

PRELIMINARY TO PRELIMINARY: SPEECH RHYTHM IN AKAN (TWI)

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Abstract: The following report concerns itself with the notion of rhythm in Akan/Twi. In light of the findings concerning rhythm in speech using the Speech Cycling Task by Cummins & Port (1998), Port (2003, 2007), and Tajima & Port (2003), this study attempts to understand what kind of rhythmic timing patterns pertain to Akan/Twi. This paper is an attempt to discover the foundation on which to design more rigorous experiments. As of yet, it is not understood what rhythmic patterning appears in languages that do not have stress, or accents. That is, rhythm is not well defined in purely tonal languages. The main report in this paper is to simply understand which syllables are considered prominent in Akan. The current experiment uses the Speech Cycling Task to a minimal extent. By using the Speech Cycling task, rhythmic patterns emerge that will allow for the researcher to model the timing of a language. The paper will begin with a brief background on rhythm and some methodologies for experimentation, and a background on the Speech Cycling task itself. The hypotheses and preliminary designs of future experiments will be outlined.

1. Introduction

The rhythmic patterns of West African tone languages have undergone little research. One attempt made by Gut, Urua, Adouakou, & Gibbon (2001) discussed Ibibio, Anyi, and Ega. Obeng (1987, 1989) and Purvis (2009) discuss the rhythm of Akan, however, a large, detailed study has not been undertaken to understand the precise rhythmic patterns, and the phonological implications of those patterns, such as, the direction, and domains, of vowel harmony and tonal processes. As we are still in an exploratory stage as regards to rhythm in Akan, it is useful to have some intuitive and impressionistic description of the rhythm before pursuing answers to larger, deeper questions.

As given by the title, this squib is a report of an exploratory experiment, which was run so that we could understand how to proceed in further experimentation of rhythm in Akan. My purpose here is only to see what speakers do when asked to speak in time with a recurring beat. From this, further experiments can be designed that will enable the researcher to manipulate various aspects of the phonological/metrical system to determine the stability of prominent syllables in a hierarchical foot-level structure, and how those stable positions function in phonological processes.

For our purposes here, it is necessary to use the classical definition of rhythm to begin, that is, rhythm is a “perceptual pattern produced in speech or poetry by the occurrence at regular intervals of prominent elements; these elements may be stresses (as in English, syllables (as in Spanish), heavy syllables (as in Ancient Greek) or moras (as in Japanese) (Trask, 1996), *ticks/beats/syllable* (in Akan) (Obeng, 1987). For many years, rhythm in lan-

guage had been thought of as simple isochrony, or equidistance, between syllables (syllable-timed languages) or stresses (stress-timed languages) (Abercrombie, 1967; Cruttenden, 1986; Pike, 1947).

Languages are frequently categorized based on this typology. A language is syllable-timed when there is an equal amount of time for each syllable, and can supposedly be found in such languages as Spanish, French, Telegu, Italian, Greek, Indonesian, Hindi, Tamil, and Yoruba (Abercrombie, 1967, Dauer, 1983, Grabe & Low, 2002), and Ibibio, Anyi, and Ega (Gut et al. 2001). Stress-timed means that there is an equal amount of time between stressed syllables, and can be found in English, German, Brazilian Portuguese, Swedish and Thai (Dauer, 1983). It has also been believed these were the only classifications of rhythm for languages (Grabe & Low, 2002).¹ Another type of rhythm, mora-timing, has been found in Japanese, Finnish, and possibly a few other languages (Aoyama, 2001; Beckman, 1992; Ladefoged, 1975; Laver, 1994; Port, Dalby, & O'Dell, 1987; Tajima, 2001).² Akan/Twi is claimed to be syllable-timed (Obeng, 1989), however, recently Purvis (2009) found that, for Akan surrogate/drum poetry, the language seems to be stress-timed.

