

## Phonologically-Conditioned Allomorph Selection

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Since Jakobson's (1948) analysis of Russian verbs as having one stem rather than two, it has been an attempt of generative phonology to minimize distinctly listed allomorphs in favor of phonological rules, some of which may be morphologically specific. Nonetheless there are certain allomorphs that cannot be derived one from the other, leading to "multiple URs" for the same morphemic category, such as the Moroccan 3rd person object clitic, which varies between the allomorphs *-h* (chosen after vowel-final stems) and *-u* (chosen after consonant-final stems), as will be discussed in Section 1.3 below. Such cases require distinct suppletive allomorphs, whose distribution is determined according to their phonological environments. The division of labor in dealing with allomorphy, then, is taken up both by purely phonological rules (such as those responsible for the voicing alternations of the English plural morpheme) and by morphological selection among separately listed allomorphs competing for insertion. In this chapter, we focus on the latter type of alternation between morphemes, while emphasizing that many cases of allomorphy that not included the present discussion are still best handled by phonological derivations from a single underlying form.

While a number of instances of allomorph choice depend on morphosyntactic and lexical factors (including conjugation or declension class), many cases of allomorph selection can be predicted based on phonological configuration. Carstairs (1988) pointed out the relevance of phonological conditions on allomorph selection for morphological theory, but did not provide an implementation of how such allomorph selection should work. The tradition of analyzing allomorphy as multiple allomorphic input candidates that compete for the same morphemic realization and chosen among for the output based on phonological selection begins with Mester's (1994) treatment of Latin stem augments in the perfect.<sup>1</sup> One of the first goals in discussing the role of phonological well-formedness in allomorph distribution is an explicit connection of these phenomena to well-established categories of phonological well-formedness based on crosslinguistic research. In this chapter I will present six different types of phonological conditions that force choice of one listed allomorph over another. I will then discuss cases which appear to be arbitrary but still reference

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<sup>1</sup>However, this case will not be reviewed below, since Lapointe (1999) and Embick (2009) raise important caveats about the appropriateness of Mester's foot-based analysis for a full treatment of Latin.

phonological conditions, and thus require the mechanism of phonological sub-categorization. Finally, I will proceed to a more general theoretical discussion about the level of phonological representation at which allomorph selection takes place and the mechanism of choice.

## 1 Six Phonological Conditions Forcing Allomorph Choice

I have attempted to categorize below a wide range of cases from typologically diverse languages into six basic categories of phonological markedness. As the case studies are chosen to make more general points of contact between the languages, in some cases I have chosen only the clearest examples, and direct the interested reader to the original articles for a fuller discussion of some of the complexities. The argumentation for particular analyses is necessarily abbreviated in this overview, and the reader is advised to consult the references provided for detailed argumentation in favor of certain analyses and against possible other analyses. In addition, I should mention that my choice of citations for these phenomena often reflect the most recent, or most theoretically relevant to the current discussion, rather than choosing the locus classicus on a particular case of allomorphy per se.

The six conditions are organized in terms of segment-level phenomena, syllable-level phenomena, and prosodic-level phenomena. I begin with segmental dissimilation, as it arises in the familiar case of English as well as many other languages, and then to segmental phonotactics. I then turn to syllable structure, whereby preference for onsetful, codaless, and less complex syllables plays a role in allomorph selection, and subsequently to morphological alignment of stems with syllables and syllabic constituents, which causes resistance to resyllabification in the relevant cases. Finally, I turn to stress-to-sonority and peak prominence effects, which prefer sonorous stressed syllables and less sonorous unstressed syllables, and then to foot structure optimization.

### 1.1 Segmental Dissimilation

The English Saxon genitive *'s*, often thought to be one of the most stoic and flexible of all inflectional markers in English, has in fact two allomorphs: *'s* and a zero morpheme,  $\emptyset$  (with devoicing and epenthesis processes well-known from the plural also automatically occurring for the former, which is underlyingly /-z/). The zero allomorph is chosen when the head noun to which the genitive marker attaches contains the plural *-s* (Lapointe, 1996; Zwicky, 1987). As (1-a-b) show, choosing *'s* is ungrammatical with a pluralized head noun in *-s*, though not with other plural forms (1-c). As (1-c) shows, this is the result of a dissimilatory pressure between two *affixes* with identical segmental content: when both are [-s] (or more likely, when both are [-z]), one of them – in this case, the outermost – has to go unexpressed, but when it is part of the stem, no such constraint holds, as shown in (1-d).

- (1) English possessive clitic *'s* zero allomorphy **Marc: how do we know its**

**poss and not plural that is 0**

- a. the cats' feet are dirty ( kæts, \*kætsɪz)
- b. the pigs' hooves are clean ( pɪgz, \*pɪgzɪz)
- c. the oxen's hooves are dirty
- d. Katz's deli

Interestingly, the dissimilatory zero-allomorphy of the Saxon genitive is not enforced when the pluralized noun is not the head of the entire noun phrase – in other words, when the element undergoing possessive marking is not identical to the phonological edge at which the clitic 's is placed. In such cases, speakers (including myself) variably allow fully-fledged 's-marking even onto a noun which bears the plural -s:

- (2) Zero allomorphy optional when plural is not on head noun
  - a. the lady with the cats' name is Tinuviel (kæts, kætsɪz)
  - b. the man in front of the pigs's son won the competition (pɪgz, pɪgzɪz)

The statement of these facts require reference to the head vs. non-head status of the noun phrase bearing the external marking of genitive case, and as such present interesting challenges for fully monostratal theories of morphology-phonology interaction. Returning however to our primary concerns in (1), the choice of allomorphs and indeed the phenomenon as a whole can clearly be understood in terms of dissimilatory pressures against adjacent identity, a set of pressures we will group here under the label of the Obligatory Contour Principle (Goldsmith, 1976; Suzuki, 1998; Yip, 1988), relativized to adjacent sibilants.

A second case of dissimilatory pressures driving allomorphy is found in the interaction between masculine gender allomorphy and plural marking in Catalan (Bonet et al., 2007). Like the English case discussed immediately above, it involves avoidance of adjacent sibilants. However, unlike the English case, in which  $\emptyset$  is the exceptionally-chosen allomorph recruited in case of potential adjacent identity, in Catalan,  $\emptyset$  is the default allomorph, and avoided through choice of *-u* in order to prevent adjacent identical sequences of *-s*, even though the regular epenthetic vowel in Catalan is [ə].

In Catalan, masculine gender on nouns can be expressed by three separate allomorphs:  $\emptyset$ , the most widespread, and, according to Bonet et al. (2007), unmarked allomorph, is used for nouns such as (3-a), which have no overt expression of masculine gender. The second-choice allomorph, *-u*, is found with nouns such as (3-b,c), in both the singular and the plural, as a result of lexical specification to select this allomorph. Interestingly, however, there are nouns such as (3-d), which clearly select the zero-allomorph, as shown in the singular, but recruit the second-choice allomorph *-u* specifically in the plural, in order to avoid an otherwise adjacent-identical sequence of stridents caused by the root-final /s/ of the noun and the *-s* of the plural

- (3) Catalan theme vowel allomorphy (Bonet et al., 2007)
  - a. gət, gət-s 'glass, glasses'

- b. awt-u, awt-u-s ‘car, cars’
- c. mos-u, mos-u-s ‘lad, lads’
- d. gos, gos-u-s ‘dog, dogs’

The Catalan case thus represents another instance of allomorph selection driven by the phonological pressure of dissimilation. Interestingly, as mentioned above, the choice of allomorphy is one in which an otherwise default zero allomorph is skipped over in favor of an overt allomorph, exactly the opposite of the English possessive case above. One crucial difference between the two is that the possessive marker that went to zero occurred when it was the outermost suffix: avoiding identical stridents could only be resolved by jettisoning one of them. By contrast in the Catalan case, choice of an overt masculine gender marker before and inside the plural marker is attached involves a “prophylactic” allomorph choice, ensuring a buffer between two non-negotiably unchangeable stridents.

