

## **A formant analysis of vowel disharmony in Ika-Igbo compound nouns**

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### **Abstract**

This paper reveals the assimilatory processes that take place in disharmonic and harmonic vowels of Ika Igbo compound nouns. These assimilatory processes explain why disharmonic vowels feature in Ika compounds. In carrying out the study, a data of 192 Ika Igbo compound nouns were produced by four (two males and two females) Ika Igbo speakers. Each speaker produced 48 utterances which were recorded and digitized at 44100 Hz using the *praat* speech analysing software. Twenty four compounds had disharmonic vowels while the other twenty four had harmonic ones. The F1 values, the primary acoustic correlate of ATR, were extracted using *Praat*, at midpoint of the coarticulated vowels. Student 't' test analysis on the F1 values showed no significant difference between disharmonic and harmonic vowels ( $P > 0.5$ ); an indication that assimilation harmonizes disharmonic vowels in Ika Igbo. Our findings also provide sufficient evidence that +ATR vowels do not always dominate –ATR ones as claimed by previous findings.

**Keywords:** *vowel harmony, disharmony, coarticulation, assimilation, formants, hiatus*

### **Introduction**

Ika, a dialect of Igbo, is spoken in areas bordering the west of the River Niger (in parts of Delta and Edo states) in Nigeria. Nwaozuzu (2017) classifies it under West Niger Group of Dialects. The ISO language code reference for Ika is ISO 639-3 *ikk* ([www.ethnologue.com/language/ikk](http://www.ethnologue.com/language/ikk)). All Igbo dialects, including Ika, manifest vowel harmony. The vowels are grouped into two sets – those produced with advanced tongue root [+ATR] as well as those produced without advanced tongue root but rather with retracted tongue root [-ATR]. The vowel harmony constraint stipulates that only one group (+ATR or –ATR) may make up a word. However, in compound words, both sets of vowels tend to co-occur across adjoining syllable boundaries. This study investigates why this happens. Compound nouns have been mostly selected for this study because most nouns in Igbo begin and end with vowels.

Vowel harmony is a process in which vowels agree with one another in features. In most African languages, vowel harmony is based on [ATR] feature as seen in such languages like Igbo, Wolof (Unseth, (2009), Maasai (Quinn-Wriedt, 2013), Akan (O'Keefe, 2003) and numerous others. Vowel harmony exists in most Nigerian languages. However, some Nigerian languages like Hausa and Edo do not manifest vowel harmony (Essien, 2016). Przedziecki (2005), who worked on Yoruba language, opines that coarticulation should look like vowel harmony. Probably it is this coarticulation that enables disharmonic vowels to be pronounced as easily as the harmonic ones. Degema, an Edoid language, has ten vowels which

are divided into two harmony sets of five based on the [ATR] feature. The ones that are [+ATR] are i, u, e, o and ə while the [-ATR] ones are ɪ, ʊ, ɛ, ɔ and a (Kari, 2007).

Casali (2014) identifies that sometimes, the following vowels are missing in languages with an [ATR] contrast:

high [-ATR], low [+ATR] and mid [+ATR]  
In Ika Igbo, low +ATR vowels do not exist.

Ika Igbo dialect is selected for this study because in addition to manifesting disharmony in compound words, this dialect appears to exhibit a lot of disharmony in other (single) words more than other Igbo dialects. Some of such words include.

1. ẹ̀wùrù /ɛwuru/ 'cloth'    2. ẹ̀rù /ɛru/ 'sponge'    3. àhó /aho/ 'hoe'

These vowels can also co-occur with –ATR vowels as seen in the examples below.

4. ẹ̀mù 'laughter'    5. àlì 'ground'    6. átìà 'mischief'

The vowels, /a/ and /ɛ/ seem to function as neutral vowels in Ika though they are classified as -ATR. In the Standard Igbo, only /a/ acts as a neutral vowel and in a lesser degree. Emenanjo (1978) specifies that /a/ is a neutral vowel since it co-occurs with both [+ATR] and [-ATR] vowels.

