Opacity in Lardil: stratal vs. serial derivations in OT

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Abstract

This paper presents a derivational OT account of the word-final deletion and augmentation alternations in Lardil. It presents two arguments in favor of the stratal view of derivations where the grammar is different at different stages (Bermúdez-Otero forthcoming, Kiparsky forthcoming), and against the serial view where the ranking is the same at all steps, and each step constitutes a minimal change (McCarthy 2006, 2007 et seq.). First, Lardil consonant deletion and vowel deletion cannot both be harmonically improving with respect to the same OT ranking (Kavitskaya and Staroverov 2010, McCarthy 2006). Second, the patterns of minimal word augmentation require some amount of derivational lookahead in a theory where each derivational step may only involve a minimal change.

1. Introduction

The Australian language Lardil has been the focus of attention of phonologists since Hale's (1973) seminal description (Blevins 1997, Bye 2006, Goldsmith 1993, Horwood 2001, Itô 1986, Kiparsky forthcoming, Kurisu 2001, Lakoff 1993, McCarthy 2003, 2006, Prince and Smolensky 2004, Wilkinson 1988). Nevertheless, there is still considerable disagreement in the literature as to what exactly the generalizations are and how they should be analyzed. The facts of Lardil remain 'hard, unpleasant facts of phonological life' as Goldsmith (1993: 256) characterizes them.

This paper argues that word-final deletion and insertion alternations in Lardil are problematic for standard OT with just markedness and faithfulness

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constraints. Instead Lardil is analyzed as a case of phonological opacity. The interactions between Lardil alternations present some interesting arguments in favor of a stratal approach to opacity which crucially involves different grammars at different derivational stages (Bermúdez-Otero forthcoming, Kiparsky forthcoming). On the other hand, a serial approach which involves gradual harmonic improvement with regard to just one hierarchy (McCarthy 2007) faces two challenges. First, Lardil consonant deletion and vowel deletion arguably cannot both be harmonically improving with respect to the same OT ranking (Kavitskaya and Staroverov 2010, McCarthy 2006). Second, the patterns of minimal word augmentation require some amount of derivational lookahead in a theory where each derivational step may only involve a minimal change.

In sum, the paper argues that the facts of Lardil are better analyzed with stratal rather than with serial derivations in OT. In addition, it takes into consideration the data from the Lardil dictionary (Leman 1997), which is also analyzed by Round (2011). The dictionary will be referred to as 'NKL' in what follows.

The paper is structured as follows. Section 2 presents an ordering-based analysis of the interaction between apocope and consonant deletion in Lardil, and argues that this interaction cannot be captured with just one hierarchy of constraints. Section 3 considers subminimal word augmentation and argues that the choice of an augment presents a challenge for gradual derivations, but not for a stratal analysis. Section 4 discusses alternative approaches to Lardil apocope and section 5 concludes.

2.   Apocope and consonant deletion: a challenge for harmonic improvement

This section describes and analyzes the interaction between apocope and consonant deletion in Lardil. In order to present this famous interaction, the section considers exclusively the words and forms which are longer than two moras, and which do not run the risk of violating the word minimality requirements of Lardil. Section 3 is in turn devoted to shorter words. The key data is presented in section 2.1 followed by a Stratal OT analysis in section 2.2. Section 2.3 argues that Lardil data present a challenge for Serial OT: both

apocope and consonant deletion cannot be harmonically improving in the same language.

2.1.   Key alternations and relevant constraints

Lardil distinguishes four vowels qualities: [a], [æ], [i] and [u]. Each vowel can be long or short. The consonant inventory of Lardil is presented in (1). The transcription conventions adopted here adhere to the IPA which is only a slight deviation from the generally adopted Lardil transcription.

(1)   Lardil consonantal inventory

	bilabial	lamino dental	laminal palato-alveolar	apico-alveolar	apical post-alveolar	dorso-velar
stops	p	t̪	c	t	ʈ	k
nasals	m	n̪	ɲ	n	ɳ	ŋ
laterals			(ʎ)[1]	l	ɭ	
flap				ɾ		
glides	w		j		ɻ	

Words longer than two moras undergo deletion of a final short vowel, as in (2). This process will be referred to as *apocope*.

(2)   Stem   Nom   Gloss   cf. Acc[2]
        /jilijili/   jilijil   'oyster sp'   jilijili-n
        /majaɾa/   majaɾ   'rainbow'   majaɾa-n
        /wiwala/   wiwal   'bush mango' wiwala-n

I will assume here that apocope is an active phonological process of Lardil (although, as we shall see, the process is active only at a relatively early stratum). A number of challenges to the productive status of apocope have been raised in the literature. For one thing, the process reportedly only applies to nouns in the nominative (Prince and Smolensky 2004, Bye 2006, Horwood 2001, Kurisu 2001, Trommer and Zimmermann 2014, Zimmermann 2014). However, in section 4.1 I will present some data suggesting that apocope also applies to

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[1] ʎ only occurs in a very small number of words such as *paʎaɾiɲ* 'subsection name'

[2] I use the following abbreviations: ACC = (non-future) accusative, ACT = actuality, COM = comitative, FUT = future, NOM = nominative, NFUT = nonfuture, PERF = perfective, VOC = vocative.

vocatives, contrasting in this regard with another process of vowel lowering. Section 4.1 will also discuss some possible exceptions to apocope, and argue that these exceptions do not change the overall picture. Additional evidence that apocope is productive is presented in Round (2011).

Some of the examples of apocope given in this article appear to be the result of reduplication, e.g. the first form in (2). Although reduplication probably happened in these forms historically, for all we know reduplication is not productive at the relevant stage of Lardil. The base of the reduplication can only rarely be located in the dictionary, for example there is no word /jili/ from which /jilijili/ could plausibly be derived. In the cases where there is a possible base, the semantic relation between base and reduplicant is often idiosyncratic, e.g. /kaɾwakaɾwa/ 'tree sp.' presumably from /kaɾwa/ 'hard'.

The other process of interest is related to Lardil consonant phonotactics and syllable structure. Lardil requires syllables to have onsets and allows at most one consonant in the margins, i.e. CV(C). The dictionary lists only 5 exceptions that have complex codas (3). In all of these exceptions, the second part of the coda is also part of a homorganic NC cluster.

(3)   pilŋka   'tree sp., black mangrove'
       pulmpa   'grasshopper'
       ʈatŋka   'fish sp., barracuda'
       kalŋkuɾ   'bird sp., seagull'
       kælŋka   'grass sp., grass used for making string for bullroarer,
                 for plaited grass belt and for armband'

The consonants appearing as codas are limited. Apicals are possible codas – this set is shaded in (1). Labials and dorsals are impossible codas, except for nasals [m ŋ] sharing place of articulation with a following consonant. Laminodental [t̪] does not occur in the coda, and laminodental [n̪] only occurs in 14 entries in the dictionary, occurring word-finally in one example: /paṉapaṉa/ [paṉapaṉ] 'flower'. Finally, the situation is most complicated for lamino-palatals [c ɲ] – the patterning of these consonants will be discussed at the end of this section.

