WOLOF CONSONANT ALTERNATION: THE CASE OF CONTINUANCY

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1. INTRODUCTION

In this analysis, I show (following Paradis, 1992 on Fula), in an Optimal Theoretical framework (Prince and Smolensky, 1993) that stop-continuant alternations in Wolof are an expected phenomenon. Such alternations can be subsumed to a universal typological fact: contrastive continuant geminates are clusters systematically avoided by languages with contrastive consonant length (Kirchner, 1998). Although continuant geminate clusters arise, they are 'repaired', and the 'unexpected' contrasts signalized in previous analyses (Ka, 1993) are the manifestation of such repair strategies.

I start by presenting the data and relevant background information in section 2. In section 3, I evaluate a previous derivational approach to the data (Ka, 1993) and after assessing its weak points against new data, I propose an alternative derivational analysis. While this alternative proposal proves adequate in predicting *what* the alternations are, its shortcoming is that it provides no insights as to *why* these alternations arise. I therefore propose in section 4 an OT account of the data that will both account for what alternations are to be expected and for why these and not other alternations are expected.

2. THE DATA

2.1. Background

Wolof is a West-Atlantic language and is a national language in Senegal, Gambia and Mauritania. It is also spoken in Mali, Guinea, Ivory Coast and Gabon (a lingua franca of the region). The data come from previous sources and analyses of Wolof and from my work with two speakers of Senegalese Dakar Wolof.

The phonological consonant inventory of Wolof (excluding prenasals) is given in the table below. As it can be noticed, the only consonants that do not have a geminate counterpart are the fricative and the rhotic liquid, which is a trill.

Table 1. The phonemic consonant inventory of Wolof

	Labial	Alveolar	Palatal	Velar	Uvular
Stop	p b	t d	c ɟ	k g	q
	pp bb	tt dd	cc ɟɟ	kk gg	qq
Nasal	m	n	ɲ	ŋ	
	mm	nn	ɲ	ŋŋ	
Trill		r			
Fricative	f	s			χ
Approximant	w	l	j		
	ww	ll	jj		

There are several observations about Wolof phonology (typologically very common) that have to be spelled out before proceeding with the presentation and the analysis of the data. They will account for alternations in the data that are beyond the scope of the present paper, and that I will therefore not discuss. One fact to be kept in mind is that in Wolof voicing contrast is neutralized for word-final singletons[1]. Another cluster of facts concerns Wolof vowels. Wolof has both short and long phonemic vowels, but vowels are short/shortened in close syllables. Wolof vowels are also affected by ATR vowel harmony.

2.2. Morphological assumptions

The morphological framework that I implicitly assume (without explicitly discussing) is a process/items-and-processes one (cf. Stump1991, Anderson 1992 *inter alia*), where morphological meaningfulness is encoded in a given process of which an affix can be part, but without having to be the exclusive carrier of meaning. Thus (as will become evident in the next section), the morphological process by which a Reversive is formed in Wolof consists not only in adding an affix (–i in this specific case), but also in geminating the preceding consonant. On the other hand the process of forming an Allative consists in affixing –i. In the same way, forming a Causative consists in adding the causative marker –al and degeminating the preceding consonant, while forming the Benefactive consists only in affixing –al.

2.3. Gemination and continuancy

Certain derivational suffixes (e.g. *-i* "Reversive") trigger gemination of the previous consonant (1). There are homophonous suffixes that do not trigger gemination (e.g. *-i* "Allative"). In the morphological view that I adopt, it simply means that the processes of forming the Reversive vs. the Allative are different, as I anticipated in the previous section, reason for which I represent the Reversive as the process "geminate + -I":

(1)

Verb		Reversive (geminate + -i)		Allative (-i)	
up	close	ubbi	open	ubi	go and close
boot	to carry on the back	botti	to take off the back	booti	go and carry
təɟ	to close a door	təɟɟi	to open a door	təɟi	go and close
teg	to put	teggi	to remove	tegi	go and put
lem	to fold	lemmi	to unfold	lem	go and fold
saaɲ	to plug	saɲɲi	to unplug	saaɲi	go and plug
lal	to lay a sheet	lalli	to take off a sheetlali	go and lay a sheet	
jeew	to tie	jewwi	to untie	jeewi	go and tie