In this study, these neutral vowels are grouped appropriately in the harmony sets they belong to; hence they are placed in the interception in the chart showing the harmony sets (fig. 1). In Turkish, compound words are exceptions to vowel harmony rules (Nemeth, 2011). Anyanwu (2008) gives examples of violation of vowel harmony rules in Igbo compound words.

7. Obi + ụlọ 'obiụlọ'

Akanlig-Pare and Asante (2016) reveal that in Nkama (Guang (Kwa) language of Ghana), ATR harmony occurs in stems and prefixes, loanwords, pronominal possessions, compounds and across word boundaries. This could be possible due to assimilation and subsequently, reflecting automatic observation of the ATR harmony rule. Abubakre (2009) in his comparative work on compounding in Hausa, Igbo and Yoruba confirms that in Igbo compounds, deletion and assimilation take place. His examples reveal that vowel harmony rule is violated in Igbo compounds. In example 5 below, /e/ which is [+ATR] co-occurs with /a/ and /ʊ/ which are [-ATR].

8. Onye + amuma - 'prophet' (N+N)  
person 'prophecy'

Maduagwu (2016) discovers that in Oghè, just like in other dialects of Ìgbò, most words begin and end in vowels. Hence when two disharmonic vowels follow each other across a word boundary, complete or partial assimilation takes place, with one vowel acquiring the features of its neighbour.

Baltazani (2006), citing Zsiga (1997) opines that in Igbo, assimilation is gradient rather than categorical. He reports the same for Greek. Casali (2011) reveals that in hiatus (a break between two vowels coming together but not in the same syllable, there may be a gradient change resulting in “near elision” of one of the adjacent *vowels*, where V1 V2 sequence is realized as V2; the V2 possibly becomes elongated. It appears that this is what occurs between the V2 of the first compound constituent and the V1 of the second constituent. Citing Zsiga (1992, 1997) Casali shows that instrumental studies have revealed that glide formation and vowel elision – which are hiatus resolution patterns- that had been thought to be categorical changes, are actually gradient and variable processes. He cites Igbo examples as follows:

9. Ọtị ọzọ /ɔtɪɔzɔ/ ‘another grub’      10. Ede atọ /edeatɔ/ ‘three cocoyams’

Casali shows that the formant analyses of the pronunciation of the vowels made by three subjects revealed variations and gradation in vocalic change (rather than an abrupt one) due to coarticulation of the vowels occurring across the boundaries. This is a typical case of what happens in Igbo compound words.

According to Harrison (1999:1) surface disharmony is a natural and expected component of harmony languages. Many harmony languages tolerate disharmony. In line with Harrison, we argue that what takes place in Ika compounds is coarticulation/ spreading/local assimilation. Hence the so called disharmonic compounds involve contiguous occurrence of two vowels (hiatus) which are harmonized through coarticulation/ assimilation. This may be why compounds are usually exempted in most languages with vowel harmony constraints.

In this paper, analyses are based on the F1 values of each pair of coarticulated vowels (the second vowel (V2) of the first component of the compound and the first vowel (V1) of the second component) as produced by the respondents. F1 is the primary and consistent acoustic correlate for distinguishing between [+ATR] and [-ATR] vowels (Kent and Read (2002), Ladefoged and Johnson (2015) and Koffi (2016). Ladefoged and Johnson (2015:207) state that other cues are not as salient as F1 since it contains “on average 80% percent of the energy in the vowel” and formants are generally assumed to be the major determinants of vowel quality. Thus this work will reveal in detail, through F1 analysis, the harmony or disharmony in the co- articulation of adjoining vowels in Ika Igbo compounds.

### **Ika vowel system**

Ika has nine vowels which are / i, u, o, e, ɪ, ʊ, ε, ɔ, a/. In addition, the schwa /ə/ also features in the dialect and acts as an allophone of such vowels as /ɪ, ʊ, a and e/. These nine vowels have nasal counterparts (Uguru, 2015) but they will not be discussed here. Below is the Ika vowel charts.

