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A Constraint-Based Approach to Morphology

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by

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ABSTRACT OF THE DISSERTATION

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This thesis proposes an output-oriented theory of morphology, in which morphological processes are encoded in constraints integrated with and interacting with the familiar Markedness and Faithfulness constraints of Optimality Theory. These constraints require forms with particular syntactic features to display particular phonological properties;

they do not form a separate morphological component or module, but represent direct interaction between the syntax and the phonology.

Encoding morphological processes in constraints, which compete and interact with each other and with Markedness and Faithfulness constraints, provides accounts for a number of complex and widely-attested phenomena. Where FIAT constraints are outranked by Markedness constraints, the presence of an affix may be dependent on phonological characteristics of the form; where they are outranked by Input-Output Faithfulness, individual lexical items may form exceptions to general morphological processes. Multiple processes marking the same syntactic characteristics are encoded in potentially incompatible and competing FIAT constraints. This, combined with the effect of Markedness and Output-Output Faithfulness, accounts for phonologically conditioned allomorph selection; combined with the effect of Input-Output Faithfulness constraints, it accounts for unpredictable, lexically determined allomorph selection, and for conjugation or declension classes with unpredictable membership. Since all these rankings may occur in a single grammar, the theory can account for complex systems in which multiple morphological markers, lexical idiosyncrasy, and phonological conditioning all play a role.

The surface-oriented nature of the approach allows FIAT grammars to be learned by uninsightful, inductive processes, even for complex systems riddled with exceptions and irregularities. FIAT constraints originate as inductive generalizations about the structures observable in forms with particular syntactic properties; descriptions of observed strings, which are in most cases true only of a few forms and contradicted elsewhere. Introducing these generalizations into the constraint set and finding a ranking that generates the correct results allows subtle and complex systems to be learned without the learner ever needing to directly apprehend their subtleties.

1. Introduction

These thesis proposes a theory of morphology, couched within the framework and terminology of Optimality Theory (Prince and Smolensky 1993), in which morphological processes are encoded in phonological constraints on the shapes of surface forms. It is primarily a theory of the phonological realization of syntactic properties, not of the nature of those syntactic properties themselves; its emphasis is on accounting for the influence of phonotactic restrictions and lexical exceptionality on the phonological realization of morphological processes. The central feature of the theory is that it is output-oriented; the morphological constraints are integrated with and interact with the familiar Markedness and Faithfulness constraints of Optimality Theory, and make direct demands on the phonological shapes of surface forms.

1.1. Why output-oriented morphology?

In most treatments of morphology in Optimality Theory, the phonological component of the grammar does not mediate directly between the syntax and the surface. The input to the phonology contains all the morphemes that the output will contain; the phonology is not, itself, responsible for turning a syntactic representation into a morphological structure; only for turning a morphological structure into a phonological object.

What is involved in turning a morphological object into a phonological one may be quite elaborate. Analyses of reduplication typically involve reduplicant morphemes almost entirely lacking in input phonological structure (e.g. McCarthy and Prince's (1995) RED), this structure being filled in at GEN and controlled by the constraint system. Generalized Alignment (McCarthy and Prince 1993b) attributes the location of affixes entirely to the constraint system, even where other aspects of their phonological structure may be specified in the input. In most work on morphology within the framework of Optimality Theory, however, the action of the constraint system is limited to the phonological particulars of collections of morphemes assembled before they become inputs; the constraints do not access syntactic information directly.

1.2. Previous work in output-oriented morphology

Several recent proposals, however, hold that morphology and phonology are handled in the same part of the grammar, by the same mechanisms. These proposals take the position that inputs may be syntactically complete while failing to be morphologically complete. The input for a plural noun, for example, may consist not of a root and a plural affix, but of a root bearing the syntactic features corresponding to plurality; affixation, or whatever marks the plural, is the result of constraints sensitive to the presence of those syntactic features, constraints that are intermingled with the markedness and faithfulness constraints. Such constraints have the schematic form $S \rightarrow P$, where S is a syntactic property and P is a phonological property.

The nature of the phonological property demanded varies with the proposal. In Yip (1995, 2000a), the phonological property is the presence of an "actual" morpheme, a chunk of phonological structure in correspondence with a lexically listed element. In Russell (1995, 1999, 2001) the phonological property is a string combining phonological structure and morphological boundaries. In Bat-El (2002) and Alderete (1999, 2001), the property is one of "antifaithfulness"—difference between an output and its base. Roughly speaking, the first approach would attribute English *-s* pluralization to a constraint demanding a correspondent of the plural morpheme /z/ at the end of a plural; the second to a constraint demanding that plurals end in [z]; the third to a constraint demanding that the singular and plural differ in the presence or absence of final [z]. (The actual proposals are, needless to say, a great deal more subtle and articulated than this.)

It would be reasonable to wonder if the impulse to move morphology into the constraint system is motivated by data that is not adequately analyzed otherwise, or simply by the desire to "do it with constraints." In fact, there are at least three solid motivations for moving morphology into the constraint system (aside from the simple desire to see how it would work): the common phenomenon of morphological haplology; phonologically conditioned allomorph selection; and experimental evidence for the psychological reality of morphological generalizations concerning the shapes of outputs, not the shapes of inputs or the mapping between input and output.

1.3. Morphological haplology

Morphological haplology, in the sense of Stemberger (1981), refers to the phenomenon of an otherwise regular process of affixation failing to apply when the input to the process happens accidentally to look as if the process has already applied.[1] A familiar example involves the homophonous possessive /s/ and plural /s/ of English; though

[1] The term "haplology" has other senses predating Stemberger's use; here, it is used only to refer to phenomena of the type described.

possessive /s/ attaches to singular nouns and to irregular plurals, in forms where both the plural /s/ and the possessive /s/ are expected, only one [s] or [z] usually appears:

(1)	a.	the dog's head		
	b.	the ox's head		
	c.	the dogs' heads	vs.	*the dogs's heads
	d.	*the oxen heads	vs.	the oxen's heads

The [s] or [z] never fails to appear when a preceding identical consonant belongs straightforwardly to the noun stem:

(2) the maze's entrance vs. *the maze' entrance

Similar phenomena are common in inflectional morphology; Stemberger provides numerous examples, as does de Lacy (1999).

There is an intuitive appeal to the notion that the absent affix is absent because it is needless; that the "goal" of the process is to ensure that a possessive noun ends in a [s]/[z] morphologically distinct from the stem, rather than to insert a segment per se, and when no insertion is necessary to accomplish this goal, the process need not have any overt reflex. The idea is that morphological processes can be vacuous, just as phonological processes can. An analysis of this sort is amenable, for obvious reasons, to encoding in the constraints of the phonological grammar.

But haplology as vacuous morphology is not the only possible analysis, and curiously, it is not an analysis that has been pursued to any great extent in Optimality

Theory, though Stemberger argues for it within a rule-based framework; Russell (1995, 1999) is a notable exception. Alternative analyses boil down, in one way or another, to haplology as a markedness avoidance strategy; haplology represents the deletion or coalescence of material, in violation of faithfulness or morphological constraints, for the sake of avoiding marked structures—most plausibly, structures violating antirepetition constraints. This picture of haplology is equally compatible with output-driven morphological processes and prephonological morphological concatenation. The fact that haplology usually involves the failure to add structure, and the fact that it usually involves the absence of an expected repeated string, makes it difficult in many cases to decide whether it is markedness-driven or vacuity-driven. Below, I discuss two proposals attributing haplology to markedness-avoidance.

1.4. Haplology as markedness avoidance

De Lacy (1999) argues, within a prephonological-concatenation model of morphology, that haplology is coalescence. Haplology, in this view, occurs when some markedness constraint outranks UNIFORMITY (McCarthy and Prince 1995), which bars correspondence between a single element in the output and multiple elements in the input. Coalescence is limited to identical or near-identical strings by the demands of IDENT constraints. The idea is illustrated in (3):

(3)

$b_1a_2d_3u_4p_5i_6+p_7i_8$	*STRUCTURE	UNIFORMITY
$b_1a_2d_3u_4p_5i_6p_7i_8$	**!**	
$b_1a_2d_3u_4p_{57}i_{68}$	**	**

Haplology is not, in this view, a matter of vacuity, but of avoiding marked structures. When two strings are phonologically identical or near-identical, their coalescence does not violate IDENT constraints, or violates them less seriously than coalescence of dissimilar material; coalescence will thus be available as a markedness avoidance strategy in certain grammars. A problematic aspect of such a picture is the difficulty of accounting for the absence of haplology for one affix in a language when another, homophonous affix does haplologize; and, similarly, of accounting for the failure of stem-internal repeated strings to coalesce in languages with haplology-permitting grammars. The first problem would conceivably be solvable through the use of affix-specific ALIGN constraints; the second would presumably require that UNIFORMITY be relativized to morphological categories like "stem" and "affix."

Yip's (1995, 2000a, 2000b) earlier analysis avoids these difficulties. In Yip's account, affixation is accomplished by morphological constraints demanding the presence of particular morphemes in outputs associated with particular syntactic features. Plural suffixation in English, for example, is accomplished by a constraint PLURAL: *s*. The input associated with a word like *dogs* contains no input morpheme or phonological structure associated with -*s*; rather, it is marked with the syntactic specification PLURAL. PLURAL: *s* demands that the morphophonological structure -*s* be present in the output whenever the syntactic specification PLURAL is present.

In itself, a morphological constraint of this sort can be vacuously satisfied. Haplology is not universal where it is possible because the presence of multiple morphological affiliations on a particular string violates a constraint MORPHDIS, "Distinct instances of morphemes have distinct contents, tokenwise" (McCarthy and Prince 1995); in cases of haplology, a generalized OCP constraint, violated by the repetition of identical strings, outranks MORPHDIS.

Here again, then, haplology is not truly "vacuous morphology"; it is always preferable to realize morphemes with independent material, and it is only when markedness outweighs this consideration that haplology occurs. While the existence of haplological processes is suggestive of some element of vacuous application in morphological processes, without clear examples of haplology that cannot be attributed to markedness it is not sufficient in itself to justify an output-oriented view of morphology. Nevertheless, it is one of several kinds of phenomena that lend themselves to an output-oriented approach, and suggest that such an approach is worth exploring.

1.5. Allomorph selection

The particular exponence of a morphological process often depends on purely phonological information about the resulting form. This shows up both in cases of phonologically conditioned allomorph selection and in cases of pure process morphology (morphology that involves doing something to a base, but cannot be reduced to the addition of structure to the base and subsequent phonological readjustment).

Phonologically conditioned allomorph selection occurs when (for example) an affix has different shapes, the shape used in a particular instance depends on the phonological properties of the base or the resulting form, and the differences between the allomorphs cannot be reduced to the general phonological processes of the language. Later in this thesis (2.7) I discuss a particular case of allomorph selection in Yidiɲ (Dixon 1977), in which a choice between three affixes is made in such a way as to avoid unfooted syllables and undesirable consonant clusters. McCarthy and Prince (1993a) discuss the two allomorphs of the ergative suffix of Dyirbal, whose distribution is likewise controlled by the conditions on prosodic and cluster properties of the resulting form. There is no shortage of examples; phonologically conditioned allomorph selection is a common phenomenon; see Alderete (2002) for a long list of such cases.

If morphological processes are the effect of constraints integrated with the usual markedness and faithfulness constraints, there is a straightforward way of accounting for allomorph selection that cannot be reduced entirely to phonology. The dependence of particular morphemes on particular phonological conditions can be encoded in the relative ranking of the morphological constraints with the purely phonological constraints; allomorph selection can take place entirely within the phonology.

1.6. The psychological reality of output morphological generalizations

Certain morphological processes appear to operate as generalizations about outputs, rather than generalizations about the mapping between base and output. Bybee and Moder (1983) and Bybee and Slobin (1982) note that speakers appear to make use of such generalizations as "past tense forms end in /æŋ/," "past tense forms end with alveolar stops," and "past tense forms end in /uw/," among others, though they do not argue that these output generalizations are used productively. Albright and Hayes (2003) find that English speakers inflecting novel forms will sometimes change the vowel [ɪ] to [o], (e.g. [dɹɪt]~[dɹot], [kɪv]~[kov]) even though no actual English word forms its past tense through an [ɪ] to [o] mutation; one interpretation is that this reflects an awareness on the part of speakers that having an [o] vowel is a possible marker of the past tense in English, independent of the particular nature of the vowel in the base.

The output constraints of Optimality Theory offer a mechanism by which generalizations that apply to outputs alone, not input-output mappings, may be encoded in the grammar. Indeed, an output-constraint based morphology would treat output generalizations as the fundamental basis of morphological processes, requiring extra mechanisms to account for cases in which the input-output mapping, not simply the output shape, plays a part in a morphological process. Constraint-based morphology offers an explanation for the psychological reality of product-oriented morphological generalizations, and for their occasional productivity, that puts both aspects of the phenomenon squarely within the grammar itself, and requires neither that the generative approach to phonology be abandoned, nor that extragrammatical explanations for the phenomena be devised.

1.7. Irregularity, exceptionality, and competition between patterns

If it is granted that these are sound motivations for exploring the possibility of moving morphology, or at least some types of morphology, into the constraint system, it is reasonable to ask what kinds of new explanation constraint morphology makes available for other kinds of morphological phenomena.

The study of morphology is littered with examples of lexical unpredictability; cases where the morphological rules, however they are formulated, are not sufficient to account for the data, and we must claim that there is something special about the lexical specification of certain forms that exempt them from the general pattern. Individual forms may be exceptions to morphological generalizations, as *went* is an exception to almost all morphological generalizations about the English past tense. Sets of forms may constitute patterned exceptions to a morphological generalization, or exceptional generalization: *slung* and *sung* and *stung* form a pattern in English, but membership in this pattern is an unpredictable quality of certain words. A morphological system may be portioned out into regular but incompatible patterns marking the same syntactic or semantic features, with the particular morphological territory to which an individual form belongs being an unpredictable, lexically specified property, as in the gender-marking system of Spanish nouns.

In this thesis, I attempt to account for this mix of predictability and unpredictability in morphology by making use of the violability of constraints. To the extent possible, all forms of morphological exceptionality are attributed to the ranking of input- or base-faithfulness constraints above morphological constraints. Constraint-based morphology allows morphological generalizations to be true in a language without always being true, to be active in the grammar without being inviolate. The existence of marginally productive patterns (like the exceptional English past tense processes) that are generally confined to specific lexical items but can, under certain circumstances, be extended to new forms is attributed to morphological constraints that are too low-ranked to have any effect in ordinary language use. Speakers gather and form morphological generalizations that are too weak to be of any ordinary use to the adult speaker, even in producing the forms that justified the generalization in the first place; only under special circumstances are the effects of the higher-ranked morphological or faithfulness constraints obviated, allowing the subterranean constraints to make themselves known. This conception of marginal patterns in morphology owes a great deal to Zuraw (2000), which proposes that lexical regularities that do not produce alternations are nevertheless encoded in the grammar in the same fashion as more overtly useful constraints, but are too low-ranked to make themselves visible under ordinary circumstances.

1.8. Structure of the thesis

Chapter 2 introduces the FIAT constraint family, the constraints responsible for encoding morphological generalizations and processes, and lays out the properties of the family as a whole and of the two subdivisions within the family, FIAT-MORPH and FIAT-STRUC. Chapter 3 explores the treatment of lexical exceptionality in FIAT morphology, covering two particular cases of systematic lexical exceptionality in detail and discussing in broad terms the conception of the lexicon that the theory requires. It argues that phonological representations encoded in lexical entries are the source of both patterned and unpatterned exceptionality. Chapter 4 discusses the motivations for the distinction between FIAT-MORPH and FIAT-STRUC, both in the productive grammar and as they relate to the acquisition of morphological patterns. In Chapter 5, the theoretical architecture established in the earlier chapters is used to analyze a number of complex phenomena in various dialects in Berber, introducing new concepts as they become necessary.

2. Morphological Operations as Constraints

2.1. Introduction

This chapter introduces what I will call the FIAT constraint family, which encodes morphological generalizations,. FIAT constraints are divided into two subclasses: FIAT-STRUC constraints, which demand particular phonological structures in outputs, and FIAT-MORPH constraints, which demand the presence of particular morphemes in outputs. The properties of both kinds of FIAT constraint are discussed in this chapter, and the manner in which FIAT constraints handle allomorphy, haplology, and morphologically conditioned differences between bases and outputs are explained. The motivations for the presence of two distinct kinds of FIAT constraint is not fully explored until Chapter 4.

2.2. Output Properties

Morphological generalizations are encoded in constraints of the FIAT family. A FIAT constraint follows the schema in (4):

(4) FIAT Schema:

SYN:PHON	An output with syntactic property SYN displays the phonological property PHON.

The nature of the syntactic properties to which FIAT constraints refer will not be addressed in any detail here. Placeholder constraints such as PLURAL and FEMININE are used, but do not represent a commitment to any particular theory of syntactic representation.

The phonological property demanded by a FIAT constraint may consist of any or all of the following:

(5) a. Morphological boundaries: left and right edges of stems, roots, etc. (For discussion of the theory of boundaries assumed here, see 2.12.)

b. Phonological structures: segments, autosegments, prosodic elements, features, links between elements, etc.

c. Morpheme indexes: references to particular morphemes with particular underlying representations.

FIAT constraints whose PHONs contain only phonological structures and morphological boundaries will be called FIAT-STRUC constraints; FIAT constraints whose PHONs contain only morpheme indexes and morphological boundaries will be called FIAT-MORPH constraints. The morphemes referenced by FIAT-MORPH constraints has underlying forms, while the material introduced by FIAT-STRUC constraints does not. Because of this, the two kinds of FIAT constraint differ a great deal with respect to their interactions with Faithfulness and Markedness, and this causes them to differ in the kinds of morphological phenomena for which each can be responsible. FIAT-STRUC constraints are discussed first, though properties shared by both kinds of FIAT constraint are discussed throughout all the following sections.

2.3. FIAT-STRUC

For FIAT-STRUC constraints, PHONs consist of phonological structures possibly intermingled with morphological boundaries. An example of a FIAT-STRUC constraint is given in (6): [2]

(6)	PAST: $]_{stem}$i	A form bearing the syntactic feature PAST contains the segment [i] following a stem boundary.

The ordering of segmental material with respect to boundaries is crucial; the notation is interpreted as follows:

(7)	a.	$]_{stem}X$	X follows a stem, but is not part of it
	b.	$X\ [_{stem}$	X precedes a stem, but is not part of it
	c.	$X\ ]_{stem}$	X is the last element of a stem
	d.	$[_{stem}X$	X is the first element of a stem

PHON is not limited to segmental strings; it may consist of any phonological structure available to GEN, including autosegments, prosodic structures, and combinations of segmental and prosodic structure. We will see examples of FIAT-STRUC constraints of this sort in the analysis of Berber verbal morphology in Chapter 5.

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[2] Contrary to usual practice, the names of FIAT constraints do not contain the constraint family name. This naming convention has been adopted to allow shorter constraint names, and because confusion with other constraint types seems unlikely.

2.4. FIAT-STRUC and exact matching

A FIAT-STRUC constraint is only satisfied if its PHON is matched exactly in an output; any deviation in the output from the PHON specification results in violation of the constraint, and violations do not vary in severity with the degree of deviation from the PHON. The phonological structure in a FIAT-STRUC constraint's PHON component has no underlying or input representation, and is never protected by Faithfulness constraints in its own right.

Consider the English gerund suffix *-ing*. A FIAT-STRUC constraint demanding this affix will specify the PHON $]_{stem}$ɪŋ. If this precise string is present in an output, the constraint is satisfied; if it is not present, the constraint is violated, as shown in (8):

(8)

		GERUND: *-ing*
(a)	[hæv] (*have*)	*
(b)	[hæv]ɪŋ (*having*)	√
(c)	[hæv]ɪn (*havin'*)	*
(d)	[sɪŋ] (*sing*)	*
(e)	[sɪŋ]ɪŋ (*singing*)	√
(f)	[sɪŋ]ɪn (*singin'*)	*

Assume that all forms in (8) carry the syntactic features corresponding to GERUND. Forms (b) and (e) contain the string]ɪŋ, and thus satisfy the constraint. Form (a) contains no part of the necessary string, while (c), (d) and (f) contain partial matches. But the constraint is satisfied only when the string is matched perfectly and in its entirety; (a), (c), (d), and (f) all violate the constraint, and all violate it equally. In a grammar in which a single FIAT-STRUC constraint with the PHON]ɪŋ is the only constraint performing gerund marking, *havin'* is no better a gerund than *have*.

Obviously, this constraint will not suffice in real life,; (8) is given as an illustration of the mechanics, not as a partial analysis of English. For discussion of the quantity and nature of FIAT-STRUC constraints that arise in the course of learning, see 4.6.

The morpheme *-ing*, in this sketch, has no independent existence in the lexicon; more importantly, it lacks any input. IO-Faithfulness is not violated if]ɪŋ is not exactly matched; only the FIAT-STRUC constraint is violated, and the violation is equal in severity whether the failure to match]ɪŋ is a matter of a single feature value or of complete omission of the string.

2.5. Consequences of exact matching: affixal strength and affixal brittleness

Because of the exact matching requirement, morphemes introduced by FIAT-STRUC constraints interact with Markedness constraints in a manner different from that of other material. Affixes introduced by FIAT-STRUC may exhibit unusual strength; that is, they may be immune to Markedness-driven alternations that affect other material. Such affixes may also exhibit unusual brittleness; that is, they may fail to appear altogether, or give way to alternative affixes, under the influence of phonotactics that generally cause only minimal deformation of a morpheme. This is in contrast with the material introduced by FIAT-MORPH constraints, which (as we will see in 2.9) can "bend" in response to higher-ranking Markedness constraints. The following subsections discuss these properties in detail.

2.5.1. Special immunity of FIAT-STRUC affixes to phonotactics: affixal strength

The notion of affixal strength is illustrated by a phenomenon in German, whereby a particular affix is immune to an otherwise general phonotactically-driven alternation.

The consonants [x] and [ç] are allophones in German, with [x] appearing after back vowels and [ç] appearing elsewhere. (Benua 1997, Kenstowicz 1994, Merchant 1996). The following examples come from Merchant:

(9) [x] after back vowels

a.	ach	[ʔax]	'oh!'
b.	Koch	[kɔx]	'cook'
c.	Buches	[buxəs]	'book-GEN'

(10) [ç] after nonback vowels

a.	ich	[ʔiç]	'I'
b.	Köche	[køçə]	'cooks'
c.	Bücher	[byːçʌ]	'books'

Note that this is not simply a lexical pattern, but an active process that causes allomorphy, as shown by the alternations between the (b) and (c) examples. The pattern can be captured with three constraints:

(11)	*[+back]ç	A back vowel followed by [ç] is forbidden.
(12)	IDENT[back]-V	Vowels in correspondence have the same value for [back]
(13)	IDENT[back]-C	Consonants in correspondence have the same value for [back]

(14) Ranking:

{*[+back]ç, IDENT[back]-V}
|
IDENT[back]-C

(15)

/koç/	*[+back]ç	IDENT[back]-V	IDENT[back]-C
a. koç	*!		
☞ b. kox			*
c. keç		*!	

/koç/ is a Richness of the Base input, demonstrating that the given ranking will produce the correct pattern even if it is violated in underlying forms.

The diminutive suffix *-chen* [çən], however, maintains its initial [ç] under all circumstances. Compare the minimal and near-minimal pairs in (16) and (17):

(16) Frau-chen [fraʊçən] 'little woman'
Tau-chen [taʊçən] 'little rope'
Kuh-chen [kuːçən] 'little cow'

(17) rauch-en [raʊxən] 'smoke-INFINITIVE'
tauch-en [taʊxən] 'dive-INFINITIVE'
Kuch-en [kuːxən] 'cake'

In general, the cost of allowing /ç/ and [x] to be in correspondence (i.e. the IDENT violation) must be less than the cost of allowing [ç] to follow a back vowel, and less too than the IDENT cost of allowing an input back vowel to correspond with an output nonback vowel. We know this because /ç/ surfaces as [x] after a back vowel rather than remaining intact, and the vowel quality does not change to permit /ç/ to surface intact. But this general pattern does not hold true for *-chen*, though if the motivation for the general change is a prohibition on the sequence *[+back]ç, the affix presumably results in phonotactically undesirable sequences.

If the resistant affix is the product of a FIAT-STRUC constraint specifying the PHON]çən, the difference in behavior can find an explanation in a difference in ranking between that FIAT-STRUC constraint and the IDENT constraint that protects other instances of /ç/. Assume that the FIAT-STRUC constraint producing the affix is that in (18):

(18) DIM: $]_{\text{ROOT}}$çən, A diminutive contains a root boundary followed by [çən].

This FIAT-STRUC constraint must be ranked above *[+back]ç. As we see in (19), the winning candidate will be [fraʊçən]; [fraʊxən] would no more satisfy the FIAT-STRUC constraint than would [fraʊ], and since it is more important to obey the FIAT-STRUC constraint than to avoid the undesirable sequence of segments, the violation of *[+back]ç is tolerated. The [ç] in *-chen* is immune to the general process because the violation of low-ranked correspondence constraints is not available as a solution to the phonotactic problem it poses.

(19)

fraʊ, DIM	DIM: $]_{\text{ROOT}}$çən	*[+back]ç	IDENT[back]-V	IDENT[back]-C
☞ a. fraʊçən		*		
b. fraʊxən	*!			*
b. fraʊ	*!			

We will return to the subject of *-chen* later, in 2.10; for now, it simply serves as an example of the affixal strength resulting from the exact matching requirement. Another familiar example of affixal strength is the ability of the English past tense suffix *-ed* to form final stop-stop clusters not permitted in nonaffixal contexts; *rubbed* [ɹʌbd] and *dragged* [dɹægd] are possible past-tense forms, but tautomorphemic final [bd] and [gd] clusters do not occur.

2.5.2. Supervulnerability of FIAT-STRUC affixes to phonotactics: affixal brittleness

Affixal strength arises when a Markedness constraint that would ordinarily drive some alteration to the string is outranked by the FIAT-STRUC constraint demanding the affix. But a FIAT-STRUC constraint may also be ranked below a particular Markedness constraint while a relevant Faithfulness constraint is ranked above the Markedness constraint; in such a case, the affix will display brittleness, an inability to accommodate itself to the phonotactic gracefully: phonotactic problems that are minimally repaired when they involve nonaffixal material will result in the complete omission of an affix, even when exactly the same structures are involved.

Ayt Ndhir Tamazight (Penchoen 1973, Saib 1976a) has an affix/zero alternation explainable in this fashion. Masculine singular nouns generally begin with the prefix /a-/, as shown:

(20)	a-rjaz	'man'	
	a-sərðun	'mule'	
	a-xam	'tent'	
	a-fus	'hand'	(Penchoen, p. 13)

When the noun stem itself begins with a vowel, however, the prefix does not occur:

(21)	iləs	'tongue'	
	imənði	'grain'	
	uʃʃən	'jackal'	(Penchoen, p. 13)

The prefixal vowel is omitted in the Construct State form of the noun, allowing us to see which vowels are prefixal and which are stem-internal:

(22)	u-rjaz	'man'	
	j-iləs	'tongue'	
	w-uʃʃən	'jackal'	(Penchoen, p. 20)

The omission is presumably motivated by Ayt Ndhir Tamazight's general ban on vowel hiatus. What is significant is that deletion of /a/ is not, in general, the language's preferred method of resolving illegal a-V sequences. Elsewhere, hiatus is resolved by [j]-epenthesis in the case of a-u clusters, glide-formation in the case of a-i clusters:

(23)	/bla/ 'without' + /uði/ 'butter'	-->	[βl**aju**ði]	'without butter'
	/bla/ 'without' + /isrðan/ 'mules'	-->	[βl**aj**sərðæn]	'without mules'
			(Penchoen, p. 20)	

This is not a possibility with the Construct State prefix; the forms in (21) cannot appear with the shapes given in (24):

(24)	*ajiləs	'tongue'
	*ajimənði	'grain'
	*ajuʃʃən	'jackal'

(The data will be simplified to a degree for the sake of the example, as follows. In non-prefixal hiatus, a number of strategies are available to resolve the problem. In the tableaux below, I ignore the complex conditioning that produces epenthesis in cases like [βlajuði], as opposed to deletion or glide formation in other cases; what is crucial is not the details of hiatus resolution in nonprefixal cases, but the fact that no strategy but affix-omission is available in the prefixal cases.)

Epenthesis is banned by DEP:[j], vowel deletion by MAX:V, and hiatus by *VV. Since [j]-epenthesis, rather than V-deletion, is used to avoid hiatus, the ranking must be *VV >> MAX:V >> DEP:[j]. In /bla+uði/, [j] will be inserted:

(25)

/bla+uði/	*VV	MAX:V	DEP:[j]
βlauði	*!		
βluði		*!	
☞ βlajuði			*

The FIAT-STRUC constraint demanding [a] is MASC SING: a[, satisfied when the output contains [a] immediately before the left stem boundary. This constraint is ranked below the other three. No repair strategy is available in this case; it is better to omit the affix entirely than to have to insert [j] or delete a vowel[3]:

[3] Clearly, this analysis is homologous to one in which affixes and stems are protected by different faithfulness constraints, with the general or affixal MAX ranked below the stem-specific MAX. The intent here is not to argue that the FIAT-STRUC analysis is, in this case, superior to the alternatives, but rather to

(26)

/ils/ MASC SING	*VV	MAX:V	DEP:[j]	MASC SING: a[
ailəs	*!			
☞ ils				*
als		*!		
ajiləs			*!	

2.5.3. Gratuitous omission; the "all-or-nothing" property

In the Tamazight case, the fact that the affix is a single segment obscures a particular property of the analysis: unlike phonotactically-motivated violations of faithfulness to input material, which are always minimal in OT, the violence done to FIAT-STRUC affixes by the phonotactics is always maximal. While only a portion of some affix may incur a violation, the entire affix must be omitted; it is impossible to repair only the particular structure or element that incurs the violation.

Imagine, for example, a language in which word-final obstruents are generally devoiced. Presumably this would involve the ranking of $*[+voice]]_{word}$ (or some equivalent) above IDENT: [voice]:

(27)

/ritib/	$*[+voice]]_{word}$	IDENT: [voice]
ritib	*!	
☞ ritip		*

---

illustrate one particular prediction made by the theory; indeed, such differential Faithfulness constraints will be needed when FIAT-MORPH constraints are introduced later in the chapter.

The language has a FIAT-STRUC constraint PLURAL:]ab causing ab-suffixation. Since this affix has no input, IDENT is irrelevant to it. If the constraint is ranked above *[+voice]#, then an affixal word-final [b] will be immune to devoicing, even though nonaffixal [b] is not:

(28)

/kitik/, PLURAL	PLURAL:]ab	$*[+voice]]_{word}$
☞ kitik]ab		*
kitik]ap	*!	
kitik	*!	

If the FIAT-STRUC constraint is ranked below $*[+voice]]_{word}$, on the other hand, it will simply fail to appear when its presence would violate the phonotactic. Obviously, a morpheme that could appear only word-finally, but was always forbidden from occurring in that position, would never occur on the surface, and could not outlast a generation; the situation would only be visible if, for example, another affix was capable of following -ab. We add to the imaginary grammar a constraint POSS: $e]_{word}$, demanding that possessives contain a word-final [e]. The plural morpheme will fail to appear when [e] is absent, but show up when [e] intervenes between the plural morpheme and the end of the word:

(29)

/kitik/, PLURAL	POSS: $e]_{word}$	$*[+voice]]_{word}$	PLURAL: +ab	*STRUC
kitik+ab		*!		**
kitik+ap			*	*!*
☞ kitik			*	

(Violations of *STRUC shared by all candidates are unrepresented.)

(30)

/kitik/, PLURAL, POSS	POSS: $e]_{word}$	*[+voice]#	PLURAL: +ab
☞ kitik+ab+e			
kitik+e			*!
kitik+ap	*!		
kitik+ap+e			*!

While I am not presently aware of any examples of this phenomenon involving polysegmental affixes in real languages, this same property is responsible for phonotactically-motivated allomorph selection, in which the unsatisfiability of some FIAT-STRUC constraint allows lower-ranked FIAT-STRUC constraints conflicting with the first and triggered by the same syntactic properties to come to the fore; we will see this in section 2.7.

2.6. Allomorphy and FIAT-STRUC

An affix that is produced entirely by the action of FIAT-STRUC constraints may display allomorphy, despite the exact matching requirement. Allomorphy can arise either through underspecification of elements in the PHON, or through the action of multiple FIAT-STRUC constraints.

Underspecification allomorphy is straightforward. Consider the constraint below, in which S stands for a sibilant fricative unspecified for voice:

(31) PLURAL: $]_{stem}$S — A plural form contains a stem boundary followed by a sibilant fricative.

What is mentioned in the PHON must be matched exactly, but what is not mentioned is irrelevant to the constraint. Markedness considerations, such as a ban on clusters of consonants with unlike voicing, may require that the suffix take different shapes in different outputs, but as long as the suffix remains a sibilant, all shapes will satisfy the FIAT-STRUC constraint:

(32) a. bib]z

b. pip]s

c. cic]ʃ

Allomorphy may also arise through the action of multiple FIAT-STRUC constraints. Nothing prevents multiple FIAT-STRUC constraints from having the same syntactic trigger. If two constraints have the same SYN and are not simultaneously satisfiable (for example, if one demands a word-final [d] and the other demands a word-final [t]), then, all else being equal, the form will display the marker demanded by the higher-ranked FIAT-STRUC constraint.

The interesting cases are those in which all else is not equal, and Markedness or Faithfulness select between multiple possible exponents of a syntactic property. In this section I am concerned with Markedness-conditioned allomorphy.

2.6.1. Default and alternative allomorphy

Given two FIAT-STRUC constraints that have identical or overlapping SYNs and cannot be simultaneously satisfied (e.g. PLURAL: ʔ]$_{\text{word}}$ and PLURAL: t]$_{\text{word}}$, or MASCULINE, PLURAL: ʔ]$_{\text{word}}$ and PLURAL: t]$_{\text{word}}$), the higher-ranked FIAT-STRUC constraint will ordinarily be satisfied if faithfulness to the derived-form input (see Chapter 3) does not interfere.

If, however, there is some higher-ranked markedness constraint which is capable in a particular form of conflicting with FIAT-STRUC-1 but not with FIAT-STRUC-2, then (provided no other solution is permitted by the grammar) the lower-ranked FIAT-STRUC will assert itself in those cases of conflict. Given the constraints of the previous paragraph, and a markedness constraint *ʔ…ʔ banning two glottal stops in the same syllable, the plural suffix will appear as [ʔ] in the general case, but as [t] when the last syllable of the root contains a glottal stop:

(33)

Base: toto, PLURAL	*ʔ…ʔ	PLURAL: ʔ]$_{word}$	PLURAL: t]$_{word}$
☞ totoʔ			*
toto		*!	*
totot		*!	

(34)

Base: toʔo, PLURAL	*ʔ…ʔ	PLURAL: ʔ]$_{word}$	PLURAL: t]$_{word}$
toʔoʔ	*!		*
toʔo		*	*!
☞ toʔot		*	

This sort of phonologically conditioned allomorphy will be called "default and alternative" allomorphy, since one allomorph is preferred by the ranking and another used only when the first is unavailable. Note, however, that the "default" or preferred allomorph does not necessarily correspond in any intuitive way to the "elsewhere" allomorph, the most frequently occurring allomorph, or the allomorph with the widest distribution. If the default allomorph conflicts with a number of higher-ranked Markedness constraints, or one Markedness constraint that frequently comes into play, its occurrence might easily be restricted to a narrow range of forms; conversely, if the preferred allomorph conflicts with higher-ranked Markedness in only in a few forms or a narrow range of situations, it may have a wide and general distribution, with the alternative allomorph showing up in only a restricted set of cases.

Note that the phenomena handled by default and alternative allomorphy are in no way rare or exotic. Examples include the stem vowel-conditioned allomorph selection of the Korean nominal suffix, with [ka] after vowel-final stems and [i] after consonant-final stems (Cho 2002), and the stem consonant-conditioned allomorph selection of the Turkish passive morpheme, which occurs as [n] after vowels, [In] after [l], and [Il] after all other consonants[4] (Lewis 1953, Spencer 1991). The Korean case presumably involves a FIAT constraint NOMINAL:]i outranking a FIAT constraint NOMINAL:]ka, with constraints against hiatus and stem-vowel deletion outranking both. The somewhat more complex Turkish case involves PASSIVE:]Il,outranking PASSIVE:]In, which in turn outranks PASSIVE:]n, with all three FIAT constraints outranked by bans on hiatus and on lVl syllables. Before, I give a full analysis of a more elaborate example from Yidiɲ.

2.7. Multiple-FIAT-STRUC allomorphy in action: the Yidiɲ locative

The locative suffix in Yidiɲ (Dixon 1977) has three allomorphs:

[4] [I] represents a high vowel whose backness and rounding are determined by vowel harmony.

(35) a. -la after an odd-syllabled stem ending in a vowel

b. -ː (lengthening of stem vowel) after an even-syllabled stem ending in a vowel

c. -da[5] after a stem ending in a consonant

(36)	Root	Locative	Gloss
a.	gabaɖu	gabaɖu**l a**	'white clay'
b.	buɽi	buɽi**ː**	'fire'
c.	mujgal	mujgaːl**d a**	'hole, trap' (Dixon 1977, pp. 128-129)
d.	baɖiːgal	baɖigal**d a**	'tortoise' (Dixon 1977, p. 57)

The part of this pattern exemplified in (36)a-b echoes two general phenomena of the language, but is not reducible to them. A general pressure exists against words with odd numbers of syllables, which leads to the reduction of affixes, and some bare roots, to produce an even syllable count. Dixon proposes a rule deleting a final open syllable when it is preceded by a consonant that follows a morpheme boundary. Another process lengthens the penultimate vowel in an odd-syllabled word, and the final syllable of words shortened by the affix deletion rule; this is responsible for the vowel length alternation observable in (36)c.

