Universal and morpheme-specific constraints for allomorphy selection*

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Lee, Yongsung. 2010. Universal and morpheme-specific constraints for allomorphy selection. *Studies in Phonetics, Phonology and Morphology* 16.3. 469-490. Two constraints are proposed in this paper to account for phonologically-conditioned suppletive allomorphy found in natural languages. One is a universal constraint, DEFAULT, which favors the phonologically simplest allomorph when higher markedness constraints are not at issue. The other is an allomorph-specific distribution constraint, ALLODIST, which imposes bidirectional requirements between a particular allomorph and its environments. Given these constraints, partially-optimizing selection is the result of DEFAULT dominating some relevant markedness constraints, and non-optimizing selection is due to the work of ALLODIST that dominates relevant markedness constraints and DEFAULT. The proposal in this paper obviates separate processes or components for different allomorphy types and presents a consistent and natural explanation to allomorph alternations. **(Pusan University of Foreign Studies)**

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1. Introduction

Not all the surface allomorphs come from a single input. There are phonologically conditioned suppletive allomorphs (=PCSA, Paster 2006) that cannot be traced back to a single underlying form. In PCSA, there is no motivated phonological relation between allomorphs, but their distribution is strictly governed by phonology. Consider Western Armenian definite article allomorphy. The definite article has two surface forms [n] and [ə]. [n] appears after a vowel-final stem, while [ə] is used after a consonant-final stem. They are suppletive in the sense that there is no plausible derivational relationship between /n/ and /ə/. We can, however, clearly see the conditioning environments; /n/ is used after a vowel-final stem while /ə/ is found only after a consonant-final stem. The choice, therefore, naturally falls out from the interaction of such markedness constraints as NOCOMPLEX and ONSET/NOHIATUS. Mascaró (2007) uses the term "external allomorphy" for this and other similar cases. In external

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allomorphy, the choice of allomorphs contributes to optimizing the surface forms.

In other cases, the choice of allomorphs has no optimizing nature at all (internal allomorphy). Mascaró (2007) cites examples from Tzeltal perfective allomorphy, where /oh/ is used with monosyllable stems and /ɛh/ with polysyllabic stems. Though the distribution is easy to generalize, it is, by no means, easy to deal with them with universal markedness constraints, since there is no visible optimizing effect. In this case, we will see that the choice is due to the distributional properties of allomorphs.

There is no clear distinction between external and internal allomorphy and we find borderline cases between markedness-driven selections and distributional property-driven selections. This paper focuses on these cases, which I call external opaque allomorphy. It is external in the sense that the choice is governed by markedness constraints, and it is opaque in that the given markedness constraints alone may not be able to choose the optimal allomorphy. Based on the previous proposals, this paper argues that the choice in this case is upon the universal morphological constraint, DEFAULTALLOMORPH (=DEFAULT), which favors the phonologically simpler allomorph. DEFAULT interacts with other markedness constraints and produces partially-optimizing effect.

Further, this paper ventures into the internal allomorphy, which does not have any optimizing effect at all. This is viewed as coming from the bidirectional conditioning between a particular allomorph and its environments. A bijective constraint, ALLODIST, captures the bidirectional relation by relating a specified allomorph to the specified environments. In other words, ALLODIST penalizes a specific allomorph in the non-specified environments, and a specific environment that contains the non-specified allomorph. This way, we can explain the gradient decrease in optimizing effect in various allomorphy selection types.

2. Backgrounds

We will have a brief survey of allomorphy to set this paper in the proper contexts. Let's first consider three different types of phonologically conditioned suppletive allomorphy:

(1) a. External transparent allomorphy (ex. Western Armenian definite article suffix n/ə alternation)
b. External opaque allomorphy (ex. Korean i/ka alternation)
c. Internal (opaque) allomorphy (ex. Tzeltal perfective suffix allomorph oh/ɛh alternation)

The distinction is based on Mascaró's (2007) classification with further division of external allomorphs into transparent ones and opaque ones based on the observation of Łubovicz (2006). Internal allomorphy in (1c) shows irregularities, though the distribution is strictly governed by phonological factors. This area remains as a great challenge for phonological explanation. For the external allomorphy shown in (1a), on the other hand, we find certain phonological properties such as foot structure, syllable structure, syllable contact or phonotactics that govern the choice of allomorphs. In this sense, we may say the external allomorphy is fully optimizing (Paster 2006, 2008). In between these two extremes, there are borderline cases as in (1b). Now consider two different approaches to deal with those three different types of allomorphy summarized in (1):

(2) Different approaches to PCSA
 a. Natural analysis
  Whatever is regular should be expressed in the grammar and only the idiosyncratic exceptions should be expressed by other means. (cf. Mascaró 2007: 716)
 b. Uniform analysis
  If there is a way to deal with all three PCSA types in a consistent way, that is, by any means, better than other approaches. (cf. Paster 2006, 2008, Bye 2007)

(2a) argues that analysis with general constraints must be expanded to its maximum, with a proviso that only those exceptions to the general grammatical explanation must be dealt with by a separate mechanism. On the other hand, (2b) says that all the allomorphs, whether they be external or internal, should be dealt with under a uniform mechanism. This paper takes the natural analysis approach as laid in (2a). Theoretically, there is nothing wrong with the uniform analysis approach. But in reality, proposals in this line, like Control Theory (Bye 2007) or Lexical Subcategorization (Paster 2006), fail to recognize the role of markedness constraints in selecting allomorphs by ascribing every allomorph selection to the work of lexical information. As Mascaró claims, however, a grammar is supposed to capture regularity in linguistic phenomena. The presence of exceptions should not hinder describing sub-regularities.

