

# Functional Constraints Focused on Recoverability in Phonology\*

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Lee, Borim and Ki-jeong Lee. 2000. *Journal of the Linguistic Association of Korea*, 8(3), 47-63. In this paper we deal with some functional considerations behind phonological processes which appear to destroy the underlying contrasts. A series of truncation phenomena, in their nature, result in loss of underlying information, which in turn damages intelligibility in communication. From a functional point of view, there may exist certain processes which seem to compensate for the destruction caused by extensive truncation. We discuss a neutralization process, an influence of deleted segments over the remaining segments, a homonymy-avoiding process, and a case of restructuring in a suffix of a secret language of Lardil. We conclude, then, that all these phenomena deserve new interpretations in the context of recoverability of underlying contrasts, which is based on functional constraints in languages. (Wonkwang University and Hanyang University)

## 1. Introduction

Adequate communication is the major function of a language. It can, however, be damaged by the massive loss of information resulted from

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\*The authors wish to thank a reviewer for many valuable comments. This paper only deals with functional considerations in general which can be explained by the concept of recoverability. For a formal treatment of some of the phenomena discussed in this paper using universal constraints under the framework of Optimality Theory, we suggest that the readers refer to Lee (1997).

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the various phonological processes in a language, e.g., neutralization of phonological oppositions and truncation processes. Given the communicative function of language, we can expect that the 'forces' that lead to loss of substance must evolve other functional adjustments.

Lardil, an Australian language spoken on Mornington Island, has phonological rules which truncate up to three segments in word-final position. These processes obviously derive the surface forms which are very distant from their underlying forms, and therefore there occurs the problem of recoverability of underlying forms. A number of linguists have argued that languages show a positive predilection toward evolving recoverable derivations (Gussman 1976, Hankamer 1973, Kaye 1981). Examining the functional considerations in this context is the main purpose of this paper.

The organization of this paper is as follows. Section 2 will give a general survey on the concept of recoverability in languages. In section 3 the Lardil sound system and the major phonological rules will be presented with the relevant data. Section 4 will discuss some functional explanations related to these phenomena. And section 5 sums up the paper.

## **2. Recoverability in Phonology**

There are two broad approaches that can be adopted to appraising the notion of "linguistically significant generalization". One is formal explanations and the other functional explanations. The first requires the linguists to account for the formal structure permissible in natural languages. Chomsky and Halle (1968), for example, attempt to characterize the notion "linguistically significant generalization" through notational conventions and an evaluation measure based on simplicity. However, as Kiparsky (1972) points out, these attempts fail for intrinsic reason to provide an explanatory account of functional regularities. The second approach has its starting point in general conditions of a

functional nature. Given an item X to be explained, where C is a consequence of X being present or having a certain form in some system, S, a functional explanation has the following form (Wright 1976).

- (1) X is there because it does (results in) C in S.

That is, the functional approach tries to explain the item in terms of the role it plays in the linguistic operation.

Kiparsky (1972) reviews three types of regularities in phonology and morphology which are based on general conditions of a functional nature; distinctness of categories, paradigm coherence and optimization of phonotactic structure. First, the distinctness of categories explains how semantically relevant information can be retained in surface structure. This would appear to be motivated by the requirements of speech perception. Secondly, the paradigm coherence motivated by language acquisition states that allomorphy within a paradigm tends to be minimized. Finally, there are cases where some phonological rules fail to apply when its output would violate the phonotactic condition of the language in question. Kisseberth (1970) argues that these phonological rules can 'conspire' to avoid the violation of phonotactic constraints.

In this paper we will show that 'linguistically significant generalization' which cannot be captured in an otherwise adequate formal framework can be well accounted for on the functional ground: recoverability. Recoverability is a technical notion employed in generative grammar, the essence of which is the requirement that the content of the deletion be recoverable. The main motive behind recoverability of the input is to keep the words and sentences in a language intelligible (Campbell 1982).