The [-la]/[-ː] allomorphy, clearly, closely matches this general pattern. The general rule, however, would delete only [a], not [l], since the preceding consonant does not follow a morpheme boundary; the general pattern predicts *[buɽiːl], not [buɽiː]. The deletion of [l]

[5] The [d] in -da assimilates to a preceding nasal or glide. These assimilations appear to be consistent with underspecification of the affix, and thus not to require multiple FIAT-STRUC constraints. For simplicity of exposition, I confine myself above to examples lacking such assimilations; see Dixon (1977), section 3.3.2 for discussion of these phenomena and examples of the assimilation.

would require an additional rule specific to the locative. The [da] allomorph is not explainable in terms of any more general pattern.

These deviations suggest that despite the resemblance to the general pattern, this is a case of phonologically-conditioned allomorph selection, rather than a set of purely phonological alternations. (The general pattern itself should probably be considered a case of allomorph selection rather than phonological deletion; the locative pattern is part of a halo of special cases and exceptions surrounding the core process, which collectively suggest that a formerly phonological alternation has been reanalyzed as a phonologically-conditioned set of distinct morphological processes. See Hayes (1997) for a discussion of these issues.)

The pressure for even-syllabled words is commonly taken to be the result of requirements that every syllable belong to a foot, and that every foot be binary. In a full analysis, this would involve multiple constraints; since we are concerned here only with the overall even-syllable-requirement effect of these constraints, rather than the details of their operation, I will collapse this portion of the grammar into the placeholder constraint FOOT. (For an overview of the manner in which prosodic structure is handled in detailed OT analyses, see for example Kager (1999) or Chapter 2 of Archangeli and Langendoen (1977).)

(37) FOOT — Every syllable belongs to a binary foot. (Every word has an even number of syllables.)

One additional Markedness constraint is employed, (41):

(38) *VdV — Intervocalic [d] is prohibited

*VdV embodies a kind of morphologized lenition of [d] to [l]. This constraint does not go unviolated in the language (e.g. *gudaga*, 'dog'); its role in allomorph selection is thus a kind of "Emergence of the Unmarked" effect.

The three locative markers are the reflexes of three distinct FIAT-STRUC constraints triggered by the same syntactic property:

(39) LOC: la] A locative verb ends with [la]

(40) LOC: da] A locative verb ends with [da]

(41) LOC: Vː] A locative verb ends with a long vowel.

The ranking is as follows:

(42) *VdV >> LOC: da] >> FOOT >> LOC: la], LOC: Vː]

The *da* allomorph is preferred, but impossible after a vowel because it would lead to a violation of higher-ranked *VdV. If *da* is impossible, *la* is the preferred allomorph; but if this is impossible because it would violate higher-ranked FOOT (i.e. the root has an even number of syllables), vowel lengthening is the alternative allomorph. These cases are illustrated by the tableaux below:

(43)

a.

gabaɖu	*VdV	-da]	FOOT	-la]	V:]
☞ gabaɖula		*			*
gabaɖuː		*	* !	*	
gabaɖuda	* !			*	*
gabaːɖu		*	* !	*	*

b.

buɽi	*VdV	-da]	FOOT	-la]	V:]
buɽila		*	* !		*
☞ buɽiː		*		*	
buɽiːda	* !		*	*	*
buɽi		*		*	* !

c.

mujgal	*VdV	-da]	FOOT	-la]	V:]
mujgaːlla		* !	*		*
mujgaːl		* !		*	*
☞ mujgaːlda			*	*	*
mujgal		* !		*	*

d.

maŋgumbar	*VdV	-da]	FOOT	-la]	V:]
maŋgumbarla		* !			*
maŋgumbaːr		* !	*	*	*
☞ maŋgumbaːrda				*	*
maŋgumbar		* !	*	*	*

A two-step default and alternative allomorphy is at work here. The *da* allomorph is preferred, except where it would violate *VdV; in tableaux (c) and (d), the other FIAT-STRUC constraints, and FOOT, play no role. Where it is impossible, *la* is used, unless this would violate FOOT, which outranks the FIAT-STRUC for *la*. Where it would violate FOOT, the final alternative, low-ranked LOC: V:], can assert itself.

Specific ranking arguments are as follows. Tableau (d) shows that LOC:da] must outrank LOC:la] and LOC: V:] because locative /maŋgumbar/ surfaces as [maŋgumbaːrda] rather than [maŋgumbarla] or [maŋgumbaːr]. FOOT must outrank both LOC V:] and LOC:la] because [gabaɖula] defeats [gabaɖuː] and [buɽiː] defeats [buɽila], as seen in (a) and (b); otherwise, either ranking between V:] and LOC:la] would produce incorrect results in one case or the other:

(44) a.

buɽi	*VdV	-da]	-la]	V:]
●buɽila		*		*
buɽiː		*	*!	

b.

gabaɖu	*VdV	-da]	-la]	V:]
☞ gabaɖula		*		*
gabaɖuː		*	*!	

(45) a.

buɽi	*VdV	-da]	V:]	-la]
buɽila		*	*!	
☞ buɽiː		*		*

b.

gabaɖu	*VdV	-da]	V:]	-la]
gabaɖula		*	*!	
●gabaɖuː		*		*

*VdV must outrank LOC:da] because [gabaɖula] defeats [gabaɖuda]:

(46)

gabaɖu	*VdV	-da]	FOOT	-la]	V:]
☞ gabaɖula		*			*
gabaɖuda	*!			*	*

Finally, LOC:da] must outrank FOOT because [mujgaːlda] defeats [mujgal]:

(47)

mujgal	*VdV	-da]	FOOT	-la]	V:]
☞ mujgaːlda			*	*	*
mujgal		*!		*	*

2.8. Interim summary

In the preceding sections, we explored the workings of FIAT-STRUC constraints, specifically the phenomena that result from the requirement that the phonological material included in the PHON of such a constraint be matched exactly. These are: that affixes produced by FIAT-STRUC constraints may resist processes to which other segmentally identical strings are vulnerable (as, for example, the English past tense suffix [d] resists the general prohibition against final stop clusters in forms like *rubbed* [ɹʌbd] and *dragged* [dɹægd]), and that they may fail to appear or give way to other affixes entirely under the influence of phonotactics that generally cause only the minimal alterations necessary to satisfy Markedness (as in cases of phonologically determined allomorph selection).

We turn now to FIAT-MORPH constraints, whose PHONs specify morpheme indexes rather than particular segmental strings, and which in consequence produce affixes that interact with Markedness in much the same way as do nonaffixal elements.

2.9. FIAT-MORPH constraints

The PHON of a FIAT-MORPH constraint contains morpheme indexes rather than phonological structures. Compare (48) to the FIAT-STRUC constraint given in (6) and repeated in (49):

(48) PAST: $]_{stem}$/i/ — A form bearing the syntactic feature PAST contains some correspondent of the morpheme /i/ following a stem boundary.

(49) PAST: $]_{stem}$i — A form bearing the syntactic feature PAST contains the segment [i] following a stem boundary.

It is important to note that /i/ in the constraint above is simply a mnemonic device; it stands for "Material in correspondence with the morpheme X", where X is a morpheme with the UR /i/. It could as easily be represented as

(50) PAST: $]_{stem}$<morpheme 3546>

where morpheme 3546 in the lexicon has the UR /i/.

(49) is satisfied only if [i], and not [e] or [u] or some other segment, appears following a stem boundary. (48), on the other hand, is satisfied by any segment, so long as that segment is in correspondence with the morpheme /i/. Whether that correspondent is featurally or segmentally identical to the input /i/ is determined by the usual interactions of

Markedness and Faithfulness, not the FIAT-MORPH constraint itself. The table in (51) illustrates what kinds of structures satisfy the FIAT-MORPH constraint and what kinds do not; what is crucial is the presence of an element in the proper place in correspondence with some element of the morpheme indicated in the constraint's PHON, not the particular phonological nature of that correspondent element.

(51)

	$/p_1a_2p_3/$ $/i_4/$	PAST:]/i/
(a)	$p_1a_2p_3]i_4$	√
(b)	$p_1a_2p_3]u_4$	√
(c)	$p_1a_2p_3]i$	*
(d)	$p_1a_2p_3]u$	*
(e)	$p_1a_2p_3]$	*

Form (a) straightforwardly satisfies the constraint; there is an [i] in the necessary place, coindexed with (and fully faithful to) the /i/ morpheme demanded by PAST:]/i/. Form (b) likewise satisfies the constraint, since a segment in correspondence with /i/ appears in the necessary location. Although this [u] is featurally unfaithful to /i/ (having become round, let us imagine, under the influence of the preceding [p]; the example imitates a similar process in Tulu (Bright 1972)), and would therefore violate one or more Faithfulness constraints, this featural faithfulness is irrelevant to the FIAT-MORPH constraint. Forms (c) and (d) both violate the constraint, even though they are segmentally identical to (a) and (b), which satisfy it, since the post-stem vowels are not in correspondence with /i/. Form (e) straightforwardly violates the constraint; there is no suffix of any sort in the necessary spot.

Compare to the structures satisfying the FIAT-STRUC constraint PAST: $]_{stem}$i, which is indifferent to correspondence and cares only for phonological content:

(52)

	$/p_1a_2p_3/$	PAST:]i
(a)	$p_1a_2p_3]i_4$	√
(b)	$p_1a_2p_3]u_4$	*
(c)	$p_1a_2p_3]i$	√
(d)	$p_1a_2p_3]u$	*
(e)	$p_1a_2p_3]$	*

The FIAT-STRUC constraint cares only that the specified phonological structure occurs in the proper place. Both (a) and (c) satisfy the constraint, the index being irrelevant; (b), (d), and (e) do not, since the required vowel is not present.

Note, in (51), the lack of any candidate like $p_1a_2p_3]Ø_4$, with a null element or trace carrying the index corresponding to the /i/ morpheme. Indexed null elements and traces are absent from this theory; thus complete omission of a morpheme is different from any other deviation of the output morpheme from its input, however severe. An output from which every segment but one has been deleted from a morpheme will satisfy the FIAT-MORPH constraint responsible for the morpheme, but will violate MAX for every segment deleted; another output differing only in that the last remaining segment of the morpheme has been deleted will violate FIAT-MORPH, but will violate MAX not at all.

2.10. The inability of FIAT-MORPH affixes to produce phonologically deviant structures

Since the exact details of the material produced by a FIAT-MORPH constraint are subject to the same interactions of Faithfulness and Markedness that affect non-FIAT material, FIAT-MORPH affixes cannot exhibit exceptional strength in their own right, the way FIAT-STRUC affixes do. This can be seen by looking again at the German *-chen* suffix.

Recall from 2.5.1 that the invulnerability of *-chen* to the general [ç]/[x] alternation was the result of ranking DIM: $]_{ROOT}$çən above *[+back]ç; since changing [ç] to [x] would prevent satisfaction of DIM: $]_{ROOT}$çən, the phonotactic violation had to be tolerated. The relevant tableau is repeated below:

(53)

fraʊ, DIM	DIM: $]_{ROOT}$çən	*[+back]ç	IDENT[back]-V	IDENT[back]-C
☞ a. fraʊçən		*		
b. fraʊxən	*!			*
c. fraʊ	*!			

But if it is a FIAT-MORPH constraint rather than a FIAT-STRUC constraint that is responsible for the suffix, no ranking will provide the necessary strength. Since the general ranking of Faithfulness and Markedness makes [ç]→[x] an acceptable input-output mapping, DIM: $]_{ROOT}$/çən/ is still satisfied even if the initial segment of the suffix surfaces as [x], as long as that [x] is in correspondence with the initial C of the input suffix:

(54)

fraʊ, DIM	DIM: $]_{ROOT}$/$ç_1$ən/	*[+back]ç	IDENT[back]-V	IDENT[back]-C
a. fraʊ$ç_1$ən		*!		
☞ b. fraʊx_1ən				*

Ranking the FIAT-MORPH constraint below the Faithfulness constraints protecting the morpheme's identity will not help. A ranking such as (55) will not work for German; it does serve, however, to illustrate the fact that affixal brittleness is still a possible characteristic of FIAT-MORPH affixes, even if affixal strength is not.

(55)

fraʊ, DIM	*[+back]ç	IDENT[back]-V	IDENT[back]-C	DIM: $]_{ROOT}$/$ç_1$ən/
a. fraʊ$ç_1$ən	*!			
b. fraʊx_1ən			*!	
☞c. fraʊ				*

If a FIAT-MORPH constraint is ranked below a particular Markedness constraint, and also ranked below the Faithfulness constraints that would have to be violated to repair the violation of the Markedness constraint, complete omission of the affix will result. FIAT-MORPH affixes cannot be less vulnerable to Markedness-driven alteration than other material, since they are protected by the same Faithfulness constraints; they can, however, be more vulnerable than other material, in the same "all or nothing" fashion as FIAT-STRUC affixes, since complete omission of the affix violates only the FIAT-MORPH constraint, not Faithfulness, and will be preferred when the Faithfulness constraints at issue outrank the FIAT-MORPH constraint, as in (55).

2.11. Nonhaplological morphology and morpheme boundaries

Because FIAT constraints as conceived so far are concerned only with outputs, they are easily able to handle cases of morphological haplology. The manner in which they deal with non-haplological morphology is less obvious. In some cases, the presence of morphological boundaries in the constraints' PHONs is sufficient to explain the failure of an affix to haplologize with adjacent identical material; this section addresses such cases.

Consider two problems raised by the English past tense suffix *-s*, variously realized as [s], [z], and [əz]. Let us assume for the moment that it is the product of a single FIAT-MORPH constraint, given in (56):

(56) PLURAL:]/z/ A plural noun contains a stem boundary followed by material in correspondence with /z/.

The first question is this: the actual plural of *breeze* [bɹiz] is *breezes* [bɹizəz]. Why is it not *[bɹiz]? The shorter form is, at least phonologically, indistinguishable from a form satisfying the PLURAL constraint; it is, in fact, homophonous with the correct plural for the word *brie* [bɹi], *bries* [bɹiz]. And [bɹiz], it would seem, cannot be less faithful to the base than [bɹizəz], since [bɹiz] is identical to the base while [bɹizəz] is not; in addition, [bɹiz] has less phonological structure, and thus violates *STRUC less severely.

One answer is made available by the specification of morphological boundaries in FIAT-STRUC constraints; PLURAL demands not just a final sibilant, but a stem boundary preceding that sibilant. The form [briz] does not actually satisfy PLURAL; only [bɹi]z] does. But this by itself is not enough; if [bɹi]z] satisfies PLURAL, what makes it inferior to [bɹizə]z], which also satisfies PLURAL but contains additional structure?

It seems plausible that what dooms [bɹi]z] is that it contains a stem boundary in a location different from the stem boundary's site in the base, [briz]; but what, exactly, makes this difference significant; what constraint or constraints forbid the relocation?

To solve this, we need to be very explicit about the nature of morphological boundaries and how they arise. This is discussed in the next section.

2.12. Morphological boundary convention

The morphological constraints proposed here make crucial reference to morphological boundary symbols such as $]_{root}$ and $]_{stem}$ and $]_{word}$. Clearly it would not be appropriate to think of these boundary symbols as somehow analogous to segments, deletable or insertable or relocatable subject to the direct demands of the constraint system. The relocation of the stem boundary between [briz+] and [bri+z] is not a matter of violating MAX:$]_{root}$ and DEP:$]_{root}$ or LINEARITY or the like. Instead, a morphological boundary is a property of a form arising from the morphological affiliations of the segments within that form; and while the boundaries arising from those morphological affiliations are not subject to direct manipulation by the constraint system, the morphological affiliations themselves are.

The presence or absence of a morphological boundary is determined as follows. Any segment may or may not have one or more morphological affiliations (see below). Morphological boundaries are assigned based on those affliations according to the following convention:

(57) **Morphological boundary convention**

In $[\ldots AX]_{word}$, $[XA \ldots]_{word}$, X a string and A a segment, a morphological boundary of affiliation μ occurs between segment A and string X if and only if A has morphological affiliation μ and X contains no segment with morphological affiliation μ.

Consider [bɹi]z] again, keeping in mind that the base is [bɹiz]. The table in (58) shows three possible configurations of the output that are identical in phonological structure to each other and to the base, but differ in morphological affiliation.

(58)

$b_\mu ɹ_\mu i_\mu z_\mu$	MAX:C	PLURAL:]S
a. $[b_\mu ɹ_\mu i_\mu]z$	*	
b. $[b_\mu ɹ_\mu i_\mu z_\mu]$		*
c. $[b_\mu ɹ_\mu i_\mu]z_\mu$		

It is possible that [bɹi] is in correspondence with the base and [z] is not, as in (a). If so, however, then $[b_\mu ɹ_\mu i_\mu]z$ differs from the input $/b_\mu ɹ_\mu i_\mu z_\mu/$in that a base [z] has no correspondent in the output; there is a [z], but it is not in correspondence with the base $[z_\mu]$. MAX:C is therefore violated. It is possible that a candidate is morphologically identical to the base, as in (b); if so, however, it does not satisfy the FIAT constraint, since there is no boundary before the consonant.

It is not possible that both [bɹi] and [z] are affiliated with the base, but have a morphological boundary between them, allowing satisfaction of both MAX:C and PLURAL:]/z/, as in $[b_\mu ɹ_\mu i_\mu]z_\mu$. Because all the segments have the same morphological affiliation, [i] and [z] do not meet the conditions of the morphological boundary convention (57): there cannot be a boundary. This impossibility is indicated by the diagonal lines through the impossible candidate's cells.

Note that this convention means that one morpheme may entirely contain another, and two or more morphemes may overlap. FIAT constraints that make demands on material already present in the input, such as those introduced in 2.13, can lead to overlapping affiliations like those below.

(59)	a.	$r_\alpha i_{\alpha\beta} m_\alpha$	[r<i>m]	(see (64))
	b.	$c_\alpha o_\alpha k_{\alpha\beta} e_\beta$	[co<k]e>	(see 2.13.1)

The different morphemes are given different bracket styles for the sake of clarity. In (a), one morpheme wholly encloses a second, consubstantial morpheme. No part of the form fails to be part of morpheme α, but a substring of the form carries an additional affiliation β. In (b), a suffix partially overlaps the root to which it attaches, such that [cok] carry one affiliation, while [ke] carries another, with [k] carrying both. Thus the right boundary of the root is actually further to the right than the left boundary of the suffix.[6] Morphemes are not, in this view, like the states of the USA, which do not overlap, but like the boundaries of a water district, a school district, and a city, which may all occupy a single territory and divide it differently.

2.12.1. Morphological affiliations

The location of boundaries is determined by the morphological affiliations of the segments involved; the nature of morphological affiliations must now be made clear.

Morphological affiliation is a property of segments rather than strings. A segment may acquire morphological affiliation in several ways.

1. Morphological affiliation may be lexically listed, and thus present in the input. Every monomorphemic lexical item such as *pit* /pɪt/ gives rise to inputs in which each segment carries the same morphological affiliation: /$p_\alpha ɪ_\alpha t_\alpha$/. (The morphological affiliation specific to *pit* is represented by an arbitrary Greek letter.) To the extent that a lexically listed form is polymorphemic—that is, to the extent that its listing incorporates a

[6] The left and right boundaries of an affix per se do not generally come into play in the analyses here, in which FIAT constraints are generally concerned with root and stem boundaries. Thus the boundaries of a suffix itself usually go unrepresented in what follows.

morphological analysis—its segments may have multiple input morphological affiliations, e.g. *trashpit* /[t$_\beta$ɹ$_\beta$æ$_\beta$ʃ$_\beta$][p$_\alpha$ɪ$_\alpha$t$_\alpha$]/.

2. Morphological affiliation may arise through the satisfaction of a FIAT constraint. If the SYN of a particular FIAT constraint is present in a particular output, and the FIAT constraint is satisfied by that output, then the segments that match the constraint's PHON carry a morphological affiliation specific to that constraint. For a FIAT-MORPH constraint, these will be the segments in correspondence with the morpheme indexed by the constraint; for a FIAT-STRUC constraint, these will be any segments that go towards matching the constraint's PHON. In the case of a syntactically plural output [[pɪt]s] corresponding to an input /pɪt/ and satisfying a FIAT-STRUC constraint PLURAL:]s, [s] would carry a morphological affiliation γ specific to that FIAT-STRUC constraint, and likewise for the same output satisfying a FIAT-MORPH constraint PLURAL:]/s/.

3. For purposes of Output-Output correspondence, I will assume that all segments in any output carry a morphological affiliation specific to the output. This affiliation does not come into play in the evaluation of the output itself; it is relevant only in evaluating other outputs for which the output in question acts as a morphological base.

4. Correspondence between segments implies shared morphological affiliation. If a segment in the base of correspondence carries morphological affiliation α, then any segment in the output in correspondence with that segment also carries morphological affiliation α.

5. Epenthetic segments are assigned morphological affiliations as described in the next section.

Thus, in the case of [pɪts], an output for plural /pɪt/, the full set of morphological affiliations is as given in (60)a, and the consequent morphological boundaries are as given in (60)b:

(60) a. $p_{\alpha,\delta}ɪ_{\alpha,\delta}t_{\alpha,\delta}s_{\gamma,\delta}$
b. $[[p_{\alpha,\delta}ɪ_{\alpha,\delta}t_{\alpha,\delta}]s_{\gamma,\delta}]$

Affiliation α arises through IO-correspondence with the input /$p_{\alpha}ɪ_{\alpha}t_{\alpha}$/. Affiliation γ arises through satisfaction of a FIAT constraint. Affiliation δ arises by virtue of the form being an output, and exists only if (b) forms the base in an Output-Output correspondence relationship; it is absent (or plays no role) if (b) is itself the output being evaluated.

2.12.2. Epenthesis and FIAT-MORPH

In the theory proposed here, all segments in a form must have some morphological affiliation. This is not a condition encoded in a violable constraint, but assumed to be a property of GEN; outputs with unaffiliated segments are not constructed or evaluated.

An epenthetic segment, then, must be assigned some morphological affiliation. Epenthetic segments are assigned one of the independently existing morphological affiliations present in the output. Thus, given an input /bɹiz/ and an output [bɹizəz] satisfying PLURAL:]/z/, the schwa present neither in the input nor in the FIAT-MORPH input must nevertheless be assigned some morphological affiliation, either the lexical affiliation assigned to the segments of /bɹiz/ or the FIAT affiliation assigned to the segment of /z/:

(61)	a.	$b_{\alpha}ɹ_{\alpha}i_{\alpha}z_{\alpha}ə_{\alpha}z_{\gamma}$	Epenthetic segment assigned same affiliation as root
	b.	$b_{\alpha}ɹ_{\alpha}i_{\alpha}z_{\alpha}ə_{\gamma}z_{\gamma}$	Epenthetic segment assigned same affiliation as suffix

Following convention (57), the boundaries would be:

(62)	a.	$[[b_{\alpha}ɹ_{\alpha}i_{\alpha}z_{\alpha}ə_{\alpha}]z_{\gamma}]$	Epenthetic segment assigned same affiliation as root
	b.	$[[b_{\alpha}ɹ_{\alpha}i_{\alpha}z_{\alpha}]ə_{\gamma}z_{\gamma}]$	Epenthetic segment assigned same affiliation as suffix

Both outputs would be among the candidates provided by GEN for the input /bɹiz/; the decision between them would be made by the constraint system.

2.12.3. Analytic deletion, and epenthesis in FIAT-MORPH structure

Consider again the case of [b$_{\alpha}$ɹ$_{\alpha}$i$_{\alpha}$]z$_{\gamma}$] as an output for /b$_{\alpha}$ɹ$_{\alpha}$i$_{\alpha}$z$_{\alpha}$/ that satisfies PLURAL:]/z/. The system of morphological affiliation outlined here ensures that penalties will be assigned to what might be called "analytic deletion": the reassignment of morphological affiliations to permit satisfaction of a FIAT constraint. PLURAL:]/z/ can only be satisfied if the correspondent of /z/ is immediately preceded by a morpheme boundary; this cannot be accomplished if [z] carries the same morphological affiliation as the rest of the root. Since a segment always carries the morphological affiliation of any segment with which it is in correspondence, [z] cannot be in correspondence with the /z/ in the root input without sharing an affiliation with the rest of the root; for the boundary to precede [z], [z] must be out of correspondence with root /z/, and thus incur a violation of MAX with respect to the root.

Similarly, the relativization of Faithfulness violations to morphological affiliations allows [b$_{\alpha}$ɹ$_{\alpha}$i$_{\alpha}$z$_{\alpha}$]ə$_{\gamma}$z$_{\gamma}$] to satisfy PLURAL:]/z/, even though at first glance [ə] appears to intervene between the morphological boundary and the correspondent of /z/. By carrying the morphological affiliation associated with /z/, the schwa counts as a violation of DEP with respect to /z/, but by the same token does not count as intervening material between the boundary and the morpheme. [b$_{\alpha}$ɹ$_{\alpha}$i$_{\alpha}$z$_{\alpha}$ə$_{\alpha}$]z$_{\gamma}$], too, is among the candidates, but does not win (see 4.2).

2.13. Beyond affixation

Up to this point, we have looked at FIAT constraints whose effect is to add affixes to inputs lacking them. But the nature of FIAT constraints is simply to demand that a particular phonological statement holds true of certain outputs, and this demand need neither be one that is satisfied by affixation, nor one which always requires a deviation from the input; nothing about FIAT constraints restricts them to adding new material, or restricts their operation to root- or stem-external environments. A FIAT constraint is concerned only with finding a particular string in an output; depending on the nature of the input and the nature of the constraint's PHON, a FIAT constraint might be satisfied by an output that does not differ in any way from its input, or one that differs from its input with respect to prosody or root segmental content.

Imagine, for example, a language whose grammar includes constraint (63):

(63) PAST: i A past tense form contains [i].

Given a stem input /rum/, any of the following outputs (among others) will satisfy the constraint:

(64) a. $[r_{\alpha}i_{\alpha\beta}\ m_{\alpha}]$
b. $[r_{\alpha}u_{\alpha}y_{\alpha}i_{\alpha\beta}\ m_{\alpha}]$
c. $[r_{\alpha}u_{\alpha}i_{\alpha\beta}]$
d. $[i_{\alpha\beta}\ u_{\alpha}m_{\alpha}]$
e. $i_{\beta}\ [r_{\alpha}u_{\alpha}m_{\alpha}]$
f. $[r_{\alpha}u_{\alpha}m_{\alpha}]i_{\beta}$

Outputs (e) and (f) satisfy the constraint through affixation, but outputs (a)-(d), in which a stem-internal segment has been replaced or transformed into [i], satisfy the constraint equally well. Given an input /kip/, the constraint is satisfied by the output [kip], which is completely faithful to the input.

With other FIAT constraints, affixation may be utterly irrelevant; consider (65), a FIAT-STRUC constraint that demands that the second syllable of a verb be stressed:

(65) VERB: $[_{WORD}\sigma'\sigma$ The second syllable of a verb is stressed.

Given an input with stress on the first or third syllable (for example, a noun undergoing a verb-formation process), this constraint could result in stress shift, with no insertion or deletion of segmental material coming into play; given an input whose stress already falls on the second syllable, the constraint will be satisfied without unfaithfulness to the base.

In later chapters, we will see several examples of FIAT constraints responsible for non-affixal morphological processes, as well as examples of faithful or "vacuous" satisfaction of FIAT constraints. (The term "vacuous" with respect to the satisfaction of FIAT constraints will generally be restricted to FIAT constraints satisfied because their SYN is not true of a particular form, an issue that arises in Chapter 7; hence the quotes. Satisfaction of a FIAT constraint without unfaithfulness to the input will be called "faithful" satisfaction.)

2.13.1. Encoding of the environment in FIAT constraints

FIAT constraints may be satisfied by virtue of material that already exists in the input, as has been said; no penalty is associated with any segment carrying multiple morphological affiliation indexes. One consequence of this is that a FIAT constraint may end up making simultaneous demands on both the portion of the output in correspondence with the input and the portion of the output introduced by the FIAT constraint, and by virtue of this, in effect encode both the environment for an affix and the shape of the affix itself. An example will clarify this.

Imagine a language in which plurality is marked by a suffix has two forms:

(66) a. -ita After a stem ending with a [+coronal] consonant

b. -abu After a stem ending with a [-coronal] consonant or a vowel.

Assume that [ita] and [abu] cannot be related to each other by any plausible phonological processes of the language, and must therefore represent a case of default-and-alternative, multiple-FIAT allomorphy of the type described above in 2.6. Assume also that no synchronic phonological processes in the language would appear to forbid [a] after a [+coronal] consonant, or justify the transformation of [a] into [i].

The phonologically conditioned allomorphy can nonetheless be encoded in the FIAT constraints, given PHONs for those constraints that make demands both on the root material and the shape of the affix:

(67) PLURAL: [+coronal]]ita A plural noun contains a coronal segment followed by a stem boundary followed by [ita].

(68) PLURAL:]abu A plural noun contains a stem boundary followed by [abu].

If PLURAL:]abu is ranked below PLURAL: [+coronal]]ita, and both constraints are ranked below DEP:Segment, MAX:Segment, and constraints penalizing the transformation of a vowel into a consonant and vice versa, the desired pattern is generated:

(69)

/gagag/, PLURAL	DEP: Seg	MAX: Seg	IDENT: [coronal]	PLURAL: [+coronal]]ita	PLURAL:]abu
a. gagag				*	*!
b. gagag]ita				*	*!
c. gagad]ita			*!		*
d. gagagd]ita	*!				*
☞e. gagag]abu				*	

(70)

/dadad/, PLURAL	DEP: Seg	MAX: Seg	IDENT: [coronal]	PLURAL: [+coronal]]ita	PLURAL:]abu
a. dadad				*!	*
☞b. dadad]ita					*
c. dadad]abu				*!	
d. dada]abu		*!		*	

When a root ends in a noncoronal consonant or a vowel, as in (69), it is impossible to satisfy the higher-ranked FIAT constraint simply by adding [ita], since the constraint is only satisfiable when the segment before the boundary is [+coronal]. Faithfulness prevents the insertion, deletion, or modification of the root-final segment to allow satisfaction of the FIAT constraint; lower-ranked PLURAL:]abu decides the winner. Only where the root-final segment is [+coronal] in the input, as in (70), can PLURAL: [+coronal]]ita be satisfied by adding [ita] to the root.

In this imaginary example, environment-specifying FIAT constraints allow affixal allomorphy to be phonologically dependent on a property not ordinarily capable in the language of producing alternations.

2.14. Haplology and the English plural and possessive suffixes

As described up to this point, FIAT morphology refers only to outputs. It demands that outputs have certain properties, but does not care whether or not those properties distinguish a morphologically complex output from its base. This is useful in cases of haplology, and we now have enough of the theoretical architecture in place to propose an analysis of a classic example of morphological haplology mentioned in Chapter 1, that between the plural and possessive suffixes of English.

The possessive and plural suffixes in English are homophonous, with allomorphs [z], [əz] and [s] occurring in exactly the same environments. When a noun is both plural and possessive, however, only one instance of the suffix appears. This is not a matter of the possessive marker being restricted to singulars, as (d) shows; irregular plurals display the expected possessive suffix. Nor is it a purely phonological avoidance of repetition; as (f) and (g) show, the exact same string that double marking would create if permitted is tolerated when one instance of [z] belongs to a root rather than an affix:

(71)	a.	the dog's head		
	b.	the ox's head		
	c.	the brie's odor		
	d.	the dogs' heads	vs.	*the dogs's heads
	e.	*the oxen heads	vs.	the oxen's heads
	f.	the bries' odor	vs.	*the bries's odor
	g.	the breeze's odor	vs.	*the breeze odor

This case of haplology can be analyzed as the result of FIAT constraints with identical PHONs but different SYNs:

(72) POSS:] /z/$_{\alpha}$ A possessive noun contains a morpheme boundary followed by /z/$_{\alpha}$.

(73) PLURAL:]/z/$_{\beta}$ A plural noun contains a morpheme boundary followed by /z/$_{\beta}$.

The Greek letters indicating morphological affiliation, usually omitted, are included here to clarify the morphological affiliation issues in the tableaux below. Both constraints demand exactly the same string, and they are just as easily satisfied by an output containing a single instance of that string as by one containing multiple instances:

(74)

/dɔg/ PLURAL, POSSESSIVE	POSS:] /z$_{\alpha}$/	PLURAL:]/z$_{\beta}$/	*STRUC
[dɔg]	*!	*	***
[dɔg]z$_{\beta}$	*!		****
[dɔg]z$_{\alpha}$		*!	****
☞ [dɔg]z$_{\alpha\beta}$			****
[dɔg]z$_{\alpha}$]əz$_{\beta}$			*****!*

Since no advantage is gained by the output's having two separate instantiations of the necessary string, the candidate with double marking violates *STRUC more seriously than the winner does with no compensating benefit. In the winner, both FIAT constraints are satisfied by a single segment bearing indexes to both the FIAT morphemes; note that there is no penalty associated with multiple indexing of this sort. (See Yip (1995, 2000a) for a similar analysis proposing that the equivalent of multiple morphological affiliations on a single segment does incur a penalty.)

We saw earlier in this chapter how the fact that haplology occurs only between the identical suffixes, not between a suffix and an identical root-final segment, can be captured by incorporating morphological boundaries into FIAT constraints; the FIAT constraints demand a morphological boundary preceding /z/, and thus the suffix cannot haplologize with a root-final [z] except through analytic deletion moving [z] outside the root.

This case of "antihaplology"—mandatory difference between base and output—can be explained by the incorporation of morphological boundaries into FIAT constraints. But other cases of mandatory difference between base and output are not susceptible to this sort of explanation, and require the addition of new mechanics to the theory.

2.14.1. Antihaplological morphology

Consider the voicing exchange process in Luo discussed by Anderson (1992) and Alderete (2001). The formation of the plural involves involves the reversal of the value for [voice] of the stem-final consonant of the singular; voiced consonants become voiceless, voiceless consonants become voiced.[7]

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[7] While the fact that all the cases in which the alternating consonant is voiced in the singular involve final vowels might suggest a purely phonological explanation, Alderete (2001) states that the morphological pattern extends to cases lacking the plural suffix such as [got] "mountain" vs. [god] "mountain of", indicating that the exchange is not simply "a dual process of intervocalic voicing and (opaque) final devoicing. " (p. 129)

(75)	SINGULAR	PLURAL	GLOSS
	bat	bed-e	'arm'
	rec	rej-e	'fish'
	cogo	cok-e	'bone'
	luedo	luet-e	'hand'

This pattern cannot be generated by FIAT constraints that do not consult the input directly. Clearly there can be no single FIAT constraint, demanding a structure that is perfectly matched in all cases. A FIAT constraint demanding [+voice]e would correctly demand that the [t] of [bat] occur as [d], as in [bede]; but it would not demand any change to the [g] of [cogo], being satisfiable only by the incorrect [coge] rather than the correct [coke]. Similarly, a constraint demanding [-voice]e could demand the correct result for [coke], but would demand the wrong result for [bede].

Nor can the alternation be explained by a single FIAT constraint that makes no particular demand on the voicing of the stem-final segment, since the voicing alternation in this segment is exactly what must be explained; since such a constraint would be satisfiable either by a voiced or voiceless segment, it could produce the suffixal [e], but nothing more.

Nor can the pattern be generated simply by proposing two FIAT-STRUC constraints, one demaning [+voice]e, the other demanding [-voice]e. If the constraints are ranked with respect to each other, then the higher-ranked would always be satisfied, giving exactly the same result as a system containing only the higher-ranked constraint. If the constraints are not ranked with respect to each other, then the situation is exactly the same as in a system with a single FIAT-STRUC constraint making no demand on voicing; the less-marked alternative will be chosen, whether or not it differs from the base. The problem cannot be solved by letting markedness decide which FIAT-STRUC constraint is satisfiable in a particular form, because if the ranking of markedness constraints is consistent, once again, either voicing or voicelessness will always be produced.

What is crucial is not that the root-final segment have any particular voicing, but that it differ in voicing from its correspondent in the base. This can be accomplished by adding a new mechanism to the system, a property that any particular FIAT-STRUC constraint may or may not have: a *novelty requirement*.

2.14.2. The novelty requirement and antifaithfulness

A FIAT-STRUC constraint demands the presence of a particular morphophonological structure in an output. To the existing mechanisms must be added the *novelty* requirement, an optional property of FIAT constraints. The novelty requirement has two components:

(76) Novelty requirement

a. A FIAT constraint may specify that its PHON be novel. If its PHON is novel, then the PHON must either

i. have no correspondent string in the base

ii. have a correspondent string in the base that is non-identical to the PHON with respect to some feature specified in the PHON.

b. A FIAT constraint demanding novelty may further specify a feature or features that must differ between segments in correspondence for the novelty requirement to be satisfied.

Part (i) is straightforward; a PHON with no input correspondent is novel. Part (ii) is somewhat more complex. It demands that if the output PHON has an input correspondent, the correspondent be non-identical to the output PHON, and, further, that it be non-identical in some respect to which the PHON is sensitive.

