Fractal Harmonies of Southern Africa[1]

Martin Scherzinger

I.

At stake in this article is a demonstration of the fractal-like logic undergirding harmonic processes found in the archaic lamellaphone music in the region of Zimbabwe, Zambia, and Mozambique. Harmonic practices of African music are a largely neglected aspect of the intellectual discourse on Africa. Most ethnographic writing on music of this region (no less than the African continent at large) limits its music-analytic findings to general observations, most notably to aspects of *rhythm* alone, often with a special interest in their kinesthetic aspects. These include analyses of timelines and other asymmetric rhythmic patterns, polymeter and polyrhythm, pulse-based temporal structures, hocketing techniques, shifting metric groupings, etc., and their relation to performance practices (dance steps, and the like). Of the technical approaches to African music, very few examine non-rhythmic dimensions of African music, such as pitch spaces or pitch processes—melody, harmony, counterpoint, and so on; and, of those that do, most remain within the limits of mere pitch or chord labeling—often hesitantly and provisionally, thereby apparently avoiding the false premises of Eurocentric assignation. There is almost no work on the relation between pitch processes and rhythm.

The literature on African music is vast and varied, but the demonstrably overarching preoccupation with rhythmic complexities of this sort simultaneously traduce

[1] This article expands upon arguments made in Scherzinger 2001, sections of which have been reproduced or revised here with permission. An earlier version of the present article appeared as Scherzinger 2012, reproduced or revised here with permission.

a kind of default perspective (or commonplace—what Kofi Agawu would call a *topos*) containing African cultural practice within a zone of excluded cultural conformity (Agawu 2003). The relation of such a widespread default perspective to ideologies of cultural difference across geopolitical zones of economic disparity is a matter of urgent investigation. While global geopolitics will not be explicitly examined here, the analytic inquiry to follow is premised on vigilance toward, and resistance to, this kind of commonsensical ideological relation. Hence, the analysis deflects attention from rhythmic practices in an African music, and toward its harmonic processes; in particular, its fractal-like geometries.

Nonetheless, much is assumed, and hence provisional, in depicting mathematical ideas expressed in music. I will mention only three starkly reductive assumptions. First, the analysis largely bypasses ethnographic evidence. Apart from occasional pronouncements by *mbira* and *matepe* players about the omnidirectionality of the music they play—its movements both "forward and backward;" "in every direction … like the ocean," and so on—there is a dearth of indigenous terminology for the kinds of invertible geometric properties outlined below.[2] Some mbira specialists even claim that the vast majority of Shona traditional musicians "do not talk about [the music] much, or even at all."[3] Leaving aside this kind of ethnographic observation, it is unlikely that music can be reduced to a linguistically bound conduit for contextually determined meanings alone. This is probably especially true for music that transcends the everyday, such as the music of the *matepe* and the *mbira*, which is identified with spirit-possession.

[2] Quotes taken from a personal communication with Forward Kwenda, August 3, 2011.
[3] Quote taken from Erica Azim, posted on *Dandemutande* on November 9, 2005.

Second, much needs to be abstracted out of the musical data to come to grips with the fractal-like geometries that underlie the music's harmonic processes. Most immediately, the non-verbal contextual complexities (political valences, cultural rituals, and so on) in which the music is irreducibly embedded are suspended in favor of a strategic analysis of the music's decontextualized forms. The most striking aspects of the music's sound are also suspended in favor of harmonic ones alone. Even when one's hearing is explicitly directed toward harmony, what falls into earshot is less harmony *per se* than the striking timbres and overtones *constituting* that harmony, as well as the music's rhythmic-melodic elaborations *of* the harmonic progressions. And yet, as the ideological tendencies of the wider discourse surrounding African music amply attest, the suspension of these musical features and the abstraction of harmonic analysis itself might be strategically called-for. In other words, African music's apparently peculiar endowment for rhythmic complexity, for example, or its embodied tactility and its sonorous timbral appeal, to name another *topos*, equally reflects a mediated abstraction of an African empirical reality; one that simultaneously deflects attention from the very possibility of the music's harmonic mathematics.

Third, even if we accept the strategic political need for such abstraction, the recursive geometric shapes that approximate fractal relations in *mbira* and *matepe* music constitute but a single aspect of harmonic processes found in that music. In fact, in my view, the time-transcending symmetric and near-symmetric harmonic shapes that ground the music's rhythmic-melodic flow are perhaps the most striking mathematical aspect of the music. In *mbira* and *matepe* music we find harmonic shapes—or, more precisely, subsets within their characteristic harmonic progressions—that constitute and resemble shapes found elsewhere in the progression. The resemblance frequently involves identity across an imaginary mirror axis, projected either horizontally or vertically. In other words, harmonic shapes reappear in uncanny inversion or retrograde forms at various points in their respective cycles.[4] Furthermore, harmonic shapes also reappear in original (non-mirrored) form at various pitch-transpositions within the progression, which facilitates hearing strangely similar harmonic trajectories at different points within the cycle. In other words, this harmonic structure facilitates a kind of phase-shifted experience of similitude in the context of transformation, no less than transformation in the context of similitude. The music's unexpected mimesis can thus be heard in various ambiguous "contrapuntal" combinations.[5] Only some of these prominent aspects of the harmonic processes of *mbira* and *matepe* will be discussed here. At stake, instead, is the abstract application of harmonic analyses depicted by geometric representations that reveal only the fractal-like qualities of the music without simplifying or making more complex the music's multi-faceted harmonic processes.

II.

The *mbira* is a musical instrument with approximately twenty-two metal keys (lamellae) fixed to a wooden soundboard and wedged within a gourd resonator that amplifies its resonance. The *matepe* is similar in construction but the layout of its lamellae is quite different, and thus involves a completely dissimilar playing technique. While both instruments date back to at least the fifteenth century, when they played an important role

[4] For an extended analysis of symmetries and near-symmetries in an mbira song, see Scherzinger 2001.
[5] For an analysis of the various contrapuntal trajectories facilitated by harmonic shapes and their near-likeness, see Scherzinger 2010.

in the royal courts, the *mbira* is traditionally played by Zezuru speakers in the region of Mashonaland East, while the *matepe* is played by Sena, Tonga, and Korekore speakers in the far northeast of Zimbabwe, including the adjacent region of Mozambique. The attendant repertoires associated with each instrument do not overlap. In both cases, nonetheless, rattling pieces of metal, bottle caps or shells are attached to the instrument, which in turn produce buzzing sounds when the keys are plucked. As a result, a range of sounds, in addition to the fundamental, is produced by plucking the lamellae. Along with the vibrations of the bottle caps, the keys of the *mbira* and *matepe* tend to produce very prominent overtones resulting in various layers of rhythmic accents and inherent melodies in the upper register. *Mbira* and *matepe* players often report that their instrument sounds like more than one instrument being played at once, or that implicit sounds emerge, phantom-like, as if from nowhere. As suggested by the full name of the *mbira* (namely *mbira dza vadzimu*: "*mbira* of the ancestral spirits"), the principal role of the *mbira* involves conjuring ancestral spirits, which play a central role in the religious cosmos of the Shona. When two instruments are played together, the different paths they take (sometimes referred to as *kushaura* and *kutsinhira* parts) are in an interlocking relationship with one another. By sounding within the silences of each other respectively, the performers produce figures of intricacy and variety that exceed the movements of the fingers alone. This asynchrony between bodily motion and sounding form is one reason mbirists and matepists report the presence of phantom patterns.

The sustained back-and-forth hocketing is offset by a pair of *hosho* (rattles made from dried gourds), which is generally sounded in repeating three-pulse groups, but sometimes also elaborated into more complex rhythmic groupings. In this way, a ternary rattle pattern runs agilely alongside a binary hocketing one in the instruments. Sometimes performers add a sonic dimension to their dancing by attaching gourds filled with seeds to their legs, adding rhythmic complexity to the *hosho*'s beating.

Tuning systems for the *mbira* and *matepe* can vary regionally and historically. Some tunings are given a general formal designation (such as *gandanga, nyamaropa* or *dambatsoko* tunings); others are personal, like Forward Kwenda's *nemakonde* tunings; while still others seem to have no known name. Even those that ostensibly share systems vary. For example, using the upwardly ascending right-hand keys of the *mbira* as a reference point, Fraderick Mujuru's *gandanga* tuning follows the interval pattern (measured in cents): 131, 216, 164, 246, 140, 197, 193; while Tute Chigamba's *gandanga* tuning follows the pattern: 130, 188, 170, 210, 133, 188, 189.

In comparison with the standardized Western diatonic system, which is the condition for the possibility of its attendant harmonic practice, the *mbira* and *matepe* tuning systems seem unstable and variable; an instability and variability that all too often shifts attention away from the music's harmonic system and toward its overtone-rich timbres, rhythmic intricacies, buzzing inharmonicities, and so on. However, the kind of harmonic patterns found in *mbira* and *matepe* music are made possible precisely by assuming a small degree of variability between interval classes. Andrew Tracey (1970a, 10–11) has surmised that, for all the differences between intervals, the tuning of the *mbira* tends towards an equi-heptatonic system. In relation to the major scale, in Tracey's (1970a) view, all intervals, barring the fourth, are flat—most notably the seventh and the third. As a general view, the theory of seven equally spaced notes has the advantage of explaining why the same dyad sequences are elaborated at different pitch heights in different songs. For example, the song *Nyamaropa* elaborates the same basic harmonic progression as the song *Nhemamusasa* but using a different set of pitches. It is as if one song was a transposition of the other: *Nhemamusasa* as a kind of modulation from *Nyamaropa*?

