

1986

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Recommended Citation

Cole, Jennifer (1986) "The Interaction of Phonology and Morphology in Seri," *North East Linguistics Society*. Vol. 17 , Article 10.

Available at: <https://scholarworks.umass.edu/nels/vol17/iss1/10>

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The Interaction of Phonology and Morphology in Seri

Jennifer Cole

M.I.T.

1 Introduction

In this paper, I present a portion of the prefix phonology of Seri, and discuss the theoretical implications of my analysis for the theory of Lexical Phonology (LP). LP has been developed in an effort to explain why, within a language, groups of morphemes behave similarly with respect to phonological rules. For example, in English, there is a distinction between suffixes that shift stress (the Class I suffixes of Siegal 1974), and suffixes that don't (or the Class II suffixes). Contrast the shifting stress in pairs like *superficial* ~ *superficiality* and *professor* ~ *professorial* with the stationary stress in pairs like *happy* ~ *happiness* and *professor* ~ *professorship*. / -al/ is a Class I suffix, while / -ness/ and / -ship/ are Class II suffixes. A LP analysis of English groups all the Class I morphemes that shift stress together in the morphological stratum I, and further restricts the domain of cyclic stress assignment to that stratum. After affixation of a Class I suffix, cyclic stress assignment applies. A second morphological stratum contains the Class II morphemes that do not trigger cyclic stress assignment, and this stratum is ordered after stratum I. The stress rule is not assigned to stratum II, therefore affixation of any morpheme in stratum II will not be followed by cyclic stress assignment, and this accounts for the stress-neutral property of the Class II morphemes.

We can contrast strong and weak forms of LP. A strong form of LP would be one in which grammars are limited in the number, content, and organization of morphological strata. But note that there is nothing about the formalism that

would force any such limitation. The weakest form of LP is one in which every language has a unique morphological organization. There would be no constraint on the number or type of strata a language may employ, although it would be reasonable to assume that the language learner wouldn't posit a new morphological stratum unless there was positive evidence from the distribution of morphemes, or phonological alternations for doing so.

I will conclude on the basis of evidence from Seri that only the weakest form of LP can be maintained. In particular, I argue that the Seri data forces a version of LP in which an individual morpheme in a given language can constitute a separate stratum and specify exactly which phonological rules it triggers. (Seri isn't this language, but a LP analysis of Seri shows that such a language could in principle exist.) If the theory of LP allows this type of analysis, then it can make *no* predictions about the organization of morphology, or the interaction of morphology and phonology cross-linguistically, thus severely reducing its value.

2 Seri Prefix Phonology

Seri noun and verb roots can occur with several prefixes, choosing from among at least eighteen prefix categories.¹ Although no single prefix is present on all verbal forms, bare verb roots never stand alone. Nouns may occur without any prefixes. The order of the prefixes is very rigid. A portion of the morphological template is presented in (1):²

- 1) Oblique-Directional- Object { Subject-Mood } Neg.-Root
 { Imperative }
 { Infinitive }

There are several rules of deletion and epenthesis in the prefix phonology. Some of these rules apply generally, whenever their structural description is met. Other rules apply only across combinations of specific prefixes and fail to apply elsewhere, even when their structural description is met. I discuss here three cyclic phonological rules with restricted domains of application: Vowel Deletion, I-Deletion, and O-Epenthesis.

The rule of V-Deletion deletes a vowel to the left of a vowel, and is illustrated in (2). It's application in (2i) and (2ii) is triggered by the Mood prefix. In (2iii), Vowel-Deletion fails to apply when the Object prefix is added, although its environment is met. In (2iv), we can see that Vowel Deletion applies after the Directional prefix is added, and we can also see that it does not apply within roots.

- 2) *Vowel Deletion:* $V \longrightarrow \emptyset / _V$

- i- po-i:m → pi:m 'sleep'-irrealis
Mood-root
- ii- ?-si-i-kapot → i?sikapot 'I have-jacket'
Subj-Mood-Verb.-Root
- iii- ma-i?a-st 'to tattoo you'
Obj-Inf-Root
- iv- mo-i-y-oit → m-i-y-oit → ... → imyoit 'it's descending'
Dir-Poss-Nom Root (I-Deletion, I-Epenthesis)

I-Deletion is illustrated in (3). This rule deletes an /i/ between two consonants. In (3i) and (3ii) we see that i-Deletion is triggered by the addition of the Mood and Nominalizing prefixes. The cyclicity of i-Deletion is demonstrated in (3iii), where the rule fails to apply morpheme-internally. In the remaining examples in (3), i-Deletion fails to apply when its environment is met by the addition of the Object prefix, the Possessive prefix and the Directional prefix.