The coda restrictions are exceptionless and surface true, apart from alternative pronunciations [wukwa] pro [wukuwa] 'to work' and [wukwan] pro [wukuwan] 'work'.

Complex syllable margins are simplified via deletion, as illustrated in (4).

(4)   Stem   Nom   Gloss   cf. Acc
       /waŋalk/   waŋal   'boomerang'   waŋalk-in
       /maḻkant/   maḻkan   'deceased person' maḻkant-i³

Similarly impossible codas are deleted word-finally (5).

(5)   Stem   Nom   Gloss   cf. Acc
       /ṯuɻaraŋ/   ṯuɻara   'shark'   ṯuɻaraŋ-in
       /wuŋkunuŋ/   wuŋkunu   'queenfish'   wuŋkunuŋ-in

I assume (with the existing accounts) that cluster simplification in (4) and impossible coda deletion in (5) are active phonological processes of Lardil. As we shall see, the interaction between these processes and apocope (2) presents a challenge for the theories of opacity.

Both vowel deletion and consonant deletion create an environment for the other process. As illustrated in (6), impossible codas and consonant clusters that become word-final as a result of vowel deletion in turn undergo deletion. In other words, apocope feeds both cluster simplification and impossible coda deletion.

(6)   Stem   Nom   Gloss   cf. Acc
       /kaɻwakaɻwa/   kaɻwakaɻ   'tree sp., wattle'   kaɻwakaɻwa-n
       /jukaɻpa/   jukaɻ   'husband'   jukaɻpa-n
       /ṯipiṯipi/   ṯipiṯi   'rock cod'   ṯipiṯipi-n
       /muɻkunima/   muɻkuni   'nulla-nulla'   muɻkunima-n
       /muŋkumuŋku/   muŋkumu   'wooden axe'   muŋkumuŋku-n

On the other hand, the opposite feeding relation does not hold: a vowel that becomes word-final as a result of consonant deletion never deletes, as seen in (5). In rule terms the derivations of the examples above can be recast as in (7).

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³This form, as well as other examples later in the paper, exhibit the optional process of final apical consonant deletion – accusative is marked by [i] instead of [in]. The process, as described in Klokeid (1976: chapter 7), NKL and Richards 2001 applies optionally and probably is morphologically conditioned. Most frequently the final consonant of case endings and enclitics is dropped, but a few stems exhibit the process as well. I will not attempt to analyze this process here, but it is worth noting that all sources classify it as a separate pattern, independent of impossible coda deletion in (5).

(7)   Rule-based derivations of three crucial examples

Input	waŋalk	jilijili	muɾkunima
Apocope	n/a	jilijil	muɾkunim
C-deletion	waŋal	n/a	muɾkuni
Output	waŋal	jilijil	muɾkuni

The generalization that words do not end in a vowel is not surface-true in Lardil. Thus on the one hand apocope and consonant deletion interact opaquely. On the other hand, the two processes are also in a transparent feeding relation. This interaction is of the kind that Kavitskaya and Staroverov (2010) call fed counterfeeding: the two processes are both in a feeding relation and in a counterfeeding relation.

Before we proceed to the analysis, restrictions on codas in Lardil have to be considered in greater detail. As we have seen, the consonants which are possible codas word-medially (alveolar and post-alveolar apicals) are also allowed wordfinally. Conversely, labials, dorsals, and laminodentals do not occur in coda word-medially and are deleted word-finally (except for homorganic NC clusters and the word [paṇapaṇ] 'flower' discussed above).[4]

For laminal palato-alveolar consonants, most notably [c] and [ɲ], the situation is much more complicated. [c] and [ɲ] are possible codas word-medially, (although they only occur before labials). Yet, the fate of these consonants in word-final position is different for different items (see also Round 2011). Alongside the words ending in [c ɲ] (8a) we find others which delete their final /c ɲ/ (8b) as well as examples where stem-final /c/ undergoes apicalization (8c). In (8) the underlying forms are given based on the NKL dictionary and evidence for underlying forms is given whenever available.

(8)   Variable behavior of laminal palato-alveolar word-final consonants

   a.   [c ɲ] allowed word-finally

/kulkica, kulkici/	kulkic	'shark sp.'
/palaːɲa/	palaːɲ	'fish sp.'; cf. [palaːɲaɻ] FUT.ACC
/piɳtaɲi/	piɳtaɲ	'rainbow type'; cf. [piɳtaɲi] ACC

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[4]Round (2011: fn. 7) suggests an analysis where stems do not end in a lamino-dental /t̪/ underlyingly, and where all relevant stems end in /c/. Within OT, restrictions on underlying forms have no direct translation. It is assumed here that stem-final /t̪/ undergoes deletion, and this may in fact explain some examples that Round (2011) describes as /c/-deletion.

b.   [c ɲ] deleted word-finally

/ŋuɲiŋuɲi/	ŋuɲiŋu	'message stick'; cf. [ŋuɲiŋuɲi] ᴀᴄᴄ
/kakuci/	kaku	'uncle'; cf. [kakuciwuɻ] ꜰᴜᴛ.ᴀᴄᴄ
/wuʈalci/	wuʈal	'meat, muscle, flesh'; cf. [wuʈalcin] ᴀᴄᴄ
/paɲcipaɲci/	paɲcipaɲ	'hat'
/caɻuncaɻuɲa/	caɻuncaɻu	'term for subincision initiate used by older male members of opposite patrimoiety'

c.   [c] changes to [t] word-finally

/ŋawic/	ŋawit	'stomach'; cf. [ŋawiciŋun] ᴄᴏᴍ
/jaɻpuc/	jaɻput	'animal'; cf. [jaɻpuciŋun] ᴄᴏᴍ

The data on these stems is somewhat limited, and therefore it is not clear which of the strategies in (8) are the general phonological processes. In what follows I will not address the behavior of the stems ending in laminal palato-alveolars since these are likely to be subject to a more complicated set of restrictions than other stems.

Finally, the glide [j] is classified in the same place class as [c ɲ], but its behavior is more regular. [j] is an impossible coda word-medially, and it does not occur word-finally except for the exclamative [maj] and for the word [mimaj] 'mother-in-law'.

To summarize, I have introduced two processes in Lardil, and argued that both of these are productive. The first one – apocope – deletes a word-final vowel, and operates only at a relatively early stratum. The second one – consonant deletion – is surface-true and exceptionless. Both of these processes create an environment for each other, and they stand in a fed counterfeeding relation.

2.2.   Stratal analysis

In this section, I present a derivational analysis of Lardil within Stratal OT. My analysis (first hinted at by Goldsmith 1993) extends that of Kiparsky forthcoming. Section 2.2.1 introduces the basic assumptions and relevant constraints. Section 2.2.2 analyzes the interaction between apocope and consonant deletion. Section 2.2.3 concludes.

2.2.1.   *Constraints and general assumptions*

In Stratal OT (Kiparsky forthcoming, Bermúdez-Otero forthcoming) it is assumed that phonology and morphology operate in cycles (strata). Each stratum involves attachment of certain morphemes and application of certain phonological processes. For the phonological computation this means that at each stratum a regular Classic OT evaluation occurs (Prince and Smolensky 2004, McCarthy and Prince 1993). Crucially, the phonological grammar can be different at different strata. Opacity is captured by differences in rankings between strata.

