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A Constraint-Based Analysis of Opacity in Anaa*N̄*

By

Akpabio, Samuel Friday
Department of English
University of Uyo, Uyo, Nigeria
sf.akpabio@gmail.com
+2347064657219

Ene, Ndifreke Bills
Department of English
University of Uyo, Uyo, Nigeria
missbills15@gmail.com
+2347030876285
&
Ukpabio, Joyce Effiong
Department of Linguistics and Nigerian Languages
University of Uyo, Uyo, Nigeria
joyceukpabio020@gmail.com
+2347064535234

Abstract
This paper analyses opaque interactions in the Anaa*n̄* language. The study set out to identify the cases of opacity in Anaan in order to examine the constraints that condition opacity in the language. Data for this study which were phrases and associative constructions were obtained by competent speakers of the language from Ika, Abak and Ukanafun Local Government Areas, who were carefully selected with regard to theirage, gender, level of education, and their years of residing in their speech community. The study adopted constraints in optimality theory propounded by Alan Prince and Paul Smolensky as explanatory device to examine the constraints that condition opacity in the language. It was discovered from analysis that a back vowel at morpheme boundary position and a front vowel determine which vowel to be deleted, of which, a back vowel is often susceptible to deletion.The back vowel /ɔ̀/ at morpheme boundary position with the N. CV syllable structure, occurring with the front vowel /e/ is opaque to deletion, thus, conditioning opacity in the language. Normally, the occurrence of a stop in intervocalic position often results in the weakening of the sound flanked by two vowels. On the contrary, the result of this study showed that a stop can be flanked by two vowels in intervocalic position without it being weakened in the process of partial reduplication of verbs. This morpho-phonological process conditions opacity in the weakening of reduplicant morphemes. This paper concludes that the Anaa*n̄* language is affected by other opaque processes, calling for more studies or research on the language, so as to unearth other processes which opacity may apply in the language.

Keywords: Opacity, Non-application, Environment, OT (Optimality theory) and Constraint.

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Introduction

Phonology, a term in linguistics, refers, according to Adrian Akmajian, Richard Demers, Ann Farmer, and Robert Harnish (2010, p.109), to 'the description of sounds of a particular language and the rules governing the distribution of those sounds.' In addition, they also define phonology as 'that part of general theory of human language that is concerned with the universal properties of natural language sound systems'. The main task of phonology, in the words of Philip Anagbogu, B. M. Mbah, and Cecilia Eme (2010, p. 96), is 'to understand and describe how a sequence of sounds and the accompanying prosodic features can convey meaning in language'. In understanding and describing sounds, their function, behaviour and organisation as linguistic items, as opposed to phonetics which is rather a more 'neutral' study of the sounds themselves, phonology establishes procedures or processes available in the phonology of any language (cf. Ayo Osisanwo, (2009, p. pp 13-15). In effect, it is based on a theory of what every speaker of a language unconsciously knows about the sound patterns of that language.

Imelda Udoh (2003, p.32) defines 'phonological processes as the transformation of one representation into another under certain conditions.' Some of these processes include: deletion, assimilation, weakening and harmony insertion.Some of these processes may or may not apply in a language, thereby creating opaque interactions in the language. The aforementioned properties of phonological processes establish what is termed phonological opacity. Phonological opacity is a condition whereby a phonological rule or process fails to apply in a given context. According to John McCarthy (2002), a phonological rule B of the form A→B/C__Dis opaque if there are surface structures with either of the following characteristics: (i) instances of A in the environment C___D (ii) instances derived by B that occur in environments other than C___D. He further states that a phonological rule B is opaque when the applicability or application of B is (somehow) obscured on the surface. Phonological opacity deals with under-application and over-application of a rule. These opaque interactions result from counter-feeding and counter-bleeding.

To analyse opacity in Anaa$\bar{n}$, the Constraint-Based Theory (Optimality Theory) by Prince and Smolensky (1993/2004) is adopted together with a rule-based generative phonology by Chomsky & Halle (1968). This work analyses opaque interactions in Anaa$\bar{n}$through the examination of the environment that conditions opacity in the language.

Phonological Opacity

The meaning of Opacity is associated with the work of Kiparsky (1971, 1973) in terms of rule application such as:over/under-application and non-surface-true/apparent labels due to McCarthy (1999). Opaque interactions, that is, opacity, refer to cases where some processes do or do not apply contrary to expectation because of the way it interacts with other processes.However, opacity as analysed by Kiparsky (1971, 1973), McCarthy (1999) and Bakovic (2005), pervadesthe world's languages. On the contrary, there are cases where phonological processes fail to apply or under apply in languages. Some of these processes do not apply in some natural languages, thus, creating opaque interactions in the language.

