Phonology 17 (2000) 333–363. Printed in the United Kingdom
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*Consonant mutation and reduplication in Seereer-Siin**

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1 Introduction

Among the many types of non-concatentative morphemes are auto-segments or floating features which, in order to be realised phonologically, must attach to a root node in the stem. Akinlabi (1996) terms this process FEATURAL AFFIXATION. Featural affixes are of particular interest for models of reduplication, which make varying predictions as to whether or not they will be copied. In segmental models such as that of Marantz (1982), where nothing other than the underlying segmental base of the melody is copied, we would not expect the featural affix to be 'transferred' (Clements 1985a, Myers & Carleton 1996) between base and reduplicant.[1] In models where the entire base is copied, such as that of Steriade (1988), featural transfer depends on the particular conception of the grammar. Within serial models of the grammar featural transfer depends crucially on the ordering of word-formation rules and phonological rules, while in a non-serial model like Optimality Theory (Prince & Smolensky 1993) featural transfer depends on the rank ordering of relevant constraints. The goal of this paper is to contribute to an understanding of featural affixation and featural transfer by presenting a constraint-based account of consonant mutation in Seereer-Siin, an Atlantic (Niger-Congo) language related to Fula, and by focusing specifically on the interaction of consonant mutation and reduplication. In the analysis presented here I consider mutation to be the result of featural affixation to the root node of a stem-initial consonant. In Seereer-Siin reduplicative forms evidence of the affixed feature

* The data in this study are from my own fieldwork on the Fatick dialect of Seereer-Siin, although the general reduplicative patterns are also attested to in Crétois (1972) and Hestermann (1915). I thank Thérèse Diouf, Amadou Faye, El Hadji Arfang Diouf and Tapha Diouf for providing me with the original reduplicative forms and for their grammaticality judgements, Mamadou Dieng, Mamadou Diouf and Papa Dagamé Faye, the Seereer-Siin speaking students in my spring 2000 Advanced Phonology class at the Université Gaston Berger in Saint-Louis, Senegal, for comments on an earlier version of this article and three anonymous *Phonology* reviewers for their helpful comments. All errors are my own responsibility.

[1] Featural transfer is used here as a purely descriptive term and does not imply any theoretical status.

https://doi.org/10.1017/S0952675701003955 Published online by Cambridge University Press

sometimes appears in both the reduplicant and the base, thereby providing evidence of featural transfer.

One of the main insights of Correspondence Theory (McCarthy & Prince 1995) is that a correspondence or identity relationship exists between a reduplicant and a base. Unless other constraints intervene – and most often templatic or prosodic ones do – a base and a reduplicant should be identical. This study focuses on the behaviour of corresponding mutating consonants in base–reduplicant identity. Reduplication in Seereer-Siin (henceforth Seereer) is used to derive an agent noun from a verb with consequences that are of significant theoretical interest. As the reduplicated forms in (1) illustrate, corresponding consonants are sometimes identical and sometimes not. Moreover, in some cases, such as the examples in (1a), which involve mutation between a continuant and a stop, both forms are grammatical, resulting in free variation. The same is not true for those in (1b), which involve mutation between a voiced stop and a voiceless stop.[2]

(1) a.	**w**aad	'search'	o**b**aa**w**aad	~	o**b**aa**b**aad	'researcher'
	war	'kill'	o**b**aa**w**ar	~	o**b**aa**b**ar	'killer'
	fec	'dance'	o**p**ee**f**ec	~	o**p**ee**p**ec	'dancer'
	fiʔ	'act'	o**p**ii**f**iʔ	~	o**p**ii**p**iʔ	'actor'
	reef	'follow'	o**t**ee**r**eef	~	o**t**ee**t**eef	'follower'
	riw	'weave'	o**t**ii**r**iw	~	o**t**ii**t**iw	'weaver'
	xaʃ	'shoot'	o**q**aa**x**aʃ	~	o**q**aa**q**aʃ	'shooter'
	xoox	'cultivate'	o**q**oo**x**oox	~	o**q**oo**q**oox	'farmer'
b.	**b**ind	'write'	o**p**ii**b**ind		*o**p**ii**p**ind	'writer'
	ɓoɗ	'strangle'	o**ɓ**oo**ɓ**oɗ		*o**ɓ**oo**ɓ**oɗ	'strangler'
	dap	'launder'	o**t**aa**d**ap		*o**t**aa**t**ap	'launderer'
	ɗis	'sew'	o**f**ii**ɗ**is		*o**f**ii**f**is	'tailor'
	gaʔ	'see'	o**k**aa**g**aʔ		*o**k**aa**k**aʔ	'seer'
	gim	'sing'	o**k**ii**g**im		*o**k**ii**k**im	'singer'
	ɟal	'work'	o**c**aa**ɟ**al		*o**c**aa**c**al	'worker'
	ɟik	'buy'	o**c**ii**ɟ**ik		*o**c**ii**c**ik	'buyer'

In this paper I propose an analysis of Seereer that accounts for the variation found in reduplication by building on the insights of featural affixation theories (Akinlabi 1996, Zoll 1998) and Correspondence Theory (McCarthy & Prince 1995) within the overall constraint-based framework of Optimality Theory (OT). I conclude that unless other conflicting constraints intervene, featural transfer between base and reduplicant systematically takes place.[3] The organisation of the article is as follows: §2 presents the facts of consonant mutation in Seereer and the general approach, §3 consists of an analysis of consonant mutation within a constraint-based framework and §4 provides an account of featural transfer and variation in reduplicative forms.

[2] Throughout this article, mutating consonants are indicated by boldface.

[3] A similar conclusion is reached by Myers & Carleton (1996) with regard to tonal transfer in Chichewa.

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2 The facts of consonant mutation in Seereer-Siin

Stem-initial consonant mutation in Seereer-Siin is morphologically conditioned by noun class in nouns and dependent adjectives, and by number in verbs. There are two patterns of consonant mutation in Seereer-Siin: VOICING MUTATION, in which the initial consonant of allomorphs alternates predictably between a plain voiceless stop, a plain voiced stop and a voiced prenasalised stop, as in (2a); and CONTINUANCY MUTATION, where the stem-initial consonant alternates predictably between a continuant, a stop and a voiced prenasalised stop, as in (2b).

(2)	*singular*	*plural*	*diminutive singular*	
a.	o**d**on	xa**t**on	o**nd**on	'mouth'
	o**k**awul	**g**awul	o**ŋg**awul	'griot'
b.	o**p**aɗ	**f**aɗ	o**mb**aɗ	'slave'
	o**t**ew	**r**ew	o**nd**ew	'woman'

Verbal stems exhibit only a two-way alternation, either between a plain voiced stop and a voiced prenasalised stop, for stems that undergo voicing mutation, or between a continuant and a voiced prenasalised stop, for stems that undergo continuancy mutation. Nouns, on the other hand, exhibit the complete three-way range of possible mutations for each mutation type, thus the following expository comments will focus on consonant mutation in nominal stems.

2.1 Mutation in noun stems

Of the phonemes in Seereer-Siin, given in (3), the glottal stop [ʔ], the plain nasal stops [m n ɲ ŋ], the lateral [l] and the palatal glide [j] do not undergo mutation. All other consonants, however, participate in the mutation system.

(3) *The consonantal phonemes of Seereer-Siin*

	labial	coronal	palatal	velar	uvular	glottal
obstruent						
plosive	p	t	c	k	q	ʔ
	b	d	ɟ	g		
glottalised	ɓ	ƭ	ƈ			
	ɓ	ɗ	ʄ			
prenasalised	mb	nd	ɲɟ	ŋg	NG	
fricative	f	s		x		h
sonorant						
nasal	m	n	ɲ	ŋ		
flap		r				
lateral		l				
glide	w		j	(w)		

The typical noun stem undergoes initial consonant mutation depending

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on the noun classes to which it is assigned. There are sixteen noun classes in Seereer, and a single noun stem may belong to up to as many as five distinct classes, including singular, plural, diminutive singular, diminutive plural and augmentative singular classes. For eleven of the sixteen classes (Classes 1, 3a, 3b, 4, 8, 10–15)[4] there is an overt class prefix of the shape (C)V. In the remaining five classes (Classes 2, 5–7 and 9), however, there is no overt class prefix. Noun classes, whether they have an overt prefix or not, always condition consonant mutation. Noun class is also marked by an enclitic determiner that appears in definite NPs and whose form is distinct for each class as well as distinct from the class prefix. The paradigm for the noun 'man' in (4) illustrates these facts. The forms for Classes 1, 12, 13 and 3b have overt prefixes, while the Class 2 form does not; the enclitic determiner is distinct for each of the five classes; and the paradigm shows the three-way range of the mutation: [k–g–ŋg].

