Phonological Conditions on Affixation

by

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Abstract

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This dissertation presents results of a cross-linguistic survey of phonologically conditioned suppletive allomorphy (PCSA). One hundred thirty-seven examples are discussed, representing 67 languages. Three major generalizations emerge from the survey. First, PCSA occurs at the same edge of the stem as the trigger: PCSA in prefixes is triggered at the left edge of the stem, while PCSA in suffixes is triggered at the right edge. Second, PCSA is sensitive to underlying rather than surface forms. This is demonstrated in several examples where phonological processes render opaque the conditions determining allomorph distribution. Finally, despite its characterization in recent literature, PCSA is not always optimizing. In numerous examples, words are no more phonologically well-formed than they would be if there were no allomorphy, or if the distribution of allomorphs were reversed.

The generalizations arising in this survey distinguish between competing frameworks for modeling phonological conditions on affixation. The first is the 'P >> M' approach, where PCSA is modeled by ranking **P**honological constraints over **M**orphological constraints in Optimality Theory. This model predicts that PCSA should

be phonologically optimizing and that allomorphy may be sensitive to phonological conditions anywhere in the word.

In the alternative approach, advocated here, PCSA is modeled by incorporating phonological elements of stems into the subcategorization frames of affixes. Subcategorization frames specify the type of stem to which affixes will attach, including syntactic, morphological, and (crucially) phonological features of stems. The distribution of suppletive allomorphs results from different requirements imposed by each allomorph on stems. This approach predicts that allomorphy should be sensitive to input rather than surface phonological elements and that PCSA should be sensitive only to elements at the edge of the stem where the affix attaches. These predictions are upheld in the survey.

In the introduction and conclusion, I situate these findings in the broader context of the literature on the phonology-morphology interface. I also consider predictions of the models discussed above for other types of phonological effects in morphology, showing that research in those areas converges with the results presented here.

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Chapter 1: Introduction

This dissertation concerns phonological conditions on the morphological process of affixation, focusing on cases of **phonologically conditioned suppletive allomorphy** (PCSA). An example of PCSA is found in Dja:bugay (Patz 1991), a Pama-Nyungan language of Australia. As seen in the examples in (1), the genitive suffix in Dja:bugay has two different forms, *-n* and *-ŋun* (Patz 1991: 269).

(1) a.	guludu-**n**	'dove-GEN'	b.	girrgirr-**ŋun**	'bush canary-GEN'
	gurra:-**n**	'dog-GEN'		gaɲal-**ŋun**	'goanna-GEN'
	djama-**n**	'snake-GEN'		bibuy-**ŋun**	'child-GEN'

When the stem ends in a vowel, as in (1)a, the *-n* suffix is used. When the stem ends in a consonant, as in (1)b, the *-ŋun* suffix is used. What distinguishes this as suppletive allomorphy is that it is not obvious how any plausible phonological process could relate the two allomorphs to a single underlying form, since this would involve the simultaneous deletion or insertion (depending on the analysis) of two segments, [ŋ] and [u]. We therefore conclude that there are two separate underlying forms that can be used to mark genitive. However, even though we are not able to write rules or constraints to derive the allomorphs from a single underlying form, we can nonetheless state the distribution of allomorphs in phonological terms, since the relevant property of the stem (consonant- vs. vowel-final) is phonological in nature.

Consonants vs. vowels at stem edges are found to condition PCSA in many of the world's languages (as will be seen in chapter 2), but this is by no means the only type of condition that is found. In this dissertation, I describe results of a cross-linguistic survey that attempts to discover the precise range of possible phonological conditions on PCSA, and I show how these results bear on the general question of how to model phonological conditions on affixation. The aims and contributions of this dissertation are twofold: to present a typological overview of PCSA, and to show how these typological results point us towards a subcategorization-based model of phonological conditions on affixation.

The dissertation is structured as follows. In the remainder of chapter 1, I provide some background on the study of phonological conditions on affixation and of PCSA. I describe two competing models that have been advanced to account for PCSA, namely, the 'P >> M' model and a subcategorization-based model (both to be explained later in this chapter). In this chapter I give an overview of their respective predictions for phonological conditions on affixation; these predictions are discussed in more detail in later chapters.

Chapters 2-4 present the results of the cross-linguistic survey of PCSA, generalizations about the examples and their bearing on the choice between theoretical models, and sample analyses of some representative examples of each type. In each chapter, it is argued that subcategorization provides a superior analysis that avoids some problems of under- and overprediction that are encountered by P >> M. The examples in chapter 2 involve conditioning by individual segments or their features. Those in chapter 3 are conditioned by tone or stress. Finally, the examples in chapter 4 are conditioned by prosodic factors such as syllable count, mora count, or foot structure. Chapter 4 also features a detailed discussion of the nature and development of a set of examples found in the Pama-Nyungan languages of Australia; it is demonstrated that a diachronic perspective on PCSA is instructive in assessing the relative merits of the theoretical models that are contrasted in this dissertation.

In chapter 5, I situate the findings of the present study within the larger context of phonological conditions on affixation. In that chapter, I lay out the range of predictions that are made by the P >> M approach for all aspects of affixation, and where possible, I compare these predictions with cross-linguistic survey data. As will be seen, the predictions generally do not match up well with the survey data. This provides another argument against the use of P >> M, and by extension, an argument in favor of the alternative, subcategorization-based approach that I advocate.

Finally, in chapter 6, I conclude by summarizing the typological generalizations about PCSA and the implications of the survey results for the two competing models. I consider (and ultimately reject) a ‘hybrid’ approach that distinguishes two types of PCSA and uses both the subcategorization and P >> M models, and I conclude with some further remarks on strategies for modeling phonological conditions on affixation.

1.1 Phonological conditions on affixation

The study of the phonology-morphology interface has relatively old roots in the theoretical literature, particularly in the formal analysis of morphologically conditioned phonology (see especially Kiparsky 1982a, b and Mohanan 1986 on Lexical Phonology). However, only within the last decade has there been a push towards the study of phonological effects in morphology, and more specifically, phonological conditions on affixation. This dissertation is intended to contribute to this previously neglected area of the literature.

Subcategorization-based models of affixation have been proposed in various forms over the course of many years; see, for example, Lieber 1980, Kiparsky 1982b, Selkirk 1982, Orgun 1996, and Yu 2003. Orgun 1996 makes explicit the idea of incorporating phonological conditions directly into subcategorization frames, though this is implicit in earlier versions of the subcategorization approach. Thus, there has long been a framework available for the analysis of phonological conditions on affixation; I will refer to this general framework as the **subcategorization** approach. The basic idea behind this approach is that the underlying form of affixes includes specifications as to the type of stems to which they will attach. This can include morphological, syntactic, and semantic information; crucially, it can also include phonological properties of the stem. I will discuss the details of this approach in §1.1.2.

Beginning with the advent of Optimality Theory (OT; McCarthy and Prince 1993a, b; Prince and Smolensky 1993), some researchers have pursued a different approach to phonological conditions on affixation. From the beginning, McCarthy and Prince (1993a, b) incorporated into OT the possible ranking schema 'P >> M', where P is a phonological constraint[1] that outranks M, a morphological constraint. McCarthy and Prince claimed that '[i]n all cases of prosodic morphological phenomena, prosodic constraints dominate morphological ones' (1993b: 154). The details of this approach, which I will refer to as the **'P >> M'** approach, will be discussed further in §1.1.1. It is important to note that despite the fact that McCarthy and Prince proposed 'P >> M' from

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[1] McCarthy and Prince (1993a) use 'P' in 'P >> M' to refer to *prosodic*, not *phonological*, constraints. This implies that the P constraints being referred to might be restricted to those concerning elements of the prosodic hierarchy and not to other phonological elements such as features. However, one of McCarthy and Prince's constraints in a P >> M analysis does refer to a feature: the CODA-COND constraint in Axininca Campa (1993a: 122) mandates that coda consonants can only be nasals homorganic to a following stop or affricate. Furthermore, even if one wanted to limit P constraints in the P >> M schema to constraints referring to elements in the prosodic hierarchy, there would be no principled way of making this restriction. Therefore, when McCarthy and Prince allow for P >> M in OT, then in principle they allow any phonological constraint to outrank any morphological constraint. Thus, throughout the dissertation when I refer to 'P >> M', 'P' is meant to refer to *phonological* constraints.

the very beginning of the OT literature, this ranking schema is not a central tenet of the theory. It assumes that phonological *and* morphological well-formedness are assessed simultaneously, which is separate from the more basic principle of OT phonology that *phonological* well-formedness in all dimensions is evaluated in parallel by ranked, violable constraints. Therefore, the arguments that I will make against the P >> M approach do not constitute arguments against the independent use of OT in phonology or morphology.

Over the last decade, the P >> M approach has become the dominant model for phonological conditions on affixation, but there does not appear to have been any explicit comparison of P >> M with subcategorization until relatively recently. Thus, the widespread acceptance of P >> M has proceeded without much consideration for the consequences of the decision to use this model as opposed to subcategorization. One exception is Booij 1998. Booij argues in favor of the use of phonological constraints to account for some types of gaps and allomorph selection, while pointing out that phonological output constraints are not sufficient to account for allomorphy. Thus, in Booij's approach, either P >> M or subcategorization can be used depending on the properties of the example to be analyzed. Booij's primary argument in favor of using phonological constraints to select allomorphs is that the use of subcategorization frames makes the selection arbitrary and cannot relate the shape of the allomorph to the condition under which it occurs. For example, Booij argues that a simple statement of the distribution of Dutch suffixes ('-*s* after an unstressed syllable, -*en* after a stressed syllable') '...does not explain why this particular selection principle holds. In terms of complexity of the grammar, it would make no difference if Dutch were just the other way around, i.e. if *-s* occurred after stressed syllables, and *-en* after unstressed ones' (1998: 145). In Booij's view, P >> M should be used for cases that share this optimizing character with the Dutch example, while subcategorization should be used when the allomorphy is not optimizing. Cases of phonologically conditioned suppletive allomorphy are thereby split into two types depending on where in the grammar the phonological condition is specified (in subcategorization frames vs. in phonological constraints).

A more recent and more explicit comparison between the P >> M approach and subcategorization is made by Yu 2003, a study that focuses on patterns of infixation (see chapter 5, §5.5). Yu (2003) surveys a broad range of languages exhibiting infixation, and his findings lend support to his model of Generalized Prosodic Subcategorization, which is contrasted with the Displacement Theory approach in OT that makes use of the P >> M schema. In fact, Yu (2003: 108) proposes a universal ranking M >> P in direct contradiction to P >> M. My own proposal is somewhat different, in that I claim there is no ranking relation between P and M constraints; see chapter 6 for discussion.

In this section, I have given some historical background on the two approaches to be contrasted here. In §1.1.1 and §1.1.2, I give more detail regarding the implementation of the P >> M and subcategorization approaches, respectively.

1.1.1 The P >> M model

In this section, I introduce the P >> M model. This is the approach mentioned above in which phonological conditions on affixation are modeled by ranking phonological (P) constraints over morphological (M) constraints in OT. In §1.1.1.1, I present the details of this model, and in §1.1.1.2, I discuss the predictions that this model makes for PCSA.

1.1.1.1 Description of the model

As mentioned above, the term ‘P >> M’ refers to the fact that this approach involves ranking some P constraint over some M constraint, with the result that the phonology has an effect on a morphological process. This constraint ranking schema was first proposed by McCarthy and Prince (1993a, b).[2] Perhaps the most important evidence for the P >> M proposal was in the domain of infix placement (to be discussed further in chapter 5). A classic example of a P >> M analysis of infix placement is the Ulwa example from McCarthy and Prince (1993a). In Ulwa (Misumalpan, Nicaragua; Hale and Lacayo Blanco 1989), possessive markers occur immediately after the head foot (main stress) of the word, as shown below (head feet are in parentheses; examples are from McCarthy and Prince 1993a: 79, 109-110).

(2)

(bas)-ka	‘his/her hair’	(siwa)-ka-nak	‘his/her root’
(su:)-ka-lu	‘his/her dog’	(ki:)-ka	‘his/her stone’
(as)-ka-na	‘his/her clothes’	(sana)-ka	‘his/her deer’
(sapa:)-ka	‘his/her forehead’	(ana:)-ka-la:ka	‘his/her chin’

McCarthy and Prince (1993a: 110) propose a P constraint to account for this (where Ft' is the head foot), shown below.[3]

(3) ALIGN-TO-FOOT (Ulwa): Align([POSS]$_{Af}$, L, Ft', R)

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[2] In fact, it was originally claimed that prosodically conditioned morphology is *always* driven by P >> M. McCarthy and Prince assert (1993a: 24) that ‘[f]or morphology to be prosodic at all within OT, the ranking schema **P** >> **M** must be obeyed, in that at least **some** phonological constraint must dominate some constraint of the morphology’. A similar statement is made in McCarthy and Prince 1993b.

[3] I assume that a given constraint is a P constraint if it makes reference to a phonological element. This is following McCarthy and Prince: ‘…AFX-TO-FT is a P-constraint, because it crucially refers to a prosodic notion, the foot…’ (1993b: 114).

This constraint requires possessive affixes to occur to the right of the main stress in the word.

The M constraint given below (McCarthy and Prince 1993a: 111) designates the possessive affixes as suffixes by aligning them to the right edge of the stem.

(4) Align-in-Stem: Align ([POSS]$_{\text{Af}}$, R, Stem, R)

This reflects the assumption that every affix is either a prefix or a suffix, according to the morpheme-specific Alignment constraint that determines its placement.[4]

Finally, the ranking of Align-to-Foot (the P constraint) over Align-in-Stem (the M constraint) yields the infixation pattern observed in Ulwa, as seen in (5)a (McCarthy and Prince 1993a: 112) and (5)b.

(5) a.

/siwanak, ka/	Align-to-Foot	Align-in-Stem
a. (siwa)nak-ka	*!	
b. ☞ (siwa)-ka-nak		*

siwa,ka,nak
'his/her root'

/sapa:, ka/	Align-to-Foot	Align-in-Stem
a. ☞ (sapa:)-ka		
b. sa-ka-pa:	*!	*

sapa:-ka
'his/her forehead'

This has been a brief introduction to one use of the P >> M model. In the following section, I discuss predictions that are made by the P >> M model that refer specifically to PCSA.

1.1.1.2 Predictions for phonologically conditioned suppletive allomorphy

The P >> M approach makes four major predictions for PCSA, to be discussed here. The overall results of the survey with respect to these predictions are summarized in

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[4] See Yu (2003) for an argument against this assumption, based on the existence of 'true infixes', which always surface as infixes, and never as prefixes or suffixes.

chapter 6, §6.3. Beyond these, more detailed predictions are made for specific types of PCSA; these are discussed in chapters 2-4, each of which deals with PCSA conditioned by a different type of phonological element.

The first major prediction of P >> M for PCSA is that this phenomenon results from preexisting well-formedness constraints. This means that usually, the constraints used for allomorph selection in an analysis of PCSA should be motivated elsewhere. This may mean that the relevant P constraint is an active constraint in the language with effects manifested in areas of the grammar other than the allomorphy being analyzed. Alternatively, PCSA could result from the Emergence of the Unmarked (TETU; McCarthy and Prince 1994). This means that the relevant P constraint would not have to be motivated in the particular language being analyzed, but it should be a constraint that is well-motivated in other languages, so that it may be considered a universal constraint.

A second prediction of P >> M is that PCSA should be sensitive to phonological elements in surface forms, not in underlying forms. This prediction follows from the fact that constraints in OT generally refer to surface well-formedness. It would be contradicted by examples where allomorphy is clearly sensitive to underlying phonological elements, and where the conditions on PCSA are rendered opaque by a phonological process.[5]

A third prediction is that, in P >> M, phonological conditions on PCSA are expected to come from either the 'inside' or the 'outside' (referring to elements closer to or farther from the root, respectively). This means, for example, that phonological properties of one affix can affect the distribution of allomorphs of an affix closer to the

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[5] In fact, as will be seen in chapters 2-4, there do exist examples of precisely this type, contradicting this prediction of P >> M.

root; it also means that affixes can condition stem allomorphy. This prediction is due to the fact that standard P >> M analyses do not take morphological constituency into account; inputs consist of unordered morphemes including the root and affixes, and the P and M constraints establish both the order of affixes and the choice of allomorphs.[6]

A final prediction of P >> M for PCSA is that conditions on allomorph selection can be located anywhere in the word. In principle, there is nothing in the P >> M model that would prevent, e.g., an OCP constraint from driving allomorphy in a prefix that is sensitive to the stem-final segment, or allomorphy in a suffix that is sensitive to the stem-initial segment. No feature of the model itself predicts that allomorph distribution must be conditioned at the edge of affixation; any such effect must be explained by adjacency requirements specified in the definition of each of the relevant P constraints.

The predictions of P >> M for PCSA, discussed above, are summarized below.

(6) a. PCSA is 'optimizing' and analyzable using preexisting P constraints
    b. PCSA is sensitive to phonological elements in surface forms, not underlying forms
    c. Phonological conditioning between stem and affix can be bidirectional
    d. Conditions on allomorph selection can be located anywhere in the word

These predictions should be borne in mind when one considers the examples in chapters 2-4; these predictions (as well as more specific predictions made for each type of PCSA) are stated in each of those chapters for ease of comparison between the attested affects and those predicted by P >> M. In the following section, I discuss a competing model, the

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[6] It should be noted that this prediction would not be made if P >> M were couched in a version of OT, such as Stratal OT (SOT; Kiparsky 2000), that respects morphological constituency. This is because if words are built from the inside-out in 'layers' as in SOT (and in the pre-OT predecessor to SOT, Lexical Phonology), then an outer affix will never be able to condition allomorphy in an inner affix, since the inner affix will already have been selected and attached to the stem prior to the attachment of the outer affix.

subcategorization model; as in this section, I begin by laying out the model, then discuss the predictions that it makes for PCSA.

1.1.2 The subcategorization model

This section introduces the subcategorization approach, in which phonological conditions on affixation are modeled by incorporating phonological aspects of stems directly into the selectional requirements of affixes. In §1.1.2.1, I present the details of this model, and in §1.1.2.2, I discuss the predictions of subcategorization for PCSA.

1.1.2.1 Description of the model

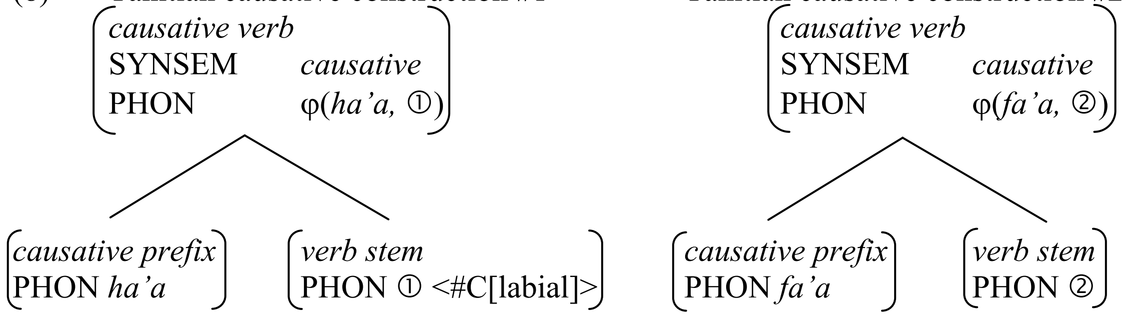
In the subcategorization approach, as mentioned above, suppletive allomorphy results when two or more different affixes with the same meaning have different *subcategorizational requirements*, which are selectional requirements imposed by affixes on stems. In a morphological subcategorization approach (Lieber 1980, Kiparsky 1982b, Selkirk 1982, Orgun 1996, Yu 2003, in press), affixation satisfies missing elements that are required as specified in the lexical entry for each morpheme. An example of a subcategorization account will be given below for an example from Tahitian (Polynesian, French Polynesia; Lazard and Peltzer 2000), which will be discussed again in chapter 2.

In Tahitian, the causative/factitive is marked by *ha'a* when the root begins with a labial ((7)a), and *fa'a* elsewhere ((7)b) (Lazard and Peltzer 2000: 224-225).

(7)	a.	fiu	'*se lasser*'	ha'a-fiu	'*ennuyer, s'ennuyer*'
		mana'o	'*penser*'	ha'a-mana'o	'*se rappeler*'
		veve	'*pauvre*'	ha'a-veve	'*appauvrir*'
	b.	'amu	'*manger*'	fa'a-'amu	'*faire manger, nourrir*'
		rave	'*faire*'	fa'a-rave	'*faire faire*'
		tai'o	'*lire*'	fa'a-tai'o	'*faire lire*'

In a subcategorization account, the distribution of *ha'a*- and *fa'a*- would result not from the ranking of a P constraint over an M constraint, but from the different subcategorizational requirements of the two forms, as shown in constructions 1 and 2 below.

(8) Tahitian causative construction #1 Tahitian causative construction #2



The same constructions can be schematized alternatively using bracket notation, shown below.

(9) Tahitian causative construction #1 Tahitian causative construction #2

[*ha'a*- [#C[labial]...]$_{\text{verb stem}}$]$_{\text{causative verb}}$ [*fa'a*- [ ]$_{\text{verb stem}}$]$_{\text{causative verb}}$

Because the phonological requirements of the *ha'a* form are more specific than those of the *fa'a* form, *ha'a* is selected when the stem is labial-initial; *fa'a* is selected in the 'elsewhere case'.

Thus, the distribution of affixes in the subcategorization approach is determined by subcategorizational requirements. These are properties of each affix, and they determine the types of stems to which each affix will be allowed to attach.

1.1.2.2 Predictions for phonologically conditioned suppletive allomorphy

The subcategorization approach makes a number of predictions for PCSA, several of which are different from those of the P >> M approach, allowing us to distinguish the two models in terms of how well they match up with the survey results to be presented in chapters 2-4. In chapter 6 (§6.3), I contrast the two models in terms of the accuracy of their respective predictions. As in the discussion of the predictions of P >> M in §1.1.1.2, the predictions to be discussed here are general. In each of chapters 2-4, more specific predictions for particular types of PCSA will be discussed where relevant.

One prediction made by the subcategorization approach is that PCSA is not necessarily phonologically optimizing, and that there should exist cases in which no plausible phonological well-formedness constraint can be written to account for the pattern of allomorphy. This is because in the subcategorization approach, phonological constraints play no role in determining the distribution of allomorphs. The phonological conditions on affixation are simply stated in the lexical entry for each affix, so the relationship between the condition on allomorphy and the shape of the affix is arbitrary. It should be stressed that this does not mean that PCSA never has an optimizing character. To the contrary, it has already been established (prior to the present survey) that many examples of PCSA look as if they maximize the well-formedness of words. This is not necessarily problematic for the subcategorization approach; since PCSA probably originates in many cases from the loss of a regular rule, it should not be surprising that many cases appear to be phonologically optimizing. In this approach it would be surprising, and problematic, if there were no examples of arbitrary, non-optimizing examples of PCSA. This is the type of example that would be problematic for P >> M, since PCSA is driven in that approach by phonological well-formedness.

Therefore, the existence or non-existence of non-optimizing allomorphy is an empirical question that bears directly on the choice between these competing models.[7]

A second prediction is that PCSA should be sensitive to phonological elements in input forms, rather than surface forms. This is because morphology is assumed to apply *before* phonology, at least at each layer of morphology. Unlike the P >> M approach, the subcategorization approach is not based on surface well-formedness constraints. Therefore, the phonological requirements imposed by affixes on stems should involve input phonological properties, not properties that are derived by the application of later phonological processes. We therefore predict that there should be some languages in which the phonological conditions on allomorph distribution are rendered opaque by the operation of a regular phonological process. This is another prediction that distinguishes subcategorization from the P >> M approach, since as discussed above, P >> M predicts that PCSA should be sensitive to surface phonological properties.

A third prediction of subcategorization for PCSA is that phonological conditioning can come only from the 'inside'. This means that the distribution of allomorphs of a particular affix can only be conditioned by phonological properties of the 'stem of affixation,' i.e. those parts of the stem that are already present at the stage of the derivation in which the affix in question will be attached. Linear order among affixes on the same side of the stem is usually assumed to correspond to the order in which affixes

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[7] In chapters 2-4, I will present several cases of apparently non-optimizing PCSA, which provide an argument in favor of subcategorization and against P >> M. The problem in dealing with such examples is to determine whether a particular pattern of allomorphy is optimizing or not, since it is impossible to anticipate every phonological well-formedness constraint that could possibly be proposed for any language. Therefore, the existence of a single instance of apparently non-optimizing PCSA would not constitute a knockout argument against P >> M in favor of subcategorization. Instead, one should consider the cumulative weight of all of the apparently non-optimizing examples to be discussed.

are attached; for example, in a word with multiple suffixes, it is assumed that the leftmost suffix was attached first, and the rightmost suffix was attached last. Of course, the possibility of infixes intervening between other affixes prevents this generalization from being true one hundred percent of the time. In the usual case, however, there is a correspondence between surface linear order and the order of affixation. Therefore, we predict that the phonological properties of a particular affix cannot condition allomorphy in an affix that occurs closer to the root. This is yet another prediction that is different from the P >> M model, since the P >> M model allows for both 'inside-out' and 'outside-in' conditioning. The existence of 'outside-in' conditioning would therefore provide evidence in favor of the P >> M model and against subcategorization (or, at least, against the particular implementation of it assumed here, in which words are built from the inside-out).

A fourth and final prediction of subcategorization for PCSA is made when we incorporate a general principle of grammar that has been proposed to account for other phenomena but, as will be seen, is quite useful in an analysis of PCSA as well. This is the Generalized Determinant Focus Adjacency Condition (GDFAC; Inkelas 1990: 201, building on Poser's (1985) Determinant Focus Adjacency Condition). The GDFAC is given below.

(10) Generalized Determinant Focus Adjacency Condition: Each phonologically constrained element must be adjacent to each constraining element.

If the GDFAC is incorporated into the subcategorization approach, we predict that affix allomorphs should occur immediately next to the phonological elements of stems that condition their distribution. For instance, prefix allomorphs should be conditioned by elements at the left edge of the stem, while suffix allomorphs should be conditioned by elements at the right edge. This prediction, as with the previous three predictions, constitutes a difference between the P >> M and subcategorization approaches.[8]

In this section, we have discussed four predictions of the subcategorization approach for PCSA, summarized below.

(11) a. PCSA is not always phonologically optimizing
    b. PCSA is sensitive to phonological elements in underlying/input forms, not surface forms
    c. Phonological conditions on PCSA can come only from the 'inside'
    d. Affix allomorphs occur adjacent to the phonological elements of stems that condition their distribution

Each of the predictions has been contrasted with predictions of the P >> M approach. We are now equipped to consider the results of the cross-linguistic survey of PCSA, since we have set up some expectations for the types of examples that should be found under each of the two competing models. In the following section, I present some background for the survey of PCSA, beginning with a discussion of previous discussions and surveys of PCSA (§1.2.1), and concluding the chapter in §1.2.2 with a discussion of the methodology for the new survey whose results will be reported in this dissertation.

1.2 Phonologically conditioned suppletive allomorphy

In this section, I focus on PCSA, first discussing at length some previous treatments of the phenomenon (§1.2.1). I then explain (§1.2.2) the setup and methodology for the survey of PCSA, whose results will be presented in chapters 2-4.

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[8] It should be acknowledged that the GDFAC is not a property of the subcategorization model in itself but is rather an assumption that is made about the nature of subcategorization. However, it should also be pointed out that while the GDFAC is easily incorporated into the subcategorization approach, it cannot be readily implemented in P >> M since that model does not really involve any 'phonologically constrained elements'.

1.2.1 Previous discussions

The first major and explicit discussion of PCSA is in Carstairs 1988. The primary concern of Carstairs 1988 is to use examples of PCSA to gain insight into how (if at all) to distinguish between inflection and derivation. Thus, the point of the article is not to document PCSA for its own sake, though Carstairs presents several examples[9] of PCSA (1988: 70-72) in order to document the existence of the phenomenon, which was not well known at the time. Carstairs discusses the notion that derivational morphology never exhibits suppletion because the concept of suppletion relies on the existence of a paradigm, and derivational morphology does not involve paradigms (1988: 74). Carstairs argues against this idea because derivational morphology does have a paradigmatic aspect (van Marle 1985, 1986) and because some of the examples that Carstairs cites do involve suppletion in derivational morphology. Furthermore, derivational morphs can have phonological restrictions (e.g., English *-en* can only attach to adjectives ending in a certain restricted set of obstruents), so it is unclear why two derivational morphs with the same meaning cannot to enter into suppletive relationships conditioned by phonology.

Carstairs makes the generalization (1988: 75) that most of the examples in his set involve inflection rather than derivation[10]. The explanation provided for this fact invokes the principle of 'inflectional parsimony', which states that for any combination of morphosyntactic features that can mark members of a particular word class, each word

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[9] Fifteen examples are discussed, from ten languages.

[10] Of course, the concept of 'most' used here is not very meaningful given the small sample size (fifteen examples). However, this finding does appear to hold up in the larger survey to be described in this dissertation. It is difficult to obtain a count of cases of inflection vs. derivation since many affixes do not clearly fall into one category or another, but among those that do, there are more cases of inflection than derivation.

will have exactly one inflectional realization. According to Carstairs (1988: 76), there are three ways in which a language can resolve a potential violation of parsimony: first, all but one of the possible realizations could drop out of use; second, all of the realizations could be distributed arbitrarily into conjugations or declensions; third, all of the realizations could be distributed according to some independent principle (whether semantic, syntactic, morphological, or phonological). Thus, the development of phonologically conditioned suppletion is just one of many ways in which a language can adhere to the parsimony principle.

Carstairs goes on to argue that '...a principle of parsimonious coverage does appear to exercise an influence over not only inflectional morphology and syntactic structure but also certain areas of lexical organisation involving even monomorphemic items. If this is so, it would be surprising if the principle could not also affect morphologically complex lexical items, including derived words' (1988: 79). An example of the former type of effect in English is pointed out, where animal species have one item in each of the categories adult male, adult female, and young. According to Carstairs, it is this type of derivation, which he describes as 'meaning-driven'[11], in which parsimonious coverage is apparent. Another example is male vs. female titles of ranks of the British peerage (*duke* and *duchess*, etc.). An example of English derivation that is not meaning-driven is deverbalization using *-ion, -al, -ment, -ance*, or stress shift. In this type of derivation, the exact meaning of the noun derived from the verb is not predictable (e.g., *remit* vs. *remission*), and we do not find parsimonious coverage: some verbs have

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[11] Carstairs defines 'meaning-driven' morphology as having 'semantic coherence, describable in terms of semantic features or components,' whereas 'expression-driven' morphology exhibits 'semantic vagueness or unpredictability' (1988: 88).

multiple possible nominal forms (e.g., *commission, commital, commitment*). In Carstairs' view, the fact that only meaning-driven derivation obeys the principle of parsimonious coverage accounts for the fact that cases of phonologically conditioned suppletion are more often inflectional than derivational. The question is then posed whether we might find some example of phonologically conditioned suppletion in a type of meaning-driven derivation, and Carstairs does present one such case from Dutch, where the distribution of suffixes that create 'neutral deverbal personal names' (e.g., terms meaning 'drummer,' 'camper,' etc.) is conditioned by the stem-final segment(s) (1988: 84). Carstairs concludes by suggesting that the concepts of 'meaning-driven' vs. 'expression-driven' morphology may turn out to be more useful than inflection vs. derivation. Thus, PCSA is used to make an argument against the distinction between inflection and derivation.

A second important paper dealing with PCSA is Carstairs 1990. This brief article outlines some implications of PCSA for phonological and morphological theory. One primary consequence for phonology, of course, is that 'the existence of a phonologically conditioned alternation does not by itself prove the existence of some synchronic phonological process giving rise to it' (Carstairs 1990: 19).

Carstairs makes some generalizations about what types of phonological factors can condition allomorphy. These seem to be based on the set of eleven examples that Carstairs provides (1990: 18). One generalization is that there are no cases where a phonological characteristic of a word or morph conditions allomorph selection for a separate phonological word. A second generalization is that, as predicted by Lexical Phonology, conditioning is generally 'outward', i.e., involving a root or inner affix conditioning the distribution of allomorphs of an outer affix. There are some apparent exceptions to this, but Carstairs points out that in each case of apparent 'inward' conditioning, the alternants are either phonetically uninterpretable in isolation, or else they can be analyzed as ‘empty morphs’.[12] Thus, the direction of conditioning in PCSA follows from a layered model of word-building such as Lexical Phonology.

The first major paper dedicated to PCSA in the OT era was Mester 1994.[13] Mester provides an analysis of Latin stress, arguing in favor of bimoraic minimality and maximality in foot structure. Mester’s analysis likely constitutes the first use of phonological constraints to determine the distribution of suppletive allomorphs, aside from McCarthy and Prince 1993a, b. Mester uses this approach to account for three instances of allomorphy in Latin, all of which appear to be configured in such a way as to avoid 'trapping' configurations in which a syllable is left unfooted due to strict bimoraic foot minimality and maximality. Further details of Mester’s Latin examples will be discussed in chapter 4.

Another important contribution to the literature on PCSA was made by Kager 1996. Kager describes a phenomenon of ‘syllable-counting allomorphy’ in Estonian, arguing that this type of allomorphy is a form of output optimization. Kager argues that syllable-counting allomorphy reduces to foot-based allomorphy, and that the result is to maximize foot parsing. As will be discussed in chapter 4, the problem with this view is

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[12] As will be seen in chapters 2-4, both of the observations made by Carstairs (1990) are upheld in a larger survey of PCSA. First, PCSA always occurs within the (phonological) word (always between an affix and the stem of attachment, or else between a clitic and its host); no cases of between-word conditioning are found. Second, conditioning does appear to be ‘inside-out’, not ‘outside-in’, and the very few cases of apparent ‘outside-in’ conditioning yield to alternative analyses.

[13] In fact, Mester’s analysis is couched in the earlier, similar theory of ‘Harmony-Theoretic Phonology’ rather than OT, which was only beginning to be developed at the time of publication. However, the Harmonic approach was also constraint-based, so the basic insights of Mester’s analysis could easily translate into OT.

the assumption that all syllable-counting allomorphy is optimizing and based on foot structure. This ignores the many cases (to be discussed in §4.1.1.3) where syllable-counting allomorphy is not optimizing and may not reduce to considerations of footing.

A final important study of PCSA is Carstairs-McCarthy 1998. This article provides a useful way of looking at PCSA which unifies it with the phenomenon of phonologically conditioned morphological gaps. In Carstairs-McCarthy's view, both phenomena result from phonological restrictions on the distribution of particular affixes. Different languages react to these gaps in one or more of three ways: (a) unsystematic filling of the gaps, (b) systematic morphological filling of the gaps, and (c) systematic syntactic filling of the gaps via periphrasis. Carstairs-McCarthy points out an interesting asymmetry: in the domain of inflection, strategies (b) and (c) are used, while in the domain of derivation, strategy (a) is used.[14] Carstairs-McCarthy relates this (1998: 148) to 'the importance of the paradigmatic dimension in inflection', though as discussed above, Carstairs (1988) points out that paradigms may play a role in certain types of derivation as well.

As can be seen, the theoretical treatment of PCSA has been relatively sparse, since the five papers discussed above constitute the important recent literature on the topic to deal with PCSA cross-linguistically.[15] This is despite the fact that, as pointed out repeatedly in this literature, PCSA has enormous potential to shed light on the nature of

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[14] Only seven examples are considered; in the larger survey of PCSA to be discussed in chapters 2-4, this generalization is contradicted by the existence of many examples of PCSA in derivational affixes (though, as pointed out earlier in this section in the discussion of Carstairs 1988, the generalization does seem to hold as a *tendency* in the data).

[15] There are several other papers that discuss PCSA to varying degrees of depth; see, e.g., Mascaró 1996, Tranel 1996a,b, Vaux 2003, Bonet 2004, Bonet et al in press, and Bye to appear.

phonology, morphology, and especially the phonology-morphology interface. The focus of most of these earlier works has been on using PCSA to answer broader questions about morphology (Carstairs 1988), providing constraint-based analyses for it (Mester 1994, Kager 1996), or explaining why PCSA occurs (Carstairs-McCarthy 1998). Only one paper, Carstairs 1990, attempts to make serious typological generalizations about the phenomenon, and that paper relies on only eleven examples of PCSA. It should therefore be clear why a larger cross-linguistic survey of PCSA is desirable. I introduce such a survey in the following section, discussing the methodology before presenting the results of the survey in chapters 2-4.

1.2.2 Survey methodology

In order to determine the precise range of phonological conditions that can determine suppletive allomorph distribution, and the specific ways in which this conditioning can be manifested, a cross-linguistic survey of PCSA was undertaken. The results of the survey will be reported in chapters 2-4, but it is important here to discuss the methodology used in the construction of the survey.

The primary problem in constructing a large cross-linguistic survey is that one can never survey enough languages. Comprehensive grammars have been written for only a small fraction of the world’s living languages, and this completely ignores extinct languages. It is impossible to know what type and amount of bias this introduces into cross-linguistic surveys. This is especially problematic when making negative generalizations of the type ‘No language has property X’.

Fortunately, most of the important generalizations that I draw based on the present survey are positive generalizations. For example, as will be discussed, I have found that PCSA can be conditioned by feet, syllables, moras, stress, tone, segments, or features. This type of generalization is much easier to make than a negative generalization, since any phenomenon for which there are multiple examples from different language families (as is the case for the generalization stated above) is clearly an 'attested' phenomenon, regardless of the sample size.

In some cases, I do make negative generalizations. One such generalization is that based on the survey data, it appears that there is no language in which PCSA in an affix is triggered at the opposite edge of the stem; for example, there is no language where prefix allomorphy is triggered by the stem-final segment. Of course, this generalization can be falsified if another researcher uncovers such an example in future research. In that case, a good scientific way to proceed would be to discern whether the apparent counterexample can be interpreted so that it does not directly contradict the theory that was devised in order to explain the generalization; if this proves impossible, then the theory should be abandoned. In the mean time, my confidence that the generalization does reflect some true fact about human languages (rather than a sampling error) can be increased by my own deliberate efforts in constructing the survey, which I discuss below.

The best way to avoid making spurious negative generalizations is to make the survey as large and broad as possible. I have attempted to do this in a variety of ways. First, I have scoured several types of sources in my search for examples. About 600 sources were consulted in total, though of course not all of these yielded examples of PCSA. Most of the examples to be presented were found by searching through descriptive and teaching grammars on the shelves at the UC Berkeley library. I also became aware of some examples by querying several specialists in phonology and morphology. This was complemented by the addition of many examples already discussed in theoretical literature (mainly in journal articles) and in linguistics textbooks. Whenever an example was found in one of these secondary sources, I have attempted to locate the primary source to confirm the examples and the characterization of patterns. The minimal standard for inclusion of a particular example in the survey was that the shape and distribution of allomorphs must be clear, and examples must be given. In general, I have used the transcriptional or orthographic conventions employed in each source, except where noted. In some instances where examples are neither provided in the primary description nor accessible elsewhere, I have described these cases in footnotes. In general, I have tried to make the survey as large as possible.

Though I did not deliberately seek out examples from every language family in creating the database, I did attempt to balance the survey. Throughout the course of the survey research, I continued to take stock of the examples, and whenever it appeared that a major language family was not well-represented in the survey, I made a particular effort to obtain grammars of languages in that family.[16] Thus, the survey was not intentionally balanced in a systematic way, but the result of the methodology described here seems to have resulted in a relatively balanced set of examples. The reader may assess this for him- or herself by consulting the Appendix, which lists the languages and families from which I obtained the data to be discussed in the following three chapters.

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[16] Except where noted, all language family classifications are from the Ethnologue (Gordon 2005).

Chapter 2: Segmentally conditioned suppletive allomorphy

In this chapter I present examples and an analysis of suppletive allomorphy conditioned by consonants and vowels and their features. The 'P >> M' ranking schema discussed in chapter 1, where phonological constraints are ranked ahead of morphological constraints, predicts that any segment or feature anywhere in the word should in principle be able to condition the distribution of suppletive allomorphs of affixes or stems for reasons of output optimization. The extent to which this prediction is or is not borne out is discussed in §2.1, where I present examples of segmentally conditioned allomorphy revealed by a cross-linguistic survey. In §2.2, I give an analysis of representative examples of this type in terms of subcategorization, demonstrating that such an analysis is feasible and superior to a P >> M analysis. The chapter is concluded in §2.3 with a summary of the findings and the analysis.

2.1 Survey results

In this section, I give examples of suppletive allomorphy conditioned by segments and their features. These examples were collected as part of a cross-linguistic survey of phonologically conditioned suppletive allomorphy (PCSA), described in chapter 1. Grammars of over 600 languages were surveyed, yielding 137 examples of PCSA in 67 languages. Seventy-two of these cases (from 32 different languages) involve conditioning by consonants or vowels or their features and are discussed in this chapter. The examples in this chapter are organized according to the effect that the pattern of allomorph distribution has on the word, as follows.

§2.1.2.1 discusses cases where allomorph distribution has an assimilatory or harmonizing effect; that is, where the degree of featural agreement between the stem and affix is higher than if there were no allomorphy or if the allomorphs had a different distribution. The examples in §2.1.2.2 involve patterns that result in dissimilation or antiharmony, where the degree of featural agreement between the stem and affix is lower than if there were no allomorphy or if the allomorphs had a different distribution. In §2.1.2.3, I discuss examples where the distribution of suppletive allomorphs appears to improve the overall syllable structure of the word. A related set of examples is discussed in §2.1.2.4, which describes examples where allomorph distribution appears to relate to syllable contact (rather than the shape of individual syllables). In §2.1.2.5, I discuss cases where the allomorphy has an effect that is non-optimizing. Finally, in §2.1.2.6, I present examples where phonological processes render opaque the conditions on PCSA. As I discuss, these are especially problematic for the P >> M model.

The organization of this section according to the 'outcome' of allomorph distribution may seem to presuppose the truth of the claim inherent in the P >> M approach, that phonologically conditioned suppletive allomorphy is phonologically optimizing. However, as will be discussed in the summary in §2.1.3, this is far from a foregone conclusion. As will be discussed, the examples in §2.1.2.5 where the allomorph distribution is phonologically non-optimizing are problematic for the claim that PCSA results in output phonological optimization, as are the examples in §2.1.2.6 where PCSA is shown to be sensitive to phonological features in the input rather than the output. The theoretical consequences of these examples are discussed in §§2.2 and 2.3.

Some generalizations that will emerge in the presentation of examples is as follows. First, the phonological element that conditions PCSA is always adjacent to the location of attachment of the affix in question. Prefix distribution is conditioned by segments and features at the left edge of the stem, while suffix distribution is conditioned by segments and features at the right edge. Second, a wide range of consonant and vowel features, as well as the C/V distinction itself, can condition the distribution of suppletive allomorphs. Third, a substantial number of examples of PCSA appear to be non-optimizing, a finding that is not predicted by P >> M and that is, in fact, problematic for that model. Finally, a related finding is that PCSA seems to be sensitive to phonological elements in input forms, rather than outputs.

2.1.1 Allomorphy vs. morphophonology

An issue that arises in the presentation of examples to follow in this chapter (and also in chapters 3 and 4 where I discuss examples with other types of phonological conditioning) is the difficulty of determining whether a particular example of phonologically conditioned allomorphy involves suppletion. Kiparsky (1996) discusses this problem and proposes the following criteria to distinguish between instances of morphophonology (phonological rule/constraint-driven allomorphy) and (suppletive) allomorphy (1996: 17):

(1)

	Morphophonology	Allomorphy
a.	general (not item-specific)	item-specific
b.	involve a single segment	may involve more than one segment
c.	observe phonological locality conditions	obey morphological locality conditions
d.	follow all morpholexical processes	ordered prior to morphophonemic rules

Some of these criteria are more useful than others, and as will become evident in the presentation of examples, there is a significant gray area left by these criteria, such that some examples are difficult to classify. Criterion (a), involving the generality of the pattern, is one of the more useful criteria. If a phonological rule/constraint proposed to account for a pattern of allomorphy in a particular morpheme can also account for one or more other patterns of allomorphy in the same language, this suggests that the allomorphy is best analyzed as resulting from the application of phonological rules/constraints to a single underlying form (i.e., that the allomorphy is not suppletive). If, on the other hand, the rule/constraint that would need to be posited to account for a pattern of allomorphy would only be manifested in that particular morpheme, then the allomorphy is more likely to be suppletive. However, in some cases it can be argued that a particular affix or group of affixes is associated with a 'co-phonology' (Inkelas, Orgun, and Zoll 1997, Inkelas 1998) that might result in particular rules or constraint rankings that do not apply throughout the entire language. This is especially useful if a construction that includes a particular affix (or one of a group of affixes) seems always to have a particular phonological property (as with, for example, stress-shifting affixes).

A related factor that bears on whether to analyze a particular pattern as suppletion or item-specific rule application is the phonetic naturalness of the proposed rule. Suppose that a particular morpheme presents the only instance in the language of the phonological configuration that would trigger the rule. In this case, the rule would be both 'general' (in the sense that it applies everywhere in which the phonological environment for its application is met) and 'item-specific' (since it would only apply to one morpheme). Therefore, in this hypothetical situation, criterion (a) is of no help in determining whether this is a case of rule-driven allomorphy or suppletion.[1] A secondary consideration in such

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[1] This situation is exemplified by an example from Spanish to be discussed in §2.1.2.5.

a situation is the plausibility of the proposed phonological rule. If the rule is item-specific but is also phonetically natural and attested in a number of languages, this is an argument in favor of rule-derived rather than suppletive allomorphy. On the other hand, if the proposed rule would be phonetically unnatural and not attested in other languages, this suggests that the pattern involves suppletion. This criterion does, of course, involve some subjective judgment as to what constitutes 'phonetic naturalness,' but this notion in combination with the frequency of such rules in other languages of the world should provide some idea of the overall plausibility of the rule.

Criterion (b), which refers to the number of segments involved in the alternation, is also relatively useful but not unproblematic. It is quite clear-cut when each of the allomorphs has several segments and none of them are the same (or even similar) from one allomorph to the other; in such a case, we would almost certainly analyze the pattern as suppletive. This is not a common situation, however. More common is a situation where one or two segments are different in the different allomorphs. If only one segment differs, the pattern may be rule-derived, though in this case we would have to evaluate the proposed rule based on the discussion above to decide whether its generality and plausibility merit positing a phonological rule for the language. If two or more segments differ, the pattern is more likely suppletive unless all the segments can be altered (or deleted or inserted) via a single phonological rule. If multiple rules are required, is each of the rules independently motivated in the language or do we have to posit multiple, separate, item-specific phonological rules just to describe the pattern of allomorphy for one morpheme (in which case it is probably suppletive allomorphy)?

Criterion (c), involving phonological vs. morphological locality, is somewhat less useful than (a) and (b) since the question of whether suppletive allomorphy can be conditioned at a distance is an empirical question being investigated here. We have not yet established whether allomorph distribution can be determined by any element in the word including those that occur ‘outside’ the morph in question (as predicted by P >> M) or only by an element in the stem to which the morph attaches. Both of these situations might be said to observe ‘morphological locality’. We also have not established that PCSA does not obey phonological locality. In fact, as will be seen in the examples to be presented here, PCSA does appear to obey phonological locality, making criterion (c) irrelevant in deciding between rule-derived and suppletive allomorphy.

Similarly, criterion (d) involving ordering is of little use, though in this case due to theoretical considerations. In OT, particularly in a version of OT allowing P >> M, the concept of allomorphy being ordered after all morpholexical rules or before all morphophonemic rules has no status. Thus, if we want to talk about examples of allomorphy in terms of OT in order to compare possible analyses, we cannot rely on criterion (d) to determine how to classify the examples.

In summary, though some of Kiparsky’s (1996) criteria for identifying suppletive vs. non-suppletive allomorphy are useful, others are not, and the set of criteria as a whole leaves a substantial gray area, so that subjective judgment will sometimes decide the categorization of a particular case. The existence of this gray area is not surprising, since many examples of suppletive allomorphy probably result from historical processes of rule telescoping and/or the restriction of productive phonological rules to particular morphological contexts. Thus, they may have many of the properties of regular phonological processes but also lack some of those properties. Fortunately, the distinction between suppletive and non-suppletive allomorphy is not crucial to the argument made in this dissertation. Since the P >> M mechanism in effect extends a phonological model to handle some morphological processes, we expect that the mechanism should handle the purely phonological (i.e., non-suppletive) examples well and that the problematic cases (if any) should be the suppletive ones. This means that if anything, if we admit any cases of rule-derived allomorphy into our discussion of suppletive allomorphy, we will err on the side of including too many examples that favor the P >> M approach. To offset any such bias, in making generalizations about PCSA I will focus on the clearest cases of suppletive allomorphy and not rely too heavily on examples that fall into the gray area.

2.1.2 Examples

2.1.2.1 Assimilation/harmony

Given that the P >> M mechanism accounts for suppletive allomorphy using the same phonological constraints that drive purely phonological processes, this model predicts that every phonological constraint can show effects in morphology. That is, constraints that commonly drive phonological processes in the world's languages should also condition suppletive allomorph selection. Assimilation is a very common type of phonological process with roots in coarticulation, and the P >> M model therefore leads us to expect assimilation to condition suppletive allomorphy. Several constraints have been proposed to drive harmony and other assimilation of various types, including AGREE, SPREAD, and ALIGN (see Pulleyblank 2002 for a summary of approaches to harmony). Under the P >> M approach, any one of these commonly used constraints (at least one of which must be highly ranked in any language exhibiting assimilation) could outrank a morphological constraint; this should give rise to PCSA driven by assimilation. In this section, I discuss five languages where allomorphy could be claimed to result in assimilation of consonant or vowel features.

One example of PCSA resulting in harmonization of vowel features is found in Kwamera (Central-Eastern Oceanic, Vanuatu; Lindstrom and Lynch 1994). The perfective prefix in Kwamera has two allomorphs that are distributed based on the initial vowel/segment of the stem (see below), and their distribution results for the most part in words that are harmonic in terms of vowel height. The Kwamera vowel system is as follows (Lindstrom and Lynch 1994: 3):

(2)

	Front	Central	Back
High	i		u
Mid	e	ɨ	o
Low		a	

The perfective prefix allomorphs are distributed as follows (Lindstrom and Lynch 1994: 12): /ɨn-/ occurs before verbs beginning with /a/, /ɨ/, and /o/, as well as most verbs beginning with /e/. As seen above, these are the non-high vowels of Kwamera. The /uv-/ allomorph occurs before verbs beginning with consonants, /i/, /u/, and a few verbs beginning with /e/ (and in these cases, /e/ surfaces as [a]). Examples are shown below with page numbers from Lindstrom and Lynch 1994.

(3) a.

r-p-ua	ia-p-**ɨn**-ata	ia-p-**ɨn**-osi
3sg-COND-state	1exc-COND-PERF-see	1exc-COND-PERF-hit

‘If I had seen it, I would have hit it’ (10)

ik-**ɨn**-ata	iakunóuihi	óuihi	nah	ua
2-PERF-see	child	small	PREVREF	or

‘Did you see that small child?’ (21)

b.

in	r-**uv**-kusi	kafete
he/she	3sg-PERF-weave	mat

‘She wove a mat’ (10)

iak-**uv**-regi	kwanage	ira
1exc-PERF-hear	story	LOC:3sg

‘I heard his/her story (the one told about him/her)’ (23)

Thus, the /ɨn-/ allomorph is used when the following vowel is [-high] ((3)a), and the /uv-/ allomorph is used elsewhere ((3)b), including before [+high] vowels (though the /uv-/ prefix is only shown before consonant-initial roots among Lindstrom and Lynch’s examples). The result of the allomorphy is therefore to harmonize the prefix vowel with the first vowel of the stem in terms of vowel height (recall that /ɨ/ is a non-high vowel in Kwamera). Note, however, that this cannot be attributed to a rule of vowel harmony, since the two prefix allomorphs also differ in their consonants (*n* vs. *v*). The difference in consonants is phonologically neutral, having no obvious effect on the well-formedness of the word.

The Kwamera example demonstrates, first, that vowel height is a vowel feature that apparently can condition PCSA resulting in an assimilatory pattern. Second, note that the affix in question is a prefix and that the stem vowel that conditions the allomorphy is the leftmost vowel of the stem. As will be seen throughout the presentation of examples in this chapter, this is a common property of examples of PCSA. Prefix allomorphy is conditioned by elements at the left edge of the stem, while suffix allomorphy is conditioned by elements at the right edge of the stem.

Another example of PCSA resulting in vowel harmony is found in Hungarian (Kenesei, Vago, and Fenyvesi 1997 [KVF], Rounds 2001). The 3sg suffix in definite present tense forms has two variants, /-i/ and /-ja/, whose distribution is conditioned by the quality of the stem vowel. After a back vowel, the form *-ja* is used ((4)a); after a front vowel, *-i* is used ((4)b) (Rounds 2001: 28). Examples below are from Rounds (2001: 29) except where noted.

(4)	a.	ad-**ja**	'he gives'	ró-**ja**	'he carves' (KVF 290)
		olvas-**sa**	'he reads'	játsz-**sza**	'he plays'
	b.	visz-**i**	'he carries' (KVF 290)	főz-**i**	'he cooks'
		kér-**i**	'he asks for'	lö-**vi**	'he shoots' (KVF 291)

There are two minor complications to the description of the pattern. The first is that, as seen above, when *-ja* follows a stem-final sibilant, /j/ assimilates to the sibilant (Rounds 2001: 27). The second is that, as also seen above, when *-i* follows a vowel-final stem, [v] is inserted before the suffix vowel (KVF 291). These can be attributed to purely phonological rules/constraints that apply after one of the two suppletive forms of the suffix has been selected. The Hungarian example shows that in addition to height, backness can also condition PCSA.[2]

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[2] This example is somewhat problematic for the GDFAC, as Hungarian is one of only two languages in the survey to exhibit allomorphy conditioned by an element that is not at the immediate edge of the stem; a set of similar examples comes from Bari, to be discussed below. In both cases, allomorphy is triggered by an edgemost *vowel* that is not the edgemost *segment* of the stem (i.e., a consonant intervenes between the triggering vowel and the stem edge). To account for these examples in the subcategorization model, one might modify the GDFAC to state that the conditioning element must be the edgemost element on its C/V tier. This would mean that the element either must be the initial/final vowel or the initial/final consonant of the stem, but not necessarily the initial/final *segment*. I avoid making this move because only two languages motivate it and no language exhibits a type of allomorphy in which the initial/final consonant triggers PCSA across a vowel. Therefore, a better approach to Hungarian and Bari may be to appeal to something like extrametricality for the intervening consonants, rather than

Other types of assimilation including consonant harmony across a vowel are also common but are not represented in this survey among examples of PCSA. There are two examples of what may have originated in lenition that could be related to C-to-V feature assimilation. One of these is found in Yidiɲ (Pama-Nyungan, Australia; Dixon 1977). In Yidiɲ, the locative/instrumental/allative allomorphs are distributed based on whether the stem is consonant-final or vowel final (Dixon 1980: 296). Their distribution is as follows: -*la* occurs after vowel-final stems,[3] as in (5)a, while -*da* (with assimilation of the initial stop to the place of a preceding nasal and predictable lengthening of the last vowel of the stem) occurs after consonant-final stems, as in ((5)b). Examples are shown below (examples are from Dixon 1977: 128-129 except where different page numbers are noted next to an example).

(5)	a.	gabuḍu-la	'white clay-LOC'	ḍimuru-la	'house-LOC' (518)
	b.	muḍa:m-ba	'mother-LOC'	warḍa:n-da	'boat-LOC'
		muyga:l-da	'hole, trap-LOC'	maŋgumbar-da	'grub sp.-LOC'

These allomorphs are not related through a general rule of the language, so the allomorphy is likely suppletive. One possible way of looking at the pattern is as lenition of the suffix-initial consonant between vowels. Perhaps in the surface form, the stem-

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modifying the GDFAC, the strong version of which does hold for all other examples in the survey.

[3] According to Dixon (1977: 128), a more precise statement of the distribution is that vowel-final stems with an odd number of syllables take -*la*, while vowel-final stems with an even syllable count have their final vowel lengthened instead. However, Dixon points out (1977: 128) that these two allomorphs could relate to a single underlying form /-la/ since, based on the usual phonotactics of the language, -*la* would reduce to -*:l* for this stem type, and one could therefore write a rule deleting [l] in this affix (though, as Dixon mentions, this would be an ad hoc rule). The possibility of a rule-based analysis of the post-vocalic allomorphs must be the reason why Dixon (1980: 296) characterizes these allomorphs as having a single underlying form.

final vowel and suffix-initial consonant share the [+continuant] feature in a configuration just like one that would result from feature spreading in a lenition rule in phonology.

Another example that may involve lenition is found in Korean (Lee 1989), where the conjunctive suffix takes the form *-wa* or *-kwa*. The *-wa* form is used following a vowel-final stem ((6)a), while *-kwa* is used following a consonant-final stem ((6)b) (Lapointe 1999). Examples are shown below (examples are from Lee 1989: 113 except where noted).

