

**ON THE PHONOLOGICAL STRUCTURE OF ESAHIE COMPOUNDS:
TONAL AND SEGMENTAL CHANGES**

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&
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Abstract

Compounding, the process which combines two or more lexemes to form a new lexeme, is a common strategy cross-linguistically for increasing word stocks. This process may trigger several changes in the output form, including phonological changes, both segmental and suprasegmental changes. This paper examines two phonological features of compound formation in Esahie (ISO 639-3: sfw), a Niger-Congo\Kwa language spoken in parts of Ghana and Cote d'Ivoire. We discuss the tonal structure of compounds, compared to those of their individual constituents, as well as changes in segmental & syllabic structure, including deletion and consonant mutation. Based on data purposively drawn from a variety of sources, this study provides evidence for the observation that, although compounding is a morphological process, there is usually an intricate interface between the morphology and the phonology as evidenced by the phonological properties of the input and output of the compounding process. Focusing on tone, this paper identifies some form of uniformity in the tonal output of compounds where, regardless of the tonal pattern of the compound constituents, the compounds bear a predictable Low-High output tonal melody, showing that Esahie compound tonal melody may be a constructional property. We discuss the tonal processes that yield the output tone of the compounds, employing formalism from Autosegmental Phonology. We further show that non-tonal changes like deletion and consonant mutation occur in the computation of the output form of Esahie compounds.

Keywords: Compounding, deletion, Esahie, mutation, OCP, tone

1. Introduction

The purpose of this paper is to discuss phonological changes that occur when compounds such as those in (1) are formed in Esahie, a Niger-Congo\Kwa language spoken in the Western North Region of Ghana and parts of Cote d'Ivoire.³ In equation (1), C₁ and C₂ represent the first and second constituents, respectively. We will, at various points in the paper, replace “C” with categorial labels of constituents like N for nouns, so we would have N₁ instead of C₁.

(1)	C ₁		C ₂		Compound word
a.	<i>mó</i>	‘madam’	<i>bráá</i>	‘woman’	<i>mòòbrá</i> ‘elderly woman’
b.	<i>búá</i>	‘pot’	<i>bùé</i>	‘half’	<i>bùàbúé</i> ‘broken pot’

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³ Esahie is alternatively referred to as Sehwi/Sefwi (ISO 639-3: sfw)

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c.	<i>̀̀z`a`a`</i> ‘wine’	<i>f`u`f`u`e`</i> ‘white’	<i>̀̀z`a`a`f`u`e`</i> ‘palm wine’
d.	<i>kr`a`ta`a`a`</i> ‘paper’	<i>p`u`e`</i> ‘open’	<i>kr`a`ta`a`p`u`e`</i> ‘page’
e.	<i>a`l`i`e`</i> ‘food’	<i>̀̀v`u`i`n`</i> ‘dead’	<i>a`l`i`e`n`v`u`i`n`</i> ‘rotten food’

Compounding brings together two or more lexemes to form a new lexeme in which the features of the constituents may or may not be retained, and the process is noted to be prevalent in the languages of the world as a strategy for growing the stock of words of relevant languages. Dressler (2006:16) affirms this when he writes that “compounds are present in all languages of the world”, with Aikhenvald (2007:24), corroborating it with the observation that compounding is found in languages of any type, but it is dominant in isolating languages. However, Štekauer, Valera, and Körtvélyessy (2012) report of the absence of compounds in some languages such as *West Greenlandic* (Eskimo-Aleut, North America/Greenland), *Diola Fogny* (Niger-Congo, Gambia/Senegal), *Kwakw'ala* (Wakashan, North America) and *Karao* (Austronesian, SE Asia/Oceania).

Various aspects of compounding have received extensive research attention, including the definition, classification, and nature of the constituents, approaches to reckoning the meaning of compounds, and headedness (Appah, 2017b, 2019a, 2019b; Appah & Ansah, 2020; Appah, Duah, & Kambon, 2017; Bauer, 2008, 2009; Bisetto & Scalise, 2005; Fabb, 1998; Fábregas & Scalise, 2012; Lawer & Appah, 2020; Scalise & Fábregas, 2010; Scalise & Vogel, 2010). For example, it has been observed that identifying the meaning of compounds can be a complex endeavor requiring information from individual constituents, their combined meaning, and sometimes extra-linguistic contextual information (cf. Bauer, 1979; Gagné, Marchak, & Spalding, 2010; Spencer, 2011).

Regarding headedness, it is noted that a compound may have a syntactic and/or semantic head, and the two may not be co-extensive. The syntactic head is a constituent that shares syntactic properties with the whole compound. Thus, the compound characteristically has the same syntactic category and distribution as the syntactic head does. On the other hand, the semantic head shares lexical conceptual information with the whole compound, so that the compound is typically a subtype of the semantic head. For example, *fish bone* is a type of *bone*, which is the semantic head (Appah, 2013a; Katamba & Stonham, 2006; Scalise, 1988; Scalise & Fábregas, 2010; Scalise & Guevara, 2006). At the syntactic level, virtually every compound may be regarded as headed, such that in almost every compound we can find a syntactic head and a dependent, but the same cannot be said for the semantic head. In other words, a compound may not have a semantic head. Hence, the meaning of a compound may not be directly related to the meaning of its constituents. For example, Dressler (2006) observed that in the compound *pickpocket*, the syntactic head is the verb *pick* and it takes *pocket* as its complement. However, the compound cannot be said to have a semantic head, because it is not a subtype of either constituent. Headedness is used to distinguish between two kinds of compounds, namely endocentric and exocentric compounds (Appah, 2016b, 2017a, 2019b; Appah et al., 2017; Bauer, 2008; Dressler, 2006; Scalise & Fábregas, 2010; Scalise & Guevara, 2006). An endocentric compound is headed by one of the constituents from which it takes meaning, so that an endocentric compound will be a subtype of its head constituent. For example, *blackboard* is a type of *board*. It has been argued that in an endocentric compound, the semantic and syntactic heads coincide (Scalise & Guevara, 2006). Other compounds such as *hotdog* and *pickpocket* are exocentric because *hotdog*, for instance, is neither a type of *dog* nor *hot*.