3) *i-Deletion*: $i \rightarrow \emptyset / C_C$

- i- si-meke → smeke 'lukewarm'-irrealis
Mood-Root
- ii- k-i-tis → ktis 'he who points at it'
Nom-Obj-Root
- iii- /sip/ 'kiss'
- iv- masi-k-noptotka?a 'we are hitting you'
Obj-Nom-Root
- v- mi-nail 'my skin'
Poss-Root
- vi- ko-nt-i-s-o:si 'take him away'-irrealis
Obl-Dir-Obj-Mood-Root

The rule of o-Epenthesis deletes an /o/ before an unsyllabified /m/. It is beyond the scope of this paper to discuss the syllable structure of Seri, but it will suffice to understand that o-Epenthesis inserts an /o/ before an /m/ when the /m/ is

preceded and followed by a Consonant. In (4i) i-Deletion first deletes the /i/ of the Mood prefix /mi-/, then o-Epenthesis applies. In (4ii) o-Epenthesis applies after the Imperative prefix is added. In (4iii) the rule of i-Deletion applies after the Mood prefix /mi/ is added. Then, when the Object prefix /?im/ is added, the environment for o-Epenthesis is met, but we can see that the rule fails to apply. Instead, a late and general rule of i-Epenthesis applies to create a syllabifiable form. The example in (4iv) is like (4iii).

4) *o-Epenthesis*: $\emptyset \rightarrow o / _ m'$ (C m C)

- i- mi-msisi:n \rightarrow m-msisi:n \rightarrow momsisi:n 'he is pitiable'
Mood-Root
- ii- k-m-tis \rightarrow komtis 'don't point at it'
Imp-Neg-Root
- iii- ?im-mi-kasni \rightarrow ?imimkasni 'it bit me'
Obj-Mood-Root
- iv- i?p-mi-pansX \rightarrow i?pimpansX 'I'm running'
Subj-Mood-Root

Although I can not argue for the cyclicity of o-Epenthesis on the basis of its non-application morpheme-internally, I claim that it is a cyclic rule based on two observations. First, its domain of application patterns with the other cyclic rules mentioned earlier, and secondly, by assuming that o-Epenthesis is cyclic I can explain its application in the form in (4v). The environment for o-Epenthesis is met twice in this example: before the initial /m/ of the root, and before the /m/ of the Negative prefix. If o-Epenthesis is cyclic, then it will apply on the first cycle, inserting an /o/ before the initial /m/ of the root. This application of o-Epenthesis will bleed its subsequent application on the second cycle, when the Mood prefix is added, deriving the correct surface form. If o-Epenthesis were not a cyclic rule, then we would have to specify that it applies in a right to left direction, given example (4v).

- 4) v- ?p-s-m-msisi:n \rightarrow i?pskmomsisi:n 'I won't be pitiable'
Subj-Mood-Neg-Root

In (5), I have diagrammed the domains of application for each of the rules I have presented. (The significance of the line separating the Directional and Object prefixes will be explained later.) We can see that a striking pattern emerges. All three rules apply across sequences derived by affixation of the Negative and Mood prefixes.³ All three rules *fail* to apply, even though their environments are met, when

the Subject and Objects prefixes are added. Vowel-Deletion applies again when the Directional and Oblique prefixes are added, although i-Deletion does not apply in the appropriate environments at this outer level of prefixation. The environment for o-Epenthesis is met when the Oblique prefix is added, but I was unable to find the form that would indicate whether the rule applies here or not.