Gonzáles (2005: 47) criticizes the subcategorization approach along the line of the argument presented here. She says that such an approach is “merely descriptive,” and it “takes away the explanation that phonology can contribute to at least a subset of those alternations.” Again we see that the natural analysis as in (2a) should be preferred whenever it is possible. One of the arguments for Paster (2008) in support of the uniform analysis is that there is no clear demarcation line between optimizing and non-optimizing allomorphy selection. It may not be a real problem, but a simple reflection of our limited understanding of optimizing allomorphy selection. We find examples of optimizing allomorphy in what was classified as internal allomorphy in Paster (2006).

Take Haitian Creole for example. Among two variants of the determiner suffix, /a/ and /la/, /a/ is chosen after a vowel final stem, leading to ONSET violation, and /la/ is chosen after a consonant final stem, resulting in NOCODA violation. If we focus on the dimension of syllable structure optimization, we would expect exactly the opposite. This is noted as the case of "anti-markedness" (Klein 2003) or "perverse" allomorphy (Paster 2006:86) in the sense that there is no optimizing effect. But Bonet et. al. (2007) convincingly shows that the apparent non-optimizing nature on syllable structure may be viewed as optimizing in the dimension of the alignment and the syllable contact markedness. This line of thought requires us to review those data previously thought to be the internal allomorphy to find the optimizing nature in some dimension of markedness. Further research can actually reveal that the so-called internal allomorphy may have to be re-classified as the external allomorphy. Now consider the following examples:

(3) Western Armenian definite article (data from Paster 2006:59 based on Vaux 1998: 252, Andonian 1999: 18)

a. After a vowel-final stem	b. After a consonant-final stem
lezu-**n** 'tongue'	atorr-**ə** 'the chair'
kini-**n** 'wine'	kirk-**ə** 'the book'
gadu-**n** 'the cat'	hat-**ə** 'the piece'

(4) Korean nominative suffix (data from Lee 2008)

a. After a vowel-final stem	b. After a consonant-final stem
anæ -**ka** 'wife-Nom.'	kam-**i** 'persimmon-Nom.'
so-**ka** 'cow-Nom.'	waŋ-**i** 'king-Nom.'
c^ha-**ka** 'car-Nom.'	sok-**i** 'inside-Nom'

(5) Tzeltal perfective suffix. (data from Paster 2006:171, based on Walsh Dickey 1999: 328-329)

a. After a monosyllabic stem	b. After a polysyllabic stem
j-il-**oh** 'he has seen ST.'	s-maklij-**ɛh** 'he has waited for SB.'
s-pas-**oh** 'he has made ST.'	s-tikun-**ɛh** 'he has sent ST.'
s-jom-**oh** 'he has gathered it'	s-mak'lin-**ɛh** 'he has fed SB.'

The examples in (3), the cases of external transparent allomorphy, can be readily explained. We may posit two allomorphs {n, ə} in the input in line of Lapointe (1999), and the choice falls from the constraint interaction. Adding /n/ after a consonant is bad, since it creates a complex coda, and adding /ə/ to a vowel is bad in the sense that the final syllable has no onset. Therefore the constraints, NOCOMPLEX and ONSET (and/or NOHIATUS) help to pick the right allomorph. This is in contrast to (5), the internal allomorphy. There does not seem to be a natural way to form a well-motivated markedness constraint that bans /oh/ after a polysyllabic word and at the same time bans /ɛh/ after a monosyllabic stem. The distributional property is simple: /oh/ is used after a monosyllable stem and its competitor is not allowed in this environment. This is simply the lexical idiosyncratic nature of the allomorph /oh/. We will look into this area in section 5.

We now turn to the external opaque allomorphy as in (4), a border line case between transparent allomorphy and internal allomorphy. At the first look, Korean data look very similar to those from Western Armenian in (3). In fact, they are treated as a case of external transparent allomorphy as in Lapointe (1999), Sung (2005) and others. On the surface, the relevant markedness constraints can pick out the optimal form as shown in (6):[1]

(6) Apparent fully-optimizing effect in Korean allomorphy selection
a. Nominative marker after a non- ŋ consonant (kam (persimmon) + Nom.)

kam-{i, ka}	*ŋ/ONS	*VV	NOCODA	ONSET	ALIGN-STEM
☞ i) ka.mi					*
ii) kam.i			*!	*	
iii) kam.ga			*!		

b. Nominative marker after a vowel. (anæ (wife) + Nom.)

anæ -{i, ka}	*ŋ/ONS	*VV	NOCODA	ONSET	ALIGN-STEM
i) a.næ.i		*!		*	
☞ ii) a.næ.ga					

Both of the suppletive allomorphs for the nominative marker are present in the input, and the constraint interaction leads to the correct choice of the optimal forms. But there are cases where the markedness constraints alone fail to produce the correct surface forms. Consider (7):

(7) Wrong evaluation: *ŋ*-final stems (waŋ (king) + Nom.)

waŋ-{i, ka}	*ŋ/ONS	*VV	NOCODA	ONSET	ALIGN-STEM
👎 i) waŋ.i			*	*!	
?☞ ii) waŋ.ga			*		
iii) wa.ŋi	*!				*

There is an issue with /ŋ/ in Korean phonology. /ŋ/ cannot come in the onset position of a syllable. Therefore, the second example in (4b) /waŋ.i/

[1] We ignore the voicing of /k/ here. Note that Korean plain stops are voiced between sonorants. Please refer to Lee (2008) for further explanation on the constraints and their ranking. Note also that ŋ-final stems are problematic not only in the nominative marker alternation, but also in the topic marker {ɨn/nɨn}, the accusative marker {ɨl/lɨl}, and the conjunctive marker {wa/kwa}.

should be syllabified as [waŋ.i] as in (7i). Given the choice of allomorphs, we may wonder why it is not *[waŋ.ga]. Compare [waŋ.i] and *[waŋ.ga] in (7). The former, actual surface form, violates ONSET (and/or NOHIATUS), while its competitor does not. The harmonic bounding of [waŋ.i] by ill-formed *[waŋ.ga] reveals the problem the markedness-only approach has in choosing the correct allomorph in this case.[2] This clearly shows the partial optimizing nature of the Korean noun allomorphy. We need something more (or something else). But at the same time, we see generally optimizing character in the choice of allomorphs; we may not want to say that the distribution is unpredictable.