The vowel harmony sets of Ika Igbo are as follows:

- (a) +ATR vowels: i, u, e and o /i, u, e, o/  
(b) -ATR vowels: ɪ, ʊ, ε, ɔ and a. /ɪ, ʊ, ε, ɔ, a/

The Ika vowel harmony sets are shown in the chart below.

High			<u>i u</u>	
-ATR	<u>i u</u>			+ATR
Mid		<u>ɛ</u>	<u>o e</u>	
Low	ɔ	<u>a</u>		

**Fig. 1:** A chart showing Ika Igbo vowel harmony sets

As seen from the chart, Ika does not have a low vowel that is +ATR. Also, two vowels, /a / and /ɛ/ are in the interception; since they can co-occur with both sets of vowels.

**Methods**

Two female and two male Ika speakers were each made to produce twenty four harmonic and twenty four disharmonic compound nouns. These were recorded and digitized at 44100 Hz using the *praat* speech analysing software. A total of one hundred and ninety two (192) utterances were analyzed using *Praat*. The study sets out to investigate the first formants (F1) of the midpoint of the adjacent (coarticulated) vowels of the compounds because F1 is the primary acoustic correlate of the ATR feature. The significance of difference between F1 values of the harmonic and disharmonic vowels was analyzed for each respondent using student ‘t’ test.

**Test utterances**

The test utterances are as follows:

**Table 1: Test Utterances (disharmonic)**

Vowel Description	Utterance	VH combination	set	Transcription	Gloss
1. rounded + unrounded	1. ɛfɔ + ime N + N omach pregnancy (N1 possessing N2)	-ATR & +ATR		/ɛfi <sup>+</sup> mé/	Pregnancy
	2. olu + ɛwuru N + N neck cloth (N2 possessing N1)	+ATR & -ATR		/ólú <sup>w</sup> èwùqù/	Collar

II. unrounded + rounded	3. <i>ishi + udara</i> N + N head udara tree (N2 possessing N1)	+ATR & -ATR	/ifí'òdàìà/	a type of fruit tree
	4. <i>alì + okete</i> N + N land oil palm (N1 possessing N2)	-ATR & +ATR	/àlì'òkètè/	oil palm plantation
	5. <i>ẹka + ukwu</i> N + A hand big	-ATR & +ATR	/ékúúk'wú/	long or big hand
III. low + high	6. <i>ụlọ + ubi</i> N + N house farm (N2 possessing N1)	-ATR & +ATR	/ólùúbì/	farm house
IV. high + low	7. <i>ishi + oma</i> N + A head good	+ATR&-ATR	/ifí'ómá/	good luck
	8. <i>ogbu+ akpun</i> N + N killer cassava (N1 possessing N2)	+ATR&-ATR	/ògbú'á <sup>+</sup> kp'ò/	siam weed(chromolaena odorata)
V. high+ mid	9. <i>ẹkpuru + oshishi</i> N + N seed tree (N2 possessing N1)	-ATR & +ATR	/ékp'ó'í'ó'w'ó'fifí/	fruit
	10. <i>alì + enumee</i> N + N land orange (N1 possessing N2)	-ATR&+ATR	/àlì'ènùmécè/	orange plantation
VI. mid + high	11. <i>okẹhen + ukwu</i> N + A man big	-ATR&+ATR	/ókèhũ'w'ók'wú/	huge man
	12. <i>onye + ikpa</i> N + N person pride (N1 possessing N2)	+ATR&-ATR	/óníí' <sup>+</sup> kpá/	proud person