This work, therefore, arises from the need to document the opaque interactions in Anaa$\bar{n}$through the examination of the constraints that condition opacity in the language. This study of opacity in Anaa$\bar{n}$ may provide the inputs that language learners may be exposed to in acquiring the system, the complex phonological system of the language, through some properties of opacity such as deletion, reduplication and weakening.

Phonological opacity refers to the process whereby a phonological rule (process) fails to apply in a specific environment even when the requirement of the environments is satisfied. As cited by Kiparsky (1973), the bulk of the attention paid to opacity has been relatively recent and has been fueled by the field's massive (but incomplete) shift from the rule-based serialism framework of the sound patterns of English (Chomsky & Halle 1968) to the constraint-based parallelism framework of Optimality Theory (Prince &Smolensky 1993). This illustrates the fact that phonological opacity is better analysed with the help of an Optimality Theory framework. Kiparsky further states that an opaque rule P is 'difficult to learn' because there are surface counter examples to P's applicability or because there are surface contexts in which P's application is not motivated. This substantive claim was built on the concept of learnability of which Kiparsky gave examples from cases of Language change, which some opaque rules or interactions became transparent. McCarthy (2002) states that phonological opacity is in two forms:

(i) Linguistically significant generalisations are often not surface true.

(ii) Linguistically significant generalisations are often not surfaced apparent.

By implication, a phonological generalisation that has been rendered non-surface-true or non-surface apparent by the application of subsequent rules is always said to be opaque. Eminent in the study of opacity are counter-feeding and counter-bleeding. 'Counter-feeding refers to the ordering of two phonological rules" so that Rule A, which could provide context for the operation of Rule B, is prevented from doing so by being ordered after Rule B. Counter-bleeding, on the other hand, is an opaque rule ordering. It is a process or condition where the application of rule B simply does not prevent rule A from applying, even if rule B had not applied. Both Counter-feeding and Counter-bleeding are derivatives of feeding and bleeding'(McCarthy, 2002). In Shimakonde; Manus, 2003), for example, vowel harmony and mid vowel reduction combine to yield opaque forms:

Shimakonde opacity (data from Liphola, 2001):

a. Kú- péét-a – 'to separate'

b. Kú-p<u>á</u>t- ééɨ -a- 'to separate for'

c. Kú- p<u>á</u>t -él-áán-a – 'to separate for e-o

The forms in (b) and (c) are opaque because the applicative suffix, /il/, is the target of mid vowel harmony due to the mid vowel in the verb root and surface as –el, but the triggering root vowel is reduced to a. Thus, there is no surface-transparent way to account for why the applicative suffix surfaces as –el-without reference to the underlying mid vowel in the verb stem.

Tableau 1: For Opacity

/ku-pet-il-a /	**ID (height) tonic**	**Harmony**	**Reduce**	**ID (height)**
(a) kúpátééla				* !*
(b) kupátáála	*!			*
(c) kupétééla			*!	
(d) ☞ k[illegible]la				*
(e) kúpétííla		*(!)	*(!)	

A problem is encountered with the rankings obtained when considering the opaque forms above. This tableau selects the incorrect surface form, ‘kúpātííla’ (d) for the /‘kúpét-il-a/; the actual output ‘kúpātééla (a) is less optimal than (d) because it violates more faithfulness constraints. Whereas in (d), only the vowel height of UR /e/ changes, in (a), both of the applicative suffixes are different than the corresponding underlying forms.

2.1.2. Deletion

Urua (2000) has aptly demonstrated that vowel deletion is a common phonological process (property) in languages of the Niger-Congo family of which Annan̄ language is a cognate. To Udoh (2003), deletion is the loss of segment in connected speech. In other words, deletion does not operate only in words but in connected speech discourse which requires the presence of at least two lexical elements. Akpabio (2020) asserts that deletion is the disappearance of a sound for ease of articulation. For instance, Japanese verb suffixes sometimes surface with an initial coronal consonant (1). The generalisation is that vowel-final stems are followed by a coronal in the suffix, whereas consonant-29final stems are followed by vowel-initial suffixes

Japanese verbs (Kurisu 2012:311)

Suffix	/tob/	‘fly’	/ne/ ‘sleep’
Infinitive	/-ru/	tob-u	ne-ru
Subjunctive	/-reba/	tob-ebane-reba	
Causative	/-sase/	tob-ase	ne-sase
Volitional	/-joo/	tob-oo-	ne-joo

Kurisu (2012) argues that underlying suffix-initial coronals are deleted when preceded byanother consonant. This deletion occurs because of the phonotactic restriction of Japanese:codas cannot have their own place specification. In OT, coronal deletion is driven by CO-DACOND(ITION) (Ito 1986/1988, 1989; Ito and Mester 1998, 2003; Goldsmith 1990). Furthermore, root segments are more faithful than suffix segments (MAXRoot ≫ MAXAffix;McCarthy and Prince 1995; Beckman 1998). In parallel OT, CODACOND can be satisfiedby deletion of the second consonant, which would have been the onset in the output (2).