3. DEFAULTALLOMORPH for external opaque allomorphy

We have noted that we need something more to explain PCSA that cannot be reducible to a single input. The starting point of our discussion is the proposal by Lapointe in dealing with PCSA in general.

(8) Multiple Input Hypothesis (=MIH, Lapointe 1999: 267)
The GEN function operates in such a way to contribute to the candidate set all prosodic parses based on all of the forms listed as possible phonological representations for a morpheme or a lexeme.

This notion is logically elaborated in Mascaró (2007: 718). Simply put, MIH allows multiple inputs for suppletive allomorphy, and GEN produces candidates for all possible cases. For example, if the input is A-{X, Y}, where X and Y are suppletive allomorphs, then GEN works both on A-X sequence and A-Y sequence and these candidates are evaluated in parallel. Along this line of thought, we may need something more to MIH to deal with partially optimizing nature of external opaque allomorphy. This paper adopts the following constraint for allomorphy selection:

(9) DEFAULTALLOMORPH (=DEFAULT) (Lee 2008)
A phonologically simpler allomorph is preferred.

An allomorph is phonologically simpler, if it has less number of segments and/or if it is less marked in terms of feature composition. The default form or the preferred form is selected by the phonological simplicity measures encoded in DEFAULT. There is no lexical idiosyncratic preference to an arbitrary allomorph. For example, given /n/ and /ŋun/ as

[2] One may argue that /ŋ/ can come in the onset position of a syllable, but not in the word-initial position, in line with Kager's (1999: 239-244) analysis of Japanese reduplication. In other words, by demoting *ŋ/ONSET in (7a), we might want to say that (7iii) is the optimal form. While this may be an option, it is rejected by Korean linguists in general. What we find is that the constraint, *ŋ/ONSET plays an important role in Korean phonology as shown in Lee and Lee (2006) and Chung (2001).

allomorphs (as in Djabugay genitive), the default form should be /n/, given the shortness of the segmental length. When two allomorphs are of the same length, as in the case of mono-segmental /t/ and /ɾ/ (as in Baix Empordà Catalan genitive), we see that /t/ is phonologically less marked and therefore is the default allomorph.

This proposal is based on Kager's (1996: 156, footnote 2) observation that one may propose "a universal constraint requiring that morphological categories are marked by minimal means (e.g. the 'phonologically shortest' morpheme)." The proposal here, however, goes one step further from Kager's suggestion and claims that the proposal is intrinsically related to the elsewhere distribution of allomorphs. This represents the typical "except-when" distribution of allomorphs: *A* except in *X*. Here we may say that *A* is a distributional default, but *A* in *X* violates some markedness constraint(s). The claim made in the present proposal is that a default allomorph (phonologically simpler form) IS the distributional default. Therefore, the proposal is immediately falsifiable if a distributional default allomorph is longer than its competitor in external opaque allomorphy.[3]

Another important aspect of the constraint DEFAULT is that it is not a morpheme specific constraint. It is a universal constraint that deals with the allomorph selection in general. In a language that has two or more sets of allomorphy, the ranking should remain unchanged across different sets of allomorphs. If the proposed ranking is ⟦M_1, M_2 » DEFAULT » M_3⟧ for one allomorph set and ⟦M_1 » DEFAULT » M_2, M_3⟧ for the other set (note the demotion of M_2 below DEFAULT in the latter ranking), then there arises a ranking paradox, which, in turn, proves that the proposal is wrong. As such, DEFAULT is a very general constraint with visible falsifiability.

(10) Possible rankings
- a. M_1, M_2 » DEFAULT: external transparent allomorphy (Fully optimizing)
- b. M_1 » DEFAULT » M_2: external opaque allomorphy (Partially optimizing)
- c. DEFAULT » M_1, M_2: No suppletive allomorphy (equivalent to single input)

If DEFAULT is dominated by all of the allomorph-selecting markedness constraints, we see no effect of DEFAULT at all. Allomorphs are selected solely based on the markedness constraints. (external transparent allomorphy in (10a)) On the other hand, if DEFAULT dominates all the related markedness constraints as in (10c), only the default allomorph shows up all the time. Then there is no allomorphy at all. This then simply means that we do not need multiple inputs, and due to lexicon optimization, we would have only one form in the input. (10b) is the interesting case.

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[3] There are cases, where we see that the more widely distributed allomorph (distributional default) is not the phonologically simpler allomorph (the phonological default). This is really the case for internal allomorphy. In internal allomorphy, the choice is governed by "only-when" distribution: *B* only in *Y*. In this case, *B* (which is not a distributional default) can be phonologically simple. We will come back to this case in Section 5.

DEFAULT is dominated by M_1 but it dominates M_2. Here, allomorphy selection is optimizing with respect to M_1 but it is non-optimizing with respect to M_2. This explains the partial-optimizing character of external opaque allomorphy. Now consider the sample evaluation of the problematic Korean data given in (4) and (7):

(11) Correct evaluation with Default: *ŋ*-final stems (waŋ (king) + Nom.)

waŋ-{i, ka}	*ŋ/ONS	*VV	DEFAULT	NOCODA	ONSET	ALIGN-STEM
☞ i) waŋ.i				*	*	
ii) waŋ.ga			*!	*		
iii) wa.ŋi	*!					*

We see that DEFAULT is placed below *ŋ/ONS and *VV but above NOCODA and ONSET. It is optimizing with respect to *ŋ/ONS and *VV, but non-optimizing in the dimension of NOCODA and ONSET, as these are dominated by DEFAULT. This naturally explains the opaque aspects of external allomorphy. Further note that if there is no DEFAULT, *[waŋ.ga] harmonically bounds [waŋ.i] as noted earlier. Here we see the important role of DEFAULT. It breaks off the chain of harmonic bounding, by dominating the otherwise harmonically bounding constraint, ONSET.

