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Outwards-sensitive phonologically-conditioned allomorphy in Nez Perce

Amy Rose Deal & Matthew Wolf

1 Introduction

When are morphemes realized relative to each other? The question occupies a central place in dividing rival theories of allomorph selection.

The answer in parallel Optimality Theory (Prince and Smolensky 2004 [1993]), as applied to phonologically conditioned allomorph selection by Mester (1994), Mascaró (1996a,b), and others, is ‘all at once’. In this theory, all aspects of a word’s pronunciation are decided at once, so in principle any portion of the word could affect any other. The answer is different in theories like Distributed Morphology (Halle and Marantz 1993), Stratal OT (Kiparsky 2000) and Optimal Interleaving (Wolf 2008). These theories appeal to a serial derivation wherein one affix or block of affixes is realized at a time, and allomorphic choices are made as each additional affix or block is realized. Some morphemes are realized before other morphemes, and the choice among allomorphs is made on the basis of the limited information available at each derivational step.

These views set up different expectations for the space of possible allomorphic distributions. Suppose, for instance, that the morphemes of a polymorphemic word are realized serially, and that this serial derivation begins with the root and proceeds outward. We then expect that (1) will hold.

- (1) The realization of ‘inner’ morphemes (morphemes closer to the root) cannot be sensitive to the phonological shape of ‘outer’ morphemes.

We describe theories which realize morphemes serially from the root on out as ‘inside-out serial’. Inner morphemes cannot depend on the shape of outer morphemes in an inside-out serial theory because the outer morphemes will not be realized until later in the derivation.

In this paper, we provide new empirical evidence for an intermediate position regarding (1) and the notion of inside-out seriality. The right theory, we propose, is partly, but not purely, inside-out serial. Cyclic domains are spelled out one at a time, proceeding from inner domains to outer ones. But within a cyclic domain, if the domain contains multiple morphemes, these may be realized in a non-inside-out fashion: either in parallel, or outside-in. Our evidence comes from two case studies of allomorphy in the verbal system of Nez Perce (Sahaptian). The primary case study involves a functional suffix appearing in contexts of possessor raising.

- (2) a. 'e-ep-én'i-tx siis!
 3OBJ-eat- μ -IMPER.PL soup
 Eat her soup!
 b. 'e-ep-éy'-se- \emptyset siis.
 3OBJ-eat- μ -IMPERF-PRES soup
 I am eating her soup.

We argue that the choice between allomorphs *en'i* and *ey'* represents outward-looking phonologically conditioned allomorphy – a type of effect we would not expect if (1) held in its strongest

form. But we also show that an important echo of (1) persists even in this seeming counterexample. Allomorphy in our case study is sensitive to the phonological shape of outer material only within a limited domain. Material outside this domain is ignored.

Our second example demonstrates sensitivity to the same limited domain. It concerns the allomorphy of the verb root meaning ‘go’, realized either as *kuu* or as *kiy*.

- | | |
|-----------------|-----------|
| (3) a. kúu-se-∅ | b. kiy-ú’ |
| go-IMPERF-PRES | go-PROSP |
| I am going | I will go |

We show that the choice between *kuu* and *kiy* is another case of outward-looking phonologically-conditioned allomorphy. Here, too, phonological material within the local domain matters, and material outside of it does not. We conclude that there is outwards-sensitivity within a cyclic domain, but not across domains.

It is our hope that these case studies shed new light on the debate over (1) in its most stringent form. As the literature stands, we have from Dolbey (1997), Bobaljik (2000), Paster (2006), and Embick (2010) a series of arguments in favor of (1); we have from Anderson (2008), Round (2009), Vaysman (2009, pp 123-4), Svenonius (2012), and Wolf (2013) a series of arguments against. We join the latter group of authors in maintaining that outward-sensitivity to phonological material does exist. Morphological realization cannot operate, then, in a fashion that is strictly inside-out serial. At the same time, we concur with the former group of authors that outward-sensitivity is tightly constrained by the framework of a serial derivation. A fully parallel morphological theory is not empirically tenable.

The ability to strike a balance between inside-out-serial and non-inside-out-serial aspects of morphological realization is not the exclusive province of any one theory. Therefore, after presenting the case studies of allomorphy by a functional suffix (sections 2 and 3) and by a root (section 4), we show how the new facts can be accommodated both in a version of Distributed Morphology (section 5) and in a version of Optimality Theory (section 6). The DM implementation requires some adjustments to a basic DM model. We call the particular variant of DM assumed here *DM with insertion by phase*. The OT implementation is done within the framework of Stratal OT. In this framework the Nez Perce facts can be accommodated without any need for basic revisions.

2 The Nez Perce morpheme μ

Our first case study of outward-looking phonologically-conditioned allomorphy concerns a Nez Perce suffix that is obligatory in cases of object possessor raising, such as (4). In this example the suffix in question is realized as *en’y*.^{1 2}

- | | |
|--|------------------------|
| (4) háama-pim hi-nées-wewkuny- en’y -∅-e | ha-háacwal-na láwtiwaá |
| man-ERG 3SUBJ-O.PL-meet- μ -P-REM.PAST | PL-boy-OBJ friend.NOM |

¹ Here and throughout, we provide Nez Perce examples in the practical orthography in use by the Nez Perce Tribe of Idaho. Note that e = IPA æ; y = IPA j; c = IPA ts; \hat{x} = IPA χ . Apostrophe indicates IPA ? word-initially and post-vocally, but marks glottalization of a consonant otherwise. Stress is marked with an acute accent. Other characters match IPA usage.

² This example is cited in Deal (2013) with form *e’ny* (IPA /æʔnj/), following Aoki (1994, 84). Further discussion with consultants and systematic elicitation of paradigms leads us to conclude that, at least for the speakers we have consulted for this project, the form is instead *en’y* (IPA /ænj/).

The man met the boys' friend.

We take this suffix to instantiate a functional category we call μ . In this section, we show how the realization of μ is affected by general properties of Nez Perce phonology and morphosyntax. This prepares the ground for our case study of allomorphy by μ in section 3.

2.1 Phonological background

The realization of μ is affected by two important phonological patterns of Nez Perce.

The first is a ban on hiatus. Hiatus avoidance is seen in an alternation between glide /y/ and short, unstressed /i/; the latter cannot occur before a vowel. We see this alternation for μ in (5), and for verb stems in (6) and (7).

- | | | | | |
|-----|-------------------------------|------------------|-----------------------------|------------------|
| (5) | a. 'e-ep-én'i-tx | 'áayato-na siis! | b. 'e-ep-én'y-u' | 'áayato-na siis. |
| | 3OBJ-eat- μ -IMPER.PL | woman-OBJ soup | 3OBJ-eat- μ -PROSP | woman-OBJ soup |
| | Eat the lady's soup! | | I will eat the lady's soup. | |
| (6) | a. píi-wewkuni-s- \emptyset | | b. píi-wewkuny-u' | |
| | RECIP-meet-P-PRES | | RECIP-meet-PROSP | |
| | We just met | | We will meet | |
| (7) | a. 'e-héetewi-se- \emptyset | | b. 'e-héetewy-u' | |
| | 3OBJ-love-IMPERF-PRES | | 3OBJ-love-PROSP | |
| | I love her | | I will love her | |

With vowels other than short, unstressed /i/, hiatus is repaired by glide insertion. We see this pattern when μ follows a stem ending in stressed /i/, as in (8). Once again, the pattern is quite general. Glide epenthesis in verbal contexts not involving μ is shown in (9).

- | | | |
|-----|-----------------------------------|--|
| (8) | a. 'e-'wí-yen'y- \emptyset -e | b. pee-tqe-nuxsí-yen'y- \emptyset -e |
| | 'e-'wi-en'i- \emptyset -e | pee-teqe-nuxsi-en'i- \emptyset -e |
| | 3OBJ-shoot- μ -P.ASP-REM.PAST | 3/3-quickly-smell- μ -P.ASP-REM.PAST |
| (9) | a. hi-poxpok'líi-yu' | b. hi-kúu-ye |
| | h-poxpok'líi-u' | h-kuu- \emptyset -e |
| | 3SUBJ-play.ballgame-PROSP | 3SUBJ-go-P.ASP-REM.PAST |

The second important phonological pattern is vowel harmony. While the proper treatment of Nez Perce vowel harmony has been the subject of a long debate (see Deal 2010, pp 15-16 for references and discussion), for present purposes it will suffice to describe this system in the terms advocated by Aoki (1970). According to Aoki, Nez Perce distinguishes five vowel qualities and two lengths.