If the verb already ends in a geminate, there is no further gemination (2). Although I could not confirm Allative forms for the verbs in (2) the prediction is that they would be homophonous to the Reversive ones:

(2)

Verb		Reversive (gem+ -*i*)	
dəpp	put upside down	dəppi	turn right side up
gəmm	to close one's eyes	gəmmi	open one's eyes
takk	tie	tekki	untie
wekk	hang on	wekki	pull out
fatt	stop	fatti	unstop

There are some alternations in the gemination context (3). Thus, simple fricatives and [r] alternate with geminate stops, while a geminate voiceless velar seems to have no singleton counterpart. This singleton continuant-geminate stop alternation and possible approaches to analyzing it are the object of the present paper:

(3)

Verb		Reversive (gem+-i)		Allative (-i)	
sof	join	soppi	disjoin	sofi	go and join

[1] It seems that there is not complete voice neutralization. This is apparent in some older sources that record alternating forms with voiced~voiceless final singleton, but I also have it attested in some of my recordings, although no quantitative formal study has been conducted yet.

fas	tie	fecci	untie	fasi	go and tie
soχ	load a gun	so**qq**i	fire a gun	soχi	go and load a gun
teer	arrive	te**dd**i	depart	n/a	
dee	die	de**kk**i	resuscitate	deeji	go and die

The same pattern of alternations can be observed for degemination contexts as well. One such degeminating context is the morphological process of forming a Causative verb form. The general pattern of degemination is exemplified in (4a) below, while the alternation pattern – singleton fricatives and [r] with geminate stops, is given in (4b). Unlike in the gemination data where geminate [kk] had no singleton correspondent, in the degemination pattern the geminate velar alternates with a singleton velar (4c):

	Verb		Causative (degemination + -al)		Benefactive (+al)	
(4a)	bax	boil	baxal	make boil	baxal	boil for
	set	be clean	setal	clean		
	fees	be full	feesal	fill/make full		
	bett	pierce	betel	make pierce	bettel	pierce for
	dugg	enter	dugəl	introduce		
(4b)	to**pp**	follow	tofal	add	toppal	follow for
	se**dd**	be cold	seral	cool		
	mu**cc**	be safe	musəl	save	muccəl	be safe for
(4c)	je**kk**	beautiful	jekal	to beautify		
	ga**kk**	spot, stain	gakal	to stain		

3. DERIVATIONAL ANALYSES

3.1. Ka's (1993) Spirantization Rule Analysis

The first analysis that was proposed for this set of data is that of Ka (1993). He suggested that the alternations presented in the previous section should be dealt with by assuming that the stop is underlying, and it becomes a continuant when a singleton and postvocalic (5b) and that *k* is deleted in the same environment (5a):

(5) Ka (1993: 71-72)

a.
$$\begin{array}{c} \mathrm{C} \\ | \\ \begin{bmatrix} -cont \\ +back \\ -voice \end{bmatrix} \end{array} \rightarrow \varnothing \,/\, \mathrm{V}\_\_$$

b.
$$\begin{array}{c} \mathrm{C} \\ \backslash\!\!\!\ddagger \\ \begin{bmatrix} -cont \\ p,c,d,q \end{bmatrix} \end{array} \rightarrow [+\mathrm{cont}] \,/\, \mathrm{V}\_\_$$

c.

sop	→ [sof]	soppi	→ [soppi]
topp	→ [topp]	topal	→ [tofal]
deek	→ [dee]	deekki	→ [dekki]

This analysis would suggest the derivations in (5c), where I assume that morphological processes (affixation, gemination, degemination) have already applied. Thus, an underlying singleton would be lenited unless it undergoes gemination (*sof, tofal*), and a singleton velar will be deleted if not geminated (*dee*).

Note that the rule in (5b) refers to an unnatural class – an alveolar voiced stop and voiceless stops at the other places of articulation, which Ka (1993) acknowledges as an unattractive feature of his analysis. Even overlooking this aspect, there is one more serious problem with the rules in (5) – they would predict the absence of postvocalic stops in Wolof (or at least in degeminating environments), a prediction contradicted by forms such as those given in (6) and (7) below.