A third case of sibilant-OCP-driven allomorph choice, quite similar to those discussed above is found in Hungarian (Carstairs, 1988), in which the 2nd singular indefinite present indicative is normally *-as*, but is *-ol* after sibilants (and affricates whose right edge is a sibilant). In short, a number of typologically unrelated segmental dissimilatory pressures dictating allomorph choice can be found involving sibilant consonants.

While dissimilation is in general more common among consonants than among vowels (Nespor et al., 2003), within vowels the most common type of dissimilation is that between low vowels (Suzuki, 1998). This type of pressure can be seen at work in choice of the Spanish feminine definite article, which is ordinarily *la* (4-a), but which recruits the masculine allomorph *el* (4-b) in case of feminine nouns beginning with stressed *á* (Harris, 1987). This allomorph selection to avoid the sequence *a á* is only in case of identical vowels (cf. (4-d)) and in fact is only in case of stressed *á*, as can be seen in the diminutive form in (4-e).

- (4) Spanish article allomorphy based on stressed vowel of following noun
  - a. el libro ‘the book.masc’
  - b. la mésa ‘the table.fem’
  - c. el água ‘the water.fem’
  - d. la ísla ‘the island.fem’
  - e. la aguíta ‘the water.fem-dim.’

A similar kind of vowel dissimilation occurs with the Dutch agentive suffix, which has the allomorphs *-aar* and *-ər*. According to Smith (1976) and van Oostendorp (2009), *-ər* is the default, and *-aar* is chosen when it follows a syllable that contains [ə], to avoid adjacent instances of schwa:

- (5) Dutch agentive suffix allomorph selection
  - a. dansər ‘dancer’, schrijvər ‘writer’, voorzittər ‘chairperson’
  - b. wandəlaar ‘walker’, bewondəraar ‘admirer’, tekənaar ‘illustrator’

What is unusual about the *-aar* allomorph is that it does not attract stress, as most other superheavy suffixes do. van Oostendorp (2009) suggests that *-ər* is inserted first, before stress is assigned, and that after stress is assigned, *-aar* is re-inserted as a dissimilatory repair when there are two adjacent schwas.

A third kind of dissimilatory pressure in allomorph selection is avoidance of wholesale identity between two homophonous but distinct morphemes. For example, the English demonstrative *that* and the complementizer *that* are distinct morphemes, but have identical phonologies. However, the complementizer *that* independently has a zero allomorph. Walter and Jaeger (2008), employing corpus studies, show that the incidence of complementizer *that* as opposed to its zero allomorph is much lower than otherwise expected when the distal demonstrative follows, e.g. *Among those two, I think that that one is better*, where the zero allomorph of the complementizer is preferred.

## 1.2 Segmental Phonotactics

While dissimilation is one kind of segmental interaction whereby segmental similar allomorphs “repel” each other, there are kinds of segmental phenomena that involve avoiding incompatible sequences of consonant + vowel or incompatible combinations of subsegmental features. These forces, too, can drive allomorph selection, leading to avoidance of particular allomorphs when they would incur violations of combinatorial phonotactics.

In Romanian, some *k*-final nouns have an alveopalatal-final stem allomorph in the plural, while others do not (Steriade, 2008), e.g. *kolak*, *kolatʃi* ‘bagel, sg./pl’ vs. *fok*, *fok-uri* ‘fire, sg./pl.’. Steriade (2008) shows that verbal formations based on the same root avoid the verbalizing suffix *-i* if they do not have an existing affricate-final stem allomorph available (e.g., one from the plural). Thus the denominal verb based on *fok*- must use the suffix *-a* to avoid the consonant+vowel sequence [ki]:

- (6) Romanian availability of stem allomorphs determines denominal suffix:
- | singular      | plural           | denominal verb           |
|---------------|------------------|--------------------------|
| kolak ‘bagel’ | kolatʃi ‘bagels’ | iŋ-kolatʃ-i ‘to roll up’ |
| fok ‘fire’    | fok-uri ‘fires’  | in-fok-a ‘to fire up’    |

This case is interesting because it shows that allomorph selection of an *affix* is dependent on the existence of availability of appropriate allomorphs of the *stem*, a notion that Steriade calls lexical conservatism – in other words, allomorphy is opportunistic but it is conservative in that it depends on recruiting existing allomorphs. That is, the default verbalizing suffix (according to Steriade (2008)) *-i* can only be chosen if a [k]-final stem has an independently-available [tʃ]-final allomorph, so as to avoid the phonotactically illicit configuration of velar stop before front vowel. Otherwise, if no [tʃ]-final allomorph is available, the verbalizing suffix *-a* will be chosen.

Turning to subsegmental phonotactic restrictions, in Udihe (Bye, 2008), the perfective is marked on stems ending with [–high] vowels by laryngealizing the vowel – in this case, the allomorph is thus smaller than a full segment.

However, since the language does not allow laryngealized high vowels, when the stem ends in a high vowel, there is a suffix *-ge* concatenated, instead of laryngealization:

- (7) Udihe perfective marked by laryngealization except with high vowels
- a. etet̃e 'work-perf.', zawa 'grab-perf.', olokt̃o 'cook-perf.'
  - b. dogdi-ge 'hear-perf.', bu-ge 'give-perf.'

In this case, therefore, a feature co-occurrence phonotactic (banning [+high] together with [+constricted glottis]) drives allomorph selection: the ordinary exponence process is overridden by a phonotactic.

### 1.3 Syllable Structure

Arguably some of the most widespread instances of phonologically-conditioned allomorphy arise in the domain of syllable structure. When there are two or more allomorphs, the choice among them often is based on yielding a syllable structure that either avoids codas, avoids hiatus, or avoids complex codas without a sufficient sonority drop.

To illustrate this phenomenon it might be interesting to take a familiar case, the English past tense, in a slightly unfamiliar context: its use by second-language learners of English, in this case those whose native language is Brazilian Portuguese (Baptista and da Silva Filho, 2006). According to these authors (and to my own observations), speakers of Brazilian Portuguese English (henceforth BPE) choose between the allomorphs *-d* and *-ed* not based on whether the verbal stem ends in a coronal consonant, but whether it ends in an obstruent:

- (8) BPE past tense recruits *-əd* allomorph for obstruent-final verbs:
- a. added (ædəd)
  - b. packed (pækəd)
  - c. act (ækt, \*ækəd)
  - d. leaned (lind, \*linəd)

As (8-b) shows, in BPE the vowel-initial allomorph of the past tense suffix is extended beyond its original context and is chosen following an obstruent, in order to avoid the sonority plateau of two adjacent stops in a syllable coda. As (8-c) shows, this is not a general process of epenthesis, as it occurs only in heteromorphemic contexts, and hence really is about choosing the allomorph *-ed* and not about general-purpose vowel insertion. Finally, as (8-d) shows, this epenthesis is sensitive to the nature of the stem-final consonant, and does not apply after sonorants. L2 phonology of this sort can be interesting as it illustrates a case in which the distribution of allomorphs may be “opportunistically” generalized beyond their original (or historical) contexts in order to improve syllable structure.

The English indefinite article *a/an* is a case of hiatus avoidance, in which choosing *an* in vowel-initial contexts allows one to avoid a sequence of vow-

els. Stem allomorphs may also be chosen in order to avoid hiatus; Rubach and Booij (2001) cites the example of *Plato* and *hero*, which have an identical syllabic template, but which differ in their adjectival forms *Platonic* and *heroic*. In the case of *Platonic*, according to Rubach and Booij (2001), there is already an existing stem allomorph *Platon-* that can be recruited in order to avoid hiatus; in the case of *heroic*, there is not. One way of putting things is that allomorph selection is resourceful but not omnipotent: avoiding hiatus is nice when possible and existing allomorphs can be recruited for that purpose, but wholly new stem allomorphs cannot spring into existence for this sole purpose.