(10) Vowel inventory (IPA transcription)

Short				Long			
	front	central	back		front	central	back
high	i		u	high	ii (i:)		uu (u:)
mid			o	mid			oo (o:)
low	e (æ)	a		low	ee (æ:)	aa (a:)	

The vowels fall into two phonetically idiosyncratic classes. The dominant class contains /o/ and /a/; the recessive class contains /u/ and /e/ (in practical orthography; recall that this is the conventional notation for /æ/). The high front vowel /i/ may appear with vowels of either class. Recessive vowels /e/ and /u/ are realized as /a/ and /o/ when a dominant vowel appears in the same word. The following examples show the switch from /e/ to /a/ throughout the word when the recessive (remote past) suffix *ne* is replaced with the dominant (recent past) suffix *qa*:

- | | | | | |
|------|----|---|----|---|
| (11) | a. | pée-nek-se-ne
pee-nek-se-ne
3/3-think-IMPERF-REM.PAST | b. | páa-nak-sa-qa
pee-nek-se-qa
3/3-think-IMPERF-REC.PAST |
|------|----|---|----|---|

Harmony is a word-level process. In (11b), it spreads to prefixes and the root from the suffix *qa*. In (12), it spreads from the root *hamool* to its prefixes and suffixes.

- | | |
|------|--|
| (12) | pá-hmol-ca-na
pee-hamool-ce-ne
3/3-pet-IMPERF-REM.PAST |
|------|--|

Vowel harmony affects the realization of μ because all allomorphs of this suffix contain a recessive vowel, /e/. When the word contains a dominant vowel, /e/ harmonizes to /a/. We see this again by contrasting words with the recessive (remote past) suffix *ne* versus the dominant (recent past) suffix *qa*:

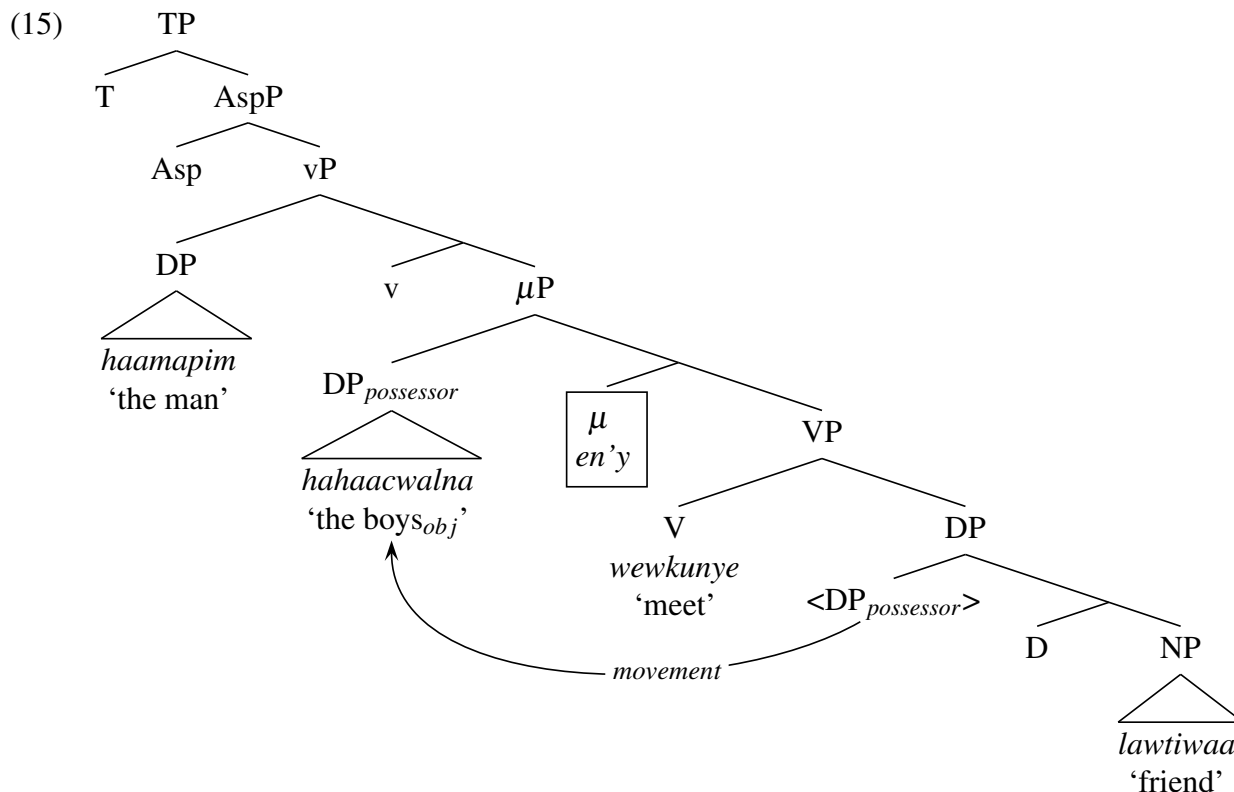
- | | | | | |
|------|----|---|----|---|
| (13) | a. | 'ee-p-éy'-se-ne
'e-hip-ey'-se-ne
3OBJ-eat- μ -IMPERF-REM.PAST | b. | 'aa-p-áy'-sa-qa
'e-hip-ey'-se-qa
3OBJ-eat- μ -IMPERF-REC.PAST |
|------|----|---|----|---|

2.2 Morphosyntactic background

Let us now briefly consider the syntax of μ , and some general morphosyntactic effects on its realization.

As noted above, μ appears in contexts of object possessor raising. In a study of the syntax of that construction, Deal (2013) proposes to treat the vP structure of examples like (14) as in (15). The special suffix is treated as the head of a functional projection μ P which hosts the raised possessor. This head assigns case to the possessum DP; the possessor DP receives case from *v*.

- | | | |
|------|--|------------------------|
| (14) | háama-pim hi-nées-wewkuny- en'y - \emptyset -e | ha-háacwal-na lówtiwaa |
| | man-ERG 3SUBJ-O.PL-meet- μ -P-REM.PAST | PL-boy-OBJ friend.NOM |
| | The man met the boys' friend. | |



In the process of assembling or checking the features of the complex verb word, an exponent of μ is concatenated with exponents of other functional heads making up the clausal spine. If the relative order of these morphemes in the verb word reflects their relative structural position in (15), à la Baker (1985), we can identify inward-sensitivity and outward-sensitivity along familiar structural lines. Sensitivity of μ to VP-internal material is inward sensitivity. Sensitivity to anything outside of VP – e.g. Aspect, appearing above vP – is outward sensitivity.

We can now approach a third generalized factor which affects the realization of μ – a pattern which shows clear inward-sensitivity. This concerns a productive pattern of morphosyntactic class allomorphy. Nez Perce rigidly divides its verb roots and verbal suffixes into two classes.³ Aoki (1970) dubs these 'S-class' and 'C-class'. Examples of each category are provided in (16).

(16) Example roots and suffixes by class

Class S		Class C	
Roots	Suffixes	Roots	Suffixes
<i>kuu</i> 'go'	<i>-toq</i> 'V back'	<i>paay</i> 'come'	<i>-te</i> 'go off to V'
<i>weqi</i> 'rain'	<i>-uu</i> 'APPL:GOAL'	<i>hatya</i> 'be windy'	<i>-qaw</i> 'V without stopping'
<i>suki</i> 'recognize'		<i>cukwe</i> 'know'	
<i>'inipi</i> 'seize, grab'		<i>la'am</i> 'finish, exhaust'	

There are two major reasons to treat class membership as morphosyntactic information. First, it is not predictable phonologically, as Crook (1999) shows. Second, in intransitive verbs, verb class

³ Interestingly, while Nez Perce verbs show prefixation of various types, prefixes seem to be outside the class system. See Deal (2010) for discussion of the nature and form of Nez Perce prefixes.

seems to correlate with unaccusativity, a clearly syntactic distinction. This correlation is revealed by the formation of the passive participle. Passive participles of transitive verbs are intransitive predicates which describe arguments which would serve as the theme argument to the basic verb. Thus the passive participle of ‘climb’ may be predicated only of the climbed structure, not the climber.

- (17) híicanwaas / *háacwal híi-we-s- \emptyset hicay-íin’
 ladder.NOM / *boy.NOM 3SUBJ-be-P-PRES climb-PASSIVE
 The ladder / *the boy is climbed.

Among intransitives, passive participles are possible only with verbs of class C – a group of verbs independently proposed by Cash Cash (2004) to constitute the class of unaccusatives. In the examples below, the class of a verb is annotated to its right in the gloss line.

