PHONOLOGY WITHOUT STRATA*

Heather Newell
Université du Québec à Montréal

This paper offers extra evidence for the claim put forth in Newell and Piggott (2014) that certain cyclic derivations cannot be properly accounted for within a parallel phonological derivational framework such as Optimality Theory (OT). This is the case even for those sub-types of OT that have re-introduced the cycle, such as Stratal Optimality Theory (SOT) (Kiparsky 2000, Bermúdez-Otero 2014). The crux of the argument here is that in cases where a single morpheme may emerge in multiple cycles of the derivation, the link between derivational history and phonological output is lost if we attribute distinct phonological outputs to the re-ordering of rules or re-ranking of constraints at each level. A full account of the phonological output forms presented here necessitates a fuller syntactic exposition, which leads to a simplification of the phonological module.

1. Introduction

The overarching goal of a phonological theory must be to not only account for the outputs that surface, but also to offer an explanation as to *why* the surface forms emerge the way that they do.[1] In order to begin to explain why the patterns we will see in the following sections have the properties that they do, the following theoretical underpinnings must be taken to hold. First, in line with the proponents of Distributed Morphology (Halle and Marantz 1993) or Nanosyntax (Starke 2009), a single morpho-syntactic derivational component is taken here to be responsible for the construction of syntactic elements that form the input to the phonological interpretation. Second, the syntactic derivation is computed in stages rather than in one fell swoop at the end of the derivation. The current formulation of this cyclic derivational functioning is exemplified by Phase theory (Chomsky 1999). This cyclic syntactic derivation entails that the phonology, being interpretive, will also be cyclic. And third, the linguistic computational system is taken to be modular (Fodor 1983, Scheer 2010). Syntactic derivations are translated into the proprietary language of the phonology; there is no direct reference between the two modules. These underlying assumptions deny the possibility of a strictly parallel (single-cycle) phonological computational system, as exemplified by classic Optimality Theory (Prince and Smolensky 2008), but I will take some time below to stress the particularly problematic nature of multi-cycle affixes for this type of theory. The main discussion below will, however, focus on a comparison of a cyclic OT, where strata are built into the phonological computational system, to a phase-generated cyclic phonology, where cycles are determined extra-phonologically. It will be argued that the SOT account utilises extra, unnecessary, machinery and therefore that the phase based account is to be preferred.

This article is organized as follows. §2 introduces multi-cycle affixes, with reference to Turkish (§2.1), Malagasy (§2.2), and Ojibwe (§2.3). The particular syntactic

[1] This is not to say that all particularities of phonological outputs are predictable, of course. Phonological forms and operations all have an arbitrary component in the Saussurean sense. We are referring here to why

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structures and phonological patterns associated with these affixes are laid out. §3 demonstrates that a parallel derivational framework cannot account for these patterns either at all, or in a non-stipulative way. §4 argues that a cyclic parallel derivational system is also insufficient to explain the data. §5 points the reader toward a theoretical framework in which the attested patterns are appropriately constrained, and concludes.

2. Multi-cycle affixes

Multi-cycle affixes are those that have morpho-syntactic properties that enable them to merge either within the same morpho-syntactic cycle as the root, or in a later cycle.[2] An analogous way to think about this is to say that these are affixes that may have the behaviour of either Level 1 or Level 2 affixes, in the terminology of Lexical Morphology and Phonology (Kiparsky 1982, Mohanan 1986), or (roughly) first-phase vs outer phase affixes in the vein of Ramchand (2006). Consider the following architecture of the grammar, where the morpho-syntax feeds the phonology cyclically:

