

# West African Polyrhythm: culture, theory, and representation<sup>1</sup>

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**Abstract.** In this paper I explicate polyrhythm in the context of traditional West African music, framing it within a more general theory of polyrhythm and polymeter, then compare three approaches for the visual representation of both. In contrast to their analytical separation in Western theory and practice, traditional West African music features integral connections among all the expressive arts (music, poetry, dance, and drama), and the unity of rhythm and melody (what Nzewi calls “melo-rhythm”). Focusing on the Ewe people of south-eastern Ghana, I introduce the multi-art performance type called Agbekor, highlighting its poly-melo-rhythms, and representing them in three notational systems: the well-known but culturally biased Western notation; a more neutral tabular notation, widely used in ethnomusicology but more limited in its representation of structure; and a context-free recursive grammar of my own devising, which concisely summarizes structure, at the possible cost of readability. Examples are presented, and the strengths and drawbacks of each system are assessed. While undoubtedly useful, visual representations cannot replace audio-visual recordings, much less the experience of participation in a live performance.

## 1 West African music as a holistic poly-kino-melo-rhythmic socio-cultural phenomenon

Traditional West African music presents complex rhythmic and metric structures, through song, dance, and instrumental music – particularly (though by no means limited to) percussion music. This situation prevails, in particular, in Ghana cf [1, p. 62], a country whose music I have studied both in North American, and during multiple visits for research and teaching there since 1988 (though I am by no means an “insider”!).

In the Volta Region, in that country’s southeast, traditional music of the Ewe<sup>3</sup> people is polyphonic, layering multiple performative lines, through diverse expressive media - dance, song, and percussion (bells, rattles, and drums), each carrying different rhythms. Some of these lines are nearly periodic (cyclical patterns, or *ostinati*), though there is typically always room for variation, both in macro-rhythm<sup>4</sup>, and in micro-timing<sup>5</sup>. Others are more dynamic, evolving in a linear fashion. Much the same situation prevails, with entirely different styling,

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<sup>3</sup> In proper orthography: “Ewe”. See Appendix.

<sup>4</sup> Toggling regular pulses from attack to rest, or vice versa, e.g. from  to , or changing their timbres.

<sup>5</sup> Shifting the attack point by less than a pulse duration, e.g. slightly anticipating the second eighth note in  (so-called “swing eighths”).

for each of Ghana's dozens of ethnic-linguistic groups, many of which also feature melodic instruments such as xylophones, flutes, and lutes. [2]

A lead drum line often sings longer phrases, using a wider array of pitch-timbres,<sup>6</sup> with greater latitude for rhythmic choice, variation, and improvisation. The lead drum frequently introduces cross-rhythms that contrast sharply with the regular beat (often danced or clapped), as well as the underlying instrumental ostinati (played on bells, rattles, and the more restricted drum parts), presenting a sharp contrast in metric organization. Often these are "calls," demanding particular responses from other drum lines, or from the dancers, whose lines emerge visually, as well as sonically-somatically, through body sounds (e.g. claps), sonorous costumes (e.g. ankle rattles), and contact with the earth, which they pound with their bare feet.

All the while there is song – exhibiting its own call/response structure and rhythms that may either supplement or complement those of percussion – and dance, a visual-spatial music of bodies: heard, felt, and seen. These rhythms also carry meaning, sometimes linked directly to the tonal Ewe language (Evegbe). Sometimes a dramatic aspect is added, introducing a narrative element. Thus "music," or (more accurately) "performance", is a polyphonic poly-kinetic semantic fabric of call/response pairs, seamlessly woven across multiple arts differentiated in the West as poetry, dance, and drama, as well as music per se.

Traditional West African music never distinguishes music as a separable art of sound, nor rhythm as a separable art of time, as is typical in the West. Rather, what the West divides among arts of music – percussive, instrumental, vocal – poetry, and dance is united as one, in name (what the Ewes call "vu", literally "drum"), and in performance itself. Likewise, the supposedly separable dimensions of music – time and frequency; rhythm, melody, and harmony—remain as audible aspects of an undifferentiated whole, unnamed as such. Indeed there is usually no word for "rhythm" itself! [3, p. 388] Any attempt to isolate one element of this holistic expressive-musical-perceptual continuum can only be characterized as imposition either of an outsider's ethnocentric bias, or of an analytic perspective ("etic") more characteristic of educated Ewe scholars than ordinary participants.

Percussion in West Africa is social, and socializing. Whereas in Western popular and jazz musics, percussion is typically concentrated in a single individual, weaving together multiple parts on a compound instrument, the "trap set" (from "contraption"), in West Africa percussive performance is distributed across interacting individuals, each playing a single instrument, cueing or responding to each other. In this way percussive performance naturally induces social interactions, intensified by polyrhythmic relationships of call and response, backbeat, syncopation, or polymeter, sedimenting as social relationships.

These three expressive forms—music, poetry, and dance—drawn from rich and continuous (though never entirely unchanging) cultural traditions, and unfolding in parallel during performance, quasi-independently but always interrelated, gather and reinvigorate social communities, through mass participation combined with communicative, adaptive feedback processes inducing shared emotion: what I call "resonance", the musical aspect of Durkheim's "collective effervescence"(see [4]). Through this emotive participation, social linkages are forged and renewed; collective memory, meaning, and identity are instilled, maintained, and confirmed, and the intergenerational continuity of sociocultural life is assured (see [5]).

In Ewe music, for instance, where melodic instruments are not generally employed, each of the three strands – percussion, song, and dance – operates through each of three musical dimensions (rhythm, tonality, movement) as situated in three perceptual-physical dimensions

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<sup>6</sup> Percussion instruments produce multiple timbres, each with a distinctive pitch range. I group these properties in the concept "pitch-timbre", further elucidated below.

<sup>7</sup> For Ewe orthography, see Appendix.

(time, frequency, space). Music structures those dimensions in order to provide expressive channels: rhythm is structured time, tonality is structured frequency, movement is structured space-time. But every expressive form operates through all three, if not equally. Thus percussion music exhibits a highly melodic style, in which pitch-timbre plays key aesthetic and linguistic roles, and often exhibits highly visual elements, especially in the physical movements of the rattle player. In particular, percussion music is never simply “rhythmic”.

	<b>Time (rhythm)</b>	<b>Frequency (tonality)</b>	<b>Space-time (kinetics)</b>
<b>Percussion</b>	Attack (onsets)	Pitch-timbres	Body movement
<b>Song</b>	Sung durations	Melody, counterpoint	Circulation of singers
<b>Dance</b>	Articulation points	Vocal calls	Choreography

**Fig. 1.** Percussion, song, and dance each exhibit multiple dimensions intersecting what Western theorists typically delimit as boundaries of aesthetic expression. For instance, dancers call; song melodies recapitulate drummed rhythms; drumming carries tonal information via multiple pitch-timbres, for both aesthetic and linguistic communication.

Yet the global image of West African music, even among scholars, centers on percussive rhythms. This reduction is a stereotype, indeed a serious distortion. Non-African scholars, musicians, and educators have tended to be preoccupied with African rhythm and percussion to the neglect of other performative aspects: melody, poetry, and dance. If von Hornbostel went so far as to say that African rhythm is primarily drumming (or “beating”) [6, p. 52], he was assuredly not alone. But it is also true that many African musicologists and educators have also focused on African music’s temporal aspects - meter, rhythm and (what is thought to most clearly carry them) percussion and drumming, though never to the exclusion of song and dance [7]–[9]. London-trained Philip Gbeho, composer of Ghana’s National Anthem, first conductor of the Ghana National Symphony, and accomplished performer in both European and traditional Ewe music, wrote that “rhythm is the heart of the tune” [1, p. 62]. Francis Bebey, Cameroonian writer and composer, wrote that drums “... epitomize the real definition of African music—a music that speaks in rhythms that dance.” [10, p. 92] Of course it may be simplistically claimed that these scholars too were operating in a colonial framework, educated in Western or Westernized institutions, preoccupied with addressing Westerners or Westernized Africans, self-exoticizing and not yet liberated from an empowered colonial gaze through which Africa appeared different and exotic, if not downright “primitive”. Even if the reality is rather more complex, the percussion-rhythm bias is certainly there.

Kofi Agawu has pioneered the most sophisticated critique of Western representations of African music, tracing the historical invention of “African Rhythm” in light of European and postcolonial discourse, as manifested in works by African as well as Western scholars [3], [11].

Prior to his eloquent and masterful deconstructions I had also naïvely confirmed and addressed the same issue in my thesis research on an Ewe funerary performative type called Kinka [12]. Counter to the “drummed rhythm” focus of much early ethnomusicology, my research focused on song, song composition, song leaders, and polyphonic song performance – not drumming – giving due attention to poetic and tonal, as well as rhythmic, aspects. But I did not intend this focus as an attempt to redress past imbalances in representation. Rather, my research showed that song is culturally and performatively central to Kinka performance. Singing and poetry, not percussion, appeared as the cognitive focus for the majority of participants, and the composer-song leader was the most important figure – not the drummer. The drumming is still critical, providing the basis for dance, but Kinka drummers are

relatively few (and exclusively male). Most participants are women, and they don't drum – they sing and dance.<sup>8</sup> The same is true of nearly all Ewe music.

The fusion of percussion music (bells, rattles, and drums), with its periodicities (ostinati), song melody and poetry, and dance, including the multiple call/response pairings, whether between lead and supporting drums, or between lead drum and dancers, and the dense aesthetic web linking these to call/response song, is called a *vu*, literally “drum”, the instrument itself serving as a synecdoche for the larger concept of “performative type,” of which there are many. Different *vu* are used to accompany rituals for each traditional deity. There are *vu* for festivals, for chief installations, and – formerly – for war. Participation as percussionist or dancer in some of these contexts is restricted – sometimes to initiates, or to specially trained performers. Other *vu*, often of more recent provenance, are performed for funerals, or for general recreational purposes; on such occasions participation is more open. This unified whole constitutes the performative fabric binding traditional Ewe community life throughout the rural areas.