- (18) híi-we-s- \emptyset pay-níin’ / *kuu-yiin’
 3SUBJ-be-P-PRES come_C-PASSIVE / *go_S-PASSIVE
 He is come / *gone.
- (19) peeley-níin’ / k’oomay-níin’ híi-we-s- \emptyset
 lost_C-PASSIVE / sick_C-PASSIVE 3SUBJ-be-P-PRES
 He’s lost / sick.
- (20) lilóoy-niin’ / *tiy’e-yiin’ 0-wee-s- \emptyset
 be.glad_C-PASSIVE / laugh_S-PASSIVE 2SUBJ-be-P-PRES
 You are happy / *laughed.

If class C intransitives are unaccusatives, and passive participles must be predicated of theme arguments, this distribution follows from the fact that only unaccusative intransitives have theme arguments.

Morphologically, class features condition allomorphy of the *immediately following suffix*. The imperfective, for instance, has form *ce* after an C-class item, and *se* after a S-class item. In gloss lines below, we annotate an item’s syntactic class feature on its right and its morphological realization type on its left.

- | | |
|--|---|
| <p>(21) C-class root</p> <p>páay-ca-\emptyset</p> <p>come_{C-C}IMPERF_{C-C}PRES</p> <p>I am coming / arriving</p> | <p>(22) S-class root</p> <p>kúu-se-\emptyset</p> <p>go_{S-S}IMPERF_{C-C}PRES</p> <p>I am going</p> |
|--|---|

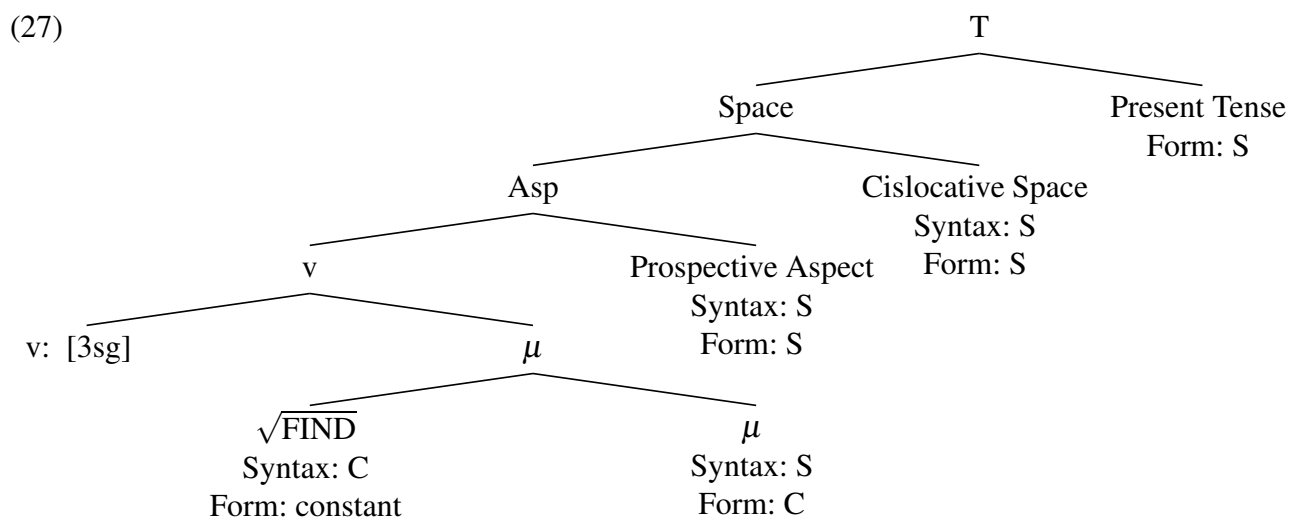
The most typical pattern is for items of form α after class S to take the form $n(V)\alpha$ after class C. Compare the choice between *nu’* and *u’* (prospective aspect), *naqaw* and *qaaw* (adverbial suffix meaning ‘without stopping’ or ‘on through’):

- | | |
|--|---|
| <p>(23) C-class roots</p> <p>a. cúkwe-nu’</p> <p>know_{C-C}PROSP</p> <p>I will know.</p> <p>b. la’ám-naqaw-ca-\emptyset</p> <p>finish_{C-C}thru_{C-C}IMPERF_{C-C}PRES</p> <p>Mine is completely gone.</p> | <p>(24) S-class roots</p> <p>a. ’e-ep-ú’</p> <p>3OBJ-eat_{S-S}PROSP</p> <p>I will eat it.</p> <p>b. ’inp-qáaw-ca-\emptyset</p> <p>grab_{S-S}thru_{C-C}IMPERF_{C-C}PRES</p> <p>I pick it up and go on.</p> |
|--|---|

The shape of μ follows this pattern: it begins with an /n/ after a C-class item. The class of μ itself can be ascertained by considering the shape of the affix immediately following it. The prospective aspect suffix appearing in (25) and (26) shows us that the class of μ is S.

- (25) 'aw-'yáx-**nan'y**-o'-(kom-)qa
 3OBJ-find_{C-C} μ _{S-S}PROSP-(CS-)REC.PAST
 I could find his/her (shirt).
- (26) 'a-ap-**án'y**-o'-qa
 3OBJ-eat_{S-S} μ _{S-S}PROSP-REC.PAST
 I could eat his/her (soup).

Class allomorphy can be handled as inward-looking dependence on morphosyntactic features of adjacent elements. Suppose the verb word in (25) has the structure in (27). Object agreement is analyzed as an exponent of v (Deal 2010).⁴



The root and each suffix bears a class feature, which we have recorded as its syntax. The root itself appears in a constant form, but the form of each suffix is determined with reference to the syntax of the node immediately to the left. Thus the form of μ reflects the syntax of the root; the form of aspect reflects the syntax of μ ; the form of space marking reflects the syntax of aspect; the form of tense reflects the syntax of space marking.

3 Outward-looking phonologically-conditioned allomorphy of μ

Now we come to the heart of our first case study. In addition to the general phonological and morphosyntactic conditions we have just reviewed, the form of μ is also affected by a third, morpheme-specific factor. We will show that the realization of μ is dependent on the phonological shape of the material to its right. This outward sensitivity determines the choice between a long form of the μ suffix, *(n)en'i*, and a short form, *(n)ey'*.

⁴ We leave open here whether (or to what extent) this structure is created by head-movement; see section 5.4. On the optional category of Space marking, see Deal 2009a and Deal 2010, pp 101-102.

3.1 The basic facts

In the following subparadigm, at most one overt suffix follows the μ suffix.⁵ The long forms of μ appear when the material following is smaller than CV. (The alternation between /y/ and short unstressed /i/ occurs here in the regular way.)

(28) Long form: (n)en'i / (n)en'y

Form	Gloss
'aw-'yáx-nan'i- \emptyset	3OBJ- find- μ - imperative.singular
'aw-'yáx-nan'i-tx	3OBJ- find- μ - imperative.plural
'aw-'yáx-nan'i-s- \emptyset	3OBJ- find- μ - P.aspect- present
'iyáx-nan'i-t	find- μ - nominalizer
'aw-'yáx-nan'y-u'	3OBJ- find- μ - prospective.aspect
'aw-'yáx-nan'y- \emptyset -a	3OBJ- find- μ - P.aspect- remote.past

The short form appears when μ is followed by a suffix which is CV or longer.

(29) Short form: (n)ey'

Form	Gloss
'aw-'yáx-nay'-sa- \emptyset	3OBJ- find- μ - imperfective.singular- present
'aw-'yáx-nay'-six- \emptyset	3OBJ- find- μ - imperfective.plural- present
'aw-'yáx-nay'-t'aa \hat{x}	3OBJ- find- μ - modal
'aw-'yáx-nay'-tato- \emptyset	3OBJ- find- μ - habitual.singular- present
'aw-'yáx-nay'-ta- \emptyset	3OBJ- find- μ - go.to - singular.imperative

The generalization is thus:

(30) μ is /ey'/ (short form) when the following material is CV+.
Otherwise μ is /en'i/ (long form).

This alternation is outward-looking. Nominalization, aspect, mood and "light verbs" all attach outside of μ .

3.2 Phonological conditioning and morpheme-specificity

At this juncture, two preliminary points are in order.

First, there is evidence in this data set that the forms of μ are indeed conditioned by phonological features, rather than grammatical ones. Neither the suffixes triggering the long form nor those triggering the short form constitute a grammatically unified class. Both the nominalizer *-t* and a range of inflectional affixes condition the long form; the short form appears before both a range of CV inflections and the affix *te* 'go away to', which appears between the root and inflectional suffixes. Suffixes which are in complementary distribution with one another, and thus plausibly instantiate the same morphosyntactic category, fall on different sides of the paradigm. Aspectual markers, for instance, are split between *s* (P aspect) and *u'* (Future/prospective) on the long form side, and *se* (Imperfective) and *tetu* (Habitual) on the short form side.