5) Vowel Deletion	xxxxxxx	xxxxxxxxx			xxxx	xxx		
O-Epenthesis	?	(n.a.)			xxxx	xxx		
I-Deletion					xxxx	xxx		
			Oblique	Directional	Object	Subject	Mood	Neg
			('xx' indicates rule application)					

3 Analysis

3.1 Direct Encoding

There are various ways in which we might try to explain the pattern in (5). One possibility would be to allow each morpheme in the language to directly encode just which phonological rules it triggers. This approach makes the prediction that no interesting generalizations can be made concerning the morphological domains defined by sets of phonological rules. Such generalizations are suggested by the Seri data. Namely, that at least at the inner layer of prefixation, the *same* morphemes trigger application of the three rules discussed above, and there is distinct set of morphemes that systematically *fail* to trigger the application of each rule. Since Direct Encoding fails to account for this kind of regularity, it is rejected here.

3.2 Lexical Phonology

A LP analysis of this data would postulate a cyclic stratum to contain the Mood and Negative prefixes. All three cyclic rules would be assigned to this stratum. Another cyclic stratum would be postulated for the Oblique and Directional prefixes. The rule of Vowel Deletion (and maybe also o-Epenthesis) would be assigned to this stratum, but not the rule of i-Deletion.

What about the Subject and Object prefixes? The learner would have no evidence to suggest that they belong to the same stratum, since there is no phonological rule that is triggered by both of these morphemes. However, they must each belong to a non-cyclic stratum, since they do not trigger the cyclic rules discussed earlier. In addition, there is a strict linear order imposed on the sequence of Subject and Object prefix, and this would lead the learner to assign each of the two prefixes to a separate stratum. In fact, I argue that the theory of LP predicts that the learner would posit a separate non-cyclic stratum for every (ordered) prefix that fails to trigger any phonological rules. Thus, the LP analysis of Seri derives a model where strata are being defined—namely, the non-cyclic strata in Seri—which serve only to identify the properties of individual affixes. This analysis represents a major weakening of the theory of Lexical Phonology, since there is no principled way to limit

the number of strata a language might possibly use. In fact, the whole notion of an ordered stratum becomes somewhat contentless when it encodes the properties of only a single morpheme. Lexical Phonology is intended to explain why *groups* of morphemes behave similarly in a given language, but the grammar of Seri appears to be sensitive, in part, to properties of *individual* morphemes.

A final comment on a Lexical Phonology style analysis of Seri: It would not be correct to correlate the ordered morpheme positions indicated in (1) with ordered strata, the reason being that not all morphemes occurring in the same position uniformly trigger or fail to trigger cyclic phonological rules. §3.3 provides evidence that the 3rd person object prefix triggers the cyclic rules of V-Deletion and Short Low Vowel Deletion, though it occurs in the same position as the other object prefixes which were shown above not to trigger cyclic phonological rules. Likewise, the infinitival prefix triggers cyclic V-Deletion, as seen in (6i), yet it shares the same position in the morpheme template as the imperative prefix, which is seen not to trigger the cyclic rule of o-Epenthesis in (6ii).⁴

6i) i?a-o:n → i?-o:n ... → i?en 'to carry' (2.68g)
 Inf-root (V-Del.) (other rules)

6ii) ko-k-m-pansX → ko-k-m-pansX ... 'don't run like him' (2.55j)
 Obl-Imp-Neg-root (O-Ep., n.a.)

In figure 1 (overleaf) is a diagram of the organization of the Seri prefixes and phonological rules presented here, according to the LP analysis. I have indicated two sets of strata, corresponding to the morphology of verbal and nominal forms (it would, in principle, be possible to collapse these two into one set of strata, but I present them here separately to avoid the question of which morphemes from the two templates should be grouped together). The striking observation about the system sketched in figure 1 is that *all* the cyclic rules can be said to apply at *all* cyclic strata (though not every cyclic stratum contains the morphemes that will trigger each cyclic rule), with the sole exception being that *i-Deletion* does not apply in the final stratum in both verbal and nominal forms. The most relevant distinction seems to be whether a morpheme belongs to a cyclic, or non-cyclic stratum. Given that most strata include a very limited number of morphemes, the organization of morphemes into strata buys almost nothing for the analysis of Seri prefixes.

