NUMERAL COMPOUNDING IN AKAN (TWI): A MULTI-TIERED ACCOUNT

Seth Antwi Ofori
Department of African Languages and Literature
1414 Van Hise University of Wisconsin-Madison
saofori@wisc.edu

This paper set out to account for the morphophonological processes involved in the formation of numbers 20 to 90, and 200 to 900 in Asante and Akyem Twi. It defines the morphemic constituents of these compounds as: $Modifier_1$ + Head + $Modifier_2$, with the translation "two, tens" for '20' for example. Phonologically, it cites harmonic processes (namely, [+Low] and [+Round]), deletion, Compensatory lengthening (CL) and tone harmony as the processes that apply at the root-root boundary (in the domain [...$\acute{v}_{1.}{}^{+}\grave{v}_{2.}$N...]) to achieve phonotactic and/or prosodic well-formedness, and thus, form a numeral compound. These processes apply in the order in which they have been presented, and result in the complementary distribution of, [$\grave{v}_2$], and the toneless homorganic [N], both of which are non-contrastive. Processes such as [+Low], [+Round] harmony and CL, which apply to stabilize [$\grave{v}_2$] and then create a non-high non-front syllabic [$\grave{v}_2$] result in [N] deletion; [N] is retained where these well-formedness processes do not apply and the [$\grave{v}_2$] syllable undergoes deletion. The circumstance under which [N] is dropped provides a great insight into Twi linguistics by explaining the non-occurrence of the sound in numbers 6, 7, 8 and 9 in Akuapem Twi where the vowel before the /N/ slot is /**a**/, the low central vowel. The paper has shown that Asante and Akyem Twi operate [+Low] harmony which ranks before [+Round] harmony; and has made a case for the loss of an /**e**/ (of /$\grave{v}_2$/) prior to [+ATR] spread to a preceding /**a**/. Root boundary units harmonize in tone with Low tone harmony overriding High tone harmony.

Cette communication vise à expliquer les procédés morphophonologiques concernés dans la formation des nombres de 20 à 90 et de 200 à 900 en asante et en twi d'akyem. Elle définit les composantes morphémiques de ces expressions comme Qualificateur1 + Tête + Qualificateur², qui se traduit par, p.ex., 'deux dizaines' pour 20. Pour la phonologie elle cite les procédés harmoniques [+Bas], et [+Rond], l'effacement, le prolongement compensatoire et l'harmonie tonale comme ceux qui jouent à la joncture racine-racine (dans le domaine [vU1. + vY².N...]) pour arriver à un état phonotactiquement et/ou prosodiquement bien formé, et ainsi former un numéro composé. Ces procédés s'appliquent dans l'ordre où ils sont présentés, et ont comme résultat la distribution complémentaire de .[vY²]. et de la nasale homorganique atone [N], qui sont tous deux non-contrastifs.
Des procédés tels que l'harmonie [+Bas].[+Rond] et le prolongement compensatoire que l'on applique pour stabiliser [vY²], puis créer un [vY²] syllabique non-bas et non-antérieur, ont comme résultat la délétion de [N]; [N] subsiste là où ces procédés ne s'appliquent pas, et c'est alors [vY²] qui s'efface. La situation où s'efface [N] éclaircit un aspect de la linguistique twi, en expliquant l'absence de ce son dans les nombres 6,7,8 et 9 dans le twi d'akwapem où la voyelle devant la place de /N/ est /a/, la voyelle centrale basse. Notre étude a démontré que l'asante et le twi d'akyem opèrent une harmonie [+Bas] qui s'applique avant l'harmonie [+Rond], et a proposé qu'un /**e**/ (ou [vY²]) se perd avant que [+ATR] n'atteigne un /**a**/ précédant. Les éléments aux jonctures des racines sont sujets à une harmonie tonale,celle du ton Bas ayant la priorité sur celle du ton Haut.

0. INTRODUCTION

The paper aims to establish the morphophonological processes involved in the formation of Twi numeral compounds. Twi is being used here as a cover term for the Akuapem, Akyem, and Asante, dialects of Akan. Akan belongs in the

New Kwa subfamily (Williamson and Blench 2002) of the Niger-Congo language family. The paper focuses attention on the variety of Akan spoken in the Asante and Akyem communities of Ghana (i.e. Asante and Akyem numeral compounds) with minimal references to the Akuapem variety which is in close proximity with these dialects, especially the Akyem variety of Akan, and, formally, has a lot in common with them. There are four subdivisions: section one briefs us on aspects of Akan (Twi) phonology and morphology that I deem essential to this study; section two focuses on data description where I also take certain positions on the form and type of numerals involved in this process in preparation for sections three, the section devoted to analysis; section four is the conclusion.

1. BACKGROUND ON TWI (ASANTE/AKYEM) PHONOLOGY AND MORPHOLOGY

There are nine oral phonemes in these dialects (Dolphyne 1988: 1) as shown on table (1).[1]

Table 1: Underspecified feature matrix of Twi

	i	**ɪ**	**e**	**ɛ**	**a**	**ɔ**	**o**	**ʊ**	**u**
High	+	+	-	-		-	-	+	+
Low			-	-	+	-	-		
Round	-	-	-	-		+	+	+	+
ATR	+	-	+	-		-	+	-	+

Phonetically, these (i.e. Asante and Akyem) dialects have a tenth oral vowel quality, [**æ**], commonly referred to as the allophonic variant of [**a**], the low central vowel, which occurs before vowels such as /**i**/, /**u**/, and sometimes before /**o**/ or before some palatal consonants (Boadi 1963, 1991, Dolphyne 1965, 1988; Stewart 1967; Schachter and Fromkin 1968; Andoh-Kumi 1977; Clements 1981, 1985, 2002; Obeng 1989; 1995; and Abakah 2002). According to Dolphyne (1988), Clements (2002) and most of the authors above, the change to [**æ**] results when the /**a**/ syllable (or the syllable it belongs in) is immediately followed by the [+ATR] trigger. There is an ongoing debate on the [+ATR] status of [**æ**] in the Twi dialects based on a claim by Lindau (1978) that [**æ**] in the Twi dialects (Dolphyne 1988:14) does not have "the hollow quality that characterizes the production of [+ATR] vowels". Some have responded to this by calling [**æ**], [+Raised] instead of the regular [+ATR]. Others have combined the two by describing the /**a**/ to [**æ**] change as the raising of a [-ATR] /**a**/ to a [+ATR] [**æ**] (Obeng 1995). Whatever side one is, one thing is irrefutable in these Twi dialects, which is that /**a**/ never remains [**a**] (i.e. [-ATR]) immediately before [**i**] and [**u**]

[1] The information here is based largely on Dolphyne (1988). The following sources may be consulted for additional information on vowels and vowel processes in Akan (Twi): Dolphyne (1965, 1988), Stewart (1967), Schachter and Fromkin (1968), Andoh-Kumi (1977), Clements (1981, 1985), Obeng (1989), Boadi (1991) and Abakah (2002).

(including other contexts described above).[2] It is not the goal of the current paper to rebuff the [+ATR] status of [**æ**] in these Twi dialects, and if there are works devoted to this, this is not one of them; I rather find myself more in line with the side where the features 'raised' and [+ATR] are employed together to describe [æ].

Permissible vowel sequences in Akan. An insight into what the permissible vowel sequences in Akan are is also very crucial to our understanding of most of the vowel processes at work in the formation of numeral compounds. Table (2) shows the permissible "…vowel combinations that occur within individual words" (Dolphyne, 1988:8). Dolphyne's usage of the phrase "individual words" suggests that there are other possibilities (or possible combinations) beyond the word, which, to make relevant to our current goal, has been taken to mean at the level of compound words, etc.

Table 2. Vowel Combinations within individual words

	i	**ɪ**	**e**	**ɛ**	**a**	**ɔ**	**o**	**ʊ**	**u**
i	**ii**		**ie**	**iɛ**	**ia**		**io**		
ɪ		**ɪɪ**		**ɪɛ**	**ɪa**				
e	**ei**		**ee**						
ɛ		**ɛɪ**		**ɛ**					
a		**aɪ**			**aa**				
ɔ		**ɔɪ**				**ɔ**			
o	**oi**						**oo**		
ʊ		**ʊɪ**		**ʊɛ**	**ʊa**	**ʊɔ**		**ʊʊ**	
u	**ui**		**ue**		**ua**		**uo**		**uu**

(Dolphyne, 1988:9)

If these are the permissible vowel sequences then the question is how are impermissible vowel sequences treated in this language? The current study will unveil some of the mechanisms these dialects have in place to avert illicit vowel sequences.