Nonetheless, Tracey's (1970a) theory seems to be empirically false, and so its paradoxical insights are frequently overlooked in the literature. Indeed, *nyamaropa*, *gandanga*, and *dambatsoko* tunings, while internally variable to some degree, have a unique and identifiable character that is probably not reducible to an overarching system. Nonetheless, there may exist, in the words of John Kaemmer (1998, 746), "greater flexibility in the acceptable norms of pitch" for tuning the *mbira* than for tuning a western instrument. This view is corroborated by the fact that pitches *approximately* an octave apart are considered equivalent. While not fixed in the empirically robust sense, the different tuning systems still result in a unique and basic arrangement of interval classes (whose exact sizes are somewhat variable). Loosening the grip of the precisely differentiated interval classes produced by tuning patterns (so crucial to the diatonic system) in favor of a kind of generalized interval equivalence casts important perspectives on the elusive geometries of harmonic patterning. In fact, modes of harmonic patterning, which is the primary focus of my analysis to follow, articulate many layers of time-transcending symmetry that are less apparent in the performance practice associated with the Western diatonic scale, and its myriad of interval classes. Indeed, it is just the delicately variable tuning undoing the possibility of orienting one's hearing to various prominent points of repose, initiation and so on, that brings the sometimes bewildering harmonic movements into audile reach.

III.

It is widely agreed that *mbira* and *matepe* songs elaborate a seemingly endless number of variations around a basic harmonic pattern, usually constituted by 12-, 36- or 48-pulse cycles, with shifting rhythms and melodies at ever-changing places in the cycles. There is frequently no agreed-upon start (or end) point, and, because of the metrically ambiguous rhythmic groupings, new and different phrases constantly relocate variations in the shifting weave. Consider the following transcriptions of the *mbira* song *Chakwi* (meaning “Duck” or “The sound of walking through a marsh (like a duck)” in Figure 1, and the *matepe* song *Aroyiwa Mwana* (meaning “The child has been bewitched” or “The enchanted child”) in Figure 2. The first transcription of *Chakwi* is made by the author, and is based on the playing of Forward Kwenda of Mutare, on the Zimbabwean border to Mozambique, in August 2011; the second is taken from Gwanzura Gwenzi of Chivero, Mhondoro, near Harare, in the 1960s as published by Andrew Tracey (1970a, 16–17). Both transcriptions deploy Tracey’s (1970b) pulse notation to facilitate the polymetric character of the music. It is a striking fact that, despite the different right-hand patterns (cascade-like descending binary patterning in the first transcription, and off-beat ternary patterning in the second), the basic bass pattern and harmonic structure has remained unchanged over the decades, even though Kwenda has no personal knowledge of Gwenzi.

The *matepe* transcriptions date back to recordings of Saini Madera of the Eastern Mtoko district made by Andrew Tracey in the late 1960s. Here too, while most of the rhythmic-melodic details between the transcriptions are variable (simple interlocking of left and right hands in the first transcription, and ternary patterning in the left hand against asymmetric patterning in the right in the second), the harmonic structure of both is the

Figure 1. Two Fragments of *Chakwi*, performed respectively by 1. Forward Kwenda, August 2011 (transcription: M. Scherzinger); and 2. Gwanzura Gwenzi, 1960s (transcription: Tracey [1970a, 23]) and Harmonic Reduction (below)

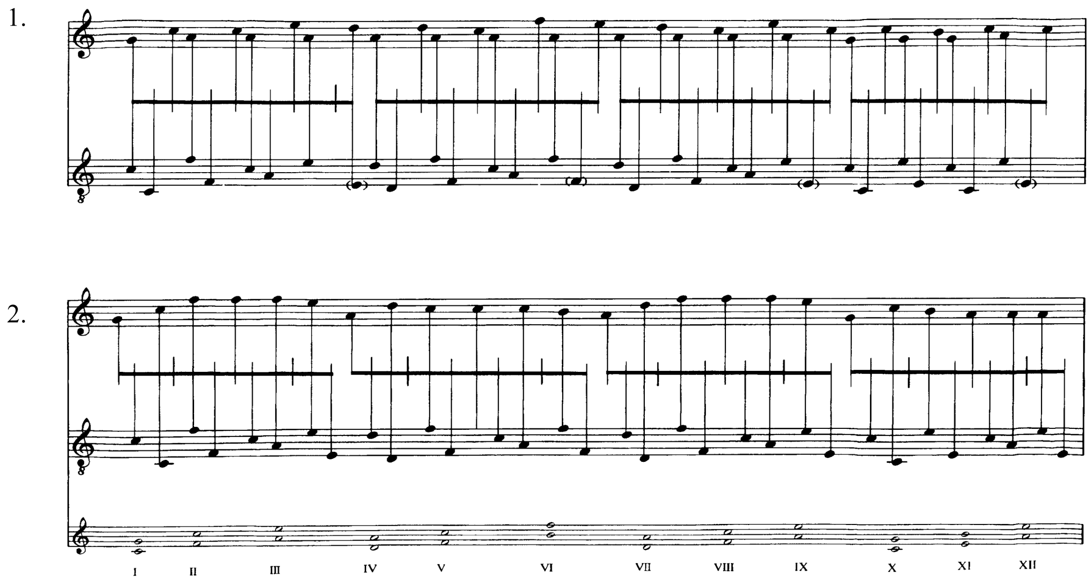
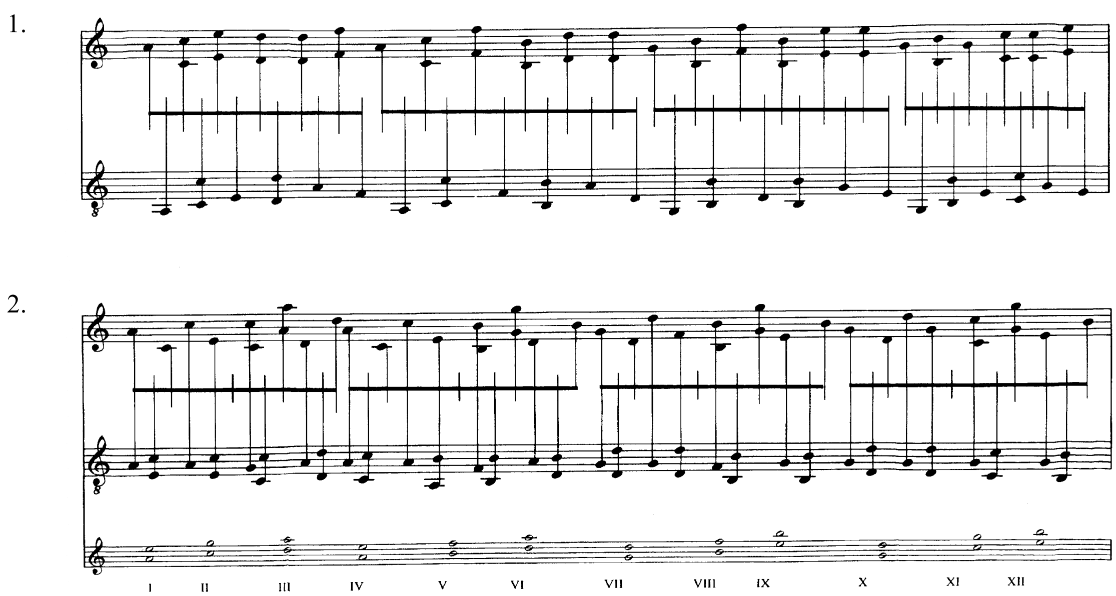


Figure 2. Two Fragments of *Aroyiwa Mwana*, performed by Saini Madera, 1960s (transcription: Tracey [1970a, 59]) and Harmonic Reduction (below)



same. This alone justifies close attention to the details of the harmonic structure.

Furthermore, regarding the politics of transcription, it might be noted that the use of

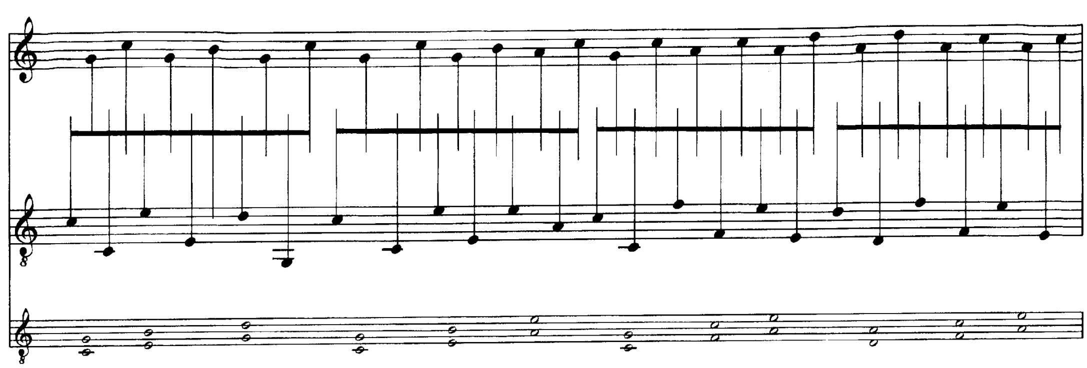
Western staff notation is paradoxically well suited to the music of the *mbira* as the quasi-heptatonic scale structure is deftly reflected in the equally-spaced lines of the staff. Nonetheless, the transcriptions should be considered fragmentary and fleeting documents of an actual performance.