(6)	Verb		Reversive (gem+-i)		Unattested form
	ɲep	close one's mouth	ɲeppi	open one's mouth	*ɲef
	sof	join	soppi	disjoin	

The example in (6) shows that not all postvocalic singletons become fricatives. There is acoustic evidence available (besides transcriptions, cf. Sauvageot, 1965) that the final stop in *ɲep* is not a geminate. In the variety of Wolof I had access to, in word-final position singletons are not distinguished from geminates by duration necessarily but by a different manner of release (Marin, ms). All recorded *ɲep* tokens pattern in this respect with singletons, and clearly not with geminates.

Another set of counter-examples to Ka's (1993) proposal comes from degemination contexts (7):

(7)	Verb		Causative (degemination +-al)		Unattested form
a.	gudd	long	gudal	to lengthen	*gural
	sedd	cold	seral	to cool	
b.	opp	sick	opal	to make sick	*ofal
	topp	follow	tofal	to add	
c.	jekk	beautiful	jekal	to beautify	*jeal
	gakk	stain	gakal	to stain	*gaal
	dee	to die	dekki	to resuscitate	

Thus, in (7a-b), besides the *dd-r, pp-f* alternation predicted by the rule in (5b), there are words where the alternation is *dd-d, pp-p*, which seem to be exceptions to this rule. Note that the contexts and the class of words that the rule correctly predicts are identical to those for which the rule makes the wrong prediction.

In (7c), postvocalic *k* is not deleted as predicted by rule (5a). While problematic for Ka's (1993) representation of the relevant rule, this set of data is not necessarily problematic in the same way in which (7a) and (7b) are. Restricting rule (5a) to word final contexts would yield the correct results: deletion of word-final singleton *k* in the word for "to die" (and other similar examples), but not of word-internal singleton *k* in the word for "to stain" (and other such examples). As I will discuss later, additional evidence (forms such as *deeji* "to go and die") will prevent the adoption of a *k*-deletion rule.

The forms in (6) and (7a-b) alone are however enough evidence that an alternative analysis should be preferably proposed, and this is what I do in the next section.

3.2. An alternative analysis – geminate strengthening

An alternative analysis that could be adopted and that could satisfactorily account for all the data (including the forms in (6) and (7)) is to assume that the continuant is underlying, and it becomes a stop when geminated. This is captured by the rule in (8a) below, followed in (8b) by model derivations. Note that the rule in (8a) cannot deal with the alternation *dee* "to die" – *dekki* "to resuscitate", but it will correctly predict *jekk* "beautiful" – *jekal* "to beautify".

(8) a.
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C          C C
|          | /
[+cont] → [-cont]
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b.

sof	→ [sof]	soffi	→ [soppi]
toff	→ [topp]	tofal	→ [tofal]
ɲep	→ [ɲep]	ɲeppi	→ [ɲeppi]

What makes such an approach intuitively appealing is the "coincidence" that the only segments that do not have phonological geminate counterparts are the exact segments showing the alternation in geminate contexts (with the exception of the voiceless velar that will be extensively discussed later).

The rule given in (8) refers to this class of segments that participate in the alternations (coinciding with the class of segments that do not have phonological counterparts) as continuant, so a discussion on what counts as continuant is in order[2]. This class of segments (as well as the alternations in general) coincides to a large extent with the class of segments participating in a similar alternation in Fula (Paradis, 1992). The similarity between the two languages breaks down with respect to their treatment of the *j* and *w* segments. In Fula *j* and *w* alternate with b/g and ɟ respectively, and do not have phonological geminate counterparts, whereas in Wolof they have geminate counterparts (cf. Diallo, 1981, Ka, 1993 *inter ala*) and do not participate in the continuant – non-continuant alternation. The difference between Fula and Wolof with respect to glides might be that Fula glides are phonologically consonantal while Wolof glides are not (part of a diphthong). As non-consonantal segments, they are presumably excluded from the set of relevant continuants together with the vowels.