Kurisu’s Parallel OT Analysis

/tob-ru/	CODACOND	MAX Root	MAX Affix
☞ a. to.bu			*
b. to.ru		*!	
d. tob.ru	*!		

Tableau 2

/r/ deletion and /w/ deletion

The right order		**The wrong order**	
UR	/kaw+ru/	UR	/kaw-ru/
/r/ deletion	/kaw+u/	/w/-deletion	/ka-ru/
/w/ deletion	/ka+u	/r/-deletion	-does not apply
SR	[kau]	SR	[karu]

Bakovic (2003), in standard OT citing (Prince and Smolensky 2004), states that it is difficult to make sense of why /ka.u/ wins over /ka.ru/, because the deserved winner /ka.u/ violates ONSET and incurs an extra violation of MAX for/r/, compared to /ka.ru/ (Sasaki (2006), Kurisu (2012)). Bakovic citing Sasaki (2006) asserts that he entertains several kinds of analysis of these opaque patterns, and concludes that the strata OT-analysis is the best analysis.

Tableau 3

/kaw-ru/	*** CC**	**ONSET**	**MAX**
a. Kaw.ru	*		
b. Ka.ru			*
c. ☞ Ka.u		*	**

Also, he states that this problem can be avoided if /r/ did not exist in the underlying representation. Similarly, Sasaki (2006), Kurisu (2012) argue that this is a case of allomorph selection. Therefore, roots like /kaw/ selects /u/ at the same of allomorph selection with the consonant /w/ being present. If there is only one consonant when /w/-deletion occurs, then there is no over kill.

Vowel Harmony

The phonological process (vowel harmony) over time has garnered much attention in the study of opacity. Essien (2010) posits that vowel harmony is a process by which the vowels of a language, usually in a single word are so constrained that all of them must have some property or properties in common as determined by the phonological environment. Williamson (1984) maintains that vowel harmony is the system whereby in many languages, the vowels are divided into two sets, 'wide' and 'narrow' in such a way that vowels from the same set normally go together in some simple word. To Hyman (1975), although there are several typologies of vowels, complete vowel harmony is often referred to as vowel copying or vowel reduplication. It is most cases referred to as partial variety. In this case, a vowel assimilates in certain features to another vowel. The most essential features assimilated are front-backness, tense-laxness and liability.

Front vowels are produced from the front part of the tongue while back vowels are produced from the back part of the tongue. On the other hand, lax vowels are produced with somewhat less muscular tension than tense ones and are also somewhat shorter in duration. Being one of the properties of opacity, vowel harmony, according to Urua (2000), is a phonological concept that reveals an interesting dichotomy with respect to word class. Furthermore, Udoh (2003) observes that vowel harmony is the assimilation between vowels where one vowel takes the properties of a neighboring vowel, thus harmonising with it. This harmonic feature can be partial or complete. In the words of Udondata (2006), 'Vowel harmony is concerned with agreement between vowels in successive syllables' (Udoh, 2003, p. 39). However, opaque vowels are consistent with a generally accepted idea that the phonetic basis of vowel harmony inheres in V-to-V co-articulation effects. This is the articulation that results from simultaneous involvement of two identifiable strictures (Eka and Udofot, 1996, p.54).

Like high vowels, low vowels may also be neutral. In Pulaar, for instance, low vowels are opaque to vowel harmony. Pulaar shows regressive harmony of mid vowels, such that the [ATR] value of suffixes migrates to stems, as in Peec-i/PƐƐC-ɔn' crack PL./crack DIM. PL? Where the plural suffix-i causes the stem to surface with a [ƗATR] vowel, while the diminutive plural suffix -ɔn imposes its [-ATR] value onto the stem. The behaviour of mid vowels may be contrasted with that of the opaque low vowel /a/.

Examples are:

1. Opaque low vowels in Pulaar (Archangeli and Pulleyblank 1994)

a.	bɔɔt-aa-ri ‘dinner’ a	a.	*	boot-aarib.
b.	pɔɔf –aa-li’ breaths’	b.	*	proof-aa-li
c.	nɔdd –aa-li ‘cal’	c.	**	nod-aa-li
d.	ŋgɔr-aa-gu‘ courage’	d.	*	ŋgor-aa-gu

In (1), the [- ATR] value of the right most suffix cannot spread to the low vowel /a/, which surface as [ATR] everywhere in Pulaar. The low vowel not only does not accept the feature value of the suffix to its rights, but it also blocks vowel I harmony from propagating to the stem to its left, and starts its own harmonic domain, as shown by the starred examples in (1) a-d; when a stem appears to the left of /a/, it cannot contain a [+ATR] vowel. In addition, phonetic features have also been implicated in grounding the phenomena of opacity in ‘tongue root’ harmony system (Archangeli and Pulleyblank 1994).