For an effective comparison, let's first consider the allomorphy data from Djabugay (Patz 1991), a Pama-Nyungan language of Australia. In this language, the genitive has two allomorphs *n/ŋun* with the following distribution:

(12) Djabugay genitive allomorphs. (data from Paster 2006: 1 based on Patz 1991: 269)

a. After a vowel-final stem		b. After a consonant-final stem	
guludu-**n**	'dove-Gen.'	girrgirr-**ŋun**	'bush canary-Gen.'
djama-**n**	'snake-Gen.'	bibuy-**ŋun**	'child-Gen.'

The choice in general is based on the avoidance of NOCOMPLEX. The genitive suffix /n/ cannot be used after consonant final stems due to high-ranking NOCOMPLEX. In case of vowel-final stems, on the other hand, we see that either /n/ or /ŋun/ can come and there is no plausible markedness constraint that would favor /n/ over /ŋun/ after a vowel final stems, ignoring segmental markedness constraints such as *ŋ, *u, and *n. The proposal in this paper is straightforward. The default allomorph is /n/, the phonologically simpler one. DEFAULT, which should be lower than NOCOMPLEX, will pick /n/ after vowel-final stems as in (12a). As for those in (12b), using default allomorph, /n/, results in NOCOMPLEX violation. The other alternative /ŋun/, though it violates DEFAULT, satisfies the higher constraint, NOCOMPLEX. Now we consider different proposals under MIH and see how they deal with the Djabugay case.[4]

(13) Previous proposals based on MIH
  a. Process Priority (Wolf and McCarthy 2010): Try /n/ first. If and only if it does not work, try /ŋun/.
  b. Morpheme as constraint (Kager 1996): GEN=n (» GEN=ŋun)
  c. Morpheme markedness (Boyd 2006, Łubovicz 2006): *ŋun (» *n)
  d. Shape Priority (Mascaró 2007, Bonet et. al 2007): {n ≻ ŋun}

The process priority proposal in (13a) gives a priority to one of the allomorphs. In Djabugay genitive allomorphy, we may say that /n/ has the priority in application. Allomorphy evaluation tries first with the allomorph with priority, which is /n/. Here, the choice of the priority allomorph is purely lexical. Assuming the ranking ⟦NOCOMPLEX » MPARSE⟧, we see that using /n/ after a vowel final stem is OK, but after a consonant final system, it may rather violate MPARSE than NOCOMPLEX, meaning there is no output. And then for those consonant final stems, and only for those null parse cases, the other allomorph, /ŋun/ is tried. As such, the postulation of process priority can deal with allomorph selection but it is fairly difficult to imagine how this concept of process priority is implemented into the parallel model of OT.

Morpheme-as-constraint approach in (13b) may posit stem-{genitive} in the input, with the stem specified with phonological materials. And there are two constraints GEN=n and GEN=ŋun. The realization of genitive marker is due to the satisfaction of either of these two morphemic constraints. If the ranking is ⟦NOCOMPLEX » GEN=n (» GEN=ŋun)⟧, then GEN=n positively favors /n/ over /ŋun/, when NOCOMPLEX is vacuously satisfied. The same result is obtained if we posit morpheme markedness constraints *ŋun (and *n) instead of GEN=n (and GEN=ŋgu). We can see that ranking, ⟦NOCOMPLEX » *ŋun (» *n)⟧, works in the manner exactly like morpheme-as-constraint approach.

The shape priority proposal in (13d) is based on an arbitrary harmonic scale of each allomorph set. In a given allomorph set, there is a lexical preference as expressed in harmonic scale. As for Djabugay genitive, the lexical preference is {n ≻ ŋun}. This means that /n/ is preferable to /ŋun/, though the preference is solely based on lexical stipulation. The constraint PRIORITY (Respect lexical priority (ordering) of allomorphs, Mascaró 2007:726) forces the choice of /n/ when the effect of NOCOMPLEX is not visible.

There might be technical differences among these proposals, but we see that there are at least two things in common to all these proposals. First, the choice of one allomorph over the other is quite arbitrary. There is no

[4] There may be other proposals on partially-conditioned allomorphy such as Control Theory in Bye 2007 and Lexical Subcategorization proposal by Paster 2006. But only those based on some forms of MIH are considered here.

principled account for the choice of, say /n/ over /ŋun/. The preferred allomorph is specifically encoded by some morpheme specific constraint, whose validity as a universal constraint is highly doubtful. Second, they fail to account for cross-morphemic generalization in the choice of allomorphs. In a language that has two or more sets of allomorphs, the preference in one set has nothing to do with that of another set. Therefore a language with *n*-number of allomorph sets has to come up with *n*-number of language-particular and morpheme-specific constraints (or processes). Consider the basic findings in the Korean allomorphy (Lee 2008) for the sake of concreteness of our discussion.

(14) Korean Noun Suffix allomorphy (Lee 2008)
   a. Nominative marker {i/ka}: /i/ is preferred.
   b. Topic marker {ɨn/nɨn}: /ɨn/ is preferred.
   c. Accusative marker {ɨl/lɨl}: /ɨl/ is preferred.
   d. Instrumental marker {lo/ɨlo}: /lo/ is preferred.
   e. Concomitant marker {wa/kwa}: /wa/ is preferred.

We immediately see that there is a cross-morphemic generalization for the preferred allomorphs, and the universal constraint DEFAULT can correctly explain the fact that the less marked forms, i.e. the shorter forms, are preferred, when markedness constraints that dominate DEFAULT do not interfere. There is no need for positing any morpheme-specific constraints at all. But this generalization cannot be obtained from any of the proposals given in (13).

