# On the domains of allomorphy, allosemy and morphophonology in compounds

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**Abstract**

In this paper I review the locality domains of contextual allomorphy, contextual allosemy and morphophonology with a special emphasis on compounds. I show that when the applications of these processes within compounds are compared, we observe a distinction between the domain of contextual allomorphy and contextual allosemy, on one hand, and morphophonology on the other. I argue that the mismatches in the domains in question lie in the timing of the operations where operations applying prior to vocabulary insertion are constrained by cycles/phases, whereas operations applying after vocabulary insertion are constrained by the timing of concatenation. Under such approach, all of these processes will make reference to the same morphosyntactic structure although their domains will be marked by different points in that same structure.

## 1 Introduction

Contextual allomorphy, contextual allosemy, and morphophonology have typically been assumed to be subject to the same locality restrictions, i.e., a cyclic domain with some possibilities of extension (see, e.g., Embick 2010, Moskal 2015), and with good reason as the locality domains of the various phenomena often appear to line up. Different proposals have been made with respect to the size of the domain in question, however, the focus of these studies has typically been on single-stem words and compound words are not taken into account. When the effects of these processes in compounds are considered, a different picture emerges: i) contextual allomorphy/allosemy appears to apply between the two elements in a compound where morphophonological and phonological processes cannot, and ii) morphophonolgy can apply in a context where contextual allomorphy/allosemy is not expected to apply under widely assumed locality restrictions.[1]

[1]Note that in what follows I refer to both morphophonological processes and phonological processes sensitive to morphosyntactic structure as morphophonology. Although these two types of processes show

In what follows I discuss three proposals regarding domains, Embick (2010), Bobaljik (2012), and Moskal (2015a), and contrast the different predictions these proposals make for contextual allomorphy/allosemy and morphophonology in single-stem words and compounds. I argue that, although any of these proposals may make correct predictions in certain cases, none of them capture the asymmetry between the domains of contextual allomorphy/allosemy and morphophonology, specifically the layering of processes that occurs in compounds. In section 2 I provide an overview of the three proposals and discuss the predictions they make with respect to compounds, following the compound structure argued for by Harðarson (2016, 2017). In section 3 I discuss cases of contextual allomorphy and allosemy in compounds and compare these cases with the predictions made by the three proposals. I argue that the application of these processes in compounds indicate that the elements of the compound (or at least parts thereof) must be contained within the same spell-out domain (to be further defined). In section 4 I compare cases of morphophonology in single-stem words with compounds and argue that given the data discussed in section 4, the proposals under discussion make erroneous predictions in compounds under the assumption that contextual allomorphy and morphophonology are subject to the same type of locality restrictions. I outline an approach, building on, e.g., Kaisse (1985), Noyer (1998), Bobaljik (2000) and Pak (2008) in which the layering of operations is achieved through referencing selection during spell-out. Finally in section 5, I summarize this paper and outline directions for future research.

# 2 Domains

All three proposals under discussion agree that cyclic nodes/phase heads tigger spell-out of their complement, i.e., the transformation of the morphosyntactic structure to a phonological string, although they differ in terms of which parts of the structure are visible at the point of spell-out. These heads include at least category-defining heads. This is schematized in (1) below with respect to what is accessible for the root.

Bobaljik (2012) provides (arguably) the most restrictive version of the three domains, in which $n$ triggers spell-out of the root and only $n$ is visible for the purposes of contextual allomorphy. The trigger itself, $n$, can, however, interact with above material as long as they are structurally adjacent. This domain can however be suspended, i.e., spell-out can be delayed, if $n$ is dependent on a higher node for its interpretation, i.e., determination of meaning or phonological form (see, e.g., Bobaljik and Wurmbrand 2013). This can be seen in root suppletion of adjectives, where the superlative suffix can only condition root suppletion if the comparative also triggers root suppletion, as in the Latin example *bonus – melior – optimus* 'good – better – best' (Bobaljik 2012).