Thus, unlike endocentric compounds, the meaning of exocentric compounds cannot be deduced from the meanings of their constituents, and where both semantic and syntactic heads occur in an exocentric compound, they do not coincide (Scalise & Guevara, 2006). Compounds tend to be binary-branching with the immediate constituents coming from the same part of speech, such as *teapot*, which contains the two nouns *tea* and *pot*, or from different parts of speech, such as *blackboard* composed of the adjective *black* and the noun *board* (Appah, 2013a, 2015; Booij, 2012). Thus, compounds in a language may be grouped based on the syntactic categories of their constituents. Akan, for instance, is said to have six binary-branching compounds: noun-noun, verb-verb, verb-noun, noun-verb, noun-adjective, and adjective-noun compounds (Abakah, 2004, 2006a, 2006b; Dolphyne, 1988; Marfo, 2004a, 2004b). However, the existence of adjective-noun compounds in Akan has been questioned (cf. Appah, 2013a, 2013b).

The phonology of these compounds is interesting. For instance, the literature on tone behavior in compounds shows tonal processes, such as tone deletion and spreading at play, in deriving output tones (Abakah, 2004; Dolphyne, 1988; Fedden, 2006; Marfo, 2004a; Rodriguez & Clemens, 2020). In the Papuan language *Skou* (Donohue, 2004), the tones of one root are deleted, and the melody of the other root spreads over the entire compound word. Writing on Mian noun-noun compounds, Fedden (2006:1) reports that “in some compounds the tonal melodies of both roots are preserved in linear order and form a composite tone pattern which is created by a process that looks like tone shunting, set off by the language-specific constraint NOCONTOUR which outlawed tonal contours on non-final syllables.” In this process, tones are neither copied nor deleted, nor are their linear order altered. In his analysis of Akan compounds, Abakah (2004) observed that all the compounds had a final H(igh) tone. For noun-noun compounds, he reports that the L(ow) tone of the first element spreads through the rightmost boundary to H, while the lexical H melody of C₂ remains unaffected at the phonetic surface, resulting in an LH output. For verb-noun compounds, he explains that the verbs are all realized on an L tone and the nouns on H tones, resulting in an LH output. Abakah employs phonological rules such as L tone spread, vowel simplification, post-sonorant vowel deletion, L tone insertion, and the Obligatory Contour Principle (OCP),⁴ with rules ordered differently to account for the tonal changes observed in Akan compounds. Nkoroo, Akinlabi, Connell, and Obikudo (2009) observed that compounds have fixed HL tone patterns, except where the noun is L-toned, in which case the entire compound is L. Notwithstanding the processes that the input may go through, they noticed that the result of each process is always the same – a fixed output pattern where the HL output tone is realized, regardless of the input tone structure, much like what is obtained in Esahie compounds, as discussed below.

It is clear from the foregoing that compounding has received considerable cross-linguistic attention. Yet, it is relatively understudied in Esahie, as extant studies are only a handful (cf. Boateng, 2017; Broohm, 2019; Broohm & Melloni, 2020; Owusu Ansah, 2019). Most of these studies focus primarily on morphological issues, although some attention is paid to phonological issues inherent in the compounding process. For example, Boateng (2017) observed that, like most languages, Esahie forms compounds from noun+noun, noun+adjective, and noun+verb constituents. Broohm (2019) also studied both the semantic and structural properties of various kinds of compounds in Esahie, comparing them with other African and Indo-European languages, in the interest of cross-linguistic typologization.

⁴ OCP is the regulatory principle which forbids identical autosegments following each other (Leben, 1973).

Like Akan, his studies reveal that compounding in Esahie is predominantly a nominalization strategy. Broohm and Melloni (2020) focused on tones. They showed in their study of Action Nominals (ANs) in Esahie that derived nominals in Esahie have a final H tone. They further observed that tone, and specifically tone raising, is a constant derivational means of forming ANs across various Kwa languages.

Despite these efforts, many issues remain to be addressed, especially regarding the phonology of Esahie compounds. However, the prosodic changes that occur during the compounding process remain largely unexplored. Against this background, the present study attempts to account for the phonological changes observed in compounding in Esahie, focusing on two principal phonological features – the tonal structure of compounds, compared to those of their individual constituents when they occur in isolation, and segmental changes observed in compound formation, including segment and syllable deletion, as well as consonant mutation.

Based on purposively drawn data from different sources, including the Esahie translation of the New Testament of the Holy Bible and other literature written in Esahie, whose form and pronunciation were crosschecked for native speaker acceptability, this study shows the interplay of morphology and phonology. That is, although compounding is a morphological process, phonological information is indispensable for understanding how compound words are realized by speakers of the language.

Starting with tone, our data provide evidence of “tonal conspiracy” (Akinlabi et al., 2009: 1) in the realization of the output tone of Esahie compounds. That is, apart from verb-verb compounds, Esahie compounds exhibit a uniform output tonal pattern with a consistent LH tonal melody, regardless of the input tones, so that constituents with different tonal patterns yield the same output tonal melody in the compound. Thus, tonal melody seems to be a constructional property of the compound per se, as is the case for some nominal constructions in languages such as Nkoroo (Akinlabi et al., 2009), Kalabari (Harry & Hyman, 2012) and Akan (Appah et al., 2017). The tonal processes that yield output tones are discussed using formalism from Autosegmental Phonology (Goldsmith, 1976, 1990; Kenstowicz & Kisseberth, 2014) which allows us to account for the observed changes in tonal patterns with autonomous segmental and suprasegmental tiers. We accounted for the output tones by means of three phonological processes: L-tone spread, L-tone insertion, H-tone deletion, and OCP. The order of application of these rules may vary depending on the input tone; however, they consistently yield the expected LH output tonal melody for compounds. Regarding other phonological changes – segment/syllable deletion and consonant mutation—we observe that either a final vowel of the first constituent or an initial vowel or consonant of the second constituent is deleted in response to the restriction on vowel sequencing across word boundaries in the language. Closely related to this is the deletion of an entire syllable from either the first or second constituent in the output. Finally, we deal with consonant mutations that are prominent in Esahie (Boateng, 2017; Owusu Ansah, 2019). We observed both full and partial mutations, including cases in which a voiceless consonant occurs intervocalically or after a nasal sound becomes voiced in response to the phonological environment.