Round harmony in Asante and Akyem. Table (3) shows perserverative [+Round] harmony in Asante and Akyem. Here, these dialects augment the suffix {-**ɛ**}, which I call an emphatic/(prosodic) suffix after Ofori (2006a:39, 2006b: 43), on noun stems that underlyingly end in a high vowel (i.e. /**i**/, /**ɪ**/, /**u**/ and /**ʊ**/) – the data in Akuapem is considered the underlying one. {-**ɛ**} stays [-**ɛ**] when the final high vowel is [-Round] and is realized as [-**ɔ**] when the stem's final (i.e. the preceding) vowel is [+Round].

[2] Akan operates [+ATR] harmony – Dolphyne as a result groups the ten oral vowels in Akan into two sets based on the absence or presence of the feature ATR: [+ATR] vowels are [**i, u, e, o, æ**], [-ATR] vowels are [**ɪ, ʊ, ɛ, ɔ, a**]. [+ATR] harmony is regressive/anticipatory in nature and causes [-ATR] vowels to become [+ATR]. Obeng (2002) makes a case for [-ATR] harmony in compounds.

Table 3. [+ Round] harmony in Asante

	Column 1: Akuapem	Column 2: Asante/Akyem	Column 4: English Gloss
a.	**Ghanafo /gaanafʊ/ [gããnãfʊ]**	**Ghanafoɔ /gaanafʊɔ/ [gããnãfʊɔ]**	Ghanaians
b.	**ataade /ataadɪ/ [ataadɪ]**	**ataadeɛ /ataadɪɛ/ [ataadɪɛ]**	clothing

Dolphyne (1988:80) provides additional evidence for the /**ɛ**/ to [**ɔ**] change in her analysis of [**ɔ**] in **ahoɔfɛ** [**ahʊɔfɛ**] 'beauty': she claims that the vowel [ɔ] derives from /**ɛ**/ which is a reduced form of **yɛ** 'be'. She therefore proposes **ho yɛ fɛ /hʊ jɛ fɛ**/ "to be beautiful$_{animate}$" (lit.: body$_{animate}$ be attractive/beautiful) as the input of **ahoɔfɛ** [**ahʊɔfɛ**]. Again, she claims that the word, **aniɛden** [**æniɛdɪn**] 'invincibility' derives from **ani yɛ den /æni jɛ dɪn**/ 'to be unbeatable/strong-willed' – here, the /**ɛ**/ to [**ɔ**] change does not happen because the preceding vowel is/remains [-Round].[3]

The syllable in Twi. In CV-terms, Dolphyne (1988) identifies three syllable types in Akan (Twi), all open and light, namely V (as in **aboa /a.bʊ.a**/ 'animal'), CV (in **ba /ba**/ 'come') and C (which may be one of the following consonants, /m/, and /n/). It must be noted that a nasal consonant is homorganic before a non-nasal consonant so it is possible to have the following phonetic syllables, [**ŋ**], [**ɲ**], [**ŋ͡m**], [**n**] etc. in these dialects.

2. DESCRIPTION OF THE TWI NUMERAL COMPOUND DATA

Numbers one to nine: Column (1) of tables (4) and (5) shows the Twi cardinal numbers one to nine which I claim enter into compounding with the root of ten (**du**) and of hundred (**ha**) to yield (cardinal) numbers in (4/Column 2) and (5/Column 2), respectively.[4] Following Christaller (1881/1993) I argue that the numbers *two* (**mmienu**/**abien**(**u**) [**mienu**/**æbien**(**u**)] and *three* (**mmeɛnsa**/**abiɛsa** [**mɪɛnsa**/**æbiɛsa**] submit reduced forms such as **enu** and **ɛsa** (and sometimes **nsa**), respectively, for compounding; it needs to be reemphasized that **enu** and

[3] Dolphyne translates **aniɛden** as 'haughtiness'. How the word is translated has no relevance to why it is being cited here.

[4] The person to have first reviewed this work made an interesting statement about which units actually enter into compounding with the root of hundred and ten, which was that ordinals and not cardinals as I have argued enter into compounding with **ha** and **du**. I have very much respect for his/her position, however, I stick to my position that cardinal forms are the forms involved in this for the following apparent reasons. Ordinals in Twi (and even Fante) are phrasal and not **kan**, **nu**, **sa**, etc. as this reviewer would have us to believe. Following are examples of Twi ordinals: **nea edi**/**odi kan** 'first (thing/being)', **nea ɛtɔ**/**ɔtɔ** so **mmienu** 'second', **nea ɛtɔ**/**ɔtɔ so mmeɛnsa** 'third', etc. That is, ordinals are formed by embedding a cardinal form in the phrase **nea ɛtɔ**/**ɔtɔ so** …. The only instance where this is different is when saying 'first' where **baako** is substituted by **kan** in the phrase **nea edi**/**odi** …. Ofori (2006a: 5) shows the cardinal and ordinal distinction in Akan (Twi).

ɛsa are not ordinal but cardinal.[5] Cardinal numbers four to nine in the Asante and Akyem dialects are **ɛnan** [**ɛnaĩ**] (4), **enum** (5), **ensia** [**ensĩã**] (6), **ɛnson** [**ɛnsʊ̃ŋw**] (7), **ɛnwɔtwe** [**ɛŋwɔtɕɥɪ**] (8) and **ɛnk(o)ron** [**ɛŋk(ʊ)rʊŋw**] (9) as obtained in Column (1) of tables (4) and (5). From the above, I contend that numbers from two to nine enter into numeral compounding with an initial vowel which is either /**ɛ**/ or /**e**/ (depending on the [ATR] status of the following vowel). The numbers ten and hundred lose their initial /**e**/ and /**ɔ**/, respectively, in the process to {**a-**}, a nominal prefix. The tables (4 and 5) show the orthographic and phonetic representations of these numbers. (A dot symbolizes a syllable boundary.)

Table 4. Data showing the numbers: 0 to 9, and 10 to 90

	Column 1: Numbers 0 to 9			Column 2: Numbers 10 to 90		
	Ortho(graphic) Form	Phonetic Form (Ak)/(As)		Ortho. Form	Phonetic Form	
a.[6]	**ohunu**	**o.hʊ̃.nʊ̃**	0			
	baako	**ba.a.kʊ̃ kʊ(rʊ)**	1	**edu**	**e.du**	10
b.[7]	**(mmienu); enu**	**(mi.e.nʊ̃) enu**	2	**aduonu**	**æ.du.o.nʊ̃**	20
c.[8]	**(mmeɛnsa) ; ɛsa**	**(mɪ.ɛ.n.sa) ɛsã**	3	**aduasa**	**æ.du.a.sã**	30
d.	**ɛnan**	**ɛ.nã.ĩ**	4	**aduanan**	**æ.du.a.nã.ĩ**	40
e.	**enum**	**e.nʊ̃.m**	5	**aduonum**	**æ.du.o.nʊ̃.m**	50
f.	**ensia**	**e.n.sĩ.ã**	6	**aduosia**	**æ.du.o.sĩ.ã**	60
g.	**ɛnson**	**ɛ.n.sʊ̃.ŋw**	7	**aduɔson**	**æ.du.ɔ.sʊ̃.ŋw**	70
h.	**ɛnwɔtwe**	**ɛ.ŋ.wɔ.tɕɥɪ**	8	**aduɔwɔtwe**	**æ.du.ɔ.wɔ.tɕɥɪ**	80
i.	**ɛnkron**	**ɛ.ŋ.k(ʊ̃).rʊ̃.ŋw**	9	**aduɔkron**	**æ.du.ɔ.k(ʊ̃).rʊ̃.ŋw**	90

[5] The older generation (e.g. people in their seventies) use these numbers interchangeably: **baako** [**baakʊ**] or **ɛko(ro)** [**ɛkʊ(rʊ)**] 'one', **mmienu/abien(u)** [**mienu/æbien(u)**] or **enu/ɛnɔ** 'two', **mmeɛnsa/abiɛsa** [**mɪɛnsa/æbiɛsa**] or **ɛsa** [**ɛsã**] 'three'. It must be restated that the reduced forms have solely cardinal usage in Asante and Akyem dialects, have never been, and can never be, used as ordinals – ordinals are phrasal.

[6] **baakʊ̃** is also **ɛkʊ**, **kʊrʊ**

[7] "**enù** two/both, this simple form is only used (in counting and) in compounds" Christaller (1881/1993:353).