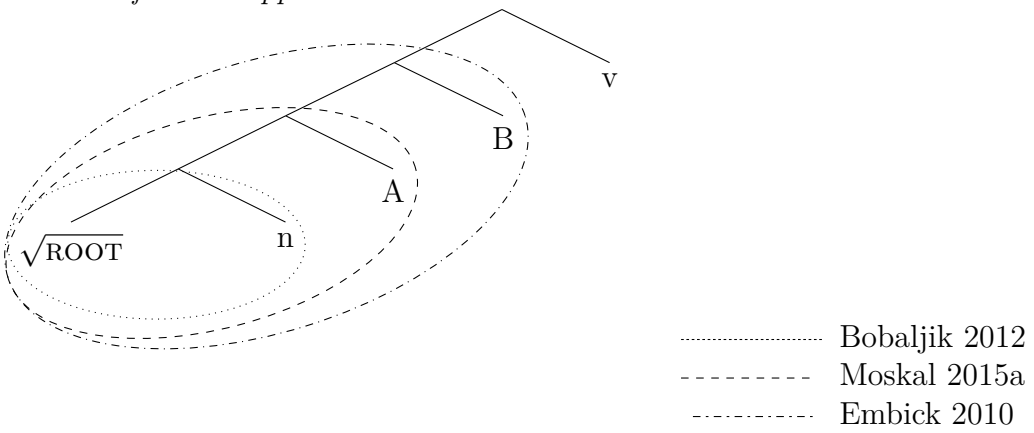
Moskal (2015a) offers a similar approach, where $n$ cyclic heads trigger spell-out of their complement. For the purposes of contextual allomorphy, both $n$ and the first non-cyclic node dominating $n$, i.e., A in (1). Under Moskal's algorithm, the domain can be suspended just in case the next node up is a cyclic node as well. However, if it is not cyclic, as in (1),

some divergent behaviours (see, e.g., Embick 2010, Embick and Shwayder 2018), in terms of the domains under discussion here, both group together in contrast to contextual allomorphy/allosemy.

spell-out of the complement of the cyclic node, $n$, is triggered. Moskal rejects the adjacency requirement (see also Moskal and Smith 2015, Smith et al. 2018).

Embick (2010) argued that spell-out of the complement of $n$ is triggered by a second cyclic node, $v$ in (1). At that point, everything up to, but excluding $v$ is accessible to the root as context for contextual allomorphy as long as no overt material linearly intervenes.

(1) *Domains of Root Suppletion*




In case of spelling out of other nodes in the structure the three proposals differ as well. First for Bobaljik, only the root and A can serve as context for $n$ under the adjacency requirement. Without the adjacenecy requirement, the range of heads serving as potential contexts could reach $v$. For Embick, the context for $n$ would be limited to the root and the next linearly adjacent overt morpheme to the right up to the next cyclic head above $v$. For Moskal, the domain could extend to the first node beyond $v$.

When it comes to compound structure, consider the structure in (2) below, based on Harðarson (2016, 2017). There are (at least) two possible starting points. On one hand, the non-head elements could be late-adjoined fully spelled out material (cf. Piggott and Travis 2013). In this case we would not expect contextual allomorphy to apply at all. On the other hand the non-head elements might not be spelled out prior to merging with the head of the compound and at least parts of the compound undergoing spell-out simultaneously.[2]

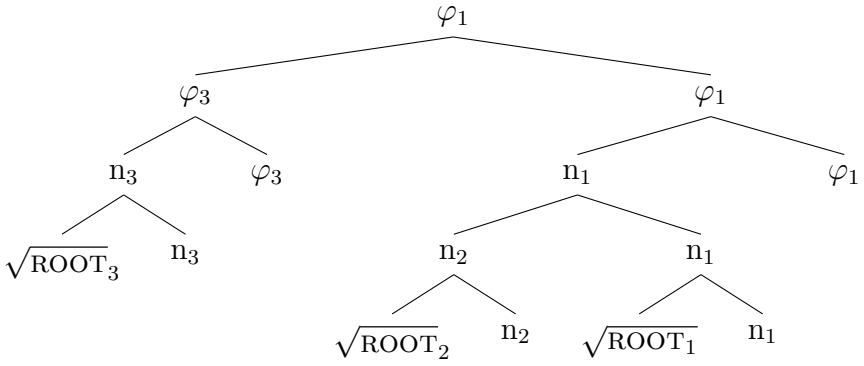
Assuming the latter of the two options, a number of questions arises. Can a head see into the structure of the projection c-commanding it, and, if so, how far? Or is it rather the case that the head can only see the projection c-commanding it? If the head can only see the projection c-commanding it, we would expect contextual allomorphy conditioned by the compound structure itself, rather than by the identity of a particular head in the structure. If it is the case that a head can see into the projection c-commanding it, we would expect that contextual allomorphy can be conditioned by the identity of a head within that structure. As we will see in section 3, both possibilities appear to be borne out.