Kenstowicz (1981) argues that certain phonological rules in Malay are constrained by this functional notion. The causative suffix *məŋ-* assimilates to the place of articulation of a following consonant which deletes if voiceless.

(2)	Active	Causative	Gloss
a.	adʒoʔ	məŋadʒuki	'tease'
b.	bayar	məmbayari	'pay'
c.	daki	məndaki	'climb'
d.	dʒawap	məŋdʒawapi	'answer'
e.	gali	məŋgali	'dig'
f.	kael	məŋgaili	'fish'
g.	pukol	məmukoli	'beat'
h.	tules	mənulisi	'write'
i.	satu	məŋatui	'unite'
j.	sumbu	məŋumbui	'cause to wick'

When the stems begin with [tʃ], [tʃ] being voiceless also deletes as in (3a). However, there are cases where the [tʃ] never deletes as in (3b, c).

(3) a.	tʃiom	məŋtʃiumi	məŋiumi	'to kiss'
b.	tʃatu	məŋtʃatui	*məŋatui	'to ration'
c.	tʃumbu	məŋtʃumbui	*məŋumbui	'caress'

By comparing the forms in (2i) and (3b), and (2j) and (3c) respectively, we can see that deleting [tʃ] would lead to homophonous forms, which damages recoverability of underlying forms.

Kaye (1981) shows that the functional principle of recoverability can have an influence on rule ordering relationships in Ojibwa. According to him, the recoverability principle can be understood as a "global constraint on the degree of ambiguity permitted in a phonology" (1981:471).

A comparable example can come from English. There is a prominent environment where vowel shortening (laxing) occurs in English. Consider the following data.

(4) a.	divine	b.	divinity
	serene		serenity
	vain		vanity

The forms in (4) illustrate Trisyllabic Shortening or Trisyllabic Laxing, in which long vowels (including diphthongs) in (4a) alternate with short vowels in suffixed forms in (4b). Suppose now that each foot is not allowed to contain more than two moras. Then the foot in *di(vi:ni)ty* obviously violate this constraint on foot structure, since it contains three moras. The violation in *divinity* is thus repaired to the shortening of the vowel /i:/ in the stressed syllable *vi*. This rule, by contrast, doesn't apply to the words like *(alge)bra*, in which the violation of foot bimoracity is maintained. What is significant here is that preservation of melodic material /l/ overrides the Trisyllabic Shortening, since once the melodic material is deleted, it is not possible to recover it from the output.

Another example of recoverability comes from the data of second language learning. Oller (1974) and Tarone (1984) attempt to demonstrate the difference between Interlanguage syllable structure and Target language syllable structure, arguing that L2 learners tend to prefer open syllables in order to conform with the universal tendency of the CV syllable. In fact, there are two strategies to lead to CV syllables. One is to delete a consonant in coda position and the other is to add a vowel to a closed syllable. L2 learners tend to simplify closed syllables by means of epenthesis, not by means of deletion. For example, in words like *big*, L2 learners more commonly favor vowel epenthesis (*bigu*) instead of final consonant deletion (*bi*). The reason that L2 learners prefer epenthesis seems to be that as in (2), they often leave some trace of the input distinctions in their outputs. That is, input segments should be recoverable from the outputs to maintain intelligibility.

In what follows, we maintain that the principle of recoverability is a major key to functional phonology which explains why certain constraints are found in some languages, in particular, Lardil. We will discuss extensive theoretical implications of the recoverability principle.

### 3. The Data

#### 3.1 The Lardil Sound System

The vowel and consonant inventories in Lardil are as follows:

(5)

Vowels		Consonants					
		Bilabial	Lam-den	Api-alv	Api-pal	Lam-pal	Velar
i	u	p	t̪	t	t̺	tʷ	k
		m	ɱ	n	ɲ	nʷ	ŋ
e	a			l			
				r	ɾ		
		w			y		

It has a four underlying vowel system which is symmetrical.<sup>1)</sup> As shown above, Lardil has a rich system of coronal consonants, i.e., apico-alveolar, apico-alveopalatal (=retroflex), lamino-dental (=interdental), and lamino-alveopalatal.

