

**Towards an Optimal Representation of Tones in the
Orthographies of African Languages**

By

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Abstract

Tone is a conundrum for linguists attempting to reduce African languages to writing. Anecdotal, empirical, and experimental data indicate that not marking tone at all leads to reading difficulties. The converse is also true, namely marking tone exhaustively reduces fluency, leads to false starts, and repairs. This article proposes an elegant but simple solution to get out of this catch twenty-two situation. First, a historical overview of various tone marking schemes is discussed. Second, the concept of Tone Optimality Model (TOM) is introduced and exemplified. The proposed model succeeds in reducing tonal density in texts without affecting readability. The main advantage of TOM over other tone marking schemes is that it draws insights from well-established phonological theories, from the Interactive Reading Model, and from research on tone universals. As a result, tone can be written minimally with maximum benefits for readers.

Résumé en Français

L'orthographe du ton représente un véritable casse-tête chinois pour les linguistes travaillant sur les langues africaines. Les études expérimentales, les observations empiriques, et les ouïe-dires confirment que ne pas indiquer le ton conduit à toutes sortes de difficultés de lecture mais en marquer de trop affecte négativement la fluidité de la lecture. Le présent article propose une solution simple et élégante à ce dilemme. La première partie de l'article est consacrée à un rappel historique des différentes propositions faites pour le marquage des tons. La seconde partie introduit le concept du Modèle Optimal des Tons (MOT). L'avantage de ce modèle sur tous les autres c'est qu'il permet de réduire la densité tonale sans affecter la fluidité de la lecture négativement. Ce modèle tire sa source de plusieurs théories phonologiques déjà établies et bénéficie aussi des apports de la théorie de la lecture et des recherches sur les universaux de tons.

0 Introduction

The orthographic representation of tone in African languages is a matter of great debate among linguists. Many linguists agree that tone should be marked in the orthography because it has a distinctive function both lexically and grammatically. However, beyond this self-evident consensus there is no agreement on how to proceed. Should the orthography represent only lexical minimal pairs or should it also indicate grammatical tone? Should phonemic and phonetic tones be given equal weight in the orthography? Should tone be marked fully or should it be marked selectively? The goal of this paper is to re-examine these issues in the light of recent analyses and proposals. It will be argued here on the basis of experimental studies conducted in several West African languages that the concept of Tonal Optimality Model (TOM) offers an elegant solution to the thorny issues of tone in the orthography. This approach steers clear of the pitfalls that have plagued orthographic decisions about tone. It offers a linguistically sound rationale for writing tone minimally but exhaustively. The arguments in favor of this model are made in two steps. The first part focuses on a general review of tone marking practices and on recent developments in theoretical linguistics that can have a great impact on tone orthography. The second part shows how these insights have been used in designing the tone orthography of Anyi, an Akan language (more specifically of the Tano sub-family) spoken in Côte d'Ivoire and Ghana.

1.1 Definition of Optimality in Orthography

The term “optimality” as used in orthographic studies is not completely synonymous with its use in Optimality Theory even though some of their semantic fields may overlap. In *Sound Patterns of English*, Chomsky and Halle (1991:48-49, 50, 54) argue repeatedly that English orthography is “near optimal”. They explain optimality as follows: “There is, incidentally, nothing particularly surprising about the fact that conventional orthography is, as these examples suggest, a near optimal system for the lexical representation of English words. The fundamental principle of orthography is that phonetic variation is not indicated where it is predictable by general rule.” In the same paragraph, they state that “English orthography, despite its often cited inconsistencies, comes remarkably close to being an optimal orthographic system for English.” Furthermore, Chomsky and Halle contend on pp. 48-49 that an optimal orthography has also the merit of being supradialectal: “It should also be observed that very different dialects may have the same or a very similar system of underlying representation. It is a widely confirmed empirical fact that underlying representations are fairly resistant to historical change, which tends, by and large, to involve late phonetic rules. [...] Thus a conventional orthography may have a long useful life, for a wide range of phonetically divergent dialects.” On p. 50, they also point out one of the benefits of an optimal orthography: “Clearly, reading will be facilitated to the extent that the orthography used for W corresponds to the underlying representation provided by the grammar G. To the extent that they correspond, the reader can rely on the familiar phonological processes to relate the visual input W to an acoustic signal. Thus one would expect that conventional orthography should, by and large, be superior to phonemic transcription, which is in general quite remote from underlying lexical or phonological representation and not related to it by any linguistically significant set of rules.” On p. 54 they restate that English orthography is near optimal because it relates to the underlying lexical

representation of words. Following the model of optimal orthography sketched in *Sound Patterns of English*, we will say that an optimal tone orthography is one that represents only underlying tone. However, before highlighting the merits of this approach, let us review briefly the various proposals that have been made regarding tone orthography in African languages.

1.2 Historical Overview

The history of tone in the orthography of African languages can be divided into three periods. The first period is characterized by the absence of tone marking. This is characteristic of the African languages written prior to the first half of the 20th century. The second historical period is marked by timid attempts to include tone in the orthography. Broadly speaking, this period covers the decades of the 1960s and the 1970s. The 1980s marked a shift in the awareness of tone. With this increased awareness came some excesses in the representation of tone in African languages. The decade of 1990s onward has been characterized by a willingness to correct the excesses of the 1980s by taking a middle of the road position. The sections below will review these historical periods in depth by highlighting the main developments in theoretical linguistics which have affected tone marking decisions.

1.2.1 The Period of Toneless Orthographies

It is a well known fact that many of the African languages that were reduced to writing in the late 19th century and in the first half of the 20th century did not represent tone in the orthography. Cahill's (2001:11)¹ overview of tone marking in the languages of Ghana is telling in this regard. Of a total of 34 languages surveyed in 1993, he notes that 21 had no tone marking at all, 9 indicated grammatical tones while 4 languages indicated tone on lexical minimal pairs. It is quite likely that most, if not all the toneless orthographies in the list were designed before the 1960s, with the exception of Ewe.² Tone was not marked in most of the orthographies designed before the 1960s because, according to Welmers (1973:77) there was widespread tonophobia among missionary-linguists. He tells the following story to underscore the fear of tones: "A missionary candidate and his wife admitted that, when they learned that the language that their African field was a tone language, they seriously questioned whether the Lord had actually called them to missionary service." Welmers (p. 77) also lists neglect and the lack of understanding of the importance of tone as additional rationale for toneless orthographies:

Writers of grammars have commonly neglected to describe and write distinctions in tone, on the theory that 'tone can be learned only by observation and practice.' Leonard Bloomfield aptly commented on this (1942), "such a statement is nothing less than downright swindle, for of course observation and practice are the only way anything can be learned." Others dismiss the entire topic of tone with only a brief statement of this sort: "Tone is important, as will be seen from the following

¹ I'm grateful to Dr. Mike Cahill of SIL for his insightful comments and suggestions on the pre-publication draft of this article.

² It may be the case that some of these orthographies were designed after the 1960s. If such is the case, then the lack of tone marking can be blamed on the orthography of Akan which, according to Cahill, exerts a strong influence on other Ghanaian languages.

examples [two or three examples follow]; however, tone will not be marked in this grammar. One grammar does discuss tone fairly fully but relegates it to an appendix explicitly added for the benefit of those who are particularly interested and who consider themselves especially gifted. Many more grammars – more than half of over a hundred grammars of African languages examined – omit all mention of tone; some go so far as to assert that the language being treated is definitely not a tone language, though a little investigation readily proves that it is. A shocking number of people concerned with African languages still seem to think of tone as a species of esoteric, inscrutable, and utterly unfortunate accretion characteristic of underprivileged languages – a sort of cancerous malignancy afflicting an otherwise normal linguistic organism. Since there is thought to be no cure – or even reliable diagnosis – for this regrettable malady, the usual treatment is to ignore it, in hope that it will go away of itself. With a more optimistic determination, one group of language learners in Africa asked a trained linguist to come and try to “get rid of tone” in the local language.

The reading difficulties associated with toneless orthographies began to attract attention in the early 1970s. Gudschinsky (1970:23) and Lucht (1978:26) observed that reading was excruciatingly difficult for readers of tone languages. Gudschinsky reports the following experience:

An intelligent, educated native speaker of a tone language of West Africa was asked to read a page from a primer in his own language. He remained staring at the page without speaking for so long that the people around him became embarrassed. Finally they said, ‘Never mind. It's quite all right if you don't want to read it.’ The African replied, ‘Oh, no, no. I'll be ready in a minute. It's just that I haven't figured out yet what it is supposed to say, so I don't know what tone to read it with.’