Consider the structure in (2) below showing an abstract representation of a three-part compound. The structure contains modifiers of different sizes, one being a categorized stem,

[2]Here I use the term *head* referring to the *locus inflectionis* and/or semantic head, i.e., the element that typically determines the category and class of the compound as a whole, which is modified by the non-head elements regardless of linear order, roughly corresponding to the semantic head (the extended projection of $\sqrt{\text{ROOT}_1}$ in (2)).

the extended projection of $\sqrt{\text{ROOT}}_2$, and one being an inflected element, the extended projection of $\sqrt{\text{ROOT}}_3$. The node $\varphi$ stands for whatever structure is necessary for the realization of inflection (see discussion in Harðarson 2016, 2017). I will come back to the possibility of compounding at the root level and the consequences of the presence/absence of category nodes will be addressed below.

(2) Compound structure (Harðarson 2016, 2017)




Under the structure in (2), the three proposals make different predictions with respect to possible interactions between the elements of the compound. Starting with Bobaljik (2012), we can expect contextual allomorphy conditioned by the compound structure, where $\varphi_3$ has access to the projection of $\varphi_1$ c-commanding it. Likewise, $n_2$ has access to the the projection of $n_1$ c-commanding it, and $n_1$ has access to the top projection of $n_2$. However, relaxing the structural adjacency condition, we might expect the identity of the heads themselves serving as contexts as well as granting $n_3$ access to the aforementioned heads.

Under Embick (2010), $n_2$ is dominated by a projection of $n_1$, which is a cyclic node, hence predicting that $\sqrt{\text{ROOT}}_2$ cannot be sensitive to elements beyond $n_2$. With respect to the other two elements, there are no cyclic nodes dominating the initial $n$s, which opens up the possibility for interactions such as contextual allomorphy of $\varphi_3$ triggered by (the phonological form of) $\sqrt{\text{ROOT}}_2$, and contextual allomophy of $n_2$ triggered by $\sqrt{\text{ROOT}}_1$ and vice versa, or even $\sqrt{\text{ROOT}}_2$ triggering contextual allomorphy of $\sqrt{\text{ROOT}}_1$. Crucially we would not expect contextual allomorphy conditioned by the compound structure in general, only the identity of particular heads would serve as context. This could be remedied by removing the linear adjacency condition or replacing it with structural adjacency, opening up the possibility of non-terminal nodes serving as context for contextual allomorphy. No adjacency under Embick's domain would allow for any node to serve as context for any other, aside from maybe $\sqrt{\text{ROOT}}_2$, whereas structural adjacency would only allow for the compound specific interactions described above and exclude the interactions predicted under linear adjacency.

Under Moskal (2015), as $\varphi$ in (2) is a non-cyclic functional head, two domains are constructed with respect to the roots: i) one containing $\sqrt{\text{ROOT}}_3$, $n_3$ and $\varphi_3$, and ii) one containing the remaining nodes. In the case of ii), any head in the structure could in principle serve as context for contextual allomorphy for $\sqrt{\text{ROOT}}_2$ and $\sqrt{\text{ROOT}}_1$. The situation is less clear with respect to the functional heads, as there is no cyclic head dominating any of the $n$s, none of them form separate accessibility domains and hence any node could in principle serve as context for any head.

As can be seen, the three approaches vary with respect to the possible interaction between elements within the compound structure. Under the assumption that morphophonology is subject to the same (or similar) locality constraints as contextual allomorphy (Piggott and Newell 2007, Embick 2010, 2014, Piggott and Travis 2013, Moskal 2015a, Shwayder 2015 i.a.), we expect the same range of possibilities, regardless of how individual proposals fare. As we see in the following sections, that is not the case.