While holism is the ideal and maximally ethical representation of West African performance, one need not find that whole in every sentence, paragraph, or even article written about it. It is in the nature of scholarship to analyze, and thus acceptable, in my view, to focus on elucidating principles of percussive rhythmic organization so long as the broader context is presented first and kept in mind. In particular, while focused on percussive rhythm we should remember the first row and first column of Figure 1: that common rhythmic principles also weave through song and dance, and that percussion music is also tonal and kinetic. For the sake of the latter point, we would be wise to follow the acclaimed Nigerian scholar, composer, performer and choreographer, Meki Nzewi (b. 1938), who stressed the fusion of the rhythmic and the tonal-timbral, in what he calls melo-rhythm [14]. As he writes:

One must understand the governing mental conception of folk rhythmic organisation. According to the prevailing notion of drumming in Africa, it carries only an unrelieved rhythmic function of a purely percussive quantity. But in actual performance there is scarcely any drum that takes on the role of an isolated percussive-rhythm function in the musical ensemble [...] I use the term *melo-rhythmic* to refer to a rhythmic organization melodically conceived and melodically born. This kind should be recognized as having a different orientation which the rhythm of a music has a more independent derivation. In West African folk music the rhythms of the percussion are firmly rooted in the melo-rhythmic essence, not in the sonalised percussion function typical of Western percussive style. [14, pp. 23–24]

Likewise, studying music of Ghana, the pioneering British musicologist A.M. Jones (1889-1980) noted that “When Africans beat drums they play *tunes* on their drums.” [15] It is not merely that the same rhythms appear in drumming, dancing, and singing, but that the drumming itself must be treated as a melodic and kinetic phenomenon, so that percussion can sing and dance, and even speak.

The significance of drummed melo-rhythm throughout West Africa is twofold. On the one hand, it is an aesthetic phenomenon. Drums are tuned, and played in different ways (with hands or sticks) to produce a range of timbres at different pitch-levels, what I call “pitch-timbres”, that can be manipulated to create moving musical beauty. On the other hand, it is a

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<sup>8</sup> Perhaps Western artists and scholars have neglected African poetry and song due to the language barrier, while finding percussion more “exotic” and hence appealing. I didn't learn Ewe but nevertheless did take the time to transcribe and translate lyrics of some 50 Kinka songs for the core of my thesis, later released in condensed form as liner notes for an audio CD [12], [13].

linguistic phenomenon, by which the contour of drummed tones mimics that of speech, for nearly all Ghanaian languages (including Ewe) are tonal.<sup>9</sup>

One might extend this notion further, to encompass dance movement, in what I call kino-melo-rhythm. Adding the concept of polyphony one arrives at a veritable, but accurate, tongue-twister: poly-kino-melo-rhythm.

The question raised by this paper is this: how can multiple melo-rhythms best be represented in a visual notation? Here the word “best” conceals many different, often incommensurable, evaluative metrics; deciding what is “best” requires considering and reconciling many issues of representation. I will not spend much time addressing them in all their social and ethical complexity, but will simply raise them here, then touch on a few of them briefly when summarizing the advantages or disadvantages of each approach.

1. **Etic vs. emic methods and perspectives:** the former characterize transcultural music theories aspiring to “objectivity”, while the latter – more characteristic of contemporary ethnomusicological approaches—seek meaning within a local cultural horizon. (But can there be any “objective” view of music?)
2. **Outsider vs. insider understanding:** whose musical understanding is represented, who is representing, and for whom is the representation? Inside the culture concerned – or outside it?
3. **Use:** is the representation to be used *prescriptively* (for performance) or *descriptively* (for documentation, analysis, or theory)? Is it effective?
4. **Writability:** Who can write it, and how easily? Does it require special skills, or software?
5. **Readability:** Who can read it, and how easily? Does it require special skills, including languages? Is it machine-readable?
6. **Representatum:** What is to be represented? Sound, perception of sound, or cognition of sound? Or perhaps the physical interaction of people and their instruments? (e.g. tablature).
7. **Parsimony:** Is it as simple as possible, but no simpler? (And what is “possible”?)
8. **Universality.** Western vs. Scientific vs. Local vs. New. Western notation is a *de facto* universal (all music students everywhere study it), but isn’t necessarily most appropriate, and continues a long history of cultural impositions and appropriations. Scientific notation appears objective and neutral, but is it? How are local representations expressed? How might local theorizations be embedded in a new notation?
9. **Afrocentrism:** African music (including that of the African diaspora), should be treated as a diverse whole, but has been *mistreated* by colonialism, raising the question: Is this an African representation? Is it an ethical one? Who has the *moral right* to represent this music in this particular way?
10. **Ethnocentrism** (Eurocentrism). How have cultural biases affected choice of notational system (notably and ironically, charges of ethnocentrism have been evoked by *both* the application *and* the rejection of Western notation for West African music [3, pp. 390–393], [16])

In this paper I compare three systems offering a descriptive representation of poly-melo-rhythm:<sup>10</sup> the Western notational approach, the matrix approach, and my own, typographical approach. All three capture aspects of poly-melo-rhythmic structure—West African or not—so that it can be better understood, whether for musical analysis, ethnomusicology, social-

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<sup>9</sup> All languages use tone prosodically (e.g. rising tone can mark a question in English). But in tonal languages, pitch can differentiate lexical units.

<sup>10</sup> I will not be treating kino-rhythm, including the dance.

psychological research, performance, composition, or sheer appreciation. None can be considered a local or African representation, but each may be useful nevertheless, in its own way.

## Concepts for poly-melo-rhythm

While no visual notation can fully capture the *experience* of melo-rhythmic polyphony – which is social as well as sonic and spatial – each notational system provides certain advantages in conveying that experience, whether the goal is to learn, to perform, or to understand.

Traditionally, people in West Africa learn music orally. They have no practical need for visual notations. Outsiders can learn orally too. But local culture bearers have the advantage of musical enculturation from infancy, growing up with regular participation in their traditional performance, over a long period of time. Such long-term enculturation is particularly critical for a musical culture, such as that of the Ewe, which lacks a formalized teaching tradition (as is found not only in Western classical music, but in other musical worlds as well, for instance in China, Japan, and India). Therefore, visual notations, while undoubtedly an artificial crutch foreign to the local musical culture, and one that should ultimately be discarded if true understanding is to be achieved, are nevertheless useful to help accelerate learning and understanding for foreign music students and scholars, who have not enculturated from infancy, but must rapidly acculturate as adults.

As a prolegomenon to presenting the three systems, I will attempt to rigorously define a number of concepts whose usual definitions are often confused or elusive. The focus is pulsed poly-melo-rhythms based on cyclic forms, a phenomenon that dominates in traditional West African music. Other types of music, and important temporal domains, such as micro-timing and ametricity, are not covered here. The following concepts will be usefully applied in what follows:

- **Subjective vs objective sounds:** Unlike other perception words (“taste”, “touch”, “smell”), the word “sound” refers both to a mental perception, and to a physical phenomenon, and these are completely different. Subjective sounds are perceptions: unsounded, and psychoacoustical; varying from one listener or performer to another, they include concepts such as pulse, beat, meter, and polymeter (see below). By contrast, objective sounds are sounded: external acoustical facts. The latter imply the former, but their implications may be ambiguous (leading to differences among simultaneous listeners concerning polymeter, for instance). Subjective sounds are potentially unsounded - psychoacoustic “possibilities” only. Being interior, they are notoriously difficult to determine in research, and typically hard to describe in language. Ethnomusicologists have grappled with this fact, particularly in African music where temporal aspects, and especially polymeter, has been the subject of so much scrutiny. Ethnomusicological fieldwork (combining interview, participant observation, music lessons, and performance) may reveal the ways people are hearing, sometimes inferred from interview or (since culture bearers typically lack the formal Western musical training required to describe their subjective soundscapes in music theoretic terms) behavior, for instance by assuming that dancing, clapping, or foot-tapping manifests an inner beat. But the matter is highly fraught since listeners may choose to tap their feet on what they sense to

be an offbeat.<sup>11</sup> The question “Where is the beat?”, difficult to translate into local languages, and (especially once translated) carrying little meaning for many, is correspondingly hard to answer accurately. Thus, determining where the beat is – or even if there is a beat – is anything but straightforward for all but the musically educated. Yet acquisition of the knowledge required to understand and answer even such a relatively simple music theoretic question tends to be correlated with a particular kind of upbringing (e.g. urban, advanced education, media immersion, even travel abroad), correlated with the loss traditional musical understanding of rural areas.

- **Block:** a duration or period of time bracketed by a minimally accented onset and (unaccented) closure point, subjective or objective, i.e. defined acoustically, or implied psychoacoustically through a combination of sonic cues and cultural habituation. The onset point tends (almost by definition) to be clear for percussive music: the attack. Closure, however, is ambiguous, and may be established by the next onset in the same line (see below). Besides timing, a block may additionally carry pitch or timbre information.
- **Note:** a block heard or felt as a sonic presence (subjective or objective). This concept, along with that of “rest”, refers metaphorically to notation, but without necessarily invoking it. A note may exhibit different levels of **accent** (perceived volume).
- **Rest:** a block heard or felt as an absence (whether sounded or not). Rests may also be accented (consider the Hindustani concept of *khali*)
- **Cycle:** a periodic musical sound, whether subjective or objective.
- **Start point:** in a cycle, the subjective moment where the cycle is perceived to begin. The start point is independent of any metrical accent and can even occur on a rest. Different listeners can disagree on the start point while agreeing on everything else (e.g. pulse, beat, meter). The start point may be approximately inferred from the first objective block, as the music begins. Otherwise, the start point of an objective cycle is arbitrary: a circle with no beginning. (Often it is arbitrarily assigned to the primary metric pulse. But listeners may not hear it that way!)
- **Phase:** the relation between subjective cycle (perceptual start point) and objective cycle (arbitrary start point).
- **Line:** (1) a linear sequence of blocks subjectively linked due to similarities in timbre, pitch, loudness, or spatial location; (2) (recursively) a bundle of simultaneous lines, subjectively fused due to similarities in timbre, pitch, loudness, or spatial location. Thus a call/response relation may be perceived as two linked lines (1) or a single fused line (2). A line may be objective or subjective.<sup>12</sup>
- **Pulse:** line comprising a sequence of relatively short blocks of fixed (or, if tempo fluctuates, gradually and continuously varying) length, the pulse period, which is also the “unit” of time as it evenly divides nearly all other blocks (in the same section): all block onsets and closures align with a pulse block onset. The pulse is primarily subjective: implied but typically not overtly stated in musical sound.

