Optimality Theory: Application of Dahl's law in Kindia

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ABSTRACT

This paper looks at Dahl's law, a voice dissimilation process prevalent in Bantu languages, and how it is manifested in Kindia, a Kikuyu dialect. Dahl's law is realized in varied ways in Zone E languages at dialectal level hence making it a significant divider amongst dialects of the same language (Kanana, 2011). Dialects tend to vary at phonological and morphological levels. While these variations can be identified, discussions of their viability can be discussed through Universal Grammar. Optimality Theory postulated by Prince and Smolensky (Prince & Smolensky 2004) can be used to establish the constraints that may be at play in determining the realization of Dahl's law in Kindia. Some Zone E Bantu languages allow for the dissimilation of the voiceless stops such as /*t*/ and /*k*/ to voiceless fricatives, /*ð*/ and /*ɣ*/ respectively depending on the verb stem (Elwell, 2010). However, Kindia shows marked difference in that the voiceless velar stop /*k*/ in the verb initial is retained regardless of the verb stem. This markedness, allowing the retention of the voiceless velar stop /k/, is one of the dominant features that distinguish Kindia from other Kikuyu dialects. Using Optimality Theory, this study seeks to demonstrate the diverse and allowable manifestations of the Dahl's law in Kindia different from other Kikuyu dialects. In the other Kikuyu dialects (Nyeri, Murang'a and Kiambu), the voiceless velar stop /*k*/ is realized as voiceless velar fricative /*ɣ*/ if the verb stem has a vowel initial or has the voiced velar fricative, /ð/. Kindia ranks constraints differently than other Kikuyu dialects.

Keywords: Dahl's law, Optimality Theory, voice dissimilation, Bantu, Kindia

INTRODUCTION

Kindia is a Kikuyu [ISO: kik] dialect spoken in Kirinyaga County (ISO 639-2). Located in Central Kenya, Kirinyaga County has a population of over 600000 people (Kenya National Bureau of Statistics, 2019). Kindia is also known as '*Gi-Kirinyaga*' as it is spoken by people from Kirinyaga County. The prefix *Ki-Gi-* is a Class 7 noun class marker as categorized in Bantu languages (Kutik, 1983). Kindia is classified as a dialect of Kikuyu spoken in Southern Mount Kenya region (Iribemwangi, 2012). Kikuyu has other dialects spoken in Nyeri, Kiambu, and Murang'a counties in Central Kenya as well as other areas in central Rift Valley. Maho (2008) lists six dialects of Kikuyu, namely, North Kikuyu, South Kikuyu, Kindia, Gigichugu, Murang'a and Mathira. Iribemwangi (2012) affirms that these Kikuyu dialects can be linguistically discerned. Thus Kindia is also distinguishable from other Kikuyu dialects in pronunciation, intonation, phonemic system and in select vocabulary as is common with dialects.

Key phonemic differences between Kindia and other Kikuyu dialects

Two key phonemic aspects that distinguish Kindia dialect from other Kikuyu dialects is the non-existence of the glottal fricative /h/. In its place, the glottal fricative /h/is either omitted or realized as the bilabial fricative /β/. This bilabial fricative /β/ is conspicuously absent from the other Kikuyu dialects as illustrated below:

Other Kikuyu dialects	Kindia	Gloss
ha**h**a	a**β**a	'here'
harea	**β**area	'there'
e**h**uta	e**β**uta	'move away'

huura	**β**uura	'wipe the surface'
ko**h**o**h**a	ko**β**o**β**a	'to wilt away'
hurutera	**mb**urutera	'fan me'
hiɣo	**mb**iɣo	'a kidney'
ke**h**uruta	**kemb**uruta	'butterfly'
hio	**mb**io	'hot item'
i**h**o**h**a	i**β**o**β**a	'a boil'

From the above examples, the glottal fricative /h/ found in other Kikuyu dialects is firstly conspicuously absent in Kindia. Secondly, it is either realized as the voiced bilabial fricative /*β*/ or as a pre-nasalized bilabial stop /mb/. This prevalence of the glottal fricative /h/ makes the Kindia speakers refer to the other Kikuyu dialects as '*ke-haha*' speakers, that is, those who use the glottal fricative /h/ sound as illustrated in the words above.