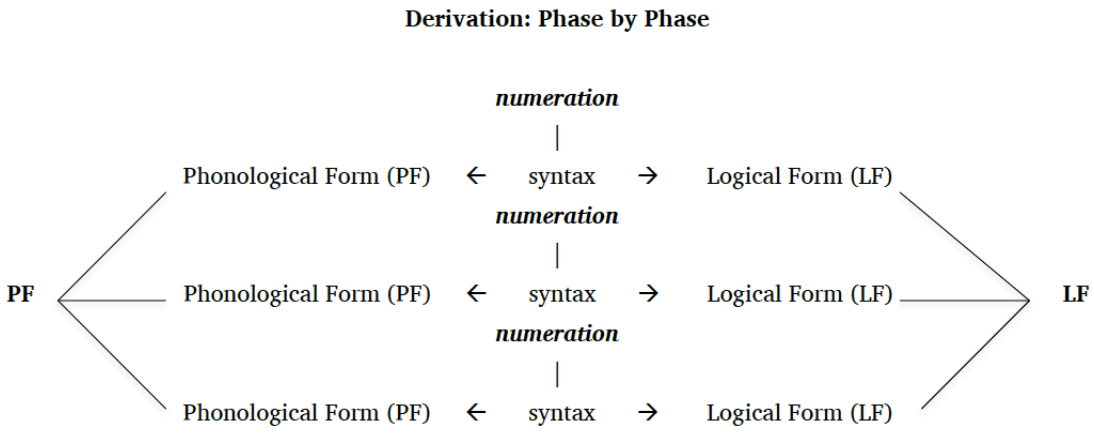


Figure 1: A Phase-based architecture of the grammar

A multi-cycle affix may be merged in either the first cycle in Figure 1, or in a later cycle, depending on the derivation. A difference in timing with regard to merger will lead to a difference in timing of phonological interpretation. It is of primary interest here that this difference in timing may evidence a distinction in the phonological output. This phonological distinction is claimed here to be indicative not only of the fact that the syntactic and phonological cycles, as predicted by phase theory, are isomorphic, but crucially that the operation of spell-out has a visible effect on the items that are interpreted (projection of prosodic structure), and therefore on the operation of subsequent phonological rules. The discussion in §2.1-2.3 offers three examples of this distinction involving different phonological operations; stress, NC cluster repair, and hiatus resolution.

[2] Note that affixes may theoretically also be multi-cyclic in that they may emerge in multiple cycles where none of these cycles are the same cycle in which the root is interpreted. Newell (in prep a, b) proposes that such affixes would not display phonologically divergent behaviour.

2.1 Turkish verbal stress

The discussion here focuses on the stress patterns within the Turkish verb. Turkish stress is canonically word-final (1a) but may, in certain derivational contexts, emerge on a non-final syllable (1b).

(1) a. gördűm
gör-dü-m
see-past-1sg
'I saw

b. gidecéktim
gid-ecek-i-ti-m
go-fut-cop-past-1sg
'I will have gone'

The literature on non-final stress in Turkish includes many accounts that propose an exceptional phonological status for the affixes that follow the non-canonically stressed syllables. (Hulst and van der Weijer 1991, Kabak and Vogel 2001, Inkelas and Orgun 2003). These 'pre-stressing' verbal inflectional affixes are as follows.

(2) a. –Dir epistemic copula
b. –y copular clitic (full form: i)
c. –dA clausal coordinator
d. –(y)ken 'when-adverbial complementizer'[3]

Newell (2008), following the syntactic analysis of Kornfilt (1996), proposes that none of the above affixes are lexically specified to pre-stress. Rather, each of these affixes falls outside of the first phase in a syntactic derivation, and it is this that causes stress to emerge to their left. The first phase of interpretation, following Chomsky (1999) in vP.

(3) $[[\text{root-aspectual affixes}]_{vP}$ copula-tense affixes-agreement$]_{TP}$ complementizer$]_{CP}$

Newell proposes that stress is always regular and final in Turkish, where finality is relativized to the first phonological cycle of interpretation.[4] This negates the need to refer to the particular lexical items in accounting for whether an affix falls within the stress domain or not. In (1b) the morpheme *–DI* 'past' falls outside of the stress domain, while in (1a) it falls inside.[5] In both cases *–DI* is in the same syntactic position. The syntactic structures for (1a) and (1b) are indicated in (4) and (5), respectively. The (a) examples

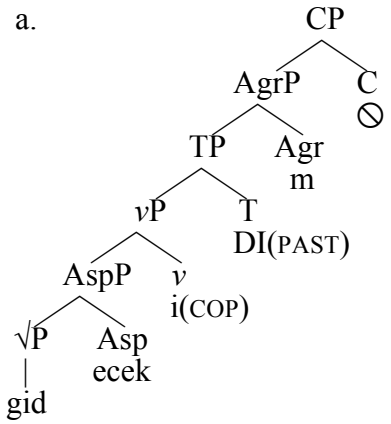
[3] The two other pre-stressing affixes in Turkish, *–mI*, the yes/no question marker, and *–mA,* a negative morpheme will not be discussed here. See Newell (2008) and Yawney (2015) for discussion.