The exact set of morphophonological strata is subject to some debate, and here I adopt the version of the theory that distinguishes between three strata: stem level comprising stems and derivational morphology, lexical level forming inflected words, and postlexical level where words are combined into phrases.

Stratal approach to opacity is not antagonistic to the Classic OT view of phonology. Rather Stratal OT derives the opacity effects via an independent mechanism of strata while leaving the essentials of a Classical OT evaluation unchanged (see also McCarthy and Prince 1993). In order to introduce a stratal grammar of Lardil, it is first necessary to formulate the relevant constraints, which include three markedness cosntraints motivating apocope, consonant cluster restrictions, and coda conditions, as well as two faithfulness constraints.

I assume a general constraint against word-final vowels – Final-C in (9)– to be responsible for Lardil apocope (Gafos 1998, McCarthy and Prince 1993, 1994). As mentioned above, this is a general phonological restriction, and not a morphological statement. For additional discussion of this point see section 4.1.

(9)   Final-C: assign a violation mark for every PWord which ends in a vowel

We have also seen that Lardil disallows sequences of consonants in syllable margins, an effect of the constraint *Complex in (10) (Prince and Smolensky 2004).

(10)   *Complex: assign a violation mark for every vowel at a PWord edge

Finally, Lardil codas are restricted to either apicals or nasals homorganic with a following stop (with some complications involving laminals, as discussed above). After Itô (1986), the interpretation of these restrictions has been that there is a general constraint on coda place – CodaCond (11) which penalizes

marked C-Place in coda unless the C-Place features of a given consonant are also linked to the following onset (as in word-medial homorganic NC clusters).

(11)   CODACOND: assign a violation mark for every coda consonant which is not apical and is not assimilated in place to the following onset consonant

The markedness constraints in (9)-(11) are opposed by faithfulness constraints that protect the properties of the input (McCarthy and Prince 1995, 1999). In particular, the two faithfulness constraints MAX and DEP will be relevant in what follows. MAX prohibits deletion while DEP militates against insertion.

2.2.2.   *Analysis of the interaction between apocope and word-final consonant deletion*

The interaction between apocope and word-final consonant deletion in Lardil is problematic for many single-level versions of OT. The constraint responsible for the mapping like /muɾkunima/ → [muɾkuni] 'nulla-nulla' is not easy to formulate: both words end in a vowel and truncation has no obvious templatic target. Furthermore since both final vowel and illicit codas delete, it is not clear why /muɾkunima/ is not truncated all the way to *[muɾkun] that would have a licit coda.

On the Stratal OT approach this interaction is not surprising (see also Kiparsky forthcoming: 38-42). The ranking responsible for deleting the final vowel is different from that responsible for deleting the final consonant. The two rankings apply at the lexical and postlexical level respectively. Thus, while complex syllable margins are prohibited at all strata, all words end in consonants at the lexical stratum and apocope applies to enforce this generalization. On the other hand, labial and dorsal codas are tolerated lexically so that words may end in non-apical consonants. Lexical stratum involves attachment of case morphology. Postlexically the picture is different: word-final vowels are tolerated, but illicit codas are no longer allowed. Postlexical morphology involves attachment of clitics, such as the actuality clitic /-kun/.

Let us examine the lexical level first. The tableau in (12) shows the effect of the lexical level phonology on the input /muɾkunima/ 'nulla-nulla': vowel deletion applies, but consonant deletion does not. Like all tableaux in this article, this tableau uses the comparative format of Prince (1999) while also noting the violation counts with subscripted numbers.

At the lexical level no word may end in a vowel because FINAL-C is ranked above MAX (12b). On the other hand, any consonant can occur in the coda, hence MAX >> CODACOND (12a,d). Finally, word-final vowels are deleted, rather than protected by an inserted consonant because DEP dominates MAX (12c).

(12)   Lexical level: vowel deletion but no consonant deletion

	/muɾkunima/	DEP	FINAL-C	MAX	CODACOND
☞ a.	muɾkunim			1	1
b.	muɾkunima		W_1	L	L
c.	muɾkunimaC	W_1		L	L
d.	muɾkun			W_3	L

Complex codas are not allowed in Lardil. The constraint *COMPLEX is ranked above MAX both lexically and postlexically, thus triggering deletion. The analysis of lexical level alternations of the input /jukaɾpa/ 'husband' in (13) illustrates this ranking.

(13)   Lexical level: complex cluster simplification

	/jukaɾpa/	*COMPLEX	DEP	FINAL-C	MAX	CODACOND
☞ a.	jukaɾ				2	
b.	jukaɾp	W_1			L_1	W_1
c.	jukaɾpa			W_1	L	
d.	jukaɾpaC		W_1		L	

Word-final consonant clusters could in principle be simplified by deleting any of the consonants. The fact that the final consonant is always deleted is presumably due to contiguity (Kenstowicz 1994).

A summary of Lardil lexical level ranking is given in (14) below. This ranking allows the application of apocope, even at the expense of violating CODACOND.

(14)   Lexical level ranking: apocope applies, all codas allowed
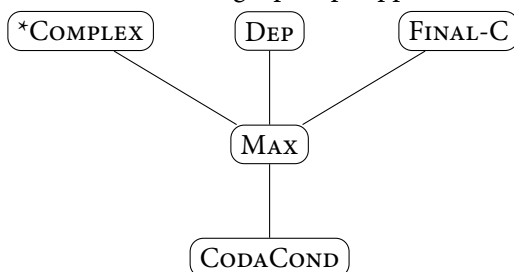
Postlexically word-final impossible codas are deleted, but apocope no longer takes place. Therefore the vowels exposed to word-final position by consonant deletion survive. The the ranking of Max, CodaCond, and Final-C is changed accordingly to CodaCond >> Max >> Final-C. The tableau (15) illustrates the application of the postlexical hierarchy to the word 'nulla-nulla' whose lexical level evaluation is in (12). The input to postlexical phonology is the output of lexical phonology, i.e. the winner in (12) /muɾkunim/. The ultimate output (15a) ends in a vowel in violation of Final-C. This is allowed since post-lexically Final-C is demoted below Max (15c).

(15)   Postlexical level: consonant deletion but no vowel deletion

	/muɾkunim/	Dep	CodaCond	Max	Final-C
☞ a.	muɾkuni			1	1
b.	muɾkunim		W_1	L	L
c.	muɾkun			W_2	L

On this analysis lexical level and post-lexical level impose very different requirements on word-final segments. While lexically words may end in any consonant, but not in a vowel, post-lexically words may end in a vowel, but only in apical consonants. The requirements which were active at an earlier, lexical, level thus become opaque postlexically. The postlexical ranking for Lardil is summarized in (16).