Optimality Theory

Optimality Theory, hereafter referred to as OT, is a development of Generative Grammar focusing on formal description of and quest for universal principles (Kager, 2007). Having noted that Universal Grammar contains a set of violable constraints, it therefore means that surface forms of a language reflect resolutions of conflicts between competing demands (Archangeli, 1999). The surface form is optimal if it incurs the least serious violations of a set of constraints, taking into account their hierarchical ranking in each language. OT identifies the constraints in a language and assigns them roles in a language (Archangeli, 1999). These markedness and faithfulness constraints are at play as they govern the output. On the one hand, faithfulness constraints determine the preservations of the input in the output by asking for the exact preservation of the input in the output along various dimensions. On the other hand, markedness constraints govern the well-formedness of the output. Thus, OT grammar employs this input-output mechanism and that each input has only one output Kager (2007). This input-output relation thereby generates a set of candidates which are then evaluated to determine the one that best satisfies the relevant constraints, and ranked in order of importance. Therefore,

Input →GEN→ Candidate set →EVAL→ Optimal candidate

Kager (2007) provides the following mapping of input to output in OT grammar:

Table 1: Mapping of input to output in OT grammar

		C_1	»	C_2	»	C_n		
	Candidate a →		→		→			
	Candidate b →							
Input →	Candidate c →		→					
	Candidate d →		→		→		→	Output
	Candidate ... →		→					

Source: Kager, 2007 pg. 8

Each language prioritizes some constraints over others based on domination; the higher-ranked constraint has priority over the lower-ranked one regardless of the violations thus resolving the conflicts by domination (Kager, 2007).The ranking of constraints in languages gives rise to systematic variation between languages and even between dialects as shall be indicated in this paper.

Dahl's Law in Zone E languages

Dahl's law is a voicing dissimilation process where Bantu voiceless stops become voiced in certain circumstances as observed in Zone E languages[1]. This dissimilation process applies in CVCV sequences where both consonants (C) are voiceless and thus turns the first consonant into its voiced counterpart (Werner, 2011). Voiceless stops, such as /p t k/, become voiced (/b d ɣ/) when immediately followed by a syllable with another voiceless stop.

Elwell (2010) illustrates that in Ekegusii, a Zone E language, the velar stops dissimilate with the voicing of the following onset.

Dahl's law in Ekegusii

Word	**Gloss**
oɣotama	'to flee'
okoraaɣera	'to eat'

Using OT, voicing is the markedness constraints in Ekegusii in the CVCV sequence. Thus, the initial voiceless stop is realized as a voiced fricative if followed by voiceless stop. In cases where the initial stop is followed by a lateral, the stop after the lateral becomes a voiced fricative /**ɣ**/. The faithfulness constraint on the other hand ensures that the CVCV syllable structure is preserved. No segments are deleted in both examples, making MAX-C a dominant constraint. Therefore, a tableau for these realizations can be mapped as follows:

Table 2: okotama/ → [oɣotama]

Candidate	***VOICELESSSTOP+STOP**	**IDENT(CVCV)**	**IDENT (voice)**	**Optimal**
oɣotama	0	0	1	√
okotama	1!	0	0	
ogotama	0	0	1	

Table 3: /okoraaɣera/ → [okoraaɣera]

Candidate	***VOICLESSSTOP+STOP**	**IDENT(CVCV)**	**IDENT (voice)**	**Optimal**
okoraaɣera	0	0	1	√
okoraakera	1!	0	0	

In both tableaux, candidates (b) and (c) violate the markedness constraints (*VOICELESSSTOP+STOP**)** where obstruents are in sequence, and thus are deemed least optimal outputs. Penalization occurs where voiced stops occur in onset positions and where voiceless stops occur in sequence. Since Candidate (a) has the least violations, it makes it the optimal output. IDENT (voice) and IDENT(CVCV) preserve the input voicing and the syllable structure. In Tableau 2, markedness constraint IDENT (voice) because the second stop after lateral becomes /ɣ/, satisfying markedness.

[1] Zone E are Bantu languages spoken in Kenya.

Dahl's Law in Tiania

Dahl's law does not just include the dissimilation process; at times it may involve deletion of sound correspondences. Hyman and Mbuui (2022) illustrate /g-/ deletion in Tiania, a Meru dialect as shown below:

Underlying form	Tiania	Meru	Gloss
ko-goro	**ko**-oro	**ko**-**g**oro	'leg'
ko-ruga	**ko**-rua	**ko**-ruga	'to cook'
ti**g**-a	oti-a	oti**g**-a	'to leave behind'

These examples demonstrate that g-deletion occurs due to the voicing dissimilation triggered by Dahl's law making it a one of the distinguishing factor of Tiania as a dialect against other Meru dialects. This means that in Tiania, Dahl's law activates the markedness constraint through the g-deletion thus ensuring that the output is well-formed. Faithfulness constraints ensure that much of the input is preserved in the output. The g-deletion is ranked high in Tiania making it a distinguishing factor from the other Meru dialects. Therefore, Table 4 illustrates the intervocalic /g/ deletion prevalent in Tiania:

Table 4: /ko-goro/ → [ko-oro] /ko-ruga/ → [ko-rua] /tig-a/ → [oti-a]

Candidate	*G/V_V	MAX	Candidate	*G/V_V	MAX	Candidate	ONSET	DEP-V
ko-goro	*!		ko-ruga	*!		tig-a	*!	
☞ ko-oro		*	☞ ko-rua		*	☞ oti-a		*

While Meru prioritizes markedness constraints over faithfulness, Tiania prioritizes faithfulness constraints over markedness. The intervocalic /g/ is deleted in Tiania while it is retained in Meru.

Dahl's Law in Kindia

Miti (2006) demonstrates that in Kikuyu the voiceless stop /*k-*/ is realized as velar fricative */ɣ-/* when it occurs before /*t, ð, ʃ, k/*. Using the same verbs that Miti (2006) uses, the realization of those verbs in Kindia is illustrated below:

Underlying form	Other Kikuyu dialects	Kindia	Gloss
ko-teɣa	**ɣo**teɣa	**ɣo**teɣa	'to trap'
ko-ðoma	ɣ**o**ðoma	k**o**ðoma	'to read'
ɣo-ʃoka	**ɣo**ʃoka	**ɣo**soka	'to return'
ko-kama	**ɣo**kama	**ɣo**kama	'to milk'

Dahl's law in Kikuyu involves the alternation between the voiceless velar stop /k-/ and velar fricative /ɣ-/. If a prefix which is to be attached to a stem has the velar stop /k-/, and the following syllable initial segment in the stem is /t, ʃ, k/, then the voiceless velar stop /k-/ of the prefix is realized as a velar fricative /ɣ-/ (Bennett, et al., 1985).

Therefore, Dahl's law in Kindia can be illustrated below as:

/k/ → /ɣ/_ /t, s, k/

Kindia realizations have the */k-/*, a voiceless consonant, occurring before voiced segments of the stem while /ɣ-/, a voiced consonant occurs before stems starting with a voiceless segment. Furthermore, the prefix for class 7 nouns is */ke-/ɣe/* depending on the noun stem due to Dahl's law.

Class 7	**Gloss**	**Class 8**	**Gloss**
ke-ɣwa	'sugarcane'	**i**-ɣwa	'sugarcanes'
ke-oŋgo	'head'	**si**-oŋgo	'heads'
ɣe-tongoro	'onion'	**i**-tongoro	'onions'
ɣe-sisio	'mirror'	**i**-sisio	'mirrors'
ke-ondʒe	'cripple'	**si**-ondʒe	'cripples'
ke-ðayo	'fool'	**i**-ðayo	'fools'
ke-ɣota	'lazy person'	**i**-ɣota	'lazy people'

These examples illustrate the alternates of initial /k-/ and /g-/ depends on the initial sound of the stem. If it is voiced, then the voiceless velar stop /k/ is applied, if voiceless, then the velar fricative /ɣ-/ is realized. Whereas the above realizations of initial /k-/ and /ɣ-/ cut across all Kikuyu dialects, there are differences in regard to dental fricatives /ð/ and /ʃ/. The velar stop */k-/*, in the prefix dissimilates in voicing and is realized as a velar fricative, */ɣ-/*. Notably, unlike Kikuyu, Kindia allows for */k-/* and */ð-/* sequence as illustrated in further in the examples below:

/k/ and /ð/ sequences

Underlying form		**Kindia**	**Other Kikuyu dialects**	**Gloss**
/**ko**-ðeka/	→	**k**oðeka	**ɣ**oðeka	'to laugh'
/**ko**-ðoma/	→	**k**oðoma	**ɣ**oðoma	'to read'
/**ko**-keða/	→	**ɣ**okeða	**k**oɣeða	'to harvest'
/**ke**-ðandoko/	→	**k**eðandoko	**ɣ**eðandoko	'a box'
/**ke**-ðori/	→	**k**eðori	**ɣ**eðori	'chest'

These sequences are characteristic of Kindia, where the occurrence of the voiced dental fricative –ð- stem initially does not trigger Dahl's law, an indication that Kindia has lost this effect compared to Kikuyu, its mother language. This prevalent phonological process triggered by Dahl's law determines the morpheme alternations of simultaneous morpheme markers, -ke- / -ɣe-.