Cases of phonologically-conditioned allomorph selection (as opposed to general purpose epenthesis, cf. (8-c), or the implausibility of lexically-specific *-n-* epenthesis in *Platonic*) are clearest when the two allomorphs are quite distant from one another. In Korean, the nominative case ending is chosen based on whether the stem ends in a vowel or consonant, as shown in (9).

- (9) Korean Nominative Case Suffix chosen based on Final Segment of Stem (Suh, 2008):
- a. mom-i 'body-nom'
  - b. k<sup>h</sup>o-ka 'nose-nom'

The vowel-initial allomorph allows for resyllabification, thus removing a coda from the representation. Both allomorphic choices result in a CV.CV profile for the suffixed stems.

The choice of phonologically unrelated allomorphs can sometimes be the result of historical divergence. For example, Mascaró (2007) discusses the fact that the Moroccan Arabic object clitic used to be *-hu*, but now has developed into two distinct (and synchronically unrelatable) allomorphs, *-h*, chosen after vowel-final stems (e.g. *xt<sup>t</sup>a-h* 'his error'), and *-u*, chosen after consonant-final stems (e.g. *ktab-u* 'his book'). Each of these allomorphs is clearly chosen in order to avoid marked syllable structure: choosing the opposite contexts for these allomorphs would result in either hiatus or in a complex coda.

Somewhat similar to the BPE past tense case discussed above is the pattern of allomorphy with the Swedish definite suffix (Löfstedt, 2008), in which an allomorph originally intended for one set of environments is recruited for another. The two allomorphs are *-n* and *-en*:

- (10) Swedish definite suffix allomorphy: *-en* recruited after heteromorphemic nasals (Löfstedt, 2008)
- a. [by:], [by:n] 'village; stem, def.'
  - b. [syk:el], [syk:eln] 'bicycle; stem, def.'
  - c. [gru:p], [gru:pen] 'hole; stem, def.'
  - d. [pilgrim], [pilgrimen] 'pilgrim; stem, def.'
  - e. [ɛlksliŋ:], [ɛlksliŋ:en] 'love-dim; stem, def.'
  - f. [hym:n] 'hymn'

As (10-a,b) show, *-n* is the allomorph ordinarily chosen after sonorants, while

*-en* is chosen after obstruents (10-c). However, *-en* is also chosen after nasals (10-d-e), despite the fact that nasal+nasal sequence are tolerated tautomorphemically in Swedish (10-f). This represents an emergent dispreference for sonority plateaus in codas that is blocked when possible by recruiting another allomorph.

In French, masculine and feminine adjectives have two allomorphs, e.g. *pəti* / *pətit* ‘small masc./fem.’. However, the latter may also be used when preceding *masculine* adjectives if they are vowel-initial. This is a case in which hiatus resolution (or perhaps the preference for a syllable onset in the noun) recruit an adjectival allomorph of the ‘wrong’ gender:

- (11) French adjectival allomorph selection resolves hiatus (Perlmutter, 1998; Steriade, 1999; Tranel, 1999)
- a. *petit canard* [pətikanar] ‘small duck, masc.’
  - b. *petite bête* [pətitbɛt] ‘small beast, fem.’
  - c. *petit animal* [pətitanimal] ‘small animal, masc.’

The consonant present in the feminine form is recruited wholesale for masculines simply for syllable-structure considerations. Similar patterns can be found with demonstratives (e.g. *cet* [sə], *cette* [sɛt]). While some authors treat patterns such as (11) in terms of phonological derivation (where /pətit/ is in the underlying form of both masculine and feminine, with a rule of final consonant deletion operative in the masculine), cases of wholesale suppletion, such as (12) below, clearly call out for an analysis in terms of allomorph selection, arguably driven by the same requirements of onset-furnishing as in (11) above:

- (12) French adjectival allomorph selection with wholesale suppletion
- a. *beau canard* [bokanar] ‘beautiful duck, masc.’
  - b. *belle bête* [bɛlbɛt] ‘beautiful beast, fem.’
  - c. *belle animal* [bɛlanimal] ‘beautiful animal, masc.’

In sum, a wide range of allomorph selection process are driven by bread-and-butter syllable structure well-formedness constraints, such as preference for onsets, dispreference for codas, and dispreference for sonority-drops in codas that are not steep enough. In the next section, we will turn to a competing force in allomorph selection, where considerations of alignment of morphological and syllabic constituents may in fact create marked syllable structure.

#### 1.4 Morphological Alignment

The tendency for C-initial allomorphs after vowel-final stems and V-initial allomorphs after consonant-final stems is occasionally trumped by other factors, resulting in the opposite pattern. The most well-known case of this is the Haitian definite article (Klein, 2003), in which a C-initial suffix occurs after C-final stems and a V-initial suffix after V-final stems:

- (13) Haitian definite article allomorphy (Klein, 2003)

- a. liv-la ‘book-the’
- b. papa-a ‘father-the’

According to Klein (2003), the default allomorph is *-a*, and *liv-la* is preferred to *li.va* because the latter would resyllabify the stem. Apparently the morphological alignment of the right edge of the stem with the right edge of a syllable is important to maintain.

The Galician article (Kikuchi, 2006) shows that morphological/syllabic alignment may enter into opaque interactions. The allomorphs of the definite article are *o/lo* (masc. sg.), *a/la* (fem. sg.), *os/los* (masc. pl.), and *as/las* (fem. pl). The onsetless forms, illustrated in (14-a-d), are the default, but following a continuant *r, l, s* in the coda of a preceding word (in combinations that are adequately close, such as infinitives or prepositions plus their complements), the liquid-initial allomorph is chosen, as shown in (14-e,f):

- (14) Galician article allomorphy (exemplified for feminine *a(s)* vs. *la(s)*)
- a. a xente ‘the people’
  - b. as mulleres ‘the women’
  - c. para as mulleres ‘for the women’
  - d. sobre a xente ‘about the people’
  - e. ve-la xente ‘I saw the people’ /ver/
  - f. tóda-las mulleres ‘all the women’ /tódas/

Kikuchi (2006) proposes that, like the Haitian Creole case discussed above, the choice of an onsetless article in Galician is motivated by a preference for morphological word edges to be aligned with syllable edges. When the preceding word ends in a consonant, *ver.la* is preferred to *ve.ra* because the latter, moves the definite article *a* inside, rather than at the edge of, a syllable.

Notice that choice of the liquid-initial onset is conditioned by a preceding segment that is deleted on the surface; in other words, the allomorphic choice shows opacity (since otherwise surface *tóda* (underlying /tódas/) should pattern like *para*). The deletion at this intermediate level involves an OCP effect: *ver-la* or *todas-las* would create adjacent identical continuant consonants, which Kikuchi (2006) posits are banned across word boundaries in prosodically close domains, such as prepositions or verbs plus their complements. Hence, once the allomorph *la* is chosen, the preceding continuant deletes.

A similar case is the Korean conjunctive suffix *-wa* and *-kwa* (Suh, 2008). The interest of this allomorphy is the fact that within the same language, the nominative (discussed in (9)) and the conjunctive have apparently contradictory distributions.

- (15) Korean conjunctive suffix allomorph selection (Suh, 2008)
- a. k<sup>h</sup>o-wa ‘nose-conj.’
  - b. mom-kwa ‘body-conj.’