(16)   Postlexical level ranking: codas are restricted, apocope does not apply

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 ( *COMPLEX )      ( DEP )      ( CODACOND )
        \            |            /
              ( MAX )
                 |
           ( FINAL-C )
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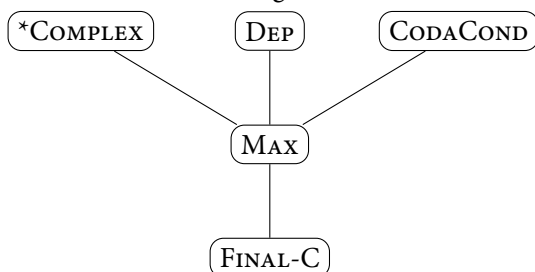
2.2.3.   Summary

In this section we have seen that Stratal OT can account for the interaction between apocope and consonant deletion in Lardil. Both of these processes create an environment for each other, and they are ordered derivationally, hence they stand both in a feeding relation (apocope feeds consonant deletion), and in a counterfeeding relation at the same time (consonant deletion counterfeeds apocope). On the other hand, the following section shows that in serial theories of opacity, such as OT-CC, this situation is inherently problematic, because both apocope and consonant deletion have to improve harmony relative to the same hierarchy.

2.3.   Fed counterfeeding presents a challenge to serial harmonic improvement

The Serial OT approach incorporates derivations in a way which is fundamentally different from Stratal OT. The two crucial properties of Serial OT are *gradualness*, and *harmonic improvement* with respect to one language-specific hierarchy. The argumentation here applies to all versions of Serial OT, i.e. both to OT-CC (McCarthy 2007) designed to deal with opacity and to Harmonic Serialism (Prince and Smolensky 2004, McCarthy 2006 et seq.) which does not aim at capturing the full range of opaque interactions (cf. Elfner 2009). For concreteness, I will mainly focus on OT-CC here.

In this theory the output is reached from the input via a series of steps (a *candidate chain*). At each step the output of the previous step is fed to Gen and Eval. Each step's Gen performs only one minimal operation. More formally, the requirement of one operation per step (*gradualness*) boils down to introducing only one violation of only one basic faithfulness constraint at a time, where basic faithfulness includes at least MAX, DEP, and IDENT.

In OT-CC the faithfulness constraints compare each form in the chain to the original input. The first step is assumed to be the most harmonic faithful parse of the input. Each subsequent step must introduce unfaithfulness, that is, fully faithful steps are assumed to be prohibited (McCarthy 2007: 61-62). Additionally, each step must improve harmony (*harmonic improvement*) and provide an optimal way of violating the given basic faithfulness constraint (*best violation*). Both of these requirements are evaluated against the same language-specific constraint hierarchy.

There is no requirement that each step's output is the most harmonic form. Thus, if a given marked configuration can be repaired by violating either Max or Dep, both repairs would represent valid ways of producing the next form as long as they improve harmony. Out of the candidates that violate one basic faithfulness constraint, only one is selected.

All possible chains for the same input are then fed to an evaluation by the so-called Prec constraints which may enforce opacity through assessing the order of steps in a chain. Importantly, Prec constraints are irrelevant for chain formation in that they do not count for the evaluation of harmonic improvement. The argumentation below will focus on chain formation (hence exclude Prec), since for every output there must be a harmonically improving candidate chain leading to it.

The interaction of apocope and consonant deletion in Lardil cannot be derived in such a system, because both processes cannot improve harmony relative to the same ranking (see also Kavitskaya and Staroverov 2010, McCarthy 2006). As we have seen, both apocope and consonant deletion create the structures which are subject to the other process, and hence any one hierarchy will prefer either one or the other, but not both. This problem is dubbed *paradox of fed counterfeeding* by Kavitskaya and Staroverov (2010).

In more technical terms the two relevant processes impose contradictory ranking requirements. Satisfying Final-C by vowel deletion introduces violations of CodaCond. The opposite is also true: satisfying CodaCond by consonant deletion introduces violations of Final-C. Since the two markedness constraints trigger violations of each other, the V-deleting mappings will require Final-C >> CodaCond while the C-deleting mappings necessitate CodaCond >> Final-C. This ranking paradox is illustrated by two steps from the derivation of the input /muɾkunima/ 'nulla-nulla' below.

The tableau in (17) illustrates the vowel deletion step. This tableau represents one step in an OT-CC derivation. The output of the previous step (or the

most harmonic faithful parse of the input) is listed in the top left corner since this is where the derivation proceeds from. The candidates are the forms that violate the same basic faithfulness constraint – in our case, Max. The opacity constraints are irrelevant in (17) since Prec constraints do not participate in the evaluation until the chains are formed.

The candidate (17a) is the actual continuation of the chain, since it leads to the ultimately correct output. For this candidate to win over the faithful (17b), Final-C should dominate CodaCond and Max.

(17)   Lardil: vowel deletion step requires Final-C >> CodaCond
       Input: /muɾkunima/

	Prev. step output: muɾkunima	Final-C	CodaCond	Max
☞ a.	muɾkunim		1	1
b.	muɾkunima	W_1	L	L

(18) illustrates the next step. In order for the actual output (18a) to be a possible chain continuation, CodaCond should dominate Final-C and Max.

(18)   Lardil: consonant deletion step requires CodaCond >> Final-C
       Input: /muɾkunima/

	Prev. step output: muɾkunim	CodaCond	Final-C	Max
☞ a.	muɾkuni		1	1
b.	muɾkunim	W_1	L	L

The ranking requirements of (17) and (18) contradict each other. Therefore, the chain <muɾkunima, muɾkunim, muɾkuni> that would be required to derive [muɾkuni] 'nulla-nulla' cannot be formed.

To summarize, I have argued that Lardil has two phonological processes, apocope and consonant deletion, which stand in a fed counterfeeding relation. The interaction between these processes can be analyzed with two different rankings in a Stratal OT derivation, but this interaction cannot be captured with one and the same ranking, as in Serial OT. Lardil thus presents a potential problem to any model that has gradualness and harmonic improvement. Circumventing this problem requires a fair amount of technical machinery, such as the new kinds of derivational constraints proposed by Kavitskaya and Staroverov (2010).

3. Subminimal word augmentation: a challenge for gradualness

This section illustrates the pattern of subminimal word augmentation in Lardil. This pattern presents a challenge for Serial OT's gradual derivations because it has to involve some derivational lookahead. At a certain step in the derivation, the grammar must correctly pick either a V or a CV augment, but this choice is based on whether place spreading from a root-final consonant can affect the inserted C, and place spreading has to happen at a later step. In section 3.1 I introduce the subminimal word augmentation and propose a Stratal OT analysis. Section 3.2 discusses the challenge that Lardil augmentation presents for gradual derivations.

3.1. Subminimal word augmentation and stratal analysis

3.1.1. *Bimoraic and shorter stems: data and relevant constraints*

In Lardil, words shorter than two moras are categorically disallowed (no exceptions found in the dictionary). This minimality requirement has several consequences. First, apocope is blocked in bimoraic words (19). If the final vowel was to be deleted here, the word would be shorter than the minimum.

(19)	/pækæ/	pækæ	'white pigeon'
	/jilæ/	jilæ	'shell sp.'
	/wiʈæ/	wiʈæ	'inside, interior'; cf. ACC wiʈæn
	/mupa/	mupa	'dorsal fin of fish'; cf. FUT.ACC mupaɹ
	/mica/	mica	'bird sp.'
	/mæla/	mæla	'sea, sea water; grog' cf. ACC mælan

Second, the words that are underlyingly shorter than two moras undergo augmentation, as illustrated in (20).[5] The content of the augment is determined by the final segment of the stem.