#### 3.2 Phonological alternations

A set of extensive phonological alternations in nominal paradigm of Lardil has been well documented through the literature (Hale 1973, Wilkinson 1988, Prince and Smolensky 1993 among others). In this section I will illustrate just three alternations that lead to word-final truncation, which will be sufficient for our purpose.

First, a word-final vowel is deleted when a word has more than two

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1. /e/ is a low front vowel, /æ/, but /e/ is used in this paper for typographical convenience.

syllables in it. Though truncation occurs only in the nominal paradigm, all three paradigms are presented for the purpose of identifying stems.

(6)	Nominal	Nonfut-acc	Future-acc	Gloss
a.	yalul	yalulu-n	yalulu-ɾ	'flame'
b.	mayar	mayara-n	mayara-ɾ	'rainbow'
c.	karikar	karikari-n	karikari-wuɾ	'butter-fish'
d.	yiliyil	yiliyili-n	yiliyili-wuɾ	'oyster sp.'

Apocope may result in a consonant cluster in the word-final position. Since Lardil does not allow complex segments in the onset or coda, the cluster is simplified by deletion of the final consonant.

(7)	Nominal	Nonfut-acc	Future-acc	Gloss
a.	yukar	yukarpa-n	yukarpa-ɾ	'husband'
b.	wulun	wulunka-n	wulunka-ɾ	'fruit sp.'
c.	wuɬal	wuɬaltʰi-n	wuɬaltʰi-wuɾ	'meat'
d.	kantukan	kantukantu-n	kantukantu-ɾ	'red'
e.	karwakar	karwakarwa-n	karwakarwa-ɾ	'wattle sp.'

Finally, some consonants in the word-final position are again deleted irrespectively of their origin. The deleted consonants are always non-apical, and consequently Lardil retains only vowels and apical consonants word-finally in the surface.

(8)	Nominal	Nonfut-acc	Future-acc	Gloss
a.	turara	turaraq-in	turaraq-kuɾ	'shark'
b.	ɣalu	ɣaluk-in	ɣaluk-uɾ	'story'
c.	putu	putuka-n	putuka-ɾ	'short'
d.	murkuni	murkunima-n	murkunima-ɾ	'nullah'
e.	ɣawuɣa	ɣawuɣawu-n	ɣawuɣawu-ɾ	'termite'
f.	tipiti	tipitipi-n	tipitipi-wu	'rock-cod sp.'

- |    |                     |   |   |                |
|----|---------------------|---|---|----------------|
| g. | ʧapu                | ʧaput <sup>y</sup> i-n  | ʧaput <sup>y</sup> i-wur                | 'olderbrother' |
| h. | t <sup>y</sup> umpu | t <sup>y</sup> umpu <sup>y</sup> ut <sup>y</sup> umpu <sup>y</sup> umpu-n | t <sup>y</sup> umpu <sup>y</sup> umpu-ɾ | 'dragon-fly'   |
| I. | muŋkumu             | muŋkumuŋku-n  | muŋkumuŋku-ɾ                            | 'wooden axe'   |

The reality of the above alternations is illustrated in the productive reduplicated nominative forms in the lexicon, e.g., /muŋkumuŋku/ → [muŋkumu], where apocope, cluster simplification and nonapical deletion seem to have applied sequentially.<sup>2)</sup> Truncation is also a part of borrowed words from English, e.g., /ʧarawuʧa/ → [ʧarawu] 'trousers', /wat<sup>y</sup>pela/ → [wat<sup>y</sup>pel] 'white-fellow' (Hale 1973:435 fn.).<sup>3)</sup>

We can summarize the above processes in three processes: first, word-final vowels are deleted in more than two syllabic words; second, word-final consonant clusters are simplified; and last, non-apical consonants are deleted word-finally.