The definitions concerning syllable-timed languages seem to overlook languages that do not use stress/accent, which is culminative. Languages of these sorts tend to be grouped as syllable-timed, and justifiably so, if syllable-timing is defined as a rhythm where each syllable recurs regularly, then, each syllable is the same duration. This definition can be seen in Selkirk (1984), Nespors (1989), Nespors and Vogel (1990), and Trask (1996). However, the definition provided by Abercrombie (1967) and Dauer (1983) claims that syllable-timing is when the syllables between successive stresses, or prominences, are equal in duration. However, the latter definition only includes languages that use some type of culminative prominence. Languages like Akan, which are not known to have culminative prominences, do not necessarily fit within this definition, thus, they would have to be classified another way. However, if syllable-timing were thought of as syllables recurring at equal intervals, then every syllable would share equal prominence, since there is no difference in prominence between syllables. A question one could possibly pose is whether there is a difference between languages whose syllables recur at equal intervals between stresses/prominences and languages whose syllables recur at equal intervals without stresses/prominences. This question could be put aside for now, however, it is an important question highlighting the need for a better theory and typology of rhythmic patterns, and the need for new definitions concerning rhythmic phonology, and will surely appear amongst further research.

Laver (1994) points out the difficulties of finding empirical evidence for isochrony and speech rhythm. He mentions that there are just too many interacting aspects to the idea, such as syllable structure, stress, speaking rate, and “utterance-marginal effects” that create spaces between phrases. Dauer (1983) and Obeng (1987) also share in this understanding of rhythm and attempt to discuss rhythm within this framework. Laver also posits that rhythm is only something that can be perceived and usually only by native listeners (p.157). Empirical evidence that rhythmic patterns are important in speech perception has been found by

¹ Research in understanding if, and how, this dichotomy exists has expanded since Abercrombie (1967). Some have found Spanish and French not syllable-timed in the classic definition. Others have determined syllable-timing may not exist, but rather the rhythm is determined by segmental factors, particularly for French (Wenk & Wieland, 1982; Dauer, 1983), or that every language is stress-timed (Nespors, 1990; Nespors & Vogel, 1989).

² For an excellent review of the controversy concerning the typology, see Fox (2000).

Quené & Port (2005). Their findings suggest that listeners expect to hear regularly stressed syllables leading to better perception.

Several researchers have developed ways to model rhythm. Grabe & Low (2002) used duration measurements, which previous researchers assumed to be equidistant, hence, isochronous. Their disbelief in isochrony led to the mathematical model called the *Pairwise Variability Index* (PVI). They measured vowel durations (vocalic), from onset to offset, and the distance between two vowels (intervocalic), from offset to onset. The PVI equations calculate the duration difference between each pair of successive measurements (vocalic or intervocalic) and take the absolute value of the difference. Thus, a high vocalic PVI would mean shorter vowels and a high intervocalic PVI meaning a longer distance between two vowels. This would represent stress-timed languages. Syllable-timed languages would have low values for both PVIs. This is the same measure employed by Gut et al. (2001) in their study of Ibibio, Anyi, and Ega. They found these languages to, in fact, be syllable-timed as they hypothesized. Also, they did not find support for Dauer's (1983) claim that syllable structure, segment inventory, and phonotactics influence the rhythmic patterns. That is, Ibibio, Anyi, and Ega do not have different timing patterns due to differences in their phonemic inventory and structure.

However, there are several problems with the methodology employed by Grabe & Low (2002). First, the model ignores voiceless vowels, which could feasibly still affect the rhythm pattern of a phrase. Second, the syllable structures and types of segments used in the data have an effect on the distance occurring within measurements that would not accurately represent the patterns. A similar concern noted by Cummins (2002) is that the two measurements are not independent, and the segmental inventory and phonotactics would interact with the rhythmic pattern. Also, pointed out by Gibbon (2004) is that this approach "assumes [a] strictly binary rhythm," meaning that it can model stress-timing well, but cannot capture a unary rhythm, which could be found in a syllable-timed language.

A similar model to the PVI was put forward by Ramus, Nespors, & Mehler (1999), which took into account the proportions of the vocalic and consonantal intervals and their standard deviations over a whole sentence. However, similar problems exist here as shown by Cummins (2002), that these measures are due to the segments and unvarying phonotactic patterns of the language, and Gibbon (2004), who says the model is incomplete because it does not have "hierarchical and alternating timing components" in reference to syllable structure, and notes that there needs to be some perceptual component to a model of rhythm.