According to Suh (2008), this pattern results from the need for right-alignment of the stem with the right edge of a syllable. As *mw-* is tolerated as an onset,

onset maximization with *mo-mwa* would result in resyllabification of the stem *mom*, while *mom.kwa* does not. What about *mo.mi*, then, the nominative form seen above? Suh (2008)'s actual constraint is about alignment with the right edge of any subsyllabic constituent. In *mo.mi* the stem-final [m] is aligned with the right edge of the onset (which is simplex), but in *\*mo.mwa* it is not, being blocked from the right edge of the onset by the following glide. By contrast, in *mom.kwa*, the stem-final [m] is comfortably at the right edge of the coda constituent.

Mòcheno is a German dialect spoken in the Trentino region of Italy, with two allomorphs of past participial prefix, according to Alber (2009): /ga-/, and a subsegmental [-voice,-cont] feature matrix. The distribution of these allomorphs depends on the initial consonant of the verb stem. With voiceless stops and with supralaryngeal fricatives, the [-voice, -cont] allomorph is chosen (16-a), which may result in  $\emptyset$  realization or affricate formation. For voiced stops and all sonorants, /ga-/ is chosen (16-b):

- (16) Mòcheno participial allomorphs (Alber, 2009): stem resists resyllabification

	stem		participial form
a.	tondərn	'to thunder'	tondərt
	krətsn	'to scratch'	krəst
	viərn	'to conduct'	pfɪərt
	ʃlo:ŋ	'to beat'	tʃlo:ŋ
b.	o:tnən	'to breathe'	gao:tnt
	rɛərn	'to cry'	garɛərt
	mɛxən	'to make'	gamɛxt
	bisn	'to know'	gabist
	griezən	'to greet'	gagriest

According to Alber (2009), the principle that a stem should not be resyllabified with a prefix (i.e. that the verb stem should be aligned with its own syllable) is what drives the allomorph selection. Voiceless stops and fricatives can form a doubly-linked representation with the [-cont,-voice] segment, leaving the stem at the left edge of its own syllable. The rest choose /ga-/ so as not to resyllabify the stem with a preceding consonant.

### 1.5 Stressedness and Vowel Quality

Stressed vowels like to be more sonorous, and unstressed positions tolerate fewer vowel contrasts (Crosswhite, 1998). A number of allomorph selection processes seem to be motivated by the distribution of non-peripheral vowels (i.e. mid-vowels, in the cases below) in unstressed positions.

Due to the Stress-to-Weight principle, stressed syllables like to be heavy, and hence may undergo processes such as Iambic Lengthening (Hayes, 1995) or glottal stop insertion. Conversely, unstressed syllables may undergo glottal stop deletion, in order to reduce their relative prominence with respect to stressed syllables.

Somewhat like the case of the Spanish definite article allomorphy, which recruits “the wrong gender” in order to avoid hiatus of identical low vowels, an allomorphy process in Hebrew plural formation occurs that borrows the wrong gender for phonological reasons. The Hebrew feminine suffix *-ot* (17-b) is exceptionally extended to masculine nouns, such as (17-c) (Becker, 2009), which otherwise take the masculine suffix *-im* (17-a).

- (17) Hebrew plural allomorph selection: feminine *-ot* recruited for nouns with unstressed [o] (Becker, 2009)
- a. yélad, yelad-ím ‘boy; masc. fem, masc.pl’
  - b. xatsér, xatser-ót ‘backyard; fem. sg, fem.pl’
  - c. xalón, xalon-ót ‘window; masc. sg, masc.pl’

One defining feature of Hebrew plural formation is that it takes stress away from the nominal stem, and this has consequences for the marking of masculine nouns whose final vowel is [o]. Becker (2009) argues that the mid-round vowel [o] is dispreferred in unstressed syllables in Hebrew (and more generally in weak positions (Beckman, 1997)), but can receive support by a kind of vowel harmony that licenses it: a weak unstressed [o] can be tolerated when adjacent to a stressed [o]. For this reason, the feminine *-ot* is recruited specifically for masculine nouns of which the last syllable contains [o]. Becker (2009) shows that this allomorphic recruitment is not a historical quirk, but is actively used in novel plural formations in a wug-test.

Surmiran Rumantsch verbs have two sets of stem allomorphs, chosen based on stress placement. The unstressed variant is not predictable based on the stress variant, ruling this out as a case of straightforward vowel reduction. According to Anderson (2008), the alternations are not predictable, and require listing of both stem allomorphs. It is a common pattern in Romance that the infinitive, 1pl, and 2pl will bear distinct allomorphs from the rest of the paradigm, as in the Italian verb conjugation for *andare* ‘to go’, which is wholly suppletive.

- (18) Italian present tense conjugation for *andare*, with stress marked and agreement endings separated:
- |   | sg     | pl       |
|---|--------|----------|
| 1 | vádd-o | and-iámo |
| 2 | v-ái   | and-áte  |
| 3 | v-á    | v-ánno   |

Given the longer endings for 1pl and 2pl, Surmiran shows a pattern which is understandable in terms of preference for unstressed syllables to be low-sonority [i,u,o] rather than [e,a]. The choice of allomorphs thus aligns prosodic weakness with segmental weakness. The stem allomorphs *ləv-* and *fit-* are thus chosen when stress is on the inflectional ending rather than on the root.

- (19) Surmiran stem allomorphy chosen based on stress (Anderson, 2008)

infin	lǝvár ‘get up’	fittár ‘finish’
1sg	lǝv	fét
2sg	lǝvas	féttas
3sg	lǝva	fétta
1pl	lǝvǝgn	fittǝgn
2pl	lǝvǝz	fittǝz
3pl	lǝvan	féttan

Anderson argues that these alternations do not involve unstressed vowel reduction, as the same stressed [e] corresponds to both [i] and [ə]. As no deterministic rule of reduction is at work here, this must be handled in terms of allomorph selection, in this case, based on stress-to-sonority.

In a somewhat similar vein, Spanish mid-vowels display an alternation whereby they diphthongize under stress. However, while certain instances of diphthongization in unstressed syllables are allowed, others are not.

- (20) Spanish mid-vowel diphthongization stem allomorphy (Bermúdez-Otero, 2009): unstressed diphthongs not tolerated at stem-level
- a. encontrár ‘to meet’
  - b. encúentro ‘a meeting’
  - c. encuentrón ‘meeting-aug.’ (word-level, ‘one hell of a meeting’)
  - d. encontrón ‘someone who bumps into others’ (stem-level, deverb-  
bal)

According to Bermúdez-Otero (2009), whether or not a mid-voweled root will diphthongize or not under stress is unpredictable, and hence two listed stem allomorphs must be kept, e.g. /eɲkwent/ and /eɲkont/. The difference between denominal derivation in (20-c) and deverb-derivation (20-d) is that, while denominal derivation (e.g. diminutives, augmentatives) is word-level (within the Lexical Phonology / Stratal OT conception of levels), the deverb-derivation is stem-level. Given such a division, Bermúdez-Otero (2007) argues that there is a relevant stem-level constraint in Spanish that disallows unstressed diphthongs. As a result, given the deverb-derivation which places stress on the suffix, the stem allomorph /eɲkont/ will be chosen, again due to the phonological preference for stress and syllabic prominence to line up.

## 1.6 Foot Structure

In this section we examine cases of allomorph selection which involve improving or maintaining the preferred foot structure in the language.<sup>2</sup> The cases are similar in spirit to the alignment of segmental prominence to stress, but often involve syllable-counting in a way that requires footing in order to determine allomorph selection.

González (2005) analyzes allomorph selection in languages of the Panoan family as choosing segmental allomorphs based on foot structure. For exam-

<sup>2</sup>All of the cases discussed here involve trochaic languages, which may be an accident, or may be part of a deeper generalization.

ple, the Shipibio repetitive suffix has the allomorphs [riba] and [ribi], with the former appearing after odd-numbers of syllables and the latter appearing after even-numbers of syllables. Since this is a trochaic language, the effect of this allomorph choice places the vowel [a] in strong syllables and [i] in weak syllables.