# 3 Selection of form and meaning

In this section I examine the interaction of elements in terms of both contectual allomorphy and contextual allosemy within compounds. The processes in question can both be conditioned by the compound structure in general and also be sensitive to particular elements making up the compound. In order for this to be possible, however, compounding must take place prior to vocabulary insertion and, furthermore, requires the elements of the compound to be (partially) accessible to each other. This hence runs counter to proposals that rely on late adjunction where the modifiers are spelled out prior to merging with the head (see, e.g., Piggott and Travis 2013, building on Nunes and Uriagereka 2000). Under such an approach contextual allomorphy is predicted to be impossible. Note that the interactions oberved appear to be highly local in nature, and they do appear to be (for the most part) compatible with a version of the three proposals under discussion.

## 3.1 Contextual allomorphy

The compound structure can serve as context for suppletive allomorphy, i.e., morphemes can be sensitive to whether they are contained within a compound or not. This can be observed in Romance V-N compounds, exemplified here by French, (3), where a nominalizing suffix *-eur* is obligatory overt in a phrasal configuration, (3a), but obligatorily null in a compound, (3b) (see, e.g., Scalise et al. 2009).[3] Note that from here on out I will use # to mark the boundaries between elements in a compound.

(3) French (adapted from Snyder 2016:95–96)

a. lav- **eur**/*∅ de vaiselle
wash- n of dishware
'washer of dishes'

b. lave- ∅/***eur**# vaiselle
wash- n# dishware
'dishwasher'

The question arises at this point, however, whether there is a null $n$ in 3b or if this is a compounding of two roots. The presence of the diminutive suffix *-elle* on the non-head indicates that *vaiselle* is a categorized stem, which, following recent work on compounding, indicates that this is a compounding of two categorized roots (Harðarson 2016, 2017, De Belder 2017, Fenger and Harðarson 2018). As this appears to be a general property of V-N compounds, this indicates that the allomorphy observed is not a matter of individual items serving as a

[3]Note that this is a left-headed compound (cf. Beard 1995), i.e. *lave-* corresponds to $\sqrt{\text{ROOT}}_1$ in (2), and *vais-* corresponds to $\sqrt{\text{ROOT}}_2$. It should also be noted that under the assumption that these are stem compounds, the inflectional node $\varphi$ will dominate the entire compound. It is linearized with respect to the whole compound stem and can hence follow the non-head, instead of intervening between the two.

context for contextual allomorphy, but a general strutural environment, i.e., the presence of a second extended projection in the complex head.

A similar pattern is observed in certain compounds in Slavic, represented here by Bosnian. In Bosnian nominalizations require an overt nominalizing suffix outside of compounds, (4b). Corresponding ∅-nominalizations are not grammatical, (4b). When these nominalizations serve as heads of a compound structure, however, the nominalizing head becomes obligatory null, (4c).[4]

(4) Bosnian (Aida Talić, p.c.)

a. hod- a- ti
walk- v- INF
'to walk'

b. hod- **anje**/*∅
walk- n
'walking'

c. mimi- o# hod- **∅**/***anje**
by/past- L# walk- n
'passing by'

As in Romance, this pattern appears not to be triggered by a particular item in the structure as it occurs with various different non-head elements, (5). But rather it is triggered by the presence of a second extended projection in the structure. Note, however, that the crucial difference between the Romance and Slavic patterns is that in Slavic, the non-head element and the nominalizer in question are not linearly adjacent.

(5) Bosnian (Aida Talić, p.c.)

a. žder- **onja**/*∅
devour- n
'devourer'

b. vođ- **enje**/*∅
lead- n
'leading'

c. ljud- o# žder- **∅**/***onja**
people- L# devour- n
'man eater'

d. dalek- o# vod- **∅**/***enje**
far- L# lead- n
'powerline'

What this indicates is that, in these cases, contextual allomorphy is not conditioned by the identity of particular items within the locality domain, but that it must be able to reference the structure itself, presumably via referencing non-terminal nodes.

