Variant Glide Repair Strategies in Kinyarwanda

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1 Introduction

- Today's puzzle: Why does Kinyarwanda (Bantu, JD61) allow clusters of unusual sonority sequencing, while banning ones of common sequencing?

Example 1 Clusters of Unusual Sonority Sequencing

[u.**mŋ**áː.ʃe]	[ku.**ɾɟ**a]	[u.mú.**tkw**e]
*mw	*bw	*tw

- Kinyarwanda (JD61) is a Great Lakes Bantu language in a dialect continuum with neighboring Kirundi (JD62), and is an official language of Rwanda
- As we will see, these unusual clusters are underlyingly consonant-glide sequences, which rarely surface in the language
- I propose an OT analysis of this phenomenon where high-ranked markedness constraints militating against consonant-glide clusters yield a variety of repair strategies
- I will compare my analysis to Kochetov 2016's analysis of the same problem in Kirundi, and show that my analysis covers gaps in his analysis, and does so with fewer constraints

2 Licit Clusters in Kinyarwanda

- Kinyarwanda is a NoCoda language, so all clusters are onsets
- Glides only surface in clusters when following a back consonant (dorsal or laryngeal)
- Glides resolve and create typologically unusual clusters
- Allomorphic, orthographic, and comparative data support glides as the underlying form

Example 2 Sample Changes

<u**bw**oko>	/u**bu**-oko/	[ú.**bg**óːko]	14-race	"race"
<ku**rw**ara>	/ku-**rw**aɾ-a/	[kú.**rgw**áː.ra]	INF-get.sick-FV	"to get sick"
<i**my**enda>	/i**m**i-end-a/	[i.**mɲ**eː.nda]	4-cloth	"clothes"
<gu**sy**a>	/ku-**se**-a/	[gu.**sc**a]	INF-grind-FV	"to grind"

- Resolution methods are fortition, epenthesis, and palatalization
- Place of articulation of both consonants determines resolution method

2.1 Labial-Glide Clusters

- Labial-glide clusters resolve through fortition
- The left consonant determines the voicing and nasality of the fortified glide
- In labial-w clusters, /w/ loses its labial feature, but retains its dorsal place
- In all j-clusters, /j/ never changes its place of articulation

Example 3 Labial-Glide Clusters

[u.**mŋ**áː.ʃe] [ku.**bɟ**aːra] [u.mú.**fk**a]

Table 1 Labial-Glide Clusters

UR	SR	Type of Change	UR	SR	Type of Change	UR	SR	Type of Change
/pw/	[pk]	GS	/fw/	[fk]	GS	/pj/	[pc]	GS
/bw/	[bg]	GS	/vw/	[vg]	GS	/bj/	[bɟ]	GS
/pfw/	[pfk]	GS	/mw/	[mŋ]	GS	/mj/	[mɲ]	GS

GS=Glide Strengthening (ie: fortition)

2.2 Coronal-Glide Clusters

- Coronal-w clusters resolve through epenthesis
- Coronal-j clusters resolve through fortition
- Epenthetic consonant is a velar occlusive of unspecified place and nasality
- The post-alveolars and the rhotic may be retroflex (Walker et al. 2008), but the exact nature of their pronunciation will not affect my rankings

Example 4 Coronal-Glide Clusters

[u.mú.**tkw**e] [kú.**ɾgw**áː.ɾa] [gu.**sc**a]

Table 2 Coronal-Glide Clusters

UR	SR	Type of Change	UR	SR	Type of Change	UR	SR	Type of Change
/tw/	[tkw]	Epen	/ʃw/	[ʃkw]	Epen	/tj/	[tc]	GS
/dw/	[dgw]	Epen	/ʒw/	[ʒgw]	Epen	/dj/	[dɟ]	GS
/sw/	[skw]	Epen	/tʃw/	[tʃkw]	Epen	/sj/	[sɟ]	GS
/zw/	[zgw]	Epen	/çw/	[çkw]	Epen	/nj/	[nɲ]	GS
/tsw/	[tskw]	Epen	/nw/	[nŋw]	Epen	/ɾj/	[ɾɟ]	GS
/ɾw/	[ɾgw]	Epen	/ɲw/	[ɲŋw]	Epen			

GS=Glide Strengthening (ie: fortition), Epen=Epenthesis

2.3 Back-Glide Clusters

- Only back-w clusters undergo no change
- Back-j clusters resolve through palatalization
- Velars may optionally palatalize in front of front vowels as well

Example 5 Back-Glide Clusters

[u.**kw**áː.ʃe] [ku.**ɟ**aːɾa] [u.mú.**hw**a]