Imagine, for example, a FIAT-STRUC constraint with the PHON [+coronal]]$_{stem}$ which must be novel. The PHON is matched by an output $t_{\alpha}]_{stem}$. If the input ends with $p_{\alpha}]_{stem}$, the constraint is satisfied; the PHON is matched, and its correspondent in the input is non-coronal. If the input ends with $t_{\alpha}]_{stem}$, the constraint is not satisfied; it PHON is matched in the output, but the matching string has an identical correspondent in the input, so the novelty requirement is not met.

The tricky case is one in which the input ends with $d_{\alpha}]_{stem}$. The PHON is matched in the output, and the corresponding string in the input is non-identical. Nevertheless, the constraint is violated, because the novelty requirement is not met. While the input correspondent is non-identical overall, it is identical in every respect to which the PHON is sensitive. The PHON specifies only that the segment be [+coronal]; it does not specify any value for [voice]. Since the input and output correspondents are identical with respect to [coronal], it does not matter that they are non-identical in other respects; only features to which the PHON is actually sensitive come into play with the novelty requirement. The FIAT constraint in this case does not say "Be coronal, and be different"; it says "Be coronal where you weren't coronal before." Note that it is not necessary for the input correspondent to differ in every respect from the PHON, just in some—if the hypothetical constraint demanded a final [d] ([d] being, of course, shorthand for the entire feature matrix for the sound), either an input [b] or an input [t] would be acceptable, since the PHON specifies both [+coronal] and [+voice], and a difference with respect to either feature satisfies the novelty requirement.

Part (b) of the requirement permits FIAT constraints to make novelty requirements more specific than the PHON itself demands. A constraint with the PHON $d]_{stem}$ and a novelty requirement might specify that the novelty must be with respect to IDENT:[coronal]; in this case, the novelty requirement would be satisfied if the input correspondent were [b], since [b] and [d] differ with respect to [coronal], but would not be satisfied if the input correspondent were [t], even though [t] is non-identical to [d] and the difference is one to which the PHON is sensitive, because the mapping from [t] to [d] does not violate IDENT:[coronal]. This additional specificity is necessary in cases where a FIAT-STRUC constraint both adds new structure to a form and makes some demand on existing structure, as in the Luo constraints given below.

Consider the FIAT-STRUC constraints usable for the Luo alternation:

(77) SYN:[-voice]$]_{stem}$e — A word with property SYN contains the string [-voice]$]_{stem}$e
Novelty: IDENT[voice]

(78) SYN:[+voice]$]_{stem}$e — A word with property SYN contains the string [+voice]$]_{stem}$e
Novelty: IDENT[voice]

Constraint (77) is satisfied if the output contains a string [-voice]$_{i}]_{stem}$e, and the base or input does not contain a string [-voice]$_{i}]_{stem}$e. The base may contain the string [+voice]$_{i}]_{stem}$, or the string [-voice]$_{k}]_{stem}$, or the string [-voice]$_{i}$X$]_{stem}$ (where X is some segment absent from the output), and the constraint will be satisfied. Only if the identical structure occurs in both base and output, with all elements capable in principle of correspondence being actually in correspondence, is the constraint violated; for example, by [pob$_{i}$]~[pob$_{i}$e] (though see the next paragraph for a complication). Constraint (78) is satisfied and violated under the same circumstances with the feature values reversed; that is, if the output contains a string $[+voice]_i]_{stem}e$, and the base or input does not contain a string $[+voice]_i]_{stem}e$. It is necessary to specify that the novelty must involve a violation of IDENT[voice], because otherwise the [e] not present in the base would constitute the necessary novelty.

The FIAT constraint itself, then, demands a particular change in a particular location. Note that despite the apparent freedom of possible changes, the nature of the change is actually restricted to those elements specified in the constraint's PHON, and further restricted here by the designation of IDENT[voice] as the site of the necessary novelty; only a change in voicing or a change in correspondence (i.e. analytical deletion, distinct from phonological deletion in that it need not involve an actual overt difference between forms) will produce the necessary difference. A base-output pair like [pog] [pobe], with [g] and [b] in correspondence, does not satisfy the constraint, because the difference between [g] and [b] is not one the FIAT-STRUC constraint cares about; both base and output contain the string $[+voice]]_{stem}$, so the constraint is violated, despite the fact that the strings are in other respects nonidentical.

(79)

bat	MAX:C	DEP:C	SYN: $[-voice]]_{stem}e$	SYN: $[+voice]]_{stem}e$	IDENT:[VOICE]
a. bet			*	*!	
b. bet]e			*	*!	
☞ c. bed]e			*		*
d. bedf]e		*!		*	
e. be]e	*!		*	*	
f. bep]e			*	*!	

(80)

cog	MAX:C	DEP:C	SYN: [-voice]]$_{stem}$e	SYN: [+voice]]$_{stem}$e	IDENT:[VOICE]
a. cog			*!	*	
☞ b. cok]e				*	*
c. cog]e			*!	*	
d. cogl]e		*!	*		
e. co]e	*!		*		
f. cod]e			*!	*	

(The change in the first vowel of [bat]/[bede] is ignored, as is the [o] suffix present in the base forms of both examples.)

In each case, one of the FIAT constraints is satisfiable only by the insertion or deletion of a segment. The FIAT demanding [+voice] cannot be satisfied even by a [+voice] segment unless that voicing represents a difference from the segment's base correspondent, or the voiced segment has no base correspondent. Since MAX and DEP outrank the FIAT constraint, it is never possible to delete or insert segments to allow FIAT satisfaction. Thus, the FIAT constraint demanding [+voice] can never be satisfied when the base ends in a [+voice] segment, and the FIAT constraint demanding [-voice] can never be satisfied when the base ends in a [-voice] segment. The ranking between the FIAT constraints is unimportant, here, since for every voiced input, all candidates surviving the MAX and DEP constraints will violate the [+voice] FIAT constraint, and for every voiceless input, all candidates surviving the MAX and DEP constraints will violate the [-voice] FIAT constraint.

We will see the novelty requirement in action in the analysis of Imdlawn Tashlhiyt Berber in 5.8.6. The theory must involve the novelty mechanism or some equivalent to account for those cases where the only plausible factor conditioning a particular alternation is that it results in a difference between output and base.

2.14.3. Subtractive morphology: Novelty with respect to MAX

Certain morphological processes are subtractive; that is, they involve the deletion in the output of material present in the morphological base. Bat-El (2002) makes a useful distinction between "true truncation," in which the essence of the process is the deletion of material, and "fake truncation," involving the imposition of a template on an output, possibly requiring deletion of material to allow the fit.. In fake truncation, no difference from the base is necessarily mandated; deletion is a matter of unfaithfulness to the base required by the need to fit into a template, not by difference from the base for its own sake. In true truncation, it is the deletion itself, not a requirement on outputs that happens to require deletion, that constitutes the morphological operation.

With true truncation, as with Luo-type shifts, it is not possible to get the right result strictly with output-only FIAT-STRUC constraints, and for much the same reason; the outputs of such a process have a number of possible descriptions, and a set of ranked FIAT constraints encoding those descriptions will only accomplish some of the changes, while a set of unranked FIAT constraints encoding the descriptions will accomplish none of them.

Bat-El provides a process in Tohono O'odham (Bat-El 2002, Zepeda 1983) as an example of true truncation. The perfective form of a verb is derived from the imperfective form by deletion of the final consonant, if any, of the imperfective:

(81)

Imperfective	Perfective	Gloss
pisalt	pisal	'to weigh'
gatwid	gatwi	'to shoot'
hehem	hehe	'to laugh'
cicwi	cicwi	'to play'

Note that there is no generalization one can make about the perfective forms that is both true in all cases and does not refer to the imperfective forms. It is not that final consonants are forbidden in the perfective; if the imperfective ends in a CC cluster, the first consonant survives in the perfective. It cannot be said whether a given perfective form is appropriately marked unless one compares it to the corresponding imperfective; the only generalization possible is that the final consonant of the imperfective, if any, is deleted in the perfective.

The particular FIAT-STRUC constraint useful for Tohono O'odham is PERFECTIVE:Segment]$_{word}$.

(82) PERFECTIVE:Segment]$_{word}$ — A perfective verb contains the novel structure Segment]$_{word}$.

Note that this is very close to contentless as a purely output constraint; it merely demands that every perfective contain a word final segment. What gives it force is the novelty requirement, and it is crucial here that the option to specify a feature as the locus of novelty is not exercised. For the novelty requirement to be satisfied, the word-final segment in the output cannot be in correspondence with the word-final segment in the input, because the word-final segment in the input matches the constraint's PHON. Because the PHON is so unspecific, *no* featural difference will satisfy the novelty requirement; as long as both the output and input end in segments, if those segments are in correspondence, the PHON is not sufficiently novel.

The output must have a word-final segment that either has no correspondent in the imperfective (i.e. a new word-final segment must be inserted), or is in correspondence with a segment that is not word-final in the imperfective (i.e. the segment that is word-final in the base must be deleted or metathesized to make a new segment word-final). The constraint is satisfied either if the word-final segment in the input is deleted in the output, or if a new word-final segment is inserted in the input, or if the word final segment is analytically deleted. (Analytic deletion, remember, refers to cases in which an input and output are segmentally identical in some respect, but some output segment fails to be in correspondence with its equivalent input segment, thus violating MAX; e.g. $p_1i_2s_3a_4l_5t_6 \rightarrow p_1i_2s_3a_4l_5t$.) If PERFECTIVE:Segment$]_{word}$ outranks DEP:Segment, which in turn outranks MAX:C, while MAX:V (preventing deletion of a vowel) outranks PERFECTIVE:Segment$]_{word}$, the correct results are generated:

(83)

BASE: $p_1i_2s_3a_4l_5t_6$	MAX:V	DEP: Segment	PERFECTIVE: Segment$]_{word}$	MAX:C
a. $p_1i_2s_3a_4l_5t_6$			*!	
☞b. $p_1i_2s_3a_4l_5$				*
c. $p_1i_2s_3a_4l_5t_6i$		*!		
d. $p_1i_2s_3a_4l_5t$		*!		*
e. $p_1i_2s_3a_4l_5d_6$			*!	*

A candidate identical to the imperfective violates the FIAT constraint. A candidate in which a final vowel is inserted to prevent the string satisfying the PHON in the output from being identical to a string matching the PHON in the base violates DEP:Segment, which outranks both the FIAT constraint and MAX:C. The winner is (b), which satisfies the FIAT constraint by deleting the base-final segment, violating only the lower-ranked MAX:C. The analytic deletion canditate, (d), in which the final segment survives but is not in correspondence with the base-final segment, violates both MAX and DEP, since the base [t] has no output correspondent and the output [t] has no base correspondent. The necessary novelty cannot be obtained simply by making a random featural change to the final segment, because the PHON specifies nothing more than "segment"; the constraint is blind to featural differences that are unmentioned either in the PHON itself or in an additional novelty specification. If the novelty requirement is to be satisfied, the input string in correspondence with the output string satisfying the PHON must be one that, itself, does not satisfy the PHON. Since any final segment will match a PHON that demands nothing more specific than "final segment," the novelty requirement can only be satisfied by ensuring that the final segment of the input and the final segment of the output are not in correspondence.

The ranking of MAX:V and DEP:Segment above the FIAT constraint ensures that nothing will be done to imperfective bases ending in a vowel:

(84)

BASE: $c_1 i_2 c_3 w_4 i_5$	MAX:V	DEP: Segment	PERFECTIVE: Segment]$_{word}$	MAX:C
☞a. $c_1 i_2 c_3 w_4 i_5$			*	
b. $c_1 i_2 c_3 w_4$	*!			
c. $c_1 i_2 c_3 w_4 i_5 t$		*!		
d. $c_1 i_2 c_3 w_4 i$	*!	*		

Since MAX:V and DEP:Segment both outrank the FIAT constraint, the FIAT constraint must go unsatisfied. A vowel cannot be deleted, and no segment can be added; and, as always, analytic deletion results in violations of both MAX and DEP, making it inferior to either a plain deletion or a plain epenthesis candidate.

In section 5.8.6, we will see a morphological operation in Berber that requires the use of FIAT constraints incorporating the novelty requirement.

2.14.4. The novelty requirement versus Antifaithfulness

This method of capturing mandatory differences between output and base may be compared to Alderete's (1999, 2001) theory of Antifaithfulness. Alderete's proposal holds that every Faithfulness constraint has a corresponding Antifaithfulness constraint, satisfied exactly when the Faithfulness counterpart is violated. Antifaithfulness constraints hold over particular OO-Correspondence domains; certain affixes subcategorize for stems in such a way as to produce the necessary OO-Correspondence domain between base and affix. The Antifaithfulness constraint outranks its Faithfulness counterpart, thus demanding a difference between base and output. In Luo, then, the relevant OO-Correspondence domain triggers a voicing Antifaithfulness constraint, outranking IDENT:[voice], and the winning candidate will thus be one that contains a violation of IDENT:[voice] somewhere.

This raises the issue of where in the form the violation will be incurred. The novelty-requiring FIAT-STRUC constraints specify the site where the change must occur; or rather, they specify that a particular string must be found and that any material in correspondence within that string must violate IDENT:[voice], and since this string necessarily incorporates the final consonant of the stem, the IDENT violation must be located in that segment. The locality of the Faithfulness violation to the site of affixation is accounted for by the necessity that it occur within the affix-containing string specified in the constraint's PHON.

Antifaithfulness constraints do not specify within themselves the site of the violation they require; Anti-IDENT:[voice] is, in its own right, satisfied by any violation of IDENT:[voice] in the output. Alderete explains the predictable location of the antifaithful segment (and its proximity to the conditioning affix) as the result of constraint conjunction; in the case of Luo, between an Anchoring constraint demanding that the rightmost element in the base be in correspondence with the rightmost element in the output, conjoined with the voice antifaithfulness constraint. The presence of the suffix [e] makes the stem's leftmost element violate Anchor in every case; but a violation of the conjoined constraint can be avoided if the Antifaithfulness constraint is satisfied. Since conjoined constraints are local in their effects—the segment violating Anchor must satisfy Antifaithfulness to avoid a violation, and some other segment's satisfaction of Antifaithfulness will not help—the [voice] switch must be in the consonant adjacent to the stem.

In both theories, then, it is predicted that if some change is mandated by the presence of an affix, the mandated change will be adjacent to the affix. A difference between the theories arises in cases where a change is mandated, but there is no conditioning affix. Alderete proposes that in phenomena involving no conditioning affix, positional faithfulness or the general markedness constraints of the language will suffice in some cases to establish a predictable site for the Faithfulness violation, while in others (such as the root-initial consonant mutation in Irish) a null affix may be required. In the present theory, the ability of FIAT constraints to specify the location for a change does not depend on whether affixal material is inserted or not; thus the site of a mutation not associated with an affix does not require an explanation in terms of markedness any more than a mutation tied to a particular prefix or suffix.

2.15. Conclusion

This chapter has introduced the FIAT constraint family, and demonstrated some of the properties of material introduced by FIAT constraints. The next chapter covers the use of FIAT morphology in explaining exceptionality and irregular or partially regular morphological patterns. The discussion of the formal properties of FIAT constraints resumes in Chapter 4, where the motivation for the division between FIAT-MORPH and FIAT-STRUC constraints is also explained.

3. Exceptionality

3.1. Introduction

Morphological processes and generalizations often have lexical exceptions. Sometimes these exceptions involve individual forms that do not participate in general patterns; sometimes they involve multiple, incompatible morphological processes marking particular syntactic properties, with membership in any particular class an unpredictable or only semi-predictable property of individual lexical items. By encoding morphological processes in constraints, FIAT morphology makes constraint violability available as an mechanism for capturing lexical exceptionality, whichever form that exceptionality takes. Exceptionality is treated as the survival of a form's input characteristics, in defiance of (or in the absence of) the demands of FIAT constraints and constraints demanding faithfulness to related outputs; it is the result of Input-Output Faithfulness constraints outranking FIAT constraints and Output-Output Faithfulness constraints. (See Zuraw (2000) for another account of exceptionality as competition between listed forms and grammatical regularities, to which the present proposal owes a great deal.) This chapter covers the relationship between FIAT constraints, IO-Faithfulness, and OO-Faithfulness, focusing on two cases of imperfect morphological patterns in English and Spanish. The conception of the lexicon necessary for this analysis is discussed, and compared to other ideas of the lexicon and lexical exceptions in generative grammar.

3.2. The web of faithfulness

Following Steriade (1999, 2000), I assume that an inflected word may enter into faithfulness relationships with a number of different entities. A derived form is in Output-Output Correspondence with its morphological base (Benua 1995, 1997), and conceivably with other outputs too. If FIAT-MORPH constraints come into play with a particular form, then some portion of the word may be in Input-Output Correspondence with the inputs of the FIAT morphemes.

Lexical exceptions to general morphological patterns are the result of another kind of IO-Faithfulness; faithfulness to a *derived-form input*. Despite the word "derived" in its name, a derived-form input, like any other input, is listed in the lexicon, and is not the output of any process in the grammar that does not also apply to root inputs. A derived-form input differs from other inputs only in that it is specific to a particular syntactic situation; while the input to *cat* /kæt/ is called up whenever the semantic element CAT occurs–in the plural, the singular, or the genitive–a derived input like *oxen* /ɑksən/ is called up only when OX appears in conjunction with the syntactic property PLURAL. A derived form input is simply an input listed for forms which the language also has mechanisms for generating productively (though the productively generated form may be different from the listed form).

Derived-form inputs come into play in cases of suppletion, minor processes, and process exceptions (these latter two are defined below). IO-Faithfulness to derived-form inputs, OO-Faithfulness, Markedness, and FIAT constraints interact to produce different kinds of exceptionality. In the analysis of the English participle below, we see a case of high-ranking IO-Faithfulness allowing unlimited exceptionality. In the analysis of Spanish gender marking, and, in a later chapter, Berber verb stem alternations, we will see how ranking IO-Faithfulness below OO-Faithfulness, FIAT-STRUC constraints, and Markedness can lead to exceptionality within strict limits short of suppletion.

3.2.1. Suppletion

The simplest cases of suppletion are those in which the suppletive form bears no phonological resemblance either to its base or to the equivalent inflected forms of other bases, and is clearly unrepresentative of any general pattern. The past tense of the English verb *go* [goʊ] is the unpredictable *went* [wɛnt].[8] Compare this to *glow* [gloʊ], whose past tense form is the predictable *glowed* [gloʊd].

The base of the past tense is the bare stem. The FIAT constraint responsible for *-ed* suffixation is PAST:]/d/.[9] Both *went* and *glowed* are in correspondence with their bases, *go* and *glow*; they differ in that *went* is also in correspondence with the derived-form input [wɛnt].

(85) a.

Base: gloʊ Input: Ø	IO-Faith	PAST:]/d/	OO-Faith
[gloʊ]		*!	
☞ [gloʊ]d			

[8] Although the final [nt] of *went* matches similar past-tense endings in e.g. *spent* and *lent*, the change from *go* to *we-* has no parallel in English.

[9] The alternations between [d], [əd], and [t] will be ignored here.

b.

Base: goʊ Input: went	IO-Faith	PAST:]/d/	OO-Faith
[goʊ]	*!	*	
[goʊd]	*!		
☞ [wɛnt]		*	*

Glowed lacks any specific input for the past tense; thus any candidate vacuously satisfies IO-Faith. PAST:]/d/ requires that a post-stem [d] be present in the output, and makes the decision in this case. Any candidate containing the string [gloʊ], with stem boundaries on each side, satisfies OO-Faith. Note that this is a difference between OO-Faith and IO-Faith; OO-Faith only requires matching between the base and the portion of the candidate in correspondence with the base; additional material outside the morphological boundaries of the base-component does not incur any OO-Faith penalty. IO-Faith, on the other hands, demands matching between the entire input and the entire output; any mismatch incurs some penalty. Thus suffixation does not cause OO-Faith violations, but does cause IO-Faith violations.

Go, unlike *glow*, does have a specific input for the past tense. Any candidate that does not match the string [wɛnt] completely will violate some IO-Faith constraint. Since IO-Faith outranks both the FIAT constraint and OO-Faith, the past tense form is the suppletive [wɛnt]; the usual morphological operations specific to the English past tense have no chance to apply.

Note that it is entirely possible that a derived-form input, i.e. *glowed*, exists for *glow* as well, representing memorization of the inflected form as well as the base form; but since *went* shows that IO-Faith must outrank OO-Faith and FIAT, the fact that *glowed* is the actual past tense form indicates that any derived-form input for it must match exactly the output predicted by the usual morphology.

3.2.2. Minor processes and process exceptions

By *minor process*, I mean a morphological process that applies to more than one form in a language and can be captured by some generalizing rule (that is, it relates a base to a derived form in some manner describable as something other than complete replacement), but whose application to any particular form is unpredictable. The plural marker *-en* in English (as seen in *children* and *oxen*) is an example of a minor process.

Process exceptions are cases in which a very general rule fails to apply to some phonologically unpredictable subset of forms which it would be expected to affect. The past tense of English *beat* is homophonous *beat*, rather than the predictable **beated*; compare to *bleat*/*bleated*. This is a process exception to the English past tense rule.

(86) a. We *beated/beat them at tennis.

b. The lambs bleated/*bleat in the meadow.

We saw in the previous chapter how multiple FIAT-STRUC constraints can lead to phonologically-conditioned allomorph selection. But since minor processes and process exceptions are not conditioned by markedness, the same mechanism cannot be at work here; given two incompatible FIAT-STRUC constraints, the highest-ranked should always be satisfied.

Patterned but non-phonologically-conditioned exceptionality of this sort is, like suppletion, due to the effect of derived-form inputs and IO-Faithfulness. The irregularities of the English past participle will be used to illustrate.

3.3. The English past participle—summary of the data

For regular English verbs, the past participle is identical to the past tense:

(87)	I cover	I covered	I have covered
	I smile	I smiled	I have smiled
	I snitch	I snitched	I have snitched

This is also true of some irregular verbs (verbs not displaying any allomorph of the *-ed* suffix in the past tense):

(88)	I hang	I hung	I have hung
	I lead	I led	I have led
	I think	I thought	I have thought
	I say	I said	I have said

Some irregular verbs have a past participle identical to the simple past except for the *-en* suffix*:*

(89)	I bear	I bore	I have borne
	I weave	I wove	I have woven
	I lie	I lay	I have lain
	I get	I got	I have gotten

Some irregular verbs have a past participle identical to the present except for the *-en* suffix:

(90)	I blow	I blew	I have blown
	I give	I gave	I have given
	I fall	I fell	I have fallen

Some verbs with regular past tense also form the participle with *-en*:

(91)	I prove	I proved	I have proven

For other verbs, the past participle, simple past, and present are all different from one another. The past participles of some of these verbs carry the *-en* suffix:

(92)	I strive	[stɹaɪv]	I strove	I have striven [stɹɪvən]
	I rise	[ɹaɪz]	I rose	I have risen [ɹɪzən]

Others do not:

(93)	I shrink	I shrank	I have shrunk
	I sink	I sank	I have sunk
	I swim	I swam	I have swum

3.3.1. The suffix *-en*

It would be possible in principle to capture the basic pattern of the English *-en* suffix by treating it as if it were not a pattern at all; all *-en* participles (as well as those formed by vowel mutation) are simply suppletive forms that happen to resemble the other members of their paradigm more than *went* resembles *go*.

By ranking IO-Faith higher than OO-Faith, and including no FIAT-STRUC constraint specific to the past participle, we accomplish such an analysis. In the default case, a past participle will be identical to the simple past, but when a derived-form input exists for a given form's past participle, faithfulness to that input will outweigh faithfulness the simple past base.

(94) a.

Base: *milled* {[mɪl]d} Input: Ø	IO-Faith	OO-Faith
☞ mild		
mɪln		*!

b.

Base: *proved* {[pruv]d} Input: [pruvən]	IO-Faith	OO-Faith
pruvd	*!	
☞ pruvən		*

3.3.2. The problem with suppletion

Clearly, there is a problem with the suppletion analysis of the past participle. The problem is not "There is a pattern here, so the grammar should encode that pattern." To the extent that a phonological or morphological generalization becomes encoded—perhaps redundantly—in the lexicons of a set of speakers, that generalization can be transmitted to a new set of speakers solely as an accident of the lexicon, independent of the original generalization or process. If there is evidence that speakers are able to manage the pattern—for example, if they can accidentally extend a pattern to new forms—there is good reason to suppose that the grammar encodes it; but the mere existence of a pattern itself does not indicate that the grammar encodes it, unless we suppose that the grammar, thirsting for elegance and ruthlessly pruning every redundancy from the lexicon, simply will not tolerate the existence of generalizations it does not embody. It is not clear that there is reason to believe this.

In any case, *-en* is unambiguously something that belongs in the grammar, or at any rate in the production mechanisms of the speaker. The suffix may be extended to new forms in cases of speech error (e.g., "I should have broughten both"). While speakers are able to extend the pattern to new forms under direct instruction, too, what is crucial is that the extension can also occur "naturally"; the extension is not plausibly attributed in all cases to conscious artistry. Suffixation of *-en* is an operation the speakers are capable of spontaneously performing, and they do so.

Nevertheless, it is inescapable that the pattern is, at root, a matter of memorized exceptions specific to particular lexical items. No overarching generalization exists in the synchronic grammar that tells exactly when to use the *-en* suffix and when not to, except for the brute rule "Use the *-en* form for words you use the *-en* form for." (While subgeneralizations may exist, such that forms with particular phonological characteristics regularly and exceptionlessly the *-en* marker in the participle—"islands of reliability" as described by Albright and Hayes (2002)—what is at issue here is the set of forms for which the presence or absence of *-en* is truly unpredictable.)

These, then, are the crucial characteristics of the pattern: there is a rule, and there is no way to predict when to apply it.

3.3.3. Analysis of the process

Recall that in the vast majority of cases, the past participle is identical to the simple past. I will assume, then, that the simple past is the base for the participle; i.e., that OO-

Faith constraints with the participle as Output are evaluated with the simple past as Base. While it is true that some participles appear to be "based" in an informal sense on the present tense form rather than the past (e.g. *see/saw/seen*, *give/gave/given*), there is little to be gained either by setting up the present form as the base in all cases or by allowing individual forms to vary from one another in whether they take the past or the present form as their bases. As we will see, *-en* suffixation is apparently sensitive to the regularity or irregularity of the past tense form, a characteristic not readily discerned from the present alone; this suggests that if one or the other must always be the base, the past is more appropriate. As for varying the base according to the word involved, the mechanism that would allow idiosyncratic base-selection—for example, by triggering reranking of Base-Output correspondence constraints, with the Past-correspondence constraints high for some forms and the Present-correspondence constraints high for others—introduces new complications into the theory without eliminating the need for the independently-motivated suppletion mechanisms which, I will argue, are responsible for the "present base" cases. While *seen* may be based on *see* rather than *saw* in a historical sense, I will argue that in the living grammar, it makes the most sense to treat it as a case of suppletion.

Where there is a default or elsewhere version of a morphological process—one that applies to unfamiliar or wug-forms (imaginary nonce forms)—this theory's assumption is that the nonce words lack any derived-form inputs; the default case must be what happens when IO-Faith is irrelevant to the evaluation of a form, and only OO-Faith, FIAT-STRUC constraints, and markedness determine the outcome.

The suffix is demanded by the FIAT-STRUC constraint PART:]/n/:

(95) PART:]/n/ A participle contains a stem boundary followed by /n/.[10]

[10] A FIAT-MORPH constraint is used on the assumption that the [ə] occurring before the suffix in forms like *risen* may be attributable to a general epenthesis process of English. As with /d/, the details of this process are not explored here.

We know that in the default case, this constraint is violated. The relevant OO-Faith constraints, then, must both outrank PART:]/n/ and conflict with it.

The simple past form of a regular verb is morphologically complex, consisting of a root plus the suffix *-ed*, discussed earlier. This *-ed* suffix never co-occurs with *-en* in the participial form. I will treat the incompatibility of the suffixes as matter of *-en* needing to occupy a place in the form—i.e. immediately following the stem—that it cannot assume without the deletion or relocation of the already-present *-ed*; *-en* cannot attach to a form already containing *-ed* without violating MAX-BO:C or DEP-BO:C. (MAX-BO:C, DEP-BO:C stand for MAX:Consonant and DEP:Consonant between the Base and the Output.)

(96) Chart of violations

{[maɹk]d}	MAX-BO:C	DEP-BO:C	PART:]/n/
a. {[maɹk]nd}	√	*	√
b. {[maɹk]d}ən	√	√	*
c. {[maɹk]ən}	*	*	√
d. {[maɹk]}ən	*	√	√

For the sake of clarity, root and stem boundaries here are distinguished by different kinds of brackets—square brackets for root boundaries and curly brackets for stem boundaries—rather than the usual subscripts.

In (a), the [n] immediately follows the root boundary, as it should, but since it intrudes within the string in correspondence with the base {[maɹk]d}, it incurs a DEP violation. (To be within the boundaries of the base, it must share the morphological affiliation of that string; it thus represents a new element, and a DEP violation. Were it outside the string in correspondence with the base, it would not need to share the base affiliation, and would not violate DEP. See 2.11 for the full discussion of morphological affiliation and faithfulness.) In (b), the base string is intact, but [n] is not adjacent to the root, so PART:]/n/ is violated. In (c), [n] is root-adjacent, but intrudes within the base, and [d] has been deleted; both MAX and DEP are violated. In (d), [n] is root-adjacent and outside the base (no ordering exists between boundaries unless some segment intervenes between them), but since [d] has been deleted to allow this, a MAX violation is incurred.

There is no such problem when the past tense does not end with the [d] suffix, since the root is coterminous with the base:

(97) Chart of violations

{[stol]}	MAX-BO:C	DEP-BO:C	PART:]/n/
{[stol]}ən	√	√	√

If MAX-BO:C is ranked above PART:]/n/, then, the prediction is that regular verbs will have participles identical to the simple past, while irregular verbs with no simple past suffix will display the *-en* marker.

This is not, of course, true, but it will prove useful. To explain why it is not generally true—and why we get *-en* in forms with regular simple past forms (i.e. *prove*/*proved*/*proven*)—we need to make use of derived-form inputs for the past participle.

3.3.4. Participial inputs

The analysis as it stands predicts *-en* for forms with irregular simple pasts, and identity with the simple past otherwise. The only source of exceptionality in inflected forms is derived-form inputs. Thus any form that behaves unpredictably (e.g. *proven*, *snuck*, *written, risen*, *sought*, *done*) must have an input specific to the participial form. Some examples are below. FAITH-BO:C is a bundled or placeholder constraint, standing for all

Faithfulness constraints relevant to consonants defined on the Base/Output correspondence relationship. As before, square brackets stand for root boundaries, curly brackets for stem boundaries.

(98)

a. *marked/marked*

Base:{[maɹk]d} Input: Ø	IO-Faith	Dep-BO:C	Ident-BO:C	Max-BO:C	PART:]/n/
☞{[maɹk]d}					*
{[maɹk]ənd}		*!			
{[maɹk]ən}		*!		*	
{[maɹk]}ən				*!	

b. *rose/risen*

Base:{[ɹoʊz]} Input: [ɹɪzən]	IO-Faith	Dep-BO:C	Ident-BO:C	Max-BO:C	PART:]/n/
{ɹoʊz}	*!				*
☞ {[ɹɪzən]}		*	*		*
{[ɹoʊz]}ən	*!				

c. *thought/thought*

Base:{[θɔt]} Input: [θot]	IO-Faith	Dep-BO:C	Ident-BO:C	Max-BO:C	PART:]/n/
☞{[θɔt]}					*
{[θɔt]}ən	*!				

d. *sank/sunk*

Base:{[saŋk]} Input: [sʌŋk]	IO-Faith	Dep-BO:C	Ident-BO:C	Max-BO:C	PART:]/n/
{[saŋk]}	*!				*
☞ {[sʌŋk]}			*		*
{[saŋk]}	*!				*
{[sʌŋk]}ən	*!		*		

e.*wove/woven*

Base:{[wov]} Input: Ø	IO-Faith	DEP-BO:C	IDENT-BO:C	MAX-BO:C	PART:]/n/
{[wov]}					*!
☞{[wov]}ən					

Note that in every case but *marked* and *woven,* it is the derived-form input that determines the form of the participle; OO-Faith and PART:]/n/ do not participate. The prediction here, then, is that forms whose past tenses are irregular and lack an *-ed* suffix will, in the absence of a derived-form participial input, have the *-en* suffix in the participle; that past-*wove*/participle-*woven* is as much a regular pattern as past-*marked*/participle-*marked*.

3.3.5. Why bother?

What distinguishes this from the suppletion analysis? This analysis works in exactly the same way, except that *woven* and a few other forms with *-en* can be formed productively, rather than being pulled entire from the lexicon. Most irregular forms, with or without *-en*, are what they are because of their derived-form inputs; e.g. forms whose participles resemble the present tense plus *-en,* such as *proven*, and forms whose participles are formed by vowel mutation, such as *sprung*. If the goal is to put as many forms as possible into the realm of the predictable, this analysis moves only feebly towards that goal. Does keeping *woven* out of the lexicon justify the existence of PART:]/n/?

Probably not; but that is not what PART:]/n/ is for. Unpredictable exceptions must, by virtue of being unpredictable, be lexically listed; the claim here is that this listing takes the form of full inputs for exceptional forms, rather than diacritics triggering minor rules. It is not the existence of the pattern itself that necessitates PART:]/n/, but the fact that speakers are capable of extending the pattern to new forms. Below, I show how memory failure can lead to overextension of the *-en* suffix to irregular verbs normally lacking it, such as *brought*.

3.3.6. Errors involving *-en*

I do not have data concerning the actual frequency or nature of speech errors and pattern extensions involving the English past participle, and rely here on unsystematic observation and introspection, informally confirmed by searches of archived Usenet posts using Google; all examples given below come from the Google archives[11]. Possible speech errors involving *-en* include:

a. Attaching *-en* to participles that usually lack it. I have observed this a number of times, in my own speech and that of others, with verbs whose simple past forms are irregular: *should have broughten*, *would have fitten better*. These are unambiguously speech errors. I have not observed any cases in which *-en* is attached to a form with a regular simple past form, after the model of *proved/proven*, but they may exist. Examples:

(99) I almost wish I would have broughten a cassette recorder since it would have been easy to get away with.[12]

[11] Caution must be exercised in looking for data on Usenet, as it is not always obvious whether an unusual form has been used in jest (for example, in mocking imitation of what the writer imagines is a rustic dialect), by a non-native speaker (as is the case in a great many instances), or is strictly a typographical error rather than a grammatical one. As such, providing raw numbers for instances of "have broughten," etc., would be of little use. All examples given here appeared to me to be sincere errors by English speakers, but I may have been mistaken in some cases.

[12] 10/1/1998 post to alt.fan.hanson, archived at http://groups.google.com/groups?q=%22have+broughten%22&hl=en&lr=&ie=UTF-8&oe=UTF-8&safe=off&selm=19981001171017.20258.00004055%40ng155.aol.com&rnum=6

(100) I know that many people have broughten up this point, but I wonder if Asquith and Grey would have stood by Belgium.[13]

(101) I often wonder: could they have fitten all this on maybe 1 or 2 pages and saved me all this reading, and not having written it in a mind-destroying style?[14]

(102) I was amazed to find that they had wroten back so fast![15]

b. Using a participle identical to the simple past when the usual form has *-en*; *could have broke it*, *should have wrote it down*. Examples are easy to find. It is difficult in any particular case, though, to say whether such a participle is truly a speech error; many such forms are grammatical in some dialects of English, and even for a speaker whose dialect does not usually include participial *wrote*, such a form may be used for stylistic reasons; even when not so used, it seems possible that the *-en*-less participles are stored as alternate representations, rather than arising from a momentary malfunction of the grammar. Examples:

(103) I think you should have wrote that YOU have no future.[16]

(104) He could have broke his nose, lost some teeth, or even lost an eye.[17]

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[13] 9/30.1998 post to soc.history.what-if, archived at http://groups.google.com/groups?q=%22have+broughten%22&hl=en&lr=&ie=UTF-8&oe=UTF-8&safe=off&selm=6us9gs%24daa%241%40nnrp2.snfc21.pbi.net&rnum=3

[14] 8/2/2003 post to comp.games.development.programming.misc and to comp.games.development.programming.algorithms, archived at http://groups.google.com/groups?q=%22have+fitten%22&hl=en&lr=&ie=UTF-8&oe=UTF-8&safe=off&selm=vinlgejjt2g931%40corp.supernews.com&rnum=1

[15] 9/22/1887 post to alt.music.sonic-youth, archived at http://groups.google.com/groups?q=%22had+wroten%22&hl=en&lr=&ie=UTF-8&oe=UTF-8&safe=off&selm=19970922090101.FAA19592%40ladder01.news.aol.com&rnum=11

[16] 6/23/1995 post to rec.games.video.sega and rec.games.video.advocacy, archived at http://groups.google.com/groups?q=%22should+have+wrote%22&hl=en&lr=&ie=UTF-8&oe=UTF-8&safe=off&selm=3se6uv%241b0%40odo.PEAK.ORG&rnum=16

c. Attachment of *-ed* to a form with a preceding *-en* already attached, e.g. *brokened, writtened.* [18] I do not address these cases in the analysis that follows, though they can be straightforwardly attributed to the action of a PARTICIPLE: *ed* constraint competing with PARTICIPLE: *en*. I note, however, that *brokened* and *writtened* appear to occur as frequently as adjectives (*e.g. heart-brokened*) as they do as participles, and it is possible that the apparent participial dual-markings are a consequence of the independently-existing adjectival dual marking.

Examples:

(105) My heart was brokened when my Marshmallow died last Friday.[19]

(106) Which ones have been writtened by State Wildlife Agencies?[20]

d. Prescriptive confusion; some unusual verbs give rise to conscious confusion as to the proper form of the participle; in my own speech, "sink" ("sank" vs. "sunk") and "strike" ("struck" vs. "stricken") are problematic.