[8] "**èsã̀ , nsã** three; compounds" Christaller (1881/1993:417).

Table 5. Data showing the numbers: 0 to 9, and 100 to 900

	Column 1: Numbers 0 to 9			Column 2: Numbers 100 to 900		
	Ortho.	Phonetic Form		Ortho.	Phonetic Form	
a.	**ohunu**	**o.hũ.nũ**	0			
	baako	**ba.a.kʊ̃; kʊ(rʊ)**	1	**ɔha**	**ɔ.ha**	100
b.	**(mmienu) enu**	**(mi.e.nũ) enu**	2	**ahaanu**	**a.hæ.æ.nu**	200
c.	**(mmeɛnsa) ɛsa**	**(mɪ.ɛ.n.sa) ɛsã**	3	**ahaasa**	**aha.a.sã**	300
d.	**ɛnan**	**ɛ.nã.ɪ̃**	4	**ahanan**	**a.ha.nã.ɪ̃**	400
e.	**enum**	**e.nũ.m**	5	**Ahanum**	**a.hæ.nu.m**	500
f.	**ensia**	**e.n.sĩ.ã**	6	**ahansia**	**a.hæ.n.sĩ.a**	600
g.	**ɛnson**	**ɛ.n.sʊ̃.ŋw**	7	**ahanson**	**a.ha.n.sʊ̃.ŋw**	700
h.	**ɛnwɔtwe**	**ɛ.ŋ.wɔ.tɕɥɪ**	8	**ahanwɔtwe**	**a.ha.ŋ.wɔ.tɕɥɪ**	800
i.	**ɛnkron**	**ɛ.ŋ.k(ʊ̃).rʊ̃.ŋw**	9	**Ahankron**	**a.ha.ŋ.kʊ.rʊ.ŋ w**	900

Numeral compounds have the structure: {**a-**} 'a nominalizing prefix' followed by the root of ten or of hundred followed by a number from two to nine as shown in Column (1) of table (6). There are therefore two vowels (V_1-V_2) at the numeral-numeral boundary, the first (i.e. V_1) being the vowel of the root of ten or hundred, and the second vowel (V_2), the initial of the second root numeral. The argument to be pursued is that [**o**], [**ɔ**], and [**a**] are different phonetic realizations of V_2 and that V_2 is deleted in some contexts. (Note: units of interest appear darker).[9]

[9] I have received suggestions to consider vowels such as [**o**], [**ɔ**] and [**a**] between [**ha**/**du**] and numbers two to nine as an interfix – in other words, stick to this aspect of the two proposals, the connective morphemic account and the non-connective morphemic account – I put forward in an earlier version of this paper. Positing an interfix (i.e. under my connective morphemic account) is not necessary – you do not posit a form only to delete it; if it is that relevant then it should always remain which it does not. The [**o**], [**ɔ**], [**a**] or lack of it can be accounted for without having to posit the so-called interfix; more so, there is no evidence in the language for such a form (neither can we justify one) during compounding; what is rather common in the language is the fact that there is vowel hiatus during compounding and that there is modification of such abutting vowels or loss of one in the process.

Table 6. Inputs of numbers 20 to 90, and 200 to 900 all in Column (1)

	Column 1. Input: /Prefix + {**du**}/{**ha**} + {2, 3, … 9}/		Column 2: Numbers: 20 to 90 200 to 900	
a.	i.	**/a + du + e.nũ/**	**æ.du.o.nũ**	20
	ii.	**/a + ha + e.nũ/**	**a.hæ.æ.nũ**	200
b.	i.	**/a + du + ɛ.sã/**	**æ.du.a.sã**	30
	ii.	**/a + ha + ɛ.sã/**	**a.ha.a.sã**	300
c.	i.	**/a + du + ɛ.nã.ɪ̃/**	**æ.du.a.nã.ɪ̃**	40
	ii.	**/a + ha + ɛ.nã.ɪ̃/**	**a.ha.nã.ɪ̃**	400
d.	i.	**/a + du + e.nũ.m/**	**æ.du.o.nũ.m**	50
	ii.	**/a + ha + e.nũ.m/**	**a.hæ.nu.m**	500
e.	i.	**/a + du + e.n.sĩ.ã/**	**æ.du.o.sĩ.ã**	60
	ii.	**/a + ha + e.n.sĩ.ã/**	**a.hæ.n.si.a**	600
f.	i.	**/a + du + ɛ.n.sũ.ŋw/**	**æ.du.ɔ.sũ.ŋw**	70
	ii.	**/a + ha + ɛ.n.sũ.ŋw/**	**a.ha.n.sũ.ŋw**	700
g.	i.	**/a + du + ɛ.ŋ.wɔ.tɕɥɪ/**	**æ.du.ɔ.wɔ.tɕɥɪ**	80
	ii.	**/a + ha + ɛ.ŋ.wɔ.tɕɥɪ/**	**a.ha.ŋ.wɔ.tɕɥɪ**	800
h.	i.	**/a + du + ɛ.ŋ.k(ũ).rũ.ŋw/**	**æ.du.ɔ.k(ũ).rũ.ŋw**	90
	ii.	**/a + ha + ɛ.ŋ.k(ũ).rũ.ŋw/**	**a.ha.ŋ.kʊ.rʊ.ŋw**	900

Similarly, a homorganic nasal (/N/) immediately after V_2 (in numbers six, seven, eight, and nine) is either retained or deleted in the process. For example, whereas numbers 600, 700, 800, and 900 retain their homorganic nasals (i.e. /N/s), numbers 60, 70, 80 and 90 lose them. The loss of /N/ in numeral compounds coupled with the fact that it (i.e. /N/) does not even exist in the Akuapem dialect (see: footnote) give us room to argue for a non-contrastive homorganic nasal (i.e. non-contrastive /N/) in Twi numerals. A non-contrastive /N/ (henceforth [N]) then is a homorganic nasal which is not phonemically or morphologically significant: in other words, its deletion does not cause any (significant) damage, semantically.[10] The context of [N] loss is unique in having

[10] Cardinal numbers in Akuapem are **anan** (4), **anum** (5), **asia** (6), **ason** (7), **awotwe** (8), and **akron** (9). Initial /**ɛ**/ and /**e**/ in Asante are realized as /**a**/ in Akuapem and there is no homorganic nasal after initial /**a**/ in Akuapem.

a sequence of two vowels considered to be V_1 and V_2; V_1V_2 is reduced to V_1 where [N] is present.

3. ANALYSIS

This section focuses on morphophonological process at the numeral-numeral boundary. The central question is which morpho-phonological processes apply to sew these root numerals into a single unit? It is known, from section two, that root boundary units such as V_2 and non-contrastive [N] do not co-occur in a numeral compound. A more specific question to be addressed therefore is which morphophonological processes regulate their co-occurrence restriction? In other words under what conditions is V_2 preferred over [N] and vice versa in the formation of numeral compounds in Asante and Akyem Twi? These are the questions the section attempts to address under the subdivisions, namely (3.1) impermissible vowel sequences at root boundaries and how the language deals with them; (3.2) the question of when the non-contrastive [N] is retained or not retained in Twi numeral compounds; and (3.3) tone in numeral compounding.

3.1 IMPERMISSIBLE VOWEL SEQUENCES AT ROOT BOUNDARIES AND HOW THE LANGUAGE DEALS WITH THEM

Table (7) combines numeral compounds from 20 to 90, and 200 to 900. As shown by the data in Column (2), and has already been pointed out, the Numeral-Numeral string creates a sequence of two vowels (V_1V_2), most of which are impermissible. Vowel sequences such as /**uɛ**/, /**ae**/, and /**aɛ**/ from table (2) are impermissible. The only permissible vowel sequence is /ue/ in the formation of numbers 20, 50, and 60. Impermissible vowel sequences I argue are resolved by either deleting V_2 (partially or completely) or by modifying it – the modification is triggered by an abutting vowel leading to phonetic forms such as [**o**], [**ɔ**], [**a**] and [**æ**] after V_1 in numbers 20 to 90, 200, and 300. (Illicit forms are marked with '*' the asterisks.)