(6)	a.	ai-**wa**	‘child and X’ (Lapointe 1999: 271)
		sɛ-**wa**	‘bird and X’
	b.	pap-**kwa**	‘rice and X’ (Lapointe 1999: 271)
		san-**kwa**	‘mountain and X’
		gaŋ-**kwa**	‘river and X’
		mul-**kwa**	‘water and X’

This example is noteworthy because it seems to decrease well-formedness in terms of syllable structure. As pointed out by Bye (to appear), we might have expected the opposite distribution of allomorphs since this would have avoided onset consonant clusters. As will be seen in §2.1.2.3, Korean does exhibit PCSA that appears to optimize syllables by avoiding consonant clusters, so it is interesting that the example seen here has the opposite effect. As with the Yidiɲ example above, in this example it appears that the allomorphy relates to lenition, since the ‘weaker’ consonant occurs in intervocalic position. If we assume that the initial *w* of *-wa* ends up sharing the [+continuant] feature with the stem-final vowel, this could be seen as an example of PCSA involving assimilation of a consonant to a vowel feature.

Another possible example of PCSA resulting in consonants assimilating to vowels is the allomorphy exhibited by some suffixes in the Sibe variety of Manchu (Tungusic, China; Li 1996). According to Li (1996: 201), there are five suffixes in Sibe whose initial consonant surfaces as either a velar or a uvular. If a low vowel occurs in the stem, the uvular-initial allomorph is used; otherwise, the velar-initial allomorph is used. The suffixes involved in the pattern are the adjectival diminutive (with the variants *-kɨn, -kun, -qɨn, -qun*), the comparative (*-kɨndi, -kundi, -qɨndi, -qundi*), the self-perceived immediate past (*-xɨ, -xu, -χɨ, -χu*), the non-self-perceived past (*-xɤi, -xui, -χɤi, -χui*), and the self-perceived remote past (*-xɨŋ, -xuŋ, -χɨŋ, -χuŋ*). Examples of the self-perceived immediate past are shown below (Li 1996: 202).

(7)	tükɛ-**χu**	'to watch'	gɨnɨ-**xɨ**	'to go'
	bɔdu-**χu**	'to consider'	türü-**xu**	'to rent'
	lavdu-**χu**	'to become more'	utu-**xu**	'to dress'
	ömi-**χɨ**	'to drink'	tɨsu-**xu**	'to satisfy'

This example is also discussed by Bye (2005), who has two arguments for why these examples should be considered cases of PCSA. The first is that the pattern violates strict locality, since a high front vowel can intervene between the triggering low vowel and the initial consonant of the stem, suggesting that this is not a regular phonological rule. The second reason is that not all velar-initial suffixes undergo the alternation: for example, the imperative suffix surfaces as *-kin* even when the stem has a low vowel. Thus, Bye (2005) analyzes the suffixes as each having two underlying forms in a suppletive relationship. However, the problems for a purely phonological analysis that were pointed out by Bye seem to be less problematic than the loss of a generalization in the suppletive analysis. If the allomorphy is suppletive, we cannot explain why five suffixes exhibit the same pattern. If, on the other hand, we assume that the allomorphy is not suppletive, we have only to explain the transparency of high vowels and the failure of the imperative to participate.

The transparency of high vowels can be achieved via underspecification. As one might have noticed in looking at the examples above, there is no mid vowel category in Sibe, so the vowels /ɛ/, /ɔ/, and /ö/ pattern with /a/ in triggering the use of the uvular-initial suffix allomorphs. Therefore, we need only one feature to describe vowel height in Sibe (see also Dresher and Zhang in press), and this means that if we specify the low vowels for height (either with [+low] or [-high]), then high vowels do not need any underlying height features in order for the contrast to be maintained. We could say, for example, that the initial consonant in each of the five participating suffixes is a [-coronal, -labial] suffix that is unspecified for [±high]. If the stem has a [-high] segment, then this feature will spread to the suffix-initial consonant, resulting in a uvular consonant. Otherwise, [+high] is filled in by default on both the unspecified vowels and the suffix-initial consonant, resulting in high vowels and a velar consonant, respectively. The underspecification analysis also allows us to account for the behavior of the imperative suffix. All that must be said is that unlike the five suffixes whose initial consonant is unpecified for [±high] and therefore alternates between velar and uvular, the initial consonant of the imperative suffix is prespecified as [+high], and it therefore invariably surfaces as a velar. Because five suffixes participate in this pattern and because we can formulate a straightforward phonological analysis using underspecification, I conclude that this is probably not an example of PCSA.[4]

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[4] I have included the example here for completeness since Bye (2005) categorizes it as an example of PCSA.

To summarize, we have seen here that PCSA can be conditioned by consonant or vowel features, resulting in assimilatory patterns. In each case, the stem segment bearing the feature conditioining the allomorphy occurs at the edge of the stem where the affix attaches.

2.1.2.2 Dissimilation/disharmony

Though perhaps less common than assimilation, dissimilation/disharmony is common enough cross-linguistically that we expect to find some cases of PCSA resulting in dissimilatory or disharmonic patterns. In phonology, dissimilation is often accounted for in OT analyses using the Obligatory Contour Principle (OCP; Leben 1973, McCarthy 1986). One version of the OCP as an OT constraint is given below (Pulleyblank 1996: 330).

(8) OBLIGATORY CONTOUR PRINCIPLE: A sequence of identical elements within a tier is prohibited.

The P >> M model predicts that in some languages, this constraint should drive PCSA, resulting in dissimilatory effects. We do in fact find some examples of this type, which will be discussed below.

According to Hansson (2001: 165-166), consonant place dissimilation, even long-distance dissimilation, is a relatively common phenomenon. The P >> M model therefore predicts that we should find cases of PCSA involving consonant place dissimilation. As will be seen, this survey did reveal some such cases.

One example of PCSA involving consonant place dissimilation is found in Tahitian (Polynesian, French Polynesia; Tryon 1970, Lazard and Peltzer 2000). The causative/factitive in Tahitian is marked by one of two prefix forms, *fa'a-* or *ha'a-*. The *ha'a-* form occurs when the root begins with a labial (f, m, p, or v), and the *fa'a-* form occurs elsewhere (Lazard and Peltzer 2000: 224), with a small number of exceptional roots that can take either form. The distribution is shown below (Lazard and Peltzer 2000: 225).[5]

(9)	fiu	'*se lasser*'	**ha'a**-fiu	'*ennuyer, s'ennuyer*'
	mana'o	'*penser*'	**ha'a**-mana'o	'*se rappeler*'
	veve	'*pauvre*'	**ha'a**-veve	'*appauvrir*'
	'amu	'*manger*'	**fa'a**-'amu	'*faire manger, nourrir*'
	rave	'*faire*'	**fa'a**-rave	'*faire faire*'
	tai'o	'*lire'*	**fa'a**-tai'o	'*faire lire*'

The allomorphy appears to be suppletive since a rule of place dissimilation needed to relate the allomorphs to a single underlying form would not be a general rule of the language. There do not seem to be any affixes with /f/ that we could compare with the causative, but we do find many surface counterexamples to /f/ dissimilation in (apparent) reduplicated forms and within roots (10), some of which are seen below (Tryon 1970: 148-160).

(10)	fefe	'twisted'	fe:fe:	'a boil'
	fifi	'to be in difficulties'	faufa'a	'gain, profit, worth'

Thus, there is no general ban against sequences of labial consonants (with intervening vowels and with or without intervening glottal stop). There is, however, some other evidence for a relationship between /f/ and /h/. According to Tryon (1970: 2), there are

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[5] It is worth pointing out that there is a large number of roots (43, to be exact) that can take either form of the prefix (Tryon 1970: 42), and there are several that take a form not predicted by Lazard and Peltzer's generalization. For example, Tryon (1970: 149-150) lists six *f*-initial roots and two *m*-initial roots that take *fa'a-*. However, all of the roots listed as taking *ha'a-* are, as predicted by Lazard and Peltzer, labial-initial. Perhaps the discrepancy reflects a dialectal difference. An interesting alternative is that the pattern may have been in the process of becoming regularized in 1970, and perhaps the difference simply reflects the result of this process over the 30 years that passed between the two studies.

several words where we find ‘*f* and *h* as variants’. The examples that are cited are shown below.

(11)	pufa ~ puha	‘copra’
	u:fi ~ u:hi	‘yam’
	tufa’a ~ tuha’a	‘share’

Still, since there is no indication of a synchronic rule of *f* → *h* in the language, I assume this to be an example of suppletive allomorphy. This example is noteworthy because the consonants that are, in effect, dissimilated by the suppletive allomorphy are not strictly adjacent or even adjacent on the CV tier, since vowels and a glottal stop intervene between the two consonants involved in the pattern.[6] But note that this is not problematic for the GDFAC, since the ‘constraining’ (conditioning) element (a stem-initial labial) is at the left edge of the stem and is therefore immediately adjacent to the ‘constrained’ element (the prefix).

An example involving fricative dissimilation is found in Hungarian (Kenesei, Vago, and Fenyvesi 1997, Rounds 2001). In present tense indefinite verbs, the 2sg is usually marked by [-s] (Kenesei, Vago, and Fenyvesi 1997: 289-290; note that [s] corresponds to Hungarian orthographic <sz>, as in the examples below). When the stem ends in CC or in a long vowel + *t*, a ‘linking vowel’ is used between the root and the suffix (Rounds 2001: 26). Examples using this allomorph are seen in (12)a. However, when the stem ends in a sibilant ((12)b), the 2sg is marked by *-El* (where E is a mid

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[6] The [’] in these forms is a full glottal stop (Tryon 1970: 4-5), rather than a glottalization feature on the vowel as is the case in other language families. For any sequence of two vowels (whether they are identical or not), [’] can occur before the first vowel, between the vowels, in both locations, or neither (Tryon 1970: 5). According to Tryon (1970:5), the sequence V’V is disyllabic, even if the two vowels are identical.

vowel that undergoes backness and rounding harmony).[7] Examples are from Abondolo (1988: 102), except where noted.

(12) a.	mond-a-**sz**	'you say'
	vág-**sz**	'you cut'
	vár-**sz**	'you wait'
	nyom-**sz**	'you press'
	rak-**sz**	'you place'
b.	vonz-**ol**	'you attract'
	edz-**el**	'you train'
	hajhász-**ol**	'you seek'
	főz-**öl**	'you cook' (Rounds 2001: 27)

I am treating the pattern seen here as suppletive for two reasons. First, the allomorphs differ in more than one segment since the *-El* form has an initial vowel that the *-sz* form lacks. Also, there is no general process of sibilant dissimilation in the language. In fact, adjacent sibilants occur regularly and are subject to a rule of sibilant assimilation in which the first sibilant assimilates in place of articulation to the second (Kenesei, Vago, and Fenyvesi 1997: 444-446). This case demonstrates that [+sibilant] is a feature that can condition PCSA.

In Caddo (Caddoan, Oklahoma; Melnar 2004), the simple future suffix exhibits allomorphy that results in dissimilation of sequences of glottal stops. When the stem ends in glottal stop, the future suffix appears as *-waʔ*. Otherwise, the allomorph *-ʔaʔ* is used. Examples are provided below (Melnar 2004: 65; Melnar takes the examples from the mostly unpublished field notes of Wallace Chafe).

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[7] It is not clear whether this form is used with all sibilant-final stems. Rounds (2001: 26) states that it is used when the stem ends in *s, sz, z,* or *dz*, while Kenesei, Vago, and Fenyvesi (1997: 290) state that it is used when the stem ends in *s, sz,* or *z* and do not mention *dz* (which they do treat as a single affricate segment rather than as a sequence of /d/+/z/ (1997: 383)). It may simply be that there there is a lack of stems ending in sibilants other than *s, sz,* and *z* that would allow us to distinguish whether or not the allomorphy extends to all sibilants. Since there do not appear to be any counterexamples given, I will assume that *-El* occurs after sibilants.

(13)	basisʔ.aʔ	dikattumbakáiʔwaʔ
	/ba=sis-**ʔaʔ**/	/dikat#nu-n-baká=hiʔ-**waʔ**/
	boil-Future	what.Inter#3Dat-App-have.to.say-Future
	‘it will boil’	‘What will he have to say (to someone)?’

These allomorphs differ in only one segment, and the use of a separate allomorph for glottal stop-final words appears to be functionally motivated since a series of two glottal stops might be difficult to produce. However, the rule relating these allomorphs would have to be item-specific, since elsewhere in the language, a sequence of two glottal stops simplifies to a single glottal stop, rather than dissimilating to [wʔ] (Melnar 2004: 203).

Thus, in Caddo it seems that the dispreferred sequence /ʔʔ/ is repaired differently depending on whether we look at the behavior of the future suffix (which exhibits dissimilation) or the general phonological pattern in the language (which fuses /ʔʔ/ into [ʔ]). If both patterns were to be handled via a phonological constraint such as *ʔʔ, as would be done under the P >> M approach, we would not have a way of accounting for the two different repair strategies without a specific constraint referring to the future suffix.

In addition to consonant dissimilation, this survey also revealed some unusual instances of PCSA involving vowel dissimilation/disharmony in Bari (Eastern Nilotic, Sudan; Spagnolo 1933).[8] Vowel disharmony in itself seems to be relatively uncommon, especially in comparison to vowel harmony.[9] Even more unusual in Bari is that several of

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[8] Hall and Yokwe’s (1981) discussion of ATR harmony includes examples of some of the affixes discussed by Spagnolo (1933) and accounts for some of the patterns seen here. Where relevant, Hall and Yokwe’s (1981) analysis is referred to below, though Spagnolo gives some disharmonic examples that Hall and Yokwe (1981) do not mention or account for in their analysis.

[9] See Krämer 1998 for a model of harmony/disharmony that accounts for the relative rarity of vowel disharmony.

these instances of PCSA result in vowel disharmony in terms of height and possibly ATR even in a language that appears to exhibit vowel harmony. The vowel inventory of Bari is as follows (Spagnolo 1933: 8), with one modification.

(14) i u
ɪ ʊ
e o
ɛ ɔ
ə
a

The vowel given as [ə] above is described by Spagnolo as a ‘central vowel, between i and u... the sound is not lip-rounded’ (1933: 4). I characterize it above as being low, which is inconsistent with Spagnolo’s description of this vowel as being ‘between i and u’, but consistent with the way in which this sound behaves in the patterns to be described below. Spagnolo uses the symbol [ö] for this sound, suggesting Spagnolo himself did not intend it to be considered a high vowel; regardless of its actual phonetic realization, this vowel patterns as if it were the [+ATR] counterpart to /a/, as will be shown below.[10] In the examples to be discussed, I have replaced Spagnolo’s [ö] with [ə]. The feature values that I am assuming for the Bari vowels are as follows.

(15)

	i	u	ɪ	ʊ	e	ə	o	ɛ	ɔ	a
high	+	+	-	+	-	-	-	-	-	-
low	-	-	-	-	-	+	-	-	-	+
back	-	+	-	+	-	+	+	-	+	+
ATR	+	+	-	-	+	+	+	-	-	-

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[10] This is also the analysis of Hall and Yokwe, who describe this vowel in Bari as ‘a somewhat raised and markedly centralized low vowel… slightly lower and slightly more back than the vowel in American English *but*’ (1981: 55). This vowel is also treated as the [+ATR] counterpart to /a/ in Kukú (a closely related language spoken in Uganda and Sudan). However, it is transcribed as [ɨ] in Kukú, and Cohen (2000: 6) describes it as ‘a central-like vowel of high-mid height’.

The causative/reciprocative prefix exhibits height disharmony as well as ATR harmony. Both categories are marked by the prefix *tV-*, where V is a [+back, -low] vowel whose other features are determined by the vowel of the root, though not in an immediately obvious way, as shown in the examples below (Spagnolo 1933: 157).

(16)	nək	‘to suck’	**tu**-nək	‘to give suck’
	ŋa	‘to open’	**tʊ**-ŋa	‘to open with force’
	rik	‘to drive away’	**to**-rik	‘to pursue’
	gwut	‘to beat’	**to**-gwut	‘to beat each other’
	rem	‘to stab’	**to**-rem	‘to cause to stab; to stab each other’
	mor	‘to insult’	**to**-mor	‘to abuse violently; to insult each other’
	mɛt	‘to see’	**tɔ**-mɛt	‘to look at each other; to cause to see’
	kɔr	‘to divide’	**tɔ**-kɔr	‘to settle a dispute’
	yɪŋ	‘to hear’	**tɔ**-yɪŋ	‘to listen attentively; to attract attention’
	kʊr	‘to till’	**tɔ**-kʊr	‘to help each other with the tilling’

This pattern can be schematized as follows.[11]

(17)	Stem vowel	Prefix vowel
	ə	u
	a	ʊ
	i, u, e, o	o
	ɪ, ʊ, ɛ, ɔ	ɔ

The generalization can be stated as follows: stems with [-low] vowels take a suffix vowel that is [-high]; this vowel then undergoes ATR harmony[12] with the stem vowel to be realized as either [o] or [ɔ]. Stems with other vowels (i.e., the [+low] vowels /ə/ and /a/) take a suffix vowel that is [+high], which also undergoes ATR harmony with the stem vowel, surfacing as [u] or [ʊ]. This pattern is interesting because (assuming the feature specifications that I have laid out for the Bari vowel system) this is not straightforward dissimilation involving a single feature, but rather a type of indirect dissimilation that

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[11] The exact same pattern is exhibited in Kukú for the same prefix (Cohen 2000: 17).

[12] A general process of ATR harmony has been documented in Bari by Hall and Yokwe (1981).

involves the interaction of two related features, [±high] and [±low]. One observation that can be made about the emphatic suffix pattern is that whatever value the stem vowel has for [±low], the prefix vowel will have the same value for [±high]. This is reminiscent of the so-called ‘α-rule’, which has since been argued to be too powerful a notational device since it predicts unattested rules (see, e.g., McCawley 1979). Thus, the pattern of PCSA seen here exemplifies a pattern of phonologically conditioned morphology that is not supposed to exist in pure phonology. This is problematic for the P >> M model, which, as has been discussed above, predicts that the same effects that are manifested in phonology should also be manifested in PCSA since the same phonological constraints are supposed to be responsible for both.

Several suffixes also show patterns of allomorphy determined by stem vowel quality in such a way as to produce vowel disharmony. The emphatic verb suffix (Spagnolo 1933: 133-134) has the form *-jV*, where V is always a [+back] vowel that patterns as in the examples below (Spagnolo 1933: 134).

(18)	gir-**jə**	‘to wipe a plate, etc.’	kur-**jə**	‘to borrow’
	kər-**ju**	‘to spoil, contaminate’	kar-**ju**	‘to spoil, ruin’
	kor-**ju**	‘to bore beads for threading’	ker-**ju**	‘to steer’
	kɛr-**ja**	‘to notch’	kər-**ja**	‘to divide, separate’
	dɪr-**ja**	‘to look at’	tʊr-**ja**	‘to pour in’

The stem and suffix vowels correspond as follows.

(19)	Stem vowel	Suffix vowel
	i, u	ə
	ə, e, o, a	u
	ɪ, ʊ, ɛ, ɔ	a

Stems with [+high, +ATR] vowels have a [-high, +low, +back, +ATR] suffix vowel ([ə]). Stems with a [-low, -ATR] vowel have the suffix vowel [a], which is [-high, +low, +back, -ATR]. All other stems take [u], which is [+high, -low, +back, +ATR]. In these examples, words are not fully harmonic with respect to the feature [±ATR] (under our assumed feature system), since [a] is [-ATR] but corresponds as a stem vowel with the [+ATR] suffix vowel [u].[13] A possible explanation for this is that ATR harmony (which I have assumed to be a phonological rule rather than part of a pattern of suppletive allomorphy) is stem-controlled and right-to-left. This would account for why the causative/reciprocal prefix undergoes ATR harmony (as seen in the previous set of examples), but suffixes and stems do not. In this case, ATR harmony could be part of the suppletive pattern. Thus, PCSA in the emphatic verb suffix results in both harmony and disharmony: ATR harmony, but height disharmony in some cases (i.e., in some instances a [+high] stem vowel is paired with a [-high] suffix vowel, and a [-low] stem vowel is paired with a [+low] suffix vowel. The pattern of harmony/disharmony is unlike a phonological rule of dissimilation because two of the suffix allomorphs have the features [-high, +low], so the dissimilation is only apparent when we compare the disharmonic examples with what they would have looked like if they took the 'elsewhere' allomorph instead. If stems with /i/ and /u/ took the elsewhere (/-ju/) allomorph, then these words would be harmonic in terms of both [±high] and [±low]. If stems with /ɪ, ʊ, ɛ, ɔ/ took the /-ju/ allomorph, the resulting words would be harmonic in terms of [±low], though words

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[13] Hall and Yokwe (1981: 58) note that there are some regular exceptions to vowel harmony, including the fact that a [+high, +ATR] vowel in a suffix will 'fail to interact with vowel harmony' in certain morphemes. The behavior of the suffix vowel *u* here is subsumed under this generalization, though Hall and Yokwe do not offer an explanation for it.

with stem vowels /ɛ, ɔ/ would be disharmonic in terms of [±high]. Thus, the PCSA seen here results in a pattern of disharmony that nonetheless does not work in quite the same way as a pattern that is derived via the application of a phonological rule or constraint to a single underlying form. This is somewhat problematic for the P >> M model, which predicts that PCSA ought to behave just like other, purely phonological processes driven by P constraints.

A second suffix in Bari exhibiting allomorphy is the emphatic imperative, which Spagnolo characterizes as having two allomorphs, /-é’/ and /-í’/ (1933: 136). Examples are shown below.

(20)	gir**-jé’**	‘wipe a plate’	’bidd**-yé’**	‘beat’
	kur**-jé’**	‘borrow’	jund**-yé’**	‘vindicate’
	rəb**-bí’**	‘wrapt’ [*sic*]	ped**-dí’**	‘tether’
	kɛg**-gí’**	‘hit target’	gɪ’**-yí’**	‘strip off’
	kam**-bí’**	‘paddle’	son**-dí’**	‘send’
	jɔŋ**-gí’**	‘take’	rʊ’**-yí’**	‘press’

The actual form of the suffix appears to be -CV because it appears (based on the available data) that the suffix has an initial consonant whose features come from the root-final consonant. Leaving this issue aside, we can characterize the phonological conditioning of the vowel alternation as follows.

	Stem vowel	Suffix
(21)	i, u	/-é’/
	all others	/-í’/

The vowel of the suffix is a [-low, +ATR] whose distribution is as follows: the /-é’/ form (whose vowel has the features [-high, -low, +ATR]) occurs after [+high, +ATR] stem vowels; /-í’/ ([+high, -low, +ATR]) occurs elsewhere (i.e., it occurs with stems whose vowel is either [-high] or [-ATR] or both).[14] The result is height disharmony for most stem types, and [±ATR] disagreement for some stems. Once again, however, the pattern is different from pure phonological disharmony because we can only understand it as disharmonic given the incompatibility of the two features involved. One observation that we can make is that if the stem vowel is not [+high, +ATR], then the suffix vowel has to disagree with it in at least one of the features [±ATR] or [±high]. This is not a typical phonological rule type, again posing a potential problem for the P >> M model. It is reminiscent of the anti-identity effects described by, e.g., Alderete 2001, where an output segment must differ minimally from its correspondent in the input or in a morphologically related form, but these constraints generally refer to a single feature (e.g., ¬IDENT(voice) discussed by Alderete 2001) and would therefore have to be formulated in a different way to account for the case being discussed here.

Another suffix exhibiting phonologically conditioned allomorphy in Bari is the passive suffix, which has two variants, /-wɛ’/ and /-we’/. Unlike some of the Bari allomorphy described above, this suffix would appear to involve ATR dissimilation, since Spagnolo states (1933: 144) that the distribution of passive suffix variants is as follows.

(22)

Stem vowel	Suffix
i, u, ə, e, o	/-wɛ’/
a, ɛ, ɪ, ɔ, ʊ	/-we’/

This could be characterized as [ATR] dissimilation, since [+ATR] stem vowels correspond with the [-ATR] suffix vowel variant, while [-ATR] stem vowels correspond

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[14] This is another example that falls under the category of exceptions to ATR harmony given by Hall and Yokwe (1981: 58), since the *i* here is a [+high, +ATR] vowel in a suffix.

with the [+ATR] suffix vowel. However, Spagnolo's characterization may have been in error, since the two examples that are presented contradict the generalization, and in a way that makes sense based on the ATR harmony exhibited elsewhere, since both forms are harmonic with respect to ATR. The examples are given below (Spagnolo 1933: 144).

(23)	yuŋ-we'	'to be born'	'bɔk-wɛ'	'to be dug out'

One cannot say for sure whether the initial characterization of the allomorphy was stated incorrectly since only two examples are given, but this seems likely since the pattern is otherwise highly unusual.

A second type of passive in Bari is marked by one of three suffix allomorphs, all of which have the form -V (where the vowel is [+back, -high] and seems to exhibit height disharmony with the stem vowel. Representative examples are shown below (Spagnolo 1933: 107-108).

(24)	kət-**ə**	'to be cleared away'	lip-**ə**	'to be nagged'
	tur-**ə**	'to be pursued'	ter-**ə**	'to be steered'
	kor-**o**	'to be bored for threading'	gwalak-**a**	'to be smashed'
	tɛr-**a**	'to be satisfied'	lɪp-**a**	'to be skimmed off'
	kɔr-**a**	'to be divided'	tʊr-**a**	'to be poured in'
	kɪn-**ʊ**	'to be closed'	kʊr-**ʊ**	'to be cultivated'

The allomorphs are distributed as follows.

(25)	Stem vowel	Suffix vowel
	i, u, ə	ə
	e, o	o
	a, ɛ, ɪ, ɔ, ʊ	a (sometimes ʊ after ɪ or ʊ)

The generalization (apart from the roots that sometimes take [ʊ], which I assume are lexical exceptions) is statable as follows: stems with [-high, -low, +ATR] vowels have the suffix vowel [o]. These words end up being harmonic with respect to [±low]. Other stems take a [+low] suffix vowel, whose value for [±ATR] matches that of the stem vowel. Thus, words using this passive marker end up being harmonic in terms of ATR, and those with stem vowels /e, o, ə/ are also harmonic in terms of height, but those with stem vowels /i, u, ɪ, ʊ, ɛ, ɔ/ end up being disharmonic with respect to [±low]. Thus, the allomorphy in this passive suffix does not have a uniform effect on the harmony or disharmony of vowels in a word: for some stems, it is harmonizing, while for others, it causes disharmony.[15]

A final example from Bari is the imperative active, which is marked by one of three suffix allomorphs (Spagnolo 1933: 111): /-í/, /-é/, or /-ɛ́/. Examples are shown below.

(26)	’bət-**í**	‘skin’	lip-**é**	‘nag’
	tur-**é**	‘pursue’	ter-**é**	‘steer’
	kor-**é**	‘bore and thread’	kam-**ɛ́**	‘paddle’
	tɛr-**ɛ́**	‘satiate’	lɪp-**ɛ́**	‘skim off the best’
	kɔr-**ɛ́**	‘divide’	kʊr-**ɛ́**	‘till’

The allomorphs are distributed as follows.

(27)	Stem vowel	Suffix vowel
	ə	i
	i, u, e, o	e
	a, ɛ, ɪ, ɔ, ʊ	ɛ

The generalization for the distribution of the active imperative suffix allomorphs is as follows. Stems with the [+low, +ATR] vowel take a [+high, -low, -back, +ATR] suffix vowel. All other stems take a [-high, -low, -back] suffix vowel, which agrees with the

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[15] Hall and Yokwe (1981: 58) account for this pattern by positing a rule of Mid-Vowel Assimilation, in which a [+low, +back, +ATR] vowel becomes [-low, -high] following a [-low, -high, +ATR] vowel. Given this and a rule of ATR harmony, all of the allomorphs of this passive suffix could be reduced to /-a/.

stem vowel in ATR. The suffix allomorphs both have a vowel that is [-low, -back], which might suggest a single underlying suffix form with a [-low, -back] vowel that undergoes ATR harmony. However, the specification for [±high] is not derivable from the stem vowel via any normal phonological rule. Thus, it seems we have to stipulate that stems with the vowel /ə/ take the /i/ suffix vowel. This is reminiscent of the pattern seen above in the causative/reciprocal prefix where the affix vowel has the same value for [±high] as the stem vowel has for [±low]. However, in this case, the pattern holds only for stems with the /ə/ vowel.

To summarize the Bari examples presented above, in each case, the affix vowel quality is conditioned by the root vowel, but not in any consistent way. In several cases, the effect of the allomorphy is dissimilatory, but not always in the same dimension. The distribution of affix vowels almost seems random, yet the phonological conditions on the distribution are straightforwardly statable. Since in each case, the allomorphs are phonetically similar (all -V, all -CV, etc.), it might seem reasonable to posit single underlying forms for each set of alternants and to relate the allomorphs through item-specific rules based on the generalizations given for each example. However, this would violate Kiparsky's generalization that non-suppletive allomorphy results from rules that are not item-specific, since no one set of rules could account for the behavior of all of the affixes, and in fact, in the case of ATR, some of the affixes exhibit harmony while others sometimes disagree with the stem in ATR (and the passive may even exhibit disharmony, though this could have been a descriptive error). This fact would be difficult to handle under a P >> M account where all of the allomorphy (including pure phonological allomorphy, in this case including ATR harmony) is driven by a single set of P constraints interranked with M constraints. We could get a P >> M analysis to work if we assumed separate co-phonologies (with different constraint rankings) for each of the affixes described above, but the standard version of OT incorporating the P >> M schema does not make use of the co-phonology concept. Furthermore, if we did posit individual co-phonologies for each affix, some would have patterns that are contradictory to each other, and this could not be modeled via a simple difference in the ranking of a small number of constraints as is usually the case in analyses making use of co-phonologies. Thus, even if one is willing to posit affix-specific co-phonologies, they would probably be incompatible with each other. It seems therefore that these patterns of allomorphy in Bari are suppletive, and furthermore that they would be somewhat difficult to account for using the P >> M approach.

In this section, we have seen several cases of PCSA resulting in dissimilatory patterns. The Bari vowel disharmony examples discussed here are of particular interest (and worthy of future study). Such a case is unexpected under P >> M since there are several different patterns that contradict each other in terms of harmony vs. disagreement or disharmony, making it difficult to account for the overall pattern in terms of a single set of phonological constraints, as would be done in the P >> M approach.

2.1.2.3 Syllable structure optimization

Many phonological rules/constraints seem to serve the purpose of optimizing syllable structure. In fact, it was ‘conspiracies’ such as the ‘law of open syllables’ in Slavic (see, e.g., Martinet 1952, Mareš 1965) that provided part of the impetus for Optimality Theory. This is because rule-based approaches have no way of formally encoding the fact that in many languages, multiple different rules often work together in producing a particular kind of outcome, especially in the domain of syllable structure. In most languages, the ‘optimal’ syllable has an onset and has no coda, or a simple coda. Candidates with optimal syllable structures are selected by constraints such as ONSET, NOCODA, and COMPLEXCODA, which feature prominently in the phonological systems of many languages. We therefore expect under the P >> M model that we should find examples of PCSA resulting in optimal syllables. It does appear that there are several such cases (although, as will be seen in §2.1.2.5, there seem to be just as many cases in which PCSA referring to the C/V distinction fails to optimize syllables).

An example of PCSA that optimizes syllable structure by avoiding complex codas is found in Russian (Timberlake 2004). According to Timberlake (2004), the Russian reflexive marker exhibits both morphologically and phonologically conditioned suppletive allomorphy. The reflexive suffix has two allomorphs, [s^{j}a] and [s^j]. The [s^{j}a] variant is always used in active participle forms. In other forms, the [s^{j}a] variant occurs after consonants, while the [s^j] variant occurs after vowels (Timberlake 2004: 345). This pattern has the effect of eliminating a potential final coda cluster that would be created by affixing [s^j] to a consonant-final stem. The examples below are from Wade (2002: 137) (the transliterations are mine).

(28)	a kupaju-**s^j**	‘I bathe myself’	on kupajet-**s^{j}a**	‘he bathes himself’
	kupajt^{j}e-**s^j**	‘bathe yourselves!’	kupaj-**s^{j}a**	‘bathe yourself!’
	ona kupala-**s^j**	‘she bathed herself’	on kupal-**s^{j}a**	‘he bathed himself’

Though the allomorphs are phonetically similar, I treat this as suppletive allomorphy since the pattern does not result from the application of any general rule of the language to a single underlying form for the suffix. In this example, the allomorphy optimizes syllables since if -s^j were used with consonant-final stems, the result would be word-final CC clusters. Therefore, under P >> M, this pattern could be accounted for using *COMPLEXCODA.

Turkish (Lewis 1967) exhibits an alternation in the causative that is conditioned by the stem-final segment and by syllable count, the result of which may be said to optimize syllable structure. The causative is marked by *-t* with polysyllabic stems ending in vowels, /r/, or /l/; the suffix *-DIr* (where *D* is a coronal stop having surface alternants [t] and [d], and *I* is a high vowel) is used with all other stems (except for some specific monosyllabic stems that take a different, lexically determined allomorph). Some examples are shown below (Haig to appear: 6).

(29)	bekle-**t-**	'wait-CAUS'	öl-**dür**-	'die-CAUS'
	bayil-**t**-	'faint-CAUS'	ye-**dir**-	'eat-CAUS'
	getir-**t**-	'bring-CAUS'	çalis-**tir**-	'work-CAUS'

There are two ways in which this pattern may be said to be optimizing. The first is in terms of syllable structure, since the avoidance of *-t* after obstruent-final stems prevents causative stems from ending in a sequence of two low-sonority consonants. The second is that, as pointed out by Haig (to appear: 6), the distribution of allomorphs is such that in words with multiple causatives, there is never a sequence of two phonologically identical causative suffixes. Some examples involving multiple causatives are shown below.

(30)	öl-**dür**-**t**- die-CAUS-CAUS-	'cause to kill, have killed'	(Haig to appear: 5)
	ye-**dir**-**t**- eat-CAUS-CAUS-	'cause to feed'	(Németh 1962: 88)
	kapa-**t**-**tır**- close-CAUS-CAUS-	'cause to make closed'	(Underhill 1976: 353)

The distribution of allomorphs prevents two identical causative suffixes from occurring next to each other. Causative stems formed with the *-DIr* suffix will always be polysyllabic and /r/-final and will therefore take the *-t* allomorph if another causative is to be added. Stems formed with *-t* end in an obstruent and will therefore always take the suffix *-DIr* if a second causative is used. Though Haig resists formulating specific constraints against repeated morphs, he does acknowledge (to appear: 10) that the Turkish causative allomorphy ‘appears to conspire to avoid’ adjacent suffixes that are identical in both their form and their meaning. Thus, it could be the case that the pattern seen here is phonologically optimizing, not in terms of syllable structure, but in terms of the avoidance of morpheme repetition. Note, however, that this cannot be what drives the allomorphy, since a constraint against morpheme repetition would account for the distribution of allomorphs only in words with double causatives.

An example of PCSA in a clitic that appears to optimize syllable structure is found in Moroccan Arabic (Harrell 1962; also discussed by Mascaró 1996). The 3sg masculine object/possessor clitic takes the form *=h* after a vowel-final stem and *=u* after a consonant-final stem (Harrell 1962: 135). Some examples are shown below (Harrell 1962: 136).

(31)	xtˤa=**h**	‘his error’	mɛa=**h**	‘with him’
	šafu=**h**	‘they saw him’		
	ktab=**u**	‘his book’	menn=**u**	‘from him’
	šaf=**u**	‘he saw him’		

Mascaró uses the constraints ONSET and NOCODA to select the allomorphs, since the distribution of the allomorphs maximizes onsets and minimizes coda consonants. This is our first example of PCSA involving a clitic rather than an affix (though since clitics behave like affixes for phonological purposes, we expect them to exhibit PCSA just as affixes do).

The *a* ~ *an* alternation in the English indefinite article has been characterized as suppletive (Zwicky 1986) since there is no longer any general rule deleting /n/ before another consonant or epenthesizing [n] between vowels. Any such rule would have to be limited to applying only to the indefinite article. If we accept that the alternation does involve suppletion, we may view it as optimizing syllable structure because it provides an onset to V-initial words while avoiding a coda consonant. This then is another example of a clitic (in this case, a proclitic) participating in PCSA.

Another example that seems to maximize alternating C-V sequences is found in Tzeltal (Mayan, Mexico; Slocum 1948, Kaufman 1971). The 2sg is marked by *aw*- before V-initial stems and by *a*- before C-initial stems in this language. Slocum (1948: 80) appears to assume that V-initial stems begin with underlying glottal stop, which would mean that the distribution is determined by the presence of glottal stop. However, it seems possible that V-initial stems do not have underlying initial glottal stops, and Slocum does not provide evidence for them. Some examples are given below (Slocum 1948: 80).

(32)	ʔinam	'wife'	**aw**-inam	'your wife'
	(a)h-kanan	'idol'	**aw**-ah-kanan	'your idol'
	lumal	'land'	**a**-lumal	'your land'
	mamlal	'husband'	**a**-mamlal	'your husband'

If the stems taking *aw*- do not have initial glottal stops, then we can say that the pattern maximizes onsets, since the use of *a*- with a vowel-initial stem would yield two onsetless syllables. On the other hand, if these stems do have initial glottal stops, then the motivation is not clear; for the moment, I will assume that these stems do not have initial glottal stops. According to Kaufman (1971: 11), [w] is allowed to occur in the environment V_C, so the observed alternation does not result from a general constraint against wC in the language. Assuming there are true vowel-initial stems, then this example is parallel to the English *a/an* example in that it maximizes alternating C-V sequences and avoids both codas and vowel hiatus.

Another example of PCSA possibly motivated by syllable structure considerations in Tzeltal is found in the 1sg marker. In Tzeltal, the 1sg is marked by *k-* with V-initial stems and *h-* with C-initial stems (Slocum 1948: 80).

(33)	(a)h-ʔat’el	‘workman’	**k**-ah-ʔat’el	‘my workman’
	ʔakan	‘leg’	**k**-akan	‘my leg’
	k’ab	‘hand’	**h**-k’ab	‘my hand’
	talel	‘character’	**h**-talel	‘my character’

The characterization of this pattern is complicated by the fact that, as mentioned earlier, Slocum (1948: 80) apparently assumes that V-initial stems are underlyingly glottal stop-initial and undergo glottal stop deletion. No evidence is given for this position. If it is true that these stems are glottal stop-initial, then the generalization here is that /k-/ occurs before glottal stop and /h-/ occurs before other consonants (or ‘elsewhere’). Either way, this appears to be a case of suppletive allomorphy because any rule of $h \rightarrow k$ before vowels (or before glottal stop, depending on the analysis) would be specific to the 1sg. The pattern could be driven by syllable structure considerations since *hC* is a pronounceable onset and could therefore be straightforwardly syllabified, while *kC* in many instances would result in an onset sequence that is difficult to produce and might therefore need to be broken up via epenthesis. This is avoided because of the distribution of allomorphs.

A third example of PCSA in Tzeltal resulting in syllable structure optimization is in the 3rd person marker, which surfaces as *y*- before V-initial stems and *s*- before C-initial stems (Slocum 1948: 80).

(34)	ʔahwal	'ruler'	**y**-ahwal	'his ruler'
	ʔat'el	'work'	**y**-at'el	'his work'
	mul	'sin'	**s**-mul	'his sin'
	k'op	'language'	**s**-k'op	'his language'

As with the 1sg prefix described above, the allomorphs of the 3rd person prefix could only be related to a single underlying form via an item-specific rule, so based on Kiparsky's (1996) criteria, this should be considered suppletive allomorphy. As with the 1sg prefix, the distribution seen here optimizes syllables since it produces pronounceable onset clusters when the stem is consonant-initial. If *y*- occurred in this position, we would have onsets with falling sonority, which are universally dispreferred. Thus, once again, the pattern seen here can be said to optimize syllables.

Modern Western Armenian (Andonian 1999) exhibits another example of PCSA that appears to optimize syllable structure, in this case by maximizing onsets and minimizing coda clusters. The definite article surfaces as -*n* after a vowel-final stem, and -*ə* after a consonant-final stem. Examples are shown below (Andonian 1999: 18, except where noted; transliterations based on Andonian 1999: 8-9).

(35)	lezu-**n**	'tongue'	
	kini-**n**	'wine'	
	gadu-**n**	'the cat'	(Vaux 1998: 252)
	atorr-**ə**	'the chair'	
	kirk-**ə**	'the book'	
	hat-**ə**	'the piece'	(Vaux 1998: 252)

The distribution of allomorphs results in an alternating C-V pattern that seems to be universally preferred. However, it should be noted that although this pattern does have the effect of providing onsets and preventing coda clusters, it creates codas when the stem is vowel-final; codas are said to be universally dispreferred, and therefore although the pattern is optimizing in some respects, this comes at a price. Thus, this example, though it can be said to optimize syllables, also foreshadows some examples (such as in Haitian Creole) to be discussed in §2.1.2.5 in which PCSA patterns referring to the C/V distinction actually make syllable structure less optimal, not more.

In Warrgamay (Pama-Nyungan, Australia; Dixon 1980: 266) as well as some other Pama-Nyungan languages (including Yidiɲ and Biri)[16], ergative is marked by the suffix /-ŋgu/ after a vowel-final stem, or /-du/ after a consonant-final stem, as shown below.

(36)	ŋulmburu-**ŋgu**	‘woman-ERG’	wurrbi-**ŋgu**	‘big-ERG’
	wurrbi-bajun-**du**	‘very big-ERG’		

In this example, the optimizing effect is that CCC sequences are avoided. However, there is no reason why the vowel-final stems could not also take the *-du* allomorph. If *-du* were the only surface form of the ergative suffix, this would also satisfy UNIFORMEXPONENCE or whatever other constraint is used to ensure that in the usual case, each morphological category is marked by a single affix. Thus, we must have some way of making clear that the *-du* allomorph occurs only in the special case and that *-ŋgu* is the ‘elsewhere’ allomorph. This problem is addressed by Wolf and McCarthy (to appear), who analyze a similar example in Dyirbal by stipulating a ‘priority relationship’ between the two allomorphs such that the higher priority suffix must be ‘tried first’, and if this fails to produce a well-formed output, then the other allomorph is used. Of course, this notion of

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[16] These and other examples of ergative allomorphy in Pama-Nyungan are discussed in chapter 4, §4.2.

the specific vs. elsewhere allomorphs must be accounted for regardless of the framework that is used to analyze the pattern. However, this seems less problematic in a subcategorization-based approach than in an approach where OT constraints select the allomorphs, since the OT analysis advanced by Wolf and McCarthy seems to require the grammar to 'try' allomorphs in a sequential order that is antithetical to the parallel nature of OT.[17] Pama-Nyungan ergative allomorphy, including the Dyirbal example mentioned here, will be discussed further in chapter 4 since many related cases involve conditioning by syllable count rather than (or in addition to) having to do with syllable structure as is the case here.

An interesting example of syllable-optimizing allomorphy is found in Midob (Nubian, Sudan; Werner 1993), where the verbal extension denoting 'affirmation' takes the form -*nò*- before a consonant-initial suffix and -*nòn*- before a vowel-initial suffix (Werner 1993: 50). The two available examples are reproduced below (Werner 1993: 49; interlinear glosses mine).

(37) tii-**nò**-hèm
drink-affirm-1sg.perfect
'I drank (completely/really)'

tii-**nòn**-ùwà
drink-affirm-1sg.continuous.indicative
'I really drink completely'

This example is striking because one would assume that the order of affixation is the same as the surface order of the morphemes. If true, this would mean that the grammar has to 'look ahead' when selecting the form of the affirmative affix since its distribution is based on whether the initial segment of the following morpheme is a consonant or

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[17] It is possible that Wolf and McCarthy's characterization of this sequential ordering of tasks is only metaphorical and that the 'priority relationship' could be encoded in a way that does not require sequential ordering; Wolf and McCarthy do not spell out the specific mechanism by which the priority relationship is manifested.

vowel. However, the example does not necessarily involve suppletive allomorphy; the fact that the two allomorphs are very similar is one indication that it does not. A possible analysis not involving suppletion is to say that the *-nò* form is based on /-nòn/ and undergoes deletion of /n/ before another consonant. This analysis would not require any ‘lookahead’ on the part of the grammar. However, the rule deleting /n/ would have to be specific to this construction, because nC sequences are permitted elsewhere in the language, as in the following examples provided by Werner: *èdéekìndóohèm* ‘I sold’ (1993: 23), *kándír* ‘on top’ (1993: 23), *kúndúl* ‘name of well’ (1993: 32), *àndèn* ‘that’ (1993: 38), *tìdánwà* ‘I am a Midob’ (1993: 57), and *àrdànkírídnûm* ‘it surrounded’ (1993: 81).

An alternative, non-suppletive analysis of this Midob example is in terms of a ‘ghost’ or ‘latent’ consonant, as in some examples discussed by Zoll (1996).[18] Following the analysis assumed by Zoll for, e.g., latent consonants in French (1996: 32-33), we could assume that the affirmative suffix in Midob is /-nò(n)/, where the final /n/ is a latent consonant that only surfaces when followed by a vowel. We could formulate a rule or constraints resulting in the insertion of a root node in the environment V_V, and the features of the latent /n/ could associate to this root node, so that the suffix would end up having the shape [-nòn]. In environments in which a root node was not inserted (namely, before a consonant-initial ending), the features of the latent /n/ would simply be stray-erased, resulting in [-nò].

On either analysis, the example does not necessarily involve suppletive allomorphy. This is important because, as mentioned above, this would have been our

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[18] Thanks to Sharon Inkelas for pointing out this alternative analysis.

first example that seemed to be sensitive to properties of an affix ‘outside’ the affix in question, a situation that otherwise seems not to be attested. This type of situation is predicted by OT using P >> M, since in its standard form, this model has not included any sensitivity to morphological constituency, and therefore it predicts that PCSA can be sensitive to phonological elements anywhere in the word. The Midob example could therefore have confirmed a prediction of P >> M that otherwise has yet to be attested in the literature. However, because there are alternative analyses available (discussed above) that do not require lookahead, we cannot rely on this example as confirmation of the prediction. What is needed is a similar example in which the allomorphs are so phonetically distinct as to eliminate the possibility of an analysis in terms of latent segments.[19]

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[19] Another similar example is found in Kashaya (Pomoan, northern California; Oswalt 1960, Buckley 1994), where the negative suffix has two phonologically selected allomorphs, *-t^h* and *-t^{h}i* (Buckley 1994: 334). According to Buckley, the *-t^h* allomorph occurs before a vowel, while the *-t^{h}i* allomorph occurs before a consonant, and the [i] in the preconsonantal allomorph cannot be treated as epenthetic (Buckley 1994: 334). This pattern is of interest because, as in the Midob example, the selection of the negative in Kashaya seems to require the grammar to ‘look ahead’ to see what suffix will be added next and whether it begins with a vowel or a consonant. The examples cited are *moh-t^h* ‘it isn’t running across’ and *moh-t^{h}i-q^h* ‘it didn’t run out’ (Oswalt 1960: 234). Based on these forms, the generalization would have to refer to underlying segments rather than surface segments. Both of these forms in are claimed to contain the factitive marker, which appears to consist of a mora (since it lengthens a preceding vowel) and a tonal contour which ‘...consists of a pause of variable duration coupled with a slight lengthening of a preceding vowel, sonorant, or [mora]... and a fall in tone and fade-out or diminution in force on the preceding syllable’ (Oswalt 1960: 30). It apparently does not affect obstruents, which is why it is omitted in the examples cited here. However, Oswalt seems to assume that the mora contributed by the factitive counts as a vowel for the purposes of the negative allomorphy. It is not clear whether there may be examples where the *-t^h* allomorph occurs before a vowel that surfaces, or whether there may be some different generalization (for example, based solely on the examples provided, the generalization could be that [i] is epenthesized between *-t^h* and a following consonant). Even if the generalization is correct, we could analyze the [i] in terms of a latent /i/ (along the lines of the latent /n/ proposed for Midob above), since here again the allomorphs are very

The durative suffix in Kashaya (Pomoan, northern California; Oswalt 1960, Buckley 1994) exhibits another pattern of allomorphy that seems to optimize syllable structure, though in this case there is no issue of ‘lookahead’. According to Buckley, the allomorphs are distributed as follows (1994: 328). ‘After a vowel-final stem, two allomorphs occur: *-cin’* if the visible stem is monosyllabic, otherwise *-men’*. When the stem ends in an /n’/ which is part of a suffix (rather than the root), the Durative is *-icen'*. After any consonant except the alveopalatals /c, c’/, including the case of /n’/ at the end of a root, the Durative is *-an’*.’ The uses of the durative suffix that are not covered in the description given above involve very complex conditions that are partly morphologically determined and will not be discussed here. Some examples are shown below (Oswalt 1960: 212-213).[20]

(38)	sime-sime-**ci·d**-u	‘to keep on sprinkling’	buwi-**ci·d**-u	‘to keep on stringing’
	duk’ilci-**me·d**-u	‘to keep pointing once’	mohqa-**mé·d**-u	‘to drive’
	mom-**á·d**-u	‘to keep running across’	duhlud-**á·d**-u	‘to keep picking one’

The shape of the allomorphs relates to the shape of the stems since the vowel-final stems take one of two -CVC allomorphs, while most consonant-final stems take a -VC allomorph. This avoids both consonant clusters and vowel hiatus, and can therefore be said to have an overall optimizing effect on the syllable structure of the word.

Also in Kashaya, the plural movement suffix (which denotes plural people or objects moving) has two variants whose distribution could be said, at least in part, to

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similar, suggesting that they can reduce to a single underlying form and do not have a suppletive relationship.

[20] Note that what Buckley refers to as *-cin’* is transcribed as [ci·d], Buckley’s *-men’* is transcribed as [me·d], and Buckley’s *-an* is transcribed as [a·d].

optimize syllable structure. The allomorphs are *-h-*, which is infixed before the final consonant of a C-final root, and *-ht*, which is suffixed after V-final roots (Buckley 1994: 323). Some examples are provided below (Oswalt 1960: 154, 178).

(39)	mo-**ht**-an’-	‘they run along (caused by some outside force)’
	mo-**ht**-ac’	‘they run along (of their own will)’
	ké,**h**,l-ala-w	‘several to peer down’
	du-k’í,**h**,s-im-’	‘to scratch across several’

The pattern seen here always results in stems ending in *hC*. This is suggestive of a pattern of ‘imbrication’[21] since all surface forms that are marked with some particular morphological category have a common shape that may be arrived at by fusing some part of the stem with some part of the affix. When necessary, a full version of the affix attaches in order to achieve the necessary surface shape, but in some cases the stem already contains some part of the output that would otherwise have been supplied by the affix, and it is in these instances where the imbrication or fusion occurs. In the case of the Kashaya plural movement suffix, we could say that forms marked for plural movement need to end in *hC*, and that if the stem ends in a vowel, the required *hC* is supplied straightforwardly by the *-ht* suffix. However, if the stem already ends in C, then the *t* of the suffix fuses with the final consonant of the stem, giving the appearance of having infixed *-h-*. This would account for the phonetic similarity between the suffix allomorph and the apparent infixing allomorph.

Under an analysis involving two separate allomorphs, *-ht* and *-h-*, this could still be viewed an example of PCSA that functions in order to fulfill a particular surface requirement. It also optimizes words in a more general way, in that it avoids a possible

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[21] This is a term used by Bantuists to describe patterns where an affix fuses with part of a stem; see Bastin 1983, Hyman 1995, and Hyman and Inkelas 1997.

CCC cluster that would occur and need to undergo epenthesis if consonant-final stems took the *-ht* form. Thus, it optimizes syllable structure, and in particular it allows the grammar to avoid having to fix the syllable structure using the general strategy of epenthesis that is otherwise applied in order to break up consonant clusters. Under the analysis with two suppletive allomorphs, this is an example of an infix alternating with a suffix (which is an effect that is predicted by P >> M, though this is the first such example that we have seen so far).[22] Recall, however, that under an imbrication analysis we would not necessarily assume that there are multiple underlying forms that mark plural movement in Kashaya.

Another example where suppletive allomorphs differ in their position in the word is found in Biak (West New Guinean, New Guinea; discussed by Booij 2005: 174-175). In this language, the 2sg is marked by *-w-* or *wa-*, and the 3sg is marked by *-y-* or *i-*. The choice of whether a stem will take the prefix or the infix variant is lexically determined, but there is a clear phonological generalization involved as well, which is that all stems

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[22] Another Californian language that may have exhibited PCSA was Chimariko (Northern Hokan, Northwestern California; Dixon 1910). According to Conathan (2002), based on the unpublished field notes of George Grekoff, a set of pronominal markers had different forms and positions in the word that may have been phonologically conditioned, such that vowel-initial stems took prefixes while consonant-initial stems took suffixes. There are two classes of verbs (Conathan's *set I* and *set II*) that take different sets of affixes, and there may have been additional factors involved, but Grekoff's analysis was purely phonological aside from the distinction between sets I and II (Conathan 2002: 24). Examples from Grekoff's notes appear to support the generalization (if one assumes that some roots assumed by Dixon (1910) to be vowel-initial actually have underlying initial glottal stops). These include forms (Conathan 2002: 20) with vowel-initial roots /**y**-ama/ 'I eat' (set I) and /**čhu**-iman-damu-t/ 'I fell down' (set II), and forms with consonant-initial roots /kow-**ʔi**/ 'I holler' (set I) and /čhele**ʔ-či**-t/ 'I am black' (set II). However, this is not a clear-cut example of PCSA since other researchers (e.g., Dixon 1910) proposed other analyses involving semantic rather than phonological conditioning.

with an initial consonant cluster take the prefix variants for both affixes. Some examples are shown below (Booij 2005: 175).

(40)

	stem	2sg	3sg	gloss
a.	ra	r,**w**,a	r,**y**,a	to go
b.	rov	**wa**-rov	**i**-rov	to fly
c.	kvok	**wa**-kvok	**i**-kvok	to stand up
	snai	**wa**-snai	**i**-snai	to be clear
	smai	**wa**-smai	**i**-smai	to have

A comparison of examples (40)a and b shows that the allomorphy is partly lexically conditioned, since these stems have the same onset but take different allomorphs of the 2sg and 3sg affixes. The examples in (40)c, on the other hand, are representative of all stems in the language having an initial consonant cluster. Stems of this type invariably take the prefix allomorphs. This can be seen as an example of syllable structure optimization because if these stems took the infixing allomorphs, the result would be initial CCC clusters, which are avoided by using the prefix allomorphs of the 2sg and 3sg.

In Korean, as discussed by Odden (1993), some suffixes exhibit allomorphy based on whether the stem-final segment is a consonant or a vowel. The accusative is marked by *-rɨl* after a vowel and *-ɨl* after a consonant; the topic marker takes the form *-nɨn* after a vowel and *-ɨn* after a consonant, and the nominative is marked by *-i* after a consonant and *-ka* after a vowel (Odden 1993: 133). Some examples are shown below (this example is reproduced directly from Odden 1993: 133).

(41)

citation:	param	pori
nominative:	param-**i**	pori-**ka**
accusative:	param-**ɨl**	pori-**rɨl**
topic:	param-**ɨn**	pori-**nɨn**
	'wind'	'barley'

Odden advocates writing (presumably item-specific) rules deleting the initial consonants of the CVC forms of the accusative and topic suffixes to generate the postconsonantal allomorphs. The nominative alternation looks more like suppletive allomorphy, but Odden posits a rule of Nominative Destructuring (1993: 134), which derives the *-i* allomorph from /-ka/ by deleting all of the segmental content of /-ka/, resulting in a mora not associated to any segmental features. The mora then acquires some features via default rules, and ends up surfacing as [i]. While it seems reasonable in some cases to posit item-specific rules rather than suppletive allomorphs, this is probably best limited to cases where the allomorphs are very similar in their surface phonological shape (not the case with *-i* vs. *-ka*) and where the rule relating the allomorphs is a natural rule that is also attested in other languages (also not true of the proposed Nominative Destructuring rule). Although we cannot rule out the possibility that the allomorphs do have a single underlying form and that Nominative Destructuring is responsible for the allomorphy, I will assume for cases like this that there are two underlying forms, not only for the reasons given above but also because it seems likely that a language learner will posit multiple underlying forms if the allomorphs are not similar in shape. Thus, I conclude that the nominative *-i* ~ *-ka* should count as a case of suppletive allomorphy conditioned by C vs. V-final stems and resulting in well-formed syllables. The accusative and topic allomorphy examples, on the other hand, are not necessarily suppletive since both could be derived via a rule deleting a consonant after another consonant (which, even if not a general rule of the language, would generalize at least to these two suffixes).

Also in Korean (Martin 1954: 28, 37-39) there two main verb classes, determined by whether the root is consonant- or vowel-final. Although Martin characterizes these as lexical classes, they are nonetheless unified by a phonological criterion. There are several verb suffixes that have separate forms for the two classes of roots, including the honorific, formal, prospective, processive, declarative, imperative, modifier, adversative and extended adversative, sequential and extended sequential, substantive, conjunctive and extended conjunctive, contingent, assumptive, intentive, purportive, frustrated intentive, prospective assertive, prospective attentive, intentive assertive, and cajolative suffixes. Interestingly, the difference between the two forms of each suffix is not the same in every case. For example, some suffixes (such as the authoritative indicative assertive *-so* ~ *-o*) have an initial *s* with vowel-final roots corresponding to Ø with consonant-final roots; others (such as the conjunctive *-mye* ~ *-umye*) have initial *u* with consonant-final roots corresponding to Ø with vowel-final roots; others (such as the formal indicative assertive *-sumnita* ~ *-mnita*) have both *s* and *u* with consonant-final roots corresponding to Ø with vowel-final roots; while yet others (such as the plain processive assertive *-nunta* ~ *-nta*) have *n* and *u* after consonant-final roots corresponding to Ø with vowel-final roots. Because the different suffixes have different correspondences between allomorphs that occur with consonant vs. vowel-final roots, any rules written to derive the allomorphy would have to be specific to certain affixes or sets of affixes. We could potentially approach these examples using a ‘latent segment’ analysis such as the ones proposed earlier for Midob and Kashaya. Thus, each of these affixes may not necessarily exhibit PCSA.