⁵ The parsing conventions followed here are proposed and justified in Deal (2010, ch 2).

Second, there is evidence that the choice between short and long forms of μ is ultimately morpheme-specific; it is not indicative of more general phonological processes. Suppose, for instance, that the short form appeared with only a following /s/, in the present P aspect. The resulting form, *'aw-'yáx-nay'-s, is ungrammatical, but in other cases the language freely allows e/ay's-final words:

(31) paay's
maybe

(32) kicéey'-s
be.ashamed-ADJ

This suggests that there is not a general prohibition on e/ay's sequences that could be repaired by /n/-insertion and vocalization, deriving the long form in 'aw-'yáx-nan'i-s from an underlying short form as in *'aw-'yáx-nay'-s.

The same argument can be made in the opposite direction. Consider the long form appearing prior to a CV suffix, e.g. the imperfective singular *se*. The resulting form, *'aw-'yáx-nan'i-sa violates no known constraints on Nez Perce phonology. Forms ending in similar ways include

(33) pé-wye-sepn'i-se- \emptyset
3/3-as.one.goes-ask-IMPERF-PRES
He is asking him as he goes.

(34) 'e-tmípn'i-se- \emptyset
3OBJ-remember-IMPERF-PRES
I am remembering it.

This suggests that there is not a general prohibition on n'ise/a sequences that could be repaired by /n/ deletion and glottal metathesis, deriving the short form in 'aw-'yáx-nay'-sa from an underlying long form as in *'aw-'yáx-nan'i-sa.

We might finally consider whether the short and long forms could be derived from an alternative common underlying representation, perhaps *en'y*. In this case glide vocalization would be required for long-form words like 'aw-'yáx-nan'i-s (from *'aw-'yáx-nan'y-s); /n/-deletion would be required for short-form words like 'aw-'yáx-nay'-sa (from *'aw-'yáx-nan'y-sa). Such processes would have to apply only in a highly limited phonological environment, as we find no evidence of them in the general case. One might imagine, for instance, that the two processes serve as repairs for sequences of nasal, glottal, glide and consonant, ruled out by a high-ranked markedness constraint *n'GC. To pursue this analysis, we must identify constraints that could properly adjudicate between the two repairs. These constraints must favor vocalization (and thus -nan'i-s over *-nay'-s) when n'GC falls in word final position, but favor /n/-deletion when a vowel immediately follows n'GC (in which case *-nan'i-sa loses to -nay'-sa). We are not aware of independently motivated constraints that would give us this effect while remaining consistent with the data in (27)-(30).

These considerations force us to conclude that the choice between the short and long forms of μ is unlikely to be the result of independent phonological processes in Nez Perce. It is a case of item-specific morphological alternation, a.k.a. allomorphy. The allomorphic distribution is phonologically-conditioned, and looks 'out'.

3.3 Locality effects

Let us now consider cases where the μ suffix is followed by two or more overt suffixes. As we might expect, when the additional material is added after the CV suffixes conditioning the short form, the short form persists. It also persists when the first suffix following is greater than CV, as in the case of 'low future' suffix *tet'ee*.

(35) Short form

Form	Gloss
'aw-'yáx-nay'-sa-qa	3OBJ- find- μ - imperfective.singular- recent.past
'aw-'yáx-nay'-si-na	3OBJ- find- μ - imperfective.plural- remote.past
'aw-'yáx-nay'-qa-qa	3OBJ- find- μ - habitual- recent.past
'aw-'yáx-nay'-ta-ca- \emptyset	3OBJ- find- μ - go.to- imperfective.singular- present
'aw-'yaâ-nay'-tat'áa-sa- \emptyset	3OBJ- find- μ - low.future- imperfective.singular- present

What is more striking is that the long form environments behave in a parallel way. The realization of μ is sensitive outwards only to its immediately local environment.

Forms involving the prospective aspect suffix *u'* provide a first example of this. The fact that CV+ suffixes *kom* (cislocative) and/or *qa* (recent past) appear to the right of μ in the same word is insufficient to trigger the short form; prospective *u'* is in the way.

(36) Long form

Form	Gloss
'aw-'yáx-nan'y-o'-qa	3OBJ- find- μ - prospective.aspect- recent.past
'aw-'yáx-nan'y-o'-kom	3OBJ- find- μ - prospective.aspect- cislocative
'aw-'yáx-nan'y-o'-kom-qa	3OBJ- find- μ - prospective.aspect- cislocative- recent.past

Even though quite a substantial amount of phonological material separates μ from the end of the word, the realization of μ remains sensitive only to whether the *first suffix to its right* does or does not begin with CV. This is an instance of opacity in allomorph selection: the long allomorph is chosen even though its conditioning environment is not met in the surface form.

A second example of this type of opacity involves the P aspect, an aspectual category common to constructions translated with the English perfect or perfective. There is no overt realization of the P aspect in the examples below. Material attached outside of P aspect, *even if CV in form*, does not condition the short form of μ :

(37) Long form

Form	Gloss
'aw-'yáx-nan'i- \emptyset -m-a	3OBJ- find- μ - P.aspect- cislocative- remote.past
'aw-'yáx-nan'i- \emptyset -ki- \emptyset	3OBJ- find- μ - P.aspect- translocative- present

The challenge for theories of allomorphic conditioning is to account for both the existence of outward-sensitivity of this type and its sensitivity to this locality constraint.

4 Outward-looking phonologically-conditioned allomorphy of $\sqrt{\text{GO}}$

We now present a second case study of outward-looking phonologically-conditioned allomorphy in Nez Perce. This example features not an affix, but the verb root meaning 'go' (and also 'do'). It is not uncommon for roots to show phonologically-conditioned allomorphy; conditioned allomorphy of a root will always, by definition, be outward-looking (Wolf 2013, 165-7). What we want to show with this particular example of root allomorphy is that outward-looking phonological sensitivity is once again restricted to a limited domain. Crucially, the limited domain of relevance is the same for root allomorphy as for allomorphy of μ .

The root \sqrt{GO} takes the form *kuu* when followed by a consonant; the vowel shortens when unstressed.⁶ (We give harmonizing forms in parentheses.)

(38) *kuu* form

Form	Gloss
kúu-se- \emptyset	go- imperfective.singular- present
ku-síix- \emptyset	go- imperfective.plural- present
kúu-tetu- \emptyset	go- habitual- present
ku-t'ipéec	go- frequentative
kuu-qa-qa (kóoqaqa)	go- past.habitual- recent.past
kuu-s- \emptyset	go- P.aspect- present
kuu-t	go- nominalizer

When a vowel follows, /kiy/ appears. This may be analyzed in two ways: either as root *ki* followed by epenthetic /y/ (resolving hiatus), or simply as root *kiy*. We adopt the latter analysis here, noting that hiatus with short unstressed /i/ is not typically resolved by glide insertion; however, none of our conclusions about allomorphy crucially depend on this choice.

(39) *kiy* form

Form	Gloss
kiy-ú'	go- prospective.aspect
kiy-úu-se- \emptyset	go- goal.applicative- imperfective.singular- present
kiy-éy'-se- \emptyset	go- μ - imperfective.singular- present
kiy-áatk-sa- \emptyset	go- take.away- imperfective.singular- present

Just as for μ , the choice between allomorphs of \sqrt{GO} is clearly phonologically conditioned. Once again, the alternation at stake is not one that can be explained by reference to general properties of Nez Perce phonology. There is no general /uu/ \sim /iy/ alternation. The goal applicative, for instance, has form *uu* regardless of whether a vowel follows. In (40), \sqrt{GO} adjusts its form to reflect the vowel following it, but the goal applicative does not. A glide is inserted to resolve the resulting hiatus:

- (40) kiy-úu-yu'
 kiy-uu-u'
 go-APPL:GOAL-PROSP

This is thus a case of outward-looking phonologically conditioned allomorphy.

This allomorphy shows a locality effect precisely parallel to what we see for μ in (37). \sqrt{GO} , like μ , is sometimes followed by the P aspect with no overt realization. This means that \sqrt{GO} is sometimes realized phonologically adjacent to a vowel which its not in its local domain – for instance, a vowel that realizes Tense. In this case, \sqrt{GO} takes the form *kuu*.

- (41)

Form	Gloss
kúu- \emptyset -e (kuuye)	go- P.aspect- remote past

⁶ This shortening is a pattern of some generality in the language, which we leave unanalyzed here.