VII. low+ mid	13. <i>ụlọ + elu</i> N + A house high	-ATR&+ATR	/óléé <sup>+</sup> lú/	storey building
	14. <i>ẹkpa + egho</i> N + N bag money (N2 possessing N1)	-ATR&+ATR	/èkpèé <sup>+</sup> γó/	#200.00 (two hundred naira)
	15. <i>ogèdẹ + oyiya</i> N + A plantain raw	-ATR&+ATR	/ògèdòójíjì □	raw plantain
VIII. mid + low	16. <i>izee + akpa</i> N + A shrimp large	+ATR&-ATR	/ìzèáákà/	prawn/large shrimp
IX. Rounded + Rounded	17. <i>okwu + onu</i> N + N Talk mouth	+ATR&-ATR	/ók <sup>w</sup> ú <sup>w</sup> ó <sup>+</sup> nó/	Speech
	18. <i>ụzọ + ugbo</i> N + N Road farm	-ATR&+ATR	/úzùú <sup>+</sup> gbó/	Farm road
X. Unrounded + Unrounded	19. <i>Èka + iken</i> N + A Hand strong	-ATR&+ATR	/ékíí <sup>+</sup> kẽ/	Strong hand
	20. <i>Akasị ezhi</i> N + N Cocoyam compound	-ATR&+ATR	/àkàsìé <sup>+</sup> zì/	Farmyard cocoyam
XI. High + High	21. <i>ụmụ + ihe</i> N + N Children things	-ATR & +ATR	/ómìí <sup>+</sup> hè/	Little things
	22. <i>Okuku + isha</i> N + N Calabash beads	+ATR & -ATR	/òkúkú <sup>w</sup> ìfà/	Musical instrument
XII. Mid + Mid	23. <i>Ekerẹ + okpoho</i> A + N Small woman	-ATR&+ATR	/èkéíóòkphó/	Small woman
	24. <i>Ukpe + eka</i> N + N Light hand	+ATR & -ATR	/úkpeé <sup>+</sup> ka/	Local lamp

**Table 2: Test Utterances (harmonic)**

Vowel Description	Utterance	VH combination	set	Transcription	Gloss
I. rounded + unrounded	25. <i>okpu</i> + <i>ishi</i> N + N Cap + head (N1 possessing N2)	+ATR & +ATR		/òkpú <sup>wí</sup> †jǐ/	Head scarf
	26. <i>umụ</i> + <i>eka</i> N + N Children hand	-ATR & -ATR		/ómò <sup>wé</sup> †ká/	children
II. unrounded + rounded	27. <i>alì</i> + <i>oǝ</i> N + N Land colanut (N1 possessing N2)	-ATR & -ATR		/alǐó <sup>†</sup> ǝǝ/	Colanut plantation
	28. <i>ugbugbe</i> + <i>ofe</i> N + N claypot soup (N1 possessing N2)	+ATR & +ATR		/ùgbùgbòó <sup>†</sup> fě/	Soup claypot
III. low + high	29. <i>ulo</i> + <i>uka</i> N + N house church	-ATR & -ATR		/ólòókà/	Church
	30. <i>enya</i> + <i>uran</i> N + N eye sleep (N1 possessing N2)	-ATR & -ATR		/éǝóó <sup>†</sup> ǝǝ/	Sleepy
IV. high + low	31. <i>onu</i> + <i>oma</i> N + A mouth good	-ATR&-ATR		/ónó <sup>w</sup> ómá/	Soft speech
	32. <i>nshì</i> + <i>azun</i> N + N Faeces fish (N2 possessing N1)	-ATR&-ATR		/ǝǝǐázò/	Fish faeces
V. high+ mid	33. <i>ishi</i> + <i>ogede</i> N + N head plantain (N2 possessing N1)	+ATR & +ATR		/ǐǐǐògèdè/	Plantain tree
	34. <i>ok<sup>w</sup>u</i> + <i>elu</i> N + N talk world (N1 possessing N2)	+ATR&+ATR		/ók <sup>w</sup> ú <sup>wé</sup> †lú/	Life problems