Kager (1996) discusses a case of allomorphy in Dja:bugay (Pama-Nyungan, Australia; Patz 1991) that seems to optimize syllable structure. In Dja:bugay, the genitive suffix has an *-n* allomorph that occurs with vowel-final stems, and a *-ŋun* allomorph that follows consonant-final stems. Some examples are shown below (examples are from Patz 1991: 269 except where a different page number is given in parentheses).

(42)	guludu-**n**	‘dove-GEN’	girrgirr-**ŋun**	‘bush canary-GEN’
	gurra:-**n**	‘dog-GEN’	gaɲal-**ŋun**	‘goanna-GEN’
	djama-**n**	‘snake-GEN’	bibuy-**ŋun**	‘child-GEN’
	ɲurra-**n**	‘2sg-GEN’ (272)		

According to Kager (1996: 155), Dja:bugay does not allow coda clusters, which could account for the fact that consonant-final stems take *-ŋun* instead of *-n.* However, as Kager acknowledges (1996: 156), this accounts for only part of the distribution, since there appears to be no reason why vowel-final stems cannot also take *-ŋun*. This means that we must have some way of encoding the notion of the specific allomorph and the elsewhere allomorph. A similar problem was encountered in the Warrgamay example in §2.1.2.3.

In Dakota (Siouan, northern United States; Shaw 1980), the 1du/pl marker is marked by either *ų-* or *ųk-* depending on whether the stem begins with a consonant or a vowel, respectively. Examples of the preconsonantal allomorph are shown below (Shaw 1980: 77).[23]

(43)	**ų**-híyu	‘we (dual) start to come’
	ų-híyaya	‘we (dual) go past’
	ų-xá=pi	‘we (pl.) bury’
	ų-xą́=pi	‘we (pl.) do, work’
	ų-k’a	‘we dig it’ (Shaw 1980: 193)[24]

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[23] Shaw includes the word-initial glottal stops that are inserted by rule; I omit these here.

[24] This example is from the Teton dialect rather than the Santee dialect, which is the primary source of Shaw’s data.

As seen below, vowel-initial stems take the *ųk-* prefix (Shaw 1980: 71; data are from the Teton dialect).

(44)	**ųk-**ípi	'we go'
	ųk-úpi	'we are coming'
	ųk-ų́spepi	'we know how'

However, there is further evidence from the behavior of *ʔ*-initial stems suggesting that the pattern of allomorphy seen here may not be suppletive. *ʔ*-initial stems, rather than patterning with other consonant-initial stems in taking the *ų-* allomorph (as would be predicted under the ONSET-driven approach), take the *ųk-* allomorph, as shown below (Shaw 1980: 71). The glottal stop surfaces as glottalization of the /k/ of the prefix.

(45)	**ųk-**'į́yąka	'we run'
	ųk-'į́pi	'we wear it'
	ųk-'ų́pi	'we use it'
	ųk-'ópi	'we shoot it'

In these examples, the roots must have underlying initial glottal stops, because they differ minimally from the true vowel-initial stems in glottalizing the /k/ of the prefix. There are near-minimal pairs in the data above that illustrate this point; e.g., *ųk-úpi* 'we are coming' vs. *ųk-'ų́pi* 'we use it'.

We can account for the behavior of the glottal stop-initial stems if we assume that the 1du/pl marker has a single underlying form, /ųk-/. The /k/ is deleted before another consonant, with the exception of /ʔ/ (this is Shaw's analysis (1980:77)). The exceptionality of /ʔ/ can be handled in one of at least two different ways. The first would be to assume that the rule deleting /k/ is triggered by a consonant with a consonant-place node. This would prevent /ʔ/ from triggering the rule if we assume that /ʔ/ has no place features. Alternatively, we could capture the pattern using rule ordering or its equivalent translation into OT constraints, the idea being that the fusion of the glottal stop with the /k/ of the prefix prevents the deletion of /k/, either because fusion applies ‘first’ or because it is preferenced by the constraint ranking.[25]

We have seen a number of examples here in which allomorphy is conditioned by the C/V distinction and results in optimal syllable structure (in terms of eliminating codas or consonant clusters, or providing syllable onsets). In every case, it is the stem that conditions allomorphy in an affix, and the stem segment that conditions the allomorphy is immediately adjacent to the affix in question.

2.1.2.4 Syllable contact constraint satisfaction

Another phonological factor that we might expect to condition PCSA is syllable contact. In many languages (see Gouskova 2004 for examples and discussion), codas are required to have higher sonority than a following onset, or at least not to exceed the following onset in sonority by more than a specified amount. The Syllable Contact Law (SCL) was formulated for this purpose (see Davis 1998, Rose 2000b for recent

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[25] McCarthy and Prince (1993a) discuss this affix in Dakota, but focus on a set of stems including *ali* ‘climb’ and *manų* ‘steal’ that are said to be lexically specified as taking infixed rather than prefixed person marking (Shaw 1980 does not discuss these stems). McCarthy and Prince cite two examples, *ų***k***-ali* ‘we (du.) climb’ and *ma-ų-nų* ‘we (du.) steal’ (1993a: 114) in support of the claim that the use of prefixed *ųk*- in *ųk-ali* is determined by ranking the phonological constraint ONSET over the morphological constraint ALIGN-ROOT. Though it is implied that these constraints are also responsible for the selection of allomorphs, the selection follows naturally from the generalization that vowel-initial stems take *ųk*- while consonant-initial stems take *ų*-, and it is really the placement of the affix (prefix vs. infix) that is relevant in McCarthy and Prince’s discussion.

implementations). Most recently, Gouskova (2004) has proposed a hierarchy of relational constraints to account for the range of syllable contact effects found in a number of languages. Regardless of the specific implementation, many analyses make use of phonological constraints to account for syllable contact phenomena, and therefore the P >> M model predicts that we should find cases of PCSA driven by these constraints. Two possible examples of this were found in the present survey, both in Martuthunira (Pama-Nyungan, Australia; Dench 1995), though as will be discussed, these may not be true cases of suppletive allomorphy.

The first example is found in the accusative and genitive suffixes in Martuthunira, which exhibit allomorphy based on the root-final segment when marking common nouns (Dench 1995: 63). Following a nasal, the accusative and the genitive take the form *-ku* *(*(46)a). Following a lateral or rhotic, both suffixes take the form *-yu* ((46)b) (the only consonants allowed at the end of a word are nasals, laterals, and rhotics (Dench 1995: 30); this apparently holds for roots as well). With vowel-final stems, the accusative lengthens the final vowel, while the genitive is marked by *-wu* ((46)c) (examples are from Dench 1995: 91 except where page numbers are given).

(46) a. tharlwan-**ku**-wuyu
tame-ACC-SIDE
'on the tame side' (98)
b. tharratal-**yu**
bird(sp.)-GEN
'*tharratal*'s'
c. nhartu-**u** nganaju-**wu**-lu yaan-tu
something-ACC 1SG.OBL-GEN-EFF spouse-EFF
'(about) something' (98) '...by my wife'

The alternation involving consonant feature assimilation is the *-ku* ~ *-yu* alternation conditioned by nasal vs. liquid-final roots, respectively. According to Dench, 'a number of morphemes' exhibit lenition of *k* to *y* after a stem-final lateral or rhotic (1995: 38), but the only morpheme that is cited as exhibiting the alternation aside from the accusative and genitive is the 'body-noise' verbal derivational suffix, which takes the form *-karri* after nasals and *-yarri* after laterals and rhotics (1995: 38). It is not clear what form the body-noise suffix takes after vowels since the suffix is not fully productive.

Another, related example is the 'belonging' suffix in Martuthunira, which takes the form *-ngura* when marking proper nouns, pronouns, and demonstratives; otherwise, the suffix *-kura* is used after nasals ((47)a), and *-wura* after a vowel, rhotic, or lateral ((47)b) (Dench 1995: 64). Some examples are given below (Dench 1995: 91).

(47) a. ngurnu-**ngura** parnparn-**kura**
that.OBL-BELONG budgerigar-BELONG
'...belonging to that budgerigar...'

b. yirna-tharra-**wura**-a kanparr-**wura**
this.OBL-DU-BELONG-ACC spider-BELONG
'...the ones belonging to these two' '...of the spider's...'

The relevant alternation here is the *k* ~ *w* alternation between nasals vs. rhotics and laterals. This parallels the situation for the accusative, genitive, and body-noise suffixes described above, except that in this case *k* alternates with *w* instead of *y*. The belonging suffix is apparently the only suffix to exhibit this particular alternation.

Considering only the allomorphs that occur after consonants here, both of these examples from Martuthunira can be analyzed in terms of syllable contact. In both cases, a possible generalization is that sonority is not allowed to increase by three or more points on the syllable contact scale as formulated by Gouskova (2004: 211). Gouskova (2004: 208) uses the sonority scale laid out by Jespersen (1904: 191): glides > rhotics > laterals > nasals > voiced fricatives > voiced stops > voiceless fricatives > voiceless stops.

Applying this scale to the accusative/genitive suffix, we see that the sequence *n.k* is permitted, and *r.y* is permitted, while *n.y* does not occur. On Gouskova's scale, these sequences would correspond to a change in sonority of -4, +1, and +3, respectively. If the grammar does not allow an increase of three points between the coda and following onset, then we can account for why *n.y* is not allowed and why the accusative/genitive surfaces as *-ku* instead of *-yu* after nasals. The same principle can be applied to the belonging suffix allomorphs *-kura* and *-wura*. The sequence *n.w* would result in a change of +3, which is not allowed, and therefore the *-kura* allomorph is used after nasals. We could use the relational constraints used by Gouskova (2004) to account for this phenomenon in a P >> M analysis.

However, a P >> M analysis may not be necessary. It is unclear whether glide ~ *k* alternations involve suppletive allomorphy. If we assumed that the glide-initial allomorph were the underlying form in each case, then we could write a single phonological rule or set of constraints that could change a glide into [k] after a nasal, either because of the syllable contact principles discussed here, or perhaps because the feature [-continuant] spreads from the nasal to the glide. This would account for all of the forms of the belonging suffix and also the postconsonantal allomorphs of the accusative/genitive suffixes, leaving only the postvocalic forms of the accusative/genitive to account for. We may need to posit separate postvocalic allomorphs /-V/ and /-wu/ for the accusative and genitive suffixes, respectively. These would probably be considered suppletive allomorphs, and note that their distribution does not appear to be optimizing; this anticipates some examples to be discussed in the following section in which entire patterns of suppletive allomorphy are non-optimizing or even detrimental in terms of well-formedness.

In this section, we have seen two examples from Martuthunira in which allomorphy seems to result in optimized syllable contact configurations. As discussed, though, these cases may not necessarily involve suppletive allomorphy, and therefore we cannot be sure that we have a case of PCSA driven by syllable contact considerations.

2.1.2.5 Non-optimization

Though the examples in the preceding sections have all been cases where the distribution of allomorphs can be construed as phonologically optimizing or at least could arguably be accounted for using phonological constraints that have already been proposed in the literature, this is by no means always the case (see, e.g., Paster 2005a on non-optimization in 'syllable-counting allomorphy', a type of PCSA to be discussed in chapter 4; see also Bye to appear for several examples and discussion of non-optimizing PCSA). In many instances, PCSA is neutral or even detrimental with respect to the overall well-formedness of the word. Such 'non-optimizing' examples are discussed in this section. An important point should made here, which is that I do not claim that there are no phonological constraints that have ever been proposed or will be proposed that could possibly account for the allomorphy exhibited in these examples. Presumably there is some P >> M account that could be proposed for every example if we allow the use of stipulated, language-specific P constraints. However, as will become clear in the presentation of examples, characterizing these examples in terms of optimization would be to mischaracterize them. They do not appear to relate to any universal well-formedness generalizations, nor does any example appear to follow from the general phonotactics of the language.

Under P >> M, we do not expect non-optimizing PCSA to be very common since their phonological counterparts, ‘crazy rules’ (Bach and Harms 1972), though attested, are not particularly common and do not result from universal phonological constraints.[26] In this section, we will see many examples of PCSA that are non-optimizing. In an OT account using P >> M, each of these cases would require a language-specific, stipulated constraint to create the pattern of allomorphy. This is also true of crazy rules, but the PCSA examples are more problematic because it seems that non-optimizing examples of PCSA are more frequent relative to the total number of examples of PCSA than crazy rules are to the total number of attested phonological rules.

There are 12 examples to be discussed in this section. The first set of examples includes cases where PCSA is conditioned by the C/V distinction but the pattern nonetheless does not seem to involve syllable structure optimization. These examples can be contrasted with those presented in §2.1.2.3, where some instances of C/V conditioned allomorphy seemed to optimize syllables by avoiding consonant clusters and/or vowel hiatus. The existence of the examples to be discussed here demonstrates that PCSA can refer directly and arbitrarily to the C/V distinction, and that this does not always reduce to syllable structure considerations. As will be seen, in every case, the relevant consonant or vowel of the stem is at the edge of stem where the affix attaches.

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[26] In fact, if we assume a version of OT in which constraints are universal and cannot be language-specific, then under P >> M we would never expect to find non-optimizing PCSA (though a version of OT with universal constraints would have difficulty handling crazy rules as well, so presumably whatever ‘patch’ were applied to the model to account for crazy rules could also account for non-optimizing PCSA).

One example of apparently non-optimizing allomorphy conditioned by the C/V distinction is found in Turkish (Lewis 1967). The Turkish passive is marked by *-n* following a stem ending in a vowel ((48)a) or in /l/ ((48)b), and by *-l* elsewhere ((48)c). Examples are shown below (Underhill 1976: 332).

(48)	a.	ara-**n**-	‘be sought’
		de-**n**-	‘be said’
		oku-**n**-	‘be read
	b.	çal-**ın**-	‘be struck’
		bil-**in**-	‘be known’
	c.	kullan-**ıl**-	‘be used’
		yor-**ul**-	‘be tired’
		kaybed-**il**-	‘be lost’

We can treat the alternation between -C and -VC forms of each allomorph as epenthetic, so we are left with two underlying forms, *-n* and *-l*, whose distribution is determined primarily by the C/V distinction with no apparent optimizing effect on syllable structure or any other aspect of well-formedness. This is an example in which C/V conditioned PCSA cannot be driven by syllable structure constraints. The overall pattern of allomorphy in the passive suffix is not entirely arbitrary, however, since the use of *-n* with stems ending in /l/ is dissimilatory. Turkish does not exhibit sonorant dissimilation elsewhere in the system (Kornfilt 1997: 510-511), so this aspect of the allomorphy could be suppletive as well, though the dissimilation could also be said to result from an item-specific dissimilation rule. Regardless, the pattern of allomorphy involving the distinction between consonant- and vowel-final stems does not appear to be optimizing in any way.

An interesting observation about this pattern is that, as with the Turkish causative suffixes described in §2.1.2.3, the allomorphy prevents sequences of identical affixes, as discussed by Haig (to appear). In Turkish words with a ‘double passive’, the two passive allomorphs will never have the same shape, since the attachment of one variant to form the first passive automatically conditions the use of the other variant to form the double passive. When the first passive is marked by *-n*, then the second passive is marked by *-l*, and vice versa. Examples are from Underhill (1976: 332), except where noted.

(49) de-**n**-**il**- ‘say (double passive)’
iste-**n**-**il**- ‘want (double passive)’
döv-**ül**-**ün**- ‘hit (double passive)’ (Haig to appear: 5)

It is possible that avoidance of repeated morphemes had something to do with the historical origins of the modern allomorphy pattern, but just as in the causative example discussed earlier, this cannot be responsible for the overall pattern. Using a constraint against repeated morphemes would account only for the distribution of allomorphs in words with double causatives and would not explain the pattern as a whole. Thus, we still need either an item-specific rule of dissimilation or a subcategorizational requirement to account for the use of *-n* with *l*-final stems.

An unusual case of non-optimizing C/V-sensitive PCSA is found in Mafa (Chadic, Cameroon). Le Bleis and Barreteau (1987) report that in the verbal suffix indicating ‘le directionnel de rapprochement’ occurs as *-ká* when preceding a word that begins with a consonant, and as *-káɗá* elsewhere (Le Bleis and Barreteau 1987: 108-109; English translations mine).

(50) á mbálə-**ká** kəda
il-INACC chasser-RAPPR chien
‘il court après le chien vers nous’
[‘he runs after the dog towards us’]

m ɓálə-**ká** yim (á duwzlak)
(no interlinear glosses provided)
‘il a puisé de l’eau (l’a versée dans la jarre) et l’a rapportée’
[‘he drew some water (poured it in the jar) and brought it back’]

n	tə́v-**káɗa**	aa	gírzhe
il-ACC	monter-RAPPR	sur	rocher

‘il est monté sur le rocher (qui se trouve entre l’endroit d’où il vient et celui où se trouve le locateur)’
[‘he climbed onto the rock (which is located between the location from which he came and the location of the speaker)’]

kalədə-**káɗá**
tomber.CAUS-RAPPR
‘jette-le vers moi!’
[‘throw it towards me!’]

This example is particularly interesting in that the allomorph distribution seems to be determined by a property of a separate word from the one to which the affix in question belongs. No other examples having this property were revealed by the survey. Even in the case of English *a/an* discussed in §2.1.2.3, the morpheme that is affected is a clitic and therefore part of the same phonological word as what follows despite being a separate morphosyntactic word. We do not have evidence for the directional morpheme in Mafa being a clitic; it is not described as having other properties that we could use to argue that it is a clitic rather than an affix (for example, it seems always to occur immediately after the verb stem rather than allowing other words to intervene). However, perhaps with more data we could argue that this morpheme is, in fact, a clitic. In any case, since it is the only apparent example exhibiting conditioning by a separate phonological word, we do not have enough evidence to conclude that PCSA in an affix can refer to a property of a separate phonological word.

Aside from the problem of the word-external conditioning, another point to be made regarding the Mafa example is that there is no apparent functional motivation for the distribution of the allomorphs. Both allomorphs are vowel-final and should syllabify equally well with the following word regardless of whether it is consonant- or vowel-initial. Therefore, this is another case of PCSA whose effect is neutral rather than optimizing.

Another case of PCSA conditioned by consonants vs. vowels is found in Winnebago (Siouan, Wisconsin; Lipkind 1945). Here, the declarative is marked by the suffix /-nə̃/ after vowel-final roots and by /-sə́nə̃/ after consonant-final roots, as shown in the examples below (Lipkind 1945: 33). No examples of the postconsonantal allomorph are given.

(51)	wa-jəra	sepsə́-**nə̃**	nãná	tira-je-**nə̃**
	boat-DEF	black-DEC	tree-DEF	move-standing.position-DEC
	‘the boat was black’		‘the tree is growing’	
	wasí-**nə̃**-gi	nã-wãnã-**nə̃**		
	dance-COND-SUBORD	sing.1sg-COND-DEC		
	‘if he danced I would sing’			

Despite the fact that we can recognize the post-vocalic allomorph in the shape of the post-consonantal allomorph, this is a clear case of suppletion because if these allomorphs reduced to a single underlying form, we would have to write a highly unnatural and unusual rule inserting or deleting [sə́]. It is possible that /sə́/ could be a separate morpheme, perhaps an empty morpheme that is added to consonant-final roots to form stems. However, even if this is true, there is no apparent motivation for its presence in that environment. Regardless of whether /sə́/ is a separate morpheme or just a part of the /-sə́nə̃/ allomorph, its distribution is still arbitrary and non-optimizing since it does not affect syllable structure or any other apparent factor in the well-formedness of words in Winnebago. The condition on allomorphy (the C/V distinction) does not seem to relate to the differences between the allomorphs (the most salient of which is their syllable count).

Another case in which PCSA is conditioned by the C/V distinction but does not result in syllable structure optimization is found in Jivaro (Jivaroan, Ecuador; de Maria 1918). In Jivaro, the negative is marked by one of two suffix allomorphs, as follows (de Maria 1918: 9). Among nouns, adjectives, and adverbs, all stems ending in a consonant take the negative suffix *-cha*. Also, ‘some’ verbs take *-cha* (this is not addressed further, so apparently verbs have lexically specified negative forms). Among vowel-final stems, there is a distinction between monosyllabic and polysyllabic stems. All polysyllabic vowel-final stems take *-chu*. Among monosyllabic stems, those ending in /e/, /i/, or /a/ take *-cha*. All other stems are said to take *-chu* (though no examples of monosyllabic stems not ending in /e/, /i/, or /a/ are given). The distribution is shown in the examples below (de Maria 1918: 9).

(52)	Apár-**cha**	‘no padre’
	Puéngar-**cha**	‘no bueno’
	Aho-**chu**	‘no él’
	Tuná-**chu**	‘no tonto’
	Ví-**cha**-itijae	‘no soy yo’

Though this is a complicated pattern, the element of PCSA here seems to be that consonant-final stems take the *-cha* allomorph and vowel-final stems take the *-chu* allomorph (though, as to be discussed, the vowel of this suffix undergoes a vowel harmony rule that complicates the picture). Looking only at the suppletive distribution of allomorphs based on consonant- vs. vowel-final stems, this is an example of non-optimizing allomorphy because there is no apparent way in which the distribution improves the overall well-formedness of words containing either type of stem. What is interesting about this case, as in the Winnebago example described above, is that although the allomorphs are distributed based on whether the stem is consonant- or vowel-final, the pattern ends up having no effect on syllable structure.

The distribution of *-chu* vs. *-cha* on vowel-final stems can be derived by rule from underlying /-chu/. One thing to notice about the distribution of these allomorphs is that *-cha* occurs when the stem has a front vowel (assuming that /a/ is a front vowel) and when the suffix can form a single disyllabic foot with the stem (i.e., when the stem is monosyllabic). This suggests that there could be a foot-bounded fronting harmony process responsible for the change of /u/ to [a] in the suffix. When the stem has two syllables, even if the stem-final syllable has a front vowel, the suffix vowel surfaces as [u] because the stem forms its own foot to the exclusion of the suffix, and therefore the suffix vowel /u/ is outside the domain of fronting harmony. The one troubling fact about this proposed harmony rule is that we would expect it to change /u/ to its high, front counterpart [i] rather than the low vowel [a]. However, given that the process appears to be so regular and that it accounts for a pattern of allomorphy that is otherwise mystifying, we should accept this one complication to the rule. There is further reason to assume that this is a regular rule of the language, which is that it also applies to the genitive suffix, to be described below.

The genitive suffix in Jivaro exhibits allomorphy that is very similar to that of the negative suffix, except that there are four surface allomorphs. The generalization is as follows (de Maria 1918: 6). All stems ending in a consonant take the *-na* suffix. All stems ending in /e/ take *-ña*. Among stems ending in /i/, polysyllabic stems take *-ñu*, while monosyllabic stems take *-ña*. All other stems (that is, stems ending in any vowel except *i* or *e*) take *-nu.*[27] Examples are shown below (de Maria 1918: 6).[28]

(53)			
	Yátzúm	Yatzúm-**na**	
	Gé	Gé-**ña**	
	Nucurí	Nucurí-**ñu**	'your mother's'
	Vi	Vi-**ña**	'my'
	Apa	Apá-**nu**	'father's'
	Aho	Aho-**nu**	'his'
	Núcu	Nucú-**nu**	

The number of underlying forms can be reduced if we assume that the *n* ~ *ñ* alternation results from palatalization following *i* or *e.*[29] This leaves us with two suppletive allomorphs, distributed as follows: stems ending in a consonant take *-na*. Stems ending in /e/ take *-na*. Among stems ending in /i/, those with one syllable take *-na*. All other stems take *-nu*. We can simplify this, as we did above for the negative, as follows. Consonant-final stems take *-na*, and vowel-final stems take *-nu.* The same vowel fronting harmony described above applies to the suffix vowel when the stem vowel is front and when the suffix syllable can form a foot with the stem, resulting in *-na*.

There are two minor problems with this. The first is that, unlike for the negative, we have examples of the genitive suffix combining with trisyllabic stems. Under the analysis assuming a foot-based harmony domain, we would expect trisyllabic forms to behave like monosyllabic stems, since the first two syllables of the stem can form a disyllabic foot, leaving the stem-final syllable to form a foot along with the suffix,

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[27] In the very closely related language/dialect Achuar, the genitive allomorphs are *-nau* and *-nu* (Fast Mowitz et al 1996: 31). Though the distribution of these allomorphs is not discussed, the two examples given (*áints-nau* 'de un hombre' and *nuwá-nu* 'de una mujer') are consistent with the distribution in Jivaro if we assume that Achuar *-nau* corresponds to Jivaro *-na*.

[28] Examples are not glossed; the glosses here are from Fast Mowitz et al (1996) and Jintia et al (2000).

[29] Fast Mowitz et al (1996: 15) document a rule in Achuar in which some consonants are palatalized following /i/.

thereby creating a domain in which the harmony rule can apply. However, as seen in the example *Nucurí-ñu* above, this is not what happens. Instead, trisyllabic stems behave like disyllabic stems in not triggering the vowel harmony rule. A possible explanation for this is that perhaps Jivaro allows trisyllabic feet in cases where this would allow the right edge of a stem to be aligned with the right edge of a foot. Thus, the example *Nucurí-ñu* would be footed as $(\text{Nucurí})_{\text{Ft}}$-ñu, thus explaining the failure of the suffix vowel to undergo harmony. The second problem is that, unlike the in negative example described above, the genitive suffix vowel is claimed not to surface as [a] when the stem vowel is /a/. The only genitive example provided that has a stem-final /a/ happens also to have a disyllabic stem, so the suffix vowel would not be expected to undergo harmony in this example anyway. With no further examples, I will assume that monosyllabic stems with final /a/ do take the *-na* allomorph, since otherwise the application of the harmony rule to the genitive suffix exactly parallels its application to the negative suffix.

The PCSA seen in both the genitive and the negative suffixes in Jivaro has been argued to reduce to allomorphy conditioned by whether the stem ends in a consonant or a vowel. As in the Winnebago example discussed above, this example is of interest because unlike some other examples involving conditioning of this type, the pattern seen here does not optimize syllable structure. Therefore, the distribution based on the C/V distinction is not simply an artifact of syllable optimization. If the allomorphy optimized syllables, we might have been able to state the generalization in terms of syllable types and structures such as ‘onset,’ ‘nucleus,’ and ‘coda’ instead of C and V. Since this is not the case, we must conclude that the mechanism responsible for PCSA is able to refer directly to C and V.

Another example of C/V conditioned allomorphy is found in Haitian Creole (Hall 1953, Klein 2003). In this language, there is a determiner whose form varies between *-a* and *-la* in a pattern that is the exact opposite of what would be expected if the pattern optimized CV syllable structure: *-a* occurs after vowel-final stems while *-la* occurs after consonant-final stems. Some examples are shown below (Hall 1953: 32).

(54)	panié-**a**	'the basket'	pitit-**la**	'the child'
	trou-**a**	'the hole'	ãj-**la**	'the angel'
	figi-**a**	'the face'	kay-**la**	'the house'
	chẽ-**ã**	'the dog'	madãm-**lã**	'the lady'

In this example, if regular phonological well-formedness constraints were responsible for the allomorphy, we would have expected the opposite distribution, since this would avoid coda consonants and vowel hiatus. In this case, then, the allomorphy is not only non-optimizing, but it is 'perverse' in the sense that it makes words less phonologically optimal with respect to syllable structure (see also Bye to appear for discussion of this example).[30]

We could analyze this as non-suppletive allomorphy resulting from deletion of /l/ between vowels. However, this would not be a general rule of the language, and it is also

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[30] Bonet et al (in press) propose an analysis of this example in terms of P constraints on syllable contact and alignment of stems with syllable boundaries. Such an analysis requires proposing a PRIORITY constraint stipulating that the /a/ allomorph takes precedence over the /la/ allomorph. The analysis requires many constraints and is arguably much more complex than a subcategorization account, but Bonet et al reject the subcategorization approach to this example in footnote 11 on the grounds that '… just stating the distribution misses a phonological generalization; the choice is not random but systematic, and the systematicity is directly related to phonological information.' If 'systematic' here is meant to mean 'phonologically natural', then it is not clear that the statement is true at all, since the constraint-based analysis crucially depends on a stipulated priority relationship between allomorphs. If, instead, 'systematic' merely means 'able to be captured via reference to a consistent phonological generalization,' then the subcategorization approach is just as well-equipped to capture the generalization as is the account proposed by Bonet et al.

an unnatural rule since it results in VV sequences and since V_V is an ideal environment for a consonant to be perceived and produced. Thus, even if this were analyzed as a ‘crazy rule’ rather than PCSA, we would still have difficulty accounting for it using regular, natural phonological constraints.

Another potential alternative analysis is a ‘ghost consonant’ analysis as discussed for the Midob example in §2.1.2.3 (in fact, analyses of Haitian involving ghost consonants (or ‘floating segments’) are proposed by Cadely 2002 and Nikiema 1999). The determiner could be represented as /-(l)a/ with a ‘latent’ /l/ consisting of consonant features not attached to any root node (following the representation advocated by Zoll 1996: 48) that would only surface when a root node is inserted for its features to associate to. One problem for such an analysis is that we would have to explain why a root node is inserted in the context C_V but not in the context V_V; the pattern would still be non-optimizing even if it were not analyzed as suppletive. Another problem for a ‘ghost consonant’ analysis of this phenomenon is that when the stem has a final [+ATR] vowel, a glide is inserted between the stem and suffix (Klein 2003), as seen below.

(55)	pape[j]-**a**	‘the paper’
	bato[w]-**a**	‘the boat’
	lapli[j]-**a**	‘the father’
	tu[w]-**a**	‘the hole’

In an OT analysis involving a latent suffix-initial /l/, we would have to explain why a different consonant gets inserted in this context. Since the choice of the inserted glide is predictable from the roundness of the stem-final vowel, we would not want to supply the inserted glide with underlying consonant features. However, if the glide insertion rule simply inserted a root node, then we might expect the root node to take on the features of the latent /l/ rather than taking on features from the preceding vowel, since this would avoid the violation of MAX that would be incurred when the latent features of /l/ failed to surface.

Two points should be made regarding glide insertion in the Haitian Creole examples. First, there is the question of whether this example can be claimed to be 'non-optimizing', given that these examples with the *-a* suffix do end up having well-formed CV syllables on the surface. Since glide insertion applies only to stems ending in a [+ATR] vowel, the distribution of allomorphy still does create VV sequences in words where the stem ends in a [-ATR] vowel. Therefore, the result of the allomorphy is that some words are indeed less well-formed, with respect to the constraint ONSET, than they would be with the opposite distribution of allomorphs. A second point is that in words which undergo glide insertion, the condition that determines allomorphy (C- vs. V-final stem) is rendered opaque, since the suffix in these words does end up being preceded by a consonant rather than a vowel. This suggests that glide insertion operates on the output of suffixation, rather than applying at the same time as the suffix allomorph is selected. In §2.1.2.6, I discuss more examples in which conditions on allomorph distribution are rendered opaque by phonological processes.

Some examples of non-optimizing PCSA involve conditioning by features of a consonant or vowel in the stem. As with the C/V-conditioned cases described above, in these examples the triggering segment of the stem is always at the same edge at which the affix attaches. In these examples, unlike in the assimilatory and dissimilatory examples presented in §2.1.2.1 and §2.1.2.2, the features that condition allomorphy do not seem to be related to features of the suppletive allomorphs. This makes it difficult to account for these examples in terms of any well-known phonological constraints.

Harris (1979: 288-289) discusses an interesting case of allomorphy in Spanish that is conditioned by vowel quality. According to Harris, the imperfective aspect is marked by *-a* following /i/, and as *-ba* elsewhere. Examples are provided below (Harris 1979: 288).

(56)	viví-**a**	'lived'	pasá-**ba**	'passed'
	caí-**a**	'fell'	tomá-**ba**	'took'

Harris (1979: 289) proposes a rule of *b* → *Ø* after /i/ and a morpheme boundary, but since the rule would only apply to the imperfective suffix and since this rule is apparently not phonetically motivated, it seems more reasonable to posit two separate underlying forms, /-a/ and /-ba/. This does not seem to be a common rule type cross-linguistically, and there is no immediately apparent phonetic motivation for deleting /b/ after a high vowel.

A second example in which PCSA is triggered by stem-final vowel features is found in Yucunany Mixtepec Mixtec (Otomanguean, Mexico; Paster and Beam de Azcona 2005). This language exhibits another pattern of allomorphy that does not seem to maximize phonological well-formedness (though as to be discussed, depending on one's perspective, the pattern could be said to be optimizing in a different way). In this language, the distribution of allomorphs of the third person singular familiar (subject and possessor) is determined by the final vowel of the root. The allomorphs, *-à* and *-ì*, occur in place of the final vowel of the verb or noun phrase and are selected based on the quality of the final vowel. When the final vowel is [i], the third person singular familiar is marked using the *à* allomorph; with all other final vowels, the *-ì* allomorph is used. All native roots end in vowels, but there are some consonant-final Spanish loanwords that take *-ñaà*; this is allomorph is probably better viewed as being specific to loanwords rather than conditioned by the root-final segment. Examples of the -*à* allomorph are given below (Paster and Beam de Azcona 2005: 74; underlining indicates nasalization).

(57)	sì̲’i̲	‘leg’	sì̲’**a̲à̲**	‘his leg’
	kachìí	‘cotton’	kachì**áà**	‘his cotton’
	tzí’ì yù	‘I am dying’	tzí’**à**	‘she is dying’

Occurrences of the -*ì* allomorph are shown below (Paster and Beam de Azcona 2005: 74).

(58)	sàmá	‘clothing’	sàm**îì**	‘his clothing’
	vàá’a	‘bad’	vàá’**ì**	‘it is bad’
	tá’a	‘relative’	tá’**ì**	‘his relative’
	nda’á	‘hand’	nda’**îì**	‘her hand’
	ma tzá’nu̲	‘grandmother’	ma tzá’n**ì**	‘her grandmother’
	kù’ù	‘woman’s sister’	kù’**ì**	‘her sister’

This pattern does not make more well-formed words in any obvious way. It does, however, have the effect of preventing homophony with the plain form, since plain stems ending in L-toned [i] would be homophonous with their 3sg familiar forms if the -*à* allomorph were not available. In addition, the use of -*à* prevents homophony with the 1sg form of underlyingly H-M and M-M roots ending in [i], which would otherwise take the same form in the 3sg familiar. Both allomorphs consist of a single vowel that takes the place of the root-final vowel, but the pattern is not derivable via a regular phonological rule of the language. I conclude that the allomorphy is suppletive, and though it apparently does not optimize the phonological well-formedness of individual words, one might argue that it maximizes distinctness among morphologically related words. If one is willing to posit phonological constraints enforcing non-homophony within paradigms, then perhaps this example could be analyzed along these lines using the P >> M model.

The survey also revealed some examples in which allomorphy is triggered by features of stem-peripheral consonants. For example, the locative suffix in Martuthunira (Dench 1995) exhibits non-optimizing allomorphy based on both the root-final segment and on mora count. Bimoraic stems with a final vowel take *-ngka*, stems with three or more morae with a final vowel take *-la*, stems with final *n* take *-ta*, stems with final *rn* (apico-postalveolar nasal) take *-rta* (*rt* is an apico-postalveolar stop), stems with final *ny* or *nh* (lamino-palatal or lamino-dental nasal) take *-tha*, (*th* is a lamino-dental stop) and stems with a final rhotic or lateral take *-a* (Dench 1995: 64). The effector suffix has the same shape as the locative in all of these contexts, except that in each case, the effector suffix has /u/ rather than /a/. The sensitivity to mora count seen here will be taken up in chapter 4; for our present purposes, we will focus on the allomorphy that relates to whether the stem ends in a nasal or a liquid. Examples are given below (with page numbers from Dench 1995 in parentheses), though no examples of the *-rta* or *-tha* form are provided.

(59)

panyu-**ngka**-a
good-LOC-ACC
'in a better (tree)' (73)

yartapalyu-**la**
other.group-LOC
'...out of that other mob' (75)

kalyaran-**ta**-a
tree-LOC-ACC
'in a tree' (73)

kuyil-**a**
bad-LOC
'on that bad (hill)' (94)

The aspect of this pattern of interest here is the *-ta* ~ *-rta* ~ *-tha* ~ *-a* alternation in the locative suffix, and the corresponding *-tu* ~ *-rtu* ~ *-thu* ~ *-u* pattern of the effector suffix. It seems possible that /t/ is not part of the locative or effector suffixes, but some kind of stem-former or empty morpheme that can be used with the locative and effector suffixes; regardless of whether it belongs to the suffixes or the stem, the alternation exhibited in the consonant in this position should be explained. Dench (1995: 41) proposes an assimilation rule to account for the first three of each of these allomorph sets, leaving us with two basic locative allomorphs, /-ta/ and /-a/, and two basic effector allomorphs, /-tu/ and /-u/. Assuming Dench's assimilation rule, we still need to explain the -V form of the suffixes after a rhotic or lateral. This could be handled via a rule specific to this affix that deletes /t/ following a liquid, but the rule would be unmotivated since if anything, liquids seem to make better codas than other consonants. The result of this case of PCSA can therefore be said to be phonetically unnatural. Here the feature that distinguishes nasals from other sonorant consonants (whether it is [±liquid], [±nasal], [±continuant], or some combination of these is not important here) causes an allomorph to be used that has no initial consonant; this is parallel to a phonological rule deleting the initial consonant of the suffix after a [liquid] consonant. We could analyze this in terms of a constraint such as *LT banning voiceless consonants after a liquid, an extension of the *NT constraint (referred to as *NC̥) used by, e.g., Pater (1999). Paster (2004: 389) proposed a constraint *NT/lT banning voiceless consonants after nasals and /l/, but the use of that particular constraint for Martuthunira would not work since in that case we would expect the vowel-initial suffix allomorph to occur after nasals as well as liquids. We would therefore need a more specific constraint *LT referring only to liquids and not nasals; we would also need to explain why *NT was not also active in a language with *LT, since *NT effects seem to be common and are phonetically well-motivated, probably by the same mechanism that would be responsible for *LT.[31] It may thus be possible to account for this pattern if we propose a new constraint, but it is not at all clear that the overall pattern

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[31] See Pater 1999 for further discussion of *NT.

is optimizing. Certainly, this example is not like the other Martuthunira examples seen in the previous section that appear to be driven by syllable contact considerations. Since nasals are considered to be less sonorous than /l/, we might expect that the sequence *l.t* should be preferred over *n.t* and therefore that the *t*-initial suffix allomorphs should occur after /l/ and not after nasals. Viewed in this way, we might almost say that the pattern of allomorphy here is the exact opposite of what we would expect if it were optimizing.

A second example of apparently non-optimizing PCSA conditioned by consonant features is found in Nishnaabemwin (Algonquian, Ontario; Valentine 2001), where the conjunct order third person suffix takes the form *-g* following a nasal-final stem and *-d* following other stems (except in some conjunct negatives) (Valentine 2001: 227). Some examples are provided below.[32]

(60)	dgoshin-**g**	'if/when ANsg arrives'
	boodwe-**d**	'if/when ANsg builds a fire'
	dgoshnini-**d**	'if/when ANsg (obv.) arrives'

There is no indication of a general rule of *d* → *g* elsewhere in the language, and there do exist *nd* sequences, including coda clusters, as in the examples below (*nd* sequences appear in bold; page numbers are from Valentine 2001).

(61)	bbaamaa**nd**we	'climb around' (375)
	gaa**nd**nan	'push X (with an instrument' (427)
	naagdawenmi**nd**	'(CONJ) ANsg is taken care of' (563)
	niinwi**nd**	'we/us/our' (574)
	aani**nd**	'some' (575)

Although the *-g* and *-d* allomorphs have a similar phonological shape, an item-specific rule changing *d* to *g* after nasals would be unnatural since there is no apparent phonetic

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[32] Valentine indicates (2001:74) that final *ng* reduces to [ŋ]; it is not clear whether this applies only to *ng* or to final nasal+stop sequences in general. A general postnasal stop deletion rule is not included in the discussion of phonological processes applying to consonants (Valentine 2001: 73-89).

motivation for such a rule. This is an example where PCSA has a ‘neutral’ effect (i.e., no effect) on the well-formedness of words, since there is no phonological optimization in this pattern, and the distribution of allomorphs could just as easily be reversed or reduced to a single allomorph in all environments without any change in the number of violations of phonological well-formedness constraints.[33]

In Kashaya, the absolutive involves suppletion conditioned in part by the final consonant of the stem (Buckley 1994: 336, Oswalt 1960: 265). Buckley states that the allomorphs of the absolutive are distributed as follows: the suffix *-w* occurs after a vowel ((62)a), *-i* occurs after *n’* (and later undergoes [+round] insertion, surfacing as [u]) ((62)b), and *-ʔ* occurs elsewhere ((62)c).[34] Examples are from Oswalt 1960: 265, except where noted.

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[33] Another example involving conditioning by a stem-final nasal is found in Northern Sotho (Bantu, South Africa; Kosch 1998). According to Kosch (1998: 35-36), Northern Sotho exhibits phonologically conditioned allomorphy in the past tense suffix *-ile* / *-e*. The past tense is marked with *-ile* (e.g. *-rut-ile* ‘teach-past’) except after certain verb roots, all of which end in a nasal (e.g. *-em-e* ‘stand-past’ and *-bon-e* [no gloss]). This suggests that the selection of the *-e* allomorph may be conditioned by the presence of a root-final nasal, though Kosch acknowledges that there are some cases in which a nasal-final root takes *-ile* (e.g. *-rom-ile* ‘send-past’). It is unclear how many nasal-final roots take *-ile*, but Kosch implies that there are several. However, Kosch claims that the allomorphy was strictly phonologically conditioned at an earlier stage of the language. The allomorph distribution seems to have nothing to do with the conditioning factor, namely the presence of a final nasal. One possibility is that there is a dispreference for a high vowel following a nasal, though there does not appear to be any such dispreference exhibited elsewhere in the language. Thus, ‘pre-Northern Sotho,’ if it did indeed exhibit exceptionless phonological allomorph distribution, would constitute another example where allomorphy is not obviously optimizing and the nasal feature that triggers the allomorphy has no clear relationship with the shape of the allomorphs.

[34] This is essentially the same as Oswalt’s (1960: 265) characterization except that Buckley’s *n’* corresponds to Oswalt’s *d*, and Oswalt assumed that the absolutive allomorph for stems ending in this segment was /-u/ rather than /-i/ with [+round] insertion.

(62) a.	mo-ˑla-**w**	‘to run down’
	bahcú-**w**	‘to jump’ (Buckley 1994: 61)
	ca-hcí-**w**	‘to sit down’ (Buckley 1994: 61)
b.	mo-laˑmed-**u**	‘to keep running down’
c.	mom-**’**	‘to run across’
	c’ihwín-**’**	‘get red hot’ (Oswalt 1960: 171, via Buckley 1994)
	dahal-**’**	‘dig (a hole)’ (Oswalt 1960: 171. via Buckley 1994)

Under an analysis without [+round] insertion, in which the underlying form of the absolutive suffix was /-u/, the *u* ~ *w* distribution could be accounted for by post-vocalic glide formation (*u* → *w*). However, [u] and [w] do not easily relate to [’], and there is no apparent reason why /d/ should behave differently from other consonants in not triggering a rule of *u* → *ʔ*. Even if we assume, with Buckley, that [d] corresponds to /n’/, we cannot explain its behavior as being related to its already being glottalized, since this segment still behaves differently from other glottalized segments, in that stems ending in other glottalized consonants do not take *-u*. In fact, according to Buckley (1994: 73), in general when a glottal stop occurs to the right of an already glottalized segment, the glottal stop simply deleted. The distribution of *w* vs. *’* might be argued to optimize syllable structure since adding /w/ to the end of a consonant-final stem would create a complex coda that would have to be repaired via epenthesis (Buckley 1994: 249), where as adding /’/ only glottalizes the consonant. However, the behavior of *d*-final stems is arbitrary and puzzling, and it seems that we cannot account for it based on any well-known phonological constraints.

A final example of seemingly arbitrary, non-optimizing PCSA is found in Coptic (Kramer 2005, to appear). In this unusual example, allomorphy appears to be driven by the number of consonants in the stem. According to Kramer (2005: 14), the quality of the vowel that marks the stative in Coptic root and pattern morphology can be predicted based on the number of consonants making up the root of the verb. Roots with a single consonant ((63)a) take *eu*, roots with two consonants ((63)b) take *e*, roots with three consonants ((63)c) take *ɔ*, and roots with four consonants ((63)d) or five consonants ((63)e) take *o.*[35] Examples of stative forms are shown below (Kramer 2005: 4, 9, 14-15, 23; capital letters indicate syllabic consonants, and periods indicate syllable boundaries).

(63)	a.	s**eu**	‘is sated’
		tʃ**eu**	‘is sown’
		w**eu**	‘has become distant’
		ʃ**eu**	‘is measured’
	b.	p**e**t	‘has run’
		k**e**β	‘has been made cool’
		s**e**h	‘is written’
		k**e**t	‘is built’
	c.	s**ɔ**.tM	‘to be listened to’
		k**ɔ**.nS	‘to be stinky’
		m**ɔ**.səʔ	‘to be born’
		s**ɔ**.βK	‘to be few’
	d.	wS.t**o**n	‘is broadened’
		tN.t**o**n	‘is likened’
		sL.s**o**l	‘is consoled’
		ʃF.ʃ**o**f	‘has burrowed’
	e.	srM.r**o**m	‘is dazed’
		ʃtR.t**o**r	‘is disturbed’
		k^{j}lM.l**o**m	‘is twisted’
		slK^{j}.l**o**k^{j}	‘is made smooth’

This example is unusual and difficult to characterize. It is undesirable to allow the grammar to refer to the number of root consonants in selecting the stative vowel, and yet the pattern is straightforward, and we would like to capture it rather than say that the stative vowel quality is lexically determined (in which case the generalization about the

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[35] Though most quadriconsonantal stems and all quinquiconsonantal roots look like reduplicants on the surface, Kramer argues persuasively that they do not result from any synchronic reduplication process since the form and meaning of the apparent reduplicants is not consistent, and in some cases there is no shorter root that could have been the base for reduplication.

number of root consonants would be lost). A possible way around this problem is to refer to the number and/or shape of syllables in the output form. Though it does not appear that this would allow us to explain the particular vowel that is used with each root type, we at least have a way to characterize the pattern without allowing the grammar to ‘count’ root consonants. In the case of monoconsonantal roots, the use of *eu* does make some sense phonologically, since the output form ends up consisting of a single syllable, and perhaps using *eu* allows the word to be bimoraic. Similarly, for the biconsonantal roots, we could say that the *e* allomorph occurs when the word will consist of a closed syllable. Likewise, the *ɔ* allomorph occurs in an initial open syllable, and the *o* allomorph occurs in a final closed syllable in words with two syllables. Note that except in the case of the diphthong used with monoconsonantal roots, there is no apparent principled relation between the quality of the vowel and the number of root consonants or the CV structure of the word. A particularly interesting contrast is between stems with two vs. four or five consonants. In both cases, the vowel ends up in a word-final CVC syllable, yet with biconsonantal roots it surfaces as *e*, while with quadri- or quinquiconsonantal roots it surfaces as *o*. Thus, although the pattern can be described in terms of syllable structure and syllable count (rather than consonant count), it does not optimize syllable structure, with the possible exception of words with monoconsonantal roots. We can therefore capture the pattern in phonological terms, but we cannot do this by using regular phonological well-formedness constraints in OT. This case is therefore not easily handled using P >> M.

In this section, we have seen numerous examples of PCSA that do not maximize well-formedness, and some in which the distribution of allomorphs actually makes words less well-formed. As has been discussed throughout, these examples are problematic for the P >> M approach, because that approach seeks to account for phonological effects in morphology using the same constraints that account for purely phonological, non-suppletive allomorphy, and yet unlike phonology, which is usually ‘natural’ (though cf. Anderson 1981), many cases of PCSA are not at all natural. A model in which suppletive and non-suppletive allomorphy are analyzed in exactly the same way is incapable of accounting for this asymmetry.

2.1.2.6 Opaque conditioning

There is another class of examples of PCSA that are problematic for the P >> M model. This survey revealed a number of cases in which the phonological element that conditions the distribution of suppletive allomorphs does not appear in the surface form, rendering opaque the phonological condition on PCSA. Though the original version of OT was intended to be purely surface-based, later versions incorporated two-level constraints, sympathy, conjoined constraints, and other strategies to account for opaque phonological interactions. Thus, by incorporating some of these mechanisms, current OT is equipped to model opacity and, by extension, to model opaque interactions in PCSA. Given this, the P >> M model does predict the existence of opaque conditioning in PCSA. However, just as opaque phonological processes have been problematic for OT in making it necessary to continually add new mechanisms to the model, opaque conditions on PCSA are equally problematic. This survey revealed several such examples, to be discussed below.

In Turkish (Lewis 1967), the 3rd person possessive suffix exhibits allomorphy whose conditioning is rendered opaque by a regular process of velar deletion. The suffix takes the form *-I* following a consonant-final stem and *-sI* following a vowel-final stem, as seen in the examples below (examples are from Aranovich et al 2005 and from Gizem Karaali, p.c.; note that vowel alternations are due to regular vowel harmony).

(64)	bedel-**i**	'its price'	fire-**si**	'its attrition'
	ikiz-**i**	'its twin'	elma-**sɪ**	'its apple'
	alet-**i**	'its tool'	arɪ-**sɪ**	'its bee'

A proponent of the P >> M approach might cite this as an example of syllable structure optimization since the distribution of allomorphs serves to avoid both vowel hiatus and syllable codas. However, as pointed out by Aranovich et al (2005), there are examples in which the distribution of allomorphs is rendered opaque by a regular phonological process. Turkish exhibits a regular process of Velar Deletion (see, e.g., Sezer 1981), which deletes /k/ in intervocalic position. This interacts with the third person possessive suffix allomorphy in an interesting way: underlyingly /k/-final stems take the /-i/ suffix allomorph since the stems are underlyingly consonant-final, but then because of the addition of the vowel suffix, the /k/ is in intervocalic position and is therefore deleted. Thus, as seen in (65), the interaction of PCSA and Velar Deletion produces the very vowel hiatus that the distribution of /-i/ vs. /-si/ was supposed to avoid.

(65)	açlı-**ɪ**	'its hunger'	(cf. *açlɪk* 'hunger')
	bebe-**i**	'its baby'	(cf. *bebek* 'baby')
	gerdanlı-**ɪ**	'its necklace'	(cf. *gerdanlɪk* 'necklace')
	ekme-**i**	'its bread'	(cf. *ekmek* 'bread')

The explanation for this situation seems to be that suppletive allomorph selection takes place first in the morphology, and then the regular phonology of the language (including Velar Deletion) applies to the *output* of morphology, in some cases rendering the conditions on PCSA opaque. This is easy to capture in the subcategorization model, since we can say that /-i/ subcategorizes for stems that are consonant-final in the *input*, and then the output of morphology is the input to phonology. It is much more difficult to capture using P >> M because the constraints on allomorph distribution are not surface-true. The distribution cannot be stated using only output-based constraints in P >> M because that model does phonology and morphology together in parallel; it is crucial that morphology apply before phonology in this case.

In Sa'ani Arabic (Egypt; Watson 2002), there is another pattern of PCSA in which the result appears to be neutral with respect to phonological well-formedness, and in which the conditions on PCSA are not transparent on the surface. In this language, some subject suffixes have phonologically conditioned allomorphy determined by whether the stem ends in a consonant or a vowel. According to Watson (2002: 178, 184), the perfect aspect 3pl masculine suffix is *-ū* after consonant-final verb stems and *-aw* after vowel-final verb stems. Some examples are shown below (Watson 2002: 185). Note that the stems taking *-aw* have underlying final vowels that are lost.

(66)	katab-**ū**	'they (masc.) wrote'	ram-**aw**	'they (masc.) threw'
	libis-**ū**	'they (masc.) wore'	mall-**aw**	'they (masc.) filled'

Because of the deletion of stem-final vowels, the condition on allomorph distribution is lost on the surface in these examples.

Also in Sa'ani Arabic, The perfective aspect 3sg feminine suffix has the form *-at* following consonant-final roots, and *-it* following vowel-final roots. Examples are given below (Watson 2002: 185); again, the forms taking the postvocalic allomorph have root-final vowels that are lost.

(67)	katab-**at**	'she wrote'	ram-**it**	'she threw'
	libis-**at**	'she wore'	mall-**it**	'she filled'

Here, the stem-final vowel that triggers the use of *-it* is lost, rendering the condition on PCSA opaque. In this case, even if the stem-final vowel had been retained, there is no immediately apparent way in which the allomorphy is optimizing, since both allomorphs have the structure -VC.

Thus, in both of the Sa'ani Arabic examples, we see that PCSA can be conditioned by a phonological element that is lost on the surface via the application of a regular phonological rule or constraint. This type of example is problematic for the P >> M model. In OT, phonological constraints generally either optimize output well-formedness or maximize faithfulness to the input. In the P >> M model, the same phonological constraints that are active in the phonological grammar are also responsible for PCSA, and therefore we expect cases of PCSA either to be optimizing or to maximize faithfulness (the latter being somewhat improbable since faithfulness to the input form of an affix would have the effect of preventing allomorphy, not producing it). In Sa'ani Arabic, PCSA does not seem to result in surface optimization in any way, and therefore modeling it using regular phonological constraints is problematic. We can account for it by writing specific constraints that specify which allomorph to use in which environment, but this defeats the purpose of modeling PCSA using P >> M, since the P >> M model was designed to account for examples where PCSA can be said to follow from general phonological constraints.

Another example that exhibits PCSA conditioned by an element that is later deleted is found in Kimatuumbi (Bantu, Tanzania; Odden 1996). According to Odden (1996), the perfective has four allomorphs: *-i̧te,* *-i̧i̧le*, *-i̧i̧ye*, and the infix *-i̧-*. The allomorphs are distributed according to both segmental and syllable count-based factors as follows (Odden 1996: 51-53). Monosyllabic verbs (of shape (C)V(V)C), as well as stems whose final vowel is long, take *-i̧te*. Polysyllabic stems (except those with a final long vowel) take the *-i̧-* infix, which is inserted into the stem-final syllable; these forms also take the final vowel *e* rather than *a*. Stems ending in *yaan* or *waan* take the *-i̧i̧ye* suffix variant, and of particular interest here is the fact that glide-final roots take the *-i̧i̧le* allomorph, as shown below in (68)a-b (Odden 1996: 52) and that root-final [y] undergoes deletion in the examples in (68)b.

(68) a. naa-bóyw-**i̧i̧le** ‘catch’ ni-chékw-**i̧i̧le** ‘shave’
b. tu-sák-**i̧i̧le** ‘germinate’ naa-égel-**i̧i̧le** ‘approach’

The overall generalization is as follows: among polysyllabic stems, glide-final stems take *-i̧i̧le*, and all other polysyllabic stems take *-i̧-* unless a more specific factor selects some other allomorph (such as a final long vowel, or as in the case of stems in *yaan/waan*). The post-glide allomorph does not readily derive from the same underlying form as the general allomorph that occurs with polysyllabic stems (*-i̧-*). Therefore, this appears to be a case of suppletion conditioned by the presence of a stem-final glide. What is particularly interesting is that the glide that conditions the selection of the *-i̧i̧le* allomorph is not actually present in some examples, as in examples such as *naa-égel-i̧i̧le* ‘approach’, corresponding to the infinitive form *égelya*. The perfective form undergoes glide deletion in this example through a general rule of the language, Homorganic Glide Deletion (Odden 1996: 108), which deletes glides before a homorganic vowel. The fact that the glide that conditions suppletion is itself not present in the surface form presents a problem for any approach that would attempt to account for allomorph distribution solely through surface constraints. This can only be handled in the P >> M approach if we make our P constraints refer to underlying glides that do not surface.

To summarize, in this section we have seen examples in which the conditions on allomorph distribution are rendered opaque by other phonological processes. These examples cannot be handled by surface well-formedness constraints. Since they do not produce better-formed outputs, these examples can be said to be non-optimizing just like the examples seen in the preceding section, the only difference being that in some cases we can account for the opaque examples using regular phonological constraints, provided that we allow these constraints to refer to underlying elements that do not surface. As has been pointed out throughout this section, the existence of opaque PCSA is problematic for P >> M. However, it is predicted and easily accounted for in the subcategorization approach that I advocate here, since in this approach, the selection of affixes for stems takes place in morphology, which precedes the application of phonological processes at each level.

2.1.3 Summary

In the preceding discussion, we have seen examples of PCSA resulting in assimilation, dissimilation, syllable structure optimization, and syllable contact optimization (perhaps). We have also discussed a number of examples that do not optimize surface forms, including examples in which the conditions on allomorph distribution fail to surface, due to regular phonological processes. As has been discussed, the C/V distinction as well as a range of phonological features can condition PCSA, and in some cases the results look similar to the results of phonological rules. This is a pattern that we would predict under the P >> M model of PCSA. On the other hand, we have seen a number of examples that do not conform well to the predictions of P >> M. For example, in Bari, we found a number of affixes exhibiting PCSA that resulted in vowel harmony or disharmony or a combination of both. In some cases the pattern for one allomorph was the opposite of that for another allomorph, making it virtually impossible to capture the whole pattern using a single set of P constraints for the language as a whole. We also saw a number of non-optimizing PCSA examples. These are also problematic for the P >> M model, which was designed to account for optimizing PCSA. Though we can still analyze at least the neutral examples using P >> M, it is not clear why we would want to do this, since we lose the original motivation for analyzing PCSA using the same phonological constraints that are used to drive purely phonological processes. In the following section, I propose an analysis for these cases in terms of subcategorization frames. As will be seen, we can account for PCSA straightforwardly using such an approach, and we avoid the problems that come up when we try to model PCSA using phonological constraints.