Table 3 Back-Glide Clusters

UR	SR	Type of Change	UR	SR	Type of Change	UR	SR	Type of Change
/kw/	[kw]	No	/gw/	[gw]	No	/hw/	[hw]	No
/kj/	[c]	Pal	/gj/	[ɟ]	Pal	/hj/	[ç]	Pal

Pal=Palatalization, No=No change

2.4 Summary

- Back-j palatalize
- Back-w do not change
- Coronal-w epenthesize
- The rest fortify

Table 4 Glide Clusters by Resolution Method

UR	SR	Type of Change	UR	SR	Type of Change	UR	SR	Type of Change
/pw/	[pk]	GS	/tw/	[tkw]	Epen	/tj/	[tc]	GS
/bw/	[bg]	GS	/dw/	[dgw]	Epen	/dj/	[dɟ]	GS
/fw/	[fk]	GS	/sw/	[skw]	Epen	/sj/	[sɟ]	GS
/vw/	[vg]	GS	/zw/	[zgw]	Epen	/nj/	[nɲ]	GS
/pfw/	[pfk]	GS	/ʃw/	[ʃkw]	Epen	/ɾj/	[ɾɟ]	GS
/mw/	[mŋ]	GS	/ʒw/	[ʒgw]	Epen	/kw/	[kw]	No
/pj/	[pc]	GS	/çw/	[çkw]	Epen	/gw/	[gw]	No
/bj/	[bɟ]	GS	/tsw/	[tskw]	Epen	/hw/	[hw]	No
/mj/	[mɲ]	GS	/tʃw/	[tʃkw]	Epen	/kj/	[c]	Pal
			/nw/	[nŋw]	Epen	/gj/	[ɟ]	Pal
			/ɲw/	[ɲŋw]	Epen	/hj/	[ç]	Pal
			/ɾw/	[ɾgw]	Epen			

GS=Glide strengthening (ie: fortition), , Epen=Epenthesis, Pal=Palatalization, No=No change

- The method of resolution is different when the direct causative /-j-/, nominalizer /-ji/, or perfective /-je/ is in the cluster. See appendix for more information.

2.5 Sonority Sequencing of Glide-Clusters

- Glide clusters come in five different sonority sequences
- It is typologically unusual to allow more even and falling clusters than raising (Clements 1990)

Table 2 Kinyarwanda Glide Clusters by Sonority

Even		Falling		Raising		Even-Raising		Falling-Raising	
pk	bg	fk	vg	kw	gw	tkw	dgw	skw	zgw
pc	bɟ	sc		hw		nŋw		ʃkw	ʒgw
tc	dɟ	pfk				ɲŋw		çkw	
mŋ		ɾɟ						tskw	
mɲ								tʃkw	
nɲ								ɾgw	

3 Analysis

- The rankings need to prevent glides from surfacing in clusters, except for in back-w clusters, and need to choose the correct resolution for the different consonant-glide pairings
- I propose two markedness constraints *Back+Pal and *Front+Glide, which interact with faithfulness constraints to resolve clusters in back-j and front-glide clusters respectively
  - I have devised these constraints by modifying Kochetov 2016's *Dor+Pal, *Lab+Vel, *Lab+Pal, etc., into two unified constraints for each glide

Example 6 Markedness Constraints

‣*Front+Glide : Assign a mark for every front consonant followed by a glide
‣*Back+Pal : Assign a mark for every back consonant followed by a palatal consonant

- Fortition involves a change in [±consonantal] (glides are [-consonantal], nasals and stops are [+consonantal]) so we will use Ident[Consonantal] as the faithfulness constraint in fortition
- For palatalization and epenthesis, we will use the faithfulness constraints Ident[Palatal] and Dep

Example 7 Faithfulness Constraints

‣Ident[Consonantal] : Assign a mark for every sound in the input whose corresponding segment in the output has a different value for [±consonantal]
‣Ident[Palatal] : Assign a mark for every sound in the input whose corresponding segment in the output has a different value for [±palatal]
‣Dep : Assign a mark for every segment in the output without a corresponding segment in the input

3.1 Palatalization

Tableau 1 *Back+Pal>>Ident[Palatal]

/ku-ke-a/	*Back+Pal	Ident[Palatal]
[gú.kja]	*!	
☞ [gú.ca]		*

3.2 Fortition

Tableau 2 *Front+Glide>>Ident[Consonantal]

/ubu-oko/	*Front+Glide	Ident[Consonantal]
[ú.bwóː.ko]	*!	
☞ [ú.bgóː.ko]		*

Tableau 3 *Back+Pal>>Ident[Consonantal]