(4)	o**k**oor-oxe	Class 1	singular
	goor-we	Class 2	plural
	o**ŋg**oor-ONGE	Class 12	diminutive singular
	fo**ŋg**oor-ne	Class 13	diminutive plural
	a**ŋg**oor-ale	Class 3b	augmentative singular

Consonants that undergo voicing mutation have up to three homorganic variants, which, following Arnott (1970) for Fula, are termed GRADES. The three grades of a consonant are known as a GRADATION SET. Seereer-Siin exhibits seven gradation sets that involve voicing mutation, four of which alternate between a voiced stop, a voiceless stop and a voiced prenasalised stop, while the remaining three, which involve glottalised stops, appear as voiceless stops in the nasal grade. These gradation sets are given in (5).

(5) *Voicing mutations*

		labial		coronal				dorsal
a.	voiced	b	ɓ	d	ɗ	ɟ	ʄ	g
b.	voiceless	p	ƥ	t	ƭ	c	ƈ	k
c.	nasal	mb	ƥ	nd	ƭ	ɲɟ	ƈ	ŋg

There are also seven gradation sets, given in (6), associated with continuancy mutations, all of which alternate between a continuant, a stop and a prenasalised stop.

(6) *Continuancy mutations*

		labial		coronal		dorsal		
a.	continuant	w	f	r	s	w	x	h
b.	stop	b	p	t	c	k	q	k
c.	nasal	mb	mb	nd	ɲɟ	ŋg	NG	ŋg

[4] The class numbering system used here is the same as that of Mc Laughlin (1994), which is based on Fal (1980), with only one difference: Fal's Class 3 is divided into Classes 3a and 3b, based on the fact that they condition two different mutations, with 3a being a regular singular class and 3b a diminutive singular class.

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In stems that undergo mutation, a given noun class always conditions the same grade, either a, b, or c, regardless of the gradation set or the mutation type (see Appendix 1). Thus, for example, Class 1, which contains human singular nouns, conditions the b-grade. Stems that undergo voicing mutation will appear in voiceless stop-initial forms in that class, while those that undergo continuancy mutation will appear in stop-initial, as opposed to continuant-initial, form. Class 2, which contains human plural nouns, conditions the a-grade, and Class 3b, which contains augmentative singular nouns, conditions the c-grade. By way of example, consider the two nouns in (7). The stem for 'sick person' undergoes voicing mutation, while the stem for 'dead person' undergoes continuancy mutation. In Class 1, the allomorphs occur in their b-grade forms: a voiceless stop, [c], for 'sick person' and a stop, [q], for 'dead person'. In Class 2, the allomorphs occur in their a-grade forms: a voiced stop, [ɟ], for 'sick person', and a continuant, [x], for 'dead person.' In Class 3b they both exhibit prenasalised stops or c-grade forms: [ɲɟ] and [NG], respectively.

(7)

	Class 1	Class 2	Class 3b	
	b-grade	a-grade	c-grade	
Voicing mutation	o**c**ir	**ɟ**ir	a**ɲɟ**ir	'sick person'
Continuancy mutation	o**q**on	**x**on	aNGon	'dead person'

Of the sixteen classes in Seereer-Siin, Classes 2, 3a, 5, 7, 8 and 10 condition the a-grade, Classes 1, 4, 9, 11 and 15 condition the b-grade and Classes 3b, 6, 12, 13 and 14 condition the c-grade; thus the distribution of grades is more or less even across classes, with each grade appearing 5 (+1) times (see Appendix 2).

With the exception of the [w–k–ŋg] and [s–c–ɲɟ] continuancy mutation gradation sets, all mutations are robust. The former is restricted to a single lexical stem (*-kiin/-wiin/-ngiin* 'person') while in the latter, the [s]–[c] alternations appear to be merging to [s], which still alternates with the prenasalised stop, [ɲɟ].

2.2 Mutation in verb stems

Verbal stems in Seereer-Siin exhibit two-way mutations between a continuant-initial form and a prenasalised stop-initial form for those stems that undergo continuancy mutation, and between voiced stop-initial and prenasalised stop-initial allomorphs for stems that undergo voicing mutation. Plurality conditions the nasal grade, while infinitival and singular forms are non-nasal, as illustrated in the examples in (8a) for voicing mutation and (8b) for continuancy mutation.

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(8)

	infinitive	*singular*	*plural*	
a.	**b**ug	**b**ugu	**mb**ugu	'want, like'
	ɓaf	**ɓ**afa	**ɓ**afa	'pour out waste water'
	duʔ	**d**uʔa	**nd**uʔa	'stutter'
	ɗeg	**ɗ**ega	**ɟ**ega	'cut'
	ɟir	**ɟ**ir	**ɲɟ**ir	'be ill'
	gen	a**g**enu	a**ŋg**enu	'live'
b.	**w**aaɗ	**w**aaɗa	**mb**aaɗa	'look for'
	fiʔ	**fi**ʔa	**pi**ʔa	'do'
	ref	a**r**efu	a**nd**efu	'be'
	xoox	a**x**ooxu	aNGooxu	'cultivate, farm'

2.3 An approach to consonant mutation

Consonant mutation of the sort found in Seereer-Siin has proved a perennial challenge to linguistic theory. Recent approaches to similar mutations in a variety of languages, including Fula, Irish and Welsh (Ni Chiosáin 1991, Elzinga 1996, Gnanadesikan 1997, Kibre 1997) have yielded no consensus on how best to treat the phenomenon from a morphophonological perspective. Historical evidence (Greenberg 1977) strongly suggests that in the Atlantic languages at least, consonant mutation is the residue of once overt prefixation.[5] Such a view is compatible with the approach I have adopted here, namely that consonant mutation in Seereer is the result of the affixation of a floating feature to the root node of a stem-initial consonant. In this view, noun class prefixes in Seereer consist of either an overt (C)V string plus a floating feature, or simply a floating feature in cases where there is no overt string.[6]

In order to determine what the mutation triggering features are, as well as what the underlying forms of the mutating consonants are, we must examine the patterns of stem behaviour in both nouns and verbs. In addition to fully mutating nominal stems in which all three members of a gradation set occur, Seereer also has partially mutating stems in which only two of the three forms occur in a set of morphological environments where we would expect all three. In such cases, one of the two grades is always the nasal or c-grade. The unfailing occurrence of the nasal grade in

[5] Of the three languages that make up the Northern branch of Atlantic, the other two being Fula and Wolof, Seereer-Siin is the only one to retain any kind of overt prefix in addition to consonant mutation (Mc Laughlin 1997).

[6] As an anonymous reviewer points out, a problem associated with this view is that floating features must have a very restricted distribution in the language, and that given Richness of the Base, such a degenerate distribution can only occur if some constraint ensures that the floating feature only occur at the end of prefixes. While this may be true, the alternative, namely positing mutation triggers that are full segments that coalesce with a stem-initial consonant to avoid violating onset constraints, presents its own problems. If mutation triggers were full segments, we would have to predict that such segments should show up occasionally as prefixes to vowel-initial stems, which is not the case.

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nominal paradigms is due to the fact that augmentative and diminutive formation, which in each case involves assignment of a stem to a class that conditions nasal mutation (3b, 12 or 13), is an extremely productive process.[7] Partially mutating stems that undergo voicing mutation alternate between a plain voiced stop and a prenasalised stop to the exclusion of the voiceless stop; there are no partially mutating stems that would normally undergo voicing mutation that alternate between a voiceless stop and a prenasalised stop. Partially mutating stems undergoing continuancy mutation alternate between a stop and a prenasalised stop to the exclusion of the continuant, with the sole exception of stems in which the [s]–[c] alternation has merged to [s]; there are no other partially mutating stems that should normally undergo continuancy mutation that alternate between a stop and a prenasalised stop.[8] The distribution of grade occurrence across stems that undergo voicing mutation and examples of fully mutating and partially mutating stems with their noun classes are given in (9a) and (9b) respectively.