	35. <i>ofe + Igbon</i> N + N soup slave	+ATR&+ATR	/ófiígbò/	Palm oil
VI. mid + high	36. <i>okoro + ugbo</i> N + N Youngman farm (N1 possessing N2)	+ATR&+ATR	/òkórúú <sup>+</sup> gbó/	Old fashioned fellow
VII. low+ mid	37. <i>ita + emu</i> N + N Story laugh N1 possessing N2	-ATR&-ATR	/íté <sup>+</sup> mó/	Mockery/ridicule
	38. <i>ikọ + etu</i> V + N Shaving beard (Verb possessing Noun)	-ATR&-ATR	/í <sup>+</sup> kèè̀tù/	Shaving beard
VIII. mid + low	39. <i>okehen + oyada</i> N + A man dirty (Noun possessing adjective)	-ATR&-ATR	/ókèhṣ̀òjádá/	Dirty man
	40. <i>ekere + ali</i> A + N Small land (Noun possessing adjective)	-ATR&-ATR	/ékéiááli/	Small parcel of land
IX. Rounded + Rounded	41. <i>ugwo + ulọ</i> N + N debt house (N1 possessing N2)	-ATR&-ATR	/óg <sup>w</sup> úólò/	House rent
	42. <i>utu + oka</i> N + N Weevil maize	-ATR&-ATR	/òtó <sup>w</sup> ókà/	Maize weevil
X. Unrounded + Unrounded	43. <i>Ishi + ebulu</i> N + N Head ram (N1 possessing N2)	+ATR&+ATR	/íʃíè̀bùlù/	Ram's head
	44. <i>Onye + ishi</i> N + N Person head (N1 possessing N2)	+ATR&+ATR	/òníí <sup>+</sup> ʃí/	Leader
	45. <i>Ishi + ukwu</i> N + A Head big		/íʃíú <sup>w</sup> ú/	



XI. High + High	(N possessing A)	+ATR&+ATR		Big head
	46. <i>Ihun</i> + <i>iyi</i>	+ATR&+ATR	/íhù <sup>w</sup> í <sup>†</sup> ji/	Shrine
	N + N			
	Front	curse		
XII. Mid + Mid	47. <i>Onye</i> + <i>ohu</i>	+ATR&+ATR	/óṅóó <sup>†</sup> hú/	Somebody
	N + D			
	Person	one		
	48. <i>Ugbo</i> + <i>eze</i>	+ATR&+ATR	/úgbèèzè/	King's farm
	N + N			
	Farm	king		

**Presentation, discussion and analyses of data**

In this section, the data are analysed and the first formant of the coarticulated disharmonic/harmonic vowels of the compound nouns are presented and discussed. Much of the discussion is in tables, with the statistical analyses explained. For each compound word, the combined pronunciation (coarticulation) of the second vowel of the first element (V1) and that of the first vowel of the second element (V2) is analysed (see figs. 2 and 3).