#### 4. Functional Considerations in Lardil

As we have seen in the previous section, a set of truncation rules in Lardil lead to loss of original information to a greater or lesser extent. In this section, we will attempt to look for some functional forces which may not be readily apparent in these processes.

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2. Most of the reduplicated forms do not have their original underlying forms in the lexicon. In the rare cases where they exist, there is not always the obvious semantic relationships between the forms.

/kantu/	'blood'	/kantukantu/	'red'
/karmu/	'bone'	/karmukarmu/	'bony, skinny'
/paŋa/	'stone'	/paŋapaŋa/	'stony, rocky'
/wiʧe/	'inside'	/wiʧewiʧe/	'open sea'
/karwa/	'hard'	/karwakarwa/	'wattle sp.'
/ŋawu/	'dog'	/ŋawuŋawu/	'termite'

3. It may be strange to note that truncation processes do not normally apply to the borrowings from Mainland Australian languages. Examples such as /ŋaritypalaŋi/, /panaŋinyi/, /palyarinyi/, and /kamaraji/ do not normally truncate, but introduce an alien phonological segment into the language, i.e., /ly/. (Hale 1973:435, fn.)



#### 4.1 Neutralization of Coronal Consonants

It was shown in section 3 that Lardil consonants exploit as many as six points of articulation, especially coronals range four places. In the surface, however, only the apical consonants are allowed in the word-final position through Cluster Simplification and Nonapical Deletion rule. Aside from the peripheral (labial and velar) consonants, coronals are consequently neutralized to apicals, and why neutralization occurred this way is the main concern of this subsection.

Formal mechanism can account for this neutralization by using the feature [distributed], the articulation of which involves a relatively wide constriction. In this framework, laminals are [+distributed] and apicals [-distributed]. Therefore, we can simply say that distributed consonants are deleted at the end of a word.

However, this neutralization process is not readily explicable in functional terms. Functionally, most distinct segments are expected to remain, but in fact we are left with the two of seemingly most similar segments, i.e., apico-alveolar, and apico-alveopalatal. However, a close examination of the phonetics and the distribution of the coronal consonants reveals that the choice is also well motivated on functional grounds.

Dixon (1980:158) in *The Languages of Australia* reconstructs proto-Australian consonants as follows:

(9)

	apical	laminal	dorsal	labial
stop	d	j	g	b
nasal	n	ny	ŋ	m
lateral	l	(ly)		
rhotic	rr, r			
semi-vowel		y	w	

Dixon argues that at an early stage apicals had retroflex allophones

after /u/, but this phonetic distinction became phonologically significant. More recently, the allophonic alternation in the laminals between a palatal before /i/ and a(n) (inter-)dental elsewhere became also phonologically contrastive.

The distributional facts of coronal consonants in modern Lardil also support the closer relationship between laminal consonants than that between apical consonants. Though they are all phonemes in modern Lardil, /tʲ/ and /ɬ/ still retain the allophonic characteristics of proto-Australian: from the data in Hale (1973) /tʲ/ occurs before i with 67%, whereas ɬ never does. On the other hand, there is no comparable distributional property between /tʲ/ and /ɬ/ in modern Lardil. Furthermore, Dixon (1980:156) notes that the apical contrast probably carries a greater functional load than does the laminal contrast.

Given all these observations, it can be argued that the two apical consonants that survive by neutralization are a rather natural consequence. A laminal palatal is not a strong candidate for survival when a perceptual characteristic of palatalized consonants in general are considered, i.e., they are primarily perceived by the transition to a following vowel, hence neutralized. On the other hand, a laminal dental, which still has an allophonic relationship with a laminal palatal, seems to be also neutralized. As a result, there remain a most unmarked coronal consonant /t/ and a retroflex /ɬ/ as the result of neutralization.