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<sup>11</sup> In Ghana, around 2010, I once witnessed two master musician-dancers, listening to the same polymeter and foot-tapping on different beats!

<sup>12</sup> Subjective play in line formation results in the phenomenon of auditory streaming, playing a key role in Zimbabwean mbira music, for instance. But the same phenomenon can be perceived in a Bach solo cello suite. In either case there is *polyphony of perception*.

(Ethnomusicologists have called this fastest pulse the “density referent” [17], “common fast beat” [18], and “referent” [19].)

- **Section:** temporal span during which a single pulse prevails. The pulse changes discontinuously or stops at the section’s beginning and end (these points may or may not mark the end of the “piece”, whatever that is construed to be).
- **Rhythm:** a contiguous segment of a line, reduced to a sequence of pairs, each pair indicating block type (note or rest) and length (in pulse units). May be objective or subjective.
- **Cyclic rhythm:** a repeating (periodic) rhythm
- **Melo-rhythm:** a rhythm whose blocks are characterized by pitch and timbre as well as type and timing.
- **Cyclic melo-rhythm:** a repeating (periodic) melo-rhythm.
- **Kino-rhythm:** a rhythm established by or impelling corresponding body movement (clapping, foot tapping, dancing)
- **Beat:** line comprising sequence of blocks of fixed (or continuously varying) length, manifested in the primary kino-rhythm (feel, i.e. basic physical movements such as clapping, foot tapping, and dancing tend to align with a beat block onset). The **offbeat** is a phase-shifted beat, while the **backbeat**—defined for meters whose top hierarchical level is four-fold (i.e.  $4/4$ ,  $12/8=4*(3/8)$ )—is the line comprising beats 2 and 4 in the cycle. (The combination of beat and backbeat may be interpreted as a simple form of polyrhythm or polymeter.) The beat always aligns with the pulse, with a fixed number of pulse blocks per beat block. The beat is primarily subjective: implied but typically not overtly stated in musical sound.
- **Tempo:** number of beat blocks per minute (i.e.  $60/\text{length of a beat block in seconds}$ )
- **Meter:** a subjective cyclic (periodic) poly-melo-rhythm comprising a polyphony of subjective, cyclic melo-rhythms, such that the metrical period (the length of the longest cycle) is divisible by the period of every cycle in the polyphony. Inverting these periods to obtain frequencies, we see that each cycle establishes a harmonic of the fundamental. If the ratios between successive harmonics is a series of integers, the meter is called *divisive*. A metric cycle constructed by concatenating a single period from each of a series of different divisive meters yields an *additive* meter. Combining these cycles generates a pattern of timbral-tonal accents of varying intensities. In Western music and its notation, one of a small number of patterns are denoted by fractions, the denominator indicating the reciprocal of the note value, whose quantity is indicated by the numerator, which may denote either the beat or pulse period. Common denominators are 2, 4, and 8, indicating half note, quarter note, and eighth note (respectively). Common numerators are 2, 3, 4, 6, or 12, where 6 and 12 indicate a “compound” meter, two or four groups of three. Each numerator/denominator combination is conventionally associated with a particular hierarchical pattern of accent groupings.<sup>13</sup> Meter is subjective, but is typically implied by acoustic cues (e.g. accent) shaped by perceptual processing and cultural habituation, and may be

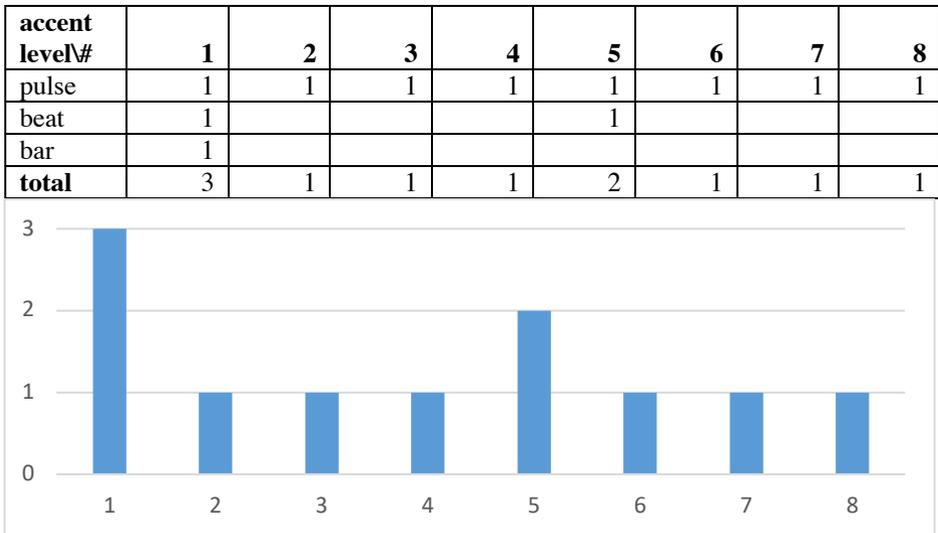
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<sup>13</sup> These are all “divisive” meters, e.g.  $4/4$  is generated by dividing the metrical length in half, then those halves in half, and so on. In contrast, “additive” meters containing odd numbers of equal beats, such as  $7/8$  (which may be formed by concatenating  $3/4$  and  $4/4$ ), are uncommon either in the West or in West Africa, but appear frequently in former Ottoman lands, from Turkey to the Balkans.

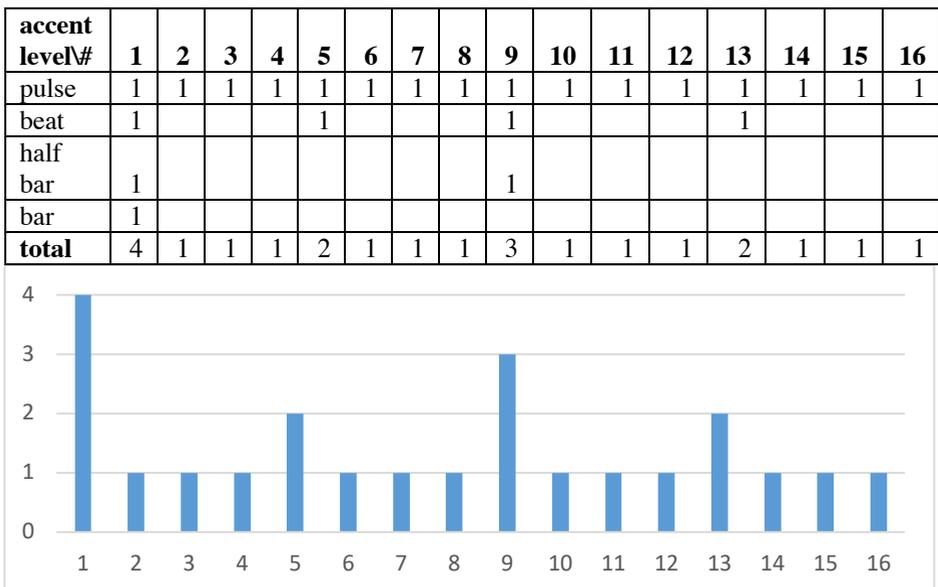
expressed in movement (such as clapping, tapping, dancing). In the absence of such cues, maintaining a meter may be difficult, if not impossible (e.g. hearing the objective sound of a waltz in a 4/4 meter).

- **Macrometer:** metrical subharmonics—structures grouping multiple bars, at one or more levels (e.g. in two levels: four cycles of four bars of 4/4), often implied by melo-rhythmic phrasing structure. Macrometer cannot be notated using conventional Western notational tools.

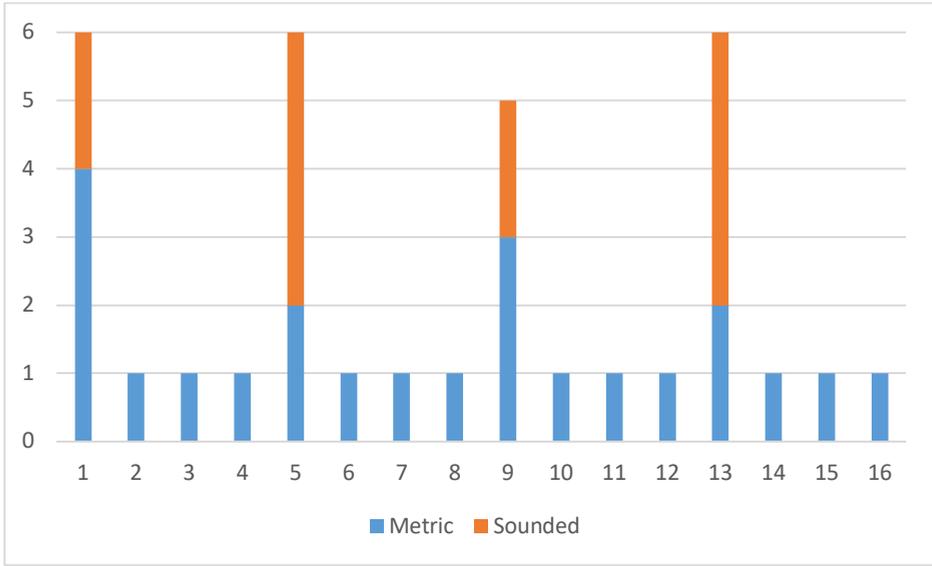
See Figures 2 to 8 for examples of the aforementioned metrical phenomena. Each table shows the accent patterns for each cycle, along with the total accent, graphed in the bar chart below.