2.2 Analysis

In the preceding section, I presented examples of suppletive allomorphy conditioned by segments or their features. Here, I outline a general strategy of analysis for examples of this type. The analysis is in terms of subcategorization. The subcategorization approach to morphology has been advanced in various forms by Lieber 1980, Kiparsky 1982b, Selkirk 1982, Orgun 1996, and Yu 2003, among others. In this approach, affixation is handled through subcategorization frames, which include specifications for the type of element an affix will attach to (whether the element is a stem of a certain category or having certain features or properties, or a phonological element, or any combination of these). Affixes can subcategorize for any element in the phonological representation of the stem (as well as for elements of morphological, lexical, and other aspects of the stem), the only apparent restriction being that the affix in question must end up adjacent to the phonological element for which it subcategorizes.[36] Affixation is the selection of affixes for stems in such a way as to satisfy the subcategorizational requirements of each morpheme, including phonological requirements.

Taking Hungarian 2sg suffix allomorphy as a representative example, I will now demonstrate how a subcategorization approach can be used to analyze cases of suppletive allomorphy conditioned by features of the stem-initial or stem-final consonant. Recall from §2.1.2.2 that in Hungarian in the present indefinite, the 2sg is marked by /-El/ suffix when the root ends in a sibilant; otherwise, it is marked by /-s/. A set of subcategorization frames for these suffix allomorphs is shown below.

(69) Hungarian 2sg present indefinite construction A
$[[\ [\text{sibilant}]\#]_{\text{stem}}\ \mathit{El}_{\text{2sg pres indef suffix}}\ ]_{\text{2sg pres indef word}}$

Hungarian 2sg centripetal construction B (‘elsewhere’)
$[[\ \ ]_{\text{stem}}\ \mathit{s}_{\text{2sg pres indef suffix}}\ ]_{\text{2sg pres indef word}}$

The subcategorization frames are interpreted as follows. In construction A, which uses the suffix allomorph found in the more specific context, *-El* will attach to the right edge of any stem (modulo the non-phonological requirements, which I omit here) that ends in a segment that is specified [sibilant]. The result of the affixation of *-El* to the stem is a

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[36] This restriction is predicted by the Generalized Determinant Focus Adjacency Condition (Inkelas 1990), to be discussed later in this section.

word that is marked as 2sg, present indefinite. In construction B, the ‘elsewhere’ case,[37] -*s* attaches to the right edge of any eligible stem regardless of its phonological shape, and the result of the affixation is again a word that is marked as 2sg. present indefinite.

Suppletive allomorphy conditioned by the stem-initial or stem-final vowel can be handled in the same way. For example, in §2.1.2.5, I described a situation in Yucunany Mixtepec Mixtec where 3sg is marked by -*à* on *i*-final stems and by -*ì* elsewhere. Under the subcategorization approach, we can say simply that /-à / selects for a stem with a final /i/, while /-ì/ selects for any stem. This is schematized below.

(70) Yucunany Mixtepec Mixtec 3sg construction A
$[[\text{i\#}]_{\text{stem}}\ \textit{à}_{\text{3sg suffix}}]_{\text{3sg word}}$

Yucunany Mixtepec Mixtec 3sg construction B (‘elsewhere’)
$[[\ \ ]_{\text{stem}}\ \textit{ì}_{\text{3sg suffix}}]_{\text{3sg word}}$

Construction B involves the further complication that the -*ì* suffix replaces the final vowel of the stem, but this can be handled in the phonology and therefore is not problematic for the simple analysis provided here.

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[37] The notion of the ‘elsewhere’ case may be implemented in any number of different ways; for example, in an OT model of morphology, some morphological constraint requiring 2sg to be marked by -*s* could be outranked by another morphological constraint requiring 2sg to be marked by -*El*, which could in turn be outranked by an undominated (and perhaps inviolable) constraint prohibiting subcategorization frames from being disobeyed. Under such a ranking, a hypothetical stem that satisfies both the phonological subcategorization requirements for the more specific -*El* allomorph and the (nonexistent) requirements for the -*s* allomorph can have two 2sg candidates that satisfy the highest ranked constraint against violation of subcategorization frames, but the candidate satisfying the highly ranked 2sg=-*El* constraint will win out over the candidate satisfying 2sg=-*s*, and therefore the allomorph with the more specific environment will always be used when that environment is met. In a different hypothetical case where the stem does not meet the requirements for affixation of the more specific allomorph, the inviolable constraint against violating subcategorization frames will filter out candidates that incorrectly use the more specific allomorph.

This approach can also easily handle suppletive allomorphy conditioned based on whether the stem-initial/final segment is a consonant or vowel. Ergative allomorphy in Warrgamay (Dixon 1980), discussed in §2.1.2.3, is an example of this. As described above, in Warrgamay the ergative is marked by *-ŋgu* after a vowel-final stem, or by *-du* after a consonant-final stem. Subcategorization frames for these two suffixes are shown below. Note that I have not characterized either suffix as the 'elsewhere' form since the two allomorphs exhibit perfect complementarity and neither occurs in a more specific environment than the other.

(71) Warrgamay ergative construction A
[[V#]$_{\text{stem}}$ *du*$_{\text{ergative suffix}}$]$_{\text{ergative word}}$

Warrgamay ergative construction B
[[C#]$_{\text{stem}}$ *ŋgu*$_{\text{ergative suffix}}$]$_{\text{ergative word}}$

Because the subcategorization frames do not encode the apparent optimization that results from some examples of C/V-conditioned PCSA, the exact same analysis can be used with equally good results for both the optimizing and non-optimizing examples of this type.

So far in this discussion we have not addressed one of the most interesting properties common to all of the examples presented in this chapter: namely, that the affixes involved in the suppletive relationship are always adjacent to the conditioning segment or feature of the stem. This is result of the survey is of theoretical interest for two reasons. The first reason is that it confirms a prediction inherent in a claim made by Inkelas (1990) building on Poser 1985, relating to a different phenomenon (namely, extrametricality). Extending Poser's (1985) Determinant Focus Adjacency Condition, Inkelas (1990) proposed a Generalized Determinant Focus Adjacency Condition

(GDFAC), given below (this was also discussed in chapter 1).

(72) Generalized Determinant Focus Adjacency Condition: Each phonologically constrained element must be adjacent to each constraining element.

If the GDFAC is a true principle of grammar, then the adjacency phenomenon observed in the survey can be said to follow from this principle. However, there is another possible explanation for the fact that PCSA always involves local conditioning. This relates to the historical development of PCSA, which I hypothesize to arise, in many cases, from a general phonological rule whose domain of application somehow becomes restricted to a single morphological context. This hypothesis is supported by the difficulty, pointed out above, in distinguishing suppletive allomorphy from allomorphy derived via phonological rules specific to particular morphological environments. If it is true that PCSA often or usually arises via the restriction of a phonological rule to a particular morpheme, then this could explain why allomorphs are adjacent to the edge of the stem that determines their distribution. Phonological rules generally apply locally (if we expand the term ‘local’ to refer not only to strictly adjacent segments but to features that are tier-adjacent), so the morphological patterns of suppletion that arise from the allophony derived by these rules should also occur at the same edge of the stem. Thus, the GDFAC may not be the ultimate explanation for the adjacency effect observed in PCSA, but as a principle of grammar it is consistent with the results of this survey, and it provides us with a way of accounting for the adjacency effects within the subcategorization approach.

We have thus seen that the subcategorization approach is well equipped to model the locality generalization observed in the data. Under the P >> M approach, on the other hand, examples of non-locally conditioned PCSA are predicted to exist. For example, an

OCP constraint banning multiple instances of a particular feature in a word (e.g., [labial]) could force the grammar to choose a different allomorph if an *-m* suffix were to be attached to a labial-initial stem. This type of example is unattested in the surveyed languages, so in this domain it appears that the P >> M model overpredicts and is too powerful. This is therefore an important difference between the two models, since as discussed above, the subcategorization rules out the unattested non-local conditioning of PCSA.

2.3 Conclusion

In this chapter we have seen a number of examples in which suppletive allomorphy is conditioned by segments and/or their features. Some observations that were made about these examples were as follows. First, we have seen that conditions on PCSA are local, in that the condition is always at the edge of the stem where the affix allomorphs attach. Second, it was demonstrated that a wide range of features, in addition to the C/V distinction, can determine allomorph distribution. Third, we have seen many examples that are not obviously optimizing. Finally, we have seen examples of opaque conditions on PCSA, which show that allomorph distribution is sensitive to input properties of the stem, not output properties.

An analysis of these examples based on subcategorization for phonological elements was proposed in §2.2. We have seen that subcategorization can handle the examples described above without difficulty. As has been discussed, the P >> M model does not fare as well in dealing with some of the cases presented here. P >> M was conceived in order to account for cases of phonologically optimizing PCSA that follows from well-known phonological constraints. When PCSA seems not to be optimizing or would require stipulating unnatural or language-specific constraints, we lose the advantage of generality and explanatory power that has compelled researchers to use the P >> M model to account for PCSA in the past. This problem is avoided in the subcategorization model, which does not rely on phonological constraints to account for phonological effects in morphology.

In chapters 3 and 4, I discuss further results of the cross-linguistic survey involving suppletive allomorphy conditioned by other types of phonological factors, and I propose analyses for those examples along the same lines as the analysis outlined in this chapter. As we will see, the other types of PCSA to be discussed pose similar challenges for P >> M and lend themselves equally well to subcategorization-based analyses.

Chapter 3: Tone/stress conditioned suppletive allomorphy

In this chapter, I consider cases of phonologically conditioned suppletive allomorphy (PCSA) where the conditioning factor is the tone or stress pattern of the stem. This survey revealed few such cases in comparison to the other types of PCSA described in chapters 2 and 4, but each case is robust enough so that there can be no question that the phenomenon exists. This chapter is structured as follows. First, in §3.1, I give examples of PCSA conditioned by tone or stress. In §3.2, I give a subcategorization-based analysis of this phenomenon along the same lines as the analyses provided in chapters 2 and 4 for different types of PCSA. I conclude in §3.3.

3.1 Survey results

In this section, I present examples of PCSA that involve conditioning by stress or tone. These examples were revealed by a cross-linguistic survey of PCSA, the details of which were described in chapter 1. A search of over 600 grammars revealed 137 cases of PCSA in 67 different languages. Of these, eight cases (from seven different languages) are stress- or tone-conditioned; these are the cases that I will discuss here. The relatively small number of cases of this type in comparison to other types of PCSA is somewhat puzzling. Languages with tone or a prominent stress pattern often exhibit several phonological rules or constraints resulting in tone or stress pattern effects (such as high tone dissimilation, tonal plateauing, tone spreading, and stress clash and lapse avoidance), so we might expect this to extend to PCSA as well.

Contrary to this expectation, few cases of PCSA conditioned by stress or tone were found. There is the possibility that some cases were missed by the survey, but given the efforts to make the survey large and balanced, it seems unlikely that such a significant class of examples could have been systematically neglected. One possible factor in the apparent lack of cases of stress-conditioned allomorphy is that there is some overlap between these cases and the cases of foot-conditioned PCSA to be described in chapter 4. Some cases that we might want to describe as being stress-conditioned may have ended up in chapter 4 since they could also be viewed as being foot-conditioned. The lack of cases of stress-conditioned allomorphy may therefore be due in part to the (somewhat artificial) division between the stress-conditioned allomorphy described in this chapter and the foot-conditioned allomorphy to be described in chapter 4.

However, this does not explain the lack of cases of tone-conditioned allomorphy, which remains puzzling. Only two examples of tone-conditioned PCSA were revealed by the survey, despite the fact that over half of the world's languages have tone and a significant number of these languages must exhibit some tonal phonology. I will leave this problem for future consideration.

This section is organized as follows. I begin in §3.1.1 with a general discussion of the expected and attested types of stress- and tone-conditioned PCSA. In section §3.1.1.1, I present examples of stress-conditioned allomorphy conditioned by stress. In §3.1.1.2, I discuss examples of stem allomorphy (tone- and stress-conditioned). In §3.1.1.3, I present an example of tone-conditioned PCSA. In §3.1.1.4, I discuss an example of stress-conditioned allomorphy that appears not to be optimizing. I conclude in §3.1.2 with a summary of these examples before moving to the analysis in §3.2.

3.1.1 Examples

3.1.1.1 Stress effects

Many languages exhibit stress assignment rules/constraints that seem to maximize alternating patterns of stressed and unstressed syllables in a word. Constraints such as CLASH and LAPSE have been devised to account for the apparent universal dispreferences for sequences of two stressed or two unstressed syllables, respectively (see e.g. Prince 1983, Selkirk 1984). In phonology, violations of CLASH and LAPSE are most commonly repaired via stress shift, so that the underlying stress pattern (if any) of a morpheme or the stress pattern assigned to it in citation form is changed in certain contexts to optimize the overall stress pattern of the word. In PCSA, we might imagine that highly-ranked CLASH or LAPSE could cause an inherently stressless affix allomorph to be selected when it occurs next to a stressed stem syllable, or vice versa. Of course, in order for us to know that a given example involved suppletive allomorphy rather than purely phonological allomorphy, the affix allomorphs in question would have to differ in more than just their stress pattern; i.e., they would probably also need to be different in their segmental makeup. Three such examples are attested in the survey, to be discussed below.

Aside from alternating stress patterns, another stress-related consideration is the notion of the optimal stress-bearing syllable. In many languages, stress is ‘attracted’ to certain syllable types, usually heavy syllables. In some cases, it has been claimed that stress can also be attracted to syllables having certain vowels, not only in terms of their length, but in some cases their quality (though this may relate to duration if high vowels are inherently shorter than low vowels). In this section, I discuss one case where it has been claimed that PCSA results in stress occurring on syllables containing a vowel that is an optimal bearer of stress.

An example of PCSA resulting in an alternating stress pattern is found in Dutch (Booij 1997), where the plural is marked by *-s* or *-en*, depending on whether the final syllable of the base word is unstressed or stressed, respectively. Examples are given below (Booij 1997: 272-273; stem-final doubled consonants are orthographic only).

(1) a.	dam	'dam'	dámm-**en**	'dams'
	kanón	'gun'	kanónn-**en**	'guns'
	kanáal	'channel'	kanáal-**en**	'channels'
	lèdikánt	'bed'	lèdikánt-**en**	'beds'
	ólifànt	'elephant'	ólifànt-**en**	'elephants'
b.	kánon	'canon'	kánon-**s**	'canons'
	bézəm	'sweep'	bézəm-**s**	'sweeps'
	tóga	'gown'	tóga-**s**	'gowns'
	proféssor	'professor'	proféssor-**s**	'professors'

If the *-en* suffix is inherently unstressed, then using it with the stems in (1)b would have resulted in a sequence of unstressed syllables. It could therefore be said, in P >> M terms, that the allomorphy is driven by LAPSE. Of course, an alternative way to avoid a LAPSE violation if *-en* were used with unstressed-final stems would be to stress the syllable containing the *-en* suffix. However, this would require us to posit a monosyllabic foot at the end of the word; the allomorphy can therefore be said to optimize foot structure as well (or, to help avoid the creation of subminimal feet).[1]

This Dutch example is interesting for another reason, namely that it appears to be sensitive to derived phonological information since stress when predictable is usually

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[1] For this reason, the Dutch example also fits into the category of examples discussed in chapter 4 (§4.1.1.1) in which allomorphy appears to be motivated by foot structure. I have discussed the example here instead of in chapter 4 since Booij (1997) characterizes it as being driven by stress.

assumed to be assigned by the grammar rather than being lexically specified. Sensitivity to derived properties is predicted for PCSA both by the P >> M model and by any approach such as Lexical Phonology (Kiparsky 1982a, Mohanan 1986) where morphological processes apply cyclically and where phonological and morphological processes are ‘interleaved’ in grammar. However, it is not entirely clear that Dutch provides an example of sensitivity to derived properties, because stress is not entirely predictable, as acknowledged by Booij and Lieber (1993: 41) in their treatment of the Dutch adjectival suffix (to be discussed in §3.1.1.4). Assuming that stress normally falls on the penultimate syllable, the stems in (1)a would need to be lexically specified as having final stress. Thus, if we claim that *-en* occurs with final-stressed stems and *-s* occurs ‘elsewhere’, then we do not have to refer to any derived properties. On the other hand, if *-s* is considered to be the more specific allomorph, then its distribution would need to refer to a derived property, namely the default penultimate stress that is assumed to be assigned by a general rule of the language. The problem is that it is not entirely clear which is the more specific allomorph and which is the ‘elsewhere’ allomorph here.

Another possible case of reference to a derived property is found in Spanish, where the feminine definite article has two allomorphs whose distribution is stress-sensitive (Kikuchi 2001). The most commonly used allomorph is *la*, but the form *el* occurs before stems that begin with a stressed /a/. Some examples involving *a*-initial stems are shown below (Kikuchi 2001: 50). Note that all of these nouns have feminine gender.

(2)	a.	**la** alméja	‘the clam’	**la** anguíla	‘the eel’
		la aréna	‘the arena’	**la** amíga	‘the friend’
	b.	**el** álma	‘the soul’	**el** águila	‘the eagle’
		el área	‘the area’	**el** áma	‘the mistress’

Kikuchi argues that this pattern is driven by positional faithfulness (Beckman 1998). When *la* occurs before an unstressed /a/, the /a/ vowels of the article and stem coalesce into a single [a]. Kikuchi claims that *el* is used when the stem-initial /a/ is stressed in order to avoid coalescence of a stressed vowel with another vowel. Thus, the initial stressed /a/ is 'protected' by the use of *el*.

An interesting aspect of this pattern is that the article that is used can change with the addition of certain affixes to the stem if this causes its stress to shift. Some examples are shown below (Kikuchi 2001: 50, except where noted).

(3)	**el** água	'the water'	**la** aguáda	'the water supply'
	el árma	'the weapon'	**la** armadúra	'the weaponry' (Kikuchi 2000)

If the examples in (3) are indeed productively suffixed forms, then this constitutes an example of PCSA that makes reference to a derived phonological property. The determination of which allomorph to use for the definite article must be carried out after the attachment of affixes in (3). These affixes trigger a shift of the stem stress one syllable to the right, so that the initial /a/ is no longer stressed. Then, when the definite article is added, the more specific (*el*) allomorph 'checks' the stem for a stressed initial /a/. Due to the stress shift triggered by affixation, *aguáda* and *armadúra* do not satisfy this condition, so *el* is not used; the more general allomorph *la* is used instead. Thus, the distribution of allomorphs refers to a stress pattern that was not present in the underlying form of the stem.

Although this seems on its surface to be a good example of PCSA that refers to a derived property, there is a problem with the example, which is that in some cases a stress shift does not result in a change to the form of the definite article as expected. Kikuchi

(2000) points out that diminutive forms whose stems have initial stressed /a/ take the *el* article even though their stress shifts, as in the examples below.[2]

(4)	**el** áma	'the mistress'	**el** amíta	'the mistress (dim.)'
	el álma	'the soul'	**el** almíta	'the soul (dim.)'

Furthermore, *el* is also used with compounds, which have stress on the rightmost element, when the leftmost element has initial stressed [a] in its citation form.

(5)	**el** água	'the water'	**el** aguafuérte	'etching'	**el** aguamála	'jellyfish'

The fact that *el* occurs unexpectedly in these examples suggests that the definite article is sensitive to the stress pattern of the stem rather than the word. This is somewhat puzzling since the morphological bracketing should be such that the definite article (which is a clitic) occurs outside the stem+affixes, as follows: [article [[stem]-suffix]]. There are two possible solutions to this puzzle. The first is to assume that stress is assigned at the stem level and that stress shift in compounds and affixed forms occurs not immediately after compounding or affixation has applied, but rather at the level of the phonological word, i.e. after cliticization. This would allow the clitic to refer to the stress pattern of the stem before stress shift takes place. A second possibility is that there is a mismatch between the morphological and phonological bracketing of words with the definite article, so that the article and the word-initial stem form a phonological constituent to the exclusion of what follows (i.e., a suffix or the second member of a compound). In either case, we have a way around the problem in the subcategorization approach to PCSA, but this example is difficult in the P >> M model because the condition that determines the allomorph distribution is rendered opaque by stress shift.

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[2] Much of Kikuchi (2000) is duplicated in Kikuchi (2001), but the diminutive and compound forms discussed here appear only in Kikuchi (2000).

Because OT (and, in particular, the P >> M model) is surface-oriented, the P >> M model predicts that we should not find examples of PCSA whose conditions are rendered opaque by 'later' phonological processes. Some other examples of this type were seen in chapter 2 as well and were argued to provide evidence in support of the subcategorization approach to PCSA.

An example of a different type of stress-conditioned allomorphy is found in Shipibo (Panoan, Peru; Elías-Ulloa 2004). This case seems to involve the notion of optimal stress-bearing syllables or vowels. In Shipibo, the suffix meaning 'again' takes the form *-ribi* when the second syllable of the suffix is an even-numbered syllable (counting from left to right) and *-riba* when the second syllable of the suffix is in an odd-numbered syllable. Some examples are provided below (Elías-Ulloa 2004: 2-3; examples are originally from Lauriault 1948 except where noted).

(6) yono-**ribi**-kɨ
command-Again-Past
'commanded again'

ka-ma-**ribi**-kɨ
go-Caus-Again-Past
'went again'

pi-**riba**-kɨ
eat-Again-Past
'ate again'

yomɨtso-**riba**-kɨ
steal-Again-Past
'stole again'

ka-yama-**riba**-kɨ
go-Neg-Again-Past
'do not go again' (from Elías-Ulloa field notes)

Elías-Ulloa relates this to the stress pattern of the language, which stresses the second syllable if it is closed, or otherwise the first syllable. He accounts for the *-ribi* ~ *-riba* allomorphy using the constraint rankings *i/Head >> *a/Head and *a/NonHead >> *i/NonHead. These constraints are claimed to account for why *-riba* allomorph occurs when its second syllable will be stressed, while *-ribi* occurs when its second syllable will not be stressed: [a] is more sonorous than [i] and is therefore a better bearer of stress than [i]. While it seems desirable to relate the allomorphy to the stress system, Elías-Ulloa does not consider the possibility that /-ribi/ surfaces as *-riba* when the second syllable is stressed. This would require a rule, specific to the 'again' suffix, changing *i* to *a* in a stressed syllable. Though this rule would be item-specific, it would still be a phonetically motivated rule, using Elías-Ulloa's argument that [a] is a better stress-bearer than [i]. Thus, we cannot be sure that this is a case of PCSA. Nonetheless, it does seem to be an example of allomorphy that results in stress occurring on a more 'stressable' syllable than it would if there were no allomorphy.

In this section we have seen three examples of stress-related allomorphy. One example, from Dutch, involved PCSA that seemed to maximize an alternating stress pattern while preventing the creation of monosyllabic feet. Another example, the case of the Spanish feminine definite article, involved the preferential retention of a stressed vowel in surface forms. The third example, from Shipibo, appeared to ensure that stress occurred on syllables containing /a/, which is considered to be a good stress-bearing vowel since it is highly sonorous. Thus, we have seen three different ways in which PCSA can be argued to be driven by phonological optimization. This is consistent with the P >> M model, though note that it is also consistent with the subcategorization approach (as will be demonstrated in §3.2).

3.1.1.2 Stem allomorphy

In the preceding section, we saw examples in which the distribution of allomorphs of an affix or clitic was determined by stress. So far, we have not discussed any examples in which a stem exhibits PCSA; even in chapter 2, where 74 cases of segmentally conditioned PCSA were discussed, we did not find any examples of stem allomorphy. This is a striking result. It raises the question of why there are not more examples, and also why the attested examples are not segmentally conditioned but rather conditioned by more ‘global’ or suprasegmental factors such as stress and tone. The P >> M model of PCSA does not answer these questions.

The subcategorization approach, on the other hand, allows us to account for this cross-linguistic pattern as follows. First, since we are assuming that words are built ‘from the inside out,’ we predict that allomorphy in a root should never be sensitive to properties of an affix. As will be seen, this prediction can be maintained based on the present survey. We furthermore predict that allomorphy in the ‘stem of affixation’ should also never be sensitive to properties of any affix, with the following exception: if what appears to be the stem is morphologically complex, then in some cases the material that occurs next to the root could possibly be an infix, in which case its distribution could be conditioned based on some property of an affix that attaches ‘before’ the infix but ends up farther away from the root in terms of surface linear order. Since this is a very specific and complex scenario, we expect that it should not occur very often, and therefore that examples of this type should be rare. It is also crucial that in such cases, the root should be extractable from the ‘pseudo-stem’ that is formed by the addition of the infix; if all of the root’s segments are not contained in this pseudo-stem, then we must conclude that we are dealing with *root* allomorphy rather than *stem* allomorphy; this then would contradict a prediction of the subcategorization model as presented here. The subcategorization approach severely restricts the possibility of affix-conditioned stem allomorphy, but note that other types of phonological conditioning on stems may still be permitted if the phonological condition is imposed from outside of the word. The model that I am using here is only meant to account for morphological processes and does not make predictions for or set limitations on phonological interactions above the level of the word.

While P >> M predicts that stem allomorphy conditioned by phonological properties of affixes should be perfectly acceptable, the subcategorization approach severely restricts the instances in which stem allomorphy can occur, as discussed above. Nonetheless, some types of stem allomorphy are still allowed and able to be captured in the subcategorization approach, and in fact, as mentioned above, some such cases are attested. In this chapter, I discuss two cases of PCSA involving stem allomorphy: one conditioned by stress, and the other conditioned by tone.

An example of stress-conditioned stem allomorphy occurs in Italian (Hall 1948). In Italian, some stems have allomorphs ending in /isk/ that occur only in morphological contexts where the word stress falls on the root-final syllable, namely, in the present and subjunctive 1sg, 2sg, 3sg, and 3pl and in the 2sg imperative (Hall 1948: 25, 27). One such root is *fin-* ‘finish’; some examples are shown below (Hall 1948: 214).

(7)	Present			
	finísk-o	‘I finish’	**fin**-iámo	‘we finish’
	finíšš-i	‘you (sg.) finish’	**fin**-íte	‘you (pl.) finish’
	finíšš-e	‘s/he finishes’	**finísk**-ɔno	‘they finish’
	Subjunctive			
	finísk-a	‘that I finish’	**fin**-iámo	‘that we finish’
	finísk-a	‘that you (sg.) finish’	**fin**-iáte	‘that you (pl.) finish’
	finísk-a	‘that s/he finish’	**finísk**-ano	‘that they finish’
	Imperative			
			fin-iámo	‘let’s finish’
	finíšš-i	‘(you (sg.)) finish!’	**fin**-íte	‘(you (pl.)) finish!’

Other roots of this type include *aǧ*- ‘act’ (Hall 1948: 43), *argu*- ‘argue’ (1948: 44), *dilu*- ‘add water’ (1948: 45), *mɛ́nt*- ‘lie’ (1948: 45), *diminu*- ‘diminish’ (1948: 52), and *ammon*- ‘admonish’ (1948: 61). There appears not to be any semantic or phonological generalization regarding which roots pattern with this class. A possible motivation for this pattern of allomorphy is stress clash avoidance. If we assume that /isk/ is inherently stressed, then its occurrence next to an inherently stressed suffix would create a stress clash, so /isk/ is avoided in that context.

This example is particularly interesting and important because it is the first case of apparent stem allomorphy that we have seen. As noted above, no examples were discussed in chapter 2, which described cases of segmentally conditioned allomorphy. The subcategorization approach allows us to explain the relative rarity of stem allomorphy, but it also requires us to assume that /isk/ here is an infix. This may provoke some skepticism, but in modern analyses of Italian stem allomorphy (e.g., DiFabio 1990, Schwarze 1999), *-isc* is considered to be an affix or ‘stem extension’ (Schwarze 1999). Therefore, it is already assumed that stems containing *-isc* do not exhibit root allomorphy, but rather the presence or absence of *-isc* is determined by the stress pattern of the word. And, in fact, DiFabio (1990) analyzes *-isc-* as an infix.[3] Assuming that *-isc-*

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[3] The fact that separate stems *fin*- and *finisc*- co-existed at an earlier stage in the history of Italian does not preclude an infixation analysis, since speakers could have created the infix *-isc-* on the basis of the existence of other such pairs of verbs in the language. However, if each of the two separate stems previously was able to occur in all of the morphological/phonological environments in (7), then we are faced with the question of how the stem allomorphs came to be distributed in the modern language (after the stems collapsed into a single suppletive paradigm) in just such a way so as to avoid stress clash. One possibility is that forms of each stem with every possible inflectional suffix co-existed at some stage, and as the separate stems merged, perhaps via the creation of the *-isc-* infix, the forms without *-isc-* preferentially survived in the stressed suffix environment because they had a more harmonic rhythmic pattern than those with *-isc-*

is an infix explains how it can be sensitive to a property of the stem that is determined by affixes that occur later in the word (in terms of their linear order), without posing any problem for the ‘inside-out’ direction of word formation in the subcategorization approach advocated here. This move may seem to be a clever trick designed to uphold the prediction that affixes cannot condition stem allomorphy. However, as discussed earlier, the lack of cases of phonologically conditioned stem allomorphy is striking given the number of cases involving affix allomorphy. Furthermore, it is not the case that any possible putative case of stem allomorphy could be explained away. The infixation account is possible for Italian because *isc* is present in all of the extended stems, but imagine a language in which some stems had an etymologically unrelated allomorph with an extra syllable that was used in a particular stress context. For example, if *complet-* (lit. ‘complete’) were used instead of *finisc-* where it occurs in the paradigm of *fin-*, it would be impossible to claim that the allomorphy resulted from the addition of a stem extension, and we would have to conclude that this was a counterexample to our model. No such cases were revealed by the present survey.

Another case of stem allomorphy is found in Zahao (Chin, Burma; Osburne 1975). According to Yip (2004), Zahao exhibits suppletive allomorphy in verb stems that involves tonal alternations. In particular, verbs in Zahao have two stems, a ‘primary’ stem

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(this would be true whether *-isc-* had inherent stress or not; for example, the modern form *fin-íte* ‘you (pl.) finish’ has an alternating stress pattern, whereas its hypothetical competitors *finísk-íte* and *finisk-íte* do not). Note, however, that this historical scenario does not require that speakers ever utilized a phonological constraint in determining when *fin-* vs. *fin-isc-* would be used. In the P >> M model, P constraints are used to determine which affixes will be allowed to combine with which stems, not to choose between multiple pre-existing semantically equivalent words. Perhaps the choice between words already existing in a language is more a conscious stylistic decision than one that is driven by constraints or rules of grammar.

and a ‘secondary’ stem. The primary stem is used in main clauses, while secondary stems are used in subordinate clauses. Though this can be stated in syntactic terms, there is some interaction with focus, and Yip suggests that the conditioning is prosodic. Some examples of primary-secondary stem pairs are shown below (following Yip 2004, tones are given next to the stem; stems with no tone are underlyingly toneless).

(8)	Primary stem	Secondary stem	Gloss
	hmaan L	hmaan L	‘be correct’
	hreen L	hren H	‘lock up, close’
	laam LH	laam L	‘dance’
	hmaan L	hmaan L	‘be correct’
	ŋaan H	ŋaan L	‘write’
	ree LH	reet H	‘insert’
	khur L	khurʔ	‘shiver’
	cat H	caʔ	‘cut off’

Yip points out that in each pair, the secondary stem is equally or less ‘marked’ than the primary stem in terms of its laryngeal specification (tone or final glottal stop): if the primary stem has a contour tone, then the secondary stem has a level tone; if the primary stem has a level tone, then the secondary stem has either a level tone or a final glottal stop, which is considered to be less marked than a level tone. Yip proposes a harmonic scale ʔ > H,L > LH, where the glottal stop is most harmonic and least marked, the H and L tones are somewhat less harmonic and more marked (but equivalent to each other on the scale), and LH is the least harmonic and the most marked. With respect to the primary stem, a secondary stem can either stay at the same level on the scale or move up by one degree (but not two). As seen in the examples above, in some cases there is no change between the primary and secondary stem. In Yip’s analysis, the allomorphy is driven by several different factors, including: first, the existence in the lexicon of multiple underlying forms for stems as well as a constraint MAXPARADIGM that requires every underlying stem form to be realized in some environment; second, a constraint requiring that every stem must have a laryngeal specification; third, conjoined MAXH and MAXL constraints that prevent the secondary stem from differing from the primary stem by more than one degree on the harmonic scale given above; and finally, a constraint prohibiting contour tones in a secondary stem. In a P >> M terms, all of these constraints would outrank UNIFORMEXPONENCE, which is the morphological cosntraint that requires morphemes to be realized consistently regardless of the environment in which they occur.

Note, though, that the existence of this example of stem allomorphy does not contradict any of the predictions made by the subcategorization model as discussed above, and therefore this need not be taken as evidence in favor of the P >> M model simply because it can be analyzed in those terms. As noted above, stem allomorphy that is not conditioned by an affix does not constitute a counterexample to the subcategorization approach that I am using, especially given that in this particular case, as acknowledged by Yip (2004), the distribution of stem allomorphs may reduce to syntactic conditioning, which is outside the scope of what is covered by either model of PCSA being contrasted here.

In summary, in this section we have seen two examples of stem allomorphy, one conditioned by stress and one conditioned by syntax and/or prosodic factors and involving tonal alternations. As has been discussed, the small number of examples is problematic for the most basic form of the P >> M model, which does not take into account morphological constituency, since in principle this means that stems can exhibit PCSA just as easily as affixes, which seems not to be the case. On the other hand, as discussed above, the subcategorization approach allows us to explain why stem PCSA is relatively rare, while still not ruling out the examples that are attested in the present survey.

3.1.1.3 Tone effects

In addition to the Zahao example described above, one other example of PCSA involving tone was found in this survey. The fact that only two examples of tone-related PCSA were found is somewhat surprising given the fact that phonological tone rules are so common in the world's languages. We might have expected to find a number of examples of PCSA resulting in the same surface patterns that result from these tone rules: tone spread, dissimilation of adjacent H tones, and tonal plateauing, to name a few. The OT constraints CLASH and LAPSE, originally formulated to account for stress patterns, are now also used for tone (as advocated by Zoll 2002), so we might expect these constraints to be among those that could be ranked above a morphological constraint (in a P >> M analysis), resulting in PCSA. No such examples are found. Other constraints that have been used for tone include the OBLIGATORY CONTOUR PRINCIPLE (OCP; Leben 1973, McCarthy 1986) for dissimilation and *H to capture the idea that a high tone is 'marked', especially in languages with an underlying H vs. Ø tone contrast. In the P >> M approach, we would expect that these constraints could play a role in PCSA as well.

The P >> M also predicts the existence of some non-local tone effects. For example, a conjoined constraint *H&*H ranked over UNIFORMEXPONENCE could result in long-distance tonal dissimilation such that a H-toned affix allomorph could fail to be selected if there is a H tone anywhere in the stem. The subcategorization approach that I take here, which includes a requirement that affixes must be adjacent to the phonological elements for which they subcategorize, predicts that any such effect should be purely local, so that the triggering H tone would have to be at the edge of the stem (or, at the edge of the stem on the tonal tier). This difference in predictions turns out to be somewhat of a moot point since no cases of PCSA resulting in tone dissimilation of any kind are found. However, the fact that the subcategorization approach is more restrictive regarding types of tone dissimilation is a point in its favor given the lack of any cases at all. The possibility of constraint conjunction vastly increases the number and type of possible phenomena predicted by P >> M, and contrary to any argument that constraint conjunction is not an accepted mechanism in modern mainstream OT, Yip's (2004) analysis of Zahao discussed above demonstrates that constraint conjunction is still very much in use in modern OT analyses.

One example of tone-conditioned PCSA is attested in the survey, though it does not fit into any of the predicted types described above. The example is found in the Yucunany dialect of Mixtepec Mixtec (Otomanguean, Mexico; Paster and Beam de Azcona 2005). This language exhibits PCSA in the first person singular clitic (subject or possessor). The 1sg is marked by a floating low tone that associates to the end of the verb or noun phrase, except in those cases where the final tone of the verb or noun phrase is low, in which case the first person singular is marked by the *yù* allomorph. Examples M- or H-final stems taking the floating L tone allomorph are shown below (examples are from my field notes).

(9)	nàmá	‘soap’	nàmá**à**	‘my soap’
	kwíìí	‘narrow/thin’	kwíìí**ì**	‘I am narrow/thin’
	vílú	‘cat’	vílú**ù**	‘my cat’
	tìinà ncháá	‘blue dog’	tìinà ncháá**à**	‘my blue dog’
	tzààku	‘corral’	tzàáku**ù**	‘my corral’
	yùúti	‘sand’	yùúti**ì**	‘my sand’
	sì’i	‘leg’	sì’i**ì**	‘my leg’
	kwà’a	‘man’s sister’	kwà’a**à**	‘my sister’

As seen in the examples below, the *yù* allomorph occurs following a L tone.

(10)	sòkò	‘shoulder’	sòkò **yù**	‘my shoulder’
	tutù	‘paper’	tutù **yù**	‘my paper’
	chá’à	‘short’	chá’à **yù**	‘I am short’
	ve’e nchá’ì	‘black house’	ve’e nchá’ì **yù**	‘my black house’

This case likely involves suppletion since the two different forms of the 1sg are not phonologically similar enough to warrant relating them to a single underlying form. Even if they were, we would want the underlying form to resemble the ‘elsewhere’ allomorph (the floating L that occurs after H- and M-final roots) rather than the allomorph that occurs in the more specific environment (the *yù* form that occurs with L-final roots), and yet this would require us to posit *insertion* of [yu] following a L-toned root. This seems implausible. I conclude that this example involves genuine suppletive allomorphy, conditioned by the final tone of the root.

This pattern, where the floating L tone allomorph occurs in all environments except where preceded by a L tone, serves to maintain a distinction between 1sg and unmarked forms. Without the *yù* allomorph, 1sg forms would be homophonous with the unmarked forms of verbs and noun phrases with final L tone. One possible way of modeling this is to use a phonological constraint against homophony among forms in a paradigm. However, we can explain the apparent homophony avoidance without positing a constraint that generates it. In a different dialect of Mixtepec Mixtec described by Pike and Ibach (1978), *yù* is a 1sg polite marker, while the floating low marks the informal 1sg. This is most likely the conservative dialect since it would be difficult to develop the semantically conditioned allomorphy from the phonological condition. Furthermore, the Yucunany dialect does exhibit an informal vs. polite distinction in the 2sg and 3sg, suggesting that it had such a distinction in the 1sg at an earlier stage.

The tables below show the proposed stages in the development of the modern pattern of allomorphy in the Yucunany dialect. (11)a shows the original stage, where the two 1sg markers are distributed based on the informal vs. polite distinction. This pattern is retained in the modern dialect described by Pike and Ibach (1978). (11)b shows a proposed intermediate stage in the Yucunany dialect, where the semantic distinction between informal and polite in the 1sg has been lost, and both forms of the 1sg marker still exist in free variation. At this stage, each type of root has two possible 1sg forms, but L-final stems have only one form that is not homophonous with the root. In some contexts where a L-final root is marked with a redundant final L tone, the intended 1sg form may be mistaken for a plain form if the 1sg meaning is not of critical relevance in the discourse. Therefore, assuming that the two allomorphs are used by speakers with equal frequency, the majority of underlyingly L-final stems that are understood by the listener to be 1sg forms will have the *yù* allomorph rather than the floating L tone. Since it is used more frequently than the floating L tone, the *yù* allomorph ultimately 'wins out', becoming the only 1sg marker to be used with L-final roots, as shown in (11)c. At this stage, one possible development is for the 1sg of M- and H-final roots to be marked only by *yù* by analogy with L-final roots. Instead, in the modern dialect, the M- and H-final roots converge on the floating L tone as the marker of 1sg, as seen in (11)d. One explanation for this is that speakers picked up the discrepancy between the existence of the L-final 1sg forms for M- and H-final roots on the one hand, and the lack of L-final 1sg forms for L-final roots on the other hand. This could have led to the generalization that *yù* is used with L-final roots while the floating L tone is used with M- and H-final roots.

(11) a. Mixtepec Mixtec

Root type	Plain form	1sg informal	1sg polite
final L	final L	final L	=yù
final M	final M	final L	=yù
final H	final H	final L	=yù

b. Early Yucunany Mixtepec Mixtec

Root type	Plain form	1sg
final L	final L	final L ~ =yù
final M	final M	final L ~ =yù
final H	final H	final L ~ =yù

c. Intermediate Yucunany Mixtepec Mixtec

Root type	Plain form	1sg
final L	final L	=yù
final M	final M	final L ~ =yù
final H	final H	final L ~ =yù

d. Modern Yucunany Mixtepec Mixtec

Root type	Plain form	1sg
final L	final L	=yù
final M	final M	final L
final H	final H	final L

Thus, the pattern of tone-conditioned suppletive allomorphy emerged in Yucunany Mixtepec Mixtec without necessarily being driven by homophony avoidance. We are therefore free to analyze the pattern in a way that captures the generalization without necessarily encoding the anti-homophony concept in our analysis. A subcategorization analysis is thus well-suited to this example, as will be demonstrated in §3.2.

In this section, we have discussed one example of tone-conditioned PCSA. Including the Zahao example discussed in the preceding section, there were two tone-related examples of PCSA found in this survey.

3.1.1.4 Non-optimization

In addition to the examples described above, which can each be viewed as phonologically optimizing in some way, the survey also revealed two examples of stress-conditioned allomorphy where the distribution of allomorphs does not appear to optimize the overall phonological pattern of the word. By now, such cases will not be surprising since a number of examples were discussed in chapter 2. However, it should be pointed out once again that examples of this kind are problematic for the P >> M model, which reduces PCSA to resulting from regular phonological well-formedness constraints. The subcategorization approach, on the other hand, predicts and accounts straightforwardly for non-optimizing PCSA.

One example of apparent non-optimizing PCSA that relates to stress is found in Woleaian (Trukic, Micronesia; Sohn 1975, Sohn and Tawerilmang 1976). According to Kennedy (2002), the 'denotative' marker (which converts intransitive verbs from transitive verbs) has two allomorphs. It can either appear as a suffixed reduplicant[4]

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[4] The characterization of this pattern as suffixing (rather than infixing before the stem-final foot) is Kennedy's. Kennedy does not seem to entertain the infixing analysis, focusing instead on the choice between prefixing vs. suffixing reduplication: 'Note that the order of stem and affix is not immediately certain for forms like *fatifeti* and many others, in which a complete bivocalic stem is reduplicated. I treat these forms as suffixed to be uniform with trivocalic denotatives in this group [which] are clearly suffixed, as in

consisting of the final two syllables of the stem, or as gemination of the initial consonant.[5] Examples are shown below (Kennedy 2002: 4).[6]

(12)

a.	feragi	'spread'	**f**feragi	'to be spread'
	ŋüsü-ri	'snort it'	**ŋ**ŋüsü	'to snort'
	pilegü-w	'bundle it'	**p**pilegü	'to be bundled'
	sawee-y	'go along side of it'	**s**sawe	'to go along side of'
	tabee-y	'follow it'	**t**tabe	'to follow'
b.	βugo-si	'tie it'	βugo-**βugo**	'to tie'
	faŋošo	'current'	faŋošo-**ŋošo**	'to have a little current'
	file-ti	'stir it'	file-**file**	'to stir'
	masowe	'hard'	masowe-**sowe**	'to be strong'
	perase	'to splash'	perase-**rase**	'to scatter'

In Kennedy's analysis, the location of the denotative affix (prefix or suffix) is lexically determined. Then, based on its position the shape of the allomorph is determined by phonological constraints, such that prefixes consist of gemination of the initial consonant, while suffixes consist of a reduplication of the final two syllables of the stem. In order to get the shape of the allomorphs, Kennedy first assumes that stems that take the suffixing form are lexically specified as having a 'flag', whose surface correlate is stress, and which is required to be anchored at the left edge of the word. In effect, this means that the leftmost syllable of the stem will be the first stressed syllable in the word if the stem has a flag. By using constraints such as LAPSE and ALLFEETRIGHT, this analysis ensures that

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*perase-**rase***.' (2002: 4). Sohn (1975) does not say explicitly whether reduplication is infixing or suffixing, and the examples do not include morpheme breaks.

[5] Though one may be tempted to suggest that initial gemination and reduplication are two different morphological processes, Sohn implies (1975: 132) that they are the same in stating that 'transitive stem minus thematic element + reduplication equals neutral verb. (Here reduplication in neutral verbs includes that of a whole-stem, a part, *and consonant-doubling*)' (emphasis mine).

[6] According to Sohn (1975: 132-133), these are not the only two ways to create an intransitive verb. For example, some verbs undergo truncation and/or vowel changes (e.g., *petangi* 'land on it' → *pat* 'to land', *fangiuli* 'wake him up' → *fang* 'to wake up'). Others appear to undergo prefixing reduplication (e.g., *torofi* 'catch it' → *tottor* 'to catch', *telati* 'free it' → *tettal* 'to free').

the suffix allomorph can only be a two syllable reduplicant. Similarly, the constraints ALLFEETRIGHT and *SEGMENT (similar to *STRUC) cause the prefix always to surface as initial gemination.

Thus, in an indirect way, the shape of the denotative affix in Woleaian is determined by stress. This example does not fit neatly into any particular category of PCSA, nor is it of a type predicted by the P >> M model: even though the OT analysis is perfectly compatible with the P >> M approach, the 'flag' and the constraint that aligns it to the left edge of the word is stipulative and language-specific, so even though it can be analyzed using phonological constraints in OT, it is not exactly 'optimizing' in the way that proponents of the P >> M model view PCSA to be. It could only be argued to be optimizing in a very language-specific sense.

Another example of stress-related PCSA that does not appear to be phonologically optimizing is found in Dutch. In Dutch, two suffixes that are commonly used to derive adjectives from nouns are *-isch* /is/ and *-ief* /iv/ (Booij and Lieber 1993). For nouns ending in *ie* /i/, the distribution of the adjectival suffix allomorphs is determined by the stress pattern of the stem, as follows: *-isch* is used if the stem has final stress, while *-ief* is used if the stem-final syllable is unstressed.[7] Examples are shown

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[7] It is possible that the different patterning of forms in (13)a vs. (13)b is based in some way on the origin of the stems rather on their stress pattern, since those in (a) have a Greek origin while those in (b) have a Latin origin. This generalization is not contradicted among the nouns in *ie* provided by Booij and Lieber (1993), though as will be seen in (14), there are other, non-*ie* nouns taking *-isch* that are not of Greek origin, e.g. *álgebra* (from Arabic). In fact, additional forms found in Booij (2001: 128) uphold the alternative generalization: *agressief* 'aggressive', *demonstratief* 'demonstrative', *imitatief* 'imitating', and *suppletief* 'suppletive' are based on stems of Latin origin, as is *conservatief* 'conservative' (Booij 2001: 106); *filosofisch* 'philosophical' (Booij 2001: 108) is of Greek origin. Thus, the trigger of allomorphy could actually be a diacritic indicating the perceived origin of the stem, rather than its stress pattern. Already Booij

below (Booij and Lieber 1993: 25).[8]

(13) a.	sociologíe	‘sociology’	sociolog-**isch**	‘sociological’
	blasfemíe	‘blasphemy’	blasfem-**isch**	‘blasphemous’
	allergíe	‘allergy’	allerg-**isch**	‘allergic’
b.	prevéntie	‘prevention’	prevent-**ief**	‘preventive’
	constrúctie	‘construction’	construct-**ief**	‘constructive’
	integrátie	‘integration’	integrat-**ief**	‘integrating’

Here, there is no indication that the pattern of allomorphy is optimizing, since both allomorphs have the shape /iC/ and therefore would not affect the number of syllables for the creation of stress feet. The allomorphy therefore appears to be non-optimizing, unlike the Dutch plural example described earlier.

Also unlike the plural, this pattern seems crucially to refer to a derived phonological property. Recall that the distribution of plural suffixes was able to be stated in such a way that we did not have to refer to any derived properties, since the stress in one class of words had to be lexically specified. In this case, however, it is more difficult to avoid reference to a derived property. As discussed by Booij and Lieber (1993: 25,41), the *-ief* suffix must be the more specific allomorph because it only occurs productively

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(2001: 76) has proposed a feature [-native] to mark non-native stems, since these are the only stems to which non-native suffixes can attach (Booij 2001: 75), and also features [+French] and [+Germanic] ((2001: 104). Perhaps other features could be used to distinguish the Latin and Greek vocabulary. Under such an analysis, distrubution of *-isch* vs. *-ief* would not be an example of phonologically conditioned allomorphy. Thanks to Andrew Garrett for pointing out this alternative generalization.

[8] Booij and Lieber (1993) do not mark stress on the derived forms. Based on Booij (2001: 114), it may be inferred that forms with the *-isch* suffix assign stress to the last stressable syllable before the suffix, but this is a generalization referring to the ‘native’ suffix *-isch*, while the *-isch* that attaches to non-native stems is listed separately (Booij 2001: 76) as a non-native suffix. Therefore, Booij may be assuming there are two *-isch* suffixes (though it is not clear how one would distinguish them). Stress is marked on one form with *-ief*: *cònservatief* ‘conservative’ (Booij 2001: 106), suggesting that *-ief* gets the main stress in words where it occurs, but there are not enough examples to demonstrate that this generalization holds for all forms with *-ief*.

with stems ending in *ie*, whereas *-isch* also occurs with other types of stems, as in the examples below (Booij and Lieber 1993: 25).

(14)	proféet	‘prophet’	profet-**isch**	‘prophetical’
	álgebra	‘algebra’	algebra-**ïsch**	‘algebraic’
	organisátor	‘organizer’	organisator-**isch**	‘organizational’

Therefore, as Booij and Lieber argue, *-ief* must be the allomorph that imposes a phonological requirement on stems, and since this is the allomorph that occurs with stems having the predictable (penultimate) stress pattern, this means that the distribution of *-ief* refers to a derived phonological property. As mentioned earlier, the existence of such examples is predicted both by P >> M and by the subcategorization approach. Although the fact that this type of pattern is attested does not help us to choose between the competing ways of modeling PCSA, it is nonetheless important to document the fact that this type of example does in fact exist.

In this section we have seen two examples of apparently non-optimizing stress-related PCSA. These cases are significant in that they fail to uphold the prediction of the P >> M model that PCSA is phonologically optimizing, unless we extend the notion of ‘optimizing’ to such a degree that it is virtually meaningless. Another important point was made by the Dutch example, which is that stress-conditioned PCSA can involve reference to derived phonological properties.

3.1.2 Summary

In §3.1, we have seen eight examples of PCSA involving stress or tone. In some cases, in particular in the non-optimizing examples discussed in §3.1.1.4, the results of the survey contradicted a claim of the P >> M approach, namely that PCSA is phonological optimization. The failure of this claim to be upheld in the survey data is by now a recurrent theme, since this was also demonstrated in chapter 2. In general, then, it can be said that although not very many examples of tone- or stress-conditioned PCSA were attested in the survey (for the possible reasons discussed earlier), those examples that are attested tend to favor the subcategorization approach. In the following section, I demonstrate how this approach applies to some of the examples described above.

3.2 Analysis

Tone- and stress-conditioned suppletive allomorphy are easily modeled using the subcategorization approach as described and implemented in chapter 2. I will reiterate the basics of this approach here; for a fuller description, see chapters 1 and 2.

Subcategorization is a mechanism in which an affix is prespecified with properties that are required to be present in any stem to which it will attach. These properties may be morphological, lexical, or otherwise; crucially, they may also be phonological. Subcategorization approaches have been advanced by Lieber 1980, Kiparsky 1982b, Selkirk 1982, Orgun 1996, and Yu 2003, among others. The basic approach here is the same; the one stipulation that seems to be necessary (though see chapter 2 for more discussion) is that an affix must be adjacent to the phonological element that it subcategorizes for. This requirement is covered by the Generalized Determinant Focus Adjacency Condition (GDFAC), which was proposed by Inkelas 1990 building on a proposal of Poser (1985). The GDFAC is given below.

(15) Generalized Determinant Focus Adjacency Condition: Each phonologically constrained element must be adjacent to each constraining element.

With this in mind, let us move to a demonstration of how the subcategorization approach works for cases of tone- and stress-conditioned PCSA. Tone-conditioned allomorphy is modeled in the same way as feature-conditioned allomorphy discussed in chapter 2, except that the features that are subcategorized for are on the tonal tier rather than being features belonging to particular segments. Below I give subcategorization frames for each of the two 1sg allomorphs in Mixtepec Mixtec, accounting for their distribution.

(16) Mixtepec Mixtec 1sg construction A
$[[\ \text{L\#}]_{\text{stem}}\ \textit{yù}_{\text{1sg clitic}}\ ]_{\text{1sg word}}$

Mixtepec Mixtec 1sg construction B ('elsewhere')
$[[\ \ ]_{\text{stem}}\textcircled{L}_{\text{1sg clitic}}\ ]_{\text{1sg word}}$

An alternative approach would encode homophony avoidance directly into the synchronic account of the allomorphy via an OT constraint that penalizes any word that is homophonous with another word in the same paradigm, such as Crosswhite's (1999) ANTI-IDENT, shown below.

(17) ANTI-IDENT: For two forms, S_1 and S_2, where $S_1 \neq S_2$, $\exists\alpha, \alpha \in S_1$, such that $\alpha \neq \Re(\alpha)$.

One could account for the allomorphy by ranking ANTI-IDENT (a phonological constraint) ahead of the morphological constraint that requires morphological categories to be expressed uniformly on all stems. This would be an example of the P >> M ranking schema (McCarthy and Prince 1993a,b) discussed earlier. Such an alternative analysis would be problematic because, as shown above, it is possible to explain the apparent homophony avoidance effect based on its historical development. Therefore, the P >> M analysis provides an unnecessary and contradictory explanation. The subcategorization approach, on the other hand, does not include a synchronic explanation for the pattern, and therefore it accounts for the distribution of allomorphs without duplicating or contradicting the historical explanation for the pattern.

Stress-conditioned suppletive allomorphy under this approach amounts to subcategorization for a stressed syllable, as I will demonstrate here for the Dutch example. A different option would be to view this as subcategorization for a foot, so that Dutch plural allomorphy would fall under the category of foot-conditioned suppletive allomorphy, to be described in chapter 4. I have rejected this option because the Dutch plural suffixes seem to be sensitive not only to the presence of a stem-final foot, but specifically to the stress pattern within the foot. In comparing *kanón* 'gun' with *kánon* 'canon', I am assuming that each word is exhaustively parsed into a single, disyllabic foot, and that the difference is that *kanón* exceptionally has an iambic rather than a trochaic foot structure. Given this, it is not the alignment of the foot that differentiates the two words, but rather which syllable of the foot is stressed.

I give subcategorization frames below showing the distribution of *-en* vs. *-s*.

(18) Dutch plural construction A
$[[\ \acute{\sigma}\ \#]_{\text{stem}}\ \textit{en}_{\text{ pl suffix}}\ ]_{\text{pl word}}$

Dutch plural construction B ('elsewhere')
$[[\quad]_{\text{stem}}\ \textit{s}_{\text{ pl suffix}}\ ]_{\text{pl word}}$

In this analysis, *-s* is the 'elsewhere' allomorph. This proposal is corroborated by the fact that loanwords are inflected with *-s* rather than *-en*, though the choice of a default allomorph is not uncomplicated (see van Wijk 2002 for discussion).

This is how the subcategorization approach handles tone- and stress-conditioned allomorphy. As was demonstrated, the approach straightforwardly captures the patterns of allomorphy described in this chapter. Although the P >> M model is also capable of modeling the same patterns, the subcategorization approach has an advantage in that, as has been pointed out throughout this chapter as well as chapter 2, the predictions of the subcategorization approach seem to fit better with the survey results being presented here than do the predictions of the P >> M approach.

3.3 Conclusion

In this chapter, I have presented examples of suppletive allomorphy conditioned by tone or stress. It was noted that there are fewer such examples than we may have expected. Some reasons for this were discussed, including the fact that some cases potentially falling into the stress-conditioned category may overlap with the cases to be described in chapter 4, thereby artificially reducing the number of cases of stress-conditioned PCSA. Still, the lack of cases of tone-conditioned PCSA is surprising since phonological phenomena involving tonal alternations are quite common cross-linguistically; this remains an unresolved issue.

The examples in this chapter were demonstrated to be straightforwardly analyzable using the subcategorization approach outlined in chapter 2. For the example of tone-conditioned allomorphy in Mixtepec Mixtec, it was argued that a subcategorization analysis is superior to an OT account based on homophony avoidance because the explanation provided by the OT account is made unnecessary by the historical explanation outlined above. In the following chapter, I discuss examples of allomorphy conditioned by elements of the prosodic hierarchy and demonstrate that the subcategorization approach is easily and fruitfully extended to those cases as well.

Chapter 4: Prosodically conditioned suppletive allomorphy

Probably the best-known cases of phonologically conditioned suppletive allomorphy (PCSA) are those that are prosodically conditioned. Kager (1996) devotes an article to the topic of syllable-counting allomorphy (SCA), which he claims can actually be reduced to foot-parsing (though, as will be seen in this chapter, not all cases of syllable-counting allomorphy can be handled in this way). In this chapter, I consider cases of prosodically conditioned suppletive allomorphy as follows. First, in §4.1, I present results of a cross-linguistic survey of the phenomenon. In §4.2, I discuss the historical development of a set of related examples in Pama-Nyungan languages, showing how a diachronic analysis of the phenomenon clears the way for a straightforward and unified approach to prosodically conditioned suppletive allomorphy that is consistent with the analysis of PCSA presented in chapters 2 and 3. In §4.3, I review the synchronic analysis of PCSA and demonstrate how it accounts for the prosodically conditioned examples presented in this chapter, contrasting it with the Output Optimization approach espoused by, e.g., Kager (1996). The chapter is concluded in §4.4.