/ku-tjo/	*Front+Glide	*Back+Pal	Ident[Consonantal]
[gú.tjo]	*!		
[gú.tkjo]		*!	
☞ [gú.tco]			*

3.3 Epenthesis

Tableau 4 Ident[Consonantal]>>Dep

/umu-twe/	*Front+Glide	Ident[Consonantal]	Dep
[u.mú.twe]	*!		
[u.mú.tke]		*!	
☞ [u.mú.tkwe]			*

Tableau 5 Incorrect Output

/ubu-oko/	*Front+Glide	Ident[Consonantal]	Dep
[ú.bwóː.ko]	*!		
! [ú.bgóː.ko]		*!	
☞ [ú.bgwóː.ko]			*

- The rankings in Tableau 5 produce the wrong output in Tableau 6. We will rectify this by introducing an OCP constraint that forces the /w/ in labial-w clusters to fortify
- I will be using local conjunction to express my OCP constraint, à la Alderete 1997.

Example 8 OCP Constraint

▸*Labial$^2_\sigma$: Assign a mark for each syllable that has more than one [+labial] consonant

Tableau 6 *Labial$^2_\sigma$>>Ident[Consonantal]

/ubu-oko/	*Front+Glide	*Labial$^2_\sigma$	Ident[Consonantal]	Dep
[ú.bwóː.ko]	*!	*!		
☞ [ú.bgóː.ko]			*	
[ú.bgwóː.ko]		*!		*

3.4 Summary

- *Back+Pal >> Ident[Palatal]
- *Front+Glide, *Labial$^2_\sigma$, *Back+Pal >> Ident[Consonantal]>>Dep

*** Ident[Palatal] and *Back+Pal can never be violated by w-clusters, so they are not included in Summary Tableaux 1-3 for simplicity ***

Summary Tableau 1 Labial-W

/ubu-oko/	*Front+Glide	*Labial$^2_\sigma$	Ident[Cons]	Dep
☞ [ú.bgóː.ko]			*	
[ú.bgwóː.ko]		*!		*
[ú.bwóː.ko]	*!	*!		

Summary Tableau 2 Coronal-W

/umu-twe/	*Front+Glide	*Labial$^2_\sigma$	Ident[Cons]	Dep
[u.mú.tke]			*!	
☞ [u.mú.tkwe]				*
[u.mú.twe]	*!			

Summary Tableau 3 Back-W

/uku-aʃe/	*Front+Glide	*Labial$^2_\sigma$	Ident[Cons]	Dep
[u.kká:.ʃe]			*!	
[u.kkwá:.ʃe]				*!
☞ [u.kwá:.ʃe]				

***Our OCP constraint, *Labial$^2_\sigma$ can never be violated by j-clusters, so it is not included in Summary Tableaux 4-6 for simplicity ***

Summary Tableau 4 Labial-J

/ku-bjaɾ-a/	*Front+Glide	*Back+Pal	Ident[Pal]	Ident[Cons]	Dep
☞ [ku.bɟa:.ɾa]				(*)	
[ku.bga:.ɾa]		*!			*
[ku.bja:.ɾa]	*!				
[ku.ɟa:.ɾa]			*!	(*)	

Summary Tableau 5 Coronal-J

/ku-tjo/	*Front+Glide	*Back+Pal	Ident[Pal]	Ident[Cons]	Dep
☞ [gú.tco]				(*)	
[gú.tkjo]		*!			*
[gú.tjo]	*!				
[gú.co]			*!	(*)	

Summary Tableau 6 Back-J

/gu-ke-a/	*Front+Glide	*Back+Pal	Ident[Pal]	Ident[Cons]	Dep
[gú.kca]		*!		*	
[gú.kkja]		*!			*
[gú.kja]		*!			
☞ [gú.ca]			*	*	

4 Kochetov 2016's Analysis

- Kirundi has the same phenomena, and has the same pattern of resolution
- To express the rules against glide clusters, Kochetov 2016 uses 7 constraints instead of my 2
- He considers velar-glide sequences to be complex segments (k^w), not sequences (kw)
- Treats cases of epenthesis in coronal-w clusters as glide strengthening
- As his rankings for j-clusters work perfectly fine, we will only be looking at the w-clusters and their rankings

Example 9 Kochetov 2016's Tableaux

(32) Post-consonantal glide strengthening in the /m/ + /w/ sequence (see (28a)).