We may find the use of DEFAULT in other allomorphy-related investigations. Boyd (2006), in his analysis of Italian article *il/lo* alternation, has to postulate a constraint, *lo (do not use /lo/), to capture the distributional generalization. This implies that /il/ is the preferred constraint. Comparing /il/ and /lo/, we see that they both have two segments but we may say that /i/ is less marked than /o/, given the markedness scale and complexity based on Chomsky and Halle (1968: 409). Then the morpheme markedness constraint, *lo, can be replaced by a general constraint DEFAULT.[5]

Łubovicz (2006), in her attempt to explain the opaque nature of Polish locative suffix allomorph, {u, e}, introduces morpheme specific constraints and their ranking, ⟦*e » *u⟧ (allomorph /u/ is preferred to allomorph /e/) Again, we can easily see that what is working here is the constraint DEFAULT in selecting less marked segment as the default allomorph.

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5 It is granted that the less marked nature of /i/ over /o/ should be put to further elaboration, as one of the reviewers pointed out. But at least in terms of Implicational Universal, we know that the presence of /o/ presupposes the presence of /i/. And in this sense, we may say that /i/ is less marked than /o/. Also note that the syllable structure markedness of these allomorphs is not an issue here: there is no syllable structure for these allomorphs in the input and the constraint DEFAULT does not say anything about syllable structure markedness.

This list can go on and on. Axininca Campa noun genitive has two allomorphs, /ni/ and /ti/. /ni/ is used only after a bimoraic stem and /ti/ is used elsewhere. In Tahitian, the causative/factitive is marked by /ha'a/ before a labial initial root, and by /fa'a/ elsewhere (Paster 2006: 11). Dyirbal ergative is /ŋgu/ only after a head foot and /gu/ elsewhere (Wolf and McCarthy 2010). Again, in all these cases, we see that the distributional default is the shape default, i.e. the phonologically simpler one. While there may be some technical difficulties in explaining them in OT, we can clearly see the role of DEFAULT in these and other related cases.

4. Baix Empordà Catalan overassimilation

In this section, we will look into Baix Empordà Catalan (=BEC) overassimilation. The previous analysis by Mascaró (2007) shows that there should be a lexical preference in genitive suffixes in BEC, which favors /ɾ/ over /t/. This goes counter to the proposal made in this paper in the sense that [ɾ] is more marked than [t]. However, it will be shown that BEC data can be reanalyzed with DEFAULT.

BEC has six surface infinitive-marker allomorphs {ɾ, t, s, l, m, n}. The distribution is governed by the phonological nature of the initial segment of the following morpheme. Consider the following data:

(15) BEC overassimilation (data from Mascaró 2007: 724)

a.	posa[ɾ-u] 'to put it'	posa[ɾ-i] 'to put there'
b.	posa[m-mə] 'to put me'	posa[t-tə] 'to put you'
	posa[l-lə] 'to put it-FEM'	posa[l-ləs] 'to put them-FEM'
	posa[l-li] 'to put him/her-DAT'	posa[n-nə] 'to put some'
	posa[s-sə] 'to put oneself'	

Infinitive markers are underlined for clarity. In the intervocalic positions, where the consonantal assimilation is not at issue, the infinitive marker is realized as /ɾ/. But in pre-consonantal positions, we see that the infinitive marker is identical to the following consonants. The apparent distributional generalization is that the infinitive marker is identical to the following consonant and it is [ɾ] in intervocalic positions. In BEC, liquids do not assimilate to the following consonants in normal phonology. But in the case of infinitive allomorphy, /ɾ/, if we assume that it is the distributional default, seems to assimilate to the following consonant, hence the term overassimilation.

Mascaró (2007) posits five allomorphs, with /ɾ/ as the preferred allomorph, {ɾ ≻ n, l, t, s}. The constraint PRIORITY will favor /ɾ/ over the other allomorphs. Consider the following two representative tableaux:

(16) Exemplary Tableaux with PRIORITY

a. posa-{ɾ$_1$ ≻ n$_2$, l$_3$, t$_4$, s$_5$}-u (to put it)

posa-{ɾ$_1$ ≻ n$_2$, l$_3$, t$_4$, s$_5$}-u	AGREE/STOP	IDENT(F)	AGREE/C	PRIORITY
☞ i) pɔsá- ɾ$_1$-u				
ii) pɔsá- n$_2$-u				*!
iii) pɔsá- l$_3$-u				*!
iv) pɔsá- t$_4$-u				*!
v) pɔsá- s$_5$-u				*!

b. posa-{ɾ$_1$ ≻ n$_2$, l$_3$, t$_4$, s$_5$}-lə (to put it-Fem.)

posa-{ɾ$_1$ ≻ n$_2$, l$_3$, t$_4$, s$_5$}-lə	AGREE/STOP	IDENT(F)	AGREE/C	PRIORITY
i) pɔsá- ɾ$_1$-lə			*!	
☞ ii) pɔsá- l$_3$-lə				*

All the constraints are from Mascaró (2007). AGREE is a constraint that requires featural identity between two adjacent consonants. The ranking, ⟦AGREE/STOP » IDENT(F)⟧, allows a stop sound to assimilate to the following consonant. On the other hand, the ranking, ⟦AGREE/STOP » IDENT(F) » AGREE/C⟧, forbids any featural change for non-stop consonants. The result of the evaluation is quite clear. An infinitive marker assimilates to the following consonant as in (16b). When there is no consonant to assimilate, however, /ɾ/ is chosen, as shown in (16a). Apparently, the analysis by Mascaró may pose a serious challenge to the present proposal that the priority should be given to the less marked segment, presumably /t/.

But the data can be reanalyzed using DEFAULT. First we will have to revise Mascaró's constraints. The ranking, ⟦AGREE/STOP » IDENT(F) » PRIORITY⟧, does not allow a stop to be an allomorph with priority. If a stop is a default, then it should assimilate to the following consonant violating IDENT(F) with this ranking. But since IDENT(F) dominates PRIORITY, a sonorant should be selected. However, sonorant in the pre-consonantal position as in (16b-i) is not surface true. Therefore /t/ cannot be the default, given the ranking, ⟦AGREE/STOP » IDENT(F) » PRIORITY⟧. Note here that in the given ranking, ⟦AGREE/STOP » IDENT(F) » AGREE/C⟧, we find that the markedness constraint AGREE is split into two subconstraints, AGREE/STOP and AGREE/C. We will call it Split Markedness approach to assimilation.

