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Acoustic Evidence of [m] and [n] as Syllabic Consonants (Ç) in Akan

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Abstract:

The study which is ethnographic in nature employs qualitative and acoustic analytical approach to examine [m] and [n] as syllabic consonants in Akan. In all, 30 Akan (Akuapem, Asante Twi and Fantse) native speakers were recorded; ten from each dialect area, made up of five males and five females aging between 35 and 56 who were illiterate or could read little Akan. Words such as bam, kɔm, som, ntɛ, nkã, mpa were put in a carrier frame or were produced in isolation. The Asante and Fantse speakers were asked to repeat the words presented in a carrier frame "Ɔse {key word} anaa?" [ɔsɪ…anaa] three times, as Akuapem speakers were asked to repeat "Ose {key words} anaa?" [ose…..anaa]. The carrier frame was given to 18 participants (9 males and 9 females) to repeat three times, whilst 12 participants, comprising 6 males and 6 females were also given the same word list to repeat three times in isolation. The result showed that on Ç syllabic structure (where Ç is always a nasal consonant), pause duration and intensity measurement identified it to exist at word-initial and not final. In most cases, it is seen as a nasal consonant at word-initial. It constitutes a syllable alone and more importantly contains pitch which makes it sonorous. Again, CVN is one syllable and so the N at the word final cannot be syllabic.

Keywords:

Syllabic Consonants, Ethnographic, Akan, Acoustics

1. Introduction

Syllable (σ) as a basic unit of speech is studied on both the phonetic and phonological levels of linguistics. In most languages, syllable exists and it is the level immediately above the level of the segmental phoneme [8]. That is to say, the syllable is the next unit bigger than the phoneme. The notion that there exists a unit of speech at a level higher than the phoneme known as the syllable has seen many attempts in recent times to define the term syllable.

However, providing a precise definition of the syllable is not an easy matter; indeed it is a unit of speech for which there is no satisfactory definition. Attempts made to define the syllable fall into two main categories; those which seek a universal

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definition in phonetic terms and those which look for a specific functional definition in terms of a particular language.

Phonetically, syllables “are usually described as consisting of a centre which has little or no obstruction to airflow and whose sounds are comparatively loud; before and after that centre, there will be greater obstruction to airflow and/or less loud sound” [24]. In the monosyllable (one-syllable word) cat /kæt/, the vowel /æ/ is the “centre” at which little obstruction takes place, whereas we have complete obstruction to the airflow for the surrounding plosives /k/ and /t/. Thus in Akan, a CVC syllable type occurs with the final ‘C’ being a nasal or a lateral, contrarily to [13] assertion. For example, we can have CV(N) – where N is a nasal consonant like fam [fam] ‘to attach’, kan [kaŋ] ‘to count’ in Akuapem, CV(L) – where L is lateral or liquid in Fantse. For example, tar [tar] ‘to fix’ and tow [tʊw] ‘to throw’ respectively.

The ‘chest pulse’ or ‘motor’ theory of syllable production proposed by [25] argues that each syllable corresponds to an increase in air pressure, air from the lungs being released as a series of chest pulses. This can often be readily felt and measured, particularly in emphatic speech, but it is also often difficult to detect such a pause in adjacent syllables, as when two vowels co-occur, e.g. seeing /si:in/ or going /gəʊɪŋ/ (which most English speakers feel is two syllables but usually said in a single muscular effort), it is doubtful whether a double chest pause will be evident, although it is clear that the word is to be divided linguistically into two units [24]. It can therefore be inferred that CV, CVV and CVVV are all possible single syllables in Akan, contrarily to [13]’s claim since they all have one pause of speech production.

Sonority theory also accounts for phonetic explanation of syllables. It is a theory according to which the pauses of pulmonic air stream mechanism in speech “correspond to peaks in sonority” ([16] as cited in [24]). [16] further explains that the sonority of a speech sound is discussed as its relative loudness compared to other sounds and each syllable corresponds to a peak in the flow rate of pulmonic air. Thus, nuclear elements or syllabic segments can be described as intrinsically more sonorous than marginal or non-syllabic elements [24] we are very much aware that vowels, nasal consonants, glides and liquids are sonorous as well. In this case, it is possible V, Ç, CV, CVV and CVN are syllables in Akan. If so, then it is contrary to [13] claim that only V, Ç, CV are considered the only syllable types in Akan.

The Prominence Theory is also a phonetic approach to define the syllable in physiological, acoustic and auditory term. This theory argues that in a string of sounds, some are intrinsically more ‘sonorous’ than others, and that each ‘peak’ of sonority corresponds to the centre of a syllable. Putting it in another way, in any utterance, some sounds are said to be more ‘prominent’ or ‘sonorous’ than others, that is, they are felt by listeners to stand out from their neighbours. In the word sonority /sənɔrɪti/, such ‘peak’ of prominence is carried by /ə/, /ɔ/, /ɪ/, /i/. The number of syllables is being determined by the number of peaks of prominence. This approach gives a useful general guideline, but it does not determine to which syllable the weak sound, constituting the boundary between two syllables, is to be attributed.

Another way of defining syllable is through the lenses of phonology. [20] as cited in [24] defines the phonological syllable as “a complex unit made up of nuclear and marginal elements”. Nuclear elements are the vowels or syllabic segments; marginal elements are the consonants or non-syllabic segments. In the syllable paint /peɪnt/, the diphthong /eɪ/ is the nuclear element, while initial consonant /p/ and the final cluster /nt/ are marginal elements. [23] also sees syllable as, “a phonological unit consisting

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of a vowel or other unit that can be produced in isolation, either alone or accompanied by one or more less sonorous units.” [12] views a syllable as, “an element of speech that acts as a unit of rhythm, consisting of a vowel, syllabic, or vowel/consonant combination” which leads to the syllable structure.