**Fig. 2.** 2/4 meter, comprising 8 pulses, and accent levels, with total accent shown in the bar chart.

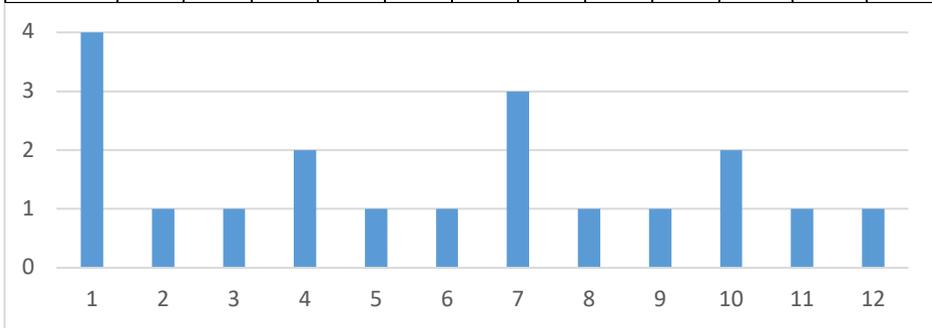


**Fig. 3.** 4/4 meter, comprising 16 pulses, and accent levels, with total accent shown in the bar chart.

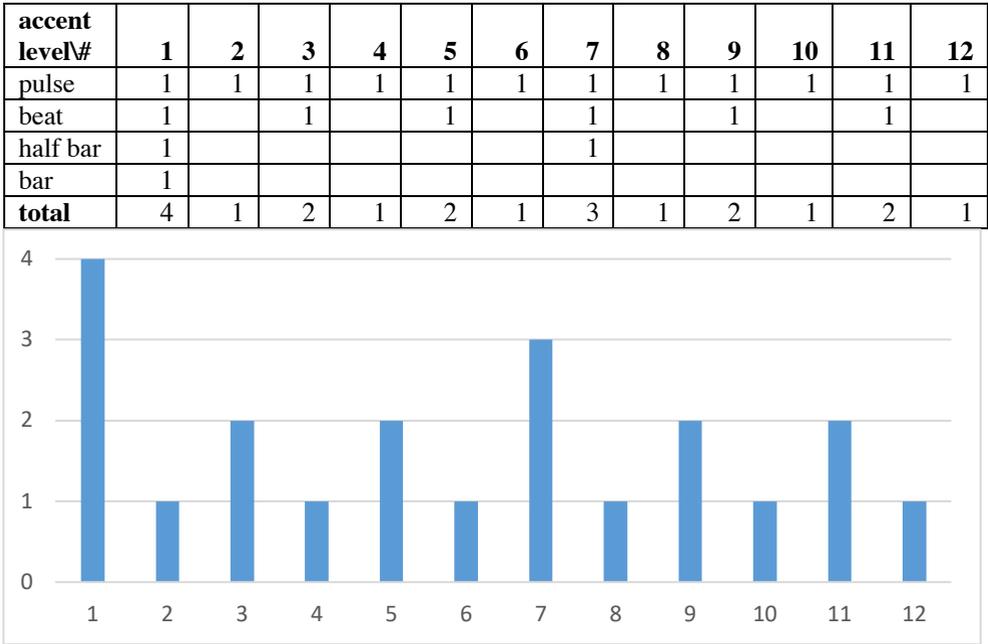


**Fig. 4.** 4/4 meter plus "backbeat" (adding emphasis to pulses 5 and 13) resulting in a kind of syncopated polymeter

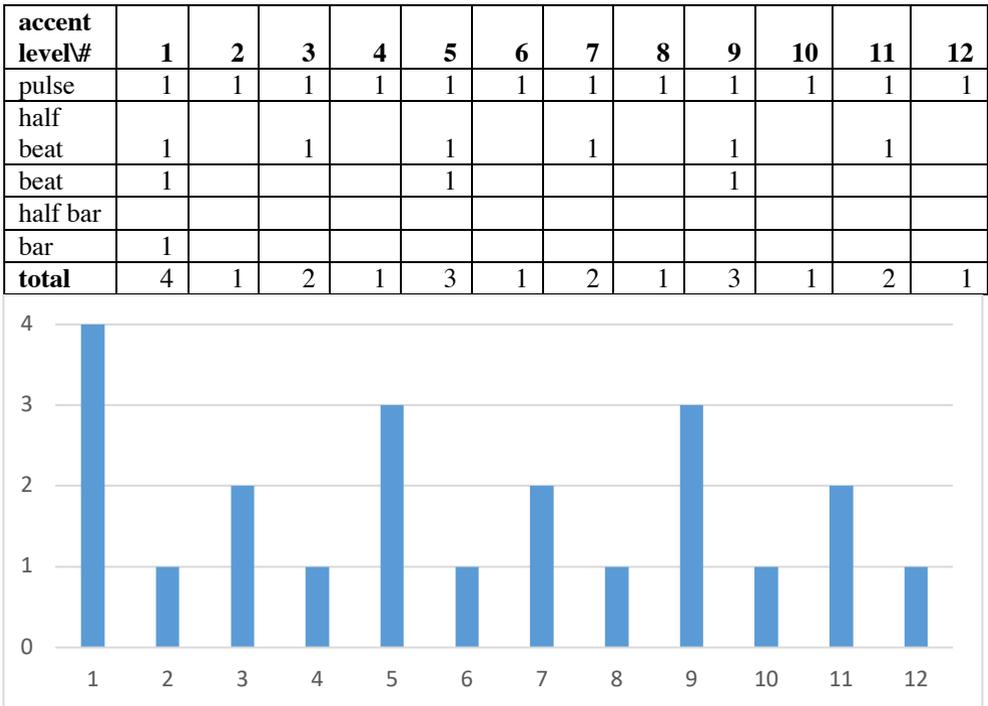
accent level#	1	2	3	4	5	6	7	8	9	10	11	12
pulse	1	1	1	1	1	1	1	1	1	1	1	1
beat	1			1			1			1		
half bar	1						1					
bar	1											
<b>total</b>	4	1	1	2	1	1	3	1	1	2	1	1



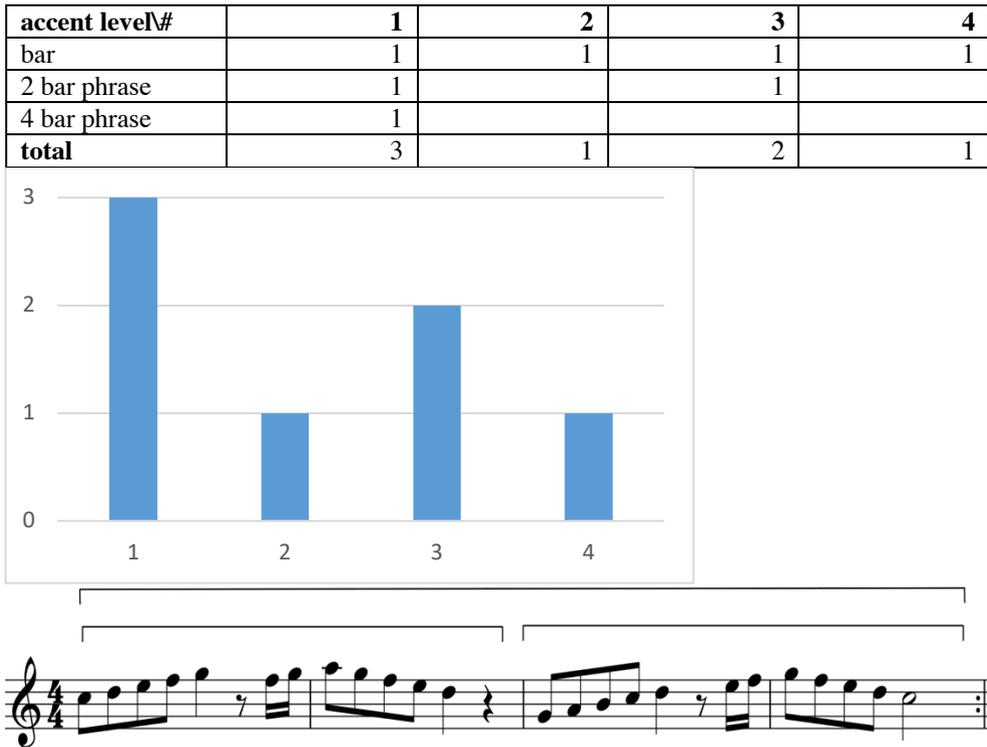
**Fig. 5.** 12/8 meter, comprising 12 pulses, and accent levels, with total accent shown in the bar chart.



**Fig. 6:** 6/4 meter, also comprising 12 pulses, and accent levels, with total accent shown in the bar chart. Compare to Fig. 5.



**Fig. 7:** 3/2 meter, comprising 12 pulses, and accent levels, with total accent shown in the bar chart. Compare to Figs. 5 and 6.



**Fig. 8.** Macrometer: a repeated cycle comprising two phrases of two bars each. Just as in 4/4, the first bar receives the strongest accent, followed by the third; these correspond to the incipits of the call and response phrases.

Finally, we arrive at polyrhythm and polymeter. These two terms denote similar phenomena, but can be distinguished as (respectively) objective and subjective. Cyclic objective sounds give rise to three subjective phenomena that cannot be definitively inferred, particularly in a polyrhythmic texture: meter(s), phase(s), and start point(s).