Similar reading difficulties were reported in other African languages whose orthographies were toneless:

A native speaker of a Bantu language of Rhodesia was asked: Does the fact that tone in your language is not written make any problems when people read it? He replied immediately, ‘No. Not at all. Everybody learns to read and has no problem. He was then asked, ‘But don't people sometimes have to read things twice? Once to know what it says and once to read it correctly?’ With a look of shocked surprise, he said, ‘Oh! Is that why we read our own language back and forth? We always say that we read our own language back and forth and back and forth, but we read English straight along. We can read English in about half the time that it takes to read our own language, but never knew why, Gudschinsky (p.24).

Wa Thiong’o (1986:74) expresses the same kind of frustration with the orthography of Gikuyu as follows:

Words and tenses were even more slippery because of the unsatisfactory Gikuyu orthography. Gikuyu language had been reduced to writing by non-native speakers such as European missionaries and they could not always identify the various lengths of vowels. The distinction between the short and long vowel is very important in Gikuyu prose and poetry. But the prevailing orthography often left the reader to guess whether to prolong or shorten the vowel sound. This would be very tiring for an extended piece of prose. This lack of the means of making distinction between long and short vowel sound assumed a previous knowledge of all the words on the part of the reader. I tried to solve the problem by using double vowels where I wanted to indicate the long vowel. But it took several pages before I could get used to it. And even then it was never finally satisfactory for what it called for was a new letter or a new marker for the long vowel.

He goes on to show that the difficulties associated with long and short vowels pale in comparison with the even harder task of reading a toneless orthography:

Gikuyu is also a tonal language but the prevailing orthography did not indicate tonal variations. So for all these reasons, I would write a paragraph in the evening sure of how it read, only later to find that it could read in a different way which completely altered the meaning. I could only solve the problem by severely controlling the context of words in a sentence, and that of sentences in a paragraph, and that of the paragraph within the entire situation of the occurrence of the action in time and space. Yes, words did slip and slide under my own eyes. They would not stay in place. They would not stay still. And this was often a matter of great frustration, p. 75

The problems encountered by readers when tone is not marked in the orthography seem be very widespread. Lucht (1978:26) provides an example from Siane, a language spoken in Papua New Guinea which shows that the problem is not limited only to African languages:

It is because of tone that I've had to go back and reread several times what I wrote the day before in order to know what I meant on this translation work I've been doing. We all have to do something about it. What shall we do?

These published accounts of reading difficulties associated with toneless orthographies parallel what Rev. Koussougon René, the main translator of the Ditammari New Testament, told me a few years ago. Even though he and his team spent about two decades translating the Scriptures, he told me that if anyone of them were to be asked to read a passage spontaneously, that is, without advance warning, it would be a "disaster." To avoid public humiliation during Sunday services, readers were assigned their portions well ahead of time, preferably the Friday before the service. This way, readers had a lot of time to practice. This and countless other testimonies underscore the reading difficulties created by toneless orthographies.

1.2.2 The 1970s: A Decade of Tone Experimentation

The missionary-linguists who began arriving in Africa in the 1970s were quite different from their predecessors. The newcomers were linguistically sophisticated and understood that, because tone has a distinctive function, it should be represented in the orthography. In fact, many of these missionaries were graduates from the Summer Institute of Linguistics and had studied under Kenneth Pike, the great advocate of marking tone in the orthography. They used the phonological method of minimal pair analysis to catalogue lexical and grammatical tones and began representing tone in the orthographies that they were designing, as Pike (1946:255) had instructed them to do:

Symbols for tone and stress should reflect an adequate analysis of the language. Where tone and stress are phonemic and affect the meaning of words, they should be symbolized at each occurrence of the units. One should not content oneself with writing tone merely on those words which may be misunderstood if the tone is given inaccurately. Tone should be written on each of the words of the tone language, wherever the tones occur. In this way the native learns the meaning of the tone symbols and how to read them within the words where the consonant and the vowels and the context make these particular words unambiguous. Once he has learned the meaning of the tone symbols in unambiguous contexts of this type, he should then be able to utilize these symbols to distinguish words where the tone is the only distinctive characteristic.

However, Pike's recommendations were not fully implemented because the initial results of tone analysis were disappointing. First, African languages varied widely in the functional load carried by tone. Some languages relied more heavily on tone than others. Second, as noted by Welmers (1973:117), the amount of lexical and grammatical minimal pairs that linguists expected to see was far smaller than what they had anticipated. Consequently, in a large number of orthographies, tonal diacritics appeared so infrequently that their pedagogical value and their impact on reading accuracy came to be doubted. Wiesemann (1989:16) used this as her rationale for rejecting writing tone selectively:

It should be mentioned here that a system which marks tone where it is minimally different in individual words is not a good system. In such a system, for each individual word one must learn whether it carries a tone mark or not. To mark low tones only on words where there is a minimal tone pair makes the teaching of tone a matter of memory, rather than a matter of rules linked to pronunciation.

Smalley (1964:41) also rejects selective tone marking because "it represents the speech system of the language in such an inconsistent way, it compounds the learning problem seriously and, in many cases, means that the reader never learns to use the tone symbols at all because he meets them in such an inconsistent fashion." Longacre (1964:133) published an influential paper in which he argued strongly against writing tone only on lexical minimal pairs. He insisted that writing tone selectively is not a good solution to the problem of toneless orthographies because "[it] presupposes that one has already made a list of all the words in the language to see which ones are minimal pairs. Such a claim is pretentious since most newly written language do not have good dictionaries." The 1970s come to a

close with uncertainties still hanging on how to mark tones in the orthography of African languages. This uncertainty is clearly seen when one does a tone analysis of the Bibles and New Testament that were begun during this period.

1.2.3 The 1980s and the Advent of Full Tone Marking Proposals

The decade of the 1980s is marked by a sense of triumphalism in theoretical linguistics. This decade ushered in a new era for the representation of tone in the orthography of African languages. Under the influence of Wiesemann (1989) and many of her Summer Institute of Linguistics colleagues, the issue of tone took center stage. Several important workshops and seminars were organized in Central and West Africa. During these training sessions, participants were encouraged to represent tones **fully** in the orthography of their languages. This practice is in keeping with Pike's recommendation mentioned in the previous section. It was also a way of correcting the deficiencies in the selective tone marking scheme which was in vogue in the 1970s. Marking tone fully was synonymous with writing only phonetic/surface tones. Bird (1998b: 7-8) identifies three such schemes, as shown in the chart below.

N0	Orthography Type	Tone Density	Reading Results	Writing Results
1.	Stable	35%	90%	63%
2.	Basic	57%	62%	63%
3.	Surface	62%	57%	35%

Table 1: Tone Marking Schemes

Stable tone marking consisted in marking the least variable tone while basic tone marking indicated tone only on nouns and verbs. Surface marking, on the other hand, indicated tone on all syllables except on affixes. In recent years voices have been raised here and there to question the wisdom behind these tone marking schemes because increasing tone diacritics did not yield the anticipated results. In 1998, Bird published a critical article entitled "When Tone Marking Reduces Fluency." In it he shows that none of the schemes in Table 1 which represents phonetic tone yields a better result than the selective tone marking approach that was prevalent in the 1970s. Furthermore, he contends that these three schemes clutter the orthography with tonal diacritics. Worse, readers do not fare better with higher tonal density than with no tone at all! He also showed that with only 4% of tonal density, readers received a reading score of 60%. All this led him to ask the following question: "Why did surface tone marking get adopted in Dschang and other languages when it appears to be so inefficient?" He answers his own question as follows:

Although each of the three experiments uses different methods, different kinds of subjects and different language, *all agree that full surface tone marking is not optimal*. The high tone density which results from surface tone marking imposes too great a cognitive load on readers, and they are unable to use the information conveyed by the tone marks effectively. (Emphasis added) Bird (2001:6)

In the end Bird (2001:18-20) proposed to return to a toneless orthography for Dschang. But his proposals were soundly rejected:

The literacy workers opposed the orthographic changes proposed by the author, claiming that the changes were too radical. They were unpersuaded by the experimental findings. Having mastered such a complex tone orthography, it was not in their interest to make the task easier for others. Perhaps they thought that their status was at risk, or that the skill on which their livelihood depended was under threat.

In the end Bird blames the failure of his radical proposals on three agencies: Dschang literacy workers, the National Association of Cameroon Language Committees (NACALCO), and the Summer Institute of Linguistics to which he refers to as “expatriate linguists.” Bird took his frustrations on these entities instead of acknowledging that a toneless orthography is not the best solution for the reading difficulties encountered in Dschang or any other tone language.