[4] Turkish also has cases of lexical stress. These are not discussed here. See Kabak and Vogel (2001) for an overview.

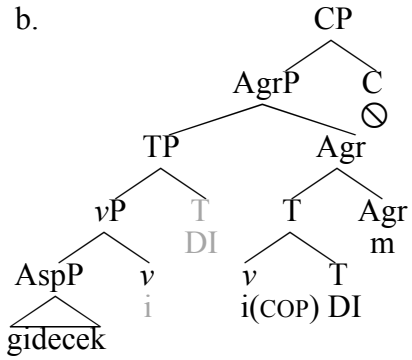
[5] D indicates a coronal stop underspecified for [voice]. I indicates a high vowel underspecified for [back] and [round].

indicate the initial merger sites of each morpheme, the (b) examples their positions after movement.

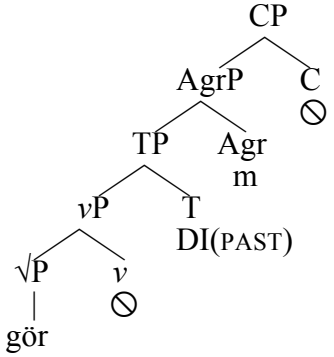
(4) a.



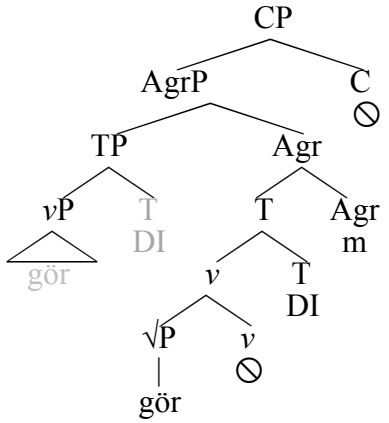
b.



(5) a.



b.



Verbs with aspectual affixes may, in slow, formal speech, be pronounced as two words (6). This is in line with the proposal in Newell (2008) that only the highest verbal element raises in Turkish to host Tense and Agreement; the copula in (4b), and the verb/root in (5b).

(6) gidecék idím

Taking (4-6) into account, and following classic proposals of Phase theory, it is proposed that the phonology of Turkish verbs containing a copula is computed in two cycles. In (4b) the *v*P is sent to Phonological Form (PF) and the aspectual head and everything it c-commands are therefore the input to phonological computation. The stress rule of Turkish applies, and ultimate stress is assigned (7a). At the interpretation of CP in (4b) the copula and its affixes are cliticized to the string in (7a). Phonological rules apply, causing the non-pronunciation of the copular vowel, the agreement of the consonant in the past tense morpheme, and vowel harmony, but stress, having already been assigned to this string, is not reassigned (7b).[6][7]

(7) a. gidecék

b. gidecéktim

In the derivation of (5b), the first phase of interpretation, *v*P, is phonologically empty. Head-movement has removed the verb from the lower domain before PF interpretation.[8] PF interpretation then occurs at CP, and the string undergoes the relevant phonological rules, including main stress assignment.

(8) gördűm

[6] Cliticization is a poorly understood operation, and has different effects cross-linguistically. Here I take it to be whichever operation that causes the two domains in (5b) to be pronounced as an inseparable phonological string.

[7] Whether stress is reassigned in outer cycles in any language is open to debate. Newell (2008) proposes that English main stress, for example, is only assigned once at the end of the construction of a word.

[8] There is a debate in the literature over whether head movement can bleed phonological interpretation. See Matushansky 2006.

