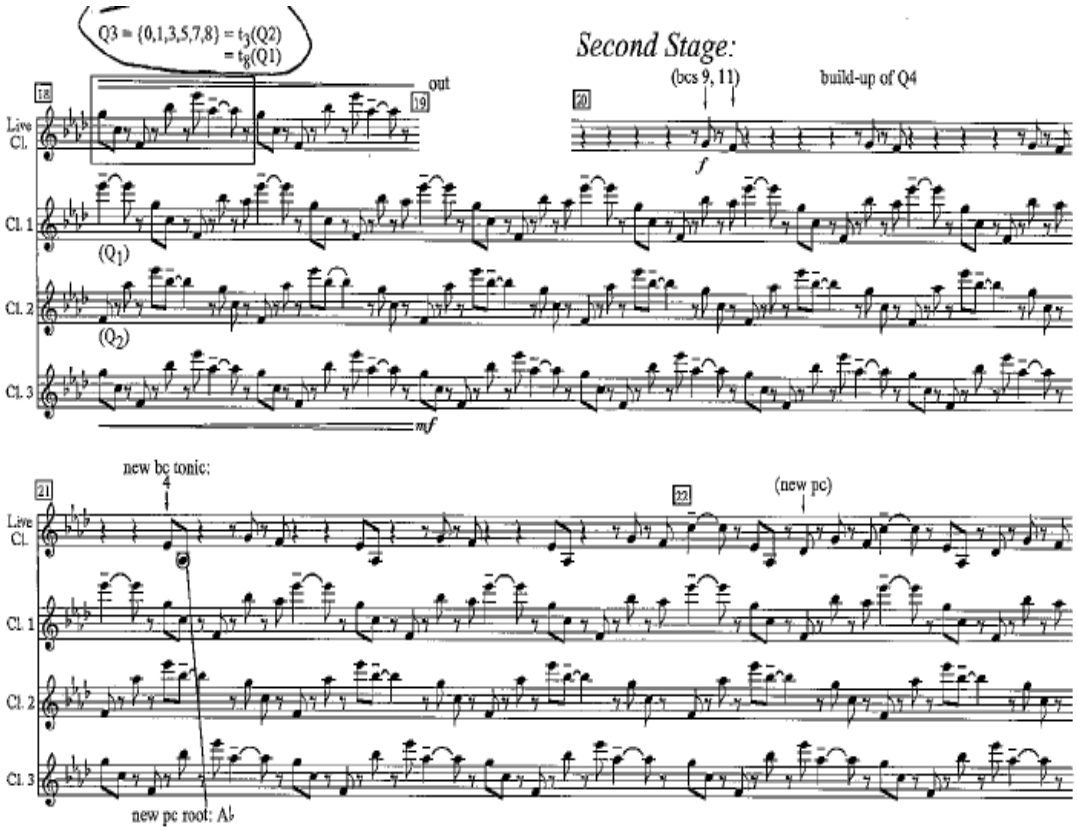


Figure 7a: Pattern relations and processes of bc modulation in the first movement of *New York Counterpoint* – Q1 and Q2

Source: Roeder, "Beat-Class Modulation in Steve Reich's Music," 281.



Example 7b: Pattern relations and processes of bc modulation in the first movement of *New York Counterpoint* – Q1, Q2, and Q3

Source: Roeder, "Beat-Class Modulation in Steve Reich's Music," 281.

New York Counterpoint begins with a single clarinet presenting a repeated pattern lasting twelve eighth notes. The repeated pattern places attacks on the bc set {04579E}, which Roeder labels Q1 (Roeder 2003, 279). The bc sets in Figures 7a and 7b are transpositionally related by several t levels: Q2, {02459T}, is t_5 to Q1; Q3, {013578}, is t_8 to Q1; and Q3 is t_3 to Q2 (Roeder 2003, 279-280). What is interesting about these bc sets is that "the combination of these transpositions does not create the *bc aggregate*, for bc 6 is never attacked," (Roeder 2003, 280). According to Roeder, "the beat-class aggregate means that every beat is attacked," (Roeder 2003, 275). Roeder continues, "Formally, generating the beat-class aggregate by phasing a particular

beat-class set against itself is analogous to generating the pitch-class aggregate by taking the union of transpositions of a particular pitch-class set," (Roeder 2003, 275).

Roeder's article also provides another important term related to bc analysis: *bc tonic*. He mentions that bc tonic is the bc that, in a given context (i.e. set), "acts as a reference for the other accented beat classes, in the sense that one perceives their temporal position in terms of the interonset durations from it to them," (Roeder 2007, 288). According to Roeder, "0 is projected as bc tonic[4] by intrinsically rhythmic features of the pattern. It is the first accented beat class, and at its first two attacks[5] it takes more types of accent than does any preceding timepoint," (Roeder 2003, 288). "Then, as beat classes and accents multiply in the build-up of new voices, first bc tonic 4, then bc tonic 8 becomes more prominent," (Roeder 2003, 292).

A final important term Roeder discusses is *bc mode.* The bc mode "is identified by matching the most accented beat classes with distinctive series of durations," (Roeder 2003, 288). In simpler terms, bc mode is a beat pattern that is repeated frequently. According to Roeder, "In all the analyses of Reich's music presented above (*Six Pianos* and *New York Counterpoint*), change of bc mode and tonic depends crucially on the accentual details of the repeated patterns," (Roeder 2003, 300). In the conclusion of his article, Roeder says that "by modeling rhythm 'modally,' not simply 'atonally,' we can better appreciate Reich's craft, and account for the otherwise incompatible qualities of efficiency and variety in his highly repetitive

[4] Bc modes do not have to have a tonic of 0.

[5] Roeder defines five different types of attacks: *climax, nadir,* (interonset) *duration*, *subcollection shift*, *beginning of connected series*, and *pulse*. "An accent of *climax* appears at the onset of an event whose pitch exceeds those of the preceding and subsequent events," (Roeder 2003, 280). "An accent of *nadir* appears at each onset of each event whose pitch is equal to or lower than the lowest pitch so far, and that is lower than the immediately preceding and following events," (Roeder 2003, 284). "An accent of (interonset) *duration* appears at the onset of an event that is much longer than the preceding event, or when the time to the next onset is much greater than the time since the last onset," (Roeder 2003, 284). "Accents of *subcollection shift* originate in the special pitch context of Reich's music: diatonic scales organized into rooted triads that are extended, as in jazz, by tertian "tension tones," (Roeder 2003, 285). "Accent groups of *beginning* arise naturally from Reich's highly constrained rhythms," (Roeder 2003, 286). "Regularly repeating durations marked by accent induce a *pulse stream*, which itself accents timepoints *metrically*, (Roeder 2003, 287).

music," (Roeder 2003, 300). Roeder's special attention to accentual details is indeed an important aspect of bc mode, tonic, and set perception, and one that will be influential on the analysis of *The Desert Music*.

Chapter three contains a discussion of Reich's *oeuvre* from a bc perspective. Bc analysis, as well as an analysis of phasing patterns will accompany the discussion where appropriate. Chapter four will then take the bc analysis terms introduced by Cohn and developed by Roeder and apply them to the A and A' sections of movement III of Reich's *The Desert Music*. This chapter will integrate concepts such as bc tonics, modulations, prolongational regions, and transpositional relationships present in the movement.

Chapter 3: Evolution of Reich's Music from Beat-Class Perspective

This chapter contains a discussion of Steve Reich and his compositional periods, as well as a chronological presentation of the evolution of Reich's music from the perspective of bc analysis and phasing in several of his works: *Piano Phase* (1967), *Clapping Music* (1972), *Vermont Counterpoint* (1982), *City Life* (1995), *Three Tales* (2002), and *2x5* (2008). These pieces were chosen because they are representative of the three compositional periods I will define in this chapter. There are two qualities that a piece of music must possess in order to be a candidate for bc analysis: a consistent meter and repeated rhythmic patterns. A consistent meter is necessary to determine the modulus. In each work, I will discuss the applicability of bc analysis as well as provide a brief analysis and a discussion of the place of the composition within Reich's *oeuvre*.

Steve Reich

Steve Reich was born in New York on October 3, 1936. He began his study of western percussion at the age of 14 with Roland Kohloff and later took composition lessons with Hall Overton (1957). During his work with Overton, he devoted extensive study to the *Mikrokosmos* of Béla Bartók, particularly Bartók's application of contrapuntal methods (Struble 1995, 326). Reich also developed an interest in African, Balinese, and other non-Western music (Struble 1995, 328).

Reich's works fall into three compositional periods. The first spanned the 1960s and until about 1971. This period consisted primarily of pieces that used tape loops and his phasing

technique[6]. Between 1968 and 1970, Reich heavily applied the technique known as "phase shifting" to his music. Reich's phase shifting involved the following processes:

> Two identical musical or acoustic activities are begun at the same time and are repeated. These sounds can be recorded on tape or performed by musicians. As the sounds are repeated, they become slightly out of sync with one another. As more and more repetitions occur, the discontinuities become more extreme and new rhythmic relationships begin to emerge as a result of the continual shifting of the phase patterns (Struble 1995, 327).

Reich first used the gradual phasing process in *It's Gonna Rain* (1965) and then used it in every piece from 1965 through *Drumming* in 1971, with the exception of *Four Organs* in 1970 (Reich 2002, 68). During his phase shifting period, Reich was uninfluenced by traditional tonal Western compositional techniques (Cohn 1992, 147). Reich acknowledged the difference between his original phase pieces and the music from what I call his second period. In 1972, Reich claimed he admired the music of Bach, but said that his interest in Western music decreased from Perotin onward. He later admitted interest in the music of Stravinsky, Bartók, and Webern (Cohn 1992, 147). In 1970, Reich began work on *Drumming,* which would prove to be a critical composition in the evolution of his unique style. In this piece, he began to move away from his interest in the concept of phasing and concentrated almost exclusively on the purely rhythmic dimension. He became more interested in polymetric processes derived from African drumming techniques (Struble 1995, 328).