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[17] 3/20/1995 post to rec.guns, archived at http://groups.google.com/groups?q=%22could+have+broke%22&start=20&hl=en&lr=&ie=UTF-8&oe=UTF-8&safe=off&selm=3kl804%24a3s%40xring.cs.umd.edu&rnum=40

[18] The reader who searches the Google archives should note than a great many of the cases of *brokened* and *writtened* appear to be humorous, especially where news-readers and web pages are referred to.

[19] 2/28/1996 post to alt.pets.rabbits, archived at http://groups.google.com/groups?q=brokened&start=80&hl=en&lr=&ie=UTF-8&oe=UTF-8&safe=off&selm=4h2akv%24hhr%40mark.ucdavis.edu&rnum=100

[20] 12/10/1999 post to alt.animals.furtrapping, archived at http://groups.google.com/groups?q=%22been+writtened%22&hl=en&lr=&ie=UTF-8&oe=UTF-8&safe=off&selm=19991209201827.23303.00000014%40ng-xa1.aol.com&rnum=3

3.3.7. How the pattern is extended

Since exceptionality is encoded in derived-form inputs, extension of a default pattern to new forms is explainable as failure to access the exceptional derived-form input. When the exceptional input for, e.g., participle *thought* is unavailable, the shape of the output is determined by OO-Faith and FIAT alone.

In the case of *thought*, failure to access the input results in *thoughten*:

(107)

Base:{[θɔt]} ~~Input: [θot]~~	IO-Faith	DEP-BO:C	IDENT-BO:C	MAX-BO:C	PART:]/n/
☞{[θɔt]}					*!
☞{[θɔt]}ən	~~*!~~				
{[θɔt]ən}				*!*	

(Symbols stricken through indicate what the situation would be in the absence of memory failure.)

With the input unavailable, no violations of IO-Faith can be incurred, allowing PART:]/n/ to make the decision. Where a verb has a regular past tense but an irregular participle (e.g. *proved*/*proven*), failure to access the exceptional input results in a participle identical to the simple past, just as in the default English pattern:

(108)

Base:{[pɹuv]d} Input: ~~[pɹuvən]~~	IO-Faith	DEP-BO:C	IDENT-BO:C	MAX-BO:C	PART:]/n/	*STRUC
{[pɹuv]ənd}	~~*!~~	*!		*		*******
☞{[pɹuv]d}	~~*!~~				*	*****
☞ {[pɹuvən]}		*!		*	*	******
{[pɹuv]ən}		*!		*		
{[pɹuv]}ən	~~*!~~			*!		******
{[pɹuv]d}ən	~~*!~~				*	******!*

The listed form, [pɹuvən], wins in the ordinary case, because faithfulness to the input outweighs every other consideration. When the input is inaccessible, however, the high-ranked IO-Faithfulness constraints become irrelevant. All the forms satisfying PART:/n/ violate one BO-Faithfulness constraint or another. {[pɹuv]ənd} has a string [ən] within the stem that is not present in the base, and thus violates DEP. Those forms with [ən] inside the stem, as does {[pɹuvən]} or inside both the root and the stem, as does {[pɹuv]ən} violate DEP also; and because they also lack the [d] in the base, also violate MAX. No form satisfying PART:/n/, then, survives. {[pɹuv]d}ən fails because its [ən], since it does not immediately follow the root boundary, does not satisfy PART:]/n/; it fails to satisfy the FIAT constraint just as {[pɹuv]d} does. The additional structure provides no advantage, and incurs more violations of *STRUC than {[pɹuv]d}; thus {[pɹuv]d} is the winner.

3.3.8. Where does *-en* come from?

Note again that even though the grammar contains a constraint attaching *-en*, this constraint often has nothing to do with the actual appearance of *-en* in a word. *Proven* may satisfy PART:]/n/, but only because its input happens to be the right shape; PART:]/n/ gets its way even in cases where it is not strong enough to demand its way.

The language learner has no way of knowing in advance which generalizations about the morphology will be the "good" ones; presumably the learning process involves positing a number of generalizations, some of which can be combined into broader generalizations, some of which prove to be entirely spurious, some of which turn out (like the *-en* generalization) to be neither spurious nor productively usable. (Albright and Hayes 2003, Pinker and Prince 1988, 1993). This is discussed further in the next chapter.

The dual-mechanism model (Pinker and Prince 1993, etc.) holds that both spurious and useless generalizations are expunged from the grammar. I propose instead, following Zuraw (2000) among others, that useless (and even spurious) generalizations are retained in the grammar, in exactly the same fashion as more useful generalizations—as FIAT-STRUC constraints. Their uselessness is encoded in their low ranking, not in their absence.

3.4. Spanish word markers and gender

Spanish gender marking is a morphological system in a certain amount of disarray. A set of suffixes exist that correlate roughly with gender, but the correlation is so riddled with exceptions that the presence of a particular suffix on a word is necessarily encoded in that word's lexical entry independently of the encoding of grammatical gender. Generalizations about the relationship between suffix and gender exist, but for any particular word, it is more important to express its underlying phonological shape than to obey the generalizations.

Nevertheless, the generalizations can be made, and under certain circumstances can have an effect. Where faithfulness to underlying information does not come up—in this case, where words are derived from other surface forms—the morphological generalizations are able to assert themselves. Spanish gender morphology is only a thin film over the lexicon, pierced in any number of places by lexical prominences; only where this film stretches across a lexical gap does the morphology itself, rather than the lexical listings underlying it, determine the shape of the system.

Most of the data in this section derives from Harris (1991), and the insights that are particular to Spanish are almost entirely his. In particular, I have for the most part followed Harris's statements concerning what part of a form comprises the word marker. Harris makes a distinction between final *e* as a true word marker and *e* as an epenthetic vowel that I have not found necessary to preserve.

3.4.1. The Spanish word marker suffixes

Spanish has a set of *word marker* suffixes (Harris 1991) that correlate only imperfectly with particular syntactic or semantic features. Word markers may occur on nouns, adjectives, and adverbs, but not verbs; however, not all nouns, adjectives, and adverbs display word markers. Word markers are all of the shape -(V)(*s*), where V is any vowel in the language (*a, i, u, e,* or *o*), with *-o* and *-a* markers being in the majority. The main word markers are *-a*, *-o*, and *-e*; *-es*, *-os*, *-is*, *-s*, *-i*, and *-u* are more marginal.

Word markers are identifiable as such because they disappear or relocate when other affixes are attached:

(109)	democrat-a	'democrat'	→	democrat-izar	'democratize'
				democrat-ic-o	'democratic'
	virgul-a	'thin line'	→	virgul-illa	'fine line'
	calin-a	'haze'	→	calin-osa	'hazy'

This cannot simply be deletion to resolve hiatus, since vowel sequences not involving word markers are permitted; e.g. *hero-ica* 'heroic'.[21]

While there is a strong correlation between grammatical gender and the form of the word marker, with masculine words usually ending with *-o* and feminine words usually

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[21] The circularity here is not only apparent, but real; it is not, however, pernicious. The Spanish learner, no less than the analyst, identifies a vowel as a word marker or not based on whether it does what a word marker does-i.e. disappears in the presence of another affix. The category of "word marker" consists only of the properties that vowels belonging to the category display. Such matters are addressed in Chapter 4.

ending with -*a*, this correlation is not perfect, in either direction; words of either gender may have any possible word marker, and every word marker may occur with words of either gender.

3.4.2. Morphological analysis at the surface; unpredictability of the word marker

Unless a Spanish word lacks word markers entirely, or has a word marker only in one gender, it never occurs without its word marker or some other affix; the vast majority of bare roots (excluding verbs, which lack word markers) never occur by themselves. Harris argues that all Spanish non-verb roots and stems are bound morphemes, which must undergo additional affixation (in some cases, of a zero morpheme) to be grammatical on the surface.

I will take a somewhat different approach. I will assume that in general, Spanish nonverbs are recorded in the lexicon as surface-possible stems; the noun *libra* 'plate' is not listed in the lexicon as $[\text{libr}]_{\text{root}}$, with additional diacritics indicating that it is subject to *a*-suffixation rather than *o*-suffixation or no suffixation at all; rather, it is listed as $[\text{libra}]_{\text{stem}}$ or $[[\text{libr}]_{\text{root}}\text{a}]_{\text{stem}}$ The listing need not encode the morphological analysis, though it may. This is as it should be; what is predictable in Spanish is not whether or not a word will bear a word marker, or what particular word marker it bears, but that a final (V)(*s*) of the stem, if it occurs, is a word marker affix, not part of the root; the grammar can supply this analysis even where it is absent in the lexicon.

3.5. The word marker generalizations and their associated constraints

Recall that all word markers have the form (V)(*s*), where (V) may be any vowel of the language. The word marker generalization is encoded in three FIAT-STRUC constraints, as follows:

(110)	a.	NONVERB: $]_{root}$V	A nonverb root is followed by a vowel.
	b.	NONVERB: $]_{root}$Vs	A nonverb root is followed by a vowel plus [s]
	c.	NONVERB: $]_{root}$s	A nonverb root is followed by [s]

Both these constraints are ranked below MAX:Segment, DEP:Segment), and IDENT:[syllabic]. Thus they have no power at all to induce suffixation, or phonological changes of any sort; a word like *sol* 'sun' will surface as *sol,* not **sole* or **soles*.

They do have the power, however, to make the morphological analysis of the surface form—the location and nature of morphological boundaries—different from that of the input. If an input ends with a vowel, *s*, or V*s*, and does not have an input morphological analysis beyond stem boundaries at either end of the input string, then the FIAT-STRUC constraints will demand that a root-boundary be added between the final segment(s) and the remainder of the stem. (cf. Hammond's (1999) Aggressive Suffixation.)

Recall that morphological boundaries are not elements that can be added and deleted like segments; they arise only when elements on one side have a morphological affiliation that no segment on the other side shares. Thus the action of these constraints is not directly to add a boundary, but to add a morphological affiliation *root*—that is, adding root morphological affiliation indices—to the elements to the left of the final V in a word. Some examples:

(111) libra 'plate'

$[\text{libra}]_{\text{stem}}$	MAX:Seg	DEP:Seg	NV: $]_{\text{root}}$V	NV: $]_{\text{root}}$Vs	NV: $]_{\text{root}}$s
☞$[[\text{libr}]_{\text{root}}\text{a}]_{\text{stem}}$				*	*
$[[\text{libr}]_{\text{root}}\text{as}]_{\text{stem}}$		*!			*
$[\text{libra}]_{\text{stem}}$			*!	*	*

(112) sol 'sun'

$[\text{sol}]_{\text{stem}}$	MAX:Seg	DEP:Seg	NV: $]_{\text{root}}$V	NV: $]_{\text{root}}$Vs	NV: $]_{\text{root}}$s
$[[\text{sol}]_{\text{root}}\text{a}]_{\text{stem}}$		*!		*	*
$[[\text{sol}]_{\text{root}}\text{as}]_{\text{stem}}$		*!*			*
☞ $[\text{sol}]_{\text{stem}}$			*	*	*

(113) tórax 'thorax'

$[\text{toraks}]_{\text{stem}}$	MAX:Seg	DEP:Seg	NV: $]_{\text{root}}$V	NV: $]_{\text{root}}$Vs	NV: $]_{\text{root}}$s
$[\text{toraks}]_{\text{stem}}$			*	*	*!
$[[\text{toraks}]_{\text{root}}\text{a}]_{\text{stem}}$		*!		*	*
$[[\text{torak}]_{\text{root}}\text{as}]_{\text{stem}}$	*!	*			*
☞$[[\text{torak}]_{\text{root}}\text{s}]_{\text{stem}}$			*	*	
$[[\text{toraks}]_{\text{root}}\text{s}]_{\text{stem}}$		*!	*	*	

(114) Lucas 'Luke'

$[\text{lukas}]_{\text{stem}}$	MAX:Seg	DEP:Seg	NV: $]_{\text{root}}$V	NV: $]_{\text{root}}$Vs	NV: $]_{\text{root}}$s
$[\text{lukas}]_{\text{stem}}$			*!	*	*
$[[\text{luk}]_{\text{root}}\text{a}]_{\text{stem}}$	*!			*	*
☞$[[\text{luk}]_{\text{root}}\text{as}]_{\text{stem}}$					*
$[[\text{luck}]_{\text{root}}\text{s}]_{\text{stem}}$			*!	*	
$[[\text{lukas}]_{\text{root}}\text{s}]_{\text{stem}}$		*!	*	*	

It is crucial that NV: $]_{\text{root}}$Vs or NV: $]_{\text{root}}$V outrank NV: $]_{\text{root}}$s, since otherwise a final [s] would be analyzed as the word marker even if an [a] preceded it, yielding *$[[\text{luca}]_{\text{root}}\text{s}]_{\text{stem}}$ rather than $[[\text{luc}]_{\text{root}}\text{as}]_{\text{stem}}$.

Morphological structure is added, creating $]_{root}$Vs if possible; but nothing can be added or subtracted from the form to make this possible; only morphological affiliations can be changed without penalty.

Note exactly what this imposition of morphological structure means: the segments that occur at the end of a word are purely a matter of lexical listing, just as the segments at the beginning of the word are; but if those segments happen to be of a particular kind, they are interpreted as forming a word marker.

When a noun or adjective or adverb simply occurs on the surface in its listed form, without any additional affixation, the additional morphological structure is invisible; it has no phonological exponent. It comes into play only when the noun forms the morphological base for a more complex form.

3.5.1. Masculine and feminine

The analysis so far has made no mention of gender or its relationship to word markers. Harris argues convincingly that although there is a strong relationship between masculine gender and final *-o*, and feminine gender and final *-a*, the system cannot be explained by a simple analysis in which *-o* is a masculine marker and *-a* a feminine marker, with many forms being lexical exceptions. But there is a relationship, and several facts concerning that relationship need to be explained.

The most interesting cases are those in which a particular word is capable of occurring with either masculine gender or feminine gender. There are a number of nouns of this sort, most of which describe human beings, but the problem is at its simplest in the adjective system.

3.5.2. Gender and word markers in adjectives

Spanish adjectives agree in gender with the noun with which they are associated. For the vast majority of adjectives, the difference between the masculine form and the feminine form corresponds to a difference in word marker, with the masculine form of the adjective ending in *-o* and the feminine form ending in *-a*.

(115)

Masc	Fem	Gloss
crud-o	crud-a	'raw'
bonit-o	bonit-a	'nice

Not all adjectives follow this pattern, however. Some adjectives have no word marker in either the masculine or the feminine:

(116)

Masc	Fem	Gloss
azul	azul	'blue'
fácil	fácil	'easy'

Others have no word marker in the masculine, but have word marker *-a* in the feminine. These are what Harris calls the "gentilic" adjectives; they will receive particular attention in 3.5.5:

(117)

Masc	Fem	Gloss
español	español-a	'Spanish'
inglés	ingles-a	'English'

Others have word marker *-a* in both the feminine and the masculine:

(118)

Masc	Fem	Gloss
belg-a	belg-a	'Belgian'
agrícol- a	agrícol-a	'agricultural'

As Harris points out, the interesting part is what is not present. There are no adjectives with *-o* in both the masculine and the feminine:

(119)

Masc	Fem
italian-o	*italian-o
alt-o	*alt-o
lind-o	*lind-o

Nor are there any adjectives with *-a* in the masculine and *-o* in the feminine:

(120)

Masc	Fem
*italian-a	*italian-o
*alt-a	*alt-o
*lind-a	*lind-o

Nor are there any adjectives with *-o* or *-a* in the masculine and no word marker at all in the feminine:

(121)

Masc	Fem
italian-o	*italian
*inglés-a	*ingles
lis-o	*lis

As we will see below, these facts can be accounted for by the interaction of FIAT constraints and Base/Output Faithfulness constraints. FIAT constraints demanding the presence of word markers, and specifically the presence of final [a] in feminine adjectives, outrank certain BO-Faith constraints, and are thus strong enough to ensure that an [o]-ending in the masculine will correspond to an [a]-ending in the feminine, and to prevent the impossible forms in (121); the FIAT constraints are outranked by other BO-Faith constraints, however, and are thus unable to impose word markers in cases like those in (116). The interaction of Faith and FIAT produces a system in which both lexical idiosyncrasy and morphological exponence operate within strict limits.

3.5.3. FIAT-STRUC and feminine gender; exponence within strict limits

Harris argues that there is no masculine marker *-o*, but there is a feminine marker *-a*. In his analysis, imposition of this feminine marker on a form, combined with diacritics which mark some forms as bearing an *-a* marker regardless of gender and other forms as bearing no word marker, conspires to mark most feminines with *-a*, some masculines with *-a*, and some forms with nothing, with everything left over (the masculines without diacritics, for the most part) assigned the *-o* word marker by default.

In the present analysis, all unpredictable variation arises from below; that is, from the phonological structure specified in the input. Here, too, only the feminine gender is capable of inducing actual morphological marking. The other peculiarities, however, arise not from diacritics inducing special processes or granting immunity from general processes, but from the relative weakness of the feminine FIAT-STRUC constraint; it outranks some faithfulness constraints, but not others, and so is capable of imposing itself only on a limited set of forms.

The FIAT-STRUC constraint responsible for *-a* suffixation is FEMININE:$]_{root}$a:

(122) FEMININE:$]_{root}$a A feminine form contains the string $]_{root}$a

Note that except for its syntactic trigger, this is simply a more specific version of one of the word marker FIAT-STRUC constraints, NONVERB:$]_{root}$V. That constraint demands that nonverbs end with some vowel; this one demands that if a nonverb is feminine (verbs have no gender), it ends with the vowel [a].

The feminine form of an adjective is assumed to be derived from the masculine; that is, the feminine is subject to OO-Faithfulness, with the masculine as the base, while the masculine is subject only to IO-Faithfulness. (Harris argues that adjectives are universally incapable of being lexically restricted to a particular gender.)

3.5.4. Variation in the masculine, and its transmission to the feminine

If the masculine form of an adjective ends in *-o* or *-a*, the feminine form of the adjective will end in *-a*. The final vowel of a masculine form is, necessarily, interpreted in the output as affixal; that is, as coming after a root boundary (see section 3.4.2.). This is the same position that must be occupied by [a] for FEMININE:]a to be satisfied. Since FEMININE:]a outranks IDENT-BO:[low] and IDENT-BO:[round], a final [o] will deviate from its input character to surface as [a]. A final [a] in the masculine requires no alterations; FEMININE:]a is satisfied at no cost to OO-Faithfulness.

(123)

italiano$_1$	MAX-BO:V	DEP-BO	IDENT-BO: [back]	FEMININE:]$_{root}$a	IDENT-BO: [low]	IDENT-BO: [round]
italiano$_1$				* !		
italian]a	* !	*				
☞italian]a$_1$					*	*

If the masculine ends in *-e* or a consonant, however, FEMININE:]a must go unsatisfied. Alteration of base [e] to satisfy the constraint would violate higher-ranked IDENT:[back]; deleting it and replacing it with [a] would violate higher-ranked MAX:V and DEP:V both.

(124)

Base: posibl-e$_1$	MAX-BO:V	DEP-BO:V	IDENT-BO: [back]	FEMININE:]$_{root}$a	IDENT-BO: [low]	IDENT-BO: [round]
☞posibl-e$_1$				*		
posibl-a	* !	*				
posibl-a$_1$			* !		*	

With a consonant-final masculine form, the situation is similar. Changing a consonant to a vowel, suffixation of an [a] not corresponding to any vowel in the base, or deletion of a final consonant to expose an internal [a] would violate IDENT:[syllabic], DEP:V, or MAX:C, respectively, all of which outrank the FIAT-STRUC constraint.

(125)

Base: azul$_1$	MAX-BO:V	DEP-BO:V	IDENT-BO: [syllabic]	FEMININE:]$_{root}$a	IDENT-BO: [low]	IDENT-BO: [round]
☞azul$_1$				*		
azu-a$_1$			* !			
azul$_1$-a		* !			*	

We might wonder what would happen if a masculine form ended with [i] or [u]; the situation does not appear to arise. (Remember that for the moment we are talking about adjectives rather that nouns; nouns ending in [i] and [u] do exist.) With the grammar above, the prediction is that such masculines would have identical feminine equivalents; other rankings of the FIAT-STRUC constraint with respect to the various members of the IDENT:[feature] family would produce different results.

If we look back at (115)-(121), we see that we have achieved exactly the desired result. This analysis predicts just what we see in (115)-(116) and (118) Any form with a final [o] or [a] in the masculine will have final [a] in the feminine, because the feminine FIAT constraint is high-ranked enough to transform [o] into [a]. Any form with no final vowel in the masculine will have no final vowel in the feminine, because the feminine FIAT constraint is not powerful enough to force the insertion of a vowel, only to adjust the quality of a preexisting vowel. The analysis forbids the nonexistent types of adjective pairs shown in (119)-(121); no masculine [o] (or [a] can resist being realized as [a] in the feminine. The issue of the forms in (117) is discussed below.

3.5.5. What is excluded

This analysis predicts that several kinds of masculine/feminine alternations should be impossible in adjectives. There should be no *-o*/*-o (*m. *italiano*/ f. *italiano)*, *-o*/*-e (*m. *italiano*/ f. *italiane)*, *-o*/*Ø (*m. *italiano*/ f. *italian)*, *-a*/*-o (*m. *italiana*/ f. *italiano)*, *-a*/*-e(*m. *italiana*/ f. *italiane)*, or *-a*/*Ø (*m. *italiana*/ f. *italian)* pairs, since a masculine *o* or *a* always demands a feminine *a*; and in fact, such pairs do not occur.

The analysis also makes a more troublesome prediction; that there should be no pairs in which the masculine ends with a consonant and the feminine ends with *-a*. While there is a class of adjectives in which a consonant-final masculine corresponds, as predicted, to an identical feminine, there is a smaller class of adjectives in which a consonant-final or *e*-final masculine corresponds to an *a*-final feminine:

(126)

Masc	Fem	Gloss
anglosajón	anglosajon-a	'Anglo-Saxon'
español	español-a	'Spanish'
holgazán	holgazan-a	'lazy'

Harris calls these the "gentilic" adjectives, and claims that they are largely, though not entirely, confined to national or ethnic descriptors. Other sources claim that the property is partly semantically conditioned, partly phonologically conditioned. According to Williams (1987), the vowel occurs in the feminine of "adjectives of nationality [with masculine forms] ending in -l, -s, or -z and adjectives [with masculine forms] ending in -or, -án, and ón." (p. 712)

Caution must be exercised in trusting this source; it is a paperback dictionary intended for the general reader, and as such may be providing rules of thumb useful to the language learner rather than exceptionless generalizations. Indeed, Harris gives an example of a gentilic adjective lying outside this generalization: *grandote~grandota*, 'big (augumentative)'. Assuming for the present that the generalizations are robust, however, this mixture of phonological and semantic conditioning suggests a solution to the problem.

Recall from 2.13.1 that a FIAT-STRUC constraint, may, by specifying structure on both sides of a morphological boundary, encode both an affix and the environment in which the affix may be attached.

(127) FEMININE: on$]_{root}$a — A feminine form contains the string [on], followed by a root boundary, followed by [a].

FEMININE: $]_{root}$a is unable to attach [a] to consonant-final stems because it is outranked by DEP-BO:V. If FEMININE: on$]_{root}$a outranks DEP-BO:V, it will be able to force attachment of the vowel, even when FEMININE: $]_{root}$a cannot, as we will see in (129).

It is necessary, however, to ensure that the power of FEMININE: on$]_{root}$a is limited to stems ending in [on]. Since all the alternations we have discussed so far have occurred outside the root (but within the stem), we have not had occasion to distinguish between BO-Faithfulness constraints specific to the root and BO-Faithfulness constraints in general. Let us assume that all BO-Faithfulness constraints protecting root material outrank FEMININE: on$]_{root}$a; with this ranking, stem-external vowels can be added, or the values for [low] and [round] of existing stem-external vowels changed, to permit satisfaction of FEMININE: on$]_{root}$a, but no modifications of root-internal material can be made. The effect of this is to allow FEMININE: on$]_{root}$a to impose an additional, root-external [a] where the root ends in [on], while making FEMININE: on$]_{root}$a completely unsatisfiable—unable to affect the root, and unable to add [a] outside it—where the root does not end in [on].

(128)

Base: $a_1z_2u_3l_4$	MAX-BO:root	IDENT-BO:root	DEP-BO:root	FEMININE: on$]_{root}$a	DEP-BO:V	FEMININE: $]_{root}$a
☞ $a_1z_2u_3l_4$				*		*
$a_1z_2u_3l_4$]a				*	*!	
$a_1z_2u_3l_4$on]a			*!*		***	
$a_1z_2o_3n_4$]a		*!*			*	
$a_1z_2$on]a	*!*		**		***	

Adding only [a] allows satisfaction of FEMININE:$]_{root}$a, but not FEMININE: on$]_{root}$a, and only FEMININE: on$]_{root}$a outranks DEP-BO:V. Adding [on] within the root violates DEP-BO:root, while changing [ul] to [on] violates numerous IDENT-BO:root constraints not specifically enumerated above, but all of which outrank FEMININE: on]$_{root}$a. Deleting [ul] and adding [on] within the root is worse than simply adding [on]. Where some modification to the root would be necessary, FEMININE: on]$_{root}$a cannot be satisfied.

With a stem ending in [on]. however, on]a can be superimposed on the existing stem-final string without any violations of BO-Faithfulness to root elements:

(129)

Base: aŋglosa$_1$h$_2$o$_3$n$_4$	Max-BO:root	Ident-BO:root	Dep-BO:root	FEMININE: on]$_{root}$a	Dep-BO:V	FEMININE:]$_{root}$a
aŋglosa$_1$h$_2$o$_3$n$_4$				*		*
☞aŋglosa$_1$h$_2$o$_3$n$_4$]a					*	
aŋglosa$_1$h$_2$o$_3$n$_4$on]a			*!*		***	
aŋglosahon]a					***	

The other "gentilic" endings—[ora] and [ana]—are imposed by similar and similarly-ranked Fiat-Struc constraints. By specifying part of the environment within the PHON itself, the gentilic Fiat constraints can be both stronger than the general FEMININE constraint, in that they outrank Dep-BO:V, and more specific in their application, since they can only make themselves felt where they will not conflict with root faithfulness.

If it is true that adjectives whose masculine forms end in [s], [z], and [l] gain [a] in the feminine only if they are adjectives of nationality, it would perhaps be appropriate to use similar environment-specifying Fiat constraints to account for them, with an additional semantic specification corresponding to "indicates nationality" in each's SYN. Lacking fully trustworthy data at present concerning the robustness of the phonological and semantic generalizations given here, however, I will leave the matter where it stands for now.

3.5.6. Gender marking in nouns

The behavior of nouns is more complex. Unlike adjectives, whose gender arises only through agreement, nouns have inherent gender. As noted earlier, not all nouns bear a word marker, but if a word marker occurs it is always of the shape (V)(s), with any vowel of the language possible for V.

For nouns that do not shift in gender, there are no alternations to explain. Some nouns referring to human beings, however, come in matched pairs, with the member of the pair referring to male persons also carrying male gender, and the member referring to female persons carrying female gender. Some such pairs consist of unrelated forms with equivalent semantic force, or forms related to one another but differing in affixes other than word markers:

(130)

Masc	Fem	Gloss
mach-o	hembr-a	male/female
hombr-e	mujer	man/woman
yern-o	nuer-a	son-in-law/daughter-in-law

Others, however, appear to be versions of one another, differing only in the word markers they bear:

(131)

Masc	Fem	Gloss
colegial	colegial-a	'*collegio* student'
monj-e	monj-a	'monk/nun'
nen-e	nen-a	'child'
criad-o	criad-a	'servant'
alumn-o	alumn-a	'student'

Others pairs are phonologically identical, differing only in grammatical gender (as expressed by agreement). Some bear word markers, others do not:

(132)

Masc	Fem	Gloss
artist-a	artist-a	'artist'
model-o	model-o	'model'
sopran-o	sopran-o	'soprano'
mártir	mártir	'martyr'
joven	joven	'youth'

The cases in (130) require no special explanation. Like ordinary nouns, they have gender and have word markers, differing from ordinary nouns only in that they are in a pair relationship with another noun (see Harris (1991) for discussion of the blocking effect such a pair member has on the sex/gender-switching operation that appears to relate the forms in (131).)

What is interesting is the limitations on possible relationships between the pairs in (131) and (132). The word marker on the male/masculine member of the pair and the word marker on the female/feminine member of the pair are interdependent; we do not see every possible matching of gender and word marker in individual forms, as we do with unpaired nouns.

This relationship is reminiscent of the relationship between the masculine and feminine forms of adjectives. The paired nouns differ from adjectives, however, in exactly what kinds of pairing are excluded. In paired nouns, the excluded relationships are:

(133) a) Word marker (*o* or *a* or *e*) in the masculine, no word marker in the feminine. (e.g. m. *colegial-o, *f. colegial)

b) Word marker *a* or *e* in the masculine, word marker *o* in the feminine. (e.g. m. *colegial-a, f. colegial-o)

c) Word marker *o* or *a* in the masculine, word marker *e* in the feminine. (e.g. m. *jef-a, f. *jef-e)

d) No word marker in the masculine, word marker *o* or *e* in the feminine. (e.g. m. colegial, f. *colegial-o, *colegial-e. (Unlike with non-"gentilic" adjectives, however, it is perfectly possible to have no word marker in the masculine, but *a* in the feminine, e.g. m. profesor, f. profesor-a.)

The implicational relationships—that is, what shapes one gender may have when the other has a particular shape—are as follows:

(134)

Masc		Fem
o	→	a or o
a	→	a
e	→	e or a
Ø	→	Ø or a
o	←	o
o or e or a or Ø	←	a
e	←	e
Ø	←	Ø

The overarching generalization is that if the masculine and feminine differ, they differ in that the feminine has final *a* and the masculine does not.

3.5.7. Capturing the pattern

The crucial difference between paired nouns and adjective pairs is that nouns appear to be capable of being listed with gender information, while adjectives do not. Some masculine/feminine noun pairs are related to each other by OO-Faith, one derived from the other, while others (such as *hombre*/*mujer* are not. The basic form of the constraints involved is the same, but their respective ranking is a little different.

Here, as with the adjectives, the constraint FEMININE:]a is responsible for the alternations. But since this is a different base-output relationship, the OO-Faithfulness constraints are distinct from those at work in the adjective system, and have different rankings with respect to FEMININE:]a.

FEMININE:]a outranks DEP-BO:V and MAX-BO:V. Where a feminine noun is derived from a masculine noun, then, the FIAT-STRUC constraint is capable of forcing the insertion of a new suffixal [a] vowel, or substituting [a] for the final vowel of the masculine form. Whenever the feminine is derived from the masculine, then, the output will end in [a]:

(135)

Base: alumn-o	FEMININE: $]_{root}$a	MAX-BO:V	DEP-BO:C
alumn-o	*!		
☞ alumn-a		*	*

(136)

Base: jef-e	FEMININE: $]_{root}$a	MAX-BO:V	DEP-BO:C
jef-e	*!		
☞ jef-a		*	*

(137)

Base: colegial	FEMININE: $]_{root}$a	MAX-BO:V	DEP-BO:C
colegial	*!		
☞ colegial-a			*

This does not account for those cases in which neither form has a word marker, or both forms have the same non-*a* word marker, such as *canibal*/*canibal* 'cannibal' and *modelo*/*modelo* 'model.' But recall that nouns are capable of having separate masculine and feminine forms, unlike adjectives, in which the feminine form is (by hypothesis) always derived from the masculine; this is shown by the existence of suppletive masculine/feminine pairs like *hombre*/*mujer*. The complete lack of resemblance in these suppletive cases shows that IO-Faithfulness must outrank BO-Faithfulness in nouns If cases like *collegial*/*colegiala* represent the derivation of a feminine form from a listed masculine, cases like *canibal*/*canibal* and *modelo*/*modelo* represent independently listed masculine and feminine forms which happen to be identical.

3.6. Conclusion

In this chapter we have seen that FIAT constraints interacting with Output-Output correspondence are capable of accounting for a complex system of partly phonologically conditioned, partly unpredictable declension classes. Furthermore, they do so without granting declension classes any formal status within the analysis itself; the "class membership" of any form is a consequence of the interaction of its underlying phonological structure with the FIAT and Faithfulness constraints.

As such, the grammar proposed here proceeds directly from the forms and generalizations that the language learner must make in acquiring the grammar, and does not require the learner at any point to engage in the wholesale transformation of a lexicon made up of observed forms into a lexicon of stripped roots, marked with diacritics that will trigger particular rules. Any theory must propose that the learner at some point records the observations that the masculine form of 'Italian' is *italiano* and the feminine form is *italiana*, and that both the masculine and feminine forms of 'Belgian' are *belga*. A diacritic theory like that of Harris (1991) proposes that at some point, the learner strips these forms of their final vowels and assigns *belga* a diacritic telling the grammar always to attach the final vowel [a], while for *italia,* the default [o] marker is attached in the masculine and [a] is attached in the feminine. The observed property—ending in [a]—gives rise, in an analytical leap by the learner, to the derived property of bearing a particular diacritic, whereupon the observed property is expunged from the lexicon. The theory proposed here, in contrast, assumes that the observed properties of forms are forever directly responsible for the behavior of the speaker; *belga* ends with [a] in the masculine not because it belongs to an "a" declension class, but because its underlying form ends with [a]. There is continuity between the lexicon or the learner and the lexicon of the speaker. The issue of inductive learning in FIAT morphology is explored in more depth in the next chapter.

3.7. Summary of the theory

The essential features of the theory being, at this point, all in place, let us review them.

Processes of inflectional morphology are the result of FIAT constraints, which demand that forms with particular syntactic properties display particular phonological properties. Some FIAT constraints demand the presence of particular phonological structures; material introduced by these FIAT-STRUC constraints lies partly outside the interaction of Faithfulness and Markedness, and FIAT-STRUC constraints are thus responsible for the deviation from general phonological processes that is common in inflectional morphology. FIAT-MORPH constraints introduce new morphemes, which lie completely within the system of Faithfulness and Markedness, creating structures that share the same susceptibility to phonological processes as non-FIAT structures.

FIAT constraints are violable and ranked with respect to Faithfulness constraints, Markedness constraints, and each other. This permits exceptionality to be treated as the result of Faithfulness outranking the productive FIAT constraints; further, it allows "useless" marginal or unproductive patterns to coexist in the grammar in the form of constraints too low-ranked to produce any effects under ordinary circumstances, but able in cases of momentary reranking or unsatisfiability of higher-ranked constraints to extend the unproductive patterns to new forms or incorrect forms; speakers' knowledge of unproductive patterns is thus encoded in the grammar in exactly the same fashion as the knowledge of more productive patterns. Competition between FIAT constraints also provides an account of systems in which multiple processes are available to mark the same syntactic characteristic, with the decision between them made by phonological or lexical characteristics of the form.

The next chapter resumes the discussion of FIAT-MORPH and FIAT-STRUC and the relationship between them. The origin of any particular grammar's FIAT constraints in the set of generalizations the learner makes about morphological markers in the available evidence is discussed, using a particular class of exceptional affixes in Berber as the ground for discussion.

4. The Relationship Between FIAT-STRUC and FIAT-MORPH

4.1. Introduction

This chapter examines the relationship between FIAT-STRUC and FIAT-MORPH, and proposes that FIAT-STRUC constraints are direct encodings of observational generalizations made by the language learner, while FIAT-MORPH constraints are the result of a process by which those generalizations are turned into larger generalizations and lexical entries for morphemes. The process of turning collections of FIAT-STRUC constraints into FIAT-MORPH constraints is not always successful, since where an affix deviates from the general phonological patterns of a language, a grammar encoding it only in FIAT-MORPH constraints cannot generate the observed behavior of the affix. FIAT-STRUC constraints, then, represent the retention in the adult grammar of partial generalizations made during language learning.

4.2. The English plural suffix -*s*

Consider the English plural suffix -*s*. It has three allomorphs: [z] after stems ending in voiced nonsibilants ([dag]~[dagz]), [s] after stems ending in voiceless nonsibilants, ([kæt]~[kæts]) and [əz] after stems ending in sibilants ([bʌz]~[bʌzəz]).

This allomorphy is equally susceptible to a strictly FIAT-STRUC analysis and a strictly FIAT-MORPH analysis. In the next two sections, one analysis of each sort is presented; this will form the foundation for a discussion of the relationship between FIAT-MORPH and FIAT-STRUC, both in a particular grammar and in the acquisition of morphology.

4.2.1. *-s* by FIAT-STRUC

In one approach, each of the three allomorphs of *-s* could be encoded in a single FIAT-STRUC constraint:

(138)	PLURAL: $]_{stem}$z	A plural noun contains the string $]_{stem}$z.
(139)	PLURAL: $]_{stem}$s	A plural noun contains the string $]_{stem}$s.
(140)	PLURAL: $]_{stem}$əz	A plural noun contains the string $]_{stem}$əz.

Selection between the three allomorphs of *-s* is the result of two Markedness constraints, one banning adjacent obstruents unlike in voicing, the other banning adjacent sibilants:

(141)	*D//T	Adjacent obstruents differing in voicing are prohibited.
(142)	*SS	Adjacent sibilants are prohibited.

Three Faithfulness constraints play a role in the analysis:

(143)	IDENT (IO):[voice]	Correspondent segments in input and output have the same value for [voice]
(144)	MAX:Seg	A segment in the input has a correspondent in the output.
(145)	DEP:ə	A [ə] in the output has a correspondent in the input.