It is therefore clear that the inclusion of the past tense morpheme (or any morpheme merged outside of vP, for that matter) in the main stress domain of Turkish is completely unrelated to the lexical (stored, idiomatic) identity of said affix. Phonological rules are insensitive here to lexical items, and any proposal that ties phonological behavior to lexical-group affiliation (like Lexical Phonology, or Stratal OT) is missing an important generalization. The stress rule in Turkish is not sensitive to whether the construction contains 'level 1' (stem) or 'level 2' (word) morphology. It is sensitive only to (i) the syntactic derivation that derives the size of strings that are the input to phonological rules, and (ii) the phonological input to said rules. We do not need two different 'levels' of phonological rules to account for the phonological pattern evidenced. The main stress rule does not *underapply* in the outer domain; a string that contains a main stress bleeds the application of the main stress rule.

Interestingly, the past tense morpheme in Turkish may also have an aspectual, perfective function (Cinque 2001).

(9) [[kal-dí]$_{vP}$-y-sa-niz]$_{CP}$
stay-past-COP-cond(high)-2pl
'If you have stayed'

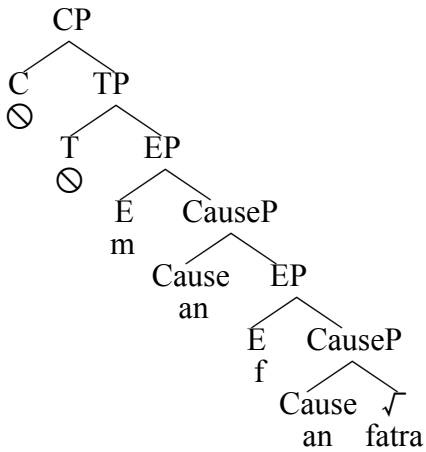
In (9) *-DI* receives main stress, as it falls at the end of the phonological string interpreted at *v*P. Lexical identity and the ability to be part of a string that is a licit input to the main stress rule in Turkish must be completely dissociated.

2.2 Malagasy NC sequences

In Malagasy we see a similar pattern to the one evidenced above in Turkish. Here, the causative morpheme *an-* may be merged low, within the phase that includes the root, or high, in the outer event phrase.

(10) a. ma^{m}pamatra
m-an-f-an-fatra
t.event-cause-event-cause-measure
`to make measure'

b.



(Kilbourn-Ceron et al. to appear, Travis 2000)

As can be seen in comparing (10a) and the position of the causative morphemes in the structure in (10b), there is a correlation between structural position and phonological output. Malagasy repairs any sequence of [nf] in the language, but does so by two distinct means; coalescence, or prenasalization. These distinct repairs track whether the causative morpheme is involved in the construction of a so-called 'lexical causative' or a 'syntactic causative'. These terms correlate with whether the causative morpheme is merged inside or outside the lowest Event Phrase (EP). This distinction is not limited to constructions where both these causative heads are merged. Simple 'lexical' (11) or 'syntactic' (12) causatives evidence the same phonological behaviour.

(11) mamatra
m-an-fatra
event-cause-measure
`y measures x'

(12) ma^{m}pifatra
m-an-f-i-fatra
event-cause-event-intrans.-measure
'z makes x be measured'

In (10b) the label EP can be equated with the label *v*P in (4) and (5) (Svenonius 2005, Travis 2010). Each is the highest projection in the event domain of a particular verbal root. It is therefore the case that EP defines a phase. An [nf] sequence that emerges within a phase will undergo coalescence. This is the case for the 'lexical' causatives (13). In the case of a syntactic causative, the lower domain is interpreted at PF separately from the domain that includes the 'syntactic' causative head (14a). The outer domain is then cliticized to the inner upon interpretation of the next phase (14b). Just as in the Turkish examples, the input to the rule that repairs structures that violate the ban on nasal-consonant sequences in the language at the second phase of interpretation is different from the sequence submitted to the same rule in the first phase. The nature of this difference will be elaborated upon in §5.

(13) [m-an-fatra]$_{EP}$ → mamatra

(14) a. [f-i-fatra]$_{EP}$ → fifatra

b. fifatra + $_{CP}$[m-an- …] → ma^{m}pifatra

Here again we must note the attributing this distinction to a lexical distinction between the form *an-* 'lexical causative' and *an-* 'syntactic causative' would be missing a crucial generalization. There is only one causative morpheme *an-* in the language, and the different phonological repair strategies seen are a result of the different possible syntactic derivations that impact the timing of interpretation of each morpheme. The particular phonological repair strategies effected are, of course, determined in the phonology. Motivations for the pattern seen here will also be discussed in §5.