1.2.4 Evaluation and Diagnosis of Past Practices

After evaluating the orthography of Dschang and the reading and spelling scores of the participants in his experimental studies, Bird (1998b:16) asks this penetrating question: “Why do readers do so poorly when tone marks are added?” To answer this question, let us consider three interrelated factors: the nature of tone, the complexity of tone assimilation rules, and the difficulties that native speakers have in perceiving the subtle pitch changes.

Tone can be likened to a mirage. From a distance, the tonal structure of African languages seems rather simple and straightforward. Many languages have only two level tones, High and Low and two contour tones, rising (Low-High) and falling (High-Low). Therefore, it is rather easy for a foreign linguist or for a native linguist who simply does analyses on the language but does not write in the language to ask translators and literacy workers to represent tone in the orthography. However, when one gets serious about writing tones, myriads of problems surface. Quaireau (1987:44) explains why this is so for Anyi: “In itself, the Anyi tone system is very simple because it has only two [level] tones. However, discovering the tone assimilation rules is not as easy. This is due to the fact that complex phonetic realizations are hidden behind this apparently simple tonal system.” Schuh’s (1978:221-256) article on tone rules underscore the fact that tone assimilation rules in most languages are notoriously difficult to describe. The translators of Ditammari and Lokpa, two languages spoken in northern Benin, experienced the trickiness of tone the hard way. After attending a seminar during which Wiesemann encouraged participants to write phonetic (surface) tones fully in the orthography, the translators embarked with enthusiasm on their task. However, their enthusiasm quickly turned into frustration, and frustration gave way to discouragement. After marking the tones on the first three chapters of Genesis, they became overwhelmed with the amount of decisions that had to be made at every turn. First the translators’ perception of the tone of the same word changed from syntactic context to syntactic context. Second, they never quite agreed on the tone of many words: where one person perceived a high tone another heard a mid tone. Third, on subsequent readings of the same passage, the translators agonized over the accuracy of the tone that they had written previously.

Tone assimilation rules make it extremely difficult for native speakers to perceive tones accurately. It goes without saying that a faulty perception leads to a haphazard tone orthography. Phenomena such as downdrift and downstep affect the behavior of tones in the sentence. Ladefoged (2001:236-238) describes the former as follows:

Even in a tone language, the pitch of the voice changes continuously throughout sequences of voiced sounds. There are seldom sudden jumps from one pitch level to another. As a result, assimilations occur between tones in much the same way as they do between segments. When a high tone precedes a low tone, then the low tone will usually begin with downward pitch change. Conversely, a high tone following a low tone may begin with an upward pitch movement. Considering two adjacent tones, it is usually the first that affects the second rather than the other way around. There seems to be a tendency in the languages of the world for tone assimilations to be preverative—the tone of one syllable hanging over into that of later syllables—rather than anticipatory—the tone of one syllable changing because it anticipates that of a syllable yet to come. [...] As I mentioned earlier, tone languages also use intonational pitch changes. In many tone languages, ordinary statements will have a generally falling intonation, and at least some questions will have a rising intonation over part of the utterance. Doubt, anger, excitement, and many other emotional signals conveyed by intonation not all that dissimilar from those of English, the distinctive tones of individual words being superimposed on the overall patterns.

To make matters worse, Anderson (1978:138) points out that emotional and expressive factors influence tones. Bolinger (1978:474) notes that pause and intonation affect tones. Hombert (1974:171) argues that there are tone differences between long and short utterances. Akouadou (2005:141, 181, 194) has shown through various acoustic measurements that in Anyi Idenie the pitch of the tone changes if a sentence is in the declarative, interrogative, imperative, and negative moods. Moreover, topicalization and pauses affect the acoustic behavior of tones. These linguistic and paralinguistic factors make it almost impossible to perceive and represent phonetic tone accurately in the orthography.

In addition to downdrift, many African languages have downstep tone. Following Welmers (1973:87), downstep is often defined simply as the lowering of a high tone when a segmentless low tone morpheme is present. This “invisible” morphotoneme is referred to in the literature as a “floating tone.” Quaireau (1987:49) provides the following acoustic information to demonstrate downstep high in Anyi:

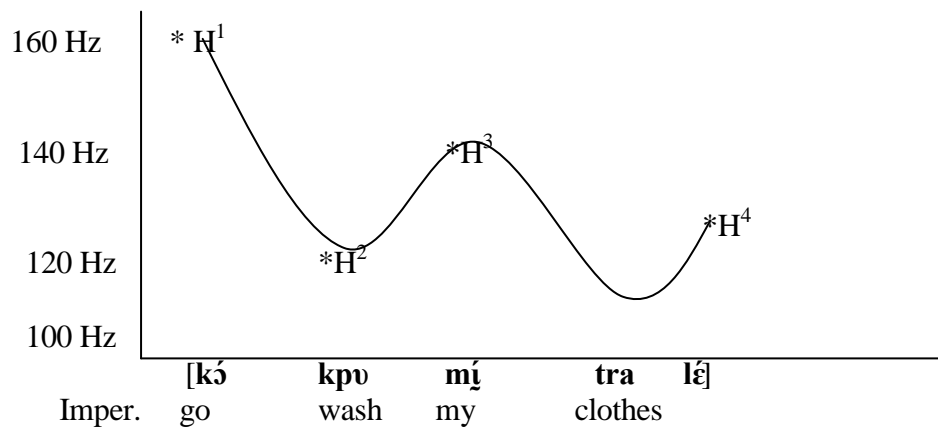


Figure 1: Anyi Downstep

Phonemically, H¹ and H² have the same high tone because monosyllabic verbs have an underlying high tone. However, in some dialects of Anyi, when a verb is followed by a direct object, its tone is lowered. Thus, here the phonetic tone of the verb <kpu> is almost as low as the phonemic low tone of the syllable [tra]. The combined effects of downdrift and downstep makes it extremely hard for writers in African language to grasp the behavior of phonetic tones. In the light of all this, it should not come as a surprise that the participants in Bird's (1998b:17) experimental study made spelling errors when they were asked to write phonetic tone in their texts:

The most surprising fact about this data, I believe, is the low overall accuracy (73.1) of the experienced writers. This group of six people includes three full time language development workers who probably control the orthography better than any other speakers of the language. Another surprising fact is that inexperienced writers perform worse than chance when they have to write a high tone (22 %).

1.3 Theoretical Linguistics Solutions

Forty consecutive years of advances in theoretical linguistics can help find reasonable solutions to the issue of tone in the orthography of African languages. The theories and approaches that are more helpful in this endeavor are Generative Phonology, Autosegmental Phonology, research on language universals, Lexical Phonology, and the interactive reading model in psycholinguistics. Let us see how these insights have deepened our understanding of tone and how they might contribute to an optimal representation of tone.

1.3.1 Generative Phonology and Underlying Tone

There is usually a considerable delay between the findings of theoretical linguistics and their orthographic applications. Up until now the full impact of Chomsky's and Halle's generative phonology has not been felt in orthographic decisions about tone. Their central claim that orthographies are optimal if they represent underlying segments as opposed to phonetic manifestations has gone largely unnoticed except for Anyi where Koffi (1990) proposed a supradialectal orthography based on generative phonology. Bird (1998b:10) predicts that Cameroonian orthographies would have fared better if underlying tone were

represented in the orthography instead of surface tone. He puts it as follows: “Perhaps this smaller, more abstract set ought to be the foundation for a tone orthography.” Thus, representing phonemic tone in the orthography is one of the most important axioms of the Tone Optimality Model proposed in this paper.

1.3.2 The Contribution of Tone Universal Research

Maddieson’s (1987:342) work on universals of tone has been influential on my approach to tone orthography. His research led him to this important finding:

Systems in which high tones are marked are more frequent than systems in which low tones are marked.

In designing a tone orthography, one can use this insight to considerably reduce the number of tonal diacritic. If a language has two level tones: High and Low, and if the universal tone tendency applies to this language, only high tones need to be represented in the orthography because they are less frequent, i.e., marked. The converse is also true for languages in which low tones are less frequent, and high tones are more frequent. Maddieson’s findings lend support to Williamson’s (1984:42) Tone Economy Principle which she formulated as follows:

If we are marking the tones fully in the language, we can reduce the number of diacritics used by agreeing to leave the most common tone of the language unmarked. This is a kind of spelling rule.

Any tone orthography that takes into account these two important principles can reduce the number of tone diacritics without affecting negatively reading fluency.