In section 2, we focus on the nature of the compounds in Esahie and attempt to explain their morphological structure. In anticipation of the discussion of the output tone of compounds, we present data on the varied tonal melodies of the word classes that form compounds in Esahie: nouns, verbs, and adjectives. Section 3 deals with the tonal structure

(C₂), with the first element (C₁) functioning as a modifier. Thus, these compounds are classified as C₂. For example, èbòtèbòén ‘rat hole’ in (11a) is a type of *bòen* ‘hole’ not *ebote*. All other examples in (11) are right-headed with compounds that share hyponymous relationships with C₂.

(11)	C ₁		C ₂		Compound word	
a.	<i>èbòté</i>	‘rat’	<i>bòén</i>	‘hole’	<i>èbòtèbòén</i>	‘rat hole’
b.	<i>àtèià mí</i>	‘linguist’	<i>pòmá</i>	‘staff’	<i>àtèiàmpòmá</i>	‘linguist staff’
c.	<i>jà míé</i>	‘god’	<i>nzùé</i>	‘water’	<i>jà mízùé</i>	‘rainwater’
d.	<i>mó</i>	‘madam’	<i>bráá</i>	‘woman’	<i>mòðbrá</i>	‘elderly woman’
e.	<i>kyìrèmvùá</i>	‘egg’	<i>èbòén</i>	‘outer cover’	<i>kyìrèmvùàbòén</i>	‘egg shell’
f.	<i>sànzámé</i>	‘promiscuity’	<i>brá</i>	‘life’	<i>sànzàmbrá</i>	‘aimless life’

2.2.2 Noun-Adjective compounds

Esahie compounds formed from non-adjective constituents tend to exhibit interesting properties. Similar to Akan noun-adjective compounds (cf. Appah, 2016a), the noun constituents in these compounds are usually simplex words. They include *sunzume* ‘ghost’, *nzue* ‘water’ and *nzaa* ‘wine.’ The adjectives were equally simple and semantically varied. They include adjectives of size, color, shape, quality, etc. as in *píri* ‘big’, *Kaaba* ‘small/young’, *bòne* ‘bad’, *fèè* ‘sweet/nice’, etc. See the data in Eq.(12).

(12)	C ₁		C ₂		Compound word	
a.	<i>nzáá</i>	‘wine’	<i>fúfúé</i>	‘white’	<i>nzàáfúé</i>	‘palm wine’
b.	<i>nzùèyílí</i>	‘flood’	<i>píri</i>	‘big’	<i>nzùèyilípíri</i>	‘great flood/deluge’
c.	<i>sùnzùmé</i>	‘ghost’	<i>bòní</i>	‘bad’	<i>sùnzùmmòní</i>	‘bad spirit’
d.	<i>nzùé</i>	‘water’	<i>píri</i>	‘big’	<i>àsùèpíri</i>	‘big river’
e.	<i>búá</i>	‘pot’	<i>bùé</i>	‘half’	<i>bùàbúé</i>	‘shard’
f.	<i>mvrà má</i>	‘air’	<i>fèé</i>	‘sweet/nice’	<i>mvrà mǎfèé</i>	‘fresh air’
g.	<i>dàdèé</i>	‘metal’	<i>kààbá</i>	‘small/young’	<i>dàdèèbá</i>	‘knife’

The relation between nouns and adjectives in this dataset is of the modification type, where the adjective provides extra information about the noun. In (12a), for instance, the adjective *fufue* ‘white’ is an attributive modifier to the noun *nzaa* ‘wine’. Similarly, in *nzueyipiri* ‘deluge’ in (12b), the adjective *píri* ‘big’ is a modifier to *nzueyili* ‘flood,’ attributing a property to the referent of the noun constituent. The adjective, therefore, helps to delineate the referent of the noun from other nouns of the same type by assigning to them some unique/identifying characteristic or quality.

2.2.3. Noun-Verb compounds

Esahie has a class of compounds formed from nouns and verbs in that order, as shown in (13): Except for *nvuin* in example (13b), which is stative, the verbs in the data are all dynamic and are a mixture of transitive and intransitive verbs.

adjective compounds (12), noun-verb compounds (13), and verb-verb compounds (14). Although the constituents may belong to different syntactic categories, the output compound is always a noun. This confirms Broohm's (2019) observation that compound words in Esahie are invariably nominal, notwithstanding the syntactic category of the constituent, a phenomenon also observed in Akan (Appah, 2015, 2017b). In terms of headedness, we noticed that some of the compounds were exocentric, with the compound not being a type of either constituent, while others were endocentric, with one of the constituents being the head of which the whole compound is a subtype, so that the meaning of the compound comes compositionally from the constituents. Finally, a careful examination of the compounds revealed some phonological changes in the compound compared to the individual constituents in isolation. This is the focus of this study, and we turn to it in the next two sections.

3. Tonal changes in Esahie compounds

Several phonological changes occur when complex words are formed. For example, in Akan (Abakah, 2006b; Appah, 2003; Dolphyne, 1988; Marfo, 2004b) and Lete (Akrofi-Ansah, 2012) phonological changes such as deletions and tonal alternations have been identified to occur within compounds. For instance, Marfo (2004a) observed that the application of phrasal rules in Akan compound formation is triggered by phonological contexts. He explains that in the construction of Noun-Noun and Noun-Adjective compounds, rules such as H-deletion, Prefix deletion, Diphthong simplification, H-insertion, and boundary assimilation apply. Abakah (2004) also observed L-tone spread and H-tone delinking in Akan compound formation. For Nkoroo, Akinlabi et al. (2009) studied compounds with different tonal inputs and observed a phenomenon in which all tonal outputs of compounds take one form, HL. Abiodun (2000) mentions phonological changes such as deletion of final vowels, nasalization, de-nasalization, assimilation across segments, and realignment of tone in some dialects of Yoruba.

Clearly, tone plays a crucial role in many languages, signalling both grammatical and lexical functions (Akanlig-Pare, 2005, 2007; Dolphyne, 1988; Kügler, 2016; Marfo, 2005; Schwarz, 2003). Broohm and Melloni (2020) also observed that tone is employed to nominalize verbs in Esahie. In the process, they notice a leftward assimilation in anticipation of H-tone raising, much like what is observed in compounds. These examples confirm the interplay between phonology and morphology in compound formation. In this section, we discuss the tonal changes that occur in Esahie compounds. The tonal analysis is couched in Autosegmental Phonology. In autosegmental phonology, two similar tones associated with two tone-bearing units are realized as one tone. Thus, an L(L) tone is the same as an L tone, and an H(H) tone is the same as an H tone. Additionally, in the tonal tier, one tone can be associated with many tone-bearing units. To clarify our discussion, we organized this section around the word classes of the constituents.