(9) *Voicing mutation*

a. Fully mutating voiced voiceless nasal
Partially mutating voiced nasal

b.

	a-grade	b-grade	c-grade	
Fully mutating	o**g**ac 10	a**k**ac 4	fo**ŋg**ac 13	'stone'
	ɟir 5	a**c**ir 4	a**ɲɟ**ir 3b	'illness'
	o**ɓ**ay 10	xa**β**ay 11	fo**β**ay 13	'hand, arm'
Partially mutating	**ɟ**umaa 7	**ɟ**umaa 9	fo**ɲɟ**umaa 13	'mosque'
	guru	**g**uru 9	fo**ŋg**uru	'cola nut'
	daakande 7	**d**aakande 9	fo**nd**aakande 13	'gum arabic'

It becomes clear from these stem patterns that the features involved in class prefixation are [+voice] and [+nasal]. The floating feature, [+voice], drives the voicing of underlying voiceless-initial stems, which are fully mutating, but has no effect on underlying voiced-initial stems, which, as a result, are partially mutating stems. If we were to posit a [−voice] prefix that drives the devoicing of underlying voiced-initial stems, we could not explain why the b-grade forms of partially mutating stems remain voiced stem-initially.[9]

[7] Augmentative and diminutive formation always involves mutation of a consonant to the c-grade or nasal grade. Consequently, the very few stems that do not alternate where we would expect them to are generally prenasalised stop-initial, as in the following example: 'hat' *mbaxana* SG (Cl. 5, a-grade), *xambaxana* PL (Cl. 11, b-grade), *ombaxana* DIM SG (Cl. 12, c-grade).

[8] Given the high overlap of segments between those involved in continuancy mutation and those involved in voicing mutation, I had to rely on the behaviour of the restricted class of non-overlapping segments to determine the patterns of stem distribution. These included [ɟ g d] and the glottalised consonants for the voicing mutations, and [w f r s x q h NG] for the continuancy mutations.

[9] The notion of underlying forms in OT has been called into question in several parallel lines of inquiry quite recently by Hammond (1995, 1997), Russell (1995),

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Turning now to the distribution of grade occurrence across stems that undergo continuancy mutation, examples of fully mutating and partially mutating stems with their respective noun classes are given in (10a) and (10b).[10]

(10) *Continuancy mutation*

a.

Fully mutating	continuant	stop	nasal
Partially mutating		stop	nasal
Non-mutating			nasal

b.

	a-grade	b-grade	c-grade	
Fully mutating	**s**aytaane 7	**c**aytaane 9	a**ɲɟ**aytaane 3b	'devil'
	xaβ 5	a**q**aβ 4	a**NG**aβ 3b	'manioc'
	ruul 5	a**t**uul	o**nd**uul 12	'pig'
Partially mutating	o**c**ok 10	xa**c**ok 11	a**ɲɟ**ok 3b	'neck'
	paaŋ7	**p**aaŋ9	a**mb**aaŋ3b	'oyster'
	o**t**engaado 10	xa**t**engaado 11	a**nd**engaado 3b	'hat'

The patterns of those stems which undergo continuancy mutation allow us to posit that in addition to the [+voice] and [+nasal] floating features that participate in the mutation system as class prefixes, there is a third floating feature, namely [−continuant]. The floating feature drives the hardening of basic continuant-initial stems, which are fully mutating, into stops, but has no effect on basic stop-initial stems, which, as a result, are reduced to partially mutating stems.

When compared with one another, what the sets of stem patterns for stems that undergo voicing mutation and those that undergo continuancy mutation show is that there is a [+voice] floating feature that drives the a-grade mutations. The feature has no effect on continuants that are voiced, nor on fricatives, which cannot be voiced in Seereer (see §3.3). There is also a [−continuant] prefix that drives the b-grade mutations, a feature that is of no consequence to stem-initial segments of stems that undergo voicing mutation, since they are all stops. And finally, there is a [+nasal] floating feature that drives the c-grade mutation.[11]

Verbal stems that alternate between a voiceless stop and a prenasalised stop do not occur in Seereer. Stems that are voiceless stop-initial simply

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Benua (1997) and Burzio (1999) as being in some sense the artefact of a serial model of the grammar. At this point, I am not aware that abandoning the traditional notion of underlying representation for another approach will have any significant bearing on my analysis of consonant mutation.

[10] There are also some stems in Seereer that begin with consonants that we would normally expect to undergo mutation but which do not. They can occur in any grade, and a substantial number of them are loanwords, although non-loans are also found among them. Such idiosyncratic stems present a challenge for the various treatments of consonant mutation within OT.

[11] The affixation of these prefixes is not quite sufficient in itself to account entirely for the patterns of consonant mutation. The [r–t–nd] gradation set involves not only hardening of the continuant [r], but also devoicing to [t] rather than [d]. This issue will be discussed in §3.4.

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do not undergo mutation. Such stems exhibit plain voiceless stops in both the a-grade and c-grade forms, namely where we would expect either continuants or voiced stops in the singular and prenasalised stops in the plural. Examples of such non-mutating stems are given in (11).

(11)	*infinitive*	*singular*	*plural*	
	paf	**p**afa	**p**afa	'end up (doing something)'
	paq	**p**aq	**p**aq	'be exhausted'
	qec	**q**ec	**q**ec	'pull (as a string)'
	taɓ	**t**aɓ	**t**aɓ	'be miserly'

The patterns of mutation and grade distribution across mutation types in verbal stems are given in (12).

(12)	Fully mutating	voiced	nasal	(voicing mutation)
		continuant	nasal	(continuancy mutation)
	Non-mutating	voiceless stop		

From this distribution of stem types, we can posit a single floating feature, [+nasal], which constitutes the plural morpheme in the verbal system. The featural prefix attaches to basic voiced stop-initial stems for those that undergo voicing mutation, and to basic continuant-initial stems for those that undergo continuancy mutation.[12]

Two observations can now be made. First, mutations in verbal stems that undergo continuancy mutation are a subset of nominal stem mutations: the basic forms of both nominal and verbal stems are continuant-initial; verbal stems undergo nasal mutation while nominal stems undergo both nasal and stop mutation. Second, mutations in verbal stems that undergo voicing mutation are not, on the other hand, a subset of nominal stem mutations: while both undergo nasal mutation, the basic forms of nominal stems are voiceless stop-initial, while the basic forms of verbal stems are voiced stop-initial.

3 Constraints on consonant mutation in Seereer

The central tenet of Optimality Theory is that grammars are composed of hierarchies of ranked markedness and faithfulness constraints that are frequently in direct conflict with each other. Markedness constraints favour unmarked output structures such as codaless syllables, while

[12] There is a problem here with regard to the glottalised stop-initial stems, which are voiced in the infinitival and singular forms, but which are voiceless in the plural. See note 22 in §3.4 for a way to solve this.

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faithfulness constraints favour output structures that are identical to input structures, regardless of how marked they might be. McCarthy & Prince (1995) have shown that the correspondence (faithfulness) relationship that holds between input and output also holds between certain pairs of output forms such as base and reduplicant, with far-reaching theoretical consequences. As first elaborated by McCarthy & Prince (1995), Correspondence Theory implicitly privileges segments as the smallest units between which correspondence relationships could be established; Zoll (1998) further develops the theory by presenting a coherent framework within which to analyse subsegmental units. The following analysis of consonant mutation in Seereer is cast within the general framework of OT and appeals particularly to Correspondence Theory and theories of featural affixation (Akinlabi 1996, Zoll 1996).

3.1 Correspondence and faithfulness

Correspondence Theory (McCarthy & Prince 1995) posits a set of identity relationships (R) between an element (*a*) of one structure, and an element (*b*) of another structure. A correspondence relationship naturally exists between input and output, formalised as the faithfulness constraints given in (13).

(13) a. MAX-IO
Every element in the input has a correspondent in the output. (No deletion.)
b. DEP-IO
Every element in the output has a correspondent in the input. (No augmentation.)

Within these two constraints, an element is defined as a segment. Corresponding segments are not required to be featurally identical by MAX-IO or DEP-IO. Featural identity between input and output is governed by a set of identity constraints that are subsumed under the umbrella constraint, IDENT-IO(F), given in (14).

(14) IDENT-IO(F)
Correspondent IO segments have identical values for the feature F.

Noting that MAX-IO has nothing to say about subsegmental inputs, Zoll (1998) further develops the constraint-based framework to deal specifically with elements that are smaller than segments, namely floating features of the type found in Seereer, and latent segments such as Polish yer, which she unites under the rubric SUBSEGMENT. A subsegment is defined as an

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undominated F-element (Archangeli & Pulleyblank 1994), which subsumes both floating class nodes and floating features (Zoll 1998: 44).

To ensure that subsegmental inputs are realised in the output, Zoll posits the constraint MAX(subseg), given in (15).