Extensive truncation processes in Lardil cause loss of information. On the functional grounds, it may be expected that there are some mechanism by which they can retrieve the underlying information, and in fact this is the case in Lardil, although the effect is not far-reaching.

#### 4.2 The Phantom-limb Phenomenon

Hale (1973:439,fn) presents some puzzling data involving influence of deleted segments over the remaining segments. The first case is Lardil [r], which becomes [d ~ n] optionally before a nasal, appears as [n] obligatorily when a following nasal is lost by Cluster simplification:



Syllabifying CVCC as a single syllable, however, is not usually allowed in Lardil with only one exception: [tarnjka] 'barracuda', which appears as [tanka] in other source. Extra-tenseness in final vowels, which Donegan and Stampe do not discuss, has to introduce a glide-final syllable, which is absolutely unprecedented in Lardil.

Lee (1997) proposed a correspondence-theoretic account of this phenomenon within the framework of Optimality Theory (Prince and Smolensky (1993), McCarthy and Prince (1993, 1995) focusing on the fact that recoverability of lost features can be measured by faithfulness relations applied to featural correspondence between input and output.

In this paper, we will focus on functional explanation of this fact by elaborating the notion of functionalism adopted in this paper. Functionalism considered in this paper has largely to do with the notion of recoverability developed in Kaye (1974, 1975). He defines recoverability as a functional notion viewing phonology as a parsing device. It concerns the degree of ambiguity manifested by a given surface form, and therefore, the fewer the number of potential sources for the form, the greater its recoverability. Kaye also argues that in determining the recoverability of a form there is no recourse to morphologically related forms, since people do not normally talk in paradigms.<sup>4</sup>

Returning now to the "phantom-limb phenomenon", we observe that the form [puŋtun<sup>y</sup>] contains an otherwise disallowed word-final consonant, a laminal palatal nasal [n<sup>y</sup>]. Kaye (1974) suggests that development of a novel segment (i.e., a segment which is not part of the inventory of underlying segments) in the surface increases the recoverability of the underlying form. This may apply in Lardil to the word-final palatal in [puŋtun<sup>y</sup>]: presence of a novel segment makes us deduce the earlier existence of a deleted final palatal. The other cases of the phenomenon also contribute to recovering the underlying forms in

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4. This position may be refuted by a recent development of Optimality Theory proposed by Kenstowicz (1997) and others under the notion of uniform exponence. We will not get into the details here.

that the altered part of the context is recoverable when it has left its trace on the phonetic material that remains.

This kind of compensatory change for the loss of information is also found in other Australian languages. Dixon (1980:196-207) describes the initial-dropping phenomenon in many Australian languages. For example, the phenomenon in north Cape York languages is summarized as loss of  $C_1$  and dropping or shortening of the  $V_1(V_1)$  depending on the quality of the vowel, in words whose structure consists of  $C_1V_1(V_1)C_2V_2...$  The compensatory change that followed was that the phonetic distinction at  $C_2$  or  $V_2$ , which was subject to the  $C_1$  and /or  $V_1(V_1)$ , became phonologically significant.

On the other hand, Lardil developed "final-dropping" processes and also has some comparable compensatory changes discussed above. In the next subsection, we will bring up a functional consideration dealing with the issue of homonymy.

#### 4.3 Homonymy-avoiding principle

Hale (1973:423 fn.) reports that some Lardil speakers do not pronounce the final /-r/ and/or /-n/ in the future and nonfuture endings respectively. In that case, however, the resulting words in question do not undergo lowering of the final vowel as follows:

- (14) a.  $ke\eta i-n \rightarrow$  nonfuture  $[ke\eta i] \rightarrow *[ke\eta e]$  'wife'  
           cf. uninflected  $[ke\eta e]$   
       b.  $ke\eta i-r \rightarrow [ke\eta i]$

Considering the optional deletion rule to be a low level variation rule, we can get the desired surface form  $[ke\eta i]$  for nonfuture accusative since this deletion rule follows Lowering rule.