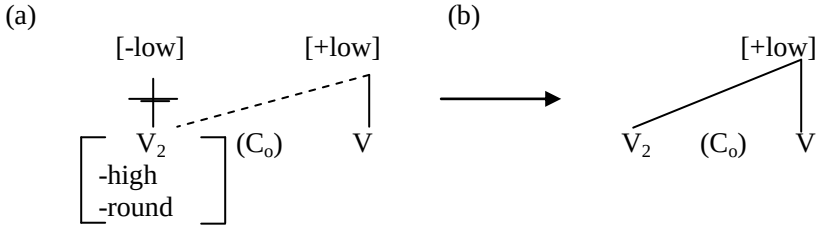
Table 7. Inputs of numbers 20 to 90, and 200 to 900 all in Column (1)

	Column 1: Input – Root of '10', /**du**/, and '100', /**ha**/combines with parts of 2 to 9	Column 2: Phonetic Rep. (from 20 to 90) Candidates		Column 3: Phonetic Rep. (from 200 to 900) Candidates	
a.	/**a + du + e.nũ**/ /**a + ha + e.nũ**/	**æ.du.o.nũ** ***æ.du.e.nũ** ***æ.du.u.nũ** ***æ.du.nũ**	20	**a.hæ.æ.nũ** ***a.ha.e.nũ** ***a.ha.æ.nũ** ***a.hæ.e.nũ** ***a.hæ.nũ** ***a.ha.nũ**	200
b.	/**a + du + ɛ.sã**/ /**a + ha + ɛ.sã**/	**æ.du.a.sã** ***æ.du.ɛ.sã** ***æ.du.ɔ.sã** ***æ.du.u.sã** ***æ.du.sã**	30	**a.ha.a.sã** ***a.ha.ɛ.sã** ***a.ha.sã**	300

c.	/**a + du + ɛ.nã.ĩ**/ /**a + ha + ɛ.nã.ĩ**/	**æ.du.a.nã.ĩ** ***æ.du.ɛ.nã.ĩ** ***æ.du.ɔ.nã.ĩ** ***æ.du.u.nã.ĩ** ***æ.du..nã.ĩ**	40	**a.ha.nã.ĩ** ***a.ha.ɛnã.ĩ** ***a.ha.a.nã.ĩ** ***a.ha.nã.ĩ**	400
d.	/**a + du + e.nũ.m**/ /**a + ha + e.nũ.m**/	**æ.du.o.nũ.m** ***æ.du.e.nũ.m** ***æ.du.u.nũ.m** ***æ.du.nũ.m**	50	**a.hæ.nu.m** ***a.ha.e.nu.m** ***a.hæ.e.nu.m** ***a.hæ.æ.nu.m** ***a.ha.a.nu.m** ***a.ha.nu.m**	500
e.	/**a + du + e.n.sĩ.ã**/ /**a + ha + e.n.sĩ.ã**/	**æ.du.o.sĩ.ã** ***æ.du.e.n.sĩ.ã** ***æ.du.e.sĩ.ã** ***æ.du.o.n.sĩ.ã** ***æ.du.n.sĩ.ã** ***æ.du.u.n.sĩ.ã** ***æ.du.u.sĩ.ã** ***æ.du.sĩ.ã**	60	**a.hæ.n.sĩ.ã** ***a.hæ.e.n.sĩ.ã** ***a.ha.e.sĩ.ã** ***a.hæ.æ.n.sĩ.ã** ***a.ha.a.n.sĩ.ã** ***a.ha.n.sĩ.ã** ***a.hæ.æ.sĩ.ã** ***a.hæ.n.sĩ.ã** ***a.hæ.sĩ.ã**	600
f.	/**a + du + ɛ.n.sũ.ŋw**/ /**a + ha + ɛ.n.sũ.ŋw**/	**æ.du.ɔ.sũ.ŋw** ***æ.du.ɛ.n.sũ.ŋw** ***æ.du.ɛ.sũ.ŋw** ***æ.du.ɔ.n.sũ.ŋw** ***æ.du.n.sũ.ŋw** ***æ.du.u.n.sũ.ŋw** ***æ.du.u.sũ.ŋw** ***æ.du.sũ.ŋw**	70	**a.ha.n.sũ.ŋw** ***a.ha.ɛ.n.sũ.ŋw** ***a.ha.ɛ.sũ.ŋw** ***a.ha.a.n.sũ.ŋw** ***a.ha.n.sũ.ŋw** ***a.ha.a.sũ.ŋw** ***a.ha.sũ.ŋw**	700
g.	/**a + du + ɛ.ŋ.wɔ.tɕɥɪ**/ /**a + ha + ɛ.ŋ.wɔ.tɕɥɪ**/	**æ.du.ɔ.wɔ.tɕɥɪ** ***æ.du.ɛ.ŋ.wɔ.tɕɥɪ** ***æ.du.ɛ.wɔ.tɕɥɪ** ***æ.du.ɔ.ŋ.wɔ.tɕɥɪ** ***æ.du.ŋ.wɔ.tɕɥɪ** ***æ.du.u.ŋ.wɔ.tɕɥɪ** ***æ.du.u.wɔ.tɕɥɪ** ***æ.du.wɔ.tɕɥɪ**	80	**a.ha.ŋ.wɔ.tɕɥɪ** ***a.ha.ɛ.ŋ.wɔ.tɕɥɪ** ***a.ha.ɛ.wɔ.tɕɥɪ** ***a.ha.a.ŋ.wɔ.tɕɥɪ** ***a.ha.ŋ.wɔ.tɕɥɪ** ***a.ha.a.wɔ.tɕɥɪ** ***a.ha.wɔ.tɕɥɪ**	800
h	/**a + du + ɛ.ŋ.k(ũ).rʊ̃.ŋw**/ /**a + ha + ɛ.ŋ.k(ũ).rʊ̃.ŋw**/	**æ.du.ɔ.k(ũ).rʊ̃.ŋw** ***æ.du.ɛ.ŋ.k(ũ).rʊ̃.ŋw** ***æ.du.ɛ.k(ũ).rʊ̃.ŋw** ***æ.du.ɔ.ŋ.k(ũ).rʊ̃.ŋw** ***æ.du.ŋ.k(ũ).rʊ̃.ŋw** ***æ.du.u.ŋ.k(ũ).rʊ̃.ŋw** ***æ.du.u.k(ũ).rʊ̃.ŋw** ***æ.du.k(ũ).rʊ̃.ŋw**	90	**a.ha.ŋ.kʊ.rʊ.ŋw** ***a.ha.ɛ.ŋ.kʊ.rʊ.ŋw** ***a.ha.ɛ.kʊ.rʊ.ŋw** ***a.ha.a.ŋ.kʊ.rʊ.ŋw** ***a.ha.ŋ.kʊ.rʊ.ŋw** ***a.ha.a.kʊ.rʊ.ŋw** ***a.ha.kʊ.rʊ.ŋw**	900

Following are the processes that apply to featurally modify and retain V_2 in Twi numeral compounds. Two vowel processes are involved here, namely, [+low] harmony (in 8), and [+Round] harmony (in 9).

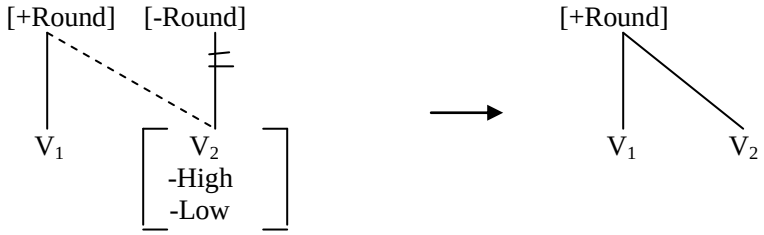
Table 8. [+low] harmony



Derivations: (i) /**adu-ɛsã**/→ [**æduasa**] '30'; and (ii) /**adu-ɛnan**] → [**aduanan**] 40'

[+low] harmony is anticipatory (Trask 1996) as schematized above: V_2 (which is non-high non-low non-back) becomes low after a succeeding vowel and accounts for the low vowel after [u] in numerals like, [**æduasa**] '30' (7b, Column 2), and [**æduanan**] '40' (7c, Column 2) (and possibly [a] after [ha], the root of hundred, in [**ahaasa**] '300'). In (9) below is the [+Round] harmony rule, which applies preseveratively (Trask 1996).