Despite the fact that \sqrt{GO} appears phonologically adjacent to a vowel-initial suffix, the form *kiy* is not chosen. This makes for an important difference between (41) and the forms in (39). In both cases, \sqrt{GO} occurs with a vowel-initial affix following. What seems to matter is that in one case, but not the other, this affix falls within the local domain of \sqrt{GO} allomorphy.

In the next two sections, we consider how the two case studies we have now seen can be analyzed within a version of Distributed Morphology (§5) and within Stratal OT (§6).

5 Realization by cyclic domains: Distributed Morphology with insertion by phase

In this section we outline a slightly revised version of Distributed Morphology (Halle and Marantz 1993, Harley and Noyer 1999, Embick 2010), and show how it allows us to capture the Nez Perce facts we've just reviewed. The key DM tool for handling allomorphic distributions is the process of Vocabulary Insertion. Following Bobaljik (2000), Adger, Bejar, and Harbour (2003), and Embick (2010), we propose that Vocabulary Insertion operates in a cyclic manner. Where we depart from prior work is in the size of the cyclic domains in which Insertion applies. We propose that Insertion takes place in cycles that may be non-trivial – they need not consist of just a single node. This innovation allows a natural account of limited outward-sensitivity to phonological material.

5.1 DM with Insertion by Phase: the framework

We adopt three particular constraints on Vocabulary Insertion.

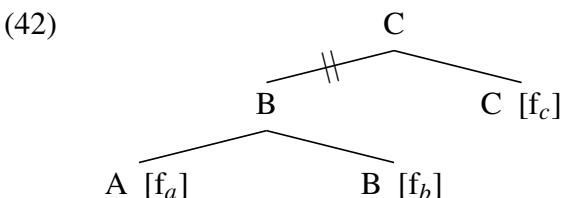
The first and most crucial constraint is *cyclicity*: Insertion proceeds inside-out, cycle by cycle. This, we propose, is the only hard-wired constraint on order of insertion. Within a cycle, items can in principle be inserted in any order. The order of insertion may be constrained only by phonological conditioning requirements of particular VIs: if VIs competing for insertion at α reference the phonology of cycle-mate β , β will need to be inserted before α . A derivation attempting insertion at α before insertion at β will result in failure; competition for Vocabulary Insertion cannot be resolved.

In principle, the cycles we require could be particular to the morphological component of grammar, but they could also reflect cyclic domains which have independent motivation in other areas. It is tempting in particular to identify the cyclic domains for Vocabulary Insertion with phasal domains of syntactic computation, as has been explored by Svenonius (2012). This hypothesis connects the proposal that allomorphy need not be strictly inside-out within a cyclic domain with proposals by Hiraiwa (2005) and Chomsky (2008) that syntactic operations need not operate strictly inside-out within a phase. We tentatively adopt the identification hypothesis for our discussion of Nez Perce allomorphy, and return to some of its consequences in section 5.4.

The second constraint is *monotonicity*: Insertion strictly adds information. We thus assume that after Insertion, both morpho-syntactic and phonological features are present. This constraint is prefigured by the work of Adger et al. (2003) and Gribanova and Harizanov (In press).

The final constraint is *linearity*: the conditioning environment for allomorphy of α must be linearly adjacent to α . This constraint figures centrally in the argumentation of Paster (2006) (drawing on Inkelas 1990) and Embick (2010). A consequence of this constraint in the most straightforward sense is that null affixes must be inert with respect to allomorphic conditioning, because they do not contain anything for other affixes to be phonologically adjacent to.

With these pieces in place, let us consider the possibilities for allomorphy in a toy example consisting of two phases. The lower phase consists of two nodes, A and B; the higher phase consists of just one node, C. Each node bears various syntactic features; the phase boundary is marked with a double dash.



Vocabulary Insertion begins with the lower phase. A and B are inserted in any order which makes it possible to resolve conflicts between VIs. Given cyclicity and linearity, allomorphy of A may be conditioned *only* by features of B. Allomorphy of A may look to phonological features of B (in which case B will have to be inserted before A); it may also look to morphosyntactic features of B (regardless of the order of insertion, given monotonicity). Allomorphy of B likewise may look to phonological features of A (if A is inserted first), or to A's morphosyntactic features; but it may also be sensitive to morphosyntactic features of C. Since C belongs to the higher phase, it cannot be inserted before B is. Therefore it is not possible for B to show allomorphy conditioned *phonologically* by C. The only type of outward dependence possible between B and C is morphosyntactic.

5.2 Handling the realization of μ

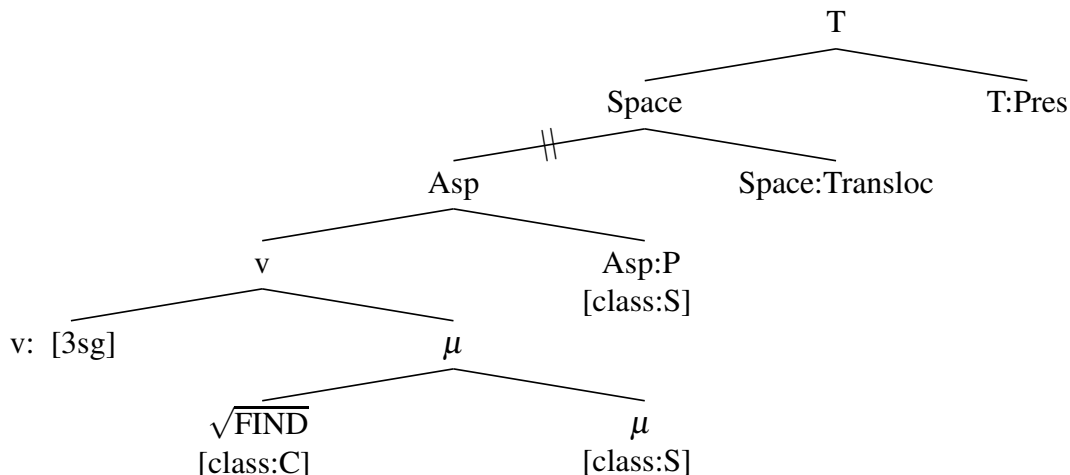
We are now ready to apply the proposal to a real example. Particularly illustrative will be the derivation of an example like (43). Here, μ appears in a long form even though it is followed by a CV suffix, translocative *-ki*.

- (43) 'aw-'yáx̂-nan'i- \emptyset -ki- \emptyset
 3OBJ-find- μ -P.ASP-TRANSLOC-PRES

This suffix will be unavailable to condition allomorphy on μ in virtue of the cyclic nature of Vocabulary Insertion.

The structure of word (43) is shown in (44). Note the presence of a phase boundary between Aspect and Space marking, and the absence of such a boundary between v and Aspect. (For simplicity, we have suppressed morphosyntactic features of material in the higher phase.)

(44)



The order of insertion in the lower phase is constrained only by the particular VIs available. Consider, to begin, the case of v . Bearing the features [3sg], the v head has two potential realizations: /'ew/ before a glottal stop, and otherwise /'e/. This means there is competition between two VIs for insertion here. (We use the symbol \frown to indicate linear adjacency.)

- (45) a. $v \leftrightarrow \text{'ew} / __ \frown$
 b. $v \leftrightarrow \text{'e}$

In order to resolve this competition, the material linearly right-adjacent to v will need to be present before v is inserted. This means that phonological material must be inserted at the root before at v . Fortunately, the root in this example is quite simple. It shows no allomorphy. This means that there is only one VI available to realize the root's syntactic features.

- (46) $\sqrt{\text{FIND}} \leftrightarrow \text{'yaq}$

Insertion in the lower phase can in principle begin with the root, given that there is no phonologically-driven competition for insertion here. What is crucial, though, is not the *absolute* timing in the derivation of insertion at the root. The theory requires only a *relative* ordering between insertion at the root and insertion at v . The former must precede the latter in order for the competition in (45) to be resolved.

Insertion at μ imposes additional ordering constraints. As we've seen, allomorphy here depends inward on morphosyntax and outward on phonology. Four VIs compete for insertion:⁷

- (47) a. $\mu \leftrightarrow \text{ney}' / [\text{Class:C}] \frown __ \frown \sigma($
 b. $\mu \leftrightarrow \text{ey}' / __ \frown \sigma($
 c. $\mu \leftrightarrow \text{nen}'i / [\text{Class:C}] \frown __$
 d. $\mu \leftrightarrow \text{en}'i$

⁷ This list makes it clear that syntactic information to the left and phonological information to the right make independent, non-interacting contributions to the form of μ . While the contribution of phonological material is idiosyncratic, the /n/ triggered by a [Class:C] feature to the left is somewhat regular. In view of this, Peter Svenonius has suggested to us that /n/ might be parsed as an independent morpheme appearing to the right of items bearing a [Class:C] feature. We leave this interesting suggestion to future work, noting only that there are many suffixes which do not show an /n/-initial form when following a class C item. See the examples discussed in Deal (2010, pp 80-82).