3.3 An Alternative Analysis

In this section, we consider an analysis of this data without invoking the ordered morphological strata of LP. We begin by characterizing the difference between the Oblique and Directional prefixes and the Mood and Negative prefix. Recall from (5) that the cyclic rule of *i-Deletion* fails to apply to the Oblique and Directional prefixes, though cyclic Vowel-Deletion does apply there. Thus, there seems to be two domains for cyclic phonological rules. These two domains correlate with another

Figure 1: Standard Lexical Phonology of Seri

	Morphology	Phonology	Cyclic
<i>Verbal Strata</i>			
S1:	Mood Neg.	o-Epenthesis i-Deletion Vowel Deletion	yes
S2:	Subject	—	no
S3:	Object	—	no
S4:	3-Object	o-Epenthesis (n.a.) i-Deletion Vowel Deletion	yes
S5:	Oblique Directional	o-Epenthesis (?) Vowel Deletion	yes
<i>Nominal Strata</i>			
S1:	Neg. 3-Object Nominal.	o-Epenthesis i-Deletion Vowel Deletion	yes
S2:	Object	—	no
S4:	Poss.	—	no
S4:	Oblique Directional	o-Epenthesis (?) Vowel Deletion	yes

difference between these two sets of prefixes. The Mood and Negative prefixes are always bound morphemes, while the Oblique and Directional prefixes may appear freely, as in (7):

- 7) ko-nt k-i-s-km-ak-a: ak
 Obl-Dir Obl-Poss-Mood-Neg-Subj-Root Determiner
 ‘one’s not going away’

I suggest that the Mood and Negative prefixes are part of the *word-internal* derivation, while the Oblique and Directional prefixes are really clitics, and belong to the *word-external* derivation. This distinction corresponds roughly to the lexical and post-lexical distinction of LP, but I am making no claims about *where* in the derivation of a word these two types of affixation take place. Each phonological rule is assigned to one or both of these levels of derivation. Thus, i-Deletion is assigned only to the word-internal level, and will not apply to morphemes attached word-externally.

Likewise, each morpheme is specified as affixing in the word-internal or word-external derivation.

Orthogonal to the word-internal/-external distinction, there is a distinction between Class I morphemes—those that trigger the cyclic phonological rules, and Class II morphemes—those that don’t. It is possible to analyze all the Seri data solely in terms of the diacritics “Class I” and “Class II”, with every Class I morpheme triggering all the cyclic phonological rules assigned to the level in which it is affixed.

As indicated in (5), I have included the Subject and Object prefixes as part of the word-internal derivation. This is because, like the Mood and Negative prefixes, they are always bound morphemes. So, it might appear that within each level, the morphemes that trigger cyclic phonological rules are internal to the morphemes that don’t trigger cyclic phonological rules. This is reminiscent of the situation in English with Class I and Class II suffixes, and may suggest that there is a cross-linguistic generalization to be made. Unfortunately, this is only an apparent generalization in Seri. Consider the behavior of the 3-Object prefix in (8). This prefix triggers cyclic Vowel Deletion, as in (8i).

- 8) i- k-i-a:fk → ka:fk ‘who is pounding it’
 Nom-3Obj-Root

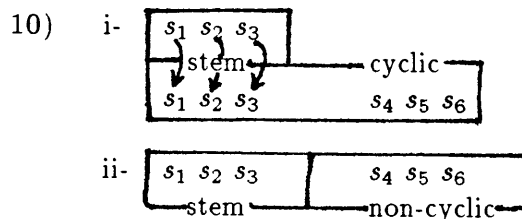
It also triggers the cyclic rule of Short Low Vowel Deletion. This rule causes a short /e/ or /a/ to delete to the right of another vowel. Thus, in (8ii), the /i/ of the 3-Object prefix causes the short root-initial /a/ to delete. The fact that SLV Deletion is cyclic is illustrated in (8iii), where the rule fails to apply morpheme-internally.

- 8) ii- Short Low Vowel Deletion:
 k-i-ap → kip 'who is sewing it'
 Nom-3Obj-Root
- iii- /oekx/ 'hang'

The 3-Object prefix triggers cyclic phonological rules, yet in nominal forms it appears external to the Subject prefix, which always fails to trigger cyclic rules. So, we actually get an alternating pattern of Class I and Class II prefixes within the word-internal level, as in (9).