[27] see syllable as a speech segment consisting of a cluster of phones surrounding a vowel-like energy peak. To Villing and co, detecting vowel like energy peaks is relatively straightforward using spectral methods but to complete the segmentation, syllable boundaries must also be detected. The authors explain that it is this boundary detection problem that has proven very difficult to do in a reliable and simple manner. The assignment of consonants among syllable centres is not easily determined and seems to be a function of the pauses between energy bursts introduced by the articulation that produced the utterance to be segmented. The location of these pauses is as a result of very complex relationships between the linguistic, grammatical, contextual and etymological variables.

A syllable may contain an onset and a rhyme. The onset is usually a consonant. It is optional. The rhyme may contain a nucleus or nucleus and coda. The coda is also a consonant.

A Syllable onset can be C or CC or even CCC depending on the language under review. The English language for instance, allows C (e.g., [dɒg]), CC (e.g., [prei), and CCC (e.g., [sprei]). In Akan, the onset C can be [b, d, f, h, k, l, m, n, p, r, s, t, w, j]. In a situation where there is CC, the first C is normally a nasal consonant followed by an oral consonant. Examples include [mpa] ‘mat’, [ntɛ] ‘pebble’, and [ŋkã] ‘scent’.

In a situation where the first consonant in CC is not a nasal consonant, the second C is realized as [r] or [l] in Fantse or some dialects of Akan (see [13]; [22]; [21]). Examples include CCV (CrV) as in [bra] ‘come’, [pra] ‘sweep’, which has generated a lot of arguments especially among Akan phonologists (see [13]; [3/4]; [22]; [21]) that this consonant cluster is a phonetic realization and should be treated as CVrV syllable structure.

[11] as cited in [2] on CCV structure observed that many West African languages have liquid clusters, CL, where L (standing for liquid) is realized as [r] or [l]. [11] argues that almost invariably these liquid clusters come about as a result of a vowel deleted in the history of the language: “CVLV > CLV.” He concludes that in different languages, the liquid shows varying degrees of affiliation to the preceding consonant. He then limits his study on the Mfantse dialect of Akan. He asserts that in the Fantse variety of Akan, for example, vowel deletion is a synchronic process, and brief transitional vowel can still be heard at the intersection between the consonant and the liquids. In many words such as [ɔ̀pŕàà] ‘s/he swept’ the liquid bears the tone (and sometimes other features) of the deleted vowel. As a consequence, the CLV sequence continues to pattern tonally like a bisyllabic CVLV sequence.

Contrary to [13], [3/4], [11], [22], [21], [2] and [6], [17] examines Bambara (also called Bamananankan or Bamana, member of the Manding group of Central-Southwestern Mande). He explains that some varieties of Bambara, for example, Colloquial Bambara [17] permits wider variety of syllable types including CCV and CVC syllables. The phonotactics of Colloquial Bambara permits such complex syllables only when the second member of a branching onset in a CCV syllable or the coda of a CVC syllable is a sonorant. The language also permits derived CVV syllables, where an intervocalic velar consonant is removed when flanked by identical vowels [17].

The syllable nucleus is usually a vowel or vowels, in the form of a monophthong, diphthong, or triphthong, but sometimes it can be a syllabic consonant. By far the most common syllabic consonants are sonorants like [l], [r], [m], [n] or [ŋ]. From the discussion, a syllable nucleus can be a vowel or sonorous consonant. In Akan, vowel in V, CV, CVV, CVVV, CVN/L are all permissible as syllable nucleus.

[19] as cited in [7], confirms that Akan has CVV syllable type in either a long vowel or a diphthong, and that when the underlying initial vowel is a [+ATR] specifically /u/, then it turns out as labio-palatal glide [ɥ] as in the Akan name Akua [akɥia] 'the name of a Friday- female born, but it becomes a labial glide [w] when the underlying initial vowel is [–ATR] such as /ʊ/ particularly in the Asante dialect [19] in the word akoa [akʷʊa]. In acknowledging the lack of clarity on this issue, Hall-Lew also argues that though it is always not very clear whether Akan has CʷVV structure instead of CVV syllable type, she believes the latter structure exists in Akan and continues to give further explanations. In CVV structure, she describes the onset C as any consonant; the first vowel, V1 as vowels which are always [+High, +Back] i.e. /u/ or /ʊ/; and the second vowel V2, vowels such as /e/ or /a/. What [19] could not account for words such as [pia] 'push', [bɪa] 'place', etc.

[7] discusses CVC syllable type in Akan, supporting [3]'s argument that there can never be a word or syllable with final consonant (obstruent) as he posits in the following:

"There is no morpheme in Akan that is consonant-final at the systematic phonemic level and, for this reason, any analysis that posits an underlying consonant as a morpheme-final consonant starts on a faulty note" [3].

According to [13], only sonorant consonants can occur at word-final in Akan. Therefore, there is no CVC structure in Akan where the final C is an obstruent, but rather CVN where 'N' is nasal consonant. In furtherance of [4]'s argument, he posits that the 'N' has two realizations. While it surfaces as [m] in all the three dialects, it becomes [n] in Fantse, [ŋ] in Akuapem, Agona and Bremang, but a nasalized high front lax vowel in Asante, Akyem, Gomua Fantse, etc, depending on the shape of the stem vowel (see [9/10]. What [4] failed to distinguish is sonorant consonant-final and obstruent consonant final. The CVN that he said exists even indicate that the whole CVN is one syllable therefore cannot have the N alone as a separate syllable so why is it that 'N' in CVN is realized as a separate syllable or syllabic consonant? Secondly, even though [4] discussed liquids and glides as word-final consonants, he did not consider them at all in his CVC analysis. This study provides acoustic evidence of [m] and [n] as syllabic consonants (Ç) in Akan in the context of N.CV and CVN structure.