Below the transcriptions is a representation of the dyad sequence that seems to guide the respective musical passages. Each dyad is designated by a whole note that represents approximately every four pulses in the transcriptions. In actual practice these harmonies are often more complex (mingled with other tones—ninths, sixths, thirds—sometimes expressible as delayed tones, anticipations, neighboring tones and passing tones; and sometimes not), and the harmonic rhythm is more elastic than that implied by the whole notes. For example, in *Chakwi* such co-mingling of harmonies occurs between left and right hand parts at various points in the pattern. In the second transcription in Figure 1, the left-hand move to A (which undergirds the third dyad A-E in the first quarter) comes two pulses before the move to E in the right hand. It is as if the F on pulse 9 is a delayed tone, held over from the previous F dyad, and thereby muddying the A dyad with a kind of harmonic suspension. Thus, the harmonic changes seem to be grouped into approximately 3+4+5 pulses in the left hand, and 4+6+2 in the right hand. The abstract 4+4+4 pulses depicted in the analytic reduction—a compromise between the harmonic rhythms here implied by left and right hands respectively—is clearly not as "expressive" as the sliding elasticity of the actual music; it nevertheless lays out a basic harmonic framework that conditions the possibility for such expressive morphing between hands.

The harmonic progression in *Chakwi* seems to be an incarnation of the well-known *Nhemamusasa/Nyamaropa* sequence, known amongst ethnomusicologists as the "standard" chord sequence.[6] Consider the performance of *Nhemamusasa* by Samuel Mujuru, as transcribed by the author in Harare in August 1996, and depicted in Figure 3. Here we find the same basic progression as posited in *Chakwi,* but in a kind of orthogonal relation to *Chakwi*; namely, rotated by four dyads and transposed up a third. In other words, *Nhemamusasa* "begins" as if on *Chakwi*'s ninth dyad in the sequence; but this dyad is on C instead of A. *Chakwi*, in short, is a kind of isomorphic rotation of *Nhemamusasa*; the one an uncanny redux of the other.

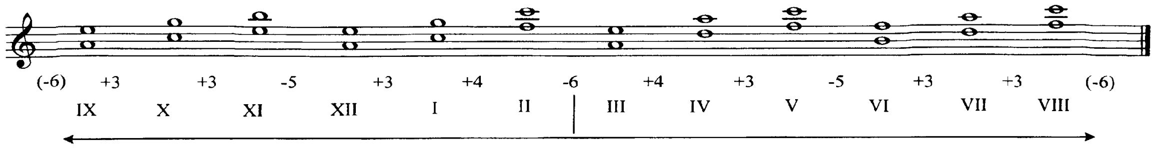
There are many interesting properties of the *Chakwi* progression, such as the intervallic palindrome represented in Figure 4, where the numbers represent the intervallic distance between the low notes of the dyad sequence. Rising and falling intervals are represented by plus and minus signs respectively. The intervallic sequence pivots after the descending sixth between dyads II and III (represented by -6) and then runs in reverse, forming a palindrome: [-6], +3, +3, -5, +3, +4, **-6**, +4, +3, -5, +3, +3, [-6].[7] In other words,

Figure 3. A Fragment of *Nhemamusasa*, performed by Samuel Mujuru, August 1996 (transcription: M. Scherzinger) and Harmonic Reduction (below)



[6] For an insightful discussion of the "standard" Shona chord sequence, see Tracey 1970b, 38–39.
[7] The -6 at the beginning and end of the progression represents the second of the two axis intervals of the cycle, between dyads VIII and IX.

Figure 4. The Intervallic Palindrome in the Dyad Sequence of *Chakwi*

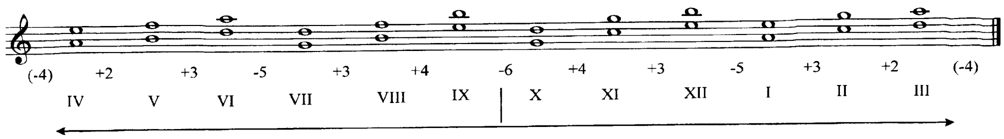


the intervallic pattern is a retrograde inversion of itself (or a palindrome). Crudely phrased, if one turned the score upside down and inside out (in a kind of double-mirror, which is to say, reading "back-to-front"), we find the identical dyad sequence.

Such symmetrical transformations are commonly associated with intellectual traditions of music cultures grounded in writing and notation. Retrogrades, inversions, palindromes, and other modular transformations, for instance, played an important structural role in the music of the Second Viennese School in the early decades of the twentieth century. However, this default assumption should not obscure the possibility that mathematical operations of this sort might, in fact, be a central component of rally-grounded African aesthetics as well. The *matepe* song *Aroyiwa Mwana*, emerging from a quite different tradition and elaborating a quite different harmonic progression, nonetheless exemplifies precisely this structural property in its dyad sequence. Figure 5, which rotates the original harmonic analysis by three dyads (for visual clarity), illustrates the intervallic palindrome of *Aroyiwa Mwana*. Once again, the intervallic sequence pivots after the descending sixth between dyads IX and X (represented by -6) and then runs in reverse, forming a different palindrome: [-4], +2, +3, -5, +3, +4, **-6**, +4, +3, -5, +3, +2, [-4].[8] As it is with *Chakwi*, the first six dyads of *Aroyiwa Mwana* constitute a kind of symmetrical analogon of the second six.

[8] Here the -4 at the beginning and the end of the progression is the second axis interval of the cycle, between dyads III and IV.

Figure 5. The Intervallic Palindrome in the Dyad Sequence of *Aroyiwa Mwana*



IV.

We can now proceed to a systematic presentation of some of the fractal-like features of the music's harmonic processes. Figures 6 represent aspects of these properties in geometric form for *Chakwi*. The analytic notation deployed here follows the example of Klaus-Peter Brenner (1997), who extends Andrew Tracey's (1970b) pulse notation to depict harmonic movement on a grid with two axes. Instead of mapping a series of durationless instants, the geometric representations dramatize the way these harmonic shapes track a kind of streaming *movement* from one dyad to another. The vertical axis represents quasi equi-heptatonic scale steps (or p values) and the horizontal axis represents a time line of quasi equidistant timespans (again, approximately four pulses per timespan). Circled points represent the low note of the dyad (marked with a C), and darkened points represent the fifth above/fourth below that chord tone. For *Chakwi,* timespan 1 (or t1) in the geometric representation lines up with dyad IX in the original music, and timespan 2 (t2) lines up with dyad X, and so on.

If the dyads outlined above are grouped together across different timespans (that is, on a diminished, or expanded, time scale), we find that harmonic groupings frequently constitute and resemble their own likeness elsewhere in their harmonic sequences. In other words, harmonic shapes are replicated in some form on a reduced, or enlarged, time scale within the same progression. The perceptual relevance of variable time span groupings is evident if we calibrate the internally patterned sub-grouping of the harmonic motion within these cycles in relation to the logic of variable/static elements *between* these sub-groupings (or harmonic shapes). For example, it is worth noting that in *mbira* and *matepe* music, the rate of harmonic change in a progression is often asynchronous with the patterned sub-grouping of the harmonic motion. Notice how in *Aroyiwa Mwana*, for instance, while the music is patterned around a ternary sub-grouping of harmonies (three harmonies per quarter of the cycle), we find a harmonic change on every *second* dyad. This results in a kind of harmonic "hemiola," where chord changes occur in a cross-rhythm to the unfolding of the four basic harmonic shapes. *Chakwi* too elaborates a kind of hemiola across its four quarters (although, unlike *Aroyiwa Mwana*, the hemiola in *Chakwi* is disrupted between its fourth and first quarters).[9]

If the dyads in *Chakwi* are grouped together as implied by the hemiola, and then contrasted with the original harmonic sequence, we find a series of untransposed fractal-like reflections on two time scales. These mirrored relations between harmonic shapes are often duplicated across time points under different transformational operations (retrograde, inversion, or retrograde inversion). In *Chakwi*, such identical harmonic shapes are expressed in retrograde diminution across the entire pattern. These fractal-like reflections in *Chakwi* are depicted in Figures 6.1 and 6.2. The figures illustrate the twelve possible three-dyad harmonic shapes constituted by grouping together every second dyad into a three-dyad entity and contrasts these with the twelve possible consecutive three-dyad shapes. The reduced-sized retrograde copies are untransposed reflections (sharing common dyads, or p values on the horizontal axis) of the larger shapes.

[9] For a discussion of the hemiola in the related song *Nyamaropa*, see Scherzinger 2001, 79–82.

Most enigmatically, the placement and timing of the changing fractal reflections itself constitutes a noteworthy set of phasing relations which unfold two simultaneous circles at two different tempi in contrary motion. In Figure 6.1 and 6.2, that is, the retrograde diminution forms occur at different points relative to the shapes they duplicate on a reduced scale. The large shape beginning on t1 (depicted on the upper left hand side of Figure 6.1.1), for example, embeds its reduced retrograde iteration within its spaces (depicted below it). The two shapes share the central dyad p5 at t3. The large shape beginning at t3 borders its reduced iteration on the left, as if the fractal had drifted to the left of the original shape, thereby musically anticipating it. The two shapes now share p5 at t3 as a bordering dyad. Where we find the large shape beginning at t5, the fractal is set adrift further to the left again and is thereby perceptually dislodged from the larger shape. Instead, the fractal now borders an additional congruent large shape constituted within the progression (depicted by dotted lines in the figure). Where we find the large shape beginning at t7 (in Figure 6.1.2), the fractal is set adrift to the left once more, thereby again bordering the large shape, but this time on the right hand side of the initial shape, thereby musically echoing it.