Markedness and Faithfulness Constraints in Kindia

OT categorizes constraints as either markedness constraints or faithfulness constraints. The realization of Dahl's law in Kindia identifies these constraints at play and their ranking. Evidently, Kindia alternates between maintaining voicelessness and introducing voicing depending on the phonological environment. Agreement in voice, is the marked constraint as it governs the well-formedness of the output, therefore the adjacent consonants must agree in voicing. Consequently, Kindia penalizes sequences of two adjacent voiceless obstruents, thus one has to become voiced. Moreover, to preserve faithfulness in the output, the segments must preserve their voicing specification in one segment. Consonants are neither deleted nor epenthesized. This implies that in Kindia, the IDENT-IO (voice) constraint is ranked higher than the AGREE(Voice) as illustrated below.

Constraint set and ranking in Kindia

Using OT, it can be deduced that the following constraints are predominant in Kindia:

- MAX-C: no deletion of consonants
- IDENT-IO (voice): preserve voice in input
- AGREE (voice): Adjacent consonants agree in voicing
- *VV less Seq: Penalize sequences of adjacent voiceless obstruents

These constraints can be ranked as follows:

Ranking: MAX-C, IDENT-IO (voice) ≫ AGREE (voice), *VVlessSeq

Tables 5, 6 and 7 demonstrate these constraints, their ranking and the rationale for the determination of the optimal output**.**

Table 5: Input /ko-ðoma/

Candidate	MAX-C	IDENT-IO (voice)	AGREE (voice)	*VVless Seq	Optimal
koðoma	0	0	1	0	√
ɣoðoma	0	1	0	0	

Rationale: Faithfulness to voicing is high-ranked; no pressure to change /k-/ before a voiced onset.

Outcome: koðoma is optimal because violating lower-ranked AGREE (voice) is tolerated when IDENT-IO (voice) is satisfied as stem begins with voiced /ð/.

Table 6: Input /ko-teɣa/

Candidate	MAX-C	IDENT-IO (voice)	AGREE (voice)	*VV less Seq	Optimal
ɣoteɣa	0	1	0	0	√
koteɣa	0	0	1	1	

Rationale: Adjacent voiceless obstruents are disfavored; AGREE (voice) and *VVlessSeq push for [ɣo-]. With IDENT-IO (voice) lower-ranked than these markedness pressures in this environment.

Outcome: ɣoteɣa is the optimal output; the single violation of IDENT-IO(voice) is preferred over dual markedness violations (AGREE + *VVlessSeq) as the stem begins with voiceless /t/.

Table 7: Input /kokama/

Candidate	MAX-C	IDENT-IO (voice)	AGREE (voice)	*VVlessSeq	Optimal
ɣokama	0	1	0	0	√
kokama	0	0	1	1	

Rationale: The sequence of voiceless obstruents is penalized, favoring [ɣo-] because stem begins with voiceless /k/.

Outcome: ɣokama is the optimal output because minimizing markedness violations outweigh faithfulness violations.

This means that before voiced onsets such as /ð/ the voiceless obstruent /k/ is retained. However, before voiceless onsets such as /t, k/, the optimal output is / ɣ/. MAX-C is ranked high in Kindia as no consonants are deleted.

CONCLUSION

As illustrated in the discussions above, the diachronic process of Dahl's law comes into play when determining the morpheme alternations of the phonological /k/ and /ɣ/ segments depending on the initial segment of the stem due to the dissimilation process (Davy, J. I. M & Nurse, D., (1982). However, Kindia deviates from other Kikuyu dialects in that Dahl's law operates with any voiceless obstruent and not just with plosives. This feature distinguishes Kindia from other Kikuyu dialects specifically the realizations of the /k, ɣ/ before /ð/ and /s/ fricatives as summarized in Table 8 below.

Table 8: /ko-ðoma/

Candidate	AGREE	IDENT (stem)	IDENT (prefix)	*[+voice] [+fric]	MAX	DEP
a. [ɣo-ðoma**]**			*	*		
b. [ko-**ð**oma]	*!					
c. [go-**ð**oma]		*!				
d. [o-**ð**oma]					*!	
e. [toma]		*!	*	*	*!	*

Table 9: /ko-soka/

Candidate	AGREE	IDENT (stem)	IDENT (prefix)	*[+voice] [+fric]	MAX	DEP
a. [ɣo-soka]			*	*		
b. [ko-soka]	*!					
c. [go-soka]		*!				
d. [o-soka]					*!	
e. [goka]		*!	*	*	*!	*

This paper demonstrates that Dahl's law not only influences Zone E languages at language level but also at dialectal level. The morpheme alternations found in Kindia are distinct enough to set it apart from other Kikuyu dialects. Kindia dialect applies Dahl's law more broadly to voiceless obstruents unlike other Kikuyu dialects where voicing dissimilation primarily targets plosives. This results in unique realizations of /k, ɣ/ before fricatives /ð, s/ and a tolerance fro /k-ð/ which other Kikuyu dialects avoid.