Table 9. [+Round] harmony



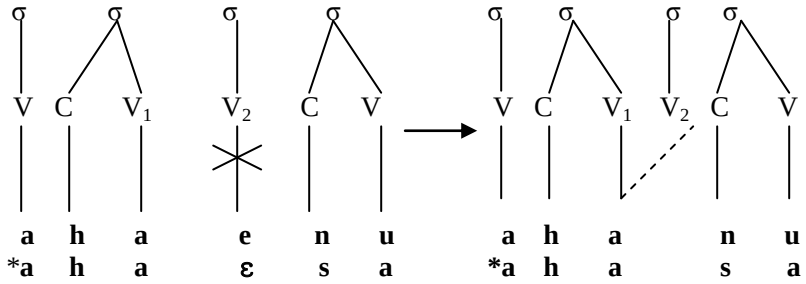
/**u**/ of {**du**} 'ten' (or V_1) is the trigger here with V_2, a non-high non-low non-round vowel, as its target. The result is vowels like [**o**] and [**ɔ**] after [**u**] in numbers, [**æduo̲nũ**] '20', [**æduo̲nũm**] '50', [**æduo̲sĩã**] '60', [**æduɔ̲sũŋw**] '70', [**æduɔ̲wɔtɕɥɪ**] '80', and [**æduɔ̲k(ũ)rũŋw**] '90'. The left-to-right spreading of round is justified by the fact that V_2 is succeeded by a non-round vowel (i.e. [**ĩ**]) in [**æduo̲sĩã**] '60'.

Now the fact that the output forms of '30' and '40' are [**æduasã**] and [**aduanãĩ**], and never *[**æduɔsa**] and *[**æduɔnan**], respectively, reveals that [+Low] and [+Round] harmony rank crucially with each other with the former preceding the latter – and possibly signifies the preference of an [**ua**] vowel sequence over [**uo**] and [**uɔ**] in these dialects of Akan; and indeed an [**ua**] vowel sequence is more frequent in these dialects than the [**uo**] and [**uɔ**] sequences. V_2 does not become [a] in numbers 20, 50, 60, 70, 80, and 90 because the succeeding vowel is not low. Also, the fact that [ue] is a permissible vowel

sequence but changes to [uo] in forms like '20' (e.g. /**a-du-enu**/ → [**æduonu**]), '50' and '60' could be considered the preference of an [**uo**] vowel sequence over [**ue**]. Where [**u**] is our V_1 we can conceive the following as the order of permissible vowel sequences in these dialects: **ua** > **uo** > **ue** > **uɔ** > **uɛ**.

In non-contexts of [+Low], [+Round] harmony, an impermissible (V_1V_2) vowel sequence is resolved through V_2 deletion. This explains why V_2 got deleted (in both segment and syllable) from forms such as 400, 500, 600, 700, 800, and 900 where we had impermissible [**ae**] and [**aɛ**] sequences. In numbers '200' and '300', however, V_2 is preserved prosodically (i.e. syllabically) but not segmentally – it is preserved prosodically to ensure that there is more than a single syllable after the first root numeral. V_1 then lengthens to the right to compensate for the V_2-segment loss. The lengthening of the segment of V_1 to V_2 is therefore an attempt to ensure that we attain the permissible vowel sequence and consequently the required number of syllables after the domain specified. (Schema 9 illustrates the V_2-segment deletion and V_1 lengthening concurrently; these processes combine to derive the low-low vowel sequence in number '200', and probably *'300'.)[11]

Table 10. (a) (b)



Derivations: *[**ahaanu**] *'200' (not complete yet hence *);* *[**ahaasã**] *(see footnote)*

Lengthening does not apply, and the V_2 syllable undergoes deletion, in numbers 400, 500, 600, 700, 800, and 900 where the loss of the V_2-syllable does not lessen the number of syllables that are required after the first numeral. Deletion with compensatory lengthening (CL) order after [+Low] and [+Round] harmony and explains why the output forms of numbers '20' and '30' are not *[**aduunũ**] and *[**aduusã**], respectively, but [**æduonũ**] '20', and [**æduasã**] '30'. It must be emphasized that the condition that calls for lengthening in 200 is prosodic and so are [+Round] and [+Low] harmony to some extent, for example, in the formation of numbers '20' [**æduonu**] and '30' [**æduasã**]. From the ongoing discussion, two conditions propel the application of the first three of the four processes (i.e. V_2-

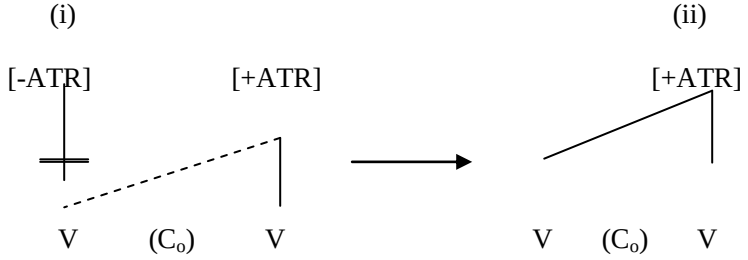
[11] [**a.ha.a.sa**] '300' can also be taken as an instance of [+Low] harmony. The argument has been that [+Low] harmony precedes V_2-segment loss and CL, which then suggests that [ahaasa] is derived through [+Low] harmony – i.e. /**ɛ**/ becoming [**a**] before the [**a**] of [**sa**] – and not by lengthening [**a**] of [**ha**] after an /**ɛ**/-segment loss as carried out here.

syllable loss being the fourth process), namely the need for prosodic well-formedness (i.e. to keep a significant number of syllables after the first root), or segmental well-formedness (i.e. to avert an impermissible V_1V_2 sequence). It is in the formation of numbers 20, 30, 200, and 300 that the two well-formedness conditions meet. It must be pointed out also that V_2 is not a contrastive sound component of the second numeral and as such is bound to undergo deletion, however, for the fact that it is subjected to these harmonizing processes and/or its syllable is required to achieve prosodic well-formedness its deletion never happens.[12]

[+ATR] Harmony in Numeral Compounds. The ensuing paragraphs concern the low vowel and [+ATR] harmony in compound numerals. According to Clements (2002:138) "[/**a**/] shifts to [[**æ**]] before a [+ATR] vowel in the following syllable". I find his position too broad given that /**e**/, the non-high, non-low, non-round, advanced vowel, cannot transmit its [+ATR] feature to a preceding /**a**/ as in the word **anene** [**anene**] 'a type of bird'; we do not say *[**ænene**]. There are two cases of [+ATR] in the numeral compound data. The first holds between /**u**/ in {**du**} 'ten' and {**a-**}, the nominal prefix, in the formation of numbers 20 to 90, with the former targeting the latter leftwardly as schematized in (11a) below.[13]

Table 11.

a. [+ATR] harmony



b. Data on /**u**/ targeting /**a**/ for [+ATR]

æ.du.o.nũ	20	**æ.du.a.nã.ɪ̃**	40	**æ.du.o.sĩ.ã**	60	**æ.du.ɔ.wɔ.tɕɥɪ**	80
æ.du.a.sã	30	**æ.du.o.nũ.m**	50	**æ.du.ɔ.sʊ̃.ŋw**	70	**æ.du.ɔ.k(ʊ̃).rʊ̃.ŋw**	90

The second context of [+ATR] harmony is between the two root numerals (i.e. root-root boundary) in the formation of numbers '200', '500' and '600' as given in (12) below.

[12] V_1 has the root advantage over V_2 and as such is not a candidate for deletion.

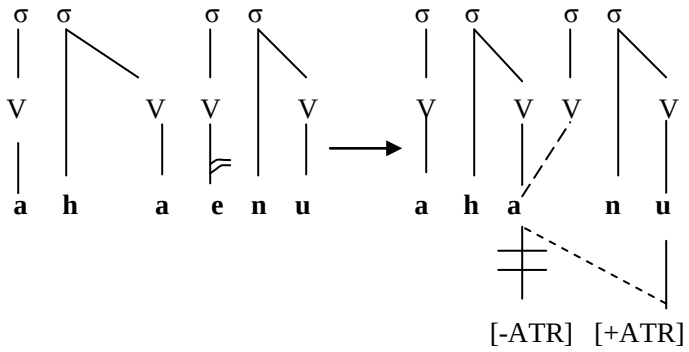
[13] [+ATR] harmony here can be conceived as vowel raising, with /**a**/, the low vowel, raising to [**ɛ**], the non-high, non-low, unadvanced vowel. Under this approach a true [+ATR] harmony in the Twi dialects will be the raising of [**ɛ**] to [**e**] after the /**a**/ to [**ɛ**] change as in /**bisa-bisa**/ 'to ask repeatedly/severally' → (Intermediate projection) [**bisɛbisa**] → (Output) [bisebisa].

Table 12.