4.1 Survey results

In this section, I present examples of prosodically conditioned suppletive allomorphy revealed by a cross-linguistic survey. I define ‘prosodically conditioned’ to refer to allomorphy that is sensitive to the presence of an element of the prosodic hierarchy, namely, a mora, syllable, or foot. The survey revealed 137 total cases of PCSA in 67 different languages, listed in the Appendix. Of these cases, 59 cases from 39 different languages involve prosodic conditioning and will be discussed in this chapter.[1]

Under the P >> M approach, the same phonological constraints are responsible for both regular phonological processes and PCSA. Therefore, we expect that the same phonological constraints that drive foot parsing should also be manifested in PCSA with approximately the same frequency cross-linguistically. For example, constraints such as TROCHAIC (requiring feet to have a stressed-unstressed pattern), FOOTBINARITY (requiring feet to have exactly two moras or two syllables), and PARSESYLL (requiring every syllable to be part of a foot) are expected to drive PCSA in a considerable number of languages since they are commonly invoked in analyses of foot parsing not involving suppletive allomorphy. The effects of these constraints could be manifested in PCSA in a variety of ways. For example, in some language where suppletive allomorphs of an affix differ in whether they are inherently stressed or not, TROCHAIC could cause the unstressed allomorph to be used next to a stressed stem syllable and the stressed allomorph to be used next to an unstressed stem syllable. FOOTBINARITY combined with PARSESYLL could cause affixes with an odd mora/syllable count to occur with stems with an odd mora/syllable count (and likewise for affixes and stems with an even mora/syllable count) in order to ensure that words have an even mora count, allowing every syllable to be parsed into a binary foot.

As we will see, some of these effects are exhibited in one or more languages, confirming a prediction of the P >> M approach and suggesting that it is on the right

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[1] Note that the sum of the number of examples discussed in each chapter is greater than the total number of examples found in the survey; this is because a few of the examples are discussed in more than one chapter.

track in accounting for prosodically conditioned PCSA. For example, as will be discussed, we do find cases where PCSA results in words with an even syllable or mora count. This was the impetus for Kager's (1996) claim that 'syllable-counting allomorphy' reduces to optimal foot parsing. However, a perhaps surprising result of this survey is the finding that not all examples of PCSA conditioned by syllable or mora count involve some complementary relation between the stress pattern or the number of moras in the stem and in the affix. As will be seen in §4.1.1.3, there are examples in which suppletive allomorphs are distributed according to the syllable or mora count of the stem but where each allomorph contributes the same number of moras to the word. Thus, foot parsing constraints alone will not be able to handle all of the cases to be discussed here. In some cases, it must be stipulated that a certain allomorph occurs only with stems having a certain number of moras, syllables, or feet. This issue will be discussed again in §4.3.

This section is organized as follows. First, I present the attested examples in §4.1.1. In §4.1.1.1, I discuss examples in which the distribution of suppletive allomorphs relates to foot parsing. In §4.1.1.2, I discuss examples that relate to word minimality. In §4.1.1.3, I discuss examples where the distribution of allomorphs seems to be arbitrary or non-optimizing, in that there is no clear relationship between the shape of the allomorphs and their distribution. The examples are summarized in §4.1.2.

4.1.1 Examples

The examples to be presented in this section exhibit essentially the same properties as those presented in chapters 2 and 3. Some major generalizations that will emerge here, each of which has already been discussed in the preceding two chapters, are the following. First, the generalization that conditioning applies from the 'inside-out' is maintained here. PCSA in affixes is triggered by elements that are closer to the root, and not by elements that are farther away; we also find no instances of affix-conditioned stem allomorphy here.

Second, we find here (as in chapters 2 and 3) some examples of opaque conditioning, where the element that conditions the occurrence of a particular allomorph is lost or changed in the surface form. This supports the claim that PCSA is sensitive to input elements, not surface elements.

A third generalization made in chapters 2 and 3 is that PCSA is constrained by locality, so that conditions on PCSA always occur at the edge of the stem at which the affix attaches. Most of the examples in this chapter do not bear on this particular generalization, since they involve conditioning by general properties of the stem (such as syllable count) that cannot be said to occur at one edge or the other. However, there is at least one type of example that could contradict the locality generalization if it were attested. This would be a case in which allomorphy is conditioned by the weight of a particular syllable in the stem, but the affix undergoing allomorphy is at the opposite edge, and the weight generalization cannot be characterized in any more general way that would refer, e.g., to the overall mora count of the word.[2] This type of example would contradict the generalization, but no such cases are attested.

A final generalization that has been made in previous chapters is that PCSA is not phonologically optimizing. In those chapters, numerous examples were presented in

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[2] For example, imagine a case in which PCSA in a suffix is conditioned by whether the stem-initial syllable is light or heavy, and it does not matter how many moras or syllables intervene between the initial syllable and the right edge.

which allomorphy did not seem to follow from any well-known or well-motivated phonological constraint. It was argued that even though many examples do appear on their surface to be optimizing, the existence of the non-optimizing examples is sufficient to contradict the predictions made by the P >> M model of PCSA because it is not able to handle non-optimizing cases without recourse to ad hoc, stipulative constraints that violate the spirit of the model. In this chapter, it seems that a higher percentage of the examples are optimizing than in chapters 2 and 3. For this reason, in §4.2 I explore the possibility of accounting for the optimization via a historical explanation, thereby freeing the synchronic model from having to account for it.

I have given an overview of some generalizations that will emerge in the data presented in this chapter; I move now to discuss the examples. I begin in §4.1.1.1 with examples of PCSA that relate to foot parsing.

4.1.1.1 Foot parsing

This survey revealed a number of cases in which the outcome of PCSA can be viewed as maximizing the number of syllables that are parsed into feet. One could claim that PARSESYLL is the constraint responsible for these effects. However, this only works when PARSESYLL is combined with some other constraint such as FOOTBINARITY, since if a foot can consist of any number of syllables or moras, then the shape of an allomorph will have no bearing on whether or not all of the syllables in a word can be parsed into feet. In this section, I discuss several examples where such an analysis is possible; the ordering of examples is roughly by continent or geographical region.

Among the languages surveyed, Latin provides the clearest examples of this type of PCSA. Mester (1994) discusses three cases of allomorphy in Latin, which he argues to result from the drive to parse all syllables into feet that are exactly bimoraic. The first of these involves the ‘theme vowel’, which has two allomorphs, -*ī*- and -*ĭ*-. This is a vowel that occurs in the so-called *io*-verbs and is sometimes referred to as the ‘stem vowel’ but is explicitly assumed here to be a distinct morpheme from the root. According to Mester (1994: 24), the form of the theme vowel is predictable ‘to a large extent’ based on the shape of the root: -*ĭ*- occurs when preceded by a single light syllable (as in *capĭmus* ‘catch’), while -*ī*- occurs when preceded by a heavy syllable or two light syllables (as in *audīmus* ‘hear’ and *aperīmus* ‘open’, respectively). Mester does not make a case for why this allomorphy must be assumed to be suppletive, except to say that ‘[g]iven its lexically restricted nature, there is no motivation for positing a general phonological rule’ (1994: 26). Thus, Mester’s implicit criterion for whether or not a particular instance of allomorphy is suppletive seems to be that rule-derived allomorphy can only result from general phonological rules. Considering how phonologically similar the two allomorphs are in this particular example, the Latin theme vowel alternation could be considered to be rule-derived rather than suppletive. However, I discuss this example here since, even if the theme vowel alternation is not suppletive, Mester discusses two other cases from Latin that are unambiguously suppletive and are argued to follow from the same principles as the theme vowel alternation. Furthermore, as was discussed in chapter 2, given that the P >> M model accounts for suppletive and non-suppletive allomorphy in the same way, it is not absolutely crucial that we exclude all non-suppletive examples from the survey.

The proposed explanation for the theme vowel alternation is that it serves to avoid the 'trapping' configuration where a light syllable is located between a well-formed bimoraic foot and either the beginning or end of the word, or another well-formed bimoraic foot. Such configurations 'trap' the light syllable and prevent it from being parsed into a well-formed foot. In the environments in which the *-ī-* theme vowel occurs (after a heavy syllable or two light syllables), the root can be parsed into a single bimoraic foot. If the light syllable (monomoraic) theme vowel *-ĭ-* occurred after such a root, it would not be parsable into a bimoraic foot, and would therefore be trapped. In these environments, the *-ī-* theme vowel occurs instead, and since it contributes a heavy syllable, this theme vowel can be parsed into its own bimoraic foot, with the result that all syllables of the word are parsed into well-formed feet.

Another Latin example described by Mester that is more likely to be suppletive involves suffixes that form abstract nouns (1994: 43), with the shapes *-ia* and *-iēs*. According to Mester, many roots can take either allomorph (for example, *māter-**ia*** and *māter-**iēs*** 'matter' apparently occur in free variation). However, some roots can only take one or the other, and there is a prosodic principle behind their selection. The *–iēs* allomorph is avoided after heavy syllables (Mester 1994: 43), which Mester attributes to their inherent trapping configuration: if *-iēs* were added to a root ending in a heavy syllable, the coda of the root would syllabify with the /i/ of the suffix, forming a light syllable, which would then be trapped between two heavy syllables since the *ēs* of the suffix would form a second heavy syllable. In this situation, *-ia* is used instead (as in *grāt-**ia*** 'grace'), avoiding the trapping configuration since the entire suffix is parsed into a bimoraic foot.

A third and final example from Latin discussed by Mester involves the perfect stem of the second (*ē*) conjugation (1994: 44). According to Mester, the generalization is that perfect stems take the *u*-perfect form except in exactly those cases where the use of the *u*-perfect would result in a trapping configuration. The *u*-perfect consists of a verb root followed by *-ŭ-,* as in *mon-**ŭ**-ī* 'warn (1sg perfect)'. This *u*-perfect is the predominant way to form a perfect stem, but there are two other ways of forming a perfect stem. The first is the *s*-perfect (Mester 1994: 45), which adds *-s* to the root, as in *auk-**s**-ī* 'enlarge (1sg perfect)'. The second is through reduplication, which Mester describes as an archaic formation; an example is *spopondī* 'vow' (<*spondēre*). Mester (1994: 46) makes the generalization that the non-canonical perfect stems are formed when the use of the *u*-perfect stem would result in a trapping configuration. This is the case with roots ending in a heavy syllable (which apparently all take one of the non-canonical perfect forms). Thus, perfect stem formation provides a third example of how mora count, as it relates to foot parsing considerations, drives allomorph selection in Latin.

To summarize the Latin examples, the distribution of allomorphs does seem to optimize words in terms of foot parsing. In the case of the theme vowel, the allomorphy is not necessarily suppletive, but in the case of abstract nouns and perfect stems, the allomorphy is probably suppletive since the allomorphs are significantly different in their phonological shape.

In some cases, the apparent optimization of foot parsing is manifested in certain contexts but not others. One such example is found in Spanish. According to Harris (1979: 291), in some dialects of Spanish, the distribution of diminutive suffix allomorphs is based, within particular word classes, on the syllable count of the stem. Disyllabic bases select -*cita*/-*cito*, while stems with three or more syllables select -*ita*/-*ito*. Examples are shown below (Harris 1979: 291).

(1) madre-**cita** *madr-ita dinosaur-**ito** *dinosaurie-cito
saurie-**cito** *saur-ito comadr-**ita** *comadre-cita

There are several interesting points to be made regarding this example. First, note that the two affix allomorphs themselves both would appear to contribute two syllables to the stem, but the initial vowel of the -*ita*/-*ito* suffix triggers deletion of the stem-final vowel, resulting in a net increase of one syllable to the word, as compared to two syllables when -*cita*/-*cito* is used. Thus, the apparent complementarity between the stem and suffix is not a property of the suffix itself, but is rather the result of a phonological rule that is triggered by one suffix allomorph but not the other. This type of 'indirect' optimization is predicted by P >> M since hiatus resolution and allomorph selection are manifested simultaneously and can therefore freely interact.

Note also, however, that not all words are optimized by this distribution of allomorphs. In these dialects of Spanish, stems with four syllables take the -*ita*/-*ito* form according to Harris; this would result in words having an odd syllable count (five syllables). Thus, the pattern cannot be claimed to be optimal for every stem in the language. In a P >> M analysis, one would have to find some way to force four-syllable stems to take -*ita*/-*ito* even though this would be phonologically less optimal than using the -*cita*/-*cito* form. In a subcategorization analysis, this would be unproblematic since the -*ita*/-*ito* suffixes can subcategorize for a disyllabic stem with -*cita*/-*cito* as the 'elsewhere' allomorphs.

A final point to be made regarding the Spanish example is that, as pointed out by Harris, there are some surface counterexamples to the pattern, in which trisyllabic stems are treated as disyllabic for the purposes of diminutive allomorphy. These examples apparently all begin with *es*, so Harris explains them by proposing that diminutive allomorph selection occurs prior to the epenthesis of initial *e* before *s* in these words (Harris 1979: 291). This type of interaction with a phonological process is not predicted to occur under P >> M, since allomorph distribution is supposed to be determined simultaneously with the application of phonological processes (and using the same phonological constraints). The fact that a phonological epenthesis rule renders the PCSA conditioning opaque in this set of examples constitutes an argument against the P >> M approach.[3]

Another example where PCSA produces words with an even syllable count is found in Saami (Lappic, Norway; Dolbey 1997). In this language, several person marking suffixes have allomorphy determined by the syllable count of the stem (Dolbey 1997). Some examples are shown below (Dolbey 1997: 103, 105).

(2)	jearra- ‘to ask’	veahkehea- ‘to help’	‘even’		‘odd’
1du	je:r.re.-**Ø**	veah.ke.he:-**t.ne**	Ø	~	-tne
2du	jear.ra.-**beaht.ti**	veah.ke.hea-**hp.pi**	-beahtti	~	-hppi
2pl	jear.ra.-**beh.tet**	veah.ke.he:-**h.pet**	-behtet	~	-hpet
3pl pret	je:r.re.-**Ø**	veah.ke.he:-**d.je**	Ø	~	-dje
passive	je:r.ro.-**juv.vo**	veah.ke.hu-**v.vo**	-juvvo	~	-vvo

In every case, stems with an even syllable count take suffix allomorphs contributing an even number of syllables (including zero), while stems with an odd syllable count take allomorphs contributing an odd number of syllables. The result, as pointed out by Dolbey, is to avoid unfooted syllables. An interesting point made by

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[3] Several other examples of opaque conditioning were discussed in chapter 2 (§2.1.2.6).

Dolbey regarding this example is that it provides strong evidence for cyclic, rather than global, evaluation of stems in terms of even syllable count. This is seen where two of the suffixes listed above are combined with a root having an even syllable count, such as in the example *je:r.ro-juv.vo-beaht.ti* 'ask-Passive-2du'. In such cases, the whole word would also have an even syllable count even if the monosyllabic allomorph of each suffix were used, as in **je:r.ru-v.vo-hp.pi*. It is not enough for the whole word to have an even syllable count, because the even syllable count requirement is evaluated at each level of morphological constituency. Since the stem of affixation for the 2du suffix in the form **je:r.ru-v.vo-hp.pi* is the ungrammatical (trisyllabic) stem **je:r.ru-v.vo-*, the whole word is ungrammatical even when the addition of the monosyllabic passive suffix allomorph would correct the syllable count problem for the purposes of global evaluation.

Thus, interestingly, although Saami does confirm the prediction of P >> M that PCSA should result in words with an even syllable count, it also provides an argument against the simplest and most common implementation of P >> M. Generally, P >> M analyses do not refer to morphological constituency, but rather show the stem and all affixes present in the input, implying that they have equal status and therefore equal potential to trigger or undergo a change in the output. The Saami example demonstrates that this type of model is too simplistic; in an OT analysis, the grammar needs to be able to evaluate well-formedness each time an affix is added to the stem.

Another case that may involve foot parsing constraints is found in Finnish, though the analysis is not as straightforward as in the Saami example discussed above. The Finnish illative has three allomorphs: *-Vn*, *-hVn*, and *-seen* (Karlsson 1999: 112-113). The *-seen* allomorph occurs after polysyllabic stems ending in a long vowel. The *-hVn* allomorph occurs after monosyllabic stems and after plural stems where the root ends in a vowel (yielding a *Vi* sequence at the end of the root after the addition of the *-i* plural suffix). The *-Vn* allomorph occurs with other stems. In each of the two allomorphs containing 'V', this vowel surfaces with the same quality as the immediately preceding vowel. The distribution of the three allomorphs is illustrated in the examples below (Karlsson 1999: 112-113).

(3)	talo-**on**	'into the house'	koulu-**un**	'to school'
	kaupunki-**in**	'to the town'	lehte-**en**	'into the newspaper'
	kunta-**an**	'into the commune'	korkea-**an**	'into the high'
	maa-**han**	'into the country'	tie-**hen**	'to the road'
	työ-**hön**	'to work'	suu-**hun**	'into the mouth'
	pullo-i-**hin**	'into the bottles'	kalo-i-**hin**	'into the fish (pl.)'
	vapaa-**seen**	'into the free'	harmaa-**seen**	'into the grey'
	perhee-**seen**	'into the family'	tietee-**seen**	'into science'
	taivaa-**seen**	'to heaven/into the sky'	rikkaa-**seen**	'into the rich'

The use of the *-hVn* allomorph with monosyllabic stems produces words with two syllables, and its use after plural stems prevents VVV sequences from arising. Perhaps the distribution of *-hVn* vs. *-Vn* can be analyzed in terms of a requirement that a foot have two syllables and a constraint against VVV; in fact, one could write rules deriving one allomorph from the other, so that the relationship between these two allomorphs is not necessarily suppletive. The distribution of *-seen*, however, does not follow from these constraints. Perhaps there is also a separate constraint requiring a foot to have at least two moras, so that with a stem such as *vapaa*, if the stem has to be parsed into a single disyllabic foot, then the suffix form is *-seen*, which can form its own bimoraic foot. Thus, the Finnish example may involve constraints on foot structure, but the overall pattern of allomorphy in the illative suffixes is complicated and would require several separate constraints in a P >> M analysis.

Three examples of syllable count-conditioned allomorphy are found in Estonian (Finno-Lappic, Estonia; Mürk 1997). These examples are discussed by Kager (1996) in support of his argument that syllable-counting allomorphy is driven by foot-parsing constraints. In Estonian, the genitive plural takes the form *-te* after stems with two or four syllables, and *-tte* with three syllables; the partitive plural takes the form *-sit* after stems with two or four syllables, and *-it* (or by a vowel mutation) after stems with three syllables (Kager 1996: 157). The partitive singular is -Ø or *-t* after 'even-numbered' stems (with the *-t* allomorph occurring only after monosyllables) and *-tt* after 'odd-numbered' stems (Kager 1996: 168). Examples given below with page numbers in parentheses are from Mürk 1997; the remaining examples are from Kager 1996: 157, 168.

(4)

Genitive plural	Partitive plural	Partitive singular	Gloss
maa:-**te** (74)	ma-**it** (74)	maa:-**t**	'land'
aas:ta-**tte** (149)	aas:ta-**it** (149)	aas:ta-**tt**	'year'
häda-**te** (77)	häda-**sit** (77)	häda-**Ø** (77)	'trouble'
paraja-**tte**	paraja-**it**	paraja-**tt**	'suitable'
raamattu-**tte**	raamaattu-**it**	raamattu-**tt**	'book'
atmirali-**te**	atmirali-**sit**	atmirali-**Ø**	'admiral'
telefoni-**te**	telefoni-**sit**	telefoni-**Ø**	'telephone'

Kager's analysis is that 'even-numbered' stems are those that can be exhaustively parsed into disyllabic feet, while 'odd-numbered' stems cannot be exhaustively parsed into disyllabic feet (1996: 158). The suffix forms selected by even-numbered stems do not end up being parsed into feet. The suffix forms selected by odd-numbered stems, on the other hand, are parsed into a foot along with the final syllable of the stem. The fact that in these cases the suffix allomorph contributes a coda consonant to the stem-final syllable, making that syllable heavy, follows from the preference for disyllabic trochaic feet. Thus, Kager claims that this is not actually a case of syllable counting, but of foot parsing.

Kager makes the stronger claim that syllable count-conditioned allomorphy in general reduces to foot parsing optimization. We will see that this claim does not hold up for all cases since, as will be demonstrated in §4.1.1.3, there are several cases of allomorphy based on syllable count where the distribution of allomorphs is arbitrary rather than optimizing. Nonetheless, the Estonian examples do appear to involve a 'conspiracy' that optimizes foot parsing. However, note that in each of the sets of allomorphs discussed by Kager (partitive singular, partitive plural, and genitive plural), the two allomorphs are very similar to each other phonetically. This suggests that we might view these as examples of rule-derived rather than suppletive allomorphy (though the rules needed to produce the allomorphy would probably have to be specific to each morpheme).

In Turkana (Nilotic, Kenya; Dimmendaal 1983), we find an example in which the apparent complementarity between the size of the stem and the size of an affix cannot be attributed to the regular application of phonological processes to a single underlying affix form. According to Dimmendaal (2000), Turkana exhibits syllable count-conditioned suppletive allomorphy in the affix used to form abstract nouns. As shown in the examples below (Dimmendaal 2000: 166), roots of shape CVC take the *-ìsí* allomorph ((5)a), while roots of shape $C_iV_jC_iV_jC$ take the *-ù* allomorph ((5)b), and other roots are partially reduplicated ((5)c).

(5)	a.	á-rɛ́ŋ**-ìsí**	‘redness’	(-rɛ́ŋ	‘be red’)
		á-jɔ́k**-ìsí**	‘kindness’	(-jɔ́k	‘be kind, good’)
	b.	á-gógóŋ**-ù**	‘strength’	(-gógóŋ	‘be strong’)
		á-bábár**-ù**	‘saltiness’	(-bábár	‘be salty’)
	c.	á-cʊ́kʊ́l-**ʊ́l**	‘depth’	(-cʊ́kʊ́l	‘be deep’)
		á-ŋáráb-**áb**	‘roughness’	(-ŋáráb	‘be rough’)

Dimmendaal’s (2000) characterization of the distribution implies that the allomorphy may result from a four-syllable requirement for abstract nouns. However, the distribution is actually more complicated than represented here, as indicated by Dimmendaal (1983). In addition to the types mentioned above, there are other root types for which the selection of the abstract noun suffix is not predictable from the factors outlined above. For example, in addition to CVC roots, roots with ‘an epipatetic high front vowel’ take the -*ìsí* allomorph (Dimmendaal 1983: 270), while roots with ‘an epipatetic vowel /o/ or /a/’ (1983: 271) take the -*ù* allomorph, as do stems containing a habitual extension. Thus, some morphological and/or stem class conditioning must be involved here in addition to the phonological conditioning; though we do not have examples of all of these different types of stems, it seems that not every nominalized form ends up with four syllables. Still, it seems that there is a strong tendency for nominalized forms to have four syllables, suggesting that a constraint enforcing this would not be implausible. One could view this as being foot-based, since a four-syllable word is easily parsed into two disyllabic feet; it could also fall into the category of minimality-related conditioning since it seems that there is a preference for a specific number of syllables in nominalized words.

In some examples found in the survey, both the shape and the placement of the allomorphs are relevant to syllable count and foot parsing. For example, in Nancowry

(Mon-Khmer, Nicobar Islands; Radhakrishnan 1981),[4] the causative is marked by either a prefix or an infix, depending on whether the stem is monosyllabic or disyllabic, respectively (Radhakrishnan 1980: 54). When the stem is monosyllabic, the causative is marked by a *ha-* prefix, as in the examples below.

(6)	**ha**-káh	'to cause to know'	**ha**-míh	'to cause to rain'
	ha-míʔ	'to cause to be soaked'	**ha**-suáh	'to cause to burn'

When the stem is disyllabic, the causative is marked by an *-um-* infix, which 'overwrites' the rhyme of the stem-initial syllable, as in the examples below.

(7)	p-**um**-ʔũy	'to cause to have a bad smell'	paʔũy	'bad smell'
	p-**um**-rẽ	'to cause something to be flat'	pirẽ	'flat'
	p-**um**-lóʔ	'to cause someone to lose s.t.'	palóʔ	'lose'

The result of this allomorphy appears to be that causative forms always have two syllables. As with the Turkana example above, the result of the allomorphy could be analyzed in terms of both foot parsing (since causative forms end up with two syllables, which presumably form a single foot) and minimality constraints.

Radhakrishnan (1980: 55) discusses some interesting 'double causative' examples, which are formed by prefixing *ha-* and infixing *-um-*. The double causative can only apply to monosyllabic roots. Examples are shown below (Radhakrishnan 1980: 55).[5]

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[4] Recent discussions of Nancowry phonology can be found in Steriade 1988, Alderete et al 1999, Hendricks 1999, and Inkelas and Zoll (2005: 223-224); these deal primarily with reduplication.

[5] The meaning of the double causative is not clear since the examples are given out of context, but based on the glosses, it does not necessarily involve the introduction of two new causative agents as might be expected.

(8)	**ha**-káh	**h**-**um**-káh	‘to cause to know’
	ha-míh	**h**-**um**-míh	‘to cause to rain’
	ha-ʔuáh	**h**-**um**-ʔuáh	‘to cause to cough’
	ha-sɯ́l	**h**-**um**-sɯ́l	‘to frighten’

On the surface, these examples might appear to provide an argument in favor of using a foot parsing or minimality/maximality constraint to analyze the Nancowry causatives, since the combination of two causatives still always results in a disyllabic word. However, the subcategorization approach also provides a straightforward explanation for the fact that one instance of each causative allomorph is used in the double causative construction. If the *ha*- allomorph subcategorizes for a monosyllabic stem, then this allomorph will apply first to the root; then, when a second causative is applied to the (now disyllabic) stem, the -*um*- allomorph will be used since *ha*- can only attach to a monosyllabic stem. Thus, the double causative does not provide an argument in favor of one analysis or the other. However, it does constitute an example in which allomorph selection is sensitive to a phonological property contributed by another affix (in this case, a different allomorph marking the same morphological category), since the use of -*um*- in the double causative is conditioned by the extra syllable contributed by *ha*-. Other examples involving this type of interaction between affixes have already been discussed (for example, the Saami examples discussed earlier in this section, and the Turkish ‘stacked’ causatives discussed in chapter 2), but this is worth pointing out nonetheless.

One example that has been claimed to relate to foot parsing is found in Martuthunira (Pama-Nyungan, Australia; Dench 1995), where the ‘full laden’ suffix takes the form -*warlaya* following trimoraic and larger stems, and -*warla* following bimoraic stems (Dench 1995: 65). Dench claims that this pattern is ‘based on a preference for an even pattern of stressed-unstressed syllables in the word' (1995: 65).[6] Some examples are shown below (from Dench 1995: 94, except where noted).

(9)	jinyji-**warla** fat-FULL	'fat, plump, obese'	marrari-**warlaya** word-FULL (Dench 1995: 38)	(no English given)
	ngungku-**warla** weight-FULL	'strong'	kunkuwarra-**warlaya** honey-FULL	'full to bursting with honey'

Dench appears to claim that the *-warla* form occurs with bimoraic roots so that the resulting form will have an even number of moras, which can be parsed into exactly two feet. However, since the *-warlaya* allomorph occurs with stems with an even mora count of more than three moras (as in *kunkuwarra-warlaya*), Dench's explanation does not extend to all cases since the distribution of allomorphs does not always result in an even-numbered syllable count. Therefore, the allomorphy seems not to refer to feet, but specifically to mora count, and in general it cannot be considered to optimize footing. Furthermore, note that this pattern cannot be analyzed in terms of either minimality or maximality, since the pattern here is the exact opposite of the type of complementarity that we have seen in some previous examples: the smaller suffix attaches to the smallest stems, while the larger suffix attaches to larger stems. This example lends itself to a subcategorization approach, since we can easily characterize the *-warla* suffix as subcategorizing for a stem with two moras (or, to avoid allowing the grammar to 'count',

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[6] Since Dench's claim refers specifically to stress patterns, it might have made sense to discuss this example along with the other stress-conditioned examples in chapter 3. However, the notion of alternating stress does relate directly to foot parsing, and furthermore, I argue against Dench's explanation here. Therefore, I have opted to include the example in this section along with other similar examples where allomorph distribution is conditioned by syllable/mora count.

we could assume that the bimoraic stem is parsed into a foot before the addition of the suffix, so that the suffix attaches to a stem consisting of a single foot).

A final example of apparent foot-based allomorphy is found in Shipibo (Panoan, Peru; Elías-Ulloa 2004) . In Shipibo, the ergative suffix has two allomorphs, *-n* and *-nin* (Elías-Ulloa 2004: 1). The *-n* allomorph occurs when the noun stem has an even syllable count, while the *-nin* allomorph occurs with noun stems with an odd syllable count. Some examples are shown below (Elías-Ulloa 2004: 3).

(10) bakɨ-**n** ‘child-ERG’ atapa-**nin** ‘hen-ERG’

The distribution of ergative allomorphs results in words with an even syllable count, as in the Saami case discussed earlier in this section. Thus, this is another example that could be analyzed in terms of foot parsing, since the distribution of allomorphs results in a configuration of syllables that is optimal for foot formation.

In this section, we have seen several examples of allomorphy conditioned by syllable or mora count (17 examples from nine different languages) whose net result is that every syllable can be parsed into a binary foot. This is an important finding since it is the first type of allomorphy that we have seen so far in which a prediction of the P >> M model is borne out in a significant way. Since this is one of the more well-known types of PCSA, it should not be surprising that such cases exist. In fact, we might have expected to find more examples, since the effects of foot parsing constraints are evident in the phonological systems of so many of the world’s languages. However, one point should be kept in mind, which is that although the P >> M model predicts and explains examples of this type, the subcategorization approach is also able to account for these examples. The difference is that in a subcategorization analysis, we would not have a built-in explanation for the apparent drive towards exhaustive parsing into binary feet; the foot-parsing effect would be (from a synchronic perspective) coincidental. This missed generalization might seem to be a serious disadvantage of the subcategorization approach. However, as will become clear when we discuss the non-optimizing examples in §4.1.1.3, there is a good reason to avoid using foot-parsing constraints to analyze syllable-counting allomorphy: many examples of syllable-counting allomorphy seem to be arbitrary and make no difference to foot parsing, and yet in terms of their behavior and the factors that condition allomorph distribution, they look exactly like the examples seen in this section. The P >> M model fares poorly when we attempt a unified account of all syllable-counting allomorphy.[7] This issue will be taken up in §4.3.

4.1.1.2 Minimality

Another set of constraints expected to play a role in prosodically conditioned PCSA is minimality constraints. These constraints stipulate that a word must have some minimum number of moras, syllables, or feet in order to be a well-formed word.

An example of allomorphy that could be analyzed as resulting from a minimality constraint is found in Spanish, where the nominalizing suffixes *-ez* and *-eza* are distributed according to the syllable count of the stem. As seen in the examples below, the form *-ez* is used when the citation form of the corresponding adjective has three or

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[7] It has been suggested (Booij 1998) that the P >> M approach could be used for the optimizing type of PCSA, while another mechanism could be used to handle the non-optimizing types. I argue against this approach in §4.3 and again in §6.4 on the grounds that it is unsatisfying to the linguist looking for a unified solution to the problem of syllable-counting allomorphy, and also that it is scientifically unsound.

more syllables, while the suffix *-eza* is used when the adjective has one or two syllables (Aranovich et al 2005).

(11)

rigido	rigid-**ez**	'rigid'
estupido	estupid-**ez**	'stupid'
vil	vil-**eza**	'vile'
franco	franqu-**eza**	'truthful'
gentil	gentil-**eza**	'gentle'
real	real-**eza**	'royal, regal'

One generalization is that nominalized forms have no fewer than three syllables (e.g., **vil-ez* is unacceptable). Thus, in a P >> M account, the distrubution of *-eza* could be attributed in part to a minimality constraint (3 syllable minimum for nominalized words) if we assume that *-ez* is the default or 'elsewhere' allomorph. However, this would not explain why disyllabic consonant-final stems such as *gentil* take *-eza* instead of *-ez*. The problem for a P >> M account is that the number of input stem syllables is obscured by the deletion of the stem-final vowel that is triggered by the addition of the vowel-initial suffix.[8] In a subcategorization analysis, we can state that the *-ez* suffix subcategorizes for a stem with at least three syllables, while *-eza* is the 'elsewhere' allomorph.[9] Thus, although we can still say that minimality may be playing a role here, the surface patterns cannot all be explained in this way, and the example does not lend itself to a standard, surface-based P >> M analysis involving minimality.

In Qafar (Cushitic, Ethiopia; Parker and Hayward 1985, Hayward 1998), the indefinite genitive suffix exhibits PCSA that may be driven in part by word minimality

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[8] Aranovich et al (2005) argue that the distribution of allomorphs is driven by a constraint on inputs (stem + suffix) requiring them to consist of two binary feet. A problem with this type of approach is that it requires the phonology to build feet out of the stem and suffix prior to the evaluation of the input by the phonology, which should logically take place before any phonological processes (such as foot formation) apply to the input.

[9] Alternatively, *-eza* could subcategorize for stems of one or two syllables, with *-ez* as the elsewhere allomorph.

considerations. As seen in the examples below (Hayward 1998: 630), among masculine stems,[10] those that are monosyllabic and consonant-final take the *-ti* suffix ((12)a). Those that are polysyllabic and consonant-final undergo no segmental changes, though stems that bear lexical accent are de-accented in the indefinite genitive ((12)b). Those that are polysyllabic and vowel-final undergo de-accentuation and have their final vowel replaced by [i] ((12)c).

(12)	a.	/ħan/	‘milk’	ħan-**tí** dala	‘(a) milk gourd’
	b.	/áʕan/	‘frog’	aʕán iba	‘(a) frog’s leg(s)’
		/danan/	‘donkey’	danán iba	‘(a) donkey’s leg(s)’
	c.	/kúta/	‘dog’	kut-**í** ɖagor	‘(a) dog’s fur’

One result of the allomorphy seen here is that no possessor noun has fewer than two syllables. This could account for why monosyllabic possessor stems take the *-ti* suffix instead of -Ø. However, this still does not explain why polysyllabic vowel-final stems behave differently from their consonant-final counterparts in taking *-i* rather than -Ø, since they would still be disyllabic without the *-i* suffix. This aspect of the allomorphy does not follow from minimality. A possible way of accounting for the distribution of *-i* vs. -Ø is to propose a two-syllable *maximality* constraint as well, so that possessor nouns must have both a minimum and a maximum of two syllables. Suppose that the constraint MORPHEXPR (Rose 2000a) requires every morphological category to be marked by some affix, and suppose that the stress shift that applies to the forms in (12)b and (12)c is secondary and does not count as an expression of the category. Then, the distribution of *-i* vs. -Ø can be explained because while *-i* can fuse with a stem-final vowel, yielding

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[10] Feminine nouns take a *-C* suffix, with the quality of the consonant determined by the initial consonant of the possessed stem that follows, unless this stem is vowel-initial, in which case the suffix consonant surfaces as [h] by default (Hayward 1998: 630).

disyllabic words in (12)c, using *-i* with the consonant-final stems in (12)b would add a third syllable, which would violate the disyllabic maximality constraint.

An important point to note regarding this example is that it requires us to posit both a minimality and a maximality constraint, plus MORPHEXPR, to account for the single fact that all possessor nouns have exactly two syllables. Thus, in a P >> M analysis, the drive towards disyllabic words here is the combined effect of multiple constraints; this is not a very straightforward way of getting at the syllable count generalization.[11]

One example that has been argued to result from word maximality is found in Miya (Chadic, Nigeria). According to Schuh (1998), the maximal native verb is trimoraic, accounting for the fact that trimoraic roots do not undergo reduplication in the pluractional form as other roots do. As shown below, roots with the shape /Ca/ undergo reduplication, surfacing as *CəCa* ((13)a). Roots with the shapes /C_1əC_2(ə)/ and /C_1əC_2a/ also undergo reduplication, surfacing as *C_1aC_1əC_2a* ((13)b). Roots of the shape /C_1aC_2/ undergo vowel lengthening, surfacing as *C_1aaC_2a* ((13)c). However, roots with the form /C_1VC_2(ə)C_3(ə)/ undergo a vowel change but no reduplication or vowel lengthening, surfacing as *C_1aC_2(ə)C_3a* ((13)d). Examples are from Schuh 1998: 175-176.

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[11] Note also that we cannot use foot parsing constraints to account for the pattern, since there do exist trisyllabic stems in the language which, according to Hayward's (1998) generalization, pattern with disyllabic stems, rather than with monosyllabic stems as would be the case if foot parsing constraints were responsible.

(13) a.	za	‘enter’	à **zə**-za-ya sáy	‘he entered’
	pa	‘collect’	à **pə**-pa sáy	‘he collected’
b.	tsər	‘stop’	à **tsa**-tsə́r-**a**-yà sáy	‘he stopped’
	pər	‘cut’	à **pa**-pə́r-**à** sáy	‘he cut’
	zəna	‘spread to dry’	à **za**-zən-**a** sáy	‘he spread to dry’
c.	tlakə	‘scrape’	à tlá**a**k-**à** sáy	‘he scraped’
	dzar	‘disperse’	sə̀bə dza**ar**-**a**-ya sáy	‘the people dispersed’
d.	tsəryə	‘step on’	à ts**a**ry-**á** say	‘he stepped on’
	kərmə	‘scoop up’	à k**a**rm-**a** sáy	‘he scooped up’

Schuh’s explanation for the failure of the roots in ((13)d) to reduplicate is compelling but does not explain why the C_1aC_2 roots also do not reduplicate. If the generalization is that the pluractional involves reduplication except in the case that the three-mora restriction prevents reduplication from applying, then we cannot account for the behavior of C_1aC_2 roots. One possible conclusion is that the form of the pluractional for C_1aC_2 and C_1VC_2(ə)C_3(ə) is lexically conditioned (despite the fact that the generalization is stated in terms of the phonological shape of the roots), while the allomorphy that distinguishes CV roots from CVC/CVCV roots (excluding those with a lexically specified pluractional form) is conditioned by mora count and may relate, at least historically, to Schuh’s proposed trimoraic constraint on verbs.

New Zealand Maori (Polynesian, New Zealand; Biggs 1961) provides another example of stem-affix complementarity that could be driven by word minimality. In New Zealand Maori, the form of the inceptive prefix is *kaa-* before monosyllabic stems and disyllabic stems where both syllables are short (i.e., before bimoraic stems), and *ka-* elsewhere. Examples of the *kaa-* allomorph are shown below (Biggs 1961: 29); Biggs does not provide examples with *ka-*.

(14)	**kaa**-pái	‘becomes good’	**kaa**-ríro	‘is carried away’

This distribution can be restated as referring to mora count: bimoraic stems take *kaa-*, while larger stems take *ka-*. A possible way of accounting for this would be to posit a constraint requiring inceptive forms to have a minimum of four moras. Note, however, that we can use such a constraint in an OT analysis of the allomorphy without P >> M, since the allomorphs are not necessarily in a suppletive relationship. Since they are so phonetically similar to each other, these allomorphs could be related to a single underlying prefix, /ka-/, whose vowel undergoes lengthening when it occurs before a stem with two moras. Therefore, this example may result from minimality, but it is not an ideal candidate for a P >> M analysis.[12]

In this section, we have seen five examples in which allomorphy appears to be driven by word minimality or maximality. However, some of these examples do not necessarily involve suppletive allomorphy, and as was discussed, some cannot easily be accounted for using the P >> M model. In §4.1.1.3, I discuss several more examples that defy analysis using P >> M since they involve allomorphy that is not optimizing with respect to any well-known P constraints.

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[12] Note also that the distribution of allomorphs cannot be analyzed in terms of foot parsing. This is because there do exist stems in the language that are polysyllabic and have an initial long vowel. Some examples (from Harlow 1996, with page numbers in parentheses) include *we:ra* ‘whale’ (13), *te:pu* ‘table’ (19), *pu:hi* ‘shoot’ (47), *wa:hi* ‘place’ (49), *ta:ne* ‘man’ (51), and *ma:ku:* ‘wet’ (18). According to Biggs’ (1961) generalization, stems with these shapes (CV:CV(:)) take the *ka-* prefix; this is problematic for foot parsing since the single light syllable contributed by *ka-* is prevented from being parsed into a well-formed foot when the stem-initial syllable is heavy.

4.1.1.3 Non-optimization

In the preceding sections, we have seen examples in which the distribution of allomorphs appears to have some motivation based on foot parsing or word minimality/maximality. In this section, we will consider some examples of PCSA in which the motivation for allomorphy is unclear, suggesting that the distribution of allomorphs is arbitrary rather than optimizing. This is not to say that one could never come up with some possible motivation for any of these examples. However, unlike some of the examples presented above in §§4.1.1.1-2, there is no immediately obvious phonological constraint that can be identified as driving the allomorphy.

One example of PCSA in which the motivation for allomorph distribution is unclear is found in Turkana (Dimmendaal 1983). In Turkana, plural is marked on nouns by a prefix *ŋa-* or *ŋI-* and one of three suffix allomorphs, *-a*, *-In*, or *-I.*[13] As seen in the examples below (Dimmendaal 1983: 226, Dimmendaal 2000: 44, 235), the *-a* allomorph occurs with stems of shape CV(C)VC ((15)a), the *-In* allomorph occurs with stems of shape CV(C)V ((15)b), and the *-I* allomorph occurs with stems of shape C(C)VC ((15)c).

(15)	a.	ŋa-kìɲàŋ-**a**	‘crocodiles’	ŋa-ŋàjɛ̀p-**a**	‘tongues’
		ŋa-ŋàsɛ̀p-**a**	‘placentas’	ŋɪ-kààl-**a**	‘camels’
	b.	ŋa-kwap-**ɪnˋ**	‘lands’	ŋi-rot-**inˋ**	‘roads’
		ŋa-rʊk-**ɪn**	‘humps’	ŋa-kʊŋ-**ɪn**	‘knees’
	c.	ŋi-wɔrʊ-**ɪˋ**	‘cloths’	ŋi-suro-**iˋ**	‘dik-diks’
		ŋa-pɔɔ-**ɪˋ**	‘hares’		

If coda consonants are moraic, then the use of *-In* with monosyllabic stems could be seen as the result of a requirement that plural forms have a minimum of four moras. However,

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[13] *I* is a high, front vowel whose value for ±ATR is determined by the stem vowels.

this still does not explain the distribution of *-a* vs. *-I.* This could have something to do with sequences of vowels that are permitted to be adjacent to each other; perhaps [a] is dispreferred after another vowel, so *-i* is used in that environment instead. We can therefore possibly explain the distribution of allomorphs in these examples using common constraint types, but such an explanation would be contingent on some unsubstantiated assumptions.

Another example in which allomorph distribution is not obviously optimizing is found in Kimatuumbi (Odden 1996). As was also discussed in chapter 2, the perfective in Kimatuumbi has four allomorphs: *-i̧te*, *-i̧i̧le*, *-i̧i̧ye*, and the infix *-i̧-*. The allomorphs are distributed as follows (Odden 1996: 51-53). Monosyllabic verbs (of shape (C)VC or (C)VVC), as well as stems whose final vowel is long, take *-i̧te*. Examples are shown below (Odden 1996: 51).

(16)	ni̧-chól-**i̧te**	'draw'	ni̧-tí̧n-**i̧te**	'chop'
	ni̧-bálaang-**i̧te**	'count'	ni̧-chéleew-**i̧te**	'be late'

Polysyllabic stems (except those with a final long vowel) take the *-i̧-* infix, which is inserted into the stem-final syllable, as in the examples below (Odden 1996: 51). These forms also select the final vowel *e* rather than *a*.

(17)	ni̧-áandi̧-**i̧**-ke	'write'	ni̧-béli̧-**i̧**-ke	'bear'
	ni̧-chíili̧-**i̧**-ye	'be late'	ni̧-sábi̧-**i̧**-te	'beat'

As was discussed in chapter 2, glide-final roots take *-i̧i̧le*, while stems ending in *yaan* or *waan* take *-i̧i̧ye* (Odden 1996: 53).

The distribution could be construed as resulting from a requirement that perfective forms, including their prefixes, have four syllables. However, the four-syllable generalization does not apply in all cases, since disyllabic stems whose final vowel is long take -*i̦te*, thereby ending up with five syllables. Also, all roots ending in *yaan* or *waan* take the -*i̦i̦ye* suffix, resulting in words with more than four syllables. Furthermore, if the four-syllable requirement were invoked to explain the use of -*i̦te* with monosyllabic stems, then we would also have to explain why this allomorph is used after stems with a final long vowel. Therefore, much of the pattern seen here cannot be attributed to a minimality constraint, and appears to be arbitrary.

In Nancowry (Radhakrishnan 1980), there is another example of syllable count-based PCSA in which the distribution of allomorphs appears to be arbitrary. In Nancowry, there the instrumental is marked by either -*an*- or -*in*-. Monosyllabic stems select -*an*-, while disyllabic stems (including those built from a monosyllabic root plus causative prefix) select -*in*-, which overwrites the rime of the initial syllable (Radhakrishnan 1980: 60-63). Some examples are shown below (Radhakrishnan 1980: 61, 62-63).

(18)	káp	‘to bite’	k,**an**,áp	‘tooth’
	tián	‘to file’	t,**an**,ián	‘a file’
	léʔ	‘to catch’	l,**an**,éʔ	‘an object to catch with’
	rɯ́k	‘to arrive’	r,**an**,ɯ́k	‘a vehicle’
	kaʔáp	‘to close’	k,**in**,ʔáp	‘a trap’
	tikóʔ	‘to prick’	t,**in**,kóʔ	‘pin, needle’
	sahuáŋ	‘cool’	s,**in**,huáŋ	‘something that cools’
	ha-kiãk	‘to inflate’	h,**in**,kiãk	‘a pump’

In this example, there appears to be no functional motivation for the distribution of the allomorphs. As with the causative examples given above in §4.1.1.1, instrumental forms appear always to have two syllables, so one might argue that the distribution of allomorphs is ‘optimizing’ with respect to syllable count. However, once we distinguish between affix shape and affix placement, the distribution of allomorphs seems arbitrary as in many other examples described in this section. The *-in-* allomorph overwrites the first vowel of a disyllabic stem, yielding a disyllabic word, while the *-an-* allomorph is inserted after the first consonant of a monosyllabic stem without overwriting the vowel. However, the infixes themselves could just as easily pattern in the opposite way; their actual behavior is no more natural than if the *-in-* suffix were inserted after the first consonant of a monosyllabic stem and the *-an-* suffix were to overwrite the first vowel of a disyllabic stem. Thus, the distribution of the allomorphs in terms of their shape does not appear to be functionally motivated.

Another example involving apparently arbitrary allomorph distribution is found in Martuthunira, where there are two different forms of the collective suffix (Dench 1995: §6.1.5, §6.3.2) on ‘L-conjugation’ verbs that are distributed according to the size of the verb stem (1995: 38). Bimoraic stems take *-yarri*, while larger stems take *-lwarri*. Some examples are provided below (Dench 1995: 38).

(19)	karta-**yarri**	stab-COLL	thuulwa-**lwarri**	pull out-COLL
	thani-**yarri**	hit-COLL	kartatha-**lwarri**	chop-COLL

This is an interesting case because not only is there not a complementary relationship between the size of the stem and affix, but if anything, the situation is the exact reverse: larger stems take the larger allomorph.[14] There does not seem to be any way to predict the distribution of allomorphs based on their shape.

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[14] Of course, if coda consonants are not moraic, then the notion of the ‘larger’ allomorph is not very significant (it would simply refer to the allomorph with more segments). However, it is worth pointing out this generalization, because it underscores the fact that this example does not show the kind of complementarity between the stem and affix that was seen in some examples in §§4.1.1.1-2.

Another interesting example of syllable count-conditioned allomorphy in which the allomorphs contribute the same number of syllables to the stem is found in Kashaya (Oswalt 1960, Buckley 1994). As discussed in chapter 2, the durative in Kashaya exhibits PCSA conditioned both by syllable count and by the stem-final consonant. According to Buckley (1994: 328-329), the allomorphs are distributed as follows. The first split (described in chapter 2) is between consonant- and vowel-final stems. Among vowel-final stems, there is another split based on syllable count: monosyllabic stems take *-cin',* while polysyllabic stems take *-men'*. Finally, in general, consonant-final stems take *-an.*[15] Examples of vowel-final roots exhibiting syllable count-based allomorphy are provided below (Oswalt 1960: 212-213).[16]

(20)	sime-sime-**ci·d**-u	'to keep on sprinkling'
	buwi-**ci·d**-u	'to keep on stringing'
	duk'ilci-**me·d**-u	'one to keep pointing once'
	mohqa-**mé·d**-u	'one to drive'

The stems characterized as monosyllabic appear in these examples to have more than one syllable; this leads Oswalt to characterize the distribution of durative allomorphs somewhat differently from Buckley (Oswalt states that *-cin'* is used 'after a vowel... when that preceding vowel is in the second syllable of the verb' (Oswalt 1960: 212), while *-men'* '...is used after a vowel... when that preceding vowel is in the third or later syllable of the word' (Oswalt 1960: 212). However, vowel epenthesis may be argued to apply to stems only after the attachment of *-cin'*, so that the stem for attachment of this allomorph is actually monosyllabic as characterized by Buckely. This is an important

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[15] Among consonant-final stems, there also exists an elaborate subpattern of allomorphy, discussed in chapter 2, which seems to reduce to morphological conditioning.

[16] Note that what Buckley refers to as *-cin'* is generally transcribed as [ci·d], while Buckley's *-men'* is transcribed as [me·d].

point, because if *-cin'* attaches to monosyllabic stems which later gain an extra syllable through epenthesis, then the condition for the attachment of *-cin'* is rendered opaque. This then is another example of the type of opaque conditioning of PCSA that would be difficult to capture in a P >> M analysis; other examples of this type include the Spanish example discussed in §4.1.1.1, and several examples discussed in chapter 2 (§2.1.2.6).

Zuni (isolate, New Mexico; Newman 1965) exhibits another example of possibly arbitrary PCSA. The form of the singular suffix that attaches to nouns in Zuni depends in part upon the number of syllables in the stem, as follows (Newman 1965: 23-24). Nouns of class 2 (which are all monosyllabic) take the suffix *-mmeʔ* ((21)a). Nouns of class 3 (which are all polysyllabic) take *-ʔe* ((21)b). Among class 1 nouns, the distribution of allomorphs depends on syllable count. Those with one syllable take *-ʔleʔ* ((21)c). Those with two syllables take the allomorph *-nne* ((21)d). Examples are shown below (Newman 1965: 24).

(21) a.	kʔe-**mmeʔ**	‘stalk’
b.	sap-**ʔe**	‘box of dishes’ (< *sapa*)
c.	ɬi-**ʔleʔ**	‘sinew’
d.	homa-**nne**	‘juniper leaf’

Though part of the distribution refers to lexical classes, the allomorphy within class 1 is phonological since it is determined by syllable count. However, note that the distribution of allomorphs does not affect the surface syllable count. Each suffix allomorph contributes exactly one syllable to the word, so their distribution does not complement the syllable count of the stem. It is possible that the generalization could have to do with mora count instead, since in the examples seen above, both of the class 1 singular forms may have four moras, if it is assumed that coda consonants contribute a mora. However, not all singular nouns fit this pattern (e.g., the example *sap-ʔe* in (21)b has only three moras).

Another apparently non-optimizing example of PCSA is found in Tzeltal (Mayan, Mexico). According to Walsh Dickey (1999), perfective suffix allomorphs in Tzeltal are selected based on syllable count, but the shape of the affixes themselves does not seem to relate to syllable count: the variants are *-oh* (occurring with monosyllabic stems) and *-ɛh* (occurring with polysyllabic stems). Examples of the *-oh* variant are provided below (Walsh Dickey 1999: 328-329).

(22)	s-mah-**oh**	'he has hit something'	j-il-**oh**	'he has seen something'
	s-pas-**oh**	'he has made something'	s-kut͡ʃ-**oh**	'she has carried it'
	s-nut͡s-**oh**	'he has chased something'	j-al-**oh**	'he has told something'
	s-tsak-**oh**	'he has taken something'	s-jom-**oh**	'he has gathered it'
	s-nɛt'-**oh**	'he has squashed something'		

When the root is polysyllabic, the perfective suffix is *-Eh*, as shown below (Walsh Dickey 1999: 328).

(23)	s-majlij-**ɛh**	'he has waited for someone'	s-mak'lin-**ɛh**	'he has fed someone'
	s-maklij-**ɛh**	'he has listened to something'	s-tikun-**ɛh**	'he has sent something'

The *-ɛh* variant is also used with a monosyllabic root when another suffix intervenes, resulting in a polysyllabic stem, as shown in the examples below (Walsh Dickey 1999: 329, no interlinear glosses provided).

(24)	s-hol-intaj-**ɛh**	'he has thought about it'
	h-pak'-antaj-**ɛh**	'I have patched it'
	s-kut͡ʃ-laj-**ɛh**	'she was carrying it repeatedly'

This constitutes another example in which the shape of the allomorphs does not relate to the phonological condition on their distribution.

A final example of apparently non-optimizing PCSA is found in Axininca Campa (Arawakan, Peru; Payne 1981). In Axininca Campa, there is a genitive suffix that takes one of two forms, *-ni* or *-ti*, depending on whether the stem (not including the person marking prefix) has two vocalic moras or more than two, respectively. Examples are shown below (Payne 1981: 244-246).

(25)	no-sari-**ni**	‘my macaw’	a-toniro-**ti**	‘our palm (*aquaje*)’
	p-ana-**ni**	‘your black dye’	pi-wiiri-**ti**	‘your bat’
	o-çaa-**ni**	‘her anteater’	o-itairiki-**ti**	‘her wild pig’
	i-yimi-**ni**	‘his squash’	n-aawana-**ti**	‘my mahogany’

Once again, there does not appear to be any motivation for the distribution of the two allomorphs; the distribution seems to be arbitrary.

The examples in this section are of interest because, unlike the more well-known examples in the literature, these examples do not seem to involve phonological optimization, at least not in any obvious way. Even if some motivation were proposed for some of the examples seen in this section, the existence of several examples in which stem syllable count determines allomorphs that contribute the same number of syllables to the word is sufficient to demonstrate that, contrary to Kager (1996), syllable-counting allomorphy does not always reduce to foot parsing constraints.

4.1.2 Summary

We have discussed numerous examples in which the distribution of suppletive allomorphs is conditioned by syllable or mora count. Some of them appeared to be driven by foot parsing (§4.1.1.1), and others by word minimality or maximality (§4.1.1.2); some did not appear to optimize words in any readily apparent way (§4.1.1.3). One generalization that holds for all three of these example types is that every example discussed in this chapter involves affix allomorphy, rather than allomorphy in stems or clitics. This follows from a model of morphology in which words are built from the inside out; it does not follow from the simplest version of the P >> M model, in which unordered stems and affixes appear together in the input with no bracketing or other indication of the structure of the word.

As has been discussed throughout this section, some of the examples seen here have other characteristics that suggest that the P >> M model is not the best way to handle them. For instance, some of the examples discussed above involve opaque conditioning, in which the condition for the attachment of an affix is rendered opaque by a phonological process. This shows that PCSA is not necessarily a process that optimizes surface forms, and it suggests that the selection of suppletive allomorphs occurs before the application of regular phonological processes.[17] Also, in several examples, particularly the examples of minimality/maximality-related allomorphy discussed in §4.1.1.2, we can only capture the phonological conditions using language-specific constraints. Thus, the patterns are only 'optimizing' if we define optimization to mean that some constraint can be written to account for them. For example, in the Miya example discussed in §4.1.1.2, the differential application of reduplication and vowel lengthening to stems with different mora counts was claimed to result from a constraint requiring verbs to have no more than three moras. However, PCSA driven by such a constraint can only be 'optimizing' in a language that prefers verbs to have no more than three moras; there is nothing inherently optimal about trimoraic verbs. Thus, although it

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[17] In using the word 'before' here, I mean that phonological rules/processes apply to whatever is the outcome of allomorph selection; this does not have to be understood as a serially ordered sequence of events.

is possible to provide a P >> M analysis for the examples in this chapter, many of the analyses would involve stipulative language-specific constraints.

I have argued against using the P >> M model to account for these examples, and yet, as has been acknowledged throughout this chapter, there are many examples of prosodically conditioned suppletive allomorphy that truly do seem to optimize words in some way, particularly in the cases relating to foot structure discussed in §4.1.1.1. Since the subcategorization approach does not incorporate the notion of optimization, there is some sense in which the burden is on advocates of subcategorization to explain why these examples appear to optimize words; to say that this is a coincidence would be unsatisfying. Explaining the apparent optimization in prosodically conditioned PCSA is therefore somewhat of a challenge for the subcategorization approach. In the following section, I respond to this challenge by providing a historical explanation for a set of related examples of PCSA from the Pama-Nyungan languages of Australia. I will demonstrate that, despite the fact that several of the examples appear to be phonologically optimizing, many are not, and all have a common historical source involving individual and independently motivated changes not driven by prosodic optimization.