2. Methodology

The study which is ethnographic in nature employs qualitative and acoustic analytical approach. In all, 30 Akan (Akuapem, Asante Twi and Fantse) native speakers were recorded, ten from each dialect area, made up of five males and five females aging between 35 and 56 who were illiterate or could read little Akan. The Asante and Fantse speakers were asked to repeat the words presented in a carrier frame "Ɔse {key word} anaa?" [ɔsɪ…anaa] three times, as Akuapem speakers were asked to repeat "Ose {key words} anaa?" [ose…..anaa]. The frame was given to 18

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participants (9 males and 9 females) to repeat three times, whilst 12 participants, comprising 6 males and 6 females were also given the same word list to repeat three times in isolation.

Table 1. *Akan word list.*

Akan	Syllable Type	Words	English Gloss
As/Ak/Fa		ɔman	country
As/Ak/Fa		nkwan	soup
As/Ak/Fa	CVN	bam	embrace
As/Ak/Fa	CVN	kɔm	to do incantation
As/Ak/Fa	CVN	som	serve/worship
As/Ak/Fa	N	ntɛ	pebble
As/Ak/Fa	N	nkã	scent
As/Ak/Fa	N	mpa	mat
As/Ak/Fa		abowa	animal
Fa		anoma	bird
As/Ak		anomaa	bird

Source: Field Data, Bosiwah (2015)

Recording:

Data was collected through recordings. Data collection was carried out using DAT (Digital Audio Tape) recorder (Sony IC digital recorder ICD − PX333) to record the readings of the word lists by the various native speakers. The recorder was manually held at a constant distance of 10cm from each speaker's mouth. I used Praat 5.4.15 software to analyse the sounds. Praat is a software package written and maintained by Paul Boersma and David Weenink of the University of Amsterdam [26]'s analysis was done using pause duration and intensity.

3. Results

3.1. Ç (Syllabic Consonants)

The study set up to find out whether there is a syllabic nasal at word initial position. Three words which all have nasals at word initial – [mpa] 'bed/mat', [ntɛ] 'pebble', and [ŋkã] 'scent', were employed for the study. Again, in all the three dialects of Akan, I wanted to find out if the nasals stand out as separate syllables at word-initial, especially, when the nasal consonant follows another consonant by using pause duration and intensity.

3.2. Pause Duration of Ç (Syllabic Consonants) Type in Akan

Sample 1 demonstrates the waveform (top box) and spectrogram (bottom box) showing the pause duration of Fantse male speaker producing the word mpa. It is a picture frame taken from Praat software in the analysis of pause durations between syllables.

It is clear from the highlighted portion of Sample 1 that there is significant pause duration of 63ms between [m] and [p] in mpa. This suggests that [m] can be identified as a syllabic nasal or consonant.

Table 2 below displays the mean pause duration in milliseconds of the syllables in *mpa*, *ntɛ* and *nka* by Akuapem, Asante Twi and Fantse speakers. It is clear from the

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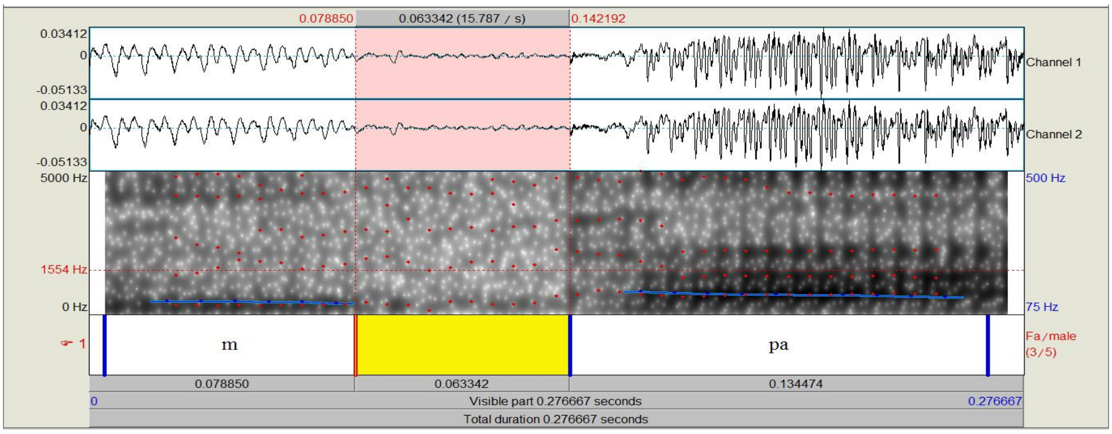
table that there is a significant pause duration in establishing that there are two syllables in each case of the three words under study here.



Sample 1. *A waveform (top box) and spectrogram (bottom box) of Fantse male speaker showing a pause between initial [m] and [p] in [mpa].*

Table 2. *Pause duration of Ç syllable type in Akan.*

Ç Syllable Type in Akan			
Mean pause Duration in ms	m.pa	n.tɛ	ŋ.kã
Akuapem	120	118	96
Asante Twi	106	100	78
Fantse	95	93	75

From Table 2, it can be seen that, in producing mpa, Akuapem recorded the mean pause duration of 120ms between [m] and [p] followed by Asante Twi of 106ms and 95ms for Fantse. In all, the mean pause duration for Akan was 107ms. In the production of ntɛ, the mean pause duration observed between [n] and [t] was 118ms for Akuapem followed by 100ms for Asante Twi and 93ms for Fantse. In Akan, it was realized as 104ms. In the same way, the [n] in nka showed some pause duration between the [n] and [k]. Akuapem recorded the mean pause duration of 96ms followed by 78ms for Asante Twi and 75ms for Fantse. From all the three dialects, Akan would have mean pause duration of 83ms.