2.3 Ojibwe

Ojibwe evidences a three-way phonological response to hiatus. VV sequences may be repaired through deletion (15, 16), epenthesis (16, 17), or may remain unresolved (18).

(15) nó:komìs
ni-o:komis
1-grandmother
'my grandmother'

(16) nidákwè:m
ni-akwe:-im
1-woman-possessive
‘my wife’

(17) gadá:gamòsè:
ga-a:gam-ose:-Ø
future-snowshoe-walk-fin
’He will (probably) walk in snowshoes’

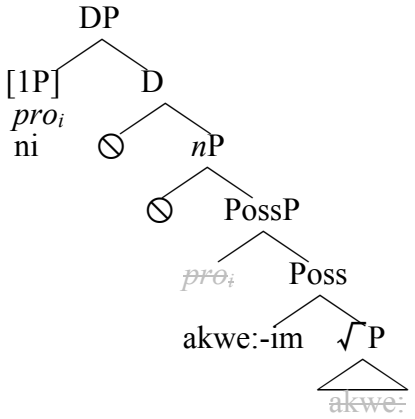
(18) gì:á:gamòsè:
gi:-a:gam-ose:-Ø
past-snowshoe-walk-fin
'he walked in snowshoes’

The analysis of the distinctions between the hiatus resolution strategies, and their relation to the syntactic structure that underpins each derivation is fully elaborated in Newell and Piggott (2014). The discussion here will therefore be brief; remember that the goal of this paper is not to reiterate the analysis of Ojibwe, but rather to add support for the analysis in Newell and Piggott (2014) using the data we just saw in §2.1 and §2.2. I will therefore only discuss here the derivations of (16) and (17), which display both deletion and epenthesis strategies involving an identical morpheme, with a brief mention of the non-resolution strategy seen in (19).

Possessive constructions parallel the verbal derivations we saw in Turkish and Malagasy in that the DP contains (at least) two phases, or cycles of syntax/PF interpretation. This follows naturally from argumentation in the syntactic literature that the structure of DP mirrors the structure of CP (Abney 1987). The structure of (16) is as in (19).[9]

[9] This structure has been simplified to exclude unrealised Agreement phrases and other potential null heads discussed in (Newell and Piggott 2014). Their exclusion does not impact the current discussion.

(19)



Here *n*P and DP, like *v*P and CP, are phases that send their complements to PF interpretation. The root and possessive morpheme will therefore be interpreted in the same phonological cycle (20). Morphemes interpreted in the same phonological cycle always resolve hiatus through epenthesis in Ojibwe.

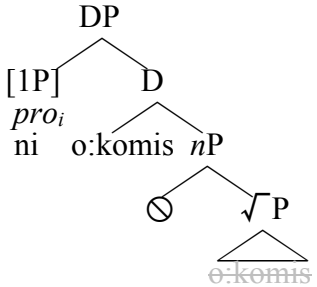
(20) akwe:-im → [akwe:m]

At the edge of the DP phase, the 1P *pro* is interpreted. Morphemes that are interpreted in a separate phase will not induce hiatus resolution (this is what occurs in (18)) unless they are monomoraic. Monomoraic feet are illicit at the left edge of a phonological domain, and therefore *ni-* undergoes Phonological Merger into the domain of the nominal root. Only in these circumstances is hiatus resolved by epenthesis.

(21) [ni[akwe:m]] → [~~ni~~[niakwe:m]] → [~~ni~~[nidakwe:m]]

The derivation of (15), on the other hand, involves all morphemes in the construction being interpreted in the same phase. (15) is an example of an inalienable possession construction. Inalienable nouns are ineffable in Ojibwe without a possessive argument. They also never combine with a PossP. The possessive *pro* is therefore directly merged in Spec,DP. The nominal root raises to D in order to check its unvalued possessor feature.

(22)



In (22) no morphemes are spelled out in the complement of *n*P or DP. The first cycle of interpretation will include the edge of DP (D and Spec,DP). As these morphemes are interpreted in the same cycle, hiatus is resolved through deletion, just as in (20).