4.2 Historical development of prosodically conditioned suppletive allomorphy: The case of Pama-Nyungan ergative suffix allomorphy

In this section I examine the historical origins of the syllable- or mora-counting allomorphy exhibited by the ergative suffix in many Pama-Nyungan (henceforth PN) languages, which will be described here. This is an important case study because it can help shed light on an important question raised by the subcategorization approach to PCSA. One potential objection to the subcategorization approach is that it does not explain why many cases of PCSA, perhaps more than expected to occur by chance, seem to be phonologically optimizing. For example, as has been seen in this chapter, many cases of syllable- and mora-counting allomorphy pattern in such a way that the distribution of allomorphs results in words with an even syllable/mora count, which facilitates exhaustive parsing into binary feet. The subcategorization approach can easily capture these patterns, but does not explain the apparent foot-parsing optimization that seems to drive them.

One may therefore wish to argue that although subcategorization is needed to handle the apparently arbitrary (non-optimizing) cases of PCSA, an output optimization approach should still be used for the apparently optimizing cases so as not to lose any phonological generalizations (such as the foot-parsing optimization mentioned above). However, the lack of explanatory power is not problematic for subcategorization if there is an external explanation for the apparent optimization. For example, if we can explain a case of apparent optimizing PCSA diachronically, then there is no need to incorporate this into the synchronic model of PCSA at the expense of a unitary account of the phenomenon. In this section I discuss the origins of PN ergative allomorphy, arguing that the apparent optimizing pattern exhibited in the ergative allomorphy in some modern PN languages arose by accident and not for the purpose of phonological optimization.[18]

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[18] I do not claim here that there is no bias in language acquisition towards finding patterns that are optimizing; this may be the case. However, as I will show, none of the specific changes that led to the modern patterns of PN ergative allomorphy were necessarily optimizing. As will be seen, in some modern languages, the result of these accumulated changes has the appearance of being optimizing; in other languages, however, the result of these changes looks arbitrary.

4.2.1 Examples

In this section, I describe some examples of ergative and/or locative allomorphy in several PN languages. I include the locative suffixes here because in many languages, they pattern just like the ergative (in most instances, the only difference is that the locative suffixes have the vowel *a* where the ergative suffixes have *u*).[19] A fuller list of examples is provided by Sands 1996 (for ergative only); here I focus on a smaller set of languages that exemplify the range of patterns found throughout the continent. I have attempted to balance the survey by providing broad geographical coverage of the Pama-Nyungan area; below I give a map showing the locations of the languages to be discussed in this section.

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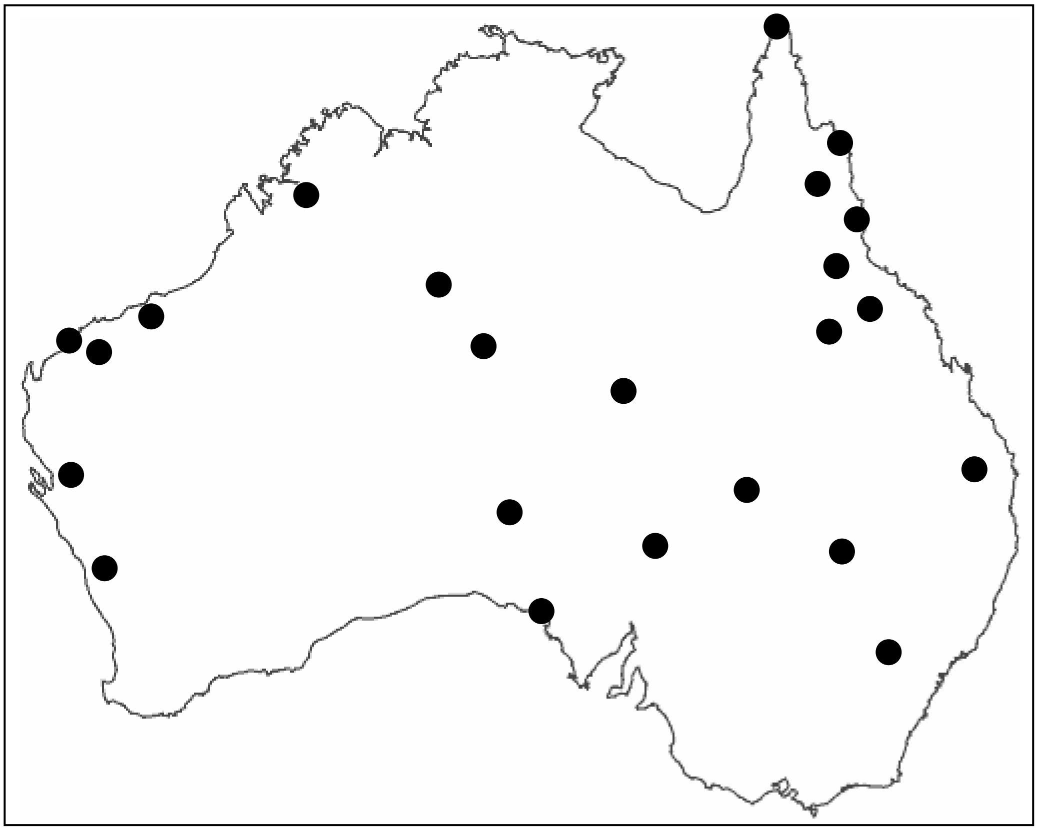
[19] In fact, it may be the case that in at least some of the languages to be discussed here, the initial consonant(s) of the ergative and locative suffixes is actually a stem ending, and that the suffixes themselves consist only of vowels. This would mean that in some languages, the apparent parallel allomorphy between ergative and locative reduces to a single pattern of allomorphy in the stem ending that co-occurs with the ergative and locative suffixes. The resolution of this issue is not crucial to my analysis.

Figure 1: Map showing location of examples of ergative allomorphy



Map outline © 2006 Commonwealth of Australia (Geoscience Australia).
Used with permission.

Below I present a number of examples of ergative and locative allomorphy in languages represented on the map. The examples are organized according to the condition that determines the distribution of allomorphs. I begin with examples conditioned by syllable count. For readers not wishing to read through descriptions of all of the examples, I provide tables summarizing the patterns of ergative and locative allomorphy; these tables are given at the end of all of the descriptions.

One example of syllable count-conditioned suppletion that looks on its surface to be driven by a minimality constraint (but probably is not) is the ergative marker in

Dyirbal (Dixon 1972). In Dyirbal, the ergative case is marked by *-ŋgu* or *-gu*, as shown below.

(26) yara-ŋgu ‘man-ERG’ yamani-**gu** ‘rainbow-ERG’

The phonological generalization is that *-ŋgu* occurs with disyllabic stems, while *-gu* occurs with larger stems. According to McCarthy and Prince (1990), although it has been proposed that this (and similar phenomena in other Australian languages) be analyzed as fulfilling a requirement that the ergative construction has four moras, such an analysis is problematic because consonants generally are not mora-bearing in Pama-Nyungan languages.[20] Thus, this putative example of allomorph selection based on minimality probably does not go through. This is a simple case of arbitrary suppletive allomorphy conditioned by a phonological factor (syllable count) not related to the shape of the allomorphs.

Another syllable count-related example is found in Kaititj (Koch 1980), where the ergative/ instrumental/ locative suffix has three surface realizations (probably relating to two underlying forms). The *-ŋ* form occurs only after disyllabic stems, while the *-l* form is selected after stems with three or more syllables (and exceptionally after a few specific disyllabic stems) (Koch 1980: 265-266). In addition to this split, the *-l* suffix also has two realizations: [ɭ] following an apical consonant and [l] elsewhere (Koch note 9). I assume that these latter allomorphs correspond to a single underlying form, /-l/. The distribution of the ergative/instrumental/locative forms is shown below (N, M = prestopped apical and labial nasals, respectively; examples are from Koch 1980: 264-266).

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[20] This is made explicit in analyses of, e.g., Yindjibarndi (Wordick 1982).

(27)	aki-**ŋ**	‘head-ERG’	ilt^{y}i-**ŋ**	‘hand-ERG’
	aNmi-**ŋ**	‘red ochre-ERG’	aynpi-**ŋ**	‘pouch-ERG’
	aliki-**l**	‘dog-ERG’	aʈuyi-**l**	‘man-ERG’
	aɣirki-**l**	‘sun-ERG’	awiyawi-**l**-amiɳ	‘dead person (pl.)-ERG’
	aɣiri-ɭ	‘kangaroo-ERG’	ɭuNpiri-ɭ	‘forehead-ERG’
	at̪iri-ɭ	‘two-ERG’	aMu-ŋi-t̪iri-ɭ	‘snake-ERG’

The -*N* and -*l* allomorphs could be related to a single underlying form by using some arbitrary rule referring to the number of syllables in the root, but this seems undesirable. Such a rule would not be motivated by any principle of the language or by any functional considerations. Furthermore, the conditioning environment has no relation to the shape of the allomorphs. Therefore, this example appears to be non-optimizing in nature.

Diyari (Austin 1981) marks ergative case with the suffixes *-ndu*, *-li*, and *-yali*. The distribution of the allomorphs is determined both semantically and phonologically (based on syllable count and the stem-final segment) as follows (Austin 1981: 48-49). Female personal names take *-ndu*. Male personal names, non-singular common nouns with final *u* becoming [a], and singular common nouns with final *u* or *i* becoming [a] take *-li*. Singular common nouns with two, four, or five syllables with final *u* or *i* take *-yali*, and singular common nouns with three syllables with final *u* or *i* can take either *-yali* or *-li*. Examples are shown below (Austin 1981: 49).

(28)	ţiɽimiri -**ndu**	‘(woman’s name)-ERG’
	waɲamiri-**li**	‘(man’s name)-ERG’
	t̪aɽiwuɭa-**li**	‘youth.DUAL-ERG’
	t̪aɽiwaɽa-**li**	‘youth.PL-ERG’
	kanku-**yali**	‘boy-ERG’
	wadukat̪i-**yali**	‘emu-ERG’
	yapakaɲţin̪t̪u-**yali**	‘fear-EXCESS-PROP-ERG’
	kan̪ina-**li** ~ kan̪ini-**yali**	‘mother’s mother-ERG’

A number of examples also refer to mora count rather than syllable count. For example, in Warlpiri (Nash 1986), the ergative is marked by *-ngku* after bimoraic stems, and by *-rlu* after longer stems. Examples are shown below (page numbers from Nash 1986 are given next to each example).

(29)	ngurrpa-**ngku**	'unknowing-ERG' (34)	nguurrpa-**rlu**	'throat-ERG' (34)
	ngapa-**ngku**	'water-ERG' (41)	nyanungu-**rlu**	'he-ERG' (235)
	ngarrka-**ngku**	'man-ERG' (234)	Jakamarra-**rlu**	'(name)-ERG' (217)
	kurdu-**ngku**	'child-ERG' (227)	kurdu-jarra-**rlu**	'child-DUAL-ERG' (231)

The locative in Warlpiri exhibits the same pattern as the ergative, except that the locative suffixes have *a* where the ergative suffixes have *u*. Examples are shown below (page numbers from Nash 1986 are shown next to each example).

(30)	ngulya-**ngka**	'hole-LOC' (30)	karti-**ngka**	'cards-LOC' (203)
	karru-**ngka**	'creek-LOC' (203)	pirli-**ngka**	'rock-LOC' (176)
	yali-**rla**	'that-LOC' (176)	turaki-**rla**	'vehicle-LOC' (145)
	Yalikarangu-**rla**	'(placename)-LOC' (132)		
	manangkarra-**rla**	'spinifex plain-LOC' (102)		

In Nhanda (Blevins 2001), ergative and instrumental suffix allomorphy is conditioned by the minimal vs. non-mininal word stem distinction, again in terms of moras (Blevins 2001: 48, 50). Ergative is marked by *-(ng)gu* with bimoraic stems and *-lu* with longer stems, as shown below (*ng* is deleted following a homorganic NC cluster (Blevins 2001: 48-49)).

(31)	nyarlu-**nggu**	'woman-ERG'	nguutu-**lu**	'horse-ERG'
	uthu-**nggu**	'dog-ERG'	arnmanu-**lu**	'man-ERG'
	munda-**gu**	'poor-ERG'	kurndi-waa-**lu**	'club-COM-ERG'

Instrumental exhibits the exact same allomorphs and pattern of allomorphy (Blevins 2001: 50-51). Examples are shown below.

(32)	mara-**nggu**	'hand-INST'	yadiwa-**lu**	'axe-INST'
	wana-**nggu**	'digging stick-INST'	yawarda-**lu**	'kangaroo-INST'
	mambu-**gu**	'bone-INST'	arnmanu-**lu**	'man-ERG'

The locative in Nhanda is marked by *-(ng)gu*; there is no *-lu* allomorph (Blevins 2001: 52).

(33)	malu-**nggu**	‘shade-LOC’	mambu-**gu**	‘bone-LOC’
	uthudu-**nggu**	‘ground-LOC’	marnda-**gu**-tha	‘buttocks-LOC-1sgOBL’

In some cases, allomorph distribution refers both to mora count and to another phonological factor. For example, the locative suffix in Martuthunira (Dench 1995) exhibits allomorphy based on both the root-final segment and mora count. Bimoraic stems with a final vowel take the suffix *-ngka*, stems with three or more morae with a final vowel take *-la*, and there is further allomorphy among consonant-final stems depending on the consonant (Dench 1995: 64). The effector suffix has the same shape as the locative in all of these contexts, except that in each case, the effector suffix has /u/ rather than /a/. Some examples are provided below (Dench 1995: 38). This example is discussed further in chapter 2 because allomorph selection is sensitive to consonant features and the C/V distinction in addition to mora count.

(34)	nguu-**ngka**	‘face-LOC’	kaara-**la**	‘hip bone-LOC’
	nharnu-**ngka**	‘sand-LOC’	malarnu-**la**	‘shade-LOC’
	muyi-**ngku**	‘dog-EFF’	muyira-**lu**	‘dingo-EFF’
	tharnta-**ngku**	‘euro-EFF’	mirntirimarta-**lu**	‘goanna-EFF’

Since codas are not moraic, the distribution of allomorphs has no effect on the number of moras in the surface forms.

A similar example is found in Yindjibarndi (Wordick 1982), where the locative is marked on common nouns by *-ŋka* or *-la* (Wordick 1982: 56). The *-ŋka* allomorph occurs with monosyllabic roots ending in a vowel and with disyllabic roots ending in a vowel if each syllable contains only a single short vowel. The *-la* allomorph occurs with roots having three or more morae and with consonant-final roots. Some examples are given below (examples are from Wordick 1982: 63-65 and have been adapted into phonetic notation).

(35)	parlu-**ŋka**	‘cliff-LOC’		
	warkamu-**la**-ŋu	‘work-LOC-ABL’	maatha-**la**	‘boss-LOC’
	kuɲciri-**la**-mpa	‘one-LOC-TOP’		

Coda consonants are not considered to be moraic (Wordick 1982: 40), so although the allomorphy is based partly on mora count, the choice of the locative allomorph does not alter the mora count of the word: each contributes one mora. In terms of mora count, then, the allomorphy does not contribute to well-formedness. However, the V/C sensitive aspect of the distribution is optimizing with respect to syllable structure, since the selection of *-la* after consonant-final roots prevents the creation of three-consonant clusters (which would occur if *-ŋka* were suffixed to a consonant-final root, assuming that /ŋk/ is not a single segment but two separate segments). Three-consonant clusters do not exist in the language (Wordick 1982: 14).

Yet another very similar example is found in Yingkarta (Dench 1998), where the ergative and locative markers exhibit allomorphy based on mora count and the final segment (Dench 1998: 15-16). Vowel final stems with two moras mark ergative with the suffix *-ngku*, and locative with *-ngka*. Vowel-final stems wtih three or more moras mark ergative with *-lu* and locative with *-la*. Stems with a final consonant take the ergative suffix *-Su* and locative *-Sa* (where *S* is a stop homorganic with the preceding consonant; ergative and locative examples with stem-final consonants are limited to apical nasals and laterals in Dench’s corpus, so it is not known which allomorph is selected by *rr*-final stems). Examples are shown below (Dench 1998: 19-21, except where noted).

(36)	Ergative			
	ngampu-**ngku**	‘stick-ERG’	mayu-**ngku**	‘child-ERG’
	kutharra-**lu**	‘two-ERG’	partirri-**lu**	‘returning-ERG’
	majun-**tu**	‘turtle-ERG’		

Locative

jurla-**ngka**	‘scrub-LOC’	kuru-**ngka**	‘eye-LOC’
parrumpa-**la**	‘wattle-LOC’	paapa-**la**	‘guts-LOC’
kurtan-**ta**	‘bag-LOC’		

(Dench 1998: 29)

In several cases, the distribution of ergative or locative allomorphs refers solely to the final segment of the stem, and in particular, to whether the stem is consonant- or vowel-final. For instance, as discussed in chapter 2, the ergative in Warrgamay (Dixon 1980: 266) is marked by the suffix -*ŋgu* after a vowel-final stem and by -*du* after a consonant-final stem, as shown below.

(37)	ŋulmburu-**ŋgu**	‘woman-ERG’	wurrbi-**ŋgu**	‘big-ERG’
	wurrbi-bajun-**du**	‘very big-ERG’		

This distribution results in avoidance of three-consonant clusters.

A similar pattern is found in Yidiɲ (Dixon 1977). Ergative is marked by -*ŋgu* after a vowel-final stem, or -*du* after a consonant-final stem (*d* assimilates to a preceding stem-final nasal (Dixon 1977: 126)). Examples are given below (Dixon 1977: 126-127).

(38)	waguḍa-**ŋgu**	‘man-ERG’		
	warabal-**du**	‘flying squirrel-ERG’	ḍuḍu:m-**bu**	‘father’s sister-ERG’

The locative and allative allomorphs in Yidiɲ are selected based on whether the stem is consonant-final or vowel final (Dixon 1980: 296), though in this case (unlike in the ergative), the allomorphy cannot be claimed to optimize syllable structure in any way since both allomorphs have the shape -CV. Their distribution is as follows: -*la* occurs after vowel-final stems; -*da* occurs after consonant-final stems (*d* assimilates to the place of a preceding stem-final nasal (Dixon 1977: 129)). Examples are shown below.

(39) digarra-**la** — ‘beach-LOC’ (Dixon 1980: 296)
gabuḑu-**la** — ‘white clay-LOC’ (Dixon 1977: 128)

warḑa:n-**da** — ‘boat-LOC’ (Dixon 1977: 129)
muḑa:m-**ba** — ‘mother-LOC’ (Dixon 1977: 129)

Although these allomorphs are not related through a general rule of the language, one might still assume that they correspond to a single underlying form, /-da/, and that /d/ surfaces as [l] after a vowel due to a lenition rule specific to the locative and allative suffixes. This example is therefore not necessarily suppletive, though the rule relating the allomorphs would apply only to the locative and allative.

Another example of C/V-conditioned allomorphy is found in Biri (Terrill 1998), where once again the ergative/instrumental and locative suffixes exhibit allomorphy determined by the final segment of the stem. Vowel-final stems select the ergative/ locative form *-ŋgu*, while consonant-final stems select *-du*, as seen below (page numbers from Terrill 1998 are given next to each example).

(40)				
	gunhami-**ŋgu**	‘that-ERG’ (15)	bunbun-**du**	‘pheasant-ERG’ (36)
	gayu-**ŋgu**	‘woman-ERG’ (15)	dhagany-**dyu**	‘crocodile-ERG’ (35)
	mala-**ŋgu**	‘hand-INST’ (16)	waŋgarany-**dyu**	‘all-ERG’ (50)
	balgu-**ŋgu**	‘axe-INST’ (16)		

The locative suffix in Biri shows the same pattern except that it has *a* where the ergative/instrumental has *u*, as shown below (Terrill 1998).

(41)				
	dhula-**ŋga**	‘tree-LOC’ (19)	bidhal-**da**	‘Woodhouse Station-LOC’ (54)
	yamba-**ŋga**	‘camp-LOC’ (19)	waŋal-**da**	‘boomerang-LOC’ (20)
	buri-**ŋga**	‘fire-LOC’ (19)		
	ŋugunda-**ŋga**	‘night-LOC’ (19)		

In Nyangumarta (Sharp 2004: 117), ergative is marked by *-ju* with consonant-final stems and by *-lu* with vowel-final stems.

(42)	partany-**ju**	‘child-ERG’	ngagu-**lu**	‘1sg-ERG’
	wangal-**ju**	‘wind-ERG’	mirtawa-**lu**	‘woman-ERG’
	Minyjun-**ju**	‘(name)-ERG’	pirirri-**lu**	‘man-ERG’
	parirr-**ju**	‘hand-ERG’	Yinyjana-**lu**	‘(name)-ERG’

Locative is marked in Nyangumarta by *-jV* with consonant-final stems and *-ngV* with vowel-final stems, where the vowel of the suffix assimilates to the final vowel of the stem (Sharp 2004: 118).

(43)	parirr-**ji**	‘hand-LOC’		
	tili-**ngi**	‘flame-LOC’	mirtawa-**nga**	‘woman-LOC’
	karru-**ngu**	‘creek-LOC’		

In Kuuku Yaʔu (Thompson 1976), ergative and instrumental are marked by *-lu* with consonant-final stems, and by *-Vlu* or *-ʔV* with vowel-final stems, where V is a copy of the stem-final vowel (the two suffix variants for vowel-final stems vary freely) (1976: 329). Examples are shown below (Thompson 1976: 329-331).

(44)	John-**lu**	‘John-ERG’		
	piipi-**ilu** ~ piipi-ʔ**i**	‘father-ERG’	mukana-ʔ**a**	‘big-ERG’
	yuku-**ulu** ~ yuku-ʔ**u**	‘tree-ERG’		

In Ngiyambaa (Donaldson 1980), allomorphy is conditioned not only by whether the stem ends in a consonant or a vowel, but also by more specific features of the stem-final segment. Ngiyambaa has three primary ergative/instrumental allomorphs, *-gu*, *-u*, and *-DHu* (DH is a laminal stop archiphoneme), though Donaldson (1980: 83) reduces these to two underlying forms, /-gu/ and /-DHu/. The *-gu* allomorph occurs with vowel-final stems (including stems ending in *VN*). The *-u* allomorph occurs with stems ending in *l* or *r*. The *-DHu* allomorph occurs with other consonant-final stems. Examples are shown below (Donaldson 1980: 82).

(45)	mura-**gu**	‘spear-ERG’	miri-**gu**	‘dog-ERG’
	dhuruŋ-**gu**	‘snake-ERG’	dhuli:ŋ-**gu**	‘sand goanna-ERG’
	gaɽul-**u**	‘stone-ERG’	mugar-**u**	‘prickle-ERG’
	gamugin-**du**	‘mosquito-ERG’		
	bura:-**dhu**	‘child-ERG’ (< *bura:y-*)	ŋurunh-**dhu**	‘emu-ERG’ (< *ŋuruyN-*)

Donaldson formulates a morphophonological rule (1980: 50) deleting *dh* of a case marker after *l* or *r*, which allows the *-u* allomorph to be derived from /-DHu/. The motivation for making this a general rule of the language is that two other cases, locative and circumstantive, exhibit similar patterns. Locative forms are identical to ergative forms except that they have *a* instead of *u*, as seen below (Donaldson 1980: 82).

(46) a.	mura-**ga**	‘spear-LOC’	miri-**ga**	‘dog-LOC’
	dhuruŋ-**ga**	‘snake-LOC’	dhuli:ŋ-**ga**	‘sand goanna-LOC’
b.	gaɽul-**a**	‘stone-ERG’	mugar-**a**	‘prickle-LOC’
c.	gamugin-**da**	‘mosquito-LOC’		
	bura:-**dha**	‘child-LOC’ (< *bura:y-*)	ŋurunh-**dha**	‘emu-LOC’ (< *NuruyN-*)

An interesting point to be made regarding this example is that in the forms *bura:-dhu* and *bura:-dha* in (45)c and (46)c, respectively, the stem-final /y/ that conditions the use of the *-DHu* suffix is absent in the surface form. Thus, this is an example in which a condition on the distribution of allomorphs is rendered opaque by a phonological process.

Muruwari (Oates 1988) has three basic ergative/instrumental allomorphs (Oates 1988: 56). The *-ngku* allomorph occurs with vowel/‘semivowel’-final stems. The *-u* allomorph occurs with stems ending in *l* or *r*. Finally, *-tu/-thu/-tju* occurs with stems ending in other consonants (the place of articulation of the coronal is determined by the stem-final consonant). Examples are given below (Oates 1988: 56, 58).[21]

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[21] Bidjara (Breen 1976a) exhibits a pattern of allomorphy that is similar to Muruwari in the locative and in the ‘operative’, which marks agents and instruments and corresponds in shape to PN ergative. According to Breen (1976a: 339), the operative is marked by *-ŋu*

(47)	kuthara-**ngku**	‘child-ERG’	kamay(i)-**ngku**	‘yam-INST’
	kula-**ngku**	‘kangaroo-ERG’	kuliya-**ngku**	‘spear-INST’
	kuntarl-**u**	‘dog-ERG’	kurlur-**u**	‘widow-ERG’
	muwarn-**tu**	‘younger brother-ERG’	kaan-**tu**	‘snake-ERG’
	wilanh-**thu**	‘sp. of cloud-ERG’	mayinj-**tju**	‘man-ERG’

Locative exhibits the same pattern, except that the vowel of the suffix is *a* rather than *u*. Examples of the locative are shown below (Oates 1988: 59-63).

(48)	thuri-**ngka**	‘sun-LOC’	nhuu-**ngka**	‘this-LOC’
	partala-**ngka**	‘tomorrow-LOC’	paru-**ngka**	‘down-LOC’
	kuntarl-**a**	‘dog-LOC’	thinkal-**a**	‘knee-LOC’
	nhurran-**ta**	‘that-LOC’	karan-**ta**	‘across-LOC’
	kirin-**tja**	‘husband-LOC’	yurrin-**tja**	‘night-LOC’

A slightly more complicated pattern is found in DuuNidjawu (Kite and Wurm 2004), where the ergative/instrumental is marked by one of *-ndu, -ru*, or *-yu* when the stem has a final short vowel ((49) a), by -*wu* when the stem has a final long vowel ((49)b), by -*Du* when the stem ends in a nasal ((49)c), and by -*u* when the stem has any other consonant as its final segment ((49)d). Examples below are from Kite and Wurm 2004: 28-29 (ergative examples) and 31 (instrumental examples).

(49) a.	badja-**ru**	‘other.one-ERG’	bala-**ru**	‘jewfish-ERG’
	bebere-**yu**	‘uncle-ERG’	djuŋa-**ndu**	‘vine-INSTR’
b.	mama:-**wu**	‘uncle-ERG’		
c.	baran-**du**	‘boomerang-ERG’	ŋuwim-**bu**	‘sun-ERG’
d.	guraŋgur-**u**	‘spear-INSTR’	gurruy-**u**	‘rain-INSTR’

The locative allomorphs in DuuNidjawu are identical to the ergative except that the locative suffixes have *a* where ergative has *u* (Kite and Wurm 2004: 32). Some examples are given below (Kite and Wurm 2004: 32).

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with vowel-final stems, -*d̤u* with final *ny* (which becomes n5), and -*u* with other consonant-final stems. The locative is marked by -*ŋa* with vowel-final stems, -*d̤a* with final *ny* (which becomes *n̤*), and -*a* with other consonant-final stems. No examples are provided.

(50)	doyi-**ya**	'rock-LOC'
	djuŋa-**nda**	'vine-LOC'
	bayer-djin-**da**	'mountain-PL-LOC'
	guyum-**ba**	'camp-LOC'

The ergative in Dja:bugay (Hale 1976a) has five allomorphs distributed according to the stem-final segment (1976: 321). The form *-ŋgu* is used with vowel-final stems, *-du* is used with *n*-final stems, *-ndu* is used with *l*-final stems, *-u* is used with *r*-final stems, and *-njdju* is used with *y*-final stems (which then lose their final *y*). Stems with surface final *m* pattern with vowel-final stems. Examples are shown below (Hale 1976a: 321).

(51)	gura:-**ŋgu**	'dog-ERG'	gurina-**ŋgu**	'porcupine-ERG'
	guyuru-**ŋgu**	'wind-ERG'		
	bigumu-**ŋgu**	'fingernail-ERG' (< *bigum*)		
	djulbin-**du**	'tree-ERG'	yaraman-**du**	'horse-ERG'
	njiwul-**ndu**	'one-ERG'	dayal-**ndu**	'boy-ERG'
	dugir-**u**	'live-ERG'		
	bibu:-**njdju**	'small-ERG' (< *bibu:y*)		
	djaru-**njdju**	'bird-ERG' (< *djaruy*)		

The instrumental and locative in Dja:bugay are marked by one of three allomorphs (Hale 1976a: 322). Bimoraic vowel-final stems have their final vowel lengthened. Vowel-final stems with three or more moras take *-la*. Consonant-final stems have instrumental/locative suffixes that are identical to the ergative except that the vowel is *a*: *-da* is used with *n*-final stems, *-nda* is used with *l*-final stems, *-a* is used with *r*-final stems, and *-njdja* is used with *y*-final stems (which then lose their final *y*). As with the ergative, *m*-final stems pattern with vowel-final stems. Examples are shown below (Hale 1976a: 322).

(52) a.	bulmba-**:**	‘country-LOC’	bana-**:**	‘water-LOC’
b.	djina:-**la**	‘foot-LOC’	djumburu-**la**	‘road-LOC’
c.	djulbin-**da**	‘tree-LOC’	burŋan-**da**	‘ground-LOC’
d.	baNgal-**nda**	‘big-LOC’	waNal-**nda**	‘boomerang-LOC’
e.	dugir-**a**	‘live-LOC’		
f.	mula-**njdja**	‘hole-LOC’ (< *mulay*)		
	gimu-**njdja**	‘Cairns-LOC’ (< *gimuy*)		

As in the Ngiyambaa example discussed earlier in this section, Dja:bugay exhibits some opaque conditioning in words with a /y/-final stem. As seen in the examples seen above in ((51)e) and ((52)f), stems with final /y/ take the ergative and locative suffixes *-njdju* and *-njdja*, respectively, but the stem-final /y/ is lost in the surface form. In a surface-based account of allomorphy (such as in a P >> M account), we would predict that these stems should pattern with vowel-final stems in terms of ergative and locative suffix allomorph selection, but as seen in these examples, this is not the case.

In Wangkumara (Breen 1976b), allomorphy is conditioned by both phonological and morphological factors. In this language, the ergative (or ‘operative’) has four primary allomorphs (1976b: 336-337) distributed based on both morphological and phonological conditions (syllable count as well as the stem-final segment). The suffix *-ulu* is used with all masculine singular nouns, *-anrru* is used with non-masculine-singular nouns having two syllables or final *i* or *u*, *-nrru* is used with non-masculine-singular nouns of more than two syllables ending in *a*, and *-ŋu* is used with dual nouns. Examples are shown below (Breen 1976b: 337).

(53)	t̪it̪i-**ulu**	‘dog-ERG’	kat̪ikat̪i-**ulu**	‘snake-ERG’
	kugad̪ari-**anrru**	‘wind-ERG’	muku-**anrru**	‘bone-ERG’
	makurra-**nrru**	‘tree-ERG’	ŋamadya-**nrru**	‘mother-ERG’
	t̪it̪i-ula-**ŋu**	‘dog-DUAL-ERG’		

Locative is marked in Wangkumara by two allomorphs whose distribution is morphologically conditioned (Breen 1976b: 337). The suffix *-ŋala* is used with dual nouns, and *-laŋa* is used with all other nouns. Examples are given below (Breen 1976b: 337-338).

(54)	mirrulu-**ŋala**	‘Naryilco-LOC’	naka-**laŋa**	‘water-LOC’
	kukad̪iula-**ŋala**	‘btwn. the two hills-LOC’	murrkadya-**laŋa**	‘younger brother- LOC’

In some cases, allomorphy is semantically conditioned. For example, in Kuku Yalanji (Patz 2002), the distribution of ergative allomorphs is both semantically and phonologically conditioned. The suffixes *-nkV* and *-VnkV* are used with ‘potent’ stems that are vowel- or consonant-final, respectively ((55)a-b) (Patz 2002: 46). With ‘neutral’ stems, *-bu* is used after vowel-final stems ((55)c), *-Vbu* after *r*-final stems ((55)d), *-njV* after *y*-final stems ((55)e), and *-dV* elsewhere ((55)f).

(55) a.	ngurrku-**ngku**	‘mopoke-ERG’
	kaya-**ngka**	‘dog-ERG’
	kami-**ngka**	‘father’s father / mother’s mother-ERG’
b.	ngangkin-**angka**	‘porcupine-ERG’
	dingkar-**angka**	‘man-ERG’
	walkarr-**angka**	‘black goanna-ERG’
	dubuy-**ungku**	‘small brown kingfisher (messenger bird)-ERG’
	wabul-**ungku**	‘Torres Strait Pigeon-ERG’
c.	jna-**bu**	‘foot-ERG’
	kulji-**bu**	‘stone-ERG’
	juku-**bu**	‘tree-ERG’
d.	wungar-**abu**	‘sun-ERG’
	badur-**ubu**	‘fishing line-ERG’
e.	balbay-**nja**	‘light, lightning-ERG’
	diliy-**nja**	‘corkwood pine-ERG’
	junjuy-**nja**	‘something-ERG’
f.	jalun-**du**	‘sea-ERG’
	jalbany-**da**	‘taboo food-ERG’
	bayil-**da**	‘freshwater perch-ERG’
	balarr-**da**	‘scabies-ERG’

The locative in Kuku Yalanji also exhibits both phonologically and semantically conditioned allomorphy (Patz 2002: 48). Locative is marked by *-ndV* and *-VndV* with potent stems that are vowel- or consonant-final, respectively ((56)a-b). Among neutral stems, vowel-final stems take *-ngV* ((56)c), *r*-final stems take *-V* ((56)d), *y*-final stems take *-mbV* ((56)e), and all other stems take *-bV* ((56)f).

(56)	a.	ngiwa-**nda**	'salt-water eel-ERG'
		bulki-**nda**	'cattle-ERG'
		dunyu-**ndu**	'husband-ERG'
	b.	mukay-**anda**	'mother's older sister,/ younger sister's child-ERG'
		mukirr-**anda**	'freshwater oyster-ERG'
		wuyngkul-**undu**	'spirit of dying person-ERG'
		kukur-**undu**	'rat-ERG'
	c.	ngara-**nga**	'roots-ERG'
		ngarri-**nga**	'leg-ERG'
		kiju-**ngu**	'mud crab-ERG'
	d.	bibar-**a**	'shin-ERG'
		burrir-**a**	'island-ERG'
		bujur-**u**	'feather-ERG'
	e.	buray-**mba**	'spring (water)-ERG'
		dajaliy-**mba**	'deep water-ERG'
		wakuy-**mbu**	'upper arm-ERG'
	f.	nyabil-**ba**	'tongue-ERG'
		dalkan-**ba**	'casuarina pine-ERG'
		diburr-**bu**	'egg'

The locative suffix allomorphs in Kuuku Yaʔu (Thompson 1976) are also semantically distributed. The allomorph *-lu* (which can reduce to *-l*) is used with a 'demonstrative reference', while *-ŋuna* ~ *-Vla* are used elsewhere (*-ŋuna* also has surface variants *-ŋun and -ŋu; -Vla* can reduce to *-Vl*). Examples are given below (Thompson 1976: 329-331).

(57)	dinghy-**lu**	'dinghy-LOC'	airstrip-**ŋun**	'airstrip-LOC'
	kat̪aa-**lu**	'dead-LOC'	kulamu-**ŋun**	'road-LOC'

There also exist languages in which the ergative and locative do not exhibit any allomorphy. For example, in Warluwara (Breen 1976c), ergative is always marked by the suffix *-gu*, and locative is always marked by *-ga* (1976c: 331-332). Examples are given below (1976c: 332-333).

(58)	bumad̪a-**gu**	‘sun-ERG’	wada-**ga**	‘stone-LOC’
	yaŋad̪a-ra-**gu**	‘see-SUBJ-ERG’	wuŋaramba-**ga**	‘Carandotta-LOC’

Similarly, in Gooniyandi (McGregor 1990), the ergative is marked invariably by the suffix *-ngga* (McGregor 1990: 177-178). This suffix can have both an ergative and an instrumental function, though McGregor explicitly rejects splitting it into two separate suffixes. Examples are shown below with page numbers from McGregor 1990.

(59)	yoowarni-**ngga**	‘one-ERG’ (178)	gambayi-**ngga**	‘boy-ERG’ (506)
	ngirndaji-**ngga**	‘this-ERG’ (588)	niyi-**ngga**	‘that-ERG’ (586)

The tables below summarize the cases described above. Table 1 shows languages exhibiting ergative allomorphy, and Table 2 shows languages exhibiting locative allomorphy (as seen above, some languages have both and are therefore listed in both tables).

Table 1: Examples of ergative allomorphy

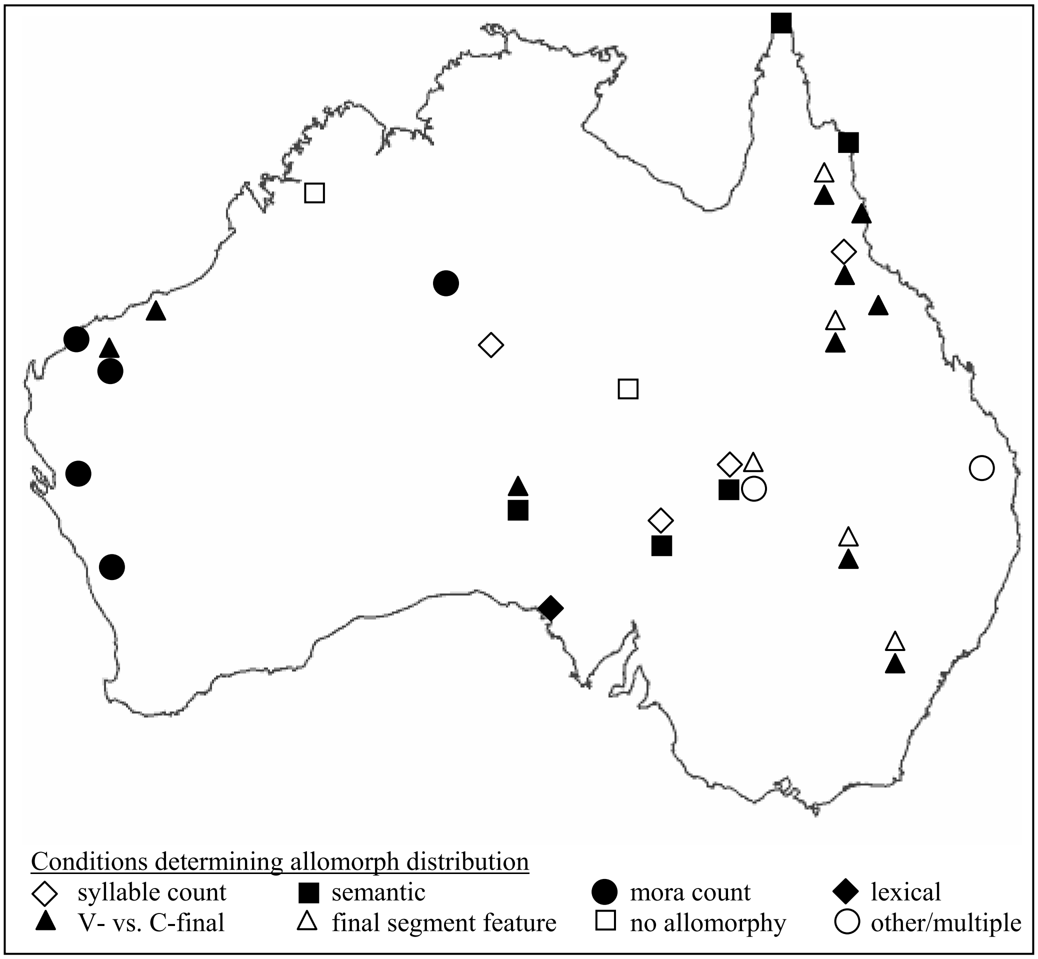
Language	Form	Environment	Form	Environment
Bidjara	-d̪u	*ny*-final stem	-u	other C-final stem
	-ŋu	V-final stem		
Biri	-ngu	V-final stem		
	-du	C-final stem		
Diyari	-ndu	female personal name	-li	male personal name, *a*-final noun
			-yali	other common noun
Dja:bugay	-ŋgu	V-final stem	-u	*r*-final stem
	-du	*n*-final stem		
	-ndu	*l*-final stem		
	-njdju	*y*-final stem		
Dyirbal	-ŋgu	disyllabic stem		
	-gu	trisyllabic+ stem		
Duuŋidjawu	-ndu/-ru/-yu	stem w/final short V	-wu	stem w/final long V
	-Du	nasal-final stem	-u	stem w/other final C
Gooniyandi	-ŋgga	all environments		
Kaititj	-ŋ	disyllabic stem	-l	trisyllabic+ stem
Kuku Yalanji	-ŋkV	potent referent		
	-dV	neutral referent		
Kuuku Yaʔu	-Vlu/-/V	V-final stem	-lu	C-final stem
Muruwari	-ngku	V-final stem	-u	*l*- or *r*-final stem
	-tu	stem w/other final C		
Ngiyambaa	-DHu	V-final stem	-u	*l*- or *r*-final stem
	-gu	stem w/other final C		
Nhanda	-(ng)gu	bimoraic stem	-lu	stem with 3+ moras
Nyangumarta	-ju	C-final stem	-lu	V-final stem
Wangkumara	-ŋu	dual stem	-ulu	masc. singular stem
	-anrru	non-masc.-sg. w/2 syllables or final *i* or *u*		
	-nrru	non-masc.-sg. w/3+ syllables and final *a*		
Warlpiri	-ŋku	noun stem with 2 moras	-rlu	stem with 3+ moras or non-noun stem
Warluwara	-gu	all environments		
Warrgamay	-ŋgu	V-final stem	-du	C-final stem
Yidiɲ	-ŋgu	V-final stem	-du	C-final stem
Yingkarta	-ngku	V-final stem w/2 moras	-lu	V-final stem w/3+ moras
	-Su	C-final stem		

Table 2: Examples of locative allomorphy

Language	Form	Environment	Form	Environment
Bidjara	-d̪a	*ny*-final stem	-a	other C-final stem
	-ŋa	V-final stem		
Biri	-nga	V-final stem		
	-da	C-final stem		
Dja:bugay	-:	V-final stem w/2 moras	-la	V-final stem w/3+
	-da	*n*-final stem		moras or *r*-final
	-nda	*l*-final stem		stem
	-njdja	*y*-final stem		
Duuŋidjawu	-nda/-ra/-ya	stemw/final long V	-wa	stem w/final long V
	-Da	nasal-final stem	-a	stemw/other final C
Kaititj	-ŋ	disyllabic stem	-l	trisyllabic+ stem
Kuku Yalanji	-ndV	potent referent		
	-ŋV	neutral referent		
Kuuku Yaʔu	-ŋunaʔ-Vla	non-demonstrative	-lu	demonstrative
Martuthunira	-ngka	V-final stem with	-la	V-final stem with
		2 moras		3+ moras
Muruwari	-ngka	V-final stem	-a	*l*- or *r*-final stem
	-ta	stem w/other final C		
Ngiyambaa	-DHa	V-final stem	-a	*l*- or *r*-final stem
	-ga	stem w/other final C		
Nhanda	-(ng)gu	all environments		
Nyangumarta	-ngV	V-final stem		
	-jV	C-final stem		
Wangkumara	-ŋala	dual stem	-laŋa	any other stem
Warlpiri	-ŋka	noun stem with	-rla	stem with 3+ moras
		2 moras		or non-noun stem
Warluwara	-ga	all environments		
Yidiŋ	-da	C-final stem	-la	V-final stem
Yindjibarndi	-ŋka	V-final stem with	-la	C-final stem or stem
		<3 moras		with 3+ moras
Yingkarta	-ngka	V-final stem w/2 moras	-la	V-final stem w/3+
	-Sa	C-final stem		moras

Each language from the tables above is plotted on the map below, and the shape and shading of each point represents the conditioning factor involved in each example of suppletive allomorphy. Note that some languages are marked by multiple symbols since some examples involve multiple different types of conditions.

Figure 2: Map showing distribution of conditions on ergative allomorphy



Map outline © 2006 Commonwealth of Australia (Geoscience Australia).
Used with permission.

As can be seen from the map above, some generalizations can be made regarding the geographical ranges of the different types of conditions on allomorph distribution. For example, in this sample, mora count-based allomorphy occurs primarily on Australia's west coast, although one example is found in central Australia. On the other hand, allomorphy based on features of the stem-final segment seems to be limited to eastern Australia. Semantically conditioned allomorphy occurs in both the south central region and in the northeast. Syllable count-based allomorphy occurs in the central and eastern regions. Finally, allomorphy determined by whether the stem is consonant- or vowel-final appears to be widely distributed, occurring in the eastern, central, and western regions.

In the following section, I discuss some previous approaches to PN ergative allomorphy, then propose an account for the development of the phenomenon based on the earlier studies and consideration of the distribution of allomorphy patterns in modern PN languages.

4.2.2 Previous discussions

The historical development of Pama-Nyungan ergative allomorphy has been discussed in at least three previous studies. The first of these is Hale (1976b). Hale's proposal for the development of ergative allomorphy can be summarized as follows. First, Hale narrows the discussion to the alternant set in (60)a and the 'extremely common' ergative/locative allomorph distribution pattern shown in (60)b (Hale 1976b: 414; S = a stop homorganic to the preceding consonant).

(60) a.

ergative	locative
**-lu*	**-la*
**-ŋku*	**-ŋka*
**-mpu*	**-mpa*
**-njtju*	**-njtja*

b. (i) **-ŋku*, **-ŋka* attach to vowel-final disyllabic stems;
(ii) **-lu*, **-la* attach to vowel-final polysyllabic stems;
(iii) **-Su*, **-Sa* attach to consonant-final stems

Hale assumes (1976b: 414) that the basic forms of the ergative and locative were *-*lu* and *-*la*, respectively. To collapse categories (ii) and (iii) in (1) above, Hale proposes an assimilation rule changing *l* into a stop with place features determined by an immediately preceding consonant across a morpheme boundary (1976b: 415). Hale's analysis centers around the observation (1976b: 415) that there is a range of allowable stem-final consonants in Australian languages, such that some languages allow no final consonants, some allow apicals only, some allow coronals, and some allow both coronals and non-coronals. In a language that allowed stem-final coronals and non-coronals and had the *l*-assimilation rule described above, the ergative forms corresponding to a CVCV*m* and CVCV*ŋ* stem would have been CVCV*mpu* and CVCV*ŋku*, respectively. Now suppose that this language lost all of its non-coronal stem-final consonants at some later stage in its history. This would mean that both stems had the form CVCV, but their ergative forms would still have had the forms CVCV*mpu* and CVCV*ŋku* (this leaves open the question of whether the same change applied to other suffixes in the language; the parallel patterning of locative allomorphy with ergative allomorphy in many PN languages suggests that the locative underwent the same changes as the ergative, though there are other possible sources for this similarity (e.g., the initial consonant of the ergative and locative could be a stem former rather than being part of the case suffixes)). Some reanalysis could have taken place such that the ergative stem was the same as the plain stem (CVCV) and the ergative suffix was reanalyzed as *-mpu* ~ *-ŋku*. This would yield a system with four ergative allomorphs, where coronal-final stems take *-Su*, and V-final stems take lexically determined allomorphs: *-lu* ~ *-mpu* ~ *-ŋku*. Some semantic or phonological condition could then develop to account for the distribution of these allomorphs. Languages that also exhibit **-njtju* can be accounted for under this scenario if the rule deleting non-coronal consonants is expanded to delete all distributed consonants, which would then include *tj*.

To account for languages that mark disyllabic stems with **-ŋku* and stems with three or more syllables ('polysyllabics') with **-lu*, Hale points out (1976b: 416) that many languages, including some Australian languages (Uradhi, Wik Me'nh, and Arandic Anmatjera) have a rule that Hale terms 'velar-posthesis', which inserts *ŋ* after a word-final vowel. There is no obvious phonetic motivation for such a rule, but it does recur in many different languages (Hale 1976b). In Arandic Anmatjera, this rule is limited to disyllabic words, and Hale proposes that this form of the rule was present in the mother language to the languages exhibiting the **-ŋku* ~ **-lu* allomorphy in disyllables vs. polysyllables. Hale proposes further that the stems undergoing *ŋ*-insertion were reanalyzed as having underlying final *ŋ* by analogy with other *ŋ*-final stems since these two types of stems would have had the same shape in their citation forms due to the application of velar posthesis; this would have resulted in a disproportionately large number of *ŋ*-final disyllabic stems. Dixon (1980: 211) reports that this has happened 'over a wide area in the south-east,' citing Muk-Thang of Gippsland, where 'almost all disyllabic roots end in a consonant, with the most common final segment being /ŋ/; amongst monosyllables and trisyllabics there are more final vowels'. Since vowel-final polysyllables would not have undergone velar posthesis, they would still have had *-lu* as their ergative allomorph, whereas disyllabic stems would all take *-Su* due to the rule changing *l* to a stop homorganic to a previous consonant. If this language then underwent deletion of final consonants (a relatively common process that may result from the loss of acoustic cues to the consonant when no vowel follows), the ergative suffix could have been reanalyzed as *-ŋku* for all of the stems that previously had final *ŋ* (either etymologically or via velar posthesis). Most of these stems would have been disyllabic, since all of the ones that got final *ŋ* through velar posthesis would be disyllabic, plus many of the stems with etymological final *ŋ* would already have been disyllabic as well. If a very high percentage of *ŋ*-final stems were disyllabic (in contrast to stems ending in other segments, which would have had a lower percentage of disyllabic stems), this pattern could have been interpreted such that all disyllabic stems took -*ŋku*, while polysyllabic stems took -*lu*. In Table 3 below, I summarize Hale's proposed sequence of changes leading to syllable counting allomorphy involving -*ŋku* vs. -*lu*.

Table 3: Hale's (1976b) proposed history of PN ergative/locative allomorphy

Stage I:	Ergative/locative is /-lu/; l → S / C + __ (where C is any consonant, + is a morpheme boundary, and S is a stop at the same place of articulation as C); velar posthesis inserts *ŋ* after every V-final disyllabic stem.
Stage II:	CVCV stems are reanalyzed as CVCVŋ, yielding a disproportionately high number of disyllabic stems ending in *ŋ*; ergative forms of these stems change from CVCV-lu to CVCVN-ku (by *l*-assimilation).
Stage III:	Final consonants are lost; former CVCVC stems are now CVCV, but their ergative forms are still CVCVCSu, reanalyzed as CVCV-CSu. Multiple primary ergative allomorphs now exist: -*lu* for stems that were always V-final (non-disyllabic stems only) and multiple different -*SCu* forms (-*ŋgu*, -*mpu*, -*njtju*) for stems formerly ending in consonants (the largest class of these likely being *ŋ*-final since this class would include stems with etymological final *ŋ* as well as final *ŋ* from velar posthesis).
Stage IV:	Since all stems taking -*lu* are non-disyllabic and most stems taking -*ŋku* are disyllabic, the ergative allomorphy is reanalyzed as follows: disyllabic stems take -*ŋku*; other stems take -*lu*.

A second source that discusses the development of ergative/locative/instrumental allomorphy is Dixon (1980).[22] Dixon rejects Pama-Nyungan as a genetic group, but reconstructs Proto-Australian ergative allomorphs that could also be interpreted as Pama-

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[22] See also Dixon 2002, which includes further discussion of some issues presented here but leaves out some data that were included in Dixon 1980. For that reason I cite Dixon 1980 throughout the remainder of this section.

Nyungan. In fact, as Sands (1996) points out, Dixon's proposed Proto-Australian ergative marker is based on evidence from Pama-Nyungan. Dixon reconstructs the following allomorphs for Proto-Australian (*S* is a stop homorganic to the preceding stop; *DH* is a laminal stop).

(61) -*Su* after nasals
-*DHu* after *y*
-*du* after *l, rr*
-*lu* after vowels when root has 3+ syllables
-*ŋgu* after vowels when root has 2 syllables

Dixon accepts as plausible Hale's (1976b) proposal that all of these allomorphs arose from *-*lu* via the series of changes described above in the discussion of Hale's analysis. Dixon's proposal is therefore basically the same as Hale's proposal, except that Dixon claims that his reconstruction holds for the ancestor of all of the Australian languages rather than just the Pama-Nyungan languages.

Sands (1996) argues for a different reconstruction of the ergative in Pama-Nyungan. Sands claims that Pama-Nyungan had three ergative allomorphs as follows (1996: 8).

(62) *-*lu* / V_ nominals which are not common nouns
*-*ŋgu* / V_ 2 syllables
*-*DHu* / elsewhere

Sands claims further that an ergative suffix *-*DHu* can be reconstructed for Proto-Australian, though the evidence for this claim is weaker than that for the proposed Pama-Nyungan ergative reconstruction. Hale's (1976b) scenario for the development of *-*ŋgu* from *-*lu* is not disputed, but Sands argues (1996: 11) that *-*ŋgu* must already have been restricted to occuring with disyllabic stems in Pama-Nyungan since the syllable count-based distribution occurs across a wide geographical area in Sands' survey. Although

Sands includes more languages than the present survey, it should be pointed out that at least four of the ten western Australian languages that Sands cites (1996: 9) as having syllable count-based allomorphy (Martuthunira, Nhanda, Yindjibarndi, and Yingkarta, each discussed above) are more accurately described as having mora count-based allomorphy. Therefore, Sands' proposal may need to be modified to state that PN had ergative allomorphy based on mora count rather than syllable count. The argument for the **-DHu* allomorph is based both on the common occurrence of laminal-initial allomorphs across the Pama-Nyungan area and the fact that **-DHu* is also plausible for some non-Pama-Nyungan languages. Note that the latter argument applies only if one accepts the claim that the Pama-Nyungan languages form a larger Australian group with the non-Pama-Nyungan languages. This is a controversial claim that has not been substantiated to the satisfaction of researchers in the field, with the notable exception of R.M.W. Dixon, who has argued for the existence of an Australian group and for the non-existence of Pama-Nyungan. Despite the question of whether it is desirable to reconstruct a Pama-Nyungan ergative suffix by taking the non-Pama-Nyungan languages into consideration, I nonetheless do not find evidence in the present survey to contradict **-DHu* as opposed to an alveolar-initial suffix.

4.2.3 A history of PN ergative allomorphy

Each of the previous studies of the history of PN ergative allomorphy assumes that both **-lu* and **-ŋgu* were present in the common ancestral language of modern PN languages (though as discussed above, Dixon (1980) denies the existence of PN and instead reconstructs these allomorphs for Australian). Under Hale's (1976b) and Dixon's

(1980) proposals, this allomorphy could have been derived by rule from a single underlying form, /-lu/. Under Sands' (1996) account, on the other hand, the allomorphs were already in a suppletive relationship in Proto-PN. Sands' justification for this assumption (1996: 7-8) is that there are several modern PN languages where *-lu* occurs with proper nouns (Sands 1996: 14-15): Yankunytjatjara, Badimaya, Yindjibarndi, Atynyamathanha, and Watjarri. However, a problem with this assumption is that according to Ethnologue all five of these languages are classified as South-West Pama-Nyungan languages (Gordon 2005).[23] Therefore, the use of *-lu* with proper nouns may be better analyzed as an innovation in South-West Pama-Nyungan than as a feature of Proto-PN. I will assume, following Hale (1976b) and Dixon (1980) that the Proto-PN ergative suffix had a single underlying form.

As mentioned above, Sands (1996) makes a good case for reconstructing a laminal as the initial segment of the ergative suffix (**-DHu*), though she does not analyze *-lu* as being a reflex of this suffix. I propose that the Proto-PN ergative suffix allomorphs were derived from one underlying form and two (synchronic) phonological rules, as follows:

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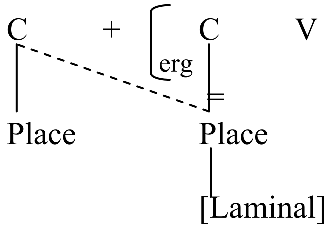
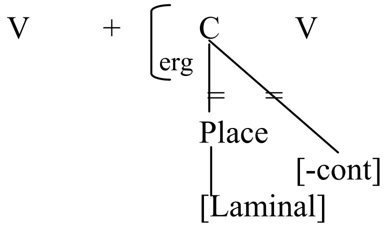
[23] More specifically, according to Ethnologue (Gordon 2005), Yankunytjatjara is Wati language, Atynyamathanha is a Yura language, Yindjibarndi is a Coastal Ngayarda language, Badimaya and Watjarri are Watjarri langauges; all of these are grouped together in the Ethnologue as South-West Pama-Nyungan. But it should be acknowledged that according to Claire Bowern (p.c.), this classification is disputed among some researchers, publicly if not in print.

(63) Underlying form: /-DHu/

Place Assimilation:



Lenition:



Though the Lenition rule may cause concern since it involves, in effect, two separate delinking processes (in addition to the later default insertion of [Alveolar] and [+cont], which I assume), this is nonetheless not an unnatural rule. It may be thought of as a general process of reduction, which happens to delete both the place and manner features of the consonant between two vowels.