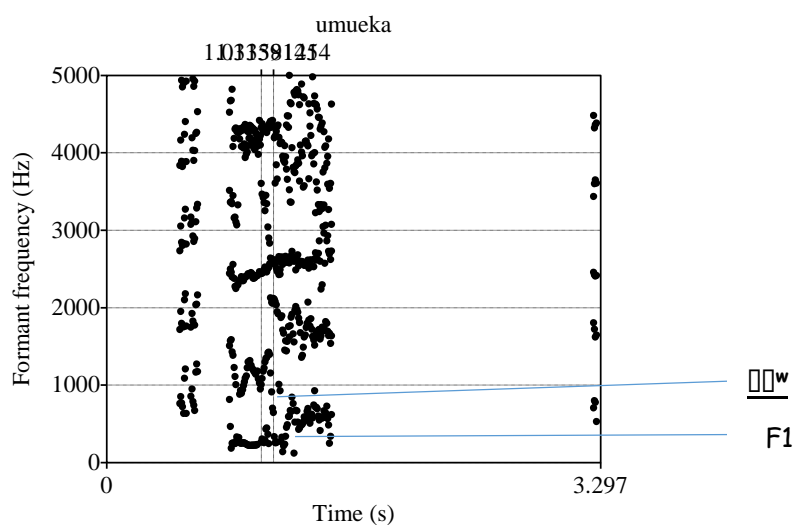


Fig. 2: formant analysis of *umueka* /ómò<sup>w</sup>é<sup>†</sup>ká/

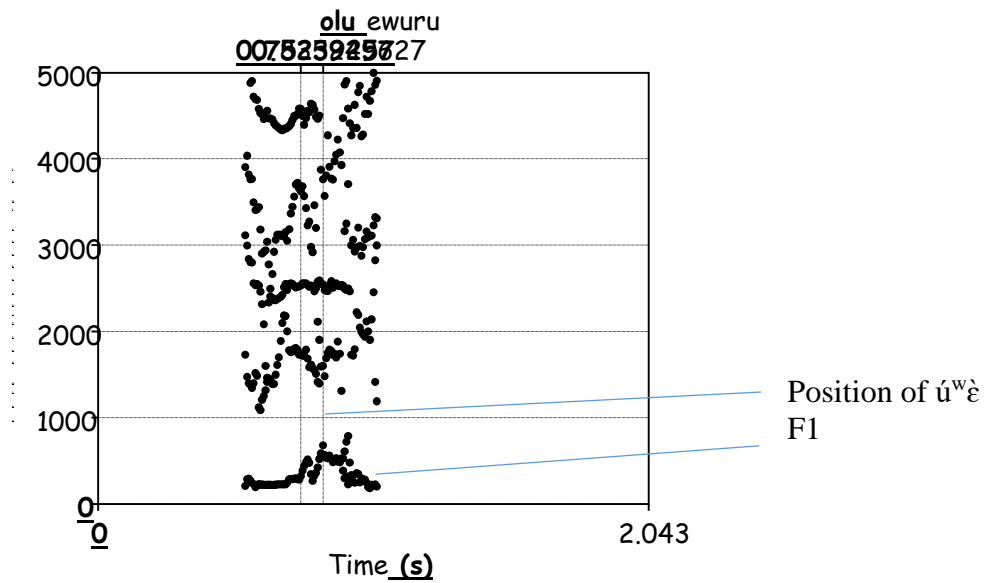


Fig. 3: formant analysis of the *olu ewuru* /ólú<sup>w</sup>èwù.̀ù/

The F1 values are presented in Table 3 below.

Table 3: F1 values of male and female speakers for coarticulated harmonic and disharmonic vowels of the compounds

Female disharmonic	1	Female1 harmonic	Female 2 disharmonic	Female 2 harmonic	Male 1 Disharmonic	Male 1 Harmonic	Male 2 disharmonic	Male 2 Harmonic
I	óí 244	XXV úí 39	39	41	318	53	368	409
II	úè 356	XXVI òé 28	28	38	700	65	611	652
III	ìò 558	XXVII íó 35	35	28	680	57	490	652
IV	ìó 323	XXVIII èó 38	38	61	522	65	571	490
V	áú 243	XXIX óó 34	34	32	671	44	571	571
VI	òú 243	XXX áó 77	77	31	898	57	1017	895
VII	íó 405	XXXI óó 31	31	57	539	61	611	409
VIII	úá 600	XXXII íá 35	35	67	531	69	571	490
IX	óó 364	XXXIII òó 40	40	48	679	36	449	611
X	ìè 321	XXXIV íè 29	29	46	540	61	287	449
XI	èú 249	XXXV èí 23	23	52	353	61	449	409

XII	éí	217	XXXVI	31	éí	38	315	éí	65	óú	1747	éí	44	ó	199
			óú	5		7	óú		2				9	ú	0
XIII	òé	350	XXXVII	51	òé	56	748	òé	57	àé	652		44	àé	733
			àé	1		5	àé		5			òé	9		
XIV	àé	413	XXXVIII	57	àé	58	563	àé	44	òè	733	àé	57	òè	530
			òè	1		7			9				1		
XV	èò	374	XXXIX	46	èò	54	656	èò	53	èò	530	èò	53	èò	652
			èò	5		2			0				0		
XVI	èà	686	XL	35	èà	99	948	èà	81	èà	652		81	èà	895
			èà	7		2			4			èà	4		
XVII	úó	611	XLI	30	úó	69	348	úó	49	óó	490		61	ó	855
			óó	3		2			0			úó	1	ó	
XVIII	òú	253	XLII	36	òú	31	619	òú	24	óó	855		36	ó	895
			óó	9		4			7			òú	8	ó	
XIX	áí	292	XLIII	33	Áí	31	507	áí	40	ìè	409	áí	32	ìè	449
			ìè	8		6			9				8		
XX	ìé	308	XLIV	40	ìé	45	337	ìé	65	éí	773		53	éí	490
			éí	9		3			2			ìé	0		
XXI	òí	245	XLV	22	òí	36	315	òí	40	íú	368	òí	57	íú	368
			íú	6		0			1				1		
XXII	ùí	319	XLVI	49	ùí	32	396	ùí	40	úí	287	ùí	36	úí	692
			úí	0		2			9				8		
XXIII	éò	413	XLVII	25	éò	58	555	éò	44	éó	368		53	é	530
			éó	5		5			9			éò	0	ó	
XXIV	éé	444	XLVIII	31	éé	77	611	éé	44	óé	409	éé	65	ó	409
			óé	1		1			9				2	é	