1.3.3 The Contribution of Autosegmental Phonology to Tone Orthography

Autosegmental Phonology has done more to enhance our understanding of tone languages than any other theory in contemporary linguistics. The architecture it uses to represent tone and the Obligatory Contour Principle (OCP) it has formulated have shed light on the behavior of contour tones. This is particularly true when it comes to the phonological analysis and representation of contour tones. Goldsmith (1990:40) spells this out clearly as follows: “In a language with High and Low tones, it is common to find falling and rising tones in addition, and among African tone languages it has been demonstrated in countless cases that the tonal patterns are best treated as sequences of High-Low and Low-High, respectively.” This insight complements Maddieson’s (1987:345) finding that, “If a language has contour tones, it also has level tones.” This led Koffi (1994) to propose that if a vowel has a contour tone, it should be represented in the orthography by two identical vocalic graphemes, each with its own tone. Thus, instead of writing the word [bá] (child) as <bá> in the orthography of Anyi, it could be written as <bàá>. However, because of the Tone Economy Principle referred to in 1.3.2, the word is spelled <baá>.

1.3.4 The Contribution of Lexical Phonology to Tone Orthography

The principal goal of all orthographies is to write the words of the language as accurately as possible. No other theory of phonology helps meet this challenge better than lexical phonology. The presentation of this theory will be succinct; most of the technical details will be overlooked in order to highlight its relevance to orthography. Let's start our discussion with Goldsmith's (1990:217-218) description of lexical phonology it:

In the late 1970s and early 1980s, a number of theoretical proposals concerning the relationship between what in pregenerative years would have been called morphophonemic rules and purely phonological rules were synthesized into a framework called lexical phonology. ... Lexical phonology can be divided into two distinct, but related theories, a theory of phonology and a theory of morphology. ... Lexical phonology begins with a division of phonology into a lexical component and a post-lexical component.

The following architecture is generally proposed to give a visual representation of how morphology and phonology interact in lexical phonology:

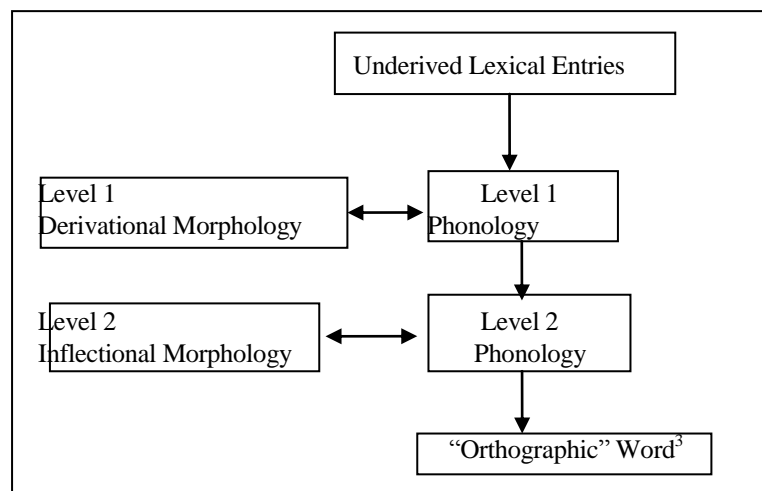


Figure 2: Lexical Phonology Architecture

According to Iverson and Wheeler (1988:334) the root of the word is directly accessible to the phonological component. The phonological Level 1 and the morphological Level 1 interact. So, at Level 1 (also known as stratum 1), phonology has access to all the derivational morphemes of the language. Word and morpheme boundaries are indicated by the symbol “+.” Any rule that needs to apply at this level applies. The form of the word that results from the application of these rules serves as the input to Level 2. The same process is repeated until finally we arrive at the form of the word that appears in the spelling or in the dictionary of the language as an “orthographic” word. Twenty years earlier, Jones

³ In the original formulation, the word in its citation form occurs here. The “orthographic” word is used here instead “phonetic representation” because the model has been adapted to orthography.

(1967:227) proposed a principle to account for orthographic words that reflects the main findings of lexical phonology. It is stated as follows:

Lexical Principle

Subject to rare exceptions, each word should be written in one way only, and its orthography form should in most cases be based on the pronunciation it has when said in isolation.

Now let's see how lexical phonology can be useful in the tone orthography of Anyi by examining the words [bàá] (child) and [m̀m̀àá] (children). Both the underived root /bàá/ and the derived root [m̀m̀àá] have a rising tone. The word [m̀m̀àá] begins with a low tone nasal morpheme but this tone does not affect the low tone that follows. Therefore, the orthographic word could be written as <m̀m̀àá> but for reasons that will be discussed later, the word is spelled as <mmaá> in Anyi orthography. The full derivational cycle, including the phonological rules that change /n/ into [m̀] and /b/ into [m], is given below:

Underlying Representation:	/#	bàá	#/
Prefixation:	#	n + bàá	#
Boundary erasure:	#	ǹbàá	#
Homorganic assimilation:	#	m̀bàá	#
Gemination rule:	#	m̀m̀àá	#
Surface Representation:		[m̀m̀àá]	

In this example, the tone remains unchanged during the derivation. So, the tone of the orthographic word is identical with the tone of the underived lexical item. Now, let's examine a different situation where the tone of the underived lexical item is different from the tone of the putative orthographic word. The same word <baá> [bàá] can help illustrate the case where there is a difference between the underlying tone and the surface tone. When /bàá/ appears in a syntactic environment where it is preceded by a possessive adjective, it changes to [wàá]. The segment /b/ glides and becomes /w/. At the prosodic level, an important shift occurs. A tone metathesis rule applies that switches the tones around. This is called tone reversal. This derivational cycle can be illustrated as follows:

Underlying Representation:	/#	bàá	#/
Gliding:	#	wàá	#
Tone reversal:	#	wáá	#
Surface Representation:		[wáá]	

What do these two examples tell us about the relevance of lexical phonology in tone orthography? In the vast majority of cases, the tone of the underived lexical item is the same as the tone of the orthographic word, that is, the tone of the word said in isolation. Consequently, the orthography should strive to reflect the underlying phonemic tone whenever possible. However, there are exceptional cases such as the one above in which a tone reversal rule applies during the derivational cycle. Since the change in melody from

rising to falling is acoustically salient, the orthographic word should reflect the tone of the derived lexical item.

1.3.5 The Contribution of Psycholinguistics to Orthography

The interactive reading model proposed by psycholinguistics offers great insights that can be beneficial to orthographers. Treiman (2003:664-6) describes the model as follows:

In the case of reading, as with other cognitive processes, psychologists have distinguished between two kinds of processing. *Bottom-up processes* are those that take in stimuli from the outside world –letters and words, for reading –and deal with that information with little recourse to higher-level knowledge. With *top-down processes*, on the other hand, the uptake of information is guided by an individual's prior knowledge and expectations. In most situations, bottom-up and top-down processes work together to ensure the accurate and rapid processing of information. However, theories about cognitive processes involved in reading differ in the emphasis that they place on the two approaches. Theories that stress bottom-up processing focus on how readers extract information from the printed page, claiming that readers deal with letters and words in a relatively complete and systematic fashion. Theories that stress top-down processing hold that readers form hypotheses about which words they will encounter and take in only just enough visual information to test their hypotheses. ... Comparisons of good and poor readers further support the claim that bottom-up processes play an important role in reading. ... The statement that bottom-up processes play a central role in reading does not necessarily mean that top-down processes are completely unimportant. Studies have shown that words that are predictable from context are fixated for shorter periods of time and are skipped more often than words that are less predictable, although the effects are relatively modest.

The interactive model involving reading aloud is presented schematically as follows:

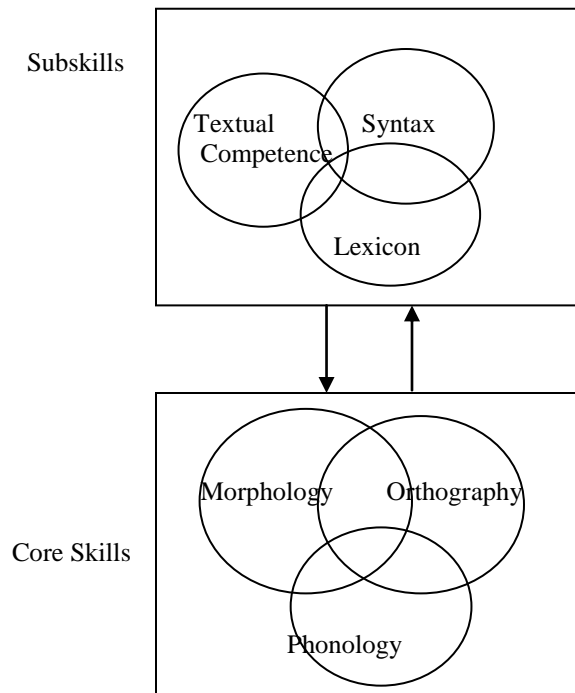


Figure 3: Interactive Reading Architecture

Reading aloud is a complex and intricate systems in which the top-down processor and the bottom-up processor interact. The components of the top-down processor include syntax, the lexicon, and textual competence. Those of the bottom-up processor are phonology, morphology, and orthography. In reading aloud, a literate person converts graphemic information into phonemic input, and then into phonetic output. A correct phonetic output presupposes that the reader has applied various morphophonological rules. In some instances accuracy in pronunciation is dependent upon the syntactic structure in which words are found. Otherwise, it is the skills found in the bottom-up processor that are absolutely needed in reading. This psycholinguistic approach to reading can inform tone orthography decisions. However, before we underscore its importance in tone orthography, let us take a short detour and focus one glaring weakness of English orthography.