- **Polyrhythm**

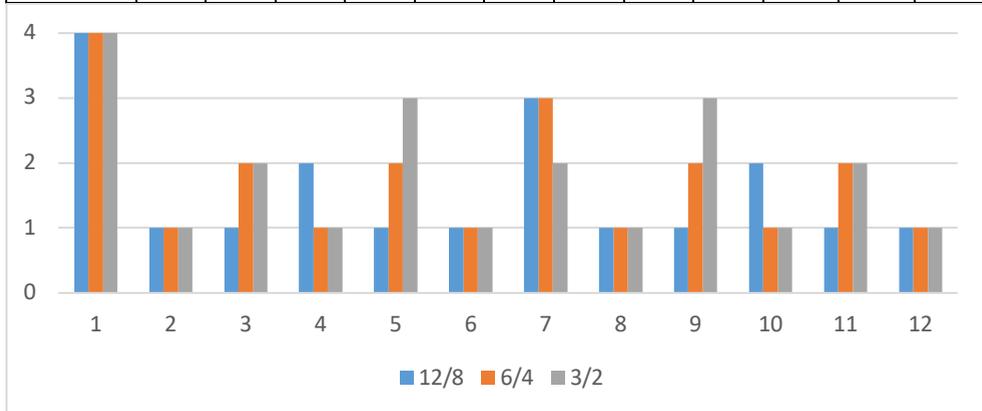
- (sense 1; broader): a polyphony of rhythm; a set of simultaneous rhythms. The term is often taken to imply sufficient contrastive for each to be heard as a separate line; otherwise, the polyrhythm is better termed homorhythm (cf polyphony vs homophony). Special cases are call/response, and syncopation (phase shift).
- (sense 2; narrower): a polyphony of rhythm; a set of simultaneous rhythms, where each rhythm strongly implies an entirely different meter. While many contrasting structures are possible, the most common arises when N contiguous pulses are multiply subdivided into beats, using different factors of N, then combined such that the resulting blocks do not always align. An instance, for N=6, is the so-called hemiola: (3+3) in parallel with (2+2+2), (4+2), or (2+4), giving the impression of “2 against 3”. Likewise, for N=12, (3+3+3+3) in parallel with (4+4+4), generating “4 against three”. Phase shifts and rests enable many more possibilities. The same phenomenon is called cross-rhythm. Note however that polyrhythm doesn’t preclude a single meter, even if each component rhythm strongly implies a different one, since meter is always subjective.

- **Polymer:** multiple meters applied to the same objective sound, heard sequentially by a single listener, or simultaneously by multiple listeners. (It is doubtful that a single listener can simultaneously hear in multiple meters.) Typically, each meter must be supported by acoustic cues, perceptual processes, and cultural habituation; polymer is typically supported by polyrhythm. However cultural insiders and outsiders may hear very differently, due to ambiguities in how those cues can be interpreted.

I would also like to introduce two concepts important for thinking about West African melo-rhythms: drum language, and metronome sense. The former is emic; the latter etic.

- **Drum language:** a mapping from tonal language to drummed melo-rhythm. Most West African languages are tonal, and thus amenable to this expressive dimension, which is unknown in Western music. As the mapping from language to tone is many to one, translating language to drumming in this way is inherently ambiguous, decipherable only by restriction of possible messaging, and often only by experienced drummers.
- **Metronome sense** (Waterman 1952): the shared perception of pulse that enables African performers to remain in sync, even at very rapid tempos and despite what might otherwise be the disorienting presence of polymer and polyrhythm, which encourage diverse subjective interpretations.

meter\#	1	2	3	4	5	6	7	8	9	10	11	12
12/8	4	1	1	2	1	1	3	1	1	2	1	1
6/4	4	1	2	1	2	1	3	1	2	1	2	1
3/2	4	1	2	1	3	1	2	1	3	1	2	1



**Fig. 9.** Polymer in 12 pulses. All three meters (cf Figs. 5,6, 7) coincide on pulses 1,2,6,8,12. Secondary beats are on 5 and 9 for 3/2, and on 7 for 12/8 and 6/4. Music structured in a 12-pulse cycle can easily be interpreted in any of the three.

## 2 Agbekor

Before proceeding it will be useful to present a specific Ewe *vu* or performative type as an illustrative example. I have selected Agbekor (also known as Atsiagbekor) for this purpose.

Due to its choreographic drama, its historic significance, as well as its particularly dense poly-kino-melo-rhythms, Agbekor has attracted considerable attention from Western scholars, students, and performers, frequently serving as example, if not object of study, in ethnomusicology, dance studies, music education, African studies, and anthropology,

including many works by African (especially Ghanaian) scholars themselves. [8, p. 49], [20]–[23], [24, p. 160], [25]–[27], [28, p. 7], [29], [30, p. 422], [31, p. 58], [32]. The leading Agbekor scholar is David Locke, who learned to play it exceptionally well (for an outsider!) and who wrote his magisterial doctoral thesis [33] about it. Agbekor also figures centrally in the widely read chapter on African music he prepared for what is probably the most influential world music textbook [34].

Originally, Agbekor was a war dance. In centuries past there was much conflict among Ewe communities, and war was a fact of life, providing impetus for post-conflict celebratory music and dance. Agbekor (literally “life clear”) was performed after a skirmish was over, its choreography mimicking heroism of the battlefield. In modern times, such conflicts have thankfully ceased, and Agbekor has taken on the status of a venerable, cherished historic dance, performed by specially trained dancers and drummers, for appreciative audiences at village festivals, funerals, civic events, school pageants or competitions (many schools field dance troupes), cultural holidays (such as the annual Hogbetsotso festival, commemorating the Ewe people’s Exodus-like escape from captivity in Notsie), staged productions of professional dance ensembles, and other special occasions.

Due to a complex choreography, which must be learned in relation to lead drum rhythms that signal each *atsia* (style), and a serious mien, Agbekor is not a broadly participatory music, unlike “recreational” types such as *Kinka* or *Agbadza*, whose dancing deploys standard movements, and are wide open to general participation. Such recreational types are particularly popular for general dance participation at funerals. Whereas recreational types may be varied relatively freely, expanding due to new creative contributions from drummers, dancers, and composers, Agbekor is comparatively fixed, though different villages and even performers have nevertheless developed unique and recognizable local styles over the years.

As I am not treating *kino*-rhythmic elements in this article, I focus on its poly-melo-rhythm. In instrumentation, pitch-timbres, and musical functions, the percussion section for Agbekor—comprising altogether six parts—closely resembles those of other Ewe performance types. Instruments include the double bell (*Gankogui*), which marks the basic ostinato timeline; the rattle (*Axatase*), which reinforces the bell; and four supporting drums each played with a pair of drumsticks: *Kagan* (slender and high-pitched), emphasizing off-beat pulses; *Totodzi* and *Kloboto*, carrying hemiola patterns; and *Kidi*, emphasizing a back beat. Finally, the immense and powerful lead drum, *Atsimevu* (*Atsimevu*), provides the primary melo-rhythmic voice, playing a variety of longer calls (*atsia*), selected at the drummer’s discretion, each corresponding to a particular dance move.

In most *vu* the lead drum call is answered by responses from support drummers, while dance moves mainly repeat a standard “Ewe movement”, with plenty of room for individual variation, particularly in recreational *vu* intended to be maximally open to participation. However, Agbekor is an instance of a different category of *vu*, in which the lead drum calls to the dancers rather than the supporting drums. The response to each call is a specific dance style; the pair (drummed call; danced response) is called an *atsia* (style). Support drums play cycles, with some room for variations in all parts, except for the bell, which is completely fixed. The sound of percussion instruments is augmented by handclaps, whose rhythms are sometimes duplicated by the *Axatase* rattle.

All of these instruments are capable of performing at least two pitch-timbral classes (differing qualitatively by timbre as well as general pitch height): one lower, more resonant and tonal, the other higher and drier, though the precise sounds and volumes depend on the instrument: the double-bell has a lower and higher pitched flare; the rattle can be struck downward (against the thigh) or upward (against the palm); the supporting drums can be struck in two ways, either allowing the stick to bounce freely (loose stick grip), or pressing the stick into the hide (tight stick grip), thereby generating two pitch-timbres.

The two pitch-timbres comprising these melo-rhythms provide the possibility of great aesthetic power, while serving communicative and poetic functions. Like most West African languages, Ewe is tonal: any speech utterance can be reduced to a sequence of high and low pitch-timbres. But because they encode only the tones and rhythms of speech, not the phonemic sequence itself, there is a many to one relation from language to drumming, hence much ambiguity in the result. Unless the Ewe listener is familiar with a restricted range of *possible* utterances (usually, proverbial expressions), they will not generally be able to interpret drum language. However master drummers often know the hidden meanings behind the melo-rhythms they play. This knowledge is esoteric, understood only by master musicians, steeped in tradition.<sup>14</sup>

Agbekor is an old *vu*, and its drum language is obscure. Thankfully, Locke’s research collaborator, master musician Gideon Alorwoyie, has provided interpretations of the supporting drum parts (Figure 10).

**Fig. 10.** Drum language in Agbekor’s supporting drum parts, as interpreted by Ewe master drummer Gideon Alorwoyie, for David Locke. Kagan: “we are going to show our bravery”. Totodzi: “we will be on the battlefield”. Kloboto: “I will die on the battlefield”. Kidi: “Look back at home” [34, p. 102] Superscript wedges indicate usual start points as performed by drummers. The bottom and top lines represent low and high pitch-timbres, respectively. Ordinary noteheads are “bounce” strokes; x noteheads are “press” strokes.

The Atsimevu offers a comparatively wider range of pitch-timbres, traditionally represented by vocables (which may be considered a form of auditory representation), but which can also be translated into visual notation. According to Locke [33, p. 506], the seven Atsimevu strokes used in Atsiagbekor and their associated vocables, are as follows (see also Figure 11):

1. ga: a bounced stroke in the center of the drum skin with the palm and fingers
2. de: a bounced stroke in the center of the drum skin with a stick.
3. gi: a bounced stroke at the edge of the drum skin with the fingers.
4. dzi: a pressed stroke at the edge of the drum skin with the fingers.
5. tsi: a pressed stroke in the center of the drum skin with a stick.