(15) MAX(subseg)
Every subsegment in the input has a correspondent in the output.[13]

Since subsegments do not occur as output forms, there is no evidence for positing a DEP constraint of the sort DEP(subseg). As Zoll (1998: 40–41) notes, 'where input subsegments have docked onto a full segment in the output, the correspondence relation returns the output segment that hosts the feature, not the feature itself'.

Consonant mutation in Seereer involves the docking of an input feature onto a stem-initial consonant, potentially resulting in a segment that contains more than one value of a given feature. When featural co-occurrence constraints rule out segments that contain conflicting features, such as [+continuant] and [−continuant] or [+voice] and [−voice], MAX(subseg) ensures that the floating feature take precedence, as in (16).

(16) *input* Class 10 prefix /o [+voice]/ + $_{\text{stem}}$[C
F

output ROOT
[+voice]

Given that the output correspondent that hosts the subsegment in (16) is featurally distinct from its input correspondent if MAX(subseg) is fulfilled, then MAX(subseg) automatically conflicts with IDENT-IO(F). Within the grammar of languages such as Seereer which involve the parsing of subsegments, MAX(subseg) outranks IDENT-IO(F), as shown in (17).

(17) ogac 'stone' (Cl. 10, SG)

kac; o[+vce]	MAX(subseg)	ID-IO(F)
☞ a. ogac [+vce]		*
b. okac	*!	

[13] An alternative to positing MAX(subseg) would be to posit a set of general identity constraints for features such as MAX(F), argued for by Lombardi (1998), among others. Such constraints would govern identity between all corresponding features regardless of whether they are attached to a root node or not. Zoll (1996: 47–49), however, provides convincing evidence from Mixteco tone association that a distinction between floating features and those that are dominated by a root node is a pertinent one, since the two may potentially conflict.

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3.2 Featural affixation

Recent studies (Kirchner 1993, Akinlabi 1996, Zoll 1996)[14] suggest that featural affixes are subject to the same kind of alignment constraints (McCarthy & Prince 1993) as non-featural morphemes. A constraint like (18), which holds for Seereer, thus potentially subsumes all affixes, regardless of their phonological exponence.

(18) ALIGN(Affix-L, Stem-L)
The left edge of an affix is aligned with the left edge of a stem. (The affix is a prefix.)

How a floating feature is actually licensed to attach to the root node of some segment has also been the topic of several recent proposals. Akinlabi (1996: 243) proposes that the alignment of all featural affixes be subsumed under the featural alignment constraint in (19).

(19) ALIGN(PFeat, GCat)
A prosodic feature is aligned with some grammatical category.

The term prosodic feature refers here to the phonological exponent of a featural morpheme which is underlyingly free and unattached to a root node. Akinlabi claims that PFeat is simply the featural spell-out of a morphological category. Of the numerous examples of featural affixation that Akinlabi provides (e.g. 3rd singular masculine object labialisation in Chaha and palatalisation in Japanese mimetics), all involve isomorphism between a feature and a morpheme. The typology of affixes implicit in his discussion thus consists of two categories: segmental affixes and featural affixes. While five of the class prefixes in Seereer consist of a single feature, falling into the latter category, the remaining eleven consist of both segmental and featural material, thereby adding a third 'hybrid' category to the typology. In these instances PFeat is not isomorphic with any morphological category.

Piggott (2000) argues explicitly against featural alignment as proposed by Akinlabi (1996) as an overly powerful mechanism. Instead, he proposes that morphological alignment be supplemented by a provision for prosodic licensing (2000: 86) so that, for example, features may be incorporated into a prosodic category such as a foot or a prosodic word.

Given the typology of Seereer prefixes, I concur that any notion of featural alignment must be limited to its morphological sense and that featural affixation be handled like any other case of affixation, governed by constraints like that in (18). MAX(subseg) ensures that the featural affix

[14] Zoll (1996) points out that constraints that align constituent edges must also contain a statement as to how violations are assessed. She proposes constraining the grammar by restating the ALIGN family as a set of NOINTERVENING constraints in order to subsume both ALIGN and assessment of its violation into a single statement. In this discussion I retain the more familiar ALIGN constraint, which is never violated in Seereer.

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will be parsed, while the alignment constraint in (18), abbreviated as ALIGN-L, ensures that it will be prefixed.

3.3 Feature co-occurrence constraints

The parsing of a floating feature involves its association to the root node of the segment to which it attaches. Following standard versions of feature geometry (Clements 1985b, Sagey 1986, McCarthy 1988, Hume 1992), a root node consists of the feature [±sonorant] and [±consonantal]. In the case of Seereer, licit root nodes, to which floating features may attach, consist of the features [+consonantal] and [−sonorant]. Well-formed structures that are the result of feature parsing have the representation in (20), where F is the floating feature.

(20) ROOT
$$\begin{bmatrix} +\text{cons} \\ -\text{son} \end{bmatrix}$$
F

Featural parsing may fail to occur when the resulting feature combination gives rise to an ill-formed structure. Such feature combinations are ruled out by highly ranked feature co-occurrence constraints. For example, glottalised consonants in Seereer do not undergo prenasalisation, so the floating feature [+nasal] is barred from attaching to the root node of segments that are [+constricted glottis] by the feature co-occurrence constraint in (21) which forbids such highly marked segments (Ladefoged & Maddieson 1996: 119).

(21) NAS/CGL
If [+constricted glottis], then not [+nasal].

Co-occurrence constraints are typically ranked high in the constraint hierarchy. Evidence of the ranking of NAS/CGL *vis-à-vis* MAX(subseg) is given in (22).

(22) foβay 'hand' (Cl. 13, DIM PL)

βay; fo[+nas]	NAS/CGL	MAX(subseg)	ID-IO(F)
☞ a. foβay		*	
b. fomβay [+nas]	*!		*

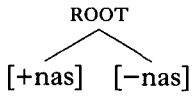
Candidate (a), the winner, fails to parse the [+nasal] subsegment, thereby violating MAX(subseg), but simultaneously satisfies the more highly ranked well-formedness constraint, NAS/CGL. Candidate (b) fatally violates the highly ranked NAS/CGL, as it satisfies MAX(subseg).

With the exception of the glottalised stops, all other segments that participate in the mutation system in Seereer may undergo prenasalisation

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as the result of the alignment of [+nasal]. I will assume a structure for prenasalised stops like the one in (23), where the features [+nasal] and [−nasal] are attached to the same root node (Ewen 1982, Sagey 1986).[15]

(23)



The fact that all prenasalised stops in Seereer are indeed stops, and voiced, is accounted for by the co-occurrence constraints in (24), which rule out cross-linguistically marked feature combinations (Ladefoged & Maddieson 1996: 101–129).

(24) a. NAS/VCE
If [+nasal], then not [−voice].[16]
b. NAS/CONT
If [+nasal], then not [+continuant].

These constraints rule out both voiceless prenasalised stops and prenasalised continuants, which are illicit segments in Seereer. The effect and ranking of NAS/VCE can be seen in the tableaux in (25), which involve the stems *rew* 'woman' and *koor* 'man' in conjunction with the Class 13 (diminutive plural) prefix, /fo [+nasal]/.

(25) a.

rew; fo[+nas]	NAS/VCE	NAS/CONT	MAX(subseg)
☞ i. fondew [+nas]			
ii. fonrew [+nas]		*!	
iii. forew			*!

b.

koor; fo[+nas]			
☞ i. foŋgoor [+nas]			
ii. foŋkoor [+nas]	*!		
iii. fokoor			*!

Voiced fricatives, which could potentially result from the affixation of the featural class morpheme [+voice] to the underlying form of the continuancy mutations, are likewise ruled out by the constraint in (26).[17]

[15] Nothing crucial hinges on this representation of prenasalised stops.

[16] Based on a sample of 1057 languages, Maddieson (1984: 69) reports that 984 (93·1 %) conform to the generalisation that if a segment is nasal, it is voiced.

[17] The majority of fricatives in the world's languages are voiceless (Ladefoged & Maddieson 1996: 176), thus voiced fricatives are more marked than their voiceless counterparts.