	/am_1-w_2a/	*Dor +pal	Morph Uniform	*Cor +pal	Uniform -IO	*Lab +vel	*Cor +vel	Agree[F] -CC	*Dor +vel
a.	am_1w_2a					*		**!	
b.	$aŋ_{1,2}{}^wa$				*!				
c.	☞ $am_1ŋ_2a$					*			

(33) Post-consonantal glide strengthening in the /s/ + /w/ sequence (see (28b)).

	/as_1-w_2a/	*Dor +pal	Morph Uniform	*Cor +pal	Uniform -IO	*Lab +vel	*Cor +vel	Agree[F] -CC	*Dor +vel
a.	as_1w_2a						*	***!	
b.	$ax_{1,2}{}^w a$				*!				
c.	☞ $ask^w a$						*		

Example 10 Agree[F]-CC Definition

(15) Agree[F]-CC: Consonants/glides in a cluster have the same values for consonantality, sonorancy, nasality, and voicing ([±consonantal, ±sonorant, ±nasal, ±voice]).

- *Dor+Pal, MorphUniform, and *Cor+Pal are all used in his j-cluster rankings, and are irrelevant here
- In lieu of my *Front+Glide, he has a markedness constraint for each of the three places of articulation, and ranks the front ones above Agree[F]-CC and the back one below it
- No explanation is provided for why /w/ in 32c loses its labial place (lacks OCP)
- Rankings make no distinction between labial-w and coronal-w clusters, in spite of the differences in their realizations
- When given the “no change” /kw/ clusters, these rankings give the wrong answer

Tableau 7 Kochetov’s Ranking with Velars

	/ku-teek$_1$-w$_2$-a/	*Dor +pal	Morph Uniform	*Cor +pal	Uniform -IO	*Lab +vel	*Cor +vel	Agree[F] -CC	*Dor +vel
a.	gute:k$_1$w$_2$a							***!	*
b.	gute:x$_{1,2}$^{w}a				*!				
c.	☞ gute:kk^{w}a								*
d.	! gute:k$_{1,2}$^{w}a				*!				

- Actual output is (d), [gute:k^{w}a], but Kochetov’s rankings select (c) [gute:kk^{w}a] instead
- Uniformity eliminates the correct candidate

- Summary
  - Kochetov 2016 accounts for j-clusters
  - The rankings cannot distinguish the differences between labial-w and coronal-w clusters
  - Rankings give the wrong output when the input is a back-w cluster

5 Conclusion

- Kinyarwanda’s unusual clusters depart from the Sonority Sequencing Principle due to high ranking marked constraints against glide clusters and faithfulness constraints that preserve some of the underlying glides’ features
- Three resolution methods are used to avoid glide-clusters: epenthesis, fortition, and palatalization
- The resolution method is determined by the place of articulation of the glide and the consonant
- With the markedness constraints *Front+Glide, *Back+Pal, and *Labial$^2_\sigma$, I can motivate the changes
- My rankings can produce the correct output for all consonant-glide pairings

6 Appendix

- Kirundi and Kinyarwanda both have a separate resolution system for j-clusters that contain certain suffixes
- In Kinyarwanda these suffixes are the direct causative /-j-/, the nominalizer /-ji/, and the perfective /-je/
- Kochetov 2016 attributes this difference to whether the cluster consists of one morpheme or multiple, and I concur
- Part of the Bantu-wide phenomena of super-close vowels from PB causing spirantization (Janson 2007)
- In Kinyarwanda, some lingual phones undergo a chain shift towards being a palatal fricative
- Other lingual phones delete or undergo epenthesize
- Labial and nasal phones do not differ between tautomorphemic and heteromorphemic cluster

Example 11 Perfective Chain Shift

Spirantization	Palatalization	No Change
/...t-je/=>[...se]	/...s-je/=>[...ʃe]	/...ʃ-je/=>[...ʃe]
/...d-je/=>[...ze]	/...z-je/=>[...ʒe]	/...ʒ-je/=>[...ʒe]
/...k-je/=>[...tse]	/...h-je/=>[...çe]	/...ç-je/=>[...çe]
/...g-je/=>[...ze]		/...j-je/=>[...je]
/...tʃ-je/=>[...ʃe]		

- /...ɾ-je/ has three different outputs, depending on the word: [...ze], [...je], or [...ɾije]
- Monosyllabic verbs stems (CV) undergo no change, and the perfective just attaches as [-je]
- When the direct causative /-j-/ and perfective /-je/ both occur next to each other, they combine into [-iʒe]
    - My current hypothesis is that this is suppletion
    - [-iʒe] occurs as the perfective form on some verbs even when there is no evidence of a direct causative

7 Sources

* Kinyarwanda words shown come from a combination of Kimenyi 1979 and my fieldwork

* Kirundi words shown all come from Kochetov 2016

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