- (21) Shipibio syllable-counting allomorphy: *ribi* vs. *riba* (González, 2005)
- a. Stem: pima ‘eat-caus.’ + REPETITIVE + PAST:  
(pi.ma)(ri.bi)ki ‘He ate it again’
  - b. Stem: pi ‘eat.’ + REPETITIVE + PAST:  
Repetitive+Past (pi.ri)(ba.ki) ‘He made him eat it again’

In Yaminahua, the allomorphs *tij*o and *tofi*, a directional perfect suffix meaning ‘on arriving’, are chosen on the same basis: the appearance of syllable counting, which is actually based on foot structure.

- (22) Yaminahua syllable-counting allomorphy: *tij*o vs. *tofi* (González, 2005)
- a. Stem: fitji ‘find’ + ARRIVE + PAST + PLURAL:  
(fi.tji)(to.fi)(afo) ‘found on arriving’
  - b. Stem: fa ‘say’ + ARRIVE + yesterday:  
(fa.ti)(fo.i)(ta) ‘said on arriving’

Somewhat like the cases of peak-prominence discussed in the section above, these cases illustrate allomorph selection based on syllable-counting that make sense once integrated with the fact that this is a trochaic language, and hence odd-numbered stems will want the more sonorous syllable coming first, while even numbered stems will want it coming second.

Similar to the Panoan cases above is the selection of allomorphy in Estonian, where the genitive plural has two allomorphs, *-te* and *-tte*, and the partitive plural has two allomorphs, *-sit* and *-it*. When these are added to vowel-final bases, the choice of allomorph is determined by what looks like syllable count: *-it* and *-tte* are chosen with odd-numbered bases. Estonian is trochaic, and Kager (1996) argues that it is foot structure that determines the choice of allomorphy: the head of a foot should be heavy if possible:

- (23) Estonian odd-numbered stems’ allomorph choice: *-tte* and *-it* (Kager, 1996)
- a. paraja ‘suitable’
  - b. (pa.ra)(jät.te) ‘gen. pl’
  - c. (pa.ra)(jait) ‘part. pl’

By contrast, when the stem is even-numbered, no suffixation can possibly improve the weight of the head of the foot, and so affixes which cause no resyllabification or realignment are chosen:

- (24) Estonian bisyllabic stems’ allomorph choice: *-te* and *-sit* (Kager, 1996)
- a. vísa ‘tough’

- b. (ví.sa)te 'gen. pl'
- c. (ví.sa)sit 'part. pl'

Kager (1996) argues that it is feet and not syllables that are counted, as bisyllabic bases with superheavy initial syllables group with *paraja*. e.g. *aas:ta-tte* 'year-gen.pl'. Hence this allomorph selection cannot be reduced to syllable counting but must be stated in terms of heads of feet and making them heavier.

Greek is a language with mostly antepenultimate stress in trisyllabic words (Drachman et al., 1996). Its syllable-counting allomorphy with action nominals involves *-ma* and *-imo*. Monosyllabic stems take *-imo*, thereby achieving antepenultimate stress unproblematically, whereas polysyllabic stems take *-ma*, keeping the stress on the initial syllable while changing word length minimally:

- (25) Greek action nominals and syllable count (Drachman et al., 1996)
- a. vréks-imo 'wetting'
  - b. skúpiz-ma 'sweeping'

The case above shows a kind of complementarity effect: the shorter stems take the longer allomorph and the longer stems take a shorter allomorph. A similar case can be found in Dutch, whose feet are preferably trochees. The plural suffixes *-en* and *-s* are chosen in order to form trochees at the right edge.

- (26) Dutch plural allomorphy: based on trochees at right edge (Booij, 1998)
- a. knie, knieën 'knee'
  - b. bal, ballen 'ball'
  - c. nátie, náties 'nation'
  - d. geníe, geníeën 'genius'
  - e. kánon, kánons 'canon'
  - f. kanón, kanónnen 'cannon'

Notice above that a complementarity effect obtains with monosyllables versus disyllables, and also in terms of distance from the right edge: the longer *-en* is chosen when there is a shorter distance of the stress from the right edge, and the shorter *-s* when there is a longer distance. A similar case can be found in Spanish with the suffix that creates abstract nouns from adjectives and has two allomorphs:

- (27) Spanish *-ez/-eza* allomorphy (Aranovich and Orgun, 2006)
- a. vil-eza, 'vileness', nobl-eza 'nobility', trist-eza 'sadness'
  - b. rigid-ez 'rigidity', madur-ez 'maturity', tirant-ez 'tenseness'

According to Aranovich and Orgun (2006), there appears to be a requirement that derived nouns be larger than a foot, but not larger than necessary. This pattern also shows the complementarity effect discussed above. However, consonant final stems appear to contradict this pattern, e.g. *gentil-eza* 'gentleness',

*sutil-eza* ‘subtlety’. This apparent misbehavior of allomorph selection can be resolved, however, given that Spanish vowel sequences delete heteromorphemically. With such an analysis available, the stems above are thus in fact *vilo-eza*, *triste-eza* vs. *rigido-ez*, *maduro-ez*, at the point before which vowel deletion applies. The more abstract underlying representation, with vowel-final stems as the conditioning environment, enable a consistent statement of allomorph selection in terms of foot structure. Aranovich and Orgun (2006) argue that allomorph selection takes place at a level of representation before vowel deletion, and that the choice is motivated by a goal of forming two perfectly binary feet at that level of representation, e.g. (vi.lo)(e.za), (ri.gi)(do.ez). This pattern thus shows allomorph selection conditioned by foot structure, but at a level removed from the surface, a point to which we will return.

## 2 Arbitrary cases that still reference phonology

Dealing with phonologically-conditioned suppletive allomorphy, Paster (2005, 2006) proposes that certain cases of allomorphy are sensitive to phonology but do not optimize anything, and proposes instead a mechanism of subcategorization in the grammar. Based on a number of cases such as Axininca and Italian, Bye (2008) echoes this conclusion, that allomorphy is selection, and that phonological optimization is due to historical or coincidental factors. Embick (2009) endorses a similar viewpoint to these authors, eschewing a model of grammar with “global” interaction between morphology and phonology. While we will discuss their models further below, it is first worth showing a few cases of these that indeed reference phonology but in which the actual choice seems to have no phonotactic/markedness-based motivation.

Two such cases involve syllable- or mora- counting allomorphy of the type that was relevant for optimization of foot structure above, but in ways which do not seem to improve anything, and cannot be easily understood in terms of existing grammatical well-formedness constraints, unless one wants to “pollute” the constraint set with a host of parochial constraints unrelated to the core intuitions of markedness. They are shown below, for Kaititj and Axininca Campa, both of which reference the phonological factor of syllable or mora count in order to determine selection of allomorphs, but choose in a way that still leaves the connection between the structural description (syllable count) and structural change (insertion of allomorph) arbitrary.

- (28) Kaititj ergative suffix: -ŋ after disyllabic stems, -l after trisyllabic stems (Paster, 2006)
- a. aki-ŋ ‘head-erg’, iltʷi-i-ŋ ‘hand-erg’, aynpni-ŋ ‘pouch-erg’
  - b. aliki-l ‘dog-erg’, aɬuyi-l ‘man-erg’, aɣiki-l ‘sun-erg’
- (29) Axininca Campa genitive: -ni after bimoraic stems, -ti elsewhere (Bye, 2008)
- a. no-yor<sup>y</sup>a-ni ‘my manioc worm’, i-ɕaa-ni ‘his anteater’, a-sari-ni ‘our macaw’

- b. *i-wisiro-ti* ‘his small toucan’ *no-yairo-ti* ‘my termite’ *a-yaarato-ti* ‘our black bee’

Another case that is not obviously amenable to an optimization analysis is the plural definite article selection in Italian, which chooses  $\lambda i$  before consonant-initial stems, but *i* before vowel-initial stems.<sup>3</sup> There is no obvious advantage to having  $\lambda i$  as opposed to *i* before a vowel-initial noun.