Incidentally, Ka (1993) also considers an analysis in the spirit of that in (8) but he rejects it as unsatisfactory in dealing with the alternation in *dee* "to die" – *dekki* "to resuscitate". His reason in doing so is that there is no apparent source for *k*. Spontaneous insertion of *kk* in words ending in vowel is not tenable, since there are word-final words that have no derived forms where the geminate *kk* manifests itself. Positing an underlying consonant to alternate with *kk* is also dismissed by Ka (1993) because χ already alternates with *qq* and he sees no other possible candidate as an underlying counterpart of the surface velar stop.

The alternation *dee* "to die" – *dekki* "to resuscitate" is indeed a thorny issue that deserves full consideration. I will discuss two possible hypotheses in dealing with the issue. The first hypothesis, and the most attractive one given the alternation *k* – *kk* in the degemination data (e.g. *jekk* "beautiful" – *jekal* "to beautify") is to assume that the relevant alternation is indeed between the singleton and the geminate velars, with the singleton being deleted in word-final position, but not elsewhere. The problem with such an analysis are forms such as *deeji* "to go and die", *deewandoo* " to die together" (with glide insertion), where singleton *k* would be expected to appear since it is not word-final. On the other hand, extending a deletion rule beyond word-final position would yield the wrong results with the degemination patterns. Because of such examples, this analysis must be rejected and alternative ones must be sought.

Another possibility is that in the alternation *dee* "to die" – *dekki* "to resuscitate", there is another segment alternating with *kk*, such as a glottal stop. First, if this is indeed a viable alternation, the glottal stop should rather pattern in this language with the fricatives than with the stops. Indeed, glottal stops patterning together with continuants is not unexpected given cross-linguistic evidence (cf. Kavitskaya, 2001 for evidence from Karok, Farsi). The alternation *ʔ-kk* should therefore not be problematic to view as a fricative-stop alternation, as long as evidence is found to suggest the presence of the glottal stop in the relevant forms.

One place to look for evidence is in the acoustic pattern of forms showing the alternation (*dee* "to die") as compared to verbs not showing the alternation (e.g. *fo* "to play", ", *ɟii* "to plant", cf. Ka, 1993). Spectrograms and waveforms are not always very clear in the case of glottal stops, especially word-finally, and unfortunately I do not have tokens of the relevant words in carrier phrases. However, looking at the spectrograms of *dee* vs. *ɟii* (Fig. 1 in the Appendix), one can notice that there is more intense and longer spectral turbulence in the high frequency after *dee* than after *ɟii*, which might be suggestive of a turbulence segment such as a continuant glottal stop-like segment. Also, F2 and F3 transitions get together like for a velar at the end of *dee* "to die" (as in the case of *dekki* "resuscitate"), but not at the end of *ɟii* "to plant". More tokens and additional words are needed to draw an indisputable conclusion on the matter, but the evidence I have to date makes me confident that this analysis is on the

[2] Note that the lateral exhibits a different type of turbulence (lateral) and does not count as continuant in any analysis.

right track. In fact, even if alternations such as *dee-dekki* might prove in the end to be analyzable in a different way, this would not falsify the validity of the rest of the analysis[3].

The rule-base analysis proposed in this section satisfactorily captures the alternations as a process of continuant strengthening, suggesting that a derivational account can be adequate as long as a decision is made on the most plausible direction of change. However, the shortcomings of such a rule-based analysis result from the very fact that either directionality – from stop to continuant, or from continuant to stop, can be argued for as 'natural'. Were it not for the counterexamples in (6) and (7), both derivational analyses, the one proposed by Ka (1993) and the one I proposed above, could have been as plausible.

Rules can be written starting from any of the two possible underlying representations and thus rules can account for *what* happens, without however offering much insight on *why* things happen (or why they happen the way they do and not otherwise). On the other hand, I will argue in the next section that only one analysis can emerge as natural and phonetically justified in an OT approach – an analysis that has the continuants in the input but whose presence in the output is not always optimal. For this reason, I will deem OT to fare better in handling the data that makes the object of this paper.