English orthography is replete with homographs, that is, words that have the same spelling but different pronunciations: <offense [ɔfɛns] vs. [ɒfɛns] offense>, <defense [difɛns] vs. defense [dɪfɛns]>, <read [ri:d] vs. read [rɛd]>, <minute [mɪnət] vs. minute [maɪnət]>, <lead [li:d] vs. lead [lɛd]>, <tear [tɛə] vs. tear [tʰiə]>, <dove [dʌv] vs. dove [dɒv], etc. Normally, when these words are read out loud, the syntactic component of the top-down processor enables readers to pronounce these words accurately. However, in some instances the information provided by syntax alone is not enough to arrive at the correct pronunciation of homographs. To dramatize this point, I have designed a reading test in which graduate and undergraduate students from two universities have been asked to read the following passage aloud as normally as possible. So far, not a single reader has

been found who has read it without hesitation or repairs. Readers often stumble on the words the words “offense” and “defense.” It is usually after the second or third attempt that readers manage to read the text below fluently:

The offense in this whole thing is that the offense did not play offense and the defense did not play defense. There is absolutely no defense for this loss.

Reading aloud difficulties faced by readers of toneless orthographies are similar to those encountered in reading the text above. The only difference is that homographs are more pervasive in tone orthographies. It is true that the syntactic context can be helpful in resolving some ambiguous cases, but as the example above shows, there are also some problems related to homographs that syntax does not readily solve. In such cases dependence on syntactic cues cause false starts, reading repairs and many other types of miscues. Coulmas (1989:173) notes that many orthographies avoid homographs so as to facilitate lexical recognition: “Homograph avoidance is an orthographic feature which is exploited widely in the interest of direct lexical access.”

Now let us return to the orthography of African languages. Most of the African languages being reduced to writing follow the phonemic principle. Ideally, this principle mandates that there be a one-to-one correspondence between graphemes and phonemes. Though strict adherence to this principle is hard to achieved, orthographers try their very best to match a phoneme with a grapheme. One of the negative side effects of the phonemic principle is that it leads to the proliferation of homographs, especially in toneless orthographies. According to Coulmas most spelling systems avoid or minimize homographs by introducing homophones in their orthographies. Homophones are words that have the same pronunciations but different spellings. English has many homophones but suffice it to mention only these: <to> [tu] vs. <too>[tu] vs. <two> [tu], <their> [ðɜː] vs. <there> [ðɜː] vs. <they're> [ðɜː], <prince [prɪns] vs. prints [prɪns], and <marry> [mɛri] vs. <merry> [mɛri] vs. <Mary> [mɛri]. Given the negative impact that homographs have on reading, every effort should be made to avoid them or minimize their numbers in tone orthographies. Consequently, it is not unreasonable to elevate this insight to the level of an orthographic principle. It can be stated as follows:

Homograph Avoidance Principle (HAP)

Avoid homographs, if possible.

Because the phonemic principle has the propensity to beget homographs, a remedy to this situation can be found by proposing that tone diacritics be used to distinguish between potential minimal pairs. Spanish, whose orthography is phonemic, has adopted exactly the same approach. In so doing, it has eliminated or drastically reduced the amount of homographs in its writing system. It simply places an acute accent diacritic to distinguish between potential lexical and/or grammatical minimal pairs, as shown in the examples below:

Nº	Lexical and Grammatical Minimal Pairs	Glosses
1.	<cómo> vs. <comó> vs. <como>	I eat vs. I ate vs. like
2.	<sí> vs. <si>	yes vs. if
3.	<esta> vs. <está>	he/she is vs. this/that
4.	<qué> vs. <que>	what vs. that
5.	<él> vs. <el>	he vs. masculine definite article
6.	<mí> vs. <mi>	my vs. me
7.	<exclamó> vs. <exclamo>	I yelled vs. I yell

Table 2: Minimal Pairs in Spanish

In addition to these lexical and grammatical minimal pairs, Spanish also uses accent diacritics to help readers pronounce words accurately if their accent deviates from predictable patterns. According to Yavaş (2006:184) disyllabic, trisyllabic, and four syllable words are stressed on the ultima. Whenever, there are exceptions to this predictable stress rule, Spanish orthography shows it by representing the deviation in the spelling of the word. Here are just a few examples <espíritu> (spirit), <apóstol> (apostle), <dádiva> (doubt), <árbol> (tree), <automóvil> (car), <típico> (typical) , <éxito> (exit). Spanish does not limit the accentual diacritic to these cases. It also helps readers pronounce verbal forms correctly if a direct object pronoun is suffixed to them. A diacritic is placed on the accented syllable as in <mirándose> (watching himself/herself) and <enseñame> (teach me) even though this pattern is predictable. This latter orthographic practice lends support to Cahill's (2001:8) suggestion that "it is important to be especially careful to give the reader every cue he needs, even to the point of redundancy."

1.4 Homograph Avoidance in African Languages

Spanish solves its homograph problem by resorting to accentual diacritics to distinguish between lexical and grammatical minimal pairs. This same approach can be used effectively in tone orthographies. As noted earlier, this approach was tried in the 1970s but was more or less abandoned because of the objections raised by Longacre and others. However, the claim that it is pretentious to mark tone on minimal pairs alone because there are hundreds of other such words that may go unnoticed is based on theoretical conjectures, not on field linguistic data. Decades of research on tone languages has shown that there are far fewer minimal pairs distinguished solely by tone than was previously believed. After nearly twenty years of research on Anyi, I have not yet come across more than more than sixty tone-induced minimal pairs. Bird (1998a:17) reports that of more than 3000 words Komo (language spoken in the Democratic Republic of Congo) studied by Thomas, only 28 lexical minimal pairs were found. Welmers (1973:117) concurs and notes that lexical minimal pairs are not as frequent as it has been claimed:

Perhaps there is no tone language which is completely devoid of minimal contrasts in tone at the lexical level. There are, however, many languages in which such minimal contrasts are far from numerous. Minimal pairs are uncommon in many

Bantu languages, in Akan, and in Hausa. In Baule, hundreds of words were transcribed before the first minimal contrast in tone was found, although tonemic contrasts had been established long before. In some other languages – Yoruba and Junkun are good examples – minimal contrasts in tone are exceedingly common.

Representing tone in the orthography of both types of languages would facilitate lexical access and result in fewer miscues and repairs during oral reading. Clearly, different strategies must be adopted for the languages on both ends of the tonal spectrum and also for the languages that fall between these two extremes. For languages where tone-induced minimal pairs are scarce, it is important to encourage designers of the orthography to catalogue and write tone on all on minimal pairs. For languages in which the functional load of tone is very high, attention should be given to high frequency minimal pairs. Efforts should be directed towards cataloguing the 100 most frequent minimal pairs. Bird (1998a:11) would not see any problem with this approach for such languages because he observes that “if there are high minimal pairs in close association, they will come to the mind of the writers, or else writers will learn from experience which words to mark for tone.” Usually a couple of months devoted exclusively to researching such pairs yield astounding results.

Whether minimal pairs are few or abundant, it is almost certain that some of them will be overlooked, but this is not as serious an oversight as Longacre (1964) would have us to believe. After all, orthographies are work in progress. They usually take century or more to stabilize. It took English orthography nearly eight centuries to stabilize, that is, from 7th century to the invention of the printing press by Johannes Gutenberg in the 15th century. Similarly, the orthography of African languages will take several decades or more before stabilizing. In the meantime, every effort should be made towards avoiding or minimizing homographs. If a decision is made to write tone on minimal pairs, it should be written in every text where the word occurs. Otherwise, Bird (1998:110) warns that “if minimal pairs are distinguished only when there is potential ambiguity in a particular text, the spelling for a word becomes text-dependent, reducing the ease of word identification and hampering spelling standardization.”