It is worth noting that, although further research is required, the presence of the linking morpheme/vowel can be taken to indicate that the non-head elements are categorized stems, as the *-o-* linker appears to be associated with nouns and adjectives and the *-i-*, (6) linker appears to be associated with verbs (see, e.g., Alexander 2006:338–339).[5]

(6) Bosnian (adapted from Alexander 2006:338)

a. kaz -a -ti
say -v -INF
'to say'

b. kaš -i# prst
say -L# finger
'index finger'

Hence it it not only the case that the presence of a non-head element can condition allomorphy on the head of the compound, but, as can be seen from Bosnian, it is even possible for the presence of a non-head element in the compound structure to condition a null allomorph

[4]I set aside the issue of the precise nature of the vowel *-a* occuring between the verb and the infinitival affix. The vowel could be considered a theme vowel (cf. Alexander 2006:331–332) or a realization of *v*. It does not necessarily correspond to the first vowel of the nominalizing suffix, cf. *(pro-)žder*-**a**-*ti and* žder-**o**nja.

[5]Thanks to an anonymous reviewer for pointing this out.

of the nominalizer despite not being linearly adjacent to the nominalizer. This indicates that linear adjacency is not a necessary factor in conditioning allomorphy (see, e.g., Moskal 2015b, Moskal and Smith 2015, Smith et al. 2018). Hence these interactions are predicted to be possible under Moskal's and Bobaljik's proposals, but not under Embick's, as it precludes any reference to non-terminal nodes. Here, *vod-* in (5d) corresponds to $\sqrt{\text{ROOT}}_1$ in (2), and *dalek-* corresponds to $\sqrt{\text{ROOT}}_2$.

There are also instances of the head of the compound conditioning the form of the non-head elements. This can be observed in Dutch, where linking morphemes occur exclusively with nominal stems and their selection is typically determined by the non-head element (Krott et al. 2001, 2002, De Belder 2017). There are, however, cases where the choice of a linking morpheme is determined by the head of the compound.

(7) Dutch (Krott et al. 2007:28)

| a. schaap-**en**#tong | b. schaap-**s**#kooi | c. schaap#herder |
|---|---|---|
| sheep-L#tongue | sheep-L#fold | sheep#herder |
| 'sheep's tongue' | 'sheep fold' | 'shepherd' |

Unlike the Romance and Slavic patterns above, the alternations in (7) are not conditioned by the compound structure itself, but by the identity of the roots in question. Following, e.g., De Belder (2013) and Fenger and Harðarson (2018), I assume the linking morpheme is a realization of features of $n$ of the non-head (*schaap-* in 7, corresponding to $\sqrt{\text{ROOT}}_2$ and $n_2$ in (2)), sensitivity to the identity of the non-head element is to be expected. The examples in 7 further indicate that the linker is also sensitive to the root of the head of the compound ($\sqrt{\text{ROOT}}_1$ in 2). This is not expected under Bobaljik (2012), whereas under Embick (2010), as $n_2$ and $\sqrt{\text{ROOT}}_1$ are linerarly adjacent but not structurally. Moskal's (2015a) adjacency-free approach can account for this interaction as well.[6]

A similar interaction occurs in Icelandic. Icelandic allows non-head elements in compounds containing additional material outside of $n$, i.e., case and number (corresponding to $\varphi$ in (2)). As argued in Harðarson (2016) inflected non-head elements are structurally peripheral to uninflected non-heads (see (2)). However, a subset of nouns denoting inalterable attributes cannot appear with an overt genitive marker in compounds despite appearing structurally peripheral to inflected modifiers.[7]

(8) Icelandic (Harðarson 2017:56)

| a. **hör-*s/∅**#[vas-a#klútur] | b. **tré-*s/∅**#[penn-a#standur] |
|---|---|
| flax-GEN.SG#pocket-GEN#cloth | tree-GEN.SG#pen-GEN#stand |
| 'linen handkerchief' | 'wooden pen stand' |

The crucial clue comes from the stem *tré-* 'tree' which alternates with the form *trjá-* in different morphological contexts. The form *trjá-* surfaces in dative and genitive plural, *trjá-m* and *trjá-a*. The form *tré-* is observed elsewhere (incl. genitive singular). *Tré* is also

[6]Note that Fenger and Harðarson (2018) do not analyze the interaction in Dutch as contextual allomorphy but as manipulation of the feature content on $n$. However, the point made by the discussion here remains the same: in order for this type of interaction to take place the non-head element cannnot have been spelled-out prior to its merger with the head of the compound, and both elements must be contained within the same cyclic domain.