Arvaniti (2009) has suggested that previous approaches to conceptualizing rhythm in language have failed, and that the notion of timing is separate from the notion of rhythm. She discusses three ways to reframe the phenomena. First, she says that experiments should not focus on durational measurements. Second, that there are prosodic factors that could guide a speaker into a certain pattern. Finally, she suggests experiments that are more perceptual-based and the use of non-prototypical languages for study because such languages have the capacity to add to our understanding of the universal phenomenon and, also, that the native speaker's intuitions should not be ignored. This paper takes these points into account, as do the future experiments.

One approach that offers a new conception of rhythm follows from the speech cycling task as devised in (Cummins, 1997; Cummins & Port, 1998; Tajima, 2001; and Tajima & Port, 2003). These studies found the most appropriate way of understanding rhythm in language; *rhythm is a hierarchical structure of prosodic segments that synchronize, or coordi-*

nate, in time. This finding seems to have been foreshadowed by Dauer (1983) who hypothesized that:

In all languages, we would expect syllables to be grouped into larger units, even if the basis for grouping is something other than a stress beat. Repetition of particular sounds, syllables, grammatical markers, or pitch patterns, might also be used to group syllables into larger units.

Cummins & Port (1998) used the Speech Cycling Task. In this type of experiment, a speaker repeats a given phrase many times in a row. This technique allows the speaker to fall naturally into a rhythmic pattern. Their experiments had speakers do this task along with a metronome that emitted a high tone along with the first word of a phrase and a low tone along with the final word in the phrase. The low tone was placed randomly between 0.3 and 0.7 of the phrase repetition cycle (PRC) at three distinct times. The results of their experiment showed three “attractors.” Figure (1) shows the results of Cummins & Port (1998). It can be seen from their figures that three clusters appear on a histogram. These clusters occur at interval ratios of the PRC; these ratios being $1/3$, $1/2$, and $2/3$. The figures also show that the subjects were not able to line up the last word of a phrase exactly with the low tone, but rather could only come close, leading to the clustering effect in Figure (1).

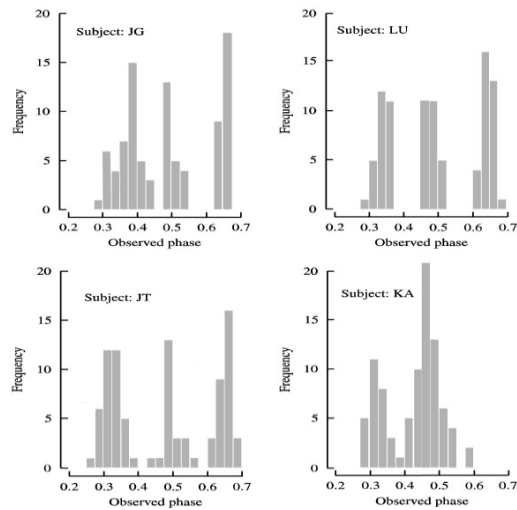


Figure 1. Results of the speech cycling task reported in Cummins and Port (1998)

Tajima & Port (2003) used the same methodology in comparing English and Japanese. Through doing a speech cycling experiment on both languages, their studies found that English and Japanese have similar foot-level structures, but that they have different rhythmic patterns.

These discoveries would be unlikely to have happened if it weren't for speech cycling. The speech cycling task has shown to be an excellent way to directly view meter in speech, capturing the temporal and perceptual components of a model of rhythm within the system of a language.

2. Experiment

There are several expectations that could occur in this preliminary experiment. First, if Akan were truly syllable-timed, three outcomes are possible. First, every syllable would land on a beat because all syllables should have equal prominence as expected by the definitions of Selkirk (1984), Trask (1996), etc. The question one could ask is whether we still say Akan is syllable-timed if speakers did not make a one-to-one synchronization between syllables and beats. This pattern had actually been found in another tone language that is said to be syllable-timed, Chinese. Bauer & Benedict (1997) claim Cantonese is syllable-timed because “every syllable...receives about equal emphasis” and “...if we tap out the rhythm of the word...each syllable receives one tap and no one syllable is louder than any other” (p. 316). They conclude that because Chinese syllables occur at equal intervals of time, Chinese must be syllable-timed. Of course, as for all phonological theories, this idea should have an empirical basis through experimentation.