<sup>14</sup> At large gatherings chiefs are welcomed by an *atumpan* (double kettledrum) announcing their arrival by calling their names in drum language. Naturally, they are accustomed to recognizing their own names!

6. t̃: a bounced stroke in the center of the drum skin with a stick while pressing the hide with the other hand.
7. kpa: a bounced stroke on the side of the drum with a stick.



**Fig. 11.** Locke’s notation of the seven Atsimevu strokes for Agbekor, as represented by vocables, and by note heads, in approximate pitch order, low to high, though they are actually pitch-timbres, each one qualitatively different. [33, p. 507],

Agbekor contains two main sections: a processional to the main performance space (vulolo) which is relatively slow, and the primary dance in that space (vutsotsoe), which is much faster. There is also a mediating section, adzo, introducing vutsotsoe, and comprising songs performed in free rhythm. [33, pp. 75–77]

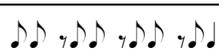
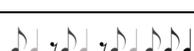
Both sections deploy the same bell cycle, suggesting twelve pulse blocks, though in some rhythms a finer-grained pulse, usually one twenty-fourth of the bell cycle, appears. The high divisibility of these values results in many possible polymetric interpretations. The cycle is typically divided into 4 equal beats (three pulses each), 6 equal beats (2 pulses each), or a combination-division into 5 unequal beats, such as 3 beats (two pulses each) plus 2 beats (3 pulses each), as in hemiola. Occasionally a division into 8 equal beats (1.5 pulses, or 3 finer-grained pulses) appears. Macrometers, stretching across multiple bell cycles, provide further possibilities. The examples presented below are drawn from the slower vulolo section.

### 3 Agbekor’s poly-melo-rhythms and their representations

Agbekor includes a highly polyrhythmic, and (potentially) polymetric, percussive texture. We will now examine its poly-melo-rhythms and polymeters, along with a few strategies for their notational representation, indicating the advantages or drawbacks of each.

#### 3.1 Western notation

I begin with two varieties of Western notation. In its simplest form, a purely typographic notation outlines each part as a linear sequence of symbols, using the smallest possible number for durational units, and colors to represent the pitch-timbres: black for low, gray for high (higher bell tone; upstroke on rattle; press stroke on drum), and intermediate shades for the Atsimevu’s more numerous tones. In this way melo-rhythms may be approximately conveyed. Any character set could be deployed, but fonts containing traditional note shapes are preferable, at least for anyone who, having studied basic music theory, has a modicum of fluency with Western music notation.

Gankogui	
Axatse	
Kagan	
Totodzi	
Kloboto	
Kidi	
Atsimevu (example atsia)	

**Fig. 12.** Simple typographical notations of Agbekor parts.

But simplicity comes with a cost, and this sort of notation exhibits several limitations. Even if attack points are clear for each part, the poly-melo-rhythmic texture is not: their relation is confusing due to the absence of vertical alignment. Are the rhythms presented in or out of phase? Beats are ambiguous because there are no clues to indicate pulse groupings – neither beams nor metric indications. The meter and its alignment is likewise unclear. Also it is difficult to notate the Atsimevu part, with its seven strokes, using grayscale (color might be more effective, but would not convey the linear arrangement of pitch-timbres, low to high).

The grouping issue can be partially rectified by using a slightly larger set of symbols. For instance, the Kidi part can be written  thereby implying four groups of three pulses each. Other limitations can be addressed in a richer score format (loosely following Locke [33]), at the cost of shifting to a non-typographical notation, extending into two dimensions on the page, requiring more advanced music-reading skills, and specialized score writing software. Here, parts are aligned by reference to a common vertical frame, enforced at the barlines, and metric structure is indicated by beaming and note values where possible. As standard musical notation provides no means of indicating the start point for a rhythmic cycle, I have added an extra mark – a superscript wedge – to mark their presumed location. Of course, as is the case for all subjective sound, determining perceptions – where a cycle begins, meter, the alignment of cycle and meter—is no simple matter.

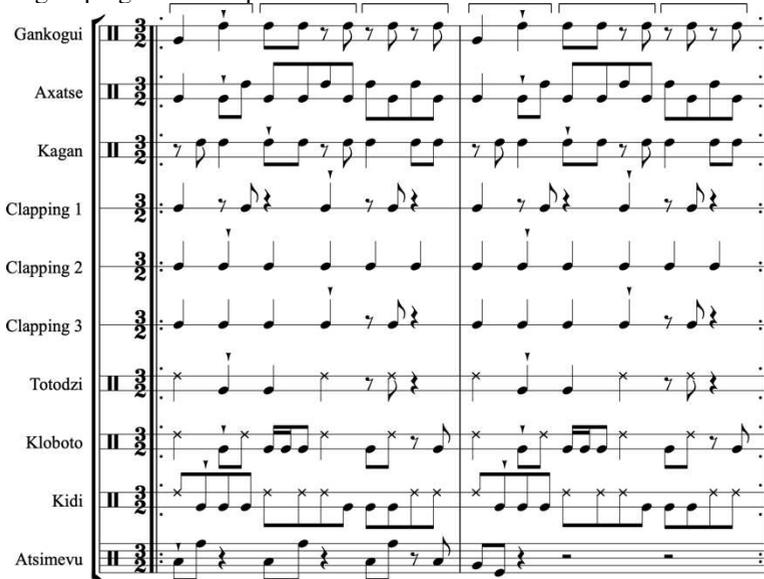
Most ethnomusicologists have been trained in Western music and are fluent in reading such notations, which are therefore widely used in scholarship. But the exigencies of diverse traditional musical systems, from Africa to China, often necessitate the addition of “neographemes” (cf neologisms): new symbols endowed with meaning. Alternatively, existing symbols can be reinterpreted.

**Fig. 13.** Agbekor in 12/8. Different pitch-timbres appear on different lines or spaces. Press strokes are redundantly marked with an x. Beaming and rests indicate metric groupings.

A notation such as that in Figure 13 describes the poly-melo-rhythmic cycles of Agbekor as well as proposing a particular interpretation, comprising the meter symbol, beaming, note values, and start markers, all of which make implicit statements about subjective sound perception, which cannot be easily verified, and may also vary from one listener to another. Certainly, the different parts imply different metrical groupings, and may lead the inner ear to particular gestalts in the poly-melo-rhythmic texture. For instance, Figure 13 implies four main beats per bar, each comprising three pulses, as indicated by Clapping 1 and harmonized by Kidi; under this interpretation Kagan appears to mark offbeats. However, Clapping 2 suggests a different meter entirely, 6/4, and the entire score can be rewritten in this meter, rebeaming accordingly, as shown in Figure 14:

**Fig. 14.** Agbekor in 6/4. Again, beaming and rests indicate metric groupings.

This particular Atsimevu atsia appears (rather unusually!) to suggest 3/2 (Figure 15). Here, brackets are added (at the top) since beams are inadequate to reveal the highest level of grouping across all parts.



The musical score for Figure 15 is written in 3/2 time. It consists of ten staves, each representing a different part of the ensemble. The parts are: Gankogui, Axatse, Kagan, Clapping 1, Clapping 2, Clapping 3, Totodzi, Kloboto, Kidi, and Atsimevu. The notation includes various rhythmic values such as eighth and sixteenth notes, rests, and beams. Brackets are placed above the staves to indicate higher-level groupings across all parts. The Atsimevu part at the bottom shows a distinct rhythmic pattern, including a dotted half note.

**Fig. 15:** Agbekor in 3/2. Brackets indicate higher level groupings.

Atsimevu changes patterns from one atsia to another. Here is a second atsia, with the score back in 12/8:



The musical score for Figure 16 is written in 12/8 time. It features the same ten parts as Figure 15: Gankogui, Axatse, Kagan, Clapping 1, Clapping 2, Clapping 3, Totodzi, Kloboto, Kidi, and Atsimevu. The notation is adapted for the 12/8 time signature, showing different rhythmic patterns for each part. The Atsimevu part at the bottom shows a more complex rhythmic pattern with many sixteenth notes.

**Fig. 16.** Agbekor in 12/8, in a different atsia.

But in this case one might even propose 24/16, with a finer pulse of sixteenth notes, and double-time beat comprising eight dotted eighths per bar, again emphasizing different groupings, as indicated by beaming and note values in Figure 17:

The image shows a musical score for the Agbekor dance in 24/16 time. It consists of ten staves, each representing a different instrument or part of the ensemble. The staves are labeled as follows: Gankogui, Axatse, Kagan, Clapping 1, Clapping 2, Clapping 3, Totodzi, Kloboto, Kidi, and Atsimevu. Each staff begins with a 24/16 time signature. The notation includes various rhythmic values such as eighth, sixteenth, and thirty-second notes, as well as rests and beams. The score is divided into two measures by a double bar line, with repeat signs at the end of each measure.

**Fig. 17.** Agbekor in 24/16, same atsia as Fig. 16.

Which is the correct meter and notation? All correspond to the sounded poly-melo-rhythms, but which one represents the way the music is heard and felt by participants – the *subjective* sound? Where are the beats and the start points? Determining the answer presents a difficult, perhaps impossible, psychoacoustic problem. Is it even the same for all participants? Perhaps each performer hears a different meter throughout? Or perhaps a performer’s metric interpretations shift, sequentially, depending on what they happen to be playing, singing, or dancing? Or perhaps interpretation shifts spontaneously, as in the flickering ambiguity of a Necker cube? (Could multiple interpretations even be held *simultaneously by a single performer*? My intuition says “no”, but...)