	Input	Output	
i.	/**a** + **ha** + **e.nũ**/	**a.hæ.æ.nũ**	200
ii.	/**a** + **ha** + **e.nũ.m**/	**a.hæ.nũ.m**	500
iii.	/**a** + **ha** + **e.n.sĩ.ã**/	**a.hæ.n.sĩ.ã**	600

[+ATR] harmony here is saddled with two constraints, namely, one, the non-spreading of [+ATR] to a non-immediate low vowel (i.e. a low vowel which is a vowel or more away from the [+ATR] trigger cannot be targeted for [+ATR])[14], and two, the non-transmission of the [+ATR] feature of /**e**/ to /**a**/.[15] Due to these two restrictions, /e/ might have undergone deletion before [+ATR] spread to the low vowel as illustrated in (13) below with V_3 (the vowel after /**e**/) as the trigger of [+ATR]; then [**æ**] lengthened to V_2 to compensate for the loss of /**e**/ to preserve the V_2-syllable and thus achieve prosodic well-formedness. There is no lengthening of the V_1 segment in numbers '500' and '600' (and also 700, 800 and 900) where the first root numeral is followed by the required amount of syllables.

Table 13. (a) ***ae** → **a**V (b) **a**V → **aa**/**æ**V → **ææ**



From this discussion, the loss of /**e**/ orders before the spread of [+ATR] to /**a**/ on the segmental plane, not on the prosodic plane.[16] My analytical claim then is that [+ATR] harmony in Akan is purely a segmental phenomenon whose scopes of

[14] To receive [+ATR] a low vowel must not fall outside a (C)V syllable before the trigger.

[15] The low vowel cannot undergo the [+ATR] change when it falls outside the (C)V-syllable immediately before the trigger (e.g. /**wʊ-a-bɛ-di**/ 'you-have-come-to.eat' becomes [**wʊabedi**]); /e/ does not transmit [+ATR] to the low vowel it is more reasonable to argue for V_2-segment deletion before [+ATR] spreading to the low vowel. The fact that the [+ATR] feature transmits to the two low vowels of '200' suggests that [+ATR] harmony in Akan is more of segmental process than a prosodic one.

[16] Now, how does the language treat a sequence of two low vowels? Under this approach, [+ATR] harmony views a sequence of two low vowels as a single unit and transmits the feature [+ATR] to the two syllables once on the segmental plane. For example: **da.a.bi** 'no' a single /**a**/ will doubly-associate two syllables and [+ATR] will target this single /**a**/.

application and non-application ought to be captured as such. The ensuing subsection seeks to establish the conditions for the non-contrastive homorganic nasal's ([N]) retention in, or deletion from, compound numerals.

3.2 THE QUESTION OF WHEN THE NON-CONTRASTIVE /N/ IS RETAINED OR NOT RETAINED IN TWI NUMERAL COMPOUNDS

The homorganic nasal (i.e. [N]) follows V_2 immediately where it ([N]) is present.[17] With regard to its distribution (i.e. deletion from or retention) in compound numerals, it is in complementary usage with V_2 (also non-contrastive). So what we are witnessing here is "a complementary distribution of the non-contrastive". The retention of the non-contrastive homorganic nasal in numeral compounds is conditioned by the non-application of context-based V_2-stabilizing processes such as [+Low] harmony, [+Round] harmony, or CL, and consequently, the deletion of the V_2-syllable; compound numerals in which [N] was expected but it did not show up are the domains whereby none of the first three processes could apply to stabilize V_2. As shown by table (14) below, V_2 triumphs over [N] in numbers 60, 70, 80, and 90 (in Column (I)); in Column (III) where we have numbers 600, 700, 800 and 900, the opposite of what goes on in Column (I) applies.

Table 14.

	Column I: Processes	Column II: Candidates for 60 to 90. ('*' means 'an illicit' form – winning form is without '*'; 'ø' mean 'deletion'))		Column III: Candidates for 600 to 900. ('*' means 'an illicit' form – winning form is without '*'; 'ø' mean 'deletion'))	
a.	i. */N/ deletion*	**æ.du.o.ø.sĩ.ã**	60	***a.hæ.æ.sĩ.ã**	600
	ii. */V_2/-syll. Deletion*	***æ.du.ø.n.sĩ.ã**		**a.hæ.ø.n.sĩ.ã**	
	iii. *Not (i), not (ii)*	***æ.du.o.n.sĩ.ã**		* **a.hæ.æ.n.sĩ.ã**	
b.	i. */N/ deletion*	**æ.du.ɔ.ø.sʊ̃.ŋw**	70	***a.ha.a.ø.sʊ̃.ŋw**	700
	ii. */V_2/-syll. Deletion*	***æ.du.ø.n.sʊ̃.ŋw**		**a.ha.ø.n.sʊ̃.ŋw**	
	iii. *Not (i), not (ii)*	***æ.du.ɔ.n.sʊ̃.ŋw**		***a.ha.a.n.sʊ̃.ŋw**	
c.	i. */N/ deletion*	**æ.du.ɔ.ø.wɔ.tɕɥɪ**	80	***a.ha.a.ø.wɔ.tɕɪ**	800
	ii. */V_2/-syll. Deletion*	***æ.du.ø.ŋ.wɔ.tɕɥɪ**		**a.ha.ø.ŋ.wɔ.tɕɥɪ**	

[17] V_2 thus represents the initial vowels of numbers two to nine; they are called V_2 after the fact that they are preceded by either /**u**/ of {**du**} '10' or /**a**/ of {**ha**} '100' during the compound process. I consider V_2, like /N/, a non-contrastive unit whose retention in or deletion from compound numerals is contextually-determined.

	iii. *Not (i), not (ii)*	***æ.du.ɔ.ŋ.wɔ.tɕɥɪ**		***a.ha.a.ŋ.wɔ.tɕɥɪ**	
d.	i. */N/ deletion*	**æ.du.ɔ.ø.k(ṹ).rṹ.ŋw**	90	***a.ha.a.ø.k(ṹ).rṹ.ŋw**	900
	ii. */V_2/-syll. Deletion*	***æ.du.ø.ŋ.k(ṹ).rṹ.ŋw**		**a.ha.ø.ŋ.k(ṹ).rṹ.ŋw**	
	iii. *Not (i), not (ii)*	***æ.du.ɔ.ŋ.k(ṹ).rṹ.ŋw**		***a.ha.a.ŋ.k(ṹ).rṹ.ŋw**	

As shown in (iii) from (14a) to (14d), a non-contrastive form (i.e. either V_2 or /N/) is deleted to avoid having two of them in a compound numeral. Evidently, this is not the case in non-compound or citation forms of these numbers, namely **ensia** '6', **ɛnsʊŋw** '7', **ɛŋwɔtɕɥɪ** '8', **ɛŋkʊrʊŋw** '9' in Asante and Akyem Twi, where the vowel (i.e. the syllabic vowel) before [N] is non-high and front (i.e. /**ɛ**/ and /**e**/). The loss of non-contrastive [N] in compounds is therefore associated with the change of the preceding syllabic vowel, which is non-high front, to non-high non-front ([**ɔ**], [**o**], and [**a**]). This can be expressed as the avoidance of the non-contrastive [N] after a non-high non-front syllabic vowel in the Twi dialects of Akan and will explain the non-occurrence of the non-contrastive [N] in Akuapem dialect where the preceding/initial vowel is [a] as in data (15). [18]

Table 15

	Asante/Akyem (Phonetic)	Akuapem (Phonetic)	Gloss
a.	**ensĩã**	**a.sĩ.ã**	6
b.	**ɛnsṹŋw**	**a.sṹ.ŋ**	7
c.	**ɛŋwɔtɕɥɪ**	**a.wo.tɕɥe**	8
d.	**ɛŋk(ʊ)rʊŋw**	**a.k(ṹ).rṹ.ŋ**	9

Data (16) provides additional evidence in support of this co-occurrence restriction; non-contrastive [N] does not occur (i.e. is dropped) because there is a syllabic /a/ (i.e. non-high, non-front) immediately before where it should have occurred;[19] the non-contrastive homorganic nasal is retained in (17) where the preceding vowel is not a non-high, non-front syllabic vowel.

Table 16. The loss of the non-contrastive [N]

a.	**ba.a.sĩ.ã**	'six people'
b.	**ba.a.sṹ.ŋw**	'seven people'
c.	**ba.a.wɔ.tɕɥɪ**	'eight people'

[18] Attention is focused on the morpheme boundaries – that is, between the Nominal Prefix and the first numeral, and the first numeral and the second numeral – and on numbers 6, 7, 8, and 9 where the non-contrastive homorganic nasal is known to exist in the Asante and Akyem dialects.