Second, speakers could show any number of patterns ranging from entraining every other syllable, or every third syllable, or every fourth syllable, and so on. Following from this, it would be hypothesized that those syllables pronounced at the same time as a beat would have some special status in the language, just as a phonetically prominent syllable is expected to in a stress-timed language, and possibly have some affect on phonological processes. It is important to note, however, that Fox (2000) claims that rhythm can still exist without any phonetic manifestation of prominence, although he does not provide references to research on this area.

Finally, speakers may not be able to do the task at all. This, however, is not expected since all languages are believed to have some sort of rhythm (Abercrombie, 1967). The task could be difficult, but this would be due to the choice of the phrase structures.

Before going any further, a quick note about the syllable, and tonal, structure of Akan is necessary. The syllable is usually a CV structure, however, CVV and CVN are also possible. When a nasal is in what appears to be the syllable coda position, it is actually considered syllabic. Frequently, /r/ will delete when it appears between two vowels, and the following vowel assimilates to the preceding vowel. Also, when a nasal, particularly /m/, appears in the onset after a vowel, the /m/ will resyllabify to the coda and the following vowel will delete. Examples of these two deletions are in (3). Speakers are able to avoid these deletions, as the speaker did with the data. The tone-bearing unit is said to be the syllable (Dolphyne, 1988), however, it may be the mora. Ofori (2006) discusses uses of the mora in Akan, however, the idea that the mora is a timing unit in Akan has had little research.

2.1 Methodology

The speech cycling task is used in this preliminary experiment in a limited way. A more rigorous design will be used in future experiments. This task was accomplished by having a subject say a short phrase repeatedly. The only difference between this experiment and previous uses of the speech cycling task is that there is no metronome for the subject to speak along with. The metronome is not totally necessary since any speaker of a language can naturally fall into a rhythmic pattern so long as the phrases allow for it.

2.2 Subjects

For this paper, only data from one speaker was recorded and analyzed. The speaker is a native speaker of Akan/Twi and a linguist who was able to provide his native intuitions in the analysis. This should allow for a subjective description of the rhythm as proposed by Arvaniti (2009). More speakers will be available shortly.

2.3 Recording and Materials

The recording was done in a soundproof booth through a digital recorder. The speaker was asked to begin repeating a predetermined phrase at a medium to fast rate. If the rate were too fast, the speaker may begin to stumble over their words, and if they were too slow, it is likely they wouldn't fall into a rhythmic pattern.

The following phrases were written by the speaker. The phrases were designed so as to try to eliminate factors that may interact with a basic rhythmic pattern. Thus, each phrase was between four and six words. The list includes four sentences for each condition: all H (no downstep), all L, alternating HL, and alternating LH.

(1) Akan phrases used in the study

High Tone Phrases

kwákwá dédé pápá nónó

wóbébé sésé sósósó pápá

wúdí dé pápá pápá

wósí sósó pápá bí nó

English Gloss

That is Kwakwa's extreme noise

You'll trot briskly

You really enjoy life

You sharpen that (certain) nice hoe

Low Tone Phrases

hòmì wò wàri kètè

bùbù pàpà wò pòtòpòtò

kà mèpè sè yèrikò

tìtì wò bì pòpòròpò

English Gloss

Rest (on) Ware's mat

Break fan at Potopoto (muddy river)

I wish we were at war

The past has a lot to offer

High and Low Alternating Phrases

wábà wátò wádi kámákámà

wádò wátù wátè wáfà

wáεϕè kwáfò pápà kámà

títeà kwáfò dádà típà

English Gloss

You've come, you've bought, you've eaten nicely

You've weeded, you've uprooted, you've planted, you've taken it

You've looked at Kwafò's fan intently

Teacher Kwafò Dada's bald-head

<u>Low and High Alternating Phrases</u>	<u>English Gloss</u>
Kòfí didí kàsá wò há	Kofi eats and talks here
kwàdwó bèdá hò mí dzì mí	Kwadwo comes to sleep and fools
pàpá kòfí sòmá kwàsí dzì má	Father/Mr. Kofi sends Kwasi Gyima
kwèsí dòkú ɛ̀ɛ̀ɛ̀ɛ̀ nìbá kòfí	Kwasi Doku looks for his son Kofi

2.4 Analysis

An impressionistic analysis was done in collaboration with the speaker. He was asked which syllables he thought the beats occurred on. The researcher would then take note, and they would try to tap together to the phrases as the speaker repeated them. Each phrase was done this way until the researcher and speaker agreed on the transcription.