(20)		Stem	Nom	Acc	Gloss
	a.	ʈil	ʈilta	ʈilin	'throat'
		wun	wunta	wunin	'rain'
		kaɳ	kaɳta	kaɳin	'grass'

---

[5]In fact, the patterns in (20) apply in nouns. Augmentation in verbs will be discussed in section 4.1.

	kaŋ	kaŋka	kaŋin	'speech'
	caŋ	caŋka	caŋin	'some'
	maɻ	maɭʈa	maɻin	'hand'
b.	jak	jaka	jakin	'fish'
	ɻælkʰ	ɻælka	ɻælkin	'head'
c.	pit	pita	picin	'odour'
	pat	pata	pacin	'west'
	juɾ, jiɾ	juɾa	jiɾin	'body'
d.	ca	caː	cajin	'foot'
	la	laː	lajin	'that (south)'
	lu	luwa	lujin	'fat'
	cu, ci	cuwa	ciːn	'axe-handle'

Subminimal words ending in a sonorant consonant (20a) augment with a Ca sequence. The inserted consonant is velar or labial after velar and labial nasals respectively and it is [t] otherwise (i. e. after /l/, /n/, /ŋ/, /ɻ/). The retroflection of inserted /t/ and lateralization of stem-final /ɻ/ in /maɻ/ → [maɭʈa] 'hand' follow from the general alternations of Lardil.

The subminimals ending in /k/ (20b) augment with just the vowel [a]. The same pattern applies to the short words ending in /t/ and /ɾ/ (20c). Finally the number of subminimal vowel-final nouns is rather small, (20d) lists all available examples. These data indicate that the augment /a/ is also attached to vowel-finals, after which identical vowel sequences are resolved by lengthening, while nonidentical VV sequences trigger glide insertion. I will not focus on these alternations in what follows, but an analysis of these is fully compatible with my proposal.

Since Prince and Smolensky (2004), the alternations in (19) and (20a-b) have been analyzed as an interaction of the constraints requiring word-minimality with the constraints on syllable structure and morphology-to-prosody alignment. I will assume a cover constraint BɪɴMɪɴ (21) that enforces the bimoraic word minimum (see Prince and Smolensky 2004 on deriving the minimum word requirement from foot binarity).

(21)   BɪɴMɪɴ: assign a violation for every output prosodic word that is shorter than two moras

B<small>IN</small>M<small>IN</small> is responded to by epenthesizing a vowel in monomoraic inputs. However, as we have seen in (20), in many cases the augment also contains a consonant. This consonant epenthesis is triggered by the alignment constraint in (22), to which I will refer as A<small>LIGN</small> (after Prince and Smolensky 2004).

(22)   A<small>LIGN</small>(MWd,R,σ,R): the correspondent of the rightmost segment in the morphological word should be present in the output and be at the right boundary of a syllable.

Adding just a vowel to an input like /ɻil/ 'throat' would create a form where the last segment of the MWord is not at the right syllable boundary: [ɻi.l|a] (dots signify syllable boundaries and the vertical line symbol "|" shows the MWord boundary).[6] Consonant epenthesis repairs the violation of A<small>LIGN</small> by putting the consonant which corresponds to the rightmost segment of the stem at the right edge of a syllable: [ɻil|.ta]. However, consonant epenthesis is only possible if it creates licit codas.

   The data in (20c) present a potential challenge to the A<small>LIGN</small>-based analysis. [t] and [ɾ] are possible codas word-medially, and yet the words ending in [t ɾ] are augmented with [a], not [ta]. I will hypothesize that Prince & Smolensky's analysis is essentially on the right track but that there are additional constraints that prohibit C-epenthesis after /t/ and /ɾ/. I will only briefly speculate as to what these additional constraints may be – a full investigation would have to involve typological comparisons and thus has to be left for further research.

   Observe that all the codas created by subminimal word augmentation are sonorant. It could be argued that [t] and [ɾ] are of lower sonority than liquids and nasals, and hence they are expected to be disfavored as codas (Zec 1995). We thus may analyze the augmentation of words in [t] and [ɾ] with just a V instead of CV as an instance of interaction of Alignment with sonority scale. I leave the full exploration of this analysis for future research, while noting that there may be complications. Ideally we would need independent evidence that Lardil [ɾ] is less sonorous than say [ɻ] as well as perhaps some evidence that codas are moraic in Lardil since sonorous segments are only better as moraic codas (Zec 1995). For the time being I will continue working with the simplified version of A<small>LIGN</small> in (22).

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   [6]This way of representing the boundaries does not necessarily imply that morphological boundaries are present in the output. In conformity with the definition in (22), we could put a "|" symbol after the *correspondent* of the rightmost segment in the input MWord.

3.1.2.   *Stratal OT analysis of subminimal word augmentation*

The minimality requirements of BINMIN hold in all strata of Lardil phonology. Thus BINMIN blocks the lexical-level apocope alternation and interacts non-trivially with CODACOND which is active postlexically.

The fate of disyllabic words at the lexical level is illustrated in (23) for the word /jilæ/ 'shell species'. As shown in this tableau, the constraint FINAL-C has to be outranked by both BINMIN and DEP in order for the input to surface faithfully avoiding consonant insertion (23b) or apocope (23c). In this and the following tableaux the capital "C" in the candidates symbolizes an epenthetic consonant.

(23)   Disyllabic words do not undergo lexical apocope

	/jilæ/	BINMIN	DEP	FINAL-C	MAX
☞ a.	jilæ			1	
b.	jilæC		W_1	L	
c.	jil	W_1		L	W_1

Since BINMIN is active already at the lexical level, I assume that vowel epenthesis in subminimal words also happens at this level. On the other hand, consonant epenthesis in subminimal words is constrained by what kind of codas the process creates (i.e. by CODACOND). Since CODACOND only comes to be high-ranked postlexically, consonant epenthesis has to happen postlexically as well.[7]

To summarize, at the lexical level all subminimals augment with a vowel. This is illustrated in (24) for the input /ɻil/ 'throat'. Crucially, the output at the lexical level violates ALIGN and DEP, hence both of these constraints must be dominated by BINMIN lexically (24b). On the other hand, consonant epenthesis does not happen at this stage, because DEP dominates ALIGN (24c).

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[7] Alternatively, one might try to entertain a Duke-of-York style analysis where all subminimals are augmented with CV lexically with the relevant consonant deleted postlexically if the cluster becomes illicit due to newly high-ranked CODACOND (e.g. yak → yakCa → yaka). This analysis is hard to maintain for Lardil since we expect the final consonant of the root, not the inserted consonant to delete in response to CODACOND. Thus, the final consonant of the stem is deleted in nouns when combined with the privative suffix /wæɻi/ (NKL 49). The illicit clusters are thus resolved by deleting the first consonant, in accordance with a general typological tendency (Wilson 2000, McCarthy 2008).