To illustrate the process of vowel harmony, OT Tableau may be used.

Tableau 4: Opacity

/ai-ä	**Agree (bk)**	**Agree a, o, u**
i [ai-ä]	*	*
Ii [ai-a]	**!	

It is a notable corollary of the Kiparsky and Pajusalu (2003) system that back vowels in ‘palatal’ harmony languages are opaque rather than transparent. That is, in the system entertained here, [ä o ä] is harmonically bound by [a o a].The sequence [ä o a] violates Generalised Marked Harmony once and AGREE(BK) once. The sequence [ä o ä] violates Generalised Marked Harmony twice and AGREE(BK) twice. Thus, regardless of the ranking between the two constraints, Generalised Marked Harmony and AGREE(BK), [ä o ä] < [ä o a], this is a remarkable result, following from two ‘first principles’ in the Kiparsky & Pajusalu system, markedness and agreement.

Theoretical Framework: Optimality Theory

Though relatively a new linguistic theory, optimality theory as an aspect of Generative Grammar has garnered much importance over the years (dating from 1993). Given its premium in Generative Phonology (GP), Optimality Theory (OT) seeks to explain the constraints posed on the phonological systems of languages as an output of the grammar of such languages. This particularly holds true as processes can be blocked by output constraints. The variations within the framework of these constraints have generated universally a system known as Universal Grammar (UG) or language universal and language specific (features only inherent and limited to a particular language). It follows, therefore, that an input to the grammar, freely undergoes any, all or none of the transformations, and candidate structure that satisfies all of the filters is a well-formed sentence of the language.

OT was propounded by Alan Prince and Paul Smolensky and was later developed to Optimality Theory in Constraints Interaction in Generative Grammar (2004). In the domain of Generative Grammar, TO is reflected in the works of Chomsky and Lasnik (1977). According to them, a transformation (T) is an effect blocked or constrained whenever a surface filter rules out the result of applying, and T is in effect triggered whenever a filter rules out the result of not applying.

Prince and Smolenky’s (1993) paper on optimality theory states that generation of utterance in OT involves two functions, Gen and Eval. In addition, they explain that Gen takes an input and returns a (possibly infinite) set of output candidates. To them, some candidates might be identical to the input, others modified somewhat, others unrecognisable. In this framework, they assert that Eval chooses the candidate that best satisfies a set of ranked constraints; this optimal candidate becomes the output.

Typical of the theoretical framework, Prince and Smolensky (1993) observe that the constraints of Eval are of two types: markedness constraints enforce wellformedness of the output itself, prohibiting structures that are difficult to produce or comprehend, such as consonant clusters or phrases without overt heads, while faithfulness constraints enforce similarity between input and output, as illustrated by them, requiring all input consonants to appear in the output or all morpho-syntactic features in the input should be realised in the output overtly.

According to them, Markedness and Faithfulness constraints can conflict, so the constraint's ranking which differs from language to language determines the outcome. Accordingly, they opine that one language might eliminate consonant clusters by deleting the consonants, despite the resulting faithfulness violations; another might retain all input consonants, violating the Markedness constraints. As it is established in standard OT by Prince and Smolensky's paper on optimality theory (1993), constraints are strictly ranked and violable. According to them, ranking means that a candidate violating a high-ranking constraint cannot redeem itself by satisfying lower-ranked constraints, while violability means that the optimal candidate needs not satisfy all constraints in any language analysed.

Equally, they recognise that Eval can be viewed as choosing the subset of candidates that best satisfies the top ranked constraint, then, of this subset, selecting the sub subset that best satisfies the second-ranked constraint in the language. However, they postulate a different way of describing Eval.

In effect, the tableau below according to them, illustrates output selection for the input /ilp/ in a hypothetical mini-language. Each of the four output candidates is flawed: Candidate *C*, the most faithful, has a consonant cluster; violating the markedness constraint *CC's column and *c*'s row. Candidate *b* has deleted a segment, and *a* has inserted a segment; these candidates violate the faithfulness constraints DON'T DELETE and DON'T INSERT, respectively, (MAX and DEP). Candidate *d* has inserted a segment without breaking up the consonant cluster, violating both DON'T INSERT and *CC.