Resolution of this competition will depend on the phonology of material to the right.⁸ This results in another relative ordering imposed on insertion. Insertion at Aspect (to the immediate right of μ) must precede insertion at μ .

As the highest node in the phase, Aspect is subject to a hard-wired constraint: it may not depend phonologically on material outside the phase. It may, however, depend on such material morphosyntactically, given that morphosyntactic features are available throughout the derivation. Indeed, insertion at Aspect in this example depends both inward and outward on morphosyntactic features. It depends inward on class features, as μ does: outside C-class items, P aspect is always /n/. Outside an S class item, it is /s/ if present tense follows; otherwise it has no realization. We must posit at least two VIs, then:

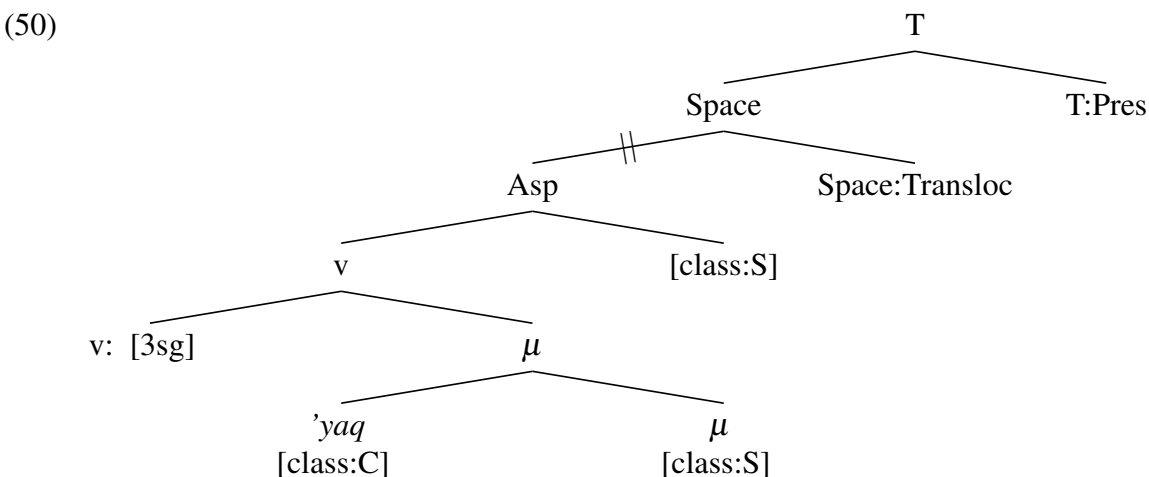
- (48) a. Asp:P \leftrightarrow s / [Class:S] \wedge __ \wedge [T:Pres]
 b. Asp:P \leftrightarrow n / [Class:C] \wedge __

For the case where Aspect has no realization, two options are available. We might posit the insertion of a zero exponent which is ignored for further morphophonological affairs; or we might posit that no exponent is applicable, and so insertion simply skips the node. We opt, for simplicity, for the latter analysis.

All together, then, the VIs available for the four nodes in the lower phase impose two constraints on insertion. Insertion must apply at the root before at v , and at Aspect before at μ . There are thus six admissible orders for insertion in the lower phase:

- (49) i. Root > v > Asp > μ iv. Asp > μ > Root > v
 ii. Root > Asp > v > μ v. Asp > Root > μ > v
 iii. Root > Asp > μ > v vi. Asp > Root > v > μ

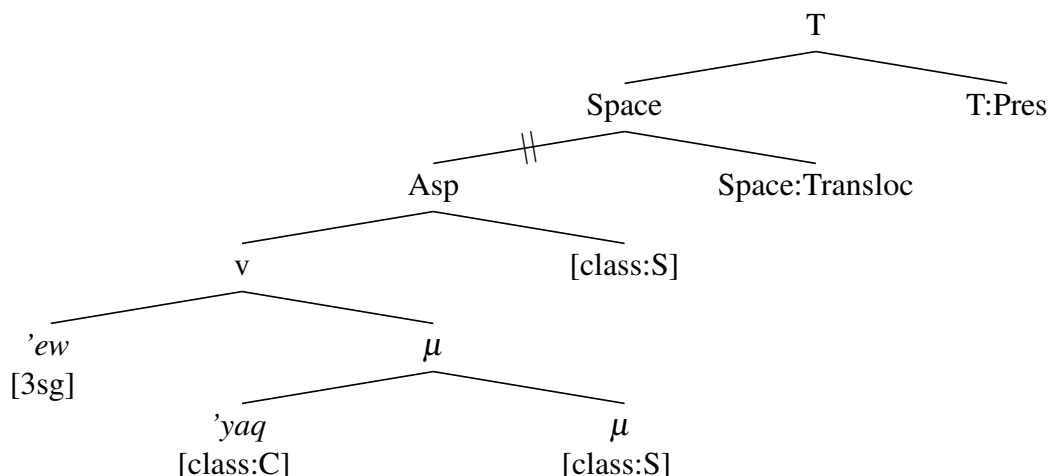
Let us exemplify with order (ii). Insertion first applies at the root, and then at Aspect. The result is (50).



⁸ Our formulation of the phonological condition in (47) references syllable boundaries, rather than CV segments, for parallelism with the Stratal OT analysis provided in the next section. This requires that CV suffixes present at least some prosodic structure at the time of Vocabulary Insertion, and correspondingly, that V-initial suffixes not be underlyingly syllabified into onsetless syllables.

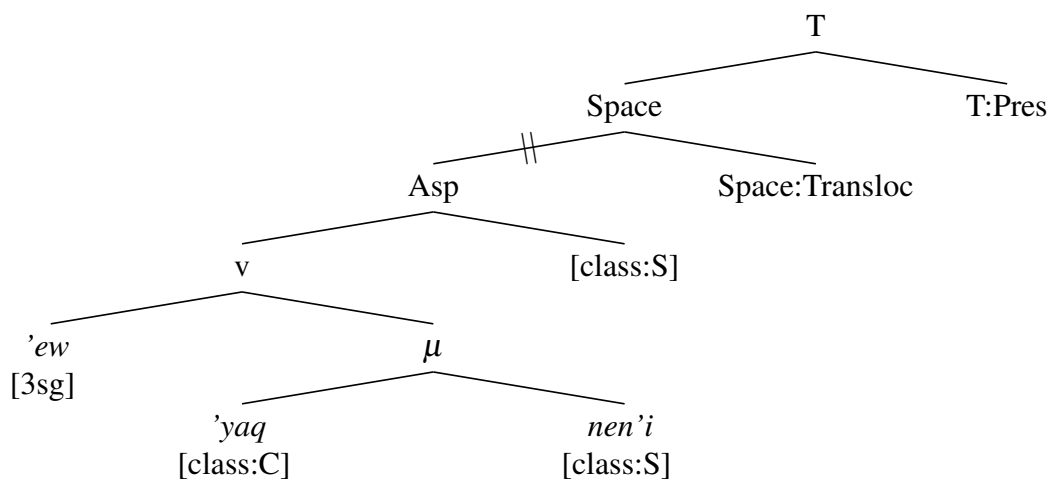
Then *v* is inserted. The phonology of the root allows the competition among VIs to be resolved in favor of *'ew*.

(51)



Finally, μ is inserted. Competition for insertion references syntactic features inward and phonological features outward. Since insertion has already applied at Aspect, it is possible to choose between a short allomorph of μ , which must be followed by σ (, and a long allomorph. In this example, the long allomorph wins.

(52)



This completes the process of Insertion for the lower phase. Insertion now proceeds to the next higher phase. Once Insertion is complete, the word is subject to a post-cyclic, word-level phonological grammar. Phonological processes of vowel harmony, hiatus resolution, epenthesis and spirantization apply at this point. Schematically, then, the overall word is formed as shown in (53).