However, the vocative, which has a phonologically vacuous ending, also inhibits Lowering and other phonological rules as well (Hale p.423.fn.).

(15)	a.keŋti	cf. keŋte	(uninflected)	'Wife'
	b.kaɬu	cf. kaɬa	'child' (uninflected)	'Son!', 'Daughter!' (woman speaking)

This vocative case, without a suffix ending, cannot be treated in the same way as the optional deletion case presented in (14).<sup>5</sup>

If the usual Lowering rule had applied, it would have produced homonyms for the different paradigms, i.e., between uninflected and vocative paradigms. Then, this exceptionality can be best understood in terms of the principle of avoiding homonymy, since homonymy and the resultant ambiguities caused by it are certainly the red signal against adequate communication. In the next subsection, we will turn to a phenomenon of innovational suffixes in a secret language of Lardil.

#### 4.4 An innovation of /-ŋin/ and /-ŋkuɾ/ in Damin

Hale (1973:442-5) documents an innovation of inflectional suffixes such as /-ŋin/ and /-ŋkuɾ/ in a secret language of Lardil called Damin.<sup>6</sup>

(16)	uninflected	nonfuture	future	gloss
a.	puuwin	puuwin-in	puuwin-kuɾ	'coolimon'
b.	t <sup>y</sup> it <sup>y</sup> iwin	t <sup>y</sup> it <sup>y</sup> iwin-in	t <sup>y</sup> it <sup>y</sup> iwin-kuɾ	'spear'
c.	m!i	m!i-ŋin	m!i-ŋkuɾ	'vegetable food'

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5. It may be assumed that at an earlier stage the vocative had an ending such as a velar '-ŋ', which was removed by Nonapical Deletion rule and consequently restructured.

6. One could argue that all of the Damin stems which appear to take these suffixes really end in /ŋ/ themselves, and that the Lardil truncation process deletes the nasal word-finally. However, there is independent evidence which indicates that the underlying stem forms in Damin are the same as the uninflected forms. The possessive suffix in Lardil has two alternants, /-ŋan/ after nasal-final stems, /-kan/ after others. The alternant used with the Damin forms in question is /-kan/, thus Damin has /n!an!a-kan/'wife's' and not \*/n!an!aŋan/ as would be expected if the stem ended in /ŋ/.

d.	n!an!a	n!an!a-ŋin	n!an!a-ŋkur	'wife'
e.	kuu	kuu-ŋin	kuu-ŋkur	'brother'
f.	Li	Li-ŋin	Li-ŋkur	'fish'
g.	wii	wii-ŋin	wii-ŋkur	'meat,etc.'
h.	n!un!u	n!un!u-ŋin	n!un!u-ŋkur	'water'

The innovated suffixes are based on velar-final stems in Lardil. Hale contends that this is attributed to the surface-underlying disparity in that Lardil allows no velar-final words in the surface. This claim seems to be too strong and has counterexamples (see Kaye (1975)).

This sign of restructuring, however, may be considered as an attempt to achieve more transparent, and thus easily recoverable, underlying forms compared to the surface forms. And this can be understood as a move to put the language (which has been removed from G-state) back to G-state, i.e., a state which some system possesses under suitable condition (Nagel 1953).

## 5. Concluding Remarks

In this paper, some phonological phenomena in Lardil were reexamined from a functional point of view. It has been shown that the truncation and neutralization rules - though they are themselves motivated - end up with the surface forms which are very distant from their underlying forms. We have tried to find and show some compensatory forces to militate against the destruction, though they are no more than sporadic in many cases. They all conspire to minimize the damage done to the recoverability of the underlying forms. It was argued that these processes are best understood by functional explanation which aims to achieve adequate communication in a speech community which is based on intelligibility between speakers and listeners.

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