In sharp comparison of the mean pause duration of the syllabic nasal in *mpa*, *ntɛ* and *nka* by the three main dialects of Akan speakers, the bar chart in Figure 1 illustrates the pictorial bar representation of the pause durations between the syllabic nasal of [m] or [n] and their respective following consonants.

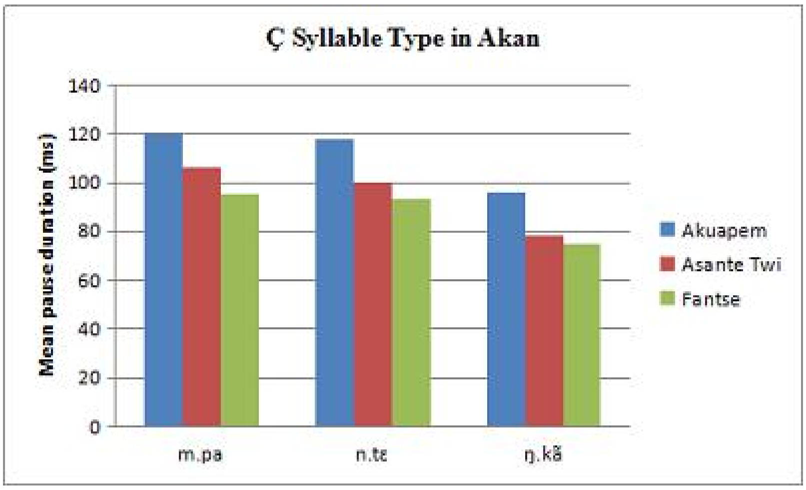
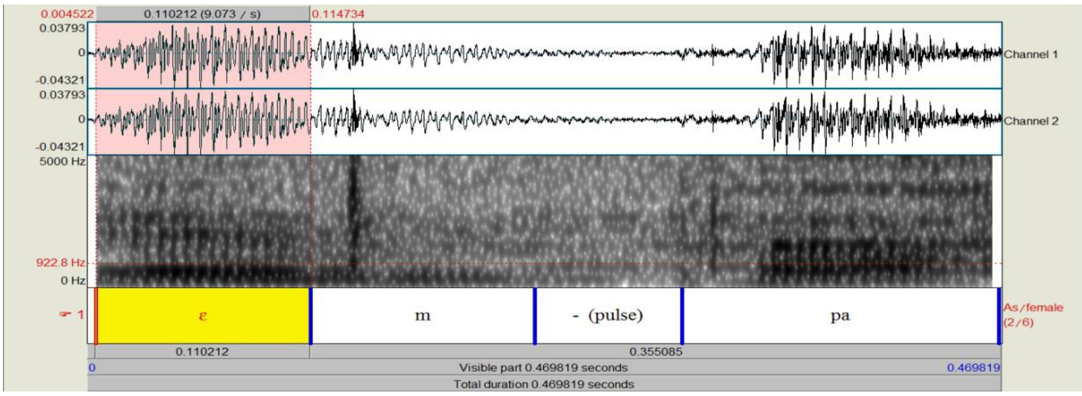


Figure 1. *A bar chart showing mean pause duration of Ç syllable type in Akan in ms.*

It is realised from the bar chart in fig.1 that Akuapem had the highest figures in terms of the mean pause duration in all the three words (mpa, ntɛ and nka) than Asante Twi and Fantse. The blue bars represent the mean pause duration (in ms) between [m] and [p] in mpa and the one for Akuapem appear tallest followed by the one for Asante Twi and then Fantse. The same trend goes for the brown bars representing the mean pause duration between [n] and [t] in ntɛ. Akuapem leads again in terms of tallest bar for the mean pause duration between [ŋ] and [k] in nka, followed by Asante Twi and lastly Fantse. The mean pause durations of the three words could be taken as enough pause to establish the initial nasal as syllabic in Akan.

However, the production of the three words (mpa, ntɛ and nka) revealed that some of the speakers, mostly Asante Twi and Akuapem, preceded some of the words with a vowel sound which rendered the syllable as a VN instead of simple ç (syllabic nasal), as can be seen in Sample 2 below.

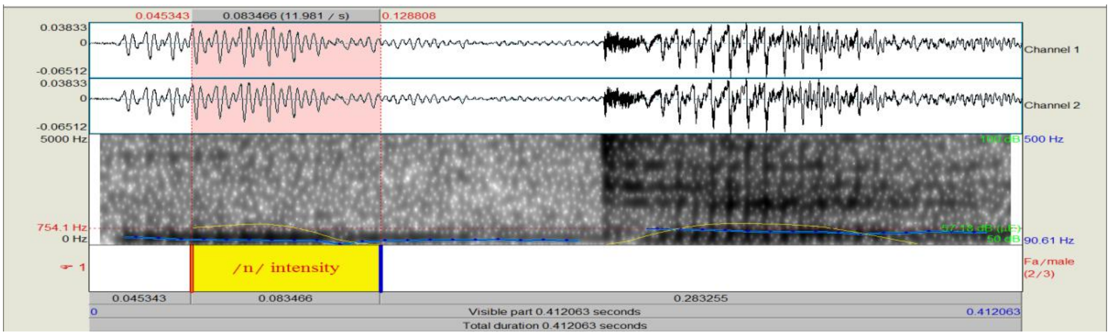


Sample 2. *A waveform (top box) and spectrogram (bottom box) of an Asante male speaker showing a pause between [ɛm] and [pa] in [ɛmpa].*

In the picture frame (Sample 2), the shaded portion displays the waveform (top box) of [ɛ] preceding [m] in mpa. Some of the Asante Twi and Akuapem speakers used [e] to precede the [m] which was pronounced as [empa].