(53)

a. After insertion on Phase 1

'ew-'yaq-nen'i-

3OBJ-find- μ -

b. After insertion on Phase 2

'ew-'yaq-nen'i-ki

3OBJ-find- μ -TRANSLOC

[phonological underlying representation (UR)]

- c. After application of post-cyclic phonological rules
 'aw'yaʔnan'iki [surface form]

The system provides a straightforward account of the outward-looking phonological dependence of μ . This unusual property of this affix is recorded in the set of VIs that compete for insertion at the μ node. Because there is such a competition, Insertion must apply at Aspect before it applies at μ . When Aspect begins with CV material, μ appears in the short form; otherwise it appears in the long form. It is clear, furthermore, why the short form of μ cannot be triggered by a CV space marker such as translocative *ki*. In order for μ to depend phonologically on the space marker, the space marker would have to be inserted before μ . But this is impossible in virtue of the geometry of phases. All material in the lower phase must be inserted before any material in the higher phase. Insertion of μ cannot be postponed until after the space marker is inserted.

5.3 Handling the realization of $\sqrt{\text{GO}}$

A very similar analysis can be provided for examples of $\sqrt{\text{GO}}$ allomorphy. Suppose the words in (54) have the (partially simplified) structures below.⁹ Again, the sole phase boundary is located above Aspect.

- (54) a. kúu- \emptyset -ye
 go-P-REM.PAST
 I went.
-
- b. ki-yúu- \emptyset -ye
 go-APPL:GOAL-P-REM.PAST
 I went over to you.
-

Two allomorphs compete for insertion at $\sqrt{\text{GO}}$. As before, the choice references the phonology of following material.

- (55) a. $\sqrt{\text{GO}} \leftrightarrow \text{kiy} / _ \text{ } \hat{\text{V}}$
 b. $\sqrt{\text{GO}} \leftrightarrow \text{kuu}$

In order for this competition to be resolvable, phonological insertion in (54) cannot begin with the root. In (54b), Insertion may target either Aspect or the applicative first. The goal applicative shows allomorphy for class, conditioned by the syntax of the root:

- (56) a. APPL:GOAL \leftrightarrow nuu / [Class:C]__

⁹ In these examples, v is zero; we have omitted it for simplicity. We have also omitted space marking. See Deal (2010) for arguments that space marking has no zero allomorph. When no space marking is overtly present, the syntactic category has not been projected.

b. APPL:GOAL \leftrightarrow uu

We propose, therefore, that the syntactic content of the root element is present throughout the derivation; only the phonological content of roots is inserted late. Because $\sqrt{\text{GO}}$ bears a syntactic S class feature, allomorphy of the applicative can be resolved. The form *uu* is chosen. Insertion can then target $\sqrt{\text{GO}}$. Because the following item begins with a vowel, the form chosen in (54b) is *kiy*.

Insertion must target Aspect first in (54a). In this environment (which is determined partly by the class feature of the root), Aspect receives no phonological realization. Insertion at $\sqrt{\text{GO}}$ thus chooses the form *kuu*; the environment for insertion of *kiy* is not met. In the second phase, insertion for remote past tense chooses allomorph *e*, placing a vowel immediately after the exponent of $\sqrt{\text{GO}}$. It is too late in the derivation, however, for *kiy* to be chosen. The production of the surface forms in (54) may be schematized as follows.

(57)	a.	After insertion on Phase 1	
		(54a)	(54b)
		kuu-	kiy-uu-
		go-	go-APPL:GOAL-
	b.	After insertion on Phase 2	[phonological URs]
		kuu-e	kiy-uu-e
		go-REM.PAST	go-APPL-GOAL-REM.PAST
	c.	After application of post-cyclic phonological rules	[surface forms]
		kuuye	kiyuuye

5.4 Cycles and phases

The particulars of these analyses bring us to a position to reflect on the identification of syntactic phases with morphological insertion domains. We have seen that there must be two such domains within the Nez Perce verb, with the dividing line falling just above Aspect. There can be no domain boundary at the vP level; this would prevent μ and $\sqrt{\text{GO}}$ from referencing the phonological content of Aspect. From the perspective of cyclic insertion domains as syntactic phases, both of these results are surprising: *v* is expected to be phasal (Chomsky 2000, Legate 2003, Rackowski and Richards 2005, Deal 2009b), and Aspect is not.

We see two avenues of possible response. On one hand, we might divorce syntactic and morphological cyclic domains, recognizing a m(orphological)-phase distinct from other syntactic cyclic domains. Such an approach builds on Marušič (2005)'s separation of PF and LF phases. On the other hand, we might retain the identification of syntactic phases with morphological insertion domains, but posit cross-linguistic variation in the location of the relevant boundaries. Thus vP may be a phase/insertion domain in English, but not in Nez Perce, and vice versa for Aspect. This approach connects to work on variation in the placement of phase boundaries by den Dikken (2007) and Gallego (2007). These authors argue that phase boundaries interact with head movement, such that the phase-inducing properties of a moving head are inherited by the head to which it moves. Movement of the phasal head *v* to T, for instance, results in phasehood at the TP level, not the vP level. This approach could be extended to Nez Perce if most but not all of the structure in (44) is built by head movement. *v* moves to Aspect, resulting in phasehood at the AspP level. The result

of head movement subsequently combines with Space and Tense via an alternative mechanism—perhaps simple cliticization of syntactically independent Space and Tense nodes to the left.

We are not presently aware of any Nez Perce-internal empirical arguments that could adjudicate between these options.¹⁰ The proper overall approach to the Nez Perce data may well then rest on the viability of the larger case to be made for either cross-linguistic variation in the location of phase boundaries or imperfect alignment between m-phases and other domains of grammatical computation.

6 Realization by cyclic domains: Stratal OT

A conceptually similar analysis can be given in Stratal OT (Kiparsky 2000, among others). The basic framework of this theory builds on Lexical Phonology and Morphology (LPM; Kiparsky 1982a,b) in dividing the morphology of a language into levels or strata, each associated with a phonological grammar. When a word receives morphology at Level n , it passes through the Level n phonology before moving on to acquire further morphology at Level $n + 1$. In LPM, the phonology of each level is a rule-based grammar; in Stratal OT, it is an OT grammar. Thus processes interact in parallel within a level, but serially between different levels.

In implementing a Stratal OT analysis, we adopt the standard assumption that separate morphological and phonological grammars are in force at each level. Class allomorphy is resolved morphologically before the level-internal phonological grammar applies. For the case of μ , this means that the morphology supplies the phonology with either of two sets of disjunctive underlying representations, as appropriate on morphological grounds: {*nen'i*, *ney'*} (after C-class) or {*en'i*, *ey'*} (after S-class). Each candidate in the phonology must pick one or the other alternative UR to be faithful to. In setting the stage for allomorphy in this way, we follow many precedents in the OT allomorphy literature, e.g. Mascaró (1996a,b). (For further references and discussion, see Wolf 2008, §1.2.3.)

6.1 Handling the realization of μ

Let us first consider an example containing only material from a single level. This will include μ and the following aspect suffix; our examples use prospective *u'* and imperfective *se*.

Two constraints are at play in the choice among allomorphs. The first is a morphology-prosody alignment constraint (McCarthy and Prince 1993), which we express below in the categorical constraint schema of McCarthy (2003).

(58) ALIGN(*nen'i*, R, PWd, R; σ)


Within a prosodic word P, assign a violation-mark if a syllable intervenes between the right edge of the morph /*nen'i*/ and the right edge of P.

For forms where μ is followed by further suffixal material which is smaller than /CV-/ in size, ALIGN is vacuously satisfied by all candidates, and so /-*nen'i*/ will be used on the assumption that

¹⁰ There is no clear morphological signature of phasehood, for instance. No relevant data is presently available on other potential diagnostics of phasehood, such as binding, quantifier stranding, ellipsis or scope reconstruction.


this is the default form.¹¹ This is shown below for μ followed by prospective aspect suffix u' . Prosodic word boundaries are indicated with |...|.

(59) Selection of long form (prospective aspect)

Input: 'aw-'yáx̂-{nen'i,ney'}-u'	ALIGN(nen'i,R,Pwd,R, σ)	DEFAULT=nen'i
a.  'aw'.yáx̂.nan'.yo'		
b. 'aw'.yáx̂.na.y'o'		*!

When the following suffix is at least CV in size, using /-nen'i/ will violate the higher-ranked ALIGN constraint, and so /-ney'/ will be used instead. This is shown below for μ followed by imperfective aspect suffix se .

(60) Selection of short form (imperfective aspect)


Input: 'aw-'yáx̂-{nen'i,ney'}-se	ALIGN(nen'i,R,Pwd,R, σ)	DEFAULT=nen'i
a. 'aw'.yáx̂.na.n'i.sa	*!	
b.  'aw'.yáx̂.nay'.sa		*

As before, we illustrate the crucially cyclic aspect of this analysis with the derivation of (61), where the choice of /-nen'i/ is rendered opaque by subsequent affixation of translocative /-ki/.