3.1 Tonal structure of Noun–Noun (N-N) compounds

The first group is composed of compounds with two noun constituents, N – N-N compounds. In example (15), the tonal melody of the first constituent (N₁) is L(L) and the tone of the second constituent (N₂) is H(H). Among these compounds, the constituents seem to retain

their underlying tonal melodies in the compounds, where the input L-tone of N₁ and the H-tone of N₂ are preserved in the output, yielding an LH output tonal melody.

(15)	L(L)		+	H(H)		Compound word
a.	<i>bùà</i>	‘waterpot’	+	<i>nóá</i>	‘mouth’	<i>bùànoá</i> ‘rim of a waterpot’
b.	<i>àsàà</i>	‘mud’	+	<i>súá</i>	‘room’	<i>àsààsúá</i> ‘mud house’
c.	<i>teìrè</i>	‘write’	+	<i>dúá</i>	‘stick’	<i>teìrèdúá</i> ‘pen’
d.	<i>bèà</i>	‘man’	+	<i>páén</i>	‘elder’	<i>bèàpáén</i> ‘an elderly man’

In compounds in which N₁ has a LH tonal melody and N₂ has H-tone throughout, giving an LH+H input, as in example (16), the output tonal melody is LH.

(16)	LH		+	H(H)		Compound word
a.	<i>tìré</i>	‘head’	+	<i>jàá</i>	‘hair’	<i>tìrèjàá</i> ‘hair’
b.	<i>jàmié</i>	‘god’	+	<i>píri</i>	‘big’	<i>jàmièpíri</i> ‘God/Supreme deity’
c.	<i>màkó</i>	‘pepper’	+	<i>jàá</i>	‘leaf’	<i>màkòjàá</i> ‘pepper leaf’
d.	<i>kàká</i>	‘animal’	+	<i>fúín</i>	‘corpse’	<i>kàkáfúín</i> ‘carcass’

To account for the output melody of the compounds in (16), we may assume that the L tone of N₁ spreads rightward to displace the final H of N₁ which becomes L. Because N₂ is already H, it does not undergo any change, and hence, the LH output. This is presented in Figure 1, using Autosegmental Phonology formalism.

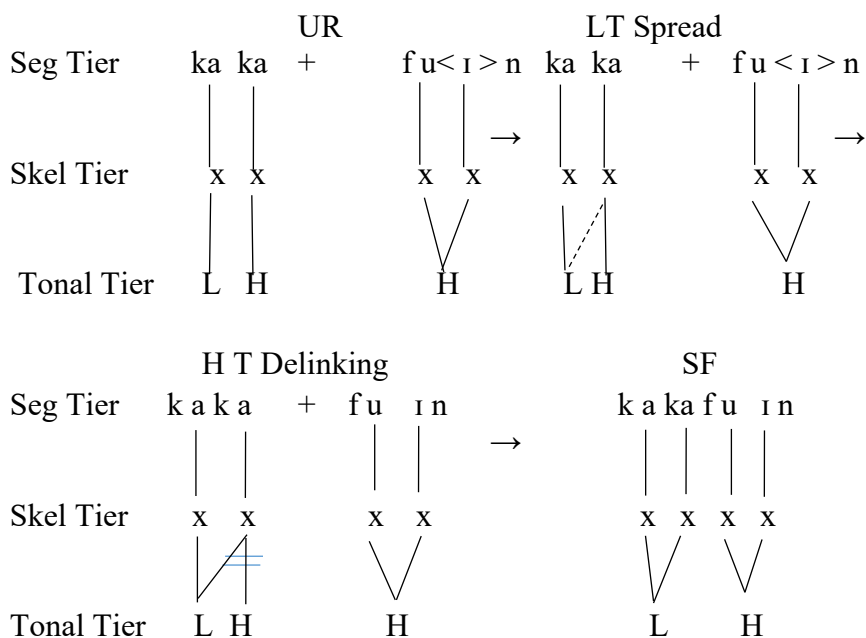


Figure 1: Tonal processes in noun-noun compounds with LH – H(H) melody

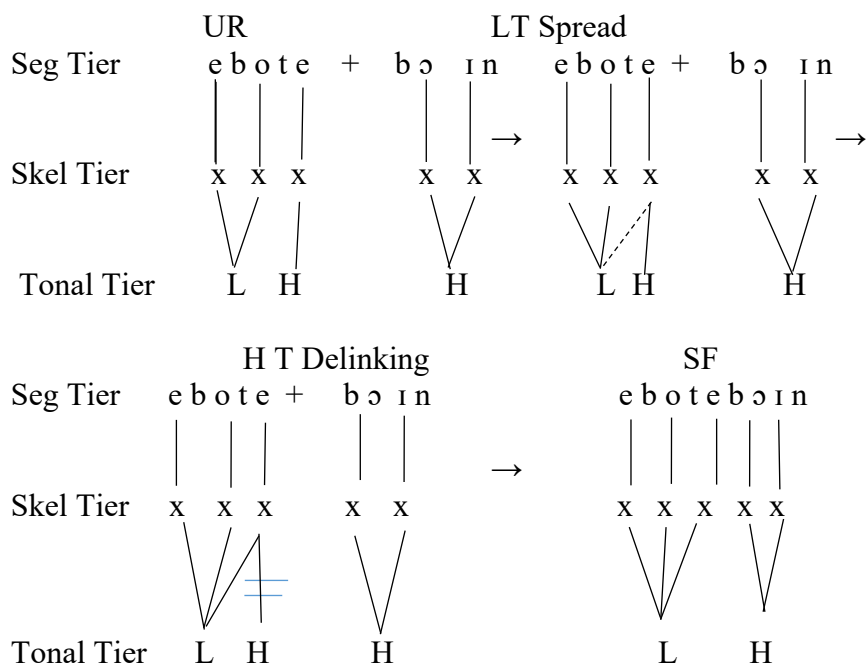


Figure 2: Tonal processes in Noun-Noun Compounds with underlying LH-LH melody

Finally, to show that the LH tonal melody, and particularly the final H of N-N compounds, might not be dependent on the presence of an H tone in the compound constituents, we provide a class of compounds that terminate in H-tone, although their second constituents bear an L-tone. As in example (19) above, the data we collected did not contain many naturally occurring compounds. Thus, we constructed examples (20c-k) based on the L-tone nouns in (2) and tested their acceptability with native speakers. While some respondents questioned the existence of some of the words in the language, they all recognized them as potential Esahie words, and their pronunciation was consistent with what our analysis predicted.