*CC is the highest-ranked constraint, according to them (ranking is indicated by left-to-right ordering of the constraints' columns. We can also write *CC>> DON'T DELETE >> DON'T INSERT). Eval first eliminates *C* and *d* from the competition (exclamation mark represents – elimination) because they alone violate *CC. The shading in the cell to the right represents the irrelevance of C's and d's performance on any lower-ranked constraints. Eval next eliminates b, because it violates DON'T DELETE; the remaining candidate a is optimal, as indicated by the pointing figure. In this language, an output string /ilp/ is pronounced [ilip]; in another language, the constraint ranking, and thus the output might be different. To them, there are rankings that would choose a or b as the optimal candidate. Candidate, *d*, however is "harmonically bounded" by a, and by *C*: its violations are a proper superset of both a's and c's. Therefore, d cannot be the optimal candidate under any ranking of just these three constraints, though it could be optimal with a larger constraint set.

Tableau 5

/ilp	***CC**	**MAX**	**DEP**
a ☞ [ilip]			*
b [il]		*!	
c [ilp]	*!		
d [ịlpi]	*!		*

The tableau below shows the evaluation of output candidates by a set of ranked constraints displayed in the tableaus.

The researchers collected data which contain phrases and associative constructions. Some native speakers in Ika, Abak and Ukanafun Local Government Areas of Anaañ speakers in Akwa Ibom State speakers were consulted. The purpose was to ensure that the data collected were accurate and authentic in their forms. Data transcription was done using the researchers' linguistic knowledge. In establishing the constraint that conditions opacity in the language, the researchers adopted the optimality theory to carefully analyse their data.

Data Presentation

Table 1

Data Showing Vowel Deletion

	Input	**Output**	**Gloss**
a.	nɔ́ɔ́ŋɔ́ + *é̲*rib	nɔ́ɔ́ŋ*é̲*rib	Give me in twenties
b.	kɔ́ɔ́ŋɔ́+ èkpàt	kɔ́ɔ́ŋèkpàt	Remove the bag
c.	fɔ́ɔ́rɔ́ + ébèn	fɔ́ɔ́rébèn	Peel the pear
d.	fɔ̀rɔ́ + èkɔ́n	fɔ̀rèkɔ́ŋ	Wear the mask
e.	kɔ́ŋɔ́+ ékpàt	kɔ́ŋékpàt	Hang the bag
f.	tɔ́ɔ́ŋɔ́ + édɔ́n	tɔ́ŋɔ́édɔ́n	Kneel down
g.	t*ù*mmɔ́ + *é*kp*ó*	t*ù*mm*é*kp*ó*	Invoke the spirit
h.	kɔ́ŋŋɔ́ + *é*si*ó*	kɔ́ŋŋ*é*si*ó*	Unhang the pot
i.	bɔ̀ɔ̀rɔ̀ + *é*kɔ̀ɔ̀m	bɔ̀ɔ̀r*é*kɔ̀ɔ̀m	Answer the greetings

Table 2

Data Showing Opacity in Vowel Deletion

	Input	**Output**	**Gloss**
a.	nnɔ̀ + érɪ́b	nnɔ̀érɪ́b	Give me in twenties
c.	ntɔ̀ + ékɑ́	ntɔ̀ékɑ́	Brothers and sisters
d.	nnɔ̀ + èsɪ̀o	nnɔ̀èsɪ̀o	Give me the pot
e.	ntɔ̀ + ètè	ntɔ̀ètè	Niece and nephew
f.	nnɔ̀ + èkpɑ̀t	nnɔ̀èkpɑ̀t	Give me the bag
g.	nnɔ̀ + énɑ́n	nnɔ̀énɑ́n	Give me the cow
h.	nnɔ̀ + ébèn	nnɔ̀ébèn	Give me pears
i.	nnɔ̀ + èkɪ̀d	nnɔ̀èkɪ̀d	Give me axes
j.	nnɔ̀ + ébɔ́t	nnɔ̀ébɔ́t	Give me the goat

Table 3

Data Showing Weakening in Anaan̄

	Input	**Output**	**Gloss**
a.	échít + úfɔ̀k	/et̡ʃirufok/	Inside the house
b.	échít + áfìt	/et̡ʃurafid/	Anus
c.	ékpàt + íwá	/ekpariiwa/	A bag of cassava
d.	keet + keet	/keerekeet/	One by one
e.	ikot + ekpene	/ikɔrekpene/	Name of a town
f.	utuut + ekpe	/utuurekpe/	Spider
g.	ntat + anen	/ntaranen/	Enlightenment

Table 4

Data Showing Opacity in Weakening of Voiceless alveolar /t/

Data Analysis on Vowel Deletion

In Anaañ, this is also one of the commonest processes found in Lower Cross languages, of which Ibibio belongs to (Urua, 2007). It entails the loss of a segment or supra-segment as the case maybe. In Ibibio, consonants and vowels can be deleted in the language depending on their environment (Urua, 2000, p. 76). Let us consider the following examples:

a)	Ke + itak	kitak	in the stem
b)	Ke + idim	kidim	at the stream
c)	Ke +ima	kima	because of love