There is, however, another way to get to the same surface forms. We can divide a faithfulness constraint and place the markedness constraint in the middle. Call it Split Faithfulness approach to assimilation. Consider the ranking, ⟦MAX-F(SON) » AGREE » MAX-F(STOP)⟧. In this ranking, we find a markedness constraint AGREE is flanked by two similar but separate

Faithfulness constraints.[6] In this approach, we see that sonorants keep their features but stops may change their features to comply to AGREE. In this ranking, the agreement effect of the infinitive allomorphy can be derived by the assimilation of /t/ due to the ranking, ⟦AGREE » MAX-F(STOP)⟧. Then we may posit just two allomorphs, {t, ɾ} and derive /l, n, s, (m)/ from /t/. Second, we may posit *VTV (No voiceless stop in an intervocalic position) for BEC. Though it is true that the intervocalic stops, especially the voiced stops, are generally not allowed in Spanish, we are not concerned with the actual presence of these intervocalic stops. With the ranking, ⟦MAX-F(STOP) » *VTV⟧, we can surely explain their presence. As for allomorphy with multiple inputs, we see TETU effect by not putting /t/ in the intervocalic position. Pursuing this line of thought, we may reanalyze BEC infinitive as shown in the following tableaux:

(17) Reanalysis of BEC infinitive allomorphy with DEFAULT

a. posa-{t_1, $ɾ_2$}-u (to put it)

posa-{t_1, $ɾ_2$}-u	MAX-F(SON)	AGREE	MAX-F(STOP)	*VTV	DEFAULT
i) pɔsá- t_1-u				*!	
☞ ii) pɔsá- $ɾ_2$-u					*
iii) pɔsá- l_1-u			*!		
iv) pɔsá- s_1-u			*!		

b. posa-{t_1, $ɾ_2$}-lə (to put it-Fem.)

posa-{t_1, $ɾ_2$}-lə	MAX-F(SON)	AGREE	MAX-F(STOP)	*VTV	DEFAULT
i) pɔsá- t_1-lə		*!			
ii) pɔsá- $ɾ_2$-lə		*!			*
☞iii) pɔsá- l_1-lə			*		
iv) pɔsá- s_1-lə		*!	*		

In (17a), in intervocalic position, the appearance of /ɾ/ is due to the ranking, ⟦*VTV » DEFAULT⟧. The default form /t/ is not allowed there. Changing the value of /t/ as in (17b-iii) and (17b-iv), violates MAX-F(STOP), which is even higher than *VTV and DEFAULT. In the pre-consonantal position, as shown in (17b), putting /ɾ/ leads to AGREE violation, and the best way is to put the default and let it assimilate to the following consonant as the ranking, ⟦AGREE » MAX-F(STOP)⟧, would demand. This way, we can explain the optimizing nature of BEC infinitive allomorphy, without resorting to any language-particular and morpheme-

[6] It is an open question, whether Split Faithfulness approach is always better than Split Markedness approach to context sensitive assimilation. More case studies are required to draw any concrete conclusion on this area. It is admittedly open to further research.

specific constraint.[7]

5. Allomorph distribution constraint for internal allomorphy

In this section, we look into internal allomorphy and see if it can be incorporated to the present framework. Mascaró (2007) says that internal allomorphy is irregular and unpredictable. However, he did not mean to say that there is absolutely no way to capture its distributional properties. As for such non-optimizing allomorphy, general constraints may not work. Bye (2007) and Paster (2006, 2008) propose Control Theory and Lexical Subcategorization respectively as devices to accommodate these purely internal allomorph sets. Paster's (2006, 2008) lexical subcategorization approach relies on the lexical information that stipulates the distribution of internal allomorphs. She does not discuss how the subcategorization information is implemented into constraints. There might be two possibilities: one is to have a constraint, REALIZE (Realize the subcategorization information) or the like, that penalizes the allomorph outside of the defined subcategorizational information, another is to translate the lexical subcategorization information into allomorph-specific constraints.

We consider the latter possibility here as the former will lead us to work more on the lexical information and take us to a path away from the present discussion. We will postulate allomorph-specific constraints that govern the distribution of internal allomorphy and see how it interacts with other related constraints with the analyses of two different internal allomorphy data: Dyirbal ergative allomorphy and Tzeltal perfective allomorphy. In Dyirbal, the ergative suffix is realized as /ŋgu/ after a disyllabic stem, and /gu/ is used elsewhere as briefly exemplified in (18):

(18) Dyirbal ergative allomorphy (data from McCarthy and Prince 1993a: 117, based based on Dixon 1972: 42, 288-9)
a. /ŋgu/ after (and only after) disyllabic V-final nouns
yaɽa-ŋgu 'man'
b. /gu/ after longer V-final nouns:
yamani-gu 'rainbow'
balagara-gu 'they'

If the selection is optimizing in nature at all, we should be able to see

[7] One of the reviewers showed concerns on the universal nature of the constraint, *VTV, used here. Though we need further research on this, we find that the constraint *VTV is invoked in explaining English flapping (Krämer 2005), Hindi spirantization (Kaplan 2008), and Dholou intervocalic voicing (Pulleyblank 2006) to cite a few. Especially the *VTV constraint in this paper is in line with intervocalic voicing as in Pulleyblank (2006). Therefore it can be safely assumed that though the nature of the constraint and exact formation should be put to further research, *VTV or its elaboration should be included as part of universal constraints.