This is the concept of polymeter: multiple meters, whether simultaneous or sequential, in the minds of a collective, or an individual. Further, the range of possible meters is not limited to the “divisive” meters, 12/8, 6/4, or 3/4. Someone may hear the music according to Clapping 3, as 3/4 + 6/8, an additive framework known as hemiola. (Such additive patterns (e.g. 3+4) are well-known in the Middle East and Balkan regions.) Many other possibilities are conceivable as well, though they may require notational innovations (for instance, Jones [35] indicates metric subgroupings using dotted barlines).

A further complexity then arises. Besides the grouping of the pulses implied by different meters, is it possible that there may also be phase shifts? For instance, might the Kagan player be hearing his part in an iambic frame, weak strong, rather than as offbeats? This way of hearing is very common among Western kagan players unaccustomed to playing offbeats, particularly at high tempos. If the Kagan player imposes an iambic frame with emphasis on the second stroke, the entire metric frame shifts left, as shown in Figure 18:

The image shows a musical score for the Agbekor dance in left-shifted 12/8 time. It consists of ten staves, each representing a different instrument or part of the ensemble. The staves are labeled on the left: Gankogui, Axatse, Kagan, Clapping 1, Clapping 2, Clapping 3, Totodzi, Kloboto, Kidi, and Atsimevu. Each staff begins with a treble clef, a key signature of one flat (B-flat), and a time signature of 12/8. The notation includes various rhythmic values such as eighth notes, quarter notes, and rests, with some notes beamed together. Vertical bar lines are present, and some notes have accents above them. The score is divided into two measures by a double bar line.

**Fig. 18.** Agbekor in left-shifted 12/8.

But maybe it is only the Kagan player who hears this way, while others hear with different phase shifts. A.M. Jones introduced notations with shifted barlines in order to represent such presumed multiplicity in hearing [35, p. 170ff]. In oral communications with me, other scholars, such as Locke and Anku, have criticized such representation, affirming that a single meter prevails, as is evident from the dance. However, is it possible that dance movements only signal what the dancers are feeling?

The bottom line is that it is extremely difficult to affirm any particular way of hearing, and hence to justify a particular notation, with absolute certainty without asking someone who has been raised in the musical tradition and retains a traditional way of hearing, and who has also studied music theory. Arguably the intersection of these categories is next to null: by the time traditional performers have studied music theory at University (and those that do are relatively few) they have also ventured far from the traditional musical environment. If this is the case, the question is tautologically impossible to answer. Resolving such issues clearly cannot rely on audio recordings alone, but video or even in-depth fieldwork cannot provide definitive answers.

In sum, the advantages of a modified Western notational system include its universal familiarity (for those with Western musical training), its capacity to represent a wide range of sonic structures, and to indicate several levels of structure using barlines, beaming, and other grouping devices such as brackets. Furthermore, several scholars have remarked that to deny Western notation for non-Western musics (though putatively well-intentioned: to avoid ethnocentrism) ironically constitutes a denigration of those musics, portraying them as too “alien” (formerly: “primitive”) to be dignified by representation in the internationally deployed notational system [11].

Its disadvantages are complexity for the musically untrained, a certain ethnocentrism by which all music is expected to adapt to a Western notational frame, and a limited range of multilevel structural representation, at least without the addition of new notational devices. In particular, neither polymeter nor macrometer (the largest unit of structure is the bar) can be effectively represented without additional symbols. Generally, the ability to clearly represent multiple levels of pulse grouping is limited to whatever can be bracketed by barlines, beaming (note values larger than an eighth cannot be beamed), or other note

groupings, and the notation is verbose. Finally, scorewriters are complex, and the resulting files, far from the transparency of a typographical encoding, are not readily machine readable without being first translated into a universal format (such as MIDI or MusicXML).

### 3.2 Tabular and tablature notations

A different approach is to arrange typographical symbols in a table or grid, e.g. where time runs from left to right, and multiple lines are stacked as rows (or the reverse, e.g. with time running top to bottom, and multiple lines as columns). This approach combines a very precise, apparently neutral “scientific” representation (the table or grid), unbiased by a particular musical tradition (though still exhibiting certain biases, for instance a predisposition to read from left to right) and a typographical symbology with a two-dimensional representation. The advantage of such a system is for the performer untrained in Western music theory – reading and writing are easier – while the disadvantage is for the analyst: representing structure is harder. Vertical alignments are maintained, a useful feature for both. However, while Western notation is capable of representing any rational timing, the grid system defines a pulse unit that cannot easily be subdivided.

Actually, an embryonic table can be generated simply by using a monospace font in multiple lines, where each monoglyph symbol denotes a pitch-timbre, time proceeds left to right, and polyrhythms are read vertically. Such notation is in use in Javanese gamelan music (symbols are numerals representing scale degrees), where it is known as “cipher” notation.

Thus, the Agbekor notation of Figure 13 might be represented as in Figure 19, using a monospace font (Courier). The limitations of just one glyph per pulse block requires condensed representations of pitch-timbres, and subdivision of the pulse is not possible. Here these limitations are overcome by using special symbols X (for two equal bounce strokes) and abbreviating Atsimevu strokes (G=gi, T=tõ, D=de, A=ga). The Gankogui cycle is marked with the vertical bar, but otherwise structure is unmarked. Other symbols are L and H for bell (low and high), P and T (pa and ti, for down and up rattle strokes), B and P (for drums: bounce and press), and C for clap.

L-H-HH-H-H-H		L-H-HH-H-H-H
P-PTPTPTPTPT		P-PTPTPTPTPT
-BB-BB-BB-BB		-BB-BB-BB-BB
C--C--C--C--		C--C--C--C--
C-C-C-C-C-C-		C-C-C-C-C-C-
C-C-C-C--C--		C-C-C-C--C--
P-B-B-P--P--		P-B-B-P--P--
P-BPXBP-BP-B		P-BPXBP-BP-B
PBBBPPPBBBPP		PBBBPPPBBBPP
GT--GT--GT-G		DA-----

**Fig. 19.** Rhythms of Agbekor. From top to bottom: Gankogui, Axatse, Kagan, Clapping 1, Clapping 2, Clapping 3, Totodzi, Kloboto, Kidi, and Atsimevu.

Greater flexibility and range of structural representation is enabled by using a table or grid, where each cell can accommodate multiple glyphs, monospacing is not required (table borders ensure alignment), and additional levels of structure can be indicated. Such a “box” notation was developed by James Koetting as TUBS (time-unit box system). This representation combines a typographical approach (obviating any musical typesetting) with a two-dimensional tabular layout. The possibility of adding tablature symbols, illustrating *how* an instrument is to be played, has been explored by Serwadda and Pantaleoni. [36]

Figures 20 and 21 present two representations of Agbekor using such notation. Note that it is possible to indicate meter and polyrhythms by selectively boldening table borders: we

can indicate that one line is to be interpreted as four groups of three, another as two groups of six, and a third as three groups of four. However, it is difficult to indicate multiple structural levels, and the system is quite verbose, since every pulse block receives equal space. These tables do have the advantage of being typographic, easily prepared in any word processor, and are readily machine- as well as human-readable.

	1	2	3	4	5	6	7	8	9	1	1	1	1	2	3	4	5	6	7	8	9	1	1	1
									0	1	1	2										0	1	2
G	L		H		H	H		H		H		H	L		H		H	H		H		H		H
Ax	P		P	T	P	P	T	P	T	P	T	P	P		P	T	P	P	T	P	T	P	T	P
Ka		B	B		B	B		B	B		B	B		B	B		B	B		B	B		B	B
C 1	C			C				C				C				C				C			C	
C 2	C		C		C			C				C		C		C			C			C		C
C 3	C		C		C			C				C		C		C			C			C		C
To	P		B		B		P			P			P		B		B		P			P		
Kl	P		B	P	B	B	P		B	P		B	P		B	P	B	B	P		B	P		B
Ki	P	B	B	B	P	P	P	B	B	B	P	P	P	B	B	B	B	P	P	B	B	B	P	P
A	g	t			g	t			g	t		g	d	a										

**Fig. 20.** Agbekor TUBS notation in 12/8. G=Gankogui, Ax=Axatse, Ka=Kagan, C=Clap, To=Totodzi, Kl=Kloboto, Ki=Kidi, A=Atsimevu. Atsimevu strokes: g=gi, t=t̃, d=de, a=ga.

	1	2	3	4	5	6	7	8	9	1	1	1	1	2	3	4	5	6	7	8	9	1	1	1
									0	1	1	2										0	1	2
G	L		H		H	H		H		H		H	L		H		H	H		H		H		H
Ax	P		P	T	P	P	T	P	T	P	T	P	P		P	T	P	P	T	P	T	P	T	P
Ka		B	B		B	B		B	B		B	B		B	B		B	B		B	B		B	B
C 1	C			C				C				C				C				C			C	
C 2	C		C		C			C				C		C		C			C			C		C
C 3	C		C		C			C				C		C		C			C			C		C
To	P		B		B		P			P			P		B		B		P			P		
Kl	P		B	P	B	B	P		B	P		B	P		B	P	B	B	P		B	P		B
Ki	P	B	B	B	P	P	P	B	B	B	P	P	P	B	B	B	B	P	P	B	B	B	P	P
A	g	t			g	t			g	t		g	d	a										

**Fig. 21.** Agbekor TUBS notation in 12/8, indicating polyrhythms in Clap 2 and Atsimevu parts. G=Gankogui, Ax=Axatse, Ka=Kagan, C=Clap, To=Totodzi, Kl=Kloboto, Ki=Kidi, A=Atsimevu. Atsimevu strokes: g=gi, t=t̃, d=de, a=ga.

### 3.3 A typographical Grammar for Poly-Melo-Cycles (GPMC)

Western notation evolved to assist performers of Western music, not for music theorists investigating Western or any other music. It is an inherently prescriptive system, adapted to particular kinds of music that developed in particular cultures at particular moments in history. While generalizable to some degree, it remains culturally biased, better at representing some sounds than others. Tabular systems for rhythmic representation, such as TUBS, are apparently acultural, but are limited in clarifying multilevel structure.