- (30) a. *i vini* ‘the wines’, *i padri* ‘the fathers’, *i ragazzi* ‘the boys’  
 b.  $\lambda i$  *alberghi* ‘the hotels’,  $\lambda i$  *inglesi* ‘the Englishmen’,  $\lambda i$  *uccelli* ‘the birds’

While one might imagine certain possibilities (e.g. ONSET is tolerably violated with vowel-initial stems, but having a vowel-initial article before it tips the scales with two violations of ONSET, perhaps due to constraint-self-conjunction), these are far from obvious. Paster (2006) discusses a similar case from Jivaro, in which consonant-final stems take the suffix *-cha*, while vowel-final stems take the suffix *-cho*.

These cases clearly reference phonology, but cannot be the result of automatic grammatical choices based on well-formedness. Instead, they require a mechanism called ‘subcategorization’, which states in the lexical entry of Kaititj ergative allomorphs that  $-ŋ$  subcategorizes for, or is chosen in case of, disyllabic stems, and  $-l$  elsewhere:

- (31) Sample Subcategorization for Kaititj ergative:  
 ERG  $\leftrightarrow$   $/-ŋ/$  in the context  $\sigma\sigma -$   
 ERG  $\leftrightarrow$   $/-l/$

Given a schema like the one above and the Elsewhere principle (see e.g. Halle (1997)) for Vocabulary Insertion / allomorph selection, the more specific contextual specification will always block the less specific one, if met.

Although Paster (2005, 2006) and Bye (2008) argue, on grounds of parsimony, that if the language faculty needs subcategorization anyway, why bother with optimization at all, there are other authors take a stance in which the case of phonologically-optimizing allomorph selection can be determined entirely by constraint satisfaction, with brute-force subcategorization arising only as a “last resort” (e.g. Lapointe (1999)) for the non-optimizing cases. Presumably such a division of labor would lead to the prediction that, as subcategorization is more costly (requiring lexical listing, whereas constraints otherwise active in universal grammar come “for free”), systems might evolve over time into becoming phonologically optimizing.

Wolf (2009) makes the interesting point that the mechanism of subcategorization is better for stating positive conditions than negative conditions. In

<sup>3</sup>The allomorph  $\lambda i$  is also chosen before geminate-initial and sC-cluster initial stems. Under certain analyses (e.g. Kaye (1992)), these can be reduced to the vowel-initial context. Whether or not this reduction is made does not change the point in the text about the seeming arbitrariness of the distribution of *i* vs.  $\lambda i$ .

other words, it works well for saying “choose -ŋ when the stem is bisyllabic”, but would not work well for cases like “choose Spanish *la* when the following noun does not start with *á*”. The logic of subcategorization conditions like (31) certainly allows reference to natural classes, even those formed by negative values of features (e.g. choose English *an* before stems beginning with [–consonantal] segment), but when such specifications involve disjunctions or miss generalizations linking the structural description to the structural change (i.e. insertion of the allomorph), they become less appealing.

### 3 Issues for Theoretical Models

Having established that a great deal of allomorph-selection is phonologically-conditioned, important consequences arise for models of morphology-phonology interaction, whether couched in terms of constraint satisfaction as the means for choosing among allomorphs (e.g. Kager (1996); Mascaró (2007)) or subcategorization / Vocabulary Insertion (e.g. Embick (2009); Halle (1997)). While I will not choose among these models here, I will identify two important issues for any class of models: the question of when (i.e. at what stage in a phonological computation) allomorph selection takes place, and what the mechanism of choice is.

#### 3.1 When does Allomorph Selection Take Place?

Stratal (e.g. Bermúdez-Otero (2007)), derivational (e.g. Wolf (2009)), or cyclic (e.g. Embick (2009)) models of grammatical computation differ from monostratal models, in that the first three potentially allow multiple levels of intermediate representation, with processes like allomorph selection occurring according to the well-formedness principles of one level, but subsequently obscured by the operations of a later level. However, monostratal (or globalist) models, which allow information from various modules to be present either simultaneously or preserved across different stages of computation, have a distinguishing trait: they allow, for example, phonological processes such as allomorph selection to freely refer to syntactic boundaries and constituency. By contrast, stratal and/or cyclic models may limit such information from entering later stages of phonological computation. In the following two subsections we turn to these two issues.

##### 3.1.1 Opacity: Allomorph Selection at Intermediate Levels

As mentioned above in three case studies, not all allomorph selection occurs at the surface. We review the relevant facts, four of which suggest that allomorph selection occurs at an earlier level of representation (therefore requiring the interaction with tools for opacity such as rule ordering, stratal optimality theory, or OT-CC), and one of which suggests the possibility of lexical *re*-insertion after certain phonological processes have applied.

Reviewing the facts in the Galician definite article case, the allomorph *la* was chosen over *a* to avoid syllabification of the definite article with a preceding onset from a different morpheme, e.g. *ver.la* ‘see the’ instead of *ve.ra*. However, the verb-final *r* was subsequently deleted due to an OCP effect, yielding *ve.la* (cf. *para a* ‘for the’, to show hiatus is clearly not at stake). Thus the phonological conditioning of allomorph selection is clearly taking place before *r*-deletion.

Similarly, in the Spanish deadjectival suffix case, the allomorph *-eza* is chosen for adjectival stems that are bisyllabic as the input to this affixation, and thus *vilo*, *triste*, *gentil* all pattern the same in taking *-eza* in order to form two feet. However, the former two undergo final vowel deletion. Thus, the statement of syllable-count in terms of allomorph selection is clearly taking place before vowel deletion.

Finally, in a somewhat different vein, the Dutch agentive suffix discussed above according to van Oostendorp (2009) requires selection of one allomorph, *-ər*, before stress is assigned, as the default. However, after stress assignment has already happened, if the suffix immediately follows another syllable containing schwa, van Oostendorp (2009) proposes another cycle of allomorph selection in which *-aar* can be chosen to resolve the schwa-based OCP.

There are two other cases I will mention here, described in Gibson (2008), which relate to allomorphs chosen after C-final and V-final stems, both of which occur derivationally prior to a process of consonant deletion. In Japanese, for example, the nonpast suffix is *-u/-ru* and the inchoative suffix is *-oo/-joo*. However, *w*-final stems delete their final consonant when preceding high or mid vowels, and do so after allomorph selection. For comparison, the negative suffix *-anai/-nai*, which does not trigger *w*-deletion, is shown.

(32) Japanese opaque allomorph selection with *w*-final stems:

	yom ‘read’	ne ‘sleep’	iw ‘say’	yow ‘get.drunk’
nonpast	yom-u	ne-ru	i-u	yo-u
inchoative	yom-oo	ne-joo	i-oo	yo-oo
negative	yom-anai	ne-nai	iw-anai	yow-anai

A very similar case occurs in Turkish, where a process of intervocalic *k*-deletion applies after C-final vs. V-final allomorph selection. The 3rd person possessive suffix *-i/-si* surfaces after C-final vs. V-final stems, but *k*-final nouns choose *-i*, even though the conditioning stem-final consonant subsequently deletes:

- (33) Turkish opaque allomorph selection with *k*-final stems:
- a. bedel, bedel-i ‘price, nom./poss.’
  - b. fire, fire-si ‘attrition, nom./poss.’
  - c. bebek, bebe-i ‘baby, nom./poss.’