	Base	**Gloss**	**RED form**	**Gloss**
a.	Top	throw	Tootop	Be throwing rather than…
b.	Tem	cook	Teetem	Be cooking rather than…
c.	Ta	chew	Taata	Be chewing rather than…
d.	tɔ	plant	tɔɔtɔ	Be planting rather than…
e.	Tie	sit	Tietie	Be sitting rather than…
f.	Tia	kick	Tiatia	Be kicking rather than…
g.	Tan	kalk	Taatan	Be talking rather than…
h.	Tua	cry	Tuatua	Be crying rather than…
i.	Tim	beat	Tiitim	Be beating rather than…
j.	Tuai	push	tuaituai	Be pushing rather than…

The occurrence of two vowels at boundary position triggers the deletion of one. In the above cases, we can observe that this process is conditioned by vowel height. Where a high vowel and one lower than it occurs, the high vowel will survive while the low vowel will be deleted. For the cases presented above, we see that this process is regulated by * $V\text{-}_{hi}+ V+_{hi}$, which states that a non-high and a high vowel should not be juxtaposed at morpheme boundary position (Udoh 2016).This is analysed thus:

Table 5

Ke-idem	**$*V_{-hi}+V_{+hi}$**	**IDENT-IO(s)**	**MAX-V(hi)**	**MAX-V**
a. keidem	*!			
b. keedem		*!	*	
d. ☞ em				*
d. kiidem		*!		

The optimal candidate is candidate (c) because it has less violation.

The next tableau presents the deletion of back vowel /ɔ/ at morpheme boundary. When a vowel is deleted, it is for wellformedness purposes. In the case of this study, there is a condition that at the morpheme boundary, a V[+ back] + V[- back] may not occur as would be presented in the tableau. The occurrence of a V[+back] + V[-back] may give rise to opacity in vowel deletion. The opacity in vowel deletion can be regulated by * V[+back] + V[-back] which states that a back vowel and a front vowel should not be juxtaposed at morpheme boundary position. This specific constraint is ranked higher than others. In assessing the candidates, markedness constraint as well as faithfulness constraint is required.

Ranking Summary

*V[+back] + V[-back] - a plus back vowel cannot occur with a minus vowel at morpheme boundary positions.

DEP-IO - don't insert anything in the input and output or every element of the output must have a correspondent in the input.

MAX-IO - Don't delete anything in the input and output.

Table 6

Kɔŋɔ + ekpat	***V[+back]+V[-back]**	**DEP-IO**	**MAX-IO**
a. k☞			!
b. kɔɔŋɔekpa	!		!
c. kɔŋɔekpat	!		
d. kɔɔekpat	*!		

From the above table, we can see that the optimal candidate is candidate (a) because it does incur less violation of the constraints. These constraints justify the case of vowel deletion. The faithfulness constraint has been violated.

The next tableau presents opacity in vowel deletion. The constraints that may regulate opacity in vowel deletion are MAX-V̀[+back] +, DEP-IO and MAX-IO which states that a low tone back vowel should or may not be deleted at morpheme boundary position. This specific constraint is ranked higher than other constraints. A tableau showing analysis of opacity in vowel deletion is presented as follows:

Table 7

	nnɔ +erib	**MAX – V̀[+back]+**	**DEP-1O**	**MAX-IO**
a	Nnerib	*!		
b	☞			
c	nnɔrib			!
d	Nneri	*!		

From the above tableau we can see that the optimal candidate is candidate (b) because it does not violate any of the constraints. These constraints tried to justify opacity in vowel deletion. The markedness as well as faithfulness constraint were not violated. However, the winning candidate is questionable because the constraint MAX-V̀[+back] + that would have regulated opacity, is faulty with some set of data and thus do not stand. The data are presented thus:

Input	**Output**
inɔ́-ekpat	inɔ́-ékpàt
ikɔ- edem	ikɔ- edem
udɔ edɔŋ	udɔ edɔŋ

Again, we need to alter the constraint to account for opacity in vowel deletion. This is seen in Table 7. This tableau that would be presented would account for opacity in vowel deletion, particularly the back vowel /ɔ/ at morpheme boundary position. Meanwhile, the constraints that regulate opacity in vowel deletion are MAX-V (Ṇ.CV), DEP-IO and MAX IO which state that a back vowel /ɔ/ may be opaque to morpheme boundary deleting. This is analysed thus:-

Table 8

	nnɔ+erib	**MAX – V[N. CV]**	**DEP-1O**	**MAX-IO**
a	nnerib	*!		
b	nn☞			
c	nnɔrib	*!		
d	nneri	*!		

The candidate (b) satisfies its constraints: MAX-V (N.CV), DEP-IO and MAX-IO which are violated by other candidates.