- 9) 3Object - Subject - Mood - Root
 Class I - Class II - Class I - Class I

I propose to characterize the Class I and Class II distinction in Seri in terms of the feature "cyclicality", developing an analysis proposed by Halle and Vergnaud (to appear) in their discussion of stress and the Cycle. Halle and Vergnaud suggest that the distinction between Class I and Class II morphemes in English is a difference in the planar properties of these two classes. In their analysis, Class I affixes are *cyclic* affixes, and define a new morphological plane. When they are added to a stem, information from the existing morphological plane is copied onto the new plane, but stress information is never copied. Thus, the stress rules apply to the new plane, and stress information from the old plane is not taken into account. Cyclic affixation is illustrated in (10i). In contrast, the Class II morphemes are *non-cyclic*, and do not constitute a distinct morphological plane. Rather, they are added to the existing plane of the stem to which they attach, without affecting any existing stress information. Non-cyclic affixation is illustrated in (10ii).



This analysis of the cyclicality of morphemes can be used to explain the existence of certain bracketing paradoxes, like the familiar example *ungrammaticality*. The problem with this form is that /un-/ is a Class II morpheme and /-ity/ is a Class I morpheme. In the LP framework this suggests the morphological bracketing in

(11i). But we know that the prefix /un-/ attaches productively only to adjectives, suggesting the bracketting in (11ii). The Halle-Vergnaud analysis resolves this paradox by saying that /un-/ is a non-cyclic prefix, and will therefore behave like all Class II morphemes in not shifting stress. The morphological bracketting will be as in (11ii). Since their analysis applies independent of ordered strata, they have no need to indicate the bracketting in (11i).

- 11) i- [un [[grammatical] ity]
 ii- [un [grammatical]] ity]

If we characterize the Class I morphemes in Seri as the cyclic morphemes, then we can explain the behavior that they all have in common: each one triggers all the cyclic phonological rules active in the level where it is attached. The non-cyclic morphemes will simply be those that fail to trigger any cyclic phonological rules. The difference between this analysis and the LP model is that I make no prediction about the linear order of cyclic and non-cyclic morphemes. While this is a weaker theory, it is necessitated by the Seri data, in which cyclic and non-cyclic morphemes alternate linearly, as shown in (9).

To summarize, we have the four-way distinction among morphemes and phonological rules given below:

1. Word-internal, cyclic
2. Word-internal, non-cyclic
3. Word-external, cyclic
4. Word-external, non-cyclic

This relatively simple system is seen to account for the complex alternations in Seri prefix phonology. My analysis in terms of the property of cyclicity is simpler than the LP analysis, which invokes a large number of morphological domains that either share the same phonological rules, or share the property of containing no phonological rules. Moreover, the LP analysis of Seri sketched here violates both the Strong Domain Hypothesis, and the hypothesis that phonological rules are not duplicated in the phonology. I have maintained from LP the ordered distinction between the word-internal and word-external levels.

4 The Bracket Erasure Convention

As a final point about the Seri data, I show that Seri provides clear evidence against the uniform application of the Bracket Erasure Convention. Consider the rule of i-y Reduction shown in (12). An /i/ deletes before a /y/ at the boundary of a nominal stem. The rule is illustrated in (12i).

12)

i-y Reduction: $i \rightarrow \emptyset / _ _ _ \left[\begin{array}{c} y \\ \text{N} \end{array} \right]$

i- [k [_Vi [_Nye:n]]] \rightarrow kye:n 'who has a face'
 Nom-Verb-Root

i-y Reduction fails to apply in (12ii), because the /y/ is at the boundary of a verbal stem. Likewise, the rule fails to apply in (12iii); although the /i/ of the Subject prefix is adjacent to a nominal stem, there is an intervening verbal boundary which blocks the rule from applying. This form would be entirely puzzling if the BEC had deleted the verb boundary before the Subject prefix was attached.

12) ii- [i [_Vyo [_Va?o]]] \rightarrow iyo:?o 'he saw him'
 3Obj-Mood-Root

iii- [?i [_N \emptyset [_Vya:i]]] \rightarrow ?iya:i 'my travelling'
 Subj-Nom-Root

Moreover, the rule has an important exception: it never deletes an /i/ after the Oblique prefix /ko-/, as in (10iv).