The ranking among these constraints is given in (146):

(146) Ranking:

{*D//T, *SS, IDENT (IO):[voice], MAX:Seg, DEP:ə}
|
PLURAL: $]_{stem}$z
|
PLURAL: $]_{stem}$s
|
PLURAL: $]_{stem}$əz

All the Markedness and Faithfulness constraints outrank all the FIAT-STRUC constraints. All three of the FIAT-STRUC constraints are ranked with respect to the other two, and each is incompatible with both of the others; no form can simultaneously satisfy all the FIAT-STRUC constraints, and unless higher-ranked Markedness and Faithfulness make it impossible, PLURAL: $]_{stem}$z will be satisfied in preference to PLURAL: $]_{stem}$s, and PLURAL: $]_{stem}$s in preference to PLURAL: $]_{stem}$əz.

This yields the correct results, as the tableaux below demonstrate:

(147) cat → cats

kæt$_{\alpha}$, PLURAL	*D//T	*SS	IDENT (IO): [voice]	MAX:Seg	DEP:ə	PLUR: $]_{stem}$z	PLUR: $]_{stem}$s	PLUR: $]_{stem}$əz
a. kæt$_{\alpha}$						*!	*	*
b. kæt$_{\alpha}$]z$_{\beta}$	*!						*	*
☞c. kæt$_{\alpha}$]s$_{\beta}$						*		*
d. kæt$_{\alpha}$]ə$_{\beta}$z$_{\beta}$						*	*!	
e. kæd$_{\alpha}$]z$_{\beta}$			*!				*	*
f. kætə$_{\alpha}$]z$_{\beta}$					*!		*	*
g. kæ$_{\alpha}$]z$_{\beta}$				*!			*	*

(148) dog → dogs

dɔg$_{\alpha}$, PLURAL	*D/T	*SS	IDENT (IO):[voice]	MAX:Seg	DEP:ə	PLURAL: $]_{stem}$z	PLURAL: $]_{stem}$s	PLURAL: $]_{stem}$əz
a. dɔg$_{\alpha}$						*!	*	*
☞b. dɔg$_{\alpha}$]z$_{\beta}$							*	*
c. dɔg$_{\alpha}$]s$_{\beta}$	*!					*!		*
d. dɔg$_{\alpha}$]ə$_{\beta}$z$_{\beta}$						*!	*	

(149) buzz → buzzes

bʌz$_{\alpha}$, PLURAL	*D/T	*SS	IDENT (IO):[voice]	MAX:Seg	DEP:ə	PLURAL: $]_{stem}$z	PLURAL: $]_{stem}$s	PLURAL: $]_{stem}$əz
a. bʌz$_{\alpha}$						*	*	*!
b. bʌz$_{\alpha}$]z$_{\beta}$		*!					*	*
c. bʌz$_{\alpha}$]s$_{\beta}$	*!	*				*		*
☞d. bʌz$_{\alpha}$]ə$_{\beta}$z$_{\beta}$						*	*	
e. bʌ$_{\alpha}$]z$_{\beta}$				*!			*	*

Where a stem ends in a voiceless nonsibilant, as in (147), high-ranked *D//T eliminates [kætz], the candidate in which the stem is completely faithful to its input and the preferred allomorph is used. Faithfulness eliminates all other candidates using the preferred allomorph, since all such candidates involve either the devoicing of the stem-final consonant, violating IDENT-[voice]-IO, its deletion, violating MAX:Seg, or the insertion of a stem-final epenthetic voiced segment, violating DEP:ə. Both [kæts] and [kætəz] satisfy Faithfulness and Markedness; since PLURAL: $]_{stem}$s outranks PLURAL: $]_{stem}$əz, [kæts] is the winner.

Where a stem ends in a voiced nonsibilant, as in *dogs*, matters are simpler; the highest-ranked FIAT-STRUC constraint can be satisfied without violating any higher-ranked constraint, so [dɔgz] is the winner. [dɔgs] is eliminated through its violation of *D//T, but even without this violation it would not survive.

Where the stem ends in a sibilant, as with *buzzes*, all of the candidates satisfying either of the higher-ranked FIAT-STRUC constraints violate Faithfulness or Markedness. Low-ranked PLURAL: $]_{stem}$əz wins by default.

4.2.2. *-s* by FIAT-MORPH

The FIAT-MORPH analysis makes use of the same Markedness constraints and Faithfulness constraints, but requires one additional Faithfulness constraint:

(150) IDENT (IO):[voice]$_{ROOT}$ Correspondent root segments in input and output have the same value for [voice].

It is ranked above IDENT (IO):[voice], and is simply a more specific version of that constraint. Its purpose is to allow a distinction between the value accorded to root and affixal material; when exactly the same featural change can be made either to a root or a nonroot segment, all else being equal, change to the nonroot segment will be preferred.

The three allomorphs of *-s* are all encoded in a single FIAT-MORPH constraint:

(151) PLURAL: $]_{stem}$/z/ Nouns contain a stem boundary followed by a correspondent of the input /z/.

The ranking among these constraints is as follows:

(152) Ranking:

{*D//T, *SS, IDENT (IO):[voice]$_{ROOT}$, MAX:Seg, PLURAL:]$_{stem}$/z/ }
|
DEP:ə
|
IDENT (IO):[voice]

As before, Faithfulness and Markedness determine which allomorph of *-s* will occur in a given form. Here, however, this determination is a matter of phonological variation, not allomorph selection; all the morphemes involved will undergo the minimal violations of Faithfulness necessary to satisfy higher-ranked Markedness. The FIAT-MORPH constraint could be removed from the analysis, and /z/ concatenated with the root prior to provision of the input to GEN, without materially affecting the way the analysis works. The tableaux below demonstrate that the winning candidates are segmentally identical to those that win in the FIAT-STRUC analysis:

(153) cat → cats

kæt$_\alpha$, PLURAL	*D//T	*SS	IDENT (IO): [voice] ROOT	MAX:Seg	PLUR:]$_{stem}$/z/	DEP:ə	IDENT (IO): [voice]
a. kæt					*!		
b. kæt$_\alpha$]z$_\beta$	*!						
☞c. kæt$_\alpha$]s$_\beta$							*!
d. kæt$_\alpha$]ə$_\beta$z$_\beta$						*!	
e. kæd$_\alpha$]z$_\beta$			*!				
f. kætə$_\alpha$]z$_\beta$						*!	
g. kæ$_\alpha$]z$_\beta$				*!			

(154) dog → dogs

dɔg$_{\alpha}$, PLURAL	*D/T	*SS	IDENT (IO): [voice] ROOT	MAX:Seg	PLUR:]$_{stem}$/z/	DEP:ə	IDENT (IO): [voice]
a. dɔg$_{\alpha}$					*!		
☞b. dɔg$_{\alpha}$]z$_{\beta}$							
c. dɔg$_{\alpha}$]s$_{\beta}$	*!						*
d. dɔg$_{\alpha}$]ə$_{\beta}$z$_{\beta}$						*!	

(155) buzz → buzzes

bʌz$_{\alpha}$, PLURAL	*D/T	*SS	IDENT (IO): [voice] ROOT	MAX:Seg	PLUR:]$_{stem}$/z/	DEP:ə	IDENT (IO): [voice]
a. bʌz					*!		
b. bʌz$_{\alpha}$]z$_{\beta}$		*!					
c. bʌz$_{\alpha}$]s$_{\beta}$	*!	*					
☞d. bʌz$_{\alpha}$]ə$_{\beta}$z$_{\beta}$						*	
e. bʌ$_{\alpha}$]z$_{\beta}$				*!			

4.3. The essential analysis and the observational analysis

The FIAT-STRUC analysis and the FIAT-MORPH analysis achieve the same results, but they work in fundamentally different ways. In the FIAT-STRUC analysis, there is no essential relationship between the three allomorphs, beyond the fact that they share the same SYN. The three allomorphs happen to be phonologically similar, but they need not be; they could be as different from one another as the three allomorphs of the Yidiɲ suffix analyzed earlier (see 2.7), and the fact that they can be derived from one another by the same phonological processes operating elsewhere in the language is accidental. They are, in a sense, not "really" three allomorphs of a single morpheme; they are three independent reflexes of the same syntactic property. FIAT-STRUC allomorphy apes the effects of phonological processes, but is not produced by those processes.

In the FIAT-MORPH analysis, on the other hand, the three allomorphs arise from the same source, /z/. The fact that the allomorphs are exactly what the general phonological processes of the language would produce is unsurprising, because the three different surface shapes of the suffic are produced by exactly those processes.

The FIAT-STRUC analysis is, in a very straightforward way, less insightful than the FIAT-MORPH analysis; it fails to capture the apparently obvious fact that these are not three unrelated allomorphs, but three phonological reflexes of the same basic form. Wherever the different allomorphs of a particular morpheme can be related to each other by the same phonological processes as are in operation elsewhere in the language—or, in fact, can be related to each other by phonological processes that are compatible with the language as a whole, though they may have no other application—a FIAT-STRUC analysis will be likewise uninsightful, will miss the generalization.

Why, then, would a FIAT-STRUC analysis ever be proposed? We have already seen the most important reasons; aside from their usefulness in accounting for morphological haplology, FIAT-STRUC constraints are necessary because, by virtue of the exact matching requirement, they are able to encode exactly those properties of morphemes that are not explainable in terms of a language's general phonological processes applying to unitary inputs. In the next section, a species of exceptionality in Berber morphology is analyzed using FIAT-STRUC constraints; the Berber phenomenon both demonstrates the necessity for FIAT-STRUC constraints in addition to FIAT-MORPH constraints, and provides the jumping-off point for a discussion of the acquisition of morphology, and the role that FIAT-STRUC constraints play in the development of a morphological grammar from the evidence available to the learner.

4.4. The Berber languages

As the remainder of this work is almost entirely concerned with phenomena from various Berber languages, a brief introduction is appropriate. The Berber languages form a branch of the Afro-Asiatic language family, and comprise several dozen languages of varying mutual comprehensibility. Berber languages are spoken across a large part of North Africa, with communities existing in (among other countries) Egypt, Mali, Niger, Libya, Tunisia, Moroccao and Algeria, as well as worldwide. The largest concentrations of Berber speakers are in Algeria, where they make up 20% of the population, and in Morocco, where they make up more than 40% of the population. The varieties of Berber relevant to this thesis are Ayt Ndhir Tamazight (Penchoen 1973, Saib 1976a), Imdlawn Tashlhiyt (Dell and Elmedlaoui 1987), and Kabyle (Bader 1983, 1984, Dallet 1982, Naït-Zerrad 1994).

A valuable bibliography of Berber language materials compiled by Kyra Jucovy and John Alderete is available (in December 2003) at http://ruccs.rutgers.edu/~alderete/bbiblio2_june01.pdf. Readers interested in the Berber-speaking peoples from a non-linguistic perspective may wish to consult Brett and Fentress (1997), from which most of the information given here was taken.

4.5. Case study: FIAT-STRUC and the phonotactics of Berber clustering affixes

In several Berber languages, certain affixes form clusters that are immune to an otherwise general process of cluster-resolving epenthesis; thus, for example, an utterance-final consonant-plus-[ð] cluster is forbidden if the final [ð] is part of the root—[əssənʁəð] ('to pulverize') vs. *[əssnəʁð]—but obligatory if the [ð] is a particular affix—[θəxðəmð] ('you (sing) work') versus *[əθxəðməð]. The discussion of the pattern and the analysis of epenthesis presented here derive largely from MacBride (2000), who draws on work by Saib (1976a, 1976b), Penchoen (1973), and Bader (1984, 1985), among others. The explanation for the phenomenon proposed here, however, represents a rejection of that earlier work's proposals (see 4.5.5 below).

4.5.1. The distribution of schwa

To understand the phenomenon at issue here, we must first understand the general pattern to which the clustering affixes form an exception. The general distribution of schwa is similar across a number of Berber dialects, and is largely explainable as schwa epenthesis motivated by pressure to avoid undesirable clusters. Ayt Ndhir Tamazight as described by Saib (1976) is typical; schwa occurs in the following environments:

(156)	a.	Between a consonant and a word-final consonant	C__C#
	b.	Between C_1 and C_2 of a $C_1C_2C_3$ sequence	C__CC
	c.	Between a consonant and a geminate	C__C:
	d.	Before a word-initial CC sequence	#__CC
	e.	Before a word-initial geminate	#__C:

For words without geminates, the occurrence of schwa is predictable from schwa-less inputs by the rule in (157), applying iteratively from right to left:

(157) $\emptyset \rightarrow ə \,/\, \begin{Bmatrix} C \\ \# \end{Bmatrix} \_\_ C \begin{Bmatrix} C \\ \# \end{Bmatrix}$ (Saib 1976, p. 128)

(158) xðm → əxðəm

Underlying Representation:	xðm
Epenthesis:	xð**ə**m
Epenthesis:	**ə**xðəm
Phonetic Representation:	əxðəm

Complexities arise when words with geminates are considered, since geminates are never broken up by epenthesis and certain clusters undergo geminating assimilation rather than epenthesis. I discuss the matter extensively in MacBride (2000), but it is not especially relevant here.

In Kabyle Berber (Bader 1984, Dallet 1953, Naït-Zerrad 1994), whose schwa epenthesis pattern is fundamentally the same, there is a wholesale reorganization of syllable structure and the locations of schwa in phrasal contexts, such that the statement of schwa's distribution given in (156) holds true over the entire string, not over individual words.

(159) (əx)(ðəm) 'fix/work' (ax)(xam) 'house'

but

(xəð)(m ax)(xam) 'fix the house' (Bader 1984)

It is not clear whether this holds true in Ayt Ndhir Tamazight as well, or the exact nature of the strings over which it applies (e.g. over the entire utterance, over the entire sentence, over individual phrases). I will assume that the pattern does hold for Ayt Ndhir Tamazight; and while the question of the precise domain of the generalizations is interesting in itself, it does not materially affect the present analysis and I will not discuss it further.

4.5.2. Analysis of the general pattern

Within Optimality Theory, the general pattern can be explained as the effect of a constraint against clusters and a constraint against schwa in open syllables, both ranked above MAX:ə, DEP:ə, ONSET, and *CODA, but below MAX and DEP for all other segments. The constraints are given in (160) through (167).

(160) MAX:Nonschwa (MAX:Seg) A segment other than ə in the base/input has a correspondent in the output.

Note that this conflates a large number of independent MAX constraints which need not be distinguished for present purposes.

(161) DEP:Nonschwa A segment in the output has a correspondent in the input.

(162) *ə]$_\sigma$ Schwa does not occur in an open syllable.

(163) *COMPLEX A syllable has neither a complex onset nor a complex coda.

(164) MAX:ə A schwa in the base/input has a correspondent in the output.

(165) DEP:ə A schwa in the output has a correspondent in the base/input.

(166) ONSET A syllable has an onset.

(167) *CODA A syllable has no coda.

Their ranking is as follows:

(168)

{MAX:Seg, DEP:Seg, *ə]$_{\sigma}$, *COMPLEX }
|
{MAX:ə, DEP:ə}
|
{ONSET , *CODA}

The effect of this ranking is to guarantee that every output form will have schwa in exactly the sites listed in (156) and nowhere else, no matter what the occurrence of schwa in the input. Tableau (169) demonstrates that the underlying absence of schwas is irrelevant to the output; (170) illustrates that the underlying presence of schwas in any location is likewise irrelevant to the output.

(169)

xðm	MAX:Seg	DEP:Seg	*ə]$_{\sigma}$	*COMPLEX	MAX:ə	DEP:ə	ONSET	*CODA
xðm				*!				*
xəðm				*!				*
☞əxðəm					* *		*	* *
xəðəm			*!		* *			*
xəðmə			*!		* *			*
xəðəmə			*!*		* * *			
xə	*!*				*			
axðam		*!*					*	* *

(170)

əxəðəmə	MAX:Seg	DEP:Seg	*ə]$_σ$	*COMPLEX	MAX:ə	DEP:ə	ONSET	*CODA
əxəðəmə			*!***				*	
xəðm				*!		***	*	*
☞əxðəm					**	**		*
xəðəm			*!			**		*
xəðmə			*!			**		*
xəðəmə			*!**			*		

Note that with the exception of the non-schwa faithfulness constraints, *COMPLEX and *ə]$_σ$ are entirely responsible for the distribution of schwa in outputs; ONSET and *CODA play no role in the determination of schwa locations for any form.

4.5.3. Clustering affixes

In many Berber languages, this general pattern fails to apply to clusters created by the attachment of certain suffixes, though the particular suffixes involved vary from language to language. In Ayt Ndhir Tamazight, the second person singular verb suffix /ð/ and the feminine plural verb suffix /θ/ are two such suffixes. The pattern is illustrated below in a paradigm copied from Saib (1976), showing the past conjugation of the Ayt Ndhir Tamazight verb /xðm/ 'to work'. Surface forms are given on the left; the same forms are shown without schwa on the right.

(171	Singular		Plural		Singular		Plural
1	xəðməx	1	nəxðəm	1	xðm-x	1	n-xðm
2	θəxðəmð	2m	əθxəðməm	2	θ-xðm-ð	2m	θ-xðm-m
		2f	əθxəðməmθ			2f	θ-xðm-m-θ
3m	ixðəm	3m	xəðmən	3m	i-xðm	3m	xðm-n
3f	θəxðəm	3f	xəðmənθ	3f	θ-xðm	3f	xðm-n-θ

(Saib 1976a)

When /x/ is attached to /xðm/ in the first person singular, the result is a word conforming to the regular pattern of schwa distribution. When /ð/ is attached, however, no schwa occurs before the affix, resulting in a word-final cluster. The /θ/ suffix in third person feminine plural forms likewise forms an otherwise illegal cluster with the preceding [m] or [n].

The word-final clustering property of these affixes is morphological in nature, not purely phonological. Except in certain biconsonantal roots, root consonants do not form exceptional clusters, even when consonants that cluster as affixes are involved. (Bader 1985, p. 234; Saib 1976 p. 134) As an affix, [ð] forms a word-final cluster; as part of a root, it does not:

(172) əssənʁəð 'to pulverize' (Saib 1976, p. 134)

If the final [ð] were the verb suffix, *[əssnəʁð] would be grammatical, and in fact obligatory; it is the morphological properties of the form, not some purely phonological property of final [ð] (for example a ranking of the constraints violated by final Cð clusters below DEP:ə, making it more desirable to tolerate the cluster than to add an extra schwa), that makes the exceptional clusters possible. The schwa that occurs before a non-clustering affix like /x/ behaves exactly like other schwas, appearing or not in phrasal contexts according to the pattern in (156):

(173) xəðməx but əxməðx axxam

Since [x] is not among those suffixes with the special property, it behaves exactly as any other consonant would in its position; *[əxməðx] in isolation is as ungrammatical as *[əssnəʁð].

4.5.4. Explaining the pattern

Various explanations for the phenomenon have been proposed, most analyses holding that whether an affix forms clusters or not is a lexical fact of some sort.

Kossman (1995) and Saib (1976) both hold that the appearance or nonappearance of schwa before an affix reflects the underlying presence or absence of a schwa in that position. The nonexceptional affixes are those that have an underlying schwa before the consonant, while the clustering affixes have no such schwa: /əx/ versus /ð/ and /θ/. This sort of analysis requires that word-final clusters not be repairable by the general schwa-insertion mechanisms of the language.

In Bader (1984), the syllabification rules which drive epenthesis refer specifically to particular affixes, assigning them to positions within the syllable such that schwa will never be inserted before them. Dell and Tangi (1992) propose that certain affixes are lexically specified as extrametrical, with similar effects.

MacBride (2000) attempts to explain the pattern without recourse to lexical specificity. Different cluster types are penalized by distinct and differently ranked markedness constraints; ALIGN demands that suffixes be immediately adjacent to the associated stems, with no intervening schwa. The clustering affixes are those creating clusters violating markedness constraints ranked below ALIGN, while the regular affixes are those creating clusters violating markedness constraints ranked above ALIGN.

4.5.5. Clustering as a property of particular affixes

I abandon here the notion pursued in MacBride (2000) that the pattern can be reduced to the interaction of ALIGN constraints and cluster-specific markedness constraints, and treat the ability to form exceptional clusters as some property specific to particular affixes, not reducible to general phonological principles of the language. [22] The question, then, is what the nature of this special property might be.

This is a more difficult problem than it might appear at first. In the first section, we saw that the distribution of schwa is in general determined entirely by $*ə]_\sigma$ and *COMPLEX; we have claimed that *COMPLEX must outrank DEP:ə. If this view is maintained, then the underlying presence or absence of schwa in these forms is irrelevant. Whether or not schwa occurs before these affixes, since the absence of schwa would result in a word final cluster, a schwa should be inserted:

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[22] While a detailed critique of MacBride (2000) would serve little purpose here, it should be noted that the present reanalysis is not pursued simply for the sake of variety. My 2000 analysis sought to attribute the particular identity of the clustering affixes across Berber languages—e.g. the fact that some [t] affixes form clusters but no [n] affixes do—to a detailed set of universal and universally ranked constraints penalizing non-vowel-adjacent consonants according to their featural identity. While I am not aware of evidence falsifying that proposal, I am also not aware of evidence from outside Berber supporting the specific system of constraints and rankings it requires. Since FIAT morphology provides mechanisms that account more simply for the same data, and can also account generally for morphological exceptions to general phonological patterns, it deprives MacBride (2000) of any especially compelling explanatory power.

(174)

θ + xðm + əð	*ə]$_σ$	*COMPLEX	DEP:ə
*☞ əθxəðməð			* *
θəxðəmð		* !	* *

(175)

θ + xðm + ð	*ə]$_σ$	*COMPLEX	DEP:ə
*☞ əθxəðməð			* * *
θəxðəmð		* !	* *

Saib, who attributes the clustering/nonclustering property to the underlying presence or absence of schwa in the suffixes, solves this problem by claiming that schwa is never inserted before a word-final consonant. He gives the epenthesis rule in (176):

(176) Ø → ə / __CCV

Since schwa is never inserted before a word-final consonant, schwa will appear before a monoconsonantal suffix only if it is underlying.

This approach has two problems. First, if it is claimed that epenthesis never occurs before a word-final consonant, it follows that any schwa before a word-final consonant is underlying. Yet except for words with nonclustering suffixes (and the exceptions discussed in MacBride (2000)), word-final CC clusters do not occur in surface isolation forms. If schwa before C# is always underlying, then the fact that in general it always occurs must be treated as an accident; a regular pattern in the lexicon that lacks any explanation in the phonology. Forms like (177) should be possible surface isolation forms, but no such words exist:

(177) *xəðm

This is far from impossible, of course; as we have seen elsewhere, the existence of a pattern in the lexicon does not imply the necessity of a synchronic explanation for the pattern in the grammar. Still, it is suspicious.

A more serious problem arises when we consider words in phrasal contexts rather than in isolation. As we have seen, generalizations about the distribution of schwa hold, at least in some dialects, at the level of the phrase, not the level of the individual word; within a phrase, schwas present in the isolation form will be absent, and schwas absent in the isolation form will be present, to permit the entire phrasal string to satisfy $*ə]_σ$ and *COMPLEX. Yet schwa never occurs before a clustering affix, even when the affix is the first consonant of a CCV string at the level of the phrase (e.g. θaqʃiʃθ θəbbi aqʃiʃ, 'the girl pinched the boy' (Bader 1984, p. 125); the feminine suffix [θ] is a clustering suffix in Kabyle Berber). It is not enough, then, to say that the difference between clustering and nonclustering affixes reflects a difference between the underlying presence or absence of schwa, since schwa fails to occur even when the epenthesis rule should insert it. Some factor must actively forbid the insertion of schwa before the clustering affixes.

Kossmann's (1995) proposal runs into similar problems. In this analysis, schwa is inserted by the following rule:

(178) Ø → ə / C(ː)__C(ː) unless this would give rise to a sequence [əCV][23]

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[23] "|CC| → |CeC| sauf si cela donne lieu à une succession |ecV|" Kossman (1995), p. 73. C stands for a geminate or singleton consonant, c for a singleton consonant.

This rule applies before any affixes are attached; schwa will thus not occur before any suffix unless it is underlyingly present. When a vowel-initial suffix is attached, this triggers "resyllabification," which presumably involves both a rule deleting schwa before CV and a reapplication of rule (178).

Since in this analysis the epenthesis rule does apply before word-final consonants, it does not require that the otherwise general occurrence of schwa in that position be treated as accidental. It faces the same difficulty as Saib's analysis, however, when epenthesis in phrasal contexts is considered. Even if the epenthesis rule applies to individual forms only before affixation, since it must apply again to the entire phrasal string, there is no explanation for the failure of schwa to be inserted before the clustering affixes. Once again, we require some force that actively prevents epenthesis in these cases.[24]

Bader (1983, 1984, 1985) and Dell and Elmedlaoui (1987) attribute the clustering property to special metrical conditions on the affixes involved, amounting essentially to specified extrametricality at some stage of the derivation preceding schwa epenthesis, followed by subsequent incorporation of the affixes into the syllable structure. Though their analyses are derivational, something of the sort is conceivably possible in a nonderivational analysis; it is not clear, however, exactly how it would work.

In the end, however, it is perhaps wrongheaded to seek an explanation for this lexical peculiarity in anything but its own overt nature. As I show in the next section, FIAT-STRUC morphology allows the clustering property to be encoded directly in the morphological process itself; these affixes form clusters because the constraints that demand them are

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[24] One could propose that *COMPLEX is violated only by word-internal complex codas, and is not violated by word-final codas even when they are followed by a consonant belonging to another word. In fact, this is not possible; certain biconsonantal verb roots form word-final clusters in isolation or at the end of a phrase, and presumably must lack an underlying schwa before the last consonant. Yet when these words occur within a phrase, a schwa is inserted between the consonants when the next word begins with a consonant. See MacBride (2000) for discussion.

satisfied only when they belong to clusters. The morphological grammar does not require a motivation at some level beneath the surface for everything it does; it only needs to be capable of encoding, and enforcing, the surface pattern.

4.5.6. FIAT-STRUC analysis

Clustering affixes such as [ð] can be encoded in FIAT-STRUC constraints making demands on the phonological material of the stem, not just the affixal material (see section 2.13.1). Two FIAT-STRUC constraints, given in (179) and (180), encode the [-ð] suffix.

(179)	2-PERS, SING: $C]_{stem}ð$	A second person singular verb contains a stem-final consonant followed by [ð]
(180)	2-PERS, SING: $]_{stem}ð$	A second person singular verb contains a stem boundary followed by [ð]

Note that (179) specifies material on both sides of the stem boundary; it is an environment-specifying FIAT constraint, such as those we saw in 2.13.1 and 3.5.5. The use of two nearly-identical FIAT-STRUC constraints to encode a single suffix may appear startling; the appropriateness of the solution will become clearer in section 4.6.

2-PERS, SING: $C]_{stem}ð$ is satisfied only when the affix is preceded by a stem-final consonant; that is, when the affix belongs to a CC cluster. It is thus satisfiable only by being attached to a consonant-final stem with no intervening epenthesis, or by being highly-ranked enough that it can force vowel-final stems to become consonant-final. 2-PERS, SING: $C]_{stem}ð$ is satisfied by a subset of the candidates satisfying 2-PERS, SING: $]_{stem}ð$;

any candidate with suffixal [ð] will satisfy (180), but among those, only those with stem-final consonants will satisfy (179).

(181) Chart of Violations

	2-PERS, SING: $C]_{stem}ð$	2-PERS, SING: $]_{stem}ð$
$…C]_{stem}ð$	√	√
$…V]_{stem}ð$	*	√
$…X]_{stem}$	*	*

2-PERS, SING: $C]_{stem}ð$ is crucially outranked by DEP:C and MAX:V; a stem-final consonant will not be inserted to permit its satisfaction, nor will a stem-final vowel be deleted to put a consonant immediately before the stem boundary. 2-PERS, SING: $C]_{stem}ð$ does, however, outrank *COMPLEX; the language will tolerate a cluster it would otherwise repair with epenthesis
to satisfy the FIAT-STRUC constraint.

The stem-blind FIAT-STRUC constraint 2-PERS, SING: $]_{stem}ð$ is satisfied in all such forms, but does not make the crucial decisions; it does, however, force addition of the [ð] suffix in forms with a stem-final vowel. The situation here is quite similar to the default-and-alternative allomorphy discussed earlier; the consonant-adjacent suffix is preferred, allowing both FIAT-STRUC constraints to be satisfied, but where 2-PERS, SING: $C]_{stem}ð$ is unsatisfiable, the other FIAT-STRUC constraint with the same syntactic trigger can still make itself felt. The difference is that here, the structure added at the behest of the FIAT-STRUC constraints is phonologically identical for both constraints. The fact that candidates satisfying (179) are a subset of those satisfying (180) makes the ranking relationship between the two FIAT-STRUC constraints unimportant; whether (179) is ranked above or below (180), the less restrictive constraint will be able to serve as a backup in cases where the more restrictive constraint cannot be satisfied.

The tableaux below show how the system works. The ranking is given in (182). Note that 2nd person singular forms also bear a prefix [θ] whose behavior is unexceptional; this prefix appears in the tableaux, but will not be discussed further.

(182) {MAX:V, DEP:C, 2-PERS, SING: $]_{stem}$ð}

|

2-PERS, SING: C$]_{stem}$ð

|

*COMPLEX

(183) xðm — 'work'

Base: əxðəm	2-PERS, SING: $]_{stem}$ð	MAX:V	DEP:C	2-PERS, SING: C$]_{stem}$ð	*COMPLEX
☞ θəxðəmð					*
əθxəðməð				*!	
θəxðəm	*!				

(184) βðu — 'divide'

Base: əβðu	2-PERS, SING: $]_{stem}$ð	MAX:V	DEP:C	2-PERS, SING: C$]_{stem}$ð	*COMPLEX
θəβðukð			*!		
☞ θəβðuð				*	
θəβðu	*!				
əθβəðð		*!			

In summary, the system works like this: the preferred situation is for the [ð] suffix to be added, and to belong to a Cð cluster. This satisfies both 2-PERS, SING: $]_{stem}$ð and 2-PERS, SING: C$]_{stem}$ð. While a word-final CC cluster would normally be repaired by epenthesis to avoid a *COMPLEX violation, such a repair would prevent satisfaction of 2-

PERS, SING: C]$_{stem}$ð; since the FIAT-STRUC constraint outranks *COMPLEX, the cluster is tolerated.

Only where the stem ends in a vowel is satisfaction impossible. Since MAX:V and DEP:V outrank 2-PERS, SING: C]$_{stem}$ð, a consonant will not be added, nor a vowel deleted, to permit the FIAT-STRUC constraint's satisfaction. It is still possible, however, to satisfy the less-restrictive 2-PERS, SING:]$_{stem}$ð, so the suffixal [ð] occurs anyway.

4.6. A learnability scheme for FIAT-STRUC

This solution might appear to be an odd one, but the existence of such phenomena follows from the overall architecture of the theory, and in fact illustrates the usefulness for the language learner of testing hypotheses about morphological processes by incorporating them into the grammar and demoting those that make incorrect predictions when ranked too highly.

In the discussion of the occasional overextension of unproductive morphological processes in 3.3.7, the proposal crucially assumed that unproductive patterns, like productive patterns, are encoded in constraints and placed in the grammar; their unproductivity is the result of their low ranking. It is generally assumed, recall, that the morphological learner must form and entertain a number of hypotheses about any particular morphological process in her language before arriving at a satisfactory solution. Pinker and Prince (1993) propose that all but the most general hypotheses are eventually discarded; other proposals hold that more-reliable but less general hypotheses may be retained by the adult speaker in addition to the most general rule (Albright 2002), or that generalizations unusable in production by the adult speaker may be retained as low-ranked constraints whose effects are felt only in exceptional situations (Zuraw 2000), as is crucial in the analysis of the English past participle suffix in Chapter 4.

While the question of the ultimate fate of useless morphological generalizations is not relevant here, the notion that the learner places multiple overlapping partial generalizations about particular morphological processes in the grammar is important. A learner who encodes all possible generalizations about the clustering suffix [ð] and the non-clustering suffix [x] as FIAT-STRUC constraints, then arrives at a final grammar by ranking those FIAT-STRUC constraints such that no incorrect outputs result, will arrive at a grammar like the one given here, which encodes the peculiarities of the suffixes in multiple declarations about what the environment of the suffix is.

Let as assume that the learner entertains hypotheses about the nature of morphological processes by encoding generalizations in constraints, introducing those constraints into the grammar, and seeking a ranking which will generate the correct outputs. For both the nonclustering affix [x] and the clustering affix [ð], a fairly large number of possible generalizations are possible; a few of the PHONs for the FIAT-STRUC constraints encoding these generalizations are given below, roughly in order of increasing specificity.

(185)

-x	*-ð*
x	ð
$]_{stem}$x	$]_{stem}$ð
V$]_{stem}$x	V$]_{stem}$ð
C$]_{stem}$x	C$]_{stem}$ð
a$]_{stem}$x	a$]_{stem}$ð
i$]_{stem}$x	i$]_{stem}$ð
u$]_{stem}$x	u$]_{stem}$ð
ə$]_{stem}$x	m$]_{stem}$ð
m$]_{stem}$x	n$]_{stem}$ð
n$]_{stem}$x	k$]_{stem}$ð
k$]_{stem}$x	…
…	

Each of these PHONs represents a true generalization about some subset of the words in the language with the relevant syntactic properties. The generalization that 2nd person singular forms contain a [ð] is true of all 2nd person singular forms, as the generalization that all 1st person singular forms contain [x]. Likewise, the generalization that 2nd person singular forms contain [ð] following a stem boundary, and the generalization that 1st person singular forms contain [x] following a stem boundary, are universally true. These constraints may appear at the top of the constraint hierarchy without resulting in incorrect forms.

All of the other constraints are violated in some outputs. Take the constraint 2ND PERSON, SING: i$]_{stem}$ð; this is violated by a great many second person singular forms in the language; all whose stems do not end in [i]. Since forms actually exist which violate the constraint, it needs to be placed beneath DEP:C, MAX:V, and all the other constraints whose violation would permit a 2nd person singular form like [əxðəmð] to surface improperly as [əxðekð] or the like. The same is true of all the other super-specific constraints; m$]_{stem}$ð, etc.

The interesting constraints are those of greater generality, given in (186):

(186)

-x	*-ð*
$]_{stem}$x	$]_{stem}$ð
V$]_{stem}$x	V$]_{stem}$ð
C$]_{stem}$x	C$]_{stem}$ð

Note that with the exception of the particular segmental quality of the suffix, the three broad constraints for each suffix are identical; at this level of generality, the environments in which [x] occurs are exactly the same in which those in which [ð] occurs.

But when these constraints are added to the grammar, the [x] constraints and the [ð] constraints must be ranked differently with respect to constraints (160)-(167). Though both suffixes occur both after vowels and after consonants, the situations in which they may so appear differ; [x] appears after a consonant only in a phrasal context preceding a vowel-initial word; that is, when there will be no *COMPLEX violation. [ð], on the other hand, will appear after a consonant whenever this is possible without adding an epenthetic consonant or deleting a vowel to expose a stem consonant, whether or not a *COMPLEX violation results.

The respective rankings are as follows; MAX:ə, DEP:ə, *CODA, and ONSET are omitted from the tableaux and the rankings to simplify the presentation.

(187)

x	ð
MAX:Seg, DEP:Seg, *ə]$_σ$,]$_{stem}$x, *COMPLEX	MAX:Seg, DEP:Seg, *ə]$_σ$,]$_{stem}$ð,
|	|
C]$_{stem}$x, V]$_{stem}$x	C]$_{stem}$ð
	|
	V]$_{stem}$ð, *COMPLEX

For [x], neither of the more specific FIAT-STRUC constraints for [x] can be ranked high enough to have any effect distinct from that of the more general constraint. If C]$_{stem}$x outranked MAX:Seg or DEP:Seg, stem segments would be deleted or epenthetic segments inserted to allow its satisfaction:

(188)

əbðu	DEP:Seg	MAX:Seg	C]$_{stem}$x
☞ əbðux			*
bəðx		*!	
əbðunx	*!		

If V]$_{stem}$x outranked *ə]$_σ$, the pre-suffixal schwa would show up even in phrasal contexts before vowel-initial words:

(189)

əxðəm]$_{word}$[a	*ə]$_σ$	V]$_{stem}$x
☞ əxðəmx a		*
xəðməx a	*!	

If $C]_{stem}x$ outranked *COMPLEX, schwa would never be inserted before the suffix, even where it would lead to a bad cluster:

(190)

əxðəm$]_{word}$[a	*COMPLEX	$C]_{stem}x$
☞ xəðməx		*
əxðəmx	*!	

For a regular suffix like [x], only the most general constraint can be permitted to have any effect; $C]_{stem}x$ and $V]_{stem}x$, like the even more specific $i]_{stem}x$, will generate incorrect outputs unless they are ranked too low to demand their own satisfaction in any situation.

For the clustering suffixes like [ð], however, one of the more specific FIAT-STRUC constraints is not only harmless, but necessary; only the ranking of $C]_{stem}$ð above *COMPLEX allows the exceptional clusters to exist in outputs. Tableau (183) is repeated below:

(191)

Base: əxðəm	$]_{stem}$ð	MAX:V	DEP:C	$C]_{stem}$ð	*COMPLEX
☞ θəxðəmð					*
əθxəðməð				*!	
θəxðəm	*!				

It is only in the ranking of the FIAT-STRUC constraint encoding the $C]_{stem}X$ environment that [ð] and [x] differ; for both suffixes, a FIAT-STRUC constraint demands that the suffix be part of a CC cluster, but only for [ð] is this constraint ranked high enough to overcome the phonotactic prohibition on complex codas.