Reich's second compositional period began in late 1972 with the completion of *Clapping Music* and continued through the late 1980s. According to Reich, "rhythmic construction, or

[6] "Each of Reich's phase-shifting compositions begins with the basic pattern in a single voice. After a brief time, the pattern issues a copy, which accelerates until it has advanced one beat ahead of the original voice. At this point, it locks back in at the original tempo, and the two voices engage in a canon at a transposition of one beat," (Cohn 1992, 152).

substitution of beats for rests (first used in *Drumming*), as well as the process of augmentation[7] similar to that in *Four Organs*," (Reich 2002, 68) characterizes this period[8]. During this period Reich also began to experiment with canons, as seen in *Vermont Counterpoint* and *The Desert Music* (Reich 2002, 119). *The Desert Music* falls in the second of Reich's compositional periods, coming out of his phasing period, and into a period focusing more on form through rhythm. My analytical focus will be on the work's A and A' sections of the third movement's A-B-A' ternary design. The B section does not lend itself to bc analysis because it contains shifting meters that do not allow for the selection of a consistent modulus.

Later, Reich combined his interest in phasing with that of pulse-driven structures. This combination of styles resulted in pieces such as his *Music for 18 Musicians* (1976), *Vermont Counterpoint* (1982) and *New York Counterpoint* (1985) (Struble 1995, 329). Reich's third and current compositional period began in the early 1990s and borrows ideas from previous compositional periods, namely the use of taped speech (Reich 2002, 6). In addition to this, he combines two of his techniques, canon and speech-melody, "the one essentially repetitive, unified, strictly and even abstractly musical; the other fortuitous, multifarious, corporeal," (Reich 2002, 6).

Piano Phase

Piano Phase was originally conceived as a piece for tape loop piano and live performer in 1966 (Reich 2002, 22). It wasn't until early 1967 that Reich and Arthur Murphy collaborated on the project and found that it could just as easily be performed with two live performers, as opposed to a tape loop and live performer, and it became the *Piano Phase* that is known today

[7] "A group of tones pulsing together in a repeated chord, with one tone at a time gradually getting longer in duration until the gradual augmentation (lengthening) of durations produced a sort of slow motion music," (Reich 2002, 44).
[8] Though Reich has discussed certain pieces as career-defining moments, he has not broken his career into three periods. This is my contribution.

(Reich 2002, 23). In his 2002 book "Writings on Music," Reich provides a description of the instructions for *Piano Phase*,

> The score shows that two musicians begin in unison playing the same pattern over and over again and that while one of them stays put, the other gradually increases tempo so as to slowly move one beat ahead of the other. This process is repeated until both players are back in unison, at which point the pattern is changed and the phasing process begins again (Reich 2002, 23).

An analysis of *Piano Phase* provides some insight as to Reich's phasing process. Figure 8 presents the original statement of the melodic line in the upper voice.

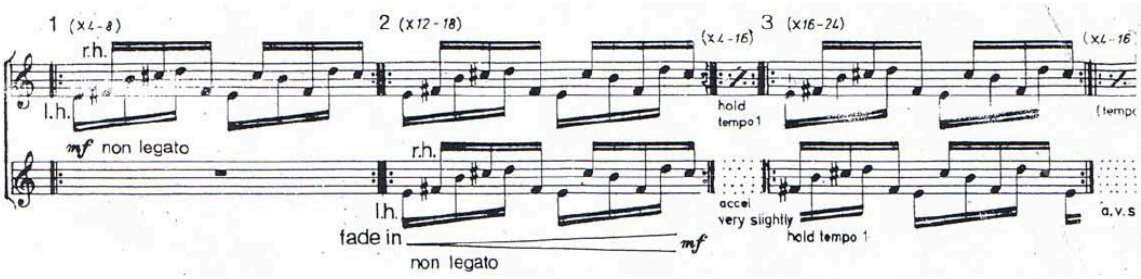


Figure 8: Beginning of *Piano Phase*; introduction to phasing

Source: Reich, *Piano Phase*, 1.

The upper voice repeats this figure 4-8 times, and then the same pattern is stated in the lower voice in m. 2 (also seen in Figure 8). It is not until the third measure that phasing begins. The pattern is shifted ahead, or phased, one sixteenth note ahead of the original pattern, creating the effect of an echo. The "echo" becomes more prominent as the pattern is continually phased, until eventually the patterns are back in unison in m. 14 (see Figure 9).

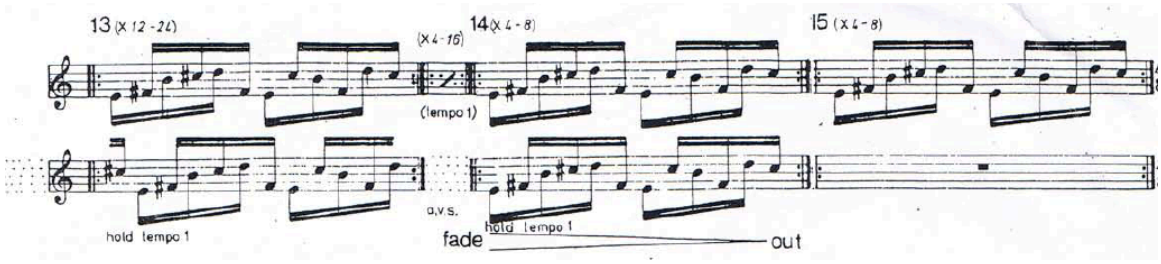


Figure 9: End of phasing in m. 14

Source: Reich, *Piano Phase*, 2.

As seen in Figure 9, the lower voice enters its last phasing in m. 13, is repeated 12-24 times, and then phases back in unison with the upper voice in m. 14.

The original melodic pattern continues in the upper voice, with a new pattern introduced in the lower voice in m. 17. As with the first section of *Piano Phase*, the pattern is shifted by a sixteenth note per measure number until the pattern phases back in unison.

Piano Phase does not lend itself to bc analysis because the melodic pattern is constructed entirely of sixteenth notes with no rests or syncopation, and there is not a pattern present to see shift. However, instances of transposition of the melodic pattern can be seen when the pattern of sixteenth notes shifts over by a sixteenth note. In this instance, it is not a rhythmic transposition, but a melodic one. This purely phasing work from very early in Reich's career is constructed entirely of sixteenth notes, and in this instance, bc analysis would not be appropriate because there is no rhythmic variety and therefore no opportunity for rhythmic transformation.

Clapping Music

Clapping Music is scored for two clappers and, according to Reich, is not a true phasing piece. In a true phasing piece, the performer gradually accelerates the tempo until s/he has phased a beat ahead of the original pattern (Reich 2002, 68). In *Clapping Music*, "one performer

remains fixed (at a certain tempo), repeating the same basic pattern throughout, while the second moves abruptly, after a number of repeats, from unison to one beat ahead, and so on, until he is back in unison with the first performer," (Reich 2002, 68). Reich describes the difference between these two techniques, "The basic difference between these sudden changes and the gradual changes of phase in other pieces is that, when phasing, one can hear the same pattern moving away from itself with the downbeats of both parts separating further and further apart, while the sudden changes here [in *Clapping Music*] create the sensation of a series of variations of two different patterns with their downbeats coinciding," (Reich 2002, 68). This shift of compositional procedure warranted a new period in my labeling of Reich's compositional output; Clapping *Music* was written at the end of Reich's first compositional period/beginning of his second compositional period.

Clapping Music differs from *Piano Phase* in that its pattern includes rests and syncopation, whereas the pattern found in *Piano Phase* consisted entirely of sixteenth notes. An examination of *Clapping Music* reveals a pattern that can be detected and quantified using bc analysis (see Figure 10). A bc analysis can posit a mod 12 on this piece due to there being twelve eighth notes in a bar with the eighth note as the smallest note value.

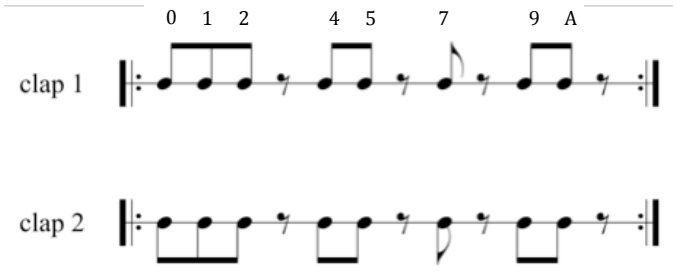


Figure 10: Bc analysis of *Clapping Music*

Source: Reich, *Clapping Music*, 1.

The bc set found in the first measure of *Clapping Music* is {0124579A}. As the first note falls on a downbeat, the bc tonic is 0. This tonic is then shifted over in the next measure in the second voice by 11 eighth notes, creating a t_{11} transposition (see Figure 11). This shifting continues through each measure number until the pattern in the second voice is again in unison with the first voice.