3.3. Intensity of Ç (Syllabic Consonants)

Using the intensity of the syllabic nasals also showed the contour movement of energy which was used to identify the nasals as syllabic, as can be seen from the shaded portion of Sample 3 below:



Sample 3. *A waveform (top box) and spectrogram (bottom box) of Fantse male speaker showing an intensity in a yellow thin line of [n] in [ntɛ].*

In Sample 3, there is a yellow thin line in the shaded region (to indicate /n/ intensity) showing the height and lowest strength of energy used to indicate how the nasal was articulated as a separate syllable from the rest. The maximum and especially the minimum levels of intensity show fall in energy to signal the end of the nasal sound. Right after the minimum intensity, the energy level falls very low and again rising to show the beginning of another sound like [t]. It is also important to note that the fall of energy for some time justifies that there is significant fall of energy to cause a pause between the nasals and the consonants that follow them. Table 3 below gives evidence of the rise and fall pattern of the mean intensities in decibles (dB) in terms of values:

Table 3. *Intensity of Ç syllable type in Akan.*

Ç Syllable Type in Akan				
Mean Intensity in dB		m.pa	*n.tɛ*	ŋ.kã
Akuapem	Minimum	38	43	42
	Maximum	58	62	62
Asante Twi	Minimum	40	42	43
	Maximum	57	61	58
Fantse	Minimum	39	39	42
	Maximum	56	57	59
	Difference	18	19	22

It is realized from Table 3 that the maximum intensity for producing [m] in mpa by Akuapem, Asante Twi and Fantse are 58dB, 57dB and 56dB respectively. The maximum intensities suggest the presence of the peak energy of the nasal [m] whereas the minimum shows the fall and the end of the sound. With respect to dialects, Akuapem emerged with highest maximum intensity followed by Asante Twi and then Fantse. In terms of the minimum intensity, Akuapem's intensity fell as low as 38dB but Asante Twi dropped to 40dB and Fantse had 39dB.

The rise and fall of intensity level of [n] in ntɛ also revealed that [n] is a separate syllable from [tɛ]. The values 62dB, 61dB, and 57dB by Akuapem, Asante Twi and Fantse respectively were recorded as maximum intensity for [n]. Their corresponding minimum intensities were 43dB, 42dB and 39dB.

In the word nka, the different levels of intensity showed a significant pause between [ŋ] and [kã]. In Akuapem, the intensity of [ŋ] fell from a maximum of 62dB to a minimum of 42dB; it also shifted from maximum of 58dB to minimum of 43dB in Asante Twi; while Fantse recorded a fall from maximum of 59dB to minimum of 42dB. In each instance, the falls in intensity remained relatively low until the rise of the following consonant, which was evident that the fall marked the beginning of the pause between the syllabic nasal [ŋ] and the [k]. Figure 2 below shows pictorial representation of the different levels of intensity marking the nasals as syllabic from the rest of their respective consonants.

In Figure 2, the blue bars represent different levels of intensity of [m] in *mpa*. In each dialect, the blue bars can be compared to see the highest to the lowest. The brown colour also stands for the varied intensities of [n] in ntɛ. The varied intensities for [ŋ] in *nka* are illustrated in the green bars. Among these bars, the fall in the difference of highest intensity to lowest is also exhibited under the bars for difference in Figure 2. The green bar (in terms of mean difference in fall) representing the pause between [n] and [k] appear as the highest fall among the three words followed by *ntɛ* and then *mpa*. In terms of dialects, Akuapem recorded the highest fall 20dB (mean difference) between maximum and minimum intensities, which was followed by both Asante Twi and Fantse with 17dB apiece. Here, levels of energy are very significant in marking the ending of the production of the nasal sound as syllabic.

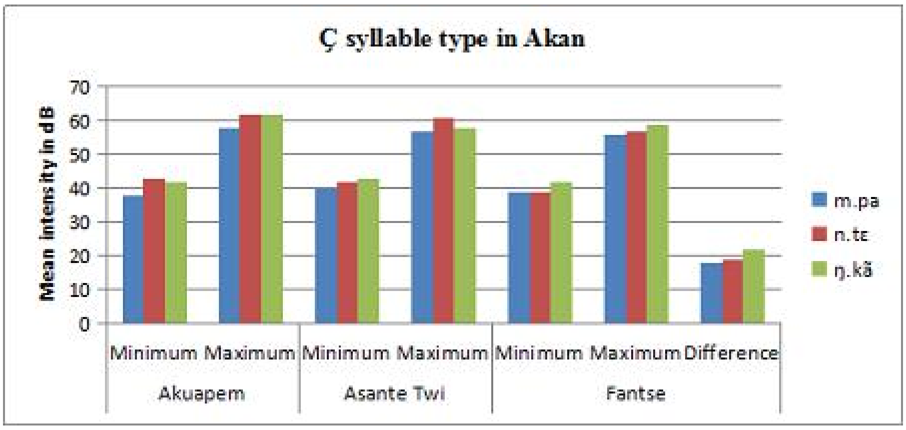


Figure 2. *A bar chart showing mean intensity of Ç syllable type in Akan in dB.*

In short, intensity contours appear more promising in syllabification, especially the syllabic nasal in Akan. So far, the result patterns of intensity contours of the Ç in the initial of Akan words *ntɛ* and *mpa* have demonstrated relative similarities with the intensity contours of the V as the syllable in words like *aba* [a.ba] and *ata* [a.ta].