The phrases with alternating tones were felt to have a beat occurring on every other syllable, that is, they always landed on the H toned syllables. This gave the impression of binary feet, however, it is possible that that impression may be an artifact of the tone structure in the phrase. Phrases with the same tones throughout were created to remove the ability for a speaker to parse a phrase based on a HL or LH pattern. The phrases with all H tones appeared to have the same structure. The beats, tapped out by the researcher, occurred in time with every other syllable, starting with the first syllable in the phrase. The phrase in (2), however, was difficult for the speaker to produce with an even rhythmic pattern. The marked positions in (2) are what is expected based on the pattern from the other H tone phrases. In (3), however, is the phrase the speaker preferred to say, even though reduplication in Akan is grammatical in the phrase in (2). The speaker felt it necessary to delete the third syllable in *sósósó* to be able to keep the binary rhythmic pattern. However, if beats were able to land anywhere within the phrase so long as they kept to a basic pattern, and the prosody of the words did not influence the rhythm, then (2) should have been easy for the speaker to repeat. Since the beats in (2) and (3) are the same until the last word, it seems that either the second syllable in *pápá* has to be prominent, making it different from the surrounding syllables, or the beat has to land on the final syllable of the phrase. More phrases would have to be created and manipulated to determine this.

x x x x x

(2) w ó b é b ó s é s é s ó s ó s ó p á p á

x x x x x

(3) w ó b é b ó s é s é s ó s ó p á p á

The L toned phrases acted differently. The phrases in (4) and (5) were found to have a beat occurring every third syllable starting with the first syllable in the phrase. The phrase in (5) can have two possible deletions that the speaker avoided for the experiment. However, we had the speaker repeat the phrase if he were to include the deletions. The resulting phrase

is in (6). Notice that the beats now land on the heavy syllables created by the deletions, showing that it is possible for these deletions to affect the rhythmic pattern.

(4) $\begin{array}{ccccc} & x & & x & & x \\ & h\grave{o} & m\grave{i} & w\grave{o} & w\grave{a}r\grave{i} & k\grave{e}t\grave{e} \end{array}$

(5) $\begin{array}{ccccc} & x & & x & & x \\ & k\grave{a} & m\grave{e}p\grave{e} & s\grave{e} & y\grave{e}r\grave{i}k\grave{o} \end{array}$

(6) $\begin{array}{ccccc} & x & & & & x \\ & k\grave{a} & m & p\grave{e} & s\grave{e} & y\grave{e}k\grave{o} \end{array}$

However, the other two L tone phrases have a slightly different pattern. The phrase in (7) has a beat occurring on every third syllable starting with the beginning of the phrase as expected with the other all L toned phrases, however, during the last word the rhythm pattern is switch to occur every other syllable. That is, the first three beats occur with two intervening syllables, whereas, the third and fourth beat are distanced by one syllable. The phrase in (8) shows the opposite pattern, where the rhythm is binary until the final word, which has two syllables intervening between the prominences.

(7) $\begin{array}{ccccccc} & x & & x & & x & & x \\ & b\grave{u} & b\grave{u} & p\grave{a} & p\grave{a} & w\grave{o} & p\grave{o}t\grave{o} & p\grave{o}t\grave{o} \end{array}$

(8) $\begin{array}{ccccccc} & x & & x & & x & & x \\ & t\grave{i}t\grave{i} & w\grave{o} & b\grave{i} & p\grave{o}p\grave{o}r\grave{o} & p\grave{o} \end{array}$

3. Discussion

At the least, the data show that Akan may not be syllable-timed, since the speaker did not synchronize each syllable with a recurring beat. However, more work would need to be done to determine what rhythmic pattern pertains in the language. It is clear from the analysis that there are many aspects of the phonological system that will influence the rhythm of Akan phrases.