The proposed underlying form and phonological rules can account for Dixon's (1980) allomorphs as follows:

(64)

Dixon (1980) allomorph	Rule(s)
-*Su* after nasals	Place Assimilation
-*DHu* after *y*	Place Assimilation
-*du* after *l, rr*	Place Assimilation
-*lu* after vowels when root has 3+ syllables	Lenition; see below
-*ŋgu* after vowels when root has 2 syllables	Place assimilation; see below

A few further comments are necessary to explain how this proposal accounts for the allomorphs identified by Dixon (1980). Although Dixon reconstructs the -*lu* allomorph as occurring after vowels when the root has 3+ syllables and -*ŋgu* after vowels when the root has two syllables, we can assume given Hale's explanation of the origin of -*ŋgu* that Proto-PN had only -*lu* after vowels, and that -*ŋgu* arose later in some languages where final *ŋ* was lost, according to Hale's (1976b) scenario.[24] Given what was said above regarding the wide distribution of *-ŋgu* vs. *-lu* for bimoraic vs. larger stems, I hypothesize that this was the basis for distribution in the first language/group to develop *-ŋgu*, and that this underwent later changes in some languages to distributions based on syllable count, consonant- vs. vowel-final stem, semantic distinctions, etc., as are found in modern PN languages. I assume, therefore, that Hale's (1976b) proposed rule of velar posthesis actually applied to bimoraic stems, rather than to disyllabic stems.

If this scenario is correct, then it need not be assumed that PN ergative allomorphy exists for the purpose of phonological optimization. Rather, as can be seen in the above discussion, the modern patterns of PN ergative allomorphy arose via a complex series of phonological changes, each of which was independently motivated, but not necessarily for reasons of optimization[25] (in fact, in the case of velar posthesis, it is difficult to imagine a phonetic or phonological motivation,[26] though Hale (1976b) and Dixon (1980) cite enough examples of the rule to justify the assumption that it is plausible and could have existed in Proto-PN). The purpose of this section has been to show that PN ergative allomorphy could have developed for other reasons than phonological optimization. Having done this, I now move to an analysis of the general phenomenon of prosodically conditioned suppletive allomorphy.

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[24] This has the advantage of accounting for languages that never have *-ŋgu* post-vocalically. Sands (1996: 13-14) lists 15 such languages.

[25] It could be argued that analogy is optimizing, since its overall effect can be to simplify the grammar. However, this would be a different kind of 'optimization' from the phonological optimization of words, which is the type of optimization that I am talking about here and the type that the P >> M model is meant to capture.

[26] Of course there must have been some motivation for the process, but it was probably something external to the phonological system itself (e.g., analogy, borrowing, or perhaps some acoustic or articulatory factor not yet identified).

4.3 Analysis of prosodically conditioned suppletive allomorphy

The apparent optimizing nature of Pama-Nyungan ergative allomorphy has been explained based on its historical origins in §4.2, and the majority of the remaining cases of syllable and mora count-based allomorphy are not phonologically optimizing. In this section, I contrast two approaches to the phenomenon as they apply to prosodically conditioned suppletive allomorphy. The first is the Output Optimization approach, which was applied specifically to cases of 'syllable-counting allomorphy' (SCA) by Kager (1996). The second approach, which I argue to be superior, is a subcategorization approach. As I will show, subcategorization is capable of handling both optimizing and non-optimizing allomorphy, and it does a much better job of handling the non-optimizing cases.

4.3.1 The Output Optimization approach

Kager (1996: 170) claims that '[s]yllable-counting allomorphy is an output-oriented phenomenon,' resulting from the Emergence of the Unmarked (TETU; McCarthy and Prince 1994). In this approach, the morphology supplies multiple suppletive allomorphs of an affix in candidates in an OT tableau, and phonological foot structure and parsing constraints select the appropriate output. This approach falls under McCarthy and Prince's (1993a,b) 'P >> M' ranking schema, where phonological effects in morphology are modeled by ranking phonological (P) over morphological (M) constraints. In phonologically conditioned suppletive allomorphy (PCSA), the relevant M constraint is one enforcing uniform marking of morphological categories. One prediction of this approach is that syllable-counting allomorphy should serve to optimize words with respect to phonological constraints that are independently motivated elsewhere in Universal Grammar.

Kager's argument is based on Estonian, where the Genitive plural, Partitive singular, and Partitive plural exhibit SCA, as seen below (examples below with page numbers in parentheses are from Mürk 1997, and the remaining examples are from Kager 1996: 157, 168; this is reproduced from (4) above).

(65)

Genitive plural	Partitive plural	Partitive singular	Gloss
maa:-**te** (74)	ma-**it** (74)	maa:-**t**	'land'
aas:ta-**tte** (149)	aas:ta-**it** (149)	aas:ta-**tt**	'year'
häda-**te** (77)	häda-**sit** (77)	häda-**Ø** (77)	'trouble'
paraja-**tte**	paraja-**it**	paraja-**tt**	'suitable'
raamattu-**tte**	raamaattu-**it**	raamattu-**tt**	'book'
atmirali-**te**	atmirali-**sit**	atmirali-**Ø**	'admiral'
telefoni-**te**	telefoni-**sit**	telefoni-**Ø**	'telephone'

Kager claims that these apparent syllable counting effects in Estonian result from foot parsing considerations rather than from true 'counting'. Kager proposes (1996: 162-163) the following constraints for Estonian:

(66) Ft-Bin: Feet are binary under syllabic or moraic analysis.
Parse-2: One of two adjacent stress units (μ, σ) must be parsed by a foot.
Align-Hd-L: Align (PrWd, L, Head(PrWd), L)
Onset: Syllables must have onsets.
Align-St-R: Align (Stem, R, Foot, R) (Each right stem edge coincides with a right foot edge)
Pk-Prom: Peak(x) > Peak(y) if |x| > |y|.

The correct genitive plural allomorphs for even-syllable (67)a and odd-syllable (67)b stems are selected via the following constraint rankings (Kager 1996: 164-167).

(67) Genitive plural

a.

/visa, {-te, -tte}/	Ft-Bin	Parse-2	Align-Hd-L	Onset	Align-St-R	Pk-Prom
☞ [(ví.sa)-te]						L
[(ví.sa-t).te]					*!	L
[vi.(sá-t.te)]			*!		*	H
[(ví).(sà-t.te)]	*!				*	L, H

b.

/paraja, {-te, -tte}/	FT-BIN	PARSE-2	ALIGN-HD-L	ONSET	ALIGN-ST-R	PK-PROM
☞ [(pá.ra).(jà-t.te)]					*	L, H
[(pá.ra).(jà-te)]					*	L, L!
[pa.(rá.ja)-te]			*!			L
[(pá.ra).ja-te)]		*!			*	L
[(pá.ra).(jà)-te]	*!					L, L
[(pá.ra.ja)-te)]	*!					L

Similarly, the partitive plural allomorphs for even-syllable (68)a and odd-syllable (68)b stems are selected as shown below (Kager 1996: 164-167).

(68) Partitive plural

a.

/visa, {-sit, -it}/	FT-BIN	PARSE-2	ALIGN-HD-L	ONSET	ALIGN-ST-R	PK-PROM
☞ [(ví.sa)-sit]						L
[(ví.sa-i)t]					*!	L
[(ví.sa).-it]				*!		L
[vi.(sá-i)t]			*!		*	H
[(ví).(sà-i)t]	*!				*	L, H

b.

/paraja, {-sit, -it}/	FT-BIN	PARSE-2	ALIGN-HD-L	ONSET	ALIGN-ST-R	PK-PROM
☞ [(pá.ra).(jà-i)t]					*	L, H
[(pá.ra).(jà-si)t]					*	L, L!
[(pá.ra).(jà-.i)t]				*!	*	L, L
[pa.(rá.ja)-sit]			*!			L
[(pá.ra).ja-sit)]		*!			*	L
[(pá.ra).ja-it)]		*!			*	L
[(pá).(rà.ja)-sit]	*!					L, L
[(pá.ra).(jà)-sit]	*!					L, L

This type of analysis works for Estonian, but we are left with the question of whether SCA is always reducible to general markedness and faithfulness, as Kager claims. In the following section, I address this question with reference to the other cases of syllable count-conditioned suppletive allomorphy described in §4.1 and §4.2.

4.3.2 Survey results revisited

As described above, this survey uncovered many cases of SCA in which the distribution of allomorphs is not predictable from their shape and must be stipulated; this in itself is an important result since it contradicts Kager's claim that SCA is optimizing.

In some cases of SCA, the distribution of allomorphs does relate to their shape. However, in some of these cases, the phonological constraints that would be needed to model the distribution are very specific constraints that cannot be assumed to be part of UG, and therefore these cases still cannot be analyzed as TETU effects.

For example, recall that in Kimatuumbi (Odden 1996), monosyllabic verbs mark perfective with -*i̦te*, while polysyllabic stems take an -*i̦*- infix (Odden 1996: 51-53). The distribution could be construed as responding to a requirement that perfective forms have four syllables, though this is not surface-true due to some systematic exceptions. But note that if this were captured using a phonological constraint, it would be language-specific, not part of UG. Therefore, Kimatuumbi perfective allomorphy is not a TETU effect.

4.3.3 Examples of non-optimizing SCA

As mentioned above, this survey revealed several examples of non-optimizing SCA. An example is found in Tzeltal (Walsh Dickey 1999), described above in §4.1, where the perfective is marked by -*oh* with monosyllabic stems, and with -*ɛh* elsewhere. [o] and [ɛ] do not alternate elsewhere (Kaufman 1971: 28), so the allomorphy is probably truly suppletive. Stress in Tzeltal is word-final (Walsh Dickey 1999: 327), so the allomorphy is not stress-conditioned. A constraint banning [ɛ] in the second syllable has not been proposed for UG, so this is not a TETU effect. Such a constraint in Tzeltal would be stipulative and used only for this phenomenon, so this appears to be a case where we would not want to describe the distribution of allomorphs as phonologically optimizing in any way.

Another such case is seen in Kaititj (Koch 1980), discussed above in §4.2. In this language, the *-ŋ* form of the ergative/instrumental/locative suffix occurs with disyllabic stems, while *-l* occurs with larger stems (examples are from Koch 1980: 264-266). Note that in these examples, /l/ → [ŋ] when the preceding consonant is apical (Koch 1980: 274), and N is a prestopped apical nasal.

(8)	aˈki-**ŋ**	‘head-ERG’	aˈliki-**l**	‘dog-ERG’
	ilˈt^{y}i-**ŋ**	‘hand-ERG’	aˈʈuyi-**l**	‘man-ERG’
	aNˈmi-**ŋ**	‘red ochre-ERG’	aˈɣirki-**l**	‘sun-ERG’
	aynˈpi-**ŋ**	‘pouch-ERG’	ˈɭuNpiri-**ɭ**	‘forehead-ERG’

There does not seem to be anything ‘better’ about /ŋ/ rather than /l/ as a stressed syllable or second syllable coda, so this seems once again to be a case of non-optimizing SCA.

A third example is found in Zuni (Newman 1965). As discussed above, in Zuni, singular nouns are marked with *-ʔleʔ* for monosyllabic stems, and with *-nne* for polysyllabic stems. Again, there is nothing to suggest that the distribution of allomorphs is phonologically optimizing.

Finally, a fourth example of non-optimizing SCA is seen in Dyirbal. As discussed in §4.2, in vowel-final stems in Dyirbal, disyllabic stems mark ergative with *-ŋgu*, while longer stems take *-gu*. McCarthy and Prince (1990) characterize this as a ‘compensatory relationship’ in that the ‘shorter’ suffix goes with the ‘longer’ stem and vice versa. McCarthy and Prince acknowledge that coda consonants are not generally considered to be moraic in Dyirbal, but one would have to assume that codas are moraic, at least in this context, to give substance to the claim that the allomorphy is motivated by compensation. However, if the notion of a closed syllable does have some status in the language, then if anything, we would expect the exact opposite distribution of allomorphs from what actually occurs in Dyirbal. The reason is as follows:

The stress pattern of Dyirbal is initial and alternating, and final syllables are unstressed (Dixon 1972: 274-276). This means that when we compare disyllabic stems with trisyllabic stems, the distribution of allomorphs causes words with *-ŋgu* to have closed unstressed syllables, while words with the *-gu* suffix have open stressed syllables. As seen in (69)a with a two-syllable stem, the *ŋ* of *-ŋgu* causes the penultimate syllable, which is unstressed, to be closed. And as seen in (69)b, the use of *-gu* rather than *-ŋgu* with the three-syllable stem results in the stressed penultimate syllable being left open.

(69) a.	ˈya.ra**ŋ.gu**	‘man-ERG’	*ˈya.ra.**gu**
b.	ˈya.ma.ˈni.**gu**	‘rainbow-ERG’	*ˈya.ma.ˈni**ŋ.gu**

If ‘syllable-counting allomorphy’ results from TETU as claimed by Kager (1996), then we would expect the distribution of allomorphs in Dyirbal to be reversed, since the Stress-to-Weight Principle should enforce a correspondence between heavy syllables (to the extent that closed syllables can be called ‘heavy’ in this language) and stress.

The observation that coda consonants are not moraic in Dyirbal may in fact render the Stress-to-Weight argument moot, and a further complication is that in at least some Pama-Nyungan languages, NC sequences can be syllabified as onsets and may even be single segments (i.e., prenasalized stops). However, if the Stress-to-Weight argument is rejected on these grounds, one must also reject McCarthy and Prince’s original comment on this example.[27] Without the notion of ‘compensation’, there is no clear way in which

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[27] It should be noted that in later work, McCarthy and Prince (1993b: 117-120) abandon reference to a ‘compensatory relationship’ between the root and affix in Dyirbal ergative

the distribution of ergative allomorphs is optimal in Dyirbal, and therefore this example is neutral at best. Even if the example is only neutral and not truly ‘perverse’, it is problematic for the P >> M approach because the relevant P constraint in such an analysis would have to be language-specific, arbitrary, and not externally motivated. If an advantage of P >> M is supposed to be the reduction of PCSA to phonological principles that are independently identified in the regular phonologies of the world’s languages, then proposing arbitrary, item-specific P constraints for individual languages completely undermines the spirit of the model.

4.3.4 Examples of SCA possibly resulting from TETU

The survey did reveal some cases of SCA aside from Estonian that may be analyzed as TETU effects. For example, as described above in §4.1, the repetitive in Shipibo (Elías-Ulloa 2004) is marked by *-ribi* with even-syllabled stems, and by *-riba* elsewhere. Elías-Ulloa (2004) claims that this allomorphy is driven by sonority, so that /a/ is a good foot head, while /i/ is not (foot-initial syllables are assumed to be heads). The main stress is on the second syllable if closed; otherwise, the first syllable. There is no secondary stress. Elías-Ulloa uses the constraints *i/Head and *a/NonHead to select the correct allomorphs in a TETU analysis.

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allomorphy. Instead, they propose a P >> M account of this pattern in which the relevant P constraint is AFX-TO-FT, which requires the *-ŋgu* suffix to attach to a base that consists of a foot. In this analysis, failure to satisfy AFX-TO-FT results in a null parse, in which case the *-gu* allomorph is used by ‘default’. Wolf and McCarthy (to appear: §6.1) discuss this aspect of the analysis further, proposing that there is a ‘stipulated priority relationship’ between the two suffix allomorphs such that the *-ŋgu* allomorph is ‘tried first’, and if this yields a null parse, then *-gu* is used since *-gu* is ‘not indexed to AFX-TO-FT’.

Note, however, that we do not need to assume that the allomorphy is suppletive. We could say simply that the repetitive suffix is /-ribV/ with an unspecified vowel, and then *i/Head and *a/NonHead could determine the vowel quality. This would not then be an instance of the P >> M ranking schema, though it could still be considered a TETU effect.

Another case of SCA that can be analyzed as a TETU effect is found in Turkana (Dimmendaal 2000). Recall from §4.1 that the suffix used to form abstract nouns occurs as *-ìsí* with CVC roots and *-ù* with $C_iV_jC_iV_jC$ roots. Since each noun has an *á-* feminine gender prefix, the resulting forms all have four syllables; this could be driven by foot structure/parsing constraints and could therefore result from TETU.

4.3.5 The Subcategorization approach

The existence of non-optimizing SCA demonstrates the need for a mechanism other than output optimization to handle SCA. A subcategorization approach captures the fact that there are cases of SCA where phonological well-formedness considerations have no bearing on the choice among allomorphs in a given environment.

An example of an SCA pattern that is particularly well-suited to the subcategorization approach is found in Nakanai (Austronesian, New Britain; Johnston 1980). In Nakanai, the *-il-* form of the nominalizing affix occurs when it can be in the first syllable and adjacent to main stress; *-la* occurs elsewhere (examples are from Johnston 1980: 177-178).

(70)

au	‘steer’	vi-gile-muli	‘tell a story’
il-au	‘steering’	vigilemulimuli-**la**	‘story’
peho	‘die’	vi-kue	‘fight (v.)’
p-**il**-eho	‘death’	vikue-**la**	‘fight (n.)’
loso	‘dive’	go-ilo	‘go in’
il-oso	‘diving’	goilo-**la**	‘entrance’

Stress is on the penult (Johnston 1980: 256). McCarthy (2003: 101-102) claimed that in Nakanai, *-il-* is attracted to the main stress of the word but is also a ‘formal prefix’, and the pattern is driven by dispreference for a stress shift with respect to the base. In McCarthy’s analysis, OO-Pk-Max penalizes the stress shift caused by *-la*, while the constraints Afx-to-Hd(-il-) and Prefix/σ(-il-) limit *-il-* to occurring with disyllabic and smaller stems. Each of these constraints presumably outranks UniformExponence, which requires each morphological category to be marked by a single affix across all forms (though McCarthy does not explicitly propose such a constraint), making this a case of P >> M. Since OO-Pk-Max is not active elsewhere in the language (McCarthy 2003: 102), this is a case of ‘the emergence of the faithful’, not TETU. Thus, even a case of suppletive allomorphy that is apparently phonologically optimizing still contradicts Kager’s (1996) claim that SCA results from TETU.

A subcategorization account for the Nakanai allomorphy is characterized as follows. The *-il-* affix subcategorizes for the first vowel and main stress (under a cyclic account of stress). *-il-* can then attach only to disyllabic and smaller stems (see Yu 2003 on using subcategorization for infixation), and *-la* will attach to all other stems by virtue of its less restrictive subcategorization frame. The Nakanai example is thus exactly the type of case predicted and accounted for by subcategorization.

4.3.6 Using Subcategorization to model SCA

In this section, I show how subcategorization works using some examples seen above. First, to account for Tzeltal perfective allomorphy, we can propose the subcategorization frames shown below.

(71)	Perfective construction A	Perfective construction B (‘elsewhere’)
	$[[\#\sigma\#]_{\text{verb stem}}\ \textit{oh}_{\text{perf suffix}}]_{\text{perf verb}}$	$[[\ \ ]_{\text{verb stem}}\ \textit{ɛh}_{\text{perf suffix}}]_{\text{perf verb}}$

In this analysis, the *-oh* suffix left-subcategorizes for a verb stem with only a single syllable, while the *-ɛh* suffix left-subcategorizes for a verb stem with no phonological requirements. This is how *-ɛh* is selected as the ‘elsewhere’ allomorph.

In Nakanai, we can characterize the nominalizing allomorphy seen above as subcategorization for a vowel and a stressed syllable. Below are proposed subcategorization frames for the two nominalizing allomorphs in Nakanai.

(72)	Nominal construction A	Nominal construction B (‘elsewhere’)
	$[\textit{il}_{\text{nominalizing prefix}}\ [\text{V}, \acute{\sigma}]_{\text{verb stem}}]_{\text{noun}}$	$[[\ \ ]_{\text{verb stem}}\ \textit{la}_{\text{nominalizing suffix}}]_{\text{noun}}$

Here, the *il-* allomorph right-subcategorizes for the leftmost vowel and stressed syllable of a verb stem. In the event that *il-* cannot be adjacent to both the leftmost vowel and the stressed syllable, then the elsewhere allomorph, *-la*, is selected. This allomorph left-subcategorizes for a verb stem with no phonological requirements.

4.3.7 Estonian revisited

Given the existence of the subcategorization mechanism discussed above, there are two possible reanalyses for the Estonian data that were the impetus for Kager’s claim that SCA is output optimization. The first is the subcategorization account outlined below. Here, I propose subcategorization frames to account for the allomorphy found in the genitive plural and partitive plural. Each of these is characterized as having the more specific allomorph subcategorize for a stem that ends in a complete foot.

(73) a. Estonian genitive plural const. A
$[[\mathrm{Ft\#}]_{\text{stem}}\ \textit{te}_{\text{gen pl suffix}}\ ]_{\text{gen pl word}}$

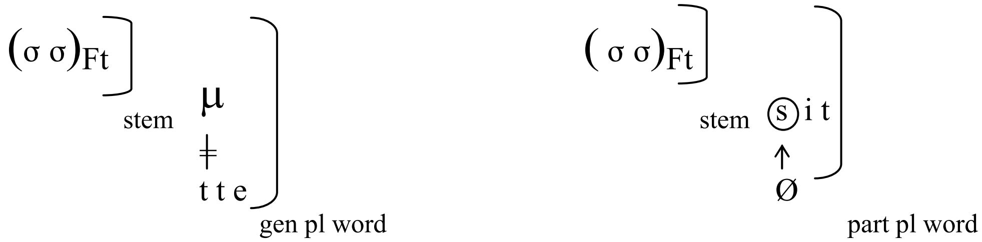
Estonian genitive plural const. B (‘elsewhere’)
$[[\ \ ]_{\text{stem}}\ \textit{tte}_{\text{gen pl suffix}}\ ]_{\text{gen pl word}}$

b. Estonian partitive plural const. A
$[[\mathrm{Ft\#}]_{\text{stem}}\ \textit{sit}_{\text{part pl suffix}}\ ]_{\text{part pl word}}$

Estonian partitive plural const. B (‘elsewhere’)
$[[\ \ ]_{\text{stem}}\ \textit{it}_{\text{part pl suffix}}\ ]_{\text{part pl word}}$

A second reanalysis is possible for the Estonian genitive plural and partitive plural: a non-suppletive account involving a single underlying form of the affix for each morphological category and phonological rules specific to each category: a rule of *tt* degemination for the genitive plural, and a rule of *s* insertion for the partitive plural. These rules are schematized below.

(74) a. Genitive plural *tt* degemination b. Partitive plural *s* insertion



This analysis in terms of phonological rules is possible because the allomorphs in each category are phonologically similar to each other, allowing us to propose a single underlying form (/-tte/ for the genitive plural and /-it/ for the partitive plural). Interestingly, this is true of some other cases of optimizing SCA as well, so that among those cases of SCA found in this survey that appear to be optimizing, some may not actually involve suppletive allomorphy. For example, in the Shipibo repetitive allomorphy discussed above, it is possible to propose a single underlying form, /-ribV/, that corresponds to the two allomorphs. This is important because not only have we demonstrated that SCA is not always optimizing, but it may even be the case that the *majority* of cases of SCA are non-optimizing once we factor out cases of optimizing SCA that do not actually involve suppletive allomorphy.

4.3.8 Summary of analysis

Given the existence of SCA that output optimization cannot handle, and the existence of subcategorization, which can handle these cases as well as those modeled by output optimization, we have 2 options for our theory. Option A is to model the optimizing cases using output optimization and the non-optimizing cases using subcategorization; this is similar to a proposal advanced by Booij (1998). Option B, the option advocated here, is to model all cases of PCSA (including SCA) using subcategorization.

Option B avoids the problem of having multiple theoretical mechanisms to model a single phenomenon. Option B also captures the fact that SCA appears to be a unitary phenomenon, rather than two distinct phenomena that can be easily differentiated, which is what Option A implies. As shown below, cases of SCA are distributed along a continuum of optimization ranging from optimizing, TETU effects (as in Estonian) to anti-optimizing or 'perverse' effects (as in Dyirbal).

(75) A continuum of optimization in SCA

Optimizing; possible TETU effects	*Non-arbitrary distribution; not necessarily optimizing*	*Arbitrary distribution; non-optimizing*	*'Perverse'*
e.g. Estonian, Turkana	Kimatuumbi, Nakanai	Tzeltal, Kaititj	Dyirbal

Furthermore, Option A represents a poor way of doing science. If we use the P >> M model only to account for the type of examples that it handles best, then the model can have no predictive power and is completely untestable. Since we are dealing with an apparently unitary phenomenon in a single domain of grammar, there is no principled reason to use two completely different models to account for different instances of the phenomenon.[1]

4.4 Conclusion

In this chapter we have seen a number of cases of suppletive allomorphy conditioned by elements of the prosodic hierarchy (mora, syllable, or foot). Examples from a wide variety of languages were presented in §4.1. One large class of cases revealed by the present survey involves the ergative/locative in the Pama-Nyungan languages of Australia. On their surface, the PN examples are problematic for my claim that PCSA is not inherently optimizing and should be modeled using subcategorization rather than Output Optimization because many of the patterns do appear to be optimizing. However, a look at the history of the PN ergative/locative allomorphy (§4.2) has revealed

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[1] This reflects a more general issue that has parallels in other areas of research, notably in the study of fixed segment reduplication. In a seminal article on the topic, Alderete et al (1999) propose two separate analyses, a phonological analysis and a morphological analysis, for what they view as two different types of fixed segment reduplication. In effect, the examples where the fixed segmentism seems to follow from phonological principles get a phonological analysis, while examples where the identity of the fixed segment is arbitrary get a morphological analysis. One could criticize this approach along the same lines as I have criticized the approach advocated by Booij (1998). However, an important difference between the use of a dual approach for fixed segment reduplication vs. PCSA is that Alderete et al identify several independent properties of the morphological type of fixed segmentism that differ from the phonological type (1999: 355-356). No such independent properties differentiate the optimizing vs. non-optimizing types of PCSA, and for this reason, a dual analysis of PCSA is unmotivated and unprincipled. See §6.4 for further discussion of this point.

a source for the apparent effect of optimization that does not involve morphological change for the sake of phonological optimization. This eliminates any problem that the PN examples might have posed for a subcategorization approach to PCSA. The subcategorization approach to prosodic PCSA is spelled out in §4.3 and contrasted with Kager's (1996) proposed use of Output Optimization to model the same phenomenon. Subcategorization is argued to be the superior account because it offers a unified analysis of PCSA and is able to handle non-optimizing allomorphy. The approach to prosodic PCSA described in §4.3 is the same subcategorization approach used in chapters 2 and 3 to model cases of PCSA conditioned by segments and by stress/tone, respectively. In chapter 5, I make explicit some predictions for other types of phonology-morphology interactions that are made by this approach and contrast them with the predictions of Output Optimization. I will argue that subcategorization offers a superior account of these other phenomena in addition to PCSA.

Chapter 5: Predictions of the P >> M model

In the preceding three chapters we have seen examples of phonologically conditioned suppletive allomorphy (PCSA) followed by demonstrations of how these cases can be modeled using the subcategorization approach to morphology. In most of these cases, the so-called ‘P >> M’ approach espoused by McCarthy and Prince (1993a,b), discussed in chapter 1, can handle the examples equally well. In some cases of apparently non-optimizing PCSA, the P >> M analysis is inferior to the subcategorization approach because the P >> M analysis requires some highly stipulative and/or poorly motivated new constraints to be proposed, as in the Tzeltal, Kaititj, Zuni, and Dyirbal examples discussed in chapter 4. However, some may argue that this disadvantage of the P >> M model is outweighed by its explanatory power, which exceeds that of the subcategorization approach in that it is able to make sense of the optimizing nature of many of the examples of PCSA observed in the survey; under the subcategorization approach, this optimizing character is coincidental (in the synchronic realm). It was argued that this failure to capture the apparent optimization is not a fatal shortcoming of the subcategorization approach because many examples of PCSA, as demonstrated in chapters 2-4, do not appear to involve optimization.

In this chapter I discuss phenomena other than PCSA where phonological considerations have some bearing on affixation. I will demonstrate that, based on what we know about those other phenomena, the P >> M model does not match very well with the range of phenomena found in the world’s languages. A consideration of other phenomena at the phonology-morphology interface thereby lends further support to my claim based on PCSA that the subcategorization model is the superior one.

Phonological conditions on affixation can in principle be manifested in several different ways involving the occurrence, shape, selection, ordering, and placement of affixes. In this chapter, I consider each of these possible effects, discussing the predictions made by P >> M for each type of effect and then comparing these predictions with the range of attested examples of each type among the world's languages (in instances where relevant survey data are available).

In terms of morpheme **occurrence**, phonology is expected to determine whether or not a particular morpheme will appear in surface forms. On the one hand, there should be instances in which a morpheme is inserted for the purpose of phonological well-formedness; this corresponds to the phenomenon of the empty morph, discussed in §5.1. The other logical possibility is that phonological considerations could prevent a morpheme from surfacing, resulting in a phonologically induced morphological gap (§5.2). Relating to this, phonology could also in principle determine whether a process such as reduplication is allowed to apply; this is covered in §5.3.

The **shape** of the surface form of a particular morpheme can be influenced by phonology whenever phonological processes end up applying to a morpheme in some words but not others depending on the phonological context. This is regular, phonologically conditioned (non-suppletive) allomorphy. I will not be discussing this type of allomorphy any further here; I consider this to be within the domain of pure phonology since it does not have any effect on the actual process of affixation *per se*.

A related effect is the phonologically determined **selection** of multiple different underlying forms of an affix. This is the phenomenon of phonologically conditioned suppletive allomorphy, which has been the primary subject of this dissertation. The reason why PCSA is considered as a phonological effect in morphology (while non-suppletive allomorphy is not) is that PCSA involves the direct influence of phonological factors on the process of affixation itself. PCSA will not be discussed further in this chapter since the predictions of P >> M and the cross-linguistic results have already been presented for this phenomenon in chapters 2-4.

A final possible phonological effect on affixation involves the location of an affix in the word, in terms of its linear **ordering** with respect to other morphemes in the word, or (in the case of infixation) its **placement** within the stem itself. Phonologically conditioned affix order and infix placement are discussed in §5.4 and §5.5, respectively.

As will be seen, those phenomena for which survey data are available tend to support the subcategorization approach while providing arguments against the P >> M approach. This will be discussed further in the conclusion in §5.6.

5.1 Empty morphs

The P >> M model predicts that empty morphs (defined by Bauer (1988: 242) as ‘a recurrent form in a language that does not appear to be related to any element of meaning’) should occur based on phonological considerations. In principle, any phonological constraint should be able to force the insertion of an empty morph. The phonological constraint in question would have to outrank a morphological constraint that I will call DEPMORPH, which bans insertion of morphemes not present in the input (note that this is a different constraint from the phonological constraint DEP, which penalizes insertion of phonological elements).

Some specific types of phonological requirements that are predicted to be met via the use of empty morphs are: dissimilation (similar phonological elements are separated from one another by insertion of an empty morph), word minimality (subminimal words are augmented by an empty morph that contributes enough moras or syllables to allow the word to satisfy minimality), licensing (an affix containing a particular marked segment or feature is only allowed to attach to the stem if an empty morph containing a segment or feature that licenses the marked segment/feature is added to the root), alignment (an empty morph that contains a segment that is eligible to link to a particular feature is added to the edge of a word so that the feature in question can spread to that edge, satisfying alignment), stress clash avoidance (an empty morph consisting of an unstressed syllable intervenes between two stressed morphemes to avoid a stress clash), anti-homophony (an empty morph occurs in some member of a paradigm to avoid confusion with an otherwise homophonous member of the paradigm), and syllable structure constraints (an empty morph consisting of a single C or V is inserted between V+V or C+C, respectively, to avoid a vowel hiatus or consonant cluster).

To my knowledge, no cross-linguistic survey has been undertaken to determine which of these scenarios actually occurs in any of the world’s languages. Impressionistically, some of these possibilities, such as the use of empty morphs to satisfy word minimality (attested in Ndebele (Sibanda 2004)) and for stress clash avoidance, seem plausible, while others, such as alignment, seem less likely to be attested. This is an empirical question for future study.

5.2 Phonologically induced morphological gaps

Prince and Smolensky (1993) first pointed out the use of OT to account for phonologically induced morphological gaps. In the traditional OT approach there is some winning candidate corresponding to every input, even if the winning candidate is not very 'good' in that incurs many violations of even highly-ranked constraints. In standard OT, phonologically induced morphological gaps should therefore not be allowed. Prince and Smolensky (1993) found a way around this problem involving the so-called 'null parse' and a constraint called MPARSE. If "Ø" is considered as a candidate output alongside the faithful candidate and other candidates that are minimally different from the input, then a gap could result from the selection of "Ø" as the winning candidate. Prince and Smolensky assumed that the null parse satisfies all constraints except MPARSE, and that no other candidate violates MPARSE. Thus, any candidate violating a constraint ranked above MPARSE is ungrammatical, and if every non-null candidate is ungrammatical, then the null parse is selected.

Under this model, the P >> M ranking that creates gaps is the ranking of phonological constraints ahead of the (presumably morphological) constraint MPARSE. In principle, any phonological constraint could give rise to gaps. As pointed out by Orgun and Sprouse (1999), Prince and Smolensky's model predicts that any phonological constraint that causes a morphological gap will not be violated anywhere else in the language. Thus, for example, a language that has morphological gaps due to stress clash avoidance cannot have any words exhibiting stress clash.

Orgun and Sprouse (1999) demonstrate that this prediction is incorrect. The analysis of some languages (Turkish, Tagalog, and Tiene are discussed) requires violation of certain constraints to be allowed in some contexts and to result in ungrammaticality in other contexts. This gives rise to a ranking paradox in Prince and Smolensky's model: in some languages a constraint must be ranked above MPARSE for some purposes but below MPARSE for other purposes. Prince and Smolensky's model undergenerates, since it cannot account for these three languages. To solve this problem, Orgun and Sprouse (1999) propose an alternative approach that involves adding a new layer to OT. Their proposal is that EVAL, the familiar OT candidate evaluation module, will always select a non-null winning candidate. This candidate must then be submitted to a higher level that Orgun and Sprouse term CONTROL. Constraints in CONTROL are absolutely inviolable, such that if the winning candidate from EVAL violates any constraint in CONTROL, then it is ungrammatical and there will be no output.

In principle, the revised OT model with CONTROL is compatible with the P >> M ranking schema. However, if gaps are created in CONTROL, then the P-M constraint interaction that actually creates gaps would be a phonological constraint in CONTROL taking precedence over a morphological constraint in EVAL (namely, MORPHEXPR, shown below) (Rose 2000a).[1]

(1) MORPHEXPR: An input morphological category is expressed in the output.

Orgun and Sprouse's model predicts that every phonological constraint should be able to cause a morphological gap. However, unlike in Prince and Smolensky's model, it

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[1] Since phonological constraints in CONTROL can 'override' morphological constraints in EVAL, the CONTROL-based model gives rise to a perhaps more restricted set of effects similar to those predicted by the EVAL ranking schema P >> M. Orgun and Sprouse (1999) do not put any limits on which constraints or constraint types can be part of CONTROL, but presumably if the CONTROL proposal were found to overgenerate in the same way as P >> M, then this problem could be addressed by putting some principled restrictions on which constraints can be in CONTROL.

is not the case that constraints that cause gaps must be inviolable everywhere in the language. Given that some languages have gaps in some paradigms caused by constraints that are violated elsewhere, Orgun and Sprouse's model is superior to Prince and Smolensky's in accounting for the kinds of phonologically induced morphological gaps that are found in the world's languages.

5.3 Reduplication

Under the Base-Reduplicant (BR) Correspondence model of reduplication (McCarthy and Prince 1995), the reduplicant (or RED) is a morpheme that copies phonological material from the BASE. In this model, the production of RED is driven by the morphological constraint MORPHEXPR (discussed above), and by the phonological constraint (or constraint family) BR-CORRESPONDENCE, which enforces similarity between RED and the BASE. This model allows for effects of P >> M just like those described in §5.2 giving rise to morphological gaps, since certain phonological constraints if ranked ahead of MORPHEXPR could prevent the reduplicant from being realized. For example, a constraint against stress clash could prevent the reduplicant from surfacing if it would have a stressed syllable that would surface next to a stressed syllable of the base. A constraint banning sequences of (tier-) adjacent like consonants could prevent the reduplicant from being realized if its realization next to the base would have resulted in such a sequence. Constraints requiring foot binarity and exhaustive foot parsing could prevent a reduplicant with an odd syllable count from surfacing if the base has an even syllable count. In general, any possible phonological constraint can in theory prevent the realization of a reduplicant. The P >> M model therefore predicts the existence of cases where the semantic content of a reduplicative morpheme is expressed but the phonological form of the word is identical to the base and does not contain any reduplicated material.

Under an alternative approach, Morphological Doubling Theory (MDT; Inkelas and Zoll 2005), the same effects of P >> M are predicted. In MDT, reduplication is a morphological rather than a phonological process. There is no 'base' to be contrasted with a 'reduplicant', but instead two underlyingly identical instances of the stem, which are governed by separate sets of ranked phonological constraints (cophonologies). In this model, presumably the expression of each copy of the stem is driven by MORPHEXPR, which could be ranked differently between the two cophonologies corresponding to the two copies of the stem. If in either cophonology, some phonological constraint outranked MORPHEXPR under the P >> M schema, then the P constraint in question could prevent that copy of the stem from being realized. However, note that it is probably more difficult to generate such an effect under MDT than under BR Correspondence. This is because in order to account for why the root (rather than the affix) is always expressed when a particular affix is incompatible with it, there must be some very highly-ranked (or perhaps inviolable) constraint requiring expression of the root (ROOTEXPR). In the BR Correspondence model, RED is an affix, so its expression is driven by the more general MORPHEXPR, which is not inviolable or as highly ranked as ROOTEXPR. This is what allows the possibility of a phonological constraint blocking the expression of the reduplicant. But in MDT, the two copies of the stem have equal status, and neither is considered an affix, so both are subject to ROOTEXPR (unless the stem for reduplication includes some affixes, in which case those particular parts of each copy of the stem would not be subject to ROOTEXPR). This means that if ROOTEXPR is inviolable, then under MDT, the P >> M model cannot result in null expression of either copy of the stem. If ROOTEXPR is not inviolable but only very highly ranked, then a phonological constraint could still outrank it, resulting in null expression, but this is no more likely than the failure of any root (in a non-reduplicative context) to be expressed.

5.4 Phonologically conditioned affix order

Though this has not to my knowledge been made explicit in the OT literature, the P >> M model makes broad predictions for phonologically conditioned affix order and could in principle be used to model that phenomenon just as it has been used for other effects of phonology in morphology (such as suppletive allomorphy, as we have seen; other effects will be discussed in subsequent sections of this chapter). In §5.4.1, I discuss important predictions made by P >> M for affix order. Then, in §5.4.2, I discuss results of a cross-linguistic search for cases of phonologically conditioned affix order, showing that the predictions of P >> M for affix order do not hold up in the face of cross-linguistic data. Finally, in §5.4.3, I discuss an affix ordering phenomenon in Pulaar (West Atlantic, West Africa) which, on its surface, appears to exemplify a type of system predicted by the P >> M model to exist. I show, however, that upon close inspection Pulaar turns out not to be an example of this, and that its affix order can be reduced almost exclusively to semantic scope.

5.4.1 Predictions for affix order

The P >> M model makes important predictions for affix order. Phonologically driven affix order is easily generated by ranking phonological constraints over morphological constraints such as Condoravdi and Kiparsky's (1998) SCOPE and Hyman's (2003) MIRROR, constraints that relate affix order to semantic scope and the order of syntactic operations. If P constraints can outrank M constraints, as allowed in OT and made explicit by McCarthy and Prince (1993a,b), then phonological constraints can outrank these and other morphological constraints governing affix order. Therefore, P >> M predicts the existence of phonologically driven affix order.[2]

Canonical OT does not respect morphological constituency. The input to a tableau, at least in the standard version of OT, includes the root and all affixes making up the word, unordered with respect to each other.[3] Therefore, P >> M predicts that affixes can be ordered phonologically. More specifically, it also predicts global, across-the-board reordering of all of the morphemes in a word for purposes of phonological optimization. This means that in some language, there could be a series of several affixes whose relative order (with respect to each other and to the root) is phonologically determined, perhaps along a phonological scale. Such a case has never, to my knowledge, been discussed as such in the literature, though a putative case from Fula/Pulaar (West

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[2] In fact, McCarthy and Prince (1993a: 85) explicitly claim that '…infixation shows that phonological constraints can determine even the *linear order of morphemes* and morpheme parts' [emphasis mine]. Strictly speaking, this is false. The existence of phonologically determined infix placement does not entail the existence of phonologically determined affix order. Infix placement is not the same as affix order; infix placement involves the order of phonological segments making up affixes, not the order of the morphemes themselves. Looking at the placement of an infix in a stem does not tell us the linear order of the infix morpheme with respect to the stem morpheme, unless one admits into the theory the rather strange concept of X being ordered *inside* Y. Therefore, it is still very much an open question whether phonological constraints can (or should be allowed to) determine the 'linear order of morphemes'.

[3] Though Kiparsky (2000) introduces Stratal Optimality Theory, an approach that does respect morphological constituency.

Atlantic, West Africa) will be discussed at length in §5.4.3. In the following section, I will discuss all of the possible examples of phonological affix order that were uncovered in the course of the search.

5.4.2 Cross-linguistic findings

Only 5 possible cases of phonologically driven affix order were identified in a search of over 400 grammars of languages representing a wide range of language families. The search also included a survey of the theoretical linguistics literature on affix ordering. The existence of templatic affix order is well established (see Zwicky 1985, Simpson and Withgott 1986, Speas 1990, Stump 1992, 1993, Inkelas 1993, Hyman and Inkelas 1997, and Good 2003), so the lack of cases of phonologically conditioned affix order is striking and may in itself be considered a negative result for the P >> M prediction.[4] I summarize the examples below.

First, Jacobsen (1973) claims that suffixes in Washo (Hokan, California/Nevada) are reordered 'to insure an even distribution of stressed and unstressed syllables, and to draw most sequences of unstressed syllables to the end of the word' (1973: 9). Affixes occur in a non-scope order in some examples. Under P >> M, we can analyze this by ranking footing constraints over SCOPE. However, this may also be analyzed via subcategorization without P >> M: stressed suffixes subcategorize for a foot to their left.

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[4] Of course it cannot be claimed that no other examples of phonological affix order exist in any language. However, the number of grammars examined in the course of this search (approximately 400 grammars) is close to the number examined in the survey of phonologically conditioned suppletive allomorphy described in chapters 2-4 (approximately 600 grammars), so it is striking that only five putative examples were uncovered here, in contrast to the 137 examples of PCSA found in the other survey. This should increase our level of confidence in the claim that phonological affix order is uncommon.

Descriptively, the verb in Awtuw (Ram, Papua New Guinea) has 13 affix slots (Feldman 1986: 53). The plural -*m* occurs in suffix position +3 or +6. -*m* cannot appear in +3 if -*re* Future or -*rere* Desiderative appears in +5, unless the -*iy* Imperfective or -*kay* Perfect is in +2. -*m* also cannot appear in +3 if -*(k)ek* Conditional is in +4 and nothing follows it (Feldman 1986: 71). Where -*m* cannot occur in +3, it can appear in +6. Wherever -*m* can occur in +3, it can also occur, doubly marked, in both +3 and +6. This complicated +3 ~ +6 alternation for plural marking may be phonologically motivated because the alternation seems to optimize syllable structure in many contexts. In each example where -*m* is disallowed in +3, the ungrammatical form would have had a more complex consonant sequence than the grammatical form. This suggests that the apparent morphological conditions on the position of -*m* are really phonological. Note, however, that two consonant sequences are allowed, even where a form with only one consonant in the same position is available. Therefore, the alternation is phonologically optimizing only for consonant-final roots. Because there is not a phonological explanation for the pattern across all root types, this may be best analyzed as morphological conditioning.

Hargus and Tuttle (1997) use P >> M to account for the placement of the *s*- Negative prefix in Witsuwit’en (Athabaskan, British Columbia). In some examples, *s*- occurs inside the Tense/Aspect prefix (Hargus and Tuttle 1997: 207). With ‘inner’ subjects, the *s*- prefix occurs outside the Tense/Aspect prefix, which Hargus and Tuttle claim occurs in order to avoid a complex coda (1997: 207). Hargus and Tuttle’s analysis is that the normal order of the prefixes is Neg-T/A, but the order changes so that *s*- can be a coda, except where this would create a complex coda. Hargus and Tuttle (1997: 207) formulate this via P >> M using the constraints in (2).

(2) *COMPLEX
ALIGN-CODA-S$_{\text{NEG}}$: S$_{\text{NEG}}$ should be a coda.
TENSE-STEM: Align the R edge of the Tense prefix to the L edge of the verb stem.
NEG-STEM: Align the R edge of the Neg prefix to the L edge of the verb stem.

The ranking *COMPLEX >> ALIGN-CODA-S$_{\text{NEG}}$ >> TENSE-STEM >> NEG-STEM selects the observed orderings. Note, however, that the data are consistent with a phonological metathesis analysis that does not involve P >> M. Since the prefixes in question each consist of a single segment, it may be the segments and not the morphemes themselves whose order is phonological. Perhaps the regular order is T/A-Neg-, and after the prefixes are in place, phonological metathesis occurs to repair complex codas. The metathesis does not have to result from the regular constraints of the language; it could be specific to the *s*- prefix (as is the ALIGN-CODA-S$_{\text{NEG}}$ constraint proposed by Hargus and Tuttle).

According to Wiering and Wiering (1994), a series of consonantal suffixes in Doyayo (Adamawa-Ubangi, Cameroon) is ordered by scope, except that the *-m* pluralizing suffix is first in any combination. It also occurs before the final consonant of a consonant-final verb root. We can model the pattern by ranking a constraint banning [m] as the second in a consonant cluster over a constraint aligning *-m* to the right edge of a stem. However, we do not need P >> M: the placement of [m] could result from simple phonological metathesis. The generalization that [m] comes first in consonant clusters is surface-true, not specific to *-m* (Wiering and Wiering 1994: 70). Therefore, this can be handled via phonological metathesis. We need not assume that the placement of the affix itself is phonological.

We have seen that the four examples presented above do not provide strong evidence for the existence of phonological affix order, since each example was either weakly documented or consistent with a different analysis not involving phonological conditioning of affix placement. Furthermore, even if these did constitute examples of phonological affix order, none involved the kind of global phonological reordering of multiple morphemes that is predicted by the P >> M approach. The correctness of that particular prediction hinges on one final possible example, to be discussed in the following section. The example is from Fula/Pulaar, a language that appears on its surface to uphold the prediction of global phonological reordering. In fact, I will argue that despite this surface appearance, affix order in Fula/Pulaar is driven by other, non-phonological considerations.

5.4.3 Pulaar

In this section, I discuss affix order in Pulaar, a West Atlantic language spoken in a wide area of West Africa and comprising a large number of dialects.[5] I will use Pulaar as a case study here because, as will be discussed, it appears to exhibit global phonological affix reordering of the type predicted by P >> M. The discussion in this section is presented in more detail in Paster (2006) and especially Paster (2005b).

5.4.3.1 Sonority-based affix order?

Fuuta Tooro Pulaar, which I describe beginning in §5.4.3.1.3, is spoken in the Fuuta Tooro region along the border between Senegal and Mauritania. The consultant for this study is a 42 year-old speaker who moved to the US from a town near Matam, which

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[5] The name 'Fula' is sometimes used for all Pulaar dialects plus other dialects known by names such as Fulfulde, Fulani, and Fulbe. However, 'Fula' usually does not include Pulaar, so there is no single cover term for all of the dialects. Since the focus of the discussion to follow is a Pulaar dialect, I use 'Pulaar' to refer to the entire language group.

is in Senegal in the eastern part of the Fuuta Tooro region. Before turning to Fuuta Tooro, I discuss in §§5.4.3.1.1-2 the order of affixes in Gombe Fula (Arnott 1970), a dialect of northern Nigeria. Arnott (1970: 333, 366) reports that the order of affixes is largely fixed in Gombe Fula. In particular, according to Arnott, immediately after the verb stem are consonantal suffixes ordered according to the formula 'TDNR': all of the /-t/ suffixes precede the /-d/ suffixes, which precede the /-n/ suffix, which precedes the /-r/ suffixes (1970: 366). This generalization, if true, is interesting (among other reasons) because 'TDNR' corresponds to increasing sonority on the sonority scale (see, e.g., Ladefoged 1982), meaning that the fixed order of affixes may be phonological (Paster 2001). This can be modeled via P >> M and would constitute the first known example of the ordering of multiple affixes along a phonological scale, a phenomenon predicted by P >> M. As I show, however, there is a better, non-phonological analysis of Gombe Fula affix order. This is an important negative result because it means that P >> M overgenerates in predicting a phenomenon that apparently does not exist.

5.4.3.1.1 Gombe Fula affix order

Arnott described eleven verb suffixes in Pulaar whose basic shape is a single consonant. These are shown below (Arnott 1970: 334, 340-364).[6]

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[6] In Arnott's orthography, < ' > represents glottal stop, <'y> is a palatal implosive, <sh> is a palatal fricative, and <c> and <j> are voiceless and voiced palatal affricates. I have normalized Arnott's transcriptions to the official Senegalese orthography (Hartell 1993:250) by using spaces where Arnott used hyphens between subject/object markers and verbs.

(3)

Shape	Label	Example
-ɗ	DENominative	fur-**ɗ**-a ‘be grey’
-t	REVersive	taar-**t**-a ‘untie’
-t	REPetitive	soor-**t**-o ‘sell again’
-t	REFlexive	ndaar-**t**-o ‘look at oneself’
-t	RETaliative	jal-**t**-o ‘laugh at... in turn’
-t	INTensive	yan-**t**-a ‘fall heavily’
-d	ASSociative	nast-**id**-a ‘enter together’
-d	COMprehensive	janng-**id**-a ‘read, learn all...’
-n	CAUsative	woy-**n**-a ‘cause to cry’
-r	MODal	ɓe mah-**ir**-i Îi ‘they built them with’
-r	LOCative	’o ’yiw-**r**-ii ‘he came from’

Arnott lists both -C and -VC forms of these suffixes (V is usually [i]). The -VC forms occurs somewhat inconsistently, so this may or may not be analyzable as epenthesis.

The meanings of the suffixes as described by Arnott are summarized below. First, the Denominative *-ɗ* generally attaches to adjectives, converting them to verb stems. The Reversive *-t* suffix produces a verb that ‘undoes’ the result of the plain verb (e.g., the reversive corresponding to ‘close’ is ‘open’). The Repetitive *-t* denotes repetition of an action. The Reflexive *-t* reduces the number of arguments of the verb by one, so that the subject performs the action on him/herself. The Retaliative *-t* indicates that an action is done to someone else in retaliation. The Intensive *-t* indicates ‘completeness, severity, intensity, etc.,’ (Arnott 1970: 343). The Associative *-d* denotes either ‘joint action’ or ‘action in association with some person or thing’ (1970: 344). The effect on the arguments of the verb is to require either a plural subject or else any subject plus a second actor introduced by a preposition. The Comprehensive *-d* indicates ‘totality or completeness’ of the subject or object (Arnott 1970: 345). The Causative *-n* suffix adds an object and contributes the meaning ‘cause to,’ ‘arrange for,’ or ‘make’ (Arnott 1970:

346-347). The Modal *-r* introduces either an instrument or a manner in which an action is done. Finally, Locative *-r* introduces a location where an action is done.

Arnott claims (1970: 366) that these suffixes have fixed order: ‘As far as [the consonantal] extensions are concerned... [the] normal order can be summarized by the formula T-D-N-R’.[7] Forms with the ‘TDNR’ order are given below with page numbers from Arnott (1970).

(4) ’o maɓɓ-**it**-**id**-ii joldɗe fuu
3sg close-REV-COM-past doors all
‘he opened all the doors’ (367)

’o yam-ɗ-**it**-**in**-**ir**-ii mo lekki gokki kesi
3sg$_i$ healthy-DEN-REV-CAU-MOD-past 3sg$_j$ medicine other new
‘he$_i$ cured him$_j$ with some new medicine’ (368)

war-**t**-**ir**-
come-REV-MOD-
‘bring back’ (367)

’o maɓɓ-**it**-**ir**-ii yolnde hakkiil
3sg close-REV-MOD-pastdoor slowly
‘he opened the door slowly’ (367)

no njooɗ-**od**-**or**-too mi ’e maɓɓe
how sit-ASS-MOD-rel.fut 1sg with 3pl
‘how shall I sit/live with them?’ (367)

Arnott also cites several examples of combinations of consonantal suffixes that do not obey the ‘TDNR’ generalization. Some of these are shown below (Arnott 1970: 368).

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[7] The Denominative *-ɗ* occurs immediately next to the root, but Arnott omits it from the ‘TDNR’ formula.

(5) mi wol-**d**-**it**-at-aa ’e maɓɓe
1sg speak-COM-REP-fut-neg with 3pl
‘I won’t speak with them again’

mi hul-**n**-**it**-oo mo
1sg fear-CAU-RET-subjunctive 3sg
‘I’ll frighten him in turn’

’o nyaam-**n**-**id**-ii ɗi
3sg eat-CAU-COM-past 3pl
‘he fed them all’

mi war-**t**-**ir**-**id**-an-te ɗi
1sg come-REV-MOD-COM-DAT-future 3pl
‘I’ll bring them all back to you’

Arnott claims that exceptions to the ‘TDNR’ generalization involve lexicalized combinations of the root and first extension: ‘Variation from the usual order seems to be confined to cases where the basic radical and first extension… frequently occur together as an extended radical…’ (1970: 370). Lexicalized forms often have idiomatic meanings not predictable from the meaning of their parts, and yet these forms have compositional meanings.[8] I show in §5.4.3.1.5 that a scope-based analysis avoids having to posit lexicalized stems; first, I present below a phonological account based on Arnott’s generalization.

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[8] This may not be immediately apparent in the example *mi war-t-ir-id-an-te ɗi* ‘I’ll bring them all back to you’ in (5), since Arnott glosses the *-t* extension here as a Reversive. However, since Reversive and Repetitive are homophonous, the [t] here could be an instance of the Repetitive suffix instead. In that case, we would have a compositional meaning: *come* + *repetitive* = *come again*, i.e., *come back*. The remaining problem would be to account for the causative meaning, *make come back*, i.e., *bring back*. Perhaps causative meaning is attributed to the verb due to the presence of the 3pl object *ɗi*, since *war*- ‘come’ usually does not have a direct object. A similar phenomenon occurs in some pairs of transitive vs. intransitive verbs in English, such as ‘I walked’ (which is intransitive and non-causative) vs. ‘I walked the dog’ (which is transitive and can be interpreted as ‘I caused the dog to walk’). This also occurs in some varieties of American English in such constructions as *to learn someone* meaning ‘to teach someone’.

5.4.3.1.2 A P >> M account of Gombe Fula affix order

Assuming that, despite the exceptions shown above, ‘TDNR’ is the correct generalization for the order of consonantal suffixes, we can analyze this phonologically using P >> M. As mentioned above, the ‘TDNR’ generalization lends itself to a phonological analysis because the order corresponds to increasing sonority, as schematized below.

(6)	**t**	**d**	**n**	**r**
	voiceless stops	voiced stops	nasals	liquids

sonority ⟶

To model sonority-based affix order, we need a phonological (P) constraint enforcing increasing sonority between consonants in separate morphemes, as shown below.

(7) *FALLINGSONORITY C+C: When a consonant C_1 is followed by a consonant C_2 across a morpheme boundary, C_2 may not be less sonorous than C_1.

The P constraint outranks a morphological (M) constraint, seen below, that requires affix order to correspond to semantic scope (Condoravdi and Kiparsky 1998).

(8) SCOPE: Morphological constituency reflects scope.

This constraint refers to the proposal (see, e.g., Baker 1985, Bybee 1985, Rice 2000) that the order of affixes corresponds to their semantic scope (broadly defined; see Rice 2000) so that an affix occurs further from the root than another affix over which it has scope. We will make use of this concept in the analysis of Fuuta Tooro Pulaar in §5.4.3.1.4.

To ensure that the P constraint affects only the order of consonantal suffixes, we also need to assume some undominated constraints to prevent non-consonantal suffixes from being reordered and to prevent violations of *FALLINGSONORITY C+C from being repaired by consonant feature changes rather than reordering (I will not formulate these here). Under this analysis, the ranking P >> M (*FALLINGSONORITY C+C >> SCOPE) selects forms with the TDNR order, even when the order violates SCOPE, as shown below.

(9) **'o irt-**in**-**ir**-ii kam supu 'o kuddu 'he made me stir the soup with a spoon'

	/irt, -r, -n/	*FALLINGSONORITY C+C	SCOPE
	irt-ir-in-	*!	
☞	irt-in-ir		*

Based on scope, we expect the order *-r-n* because Causative has scope over Modal: the instrument is used by the causee, so Causative applies to a stem that already refers to an instrument. The *-n-r* order is selected because the sonority constraint outranks SCOPE.

Crucially, however, the form ***'o irt-in-ir-ii kam supu 'o kuddu* is *not* attested by Arnott (1970) (indicated by two asterisks above). I constructed this example based on the TDNR generalization for the sake of the argument. In fact, not a single example cited by Arnott contradicts our scope-based expectation for affix order. I argue in §5.4.3.1.5 that this is not accidental.

This analysis allows for the 'exceptional' non-TDNR orderings if we assume, following Arnott, that these have lexicalized stems. In these forms, the suffix attaches straightforwardly to a stem ending in the consonant formerly belonging to another suffix.

Thus, we can account for Arnott's (1970) data using P >> M. But since Arnott's data are also consistent with scope, perhaps P >> M is not needed. Arnott provided no examples allowing us to distinguish the two analyses. I present data below from the Fuuta Tooro dialect including many examples that distinguish the two analyses in favor of the scope-based analysis. I argue in §5.4.3.1.5 that we can extend this analysis to Gombe Fula.