Notice how, for every odd-numbered movement to the right of the large harmonic shape (from t1 to t3 to t5, and so on), the diminution retrograde reflection drifts to the left by one timepoint (from t2 to t1 to t12, and so on). In other words, the fractal reflections are going out of phase with the large shapes they iterate. It is as if two self-similar dyad sequences flow along the vectors of two differently organized temporal series, which in turn are propelled by oppositely directed continuous motion.[10] This dual-speed, push-and-

[10] At t9 the process is disrupted as the fractal shape leaps four ts leftward instead of one, and at t11 the process dissolves.

Figure 6. Fractal-like Reflections for Three-Dyad Shapes in *Chakwi*:
6.1.1. Timepoints 1, 3, and 5

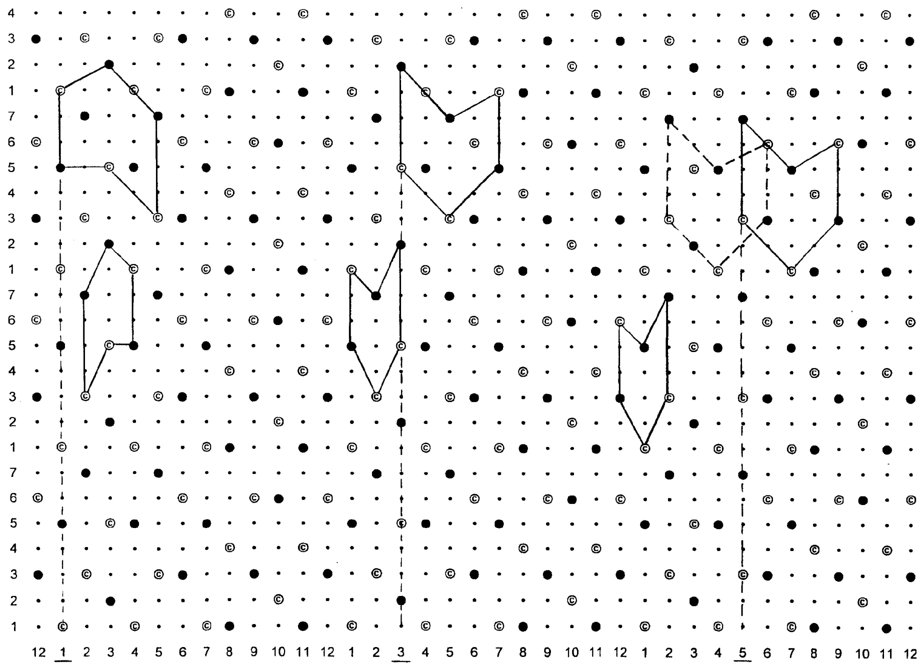


Figure 6. Fractal-like Reflections for Three-Dyad Shapes in *Chakwi*:
6.1.2. Timepoints 7, 9, and 11

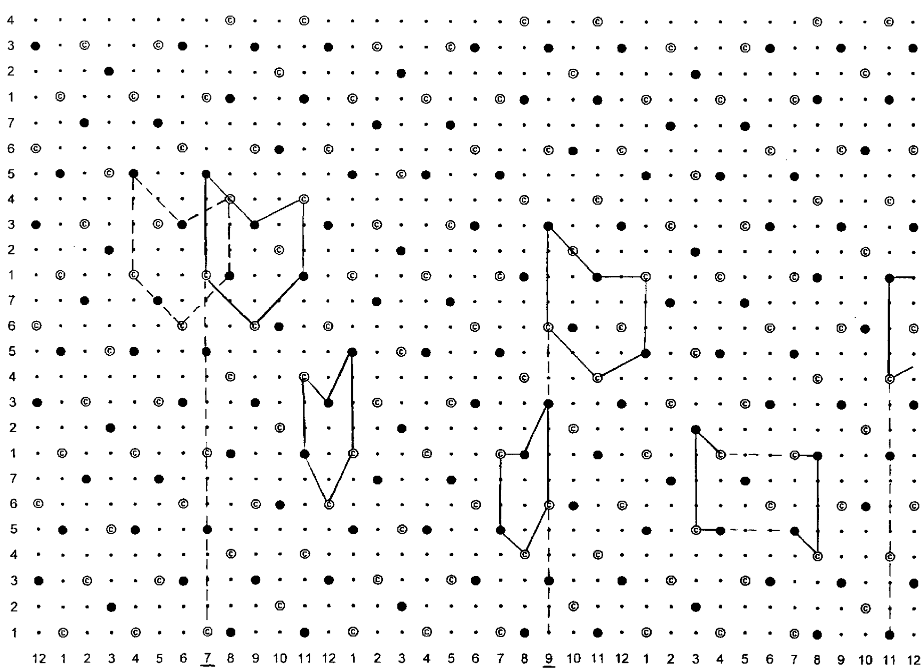


Figure 6. Fractal-like Reflections for Three-Dyad Shapes in *Chakwi*:
6.2.1. Timepoints 8, 6, and 4

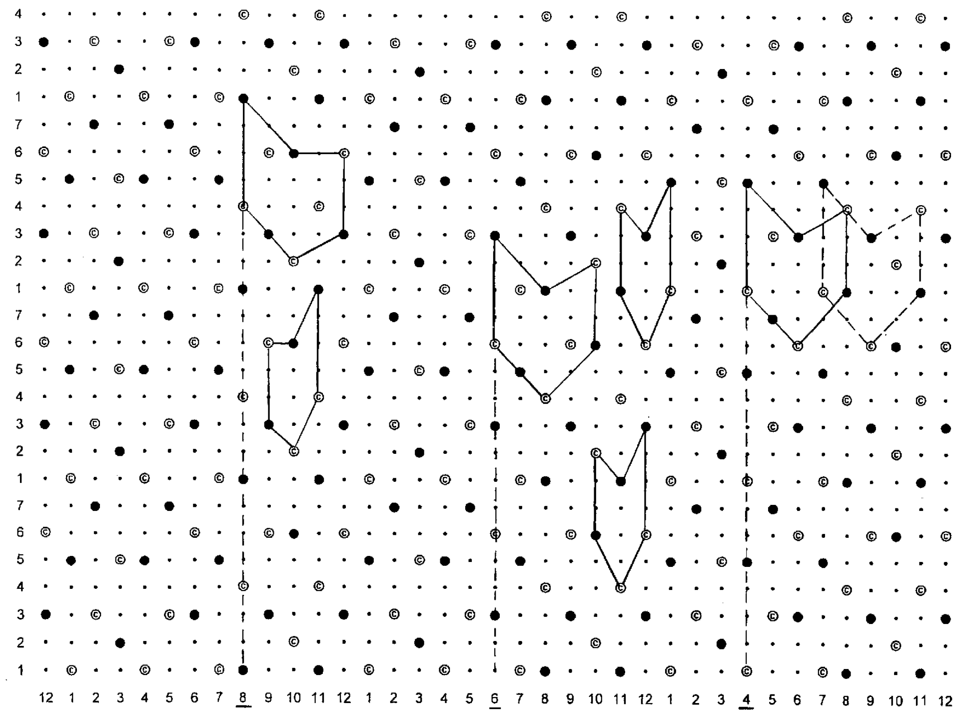
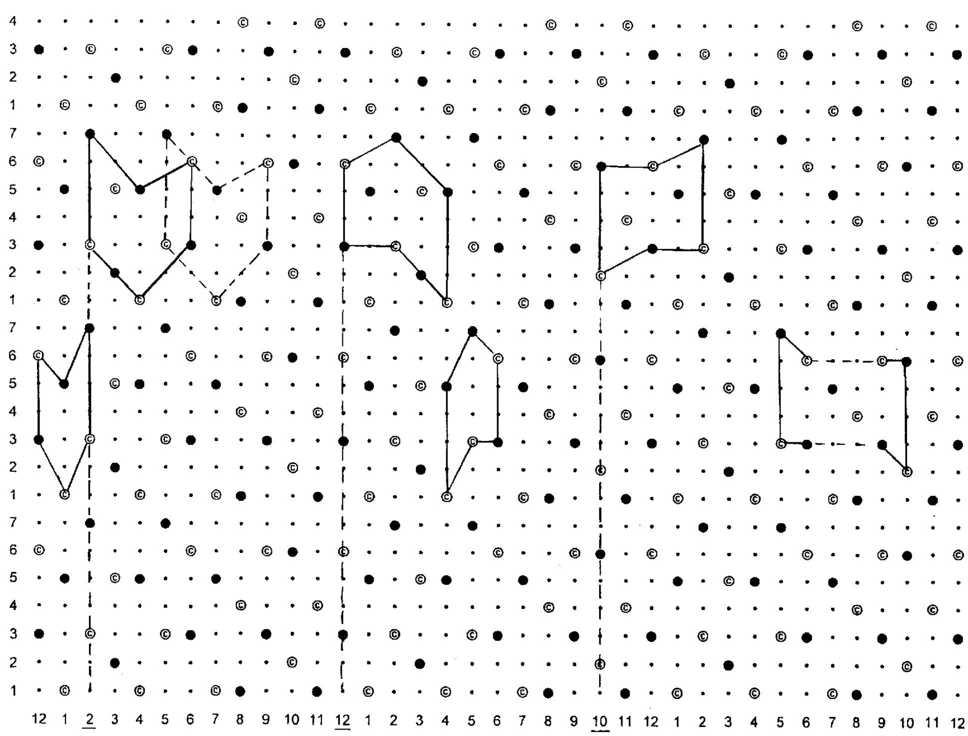


Figure 6. Fractal-like Reflections for Three-Dyad Shapes in *Chakwi*:
6.2.2. Timepoints 2, 12, and 10



pull temporality is mirrored by the shapes produced by even-numbered t-values and their fractal reflections depicted in Figures 6.2.1 and 6.2.2. Here, for every even-numbered movement to the left of the large harmonic shape, the diminution retrograde shifts to the right by one timepoint, once again touching the shape it iterates in consistently different ways.