"except-when" effect of the allomorph distribution. The distributional default in (18) is /gu/, which is phonologically simpler than /ŋgu/: /gu/ is used except after a disyllabic stem. Then the question is how we can prevent using /gu/ after a disyllabic stem. There does not seem to be any natural markedness constraints that favor /ŋgu/ over /gu/. We may go ahead and try to capture the distributional limitation by positing morpheme-specific constraint, *FT'-{gu}, which penalizes any use of /gu/ after a disyllabic word. Though this certainly is an option, we will not pursue this option for two reasons. First, Dyirbal case does not belong to the "except-when" case in the sense that there is no optimizing effect. Therefore, it is not the case that /gu/ after disyllabic stem violates some markedness constraints but that the allomorph ŋgu/ is positively conditioned only after a disyllabic stem. Second the formulation of the constraint, *FT'-{gu}, may pose theoretical problem. The anti-alignment nature of the constraint, as noted by Wolf (2007), falls out of the realm of the Generalized Alignment constraint formulation schema (McCarthy and Prince 1993b), and certainly it is not desired.

The previous analyses (Wolf and McCarthy 2010, Paster 2006, Bye 2007, and Wolf 2007 among others) show that formulating Alignment schematic constraint, ALIGN-{ŋgu}-TO-FT', is also problematic. It can penalize the use of /ŋgu/ in polysyllabic words as in (19a), but it fails to exclude the use of /gu/ after disyllabic stems as shown in (19b):

(19) Unfortunate results

a. yamani-gu ('rainbow')

yamani-{gu_1, $ŋgu_2$}	FAITH	SUFFIX	ALIGN-TO-FT'	NOCODA
☞ i) (yama)(ni-gu_1)				
ii) (yama)(ni-$ŋgu_2$)			*!	*
iii) (yama)(- gu_1-ni)		*!		
iv) (yama-ŋ)(gu_2-ni)		*!		*

b. yaɽa-ŋgu ('man')

yaɽa-{gu_1, $ŋgu_2$}	FAITH	SUFFIX	ALIGN-TO-FT'	NOCODA
? ☞i) (yaɽa)-gu_1				
👎 ii) (yaɽa-ŋ)gu_2				*!
iii) (yaɽa)-gu_2	*!			*
iv) (yaɽa-ŋ)gu_1	*!			

For completeness, FAITH and SUFFIX are thrown in the tableaux. FAITH is a cover constraint that penalizes any deletion or insertion of segments. SUFFIX simply says that Dyirbal ergative is realized as a suffix, an equivalent to RIGHTMOSTNESS in McCarthy and Prince (1993a:118). ALIGN-{ŋgu}-TO-FT' is all right with (19a), but as noted, it fails in (19b), the actual surface form, (19b-ii), violates NOCODA (and DEFAULT). The simplest way to capture the distributional generality may be to follow the proposals given in (13) and posit another morphological constraint such as morpheme-as-constraint, ERG=ŋgu, morpheme markedness constraint, *gu, or lexical preference, {ŋgu ≻ gu} and put it over NOCODA but below ALIGN-{ŋgu}-TO-FT'. Though any of these proposals can make correct prediction for (19b) without altering the outcome for (19a), these approaches miss one of the important distributional properties.

Note that there is bijectivity relation between the allomorph and the environments. /ŋgu/ appears only after a disyllabic stem and disyllabic stems do not take /gu/ as an ergative marker. The allomorph-specific alignment constraint, ALIGN-{ŋgu}-TO-FT', captures the former but fails to incorporate the latter observation. Not only does the allomorph select proper prosodic base, but the base also selects the affix. In other words, ALIGN-FT'-TO-{ŋgu} (The head foot selects /ŋgu/ as an ergative marker) is equally important in the Dyirbal ergative formation. This bidirectional relation is the key for all the "only-when" case of allomorphy selection. As these two alignment constraints are highly lexical in natural, we may combine them into one allomorph specific constraint for the sake of simplicity as shown in (20):

(20) Ergative Allomorphy Distribution [Ft'-{ŋgu}](=ALLODIST(ERG: FT'-{ŋgu}))
((ALIGN-{ŋgu}-to-FT')⋂(ALIGN-FT'-to-{ŋgu}))
a. Assign an asterisk for {ŋgu} not preceded by Ft' in ergative formation.
b. Assign an asterisk for a Ft' not followed by {ŋgu} in ergative formation.

This bidirectional constraint is morphological and lexical in nature, applicable only in specified morphological environments, but still is based on the generalized alignment schema. While positing two alignments does not raise a problem at all, combining them together has the effect of minimizing the language-particular constraints, as no candidate can violate both of the clauses in (20).[8] Now consider the evaluation results with ALLODIST(ERG:Ft'-{ŋgu}):

[8] This constraint is the combination of two separate constraints. So it is considered to be satisfied only when both of the sub-constraints are satisfied. To be more specific, it is different from conjoined constraint which penalizes the candidate when both subparts are violated.

(21) Evaluation with ALLODIST(ERG:Ft'-{ŋgu})

a. yamani-gu ('rainbow')

yamani-{gu$_1$, ŋgu$_2$}	FAITH	SUFFIX	ALLODIST	NOCODA
☞ i) (yama)(ni-gu$_1$)			*	
ii) (yama)(ni-ŋgu$_2$)			**!	*
iii) (yama)(- gu$_1$-ni)		*!	*	
iv) (yama-ŋ)(gu$_2$-ni)		*!		*

b. yaɽa-ŋgu ('man')

yaɽa-{gu$_1$, ŋgu$_2$}	FAITH	SUFFIX	ALLODIST	NOCODA
i) (yaɽa)-gu$_1$			*!	
☞ ii) (yaɽa-ŋ)gu$_2$				*
iii) (yaɽa)-gu$_2$	*!			*
iv) (yaɽa-ŋ)gu$_1$	*!		*	

First consider (21a-i)/ Since the first foot (yama) did not select {ŋgu} after it, it is assigned one asterisk for ALLODIST.[9] But if {ŋgu} is placed after (yama) as shown in (21a-iv), it violates SUFFIX. To get the right result, we posit the crucial ranking, ⟦SUFFIX » ALLODIST⟧. Again in (21a-ii), we see that a foot is not followed by {ŋgu} (one violation), and {ŋgu} is not preceeded by a foot (anther violation)

Now consider the crucial example is (21b-i). Note that the clause in (20b) assigns an asterisk for the appearance of /gu/ after a head foot. All we have to do is to assume that ALLODIST(ERG: Ft'-{ŋgu}) is higher than NOCODA (and DEFAULT). As the choice in internal allomorphy is governed by the distributional constraints, we may not see the effect of DEFAULT or markedness constraints. That explains the non-optimizing nature of internal allomorphy.