4.7. FIAT-STRUC constraints as retentions from morphological learning

The constraints the learner generates based on the data are, in effect, descriptions, varying in their specificity, of the environments in which the affixes occur. Where those descriptions are only true by accident, and nothing about the environment of the affix is unpredictable from the rest of the constraint system (as is the case for all but the most general description of the environments of [x]), the FIAT-STRUC constraints encoding the more specific descriptions must sink too low to do anything. But where some of the environments are not predictable from the rest of the grammar, as is the case for the clustering affixes, then the FIAT-STRUC constraints encoding those descriptions remain highly-ranked enough to force the unusual environment into existence in outputs. $C]_{stem}x$ occurs only where the markedness constraints and $]_{stem}x$ would already predict it; $C]_{stem}ð$ occurs where the markedness constraints and $]_{stem}ð$ would predict $ə]_{stem}ð$, so the FIAT-STRUC constraint demanding $C]_{stem}ð$ must remain powerful enough to overcome the effects of markedness.

Note that this means that the clustering property of affixes like [ð] has no synchronic explanation outside its own existence. The learner does not observe the special behavior and discern some underlying reason for it; that the affixes are extrametrical, for example, or that the markedness constraints must be rearranged so that epenthesis is not justified for certain clusters. Rather, the description of the behavior that the learner constructs becomes, itself, the source of the pattern in the speaker's grammar.

4.8. The need for FIAT-MORPH

This picture of the acquisition of morphology would suggest that the FIAT-STRUC analysis of the English plural is the correct one, and that there is no need for FIAT-MORPH in the system. The English learner forms generalizations about the shapes of plural nouns, and eventually ends up with the three FIAT-STRUC constraints given earlier, ranked as described; the grammar will successfully generate the pattern, and there is no need for FIAT-MORPH.

There are problems, however, with relying entirely on FIAT-STRUC constraints to do morphology, and these problems go beyond the distaste, in itself understandable, which an analysis that fails to recognize [s], [z], and [əz] as different forms of the same entity might provoke.

The first problem is that brittleness (see section 2.5) is an inescapable, or only partly escapable, characteristic of FIAT-STRUC constraints. Brittleness is not a problem in constructing grammars that generate the actual forms of the language; it is, however, a problem in constructing grammars that make plausible predictions about the extension of morphemes to new or nonce forms.

Consider an imaginary language in which hiatus is banned, and where potential hiatus is resolved without exception by vowel deletion. Which vowel deletes is determined by vowel quality; /ə/ is always deleted in preference to a full vowel. The pattern is exemplified in (192):

(192) /ba-əd/ → [bad] /bə-ad/ → [bad]

This language has a suffix [əd], which never alternates, and for nonphonological reasons never attaches to a vowel-final stem; perhaps it is a suffix appropriate only to color terms, which all happen to end in consonants. The FIAT-STRUC constraint encoding this suffix is (193):

(193) SYN:]əd — A word with syntactic property SYN contains a stem boundary followed by [əd].

This suffix has no other forms; thus, there are no alternative FIAT-STRUC constraints available to supply an alternative affix should SYN:]əd be unsatisfiable. (Since no allomorphs generally appear, no constraints differing from SYN:]əd in the nature of the suffix itself would have been constructed by the learner.)

If a speaker with this grammar is called upon to add this suffix to a borrowed or nonce word ending in a vowel, such as [akka], presumably one of the following things will happen:

(194) Suffix occurs in regular form, exceptionless hiatus restriction now violated: [akkaəd]

(195) Suffix entirely absent: [akka]

(196) Stem vowel deleted, though elsewhere [ə] deletes rather than [a]: [akkəd]

None of these possibilities is especially outlandish in broad outline. What is implausible is that the FIAT-STRUC analysis absolutely excludes possibility (197):

(197) Usual pattern of language extended to new form; resolve hiatus by deleting schwa: [akkad]

Since [akkad] does not satisfy the constraint any better than does [akka], there can never be any morphological reason for preferring it.

It is not a problem that the theory predicts the first three possibilities; affixes often do display unusual properties of this sort. The problem is that the perhaps more plausible fourth possibility is universally excluded. A theory of morphology making exclusive use of FIAT-STRUC constraints predicts that general phonological processes will never be extended to affixes in new environments, because the general phonological processes of a language are utterly separate from affixal allomorphy, with any resemblance being diachronic in origin and having no formal status in a speaker's mental grammar. To the extent that allomorphy actually is tied to the general processes of a language, FIAT-MORPH constraints are necessary.

4.9. The relationship between FIAT-STRUC and FIAT-MORPH; -*s* revisited

We have proposed that FIAT-STRUC constraints arise as descriptive generalizations about words with given syntactic characteristics; declarative generalizations are turned into constraints and added to the constraint system, whereupon a ranking of the entire system is found which generates the correct results.

This same procedure gives rise to FIAT-MORPH constraints; the construction of FIAT-MORPH constraints is the next step after the generation of a working FIAT-STRUC analysis. Any grammar with FIAT-STRUC allomorphy perfectly aping the general phonological processes of the language can be turned into a simpler grammar that unifies those FIAT-STRUC constraints into a single FIAT-MORPH constraint; FIAT-STRUC constraints are required only where allomorphy cannot be reduced to phonology. The next step in the process is a procedure that generates FIAT-MORPH constraints from FIAT-STRUC constraints and eliminates (or consigns to vacuity) those FIAT-STRUC constraints made needless, while retaining those that are still required. This process will be explained using the analysis of English *-s* already sketched.

4.9.1. English *-s*

Assume that the working FIAT-STRUC analysis has already been generated. The constraints and ranking are reproduced below for ease of reference.

(198)	PLURAL: $]_{stem}$z	A plural noun contains the string $]_{stem}$z.
(199)	PLURAL: $]_{stem}$s	A plural noun contains the string $]_{stem}$s.
(200)	PLURAL: $]_{stem}$əz	A plural noun contains the string $]_{stem}$əz.
(201)	*D//T	Adjacent obstruents differing in voicing are prohibited.
(202)	*SS	Adjacent sibilants are prohibited.
(203)	IDENT-IO:[voice]$_{Root}$	Correspondent segments in input and output have the same value for [voice]
(204)	MAX:Seg	A segment in the input has a correspondent in the output.
(205)	DEP:ə	A [ə] in the output has a correspondent in the input.

(206) Ranking:

{*D//T, *SS, IDENT-IO:[voice]$_{Root}$, MAX:C, DEP:ə}
|
PLURAL: $]_{stem}$z
|
PLURAL: $]_{stem}$s
|
PLURAL: $]_{stem}$əz

The first step in the procedure is to generate a plausible FIAT-MORPH constraint from the set of FIAT-STRUC constraints sharing the same SYN; this process is in effect a special case of discovering or attempting to discover an underlying representation for any set of related surface representations. While no firm proposal will be made here regarding this procedute, one possible method of generating FIAT-MORPH constraints is given below in section 4.10. For now, assume that the result of the procedure in this case is to produce the FIAT-MORPH constraint in (207):

(207) PLURAL: $]_{stem}$/z/ A plural noun contains the string $]_{stem}$/z/.

The FIAT-STRUC constraints are not removed from the grammar. The FIAT-MORPH constraint is added to the grammar, and a new ranking is found which generates the correct results. In this case, the result is

(208) cat → cats $_{\alpha\ \beta}$

kæt, PLURAL	*D/T	*SS	(IO): $[voice]_{RO}$	MAX: Seg	PL: $]_{stem}$/z/	DEP:ə	IDENT (IO): [...]	PL: $]_{stem}$z	PL: $]_{stem}$s	PL: $]_{stem}$əz
a. $kæt_{\alpha}$					*!			*	*	*
b. $kæt_{\alpha}]z_{\beta}$	*!								*	*
☞c. $kæt_{\alpha}]s_{\beta}$							*!	*		*
d. $kæt_{\alpha}]ə_{\beta}z_{\beta}$						*!		*	*	
e. $kæd_{\alpha}]z_{\beta}$			*!						*	*
f. $kætə_{\alpha}]z_{\beta}$						*!			*	*
g. $kæ_{\alpha}]z_{\beta}$				*!					*	*

(209) dog → dogs

dɔg, PLURAL	*D/T	*SS	(IO): [voice]$_{RO}$	MAX: Seg	PL: $]_{stem}$/z/	DEP:ə	IDENT (IO):	P: $]_{stem}$z	PL: $]_{stem}$s	PL: $]_{stem}$əz
a. dɔg$_{\alpha}$					*!			*	*	*
☞b. dɔg$_{\alpha}$]z$_{\beta}$									*	*
c. dɔg$_{\alpha}$]s$_{\beta}$	*!						*	*		*
d. dɔg$_{\alpha}$]ə$_{\beta}$z$_{\beta}$						*!		*	*	

(210) buzz → buzzes

bʌz, PLURAL	*D/T	*SS	(IO): [voice]$_{RO}$	MAX: Seg	PL: $]_{stem}$/z/	DEP:ə	IDENT (IO):	PL: $]_{stem}$z	PL: $]_{stem}$s	PL: $]_{stem}$əz
a. bʌz$_{\alpha}$					*!			*	*	*
b. bʌz$_{\alpha}$]z$_{\beta}$		*!							*	*
c. bʌz$_{\alpha}$]s$_{\beta}$	*!	*						*		*
☞d. bʌz$_{\alpha}$]ə$_{\beta}$z$_{\beta}$						*		*	*	
e. bʌ$_{\alpha}$]z$_{\beta}$				*!					*	*

Notice that in the resulting ranking, the FIAT-STRUC constraints do no work; the decision between allomorphs is already made before they have a chance to eliminate candidates. At this point, the redundant FIAT-STRUC constraints no longer play any productive role in the grammar under normal conditions, though their effects could conceivably be felt in cases of lexical failure.

Note, however, that this is only the case because the FIAT-STRUC allomorphy was something that could be handled by the Markedness and Faithfulness constraints. Where the FIAT-STRUC analysis encodes behavior that cannot be reduced to the ordinary processes of the language, the ranking resulting from the above procedure will be one in which the FIAT-STRUC constraint or constraints encoding exceptional properties still determine the winning candidate in some cases. Take, for example, the German *-chen* example already discussed. Turning the FIAT-STRUC constraint (211) into a FIAT-MORPH constraint, we get (212):

(211) DIM: $]_{ROOT}$çən, A diminutive contains a root boundary followed by [çən].

(212) DIM: $]_{ROOT}$/çən,/ A diminutive contains a root boundary followed by /çən/.

Recall that a grammar containing only the FIAT-MORPH constraint does not produce the correct result, since FIAT-MORPH affixes cannot resist general phonological processes:

(213)

frau, DIM	DIM: $]_{ROOT}$/$ç_1$ən/	*[+back]ç	IDENT[back]-V	IDENT[back]-C
a. frauç$_1$ən		*!		
● b. fraux$_1$ən				*

Even with the FIAT-MORPH constraint added, the FIAT-STRUC constraint is still necessary:

(214)

frau, DIM	DIM: $]_{ROOT}$/çən/	DIM: $]_{ROOT}$çən	*[+back]ç	IDENT[back]-V	IDENT[back]-C
☞a. frauçən			*		
b. frauxən		*!			*

As we saw in section 2.10, no ranking of the FIAT-MORPH constraint alone with respect to the rest of the system will produce the correct result; the FIAT-STRUC constraint must remain in the system, and remain highly-ranked enough to make itself felt.

4.10. Generation of FIAT-MORPH constraints from FIAT-STRUC constraints

One possible procedure for generating a FIAT-MORPH constraint from a set of FIAT-STRUC constraints is as follows. Given a set of FIAT-STRUC constraints with identical SYNs, an underlying representation is created from each that is identical to the portion of the FIAT-STRUC's PHON consisting of phonological structure. A candidate FIAT-MORPH constraint is then generated from each FIAT-STRUC, identical to the FIAT-STRUC except that the phonological structure is replaced by a morpheme index to the new underlying representation. Thus, given (198), the underlying representation /z/ is created, along with a FIAT-MORPH containing an index to that representation:

(215) PLURAL: $]_{stem}$/z/ A plural noun contains the string $]_{stem}$/z/

Candidate FIAT-MORPH constraints will likewise be generated for the other two FIAT-STRUC constraints active in the grammar:

(216) PLURAL: $]_{stem}$/s/ A plural noun contains the string $]_{stem}$/z/

(217) PLURAL: $]_{stem}$/əz/ A plural noun contains the string $]_{stem}$/əz/

The set of candidate FIAT-MORPHS is evaluated as follows. For cases with known winners, a constraint set containing one of the candidate FIAT-MORPH constraints, but none of the originating FIAT-STRUC constraints, is examined. If the known winner is harmonically bounded by some other candidate, the candidate FIAT-MORPH constraint is eliminated from consideration.

For the English plural, this will lead to elimination of the /s/ and /əz/ candidate FIAT-MORPH constraints, since cases exist for each in which the true winner will be harmonically bounded by a losing candidate. In the case of PLURAL:]$_{stem}$/əz/, the test that eliminates the candidate constraint is *cat~cats*; the true winner [kæts] is harmonically bounded by [kætəz], as seen below. Note that this is a chart of violations, not a tableau; what is important is not the particular ranking, but the fact that *no* ranking of the constraints will produce the correct winner given this FIAT-MORPH and none of the original FIAT-STRUC constraints:

(218) Chart of violations

kæt, PLURAL	*D//T	*SS	IDENT (IO): [voice]$_{ROOT}$	MAX: Seg	PL:]$_{stem}$/əz/	DEP:ə	IDENT (IO): [voice]
☞kæt$_\alpha$]s$_\beta$				*			*
kæt$_\alpha$]ə$_\beta$z$_\beta$							

The test eliminating PLURAL:]$_{stem}$/s/ is *flaw~flaws*; the true winner [flɔz] is harmonically bounded by [flɔs]:

(219) Chart of violations

fla, PLURAL	*D//T	*SS	IDENT (IO): [voice]$_{ROOT}$	MAX: Seg	PL:]$_{stem}$/s/	DEP:ə	IDENT (IO): [voice]
☞flɔ$_\alpha$]z$_\beta$							*
flɔ$_\alpha$]s$_\beta$							

Only PLURAL: $]_{stem}$/z/ passes all such tests, as examination of (208)-(210) will verify. As such, it is introduced into the constraint set, and a new ranking found for the constraint set as a whole, as described above. It is important to keep in mind that the procedure described here precedes and is distinct from introduction of the FIAT-MORPH into the ranking. It simply generates a set of candidate FIAT-MORPH constraints and eliminates all those which have no chance of obviating the FIAT-STRUC constraints that give rise to them.

Note that the output of this procedure will not necessarily be a FIAT-MORPH capable of doing any work in the analysis, or any FIAT-MORPH constraint at all. This is not a problem; as we saw in the case of *-chen*, not all patterns can be generated by grammars making use of FIAT-MORPH to the exclusion of FIAT-STRUC. Generalization of FIAT-STRUC to FIAT-MORPH is a grammatical simplification available in some cases, but not all, and this simplifying step is never strictly necessary for a speaker to reproduce the observed patterns of the language, even where it is possible. More research is necessary to determine the precise real-life cases in which it is empirically necessary for FIAT-MORPH constraints to arise in the grammar,[25] and whether the procedure sketched here is sufficient to account for all such cases.

4.11. Conclusion

We have seen in this chapter that FIAT morphology provides more than a set of mechanisms for capturing exceptionality, competition between patterns, and haplology (as well as less troublesome aspects of morphology); it also provides a mechanism by which

[25] A FIAT-MORPH constraint would be empirically necessary, for example, in the hypothetical case given in (197) in section 4.8.

morphological patterns can be learned, even when they are riddled with exceptions and counterexamples. By turning every generalization available in the data into a FIAT-STRUC constraint and seeking a ranking of all constraints that generates the correct results, a grammar capturing the pattern can be produced even when the pattern is one without any underlying synchronic sense. What may appear at first glance to be bizarre collections of ad-hoc constraints (e.g. (182)) are in fact the remains of an independently necessary learning process; the generalizations the learner must gather to learn any morphological system at all are directly responsible for phonotactically deviant morphology in the adult grammar.

In the next chapter, the theory is applied to a set of complex morphological patterns in the Imdlawn Tashlhiyt variety of Berber. This language's verbal system is a intricate mixture of regularity, competition between patterns, and lexical idiosyncrasy, and to account for it will require all the theory's resources.

5. The Verbal Stem in Imdlawn Tashlhiyt Berber

5.1. Introduction

In this chapter I apply the theory laid out in the previous chapters to a small part of the verbal morphology of the Imdlawn Tashlhiyt variety of Berber; specifically, the principles regulating the four possible shapes that a verb stem may assume in different syntactic contexts.

The particular subject of the analysis is what might be called "restricted idiosyncracy." A verb has as many as four distinct stem shapes, none of which is entirely predictable from the shapes of the other stems. Faithfulness to a listed input is able to overpower both FIAT-STRUC generalizations and constraints demanding resemblance among different outputs within the same paradigm. There are limits, however, on the nature and extent of the unpredictable idiosyncrasies any stem may display. The FIAT-STRUC constraints and the OO-Faithfulness constraints are, for the most part, strong enough to prevent freewheeling variation between stem shapes, but in certain limited contexts they are weak or unsatisfiable, allowing lexical idiosyncrasy to peek through. While the FIAT-STRUC and OO-Faithfulness constraints cannot uniquely predict the shape of a stem from the shapes of the verb's other stems, they are capable of restraining unpredictability within a particular compass.

This chapter is based entirely on the description and analysis of Imdlawn Tashlhiyt Berber by Dell and Elmedlaoui (1987) (see also (Dell and Elmedlaoui 1985, 1992)). Any Berber form that appears without a citation in this chapter is from Dell and Elmedlaoui (1987). Works discussing the verbal morphology of other Berber languages inform the account, especially in the discussion of the syntactic conditioning of the verb stem alternations in section 3; chief among these are Abdel-Massih (1968) and Penchoen (1973).

5.2. Aspectual stems of Imdlawn Tashlhiyt Berber

The stem of an Imdlawn Tashlhiyt Berber verb can take as many as four different forms. Which stem shape (hereafter "stem") occurs in a particular context depends on tense, aspect, and negation.

The names given to the four stems vary from Berberist to Berberist; following Dell and Elmedlaoui, I will refer to the *perfect, negative, aorist,* and *imperfect* stems. For some verbs, all four stems are different, while for others two or three (but never all four) are homophonous:

(220)	Perfect	Negative	Aorist	Imperfect	
	lsa	lsi	ls	lssa	'wear clothes'
	ħada	ħada	ħada	tt-ħada	'be next to'

The perfect stem is used in Berber for actions that have been completed or states that have been attained. The imperfect stem is used "for the expression of iterativeness . . . durativeness, continuity, generality, [and] progressiveness." (Penchoen 1973) The negative stem is used in the same contexts as the perfect stem, with the additional condition that negation be present. The aorist stem is used as the imperative, and to express "a variety of imperfect values such as future, conditional, prospective, [and] subjunctive." (Penchoen 1973)

A number of regularities hold of the relationships between the phonological shapes of these stems. The shape of a particular stem for a particular verb is not, however, entirely predictable, either from the shapes of the other stems or from any other phonological property of the verb. In the next section, I describe these regularities, and the extent to which individual forms may deviate from them.

5.3. Description of the pattern: perfect, negative, and aorist

To clarify the pattern, a rough rule-based analysis derived from Dell and Elmedlaoui (1987) accompanies the description of the data in each of the following sections.

5.3.1. Variations within the perfect stem

For the most part, a given stem of a particular verb—perfect, negative, aorist, or imperfect— does not vary in shape no matter what additional affixations it undergoes. The stem *ħada* remains *ħada* throughout the perfect conjugation, no matter what the person, number, or gender markings of the overall verb:

(221)

	Perfect		
1s		ħada	-x
2ms	t-	ħada	-t
2fs	t-	ħada	-t
3ms	i-	ħada	
3fs	t-	ħada	
1p	n-	ħada	
2mp	t-	ħada	-m
2fp	t-	ħada	-mt
3mp		ħada	-n
3fp		ħada	-nt

There is one kind of exception. The perfect stems of certain verbs (e.g. *lsa* 'wear clothes') end with [i] in the first and second person singular forms, and with [a] in all other forms:

(222)

	Perfect		
1s		lsi	-x
2ms	t-	lsi	-t
2fs	t-	lsi	-t
3ms	i-	lsa	
3fs	t-	lsa	
1p	n-	lsa	
2mp	t-	lsa	-m
2fp	t-	lsa	-mt
3mp		lsa	-n
3fp		lsa	-nt

This is the only kind of stem-internal variation conditioned by person, number, or gender, and no stem but the perfect displays it. The vowels involved are always as [i] in the 1st and 2nd person singular forms, [a] elsewhere: *lsi* versus *lsa*. Whether or not a given verb's perfect stem will undergo this alternation is not predictable; there are verbs whose perfect stems end with invariant [a], such as *ħada*, and verbs whose perfect stems end with invariant [i]. such as *ldi* 'pull'.

Verbs with variable final vowels will be called, following Dell and Elmedlaoui, *variable-a* verbs. All other verbs will be called *invariable* verbs. As we will see shortly, the variable-a property in the perfect stem implies certain other properties in the other stems.

A number of different rules could be used to capture this alternation; among them is (223), which changes a final [a] to [i] at the end of a perfect stem in a 1st or 2nd person singular form, as in the first three slots in (222) above. The rule is necessarily conditioned by a diacritic, [+var], since not every stem-final [a] undergoes the change.

(223) Perfect Final Vowel Mutation $a \rightarrow i\ /\ \_\_\ ]_{\text{stem, PERFECT, SING, 1st P, 2nd P, [+var]}}$

5.3.2. The perfect stem and the negative stem

For most verbs, the perfect and negative stems are homophonous:

(224)

Perfect	Negative
ħada	ħada
aywul	aywul
ull	ull

In verbs with variable-a perfect stems, however, the final vowel of the perfect stem is always replaced in the negative stem by [i]:

(225)

Perfect	Negative
ufa/i	ufi
uza/i	uzi
lsa/i	lsi

Some verbs with invariable perfect stems ending in two consonants have negative stems identical to the perfect except for the addition of [i] between the last two consonants.

This vowel is in free variation with Ø; the negative stem of such a verb may also be identical to the perfect stem:

(226)

	Perfect	Negative	
	dl	dil/dl	'cover'
	rwl	rwil/rwl	'flee'
	qiyd	qiyid/qiyd	'record'

There are some verbs in which the negative [i] infix is not a possibility:

(227)

	Perfect	Negative	
	ggiwr	ggiwr/*ggiwir	'sit'
	zayd	zayd/*zayid	'add'
	ffɣ	ffɣ/*ffiɣ	'get out'

There appears to be no way to predict which verbs are capable of bearing the marker and which are not.

The first process, Negative Final Vowel Mutation, can be captured with a rule such as (228):

(228) $V \rightarrow i\ /\ \_\_]_{\text{stem, NEG. [+var]}}$

The rule must be sensitive to the same diacritic [+var] that conditions the [i]/[a] person-number-gender alternation in the perfect stem.

The second process, Negative Vowel Infixation, can be captured with a rule such as (229):

(229) $\text{Ø} \rightarrow i\ /\ C\_\_C]_{\text{stem, NEG, [+INF]}}$

This rule is optional (since the infixed forms are in free variation with noninfixed versions) and must be either sensitive to a diacritic conditioning its application, in which case the verbs in (226) would bear the diacritic, and the verbs in (227) would lack it, or one forbidding its application, in which case the verbs in (227) would bear the diacritic and those in (226) would lack it.

5.3.3. The perfect stem and the aorist stem

The perfect and aorist stems for some verbs are homophonous:

(230)	**Perfect**	**Aorist**
	ħada	ħada

For other verbs, the perfect stem and the aorist stem are nonhomophonous, but the differences between the stems are limited to a narrow range; variation in the initial vowel, and variation in the final vowel.

Initial Vowel Mutation. If the perfect stem begins with a vowel ([u], [a], or [i]), this vowel's position will be occupied in the aorist stem by [a]:

(231)	**Perfect**	**Aorist**
	uzn	**a**zn
	iwi	**a**wi
	aywul	**a**ywul

I will refer to this process as Initial Vowel Mutation. Dell and Elmedlaoui capture this pattern with a rule A-INI transforming the perfect stem into the aorist. A rough equivalent to this rule is given in (232). Note that it applies vacuously when the perfect stem begins with [a]:

(232) Initial Vowel Mutation $V \rightarrow a \,/\, [_{\text{stem}} \_\__{\text{AORIST}}$

Final Vowel Deletion and Final Vowel Mutation. For the invariable verbs, Initial Vowel Mutation is the sole difference between the perfect and aorist stems. For variable-a verbs such as *lsa*, there may be an additional difference between the final vowel of the perfect and the final vowel of the aorist. The difference may take one of four forms, illustrated below.

(233)

variable				*invariable*	
(a) detachable a		*(b) mutable a*		*(c)*	
perfect	aorist	perfect	aorist	perfect	aorist
lsa/lsi	ls	fda/fdi	fdu	ħada	ħada
ufa/ufi	af	uza/uzi	azu	uzn	azn
		ura/uri	ara		
		uʒʒa/uʒʒi	aʒʒi		

(The reader may find it helpful to mark this page for future reference; in what follows, the terms *variable*, *detachable a*, *mutable a,* and *invariable* will recur again and again, sometimes at long intervals, and the reader may wish to flip back to table (233) whenever it is necessary to refresh the memory of what the terms mean.)

The final vowel of the perfect may be absent in the aorist, as is the case for the verbs in (233)a. Following Dell and Elmedlaoui, I will call these *detachable-a* verbs. The final vowel of the perfect may also be replaced by another vowel in the aorist: [u], as in perfect *fda/fd* → aorist *fdu*; [a], as in perfect *ura/uri* → aorist *ara*; or [i], as in perfect *uʒʒa/uʒʒi* → aorist *aʒʒi*. Note that in the last two examples, Initial Vowel Mutation also applies. These possibilities represent all the non-schwa vowels of the language. Verbs of these last three types will be called *mutable-a* verbs.

If the perfect stem of a verb is variable-a, the aorist stem always undergoes either Final Vowel Deletion or one of the three kinds of Final Vowel Mutation sketched in rule form below:

(234) Final Vowel Deletion $V \rightarrow \emptyset \,/\, \_\_]_{\text{stem, AOR, [+del]}}$

(235) Final u-mutation $V \rightarrow u \,/\, \_\_]_{\substack{\text{AOR} \\ \text{[+mut(u)]}}}$

(236) Final i-mutation $V \rightarrow i \,/\, \_\_]_{\substack{\text{AOR} \\ \text{[+mut(i)]}}}$

(237) Final a-mutation $V \rightarrow u \,/\, \_\_]_{\substack{\text{AOR} \\ \text{[+mut(a)]}}}$

If the stem is invariable, none of these rules ever apply, nor does Final Vowel Deletion.

5.3.4. Sample derivations

In Dell and Elmedlaoui's account, the perfect stem serves as the base for all the other stems, which are derived from it by rule. Below are sample derivations illustrating all the rules that relate the aorist to the perfect. Note that the perfect stems are marked with diacritics determining which rules apply.

(238)

UR:	ħada	ufa [+del]	fda [+u-mut]	uʒʒa [+i-mut]	ura [+a-mut]
V1-mutation	-	**a**fa	-	**a**ʒʒa	**a**ra
a-deletion	-	af**Ø**	-	-	-
u-mutation	-	-	fd**u**	-	-
i-mutation	-	-	-	aʒʒ**i**	-
a-mutation	-	-	-	-	ar**a**
SR:	ħada	af	fdu	aʒʒi	ara

The underlying representations of the variable *a* verbs *ufa/i, fda/i, uʒʒa/i,* and *ura/i* are assumed to end here with *a*, though nothing depends on this. Only variable-a verbs may bear these diacritics; except as noted in 5.3.5, there is no verb whose final vowel remains the same for every perfect stem, no matter what the person, number and gender features may be, but deletes or changes to another vowel in the aorist.

5.3.5. Marginal processes and exceptional forms

For a few verbs, the aorist stem is neither identical to the perfect, nor derivable from the perfect by the rules already given. Dell and Elmedlaoui list eight such verbs; it is not clear how many more exist.

(239)

	Perfect	Aorist	
	drus	idras	'be few'
	la	ili	'have'
	ra	iri	'want'
	!wrrɣ	!wrriɣ	'be yellow'
	ssn	issan	'know'
	nna	ini	'say'
	ggut	igat	'be numerous'
	!zzay	!izay	'be known'

(The exclamation point in the above transcriptions indicates that one or more segments in the word is emphatic.)

The marginal processes relating these aorists to the perfect are, according to Dell and Elmedlaoui, the replacement of perfect stem-internal [u] with aorist [a] in the environment C(C)__C, replacement of final perfect [a] with aorist [i], insertion of a vowel in the aorist between the final CC of the perfect, insertion of an initial [i], and the degemination in the aorist of a perfect geminate.

5.4. What requires explanation

Each of the four stems is capable of displaying unpredictable properties specific to that stem. Whether a perfect stem is variable-a or not cannot be predicted from any property of the stem, or from the properties of any other stem of the same verb; the ability of a negative stem to undergo Negative Vowel Infixation is likewise unpredictable; so is the particular Final Vowel Deletion/Mutation rule that will apply to an aorist stem.

I will assume that unpredictable properties of a form are encoded in a lexically listed input for that form, as I proposed in section 3.1. Each of the four stems of a particular verb is capable of being listed separately in the lexicon. In a certain sense, then, there is nothing in the system that absolutely requires explanation, especially in the absence of evidence about the productivity of any of these processes. The pattern as we know it can be encoded strictly in lexical entries, with the grammar playing no role.

Nevertheless, certain facts seem to deserve grammatical explanation. The extent to which a given stem's form is unpredictable is sharply limited, and the shape of any particular stem depends on properties of the other stems of the verb. Verbs may undergo Negative Final Vowel Mutation, but only if the perfect stem of the same verb is variable-a. Aorist stems may display the effects of any of four processes, and it is not predictable which one any particular verb will undergo; but it is predictable that these processes will only apply if the perfect stem of the verb is variable-a, and it is predictable that the aorist will differ from the perfect *only* in the presence, absence, or quality of the final vowel. The forms of the stems are unpredictable, but this unpredictability exists only within limits.

These limits, I propose, are the result of FIAT-STRUC constraints that demand particular properties of particular stems, and OO-Faithfulness constraints demanding resemblance between all the stems of a particular verb. The unpredictability itself is the result of IO-Faithfulness constraints demanding resemblance of an output to its input. The FIAT-STRUC and OO-Faithfulness constraints limit outputs very strictly, but not absolutely; lexical idiosyncrasy is possible, but can only take a few forms.

5.4.1. Overall paradigms and slots

I will sometimes talk about the *overall paradigm* of a verb. For now, take this to mean the set of all possible permutations of a verb with respect to person, number, gender, tense, and negation. The overall paradigm for *lsa* is shown below:

(240)

	Perfect			Negative			Aorist			Imperfect		
1s		lsi	-x		lsi	-x		ls	-x		lssa	-x
2ms	t-	lsi	-t	t-	lsi	-t	t-	ls	-t	t-	lssa	-t
2fs	t-	lsi	-t	t-	lsi	-t	t-	ls	-t	t-	lssa	-t
3ms	i-	lsa		i-	lsi		i-	ls		i-	lssa	
3fs	t-	lsa		t-	lsi		t-	ls		t-	lssa	
1p	n-	lsa		n-	lsi		n-	ls		n-	lssa	
2mp	t-	lsa	-m	t-	lsi	-m	t-	ls	-m	t-	lssa	-m
2fp	t-	lsa	-mt	t-	lsi	-mt	t-	ls	-mt	t-	lssa	-mt
3mp		lsa	-n		lsi	-n		ls	-n		lssa	-n
3fp		lsa	-nt		lsi	-nt		ls	-nt		lssa	-nt

Each box in the overall paradigm—each inflected form of a particular stem—I will call a *slot* in the paradigm. While the person, number, and gender affixes are given here, in what follows I will generally suppress them.

5.4.2. Perfect and Negative; the Inconsistent Base Effect

The negative stem of a verb is in OO-Correspondence (see section 3.2) with the perfect stem of the same verb, which serves as the Base. Three kinds of Correspondence constraints on this relationship play a role in the analysis: DEP(Perf/Neg), MAX(Perf/Neg), and IDENT(Perf/Neg).

(241)	DEP(PERF/NEG):	For any X, X a segment in the negative stem, X has a correspondent in every slot of the perfect subparadigm.
(242)	MAX(PERF/NEG):	For every X, X a segment in any slot of the perfect subparadigm, X has a correspondent Y in the negative stem.
(243)	IDENT(PERF/NEG):	For every X,Y, X a segment in any slot of the perfect paradigm, Y its correspondent in the negative stem, X and Y are identical in all features.

(Note that IDENT(PERF/NEG) is a bundle or placeholder constraint, shorthand for the entire set of IDENT constraints defined on this particular output-output relationship.)

These are OO-correspondence constraints of a new type. Usually an OO-correspondence constraint holds on a correspondence relation between some output and some specific, single other output; the past tense form of an English verb is in correspondence with the bare present tense form, for example, and the past participle is in correspondence with the past. The present constraints must be defined on a *set* of correspondence relations, holding between an output negative stem and all perfect stems in all slots of the overall paradigm. A correspondence relationship holds between any particular output negative stem for *lsa* and everything in boldface below:

(244)

	Perfect		
1s		**lsi**	-x
2ms	t-	**lsi**	-t
2fs	t-	**lsi**	-t
3ms	i-	**lsa**	
3fs	t-	**lsa**	
1p	n-	**lsa**	
2mp	t-	**lsa**	-m
2fp	t-	**lsa**	-mt
3mp		**lsa**	-n
3fp		**lsa**	-nt

For every slot $Perf_n$ in the perfect subparadigm, there is a correspondence relation between $Perf_n$ and the negative stem output Neg. There are thus eight correspondence relations between perfect slots and the negative stem output.

For the constraints given above, a violation is assessed if for *any* pair $Perf_n$,Neg, the constraint is violated. Multiple violations may be assessed if multiple properties of the negative stem are in violation; multiple violations are not assessed for single properties of the negative stem that are in violation of a constraint with respect to multiple pairs $Perf_n$,Neg.

For example, take the perfect/negative mapping below (*klsak* is an imaginary ungrammatical form):

(245) *lsa* → *klsak*

The two *k*s represent two violations of DEP(Perf/Neg) with respect to Perf_{1s}, two violations with respect to Perf_{2ms}, etc. But only two violation marks are assessed for all of these violations, not 20. Similarly, in the mapping between perfect *lsa*/*lsi* and the negative output *lsa*

(246) *lsa/i* → *lsa*

IDENT(Perf/Neg) is violated with respect to Perf_{1s}, Perf_{2ms}, and Perf_{2fs}, but not with respect to any other Perf. IDENT(Perf/Neg) is not violated three times, however, but only once, because it is the same segment in the negative stem that incurs the violation for all three Perf,Neg pairs.

The result of OO-Correspondence of this type will be called *global paradigmatic correspondence*. It is not clear to what extent it is truly distinct from regular OO-correspondence; a GPC-Faithfulness constraint whose bases are a set of identical forms will have exactly the same effect as an ordinary OO-Faithfulness constraint whose base is a single form from that set, so replacing (for example) the OO-Faithfulness constraints in the analysis of the English past participle with GPC-Faithfulness constraints will have no effect on the output of the system.

The motivation for this new type of correspondence is the fact that it is the variability itself of the perfect stem that appears to be the crucial factor in a number of morphological operations among Imdlawn Tashlhiyt stems. I will call this phenomenon the *Inconsistent Base Effect*; the general idea is that variation among the bases of a particular output is, in itself, a structural property that may have consequences in the morphological grammar. The usefulness of the notion will be seen below.

A recent proposal by McCarthy (2003) works along similar lines; it differs crucially from the present proposal in that the relative quantities within a paradigm of forms with one shape versus forms with another play a role in the evaluation of outputs; paradigm members, in effect, vote on what outputs should look like. In the theory outlined here, only the fact of disagreement within the paradigm, not the numerical superiority within that disagreement of one side or the other, play a role in the grammar.

5.4.3. The negative stem and invariant verbs

Recall from section 5.3.2 the important facts about the negative stem:

(247)

a. For invariable verbs not ending in two consonants, the negative stem is always identical to the perfect stem. (224)

b. For variable-a verbs, the final vowel of the perfect stem is always replaced by [i] in the negative stem (Negative Final Vowel Mutation). (225)

c. Invariable perfect ending with two consonants optionally insert [i] between those consonants in the negative stem (Negative Vowel Infixation). (226)

d. An unpredictable subset of invariable verbs ending in two consonants are not subject to Negative Vowel Infixation. (227)

e. No differences between the negative and perfect stems except those noted in (b) and (c) ever occur.

I propose that a FIAT-STRUC constraint is responsible for Negative Final Vowel Mutation; to wit, (248):

(248) NEGATIVE: $i]_{stem}$ A negative stem ends with [i].

The FIAT-STRUC constraint proposed for Negative Vowel Infixation is

(249) NEGATIVE:CiC$]_{stem}$ A negative stem ends with CiC.