12) iv- [ko [i [_Vy [_Vatx]]]] \rightarrow kwiyatx 'his arising'
 Obl-Poss-Nom-Root

Since the Oblique prefix isn't added until the word-external level, the rule of *i-y Reduction* can't apply until the word-external level either, otherwise the rule couldn't take into account the presence of the Oblique prefix. But this means that the brackets of the word-internal level must be visible at the word-external level, since the rule must be able to see if the appropriate nominal boundary is present before it applies. Therefore, I conclude that the BEC can not apply in these forms. I suggest, without further discussion, that the phenomena that the BEC was originally intended to explain is better subsumed under different principles.⁵

5 Conclusion

In this analysis of Seri prefix phonology, we have argued for a theory of phonology that differs substantially from standard versions of Lexical Phonology in several ways. We rejected an analysis of Seri that employs ordered strata as domains for morphological and phonological rules. The theory that emerges is one in which there is only a limited interaction between morphology and phonology. The only

morphologically specified domains are the lexical and post-lexical levels (although these terms may no longer indicate anything about *where* rules take place). All morphemes and phonological rules are specified to apply in one or both of these domains. In place of ordered morphological strata, I argue for an underlying distinction between cyclic vs. non-cyclic morphemes, where cyclic morphemes are those that trigger cyclic phonological rules. Within the domain of the lexical or post-lexical level, a phonological rule will apply whenever possible, complying with the Strict Cycle Condition when relevant. It is in principle possible for the same phonological rule to apply in both morphological domains. Moreover, the same rule may apply cyclically in one domain and non-cyclically in another. The distinctions provided by this model have been shown to be adequate in accounting for the very complex phonology of Seri prefixes.

6 Notes

¹ Three and four prefixes are very common, and we predict that up to eight prefixes can co-occur, although such forms are not adduced.

² All Seri data has been obtained from Marlett(1981). Throughout this paper, numbers in parentheses following Seri forms refer to the numbered examples from Marlett's thesis.

³ More precisely, none of the three rules need be *blocked* from applying to sequences derived by prefixation of the Negative and Mood prefixes. The environments for V-Deletion and I-Deletion are never met by prefixing the Negative morpheme.

⁴ The derivation in (6ii) does not indicate the surface form, *kokompansX*. Although it looks as though cyclic o-Epenthesis could have derived the correct output here, we know it must not have applied for the following reason. The Oblique prefix /ko-/ surfaces as [k^w-] whenever it is followed by a CV sequence (more generally, whenever it may incorporate into the following onset without violating syllable-structure constraints). Since the surface form has [ko-], we know that o-Epenthesis could not have applied before prefixation of the oblique morpheme /ko-/. Since o-Epenthesis is a cyclic rule, it follows that the imperative prefix belongs to the class of morphemes that do not trigger cyclic rules. The correct output is derived by application of the late rule of i-Epenthesis, followed by a special rule of [back]-assimilation which is morphologically governed by the Imperative morpheme ([back]-assimilation can be shown to have other applications, as well).

⁵ Sproat(1985) reviews several cases from the literature which were intended to support the BEC, and he concludes that they really only present positive evidence for the Strict Cycle Condition.

7 Bibliography

- Allen, M. (1978) *Morphological Investigations*, Ph.D. dissertation, UConn.
- Baker, M. (1985) *The Mirror Principle and Morpho-syntactic Explanation*, LI 16.3.
- Halle, M. and K. Mohanan (1985) "The Segmental Phonology of Modern English," LI 16.1.
- Halle, M. and J.-R. Vergnaud (1985) "Stress and the Cycle," MIT ms., to appear in LI.
- Kiparsky, P. (1982) "Lexical Morphology and Phonology," in *Linguistics in the Morning Calm*, Hansin, Seoul.
- Kiparsky, P. (1984) "On the Lexical Phonology of Icelandic," in C.C. Elert, I. Johansson, and I. Strangert, eds., *Nordic Prosody III: Papers from a Symposium*, Univ. of Indiana.
- Kiparsky, P. (1985) "Some Consequences of Lexical Phonology," *Phonology Yearbook*, Cambridge Univ. Press.
- Marlett, S. (1981) *The Structure of Seri*, Ph.D. dissertation, Univ. of California, San Diego.
- Mohanan, K.P. (1982) *Lexical Phonology*, Ph.D. dissertation, MIT.
- Mohanan, K.P. and T. Mohanan (1984) "Lexical Phonology of the Consonant System in Malayalam," LI 15.4.
- Siegal, D. (1974) *Topics in English in Morphology*, Ph.D. dissertation, MIT.
- Sproat, R. (1985) *On Deriving the Lexicon*, Ph.D. dissertation, MIT.