3.4. F0 of Ç (Syllabic Consonants) Type in Akan

Another important element in the consideration of syllabification is the fundamental frequency (F0) which is related to pitch. The pitch is usually conceived as the peak of sonority which constitutes the nucleus of a syllable in Sonority and Prominence theories [16] as cited in [24]. This aspect is interested in ascertaining the reality of the syllabic consonants m and n in the words mpa and nka, in terms of F0 (in Hz), in the three dialects of Akan. Table 4 below gives the results of the acoustic analysis of the pitch used by the speakers in producing the initial syllabic nasals of the words.

Table 4. *F0 of Ç syllable type in Akan.*

F0 of Ç (Syllabic Consonants) Type in Akan				
Mean Pitch (Hz)	*m*	p*a*	*n*	k*a*
Akuapem	180	220	179	209
Asante Twi	128	138	142	150
Fantse	144	168	149	179
Akan	151	175	157	180

It is clear from Table 4 that the initial nasals can be classified as syllabic consonants in the words mpa and nka because they contain F0 each in each case. The results indicated that the Akan speakers used an average F0 of 151Hz in the production of m in the word mpa and 175Hz in the articulation of the nucleus of the second syllable pa. Out of this, Akuapem speakers for the study used a mean F0 of 180Hz for the first syllable and 220Hz in the second syllable. In relation to Asante Twi and Fantse, the speakers employed average F0s of 128Hz and 144Hz for the articulation of the initial m respectively. On the other hand, the speakers used average F0s of 138Hz and 168Hz respectively to produce the nucleus of the second syllable. It must be noted that the [p] in mpa did not carry any F0 due to the fact that it is a voiceless sound.

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In confirming the syllabic nasal, the word *nka* was analysed acoustically to extract the F0. The pattern of results did not differ significantly from the *mpa* word. The results indicated that the Akan speakers for the study used the mean F0 of 157Hz in the production of n in *nka* as against 180Hz in the production of a in ka. The details from Table 4 demonstrate that the Akuapem speakers employed the mean F0 of 179Hz; the Asante speakers used 142Hz and 149Hz was used by the Fantse speakers to produce the syllabic nasal [n]. In terms of the nucleus of the second syllable [a], the speakers used the mean F0s of 209Hz, 150Hz and 179Hz respectively to articulate the [a].

So in the consideration of the syllabic nasal, the two Akan words mpa and nka have demonstrated in terms of F0 that the nasals can be relied on acoustically as a separate syllable in Akan. This is to say that the perspective of F0 has given evidence to support or add to the use of pause and intensity as justification for the identification of the Ç as an independent syllable in Akan.

3.5. Vowels Preceding the Ç (Syllabic Consonants)

It was realised that in the production of the words *mpa*, *ntɛ* and *nka*, some of the speakers preceded the nasals with vowels, especially when the words were produced in isolation but not in spontaneous form. With respect to the word *mpa*, seven of the Asante speakers preceded the m with the /ɛ/ vowel but two used the /ɪ/ vowel. Three of the Akuapem speakers used /ɛ/ before the m but seven did not. One of the speakers from Fantse also used /e/ to precede the m, but the other nine did not. For the Akuapem speakers, none of them preceded the m with a vowel in the data. With respect to the word *ntɛ*, seven of the Asante speakers used /ɛ/ to precede the n while one used /e/. One of the Akuapem speakers used /ɛ/ to precede the word *ntɛ*. For the Fantse speakers, none of them used any preceding vowel. To ascertain these vowels, their F1 and the F2 values were extracted and used to plot on a grid to locate the quality of such vowels (See Figure 3 for the vowel plot). It must be noted that the individual production of the words, specifically the vowels, were used in the plotting of the vowels.

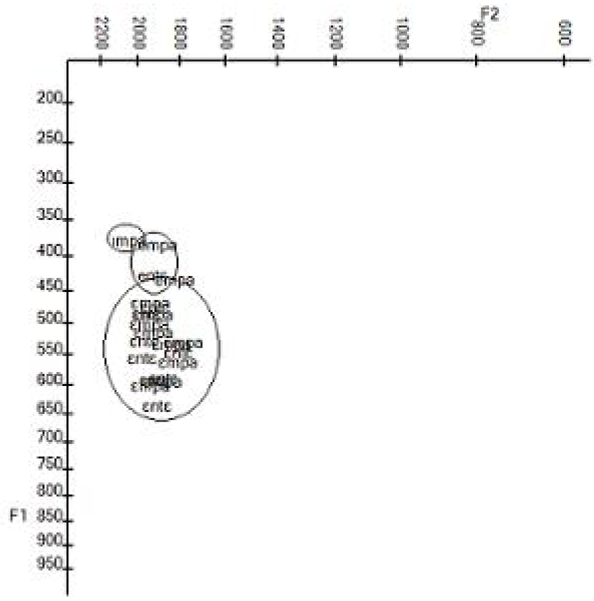

Figure 3. *Ellipse plot of the vowels used to precede the nasals.*

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We can observe from Figure 3 and Figure 4 that the /ɪ/ vowel which was used to precede the nasal in the production of *mpa* is at the top, suggesting that the /ɪ/ vowel is close to the palate of the mouth than the /e/ and /ɛ/. The /ɛ/ vowel which was used by the speakers to precede the words *mpa* and *ntɛ* appear to cluster relatively at the lower section of the plane but the few /e/s which were used also occurred in the middle of the /ɪ/ and /ɛ/ vowels. In these cases, it is possible to suggest that the vowel used to precede the nasals makes the syllable VC than the C syllable type in Akan.