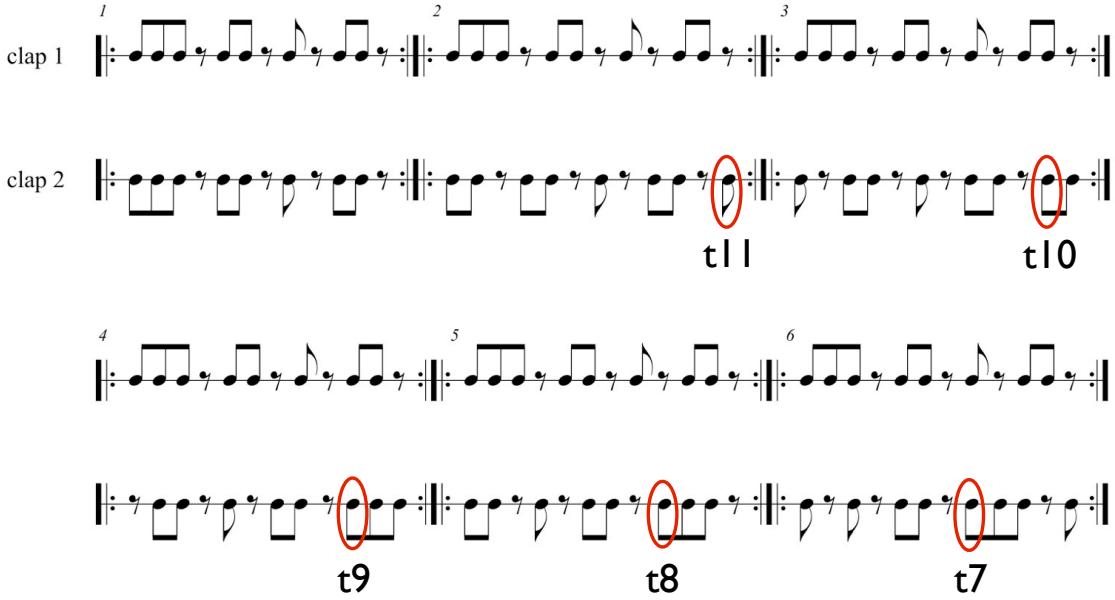


Figure 11: Bc tonic transpositions in *Clapping Music*

Source: Reich, *Clapping Music*, 1.

Though *Clapping Music* can be analyzed using bc analysis, it is not a paradigm of the analytical method because neither small nor large forms were discovered. There is a trivial bc transpositional pattern, but no multi-level analytical insight to be gained from bc analysis. According to Reich, *Clapping Music* marks the end of his use of the "gradual shifting process," (Reich 2002, 68).

Vermont Counterpoint

Vermont Counterpoint is scored for three alto flutes, three flutes, three piccolos, and one solo flute part (all prerecorded on tape), in addition to a live solo part (Reich 2002, 119). Reich began to experiment with canons in this second stage of his compositional career (Reich 2002, 119). According to Reich, "The compositional techniques used [in *Vermont Counterpoint*] are primarily building up canons between short repeating melodic fragments by substituting notes for rests and then playing melodies that result from their combination," (Reich 2002, 119).

As with *The Desert Music*, *Vermont Counterpoint* is written with a beat cycle of 12 subdivided beats, lending itself towards a bc analysis using mod 12. *Vermont Counterpoint* has a meter of 3/4 with the sixteenth note as the smallest note value, therefore serving as the modulus. The bc mode is presented in the tape-recorded version of flute 1, seen in Figure 12.

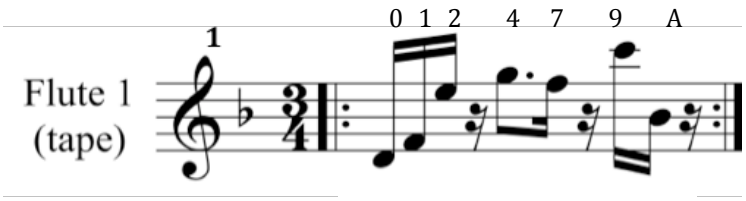


Figure 12: Bc mode, *Vermont Counterpoint*

Source: Reich, *Vermont Counterpoint*, 1.

The bc mode found in *Vermont Counterpoint* is {012479A}, and has a bc tonic of 0. The mode is gradually introduced in fragments in the live flute beginning in measure two (see Figure 13).

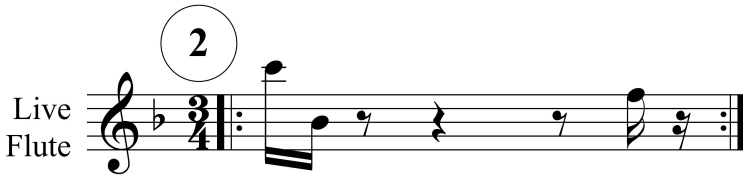


Figure 13: Fragmentation of mode in live flute, *Vermont Counterpoint*

Source: Reich, *Vermont Counterpoint*, 1.

When the mode is fully presented in the live flute in measure four (see Figure 14), it has been transposed over three sixteenth notes, creating a t_3 transposition. The circled note represents the transposed bc tonic.

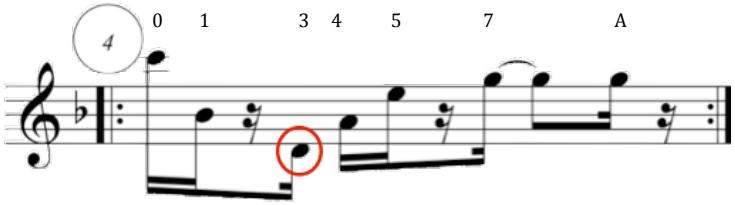


Figure 14: t_3 transposition of bc tonic, *Vermont Counterpoint*

Source: Reich, *Vermont Counterpoint*, 2.

Vermont Counterpoint serves as a canonic example from Reich's second compositional period that can be analyzed using bc analysis as it contains repeated rhythmic patterns that are transposed and modulated.

City Life (1995), Three Tales (2002), and 2x5 (2008)

Beginning in the 1990s and continuing through later works, Reich begins to deviate from canons and phasing and starts to compose using shifting meters (alternating between meters). Shifting meters are generally not conducive to bc analysis because there is often no consistent meter or repeated pattern. This lack of consistent meter/repeated pattern can be seen in *Three Tales* and *2x5*. However, there are instances where a piece written with shifting meters can be analyzed using bc analysis; for example, when there is a consistent metrical pattern in the music, and when there is consistency in the shifting (for example, when a piece of music progresses from 3/4 to 4/4 to 2/4, and then repeats this pattern). Reich's work *City Life* demonstrates the potential application of bc analysis over a shifting metric framework.

City Life

City Life is scored for two flutes, two oboes, two clarinets, two vibraphones, non-pitched percussion, two samplers, two pianos, a string quartet, and double bass (Boosey and Hawkes 2012). Like several of Reich's earlier works (*The Desert Music*, for example) the movements for *City Life* form an arch (A-B-C-B-A) (Boosey and Hawkes 2012).

The patterns in Figure 15 lend themselves to bc analysis because there is a consistent metrical pattern: a measure of 3/4 followed by two measures of 2/4 (which is then repeated). As the sixteenth note is the smallest note value found in both meters, it serves as the modulus. Figure 15 also provides a bc analysis of this pattern.

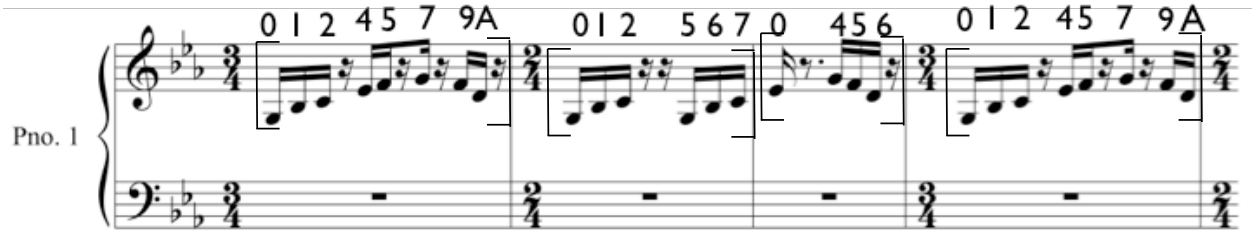


Figure 15: Bc analysis of *City Life*

Source: Reich, *City Life*, 4.

The bc sets found in this section of *City Life* are {0124579A}, {012567}, and {0456}. Through *City Life*, we can continue to pose bc analyses of Reich's recent music and we can continue to illuminate rhythmic transformations across multiple lines.

Three Tales and *2x5*

Three Tales combines historical film and video footage, interviews, photographs, etc. with sixteen musicians and singers (Reich 2002, 205). Unlike *City Life*, *Three Tales* contains shifting meter that does not lend itself to bc analysis because there is not a consistent metrical pattern, nor is there a repeated rhythmic pattern (See Figure 16).

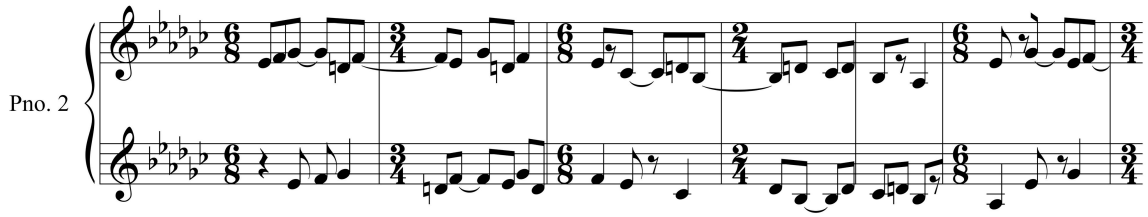


Figure 16: Shifting meter in *Three Tales*

Source: Reich, *Three Tales*, 5.

2x5 was written for five musicians and tape, or 10 musicians. As with *Three Tales*, *2x5* contains shifting meters that cannot be analyzed using bc theory due to the lack of a consistent metrical pattern and cannot be analyzed using bc theory (see Figure 17). Lack of a consistent metrical pattern does not allow for the labeling of a consistent modulus (mod 8, mod 12, etc.).