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(26) FRIC/VCE
If a fricative, then not [+voice].[18]

Predictably, there is no evidence that the feature co-occurrence constraints NAS/CGL, NAS/VCE, NAS/CONT and FRIC/VCE are ranked in relation to each other since none of them is ever violated in a winning candidate. The ranking of constraints discussed thus far is as follows:

(27) NAS/CGL, NAS/VCE, NAS/CONT, FRIC/VCE, ALIGN-L ≫
MAX(subseg) ≫ IDENT-IO(F)

In order to illustrate the interaction of these constraints, the tableaux in (28) present three output forms for the stem for the word for 'griot': *okawul* (Class 1, singular; (28a)), *gawul* (Class 2, plural; (28b)) and *aŋgawul* (Class 3b, augmentative singular; (28c)). Each of the classes conditions a different grade, therefore the entire range of mutations for the noun is covered in the three examples. Zoll (1996: 7–8) uses the cover term Segment Structure Constraints (SSC) for the set of undominated feature co-occurrence constraints which render impossible certain feature combinations. I will use this cover term in tableaux where none of the feature co-occurrence constraints is violated.

(28)

	kawul; o[−cont]	SSC	ALIGN-L	MAX(subseg)	ID-IO(F)
a.	☞ i. okawul [−cont]				
	ii. okabul [−cont]		*!		*
b.	kawul; [+vce]				
	☞ i. gawul [+vce]				*
	ii. kawul			*!	
c.	kawul; a[+nas]				
	☞ i. aŋgawul [+nas]				*
	ii. aŋkawul [+nas]	*!			*
	iii. akawul			*!	

[18] Since there is no single distinctive feature that uniquely identifies fricatives, I have used the descriptive term fricative as shorthand for those segments that are [+continuant] and [−sonorant]. This fact about fricatives has been used to support arguments for multivalued continua such as the ternary scales described in §3.4.

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The examples in (28) involve a stem that undergoes voicing mutation. When we turn to stems that undergo continuancy mutation, it becomes evident that the constraints we have posited thus far are not sufficient, because they yield the wrong results for *r*-initial stems like *roon* 'milk bowl' that undergo continuancy mutation, as (29) shows.

(29) xatoon (*xadoon) 'milk bowl' (Cl. 11, PL)

roon; xa[−cont]	SSC	ALIGN-L	MAX(subseg)	ID-IO(F)
☞ a. xadoon				*
b. xatoon				**!

The constraint hierarchy as it stands wrongly predicts that ***xadoon*** should be the winner over the voiceless form, ***xatoon***. Candidate (a) violates the specific instantiation of IDENT-IO(F), namely IDENT-IO(cont), in that it differs from the input with regard to the feature [continuant]. Candidate (b) fatally incurs both a violation of IDENT-IO(cont) and IDENT-IO(voice) by differing from the input with regard to both the feature [continuant] and [voice]; nevertheless it is the grammatical candidate.[19] The devoicing problem, which is not found in other northern Atlantic languages, is discussed in the following section.

3.4 Voicing and the continuancy mutations

Of the three voiced continuants that become stops via the affixation of [−continuant], two also undergo devoicing: [w]→[k] and [r]→[t]. Of those two, the former mutation is found only in a single lexical item, ***okiin*** ∼ ***wiin*** 'person', and therefore cannot be considered productive. The problem is thus reduced to accounting for the devoicing of the segment [t] derived by mutation from [r], and the corresponding lack of devoicing of the voiced segment [b], derived by mutation from [w]. Following recent analyses of related phenomena (Kirchner 1996, Orgun 1996, Gnanadesikan 1997), I propose that this asymmetry is partially the result of constraints on the distance between input and output values along two phonetic scales, analogous in many ways to the widely accepted notion of a sonority scale.[20] Based on cross-linguistic patterns of consonant mutation and assimilation which show consistent interaction of certain sets of segment types, Gnanadesikan proposes two scales: the INHERENT VOICING (IV) scale and the CONSONANTAL STRICTURE (CS) scale. Values on the IV scale go from 1 (voiceless obstruent) to 3 (sonorant), with 2 (voiced obstruent) occupying the middle position, while the CS scale has values that go from 1 (stop) to 3 (vocoid) via a medial position 2, occupied by a

[19] Recall that IDENT-IO(F) is an umbrella constraint that subsumes individual featural identity constraints. We can assume that there are actually two separate constraints at work here: IDENT-IO(cont) and IDENT-IO(voice).

[20] An alternative perspective, as an anonymous reviewer points out, is simply that [b] is an easier stop to voice according to aerodynamic considerations (Catford 1977: 74). The problem, however, is not so much why [w]→[b] does not involve devoicing, but why [r]→[t] does.

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fricative or liquid. Gnanadesikan proposes these ternary scales as an alternative to the binary features that would otherwise capture the distinction between the kinds of segments they contain.[21] While I adopt the IV and CS scales as reflecting common patterns of phonological behaviour, I remain agnostic on whether they are actually basic phonological units, as Gnanadesikan proposes, rather than derived ones.

The more straightforward of the two scales as far as the Seereer mutations are concerned is the inherent voicing (IV) scale. A gradation set such as [p–b–mb] would involve a one-place shift from position 1 [p] to position 2 [b] to a combination 2+3 position [mb]. For a mutating language that does not allow prenasalised stops, such as Irish, a shift occurs from the voiced position on the scale to a simple nasal, rather than a prenasalised stop. The CS scale has values that go from 1 (stop) to 3 (vocoid) via a medial position 2, occupied by a fricative or liquid. To the latter category, I add the flap, [r]. The continuancy mutations in Seereer involve movement along both scales. For example, the gradation set [f–p–mb] involves a shift from 2 (fricative) to 1 (stop) on the CS scale, but it also involves movement from 1 (voiceless) to 2+3 (voiced+sonorant) on the IV scale.

With the exception of the devoiced b-grade in the [r–t–nd] gradation set, mutations in Seereer are driven by the parsing of a mutation feature present in the class prefix. One solution would be to posit a subsegmental prefix for classes that condition the b-grade, consisting of the features [−continuant] and [−voice]. This, however, still fails to account for why devoicing does not occur in the [w–b–mb] mutation.[22] Thus, rather than positing a [−voice] feature, I propose the following necessarily parochial morpheme constraint on voicing for b-grade mutations:[23]

[21] The CS scale is very similar to the Aperture continuum proposed by Steriade (1993).

[22] Positing devoicing as the result of featural affixation would also cause great redundancy in the grammar of Seereer. Most seriously, the basic forms of the voicing mutations, namely the voiceless stops, would be derivable from featural affixation. It would then be impossible to account for the glottalised consonants being voiceless in the nasal grade. Recall from §2.2 that verbs beginning with voiced glottalised consonants become devoiced in the plural form which takes the nasal grade. I suggest that a morpheme constraint similar to that in (30) requires non-nasal c-grade forms to be voiceless.

[23] The ad hoc or parochial nature of this constraint raises the question of whether or not OT should admit language-specific morpheme constraints. Unlike phonological constraints which regulate the shape of segments and strings, morphological constraints must, on occasion, make reference to the actual morphemes of a given language which behave idiosyncratically for various historical reasons. Such constraints cannot, obviously, be universal, but the problem is a significant one for OT. Hammond (1995) argues for incorporating parochial morpheme constraints directly into the constraint hierarchy, while Blevins (1997) suggests that language-specific rules be admitted within OT grammars. The 'constraint' in (30) could, of course, be recast as such a rule, but I have opted to maintain it as a parochial morpheme constraint in the spirit of Hammond (1995). In versions of OT that do not admit such constraints, (30) may be considered a place holder until further research sheds light on what kind of universal constraints could account for the behaviour of the morphemes in question.

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(30) VCE/$C_{Class\ 1,3a,4,9,11,15}$ (VCE/$C_{Cl\text{-}b}$)
The initial consonant of noun stems in classes that condition the b-grade (Classes 1, 3a, 4, 9, 11 and 15) is voiceless.[24]

This constraint interacts with the faithfulness constraints in (31) that constrain scalar movement to an adjacent position on the CS and IV scales.

(31) a. ADJACENT-CS (ADJ-CS)
An input element and its correspondent output element can differ by no more than one position on the consonantal stricture scale.
b. ADJACENT-IV (ADJ-IV)
An input element and its correspondent output element can differ by no more than one position on the inherent voicing scale.

Violations of ADJ-CS or ADJ-IV may be assessed by degree of movement away from the input value on the CS or IV scales. If a segment moves one position on the scale – or does not move at all – it does not incur any violation; if it moves more than one position it incurs a violation. Any movement on the CS or IV scales automatically violates the umbrella constraint on featural identity between input and output that we saw in (14). The two specific featural identity constraints relevant here are those in (32).