In both of these cases, allomorph selection is applying to a level of representation prior to consonant deletion, which means that the optimization is on an intermediate form. If the consonant deletion processes can be assigned to different strata of phonological computation (e.g. post-lexical, or word-level),

then these phenomena can be easily dealt with in lexical phonology or stratal OT.

The notion that intermediate representations are evaluated for well-formedness (i.e., a derivational model that includes negative well-formedness constraints) is entirely reasonable. It is by now known that monostratalism is untenable, and also known that grammars without statements of negative constraints miss generalizations. Future models that develop a series of ordered computations with intermediate levels of representations should definitely incorporate treatment of allomorphy phenomena, particularly since they interface with interesting questions of lexical insertion (cf. Embick (2008); Wolf (2009)).

### 3.1.2 Reference to syntactic factors

As mentioned above, an important issue that arises in the study of allomorphy and “where/when” it takes place is the issue of syntactic sensitivity. For example, Russian 3rd person pronouns have two allomorphs, one vowel-initial and the other containing an initial *n-*, with the latter chosen after prepositions (presumably for the same reasons as the Galician case above; namely to avoid resyllabification and allow stems to begin their own syllable). Hence the pronoun *ix* is realized as *nix* when a preposition precedes, as prepositions are well-known to closely prosodify with their complements in Russian (34-a). However, when the pronoun is not the head of the prepositional complement, but rather a possessive modifier, no such allomorphy occurs (34-b).

- (34) Russian prepositional complement allomorphy
- a. bez nix ‘without them’
  - b. bez ix brata ‘without their brother’

In fact this is the same kind of pattern we observed in the first example in this paper: the English possessive *'s* does not display zero-allomorphy when following a plural *-s* that is *not* the head of the NP. What is interesting about both of these cases is that the affected linear string is the same. Hence “syntactic brackets” must be visible. The simplest model to envision is one in which they are literally visible to morphophonological representations. However, one might also experiment with the possibility, in cyclic models, that the possessive modifier in (34) is submitted to its own closed-off morphophonological computation prior to the cycle in which the preposition is visible to its complement. In other words, the idea might be that in [ without 3pl ]<sub>PP</sub>, the preposition is visible at the moment the pronoun is spelled out; by contrast, in [ without [ 3pl brother ]<sub>DP</sub> ]<sub>PP</sub>, the pronoun is spelled out at an earlier cycle in which the preposition is not yet visible. Whether this hypothesis can be integrated with other facts about the order of spell-out in Russian prepositional complements and noun phrase structure awaits a fuller investigation.

A second case of reference to syntactic factors regards the *-s/∅* allomorphy found in dialects of Catalan, described by Bonet et al. (2008). In these varieties, plural *-s* on adjectives is realized as zero between two consonants (a process

which the authors argue is not due to a general process of strident deletion). However, this process can only apply prenominaly:

- (35) Catalan prenominal / postnominal allomorphy:  
a. *aquel*∅ *bon*∅ *vins blancs dolços*  
those-pl good-pl wine-pl white-pl sweet-pl

The statement of these allomorphy conditions must thus take into account the hierarchical/linear position of the adjective with respect to the noun, which may be a few words away. Again, a simple model would be one in which the entire noun phrase structure is still visible at the point of allomorph selection and somehow the linear position with respect to the noun is relevant for *-s/∅* allomorphy. An approach within a cyclic model might be one in which there is a sequenced computation in which postnominal elements do not have the same syntactic relation with the noun as prenominal elements – for example, postnominal elements being spelled-out in a different cycle than the noun, and hence required to bear overt exponents of plurality. Again, while this account is potentially much more interesting (and restrictive) than a globalist model, it would require integration with independent facts about prenominal and postnominal asymmetries in the spell-out of adjectives.

In sum, much exciting work lies ahead particularly in the domain of syntactically-sensitive phonologically-conditioned allomorphy, as it raises important analytic challenges as to how the syntactic structure is made accessible – whether syntactic brackets are literally visible, or whether their effects arise as epiphenomenal due to the timing of spell-out.

### 3.2 How are Allomorphs Chosen?

Perhaps one of the most widely-debated issues within the study of allomorph selection is the mechanism of choice. The existence of phonological conditioning, and in particular, phonological optimization, suggests that grammatical, rather than morpholexical, mechanisms, are at work in accomplishing the selection – more specifically, that when a given allomorph is better for segmental, syllabic, or prosodic structure, that the grammar will somehow “automatically” choose that allomorph without having to list these contexts in its lexical representation.

The choice of the allomorph that *does* lead to some kind of phonological optimization is relatively straightforward, particularly in models such as Optimality Theory, or in fact any constraint-based models which encode well-formedness principles as an active grammatical force that can compel choice of one input over another. For example, a constraint such as \*CODA will prevent choice of Korean *-ka* after consonant-final stems such as *mom*, and will thus lead to choice of the phonologically optimizing allomorph, *-i*.

However, in most of the cases described above there is one allomorph – call it “the optimizer” – chosen for particular phonotactic reasons, and another that is simply a default. For example, in the case of English *a/an* allomorphy, *a* is

simply a default that does not optimize anything when it is chosen – it is only *an* that is recruited to improve phonotactics. The question thus arises, why is the optimizer *an* not *always* chosen – it will provide an onset when needed for vowel-initial words that follow, and is otherwise seemingly harmless. The intuition to be captured is that the other allomorph, *a*, is the default, and is chosen “elsewhere”, when providing an onset is not at stake one way or the other.

In the discussion that follows we will be concerned with a pattern as schematized in (36), (keeping in mind that in some cases *both* allomorphs are optimizers (e.g. Moroccan Arabic *-h* vs. *-u*), and neither is clearly a default).

- (36) *Optimizer*: The allomorph chosen in order to satisfy a particular phonotactic, e.g. *an* to provide an onset, in a particular set of environments (e.g. before vowel-initial words)  
*Default*: The allomorph chosen otherwise

The pressing issue for models of morphology-phonology interaction thus becomes how to grammatically state that one allomorph is the *default* within different models of grammar – in other words, that it should be inserted *unless* some phonotactic pressure demands the other one. Interestingly enough, this question becomes of more relevance to precisely those models in which all the action is encoded in terms of negative constraints: how does one force the default allomorph to be used over the other one?

A number of distinct answers have been posited in the literature, and it is not yet clear which is the best among them. One class of proposals holds that the default is always phonologically more unmarked than the optimizer, which leads specifically to the question of context-free markedness. If the default can be shown to be generally unmarked (either in terms of segmental or structural terms) compared with the optimizer, this approach will lead to selection of the default by unmarkedness criteria alone when phonotactic optimization with the stem+affix is not at stake.

Let us begin by considering cases such as Djabugay genitive, in which *-ɲun* is chosen after consonant-final stems, while *-n* is chosen after vowel final stems (a pattern which is presumably driven by avoidance of complex consonant clusters ending in *n*).

- (37) Djabugay genitive  
 a. gu.lu.du-n ‘dove’  
 b. ga.ɲal.ɲun ‘goanna’

While the choice of *-ɲun* in (37-b) can be understood in terms of avoidance of \*[ga.ɲal.n], in order to enforce selection of default *-n* in (37-a), Kager (1996) posits the constraint “GEN = -n”, which we can call a *violable exponence requirement constraint* (see Russell (1995) for elaboration of this type of constraint). These constraints demand a particular exponent for a particular morphological category and are thus one way of encoding the notion of a certain exponent being the default, but it might strike some as brute force to include and rank a

violable constraint dedicated to every exponent in the grammar.

Along the lines of context-free unmarkedness arbitrating in favor of the default, Rubach and Booij (2001) propose that instead of stipulating that /-n/ is the default in Djabugay, one should rather state that  $\eta\text{un}$  is *dispreferred*, except in special cases. They appeal to segmental markedness, and specifically claim that, in the absence of other competing factors,  $\eta\text{un}$  will be dispreferred due to a markedness constraint against velar nasals. This formulation thus chooses the default over the optimizer when coda phonotactics are not at stake via context free (but violable)  $*\eta$ . This proposal is an interesting way of encoding the default selection, but should always be kept in mind alongside whether such constraints are consistent with the full-blown grammar of the language.