(23) ni-o:komis → [no:komis]

Again, we see that the divergent behaviour of a single affix within a language cannot be due to lexical specification. *ni-* is neither a 'level 1' nor a 'level 2' affix. Its syntactic position is also the same in each of the derivations above. The phonological behaviour of the person prefix is determined by the morpho-syntactic derivation within which it is merged.

3. The problem(s) of a parallel phonological computation

It is obvious that a parallel phonological system such as Classic OT cannot account for the patterns seen above in any explanatory way. Consider the case of Malagasy.

An OT account of Malagasy would need to incorporate a constraint that bans the NC sequence. Let us call this constraint *NF. It would also need to incorporate constraints that condition the two resolution strategies; one for coalescence (COAL), and one for prenasalization (PNAS). In addition to this we must include any relevant FAITH constraints (DEP is irrelevant here). Let us consider (10a), repeated here in (24).

(24) ma^{m}pamatra
m-an-f-an-fatra
t.event-cause-event-cause-measure
`to make measure'

In this hypothetical grammar of Malagasy, COAL and PNAS must be ranked higher than FAITH, or we would get no repair at all. As both are repair options in Malagasy, neither can be ranked below FAITH. Both COAL and PNAS must also be ranked below *NF, as [nf] is never faithfully realised on the surface. This gives us two ranking possibilities: *NF>>PNAS>>COAL>>FAITH, and *NF>>COAL>>PNAS>>FAITH.[10] The crux of the matter here is that no raking of these constraints will give the correct output for (24), let alone all examples given in §2.2.

(25)

m-an-f-an-fatra	*NF	COAL	PNAS	FAITH
a. manfanfatra	!**			
b. mamamatra		!**		**
💣 c. ma^{m}pa^{m}patra			**	**
d. ma^{m}pamatra		!*	*	**

In (25) the bomb indicates the selection of the wrong output candidate by the grammar. Were we to re-rank COAL and PNAS with regards to each other another wrong candidate, (25b), would be chosen. There is no way in which a different resolution strategy can be chosen for each [nf] sequence in the input in a strictly parallel model. The usual recourse within parallel OT to morpheme-specific constraints when multiple resolution strategies are evidenced is unworkable here. Both strategies are triggered in the presence of the same morpheme.

[10] A third option would be one where COAL and PNAS are unranked in relation to each other. This might predict optionality in the output, which is also unattested.

Turkish, on the other hand, can be technically accounted for with a parallel ranking. Keeping strictly to a discussion of stress, we can propose a list of pre-stressing morphemes in Turkish. This is the case in many non-OT proposals such as Kabak and Vogel (2001), Inkelas and Orgun (2003), and van der Hulst and van der Weijer (1991). Newell (2008) offers a comprehensive critique of such accounts, as they miss the generalization that the so-called pre-stressing affixes in Turkish share the syntactic distribution discussed in §2.1. The same criticism will be levelled here against a potential parallel OT account. The OT account is really quite simple. There must be one constraint responsible for the standard final stress found in the vast majority of words in the language. Let us call it ULTIMATE. Then we need a constraint that stresses the syllable preceding the list of pre-stressing affixes in the language, such as PRESTRESS_X, where *x* ranges over the appropriate affixes. Ranking PRESTRESS_X over ULTIMATE will therefore give the correct output.

(26)

gid-ecek-i-ti-m	PRESTRESS_X	ULTIMATE
☞a. gid-ecék-i-ti-m		*
b. gid-ecek-i-tí-m	!*	

As mentioned above, this type of 'purely phonological' account of Turkish misses the syntactic generalization discussed in Kornfilt (1996) and Newell (2008). Only an interface account where the derivation of a Turkish verb entails two cycles of phonological interpretation offers an explanatory account of the pattern seen. For a discussion of Ojibwe and OT, the reader is referred to Newell and Piggott (2014).

4. The problem(s) with a cyclic OT account

Here I will argue that a Stratal/Cyclic OT (SOT) account is also unable to adequately account for the patterns in §2. As in §3, the discussion of SOT in relation to Ojibwe can be found in Newell and Piggott (2014). There we showed that it is not possible to account for the three responses to hiatus in the language within an SOT framework. Neither morpheme-specific constraints nor Strata-specific rankings can account for the distinct behaviour of the person prefixes discussed in §2.3, as well as the non-resolution strategy (18).