The fractal-like relations between harmonic shapes described hitherto are all *untransposed* iterations at reduced/enlarged time scales. Yet *Chakwi*'s harmonic cycle embeds many more fractal-like relations when we factor for transposition. For example, using only the shape constituted by a movement of a third down followed by another third down on every second dyad, such as that found at t3 in Figure 6.1.1, we find a host of identical shapes at various pitch heights throughout the progression, shown in Figure 7. These large shapes (beginning on ts 2, 3, 4, 5, and 6) are echoed by fractal retrogrades (beginning on ts 10, 11, 12, and 1). Almost every dyad is thus an inmate of a harmonic shape participating in this particular kind of canonic fractal logic. Indeed, larger harmonic shapes (than the three-dyad groupings discussed so far) in *Chakwi* equally reflect variously mirrored fractal relations across the progression. In Figure 8 we find two types of reduced-size copies of harmonic shapes spanning six-dyad units. For the shape beginning at t12 (toward the left of the figure), the untransposed iteration on a reduced time scale is a retrograde of the initial shape (beginning at t9); and for the shape beginning at t1 (congruent with the shape at t12, transposed up a third), the iteration is an inversion of the initial shape (beginning at t11). The fractal-like iterations are thus projected by vertical and horizontal mirrors respectively, indicated by arrows in the figure.

Figure 7. Transposed Fractal Relations in *Chakwi*

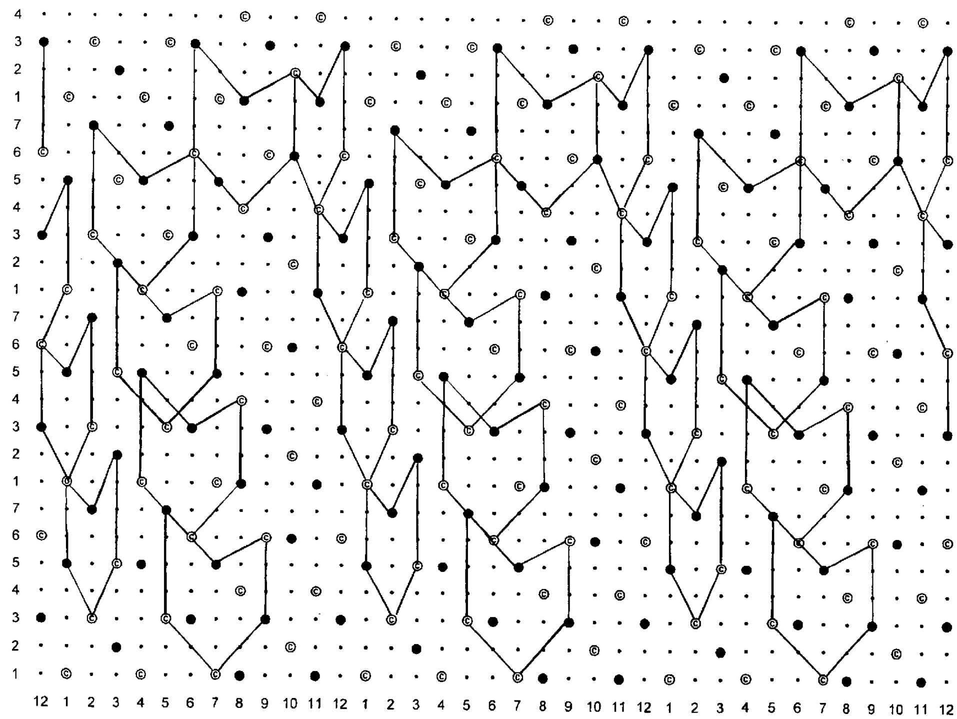
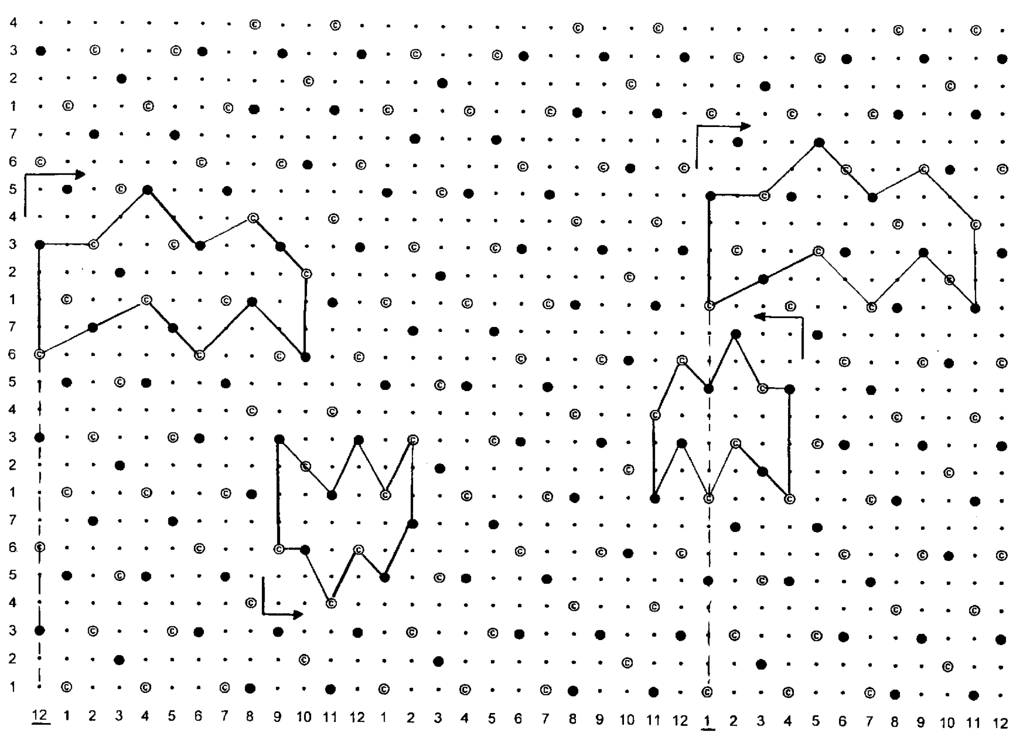
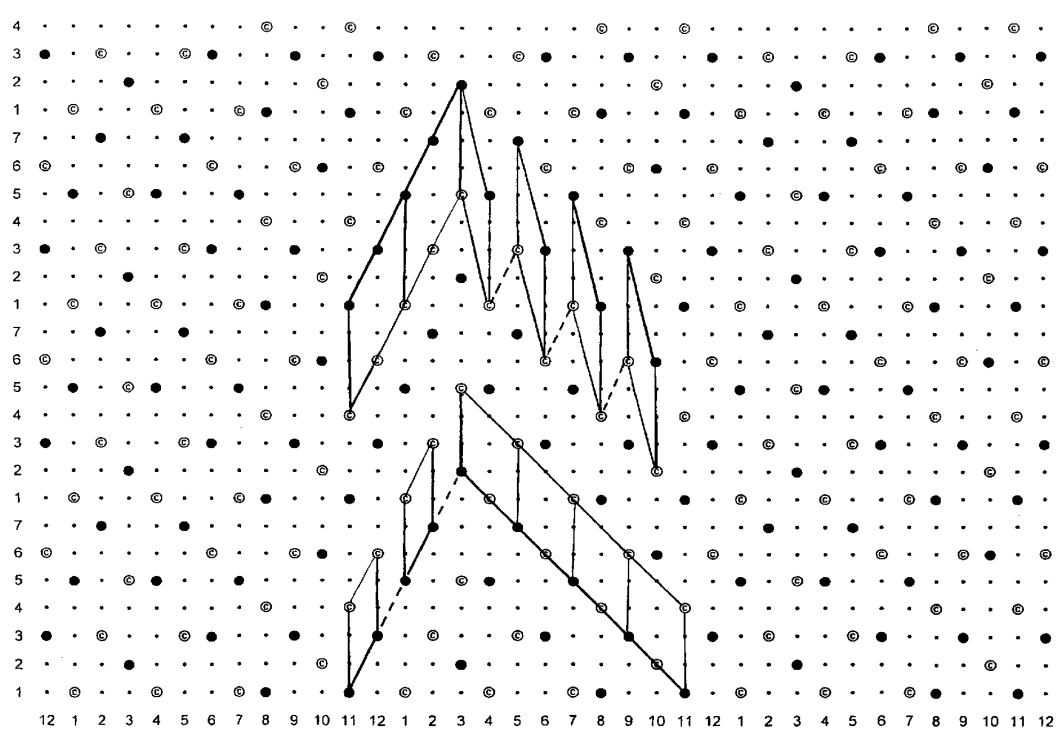


Figure 8. Six-Dyad Units and their Fractal-like Reflections in *Chakwi*



This kind of recursive self-similarity in *Chakwi* suggests ways of hearing the progression that are both ambiguous and uncanny. For instance, one could shuttle between the two-timespan groupings discussed hitherto *within* a single pattern. To mention but one example: the *Chakwi* progression could simultaneously be heard as two rising fifths (beginning on t11) followed by four descending fifths separated by rising thirds (when grouped in timespans of two, and then one, respectively); *and* as two rising thirds separated by rising thirds, followed by four descending thirds (when grouped in timespans of one, and then two, respectively). These dual possibilities are represented in Figure 9, with the former ("fifths") interpretation above and the latter ("thirds") interpretation below. Again, strangely contrasting, and yet similar, harmonic movements are produced when two tempi are delicately juxtaposed and interchanged in this way.