(24)   Lexical level: subminimals augment with a vowel

	/ɹil/	BinMin	Onset	Dep	Final-C	Align
☞ a.	ɹi.l|a			1	1	1
b.	ɹil	W$_1$		L	L	L
c.	ɹil.|ta			W$_2$	1	L
d.	ɹil.|a		W$_1$	1	1	L

Finally, the candidate (24d) solves the alignment problem via syllabification rather than consonant insertion. This is not allowed in Lardil because of the high ranked ONSET constraint (Prince and Smolensky 2004). The ranking conditions which necessarily hold of the lexical level are given in (25).

(25)   Lexical level ranking conditions
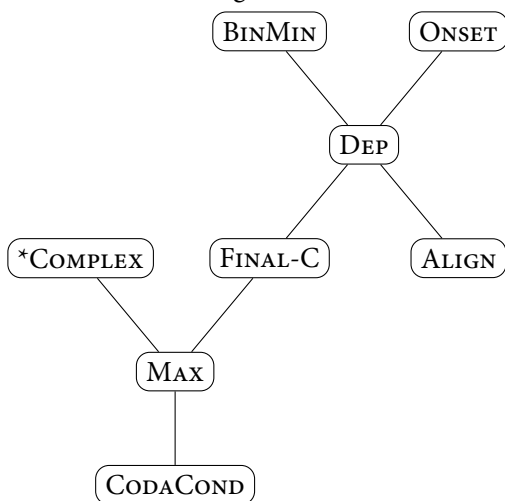
Unlike the lexical level, postlexical level allows consonant epenthesis, and hence both CODACOND and ALIGN must be ranked above DEP here (in addition to demotion of FINAL-C below MAX which was discussed in section 2.2.2).

Postlexical consonant epenthesis in [ɹilta] 'throat' is illustrated in (26). BINMIN and ONSET are undominated here, just as they were lexically, and therefore deletion or coda syllabification is prohibited (26c-d). On the other hand, ALIGN is now ranked above DEP thus triggering consonant insertion.

(26)   Postlexical level: consonant epenthesis is possible

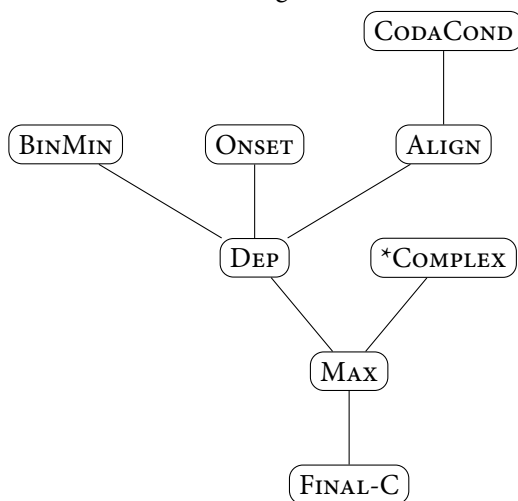| /ɻi.l|a/	BinMin	Onset	Align	Dep	Max	Final-C
☞ a. ɻil.|ta				1		1
b. ɻi.l|a			W_1	L		L
c. ɻil	W_1			L	W_1	L
d. ɻil.|a		W_1		L		1

There is an additional reason for the result in (26): all candidates in this tableau satisfy CodaCond. For an input like /jak/ 'fish' that runs the risk of violating CodaCond, misaligned candidate is the winner. This is illustrated in (27) which adds an additional ranking requirement: CodaCond must dominate Align. The lexical level evaluation of /jak/ is analogous to (24).

(27)   Postlexical level: consonant epenthesis constrained by CodaCond

/ja.k|a/	BinMin	Onset	CodaCond	Align	Dep	Max	Final-C
☞ a. ja.k|a				1			1
b. jak.|ta			W_1	L	W_1		1
c. jak	W_1			L		W_1	L
d. jak.|a		W_1	W_1	L			1

The overall postlexical ranking conditions are given in (28). This completes the stratal analysis of truncation and augmentation in Lardil.

(28)   Postlexical level ranking conditions

```
                         ┌──────────┐
                         │ CodaCond │
                         └─────┬────┘
                               │
 ┌────────┐  ┌────────┐   ┌────┴───┐
 │ BinMin │  │ Onset  │   │ Align  │
 └────┬───┘  └───┬────┘   └───┬────┘
      │          │            │
      └──────────┼────────────┘
                 │         ┌──────────┐
             ┌───┴───┐     │ *Complex │
             │  Dep  │     └─────┬────┘
             └───┬───┘           │
                 └───────┬───────┘
                     ┌───┴───┐
                     │  Max  │
                     └───┬───┘
                         │
                  ┌──────┴─────┐
                  │  Final-C   │
                  └────────────┘
```

3.2.   Minimal word augmentation as a challenge to gradualness

One of the core properties of OT-CC and Serial OT in general is that the output must be reachable from the input via a series of small changes (gradual steps) each of which improves harmony. The way in which CodaCond restricts Lardil subminimal word augmentation presents a challenge to gradualness.

To illustrate, consider two different augmentation patterns: /jak/ → [jaka] 'fish' and /kaŋ/ → [kaŋka] 'speech'. In a Serial OT analysis, both of these mappings would involve a vowel insertion step i (or steps, as in Moore-Cantwell 2013). At this step the two words would behave the same: /jak/$_i$ → [jaka]$_{i+1}$; /kaŋ/$_i$ → [kaŋa]$_{i+1}$. However, at the step $i + 1$, these two words behave differently: the input /jaka/$_{i+1}$ is the ultimate output, hence it has to be mapped to itself. On the other hand, the input /kaŋa/$_{i+1}$ triggers insertion of an additional consonant.

Upon a closer look, it turns out that this consonant insertion step in fact involves two basic operations rather than one. The first operation inserts a consonantal root node, and the second spreads the place features from root-final /ŋ/ onto a newly inserted root node. In other words, the derivation of /kaŋ/ after the step i has to proceed as in (29).

(29)   Step $i + 1$ Step $i + 2$ Step $i + 3$
        kaŋa   →   kaŋCa   →   kaŋ ka
          | | \/
        dor   dor   dor
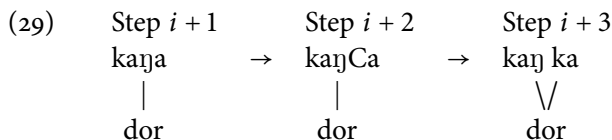
Evidence for a two-step derivation in (29) is both typological and theoretical. Typologically, there are languages where other operations happen between the insertion and place linking steps of (29). Thus in Ponapean (Rehg and Sohl 1981) morpheme-internal geminates are tolerated because they are doubly-linked (Itô 1986) while geminates that come about through morpheme concatenation are resolved via epenthesis or nasal substitution. It would be impossible to analyze Ponapean if we assumed that whenever a language requires coda consonants to be place-linked to the following onset, such place-linking automatically happens when the two consonants come together. On the other hand, a two-step analysis is readily available in a Serial OT framework such as Wolf (2008): place linking simply happens before the morphemes are put together to create 'new' geminates. Additional evidence for the derivation in (29) comes from the fact that place deletion (McCarthy 2008), place insertion (Moore-Cantwell 2013), and place spreading (McCarthy 2011) have all been independently argued to be single-step operations in Serial OT.[8]

The problem with (29) is that the step $i + 1$ creates a violation of CODACOND. Indeed, the output of this step has an illicit coda, namely [ŋ] which is not (yet) linked to a following onset. However, if violations of CODACOND are allowed in a step /kaŋa/$_{i+1}$ → [kaŋCa]$_{i+2}$, then the theory predicts that they should also be allowed for /jaka/$_{i+1}$ → [jakCa]$_{i+2}$. The availability of a doubly-linking step cannot be predicted when the consonant is inserted, at least not based on CODACOND. Thus the global benefit of achieving a doubly-linked NC cluster is available for only one of these inputs, but the ability to see this global benefit is precisely what Serial OT gets rid of, compared to Classical OT.