(32) a. IDENT-IO(cont)
Correspondent IO segments have identical values for the feature [continuant].
b. IDENT-IO(voice)
Correspondent IO segments have identical values for the feature [voice].

Returning now to the problematic asymmetry in voicing in the mutations [r] → [t] and [w] → [b], we run into a constraint-ranking paradox. The movement from [r] → [t] does not violate ADJ-CS, but both [w] → [p] and [w] → [b] do incur a violation of ADJ-CS. The featural identity constraints IDENT-IO(cont) and IDENT-IO(voice) do not help to resolve the issue. In order for [w] → [p] to be ungrammatical but [w] → [b] to be grammatical, VCE/$C_{Cl\text{-}b}$ must be ranked below the IDENT-IO constraints. But for [r] → [t] to be grammatical and [r] → [d] to be ungrammatical, VCE/$C_{Cl\text{-}b}$ must be ranked above the same constraints. This ranking paradox is illustrated in the tableaux in (33) and (34).

[24] Although the concept of b-grade can be recast as [−continuant] in phonological terms, I have explicitly rejected casting it in terms of features in order to foreground the morphological nature of the constraint.

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(33) abiil 'hair' (Cl. 4, PL)

wiil; a[−cont]	ID-IO(cont)	ID-IO(vce)	VCE/$C_{Cl\text{-}b}$
☞ a. abiil	*		*
b. apiil	*	*!	

IDENT-IO(cont), IDENT-IO(voice) ≫ VCE/$C_{Cl\text{-}b}$

(34) atuul 'pig' (Cl. 4, PL)

ruul; a[−cont]	VCE/$C_{Cl\text{-}b}$	ID-IO(cont)	ID-IO(vce)
☞ a. atuul		*	*
b. aduul	*!	*	

VCE/$C_{Cl\text{-}b}$ ≫ IDENT-IO(cont), IDENT-IO(voice)

The opacity can be resolved by appealing to the notion of Local Conjunction of constraints (Smolensky 1993, Kirchner 1996, Kager 1999), in which two constraints are conjoined locally as a single composite constraint which can then be ranked independently of its two component constraints. Violation of a locally conjoined constraint can only take place if each of the two constraints that go to make up the conjoined one is violated (Smolensky 1993). In this case, the two faithfulness constraints ADJ-CS and IDENT-IO(voice) are conjoined into the constraint given in (35), whose domain, δ, is the segment.

(35) [ADJ-CS & IDENT-IO(voice)]δ
An input element and its correspondent output element can differ by no more than two positions on the CS and must have the same value for the feature [voice].

The tableaux in (36) and (37) illustrate the outcome of local conjunction of the adjacency and identity constraints. ADJ-IV is not germane to the problem at hand, and is therefore not included in the tableau.

(36) abiil 'hair' (Cl. 4, PL)

wiil; a[−cont]	[ADJ-CS & ID-IO(vce)]	VCE/$C_{Cl\text{-}b}$	ADJ-CS	ID-IO(cont)	ID-IO(vce)
☞ a. abiil		*	*	*	
b. apiil	*!		*	*	*

Although candidates (a) and (b) both violate ADJ-CS, (b) incurs a single but fatal violation of the conjoined constraint, because in addition to

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moving two steps on the CS scale, it also fails to satisfy IDENT-IO (voice). In (37) the conjoined constraint is not violated, thus the candidate that fails to satisfy the next highest-ranked constraint, $\text{VCE}/\text{C}_{\text{Cl-b}}$, is ruled out, allowing the voiceless form, candidate (b), to win.

(37) atuul 'pig' (Cl. 4, PL)

ruul; a[−cont]	[ADJ-CS & ID-IO(vce)]	$\text{VCE}/\text{C}_{\text{Cl-b}}$	ADJ-CS	ID-IO(cont)	ID-IO(vce)
a. aduul		*!		*	
☞ b. atuul				*	*

Thus far, the ranking of the relevant constraints is as follows, although in §4.2 we will present evidence to show that IDENT-IO(voice) dominates IDENT-IO(cont).

(38) [ADJ-CS & ID-IO(vce)]$\delta \gg \text{VCE}/\text{C}_{\text{Cl-b}} \gg$ ADJ-CS, ADJ-IV $\gg$ IDENT-IO(cont), IDENT-IO(voice)

Although the interaction of synchronic (and diachronic) chain shifts in Seereer certainly merits more attention in its own right, this brief discussion should provide adequate background for assessing the analysis of featural transfer in reduplication.

4 Reduplication

The analysis of reduplication presented here is based on the framework of Correspondence Theory (McCarthy & Prince 1995). With regard to reduplication, the main insight of Correspondence Theory is to be found in a set of faithfulness constraints which optimally ensure perfect identity between input and base, and between base and reduplicant. Within this framework the common phenomena of what in derivational terms are known respectively as overapplication (where phonological processes apply unexpectedly to both base and reduplicant) and underapplication (where phonological processes unexpectedly fail to apply to base or reduplicant) can be explained by the demands of reduplicative identity, which require that the reduplicant and base maximise their resemblance to each other. These demands can be formalised by a set of constraints that require faithfulness between base and reduplicant and which are analogous to similar familiar constraints that require faithfulness between input and output, namely MAX-IO, DEP-IO and IDENT-IO. The constraints specific to reduplication are given in (39). (39a) and (39b) deal with segments, whether or not their features are identical, while (39c) deals with featural identity between segments.

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(39) a. MAX-BR
Every element of B has a correspondent in R.

b. DEP-BR
Every element of R has a correspondent in B.

c. IDENT-BR(F)
Let α be a segment in B, and β be a correspondent of α in R. If α is [γF], then b is [γF].

MAX-BR militates in favour of total reduplication and forbids partial reduplication. In cases of partial reduplication it is outranked by templatic or prosodic constraints. DEP-BR requires that there be no insertion of segments in the reduplicant that do not have an analogue in the base, thereby forbidding reduplicants that have fixed segments. IDENT-BR(F) is an umbrella constraint that requires correspondent segments to have identical features. It can be broken down into smaller constraints that specify individual features, such as IDENT-BR(voice), IDENT-BR(continuant), etc. These correspondence constraints, along with templatic or prosodic, anchoring and contiguity constraints, account for the gross behaviour of reduplicative forms (McCarthy & Prince 1995).

Reduplication in Seereer is used to derive both an agent noun from a verb and the nominal form meaning 'native of a place' from a place name. The following discussion deals only with the first category since a full range of data is not to be found in the place name examples. As stated in §1, reduplication interacts with featural affixation in ways that are puzzling. Recall that in stems that undergo voicing mutation, like the examples in (40a), there is no featural transfer from reduplicant to base, while in stems that undergo continuancy mutation, like the examples in (40b), there is free variation between forms in which featural transfer takes place from reduplicant to base and those in which it does not.

(40) a.	bind	'write'	o**p**ii-**b**ind		*o**p**ii-**p**ind	'writer'
	ɟal	'work'	o**c**aa-**ɟ**al		*o**c**aa-**c**al	'worker'
b.	fec	'dance'	o**p**ee-**f**ec	~	o**p**ee-**p**ec	'dancer'
	riw	'weave'	o**t**ii-**r**iw	~	o**t**ii-**t**iw	'weaver'

In the analysis that follows, the variation apparent in forms that undergo continuancy mutation is straightforwardly licensed by the equal ranking of pairs of faithfulness constraints. One or the other of them is violated in each of the grammatical output forms. The challenge lies in ruling out the same type of variation in stems that undergo voicing mutation.

The first part of the discussion, in §4.1, deals with what has been termed 'the emergence of the unmarked' (McCarthy & Prince 1994a) in the reduplicant. Reduplicative affixes are unique in that they are not specified for segmental content. Consequently, they are free of lexical contrasts and tend to exhibit less marked structures than their corresponding bases.

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Such is the case in Seereer, where the reduplicant must take the shape CVV, although an identical string is more often than not absent from the base. Although the reduplicant must take the form of a bimoraic syllable, it must also obey a highly ranked markedness constraint, NoCoda, that requires open syllables, thereby resulting in the emergence of an unmarked bimoraic open syllable. The initial C of the reduplicant is in the right location to undergo consonant mutation as the result of class prefixation, a requisite of nominalisation, thus the second part of the discussion, in §4.2, addresses the question of the interaction of consonant mutation and reduplication. The discussion focuses on base–reduplicant identity and featural transfer. While intuitively it would seem that featural transfer should be able to occur unless blocked by some highly ranked constraint, the results of the analysis are quite surprising. As it turns out, variation in featural transfer is due to the equal ranking of two identity constraints, so that violation of either results in equally optimal outputs; variation is ruled out when the sub-optimal candidate violates one of the two equally ranked constraints, but the optimal candidate violates none.