Figure 9. Ambiguous Modes of Hearing *Chakwi*'s Movement of Thirds and Fifths



Perhaps the omnitemporal, fractal-like recursion is best summed up for *Chakwi* in Figure 10, which depicts the four basic harmonic shapes of each quarter of the 48-pulse progression alongside four augmented retrograde reflections of these shapes. In Figure 10.1 the four adjacent harmonic shapes are labeled I to IV on the first staff (a). Each of these shapes has an augmented retrograde version of itself reflected on adjacent sides. On the right-hand border of harmonic shape I, for example, we find a reversed version, at half tempo, of the identical shape, depicted on staff (b). Both progressions share the dyad on E. We find the same fractal-like appearance of shape II on its left-hand border, depicted on staff (c), this time sharing the dyad on A; as well as for shapes III and IV on their right- and left-hand borders respectively, depicted on staff (d) and (e) respectively. Taken as whole, then, the augmented retrograde shapes saturate, canon-like, and in interlocking fashion, the entire progression (see staff (f)). Two oppositely directed harmonic paths, at two different tempi, are thus elaborated by the same basic harmonic progression. This twofold process is represented graphically in Figure 10.2.

V.

This kind of structural property probably adds evidence to the ethnomusicological proposition that the progression found in *Chakwi* is a rotation of a "standard" Shona chord sequence. Under this hypothesis, variations of the "standard" sequence are construed as elaborations or deviations, often explained with reference to structural limitations of the *mbira*-type under consideration (*njari*, *hera*, *matepe*, etc.), or to the "motor requirements" of the song in relation to the instrument.[11] However, there are a host of lamellaphone

[11] See, e.g., Andrew Tracey's (1970b, 38–43) discussion of the "standard" sequence and its variations.

Figure 10.1. Three-Dyad Harmonic Shapes and their Augmented Retrogrades in *Chakwi*'s Dyad Sequence

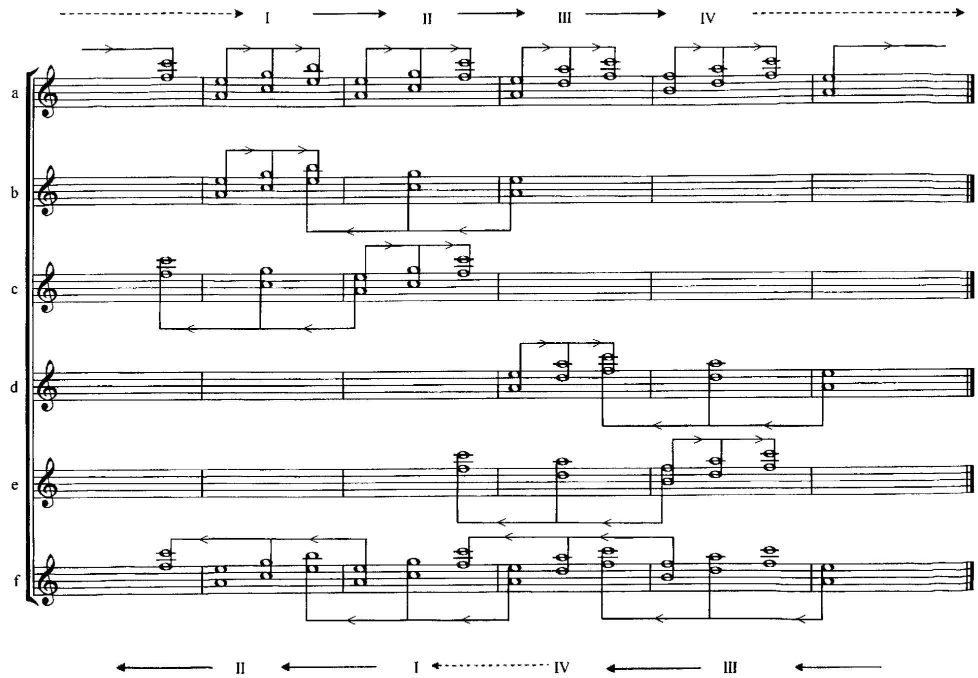
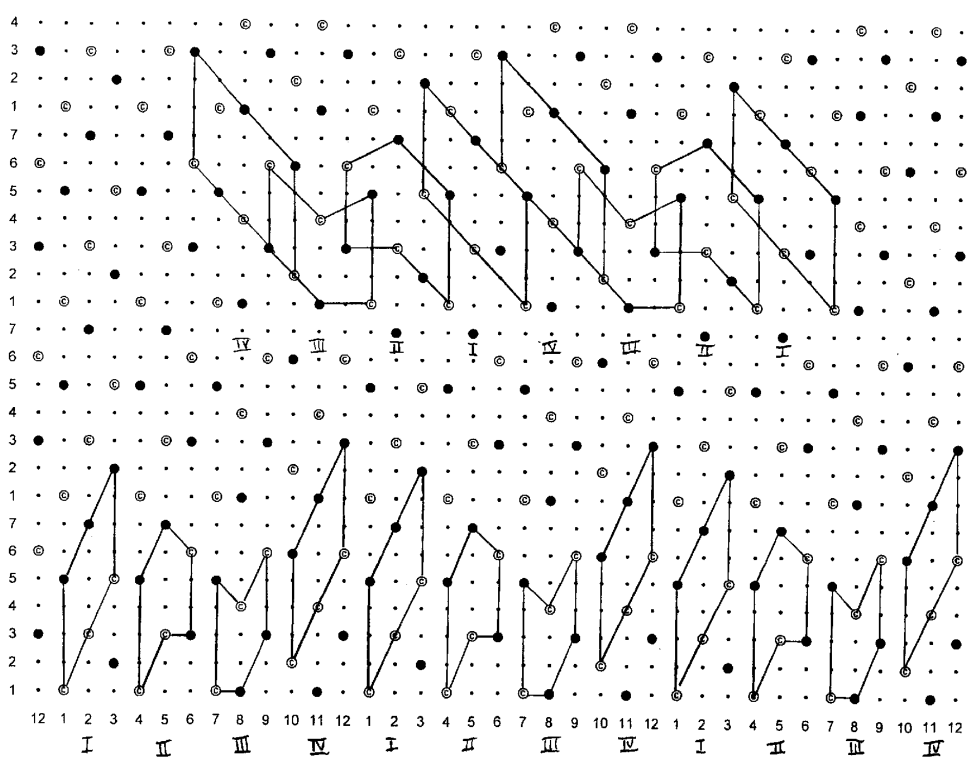


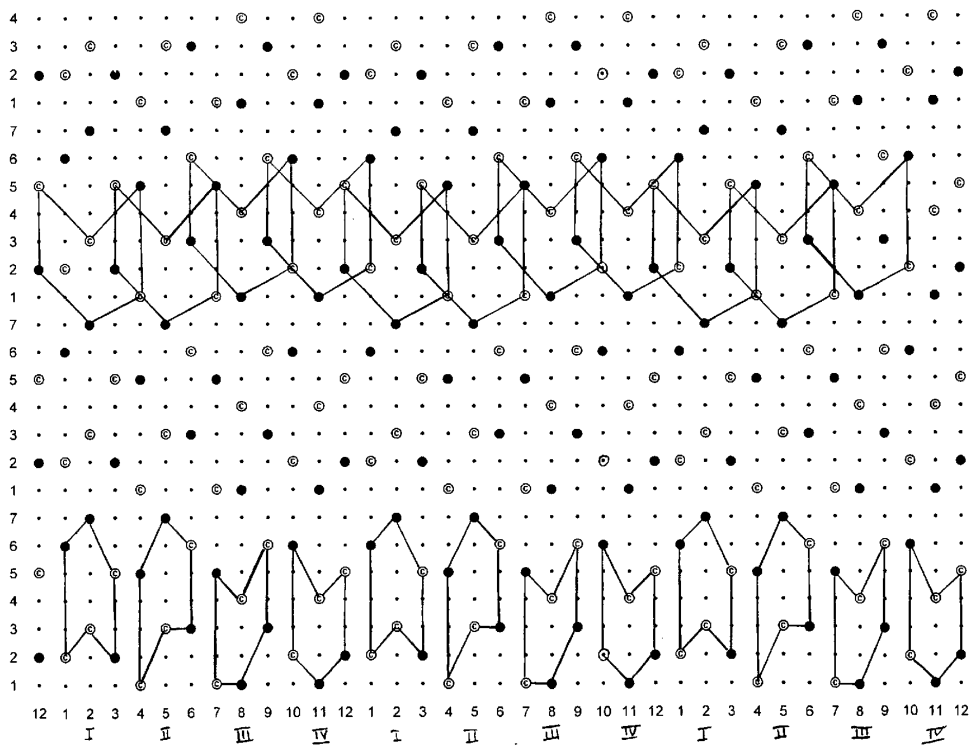
Figure 10.2. Three-Dyad Harmonic Shapes and their Augmented Retrogrades in *Chakwi*'s Dyad Sequence (Graphically Represented)



songs that do not in fact conform to the "standard" pattern, and whose deviations from that pattern may not be related to either the tactile conditions of their performance or the structural limits of the physical instruments. Here it is of particular interest that the abstract structural fractal properties found in *Chakwi*, especially the mirror relations woven across two tempi, are also found in the *matepe* song *Aroyiwa Mwana*, an obviously non-"standard" Shona chord sequence.