It is possible that there are some additional constraints which would differentiate between /kaŋa/$_{i+1}$ → [kaŋCa]$_{i+2}$ and /jaka/$_{i+1}$ → [jakCa]$_{i+2}$. However, it is clear that Serial OT, and OT-CC requires additional machinery here, and this machinery has to be motivated independently.

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[8]McCarthy (2006) on the other hand adopts a one-step derivation, although the two-step option is not discussed.

3.3.   Interim summary

To summarize, we have seen that Stratal OT can account for both deletion and augmentation in Lardil. On the other hand, Lardil data present two challenges for OTCC (and Serial OT in general). First, both apocope and consonant deletion cannot be harmonically improving given the same ranking – they both create structures that would trigger the other process. Second, subminimal word augmentation is too gradual in order for it to be controlled by CodaCond, as it is in Lardil.

4.   Alternative approaches to Lardil apocope

The argument in section 2 relied on the assumption that Lardil apocope is a general phonological process driven by the dispreference for word-final vowels. This section considers the alternative approaches to Lardil apocope and presents some arguments against these approaches.

First, the morphological account states that Lardil apocope is essentially a sort of nominative marking (Bye 2006, Horwood 2001, Kurisu 2001, Trommer and Zimmermann 2014, Zimmermann 2014). However, in section 4.1 I argue that apocope also applies in the vocative, and that non-application of apocope (Round 2011) in many cases is due to the presence of an underlying final consonant.

Section 4.2 considers the existing phonological accounts which claim that apocope is a productive phonological process, but a process which deletes only one final vowel (Prince and Smolensky 2004, McCarthy 2003). It is argued that all of these approaches involve nontrivial extensions of OT and thus require further motivation (see also Kaplan 2008 on non-iterativity in general).

3.4.   Apocope as a morphological marker

According to the morphological account, apocope is essentially a morpheme that distinguishes the nominative from other forms (Bye 2006, Horwood 2001, Kurisu 2001, Trommer and Zimmermann 2014, Zimmermann 2014). Apocope deletes only the stem-final vowel, because the morphological requirements only apply to the specific segment at an edge. For example, in the mapping /muɾkunima/ → [muɾkuni] 'nullanulla' the final vowel of the stem is deleted

due to morphological requirements, which do not apply to the final [i] of the output.

Section 4.1.1 identifies a challenge for the morphological account coming from the fact that apocope applies in the vocative, contrasting in that respect with a true nominative-only process of vowel lowering. Section 4.1.2 analyzes the nonapplication of apocope in other non-nominative contexts.

4.1.1.   *Vocative morphophonology*

In fact apocope does apply in morphological contexts other than the nominative, most notably in the vocative. The examples in (30) are vocatives that undergo deletion of the final vowel and of the non-apical consonant preceding it.

(30)   /jakuku/[9]   jaku   'older sister-VOC'
        /jukaɾpa/   jukaɾ   husband-VOC'
        /ṯapuci/   ṯapu[10]   'man's older brother-VOC'
        /kakuji/   kaku   'uncle-VOC'

Certain other kinship terms in the dictionary ([paɳṯaɾu] 'cousin of spouse', [kanṯaɾpa] 'kin pair, WiBr and his child', [ŋamalaʈuɾa] 'kin pair of elder Br + MoMoBr') seem to occur in a non-truncated form in a vocative context. However the data we have on these latter forms is rather scarce (Norvin Richards, p.c.) and these forms could be instances of a later diachronic process whereby new Lardil gradually loses apocope (Richards 2001). The only clear exception seems to be /ɲæɾiwaɾpa/ 'pair of people one of whom is ɲæræ to the other' appearing untruncated, i.e. as [ɲæɾiwaɾpa] in the vocative.

Overall this evidence suggests that vocatives are subject to apocope. This is a problem for the morphological account of apocope, because otherwise nominative and vocative are not identical, they contrast in the applicability of another alternation, namely vowel lowering.

Vowel lowering changes a word-final short /u/ to [a], while a final /i/ changes to [a] after lamino-alveolars (most notably after [j] and [c]) and to [æ] otherwise. Lowering only visibly applies in disyllabic words (31a), whereas the stem-final

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[9] Klokeid 1976 lists the underlying form of 'older sister' as /jakuci/ although NKL has /jakuku/. This could be a typographical error or an instance of variation.

[10] I am grateful to Norvin Richards (p.c.) for this example from his fieldwork on Lardil. Note that NKL (170: see *kuɳṯa*) also records a vocative form without apocope which apparently belongs to new Lardil where apocope got gradually lost.

vowel in longer words is deleted anyway. The vowels rendered final by consonant deletion do not lower (31b).

(31)   Input   Nom   Acc   Gloss

    a. /paɳka/   paɳka   paɳkan   'stone'
        /kaʈu/   kaʈa   kaʈun   'child'
        /ŋuku/   ŋuka   ŋukun   'water'
        /kæɳʈi/   kæɳʈæ   kæɳʈin   'wife'
        /ŋiɳi/   ŋiɳæ   ŋiɳin   'skin'
        /pulci/   pulca   pulcin   'heart'
        /paji/   paja   pajin   'anger'

    b. /ʈipiʈipi/   ʈipiʈi   ʈipiʈipin   'rock cod'
        /muŋkumuŋku/   muŋkumu   muŋkumuŋkun 'wooden axe'

Lowering is clearly restricted to just nouns. There are 15 examples of adjectives, pronouns or demonstratives which end in an [i] or [u] in the dictionary. In addition, I could locate 6 nouns which are apparent exceptions to lowering.

    Crucially, unlike apocope, vowel lowering does not apply in the vocative. This is illustrated in (32).

(32)   Input   Nom   Voc   Gloss
      /kæɳti/   kæɳʈæ   kæɳʈi   'wife'
      /tunci/   ʈunca   ʈunci   'brother-in-law'
      /kaʈu/   kaʈa   kaʈu   'child (of a woman)'
      /papi/   papæ   papi   'paternal grandmother'

The contrast between lowering and apocope can be derived within the stratal account if we assume that the former, but not the latter, is only applicable in the nominative. Since lowering is then essentially a case marker it will attach lexically (just like other case morphemes) and this would correctly predict that consonant deletion counterfeeds lowering.

    On the other hand, the contrast between lowering and apocope presents a genuine puzzle for the existing morphological accounts of apocope where it is assumed that apocope marks the nominative.