[19] Initial /**ɛ**/ or /**ɛ**/ got deleted before syllabic /**a**/ followed by the non-contrastive /N/ loss.

d.	**ba.a.k(ũ).rű.ŋw**	'nine people'

Table 17. Non-contrastive [N] retention

a.	**m.p(i).re.n.sĩ.ã**	'six times'
b.	**m.p(ɪ).rɛ.n.sũ.ŋw**	'seven times'
c.	**m.p(ɪ).rɛ.ŋ.wɔ.tɕɥɪ**	'eight times'
d.	**m.p(ɪ).rɛ.k(ũ).rũ.ŋw**	'nine times'

3.3 TONE IN NUMERAL COMPOUNDING.

This subpart focuses on tonological processes (or tonal changes) at the root-root boundary. (Nominal prefixes are low toned.)

Table 18. Numbers 20 to 90

	Column 1 (non compounds)	Column 2	Column 3
a.	**èdú** (10) + **ènú** (2)	**àdùònu**	'twenty'
b.	**èdú** (10) + **èsá** (3)	**àdùàsa**	'thirty'
c.	**èdú** (10) + **ènáɪ́** (4)	**àdùànáɪ**	'forty'
d.	**èdú** (10) + **ènúm** (5)	**àdùònúm**	'fifty'
e.	**èdú** (10) + **èǹsía** (6)	**àdùòsía**	'sixty'
f.	**èdú** (10) + **èǹsúŋw** (7)	**àdùɔsúŋw**	'seventy'
g.	**èdú** (10) + **èŋ̀wɔ̀tɕɥɪ́** (8)	**àdùɔwɔ́tɕɥɪ́**	'eighty'
h.	**edú** (10) + **èŋ̀k(ʊ)rúŋw** (9)	**adùɔkrɔ́n**	'ninety'

Table 19. Numbers 200 to 900

	Column 1(non-compounds)	Column 2	Column 3
a.	**ɔhá (100) + ènú (2)**	**àhàànu**	'two hundred'
b.	**ɔhá (100) + èsá (3)**	**àhààsá**	'three hundred'
c.	**ɔhá (100) + ènáɪ́ (4)**	**àhánáɪ́**	'four hundred'
d.	**ɔhá (100) + ènúm (5)**	**àhánúm**	'five hundred'
e.	**ɔhá (100) + èǹsía (6)**	**àháńsía**	'six hundred'
f.	**ɔhá (100) + èǹsúŋw (7)**	**àháńsúŋw**	'seven hundred'
g.	**ɔhá (100) + èŋ̀wɔ̀tɕɥɪ́ (8)**	**àháŋ́wɔ̀tẃe**	'eight hundred'
h.	**ɔhá (100) + èŋ̀k(ʊ)rúŋw 9)**	**àháŋ́k(ʊ)rúŋw**	'nine hundred'

V_1 loses its basic high tone before V_2 (in 18, 19a and 19b) but retains it elsewhere (i.e. from 19c to 19h); and tone bearing units (TBUs) at the root-root boundary

always agree in tone. So boundary tone sharing is one of the processes that must apply to sew the independent units into a single unit, and while V_2 cannot influence V_1 segmentally it does influence it prosodically (i.e. tonally); as shown in (18), (19a) and (19b), V_1 drops its basic high tone for the low tone of V_2. The non-contrastive homorganic nasal always has the same tone as a preceding syllable; this is true in both compound and non-compound forms – [N] takes the basic high tone of V_1 from (19e) to (19h) Column (2), but has a low tone in Column (1) where tone is low for the preceding TBU. It can therefore be argued that [N] is toneless and simply copies the tone of the preceding (V) syllable. What this also means is that V_2 deletes with its basic low tone and explains why [N] copies the (high) tone of V_1 with the loss of the V_2-syllable. With a toneless [N] and a V_2-syllable which deletes with its low tone, tonal processes at the root-root boundary can simply be expressed as the ranking of boundary low tone sharing/harmony (LT-Harm) over boundary high tone sharing/harmony (HT-Harm).[20] Tone must be basic to the TBU to trigger boundary tone harmony (i.e. the spreading tone must be local, not foreign) – anything other than this is a violation of tone harmony (both Low and High tone harmony). Below are illustrations of these tonological processes within OT; the numbers involved are 70 and 700. (Winning candidates have been highlighted and underlined at the same time.)

Table 20.

a.	Candidates	LT-Harm	HT-Harm
(i)	**àdùɔ̀sʊ́ŋw**		*
(ii)	**àdúɔ́sʊ́ŋw**	*!	
(iii)	**àdúɔ̀sʊ́ŋw**	*	*
b.	Candidates	LT-Harm	HT-Harm
(i)	**àhán̄sʊ́ŋw**		
(ii)	**àhàn̄sʊ́ŋw**	*	*
(iii)	**àhán̄sʊ́ŋw**	*	*

There are violations for not harmonizing in tone in (20.a/iii) and (20.b/iii); in (20.a/ii) is a violation of LT-Harm, V_2 has an underlying low tone which must be shared; (20.b/ii) violates both LT-Harm and HT-Harm for sharing a non-basic tone (i.e. a tone it is does not have in the first place).

[20] If [N] copies place and tone then the only thing left with it is its nasality -- this together with the fact that it is missing in Akuapem dialect bolster our non-contrastive claim on the sound – and is leading us to a point where [N] could possibly be described as basically a floating nasal.

4. CONCLUSION.

Several lessons can be obtained from the Twi numeral compound data. Morphologically/semantically, the prefixal morpheme, {**a**-}, is not just a nominalizer as simplified earlier, it is also a plural morpheme which like numbers two to nine is meant to modify **du**, the root of ten, and **ha**, the root of hundred as specified below: Modifier-1 (Pluralizing Noun prefix) + head (root numeral 1 – **du** or **ha**) + Modifier-2 (number 2, 3, … 9). A numeral compound like 20 [**æduonu**] should therefore translate as "two, ten-s" – whereby, '-s' is Modifier-1 (i.e. {**a**-}), 'ten' is the head (i.e. **du**), and 'two' is Modifier-2 (i.e. **enũ**); the number '200' [**ahææ**nu] will then translate as "two, hundreds" (a hundred and a hundred, i.e. two of them). Phonologically, aside from regular [+ATR] and [+Round] harmonic processes in Akan, the paper has also shown that Asante and Akyem dialects of Akan operate [+Low] harmony which ranks crucially before [+Round] harmony. In the absence of [+Low], and [+Round] harmony segmental/phonotactic well-formedness is achieved through V_2-segment deletion. The loss of the V_2-segment, I argued, ranks before [+ATR] Spread to V_1, which is a low vowel, and the preservation of the V_2 syllable through CL to achieve phonotactic/segmental and prosodic well-formedness, concurrently. The three harmonic processes, namely [+Low] harmony, [+Round] harmony and V_2-segment deletion with CL, have been described as V_2 stabilizing processes. The application of these stabilizing/well-formedness processes, it was observed, creates the impermissible [$V_{[-high,\ -front]}$.N] sequence. In other words, in an attempt to avert one impermissible situation (i.e. to achieve well-formedness) a second impermissible situation, requiring another/other well-formedness condition(s), is created. The latter impermissible sequence I have argue is resolved through [N] deletion, that is, the deletion of the homorganic nasal [N] after a non-high non-front syllabic vowel. This process has been invoked to explain the absence or the non-occurrence of the homorganic nasal in numbers six, seven, eight and nine in the Akuapem dialect of Akan where /a/, a non-high non-front syllabic vowel, is the initial/preceding vowel. The homorganic nasal is retained in contexts where segmental/phonotactic well-formedness can only be achieved through V_2-segment deletion, and where the preservation of the V_2-syllable through CL is insignificant, prosodically. The behavior of V_2 and the homorganic nasal [N] during numeral compounding – namely, the fact that the loss of either V_2 or [N] or the non-occurrence of [N] in Akuapem does not, in any form, damage the resultant numeral compound semantically – has caused me to describe the two sounds as non-contrastive. Their distribution has been tagged "the complementary distribution of the non-contrastive" after the fact that well-formedness processes forbid them (i.e. V_2 and [N]) from occurring together in numeral compounds. It needs to be emphasized that their mutual exclusiveness is simply an output (i.e. an end product or surface realization) of processes geared towards phonotactic and/or prosodic well-formedness at the root-root boundary. On boundary tone, tone harmony holds between units (i.e. between V_1 and N, and between V_1 and V_2) at the root-root boundary with Low tone harmony outranking High tone harmony. The non-contrastive homorganic nasal is underlyingly toneless and looks up to a preceding syllable for a surface tone; this explains why its tone changes from low to high after V_1 after the V_2 syllable loss. Below are the processes

at the root-root boundary and the order in which they apply: a *((i) >> (ii))* >> b >> c, d >> e >> f *((i) LT-harmony >> (ii) HT-harmony))*.