Malagasy and Turkish pose different problems for Stratal OT that, while not technically insurmountable, are theoretically awkward. More importantly, they miss important generalizations that link the syntactic and phonological derivations in these languages. A cohesive analysis can only be one where the syntactico-phonological parallels are acknowledged and incorporated.

Beginning again with Malagasy, we can envision a system where the output of the first phase is submitted to the ranking seen in (27).

(27)

f-an-fatra	*NF	PNAS	COAL	FAITH
a. fanfatra	!*			
☞b. famatra			*	*
c. fa^{m}patra		!*		*

A second stratum could involve the re-ranking of PNAS and COAL. Given that the output of the first strata contains no [nf] sequence, the correct form will emerge.

(28)

m-an-famatra	*NF	COAL	PNAS	FAITH
a. manfamatra	!*			
b. mamamatra		!*		*
☞c. ma^{m}pamatra			*	*

Although this account can technically capture the pattern in Malagasy, it poses problems. First, as mentioned above, it has no way of linking the shift in resolution strategy to the particular syntactic domains discussed in §2.2. The association of a shift in strata with phases cannot be motivated in this framework. Different rankings in SOT are claimed to be linked to the association of particular affixes with particular strata. The causative morpheme in Malagasy must therefore be a member of both the set of morphemes that trigger first stratum (stem) interpretation, and a member of the set of morphemes that trigger second stratum (word) interpretation.[11] This is proposed in Bermúdez-Otero (2011), where it is stated that "…the attachment of an affix to a stem may produce a stem-level or word-level category depending on the *idiosyncratic affiliation* of the affix…" (italics mine). It is not inconceivable in the system that a single affix might have two idiosyncratic affiliations, but this proposal misses the (cross-linguistic) pattern whereby causative morphemes have multiple attachment sites in the syntax, and that this heterogeneous behaviour is based on strictly non-phonological properties. Stratal association in this type of case offers no new insight into the multi-cycle behaviour of these affixes. The second issue is strictly phonological. There is no restriction in an SOT derivational system that constrains the manner of re-ranking that occurs at each stratum. SOT holds that "Stratal OT does not impose formal limits on the extent to which constraint rankings may differ across levels within the grammar of a single language." (Bermúdez-Otero 2014) This therefore predicts that we could find a language, Malagasy-prime, where prenasalization is the repair strategy effected at the stem level, while coalescence is effected at the word level. It is proposed below in §5 that this is an impossible scenario.

The Turkish data in §2.1 pose similar problems to those evidenced by Malagasy. Consider the problem of stress assignment. Here it is sufficient again in Turkish to have a single ranking, where ULTIMATE is in effect, but is dominated by a constraint that is faithful to stress assignment at a previous stratum. Lets call it STRESSFAITH.

(29)

gid-ecek	STRESSFAITH	ULTIMATE
☞a. gid-ecék		

(30)

gidecék-i-ti-m	STRESSFAITH	ULTIMATE
☞a. gidecék-i-ti-m		*
b. gidecek-i-tí-m	!*	

Here, at the word stratum (30), STRESSFAITH forces the emergence of the stress assigned at the stem stratum (29). This account falls prey to exactly the same criticisms

[11] There is also the issue of determining the domains of 'stem' and 'word' independently of the stratal association of affixes. If stem-status is linked purely to phonological behaviour, the association becomes circular. It is not evident that the lower EP in Malagasy has any independently-motivated stem-like properties. See Bermúdez-Otero (2013) for a discussion of the characteristics of stem vs. word.

put forth above in relation to Malagasy. The stratal distinction is proposed here to be lexical, rather than syntactic, missing the causal relation between the syntactic and phonological derivations. Also, we predict no restrictions on the possible re-ranking of STRESSFAITH and ULTIMATE, where earlier stress assignment would leave no trace at the interpretation of the outer cycle. The claim that this does not occur is discussed in Newell (2008).

In both cases discussed here SOT is capable of offering a licit description of the relevant patterns, but in neither case does the account offer an explanation for that causal link between the morpho-syntactic structures and phonological patterns discussed in §2. I remind the reader that an account of the Ojibwe patterns, on the other hand, is unavailable to SOT. All of this together points toward a syntactic, phase-based account of the phonological patterns herein being the correct explanation.