(20) C ₁		+	C ₂		Compound word
a. <i>sùà</i>	‘house’	+	<i>àsàà</i>	‘mud’	<i>sùàsáá</i> ‘mud house’
b. <i>nyàmèè</i>	‘god’	+	<i>tòà</i>	‘penis’	<i>nyàmètóá</i> ‘huge penis’
c. <i>Sèfwí</i>	‘Sefwi	+	<i>nàmùè</i>	‘village’	<i>Sèfwìnàmúé</i> ‘Sefwi village’
d. <i>nyàmèè</i>	‘god’	+	<i>bòèn</i>	‘sheep’	<i>nyàmèbóén</i> ‘huge sheep’
e. <i>nyàmèè</i>	‘god’	+	<i>bùà</i>	‘waterpod’	<i>nyàmèbúá</i> ‘huge waterpod’
f. <i>bòèn</i>	‘sheep’	+	<i>gròn</i>	‘nine’	<i>bòèngròn</i> ‘ninth sheep’
g. <i>ɔ̀hìní</i>	‘chief’	+	<i>yèè</i>	‘wife’	<i>ɔ̀hìnyéé</i> ‘wife of a chief’
h. <i>nìpá</i>	‘human’	+	<i>̀nzòì</i>	‘ashes’	<i>nìpà̀nzóí</i> ‘human ashes’
i. <i>à̀nà̀dwò</i>	‘evening’	+	<i>srà̀èn</i>	‘moon’	<i>à̀nà̀dwòsrà̀én</i> ‘evening moon’
j. <i>brò̀ní</i>	‘whiteman	+	<i>tà̀à</i>	‘tobacco’	<i>à̀brò̀fotáá</i> ‘whiteman’s tobacco’
k. <i>Ghana</i>	‘Ghana’	+	<i>̀ngù̀rùmà̀à</i>	‘okro’	<i>Ghà̀nà̀ngù̀rùmáá</i> ‘Ghana okro’

Among these compounds, we observed that the N₂ constituents were LL, but the output was still LH. Thus, we assumed that the derivation involves three processes: H-tone insertion, H-

tone spread, and L-tone deletion. In (20a), there is first an H-tone insertion associated with the L-tone of N₂, yielding an HL tonal melody. L-tone was subsequently deleted. Because the tone of N₁ is L, the compound surfaces are LH surfaces. For (20b), *nyàmètóá* ‘huge penis,’ the input tones are LH and LL. Therefore, the derivation process did not involve tonal insertion. Rather, the final H-tone of N₁ spread to the L-tone of N₂. The L-tone was subsequently delinked, leaving the output with an LH melody. An Autosegmental representation of the derivation of (20a) is shown in Fig. 3.

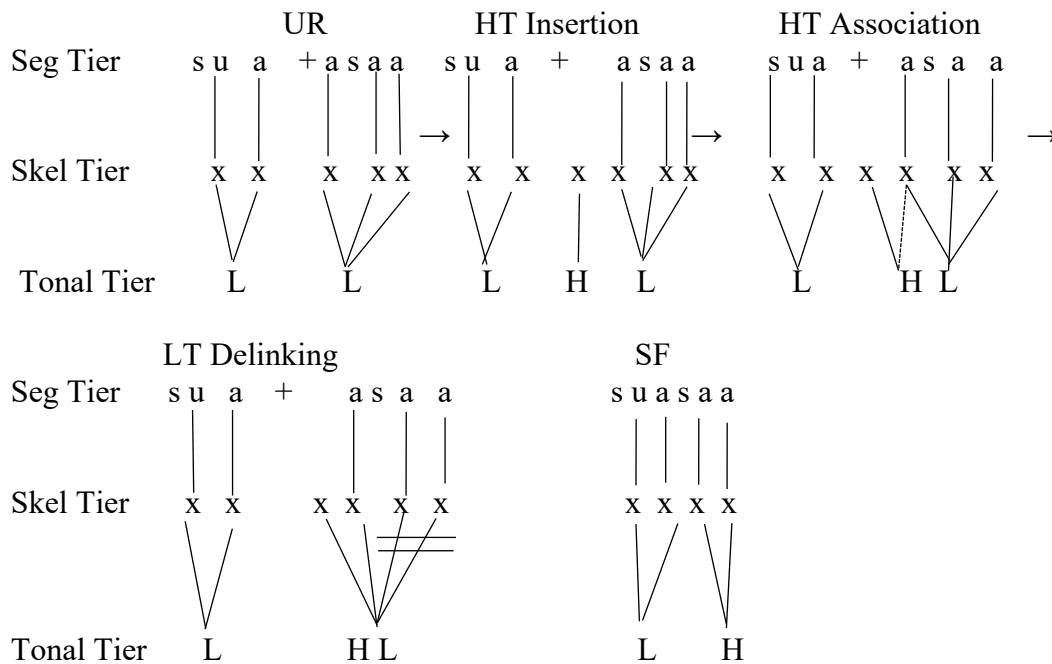


Figure 3: Noun-Noun Compounds with L-tone second constituent

3.2 Tonal structure of Noun-Verb compounds

We now turn our attention to noun-verb (N-V) compounds. Similar to N-N compounds, we consider pairings of nouns with verbs from different tonal groups and attempt to account for their output tonal melodies. The two sets of data in (21) and (22) display similar processes, differing only slightly.