Data Analysis on Weakening

Weakening, also known as lenition, is a phonological process that contrasts with consonantal strength. Weakening as a process is often in Anaañ words although it is phonetic (Udoh, 2003). Normally, consonants are weakened in intervocalic positions in Anaañ and such occurs at the lexical and the post lexical levels as it will be demonstrated below. This process of weakening may be regulated by * V stop V which states that a stop cannot occur at intervocalic positions. This constraint is ranked higher than other constraints. It is, therefore, analysed below.

Table 9

	echitufok	***VstopV**	**MAX-IO**	**DEP-IO**
A	echirufok			
B	e☞[illegible]	*!		
C	echufok		*!	
D	echitufo	*!		

From the above tableau the optimal candidate is candidate (a) because it does not incur any violation from the ranked constraints.

The next tableau analyses data showing opacity in weakening of the voiceless alveolar /t/. Although the process of weakening may occur when a stop is found in intervocalic position, the presence of this process may give rise to opacity in weakening through reduplication. In other words, opacity in weakening may occur in the process of reduplication, where the opaque environment isa reduplicate morpheme. This is regulated by the constraint IDENT-IO (ONSET) which states that input segments should be identified with the output (no change). This constraint applies to partial reduplication. Partial reduplication may come in a variety of forms, from simple consonant germination or vowel lengthening to a nearly double copy of a base. This study makes use of verbal reduplicates because partial reduplication in Anaañ applies to verbs while the complete reduplication applies to nouns and adjectives (Udoh 2016).

The data 'tootop' is an example of partial reduplication. It can be analysed thus:

Table 10

RED-top	**IDENT-IO (ONSET)**	**MAX-BR**	**DEP-BR**	***VStopV**
a. ☞				!
b.toop	*!			
c.toro	*!			
d. otop	*!			

From the above tableau, we can observe that the optimal candidate is candidate (a) because it incurs less violation. Candidate (a) is the winner in that it satisfies the constraint IDENT-IO (ONSET).

Discussion of Findings

In this study, analyses and discussions have been centered on opacity in vowel deletion and weakening in the Anaañ language. As discovered by Kiparsky & Pajusaluin Hungarian, back vowels in ‘palatal’ harmony languages are opaque rather than transparent (see tableau 4 in literature review). Similarly, in Anaañ back vowels at morpheme boundary position are opaque to deletion. However, a full word boundary is necessary before deletion can occur at the post-lexical level. Here, the results of the analysis show that when back and front vowels which may be of the same height occur together at morpheme boundary, it is the back vowel that usually gets deleted (see **Table 6)**. This does not, in any way, account for opacity in vowel deletion. A case of opacityin vowel deletion is seen when a back and front vowel occur together at morpheme boundary without triggering deletion in N.CV syllable structure, thus, conditioning opacity in vowel deletion in the language (see **Table 8**).

Findings also reveal that opacity may apply in the process of weakening, which offers a unique perspective to the study of opacity in one of the lesser studied African languages in Akwa Ibom State of Nigeria. Here, it is found that a stop is weakened in phrases or associative construction in the process of reduplication where the reduplicant morpheme of verbal reduplicates is opaque to weakening (see **Table 10)**. The constraints that condition this opaque process are indicated in above.

Conclusion

So far, opaque interactions have been identified in Anaañ through vowel deletion and weakening in the process of partial reduplication process. This confirms that opacity in any natural language may be discovered in any phonological processes that pervades natural language. Results from the present study with insights from OT tables show that the process of deletion may be opaque as a result of the N.CV syllable structure, of which, the back vowel /ɔ/ cannot be deleted at morpheme boundary.However, the case of opacity in vowel deletion may vary in other languages. Thus, with insights from optimality theory framework, this study has revealed a case where a phonological rule fails to apply (opacity) even when the environment satisfies its conditions. Findings also revealed that opacity applies on weakening in Anaañ. Weakening is a phonological process which occurswhena stop is flanked by two vowels in an intervocalic position. On the contrary, the process of partial reduplication also has a stop in an intervocalic position, and satisfies the requirements of the environment and is not weakened, therefore, conditions opacity in weakening in Anaañ. These findings support the hypotheses: what are the opaque interactions in the language and what are the constraints that condition opacity in the language?