Recall that there is, at least potentially, an input associated with the negative stems, and this input is responsible for any unpredictable properties of the stem. The only unpredictable property of any negative stem is (247)d, above; some stems that might be expected to undergo Negative Vowel Infixation are immune to it. We will return to this point, but let us ignore it for now. In all other respects, the shape of the negative stem is always maximally faithful to the perfect stem, except insofar as it satisfies FIAT-STRUC constraints (248) and (249). Keeping in mind that we will need to alter this analysis later, let us conclude that all Perf/Neg-Faithfulness constraints—that is, all Faithfulness constraints demanding OO-Faithfulness to the perfect stem—outrank all IO-Faithfulness constraints in this grammar. Where Perf/Neg-Faith and IO-Faith are in competition, Perf/Neg-Faith always wins; no idiosyncratic property of a negative stem's input can make it to the surface, and IO-Faith never plays a role in determining the shape of the negative stem.

Ignoring Negative Vowel Infixation entirely for the moment, the ranking of constraints necessary to capture the pattern is given in (250).

(250) MAX(PERF/NEG), IDENT(PERF/NEG), DEP(PERF/NEG),>> NEGATIVE: i$]_{stem}$ >> Faith(I/O)

For invariant verbs, this ranking forces the negative stem to be identical to the output perfect stems (which are all, remember, identical to each other for invariant verbs):

(251)

Perfect: $ħ_1a_2d_3a_4$	DEP (PERF/NEG)	MAX (PERF/NEG)	IDENT (PERF/NEG)	NEGATIVE: $i]_{stem}$	FAITH(I/O)
☞ a. $ħ_1a_2d_3a_4$				*	
b. $ħ_1a_2d_3i_4$			*!		
c. $ħ_1a_2d_3i$	*!	*			
d. $ħ_1a_2d_3a_4i$	*!				

In (b), [ħadi], the [i] is in correspondence with the [a] of each perfect stem, hence a violation of IDENT(PERF/NEG). In the segmentally identical candidate (c), [i] is not in correspondence with perfect [a], and the candidate incurs violations both of MAX(PERF/NEG), since the base [a] is absent, and of DEP(PERF/NEG), since [i] has no correspondent in the base.

Note two things: the negative marker [i] can never appear with an invariant verb (except accidentally, when the invariant verb happens to end in [i] in the perfect stem), since faithfulness to the perfect stem is more important than satisfying the FIAT-STRUC constraint; and the input form of an invariant verb is irrelevant to its output form, since any difference between the output form and the perfect stems would incur a violation of DEP(PERF/NEG), MAX(PERF/NEG), or IDENT(PERF/NEG), which outrank all IO-Faithfulness constraints.

5.4.4. The negative in variable-a verbs

The same ranking of constraints leads to different results for variable-a verbs. Remember once again that for these verbs, the quality of the final vowel is not consistent across all surface occurrences of the perfect stem. This means that for variable-a verbs, MAX(Perf/Neg) and IDENT(Perf/Neg) (a bundle-constraint subsuming all IDENT constraints referring to vowel features) can never be simultaneously satisfied by a single candidate. A candidate that satisfies both constraints with respect to $Perf_{1s}$, $Perf_{2fs}$, and $Perf_{2ms}$ cannot satisfy both constraints with respect to any other Perf; and a candidate that satisfies the constraints with respect to the other Perfs, cannot satisfy them with respect to $Perf_{1s}$, $Perf_{2fs}$, and $Perf_{2ms}$. Violations of IDENT(Perf/Neg) and MAX(Perf/Neg) are illustrated in (252) and (253) for the variable-a verb *lsa*.

(252) Violations of IDENT(PERF/NEG)

	Perfect	**lsa**	**lsi**	**ls**
1s	lsi-x	*	√	√
2ms	t-lsi-t	*	√	√
2fs	t-lsi-t	*	√	√
3ms	i-lsa	√	*	√
3fs	t-lsa	√	*	√
1p	n-lsa	√	*	√
2mp	t-lsa-m	√	*	√
2fp	t-lsa-mt	√	*	√
3mp	lsa-n	√	*	√
3fp	lsa-nt	√	*	√

(253) Violations of MAX(Perf/Neg)

	Perfect	**lsa**	**lsi**	**ls**
1s	lsi-x	√	√	*
2ms	t-lsi-t	√	√	*
2fs	t-lsi-t	√	√	*
3ms	i-lsa	√	√	*
3fs	t-lsa	√	√	*
1p	n-lsa	√	√	*
2mp	t-lsa-m	√	√	*
2fp	t-lsa-mt	√	√	*
3mp	lsa-n	√	√	*
3fp	lsa-nt	√	√	*

All three candidates will violate MAX(Perf/Neg) or IDENT(Perf/Neg) only once, but no candidate can entirely satisfy the constraint pair.

The effect of this is to allow NEGATIVE: i] to be satisfied for variable *a* verbs:

(254)

Perfect: $l_1s_2a_3$ $l_1s_2i_3$	DEP(Perf/Neg)	MAX (Perf/Neg)	IDENT (Perf/Neg)	NEGATIVE: $i]_{stem}$
a. $l_1s_2a_3$			*	*!
☞ b. $l_1s_2i_3$			*	
c. $l_1s_2a_3i$	*!		*	

For invariable verbs, it is possible to satisfy all the Perf/Neg-Faithfulness constraints. For variable-a verbs, it is not; while the Perf/Neg-Faith constraints eliminate (c) for the extra vowel, they cannot decide between (a), which is faithful to some of the instantiations of the perfect stem, and (b), which is faithful to the others. The decision is made by the FIAT-STRUC constraint, which wants final [i]. While normally it cannot contest the decision of the higher-ranked Faithfulness constraints, where those constraints do not specify the winner, the FIAT-STRUC constraint makes itself felt.

5.4.5. Negative Vowel Infixation and faithfulness to the negative stem input

The Negative Vowel Infixation process—or rather, the fact that certain forms have a lexically specified immunity to that process—complicates the situation.

The FIAT-STRUC constraint responsible, NEGATIVE:CiC]$_{stem}$, must, unlike NEGATIVE:i]$_{stem}$, outrank at least some Perf/Neg-Faithfulness constraints, because the infixation occurs even where complete faith to the perfect stem is possible. Specifically, NEGATIVE:CiC]$_{stem}$ must outrank DEP(Perf/Neg):V and CONTIGUITY(Perf/Neg).

(255) NEGATIVE: CiC]$_{stem}$
|
{ DEP(Perf/Neg):V, CONTIGUITY(Perf/Neg)}

This is completely consistent with the ranking given in (250); DEP(Perf/Neg):V is simply split off from the rest of the DEP(Perf/Neg) constraints. This ranking will account for the infixation cases:

(256)

Perfect: $q_1i_2y_3d_4$	MAX (Perf/Neg)	IDENT (PERF/NEG)	DEP (Perf/Neg) :C	NEGATIVE: $CiC]_{stem}$	DEP (Perf/Neg): V	CONTIGUITY (Perf/Neg)
a. $q_1i_2y_3d_4$				*!		
☞ b. $q_1i_2y_3id_4$					*	*
c. $q_1i_2y_3$	*!*					
d. $q_1i_2y_3d_4it$			*!		*	

It is worth violating DEP(Perf/Neg):V and CONTIGUITY(Perf/Neg) to permit satisfaction of the higher-ranked NEGATIVE: $CiC]_{stem}$. Adding a new consonant to the stem to allow insertion of [i] without a CONTIGUITY(Perf/Neg) violation causes a violation of the higher-ranked DEP(Perf/Neg):V; deletion of final segments to put the preexisting stem CiC sequence at the right stem boundary violates the higher-ranked MAX(Perf/Neg).

The fact that the infix is in free variation with Ø can be attributed to free constraint ranking, as in Antilla (1997); when the FIAT-STRUC constraint falls below either DEP(PERF/NEG):V or CONTIGUITY(PERF/NEG), the non-infixed candidate will be the winner.

The last fact we must account for is the existence CC-final stems for which Negative Vowel Infixation is impossible, such as those repeated below from (227).

(257)

	Perfect	**Negative**	
	ggiwr	ggiwr/*ggiwir	'sit'
	zayd	zayd/*zayid	'add'
	ffɣ	ffɣ/*ffiɣ	'get out'

Recall that there appears to be no common denominator explaining their immunity; the immunity is a listed fact, not a predictable one. The force preventing infixation in these - forms, then, must be some IO-Faith constraint outranking NEGATIVE: CiC]$_{stem}$. DEP(I/O), ranked above NEGATIVE: CiC]$_{stem}$, prevents the infix from being inserted where it is not present in the negative stem input:

(258)

Perfect: $z_1a_2y_3d_4$ Input: $z_1a_2y_3d_4$	MAX (Perf/Neg)	IDENT (Perf/Neg)	DEP (Perf/Neg)	DEP(I/O)	NEGATIVE: CiC]$_{stem}$	DEP (Perf/Neg): V	CONTIGUITY (Perf/Neg)
a. $z_1a_2y_3d_4$					*		
☞b. $z_1a_2y_3id_4$				*!		*	*

MAX(Perf/Neg) and IDENT(Perf/Neg) must outrank DEP(I/O); otherwise, if the negative stem contained non-[i] elements absent from the perfect stem, those elements would appear in the output, and we see no forms in which such a thing occurs.

5.4.6. USELISTED

In this proposal, a listed input, if it exists, always activates I/O-Faithfulness constraints. Zuraw (2000), who is likewise concerned with competition between synthetic candidates and listed candidates for the same output, proposes that a candidate may fail to be in correspondence with a listed input, even if one exists, but that all candidates not in correspondence with a listed input (whether or not one exists) violate a constraint USELISTED.

USELISTED is necessary in Zuraw's proposal because candidates do not, as here, consist of outputs alone, but of matched input-output pairs; the role of inputs in this theory is occupied there by nonphonological bundles of semantic and syntactic information called Intents. Two outputs in the same candidate set might have very different inputs with respect to phonological correspondence, and an output might therefore differ entirely from the listed lexical entry for a given Intent without violating any I/O correspondence constraints. It is thus necessary to have a mechanism which favors the use of listed inputs, since correspondence alone cannot do the job. In the theory proposed here, inputs consist entirely of phonological strings, and all output candidates are in correspondence with the same input. In effect, it is as if USELISTED is ranked at the top of the hierarchy, and if any listed input exists, all candidates not in correspondence with it are eliminated immediately.

The primary utility of this aspect of Zuraw's analysis is that, during learning, it allows certain phonotactics (i.e. constraint rankings determining phonotactics) to be learned even though they will never play a role in ordinary production; phonotactics that Zuraw's experiments demonstrate are, in fact, known to speakers. As the operation of occulted phonotactics of this sort lies outside the scope of the present work, I do not employ or further discuss USELISTED here. This does not mean, however, that the present analysis is incompatible with USELISTED; as I said, the analyses given here may be treated as cases in which USELISTED is at the top of the hierarchy and candidates violating it are left out of the tableaux.

5.4.7. The status of maximally restrictive grammars in morphology

Observing that the negative never differs from the perfect except in a few particular ways, we have devised a grammar in which all other deviations are disallowed. This is justifiable under the principle of Richness of the Base, which holds that grammatical generalizations must be stated at the level of the output; if it is true that no negative forms exist that deviate in different ways from the perfect than described above, and this fact is something that belongs in the grammar, then our constraint system must encode, and enforce, the generalization.

But this is, perhaps, begging the question. As we have already discussed, the presence of a pattern in a language does not justify encoding pattern in the grammar, unless there is some other reason to suppose that speaker has so encoded it (e.g. it is extended to unfamiliar forms). Because the evidence supplied to the learner is a mass of data with no prespecified analysis, any pattern that can be transmitted to the learner at all is, by virtue of the very fact that it can be transmitted to the learner, something that can lie implicit in an unanalyzed corpus of memorized forms.

Returning to the subject of the negative stems: since the learner will never be confronted with stems that violate the pattern above, and thus will have no reason to propose lexical entries for negative stems to which any unfaithfulness would be necessary, why should we suppose that the restrictions actually exist? A speaker who is not allowed to pronounce forms deviating from the pattern described above does not behave any differently under ordinary circumstances than a speaker who is allowed to deviate from the pattern, but has no reason to.

The question of whether this pattern really does exist in the minds of Imdlawn Tashlhiyt speakers is not one I am able to address. However, it is abundantly clear that speakers of other languages do have "unnecessary" grammatical restrictions, restrictions that the lexicon itself never contests, but to which speakers are nevertheless sensitive. Harris (1991) reports that Spanish speakers vehemently reject pairs of masculine and feminine adjectives along the lines of maculine *ganta*/ feminine *ganto*, and my own informal questioning of Spanish speakers bears this out. English speakers similarly reject the possibility of a gerund that does not consist of the bare stem of a verb plus *ing*. Both of these are similarly "unnecessary" grammatical restrictions, restrictions that the memorized lexicon will never conflict with. It is possible that Imdlawn Tashlhiyt speakers would similarly reject a perfect/negative pair such as *tada*/*tidi*; it is also possible that speakers would consider it a possible pair, just one that happens not to exist. Lacking data as to this point, I cannot make a claim as to whether the grammar given here actually corresponds to the grammar of Imdlawn Tashlhiyt speakers. Given the abundant evidence of speakers' ability to discover generalizations of this sort, however, it seems the safer course to assume that if there is a pattern in the language, its speakers' grammars encode it.

5.4.8. Aorist and perfect

The differences between the aorist and perfect stems of a given verb demonstrate a different kind of restricted idiosyncrasy or partly-predictable irregularity. The aorist may differ from the perfect in a number of ways, and cannot in all cases be predicted from the shape of the perfect; nevertheless, the possible differences are restricted to a limited set, further restricted in particular cases by the phonological properties of the perfect. As in the case of the negative stems, the relationships are determined by the interaction and competition between IO-Faith, OO-Faith, and FIAT constraints.

Recall from section 5.3.3 and table (233) the five kinds of relationship between the perfect and the aorist stems, and the rules producing these differences:

(259)

		Perfect	Aorist
	a.	ls**a**/ls**i** uf**a**/uf**i**	ls af
	b.	fd**a**/fd**i** uz**a**/uz**i**	fd**u** az**u**
	c.	uʒʒ**a**/uʒʒ**i**	aʒʒ**i**
	d.	ur**a**/ur**i**	ar**a**
	e.	ħada	ħada

The final vowel of the perfect may be deleted in the aorist, as in (a); a final vowel of the perfect may be changed in the aorist, as in (b), (c), and (d); an initial perfect vowel may be replaced by *a* in the aorist, as in (c) and (d); or the perfect and aorist may be identical, as in (e). Rules accomplishing this are restated below from (234), (235), (236), and (237).

(260) Final Vowel Deletion $V \rightarrow \emptyset \ / \ \_\_]_{\text{stem, AOR, [+del]}}$

(261) Final u-mutation $V \rightarrow u \ / \ \_\_]_{\text{AOR, [+mut(u)]}}$

(262) Final i-mutation $V \rightarrow i \ / \ \_\_]_{\text{AOR, [+mut(i)]}}$

(263) Final a-mutation $V \rightarrow u \ / \ \_\_]_{\text{AOR, [+mut(a)]}}$

(264) Initial Vowel Mutation $V \rightarrow a \ / \ [_{\text{stem}} \ \_\__{\text{AORIST}}$

5.4.9. Initial Vowel Mutation

The FIAT-STRUC constraint I propose as responsible for Initial Vowel Mutation is given in (265):

(265) AORIST: $[_{stem}$a An aorist stem begins with *a*.

AORIST: $[_{stem}$ a is only able to assert itself when the perfect stem begins with a vowel; recall that consonant-initial perfect stems undergo no stem-initial alterations in the perfect. This indicates that AORIST: $[_{stem}$a does not have the power to insert [a], but only to convert an existing stem-initial vowel to [a]. AORIST: $[_{stem}$a, then, outranks IDENT(Perf/Aor):V (shorthand for the collection of constraints that preserve vowel quality between perfect and negative), but is outranked by DEP(Perf/Aor):V. Since consonants are neither converted into [a] nor deleted to expose stem-internal [a] (e.g. [hada] → *[ada]), MAX(Perf/Aor):C and IDENT (Perf/Aor):[syllabic] must likewise outrank the FIAT-STRUC constraint.

(266) {DEP(Perf/Aor):V, MAX(Perf/Aor):C, IDENT (Perf/Aor):[syllabic]}
|
AORIST: $[_{stem}$a
|
IDENT(Perf/Aor):V

The tableau in (267) shows AORIST: $[_{stem}$a in action, producing the aorist stem [azn] from the perfect base [uzn]:

(267)

Perfect: $u_1z_2n_3$	DEP(Perf/Aor): V	MAX(Perf/Aor): C	IDENT (Perf/Aor): [syllabic]	AORIST: $[_{stem}a$	IDENT(Perf/Aor): V
a. $u_1z_2n_3$				*!	
☞b. $a_1z_2n_3$					*
c. az_2n_3	*!				
d. $au_1z_2n_3$	*!				

The candidate fully faithful to the perfect base, (a), fails at AORIST: $[_{stem}a$, since it begins with [u]. The winning candidate, (b), violates only low-ranked constraints of the IDENT(PERF/NEG):V family.. The segmentally identical (c) fails at DEP(Perf/Aor):V, since its initial segment is not a correspondent of the initial segment of the perfect base, and therefore incurs a DEP violation (as well as a MAX violation for the insertion, not indicated in the tableau.) Candidate (d), in which the aorist initial [a] is prefixed to the intact perfect stem, likewise fails at DEP(Perf/Aor):V.

In tableau (268), we see why the aorist initial [a] does not appear when the initial segment of the perfect stem is a consonant.

(268)

Perfect: ħada	DEP(Perf/Aor):V	MAX(Perf/Aor): C	IDENT(Perf/Aor): [syllabic]	AORIST: [$_{stem}$a	IDENT(Perf/Aor): V
☞ a. ħada				*	
b. aħada	*!				
c. aada			*!		
d. ada		*!			

The winning candidate violates the FIAT-STRUC constraint, but is fully faithful to the perfect stem. While IDENT(Perf/Aor):V would be violated to allow satisfaction of AORIST: [$_{stem}$a, the stem is not of such a nature that such a violation would do any good. Candidates (b), (c), and (d) all satisfy AORIST: [$_{stem}$a, but only at the cost of violating higher-ranked Perf/Aor-Faithfulness constraints: (b) adds a vowel, violating DEP(Perf/Aor):V; (b) converts the initial consonant into a vowel, violating IDENT (Perf/Aor):[syllabic]; (d) deletes the initial consonant to expose a stem-internal [a], violating MAX(Perf/Aor):C.

5.4.10. Mutable-a verbs and detachable-a verbs

The more complex alternations at the end of the aorist stem (section 5.3.3 and table (233)) are handled differently. Recall that Final Vowel Deletion and the three Final Vowel Mutation processes only apply to variable-a verbs, those in which the final vowel is not consistent across all instances of the perfect stem. With the negative stem, this inconsistency allowed a low-ranked FIAT-STRUC constraint to make itself felt; since full faithfulness to the perfect stem was impossible, changing the final vowel to satisfy the FIAT-STRUC constraint carried no penalty.

The situation is similar here. Since it is impossible for the aorist stem of a variable-a verb to be completely faithful to the perfect with respect to the final vowel, lower-ranked constraints can make themselves felt. Here, however, it is not a FIAT-STRUC constraint, or a collection of FIAT-STRUC constraints, that cause the alternations; rather, the four "processes" that apply to the final vowel of stems in the aorist reflect underlying variety in the inputs to the aorist stems. IDENT(I/O):V and MAX(I/O):V, not FIAT-STRUC constraints, are responsible for the alternations.

Mutable a verbs. Consider an invariant verb whose perfect and aorist stems end with different segments; imagine, for example, that the invariant verb [ħada] secretly has the aorist input [ħadi]. Since there is no variation in the final segment of the perfect stem, it is possible to fully satisfy both MAX(Perf/Aor) and IDENT(Perf/Aor). If MAX(I/O):V and IDENT(I/O):V are ranked below Perf/Aor -Faithfulness, then the winning candidate will be one that is segmentally identical to the perfect stem.

(269)

Perfect: $ħ_1a_2d_3a_4$ Input: $ħ_5a_6d_7i_8$	MAX (Perf/Aor)	IDENT (Perf/Aor)	IDENT(I/O):V	MAX(I/O):V
☞ a. $ħ_{1,4}a_{2,5}d_{3,6}a_4$				*
b. $ħ_{1,4}a_{2,5}d_{3,6}i_{4,8}$		*!		
c. $ħ_{1,4}a_{2,5}d_{3,}i_8$	*!			
d. $ħ_{1,4}a_{2,5}d_{3,}a_{4,8}$			*!	

In (b), the final vowel corresponds both to the final vowel of the perfect and to the final vowel of the input, and matches the quality of the input vowel, but not the perfect vowel; it thus satisfies both IDENT(I/O):V and MAX(I/O):V, but fails because it violates the higher-ranked IDENT(Perf/Aor). In (c), the final vowel corresponds only to the input vowel; this too satisfies the IO-Faithfulness constraints, but fails because it violates the higher-ranked MAX(Perf/Aor).

The winner is either (a) or (d), which are segmentally identical to each other and to the perfect. If IDENT(I/O):V outranks MAX(I/O):V, then the winner is (a), in which the final vowel of the input has no correspondent in the output, and the final output vowel has a correspondent only in the perfect stem base. If MAX(I/O):V outranks IDENT(I/O):V, the winner is (d), in which the final output vowel corresponds to both the final vowel of the perfect stem and the final vowel of the input, but matches only the perfect vowel in quality. I have decided, arbitrarily, to set IDENT(I/O):V higher in the ranking, making the winner (a).

But when the perfect stem is variable-a, it is impossible to fully satisfy both MAX(Perf/Aor) and IDENT(Perf/Aor), just as in the negative stem is was impossible to fully satisfy both MAX(Perf/Neg) and IDENT(Perf/Neg). In this situation, even though IO-Faithfulness is ranked below Perf/Aor-Faithfulness, the winning forms will be faithful to the quality of the final vowel of the input, since this faithfulness may be accomplished without incurring any violation of Perf/Aor-Faithfulness beyond what is inevitable in any case:

(270)

Perfect: $f_1d_2a_3$ $f_1d_2i_3$ Input: $f_4d_5u_6$	MAX (Perf/Aor)	IDENT (Perf/Aor)	IDENT (Perf/Aor):V	MAX (Perf/Aor):V
a. $f_{1,4}d_{2,5}a_{3,6}$		*	*!	
b. $f_{1,4}d_{2,5}i_{3,6}$		*	*!	
☞ c. $f_{1,4}d_{2,5}u_{3,6}$		*		
d. $f_{1,4}d_{2,5}a_3$		*		*!
☞ e. $f_{1,4}d_{2,5}u_6$	*!			
f. $f_{1,4}d_{2,5}$	*!			*!

All candidates violate either MAX(Perf/Aor) or IDENT(Perf/Aor). Candidates (a), (b), (c), and (d) are all faithful to the quality of at least some instances of the perfect stem final vowel; nevertheless, all violate IDENT(Perf/Aor), since they are also unfaithful to other instances of the perfect stem final vowel. Since the constraint is violated to the same degree whether the final vowel is faithful to no instances of the perfect vowel or faithful to some but not all of them, (a), (b), (c), and (d) all incur a single violation. The decision is passed down to IO-Faith, which prefers (c), the candidate with a final [u] matching the final [u] of the input, and (d), with no correspondent of the final input vowel and therefore no IDENT violation. MAX(I/O):V eliminates (d). The situation is similar with candidates (e) and (f). Neither candidate has any correspondent of the final perfect stem vowel, so both violate MAX(Perf/Aor) and neither violates IDENT(Perf/Aor). Since (f) has no correspondent of the final input vowel, (e) beats it.

Notice that there are two winning candidates here, though they are segmentally indistinguishable; the analysis as it stands does not distinguish between replacement of the perfect stem final vowel or mutation, since we have no basis for deciding whether MAX(Perf/Aor) or IDENT(Perf/Aor) is higher in the ranking. We will see in the next section that the detachable-a verbs indicate that IDENT(Perf/Aor) in fact outranks MAX(Perf/Aor), and the actual winner in mutable-a cases is the replacement candidate; (e) in the tableau above.

Irrelevance of *FIAT*. Clearly, there are generalizations to be made here about the shapes of the aorist stems: that aorists end in [a]; that aorists end in [u]; and that aorists end in [i]. Though they are contradictory and any particular generalization is true only of a minority of forms, these generalizations are not worse in any obvious way than the English -en generalization (3.3) or the various Yidiɲ suffix generalizations (2.7), all of which I have argued are present in the grammars of speakers of those languages. Clearly, then, the aorist generalizations must be gathered by the learner, and encoded in FIAT constraints:

(271) AORIST: a] Aorist stems end in [a].

(272) AORIST: u] Aorist stems end in [u].

(273) AORIST: i] Aorist stems end in [i].

The *-en* FIAT constraint in English had to be ranked low enough that it had no effect even in most of the forms where it was actually satisfied; the AORIST constraints must be ranked low enough that they have no effect in any form. No phonological fact about the perfect stem, remember, determines *which* vowel will occur in the aorist; the identity of the vowel is unpredictable, and must therefore be a lexical property, protected or imposed by IO-Faithfulness to the aorist derived-form input. If any of the aorist FIAT constraints outranked IDENT(Perf/Aor):V or MAX(Perf/Aor):V, the vowel demanded by the highest-ranked among them would always be the vowel that occurred in mutable-a verbs. Suppose, for example, that AORIST: u] was the highest ranked of the Final Vowel Mutation FIAT-STRUC constraints. If it were responsible for the cases it describes—for example, if it were responsible for the [u]/[a] alternation in perfect [fda]/[fdi] → aorist [fdu]—there would be no explanation for the failure of [i]/[a] to mutate to [u] in any of the many forms in which final perfect [i]/[a] becomes [i] or [a], since AORIST: u] would outrank AORIST: i] and AORIST: a] in all other cases as well. The particular vowel that occurs at the end of a mutating aorist form is a lexically unpredictable fact; while productively useless FIAT-STRUC constraints encode it, they cannot be responsible for it. All, therefore, must be ranked below both IDENT(Perf/Aor):V and MAX(Perf/Aor):V.

(274)

Perfect: $f_1d_2a_3$ $f_1d_2i_3$ Input: $f_4d_5u_6$	MAX (Perf/Aor)	IDENT (Perf/Aor)	IDENT (Perf/Aor):V	MAX (Perf/Aor):V	AORIST:a]	AORIST:u]	AORIST:i]
a. $f_{1,4}d_{2,5}a_{3,6}$		*	*!			*	*
b. $f_{1,4}d_{2,5}i_{3,6}$		*	*!		*	*	
☞ c. $f_{1,4}d_{2,5}u_{3,6}$		*			*		*
d. $f_{1,4}d_{2,5}a_3$		*		*!		*	*
☞ e. $f_{1,4}d_{2,5}u_6$	*!				*		*
f. $f_{1,4}d_{2,5}$	*!			*!	*	*	*

Detachable-a verbs. For some variable-a verbs, such as *lsa~ls*, the final vowel of the perfect stem disappears entirely in the aorist (see (259)-(260)). To capture this, it is necessary to be more specific about the ranking of constraints; while the mutable-a cases do not tell us whether MAX(Perf/Aor) or IDENT(Perf/Aor) is higher-ranked, the detachable-a verbs indicate that IDENT(Perf/Aor) must outrank MAX(Perf/Aor).

(275)

Perfect: $l_1s_2a_3$ $l_1s_2i_3$ Input: l_4s_5	IDENT (Perf/Aor)	MAX (Perf/Aor)	IDENT(I/O):V	DEP(I/O):V
a. $l_{1,4}s_{2,5}a_3$	*!			*
b. $l_{1,4}s_{2,5}i_3$	*!			*
☞ c. $l_{1,4}s_{2,5}$		*		
d. $l_{1,4}s_{2,5}u$		*		*!

IDENT(Perf/Aor) can only be satisfied if the final vowel of the perfect has no correspondent in the aorist, since any correspondent will violate the constraint with respect to some instances of the perfect stem. This eliminates candidates (a) and (b). Candidate (d) has a final vowel not corresponding to anything in the perfect, while (d) has none; in both cases, MAX(Perf/Aor) is violated, but since no candidates satisfying MAX(Perf/Aor) are available, the decision is passed along down to DEP(I/O):V. Since the final vowel of (d) is not present in the input, the constraint is violated, and (c) is the winner.

This ranking also generates a unique winner for the mutable-a cases like *fdu* (see (270) and second paragraph following), and indicates that vowel mutation is actually replacement, rather than true mutation (i.e. a noncorrespondent vowel occupies the place of the perfect stem vowel, rather than a correspondent vowel with a different quality).

(276)

Perfect: $f_1d_2a_3$ $f_1d_2i_3$ Input: $f_4d_5u_6$	IDENT (Perf/Aor)	MAX (Perf/Aor)	IDENT(I/O):V	MAX(I/O):V
a. $f_{1,4}d_{2,5}a_{3,6}$	*!		*	
b. $f_{1,4}d_{2,5}i_{3,6}$	*!		*	
c. $f_{1,4}d_{2,5}u_{3,6}$	*!			
d. $f_{1,4}d_{2,5}a_3$	*!			*
☞ e. $f_{1,4}d_{2,5}u_6$		*		
f. $f_{1,4}d_{2,5}$		*		*!

This analysis makes a certain prediction about the behavior of Imdlawn Tashlhiyt speakers, which I am not in a position to test: that given a nonce or wug form in the perfect with sufficient examples to indicate that it is a variable-a verb (e.g. the imaginary perfect stems *ksa~ksi)* they will produce aorist forms in which the final vowel of the perfect stem is absent (aorist *ks*). The detachable-a verbs, that is to say, represent the default behavior for variable-a verbs. This is because only IO-Faithfulness prevents deletion of the final perfect stem vowel in the aorist for variable-a verbs; IDENT(Perf/Aor) is always violated unless the vowel is deleted, and IDENT(Perf/Aor) outranks MAX(Perf/Aor). If a speaker lacks any input for the aorist, nothing demands that a vowel be present; low-ranked *STRUC will eliminate the candidate with the needless additional vowel.

(277) Imaginary form *ksa/i~ks*

Perfect: $k_1s_2a_3$ $k_1s_2i_3$ Input: Ø	IDENT (Perf/Aor)	MAX (Perf/Aor)	IDENT(I/O): V	MAX(I/O):V	*STRUC
a. $k_1s_2a_3$	*!				***
b. $k_1s_2i_3$	*!				***
c. $k_1s_2u_3$	*!				***
d. $k_1s_2a_3$	*!				***
e. $k_1s_2u_6$		*			**!*
☞f. k_1s_2		*			**

5.5. The overall picture so far

The aorist stem takes the perfect stem of the same verb as its morphological base. OO-Faithfulness constraints demand that the aorist be perfectly identical to that morphological base. Two factors are capable of preventing perfect identity: FIAT-STRUC constraints outranking OO-Faithfulness, and the unsatisfiability of certain OO-Faithfulness in cases where the morphological base is inconsistent across its various instantiations.

Initial Vowel Mutation is the result of the first factor; AORIST: $[_{stem}$a outranks Perf/Aor-Faithfulness, allowing the aorist to deviate from the perfect. Final Vowel Mutation is the result of the second factor. The inconsistency of the shape of the aorist stem of variable-a verbs makes full faithfulness to the morphological base impossible; where Perf/Aor-Faithfulness cannot completely determine the shape of the aorist stem, characteristics of the aorist input, usually overpowered by Perf/Aor-Faithfulness, peek through.

The analysis up to this point presents a somewhat idealized picture of the relationship between the perfect stem and the aorist stem; in the next section, where idiosyncratic aorists outside the scope of the analysis so far are discussed, we will see that it may require modification in some respects.

5.6. Exceptional aorists

Recall that a limited number of verbs have aorist stems differing from the perfect in ways other than Initial Vowel Mutation, Final Vowel Deletion, and Final Vowel Mutation. Among these verbs are the following, repeated from (239).

(278)

	Perfect	**Aorist**	
	drus	idras	'be few'
	la	ili	'have'
	ra	iri	'want'
	!wrrɣ	!wrriɣ	'be yellow'
	ssn	issan	'know'
	nna	ini	'say'
	ggut	igat	'be numerous'
	!zzay	!izay	'be known'

The marginal processes relating these aorists to the corresponding perfect stems are, again: the replacement of perfect stem-internal [u] with aorist [a] in the environment C(C)__C, as in *drus~idras*; replacement of final perfect [a] with aorist [i], as in *ra~iri*; insertion of an initial [i], as in both examples already given; insertion of a vowel between final CC, as in *ssn~issan*; and degemination, as in *!zzay~!izay*. The status of these marginal processes is extremely unclear; my only source is a brief footnote in Dell and

Elmedlaoui (1987). This may not be a complete list of the processes, and is almost certainly not a complete list of the forms displaying the processes.

This makes it difficult to know exactly how to approach them. While certain of the alternations are unproblematic given the analysis presented so far, the vowel mutations in *drus~idras* and *ra~iri* are incompatible with the proposal as it stands, as we will see below. There are solutions that do not require either additions to the theoretical architecture or modifications of the analysis that will lose us things we thought we had captured, but without knowing more it is impossible to say which, if any, are workable. If, for example, *la, ra,* and *nna* are the only three invariable verbs that form their aorists by adding initial [i] and changing final [a] to [i], and no other invariable verbs consisting of a liquid followed by [a] exist, we could account for them by proposing a constraint like

$$\text{AORIST:[i}\begin{bmatrix}\text{+sonorant}\\ \text{+consonantal}\\ \text{-nasal}\end{bmatrix}\text{i]:}$$

(279) $\text{AORIST:[i}\begin{bmatrix}\text{+sonorant}\\ \text{+consonantal}\\ \text{-nasal}\end{bmatrix}\text{i]}$ An aorist stem consists of [i] followed by a liquid followed by [i].

Ranked above IDENT(Perf/Aor):[low], IDENT(Perf/Aor):[high], and DEP(Perf/Aor):i, but below MAX(Perf/Aor):C and any IDENT(Perf/Aor) constraint affecting consonant features, this constraint would demand the correct aorist for exactly these two cases, but be incapable of imposing itself on any form containing more than one consonant, or any consonant other than [l] and [r]. (While such a specific FIAT constraint, affecting so few forms, might seem grotesque, we will see in Chapter 4 that such highly specific constraints are a fundamental and desirable part of the morphological learning process, and are retained high in the constraint ranking exactly where they produce results that defy the general processes of the language.) More broadly, if for any of the marginal processes it turns out that the verbs that undergo it can be picked out from the rest of the verbs of the language by some set of phonological properties, it is possible that a FIAT constraint can be constructed and ranked appropriately to generate the correct results. Without further information, however, it is pointless to devise a specific system to account for just the forms that happen to be available.

This being the case, I will instead address the worst-case scenario; that all the marginal processes given above are reasonably well-represented in the language, but no phonological criteria making them semi-predictable can be found. If such is the case, then all the marginal processes must be lexically idiosyncratic properties. If so, then all the deviations from the general pattern are encoded in the inputs to the aorist stem for the verbs in question. Since the idiosyncrasies represent deviations from the perfect stem, these input properties must be protected by IO-Faithfulness constraints outranking the Perf/Aor-Faithfulness constraints banning the deviations.

The analysis presented so far is consistent with some of these deviations, but not others. Consider first the additional vowels that occur in [drus] → [idras] and [ssn] → [issan] (among other forms). In each case, a vowel [i] is present at the start of the aorist stem that is absent in the perfect stem. It must be IO-Faithfulness that causes this vowel to appear; if it were a FIAT-STRUC constraint, we would have no explanation for the failure of this vowel to appear in the aorist generally. (Note, again, that this does not mean that there is no FIAT-STRUC constraint encoding the prefixation; only that the constraint encoding the prefixation cannot be the force in the grammar that is actually responsible for the prefixation; see section 5.4.10, subsection 2.) MAX(I/O):V, then, must outrank DEP(Perf/Aor):V.

We have not considered the ranking of DEP(Perf/Aor):V so far, so this new ranking requires only an addition to the analysis, not a change. Ranking MAX(I/O):V above DEP(Perf/Aor):V we get [issan] for an aorist input [ssn] and a perfect stem base /issan/.

(280)

Perfect: ssn Input: issan	MAX (I/O):V	DEP (Perf/Aor):V
a. ssn	*!*	
☞ b. issan		**

(When we have considered all the exceptional cases, we will integrate the additional constraints into the overall ranking.)

The gemination alternation likewise requires only an addition to the analysis, not a change. In [nna] → [ini] and [!zzay] → [!izay], a geminate in the perfect corresponds to a singleton consonant in the aorist. Again, since this is neither a general nor a predictable change, it cannot be the result of a FIAT-STRUC constraint, even if a FIAT-STRUC constraint that encodes it exists in the grammar; it must be the result of IO-Faithfulness. IDENT (I/O):[long] must outrank IDENT (Perf/Aor):[long].[26]

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[26] Later in the chapter I treat the property of being a geminate as the result of moraicity, not a feature [long]; the featural shortcut is used here simply because the particular mechanism for encoding length is unimportant to the example, and this affords the simplest representation.

(281)

Perfect: zzay Input: izay	MAX(I/O):V	IDENT (I/O):[long]	IDENT (Perf/Aor): [long]	DEP (Perf/Aor):V
a. zzay	*!			
b. izzay		*!		*
c. zay	*!		*	
☞ d. izay				*

What is left is to account for cases like [ggut] → [igat] and [la] → [ili] in which a vowel in the perfect stem is mutated or replaced in the aorist. Once again, IO-Faithfulness must be responsible. Here, however, we have a conflict with the analysis as given so far. We explained the systematic absence of Final Vowel Deletion and Final Vowel Mutation in invariable verbs like [ħada] by ranking IDENT(Perf/Aor) and MAX(Perf/Aor) above IO-Faithfulness; aorists could not deviate in the final vowel from their perfect bases because if the input contained a deviant final vowel, the vowel could not survive to the surface. Here, however, the input vowel must survive; IDENT(I/O):V and MAX(I/O):V must outrank at least MAX(Perf/Aor):V and DEP(Perf/Aor):V.