(21)	LH	+	H	Compound word
a.	<i>àmán</i> ‘country’	+	<i>yé</i> ‘do’	<i>àmàńó</i> ‘politics’
b.	<i>èní</i> ‘eye’	+	<i>ǵí</i> ‘get’	<i>èníńǵí</i> ‘happiness’
c.	<i>ńàmié</i> ‘god’	+	<i>sóm</i> ‘worship’	<i>ńàmizóm</i> ‘religion’
d.	<i>kràtáá</i> ‘book’	+	<i>púé</i> ‘open’	<i>kràtààpúé</i> ‘page’
(22)	LH	+	LH	Compound word
a.	<i>ńzúé</i> ‘water’	+	<i>yílí</i> ‘flow’	<i>ńzùèyílí</i> ‘flood’
b.	<i>àsíé</i> ‘under’	+	<i>wòzó</i> ‘shake’	<i>àsìèwòzó</i> ‘earthquake’
c.	<i>àlíé</i> ‘food’	+	<i>ńvúín</i> ‘spoil’	<i>àlièńvúí</i> ‘rotten food’
d.	<i>sikáá</i> ‘money’	+	<i>ńèbòróé</i> ‘love’	<i>sikààńèbòróé</i> ‘lover of money’

To account for the derivation of the examples in (21), we assume that the L-tone of LH C₁ spreads rightward, dislodging the H-tone of C₁ and yielding LH(H) melody, which then becomes LH by OCP.⁵ Similarly, in Example (22), the tonal spread emanates from the L-tone of C₁. Both constituents are LH so the C₁ changes its tonal pattern to LL following the rightward spread of the L of the C₁. This yields an LLH output tone pattern that becomes LH in compliance with OCP.

The foregoing shows that even when the constituents have different syntactic categories with different tonal patterns, the output tonal melody of the compound remains the same; it still yields an LH output, confirming the observation that Esahie compounds have an invariable LH output tonal melody.

3.3 Tonal structure of Noun-Adjective compounds

We now look at compounds with noun and adjective constituents in that order, as exemplified by (23).

(23) LH			LH/HH		Compound Word
a. <i>s̀̀nz̀̀umé</i>	‘ghost’	+	<i>b̀̀ǹ̀ní</i>	‘bad’	<i>s̀̀nz̀̀umm̀̀ǹ̀ní</i> ‘bad spirit’
b. <i>̀̀nz̀̀áá</i>	‘wine’	+	<i>f̀̀ííúé</i>	‘white’	<i>̀̀nz̀̀ààf̀̀úé</i> ‘palmwine’
c. <i>̀̀nz̀̀úé</i>	‘water’	+	<i>b̀̀ǹ̀ní</i>	‘bad’	<i>̀̀nz̀̀ùb̀̀ǹ̀ní</i> ‘destructive rain’
d. <i>̀̀nj̀̀vr̀̀àmá</i>	‘air’	+	<i>f̀̀éé</i>	‘sweet/nice’	<i>̀̀nj̀̀vr̀̀àmàf̀̀é</i> ‘fresh air’
e. <i>̀̀èd̀̀wíré</i>	‘words’	+	<i>f̀̀éé</i>	‘sweet’	<i>̀̀èd̀̀wíréf̀̀éé</i> ‘sweettalks’

The first thing we notice about these compounds is that, like the other compounds discussed so far, the tonal pattern of the constituents varies. However, different tonal melodies in the inputs yield the same tonal melody in the output. In terms of specifics, we observe that when both constituents have an LH melody, the output remains LH, as shown in (23a-c). Therefore, we assume that derivation involves two processes: tone spread and tone deletion. First, there is a L-tone spread where the L of C₂ spreads leftwards to the H of C₁. The H-tone of C₁ is delinked, resulting in an LLH output that is simplified to an LH output by the OCP. For example (23d-e), we postulate that the L-tone of C₁ spreads rightward to displace the final H of C₁ to become L. Since C₂ is already H, it does not undergo any further tonal alteration; hence, the LH output of noun-adjective compounds, as illustrated in Figure 4 below, is similar to the tonal output of noun-noun compounds, as discussed above.

⁵ An alternate account may assume that C₂, being the head, should control the compound. Therefore, C₂ spreads its tone onto C₁. For this alternative, we must postulate a L-tone insertion. That is, since C₂ bears H-tone only, a L-tone is inserted between C₁ and C₂. The inserted L-tone spreads leftward to the H tone of C₁, much like the intervening floating L-tone spread proposed for verb compounds in Akan (Abakah, 2004, 2010). The L-tone is associated with the H-tone of C₂ to become LH. After that, the H-tone is delinked to realize the output as LLH which subsequently becomes LH in compliance with the OCP. This process ensures that the compound is in conformity with the tonal requirement for compounds in the language where the final output is always a LH. This alternative is more complicated. Again, developing the underpinning assumption of a phonology-syntax interface is somewhat beyond the scope of this paper. We therefore do not pursue this alternative further in this paper.

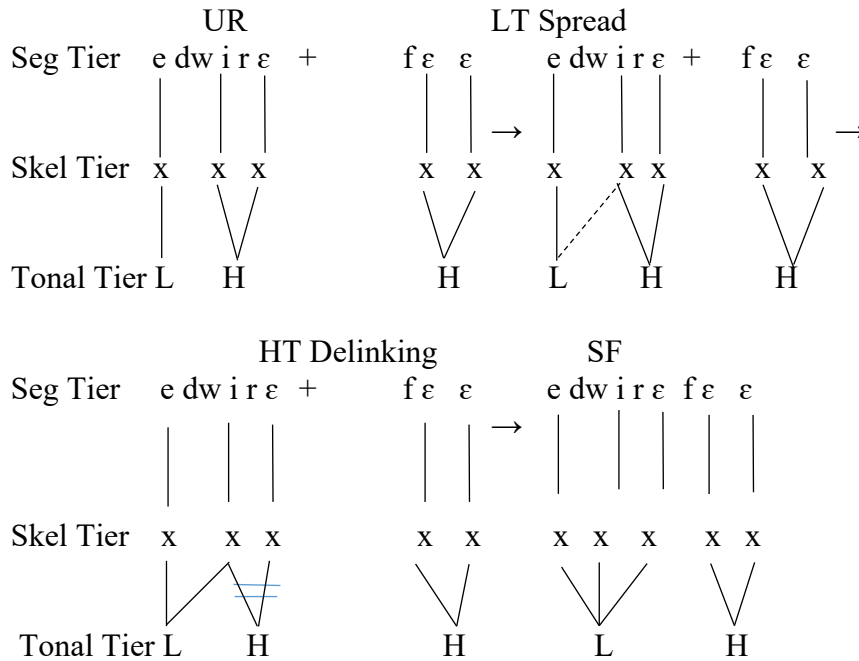


Figure 4: Noun-Adjective Compound

3.4 Verb-Verb compounds

The next class of compounds to be discussed is those whose constituents are both verbs, as exemplified in (24). As noted above, these compounds are few in language and are certainly borrowed from Akan.