4.1 The reduplicant and the emergence of the unmarked

Reduplicants in Seereer take the shape CVV, where VV is a long vowel. Ignoring for the moment the issue of consonant mutation, there are some cases, namely where the base contains a long vowel, where the CVV string of the reduplicant has an identical analogue in the base, as in the example in (41).

(41) **x**oox 'cultivate'
oq**oo-x**oox 'farmer'

In the vast majority of cases, however, the base consists of a CVC string, as in the examples in (42), rather than a CVV or CVVC string.

(42) a. **f**ec 'dance' b. **ɟ**al 'work'
o**pee-f**ec 'dancer' o**caa-ɟ**al 'worker'

In such cases, there is no CVV string in the base which is analogous to the CVV string of the reduplicant, thus something other than Ident-BR constraints must be responsible for the shape of the reduplicant. The CVV reduplicative template in Seereer emerges from the interaction of a prosodic well-formedness constraint which requires the reduplicant to take the shape of a bimoraic syllable, and a markedness constraint that requires open syllables. The open syllable of the reduplicant is an example of the emergence of the unmarked in Seereer, and results from the fact that the markedness constraint, NoCoda, dominates faithfulness constraints between base and reduplicant. Codaless syllables are unmarked,

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and thus emerge in the reduplicant, even though the requirement of a bimoraic reduplicant could be fulfilled by a CVC string. The relevant constraints are as follows:

(43) a. RED = $\sigma_{\mu\mu}$
The reduplicant is a bimoraic syllable.[25]
b. NoCoda
*C]$_\sigma$ (Syllables are open.)

RED = $\sigma_{\mu\mu}$ dominates NoCoda since the latter is frequently violated outside of the reduplicant. They both dominate the correspondence constraints Max-BR and Dep-BR, but are in turn dominated by the IO faithfulness constraints Max-IO and Dep-IO, which hold between input and base only, reduplicants having no input segments against which the output segments can be evaluated. The constraint ranking thus allows for the emergence of an unmarked reduplicant, as illustrated in (44).[26] Neither Max-IO nor Dep-IO is violated by the candidates appearing in (44), and thus they have been omitted from the tableau.

(44) okiigim 'singer' (Cl. 1, SG)

gim; RED	RED=$\sigma_{\mu\mu}$	NoCoda	Max-BR	Dep-BR
☞ a. kiigim		*	*	*
b. kimgim		**!		
c. kigim	*!	*	*	

Having established the unmarked nature of the Seereer reduplicant, I will now turn to the interaction of featural affixation with reduplication.

4.2 Base–reduplicant identity and featural transfer

Featural transfer in Seereer systematically takes place unless other conflicting constraints crucially outrank the faithfulness constraints. Featural identity between base and reduplicant is seen as being governed by Ident-BR(F), given in (39c) above, which requires corresponding base–reduplicant segments to have identical features. In Seereer, morphological constraints require featural affixation to a stem-initial consonant, a segment that is implicated in base–reduplicant identity. These

[25] With a better understanding of Seereer prosody it should be possible eventually to account for the 'template' as the consequence of the interaction of prosodic well-formedness constraints and constraints on reduplicative identity, and especially output–output constraints, in line with McCarthy & Prince (1994a, b) and Urbanczyk (1999). Since the focus of this paper is consonant mutation I have not pursued this alternative here.

[26] As pointed out by an anonymous reviewer, markedness must be calculated here against the fact that Seereer admits long vowels. Presumably, for a language that has no long vowels, a CVV syllable could not be construed as the emergence of the unmarked.

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two sets of constraints that govern featural affixation and base–reduplicant identity are thus bound to interact, and do so in ways that will be examined in this section. As we have seen, the main constraint that governs consonant mutation is the highly ranked MAX(subseg), which is crucially outranked only by segment structure and alignment constraints. BR identity is frequently violated in Seereer when the reduplicant-initial (i.e. noun stem-initial) consonant hosts the relevant subsegment while the corresponding base-initial segment does not. MAX(subseg) must therefore dominate IDENT-BR(F). The main consequence of this ranking is that variation, when it occurs, can only involve the base-initial consonant, and not the reduplicant-initial consonant, because the latter is always subject to MAX(subseg) and can therefore never vary. This observation is borne out by the data in (45), which show variation in the continuancy mutations between a stop and a continuant in base-initial position, while the reduplicant-initial consonant remains constant.

(45)

waaʃ	'search'	o**b**aa-**w**aad	~ o**b**aa-**b**aaʃ	'researcher'
war	'kill'	o**b**aa-**w**ar	~ o**b**aa-**b**ar	'killer'
fec	'dance'	o**p**ee-**f**ec	~ o**p**ee-**p**ec	'dancer'
fiʔ	'act'	o**p**ii-**f**iʔ	~ o**p**ii-**p**iʔ	'actor'
reef	'follow'	o**t**ee-**r**eef	~ o**t**ee-**t**eef	'follower'
riw	'weave'	o**t**ii-**r**iw	~ o**t**ii-**t**iw	'weaver'
xaʃ	'shoot'	o**q**aa-**x**aʃ	~ o**q**aa-**q**aʃ	'shooter'
xoox	'cultivate'	o**q**oo-**x**oox	~ o**q**oo-**q**oox	'farmer'

A further consequence of this constraint interaction is that when BR identity is fulfilled, if the reduplicant-initial segment shows evidence of fulfilling MAX(subseg) by hosting the floating feature of the input, then *de facto* the base-initial consonant also contains the same floating feature. The base 'acquires' the feature through BR identity, rather than through featural affixation, therefore an axis of correspondence must exist between base and reduplicant with regard to the floating feature. To this end I propose the constraint given in (46), which is a version of IDENT-BR(F), where (F) equals the subsegment of the input.

(46) IDENT-BR(subseg)

Let α be a segment in B, and β be a correspondent of α in R, and let F be a subsegment hosted by β. If β is [γF], then α is [γF].

This constraint is distinct from IDENT-BR(F) because it makes reference to a restricted class of features, namely those that occur as subsegments in the input; IDENT-BR(F) deals with all features other than those that have the status of subsegments in the input.[27] IDENT-BR(subseg) dominates IDENT-BR(F), as we shall see in the following discussion.

[27] Zoll (1996) admits the theoretical possibility of such a constraint, while stating that she has not found it to be violated – presumably in the empirical literature. The facts of featural transfer in Seereer appear to fill that empirical lacuna.

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With regard to featural transfer, I will first analyse the phenomenon of variation by showing that it is the result of the equal ranking of the two sets of faithfulness constraints. The first is IDENT-IO(voice) and IDENT-BR(subseg). The former governs input–output identity with regard to the feature [voice], and the latter governs base–reduplicant identity with regard to the relevant subsegment. The second set consists of IDENT-IO(cont) and IDENT-BR(F). Again, the former governs input–output identity, this time with regard to the feature [continuant], while the latter governs base–reduplicant identity with regard to features other than the subsegment. As it turns out, continuancy mutations, which involve variation, must violate one constraint in each of the two sets. But since they are equally ranked it does not matter which is violated; consequently variation may take place. I will then turn to the voicing mutations to show how variation is ruled out. Where reduplicative forms involving continuancy mutations must violate one of the two equally ranked faithfulness constraints: IDENT-IO(voice) or IDENT-BR(subseg), optimal forms involving voicing mutations violate neither of them.

Considering first the reduplicative forms that undergo continuancy mutation, in which variation is licensed, I will take as an example the forms derived from the verbal stem ***riw*** 'weave'. There are two grammatical outputs from this base: ***otiiriw***, which violates IDENT-BR(subseg) and IDENT-BR(F), and ***otiitiw***, which violates IDENT-IO(voice) and IDENT-IO(cont). Recall that IDENT-IO(F) requires corresponding input and output segments to have identical features. In this instance, the corresponding IO segments are the input or verb-initial consonant and the reduplicative base-initial consonant. I propose that an equal ranking between IDENT-BR(subseg) and IDENT-IO(voice), as well as an equal ranking between a lower-ranked set of constraints, IDENT-IO(cont) and IDENT-BR(F), results in the free variation that occurs between the two forms. The effects of this ranking can be seen in (47).