In developing a typographical Grammar for Poly-Melo-Cycles (GPMC), my goal was to represent multi-level cyclic temporal structures—rhythmic or metric—in a parsimonious, formal, general, machine- and human-readable language capable of precisely representing any number of temporal levels of polyrhythmic or polymetric structure, to address some deficiencies of both Western and tabular notations.

In what follows I first present the grammar's production rules. Next, I present its interpretation, and some concrete examples, including from Agbekor. Finally, I reflect upon the strengths and limitations of this system.

Production rules: an expression **E** may become any of the following:<sup>15</sup>

- ***n***, an integer > 0
- -, the hyphen
- (***E***) where ***E*** is an expression
- ***n(E)*** where ***E*** is an expression and ***n*** is an integer > 0
- ***E\*n*** where ***E*** is an expression and ***n*** is an integer > 0
- ***E/n*** where ***E*** is an expression and ***n*** is an integer > 0
- ***E→n*** where ***n*** is an integer > 0
- ***E1 + E2*** where ***E1*** and ***E2*** are expressions
- ***E1 ⊕ E2*** where ***E1*** and ***E2*** are expressions
- **{text}** where text is a label

Assumptions, interpretations, and augmentations:

- Square bracket pairs can be freely substituted for parenthetical pairs, and spaces can also be inserted, to improve readability.
- Curly brackets enclose text labelling the following expression.
- A single apostrophe can be inserted anywhere in a string to indicate a possible start position.
- There is a single pulse throughout.
- ***n*** (a positive integer) not followed by left parenthesis denotes the joining of ***n*** pulse blocks, i.e. deleting all onset points except the first, which retains its accent
- - (hyphen) represents a one-pulse block rest, which can be repeated using an integer prefix ***n(-)*** (but observe that rests are seldom required for percussive music, since a block can be extended to the next onset. Rotations can be deployed to avoid an initial rest.)
- ***n*** (a positive integer) followed by a parenthetical expression (***E***) means repeat ***E*** ***n*** times, with an additional accent placed on the first block.
- (***E***) followed by ***\*n*** declares a time dilation: multiply all time values by ***n***.
- (***E***) followed by ***/n*** declares a time contraction: divide all time values by ***n***.
- ***+*** is a binary operator indicating sequential addition: ***E1+E2*** represents the two successive sequences: the first block of ***E2*** follows the last block of ***E1***, within the same line. The ***+*** operator is the default for two sequences adjacent on a single typographic line, and may be assumed if omitted: thus ***121 = 1+2+1***.
- ***⊕*** is a binary operator indicating parallel aligned addition: ***E1⊕ E2*** represents the two simultaneous sequences, initial blocks aligned; each addend is then repeated until they are of equal length. The two sequences are different rhythmic lines. The ***⊕*** operator is the default for sequences on different typographic lines, and may be assumed if omitted.
- ***E→n*** rotates (circularly shifts) ***E*** to the right (left if negative), including all accents, by the corresponding number of pulse blocks

Additional notational devices external to the grammar can be added:

- Shading or color can be used to indicate pitch-timbres
- Quote marks may be added to indicate possible start points for each cycle

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<sup>15</sup> Bold terms are from the formal grammar; italics indicate that a term is variable.

- *Italic font indicates subjective sound (e.g. meter), while plain text indicates objective sound (e.g. rhythm)*

Additional observations concerning GPMC, parts and West African poly-melo-rhythm:

- The division of a poly-melo-rhythm into “parts” (and assignment of those parts to performers) is variable. Typically, top-level segments separated by  $\oplus$  constitute the parts (though each might contain multiple lines, due to internal  $\oplus$  operators), assuming an expression of the form  $E1 \oplus E2 \oplus E3 \dots$
- Using this notation, simple expressions may define complex phasing patterns, as found in the minimalist school of composition; for instance  $((3\oplus4)\oplus5)\oplus7$  defines a cycle of 420 pulses, unfolding in a 3:4:5:7 polyrhythm.
- In African polyphony, poly-melo-rhythms take the form  $E1 \oplus E2 \oplus E3\dots$  where (1) there are no “internal”  $\oplus$  within  $E1, E2, E3\dots$  and (2) each of  $E1, E2, E3$  etc. divide evenly into the longest of these (i.e. the phasing techniques of minimalism do not apply).

Using this notation, we can succinctly reformulate several of the examples presented earlier (see Figures 2-18), thereby highlighting the simplicity, precision, concision, and generality of the system:

- $\{2/4\} 2(2(2(I)))$
- $\{4/4\} 2(2(2(2(I))))$
- $\{\text{Macrometer: 4 bars of 4/4, in pairs}\} 2(2(2(2(2(I))))))$
- $\{4/4 \text{ plus backbeat}\} 2(2(2(I))) \oplus (8\ 8) \rightarrow 4$
- $\{12/8\} 2(2(3(I)))$
- $\{6/4\} 2(3(2(I)))$
- $\{3/2\} 3(2(2(I)))$
- $\{12/8 \text{ with 6 claps emphasizing } 6/4\} 2(2(3(I))) \oplus 2(3(2))$
- $\{12/8 \text{ with 8 claps emphasizing } 24/8\} 2(2(3(I))) \oplus 2(2((2(3))))/2$

Finally, here are the Agbekor polyrhythms:

$\{\text{polymeters } 12/8 \text{ and } 6/4\} 2(2(3(I))) \oplus 2(3(2(I))) \oplus$   
 $\{\text{bell}\} (2'212221) \oplus$   
 $\{\text{rattle}\} (21'111\ 3(11)) \oplus$   
 $\{\text{kagan}\} ('12) \rightarrow 1 \oplus$   
 $\{\text{Totodzi}\} (22233) \oplus$   
 $\{\text{Kloboto}\} (4\ 22112\ 2(42))/2 \oplus$   
 $\{\text{Kidi}\} (111111) \oplus$   
 $\{\text{Atsimevu}\} 2(13)12112(3(3(-)))$

We could add additional meters as well:

- $3(2(2(I)))$  occasionally implied by the lead drum, Atsimevu
- $2(2(2(3(1))))/2$  as a 24/8
- $2(2(3(I))) \rightarrow 2$  in order to place kagan in iambic mode (conceivably a kagan player might hear this way, as discussed earlier)

GPMC presents a number of advantages. It presents arbitrary poly-melo-rhythms and meters concisely and precisely. As a typographical system, it is easy to read, write, edit, and manipulate. It is not biased towards particular types of tonal-temporal organization, operates consistently at all temporal levels, and avoids arbitrary devices such as beaming, note values, or barlines for grouping. It is capable of representing an arbitrarily deep structure, including

any combination of divisive and additive rhythms and meters. It easily accommodates time shifts and dilations. It clearly separates meter from rhythm, yet highlights the parallels between them. As a formal system, it is completely unambiguous, an advantage both for human and machine readers. Finally, GPMC is capable of generating an enormously rich range of possible meters and rhythms, far exceeding that required for West African polyrhythm. Inspired by the need to represent West African polyrhythm, it is “overkill”, but should also be of wider utility for other musical systems, as well as for generating new compositional ideas exploring the broad spaces of polyrhythm and polymeter. Its primary weakness lies in not indicating vertical alignments. However, as an unambiguous formal language with a precise grammar, it should be eminently feasible to create an algorithmic mapping from GPMC to any other notational system, as well as to sound. I leave this task to the interested reader.

## 4 Conclusion

In West African societies, interactive musical performance, rooted in poly-melo-rhythm, is an important cultural system for expressing, creating, and maintaining social solidarity. Understanding that system is thus a means of understanding society, as well as its music. Like other traditional West African ethnic groups, Ewes require no visual notation to maintain the continuous, long-standing oral traditions into which they are born and enculturated. However, such notation serves to provide an essential “mechanical advantage” for the outsider (whether performer, ethnographer, analyst, or composer), who must rapidly acculturate, usually as an adult, seeking theoretical as well as practical understanding. Whether for analytical, pedagogical, or creative purposes, and whatever the form, visual notations can provide valuable guides for the outsider seeking to explore the rich world of West African polyrhythm, enhancing, though never replacing, the role of audio-visual recordings, not to mention the rich experience of participation itself.

## 5 Appendix: Ewe (Eve) language and orthography

The Ewe (Eve) language is one of about 21 tonal languages forming the Gbe subgroup of West Africa, in the Niger-Congo family<sup>16</sup> There are about six million Ewe speakers today, mostly in Ghana’s Volta Region, and in Togo. Traditionally oral, two Ewe writing systems have emerged since colonial times, both in use today. The African system draws on the International Phonetic Alphabet (IPA) to represent certain Ewe phonemes, while the British system employs Latin equivalents.

African		Latin	Pronunciation (by reference to English)
<i>lower case</i>	<i>upper case</i>		
ɔ̃	Ɖ	d	“d” with the tip of the tongue against the roof of the mouth
ɔ	Ɔ	or, wa	“awe” (avenor=aveno, kwaku=koku)
ŋ	Ɔ	ng	“ng” of “sing”
v	U	v, w	“v” with upper lip replacing upper teeth
f	Ƒ	f, p	“f” with the upper lip replacing upper teeth
ɛ	Ɛ	e	“e” in “hey”

<sup>16</sup> See [http://www.ethnologue.org/show\\_language.asp?code=ewe](http://www.ethnologue.org/show_language.asp?code=ewe)

ɣ	ɣ	y	between “y” and “l”
~	~		diacritic indicating nasalization
s	S	s, sh	between “s” and “sh”
x	X	x	“ch” of Scottish “Loch”
ts	Ts	ts	English “ch”
dz	Dz	dz	either “j” or the consonant sound of “adds”
kp	Kp	kp	simultaneous “k” and “p” sound
gb	Gb	gb	simultaneous “g” and “b” sound
<i>Other Eve letters denote sounds relatively close to their English interpretations</i>			

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