And yet, the fractal-like mirrorings found in the *matepe* song are less readily apparent than those in the *mbira* song, as they are embedded within a quite different ratio between simultaneous time scales. For example, if in *Aroyiwa Mwana* we group together every second dyad in retrograde (as in *Chakwi* in Figure 10), the resulting augmented geometric shapes, while congruent with one another, bear little relation to the initial dyad sequence. These non-relations, which contrast with the fractal-like relations in *Chakwi* depicted in Figure 10.2, are represented in Figure 11. However, if we enlarge the time-scale for the augmented retrograde shapes in *Aroyiwa Mwana* by a factor of five (instead of by two, as in *Chakwi*), the fractal logic comes into view. Consider the four adjacent harmonic shapes, labeled I to IV in Figure 12.1 (a). Once again, four identical harmonic shapes recur on an augmented time scale as retrogrades of the initial patterns (depicted in Figure 12.1 (b), (c), and (d) respectively). As it is with *Chakwi*, the fractal-like reflections of *Aroyiwa Mwana* appear consistently toward right- and then left-hand sides of the shapes they iterate, but this time they do not share a dyad on their respective borders. The untransposed retrograde shapes, augmented by a time factor of five, once again saturate the entire progression as a series of embedded interlocking canons. Two different tempi thereby likewise elaborate identical, but oppositely directed, harmonic paths through the

Figure 11. Non-Fractal-like Interlocking Harmonic Relations in *Ayoriwa Mwana*



same basic progression, depicted graphically in Figure 12.2.

Figure 13 illustrates the twelve possible three-dyad harmonic shapes constituted by grouping together every fifth dyad into a three-dyad entity and contrasts these with the twelve possible consecutive three-dyad shapes. Once again, the reduced-sized retrograde copies are untransposed reflections (sharing common dyads, or p values on the horizontal axis) of the larger shapes. The placement and timing within *Aroyiwa Mwana*'s changing fractal recursions (on two reversing time scales) constitutes a likewise enigmatic set of phasing relations. Figure 13 depicts the twelve possible augmented shapes and the retrograde diminution forms that duplicate them at various points. For example, the large shape beginning on t1 (depicted on the upper left hand side of Figure 13.1) embeds its reduced retrograde iteration within its spaces toward the right-hand side (beginning on t8).

Figure 12.1. Three-Dyad Harmonic Shapes and their Augmented Retrogrades in *Ayoriwa Mwana*'s Dyad Sequence

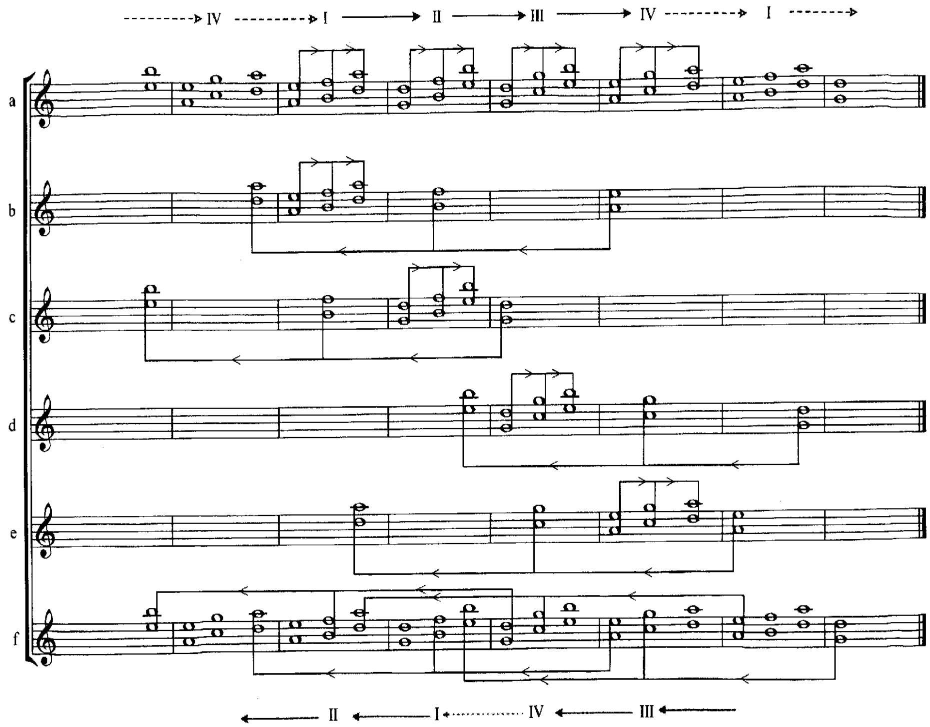


Figure 12.2. Three-Dyad Harmonic Shapes and their Augmented Retrogrades in *Ayoriwa Mwana*'s Dyad Sequence (Graphically Represented)

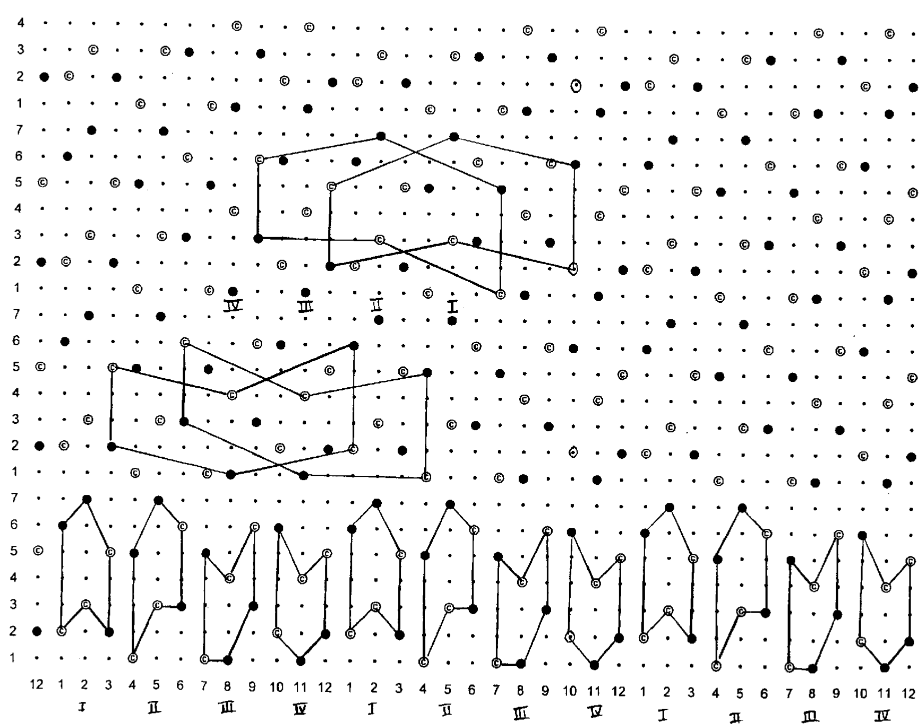


Figure 13. Fractal-like Reflections for Three-Dyad Shapes in *Ayoriwa Mwana*:
13.1. Timepoints 1, 2, 3, 4, 5, and 6