4. AN OPTIMAL THEORETICAL PROPOSAL: THE CASE OF CONTINUANCY EXPLAINED

In this section I will show how the continuant – non-continuant alternations in Wolof can be explained in an OT framework as the result of an interplay between a markedness constraint grounded in phonetics and corresponding faithfulness constraints. The OT analysis I propose here will provide insights as to *why* input geminate continuants have geminate stop outputs.

Continuant consonants, specifically fricatives and trills require critical aperture (and adequate airflow) to create the turbulence or vibration essential in producing these types of segments (Ladefoged and Maddieson, 1996). Getting length contrast with such critical aperture segments can be more difficult than with stops (requiring no critical aperture) and therefore such a contrast will be universally marked/dispreferred. Everything else being equal languages will avoid employing/maintaining such contrasts (Kirchner, 1998, Maddieson, 1984, Ladefoged and Maddieson, 1996, Paradis, 1988). Thus, of the languages that employ consonant length contrast, fewer have both stop and fricative geminates, and none have only fricative but not stop geminates. Also, in many languages that maintain a length distinction for rhotic trills, the short one is often realized as a tap/flap.

This dispreferrence grounded in phonetics translates in a markedness constraint at the phonological level - *CritGem, triggering avoidance of critical aperture geminate segments in languages where it dominates the relevant faithfulness constraints):

(9) *CritGem: critical-aperture continuants must not be geminate

We have seen that the consonant inventory of Wolof does not include geminate critical aperture continuants, which suggests that in this language the markedness constraint given in (9) must be ranked higher than some faithfulness constraint. On the other hand, the geminate can be the sole bearer of contrast (as evident in comparing the Reversive forms with the Allative forms in (1) for instance) so the geminate has to be maintained if such items are to be kept distinct. The conflict between markedness and faithfulness constraints is resolved in Wolof by retaining length contrast - MaxC-IO at the expense of losing the continuant/non-continuant distinction - Ident-IO(continuant)[4]:

[3] The fact that sources list so few of these alternations and my inability to find additional such data in my rather limited work with the speakers makes me also consider the alternative that these might be historical 'residues' of some sort.

[4] Geminate inalterability effects (i.e. exclusion of a candidate such as **sofofi* "to disjoin") follow from a ranking in which Dep-IO dominates or is co-ranked with *CritGem. The possibility of avoiding *CritGem by turning only half of the geminate into a stop (i.e. **sofpi* or **sopfi*) is excluded by general phonotactics constraints of the language ranked higher than Ident-IO(continuant). (Note that in Wolof there are no consonant clusters, only geminates and nasal-obstruent clusters, sometimes called half geminates).

(10) General ranking: *CritGem, MaxC-IO >> Ident-IO(continuant)

While this ranking prevents neutralization between related forms, it does not mean that it does not create potential neutralizations elsewhere, e.g. *sof* 'join' – *soppi* 'disjoin' vs. *ɲep* 'to close one's mouth' - *ɲeppi* 'to open one's mouth'. There are no attested pairs in the data where lexical contrast is neutralized in geminate contexts (e.g. an ambiguous *soppi* from /sof/ vs. the hypothetical /sop/). They could however exist in the language and if they indeed do, it looks like the language chose to keep the contrast between lexically related forms at the cost of producing lexically unrelated homophones (easier to contextually disambiguate).

The tableaux below show how the proposed ranking yields the correct results both in the gemination contexts (11) and in the degemination ones (12). In the tableaux in (11), it can be seen that the difference between *sof* 'join' – *soppi* 'disjoin' vs. *ɲep* 'to close one's mouth' - *ɲeppi* 'to open one's mouth' is due to a different input, */sof/* for "to join, and */ɲep/* for "to close one's mouth". There is no reason for any of the segments in the output for "to join" (11a), "to close one's mouth" (11c) or "to open one's mouth" (11d) to be unfaithful to their input, so any candidate not looking exactly like the input will not be optimal. On the other hand, the optimal output for "to disjoin" must violate Ident-IO(cont) in order to obey the higher ranked *CritGem and MaxC-IO (11c).