(282)

Perfect: $g_1g_2u_3t_4$ Input: $i_5g_6a_7t_8$	IDENT (Perf/Aor): C	MAX (Perf/Aor): C	IDENT (I/O):V	MAX (I/O):V	IDENT (Perf/Aor): V	MAX (Perf/Aor): V
a. $i_{1,5}g_{2,6}a_{3,7}t_{4,8}$					*!	
b. $i_{1,5}g_{2,6}u_3t_{4,8}$				*!		
c. $i_{1,5}g_{2,6}a_7t_{4,8}$						*
d. $i_{1,5}g_{2,6}u_{3,7}t_{4,8}$			*!			

This is a necessary change; the price is that nonexistent perfect/aorist alternations like [ħada] → [ħadi], in which invariant verbs undergo final vowel mutation in the aorist, are no longer forbidden by the grammar:

(283)

Perfect: $ħ_1a_2d_3a_4$ Input: $ħ_5a_6d_7i_8$	IDENT (Perf/Aor): C	MAX (Perf/Aor): C	IDENT (I/O):V	MAX (I/O):V	IDENT (Perf/Aor): V	MAX (Perf/Aor): V
a. $ħ_{1,5}a_{2,6}d_{3,7}a_4$				*!		
b. $ħ_{1,5}a_{2,6}d_{3,7}i_{4,8}$					*!	
☞ c. $ħ_{1,5}a_{2,6}d_{3,7}i_8$						*
d. $ħ_{1,5}a_{2,6}d_{3,7}a_{4,8}$			*!			

Since a perfect base vowel will be deleted and replaced to allow an aorist input vowel to surface, the absence of alternations like [ħada] → [ħadi] is an accidental fact about Imdlawn Tashlhiyt Berber, not a property of the grammar; there happen to be no invariant verbs with aorist inputs differing from the perfect only in the quality of the final vowel, but such verbs would be permitted by the grammar, unlike, for example, verbs whose aorist stems contain consonants dissimilar in quality from the perfect stem, which cannot occur even if aorist stem inputs of the sort exist; there can be no perfect/aorist pairs like [ħada] → [mani], for example.

Clearly, this is an unhappy result; further research is necessary before it is possible to say whether it is a necessary one.

5.7. Variation within strict limits

The central point here is that the existence of variety of different and unpredictable aorist endings does not represent the imposition of a variety of different aorist *markers*, the way the initial *a* and the negative final *i* represent the imposition of morphological markers. They are simply the output reflex of lexical variation in the aorist inputs. (Again, this does not mean that the unpredictable endings do not satisfy actual FIAT constraints, and thus receive analysis as markers; only that the FIAT constraints are not themselves responsible for their occurrence.)

One might ask why the aorist inputs are free to vary from the perfect only in certain respects, and not others. If the aorist input is not derived from the perfect stem, why can't it be entirely different from the perfect stem? Why can't we have a perfect stem *lsa* and an aorist input *waddam*?

The answer is that we can; there are no limits on the possible lexical shapes of aorist stems. But their expression on the surface is sharply restricted; the demands for resemblance to the perfect stem are so strict that only certain characteristics of the aorist input can ever surface. The aorist input may well be *waddam*, but the only property of *waddam* that makes it to the output is—at most—its absence of a final vowel.

The notion is not, of course, that lexical entries really do vary willy-nilly in invisible ways; rather, the idea is that the idiosyncrasies of aorist stems taken together represent the full variety of lexical variation capable of finding phonetic expression, the most variety than can fit through the bottleneck of OO-Faithfulness.

5.8. The imperfect stem

The imperfect stem, like the negative and the aorist, appears to take the perfect stem as its base. It differs systematically from the perfect stem in several respects. First, if the perfect stem is variable-a, the imperfect stem ends with [a], regardless of person, number, and gender:

(284)	**Perfect**	**Imperfect**
	lsa/lsi	lssa
	kka/kki	tt-kka

If the perfect stem is invariable, the final vowel (if any) of the perfect stem is retained intact in the imperfect.

The remainder of the differences are various and rather complex. In addition to the final [a], the imperfect stem always differs from the perfect stem in at least one and no more than two of the following ways: gemination, tt-augmentation, and chameleon vowel insertion. These differences are described in the next three sections.

5.8.1. Gemination

In gemination, a singleton segment in the perfect corresponds to a geminate segment in the imperfect.

(285)

	Aorist	**Imperfect**
	kri	krri
	krz	kkrz

The gemination alternation only occurs when the perfect stem has one of the following shapes:

(286) a. CCC

b. CCV

c. CC

d. CV

The alternation does not apply to any form in which the perfect stem contains a geminate; every CC in (286)a-d is necessarily a non-geminate cluster. While gemination is restricted to verbs whose perfect stems have the shapes in (286), not all verbs with perfect stems of the necessary shape display the alternation. Verbs whose perfect stems have one of the necessary shapes will be called (following Dell and Elmedlaoui) *geminable*, and verbs that actually undergo gemination in the imperfect will be called *geminating*. Whether any particular geminable verb is geminating is an unpredictable property of the verb. Dell and Elmedlaoui observe that the geminate in these cases always corresponds to an onset consonant in the perfect stem, never a nucleus or coda consonant.

5.8.2. tt-Augmentation

In tt-augmentation, the prefix or augment [tt] occurs at the beginning of the imperfect, but not at the beginning of the perfect.

(287)

	Perfect	Imperfect
	fdu	**tt**-fdu
	adr	**tt**-adr

5.8.3. Chameleon vowel insertion

Chameleon vowel insertion (to follow Dell and Elmedlaoui's (1987) terminology) affects verbs whose perfect stems end with two consonants, a high vowel followed by a consonant, or a consonant followed by a high vowel; in the imperfect stem, a vowel occurs before the final segment of the stem, and the segments on either side of it are consonants identical in melodic content to the last two segments of the aorist stem. If one of the segments adjacent to the chameleon vowel is a high vowel in the perfect, it occurs as the corresponding glide in the imperfect.

(288)

	Perfect	Imperfect
	xtm	tt-xt**a**m
	!sud	!sw**a**d
	zu	z**a**w

When no other vowel precedes the chameleon vowel in the imperfect stem, the chameleon vowel is [a]. When some other vowel does precede it, the chameleon vowel has the same quality as the preceding vowel:

(289) **Perfect** **Imperfect**

fruri	tt-frur**u**y
skkiws	tt-skkiw**i**s
knunni	tt-knunnuy

There is one sort of exception to this generalization. If the only preceding vowel in the word is followed by a glide with the same quality, then the chameleon vowel occurs as [a], not as a copy of the preceding vowel or of the glide:

(290) **Perfect** **Imperfect**

uwkkd	tt-uwkk**a**d
qiyd	tt-qiy**a**d
ʃiyr	tt-ʃiyar

The chameleon vowel is never inserted if the perfect stem begins with a vowel, except when the perfect stem begins with [uw] (e.g. *uwkkd~tt-uwkkad*). Thus there are no cases like *asni~*asnay* or *izn~*izin*.

5.8.4. Incompatabilities of the imperfect markers

I will refer to these alternations, loosely, as the *imperfect markers*, and give them the same abbreviations that Dell and Elmedlaoui give to the corresponding rules in their analysis: GEM for gemination, TT for tt-augmentation, and CHAM for chameleon vowel insertion.

The phonological restrictions on the types of stems that can bear each marker are not the only limitations on their occurrence; there are also certain nonphonological, or not obviously phonological, restrictions on the cooccurrence of multiple markers on a single imperfect stem. These restrictions are laid out below.

1. GEM and CHAM

GEM and CHAM only occur together when the perfect stem consists of CC or CV:

(291)

Perfect	Imperfect		
rg	rrag		
!di	!ttay		
but			
krz	kkrz	not	*kkraz
kri	krri	not	*krray
xtm	tt-xtam	not	*xttam

2. GEM and TT

GEM and TT never occur together in any form.

3. TT and CHAM

TT and CHAM may cooccur, and in fact TT generally occurs in all the same forms that display CHAM. There are two sets of exceptions. The first comprises the cases shown in (291) above; if CHAM occurs with GEM, then TT will be absent, because as we have just seen, GEM and TT never cooccur. The other exceptions are an unpredictable subset of those stems beginning with a coronal fricative:

(292)

Aorist		Imperfect
!sud		tt-!swad
	but	
!sug		!swad

5.8.5. Goals of the imperfect analysis

Here, as with the other stems, we have a mix of regularity and idiosyncrasy; stems display unpredictable properties, but the unpredictability is limited to the choice of which of several regular patterns the form will obey.

I will ignore the Chameleon Vowel Insertion process entirely here, and concentrate on GEM, TT, and the interaction between them. What is interesting here is the interaction between regularity and unpredictability inherent in the incompatibility between the GEM and TT processes. It is not obvious that there is any phonological incompatibility between the markers—they do not, for example, preclude each other by occupying the same position in the stem, nor would their cooccurrence create an obvious markedness problem; [tt] occurs freely on forms which contain geminates, just so long as these geminates are also present in the perfect stem (that is, as long as the geminates are not the product of GEM).

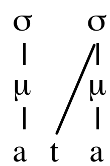
This is puzzling in two respects. The theory as presented so for does not contain any mechanism by which the satisfaction of one FIAT-STRUC constraint can prevent or obviate the need for the satisfaction of any other FIAT-STRUC constraint, except where it is phonologically impossible for both constraints to match their PHON requirements in the same form. If GEM and TT are both the products of FIAT-STRUC constraints triggered by the syntactic property IMPERFECT, they should both appear wherever possible (as TT and CHAM do).

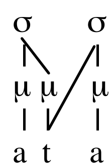
The second part of the puzzle is that even if we add a mechanism to the theory to allow two FIAT-STRUC constraints to be incompatible—for example, by "turning off" one FIAT-STRUC constraint when some particular other constraint is satisfied—it is not clear that it would help us here. GEM is, remember, a lexically idiosyncratic property, even though the lexical property consists of being susceptible to a regular process. The actual forces in the grammar demanding the difference between an imperfect stem displaying GEM and its ungeminated perfect stem correspondent must be IO-Faithfulness constraints, and any FIAT-STRUC constraint encoding GEM must be too weak to actually impose gemination on any form, as we saw earlier with the constraints encoding generalizations about the final vowels of aorist stems (5.4.10). The very regular TT, on the other hand, would seemingly need to be encoded in a constraint ranked high enough to systematically force a deviation from the perfect stem. Even if some nonphonological, stipulated conflict between GEM and TT is introduced into the grammar, then, it is not obvious why the constraint encoding GEM should ever come out the winner.

One aspect of the situation provides a way out of the difficulty; GEM and TT are, to some extent, overlapping processes, in that both introduce a geminate into the imperfect stem that is absent from the perfect. As we will see, this allows the apparent incompatibility of the markers to be handled without any addition to the theoretical apparatus. The output-oriented nature of FIAT constraints is crucial; both processes are driven by a constraint that seeks a novel geminate in an output, but is indifferent to its particular nature.

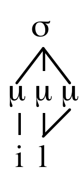
5.8.6. Gemination as the imperfect marker

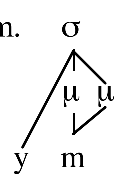
The proper analysis of geminates in Berber generally and Imdlawn Tashlhiyt specifically is somewhat problematic; see Dell and Elmedlaoui (1985, 1992) for discussion of syllabification and syllable structure in the language. For the present purpose, however, I will assume a conventional moraic analysis of length derived from Hayes (1989), with certain modifications proposed in an unpublished paper by Kaun (ms.). Syllable nodes dominate mora nodes; a syllable onset is linked directly to the syllable node; a syllable nucleus or coda is linked to the syllable node through the intermediary of a mora node. A geminate consonant is one that is linked both to a mora node and to the syllable node of the following syllable. Syllables with codas are heavy in Imdlawn Tashlhiyt Berber, implying that coda consonants have moras of their own.

(293) ata 

(294) atta 

Imdlawn Tashlhiyt Berber also has geminates that belong only to a single syllable. A geminate may form a complex coda, as in [ill.mas] 'he spun wool for him' (Dell and Elmedlaoui 1985). A geminate may also form the nucleus and coda of a single syllable, as in [ra.ym̩m.γi] 'he will grow' (Dell and Elmedlaoui 1985). Following Kaun, I will assume that these homosyllabic geminates carry two moras apiece:

(295) .ill. 

(296) .ymm. 

Below, it will be necessary to indicate moraicity and syllable boundaries with boldface and periods, respectively, rather than trees. All repetitions of a single character below should be interpreted as indicating geminates; a heterosyllabic, monomoraic geminate like that in (294) will be indicated by **d.**d, a homosyllabic, bimoraic geminate like those in (295) and (296) by **dd**.

As noted in section 5.8.1, Dell and Elmedlaoui observe that in stems displaying GEM, the geminated consonant is always one that corresponds to a singleton onset in the perfect and aorist stems. A singleton onset is, by definition, undominated by a mora. The mismatch between perfect and imperfect in GEM, then, can be stated more specifically than "A nongeminate in the perfect corresponds to a geminate in the imperfect"; in fact, a segment that dominated by a mora in the imperfect must correspond to one that is not dominated by a mora. Note that this would not necessarily be true in all cases of gemination; if (CVC)(CV) is mapped to (CVC)(:ə)(CV), for example, the second consonant has become geminated, but is dominated by a mora on both sides of the mapping.

(297)

(CVC)(CV) (CVC)(:ə)(CV)

The GEM process can be encoded in the following FIAT-STRUC constraint:

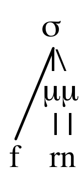
(298) IMPERFECT: GEM — The imperfect stem contains the novel structure

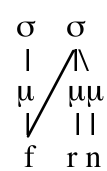
$$\begin{matrix}\mu \\ | \\ C_a\end{matrix}$$

This constraint makes use of the novelty mechanism introduced in section 2.14.2; the moraic consonant must be found in the imperfect, but no identical structure in correspondence with that structure be present in the perfect stem base.

This has two important effects. For one, it assures that any imperfect stem satisfying the constraint will differ from the perfect stem, since the constraint cannot be accidentally satisfied. For another, it assures that the geminated consonant corresponds to a singleton onset consonant in the perfect, since if the correspondent perfect consonant is in the nucleus or coda of some syllable, it is dominated by a mora, and the novelty requirement is unsatisfied. Dell and Elmedlaoui's observation that GEM only affects onsets thus requires no special stipulation.

(299) Perfect [frn][27] → Imperfect [ffrn]





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[27] Dell and Elmedlaoui consider the final *n* extrametrical; I assume (crucially) that it instead forms a coda.

(300) Perfect [rkm] → Imperfect [rkkm]

In both cases, only one element in the imperfect is available to form the correspondent of the moraic consonant satisfying IMPERFECT: GEM. The other consonants, being moraic already, would vacuously satisfy match the necessary structure, but not satisfy the novelty requirement; no addition of moras to these moraic consonants would make any difference, since the constraint pays attention not to the addition of moras per se, but to the addition of a mora to a nonmoraic consonant.

IMPERFECT: GEM provides the impetus to geminate a consonant in the imperfect; note that it also provides an impetus for (that is, will be satisfied by) adding the geminate [tt] augment, since this prefix matches the structural demand of the FIAT-STRUC constraint and, lacking a perfect correspondent, also satisfies the novelty condition. But the picture is far from complete; nothing so far tells us why one thing is done rather than the other in any particular case.

5.8.7. The imperfect augment [tt]

The second part of the picture is the FIAT-STRUC constraint IMPERFECT: $[_{STEM}$tt:

(301) IMPERFECT: $[_{STEM}$tt An imperfect stem begins with the novel structure tt

This constraint, similar to AORIST: $[_{STEM}$a, simply demands that imperfect stems begin with tt, and that this tt not correspond to any t in the perfect. Note that since the prefix is a geminate, it must be associated with at least one mora; thus any stem satisfying IMPERFECT: $[_{STEM}$tt will also satisfy IMPERFECT: GEM.

5.8.8. Idiosyncratic selection of GEM or TT

Recall two things: GEM and TT never cooccur, and it is an unpredictable fact about a geminable verb whether it displays GEM or TT.

Since displaying GEM is a lexically idiosyncratic property, the geminate must be present in the input to the imperfect stem, and protected by IO-Faithfulness. Other than the FIAT-STRUC constraints already given, the constraints that play a part in the analysis are as follows:

(302) DEP(Perf/Imp):C — A consonant in the imperfect stem of a verb has a correspondent in the perfect stem of that verb.

Note that this bans only the insertion of melodic material, and does not refer to moras; thus *krz* → *kkrz* does not violate DEP(Perf/Imp):C, while *krz* → *tkrz* does.

(303) DEP(I/O):Mora — An output consonant C is associated with no more moras than its correspondent C' in the input.

(304) DEP(Perf/Imp):Mora — A consonant C in the imperfect stem is associated with no more moras than its correspondent C' in the perfect stem.

Note that both of these constraints are defined with respect to melodic elements, not forms as a whole; if a given segment has more moras than its correspondent, there is a violation. Thus an output as a whole might contain fewer moras than its input or base as a whole and still violate the relevant constraint, if some segment has more moras than its input or base correspondent.

These constraints are ranked as follows:

(305) {IMPERFECT: GEM, DEP(I/O):Mora }
|
DEP(Perf/Imp):C
|
{IMPERFECT: [$_{STEM}$tt, DEP(Perf/Imp):Mora }

If the input imperfect stem of a verb contains a geminate that is absent from the perfect stem, then a faithful output for the imperfect stem will satisfy all the constraints above except IMPERFECT: [$_{STEM}$tt and DEP(Perf/Imp):Mora, as seen in (306) below. The prefix cannot be added to such forms because IMPERFECT: [$_{STEM}$tt is outranked by DEP(Perf/Imp):C.

If the imperfect input of a verb lacks a suitable geminate, however, it will be unable to satisfy IMPERFECT: GEM by geminating a root consonant in the output, because this would violate DEP(I/O):Mora; but since both IMPERFECT: GEM and DEP(I/O):Mora outrank DEP(Perf/Imp):C, it is possible to satisfy the constraint by adding a moraic consonant not present in the input to the start of the stem. IMPERFECT: [$_{STEM}$tt is not highly ranked enough to force *tt* prefixation by itself; but with high-ranked IMPERFECT: GEM forcing the existence of a moraic consonant outside the portion of the stem with input correspondents, IMPERFECT: [$_{STEM}$tt can determine that geminate consonant's quality and position.

The overall notion is that there is always a pressure for the imperfect stem to contain a geminate consonant absent in the perfect, and always a pressure for the imperfect stem to begin with [tt]; but the latter pressure is not powerful enough to force prefixation on its own, and so makes itself felt only when the pressure to have a geminate cannot be satisfied by any input property of the imperfect stem.

(306)

Perfect: ṛ.kṃ Input: r**kkm**	IMPERFECT: GEM	DEP(I/O):Mora	DEP(Perf/Imp):C	DEP(Perf/Imp): Mora	IMPERFECT: $[_{STEM}$tt
a.ṛ.kṃ	*!				*
☞ b.**rk**.kṃ				*	*
c.ṛr.kṃ	*!				*
d.**tt**-**r**.kṃ[28]			*!		
e.**tt**-**r**`**k**.kṃ			*!	*	

Periods indicate syllable divisions; boldface indicates moraicity. Syllabification is as predicted by Dell and Elmedlaoui (1985). I assume that a segment's mora count is a property present in inputs. Several outputs represent a removal of moras from a given segment; e.g. r**kkm**~**rk**.kṃ, in which the input geminate is bimoraic and the output geminate monomoraic. This should be considered the effect of a constraint against segments simultaneously having associations to multiple moras and to a syllable node, ranked above MAX(I/O):Mora.

[28] The syllabic status of the tt-augment is unclear. Transcriptions in Dell and Elmedlaoui (1985) seem to indicate that does not contain a syllable nucleus, but given that the transcriptions also indicate that it is a geminate, the conception of gemination as moraicity indicates that the augment is nevertheless moraic. The present analysis must remain agnostic as to whether a form like *tt-drk* is syllabified as ṭ**t**.dṛ**k**, with two syllables, or as **tt**dṛ**k**, with one syllable and a extrasyllabic initial mora.

The tableau above shows what happens when a geminable verb has an imperfect stem input with a suitable geminate. Those candidates with no geminate (r̩.**k**m̩), or a geminate corresponding to a moraic consonant in the perfect (r̩**r**.km) are eliminated for violating IMPERFECT: GEM; in the first case, no suitable geminate is present, in the second, the novelty condition is unsatisfied, since [r] is moraic in both the base and the output. The candidate with [tt]-augmentation but no gemination (**tt**-**r**.km̩*)* and the candidate with both *tt*-prefixation and gemination (**tt**-r̩**k**.km̩)are both defeated at DEP(Perf/Imp):C; while both satisfy IMPERFECT: GEM, they are inferior to the candidate that does so without violating DEP(Perf/Imp):C.

Now look at what happens when a geminable verb does not have an imperfect input with a suitable geminate:

(307)

Perfect: dr̩**k** Input: dr**k**	IMPERFECT: GEM	DEP(I/O):Mora	DEP(Perf/Imp):C	DEP(Perf/Imp): Mora	IMPERFECT: $[_{STEM}$tt
a. dr̩**k**	*!				
b. dr̩rk	*!			*	
c. **d**.dr̩**k**		*!		*	
☞ d. **tt**-dr̩**k**			*		
e. **tt**-d̩.dr̩**k**		*!	*	*	
f. **kk**-dr̩**k**			*		*!
g. dr̩**k**-**tt**			*		*!

An imperfect stem faithful to its input will violate IMPERFECT: GEM, as will one in which a consonant that is moraic in the perfect is geminated (Imdlawn Tashlhiyt syllabification would assign the syllable structure (d**r̩k**) to [drk], with the apostrophe indicating nuclear status and boldface indicating domination by a mora). The candidate [**d̩**d**r̩k**] satisfies IMPERFECT: GEM, but since the geminated consonant is not present in the input, it is defeated at DEP(I/O):Mora. The doubly-marked candidate [tt-ddrk] fails for the same reason.

The field is left to those candidates in which a geminate consonant with no correspondent in either the input or the perfect stem has been added. Those in which the additional consonant is either the wrong quality or in the wrong position are defeated at IMPERFECT: [$_{\text{STEM}}$tt, leaving [**tt**-d**r̩k**] the winner.

While (307) specifically illustrates a geminable but nongeminated verb, the system works in just this same way with nongeminable verbs. Note also that I have suppressed the CHAM or chameleon vowel alternation in (307); the actual surface form is [**tt**-dr**a̩k**].

This analysis explains why among those verbs showing the GEM alternation, the geminated consonant is always an onset in the perfect. Suppose that [rkm] had an imperfect stem input with a geminate [r] instead of a geminate [k]. The perfect stem [rkm] would be syllabified as (**r**'k**m**'), with boldface indicating domination by a mora and apostrophes indicating nuclear status. As (308) shows, the input gemination would be invisible in the output, since the fact that the perfect correspondent of [r] is nuclear and moraic makes [rrkm] unable to satisfy the novelty condition of IMPERFECT: GEM. The imperfect stem would surface with the [tt] augment:

(308)

Perfect: **r̩**.k**m̩** Input: **rr**km	IMPERFECT: GEM	DEP(I/O):Mora	DEP(Perf/Imp):C	DEP(Perf/Imp): Mora	IMPERFECT: [$_{STEM}$**tt**
a. **r̩**.k**m̩**	*!				*
b. **r̩k**.k**m̩**		*!		*	*
c.**r̩r**.k**m̩**	*!				*
☞d.**tt**-**r̩**.k**m̩**			*		
e.**tt**-**r̩k**.k**m̩**		*!	*		
f.**tt**-**r̩r**.k**m̩**			*	*!	

Note that DEP(Perf/Imp):Mora, which has not previously played any important role, is crucial here. Even though the geminate [r] has no worth with respect to IMPERFECT: GEM, its bimoraicity is presumably protected by IO-Faithfulness constraints, necessarily ranked below DEP(Perf/Imp):Mora.

5.9. Conclusions

The Imdlawn Tashlhiyt Berber verb stems exhibit a complex mix of idiosyncrasy and regularity, in which lexical unpredictability is largely (though not entirely) confined to the choice of which of several possible regular morphological processes apply. The present analysis holds that the limitations on lexical specificity of individual stems, as well as the systematic failure of regular processes to apply in some cases, are the result of demands that morphologically related forms resemble each other; the failure of some forms to undergo regular morphological processes, and the limitation of lexical idiosyncrasy to a strict scope, are not arbitrary properties of certain verbs, but systematic limitations on the entire verbal system.

More broadly, the Imdlawn Tashlhiyt Berber verb stems demonstrate the role of FIAT constraints within the phonological system as a whole, and the tight integration and interrelation between Input-Output Faithfulness, Output-Output Faithfulness, and FIAT that the present theory assumes. FIAT constraints are the driving force behind morphological productivity; every FIAT encodes a morphological generalization that seeks to be satisfied in every relevant form. The drive towards full productivity of every generalization is restrained by IO-Faithfulness to derived-form inputs, which encodes lexical idiosyncrasy, and OO-Faithfulness to morphological bases, which demands resemblance between syntactically diverse versions of a word. IO-Faithfulness ranked above FIAT leads to lexical exceptions to morphological processes and to unpredictable, lexically-listed selection of one morphological process over a competing one; OO-Faithfulness ranked above FIAT leads to phonologically conditioned exceptions to morphological processes and to predictable, phonologically predictable selection of one morphological process over a competing one. By proposing that morphological processes compete with Faithfulness within the constraint system, we are able to account for morphological systems that, like Imdlawn Tashlhiyt Berber verbal system, lexical idiosyncrasy, phonological conditioning, and morphological regularity in extremely complex ways.

6. Conclusion

This thesis has proposed an output-oriented theory of inflectional morphology, in which morphological processes are encoded in constraints integrated with and interacting with the familiar Markedness and Faithfulness constraints of Optimality Theory. These FIAT constraints demand that forms with particular syntactic features display particular phonological properties; they do not form a separate morphological component or module of the grammar, but represent direct interaction between the syntax and the phonology. The morphological constraints that encode morphological generalizations are of two sorts: FIAT-STRUC constraints, which demand the presence of specific phonological structures in outputs, and FIAT-MORPH constraints, which demand that particular morphemes have some phonological realization in outputs.

We have seen that this approach enables us to account for a wide variety of morphological phenomena. The output-oriented nature of the theory provides an account of morphological haplology, as in the case of the English plural (2.14); a constraint that demands only that a particular string be present in an output is satisfied whether or not that string exists in the output for independent reasons. The fact that morphological processes are encoded in constraints, which compete and interact with each other and with Markedness and Faithfulness constraints, allows the theory to account for a number of complex and widely-attested phenomena. Where FIAT constraints are outranked by Markedness constraints, the presence or absence of an affix may be dependent on phonological characteristics of the form. Where FIAT constraints are outranked by Input-Output Faithfulness, individual lexical items may form exceptions to general morphological processes. Multiple affixes or processes marking the same syntactic characteristics are encoded in potentially incompatible and competing FIAT constraints. This, combined with the effect of Markedness and Output-Output Faithfulness constraints, accounts for cases of phonologically conditioned allomorph selection, as in the case of the Yidiɲ locative (2.7). Combined with the effect of Input-Output Faithfulness constraints, it accounts for cases of unpredictable, lexically determined allomorph selection, and for conjugation or declension classes with unpredictable membership. Since all these kinds of ranking relationship may occur in a single grammar, the theory is likewise able to account for complex systems in which multiple morphological markers, lexical idiosyncrasy, and phonological conditioning all play a role, as in Spanish (3.4) and Berber (Chapter 5).

Furthermore, the surface-oriented nature of the approach allows FIAT grammars to be learned by uninsightful, inductive processes, even when the system to be learned is complex and riddled with exceptions and irregularities. FIAT-STRUC constraints originate as inductive generalizations about the strings and structures observable in forms with particular syntactic properties; descriptions of observed strings, which are in most cases true only of a few forms and contradicted elsewhere. By introducing these generalizations into the constraint set and finding a ranking that generates the correct results, the learner can arrive at a grammar in which each generalization has precisely the strength that it requires. Subtle and complex systems can be learned without the learner ever being required to directly apprehend their subtleties.

References

Abdel-Massih, Ernest T. 1968. *Tamazight verb structure; a generative approach*. Bloomington: Indiana University.

Albright, Adam. 2002. Islands of reliability for regular morphology: Evidence from Italian [December 2002]. *Language* 78:684-709.

Albright, Adam, and Hayes, Bruce. 2003. Rules vs. analogy in English past tenses: a computational/experimental study. *Cognition* 90:119-161.

Alderete, John D. 1999. Morphologically governed accent in Optimality Theory. Ms.

Alderete, John D. 2001. Dominance effects as trans-derivational anti-faithfulness. *Phonology* 18:201-253.

Alderete, John D. 2002. Summary: phonotactics in morphological blocking and suppletion. (Web page summarizing mailing list discussion) http://ruccs.rutgers.edu/%7Ealderete/mptactics2_june2002.html.

Anderson, Stephen R. 1992. *A-Morphous Morphology*: Cambridge Studies in Linguistics. Cambridge: Cambridge University Press.

Antilla, Arto. 1997. Deriving variation from grammar. In *Variation, Change, and Phonological Theory*, eds. Frans Hinskins, Roeland van Hout and Leo Wetzels. Amsterdam/Philadelphia: John Benjamins Publishing Company.

Archangeli, Diana, and Langendoen, D. Terence eds. 1977. *Optimality Theory: An Overview*. Oxford: Blackwell Publishers Ltd.

Bader, Yousef Farhan. 1983. Vowel Sandhi and Syllable Structure in Kabyle Berber. *Studies in the Linguistic Sciences* 13:1-17.

Bader, Yousef Farhan. 1984. Kabyle Berber Phonology and Morphology: Outstanding Issues, Linguistics, University of Illinois at Urbana-Champaign.

Bader, Yousef Farhan. 1985. Schwa in Berber. *Lingua* 67:225-250.

Bat-El, Outi. 2002. True truncation in colloquial Hebrew imperatives. *Language* 78:651-683.

Benua, Laura. 1995. Identity Effects in Morphological Truncation. In *University of Massachussets occasional papers in linguistics 18: papers in Optimality Theory*, eds. Jill Beckman, Laura Walsh Dickey and Suzanne Urbanczyk: GLSA, University of Massachusetts.

Benua, Laura. 1997. Transderivational Identity: Phonological Relations Between Words, Linguistics, University of Massachusetts Amherst: Ph.D. Thesis.

Brett, Michael, and Fentress, Elizabeth. 1997. *The Berbers*: Peoples of Africa. Malden: Blackwell Publishers Inc.

Bright, William. 1972. The enunciative vowel. *International Journal of Dravidian Linguistics* 1:26-55.

Bybee, Joan L., and Slobin, Dan I. 1982. Rules and schemas in the development and use of the English past tense. *Language* 58:265-289.

Bybee, Joan L., and Moder, Carol Lynn. 1983. Morphological classes as natural categories. *Language* 59:251-270.

Cho, Mi-Hui. 2002. Evidence for constraint promotion in acquisition: cases of vowel lengthening and onset constraints. *Studies in Phonetics, Phonology and Morphology* 8:149-164.

Dallet, J. M. 1953. *Le verb kabyle*. Fort National (Algiers): Fichier de documentation berbère.

Dallet, J. M. 1982. *Dictionnaire kabyle-français : parler des At Mangellat, Algérie*: Etudes ethno-linguistiques Maghreb-Sahara [1]. Paris: Société d'études linguistiques et anthropologiques de France.

de Lacy, Paul. 1999. Morphological Haplology and Correspondence. Ms.

Dell, François, and Elmedlaoui, Mohamed. 1985. Syllabic consonants and syllabification in Imdlawn Tashlhiyt Berber. *Journal of African Languages and Linguistics* 7:105-130.

Dell, François, and Elmedlaoui, Mohamed. 1987. Clitic ordering, morphology, and phonology in the verbal complex of Imdlawn Tashlhiyt Berber. Ms.

Dell, François, and Elmedlaoui, Mohamed. 1992. Quantitative transfer in the nonconcatenative morphology of Imdlawn Tashlhiyt Berber. *Journal of Afroasiatic Languages* 3:89-125.

Dixon, R. M. W. 1977. *A Grammar of Yidin*: Cambridge Studies in Linguistics. Cambridge: Cambridge University Press.

Hammond, Michael. 1999. English stress and cranberry morphs. Paper presented at *Annual Meeting of the Linguistic Society of America*, Los Angeles.

Harris, James W. 1991. The exponence of Gender in spanish. *Linguistic Inquiry* 22:27-62.

Hayes, Bruce. 1989. Compensatory Lengthening in Moraic Phonology. *Linguistic Inquiry* 20:253-306.

Hayes, Bruce. 1997. Anticorrespondence in Yidin.

Kager, René. 1999. *Optimality Theory*: Cambridge Textbooks in Linguistics. Cambridge: Cambridge University Press.

Kaun, Abigail. The syllabification of geminates in Imdlawn Tashlhiyt Berber. Ms.

Kenstowicz, Michael. 1994. *Phonology in Generative Grammar*. Cambridge: Blackwell.

Kossmann, Maarten Gosling. 1995. Schwa en berbère. *Journal of African Languages and Linguistics* 16:71-82.

Lewis, G. 1953. *Teach Yourself Turkish*. London: Hodder and Stoughton.

MacBride, Alexander Ian. 2000. Phonological and morphological issues in the distribution of Berber schwa, Linguistics, University of California, Los Angeles.

McCarthy, John, and Prince, Alan. 1993a. Prosodic morphology I: constraint interaction and satisfaction. Ms. University of Massachusetts, Amherst, and Rutgers University.

McCarthy, John, and Prince, Alan. 1993b. Generalized Alignment. In *Yearbook of Morphology 1993*, ed. J. van Marle, 79-153. Dordrecht: Kluwer.

McCarthy, John, and Prince, Alan. 1995. Faithfulness and reduplicative identity. Ms.

McCarthy, John. 2003. Optimal Paradigms. ROA-485-1201, http://roa.rutgers.edu/files/485-1201/485-1201-MCCARTHY-0-5.PDF. Ms.

Merchant, Jason. 1996. Alignment and fricative assimilation in German. *Linguistic Inquiry* 27:709-719.

Naït-Zerrad, Kamal. 1994. *Manuel de conjugaison kabyle : 6000 verbes, 176 conjugaisons : amyag di tmaziɣt (le verbe en berbère)*. Paris: Harmattan.

Penchoen, Thomas G. 1973. *Tamazight of the Ayt Ndhir*: Afroasiatic Dialects. Los Angeles: Undena Publications.

Pinker, Steven, and Prince, Alan. 1988. On language and connectionism: analysis of a parallel distributed processing model of language acquisition. In *Connections and Symbols*, eds. Steven Pinker and Jacques Mehler, 73-194. Amsterdam: Elsevier Science Publishers.

Pinker, Steven, and Prince, Alan. 1993. Regular and irregular morphology and the psychological status of rules in grammar. In *The reality of linguistic rules*, eds. Susan D. Lima, Roberta L. Corrigan and Gregory K. Iverson, 321-351. Amsterdam: John Benjamins.

Prince, Alan, and Smolensky, Paul. 1993. Optimality Theory: constraint interaction in generative grammar. Ms. Rutgers University, New Brunswick and University of Colorado, Boulder.

Russell, Kevin. 1995. Morphemes and candidates in optimality theory. Ms.

Russell, Kevin. 1999. MOT: Sketch of an OT approach to morphology. Ms.

Russell, Kevin. 2001. The constraint hierarchy *is* the lexicon or: how Moroccan Arabic plurals got broken. Ms.

Saib, Jilali. 1976a. A Phonological Study of Tamazight Berber: Dialect of the Ayt Ndhir, Linguistics, University of California, Los Angeles.

Saib, Jilali. 1976b. Segment organization and the syllable in Tamazight Berber. In *Syllables and Segments*, eds. A. Bell and J. Hooper.

Spencer, Andrew. 1991. *Morphological Theory*. Cambridge: Blackwell Publishers.

Stemberger, Joseph Paul. 1981. Morphological haplology. *Language* 57:791-817.

Steriade, Donca. 1999. Lexical conservatism in French adjectival liason. In *Formal Perspectives in Romance Linguistics*, eds. B. Bullock, M. Authier and L. Reed, 243-270: John Benjamins.

Steriade, Donca. 2000. Lexical conservatism and the notion *base of affixation*. Ms.

Williams, Edwin B. 1987. *The Bantam New College Spanish and English Dictionary*. New York: Bantam.

Yip, Moira. 1995. Identity avoidance in phonology and morphology. Paper presented at *Conference on Morphology and its relation to Syntax and Phonology*, UC Davis.

Yip, Moira. 2000a. Identity avoidance in phonology and morphology. Ms.

Yip, Moira. 2000b. Repetition and its avoidance: the case of Javanese. Ms.

Zepeda, Ofelia. 1983. *A Papago grammar*. Tucson: University of Arizona Press.

Zuraw, Kie Ross. 2000. Patterned Exceptions in Phonology, Linguistics, University of California, Los Angeles.