First, there are vowel and consonant deletions that resyllabify words so as to change the rhythm. Whether the deletions occur to fulfill the rhythmic structure, or whether the two are autonomous is up to further investigation, and experiments will be planned to determine the order, and direction, of these phonological processes.

Second, it will be useful to have a phonetic description of the tones and vowels, particularly concerning their duration and amplitude. There could be a difference in duration between H and L tones and the vowels will surely have different inherent durations due to their different qualities. It is likely [+ATR] vowels are longer than [-ATR] vowels, and that the high vowels are longer than the low vowels. The tones and vowels, then, could influence the durations of the syllables, thus, creating different syllable lengths, which could have an effect on the rhythm. Since there was a difference in the rhythm of H tone phrases and L tone phrases, it is possible this could be due to some duration difference previously unknown.

For amplitude, there could be differences between H and L tones, as well as difference between high, mid, and low, and [\pm ATR] vowels. Also, the vowels of the syllables that have been marked as prominent beats may have a different amplitude relative to the surrounding vowels.

Finally, vowel harmony, nasalization, downstep, and tonal processes may be directed by the rhythmic patterns of Akan. Experiments will be designed to manipulate movements of tones, positions of downstep, and the domain of vowel harmony and nasalization, to understand if rhythm and phonological processes influence each other, in any way, in Akan. These manipulations will be done similar to the experiments in Tajima & Port (2003), which are briefly described below.

First, Tajima & Port (2003) found that there is greater temporal perturbation when the inherent vowel durations of syllables are manipulated to occur within the foot than when across the foot. This is best illustrated by their materials in (9).

- (9) a. “GO for BYga DAY” (/ˈbaj.gə/) vs. “Go for BUG-eye DAY” (/ˈbʌ.gaj/)
 b. “Go by GUNner DAY” (/baj.ˈgʌ/) vs. “Goba Gunner DAY” (/bə.ˈgaj/)

Their findings led them to the conclusion that “the temporal stability of foot-initial syllables... (is) a phonetic correlate of foot-level structure.” If this same type of stability were to occur in analogous positions in Akan/Twi, which would be a very interesting finding since there has never been any mention of such structures in Akan/Twi. While it is difficult to define the foot structure from these data, we can at least get some sense of what that may be. Manipulations could occur within and across binary feet for the phrases exhibiting such feet, and with ternary feet, where those occurred.

Another manipulation similar to the one above is to add a syllable to the phrase in different positions. So, if a word had three prominences, then three patterns could be used; one where there is one non-prominent syllable between the three prominent ones, one with two non-prominent syllables between the first two prominent syllables and one between the second two prominent syllables, and one being the opposite of the previous example. The idea here is that if the timing of Akan were affected by these manipulations, then Akan would have timing more similar to Japanese. The conclusion in Tajima & Port (2003) was that Japanese was affected more due to the fact that it is mora-timed, rather than stress-timed. This would point to the idea that Akan/Twi could be mora-timed. Few references have been made to the existence of the mora in Akan/Twi, but it is widely accepted that the tone-bearing unit in Akan/Twi is the syllable, although no one has suggested it to be the mora, largely due to the idea that there are syllabic nasals. However, others have noted that Akan/Twi does make use of the mora phonologically and grammatically (Ofori, 2006), making it a candidate for mora-timing.

One other idea to pursue is to see if prominence in Akan/Twi is culminative. Of course, since Akan/Twi is a tone language, the tones are non-culminative. However, if certain syllables were singled out to synchronize, and we thus defined those as prominent, are they, then, culminative? That is, multiple prominences of this type may occur several times per word. The words in the phrases used in this report are too short to determine this; however, it would be possible to use longer words.

4. Conclusion

The above report is an exploratory experiment into the rhythm of Akan. Very little work exists on the language in this area, so it is necessary to start at a simple level and test various ways to learn how to design further experiments so that the goal can eventually be attained. This brief study showed the likelihood that Akan may not, in fact, syllable-timed, but rather resembles a stress-timing system, however, Akan is not known to have a physical manifestation of stress. The idea behind the study is to create a foundation to create a larger set of experiments where the researcher will be able to manipulate certain phonological processes, such as, vowel harmony, downstep, nasalization, and vowel deletions, to understand the foot-level structure of Akan.

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