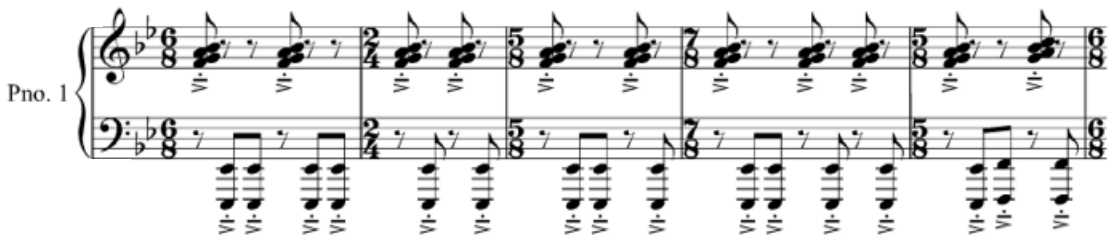


Figure 17: Shifting meters in *2x5*

Source: Reich, *2x5*, 49.

The above sampling of Reich's output suggests that his phasing pieces did not lend themselves well to bc analysis as they generally contained non-changing rhythmic patterns, or measures consisting entirely of sixteenth notes or eighth notes. The same can be said for Reich's later works (1990s/2000s), as most contain shifting meters and a modulus could not be found due to lack of a consistent metrical pattern. The pieces that lend themselves best to bc analysis are those written in the middle of Reich's compositional output (1970s/1980s). These pieces, specifically *Vermont Counterpoint* and *The Desert Music*, contain, for the most part, consistent meter that allows for a modulus to be identified. These works were also written using elements of phasing and canons, which allowed for fragmentation and development of bc modes.

Chapter 4: Beat-Class Analysis of *The Desert Music*

The first section of this chapter contains background information on Reich's *The Desert Music*, as well as a discussion of its harmonic content and form. Section two presents a discussion of the methods and processes of bc analysis for the piece. Section three presents the bc tonics found in the first A section of *The Desert Music's* third movement. It will illustrate t_n relationships found between the bc tonics and discuss how they unveil themselves in a systematic way within Reich's evolved phasing technique. This section will also expand the analysis by describing the bc mode found in both the A and A' sections of the third movement. As there is only one bc mode present in the A and A' sections, it will be shown that bc tonic transformations coordinate with local and global scale formal divisions. The final section of this chapter will compare the third movement's (henceforth abbreviated III) A and A' divisions with movements I and V. Overall, this chapter will use bc analytical findings, as well as overall rhythmic content, to illuminate Reich's use of rhythm to create a sense of form and unity.

The Desert Music

Reich began composing *The Desert Music* in 1982 and completed it in 1983, with the first performance having taken place in 1984 in Cologne (Reich 2002, 120). *The Desert Music* was written for amplified chorus (27 voices – 3 each of soprano 1, soprano 1A, soprano 2, alto 1, alto 2, tenor 1, tenor 2, bass 1, and bass 2), four flutes (2^{nd}, 3^{rd}, and 4^{th} doubling piccolo), 4 oboes (2^{nd}, 3^{rd}, and 4^{th} doubling English horn), 4 clarinets in Bb (2^{nd}, 3^{rd}, and 4^{th} doubling bass clarinet in Bb), 4 bassoons (4^{th} doubling contrabassoon), 4 horns in F, 4 trumpets in C, 2 trombones, bass trombone, tuba, 2 timpani, 2 marimbas, 2 vibraphones, 2 xylophones, 2 glockenspiels, maracas, sticks, 2 bass drums, medium tam-tam, 2 pianos, and strings (12-12-9-9-6).

The Desert Music consists of five movements performed *attaca* that shape a large arch form (A-B-C-B-A). The first and fifth movements are performed at a fast tempo and use the same harmonic cycle (Reich 2002, 120). The second and fourth movements are performed at a moderate tempo, share the same text, and also share a common harmonic cycle (which is different than that of the first and fifth movements) (Reich 2002, 120-121).

"The third movement of *The Desert Music* is the longest of the five movements and is a symmetrical arch form [ternary form] (A-B-A'), on which the A sections are slow and the B section moves up to the moderate tempo of the second and fourth movements," (Reich 2002, 121). This analysis of III designates the formal design A-B-A' since the final section is a slightly varied repetition of A. Thus Reich has described both the middle movement and the work itself in symmetrical formal terms. This suggests a relationship between the internal symmetry of the third movement and the overall symmetry of the entire work. In movement III, section A can be broken down into four separate prolongational regions based on bc modulations. "The third movement also has its own harmonic cycle, different than those from the first and fifth and second and fourth movements," (Reich 2002, 121). According to Reich, "the cycle for the large third movement is the most ambiguous of all, since all the chords are altered dominants, with their roots moving in major and minor thirds, making a clear V-I or IV-I cadence impossible" (Reich 2002, 121). For the sake of clarity, my analyses focus on the rhythmic content of the first, second, and third clarinets, as they are the first instruments to state the bc mode in III, and, their rhythmic pattern is simply mirrored by the flutes and violins (see Figure 18 for excerpt from score).

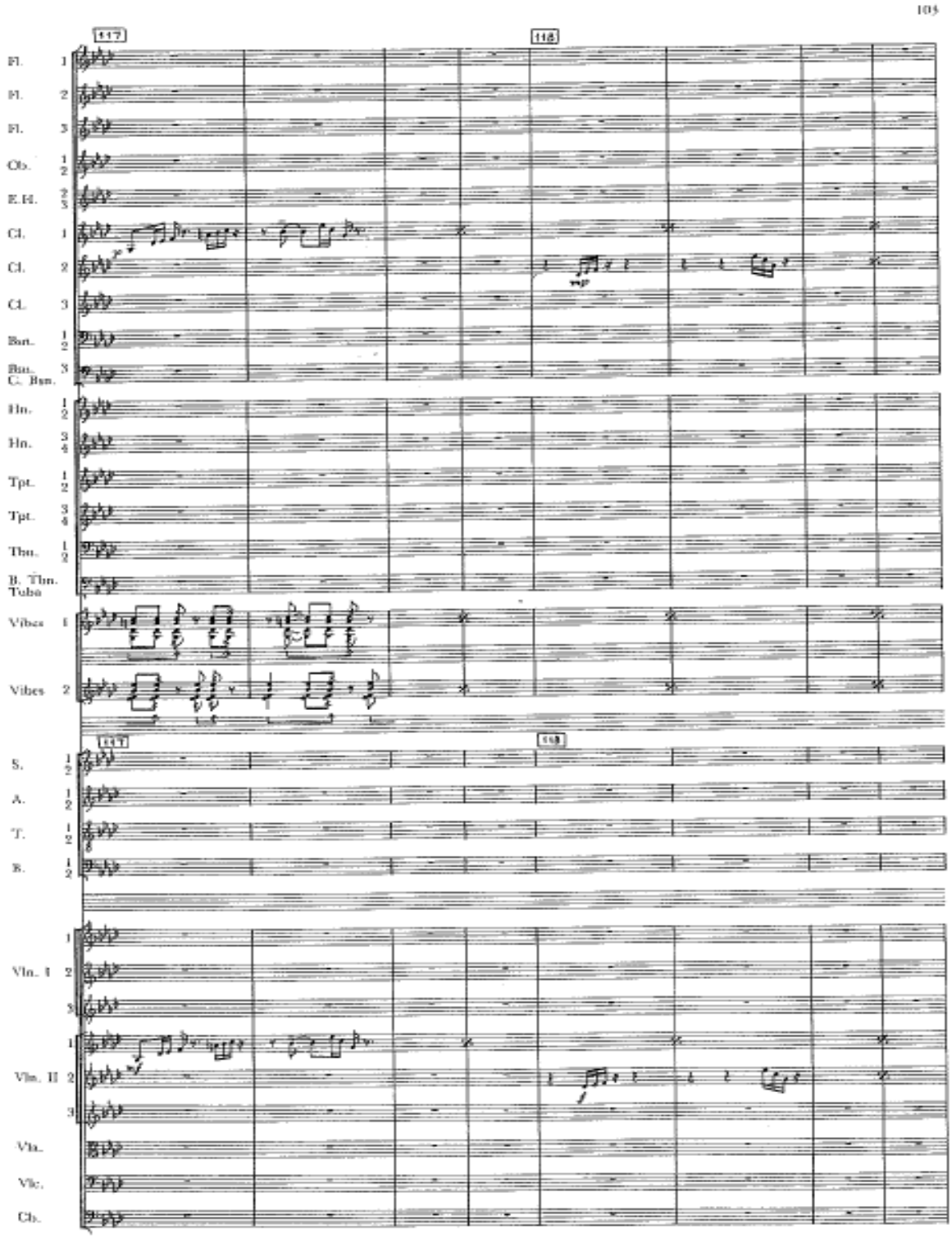


Figure 18: Beginning of section A (R117), movement III; *The Desert Music* demonstrating the doubling between clarinet and violin

Source: Reich, *The Desert Music*, 103.

Beat-Class Analysis

The first step in the bc analysis of *The Desert Music* is to determine the modulus of a given section. Cohn and Roeder's analyses of Reich's phase works posit a modulus as a value equal to the smallest note value of the music being analyzed. Figure 19 demonstrates the application of modular division by using the sixteenth note – the smallest value – as the modulus. The sections of *The Desert Music* analyzed in this paper possess a consistent metrical pattern (3/4) as well as a repeated rhythmic pattern.