(11) Gemination[5]

a. sof 'join'

/sof/	*CritGem	MaxC-IO	Ident-IO(cont)
☞ sof			
sop			*!

b. soppi 'disjoin'

/soffi/	*CritGem	MaxC-IO	Ident-IO(cont)
☞ soppi			**
soffi	*!		
sofi		*!	

c. ɲep 'to close one's mouth'

/ɲep /	*CritGem	MaxC-IO	Ident-IO(cont)
☞ ɲep			

d. ɲeppi 'to open one's mouth'

/ɲeppi /	*CritGem	MaxC-IO	Ident-IO(cont)
☞ ɲeppi			

In the degemination tableaux below in (12), there is no reason for the output not to be faithful to the input in the cases of the forms for "sick" (12c), "to make sick" (12d), or "to add" (12b), so any candidate not identical to the input will not be optimal. In the case of "to add", morphological degemination will get rid of a critical continuant geminate present in a related form (and presumably in the root). However, in the case of "to follow" the input contains a continuant geminate and therefore in order not to violate the high ranked *CritGem and MaxC-IO the optimal output will have to violate Ident-IO(cont):

(12) Degemination

[5] (11c-d) and (12c-d) are included only to illustrate input differences in the data that was problematic for Ka's (1993) analysis. Since input is identical to output, no alternative candidates are evaluated.

a. topp 'follow'

/toff/	*CritGem	MaxC-IO	Ident-IO(cont)
☞ topp			**
toff	*!		
tof		*!	

b. tofal 'add'

/tof-al/	*CritGem	MaxC-IO	Ident-IO(cont)
☞ tofal			
topal			*!

c. opp 'sick'

/opp/	*CritGem	MaxC-IO	Ident-IO(cont)
☞ opp			

d. opal 'make sick'

/op-al/	*CritGem	MaxC-IO	Ident-IO(cont)
☞ opal			

The spirantization analysis proposed by Ka (1993) cannot be readily translated into an OT constraint analysis. Such an analysis would require a ranking in which markedness of simple stops outranks markedness of geminate stops (the ranking necessary for keeping geminate stops and getting rid of simple ones) and such ranking does not follow from any phonetic considerations. Cross-linguistically geminates are more marked than singletons so it would be expected that a language in which simple stops are marked (even in specified contexts) will have no geminate ones and indeed this expectation is typologically borne out.

5. CONCLUSION

In this paper I have examined and proposed an analysis of continuant – non-continuant alternations in gemination/degemination contexts. I have shown using new data from personal elicitation that a lenition approach to the problem, such as Ka's (1993) is not adequate. I have also argued that a derivational approach, even if able to describe the phenomena, does not give any insights as to why certain alternations arise – they remain "unexpected alternations" (Ka, 1993: 68).

Viewed from an OT perspective as the result of geminate strengthening rather than as the result of a singleton lenition, the same alternations become a predicted rather than an unexpected pattern. They are part of a universal typology, arisen from the interplay between diverging forces – avoiding phonetically dispreferred clusters while at the same time preserving distinctiveness by performing minimal changes. At least for dealing with the continuancy problem in Wolof, OT seems to fare better than a derivational phonological approach.

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APPENDIX – Spectrograms of *dee* "to die", *ɟii* "to plant" and *dekki* "to resuscitate"

Fig. 1 (a) dee "to die"

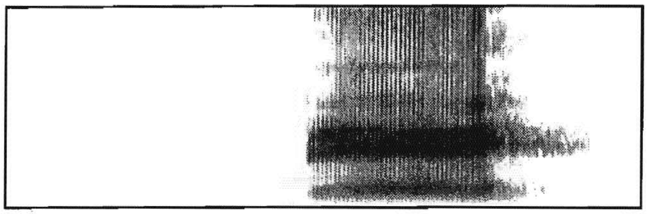

Fig. 1 (b) jii "to plant"

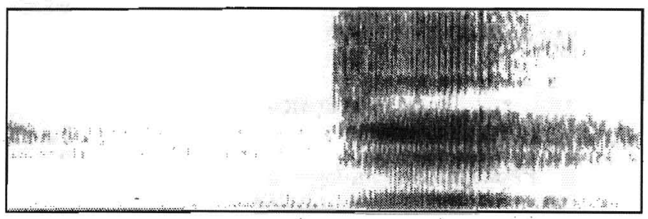

Fig. 1(c) dekki "to resuscitate"