Using OT it is evident that faithfulness constraints of voice (IDENT-IO (voice) and consonant retention (MAX-) are ranked higher than markedness constraints allowing retention of voicing in specific environments while still penalizing adjacent voiceless sequences. Thus /k/ is preserved before voiced onsets but alternates to /ɣ/ before voiceless ones.

These findings underscore the role of constraint interaction in determining the variation of dialects and highlight Kindia's phonological autonomy from other Kikuyu dialects. Future research could explore whether similar constraint hierarchies operate in other Bantu languages and their respective dialects contributing to a broader understanding of voicing dissimilation and dialect evolution.

REFERENCES

1. Archangeli, D. B. (1999). Introducing Optimality Theory. Annual Review of Anthropology, 28, 531–552. https://doi.org/10.1146/annurev.anthro.28.1.531 Retrieved 4 July 2025
2. Bennett, P. R., Bierster, A., Gikonyo, W., Hershberg, S., Kamande, J., Perez, C., et al. (1985). Gikuyu ni kioigire: A first course in Kikuyu (Vol. 1). Madison, Wisconsin, United States of America: The African Studies Program of the University of Wisconsin-Madison.
3. Davy, J. I. M and Nurse, D. (1982) Synchronic versions of Dahl's law: The multiple applications of a phonological dissimilation rule. Journal of African Languages and Linguistics 4: 157-195. https://doi.org/10.1515/jall.1982.4.2.157 Retrieved 3 September 2025
4. Elwell, R. (2010). Finite State Methods for Bantu Verb Morphology. Retrieved October 31, 2025
5. https://localizely.com/iso-639-2-list/ Retrieved 5 December 2025
6. Hyman, L. M. and Mbuui. M. G. (2022) Dahl's Law and G-Deletion in Tiania: A Dialect of Kimeru (Bantu, Kenya). In Language in Africa 3 (2) pp. 212-238. Doi: 10.37892/2686-8946-2022-3-2-212-238
7. Iribemwangi, P. (2012). A Case for the Harmonization of Kikuyu, Kiembu and Kimbeere Phonology and Orthography. In N. O. Ogechi, J. A. Oduor, & P. Iribemwangi (Ed.), The Harmonization and Standardization of Kenyan Languages (Vol. 87, pp. 21-38). The Centre for Advanced Studies of African Society.
8. Kager, R. (2007). Optimality Theory (7th ed.). Cambridge, United Kingdom: Cambridge University Press.
9. Kanana, F. E. (2011) Dialect Convergence and Divergence: A case for Chuka and Imenti. Selected proceedings of the 40th Annual Conference on African linguistics (ACAL). Eds. Bokamba et al., 99.190-205. Somerville, MA: Cascadilla Proceedings Project. Retrieved October 31, 2025
10. Kanana, F. E. (2011) Meru Dialects: The Linguistic evidence. Nordic Journal of African Studies 20(4): 300–327 (2011) Retrieved October 31, 2025
11. Kenya Census. (2019). Retrieved from https://www.knbs.or.ke/reports/kenya-census-2019/ Retrieved 4 July 2025
12. Kutik, E. J. (1983). Noun Class Assignment of English Loanwords in Kikuyu. In J. Kaye, H. Koopman, D. Sportiche, & A. Dugas (Eds.), Current Approaches to African Linguistics (Vol. 2, pp. 345-359). Dordrecht, The Netherlands: Foris Publications.
13. Maho, J. (2003). A Classification of Bantu Languages: An Update of Guthrie's Referential System. In D. Nurse, & G. Philippson (Eds.), The Bantu Languages. London: Routledge.
14. Miti, L. (2006). Comparative Bantu Phonology and Morphology (Vol. 40). Cape Town: The Centre for Advanced Studies of African Society (CASAS).
15. Prince, A., & Smolensky, P. (2004). Optimality Theory: Constraint Interaction in Generative Grammar. Oxford, United Kingdom: Blackwell Publishers.
16. The International Organization for Standardization https://www.iso.org/obp/ui/#iso:std:iso:639:-2:ed-1:v1:en Retrieved October 31, 2025
17. Werner, A. (1919). Introductory Sketch of the Bantu Languages (1st ed.). Routledge. https://doi.org/10.4324/9780429462160 Retrieved 31 October 2025