5. Phonology without strata

The goal of the above discussion has been to illuminate the shortcomings of any account of the phonological patterns in Turkish, Malagasy, or Ojibwe that does not take into account the role of the interface between the syntactic and phonological grammatical modules. Lexical affiliation of particular affixes to particular phonological strata does not admit this crucial link. In an SOT-style account, the phonology receives the output of the syntax, but then must examine the diacritic affiliation of the morphemes it has received in order to submit the string to the correct stratum, or constraint ranking. There is no way to read off of the syntax whether one is looking at a stem stratum-sized or word-stratum-sized domain.[12]

In a Phase-based account of phonological cycles the proposal starts out the same way: the morpho-syntax sends a chunk of structure to PF, and there it undergoes phonological interpretation or computation. Here, there is no necessary notion that the rules (or constraints) that are triggered are particular to a certain sub-class of affixes.[13] This then is a simpler account of the patterns seen, as it does away with unnecessary cases of morpho-phonological marking.

Now, undeniably, phase based cycles do not offer a theory of phonology. Phases are, in fact, completely external to phonology. It is the phonology-proper that interprets the strings sent to it at each instance of spell-out, and it is there that operations such as stress-assignment, coalescence, prenasalization, deletion, and epenthesis occur. I stated above in §4 that the phonological patterns seen in this article could not operate in reverse, where prenasalization occurs on an inner cycle and coalescence on an outer, or where stress is consistently overridden in an outer phase. This is also true for the pattern seen in Ojibwe. Newell and Piggott (2014) argue that there will be no language where hiatus is resolved by epenthesis in an inner cycle, but by deletion in an outer. It is proposed there that this is due to the principle of Prosodic Persistence.

[12] Selkirk (2011)'s Match-Theory rests on the assumption that these distinctions can be read off of the syntax. Selkirk and Lee (2015) admits that the mechanics of how to accomplish this reading have been elusive. It is offered here that the reason for this is that there is no one syntactic structural identity associated with the notions of 'stem' or 'word'.

[13] Constraints are licit tools in a rule-based phonological theory, and predate OT (ex. the OCP, or the No-Line-Crossing constraint).

(31) Prosodic Persistence
Constituents of prosodic categories projected at the interpretation of phase X are preserved at the interpretation of phase X+1.

There it is proposed that deletion occurs as a resolution strategy for hiatus at Vocabulary Insertion in Ojibwe, before any prosodic structure is projected by the vowels in question.[14] When hiatus emerges after the interpretation of two vowels in separate phases, the fact that they have projected syllable and foot structure alters the repair possibilities, leading to the choice of epenthesis over deletion across phonological cycles. Deletion of a vowel at a later stage in the derivation would also entail the deletion of prosodic structure, contra (31). The same is argued above, and in Newell (2008), for Turkish. Stress assignment applies to a string differently depending on whether stress (here main stress) has been previously assigned. The rule is sensitive to the presence of prosodic structure (syllabification, footing) and avoids altering this structure by widening the stress domain. It is argued here that the same is true for Malagasy. Coalescence of the two consonants may occur before the projection of prosodic structure solidifies each segment's position in a syllabic frame. After syllabification, the Root-node/X-slot/syllabic position of each segment must be maintained, leading to prenasalization rather than coalescence. Admittedly the exact mechanics of what counts as the 'preservation' of structure at the second (and third etc.) cycle of interpretation is left vague here. It is also necessarily the case that each grammar must determine the specific destructive vs. preserving phonological operations available to the language. The distinction between first-cycle deletion in Ojibwe and first-cycle coalescence in Malagasy is part of the unpredictable and language-specific nature of phonological computational systems. A more detailed discussion of the phonological responses to multi-cycle affixes and Prosodic Persistence is forthcoming in Newell (in prep a, b). What should be taken away from the discussion herein is that (i) the syntactic derivation is crucial to an understanding of the pattern of cyclic phonological rule application, and (ii) that Prosodic Persistence restricts the type of resolution strategy for any phonological repair effected both within and across phonological cycles.

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[14] We assume a realizational theory of morphology, where phonologically-endowed lexical items are inserted into a structure only at spell-out.

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