(24)	H		+	H		Compound word
a.	<i>dzi</i>	‘get’	+	<i>di</i>	‘eat’	<i>dzidié</i> ‘faith’
b.	<i>fá</i>	‘take’	+	<i>teé</i>	‘to gift’	<i>fáteé</i> ‘forgive’
c.	<i>té</i>	‘feel’	+	<i>má</i>	‘give’	<i>témá</i> ‘fellow feeling’
d.	<i>dá</i>	‘to sleep’	+	<i>dwén</i>	‘to think’	<i>dádwén</i> ‘burden’
e.	<i>sú</i>	‘to cry’	+	<i>fré</i>	‘to call’	<i>súfré</i> ‘plea’
f.	<i>dí</i>	‘to eat’	+	<i>má</i>	‘to give’	<i>dímá</i> ‘advocacy/advocate’

the V-V compounds behaved differently from the other compounds discussed above. These compounds also have H-tones in both the constituents and the output. As both constituents have the same tone value, no tonal process occurs here. Thus, contrary to the earlier claim that compounds in Esahie have a uniform LH output melody regardless of the input tone, we observe that the tonal melodies of the inputs of V-V compounds are preserved in the output form.

The observed tonal nonconformity of V-V compounds is a property to be explained, and our view is that the output tone pattern is influenced by Akan. As indicated earlier, the V-V compounds are borrowed words from Akan, and we notice from the literature that V-V compounds in Akan exhibit the same tone pattern, where the outputs consistently bear H-tone throughout (Abakah, 2004; Appah, 2017b). Therefore, we conclude that the H-tone output of the V-V compounds does not contradict our claim of a consistent LH output melody

for compounds in Esahie. Rather, the tonal output of V-V compounds is different because V-V compounds are borrowed from Akan; both the segmental and supra-segmental features are borrowed.

3.5 Concluding comments of tonal output of Esahie compounds

The foregoing analysis shows that, apart from V-V compounds borrowed from Akan, Esahie maintains a high level of uniformity in the tonal output of compounds, where, regardless of the tonal melody of the input constituents, the output tones remain the same – LH. Overall, the analysis reveals three (3) recurring process or rules: H-tone insertion, L-tone spread, and H-tone delinking. The application of these processes is ordered in a way that yields a LH tonal output. where C₂ has an L-tone, and the L-tone spreads to C₁. If the final tone of C₁ is H, it delinks, thereby yielding an LH melody. However, if there is no L-tone on C₂, an L-tone may be inserted to trigger the process of L-tone association, L-tone spreading, and H-tone delinking. As shown in example (15), where the constituents have L(L)+H(H), the output compound still exhibits an LH tonal pattern. This deletion of L-tone in the first syllable of C₂ may be triggered by the rightward spread of the L-tone of C₁ onto the initial syllable of C₂. Where C₁ is LH and C₂ is H, as in example (21), the same conclusion would hold for the output tone pattern of the compound, as discussed above, where the compound has a LH tonal pattern. Furthermore, we realize that when the C₁ is H and C₂ is LH, as in example (17), the same generalization holds for the output tonal melody of the compound. This is consistent with what has been found to occur in Akan, where Marfo (2004a) observes that in N-N compounds, when the N₁ modifies N₂, the H-tone of the final TBU of N₁ changes to a L-tone, as shown in (25) below.

- | | | | | | |
|------|----|-----------------------------|---|-----------------|-------------------|
| (25) | a. | <i>òdwáí</i> + <i>òníní</i> | → | <i>òdwàníní</i> | |
| | | sheep + a male | | ‘a ram’ | |
| | b. | <i>àsém</i> + <i>húnú</i> | → | <i>àsèmhúnú</i> | |
| | | story + useless | | ‘nonsense’ | (Marfo 2004a: 95) |

Finally, the Akan data cited in this section affirm that compounds with varied tonal patterns in the constituents can yield outputs with the same tonal melodies. This uniformity in output is what is called *constructional tone* (Appah, 2013b; Appah et al., 2017; Harry & Hyman, 2012) or *tonal conspiracy*, which Akinlabi et al. (2009:1) characterize as “phenomenon in which several independent tonal processes in a language result in the same tonal outcome. It is as if the language requires a specific tonal melody on the output, and it does not matter what the input is”.

4 Non-tonal changes in Esahie compounds

In addition to tonal alternations, other prosodic changes occur during compound formation. These include segment deletions, syllable truncations, and consonant mutations. In this section, we show how these phonological processes manifest in compound formation in Esahie.

4.1 Syllable deletion

The concatenation of compound constituents sometimes results in the loss of sound segments in the output. The deleted segment may be a vowel, consonant, or an entire syllable that is deleted in the compounding process. Deleted segments or syllables may be in the initial or final position. Let us examine the examples in (26) and (27) below, in which the deleted segments/syllables are highlighted in the constituents.

(26)	C ₁		C ₂		Compound word
a.	<i>ǎdzíré</i> ‘leg’	+	<i>èbóén</i> ‘outer cover’		<i>ǎdzàbóén</i> ‘toenails’
b.	<i>bàkàá</i> ‘tree’	+	<i>èbóén</i> ‘outer cover’		<i>bàkààbóén</i> ‘tree bark’
c.	<i>jàmíé</i> ‘god’	+	<i>sóm</i> ‘worship’		<i>jàmizóm</i> ‘religious’
d.	<i>jàmíé</i> ‘god’	+	<i>nzúé</i> ‘water’		<i>jàmizúé</i> ‘rainwater’

In these examples, we notice that either the initial vowel of the second constituent is deleted, as in example (26a-b), or the final vowel of the first constituent is deleted, as in example (26c-d). The deletion of vowels is a response to the restriction on vowel sequences across word boundaries in the language (cf. Owusu Ansah, 2019, 2020). In addition to vowels, the initial nasal consonant of the second constituent in (26d) was also deleted. Given that this nasal consonant is also syllabic, we have to say that it also exemplifies what is discussed in section 5.2 under syllable deletion.