A second class of proposals involving context-free markedness in order to favor the default, applied to this same case, is an appeal to “shorter is better”. For example, Wolf (2009) posits that constraints such as  $*\text{STRUC}$  – which penalize structure in general, and thus prefer shorter outputs whenever possible – will lead to the preference for /n/ over / $\eta\text{un}$ /, or *a* over *an*, unless trumped by phonotactic factors. In cases involving complementarity of length effects, in which for example bisyllabic stems take *-eza* to accomplish two full feet and all longer stems take *-ez*, the default can clearly be seen to be the shorter allomorph. Appeals to  $*\text{STRUC}$ , however, are not without problems, as discussed by Gouskova (2003), and further work is needed to capture the intuition that shorter is more unmarked for default allomorph selection within an implementation that does not wreak typological havoc under re-ranking.

Not all cases of default choice seem amenable to markedness, however, particularly when inflectional, rather than derivational morphology is involved. Bonet et al. (2007) and Mascaró (2007) posit pairwise preference constraints, e.g. “prefer *a* to *la*” in Haitian Creole. The more complicated use of such constraints are in cases such as the Catalan gender markers, which Bonet et al. (2007) posit are  $\emptyset > /u/ > /ə/$  for masculine, and  $/ə/ > \emptyset$  for feminine. Clearly, as the relative preference for /ə/ and  $\emptyset$  is reversed in each gender, it is not possible to reduce these to general segmental markedness hierarchies in the language. The implementation of these preference constraints involves pairwise rankings which can be used when there are more than two allomorphs, and a clear potential advantage of this implementation is that it allows *sequences* of defaults.

Stepping outside of OT models, in Distributed Morphology, e.g. Embick (2009)’s model, statement of defaults is accomplished by a list of Vocabulary Items, which are specified for insertion in certain contexts. As schematized in (31) for subcategorization models in general, the default item is thus one with the least amount of contextual specification. Although the optimizer is often not explicitly listed as performing an optimizing function in such models, one can clearly envision a variant of them in which the contextual specification of Vocabulary Items mentions *removing* violations to phonotactic constraints. A schematic proposal along these lines for the English indefinite appears in (38)

(38) INDEF  $\leftrightarrow$  /æn/ if it removes a violation of ONSET

INDEF ↔ /ə/

Such models can be likened to Kager (1996)'s proposal, in which the default has an explicit statement "GEN = -n", but differ in their implementation, in that the default allomorph in Distributed Morphology is precisely one about which nothing special *needs* to be said in the grammar.

In many cases of allomorph selection involving "recruiting" allomorphs from the "wrong" context, such as Spanish definite article allomorphy or Hebrew plural allomorphy, the default is chosen because it matches the gender features of the head noun, and that is enough to normally drive selection of *la* over *el* for feminine nouns, without need for appealing to phonological markedness in order to make *la* the default. Contextual specification – in terms of morphosyntactic features – is enough to choose the right allomorph, and this is sometimes implemented in OT with constraints referring to matching morphosyntactic features (e.g. Becker (2009); Steriade (1999)). In such cases, the default allomorph is not the one that is radically underspecified, but rather the one that realizes the correct morphosyntactic features. This intuition is not straightforward to translate into Vocabulary Items without negative statements, but one way to accomplish it, while preserving the notion that /el/ is "recruited", is to actually view *it* as the default, used for both masculine gender and for cases where the feminine *la* fails:

- (39) DEF, +FEM ↔ /la/ if it does not create a violation of *á-hiatus*  
DEF ↔ /el/

Clearly, future work will be needed in order to examine whether a true merger of the elsewhere-notion of Distributed Morphology can be fully made compatible with capturing the phonotactic generalizations that govern allomorph distribution, or whether the Priority constraints of Bonet et al. (2007) merge more seamlessly with a grammatical treatment of phonological optimization.

#### 4 Conclusion and Outlook

Phonologically-conditioned allomorph selection refers to any case in which allomorphs are chosen based on the phonology of the stem, affix, or phonological word to which they attach. We have seen that a very healthy number of these cases not only refer to phonology, but seem to involve allomorph distribution that is actively connected with improvement in (or avoidance of declination in) phonological well-formedness, at the levels of segmental, syllabic, and prosodic structure. The most active questions of debate thus revolve around whether, given that *some* allomorph selection is phonologically optimizing, this should be built into the architecture of the grammar, or whether on the contrary, given that some allomorph selection is *not* phonologically optimizing, whether a single mechanism that simply lists phonological environments is all that is needed. Potentially one way of resolving the question of whether allomorph selection is the result of grammatical computation, rather than morpholexical listing, would involve demonstrating infants' and adults'

preferences in (artificial) language acquisition, and finding that in the face of sparse or limited background evidence, such learners demonstrate a preference for phonologically optimizing patterns of allomorph selection, before they have even had a chance to attempt or fall back on lexical listing. Certainly one might argue that patterns of spontaneous allomorph recruitment, such as BPE speaker's use of *-əd* after all obstruent-final verbs in English, despite never having heard this in the input, reflect pure grammatical biases brought to the task of allomorph selection rather than rehearsed morpholexical listing or historical residue.

A second issue, mentioned in the introduction, is that a great deal of allomorphy need not involve multiple URs, but rather, like the English plural alternations, can be captured entirely in terms of a single UR coupled with phonological rules. Given this division of labor between phonological derivations as one mechanism of yielding allomorphy and morphological selection as another, we may also see divergent acquisition profiles for these two.

In phonological theory, many debates that involve recurrent grammatical generalizations in some languages and exceptions to these generalizations in other languages often devolve into discussions of whether everything is the result of diachrony or not, and end up as philosophical stalemates. Certainly, while Carstairs (1990) is right in raising the point that "The existence of a phonologically conditioned alternation does not by itself prove the existence of some synchronic phonological process giving rise to it", the existence of synchronic grammatical control over allomorph selection *can* be demonstrated when it spontaneously arises in (artificial) language acquisition experiments in which the diachrony is fully controlled by the experimenter and nonetheless the learner demonstrates the emergence of a preference for phonological optimization based on sparse or insufficient evidence.

As my own contention is that enough evidence is beginning to collect that phonologically-conditioned allomorph selection *is* under the purview of the phonological grammar and not merely the lexicon, and that some of the most important questions that therefore arise involve the levels of representation at which allomorph selection occurs and the mechanism of choice, including guaranteeing the default over the optimizer in cases in which euphony is not at stake. The cases of opaque allomorph selection make clear that it needs to happen at intermediate levels of representation (which in itself is not a shocking conclusion as by now even some of the most recalcitrant proponents of monostratalism have conceded that serial phonology computation is necessary), but leave open many possibilities in terms of whether the right model of serial morphology-phonology interaction is stratal, cyclic, or derivational. A much harder and unresolved question is the mechanism for allomorph selection, where many theoretical alternatives are good at capturing some generalizations but in doing so may fail to capture others. A clear dichotomy in this respect is the tradeoff between relying on segmental markedness to allow the default to 'emerge' without explicit statement versus explicit default status of an allomorph through either brute force constraints or by the elsewhere condition.

In the above paragraphs, I have provided a critical comparison of a wide range of current options (and apologize for ones I have no doubt overlooked in such a large field of inquiry), but most importantly, I have attempted to outline new directions for synthesizing the advantageous aspects of some of these models with those of others. One of the best ways for this study to advance is by figuring out how to incorporate the seemingly incompatible but useful assumptions of one model with those of another.

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