Table 21.

Rule Ordering/Ranking (note: processes have been schematized after References)	
a. (i) [+low] >> (ii) [+Round]	
b. Loss of a non-contrastive unit (V-segment or [N])	*Segmental/assimilation processes*
c. [+ATR]	
d. CL – segmental with prosodic conditioning	*Straddles segmental-prosodic planes*
e. Stray syllable erasure	
f. Tone harmony ((i) LT-harmony >> (ii) HT-harmony))	*Prosodic processes*

REFERENCES

Abakah, Emmanuel N. 2002. Remarks on the Akan vocalic inventory. Pp. 243 – 263 in New Direction in Ghanaian Linguistics. Ameka, Felix and E. Kwaku Osam (eds). Accra: Black Mask Ltd.

Andoh-Kumi, Kinsley. 1977. Akan kasa nnyegyee ho adesua bi (A phonology of Akan). Cape Coast: University of Cape Coast.

Boadi**,** Lawrence A. 1963**.** Palatality as a Factor in Twi Vowel Harmony. Journal of African Languages 2:133-139.

Boadi, Lawrence A. 1991. The domain of vowel harmony in Akan. A paper presented at the Linguistics Association of Ghana Conference. 1991. Accra: University of Ghana, Legon.

Christaller, Johannes G. 1881/1993. Dictionary of the Fante and Asante Language called Tshi (Twi) 2nd ed. Basel Evangelical Society.

Clements, George N. 1981. Akan vowel harmony: a linear analysis. Pp. 108-177 in Harvard Studies in Phonology 2.

Clements, George N. 1985. Akan vowel harmony: a nonlinear analysis. Pp. 55 – 98 in Goyvaerts (ed.) 1985.

Clements, George N. 2002. Phonology. Pp. 123-160 in African Languages: An Introduction. B. Heine and D. Nurse (eds). UK: Cambridge University Press.

Dolphyne, Florence A. 1965. The Phonetics and Phonology of the Verbal Piece in the Asante dialect of Twi. Ph.D. Dissertation, University of London.

Dolphyne, Florence A. 1988. The Akan (Twi-Fante) Language: Its sounds systems and tonal structure. Accra: Ghana University Press.

Lindau, Mona. 1978. The Feature Expanded. Pp. 163-176 in Journal of Phonetics 7.

Obeng, Samuel G. 1989. Advance Level Akan Phonology: Essays in honor of P.C. Sgt. D. N. Gyasi. Legon: University of Ghana.

Obeng, Samuel Gyasi. 1995. Vowel harmony. Pp 143-152 in AAP 41.

Ofori, Seth A. 2006a. Recent and Remote Past Marking in Akan: A Multitiered Account. Pp. 21-43 in From Linguistics to Cultural Anthropology: Aspects of Language, Culture and Family Issues in Ghana (West Africa). S. G. Obeng and C. S. Obeng (eds). Muenchen: Lincom Europa

Ofori, Seth A. 2006b. Aspects of Akan Grammar. Ph.D Dissertation, Indiana University

Schachter, Paul and Victoria Fromkin. 1968. A Phonology of Akan: Akuapem, Asante, and Fante. Los Angeles: Department of Linguistics

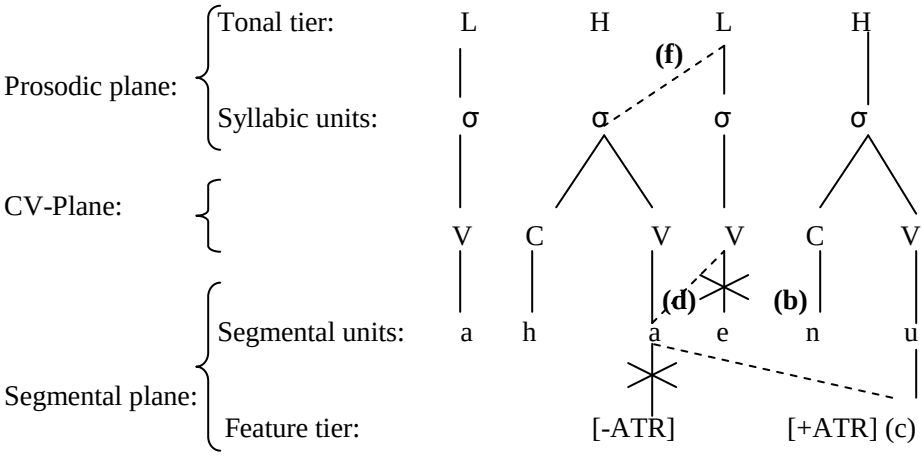
Stewart, John M.1967. Tongue root position in Akan vowel harmony. Phonetica 16:185-304

Trask, Robert L. 1996. Historical Linguistics. New York: Oxford University Press

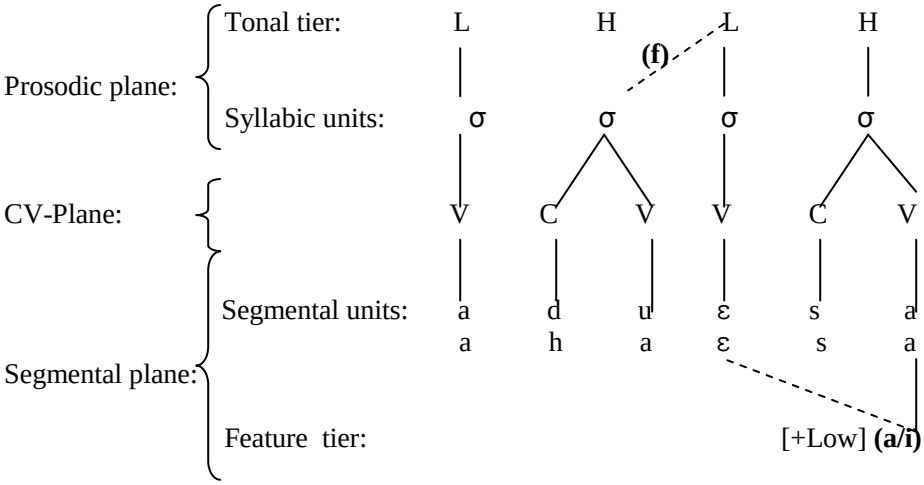
Williamson, Kay and Roger Blench. 2002. Niger-Congo. Pp. 9-42 in African Languages: An Introduction. B. Heine and D. Nurse (Eds). UK: Cambridge University Press.

Notes: Schematic representations of processes at the root-root boundary

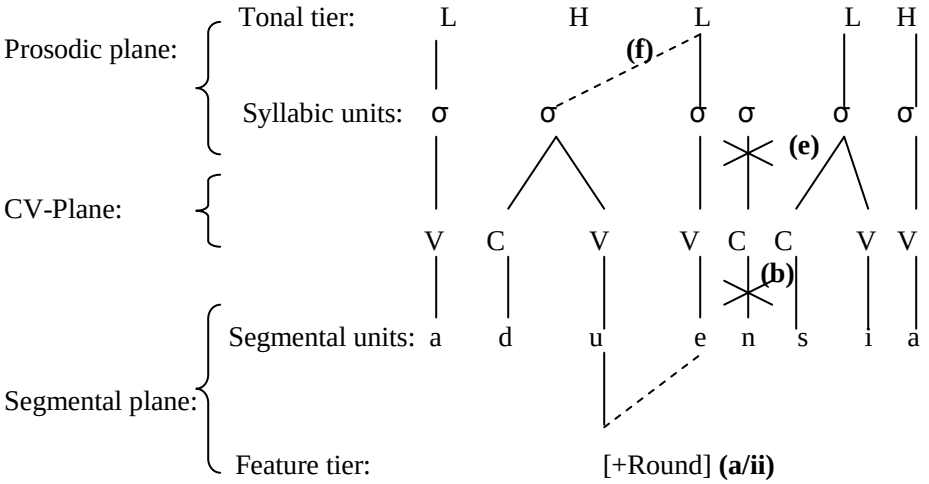
(I) V2-segment deletion, CL, [+ATR] harmony and LT-Harmony



(II) Low and LT-Harmony



(III) LT-Harmony and [+Round] Harmony



(IV) V2-segment/V2-syllable and Low tone deletion, High tone spreading to [N]