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APPENDIXES

Data Showing Vowel Deletion

	Input	**Output**	**Gloss**
a.	nɔ́ɔ́ŋɔ́ + <u>é</u>rib	nɔ́ɔ́ŋ<u>é</u>rib	Give me in twenties
b.	kɔ́ɔ́ŋɔ́+ èkpàt	kɔ́ɔ́ŋèkpàt	Remove the bag
c.	fɔ́ɔ́rɔ́ + ébèn	fɔ́ɔ́rébèn	Peel the pear
d.	fɔ̀rɔ́ + èkɔ́n	fɔ̀rèkɔ́ŋ	Wear the mask
e.	kɔ́ŋɔ́+ ékpàt	kɔ́ŋékpàt	Hang the bag
f.	tɔ́ɔ́ŋɔ́ + édɔ́n	tɔ́ŋɔ́édɔ́n	Kneel down
g.	tù̀mmɔ́ + ékpó	tù̀mmékpó	Invoke the spirit
h.	kɔ́ŋŋɔ́ + ésió	kɔ́ŋŋésió	Unhang the pot
i.	bɔ̀ɔ̀rɔ̀ + ékɔ̀ɔ̀m	bɔ̀ɔ̀rékɔ̀ɔ̀m	Answer the greetings

Data Showing Opacity in Vowel Deletion

	Input	**Output**	**Gloss**
a.	nnɔ̀ + éríb	nnɔ̀éríb	Give me in twenties
c.	ntɔ̀ + éká	ntɔ̀éká	Brothers and sisters
d.	nnɔ̀ + èsìo	nnɔ̀èsìo	Give me the pot
e.	ntɔ̀ + ètè	ntɔ̀ètè	Niece and nephew
f.	nnɔ̀ + èkpàt	nnɔ̀èkpàt	Give me the bag
g.	nnɔ̀ + énán	nnɔ̀énán	Give me the cow
h.	nnɔ̀ + ébèn	nnɔ̀ébèn	Give me pears
i.	nnɔ̀ + èkìd	nnɔ̀èkìd	Give me axes
j.	nnɔ̀ + ébót	nnɔ̀ébót	Give me the goat

Data Showing Weakening in Anaan̅

	Input	Output	Gloss
a.	échít + úfɔ̀k	/etʃirufok/	Inside the house
b.	échít + áfìt	/etʃurafid/	Anus
c.	ékpàt + íwá	/ekpariiwa/	A bag of cassava
d.	keet + keet	/keerekeet/	One by one
e.	ikot + ekpene	/ikɔrekpene/	Name of a town
f.	utuut + ekpe	/utuurekpe/	Spider
g.	ntat + anen	/ntaranen/	Enlightenment

Data Showing Opacity in Weakening of Voiceless Alveolar /t/

	Base	Gloss	RED form	Gloss
a.	top	throw	tootop	Be throwing rather than…
b.	tem	cook	teetem	Be Cooking rather than…
c.	ta	chew	taata	Be Chewing rather than…
d.	tɔ	plant	tɔɔtɔ	Be Planting rather than…
e.	tie	sit	tietie	Be Sitting rather than…
f.	tia	kick	tiatia	Be Kicking rather than…
g.	tan	talk	taatan	Be Talking rather than…
h.	tua	cry	tuatua	Be Crying rather than…
i.	tim	beat	tiitim	Be Beating rather than…
j.	tui	push	tuitui	Be Pushing rather than…

Authors' Bio

Akpabio, Samuel Friday,
Samuel Akpabio is a Broadcast Journalist with a decade of experience; he was trained with the Federal Radio Corporation of Nigeria, FRCN. He holds a Bachelor of Arts degree in Linguistics from the University of Uyo,Uyo, Nigeria, a Postgraduate Diploma in Journalism from the International Institute of Journalism, Abuja, a Diploma in French from Alliance Francaise, Paris, France, a certificate in TESOL/TEFL from the International TEFL Training Institute, New York, USA. He is currently a postgraduate student in the department of English at the University of Uyo, Uyo, Nigeria. His areas of interest are: Stylistics, Discourse Analysis, Pragmatics, Media Linguistics, and ESL Phonology. He is the author of the book entitled: '*Improve Your Oral English Fluency: A Practical Approach,*' published in 2024.

Ene, Ndifreke Bills
Ene, Ndifreke Bills hails from Esit-Eket Local Government Area in Akwa Ibom State of Nigeria. Ndifreke studied Linguistics at the University of Uyo, Uyo, Nigeria. As a trained linguist, she holds a Diploma in French. Ndifreke is currently a master's student in the Department of English at the same institution where she obtained her Bachelor of Arts degree in Linguistics. Her areas of specialization include but not limited to Pragmatics-Syntax interface, ESL Phonology, Syntax and Morphology of English.

Ukpabio,Joyce Effiong
Ukpabio,Joyce Effiong holds a Bachelor of Arts degree in Efik/Ibibio Education from the University of Uyo, Uyo, Nigeria. She is a seasoned teacher of Efik and Ibibio languages in a reputable secondary school in Akwa Ibom State. Joyce is a postgraduate student in the Department of Linguistics and Nigerian Languages, University of Uyo, Uyo, Nigeria. Her areas of interest include, Oral Literature, Sociolinguistics and their interface with other areas of linguistics.