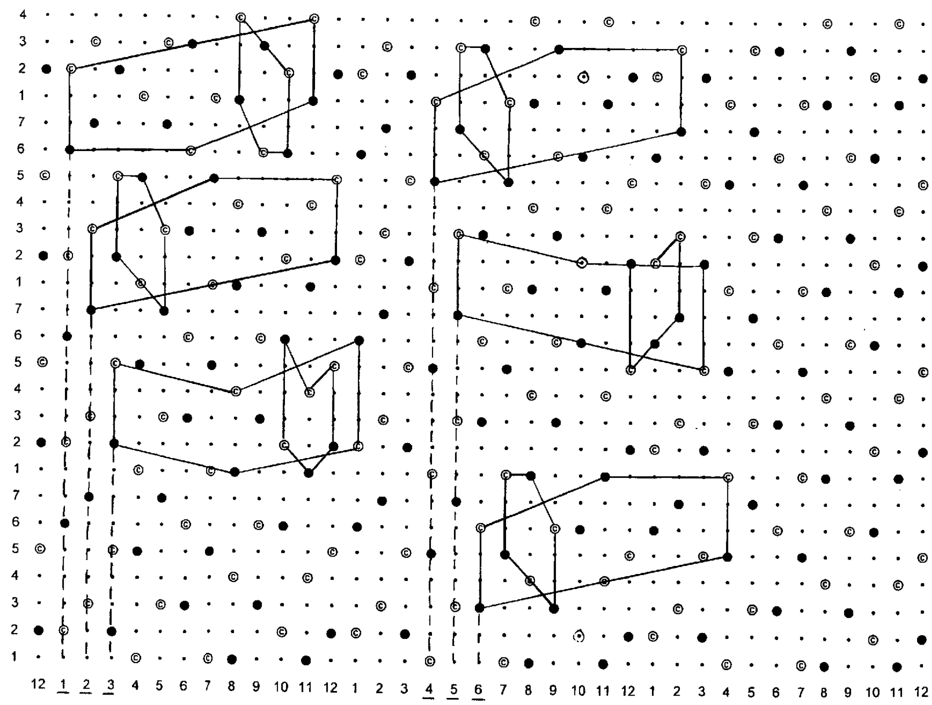
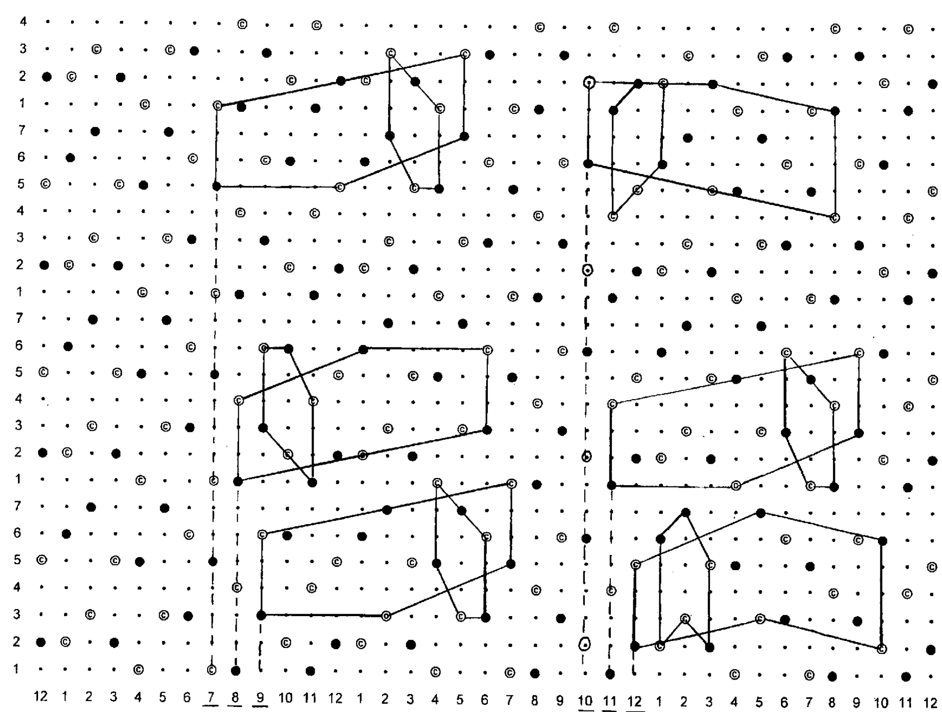


Figure 13. Fractal-like Reflections for Three-Dyad Shapes in *Ayoriwa Mwana*:
13.2. Timepoints 7, 8, 9, 10, 11, and 12



At t2, the large shape borders its reduced iteration within its spaces on the opposite side (beginning at t3), as if the fractal had drifted toward the left of the shape it duplicates. At t3, the fractal is set adrift toward the right again, at t4 toward the left, and so on. In short, for every timepoint "movement" to the right of the large harmonic shape (from t1 to t2 to t3, and so on), the diminution retrograde reflection oscillates from right to left throughout the progression (from t8 to t3 to t10 to t5, and so on). Once again, it is as if two self-similar dyad sequences flow along the vectors of two differently organized temporal series, which in turn are propelled by oppositely directed continuous motion. Unlike the phasing process of fractal reflections in *Chakwi*, the process here is not disrupted at any point, nor does it dissolve. Instead, the dual-speed, push-and-pull temporality is consistently extended throughout *Aroyiwa Mwana*, proffering fractal relations that completely saturate the progression.

It should be noted here that the fractal-like logic of *Aroyiwa Mwana* appears at a more perceptually obscure time scale than that of *Chakwi*, and yet *Aroyiwa Mwana*'s reduced symmetrical reflections recur in a more consistent and complete way than those found in *Chakwi*. This fact alone might contribute to disconcerting the notion that *Chakwi*'s progression incarnates the *Nhemamusasa/Nyamaropa* "standard" sequence against which *Aroyiwa Mwana* is merely a deviation. Still more disconcertible is the idea that such a deviation is a function of the material properties of the instrument and the performers' tactile limits—or, as it is also described, as a peculiarly African musical preference for motor movements over abstract sounding forms.[12] Indeed, a comparison

[12] Examples of such reasoning abound. In 1928 E. M. von Hornbostel advanced the idea that Europeans analyze rhythm by way of hearing, while Africans generate them by way of bodily motion (Hornbostel, 1928). More recently, John Bailey (1985) has argued that the perceptual focus on musical structure is an exclusively Western idea that cannot be readily applied to non-Western music. Using the *kalimba*

between *Chakwi*, an *mbira* song (found in the Harare region), and *Aroyiwa Mwana*, a song of the *matepe* (found in the Sena/Tonga/Korekore region) suggests an abstract structural affinity between instrumental genres, and thereby a presentiment of a different kind of "standard" pattern—now understood less as a "pattern" than a *system* grounding African musical practice across a differently inflected political geography. In fact, the geometric affinities fall outside the grasp and authority of anthropological reason itself, notably its mandatory vigilance toward cultural phenomena thrown into all-too-evident view by current cultural "practices" embedded in current social "contexts." If they speak to the anthropologically inflected discourse at all, these analyses probably imply unique cultural modes of figuring duration, directionality, temporality, and so on. But it is crucial to note here that such an implication—emphasizing the conceptual difference between African music and its Western (or Eastern) counterpart—is inaccessible to an (ethnographic) optic that asserts epistemological difference aprioristically.

The music of the *matepe* and the *mbira* elaborates striking modes of acoustic illusionism. As it is with its rhythms, the music's harmonic patterns are carefully constructed audile conundra. Their unfolding sequences have a riddle-like character, whereby every harmonic shape is imbricated in some kind of musical pun, its recursive forms running in reversible time on reduced (or enlarged) scales. What distinguishes *Chakwi* from *Aroyiwa Mwana* is less a deviation of a harmonic sequence and more a shift in the *time scale* ratio of a similarly omnidirectional fractal-like process. As I have argued

lamellaphone music of southern Africa as an example, Bailey (1985) identifies the physical patterns of fingering (instead of the sounding forms) as central to the organization of the music. His emphasis on the kinesthetic dimensions of African *kalimba* music, above the formal-perceptual ones, resonates with the words of Gerhard Kubik, who asserts that whereas "in Western music the movements of a musician playing his instrument generally have meanings only in terms of the sonic result, in African music patterns of music are in themselves a source of pleasure, regardless of whether they come to life in sound in their entirety, partly, or not at all" (quoted in Bailey 1985, 241).

in the context of the music's rhythmic processes, this can impress upon listeners and performers an experience of "phantom" likeness—a sound of unknown character or origin suddenly visited upon the music, as if from afar. The fractal-like recursion of harmonic shapes in curiously phased positions in the music can impress upon listeners and performers the beriddling experience of uncanny mimesis in contexts of transformation. Perhaps these reversible fractal logics proffer temporal structures that best reflect and reinforce the time-transcending character of the spirit possession they induce.

REFERENCES

Agawu, Kofi V. 2003. *Representing African Music: Postcolonial Notes, Queries, Positions.* New York and London: Routledge.

Bailey, John. 1985. "Musical Structure and Human Movement." In *Musical Structure and Cognition*, edited by Peter Howell, Ian Cross, and Robert West, 237–58. London: Academic Press.

Brenner, Klaus-Peter. 1997. *Chipendani und Mbira: Musikinstrumente, nicht-begriffliche Mathematik und die Evolution der harmonischen Progression in der Musik der Shona in Zimbabwe.* Göttingen: Vandenhoek.

Hornbostel, E. M. von, 1928. "African Negro Music." *Africa* 1: 30–61

Scherzinger, Martin. 2001. "Negotiating the Music Theory/African Music Nexus: A Political Critique of Ethnomusicological Anti-Formalism and a Strategic Analysis of the Harmonic Patterning of the Shona Mbira Song Nyamaropa." *Perspectives of New Music* 39(1): 5–117.

———. 2010. "Temporal Geometries of an African Music." *Music Theory Online* 16(4).

———. "Harmonic Fractals in the Music of the *Lamellaphone*." *Critical Interventions: Journal of African Art History and Culture* 9/10.

Tracey, Andrew. 1970a. *How to Play the Mbira (Dza Vadzimu)*. Roodepoort, South Africa: International Library of African Music.

———. 1970b. "The Mbira Matepe Music of Rhodesia." *African Music Society Journal* 4(4): 37–61.