Now let's turn to Tzeltal perfective suffixes, another case of internal allomorphy: /oh/ is used after a monosyllable stem, and /ɛh/ elsewhere. Here we see that the distributional default, /ɛh/, is not the phonological default. We have no reason to believe that /o/ is more marked than /ɛ/. According to Walsh Dickey (1999: 327), the stress is word-final, so the choice is not stress oriented.

As an extension from the Dyirbal analysis given in (19), we may posit an allomorph-specific distributional constraint that {oh} should be aligned to a monosyllabic stem, and monosyllabic stems allow no other allomorph as a perfective marker, ALLODIST(PERF:$[\#\sigma\#]_v$-{oh}). This will surely block /oh/ to appear after polysyllabic stems and block its competitor /ɛh/ to appear after a monosyllabic verb. Consider the following tableaux:

9 I thank one of the anonymous reviewers for pointing this out to me.

(22) Evaluation tableaux for Tzeltal perfective allomorphy

a. After monosyllabic stem (j-il-oh, 'he has seen something')

j-il-{oh_1, $ɛh_2$}	FAITH	SUFFIX	ALLODIST	DEFAULT
☞ i) jil-oh_1				
ii) jil-$ɛh_2$			*!	*
iii) jil-oh_2	*!			*
iv) jil-$ɛh_1$	*!			

b. After polysyllabic stem (s-tikun-ɛh, 'he has sent something')

s-tikun-{oh_1, $ɛh_2$}	FAITH	SUFFIX	ALLODIST	DEFAULT
i) stikun-oh_1			*!	
☞ ii) stikun -$ɛh_2$				*
iii) stik-oh_1-un		*!		
iv) stik-oh_2-un		*!	*	*
v) stikun-$ɛh_1$	*!		*	

The evaluation results are self-explanatory. With the allomorph-specific distributional constraint, ALLODIST, ranked over DEFAULT, the evaluation correctly picks out the surface forms. One final remark on (22b-v) is in order. This form is identical to the chosen form in (22b-ii). But crucially there is difference in index. In (22b-v), the input is /oh/ and this input is subject to the constraint ALLODIST and DEFAULT. Therefore even without FAITH, we have no difficulty in choosing the correct surface forms.[10]

6. Summary and Conclusion

In this paper, we have shown the gradient divergence of different types of allomorphy from regular phonology. In particular, we have focused on partially-optimizing nature of external opaque allomorphy and briefly investigated the possibility of incorporating non-optimizing nature of internal allomorphy, along the continuum of divergence. The following is the recapitulation of phonologically conditioned allomorphy types:

(23) Phonologically conditioned allomorphy types

a. Derivative allomorphy: Markedness constraints

b. Fully optimizing suppletive allomorphy: Markedness constraints, MIH

c. Partially optimizing suppletive allomorphy: Markedness constraints, MIH, DEFAULT

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[10] The example of Totzil 3rd person prefix s/j alternation (Mascaró 2007: 729) and other internal allomorphy in general can be captured along this line. The distributional constraint, ALLODIST(3[RD] PERSON:{j}-V), explains the choice of /j/ and the rejection of /s/ before a vowel initial stem, even when nothing is wrong with /sV/ sequences in general.

d. Non-optimizing suppletive allomorphy: Markedness constraints, MIH, (DEFAULT,) ALLODIST

The classical assumption in OT or phonology in general, is to posit a uniform underlying representation, and the surface contextual variation is captured by wellformedness markedness constraints. Take *s/z* alternation in English plural. The distribution is predictable, [s] after the voiceless and [z] after the voiced. And there is derivational relation between [s] and [z]; a typical case of derivative allomorphy as in (23a). In some other cases, however, the surface alternations cannot be reduced into a single input. We saw [n]~[ə] alternation in Western Armenian. Though there is no derivational relation between these two allomorphs, their distribution is phonologically governed and the choice contributes to improving markedness. Multiple Input Hypothesis along the line of Lapointe (1999) can explain these cases.

More problematic is the partially-optimizing allomorphy. Korean noun allomorphy is a typical case of this type. All five allomorphic alternations found in Korean noun suffixes belong to this case. The choice contributes to markedness improvement in some dimensions like syllable contact, hiatus avoidance and non-existence of [ŋ] in syllable initial positions. But it fails to improve the markedness in other dimensions. Here, we see the active role of DEFAULT, in choosing the right allomorph. Baix Empordà Catalan infinitive allomorphy selects more marked [ɾ] in intervocalic position, but this is viewed as avoidance of intervocalic stops, an improvement of sequential markedness. It was shown that no language-specific morphological constraint is needed for this case. Finally we see that even the internal and irregular allomorphy can be dealt with within the present system by adding language-particular and allomorph-specific constraints. The allomorph distribution constraint, ALLODIST, encodes bijective requirements of the base and the affix. This way, ALLODIST captures the "only-when" effect of internal allomorphy choice.

The present analysis, therefore, shows that there are other factors involved in different allomorphy types. We added MIH, DEFAULT and ALLODIST in that order to explain allomorphy selection down the scale of optimizing nature. Specifically two allomorphy-related constraints are introduced. One is a universal and cross morphemic constraint DEFAULT, that favors the phonologically simple one, and the other is a language-particular and allomorph-specific constraint that applies if and only if the concerned morpheme is at issue. This way, this paper lays out a maximally natural approach to all types of PCSA and still keeps the consistency in the analysis by keeping the allomorph-specific lexical information to the minimum.

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