1.4.1 Homograph Avoidance in Anyi Orthography

The optimal tone marking approach advocated in the previous sections has been applied in varying degrees to the tone orthography of Ditammari, Lokpa, Moba-lok, and Anyi, all languages spoken in West Africa. The result in all four cases has been more than satisfactory. However, in the case of Ditammari, Lokpa, and Moba-lok the changes were introduced after the orthographies had been in use for a decade or more. Therefore, in the remainder of the discussion, the focus will be on Anyi Morofou orthography which I have designed from the ground up. The Morofou dialect which is the topic of this analysis is the largest of all Anyi dialects. More than half of the million or so Anyi people in Côte More speak this dialect. Its tonal structure is as follows: two High and Low level tones and two contour High-Low and Low-High contour tones. Anyi has downstep, downdrift, and multiple other tone assimilation rules. Tone is contrastive lexically and grammatically. Nearly two decades of intense research on the language has allowed me to uncover the following tone-induced minimal and near minimal pairs.

N0.	Anyi Lexical Minimal Pairs	English Glosses
1.	<afián> vs. <afian>	middle vs. love
2.	<ajáa> vs. <ajaá>	inheritance vs. wedding
3.	<alié> vs. <alíε>	food vs. day
4.	<anunmán> vs. <anunmaán>	yesterday vs. bird
5.	<asaá> vs. <asáa>	fertile land vs. moreover
6.	<awáa> vs. <awaá>	calabash vs. government
7.	<ayaá> vs. <Aya>	intestine vs. proper name of a girl
8.	<bakáa> vs. <bakaá>	tree vs. porridge
9.	<beé> vs. <bée>	mat vs. left
10.	<bóo> vs. <boó>	nose vs. countryside
11.	<bóló> vs. <bólɔ>	fog vs. venom
12.	<daá> vs. <dáa>	in the past vs. all the time
13.	<dádáa> vs. <dadáa>	always vs. fishing net
14.	<elɔ> vs. <elóɔ>	there vs. war
15.	<eséé> vs. <esée>	funerals vs. cooking pot
16.	<εwáa> vs. <εwaá>	fence vs. desert
17.	<εyaá> vs. <εyáa>	anger vs. sneeze
18.	<-fiú> vs. <fi>	nothing vs. tight
19.	<fɔwúɔn> vs. <fɔwvun>	straight ahead vs. shade
20.	<káán> vs. <kaán>	tiny vs. locative pronoun
21.	<kangá> vs. <kánga>	crab vs. slave
22.	<kpáa> vs. <kpaá>	good vs. contract
23.	<kpánwun> vs. <kpanwún>	bread vs. prisoner's chain
24.	<kula> vs. <kúla>	to be able to vs. rival
25.	<kuló> vs. <kúlo>	village vs. heap
26.	<kúnmaán> vs. <kunmaán>	anthill vs. hole
27.	<kun> vs. <kún>	once vs. never again
28.	<máan> vs. <maán>	world vs. so that
29.	<mgbáa> vs. <mbgaá>	clay vs. bed
30.	<mín> vs. <mun> vs. <mun>	Lord vs. 1 st person singular pronoun vs. respect
31.	<mmoó> vs. <mmóo>	thank you vs. madam
32.	<mmúa> vs. <mmuá>	sheep vs. far away
33.	<ndáa> vs. <ndaá>	oath vs. twins
34.	<ndée> vs. <ndeé>	matter vs. clapping
35.	<ndóman> vs. <ndómán>	testicles vs. namesick
36.	<ngáa> vs. <ngaá>	remainder vs. ring
37.	<ngúa> vs. <nguá>	play, joke vs. south
38.	<nín> vs. <nin>	mother vs. locative pronoun
39.	<nún> vs. <nún>	voice vs. while
40.	<nnóro> vs. <nnoró>	public announcement vs. love

		dance
41.	<nnyáa> vs. <nnyaá>	leaf vs. skin disease
42.	<nzan> vs. <nzáan>	three vs. drink
43.	<nzúan> vs. <nzván>	attitude vs. ashes
44.	<sáa> vs. <saá>	conflict vs. as, like this
45.	<sí> vs. <st>	father vs. to know
46.	<sín> vs. <sun>	fire vs. to pass by
47.	<súa> vs. <suá>	trunk vs. house
48.	<téé> vs. <téé>	hammock vs. sacrifice
49.	<tí> vs. <ti>	because of that vs. head
50.	<tóo> vs. <toó>	scale vs. corn meal
51.	<wán> vs. <wan>	who vs. speak
52.	<Yáa> vs. <Yaá>	Woman's name vs. Friday
53.	<yí> vs. <yí> vs. <yí>	wife vs. my vs. save

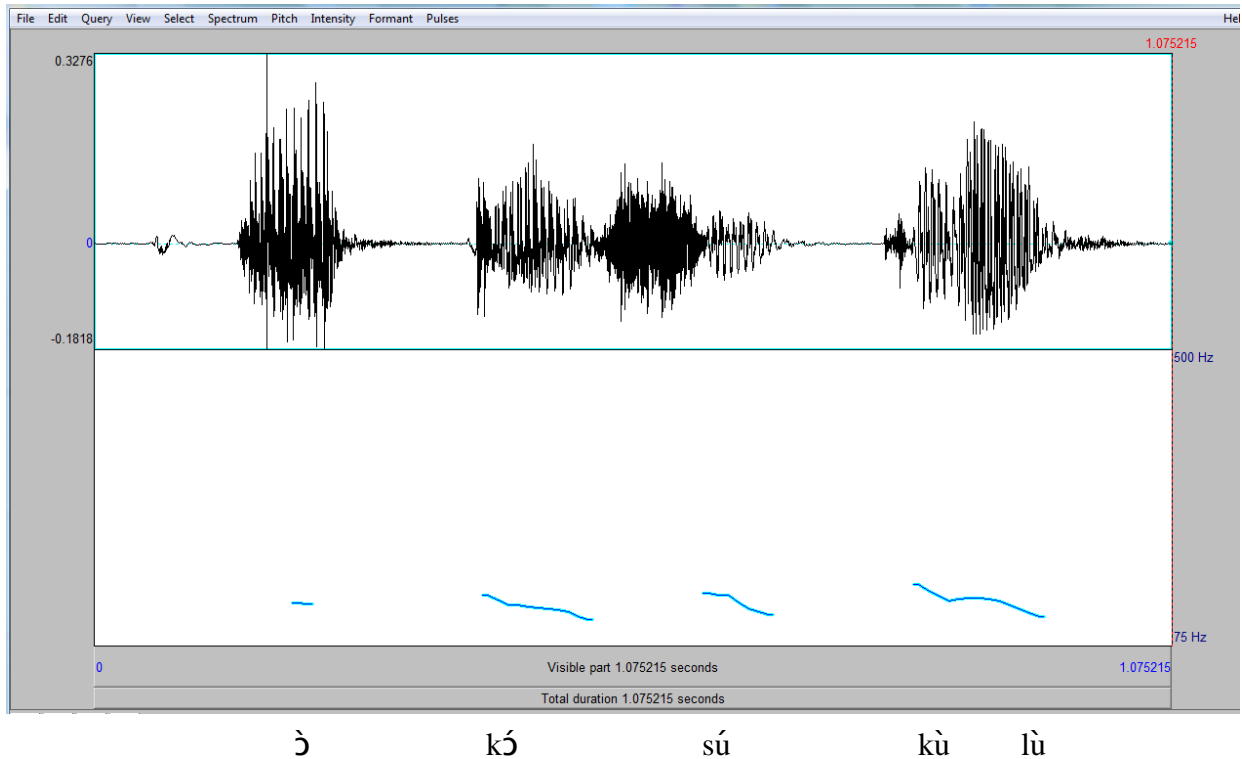
Table 3: Anyi Lexical Minimal Pairs

The orthographic merits of such a list are undeniable. For instance, Bird (1998b:7-8) found that representing tone on lexical minimal pairs alone increased reading proficiency by (60%) with only 4% of tone density. Unfortunately, he does not provide any score for the writing test. In class exercises, however, he reports that those who marked tone minimally scored 56% compared with 42% of spelling accuracy for those who wrote surface tone and 52% for those who marked basic tone. The overall picture is that marking tone minimally yields a better score for reading and writing.

1.4.3 Homograph Avoidance and Grammatical Minimal Pairs

Avoiding lexical homographs through the use of tonal diacritics is a step in right direction. An equally important step is representing grammatical tone in the orthography. It has been observed that in Akan languages, the functional load carried by tone is more frequent at the level of grammar than at the lexical level. This observation is also true for Anyi where the future tense, the simple present, and the subjunctive mood are distinguishable from each other solely on the basis of the tone on pronouns and verbs. Therefore, if no tone is indicated in the orthography, (1) can be interpreted as “he/she will go to school,” “he/she goes to school,” or “may he/she go to school.”