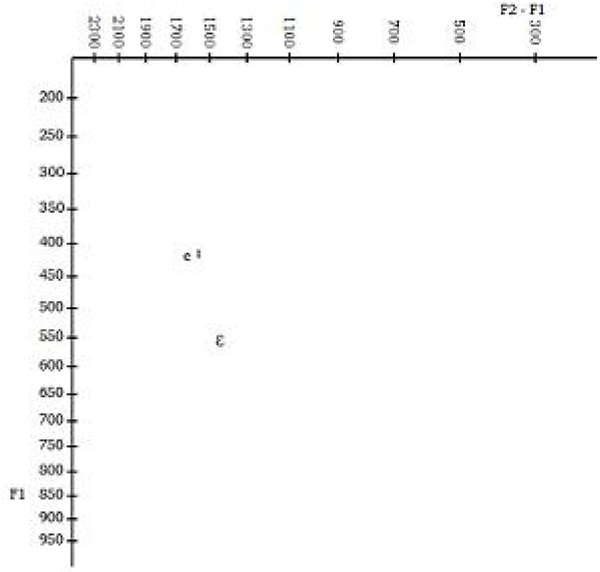


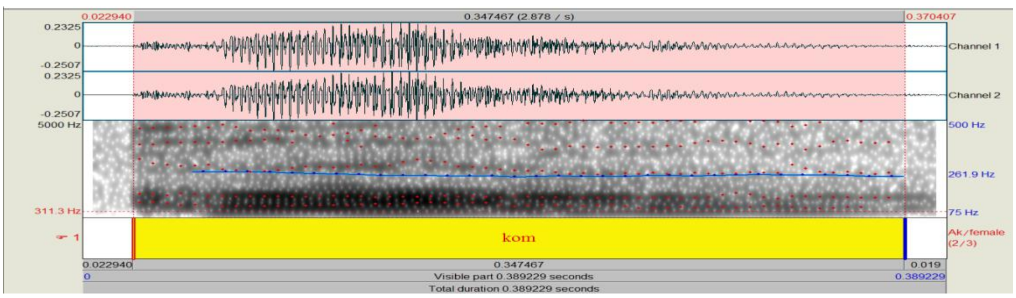
Figure 4. *Average ellipse plot of the vowels used to precede the nasals.*

3.6. CVN Syllable Type

Another focus of this study was the existence of the CVN syllable type in Akan. In trying to investigate its existence in Akan, pause duration and intensity levels were recorded and analysed. To do this, the three words *bam* [bam] 'to embrace', *kɔm* [kɔm] 'to do incantation' and *som* [sʊm] 'to serve/worship' were used. Picture frame of waveform and spectrogram was also used to find out the direction of argument of the CVN syllable.

3.7. Pause Duration of CVN Syllable Type

The study first of all wanted to test for any significant pause duration in the words under study. Unlike earlier figures observed (e.g., see Fig. 2) which shows clearly some pauses in words, the three words *bam*, *kɔm* and *som* did not exhibit any space for pause. Sample 4 shows the waveform and the spectrogram of the word *kɔm* as produced by an Akuapem female speaker of 38 years. It seems clear from the waveform in Sample 4 that there is no mark for pause in the word *kɔm*, especially between [ɔ] and [m].

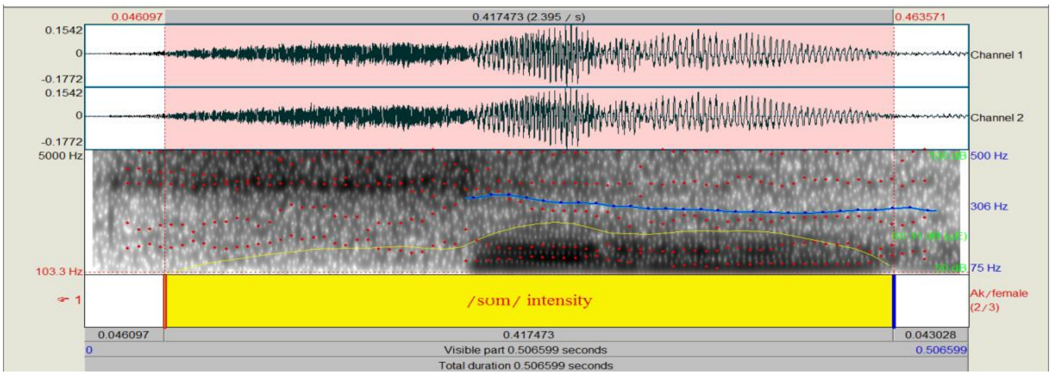


Sample 4. *A waveform (top box) and spectrogram (bottom box) of an Akuapem female speaker saying [kɔm].*

The nucleus of the syllable [kɔm] is the [ɔ] which is preceded by its onset as [k] but the [m] at the end of the word did not show any significant space between it and [ɔ], therefore it could be taken as the coda of the syllable instead of being a separate syllable.

3.8. Intensity of CVN Syllable Type

The intensity contours used by the speakers of the three dialects in pronouncing the words *bam*, *kɔm* and *som* appear to support the argument that the CVN syllable type may exist in Akan as one syllable type and not two. The picture frame below gives clear sample information about how the intensity was used to check pause in the three words for this section of the study.



Sample 5. *A waveform (top box) and in spectrogram (bottom box) of an Akuapem female speaker showing an intensity in yellow thin line of [sʊm].*

Sample 5 displays the waveform and spectrogram of an Akuapem female speaker of 38 years producing the word *som*. The thin yellow line in the spectrogram in the shaded region shows the contours of the energy used in the articulation. The yellow line is conspicuous right from the beginning of the word to the end of the word, and does not show significant fall in energy between the [ʊ] and [m]. The visible line running throughout means that the whole word could be taken as one syllable (CVN) and not two separate syllables. The values in the Table 5 also support the argument of the CVN syllable type in Akan.