(27)	C ₁		C ₂		Compound word
a.	<i>ǎdzíré</i> ‘leg’	+	<i>èbóén</i> ‘outer cover’		<i>ǎdzàbóén</i> ‘toenails’
b.	<i>ǎdùró</i> ‘medicine’	+	<i>b̀nì</i> ‘bad’		<i>ǎdùb̀nì</i> ‘hard drugs’
c.	<i>sànzàmé</i> ‘promiscuity’	+	<i>brá</i> ‘life’		<i>sànzàmrrá</i> ‘aimless life’
d.	<i>̀nzáá</i> ‘wine’	+	<i>f̀fúé</i> ‘white’		<i>̀nzààfúé</i> ‘palmwine’
e.	<i>dàdèé</i> ‘metal’	+	<i>kààbá</i> ‘small/ young’		<i>dàdèèbá</i> ‘knife’
f.	<i>mó</i> ‘elder’	+	<i>bràsúá</i> ‘woman’		<i>m̀d̀brá</i> ‘elderly woman’

Similar to what happens in example (26), in example (27), we notice that the entire syllable of one of the constituents is deleted in the output. The deleted syllable is either from the first or second constituent, and can be from the initial or terminal part of the word. In examples (27a-c), the final syllable of the first constituent in each compound is lost, whereas in examples (27d-f), the second constituent loses a syllable in each case.

It is unclear what triggers or conditions the deletion of a particular syllable, but the resultant compound word is acceptable and intelligible to speakers. Similar to the syllable deletion observed in Esahie, involving human names (Owusu Ansah, 2019, 2020), no condition was identified as being responsible for the deletion of a syllable, aside from the economy of effort (Bresnan, 2001). However, it was observed that the deletion triggers lengthening of a vowel in the first constituent to compensate for the loss, as shown in (28).

(28)	Underlying	Surface	Meaning
a.	<i>ǎdzá</i> #Kwàkú	<i>ǎdzá:kú</i> (ǎdzeeeku)	‘male name’ (Owusu Ansah, 2020: 10)

We notice a similar case of vowel lengthening in example (27f), in which the vowel in the first constituent is lengthened after harmonization.

4.2 Consonant mutation

Another phonological change observed in compound formation is the assimilatory process of the mutation of consonants, which causes a consonant to change some or all of its phonetic qualities because of prevailing phonetic conditions. The process of consonant mutation appears to be significant in Esahie (Boateng, 2017; Frimpong, 2009). Let us examine the data in equation (29) as follows:

(29) C ₁		C ₂	Compound word
a. <i>sùnzùmé</i> ‘ghost’	+	<i>b̀̀nì</i> ‘bad’	<i>sùnzùmm̀̀nì</i> ‘evil/bad spirit’
b. <i>̀̀zém</i> ‘words’	+	<i>b̀̀nì</i> ‘bad’	<i>̀̀zèmm̀̀nì</i> ‘crime’
c. <i>s̀̀nzàmé</i> ‘promiscuous person’	+	<i>brá</i> ‘life’	<i>s̀̀nzàmmrá</i> ‘aimless life’
d. <i>s̀̀ná</i> ‘person’	+	<i>b̀̀wúé</i> ‘bone’	<i>s̀̀nàm̀̀wúé</i> ‘skeleton’
e. <i>dídì</i> ‘to eat’	+	<i>p̀̀nó</i> ‘table’	<i>dídib̀̀nó</i> ‘dining table’
f. <i>̀̀zém</i> ‘words’	+	<i>pá</i> ‘good’	<i>̀̀zèmbá</i> ‘gospel’
g. <i>kòé</i> ‘stomach’	+	<i>kàlé</i> ‘pain’	<i>kòèhàlé</i> ‘stomach ache’

The data showed both partial and complete mutations. We find a full mutation in example (29a-d) where the voiced bilabial stop /b/ of the second constituent mutates into a bilabial nasal /m/ in the output. A change from a voiceless bilabial stop to a voiced bilabial stop is found in example (29e-f), and velar softening or lenition is found in example (29 g), where a voiceless velar stop changes to a glottal fricative. The mutation of the stop to the nasal is caused by the voicing environment of the surrounding sounds, which softens the plosive to the nasal. Thus, there is complete copying of both the place and manner of articulation of the conditioning sound. In all examples provided, the vocalic sounds differ, but we realize that in all cases, stop /b/ mutates to nasal /m/.

Esahie exhibits four phonetic forms of Consonant Mutation. These include nasal mutations, spirantization, glottalization, and lateralization (Frimpong, 2009). The type found in example (28a-d) exemplifies nasal mutation, whereas that of example (29 g) signals glottalization. Like Nzema, a closely related language (Chinebuah, 1970), the mutation of consonants in Esahie is a stem initial. Mutations occur in a voicing environment either under the influence of a nasal consonant or intervocalically. That is, whenever a voiceless consonant comes after a nasal sound or occurs intervocalically in Esahie, it becomes voiced. For this reason, in all examples, we notice a change from voiceless sounds to their voiced counterparts when the conditions mentioned are met, as in the examples in (29). In Akan (Dolphyne, 1988, 1994) and other languages like Dagbani (Olawsky, 1999), Selee (Agbetsoamedo & Di Garbo), among others, for instance, the voiceless consonants can occur in the environment of nasal sounds, but this is not the case in Esahie.

5 Conclusion

In this paper, we discussed the phonological changes that occur when compounds are formed in Esahie. Probably triggered by a need to meet a final high tone requirement, we have noticed that there is some form of ‘tonal conspiracy’ in the tonal output of the compounds. We observed that following the application of L-Tone Spread, L-Tone Insertion, and H-Tone Deletion, Esahie compounds always have an LH output tonal pattern regardless of the tonal input, regardless of the syntactic categories of the constituents. However, such consistency in the tonal pattern of compounds is not unique to Esahie, as we found similar occurrences

in Akan and Nkoroo. As Akinlabi et al. (2009:1) observe, “[i]t is as if the language requires a specific tonal melody on the output, and it does not matter what the input is.”

We have also shown that, aside from tonal changes, non-tonal changes such as nasal mutation as well as deletion of either sound segments or whole syllables come into play in the compounding process. We have shown cases in which consonants are either fully or partially mutated in vocalic sounds. Indeed, this paper has confirmed that although compounding is a morphological process, phonological information is indispensable in computing the final output of what are essentially morphological constructions.

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