(1) / ð kó súkùlù/
He/she go school



Typically subject pronouns⁴ have a phonemic low tone while monosyllabic verbs have a phonemic high tone. The tone of disyllabic verbs is also predictable. The first syllable has a low tone while the second syllable has a high tone. Except for reduplication, no Anyi verb has more than two syllables. Given all this, the default tone of pronouns and verbs need not be indicated in the orthography. However, representing tone becomes necessary if one wishes to distinguish between the simple present, the future, and the subjunctive. In all three constructions, the tone of the verb remains constant.⁵ Consequently, the full functional load is carried by subject pronouns, as seen in the examples below:

- (2) [ò kó súkùlù]
 He/she go school
 He/she goes to school (habitually)
 He/she is a student

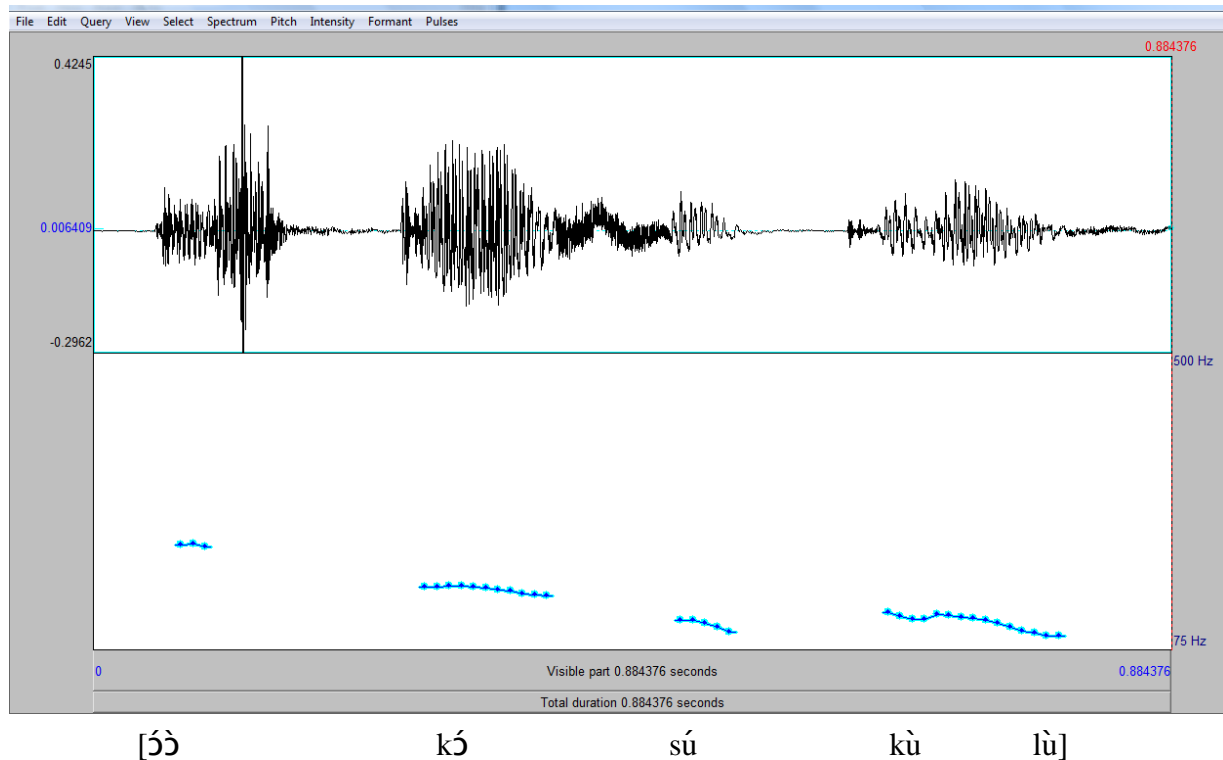
In (2) the pronoun keeps its phonemic low tone. This is indicative of the simple present. So, (2) can be interpreted simply as saying that this person is a student. The simple present is the unmarked aspect. For this reason, no tone is indicated in the orthography, neither on the pronoun nor on the verb.

⁴ The only exception is the second person plural pronoun /ámò/. This “pronoun” is peculiar because it is disyllabic while all the other pronouns are monosyllabic.

⁵ It has been noted that in some dialects the tone of the verb becomes low if it is not in sentence final position.

To express a future action, all subject pronouns except for the second person plural, undergo two important phonological processes. Let's examine these changes by considering (3):

- (3) [ǔǔ kó súkùlù]
 He/she Fut. go school
 He/she will go to school



The first phonological process is that of vowel lengthening. The unmarked pronoun [ǔ] in (2) is 94 ms long, Koffi (2008). However, the duration of (3) is 116 ms long, that is, an increase of 22 ms. The second phonological process is the appearance of a High-Low contour tone on the pronoun. The unmarked pronoun [ǔ] in (2) has a pitch value of 113 Hz whereas the aggregate pitch value of [ǔǔ] in (3) is 174 Hz. Given these important acoustic differences, the orthography distinguishes between the simple present and the future by doubling the vowel of the subject pronoun in the future tense and by marking a high tone on the first vowel, as shown below:

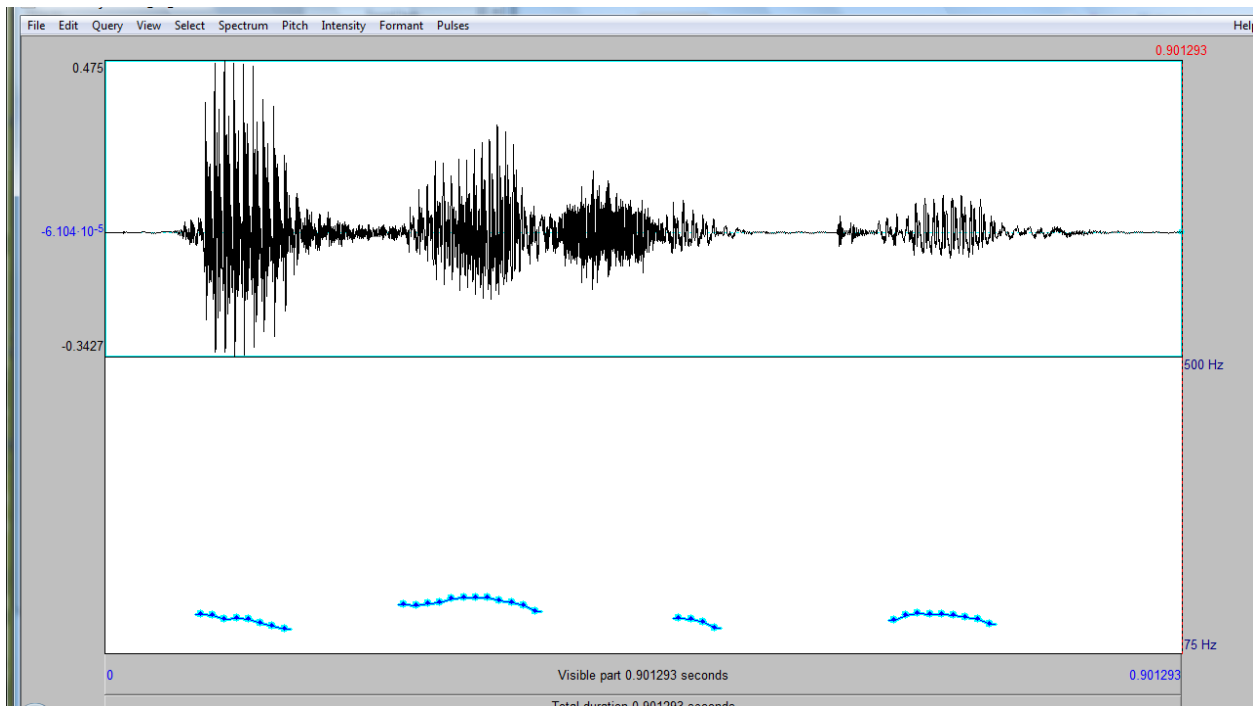
- (3) <ǔǔ kó súkùlù>= Future

Following the Tone Economy Principle discussed earlier, the second vowel of the pronominal subject does not bear any tonal diacritic in the orthography.