(47) otiiriw~otiitiw 'weaver' (Cl. 1, SG)

riw, RED; o[−cont]	ALIGN-L	MAX (subseg)	VCE/$C_{Cl\text{-}b}$	ID-BR (subseg)	ID-IO (vce)	ID-IO (cont)	ID-BR (F)
a. oriiriw		*!	*				
b. oriitiw | [−cont]	*!		*	*	*	*	*
☞ c. otiitiw | [−cont]					*	*	
☞ d. otiiriw | [−cont]				*			*

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Candidate (a) fatally fails to satisfy MAX(subseg). Candidate (b) fatally violates the highly ranked ALIGN-L, as well as five lower-ranked constraints. Candidate (c) incurs a violation of IDENT-IO(voice) since the initial consonant of the input stem, [r], corresponds to [t] in the output. This is not a fatal violation though, because its competitor, candidate (d), violates the equally ranked constraint, IDENT-BR(subseg). Candidate (c) also violates IDENT-IO(cont), but again, this is not fatal because candidate (d) violates IDENT-BR(F), where F equals [voice], which is ranked equally with IDENT-IO(cont). Since there are two equally ranked pairs of constraints, there is a tie between candidates (c) and (d), resulting in free variation between the two forms.

I turn now to reduplicative forms like those in (48), which undergo voicing mutation and do not admit variation.

(48)

bind	'write'	o**p**ii-**b**ind	*o**p**ii-**p**ind	'writer'
ɓoɗ	'strangle'	oβoo-**ɓ**oɗ	*oβoo-βoɗ	'strangler'
dap	'launder'	otaa-**d**ap	*otaa-tap	'launderer'
ɗis	'sew'	ofii-**ɗ**is	*ofii-ɗis	'tailor'
gaʔ	'see'	o**k**aa-**g**aʔ	*o**k**aa-**k**aʔ	'seer'
gim	'sing'	o**k**ii-**g**im	*o**k**ii-**k**im	'singer'
ɟal	'work'	o**c**aa-**ɟ**al	*o**c**aa-**c**al	'worker'
ɟik	'buy'	o**c**ii-**ɟ**ik	*o**c**ii-**c**ik	'buyer'

As my example I will take the form [okaagaʔ] 'seer,' derived from the verb /gaʔ/ 'to see'. As the tableau in (49) shows, it is possible to violate neither IDENT-BR(subseg) nor IDENT-IO(voice) in such forms, an outcome that is impossible in reduplicative forms involving continuancy mutation, without violating MAX(subseg).

(49) okaagaʔ 'seer' (Cl. 1, SG)

gaʔ; RED; o[−cont]	ALIGN-L	MAX (subseg)	VCE/$C_{Cl\text{-}b}$	ID-BR (subseg)	ID-IO (vce)	ID-IO (cont)	ID-BR (F)
a. ogaagaʔ			*!				
☞ b. okaagaʔ							*
c. ogaakaʔ			*!		*		*
d. okaakaʔ					*!		

Candidate (a) fatally violates VCE/$C_{Cl\text{-}b}$ by maintaining the voiced initial consonant of the verbal stem as the initial consonant of the Class 1 noun stem. Candidate (d) fatally violates IDENT-IO(voice) by satisfying a lower-ranked constraint, namely IDENT-BR(F). Candidate (c) fatally violates VCE/$C_{Cl\text{-}b}$, as well as IDENT-IO(voice), and IDENT-BR(F), where F equals [voice]. The optimal candidate, candidate (b), violates only the lowest-

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ranked constraint, IDENT-BR(F), because the initial consonant of the reduplicant and the base do not match in their voicing specifications. It is worthwhile noting that, as a consequence of constraint interaction, the violation of IDENT-IO(voice) by candidate (d) in (49) is the same highest-ranked violation as that incurred by candidate (c) in (47), but whereas the latter is grammatical, the former is not. This observation clearly supports the comparison of output candidates, rather than any absolute criterion, as an evaluative mechanism for grammaticality.

As a final observation on the patterns of featural transfer in Seereer reduplication, the corresponding Class 2 or plural forms of agent nouns do not show the same kind of variation as their singular counterparts. This is due to the dual facts that infinitival forms are either voiced stop-initial or continuant-initial, i.e. a-grade-initial, and that the Class 2 prefix also conditions the a-grade. The satisfaction of base–reduplicant identity which is responsible for variation in the Class 1 forms is thus not an issue in the Class 2 forms, because both the base and the reduplicant are required by other independent constraints to occur as either voiced stop-initial or continuant-initial. The tableaux in (50) illustrate this situation for the Class 2 plural forms of the reduplicative nouns given in (47) and (49), respectively.

(50) a.

riw; RED; [+vce]	ALIGN-L	MAX (subseg)	VCE/ $C_{Cl\text{-}b}$	ID-BR (subseg)	ID-IO (vce)	ID-IO (cont)	ID-BR (F)
☞ i. riiriw							
ii. riitiw				*(!)	*(!)	*	*

b.

gaʔ; RED; [+vce]							
☞ i. gaagaʔ							
ii. gaagaʔ				*(!)	*(!)		

The ungrammatical candidates, candidate (ii) in each case, both violate the constraints IDENT-BR(subseg) and IDENT-IO(voice). Since the two candidates are equally ranked, violation of either one is fatal.

Reduplicative forms that undergo voicing mutation do not exhibit variation in either their Class 1 or Class 2 forms. Those that undergo continuancy mutation exhibit variation in their Class 1 forms, but not in their Class 2 forms.

5 Summary and conclusion

In this article I have presented a description and analysis of consonant mutation and featural transfer in Seereer-Siin within a constraint-based theory of the grammar. Consonant mutation in Seereer involves syn-

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chronic chain shifts along two phonetic scales, the IV (inherent voicing) and CS (consonantal stricture) scales (Gnanadesikan 1997). These shifts are motivated by the affixation of floating features that constitute all or part of the noun class prefix and which are required to be parsed by the faithfulness constraint, MAX(subseg) (Zoll 1996), which is a featural version of the IO faithfulness constraint MAX-IO (McCarthy & Prince 1995). Implicit in the discussion of consonant mutation is the fact that patterning of mutations into two types, referred to as continuancy and voicing mutation respectively, is simply a consequence of the nature of the stem-initial consonant in the input and how it interacts with featural affixes, and not a lexical fact about stems. Continuant-initial stems, *de facto*, undergo continuancy mutation, while voiceless stop-initial stems, *de facto*, undergo voicing mutation. Consequently, the different patterns of featural transfer in reduplicative forms must also be the artefact of constraint interaction rather than a lexical fact about the stems involved. This is borne out by the interaction of faithfulness constraints. In their reduplicative forms, continuant-initial stems must violate either IDENT-IO(F) or IDENT-BR(subseg), and either IDENT-IO(cont) or IDENT-BR(F), but since within each set the two constraints are equally ranked, neither violation is worse than the other, so variation occurs. The same parallelism is not, however, possible in stems that undergo voicing mutation, thus variation does not occur in such forms.

The interaction of consonant mutation and reduplication is a rare one that has not previously been described or analysed. This article thus contributes a description and analysis of an additional pattern of phonological effects in reduplication to McCarthy & Prince's (1995: 126) typology, as well as providing evidence for the existence of an identity constraint for subsegments, IDENT-BR(subseg). Future research will show whether subsegmental morphemes should retain their independent status or be subsumed under a more general theory of featural correspondence.

Appendix 1

Gradation sets in Seerer-Siin

	voicing							continuancy						
a.	b	ɓ	d	ɗ	ɟ	ʃ	g	w	f	r	s	w	x	h
b.	p	ɓ	t	f	c	ɕ	k	b	p	t	c	k	q	k
c.	mb	ɓ	nd	f	ɲɟ	ɕ	ŋg	mb	mb	nd	ɲɟ	ŋg	NG	ŋg

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Appendix 2

Seereer-Siin noun classes, their prefixes and enclitics, and the mutation grade they condition. Adapted from Mc Laughlin (1994 : 284).

Class	*Prefix*	*Clitic determiner*	*Grade*	*Class content*
1	o-	oxe	b	human singular
2		we	a	human plural
3a	a-	ale	a	singular
3b	a-	ale	c	augmentative singular
4	a-	ake	b	plural
5		le	a	singular
6		ne	c	singular
7		fee	a	singular
8	fo-	ole	a	plural
9		ke	b	plural
10	o-	ole	a	singular
11	xa-	axe	b	plural
12	o-	ONGE	c	diminutive singular
13	fo-	ne	c	diminutive plural
14	fa-	fee	c	singular
15	pa-	ke	b	plural

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