4.1.2.   *Non-application of apocope*

The nominative-marker analysis of Lardil apocope capitalizes on the fact that the process does not apply in several environments where it would be expected. However, in many of these cases there is evidence that a surface final vowel arises because the word underlyingly ends in a consonant which later gets deleted.

For example, verbal stems apparently do not exhibit apocope on the surface. Nevertheless there is evidence (Klokeid 1976) that the final vowel in verbs is protected by a consonantal morpheme /t̪/. Since [t̪] is not a licit coda, it gets deleted when it happens to be the last morpheme of the word, but it is present at the lexical level thus protecting the preceding vowel from apocope. When the /t̪/ morpheme is not final, it behaves quite as expected – we find it before vowel-initial tense suffixes as well as its alternants in other cases. Additionally, monosyllabic vowel-final verb stems augment with [t̪a] as shown in (33) while the monosyllabic vowel-final nouns show vowel lengthening (although recall that there is just a handful of such nouns).

(33)   Augmentation in vowel-final verbs vs. nouns
          /ca/   [cat̪a]   'nter'   cf. /ca/   [caː]   'foot'
          /ma/   [mat̪a]   'get'   cf. /ɻa/   [ɻaː]   'south'
          /na/   [nat̪a]   'hit'
          /ti/   [t̪it̪a]   'sit'

The contrast in (33) is readily explained on Klokeid's analysis since the [t̪] part of the verbal augment is the verbal morpheme. Finally, the verbal [t̪] morpheme also makes an appearance in verbal reduplication. For example, the verb [pæɾi] 'crawl' reduplicates as [pæɾi**c**pæɾi] 'to crawl around' where [c] is a regular alternant of [t̪] (Wilkinson 1988, Round 2011). To summarize, verbal stems are not expected to undergo apocope because their surface final vowel is underlyingly followed by a consonant.

Another commonly cited exception to apocope occurs in the locative case which is [ŋæ] after consonants and mora after vowels (Klokeid 1976, Round 2011). However, so far as I could see locative always occurs word-finally, and hence it is possible that its synchronic underlying form is /ŋæC/ with a consonant protecting the final vowel. It is also possible that the element (perhaps a mora) protecting the final vowel of the locative is actually the same one that imposes lengthening on vowel-final stems. A similar kind of

exception comes from the verbal negative suffix [caɾi]. The data on this affix are somewhat contradictory however since NKL (pages 21, 28) and Round (2011) give examples with the suffix [caɾi] but Klokeid (1976: 89) reports that the same morpheme is [caɾ].

Finally, a number of nouns in the nominative nevertheless do not undergo apocope (Round (2011)). These have to be treated as exceptions on any analysis. In a detailed discussion of these forms Round (2011) reports that many of these are borrowings or come historically from locatives. Some of these exceptions may also reflect a decay of apocope happening in the so-called new Lardil (Richards 2001). Importantly however, many of the apparent exceptions do not present positive evidence of lack of apocope (see also Round (2011) who reports on a study of Hale's field notes).

4.2. IO-Antifaithfulness and Comparative Markedness

In this section, I will consider the alternative phonological analyses where apocope is assumed to apply only once (Prince and Smolensky 2004, McCarthy 2003). In each case the special non-iterativity mechanisms involve a significant amount of additional machinery.

Prince and Smolensky make use of a constraint FREEV that requires the last vowel of the word to be unparsed. The relevant constraint can be restated in accordance with correspondence theory of McCarthy and Prince (1995).[11] The revised version of FREEV will then be formulated as in (34).

(34)   FREEV: the final vowel of the input must not have a correspondent in the output

Because the constraint looks at the final vowels in the input, it does not assign a violation to all vowel-final outputs. The outputs in which the vowel gets exposed to word-final position by consonant deletion (e.g. the final vowel of [muɾkuni] from /muɾkunima/) will satisfy FREEV. Thus appealing to FREEV is a way of formulating an input-related generalization about Lardil which is true of all the relevant items. The generalization crucially involves a requirement to be unfaithful to the input.

Substantiating such an analysis would require a full-fledged theory of IO antifaithfulness (cf. Alderete 2001 on *output*-output antifaithfulness). It is not

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[11]I am grateful to Alan Prince (p.c.) for pointing this out to me.

impossible to develop such a theory, but that theory would no longer have some of the fundamental mathematical properties of OT (Moreton 2004, Tesar 2013).

A more recent take on the status of Lardil apocope is offered by the theory of Comparative Markedness (McCarthy 2003). On this theory, the markedness violations of every candidate are compared to those of the fully faithful candidate (FFC), and the new vs. old markedness constraints (i.e. penalizing the marked structures shared vs. non-shared with the FFC) are distinguished.

The Lardil generalization is recast as "only the vowels which are final in the fully faithful candidate are penalized". The analysis is akin to that of Prince and Smolensky except that the fully faithful candidate is used as a 'surrogate' of the input.

Comparative markedness, unlike Stratal or Serial OT, cannot be extended to other opaque interactions and therefore it would need to combine with some mechanism for capturing opacity (Kavitskaya and Staroverov 2008). Stratal OT is one of such mechanisms, but as we have seen, employing Stratal OT renders it unnecessary to assume comparative markedness in Lardil.

It is instructive to compare the Stratal OT approach to the ones just discussed. Unlike the theories of IO-antifaithfulness and comparative markedness, Stratal OT requires no modification to the core mechanisms of Classic OT. Opacity effects are achieved by assuming that instead of one Classic OT computation there are several which come in order. In this sense Stratal OT treats opacity as something external to OT computation. On the other hand, IO-antifaithfulness and comparative markedness introduce nontrivial modifications to the OT computation itself.

4.3. Summary

This section has considered a number of alternative approaches to Lardil apocope, most of which revolve around the idea that there is a reason (phonological or morphological) for apocope to apply only once. In conclusion it should be pointed out that the exact analysis of apocope is only relevant to its particular interaction with CODACOND which presents a potential challenge to Serial OT's harmonic improvement. However Lardil subminimal word augmentation considered in section 3 is relatively uncontroversial, and its status with regard to gradualness does not depend on the analysis of apocope.

5. Conclusion

This paper proposed an analysis of Lardil alternations which crucially involves several derivational steps but which at the same time preserves some key insights of Prince and Smolensky (2004). I have argued that Lardil phonology employs two levels which crucially differ in their restrictions on word-final consonants, and that this level difference can be encoded as constraint reranking within the Stratal OT model (Bermúdez-Otero forthcoming, Kiparsky forthcoming). On the other hand, the different derivational steps involved in Lardil phonology have to differ in the phonological grammar – hence they present a challenge for Serial OT where all derivational steps have the same ranking.

The patterns of subminimal word augmentation also present an argument for OT's global evaluation where all output candidates are evaluated together. The restriction to single-change candidates in Serial OT makes it difficult to select a correct augment (CV vs. V) since it depends on the ways in which this augment may be later integrated in the word.

To summarize, Lardil phonology can be analyzed as involving an opaque derivation, and it presents some interesting arguments in favor of the stratal view of derivations and against the serial view.

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