Finally, tone helps distinguish the subjunctive mood from the simple present and the future tense. In the subjunctive mood, the phonemic low tone of the subject pronoun remains unchanged. However, under certain circumstances, the initial consonant of the verb

undergoes the morphophonological process of spirantalization (also known as second consonant mutation). Thus, the /k/ of [kɔ́] becomes [h] in the subjunctive mood, as in (4):

- (4) [ð hɔ́ súkùlù]
 He/she subj. go school
 Let him/her go to school



[ð hɔ́ sú kù lù]

If the spirantalization rule applied consistently, there would be no need to represent tone in the subjunctive mood. Unfortunately, the process of initial consonant mutation applies only to verbs whose initial consonants are /d/, /k/, /b/, and /t/. Even then, there are exceptions for some disyllabic words. Consequently, morphophonology is not a reliable guide for reading aloud if tone is not indicated in the orthography. However, since the tone of the pronoun is phonemically low, it is not represented in the orthography. To distinguish the subjunctive from the simple present, one has to pay attention to the tone of the verb. The unmarked pitch on the verb in (1), that is, in the simple present is 129 Hz. In the future tense, the pitch of [kɔ́] is 143 Hz but in the subjunctive, the pitch of [hɔ́] is 148 Hz. This means that Anyi speakers definitely rely on the pitch of the verb to discriminate between the simple present and the subjunctive because in both cases the tone of the subject pronoun is low. However, pitch does not play a significant role in distinguishing between the future and the subjunctive because the difference of 3 Hz is acoustically negligible. Anyi speakers seem to use contour tone on the subject pronoun to distinguish between the future and the subjunctive mood. When all these insights are taken into consideration, the three grammatical constructions can be distinguished from each other in the orthography as follows:

- (1) <ɔ kɔ sukulu> Simple present
 (2) <ɔɔ kɔ sukulu> Future
 (3) <ɔ hɔ sukulu> Subjunctive

Another phonological oddity concerning the subjunctive mood is the application of a tone reversal rule on disyllabic verbs. As noted earlier, verbs have a low tone on the first syllable and a high tone on the second syllable. However, in the subjunctive, the situation is completely reversed: the high tone appears on the first syllable and the low tone on the second syllable, as in seen in (5) and (6):

- (5) / ð kɪ̀ngá fùlúwá/ underlying form
 (6) [ð kɪ̀ngàn fùlúwá] phonetic realization
 He/she subj. read book
 Let him/her read

The preceding information can be summarized as a feature matrix:

	Tone Marking Conventions In the Orthography		
	Present	Future	Subjunctive
Pronoun	-	+	-
Verb	-	-	+

Table 4: Anyi Grammatical Tone

1.4.4 The Representation of Tone on Homophonic Vowels

Homophonic vowels have the following canonical structure: CV¹V², where V¹ and V² are identical vowels. In a number of orthographies designed prior to the advent of Autosegmental Phonology, homophonic vowels having a Low-High or a High-Low contour were represented orthographically by a single grapheme with the superscripted diacritics <v> and <^>. The last diacritic is particularly confusing to Francophones because it is used in French to signal that an /s/ followed a vowel. The deletion of this /s/ in contemporary French is symbolized by the circumflex accent. In African language orthographies, however, the diacritics <v> and <^> represent homophonic (long) vowels. For readers of African languages with prior literacy in French, the usage of circumflex accent is confusing. This situation can be very easily remedied by representing homophonic long vowels as two individual vowel graphemes, as recommended in 1.3.3. Some orthographies do precisely that but they omit tone. Not writing tone on any of the two vowels increases reading difficulties because the reader has to make a decision here and there whether the vowels have a rising tone or a falling tone. Quaireau (1987:111) shows that both tonal patterns exist in Anyi:

N0	Syllable Type	Frequency
1.	Cv̂	3.5%
2.	CVCv̂	7.5%

3.	CVCVC [̂]	4.5%
4.	CVCVCVC [̂]	.5%
5.	C [̂]	3.5%
6.	CVC [̂]	9.5%
7.	CVCVC [̂]	4.5%
8.	CVCVCVC [̂]	.5%

Table 5: Structure of Homophonic Vowels

It is clear from the information in this table that homophonic vowels have both rising and falling contour. If no tone diacritic is marked, reading miscues and repairs are to be expected. For this reason, a decision was made early on to indicate the high tone on all homophonic vowels in Anyi. Moreover, as noted earlier in Table 3, a number of lexical minimal pairs such as <bɛ́ɛ> (bed) and <bɛ̀ɛ> (left) occurs rather frequently in the language. The Anyi orthography does not, however, represent tone in cases of heterophonic vowels. These are instances where in a CV¹V², V¹ and V² are two different vowels. Tone is not indicated in the orthography because it is overwhelmingly predictable. However, if minimal pairs such as <suá> (house) and <súa> (trunk of a banana tree) exist, tone is clearly indicated.

1.4.5 The Spelling of Ideophones

Welmers (1973:459, 461) observes that ideophones are abundant in West and Central African languages. He quotes Samarin who has collected as many as three thousand ideophones in Gbeya, a language spoken in the Cameroons. No effort has yet been made to count Anyi ideophones but one can hardly listen to a conversation or listen to storytelling without hearing ideophones. They seem to fall into two distinct groups as far as their tonal structure is concerned. In some instances all the vowels in the word have the same tone (isotone). Quaireau (1987:77,110-1, 114) estimates that 90% of Anyi ideophones fall within this category. Only a small fraction (about 10%) of ideophones is heterotonic. With regard to their word formation process, ideophones are either created through reduplication or by the phonological process of exaggerated final vowel lengthening. The former process creates ideophonic words such as [jéjé jájá jéjé jájá] (the noise made by gossiping) or [vùgù vava vùgù vava] (noise made by a wrap around fabric) while the latter gives us ideophones such as [sééééé] (the noise made by something being deep-fried) and [kpùààà] (noise made by splitting a snake from head to tail). The practice in Anyi orthography has been to indicate high tone on ideophones.

In the orthography, no matter how elongated the final vowel of the ideophone is, it represented only by two homophonic graphemes. Thus, the words [sééééé] and [kpùààà] appears in the orthography as <séé> and <kpuaa> respectively. Technically, a potential for confusion exists because of the way homophonic vowels are written in ideophonic and non-ideophonic words. However, in reality no such confusion exists. Non-ideophonic words have a rising or falling contour tone whereas ideophonic words have either all high tones or all low tones. The distinction between these two types of tonal patterns can be accounted for orthographically as a spelling rule. The rule can be

stated as follows: “Any word in which two vowel graphemes have the same tonal melody is an ideophone. If the tone is high, write it, otherwise, leave it unmarked.” Readers have responded well to this subtle distinction between how ideophonic and non-ideophonic words are represented in the Anyi orthography.

1.4.6 Tone and Contextual Disambiguation

Marking lexical and grammatical tone is important in designing optimal orthographies. However, there are limits to this practice. At one point or another, readers must be taught to draw on their innate pragmatic competence when reading because there are cases of polysemy where tone marking is not enough to remove lexical ambiguity. Polysemy is defined as words that have the same spelling, the same pronunciation, but different meaning. In the face of intractable polysemy such as the ones mentioned below, readers have to resort to some of the skills mentioned in the top-down processor. The syntactic context and the reader’s encyclopedic knowledge must be put to use in order to arrive at the correct pronunciation in reading aloud the words <yɪ> and <mɪn> in the following sentences:

(7) /ǎ à yí yí yí/
 He perf. pulled out his wife
 He has saved his wife from drowning

(8) /mí nyí mí mí mí/
 My eye respect my lord
 I respect my lord

The words /yí/ and /mí/ have the same underlying high tone in all three occurrences. Writing the high tone on these minimal pairs does not lead to homograph avoidance. What can one do in such a case? The designer(s) of the orthography can help disambiguate some polysemous words by judiciously marking tone on some words and not on others. In Anyi orthography, if polysemy involves closed class versus open class words, tone is marked only on open class words. This explains why tone is not written on the possessive adjectives in the orthographic counterparts of sentences (7) and (8). Furthermore, tone is not indicated on the verbs in these two sentences because, as noted in 1.4.3, tone is written only if the verb is in the subjunctive mood. After a while Anyi readers rely on these clues to arrive at the correct pronunciation of words. The words in sentences (7) and (8) appear in Anyi orthography respectively as sentences (9) and (10):

(9) <ǎ'a yɪ yɪ yí>
 (10) <mɪn nyɪn mɪn mɪn mɪn>

1.5 Conclusion

In summary, the Tone Optimality Model proposed in this paper recommends four simple steps for writing tone in the orthography:

1. Only phonemic tones are to be indicated in the orthography.
2. Only the least frequent tone should be indicated in the orthography.
3. Lexical and grammatical minimal pairs must be represented in the orthography so as to avoid homographs.
4. Lexical items whose tones are not predictable must also be indicated in orthography.

The minimal requirement for an optimal orthography is that it avoids homographs as much as possible. Undifferentiated minimal pairs clog up lexical access and cause reading miscues and repairs. On the face of it, these recommendations appear simple but they are backed by half a century of developments in phonological theory and by nearly two decades of research on various orthographies of West African languages.

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