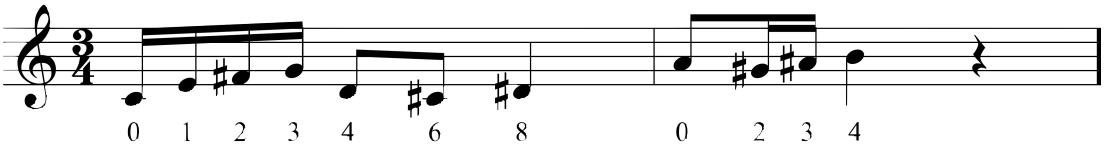


Figure 19: Example demonstrating mod 12 bc integers

As shown in this figure, 12 sixteenth notes fit into a measure of 3/4 meter; therefore, the music shown here would be analyzed using mod 12. Bc analysis need not always be mod 12. Depending on the meter, the music may be analyzed using mod 8, mod 16, etc. Figure 20 provides a numeric representation of every time-point found in a bar of 3/4 with a sixteenth note modulus, labeled 0-B, with A representing the integer 10 and B representing the integer 11. Note that 3/4 meter is the most frequently used meter in *The Desert Music*, thus, this modular division of time works throughout the piece.

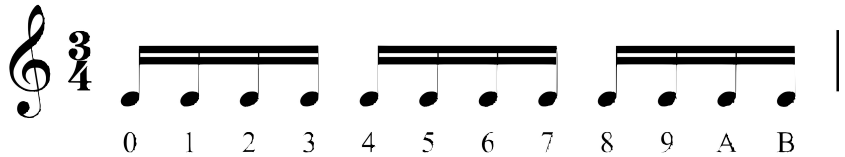


Figure 20: Possible time-points in a measure of 3/4; sixteenth note modulus

Beat-Class Modes and Their Tonics

As stated previously, Roeder defined bc tonic as the bc that, in a given context, "acts as a reference for the other accented beat classes, in the sense that one perceives their temporal position in terms of the interonset durations from it to them," (Roeder 2007, 288). Roeder's definition of bc tonic is helpful in determining the bc tonics that occur within the A section of III, the bc modes that are formed by these tonics, and subsequent modulations of the bc tonics.

There is only one bc mode found in the A and A' sections of III in *The Desert Music,* and it appears in the first clarinet in the first prolongational region of IIIA (i.e. the beginning of Rehearsal 117, or R117) (See Figure 21). This mode consists of two bc sets; the two sets create one mode rather than two because together they form a pattern that is repeated throughout the movement.

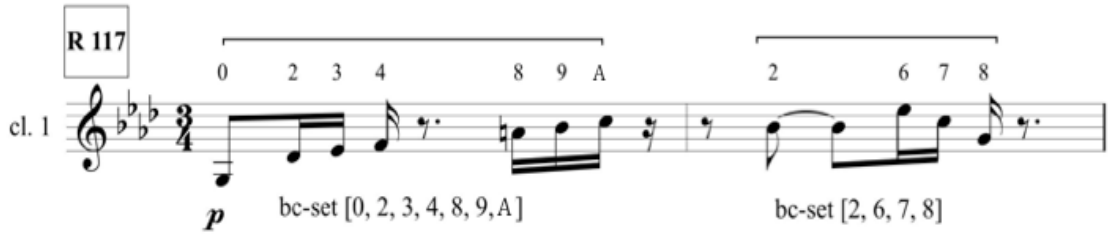


Figure 21: Mode with bc tonic "0"

Source: Reich, "The Desert Music," 103.

The first pitch of the bc set occurs on the downbeat of the measure, therefore the first bc is labeled "0" and is the bc tonic as it acts as a reference for other accented beat classes in the measure. Each bc mode always has a single bc tonic. The integer "2" in the second measure, however, does not act as a bc tonic, because the two bc sets presented in R117 form the single bc mode that permeates the first prolongational region (more than one bc set can constitute a bc

mode). This phrase consists of one bc tonic (0) and two bc sets that form one bc mode. Reich then phases in the second and third clarinets in fragments beginning in R118, and all of the clarinets are completely phased in by five measures after R119. Each of the clarinets states the same bc mode.

The bc of the second clarinet is transposed and phased in by two sixteenth notes in R119. The second and third clarinets enter five measures after R119. Also, four measures after R119, the third clarinet's entrance is transposed and phased in by four sixteenth notes from the original clarinet I phrase. The combination of these three entrances create a web of transpositional relationships: (1) t2 between the first and second clarinets, (2) t_2 between the second and third clarinets, and (3) t_4 between the first and third clarinets. These relationships are illustrated in Figure 22. A bc analysis of the clarinets can also be seen in the same figure.

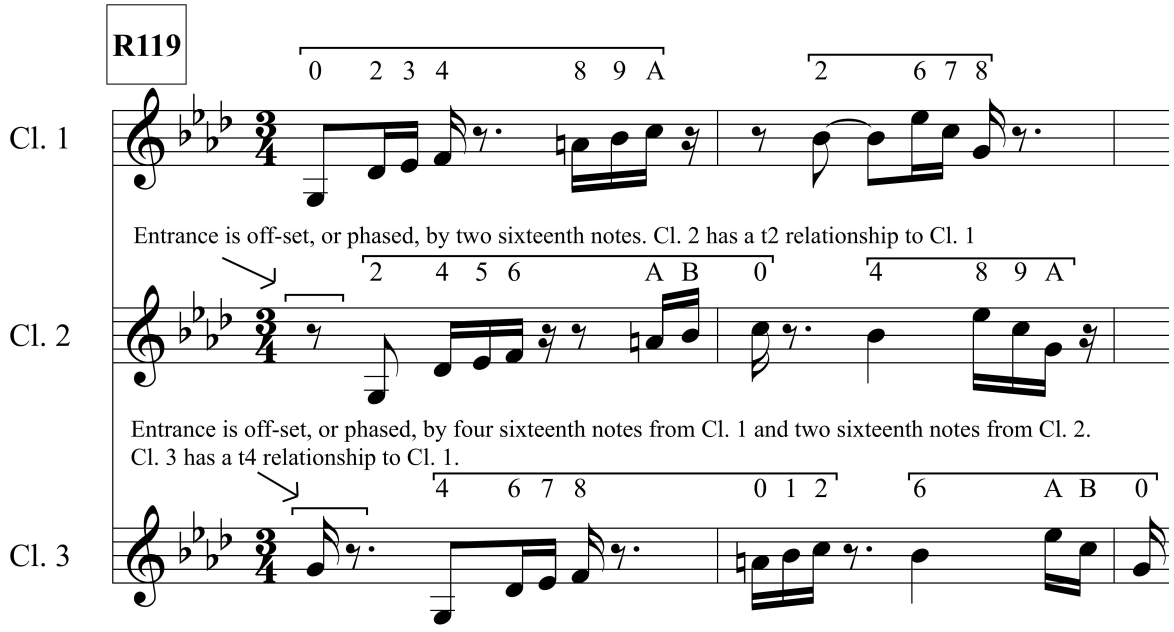


Figure 22: t_n relationships in the first prolongational region of movement III, *The Desert Music*

Source: Reich, *The Desert Music*, 105.

The ending of the first prolongational region is separated from the beginning of the second prolongational region by the entrance of a chord sustained by an SATB choir, oboe, English horn, bassoon, and contrabassoon, cello, and string bass. The chord gradually decreases *a niente*, and is echoed by a brass choir and string bass.

The second bc tonic occurs at R126 in the first clarinet. Melodic fragments phase in the second and third clarinets until they are fully presented at R127 (see Figure 23).

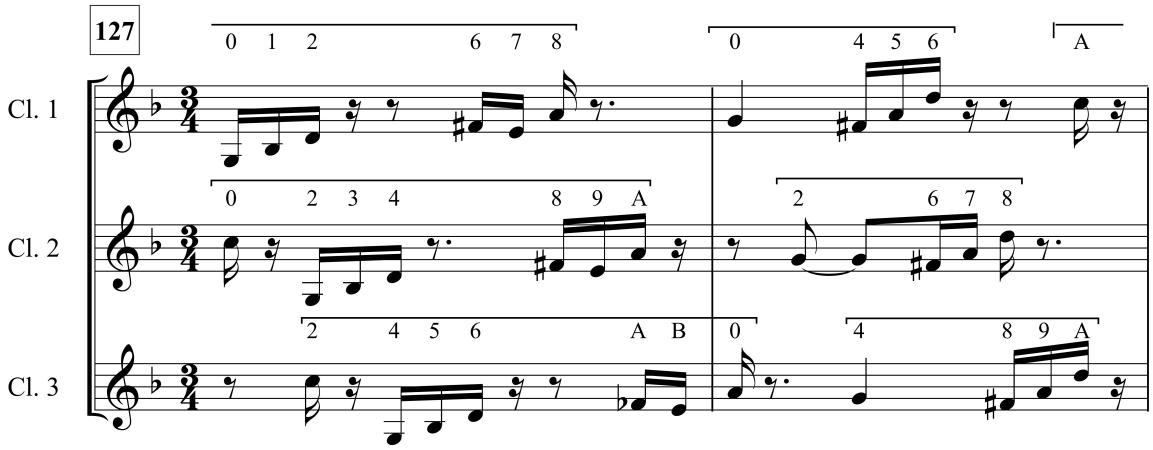


Figure 23: Bc analysis of clarinets in the second prolongational region of IIIA, *The Desert Music,* annotated

Source: Reich, "The Desert Music," 110.

The circled note in Figure 24 represents the new bc tonic. The bc sets, and therefore bc mode, remain the same as the previous prolongational region, but the group of bc sets has been rhythmically transposed. In Figure 24, the bc tonic in the first prolongational region has been transposed or time-delayed by 10 sixteenth notes, creating a t_{10} relationship between the first clarinet in prolongational region one and the first clarinet in prolongational region two, and, a new bc tonic of 10 is established, rather than 0.