5.4.3.1.3 Fuuta Tooro Pulaar (Northeastern Senegal)

The consonantal suffixes of Fuuta Tooro are shown below.[9]

(10)

Shape	Label	Example
-ɗ	DENominative	mi dom-**ɗ**-ii 'I became thirsty'
-t	SEParative/Reversive	mi udd-**it**-ii baafal ŋgal 'I opened the door'
-t	REPetitive	'o haal-**t**-ii 'he spoke again'
-d	COMprehensive/Associative	mi udd-**id**-ii baafe ɗe 'I closed all the doors'
-n	CAUsative	mi jaŋg-**in**-ii 'I taught'
-r	MODal/Instrumental/Locative	mi dog-**r**-ii paɗe 'I ran with shoes'

Note that there are fewer consonantal suffixes here than listed by Arnott (1970). This is because some suffixes of Gombe Fula are not used productively in Fuuta Tooro and because in some cases Arnott distinguished suffixes where the data in Fuuta Tooro suggest a single suffix (e.g., Modal/Instrumental/Locative). See Paster (2005b) for details.

Several pairwise combinations of consonantal suffixes exhibit ordering alternations directly related to scope. For example, when Comprehensive has scope over Separative, the Comprehensive *-d* is ordered outside Separative *-t*, as in (11)a. The scope relation is shown by the fact that the comprehensive action takes place simultaneously, a meaning contributed by the Comprehensive (Paster 2005b). In (11)b, the order is reversed. This corresponds to Separative having scope over Comprehensive, evidenced by the 'sequential' meaning, which results from the fact that Separative has no simultaneous action meaning. The original action takes place simultaneously, but the undoing does not.

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[9] Each suffix also has a -VC form as in Gombe Fula. For Fuuta Tooro, I use the official Senegalese Pulaar orthography, which omits predictable word-initial glottal stops, uses <ñ> for the palatal nasal, and uses a 'hooked *y*' for the palatal implosive, which I replace with <ɠ>.

(11) a. o sok-**t**-**id**-ii baafe ɗe fof
3sg lock-SEP-COM-past doors det all
‘he unlocked all the doors (at once)’

b. o sok-**d**-**it**-ii baafe ɗe fof
3sg lock-COM-SEP-past doors det all
‘he unlocked all the doors (in sequence)’

The Repetitive *-t* is ordered after the Comprehensive *-d* when Repetitive has scope over Comprehensive, as in (12)a. The fact that Repetitive has scope over Comprehensive is evidenced by the repetitive meaning in each case applying not only to the verb, but also to the participants referred to by the Comprehensive. When Comprehensive has scope over Repetitive, as in (12)b, the Repetitive *-t* is ordered first. The evidence for Comprehensive having scope over Repetitive is that in this example, the same participants are not necessarily involved in both the original and repeated actions. The Repetitive applies only to the verb, and then the Comprehensive applies to the output of Repetitive affixation, which is a repeated action. This is consistent with the order of the affixes.

(12) a. min cok-**t**-**id**-ii baafal ŋgal
1pl lock-REP-COM-past door det
‘we all locked the door again together’ (someone else locked it before)

b. mi yaa-**d**-**it**-ii ’e makko
1sg go-COM-REP-past with 3sg
‘I went with her again’ (I went with her before)

As shown in (13), the Causative *-n* is ordered after the Separative *-t*. This is consistent with scope, since the Causative refers not to the original action, but to the ‘undoing’. Thus, Causative applies to a verb that already has the separative meaning, which is consistent with the ordering of the Causative *-n* outside the Separative *-t*.

(13) o haɓɓ-**it**-**in**-ii kam ɓoggol ŋgol
3sg tie-SEP-CAU-past 1sg rope det
'he made me untie the rope'

If order is scope-based, we predict that the opposite order should correspond to the opposite scope relation, as was seen above where Separative-Comprehensive and Repetitive-Comprehensive were combined. In the case of Causative-Separative, however, it is impossible to find an order alternation corresponding to a meaning change because it is apparently impossible for Separative to have scope over Causative. This is explained by the fact that Separative generally applies to a verb whose semantics involve putting things together. Thus, in order for Separative to apply to a Causative, the entire Causative verb would have to have a 'putting together' meaning. There are apparently no verbs corresponding to 'make be together' that use the Causative *-n* such that a Separative would be expected to attach to the Causativized stem (see Paster 2005b for details).

When the Repetitive *-t* combines with the Causative *-n*, both orderings are acceptable, corresponding to scope. When Repetitive has scope over Causative, the Causative *-n* precedes the Repetitive *-t*, as in (14)a. The scope relation is indicated by the fact that the same agent causes both the original and repeated actions. Thus, Repetitive applies to a Causativized verb, corresponding to the ordering of the Repetitive suffix outside the Causative. As predicted by scope, the opposite order of the Causative and Repetitive suffixes corresponds to the opposite scope relation from (14)a. When Causative has scope over Repetitive (14)b, the Repetitive *-t* precedes the Causative *-n*. The scope relation is evidenced by the fact that the original action is understood to have been done voluntarily rather than being caused by the same agent who causes the repeated action. Thus, Repetitive applies to the bare verb, and Causative applies to the

Repetitive verb, meaning that causation applies to the repeated action and not necessarily to the original action.

(14) a. o sood-**it**-**in**-ii een deftere nde
3sg buy-REP-CAU-past 1pl book det
'she made us buy the book again'

b. o sood-**in**-**it**-ii een deftere nde
3sg buy-CAU-REP-past 1pl book det
'she made us buy the book again' (we bought it before voluntarily)

The relative order of the Separative *-t* and Modal *-r* corresponds to their scope. In (15), Modal has scope over Separative, as indicated by the fact that the instrument is used to undo the action and not necessarily to do the original action. Thus, the scope of the two suffixes in this example corresponds to the ordering of Modal *-r* outside Separative *-t*.

(15) a sok-**t**-**ir**-ii baafal ŋgal coktirgal
2sg lock-SEP-MOD-past door det key
'you (sg.) unlocked the door with a key'

It is apparently impossible to produce a single verb form where Separative has scope over Modal. When asked to produce such a form corresponding to, e.g., 'we unsewed the shirts with a needle,' ([we un-[sewed the shirts with a needle]]) where the needle was used to do the sewing but not the unsewing, the speaker is unable to express this with a single verb. Therefore, we cannot test the prediction of the scope principle that Separative should occur after Modal when Separative has scope over Modal.

When Modal has scope over Repetitive (16), *-r* is ordered after *-t*, as predicted. It is clear that Modal has scope over Repetitive here since it is specified that a different instrument is used in the original vs. repeated action. Thus, Repetitive applies to the verb first, and then Modal applies to the Repetitive stem.

(16)	mi	irt-**it**-**ir**-ii	supu	o	kuddu	goɗɗo
	1sg	stir-REP-MOD-past	soup	det	spoon	different

‘I stirred the soup again with a different spoon’

When Repetitive has scope over Modal, the Modal *-r* suffix is ordered after the Repetitive *-t* suffix, as shown in (17).

(17)	mi	udd-**it**-**ir**-ii	baafal	ŋgal	sawru
	1sg	close-REP-MOD-past	door	det	stick

‘I closed the door with a stick again’ (the same stick)

This is the first example we have seen where the affix order does not correspond to scope. Based on scope, we expect Repetitive *-t* to be ordered after Modal *-r* here. We know that Repetitive has scope over Modal because it is understood that the same instrument is used for both the original and repeated actions.[10] This corresponds to the application of Modal to the verb root, and then application of Repetitive to the verb that already has an instrument so that the repeated action involves the use of the same instrument. Since this order has no apparent semantic explanation, I assume the *-t-r* order is part of a morphological template. We will account for this in the analysis in §5.4.3.1.4.

The order of the Causative *-n* with the Comprehensive *-d* is scope-based. When Comprehensive has scope over Causative, Causative *-n* precedes the Comprehensive *-d*, as in (18)a. When Causative has scope over Comprehensive, the Causative *-n* is ordered after the Comprehensive *-d* as predicted. However, the opposite ordering, *-n-d*, is also compatible with this reading, as in (18)b. This may be due to the difficulty of

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[10] It is possible that the ‘same instrument’ reading is arrived at contextually, since this would likely be the default interpretation of ‘I closed the door with a stick again’ in, e.g., English. However, (17) contrasts crucially with the type of example seen in (16), where the consultant states specifically that a different instrument is used in the original vs. repeated action. Unfortunately I do not have any Modal-Repetitive sentences that differ minimally in this respect (using exactly the same verb and instrument), but there are parallel cases involving the Modal and Comprehensive ((19)a and b) which do show a minimal difference in the same vs. different instrument reading.

constructing English stimuli where Causative has unambiguous scope over Comprehensive. When the speaker is given with English sentences like this, he may interpret them so that Comprehensive has over Causative, explaining why *-n-d* is accepted. The meaning difference is subtle, and this should be investigated in conversation or narratives.

(18) a. ɓe njal-**n**-**id**-ii mo
3pl laugh-CAU-COM-past 3sg
'we all made him laugh together'

b. mi woy-**d**-**in**-ii ɓe ~ mi woy-**n**-**id**-ii ɓe
1sg cry-COM-CAU-past 3pl
'I made them cry together'

When the Comprehensive combines with the Modal so that Comprehensive has scope over Modal, Comprehensive *-d* is ordered after Modal *-r*, as in (19)a. The scope relation is indicated by the fact that a different instrument is used to perform the action on each object. When Modal has scope over Comprehensive, as in (19)b, Modal *-r* is ordered after Comprehensive *-d*. The fact that Modal has scope over Comprehensive here is clear since the same instrument is used to perform the action on each object. This is consistent with the application of Modal to a stem already having the comprehensive meaning so that the instrument applies to all of the objects referred to by the Comprehensive.

(19) a. mi sok-**r**-**id**-ii baafe ɗe coktirgal goɗŋgal
1sg lock-MOD-COM-past doors det key different
'I locked each of the doors with a different key'

b. mi sok-**d**-**ir**-ii baafe ɗe coktirgal
1sg lock-COM-MOD-past doors det key
'I locked all of the doors with a key' (the same key)

The final pairwise combination of suffixes shows variation. When Causative has scope over Modal, we expect *-n* to come after *-r*. We do find this order corresponding to this scope reading, but the opposite order can also be used, as in (20)a; either order is allowed with no meaning difference. We find the same variation when Modal has scope over Causative, as in (20)b. Here, we expect Modal *-r* to be ordered after Causative *-n*, but the opposite order can also be used. Our analysis will need to account for this.

(20) a. o irt-**ir**-**in**-ii kam supu o kuddu ~
3sg stir-MOD-CAU-past 1sg soup det spoon

o irt-**in**-**ir**-ii kam supu o kuddu
3sg stir-CAU-MOD-past 1sg soup det spoon
‘he made me stir the soup with a spoon’ (I used a spoon)

b. o irt-**in**-**ir**-ii kam supu o laɓi ~
3sg stir-CAU-MOD-past 1sg soup det knife

o irt-**ir**-**in**-ii kam supu o laɓi
3sg stir-MOD-CAU-past 1sg soup det knife
‘he made me stir the soup with a knife’ (he used a knife)

This exhausts the pairwise combinations of the consonantal suffixes. Based on these examples, we have three generalizations about the order of consonantal suffixes in Fuuta Tooro (21). In §5.4.3.1.4 I propose an analysis to account for these generalizations.

(21) a. Repetitive *-t* precedes Modal *-r* regardless of their relative scope.
b. Causative *-n* and Modal *-r* are freely ordered with each other regardless of scope.
c. Otherwise, order is determined by scope.

5.4.3.1.4 A scope-template account of Fuuta Tooro affix order

Rice (2000) claims that scope determines the order of affixes whenever there is a scope relation between them. Otherwise, order is arbitrary. Templates are ‘emergent’; in OT terms, SCOPE always outranks TEMPLATE. However, a language with scope-based order can have elements of fixed order that override scope, as seen above. This follows from TEMPLATE >> SCOPE; a ranking I use in the analysis of Fuuta Tooro affix order below.

In this analysis, I break TEMPLATE into three separate constraints, shown below.

(22) T$_{\text{REP}}$ PRECEDES R: Repetitive *-t* precedes Modal *-r*.
N PRECEDES R: Causative *-n* precedes Modal *-r*.
R PRECEDES N: Modal *-r* precedes Causative *-n*.

The observed affix order effects will be analyzed by ranking these templatic constraints above SCOPE so that scope determines the order of affixes as long as the template is not violated; when scope and the template conflict, the template 'wins'.

The ranking T$_{\text{REP}}$ PRECEDES R >> SCOPE successfully selects forms where the template and scope agree, as shown in the tableau in (23).

(23) mi irt-**it**-**ir**-ii supu o kuddu goɗɗo 'I stirred the soup again with a different spoon'

	/irt, -t, -r/	T$_{\text{REP}}$ PRECEDES R	SCOPE
☞	irt-it-ir-		
	irt-ir-it-	*!	*

Since the repeated action is not done with the same instrument as the original action, Modal has scope over Repetitive, and therefore we expect Modal *-r* to be ordered after Repetitive *-t*. This is the order that is selected since SCOPE agrees with the template.

This ranking also selects forms where TEMPLATE forces a violation of SCOPE (24).

(24) mi udd-**it**-**ir**-ii baafal ŋgal 'I closed the door with a stick again' (same stick)

	/udd, -t, -r/	T$_{\text{REP}}$ PRECEDES R	SCOPE
☞	udd-it-ir-		*
	udd-ir-it-	*!	

The scope order is *-r-t* since Repetitive outscopes Modal (the same instrument is used in the original and repeated actions), but the *-t-r* order is selected by T$_{\text{REP}}$ PRECEDES R.

The order of *-n* and *-r* is handled by variable ranking. In ranking #1, N PRECEDES R >> R PRECEDES N, SCOPE. This selects forms where *-n* precedes *-r* (25).

(25) o irt-**in-ir**-ii kam supu o laɓi ‘he made me stir the soup with a knife’ (he used a knife)

	/irt, -n, -r/	N PRECEDES R	R PRECEDES N	SCOPE
☞	irt-in-ir-		*	
	irt-ir-in-	*!		*

Here, the order predicted by scope is *-n-r*, since Modal has scope over Causative (the causer, not the causee, uses the instrument). Since this agrees with the high-ranked N PRECEDES R constraint, the winning candidate also satisfies SCOPE.

Our ranking also selects forms where SCOPE is violated (26).

(26) o irt-**in-ir**-ii kam supu o kuddu ‘he made me stir the soup with a spoon’ (I used a spoon)

	/irt, -r, -n/	N PRECEDES R	R PRECEDES N	SCOPE
☞	irt-in-ir-		*	*
	irt-ir-in-	*!		

The scope order is *-r-n* since Causative has scope over Modal (the causee uses the instrument), but since N PRECEDES R outranks SCOPE, the non-scope *-n-r* order wins.

In ranking #2, R PRECEDES N outranks N PRECEDES R and SCOPE. This selects forms with the Modal *-r* preceding the Causative *-n* regardless of scope. As seen in the tableau in (27), this ranking selects forms where the template and scope agree.

(27) o irt-**ir-in**-ii kam supu ’o kuddu ‘he made me stir the soup with a spoon’ (I used a spoon)

	/irt, -r, -n/	R PRECEDES N	N PRECEDES R	SCOPE
	irt-in-ir-	*!		*
☞	irt-ir-in-		*	

Here, the scope order is *-r-n* since Causative has scope over Modal (the causee uses the instrument). This agrees with R PRECEDES N, so the winner obeys SCOPE as well.

This ranking also selects forms where scope and the template disagree, so that the winning candidate obeys the template at the expense of a scope violation (28).

(28) o irt-**ir-in**-ii kam supu ’o laɓi ‘he made me stir the soup with a knife’ (he used a knife)

	/irt, -n, -r/	R PRECEDES N	N PRECEDES R	SCOPE
	irt-in-ir-	*!		
☞	irt-ir-in-		*	*

Here, the scope-based order is *-n-r* since the causer uses the instrument. However, because R PRECEDES N outranks SCOPE, the winning candidate has the *-r-n* order.

The two constraint rankings are summarized below.

(29) Ranking #1: T_{REP} PRECEDES R, N PRECEDES R >> R PRECEDES N, SCOPE
Ranking #2: T_{REP} PRECEDES R, R PRECEDES N >> N PRECEDES R, SCOPE

By using template constraints and SCOPE, all M constraints, we have captured the order of consonantal suffixes in Fuuta Tooro without P >> M. We will now revisit Gombe Fula, and I will show that a scope-based analysis is possible for that dialect as well.

5.4.3.1.5 A scope-based reanalysis of Gombe Fula

As mentioned earlier, every example provided by Arnott (1970) is consistent with scope. Though most of Arnott’s examples obey the ‘TDNR’, they are also consistent with scope. For instance, *-t-r* in (30) is a ‘TDNR’ order. However, the order is also consistent with scope, since the adverb ‘slowly,’ introduced by Modal, applies to the Reversive action, not the original action. The Modal applies to a verb to which Reversive has already applied, corresponding to the ordering of the Modal *-r* outside the Reversive *-t*.

(30)	’o	maɓɓ-**it**-**ir**-ii	yolnde	hakkiilo
	3sg	close-REV-MOD-past	door	slowly

‘he opened the door slowly’ (Arnott 1970: 367)

(31) is also consistent with both scope and the ‘TDNR’ generalization. Here, the order corresponds directly to the order of logical operations performed on the root. First, the Denominative *-ɗ* attaches to the adjective, converting it into a verb meaning ‘be healthy’.

Then, the Repetitive *-t* applies to this stem, yielding a new stem meaning 'be healthy again' (='be cured'). Next, the Causative *-n* applies, resulting in a stem meaning 'make be cured' (='cure'). Finally, the Modal *-r* attaches to this stem, introducing an instrument, giving the meaning 'cure with (some new medicine)'. The order of attachment of the affixes is reflected in the order of the suffixes: *-t-n-r* (Repetitive-Causative-Modal).

(31)	'o	yam-ɗ-**it**-**in**-**ir**-ii	mo	lekki	gokki	kesi
	3sg$_i$	healthy-DEN-[REP]-CAU-MOD-past	3sg$_j$	medicine	other	new

'he$_i$ cured him$_j$ with some new medicine' (Arnott 1970: 368)

Thus, the ordering generalization that Arnott (1970) accounts for using the 'TDNR' generalization can also be accounted for by scope. The two examples shown above are the clearest examples, but no example contradicts the scope generalization.

Not only does scope account for Arnott's (1970) examples obeying the 'TDNR' generalization, but it also accounts for the 'exceptions', which Arnott explained as having lexicalized stems. Several of Arnott's exceptions can be explained straightforwardly based on scope. In (32), Repetitive has scope over Comitative.

(32)	mi	wol-**d**-**it**-at-aa	'e	maɓɓe
	1sg	speak-COM-REP-future-negative	with	3pl

'I won't speak with them again' (Arnott 1970: 368)

Ignoring the Negative, the form *mi-wol-**d**-**it**-ii 'e maɓɓe* 'I spoke with them again' would mean that the subject had spoken with 'them' before and did so again. This can be schematized as [[speak with] again]. Thus, the order of the affixes corresponds to scope.

Similarly, in (33), the Comitative *-d* has scope over Causative *-n*, since the word 'fed' is used in the English translation.

(33)	'o	nyaam-**n**-**id**-ii	ɗi
	3sg	eat-CAU-COM-past	3pl

'he fed them all' (Arnott 1970: 368)

Once again, an apparent exception is explained straightforwardly based on scope.

Finally, in (34), Retaliative has scope over the Causative since the term ‘frighten’ in the English gloss means ‘cause to fear’. The interpretation is [[cause to fear] in turn], which corresponds to the *-n-t* order, which disobeys the ‘TDNR’ generalization.

(34) mi hul-**n**-**it**-oo mo
1sg fear-CAU-RET-future 3sg
‘I’ll frighten him in turn’ (Arnott 1970: 368)

Since some of Arnott’s exceptional forms are explained by scope, and none of his examples contradict scope, we can say that Arnott provided no evidence for a non-scope principle in the order of consonantal suffixes. The scope-based analysis allows an explanation of the ‘exceptional’ forms, which Arnott ignored. It also avoids the problem that the meaning of Arnott’s lexicalized stems is derived straightforwardly from their component parts rather than being idiomatic as ‘frozen’ forms often are.

Thus, we have seen that neither Fuuta Tooro Pulaar nor Gombe Fula exhibits phonological affix order. In each dialect, the order of consonantal suffixes is scope-based, with some exceptions in Fuuta Tooro that are not phonologically conditioned.

Recall from §5.4.2 that only four other possible cases of phonological affix order were uncovered in this study, and no example was particularly compelling. Thus, with this alternative explanation for the Fula/Pulaar example, we now appear to have no examples of phonological affix order requiring P >> M. This significantly weakens the case for P >> M, since a major prediction of this model is not substantiated cross-linguistically.

5.5 Infixation

Yu (2003) critiques what he terms the Displacement Theory (DT) account of infix placement, exemplified by the Prosodic Optimization approach of McCarthy and Prince (1993b). The idea behind this approach is that, under the P >> M ranking schema, infixation is accounted for by ranking prosodic well-formedness constraints ahead of the morphological constraints that state whether a given affix is a prefix or suffix (under this model, no affix is an underlying infix). In the original incarnation of the Prosodic Optimization approach, alignment constraints were gradiently violable, so that a violation was incurred for each segment by which a prefix or suffix strayed into the root from its underlying, peripheral position. Subsequently, McCarthy (2003) has revised the model so that constraints can only be violated categorically.

Yu (2003) argues that the Prosodic Optimization approach to infixation makes several inaccurate predictions. The first is that affixes should surface as infixes only if the result is prosodically better-formed than if the affix had surfaced in its underlying, peripheral position. Contrary to this prediction, Yu finds several cases in his survey of 141 examples of infixation in 101 languages where certain affixes are obligatorily infixed, never surfacing in what McCarthy and Prince would claim to be their underlying prefixed or suffixed positions. Alabama, Archi, and Tagalog (in the pluractional affix) are cited as having such infixes. An analysis where an affix that invariably surfaces as an infix is treated as a formal prefix or suffix is counterintuitive and unnecessarily abstract in comparison to the alternative, that these are underlying infixes. This criticism holds not of the P >> M ranking schema in general, but of McCarthy and Prince’s use of it in a model specific to infixation. Nonetheless, since my overarching purpose is to contrast the subcategorization approach as a coherent model with the P >> M schema as part of a coherent model, I am focusing on predictions of P >> M as it has been employed in the mainstream literature, not on predictions that would be made under some different use of P >> M. Therefore, I take this problem with the Prosodic Optimization account of infixation to be a shortcoming of the P >> M schema as a whole.

A second inaccurate prediction of Prosodic Optimization pointed out by Yu (2003) is that infixation should always result from considerations of prosodic well-formedness. Yu points out that prosodic optimization is not sufficient to account even for languages where an affix occurs only sometimes as an infix. In some such languages, a P >> M account for infix placement works only if the P constraint is an Edge Avoidance constraint. Edge Avoidance may be construed as optimizing (certainly it can be made into an OT constraint), but it cannot be said to increase phonological well-formedness. Thus, the Prosodic Optimization model at least has to be weakened enough to allow an Edge Avoidance constraint to be the P constraint in the relevant P >> M ranking. Here again, this incorrect prediction is not made by P >> M in general, but by the implementation of it in which the P constraint has to be a well-formedness constraint.

In addition to these two ways in which the Prosodic Optimization account undergenerates, Yu argues that this approach also overgenerates. Namely, it predicts what Yu calls ‘hyperinfixation’, where an affix that underlyingly belongs at one edge of a root migrates any number of segments towards the opposite edge, even going so far as to surface on the opposite periphery. For example, a formal prefix might surface just one segment in from the right edge of the root or even as a suffix. But hyperinfixation is not attested in any of the languages in Yu’s (2003) broad cross-linguistic survey of languages exhibiting infixation. Yu points out that there are ways to avoid hyperinfixation using the proper constraints and rankings, but questions why we should need special mechanisms to rule out hyperinfixation given that it apparently never occurs in any language.

A possible example of hyperinfixation not discussed by Yu (2003) is the phenomenon better known as mobile affixation. ‘Mobile’ affixes, which occur sometimes as prefixes and sometimes as suffixes depending on the phonological context, have been documented in Huave (Noyer 1994) and Afar (Fulmer 1991). Under the Prosodic Optimization approach, mobile affixation can receive the same treatment as infixation and could be construed as hyperinfixation. However, if this is to be counted as extreme hyperinfixation, then we are left with the puzzling question of why there are no ‘in-between’ cases. That is, if an underlying prefix can surface as a suffix or vice versa, then why do we not find any examples of an underlying prefix surfacing as an infix at the far right edge of the word? The lack of such examples suggests that Huave and Afar are better treated as cases of phonologically conditioned suppletive allomorphy, where one allomorph is a prefix and the other is a suffix. As cases of PCSA, Huave and Afar are unusual in that the separate allomorphs are identical in shape and differ only in their position with respect to the stem. However, they differ only minimally from Chimariko, which, as described by Conathan 2002, has a phenomenon similar to mobile affixation except that the prefix and suffix allomorphs are slightly phonologically different from each other, making it clear that this is a case of suppletive allomorphy rather than a single affix occurring in different positions. Thus, within what I consider to be PCSA, there are cases where two or more different phonologically selected allomorps occur in the same position (as in most of the examples described in chapters 2, 3, and 4), cases where two or more differently shaped allomorphs occur in different positions in the word (as in Chimariko), and cases where identical allomorphs occur in different positions in the word (Huave and Afar). Since mobile affixes in Huave and Afar never surface as infixes, they should not be counted as cases of hyperinfixation, and therefore the Prosodic Optimization model still overgenerates in predicting this phenomenon.

5.6 Conclusion

In this chapter, I have discussed some predictions of the P >> M ranking schema for several different phenomena: affix order, infixation, morphological gaps, empty morphs, and reduplication. Those phenomena for which significant cross-linguistic data are available show that the P >> M model makes many predictions that are inaccurate, which offers further substantiation for the point made in chapter 1 that the P >> M model makes incorrect predictions for phonologically conditioned suppletive allomorphy (PCSA). We have seen that in each of the logically possible effects of phonology on affixation, the P >> M predicts a wider range of effects than are actually attested, and yet there are also instances in which P >> M fails to predict or account for certain types of effects (for example, opaquely conditioned PCSA (chapters 2-4), and infixes that always surface as infixes but never as peripheral affixes (§5.5)). Thus, the P >> M model both over- and undergenerates in the domain of several different phenomena at the phonology-morphology interface.

Chapter 6: Conclusion

In this dissertation, I have presented a survey of examples of phonologically conditioned suppletive allomorphy (PCSA). In chapters 2, 3, and 4, I discussed examples of PCSA conditioned by segments and features, tone/stress, and prosodic elements, respectively. In each of these chapters, typological generalizations were drawn for each type of PCSA, and these generalizations were compared with predictions made by two competing models of phonological conditions on affixation, namely, the P >> M approach and the subcategorization approach. It was argued that the survey results for PCSA are more consistent with subcategorization than with P >> M. In chapter 5, I laid out the predictions of P >> M for types of phonological conditions on affixation other than PCSA. It was shown that results for each of these other types of effects converge upon the same conclusion drawn here, that the P >> M model both over- and underpredicts with respect to the range of phonological conditions on affixation found in the world's languages. The subcategorization approach, on the other hand, is compatible with the cross-linguistic findings and is therefore a superior model of phonological conditions on affixation.

In this chapter, I summarize the findings and arguments presented throughout the dissertation. I begin in §6.1 with a summary of the predictions of the P >> M and subcategorization approaches. Then, in §6.2, I summarize the survey results presented in chapters 2-4. In §6.3, I discuss the theoretical implications of both the survey of PCSA and the findings for other types of phonological conditions on affixation. In §6.4, I consider and argue against a 'hybrid model' using both subcategorization and P >> M,. §6.5 provides arguments in favor of a particular way of eliminating the possibility of P

>> M in an OT grammar. Finally, in §6.6, I conclude with some suggested directions for future research on phonological effects in morphology.

6.1 Summary of predictions

In chapter 1, I laid out the general predictions of the P >> M and subcategorization approaches. In this section, I reiterate those predictions before summarizing the cross-linguistic findings in §6.2.

As discussed in chapter 1, the predictions of P >> M for PCSA can be summarized as in (1) below (repeated from chapter 1, §1.1.1.2).

(1) a. PCSA is 'optimizing' and analyzable using preexisting P constraints
    b. PCSA is sensitive to phonological elements in surface forms, not underlying forms
    c. Phonological conditioning between stem and affix can be bidirectional
    d. Conditions on allomorph selection can be located anywhere in the word

Prediction (1)a means that the P constraints used to model PCSA in a P >> M account should be motivated elsewhere, either in the language being analyzed or as a widely attested constraint in other languages. Prediction (1)b indicates that PCSA should result in surface-true generalizations about allomorph distribution, since allomorph selection is handled simultaneously with regular phonological processes. By prediction (1)c, the conditions determining allomorph distribution are expected to come from morphemes that are either closer to or farther from the root than the affix undergoing the allomorphy, since as discussed in chapter 1, standard P >> M analyses do not observe morphological bracketing. Finally, prediction (1)d states that conditions on PCSA are not limited to stem edges and can instead be located anywhere in the word. This means, for example, that prefix allomorphy could be conditioned by a stem-final segment, or suffix allomorphy could be triggered by a stem-initial segment, or allomorphy in a peripheral affix could be triggered by some element in the middle of the stem.

The predictions of the subcategorization model for PCSA, also discussed in chapter 1, are summarized below.

(2) a. PCSA is not always phonologically optimizing
  b. PCSA is sensitive to phonological elements in underlying/input forms, not surface forms
  c. Phonological conditions on PCSA can come only from the 'inside'
  d. Affix allomorphs occur adjacent to the phonological elements of stems that condition their distribution

Prediction (2)a means that we should find some examples of PCSA in which the distribution of allomorphs does not optimize words. This is in contradiction to prediction (1)a, made by the P >> M approach, that PCSA can be accounted for by using established phonological well-formedness constraints. Prediction (2)b means that we should find instances in which PCSA is conditioned crucially by an input element that does not surface, rendering the conditions on allomorphy opaque. This can be contrasted with prediction (1)b, made by P >> M, that PCSA should be sensitive to surface elements. If prediction (2)c is correct, we should find that PCSA in an affix can be conditioned only by a property of the root or another affix closer to the root, and never to an affix farther from the root. On the other hand, as discussed above, the P >> M model predicts the existence of conditioning from both the 'inside' and the 'outside' (prediction (1)c). Finally, prediction (2)d states that affixes should be conditioned by the part of the stem to which they are immediately adjacent. This means that we expect prefixes to be conditioned only by elements at the left edge of the stem, and suffixes to be conditioned only by elements at the right edge of the stem. In contrast, as discussed above, P >> M predicts that we should find examples that do not obey this kind of locality restriction (prediction (2)d).

This concludes the general summary of predictions of the P >> M and subcategorization approaches. As can be seen, the predictions outlined here constitute clear-cut differences between P >> M and subcategorization. The reader should keep these different predictions in mind when considering the survey results from chapters 2-4, which will be discussed in the following section.

6.2 Summary of survey results

In chapters 2-4, I presented the results of a cross-linguistic survey of examples of PCSA. One hundred thirty-seven examples were found in 67 different languages, in a survey of sources on 600 languages. Here, I summarize the findings of the survey.

The examples in chapter 2 involve conditioning by segments or features. Several important generalizations were drawn regarding these examples. As was seen in chapter 2 (§2.1.2), it appears that the C/V distinction or the presence of any phonological feature of a segment can condition PCSA. The conditioning segment or feature is always at the same edge of the stem where PCSA occurs. Thus, PCSA in a prefix is triggered by stem-initial segments or features, while PCSA in a suffix is triggered by stem-final segments or features. It was also found that conditioning always comes from an element closer to the root; for instance, if a suffix undergoes allomorphy, then this can be triggered by a suffix to its left or by the root itself, but it apparently cannot be triggered by a suffix to its right. In this chapter, all of the examples involve allomorphy in an affix or clitic conditioned by a stem. Another important finding is that there are several cases in which PCSA does not appear to be optimizing (§2.1.2.5), and where the relationship between the allomorphs and their distribution instead seems arbitrary. Finally, examples were found where the condition on PCSA was made opaque by a phonological process (§2.1.2.6), such that the original condition on allomorphy was lost or changed in the surface form. As was discussed, this shows that PCSA is sensitive to input phonological elements rather than output elements.

Chapter 3 presented cases of PCSA conditioned by tone or stress. A general observation about these cases is that very few examples were uncovered by the survey. Nonetheless, the existence of some examples does demonstrate that tone and stress can condition PCSA. As with the examples in chapter 2, conditioning by stress or tone is always at the edge of the stem at which the allomorphy occurs. Another interesting finding in chapter 3 is that there seem to exist some instances of stem PCSA (§3.1.1.2), though they are few. These examples were reconciled with the generalization that conditioning comes from the 'inside', so the generalization can still be maintained. An example from Spanish was discussed (§3.1.1.1**)** in which the conditions on allomorph distribution are opaque on the surface, just as in the examples from chapter 2 mentioned above. Finally, some examples of tone or stress-conditioned allomorphy were argued to be non-optimizing (§3.1.1.4), since no well-motivated phonological constraint could be identified as possibly being responsible for the allomorphy.

In chapter 4, I discussed examples of PCSA conditioned by prosodic elements, namely, moras, syllables, and feet. Many examples were found, and the conditions in these examples tended to be overall properties of words rather than individual elements at the edge of the stem. Still, the locality generalization discussed above is still maintained in these examples. Overall properties of the stem count as properties at the edge, since no material intervenes between the conditioning factor (e.g., all of the syllables of the stem) and the affix undergoing allomorphy. As in chapters 2 and 3, the examples in chapter 4 involve conditioning by elements closer to the root; no instances of stem allomorphy were found here. Some examples were discussed in which, as in chapters 2 and 3, conditions on PCSA are made opaque due to regular phonological processes (see, for instance, the Ngiyambaa example in §4.2.1). There are also several examples of PCSA in chapter 4 in which the allomorphy appears to be non-optimizing (§4.1.1.3). It is acknowledged that, relative to chapters 2 and 3, a higher percentage of the examples in chapter 4 appear to have some optimizing character. For this reason, in chapter 4 I investigated in more detail a large set of related examples from the Pama-Nyungan languages of Australia involving allomorphy in the ergative suffix (§4.2). Several of these languages exhibit allomorphy that appears to optimize words, but many do not; in this discussion I showed how a historical understanding of such examples can explain the apparent optimization effects while allowing for the non-optimizing examples.

I have summarized the cross-linguistic findings for PCSA that were presented in chapters 2-4. In the following section, I compare these findings with the predictions discussed in §6.1 and discuss the theoretical implications of this comparison.

6.3 Summary of theoretical implications

In §6.1, I summarized the predictions for PCSA that are made by P >> M and subcategorization. Then, in §6.2, I summarized the results of the cross-linguistic survey of PCSA. In this section, I compare how well the predictions in §6.1 correspond to the cross-linguistic generalizations for PCSA in §6.2, demonstrating that the subcategorization approach fares better than the P >> M approach in this comparison. I conclude this section by summarizing the theoretical implications of the comparison, and also the implications of the findings discussed in chapter 5 for other types of phonological conditions on affixation.

First, regarding the predictions for PCSA, it appears that the subcategorization model is a better predictor of the attested examples, based on the present survey. This can be assessed in terms of the four major predictions made by each model. The first of these deals with phonological optimization. The P >> M approach, since it uses regular phonological constraints, predicts that every case of PCSA should be phonologically optimizing with respect to an established phonological constraint (prediction (1)a in §6.1); the subcategorization approach predicts the existence of non-optimizing examples (prediction (2)a). As discussed above, many examples found in this survey appear to be non-optimizing. While it is difficult to prove that a particular example is non-optimizing, the large number of cases of PCSA for which no phonological constraint is readily available (see examples in §2.1.2.5, §3.1.1.4, and §4.1.1.3) to handle the allomorphy suggests that the prediction of the subcategorization model is correct.

The second prediction of each model refers to input/underlying forms vs. surface forms. P >> M predicts that PCSA should refer to surface phonological properties of words (prediction (1)b), while subcategorization predicts that there should be instances where PCSA is clearly sensitive to input or underlying forms, rather than surface forms (prediction (2)b). As discussed above, several examples are found in which the conditions on PCSA are rendered opaque by the operation of regular phonological processes (see especially §2.1.2.6). This upholds the prediction of the subcategorization model and is problematic for P >> M, since in these examples, PCSA is crucially sensitive to input phonological elements, and not to surface elements.

A third prediction of each model concerns conditioning from the 'inside' vs. the 'outside'. In a standard P >> M analysis, morphological constituency is not reflected in the input form, and therefore each morpheme in the word is equally likely to trigger allomorphy in other morphemes. This means that in P >> M, an affix can condition PCSA in another affix closer to the root, or even in the root itself (prediction (1)c). The P >> M model thus predicts the existence of conditioning from both the 'inside' and the 'outside'. The subcategorization approach, on the other hand, is more restrictive in this regard. As discussed above, subcategorization as implemented within a model of morphology such as Lexical Morphology (which is standard for subcategorization analyses) predicts the existence only of conditioning from the 'inside', never from the 'outside' (prediction (2)c). Based on the survey results throughout chapters 2-4, it appears that this more restrictive prediction of subcategorization is upheld cross-linguistically. There are no clear-cut cases of conditioning from the 'outside'.

Finally, both models make predictions for the location of the condition on affixation *vis à vis* the location of the affix undergoing allomorphy. The P >> M approach predicts that the condition may be located anywhere in the word, regardless of the location of the affix (prediction (1)d). The subcategorization approach, on the other hand, predicts that conditions on PCSA are limited to elements immediately adjacent to the affix in question (prediction (2)d).[1] The survey data appear to uphold the predictions of the subcategorization model, not the P >> M model. Based on this survey, conditions on PCSA are always at the same edge of the stem where the affix allomorphs occur; this is most apparent in chapter 2 (§2.1.2). There are no examples of the type predicted by P >> M in which, for example, prefix allomorphy is conditioned by the stem-final segment. Therefore, once again, the survey results point to subcategorization as the superior model.

We have seen that the results for PCSA overwhelmingly support the subcategorization approach. In addition, results for other types of phonology-morphology interactions appear to favor this approach as well, converging with the results reported here. In chapter 5, I covered some other types of phonological conditions on affixation, laying out the predictions made by P >> M for each area and discussing, where available, the cross-linguistic results for each. The following five logically possible types of phonological conditions on affixation (aside from PCSA) were discussed: empty morphs (§5.1), phonologically induced morphological gaps (§5.2), reduplication (§5.3), phonologically conditioned affix order (§5.4), and infixation (§5.5). For infixation, there does exist a large cross-linguistic survey of the phenomenon along with a critique of the P >> M approach (Yu 2003). The results in that area converge with the results presented here, since P >> M predicts the existence of some unattested effects in affixation, and it also fails to predict some effects that are attested. Thus, Yu (2003) argues against the use

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[1] As with the third prediction (regarding the direction of conditioning), this prediction is made not by the subcategorization mechanism itself, but by a standard implementation of the model. In this case, the implementation would need to incorporate the Generalized Determinant Focus Adjacency Condition (GDFAC; Inkelas 1990), discussed in chapters 1 and 2. As pointed out in chapter 1, the GDFAC is uniquely compatible with the subcategorization approach, not the P >> M approach, so from this perspective the adjacency prediction is, at least indirectly, a prediction of the subcategorization model itself.

of P >> M for modeling infixation, as I have done here for PCSA. Large surveys for the purpose of assessing the claims of P >> M have not been conducted in the other areas discussed in chapter 5, but I have pointed out claims made by P >> M in each area, and have pointed out some unusual and likely false predictions that are made in some cases. Therefore, the available data on types of phonological conditions on affixation other than PCSA and infixation lend tentative support to subcategorization, though more work is needed.

In this section I have pointed out how subcategorization makes more accurate predictions than P >> M for PCSA, and how this is true for other types of phonological conditions on affixation for which data are available. The overall result is that the P >> M model is not upheld and should be abandoned in favor of the subcategorization approach. Thus, cross-linguistic research has given us insight into the best way to model phonological effects in morphology.

6.4 Two types of PCSA?

Although the cross-linguistic results strongly favor the subcategorization approach, one may still find problematic the model's inability to capture apparent optimization effects of PCSA. Some of the apparently optimizing examples discussed in the literature are not clear-cut cases of such (e.g. the Dyirbal example claimed by McCarthy and Prince (1990) to involve complementarity when in fact no tenable P >> M analysis has been able to make use of this insight), and in chapter 5 I discussed at length how an understanding of the historical origins of PCSA patterns minimizes the need for synchronic explanations of apparent optimization. However, one may wonder whether a hybrid model could be applied, in which the cases that seem to be optimizing are modeled via P >> M, while subcategorization frames are used for the other, non-optimizing cases. As discussed for syllable-counting allomorphy in §4.3.8, a proposal similar to this was made by Booij (1998), and this also corresponds with Mascaró's (1996) distinction between 'internal' and 'external' allomorphy.

There are a number of serious problems with this strategy. First, even the 'optimizing' examples still appear to fulfill predictions (b-d) of the subcategorization approach more closely than those of the P >> M approach: they are never demonstrably output-based, they are conditioned from the 'inside' and not the 'outside', and they never violate the adjacency requirements of the GDFAC. Thus, even those examples for which we would give a P >> M analysis under the dual approach still fail to fulfill three other predictions of the P >> M approach that distinguish it from the subcategorization model.

A second problem has to do with how we might establish the split between optimizing and non-optimizing cases to determine which model to use for a given example. Optimization vs. non-optimization is not a black-and-white distinction, but rather a continuum, as was discussed for syllable-counting allomorphy in §4.3.8.
The continuum is problematic because it is not clear where optimization ends and non-optimization begins. In order to analyze the optimizing examples in one way and the non-optimizing examples in a different way, we need a clear dividing line between the two types.

A related problem is that there is no independent basis for two different types of PCSA. The split would therefore have to be made based on which examples lend themselves to analysis in P >> M and which do not. This is circular because the claim that there are two types of allomorphy that should be analyzed differently would rest upon the fact that we analyzed the two types differently. A useful comparison can be made between this situation and the situation faced by Alderete et al (1999) in their study of fixed segment reduplication (FSR). As was discussed in §4.3.8, Alderete et al proposed that there are two types of FSR, a phonological type and a morphological type; the former follows phonological principles and is analyzed phonologically, while the latter does not follow phonological principles (e.g., the identity of the fixed segment in morphological FSR is an arbitrary segment, not a phonologically unmarked 'default' segment) and is analyzed morphologically. Unlike in our present study of PCSA, Alderete et al (1999: 355-356) identified several independent differences between their proposed phonological and morphological types of FSR. We have no such independent criteria to distinguish two types of PCSA, and the burden of proof is on those who would argue that PCSA can be split into multiple separate phenomena in a principled way. The survey presented in this dissertation represents an attempt to find independent criteria on which such a distinction might be made, but none were found.

Bonet et al (in press) advocate a dual approach based on the following argument (footnote 2):

> 'The idea that all allomorphy should be explained by the same mechanism seems to be assumed by some authors, either implicitly or explicitly (for instance, Paster, 2005[a]: section 5, states that subcategorization "avoids the problem of having multiple theoretical mechanisms to model a single phenomenon"). But 'allomorphy' is a (vague) descriptive concept that has no privileged theoretical status.'

Two points must be made regarding this line of reasoning. First, it must be clarified that while some authors may indeed claim that 'all allomorphy should be explained by the same mechanism,' Paster 2005a argues only that *syllable-counting allomorphy*, a specific subtype of PCSA (itself a subtype of ‘allomorphy’) should have a unified analysis; the argument is extended in this dissertation to all of PCSA but not to ‘allomorphy’ in general. In fact, several specific independent criteria for distinguishing PCSA from non-suppletive phonologically conditioned allomorphy are established in §2.1.1. Thus, the claim that ‘allomorphy’ has no theoretical status is immaterial to the arguments made in Paster 2005a and in this dissertation. Second, the assertion that allomorphy (or more specifically, PCSA, if this is what was actually intended in the quote above) is merely a ‘(vague) descriptive concept’ is easily turned back on Bonet et al, who rely crucially on Mascaró’s (1996) distinction between internal and external allomorphy (renamed by Bonet et al as ‘arbitrary phonologically conditioned allomorphy’ and ‘regular (natural) phonologically conditioned allomorphy’, respectively); the arbitrary ‘type’ of allomorphy apparently consists of cases in which ‘[i]t is difficult to see any natural phonological connection between the shape of the allomorphs’ (Bonet et al in press: §1). Although naturalness is one factor that I have used to determine what constitutes PCSA vs. non-suppletive allomorphy (see §2.1.1), this is not the only criterion used, whereas naturalness (defined in terms of difficulty for the analyst) does seem to be the sole difference between Bonet et al’s two types of PCSA. Classifying a particular case as optimizing or non-optimizing allomorphy based solely on the ease of analysis in P >> M vs. subcategorization is circular and not insightful.

A final problem with the dual approach has to do with how to formalize it. Even if we decide that there are two types of PCSA that should be analyzed differently, how can we ensure that the grammar will ‘do’ the optimizing type using P >> M and the non-optimizing type using subcategorization? A possible way to encode the distinction in the grammar would be to put limits on subcategorization frames so that affixes *cannot* subcategorize for the elements that commonly condition the optimizing type of PCSA. I observed earlier that PCSA conditioned by prosodic units such as feet, syllables, and moras, as well as the C/V distinction, account for most of the optimizing examples, while PCSA conditioned by specific segments and/or features are more commonly non-optimizing. Suppose, then, that subcategorization frames were limited so that an affix could only subcategorize for small units like segments and features, and not for larger prosodic units or C/V. Then suppose that the grammar were set up so that it would 'try' a subcategorization-based generalization first, and failing this, would then default to the P >> M generalization. This would achieve the effect of having the grammar (rather than the analyst) distinguish the two types of PCSA, but there is a major problem with this move. The problem is that it directly contradicts the set of things that have previously been established as elements that affixes can subcategorize for. In his study of infixation, Yu (2003, in press) found that the set of phonological elements that *can* be morphologically subcategorized for is exactly: {foot, syllable, mora, C, V}. Thus, preventing affixes from subcategorizing for these elements would have unintended negative consequences for other types of phonologically conditioned morphology.

The bottom line is that while the subcategorization model can handle both the examples that seem to optimize and those that do not, the P >> M model can handle only the optimizing examples well. And with no independent evidence to distinguish two separate types of PCSA, the subcategorization model is the one that should be used.

Assuming that one accepts these arguments for the subcategorization model, one may reasonably ask whether this means that the apparent optimization found in so many examples in the survey is merely a coincidence. The answer is no, not necessarily. As I mentioned in §2.2, one way in which PCSA can arise is from a phonological process that is lost and becomes morphologized. If the original phonological process was optimizing (and it is widely held that phonological processes often do have this characteristic), then the resulting PCSA can retain the appearance of optimization without this having to be encoded in the synchronic grammar. Therefore, although the subcategorization approach does not directly capture the optimizing effects that are apparent in some examples in the survey, this does not mean that we cannot explain them.

6.5 M >> P vs. separate components

If P >> M is rejected as a way of modeling phonological conditions on affixation, how might we rule out this ranking schema? There are at least two possibilities. One, proposed by Yu (2003: 108) is to propose a universal ranking M >> P.[2] Alternatively, P and M may be distinguished as separate components of grammar that are not evaluated in parallel and therefore have no ranking relationship. Both of these options are sufficient to rule out P >> M, but they make different predictions, which I will discuss here.

The M >> P proposal makes at least two important claims. The first is that PCSA is surface-based, since if M and P have a ranking relationship, they will be evaluated in parallel just as in P >> M. The second is that P constraints will drive morphology whenever M constraints underdetermine outputs.

The 'separate components' proposal, on the other hand, makes opposing claims. In this approach, assuming that the output of morphology is the input to phonology,

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[2] Note, however, that Yu in press, which is based on Yu 2003, does not pursue this option.

PCSA should be an input-based phenomenon. A second claim is that P constraints cannot drive morphological processes; instead their effects should be seen on the outputs of morphology only.

There is some evidence suggesting that the ‘separate components’ approach is the correct one. First, as we have seen above, PCSA is crucially an input-based phenomenon, not output-based. This is demonstrated in the Turkish example discussed in §2.1.2.6. Thus, a prediction of the M >> P proposal is contradicted by PCSA. The second type of evidence against M >> P comes from affix ordering. Assuming that affix order is handled by M constraints (an assumption that is explicitly made in some treatments of putative phonologically conditioned affix order, e.g. Hargus and Tuttle 1997), then under M >> P, we expect that anytime the M constraints do not fully determine affix order, P constraints should be able to step in and select a winner. However, as I discuss in Paster 2006, no good cases of phonologically driven affix order are attested. Furthermore, there are at least two attested examples of free affix order (in Chintang (Bickel et al in press) and in Filomeno Mata Totonac (McFarland 2007)). Under M >> P, we would expect that if the morphology left the affix order free, then the lower-ranked P constraints should come into play, as in TETU, and select a winner. Free affix order should not exist because the P constraints should always pick a consistent winner. Thus, the existence of free affix order, in combination with the other observations discussed here, favors the ‘separate components’ approach.

I have elaborated on some aspects of the argument in favor of subcategorization and against P >> M, arguing in §6.4 that a hybrid model in terms of ‘two types of PCSA’ is untenable and in this section that P and M should be understood as separate components of grammar rather than having any ranking relation in OT, even one that inherently rules out P >> M. In the following section, I suggest a few ways in which the present line of research may be advanced.

6.6 Future directions

This dissertation contributes to our understanding of the phonology-morphology interface by providing a broad empirical basis for the study of PCSA, an important instance of a phonological condition on affixation. The generalizations about PCSA that have been presented here are based on a large database of examples; previous studies have not had a very large set of examples on which to base generalizations. Because of this, the generalizations presented here and the theoretical conclusions that follow from them are perhaps more significant than those that have been made before. Thus, the dissertation makes a theoretical contribution as well as an empirical one.

The work presented here gives insight into just one part of an overall picture of phonological effects in morphology, and the phonology-morphology interface more generally. As discussed in chapter 1, the study of phonologically conditioned morphology began in earnest relatively recently, and much work in this area remains to be done.

Regarding the study of PCSA itself, some facts have been left unexplained here. One of these, pointed out in chapter 3, is that the survey revealed only a very small number of examples of PCSA conditioned by tone or stress. Perhaps this is a gap in the survey, or perhaps it reflects some deeper, yet unknown, property of language. This issue might fruitfully be probed through careful research on a particular family of languages with well documented stress or tone properties (e.g., the Bantu languages of Africa) in order to find out whether regular phonological processes involving stress and tone can evolve into patterns of stress- or tone-conditioned PCSA, and if not, why not. A second issue is the appearance of optimization in many examples discussed in the presentation of survey results, perhaps more than expected by chance under the subcategorization approach. It can still be maintained that the existence of apparent non-optimizing examples is sufficient to argue against P >> M, since that model predicts that such examples should not exist. However, in the subcategorization model, we do not have a ready explanation for the apparent fact that many examples of PCSA (perhaps the majority) can be plausibly argued to be optimizing in some way. The detailed look at examples of ergative allomorphy in the Pama-Nyungan languages in chapter 4 was intended to suggest a general historical approach to optimizing PCSA that complements the subcategorization model. This approach could be tested on other examples to see whether other apparently optimizing examples can be accounted for successfully in the historical realm. Perhaps the apparent optimizing nature of phonological processes is sufficient to explain optimization in PCSA, since it seems likely that many cases of PCSA evolved from regular phonological processes that were lost. However, analogy seems to play a major role as well, and it remains an open question whether analogy can involve some type of optimization, even if PCSA itself is not optimizing synchronically.

In addition, instances of phonological conditions on affixation other than PCSA were discussed in chapter 5, and some have not yet been well studied from a cross-linguistic perspective. In particular, empty morphs and phonologically induced morphological gaps are not well understood. Future research will show whether the conclusions regarding the best way to model PCSA hold up for those phenomena as well.

Also, I have focused here only on phonological conditions on affixation, but other morphological processes, such as compounding, should be considered as well. Further testing based on larger and better cross-linguistic studies will reveal the extent to which the claims made in this dissertation can be accepted as general principles of morphology.

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Appendix: Surveyed languages

Note: references to languages in the text included what was deemed the most useful or relevant level of specificity in classification. Here, I list the phylum to which each language belongs, in order to facilitate an assessment of the range of languages surveyed. Linguistic affiliations are from Ethnologue (Gordon 2005).

Abbreviations: AA = Afro-Asiatic; IE = Indo-European; MP = Malayo-Polynesian; NC = Niger-Congo; NS = Nilo-Saharan; PN = Pama-Nyungan.

Language name	Phylum	Location	Reference
Armenian	IE: Armenian	Armenia	Andonian 1999
Axininca Campa	Arawakan: Maipuran	Peru	Payne 1981
Bari	NS: Eastern Sudanic	Sudan	Spagnolo 1933
Biak	Austronesian: MP	New Guinea	Booij 2005
Bidjara	Australian: PN	Australia	Breen 1976a
Biri	Australian: PN	Australia	Terrill 1998
Caddo	Caddoan: Southern	Oklahoma	Melnar 2004
Chimariko	Hokan: Northern	Northwestern California	Conathan 2002
Coptic	AA: Egyptian	Egypt	Kramer 2005
Dakota	Siouan: Siouan Proper	Northern United States	Shaw 1980
Diyari	Australian: PN	Australia	Austin 1981
Dja:bugay	Australian: PN	Australia	Patz 1991
Dutch	IE: Germanic	Netherlands	Booij 1997
Duuŋidjawu	Australian: PN	Australia	Kite and Wurm 2004
Dyirbal	Australian: PN	Australia	Dixon 1972
English	IE: Germanic	United Kingdom	Zwicky 1986
Estonian	Uralic: Finnic	Estonia	Mürk 1997
Finnish	Uralic: Finnic	Finland	Karlsson 1999
Gooniyandi	Australian: Bunaban	Australia	McGregor 1990
Haitian Creole	creole	Haiti	Hall 1953
Hungarian	Uralic: Finno-Ugric	Hungary	Rounds 2001
Italian	IE: Italic	Italy	Hall 1948
Jivaro	Jivaroan	Ecuador	de Maria 1918
Kaititj	Australian: PN	Australia	Koch 1980
Kashaya	Hokan: Northern	Northern California	Oswalt 1960
Kimatuumbi	NC: Atlantic-Congo	Tanzania	Odden 1996
Korean	isolate	Korea	Lee 1989
Kuku Yalanji	Australian: PN	Australia	Patz 2002
Kuuku Yaʔu	Australian: PN	Australia	Thompson 1976
Kwamera	Austronesian: MP	Vanuatu	Lindstrom and Lynch 1994
Latin	IE: Italic	Vatican State	Mester 1994
Mafa	AA: Chadic	Cameroon	Le Bleis and Barreteau 1987
Manchu	Altaic: Tungus	China	Li 1996
Maori	Austronesian: MP	New Zealand	Biggs 1961
Martuthunira	Australian: PN	Australia	Dench 1995

Midob	NS: Eastern Sudanic	Sudan	Werner 1993
Mixtepec Mixtec	Oto-Manguean: Mixtecan	Mexico	Paster and Beam de Azcona 2005
Miya	AA: Chadic	Nigeria	Schuh 1998
Moroccan Arabic	AA: Semitic	Morocco	Harrell 1962
Muruwari	Australian: PN	Australia	Oates 1988
Nancowry	Austro-Asiatic: Mon-Khmer	Nicobar Islands	Radhakrishnan 1981
Ngiyambaa	Australian: PN	Australia	Donaldson 1980
Nhanda	Australian: PN	Australia	Blevins 2001
Nishnaabemwin	Algic: Algonquian	Ontario	Valentine 2001
Northern Sotho	NC: Atlantic-Congo	South Africa	Kosch 1998
Nyangumarta	Australian: PN	Australia	Sharp 2004: 117
Qafar	AA: Cushitic	Ethiopia	Parker and Hayward 1985
Russian	IE: Slavic	Russia	Timberlake 2004
Saami	Uralic: Sami	Norway	Dolbey 1997
Sa’ani Arabic	AA: Semitic	Egypt	Watson 2002
Shipibo	Panoan: North-Central	Peru	Elías-Ulloa 2004
Spanish	IE: Italic	Spain	Kikuchi 2001
Tahitian	Austronesian: MP	French Polynesia	Tryon 1970
Turkana	NS: Eastern Sudanic	Kenya	Dimmendaal 1983
Turkish	Altaic: Turkic	Turkey	Lewis 1967
Tzeltal	Mayan: Cholan-Tzeltalan	Mexico	Slocum 1948
Wangkumara	Australian: PN	Australia	Breen 1976b
Warlpiri	Australian: PN	Australia	Nash 1986
Warluwara	Australian: PN	Australia	Breen 1976c
Warrgamay	Australian: PN	Australia	Dixon 1980
Winnebago	Siouan: Siouan Proper	Wisconsin	Lipkind 1945
Woleaian	Austronesian: MP	Micronesia	Sohn 1975
Yidiɲ	Australian: PN	Australia	Dixon 1977
Yindjibarndi	Australian: PN	Australia	Wordick 1982
Yingkarta	Australian: PN	Australia	Dench 1998
Zahao	Sino-Tibetan: Tibeto-Burman	Burma	Osburne 1975
Zuni	isolate	New Mexico	Newman 1965