(61) 'aw-'yáx̂-nan'i- \emptyset -ki- \emptyset
3OBJ-find- μ -P.ASP-TRANSLOC-PRES

Opacity arises here because suffixes are added in two distinct levels. On the first level, only μ and the following aspect marker have been added. Since Aspect has no realization, /-nen'i/ is chosen; there is no full syllable separating it from the right edge of the prosodic word:


(62) Selection of long form at Level 1

Input: 'aw-'yáx̂-{nen'i,ney'}	ALIGN(nen'i,R,Pwd,R, σ)	DEFAULT=nen'i
a.  'aw'.yáx̂.na.n'i		
b. 'aw'.yáx̂.nay'		*!

The chosen form |'aw'.yáx̂.na.n'i| then is passed to the next level, whose morphology adds the further suffix $-ki$. The resultant form |'aw'.yáx̂.na.n'i.ki| now violates ALIGN, since a full syllable [ki] now separates /-nen'i/ from the right edge of the word. However, it's not possible for the phonology of stratum 2 to do anything about that. The alignment violation could be avoided by not syllabifying the segments of the newly-added suffix /-ki/, but we may assume that doing so is barred by highly-ranked PARSE-SEG. (Unsyllabified segments are enclosed in <...>.)

¹¹ For discussion of various strategies for bringing default preferences among allomorphs into OT models of allomorph selection, see Wolf (2015).

(63) Prior selection of long form becomes opaque upon further suffixation at Level 2

Input: 'aw'.yáx.na.n'i-<ki>	PARSE-SEG	ALIGN(nen'i,R,Pwd,R,σ)	DEFAULT=nen'i
a.  'aw'.yáx.na.n'i.ki		*	
b. 'aw'.yáx.na.n'i.-<ki>	*!		

(64) PARSE-SEG


One violation-mark for every segment that isn't part of a syllable.

Crucially, there is no candidate *|'aw'.yáx.nay'.kil, which would avoid the ALIGN violation – and thereby win – by over-writing the long form selected at Level 1 with the short form. (On the non-existence of 'replacive' morphological operations, see Kiparsky 1996.)


6.2 Handling the realization of \sqrt{GO}

The analysis of \sqrt{GO} is similar. At level 1, a choice must be made between allomorphs *kuu* and *kiy*. Allomorph *kuu* is preferred before consonants, where the choice of *kiy* would create a coda or coda cluster. Allomorph *kiy* is preferred before vowels, where the choice of *kuu* would create hiatus.¹²

(65) Selection of /kuu/ at Level 1 (imperfective aspect)

Input: {kuu,kiy}-se	*HIATUS	DEP	NO-CODA
a. kiy.se			*!
b.  kuu.se			

(66) Selection of /kiy/ at Level 1 (prospective aspect)

Input: {kuu,kiy}-u'	*HIATUS	DEP	NO-CODA
a.  ki.yu'			
b. kuu.u'	*!		
c. kuu.yu'		*!	


Opacity arises in words like (67) where a vowel is added in Level 2.

(67) kúu-∅-ye
 kuu-∅-e
 go-P.ASP-REM.PAST

The first stratum in this case consists of the root and the aspect marker, which has no realization. Allomorph *kuu* is chosen over *kiy* in view of NO-CODA. At Level 2, we are again stuck with whatever allomorphs were chosen at Level 1 (there are no candidates that replace *kuu* with *kiy*), and the ranking of *HIATUS over DEP ensures that a glide is inserted.

¹² We show a DEP » NO-CODA ranking in this section in view of the fact that Nez Perce fails to epenthesize vowels to repair codas.

(68) Analysis of (67): Hiatus resolved at Level 2

Input: kuu-<e>	*HIATUS	DEP	NO-CODA
a. kuu.e	*!		
b.  kuu.ye		*	

Overall, these analyses illustrate how μ and $\sqrt{\text{GO}}$ allomorphy in Nez Perce answer an objection to Stratal OT by Embick (2010, e.g. p 171). If phonological outwards-sensitivity did not exist at all, Embick argues, then Stratal OT is under-restrictive: it bars outwards-sensitive/parallel interactions between affixes of different strata, but still allows such interactions within a stratum. Since, as we've argued, the latter type of interaction does exist in Nez Perce, this isn't a problem after all.

6.3 Cycles and strata

Questions similar to those discussed with respect to the phase-based approach in section 5.4 can also be raised for the Stratal OT analysis. Specifically, is there any independent reason why the relevant affixes should be divided between levels 1 and 2 in the manner required to produce the correct distribution of allomorphs? It is not obvious that the levels required in Nez Perce distribute affixes into recognizable natural classes. For example, the levels do not seem to correspond to any traditional notion of inflectional versus derivational morphology, since Aspect belongs to level 1 and Tense to level 2, even though these both would be classically inflectional.

While it would certainly be desirable if the assignment of affixes to levels could be derived from independent properties, cases have been noted from other languages in which morphological level-ordering appears to be synchronically arbitrary. Buckley (This volume), for instance, notes that the Stem and Word levels required in the Kashaya data he discusses do not have an obvious basis in a distinction like inflection versus derivation. Similarly, Benua (1997, 166-7) argues that the level 1 vs. level 2 distinction in English does not reduce to any independent property of affixes, including morphosyntactic function, inflectional versus derivational status, prosodic size, or Latinate versus Germanic etymology. The same conclusion may be required for Nez Perce.

7 Conclusion

We have now seen that DM with insertion by phase and Stratal OT both capture the balance between inside-out-serialism and non-inside-out-serialism we find in the allomorphy of μ and $\sqrt{\text{GO}}$. Both approach the facts in essentially the same way. The morphemes μ and $\sqrt{\text{GO}}$ belong to an inner cycle, and the order of insertion within the cycle need not be inside-out serial. This allows for allomorphy to be outward-looking for phonological features. All insertion in the inner cycle must precede all insertion in the outer cycle, however, and this imposes a constraint on phonological outward dependence. Such dependence is possible within a single cycle but not across the boundary between two cycles. In view of the Nez Perce allomorphy facts we have introduced, we maintain that any successful theory of allomorph choice will need to make a similar distinction. Theories that forbid all phonological outward dependence are not tenable. Neither are theories that allow global interactions within words without limit.

While they both strike a balanced note on inside-out serialism, the two theories we have presented nevertheless differ in various respects. Perhaps the single biggest difference concerns the question of serialism internal to the cycle. In the DM analysis, insertion within a cycle is serial in a way that need not be inside-out. In the Stratal OT analysis, insertion within a cycle is in parallel; every morpheme is inserted at once. If the Stratal OT analysis is correct, we expect to find cases where allomorphic selection for two adjacent morphemes is resolved in a way that involves mutual phonological dependence. The two morphemes are inserted at the same time, and the grammar chooses the overall best-ranked combination of allomorphs for a particular level. If the DM analysis is correct, this type of situation will never arise. For any morphemes A and B, it is always the case that A is inserted before B or that B is inserted before A. The morpheme that is inserted second may depend phonologically on the morpheme that is inserted first. But two morphemes may not depend on each other phonologically.

We note in closing that the two proposals we have outlined here are not the only frameworks having the architecture required to deal with the Nez Perce facts. An analysis seems within reach, for instance, in the theory of Optimal Interleaving (Wolf 2008 et seq.), versions of which (Wolf 2008, 174–186, Wolf 2013) already permit outwards sensitivity under certain conditions. The basic approach can be ported over into an Optimal Interleaving grammar by simply replacing the basic operation of ‘spell out one morpheme’ with ‘spell out one phase’.

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Abstract

Theories of allomorph selection differ in the extent to which they allow the realization of morphemes closer to the root to be sensitive to the phonological shape of more peripheral morphemes. In parallel OT, all aspects of word pronunciation are determined at once, and so in principle any portion of the word could affect any other. Many alternative approaches posit that morphemes are realized one at a time (serially), beginning with the root and proceeding outwards. If this is stringently the case, no phonologically-conditioned outward-sensitive allomorphy should exist.

In this paper we discuss new evidence from Nez Perce in support of an intermediate position. The right theory, we propose, is partly, but not purely, “inside-out serial”. It is cyclic domains that are spelled out one at a time, proceeding from inner domains to outer ones. But within a cyclic domain, if the domain contains multiple morphemes, these may be realized in a non-inside-out fashion: either in parallel, or outside-in. We show how the Nez Perce facts can be accommodated both in a version of Distributed Morphology (which we call “DM with Insertion by Phase”) and in Stratal OT.

Keywords: allomorphy, peripherality, outward-sensitivity, opacity, Distributed Morphology, Stratal OT, phase, cycle, cyclic, cyclicity, serialism, parallelism, PCSA, suppletion, suppletive, spell-out