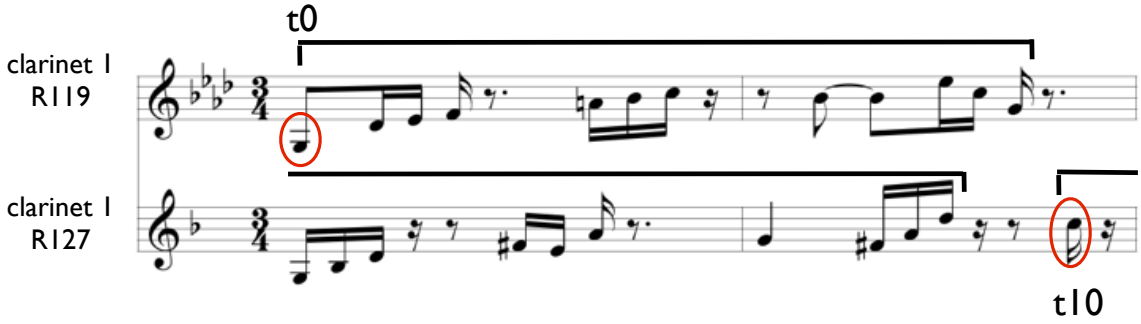


Figure 24: t_{10} relationship between clarinet 1 in prolongational region one and clarinet 1 in prolongational region two

Source: Reich, *The Desert Music*, 104, 111.

The t_n relationships found between the first, second, and third clarinets in prolongational region one are still present in prolongational region two: the first clarinet has a t_2 relationship with the second clarinet; the second clarinet has a t_2 relationship with the third clarinet; and the first clarinet has a t_4 relationship with the third clarinet. More broadly, the network of t_2 and t_4 relationships remains present in each of the four prolongational regions of III.

The entrance of an SATB choir (in addition to oboe, English horn, bassoon, contrabassoon, cello, and string bass) sustaining a chord signifies the ending of the second prolongational region. A brass choir and string bass sustaining the same chord, which gradually decreases *a niente* to signify the beginning of the third prolongational region, follow this chord (R129).

In Figure 25, a new bc tonic is seen in the third prolongational region (beginning in R131) in the first clarinet. In addition, the circled note in Figure 25 represents the new bc tonic. The bc sets presented in prolongational region one are still present in prolongational region three, however they have been transposed over by eight sixteenth notes, and have created a t_8 relationship from the first clarinet in prolongational region one (R119) and the first clarinet in

prolongational region three (R131), as well as a t_2 relationship between the first clarinet in prolongational region two (R127) and the first clarinet in prolongational region three.

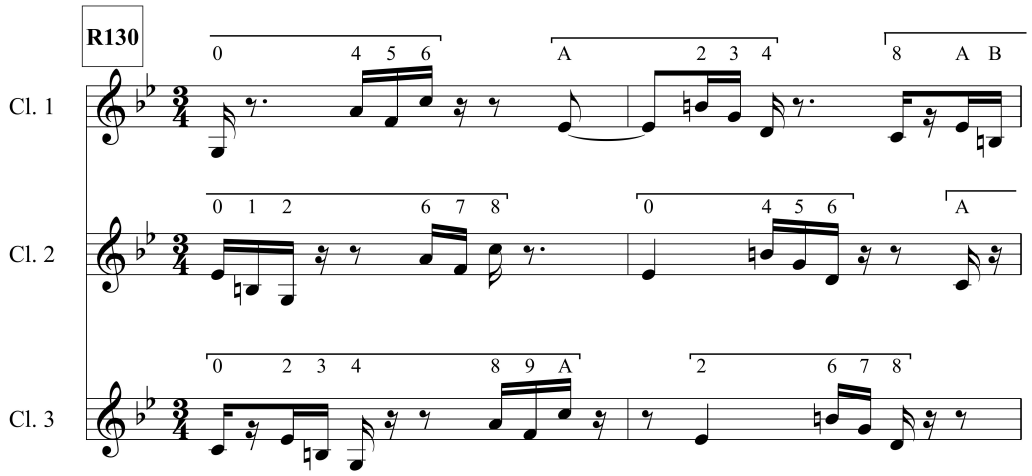


Figure 25: Bc analysis of clarinets in the third prolongational region of IIIA, *The Desert Music*

Source: Reich, "The Desert Music," 113.

A new bc tonic of 4 can be seen in the fourth and final prolongational region of IIIA, beginning in R134 in the first clarinet. The bc sets are presented fully in each clarinet in R135 (see Figure 26).

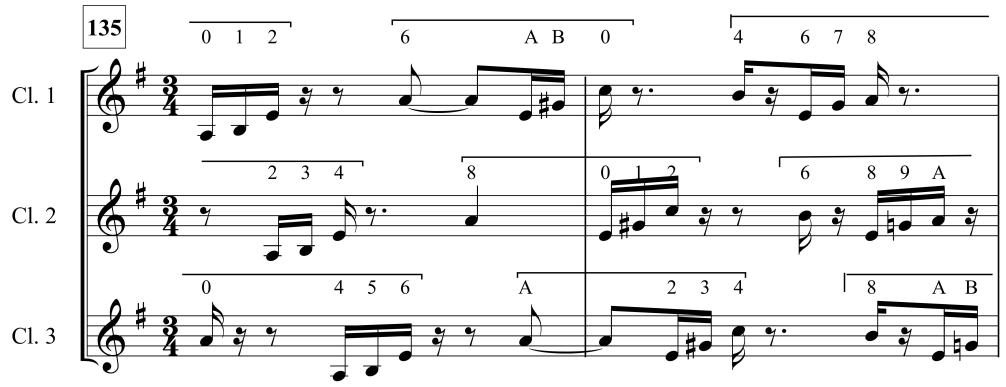


Figure 26: Bc analysis of the first, second, and third clarinets in the fourth prolongational region of the third movement, *The Desert Music*

Source: Reich, "The Desert Music," 116.

The entrance of the fourth prolongational region creates a new bc tonic as the original bc tonic of "0" has been shifted over by four sixteenth notes. This shift created a t_4 relationship from the first clarinet in prolongational region one and the first clarinet in prolongational region four, a t_6 relationship between the first clarinet in prolongational region two and the first clarinet in prolongational region four, and a t_4 relationship between the first clarinet in prolongational region three and the first clarinet in prolongational region four.

The end of prolongational region four concludes with a reduction in orchestration in R136. This reduction in orchestration signifies the beginning of material that serves as transition to the B section of the third movement. Neither section four in IIIA or IIIA' contain prolongational regions as the material that follows serves as transition to the next section (IIIB and IV) and cannot be analyzed with bc analysis due to lack of repeated rhythmic patterns. Figure 27 demonstrates the t_n relationships that occur among the four prolongational regions of the A section of movement III. A note to the reader: within the context of Figure 27 (and later Figure 29) "local" refers to within a sectional level, and "global" means across sections.

A

	Section 1 - Introduction	Section 1	1st Prolongational Region	Section 2 - Introduction	Section 2	2nd Prolongational Region	Section 3 - Introduction	Section 3	3rd Prolongational Region	Section 4 - Introduction	Section 4
Rehearsal Number:	117	119	119-125	126	5 measures after 127	127-129	130	5 measures after 131	5 measures after 131-133	134	135
What's Happening Musically:	Bc mode introduced in clarinet 1	Bc mode has been fully phased into clarinet 2 and 3	Bc mode is repeated; no rhythmic transformations	Bc mode introduced in clarinet 1; new bc tonic	Bc mode has been fully phased in clarinets 2 and 3	Bc mode is repeated; no rhythmic transformations	Bc mode introduced in clarinet 1; new bc tonic	Bc mode has been fully phased in clarinets 2 and 3	Bc mode is repeated; no rhythmic transformations	Bc mode introduced in clarinets 2 and 3; new bc tonic	Bc mode has been fully phased in clarinets 2 and 3
Bc Tonic:	0			A			8			4	
Bc Sets:	Cl. 1 [023489A] [2678]	Cl. 2 [2456AB] [489A] Cl. 3 [4678012] [6AB0]	same	Cl. 1 [A012678] [0456]	Cl. 2 [023489A] [2678] Cl. 3 [2456AB0] [489A]	same	Cl. 1 [8AB0456] [A234]	Cl. 2 [A012678] [0456] Cl. 3 [023489A] [2678]	same	Cl. 1 [4678012] [6AB0]	Cl. 2 [689A234] [8012] Cl. 3 [8AB0456] [A234]
Transposition Levels - Local:		Cl. 2 - t2; Cl. 3 - t4			Cl. 2 - t2; Cl. 3 - t4			Cl. 2 - t2; Cl. 3 - t4			Cl. 2 - t2; Cl. 3 - t4
Transpositin Levels - Large-Scale:				Cl. 1 - t10 from R 117			Cl. 1 - t8 from R 117; t2 from R 126			Cl. 1 - t4 from R 117; t6 from R 126; t10 from R 130	

Figure 27: t_n relationships in IIIA

IIIA' is similar to IIIA in that it contains the same bc mode presented in the beginning of III. IIIA' contains five prolongational regions (R212, R218, R225, R232, and R239), four of which contain bc tonic modulations, with the fifth and final prolongational region serving as transition to movement IV.

The first statement of the bc mode is seen at R212 in the first clarinet and first flute (prolongational region 1). The bc tonic is 2, creating a t_2 transposition from the original statement in R117. It is interesting to note that the order of the bc sets contained in the IIIA' section have been reversed from their original presentation in IIIA. As with IIIA, the second clarinet is transposed over two sixteenth notes from the first clarinet (t_2), and the third clarinet is transposed over four sixteenth notes from the first clarinet (t_4). These transposition levels are also true for the second and third prolongational regions of IIIA'.[9] The second prolongational region (R218) begins with a bc tonic of 4 in the first clarinet (R218), creating a t_2 transposition from the first prolongational region in IIIA' (R212), and a t_4 transposition from the first statement in IIIA (R117) (See Figure 28).