The vowels numbered under female 1 column are the ones analysed for other respondents. Note that the transcriptions showing assimilation appear in Tables 1 and 2. The actual sounds have been shown in Tables 3 and 4 so as to reveal the harmonic and disharmonic combinations.

A look at the F1 values of the disharmonic and harmonic vowels shows no striking difference. That is, there is nothing to show that a combination is harmonic or disharmonic by looking at their F1 values since their values fall within the same range; hence by mere observation, their similarity is evident. This is also proved statistically with the student 't' test conducted on the F1 values of both types of compound nouns. The F1 values of each respondent's production of harmonic and disharmonic coarticulated vowels are tested for significant difference using student 't' test. Result shows that there is no significant difference ( $p > 0.05$ ) between the F1 values of harmonic vowels and those of disharmonic vowels for each respondent. We therefore infer that phonological processes (particularly assimilation) make the two types of

vowels to become equally harmonic. A table showing the result of the ‘t’ test analysis is presented below.

Table 5: T test result of the F1 values of harmonic and disharmonic vowels

Respondent	Test statistic t	d.f.	Probability	Significant/not significant
F1d&f1h	-0.32	46	0.747	(P > 0.05) not significant
F2d &f2h	-1.15	46	0.255	(P > 0.05) not significant
M1d & M1h	-0.88	30.83	0.383	(P > 0.05) not significant
M2d & M2h	-1.18	32.34	0.247	(P > 0.05) not significant

F1d and F1h refer to the first female speaker’s disharmonic and harmonic vowels. F2d &f2h, M1d & M1h and M2d & M2h refer to disharmonic and vowels for second female speaker, first male speaker and second male speaker respectively.

The result of the ‘t’ test should not be surprising since Table 1 shows that both harmonic and disharmonic vowels undergo the same phonological process when coarticulated. This process appears to harmonize both types of vocalic combinations. Thus the hiatus condition, which would have resulted in both the disharmonic vowels and the harmonic ones, is resolved by the phonological process - assimilation.

It appears that as far as assimilation and domination are concerned, vowel height is a more determining factor in Ika Igbo. Analysis shows that under normal circumstances, the first vowel of the second element of the compound noun (V2) tends to dominate (regressive assimilation). However, we observe that in many cases, the extent of domination is determined by the height of the last vowel of the first element of the compound (V1). In other words, the higher vowels tend to retain some of their prominence in this environment. Hence they are not easily assimilated. On the contrary, when these vowels are the first vowel of the second word, the preceding vowels are easily assimilated by them particularly if such vowels are mid or low vowels.