Table 5. *Intensity of CVN syllable type in Akan.*

CVN Syllable Type in Akan				
Mean Intensity in dB		bam	kɔm	som
Akuapem	Minimum	69	68	64
	Maximum	72	70	68
Asante Twi	Minimum	65	60	55
	Maximum	67	62	59
Fantse	Minimum	59	58	59
	Maximum	62	61	61
	Difference	3	2	4

Table 5 above gives the minimum and the maximum values of intensity used in the production of the words bam, kɔm and som by the three dialects of Akan. The values speak to the energy used in the production of the words, particularly between the vowels [a], [ɔ], [ʊ] and the nasal [m] of the three words. The minimum-maximum values for the word bam by Akuapem speakers were recorded as 69-72, 65-67 for Asante speakers, and 59-62 for Fantse (all in dB). The mean difference between the minimum and maximum intensities for bam was 3dB. The minimum-maximum intensities for the word kɔm were taken as 68-70dB for Akuapem speakers, 60-62dB for Asante speakers, and 58-61dB for Fantse speakers. The mean difference between the minimum and the maximum intensities was 2dB.

In terms of *som*, the minimum-maximum intensity values were 64-68dB for Akuapem, 55-59dB for Asante Twi, and 59-6dB for Fantse. The mean difference was realized as 4dB. The mean differences of 3, 2 and 4dBs suggest that the fall in energy between the vowels and the nasals at the end of the three words were not fall enough in energy to cause a break and therefore not significant enough to identify the nasal as a separate syllable from the whole (initial) parts of the words; hence the words would be considered as monosyllabic and not disyllabic. Figure 5 below gives a brief view of these differences in terms of bar chart.

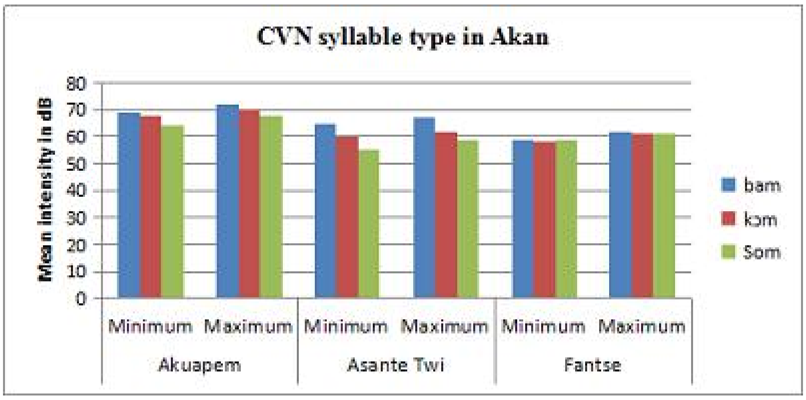


Figure 5. *A bar chart showing mean intensity of CVN syllable type in Akan in dB.*

It can be seen from Figure 5 that the blue bars represent the varied intensities in [bam], the brown bars for [kɔm] and the green ones for [sʊm], by the different dialects. It appears clear to observe from the bar chart that the tallest bar is the blue bar in the region of Akuapem whereas the shortest is the green bar in Asante Twi region. Within a particular dialect, the same colours of bars (short and long) can sharply be contrasted to know how the higher energy fall to the lower energy. Although some differences exist, they are not strong enough to cause any significant break between the CV and the N to call the words as two syllabic words.

4. Conclusion

In this study, I examined Ç and CVN. The result showed that on Ç syllabic structure (where Ç is always a nasal consonant), pause duration and intensity measurement identified it to exist at word-initial and not final. In most cases, it is seen as a nasal consonant at word-initial. It constitutes a syllable alone and more importantly contains pitch which makes it sonorous. Even at the word initial, it is controversial since some speaker realized the Ç as VN by some Akan speakers in a natural set-up instead of reading. This does not validate the fact that the Ç does not exist in Akan. The existence of Ç also confirms [13], [4,3,2,1], [22], [7,6,5], [21], and others' claim.

The study also examined CVN, which is actually CVC syllable separately. The 'N' in CVN is a nasal consonant. In our case, I chose only bilabial nasals so that I could use them for all the three main Akan (Akuapem, Asante Twi and Fantse) dialects. The intention was to use pause duration guided by chest pulse theory. The result suggested that the CVN could be considered a syllable type in Akan unlike some claims in the literature (for example, [13]). The claim that CVN is not two syllabic word probably stems from the fact that in words like wiram the nasal at the end constitutes a syllable of its own because there is vowel deletion at the end (wira + mu). However, it should be noted that there are certain words in Akan which originally exist without merging or vowel deletion, for instance *som*, *kom* and *bam*. These words do not mostly show any vowel deletion or addition of vowels—separation of the nasal makes it impossible. Besides, the issue of arguing that the final nasal vowels of such words bring about change in meaning should not equate syllable to meaning-making unit, as already indicated. Of course, the first side of argument that CVN syllable does not exist might contain some substance, but such arguments should not fail to also consider the other line of argument as espoused in this current study.

As seen in the study, there was no significant pause duration between the V and the N. Due to that; we cannot conclude that they are separate syllables but just one. The intensity also confirmed the pause duration measurement. There was no significant fall in terms of energy between the V and N. The result indicates that CVN is one syllable and so the N at the word final cannot be syllabic as claimed by [13], which is supported by [4,2,1], [22], [7,6,5], and [21].

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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