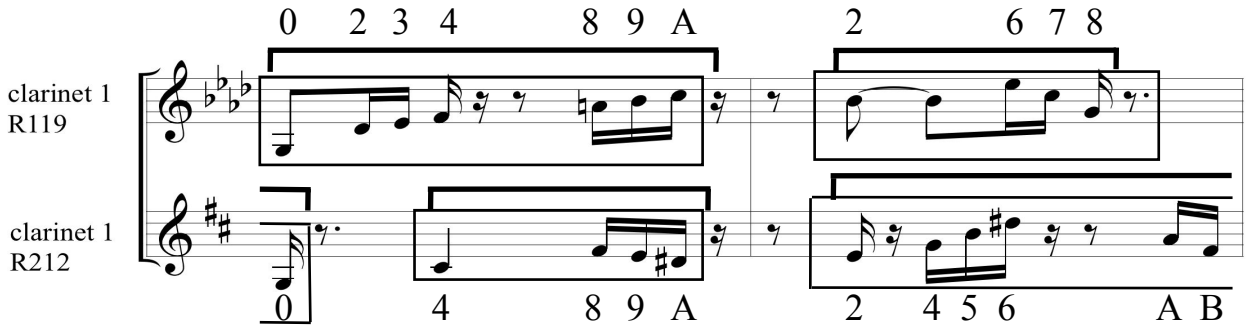


Figure 28: t_2 relationship between clarinet 1 in prolongational region one in IIIA and clarinet 1 in prolongational region one, IIIA'

Source: Reich, *The Desert Music*, 104, 178.

[9] It is important to note that rehearsal number lengths and amount of time between entrances of fragments of modes and their complete statements has been shortened by 2-4 measures from IIIA.

The third prolongational region (R225) begins with a shift in rhythmic emphasis. The same bc mode is present, however, previously the rhythmic emphasis had been on an eighth note-two sixteenth note pattern. Now, the emphasis has shifted to the quarter note. The bc tonic is 8, creating a t_8 transposition from the first statement in IIIA, a t_2 transposition from prolongational region two (IIIA'), and a t_4 transposition from prolongational region one (IIIA').

The fourth prolongational region, found at R234, and the final one to contain a bc tonic modulation, comes full circle with the original bc presentation in IIIA (R117) as it also has a bc tonic of 0. This creates a t_2 transposition with the first prolongational region of IIIA', a t_4 transposition with the second prolongational region of IIIA', and a t_8 transposition with the third prolongational region of IIIA'.

Through the bc tonic relationships seen in III, a clear sense of form is present. Each bc tonic modulation signifies the beginning of a new prolongational region within the movement, and it is through these modulations that we are able to see an overall form. Notice similarities in bc tonic modulations: First, between prolongational regions 1 and 2 in both A and A' the bc tonic 10 and bc tonic 2 form complementary mod 12 relationships, as do bc tonics 8 and 4 between prolongational regions 3 and 4. Next, the first prolongational region of IIIA and the fourth (and final) prolongational regions of IIIA' share a bc tonic of 0, creating an overall sense of unity between IIIA and IIIA'. Finally, the third prolongational region for IIIA and IIIA' is 8. Figure 29 presents a comparison of the bc tonics for IIIA and IIIA', as well as a presentation of bc tonics and bc sets by rehearsal number.

A

	Section 1 - Introduction	Section 1	1st Prolongational Region	Section 2 - Introduction	Section 2	2nd Prolongational Region	Section 3 - Introduction	Section 3	3rd Prolongational Region	Section 4 - Introduction	Section 4
Rehearsal Number:	117	119	119-125	126	5 measures after 127	127-129	130	5 measures after 131	5 measures after 131-133	134	135
What's Happening Musically:	Bc mode introduced in clarinet 1	Bc mode has been fully phased into clarinet 2 and 3	Bc mode is repeated; no rhythmic transformations	Bc mode introduced in clarinet 1; new bc tonic	Bc mode has been fully phased in clarinets 2 and 3	Bc mode is repeated; no rhythmic transformations	Bc mode introduced in clarinet 1; new bc tonic	Bc mode has been fully phased in clarinets 2 and 3	Bc mode is repeated; no rhythmic transformations	Bc mode introduced in clarinets 2 and 3; new bc tonic	Bc mode has been fully phased in clarinets 2 and 3
Bc Tonic:	0			A			8			4	
Bc Sets:	Cl. 1 [023489A] [2678]	Cl. 2 [2456AB] [489A] Cl. 3 [4678012] [6AB0]	same	Cl. 1 [A012678] [0456]	Cl. 2 [023489A] [2678] Cl. 3 [2456AB0] [489A]	same	Cl. 1 [8AB0456] [A234]	Cl. 2 [A012678] [0456] Cl. 3 [023489A] [2678]	same	Cl. 1 [4678012] [6AB0]	Cl. 2 [689A234] [8012] Cl. 3 [8AB0456] [A234]
Transposition Levels - Local:		Cl. 2 - t2; Cl. 3 - t4			Cl. 2 - t2; Cl. 3 - t4			Cl. 2 - t2; Cl. 3 - t4			Cl. 2 - t2; Cl. 3 - t4
Transpositin Levels - Large-Scale:				Cl. 1 - t10 from R 117			Cl. 1 - t8 from R 117; t2 from R 126			Cl. 1 - t4 from R 117; t6 from R 126; t10 from R 130	

A'

	Section 1 - Introduction	Section 1	1st Prolongational Region	Section 2 - Introduction	Section 2	2nd Prolongational Region	Section 3 - Introduction	Section 3	3rd Prolongational Region	Section 4 - Introduction	Section 4
Rehearsal Number:	212	214	214-217	218	220	220-224	225	226	226-231	232	234
What's Happening Musically:	Bc mode introduced in clarinet 1	Bc mode has been fully phased into clarinet 2 and 3	Bc mode is repeated; no rhythmic transformations	Bc mode introduced in clarinet 1; new bc tonic	Bc mode has been fully phased in clarinets 2 and 3	Bc mode is repeated; no rhythmic transformations	Bc mode introduced in clarinet 1; new bc tonic	Bc mode has been fully phased in clarinets 2 and 3	Bc mode is repeated; no rhythmic transformations	Bc mode introduced in clarinets 2 and 3; new bc tonic	Bc mode has been fully phased in clarinets 2 and 3
Bc Tonic:	2			4			8			0	
Bc Sets:	Cl. 1 [489A] [2456AB0]*	Cl. 2 [6AB0] [4678012] Cl. 3 [8012] [689A234]	same	Cl. 1 [6AB0] [4678012]	Cl. 2 [8012] [689A234] Cl. 3 [A234] [8AB0456]	same	Cl. 1 [A234] [8AB0456]	Cl. 2 [0456] [8AB0456] Cl. 3 [2678] [023489A]	same	Cl. 1 [0456] [A012678]	Cl. 2 [2678] [023489A] Cl. 3 [489A] [2456AB0]
Transposition levels - Local:		Cl. 2 - t2; Cl. 3 - t4			Cl. 2 - t2; Cl. 3 - t4			Cl. 2 - t2; Cl. 3 - t4			Cl. 2 - t2; Cl. 3 - t4
Transposition Levels - Large-Scale				Cl. 1 - t2 from R 212			Cl. 1 - t6 from R 212; t4 from R 218			Cl. 1 - t2 from R 212; t4 from R 220; t8 from R 225	

*order of bc sets in A' have been reversed from that in A

Figure 29: comparison chart for IIIA and IIIA'

IIIA and IIIA' Internal Divisions in Comparison with I and V

Movements I and V are based upon two separate musical ideas that alternate to create form. This idea is similar to how III is based upon one bc mode that is altered through bc tonic modulation.

Overall, movements I and V together create an arch reflective of that just shown in IIIA and IIIA'. IIIA begins with a bc tonic of 0 and IIIA' ends with a bc tonic of 0, creating an overall rounded sense at the beginning and ending. Movement I begins with pulsing chords in the piano and marimba (A), quickly followed by pulsing chords in the choir, woodwinds and strings, which functions as a transition to B. This motion builds and lasts through R125, where it fades into a slightly slower, though still rhythmically active section (B). Movement I ends with a modified restatement of the A section (A'), forming within itself an internal arch form.

Movement V has four prolongational regions and begins by stating the material from the B section of movement I, minus the SATB choir (now the A section of movement V). Section A alternates with a variation on pitch and rhythmic content found in the A section of movement I. Movement V ends with a restatement of the music found at the beginning of movement I, creating an overall arch form within *The Desert Music*. With movement I beginning on the same material that movement V ends with, and the A and A' sections of III ending with bc tonics of 0, internal and external formal connections can be heard.

Chapter five will present a summary of the concepts presented in this thesis, as well as a discussion of how other bc analysis could be useful in the analysis of works of other composers.

Chapter 5: Conclusion

Steve Reich says, "You want to hear music that moves you, and if you don't, then you're not really very curious to find out how it was put together," (Reich 2002, vii). I believe that it is our obligation as music theorists to determine how music is constructed. In order to achieve this, modifying a current technique or developing a new analytical technique in order to understand a particular style of music may be necessary. Doing so helps provide a fresh analytical perspective and potentially a deeper understanding of the music under scrutiny. For example, bc analysis was designed in order to study the small and long-range formal effects of rhythmic attacks on a composition due to the calculated transposition and layering of attack schemes. As shown, Milton Babbitt first proposed conceiving rhythm analogously to pitch (in the context of twelve-tone composition) by using mod 12 to represent the metric location of event attacks within a composition (Roeder 2003, 275). This technique was further developed by Cohn and Roeder and was applied to Reich's highly rhythmic music as a means of better understanding his compositions.