These preceding high vowels usually result in glides when they are coarticulated with other vowels; /ʊ, u/ are accompanied by /w/ while /i, ɪ/ are accompanied by /j/. This is a form of resistance to assimilation as well as a way of facilitating pronunciation. It is in line with the hiatus breaking methods as pointed out by Zsiga (1997), Casali (2011) and others. Yavas (2011) proves that glide to vowel sequencing is faster than vowel to vowel sequencing. Hence, since the high vowels are not easy to be assimilated (and regressive assimilation applies in Ika), glides are automatically formed to facilitate the pronunciation of an otherwise hiatus. The glide formation, triggered by a high vowel (V1), applies in both harmonic and disharmonic vowel combinations. The glides have the same range of (low) F1 values as the high vowels (Yavas, 2011; Olive, Greenwood and Coleman, 1993). In our data, ten disharmonic compounds had glide formation while eleven harmonic ones had glide formation. This shows that both types of compound words (those with harmonic vowels and those with disharmonic ones) undergo similar phonological processes. This further confirms their similarity, thinning down their differences.

On glide formation, our findings confirm Casali’s and Zsiga’s views that glide is used to break hiatus. Thus we view glide formation as a form of coarticulation, since it facilitates

pronunciation. It is also interesting to note that all the compounds used for the study – disharmonic and harmonic- underwent regressive assimilation. Hence both +ATR and -ATR are equally strong. Either triggers assimilation once it occupies the (V2) slot. This appears to negate the assertion of Casali (2014) that +ATR is the dominant one. Also, that all the data in the study underwent regressive assimilation is an indication that progressive assimilation is very rare in Ika.

### **Summary and conclusion**

This study has centred on analysing and revealing why vowel disharmony features in Ika compound nouns despite the vowel harmony constraints existent in the dialect. It was discovered that assimilation harmonizes the disharmonic and harmonic compound words thus making them to be similar in pronunciation. Thus because hiatus is not allowed in Ika Igbo, both the harmonic and disharmonic vowels in compound words undergo assimilation and this process harmonizes them. This is because (V1) takes on the features of (V2). This process renders both types of vocalic combinations similar. This was further confirmed acoustically through the analysis of the F1 values (a strong correlate of the ATR feature) of the coarticulated adjacent vowels of the compound nouns. The ‘t’ test analyses reveal that there is no significant difference between the F1 of both harmonic and disharmonic vowels ( $p > 0.05$ ). This paper, therefore, provides acoustic explanation for assimilation in compounds.

Glide formation was revealed in the case of high vowels as a result of their resistance to assimilation, thus confirming the findings of Casali (2011) and Zsiga (1997). This indicates a cross-linguistic tendency to have processes for breaking hiatus, a typical condition featuring in Ika Igbo compounds. In cases where the high vowels /i i u u/ resist assimilation, glides are formed to facilitate easy pronunciation. Olive *et al* (1993) have shown that vowel to glide transition usually takes place at syllable boundaries and that glides are seen as rapid transitory vowels with /w/ being regarded as fleeting /u/ and /j/ as fleeting /i/. Thus it plays the role of facilitating the pronunciation of a combination of vowels that would have been awkward and slow to produce. Hence, in this paper, we see glide formation (associated with high vowel resistance to assimilation) as a form of coarticulation.

Furthermore, the view of Casali (2014) that in harmony languages, including Igbo, +ATR dominates is not borne out from our findings; rather in the predominantly regressive assimilation that operates in Ika Igbo, any vowel (+ATR or -ATR) that is the first verb of the second constituent of the compound dominates the second vowel of the first constituent. That is V2 dominates V1. Hence Ika Igbo ATR negates Casali’s assertion. On the contrary, in Ika Igbo, it is vowel height that determines domination. High vowels tend to resist being assimilated. We therefore conclude that in Ika, high vowels dominate low ones. When they occur as the first vowel of the second element of the compound, assimilation is easy. On the contrary, if they occur as the second vowel of the first element, they resist assimilation, which usually results in glide formation.

The conclusion from this study is that disharmonic vowels feature in Ika Igbo compound nouns because assimilation harmonizes them, making them similar to the harmonic vowel

combinations. This therefore facilitates their pronunciation. The ‘t’ test carried out on the F1 values of the disharmonic vowels and the harmonic vowels of the compound nouns used for the study revealed they had no significant difference. The paper has therefore made the following significant findings: assimilatory processes harmonize disharmonic vowels in compounds, high vowels dominate the low ones in assimilation and glide formation results when high vowels are V1 because they resist assimilation.

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