With regard to musical processes, Reich says, "I am interested in perceptible processes. I want to be able to hear the process happening throughout the sounding music. To facilitate closely detailed listening, a musical process should happen extremely gradually," (Reich 2002, 35). By applying bc analysis to Reich's compositions, we are able to identify the processes by which Reich composes his music, most specifically, by his use of phasing techniques and the careful utilization of canons and imitation. When applying bc analysis to the topic of this thesis, *The Desert Music*, repeating rhythmic patterns can very clearly be labeled as bc sets. Repeating rhythmic patterns are characteristic of Reich's compositions. The bc sets exist within only one bc mode and each mode has a bc tonic. The bc mode is gradually introduced in other

instruments, creating an echo effect which is indicative of Reich's compositional style. The bc tonic is transposed multiple times, each time creating a new bc tonic. Each subsequent bc tonic signifies a new prolongational region within the movement. By manipulating the downbeat of the rhythmic pattern (bc tonic of the bc mode), Reich created a variety of sounds from one bc mode and based almost an entire movement (III) off of this one mode. Through a bc analysis of *The Desert Music*, we learn that within Reich's music, *rhythm dictates form*. Transpositions of the bc mode create variety and perceived musical "signposts" for the listener, notably in III. Each transposition signified a new bc tonic which was followed by a new prolongational region, which then generated a sense of form within *The Desert Music*. The listener can follow the series of "signposts" (transpositions) during III in the same way that one might follow key levels in a classical work. In addition, a bc analysis of *The Desert Music* reveals the predominance of the numbers two and four, as well as multiples of the numbers two and four, can be seen in bc tonic modulations and transposition levels.

A question remains: what type of music, other than that of Steve Reich, can be analyzed using bc analysis? There are several levels of criteria a composition must meet in order to be considered for bc analysis. The first is a consistent metrical pattern. It is ideal if a composition is written in one meter because it is easier to identify a modulus. However, if the composition contains shifting meters, as many of Reich's later works do, a consistent metrical pattern must be present in order to find a modulus (for example, when a piece of music progresses from 6/8 to 2/4 to 3/4, and then repeats this pattern). A repeated rhythmic pattern (labeled in the analysis as a bc set) is also a necessity and is required in order to identify transpositions of bc tonics. Typically, compositions written using elements of phasing and/or canons are more easily analyzed using bc analysis as they allow for fragmentation and development of bc modes.

Through analysis, it can be seen that certain works by composer Philip Glass lend themselves to bc analysis as they contain repeated rhythmic patterns that are gradually phased in and out of unison (for example, *String Quartet No. 5*, 1991)[10]. Though not as effective as analyzing Steve Reich's highly rhythmic music, a bc analysis of certain works by Glass is successful because it highlights rhythmic transformations present in his music.

By applying bc analysis to *The Desert Music*, my goal was to bring a fresh analytical approach to comprehending the construction of this composition, and to bring insight into the compositional processes of Steve Reich. To quote Reich, "While performing and listening to gradual musical processes, one can participate in a particular liberating and impersonal kind of ritual. Focusing in on the musical process makes possible that shift of attention away from *he* and *she* and *you* and *me* outward toward *it*," (Reich 2002, 36). In essence, by focusing on the musical process, we become more connected to the music and are better able to understand its meaning and purpose.

[10] Glass uses repeated patterns that can be analyzed in a mod 16 environment (meter is 4/4 with the sixteenth note as the smallest note value.

Bibliography

Babbitt, Milton. 1962. "Twelve-Tone Rhythmic Structure and the Electronic Medium." *Perspectives of New Music* 1:49-79.

Benjamin, William. 1984. "A Theory of Musical Meter." *Music Perception* 1:355-414.

Boosey and Hawkes. 2012. "Reich, Steve. *City Life.*" Accessed June 18. http://www.boosey.com/cr/perusals/score.asp?id=1011.

Cohn, Richard. 1992. "Properties and Generability of Transpositionally Invariant Sets." *Journal of Music Theory* 35:1-32.

Cohn, Richard. 1992. "Transpositional Combination of Beat-Class Sets in Steve Reich's Phase-Shifting Music." *Perspectives of New Music* 30:146-177.

Epstein, Paul. 1986. "Pattern Structure and Process in Steve Reich's *Piano Phase*." *The Musical Quarterly* 72:494-502.

Forte, Allen. 1973. *The Structure of Atonal Music.* Yale University Press.

Haack, Joel. 1991. "Clapping Music – A Combinatorial Problem." *The College Mathematical Journal* 22:224-227.

Horlacher, Gretchen. 1994. "Meter and Minimalism: Reich's *The Desert Music."* Paper presented at the 1994 West Coast Conference of Music Theory and Analysis, Mills College, Oakland, California.

McConville, Brendan. 2011. "A 'Simple Composition' of Charles Wuorinen: Isomorphism, Self-Similarity, and Nesting in *Cello Variations*." *Theory and Practice* 36:151-177.

Mead, Andrew. 1987. "About *About Time*'s Time: A Survey of Milton Babbitt's Recent Rhythmic Practice." *Perspectives of New Music* 25: 182-235.

Quinn, Ian. 1997. "Fuzzy Extensions to the Theory of Contour." *Music Theory Spectrum* 19:232-263.

Reich, Steve. *Music as a Gradual Process*. New York: *Anti-Illusion: Procedures/Materials*, 1968. Quoted in Richard Cohn, "Transpositional Combination of Beat-Class Sets in Steve Reich's Phase-Shifting Music." *Perspectives of New Music* 30:146-177.

Reich, Steve. 2002. *Writings on Music, 1965-2000*. New York: Oxford University Press.

Roeder, John. 2003. "Beat-Class Modulation in Steve Reich's Music." *Music Theory Spectrum* 25:275-204.

Saltini, Roberto. 1993. "Structural Levels and Choice of Beat-Class Sets in Steve Reich's Phase-Shifting Music." *Intégral* 7: 149–178.

Schwarz, K. Robert. 1981. "Steve Reich: Music as a Gradual Process Part II." *Perspectives of New Music* 20:225-286.

Struble, John Warthen. 1995. *The History of American Classical Music: MacDowell through Minimalism*. New York: Facts on File, Inc.

Appendix

Glossary

Augmentation

"A group of tones pulsing together in a repeated chord, with one tone at a time gradually getting longer in duration until the gradual augmentation (lengthening) of durations produced a sort of slow motion music," (Reich 2002, 44).

Beat-Class Aggregate

Every beat is attacked (Roeder, 2003, 275).

Beat-Class Analysis

(1) Consists of a "metric cycle consisting of *n* bcs, arranged into a mod *n* system and labeled from 0 to *n*-1, with 0 representing the notated downbeat," (Cohn 1992, 149); **(2)** A system of analysis used to analyze the rhythmic structure of a composition.

Beat-Class Mode

"Identified by matching the most accented beat classes with distinctive series of durations," (Roeder 2003, 288).

Beat-Class Modulation

"Changes in tonic or mode that arise from changes in the membership of the beat-class collection itself, or from changes in the types, strength, and placement of accent within a continuing collection," (Roeder 2003, 289).

Beat-Class Set

"A set of integers representing rhythmic attacks instead of pitch-classes," (Roeder 2003, 288).

Beat-Class Tonic

"Acts as a reference for the other accented beat classes, in the sense that one perceives their temporal position in terms of the interonset durations from it to them," (Roeder 2007, 288).

Phasing

Two identical musical or acoustic activities are begun at the same time and are repeated; the sounds are repeated, becoming slightly out of sync with one another; more and more repetitions occur and the discontinuities become more extreme and new rhythmic relationships begin to emerge as a result of the continual shifting of the phase patterns (Struble 1995, 327).

Prolongational Region

(1) "Lockings in," which "form canons at various transpositions in beat space," (Cohn 1992, 152); **(2)** a gradual manifestation of a completed musical idea.

Time Point

"A location in the flow of time," (Wuorinen 1979, 131).

Vita

A native of Burna, Kentucky, Liahna Guy graduated in 2012 from the University of Tennessee, Knoxville, with the Master of Music degree in composition, and the Master of Music degree in music theory. While at the University of Tennessee, she studied music theory and music technology with Dr. Brendan McConville, Dr. Barbara Murphy, and Dr. Donald Pederson, and music composition with Dr. Kenneth Jacobs. She earned the Bachelor of Science in Music degree in voice and music composition from Murray State University in 2009, where she studied music theory with Dr. John Steffa, Dr. Stephen Brown, and Dr. Brian Runnels, and music composition with Dr. John Steffa and Dr. Mike D'Ambrosio.

Liahna served as the student representative of the Southern Chapter of the College Music Society in 2011-2012. She has served on various College Music Society panels, and presented "Beat-Class Tonic Modulation as a Formal Device in Steve Reich's *The Desert Music*," at the 2012 Southern Regional Conference in Tampa, FL. She is also a member of the Society of Composers, Inc., the American Society of Composers, Authors, and Publishers (ASCAP), Pi Kappa Lambda, and has served as President and Vice-President of the Student Composer Organization at the University of Tennessee (SCOUT), the local Society of Composers, Inc. chapter. She currently serves as a tutor for the *Journal of Music Theory Pedagogy Online*.

While at the University of Tennessee, Knoxville, she taught ear-training and music theory courses as part of a graduate teaching assistantship.