[7]The compounds in (8) are, in principle, ambiguous between left and right branching structures.

ambiguous between count and mass interpretation in the singular. Both forms appear in compounds, as is shown in (9) below, however, the mass interpretation is only available with the *tré-* form.

(9) Icelandic (Harðarson 2018:95)

a. tré#froskur
tree#frog
'wooden frog/tree frog'

b. trjá#froskur
tree#frog
'tree frog'

When the form *tré-* in (8b) is replaced with the form *trjá-*, as in (10), the right branching structure becomes impossible and the mass reading is lost.

(10) Icelandic

a. * [trjá#[penn-a#standur]]
tree#pen-GEN#stand
'wooden stand for pens'

b. [[trjá#penn-a]#standur]
tree#pen-GEN#stand
'stand for tree (shaped) pens'

Hence, given that the availability of mass interpretation goes hand in hand with the form of the stem, whatever is resposible for this interpretation must at least be present in case of the form *tré-*. Following Cowper and Hall (2014), a.o., in that number and mass interpretation is a result of an interplay of the same set of features, this indicates the presence of the relevant features and hence the required structure for number/mass interpretation. As number and case are expressed by a single exponent in Icelandic, this, in turn, indicates the presence of case in *tré-* in (8). *Tré* hence corresponds to the extended projection of $\sqrt{\text{ROOT}}_3$ in (2).

Turning back to the proposals under consideration, as the contextual allomorphy in question is sensitive to the compound structure, and not the identity of the subsequent root, this is not expected under Embick (2010). Under Bobaljik (2012), we might expect this kind of interaction but no more. Moskal (2015a) also predicts that this interaction would be possible, although it does not rule out sensitivity to the identity of heads other than $\sqrt{\text{ROOT}}_1$ and $\sqrt{\text{ROOT}}_2$ in (2).

To summarize, the three approaches under discussion can account for different parts of the data under discussion, where Bobaljik (2012) and Moskal (2015a) can account for sensitivity to the compound structure, as in Bosnian and Icelandic. Embick (2010) and Moskal (2015a) can account for sensitivity to the identity of particular heads in the structure, as in Dutch above, with different restrictions, where Embick predicts this sort of interaction only to be possible under linear adjacency but Moskal's approach is more permissive. Further research is needed to determine whether all interactions predicted to be possible by Moskal's approach are attested.

## 3.2 Contextual allosemy

In addition to the selection of VIs at PF, Marantz (2013) and Wood (2015), i.a., have argued that an analogous choice of meaning occurs at LF, which is constrained by the same locality domains as contextual allomorphy. Marantz (2013) discusses, e.g., the case of the root *globe*, which has two possible meanings, i.e., 'the world' or 'spherical object'. This ambiguity is lost when an adjective is formed of the root, leaving only the 'world' meaning. The ambiguity is

then non-retrievable in all subsequent derivations. Marantz (2013:115, n7) mentions that for some speakers, the ambiguity is maintained in the presence of *-al*, however, these speakers lose the ambiguity in the context of *-ize* and any subsequent derivations.

(11) a. globe 'the world'/'spherical object'
b. glob-al 'pertaining to the world'/%'spherical'
c. glob-al-ize 'make worldwide'/*'make something spherical'

By further examining the root *globe*, we observe the similar limitations to the choice of meaning in different compounds as observed in derivational context in (11), i.e., that the choice of meaning appears to be conditioned by the head of the compound, (12).[8]

(12) a. globe#trotter
'world traveller'
b. globe#smasher
'smasher of spherical objects'

Following Marantz (2013) in assuming that the domain of contextual allosemy is the same as the domain of contextual allomorphy, we can examine the predictions made under the three proposals in this respect. Similar to the Dutch data in the previous subsection, the choice of meaning is sensitive to the identity of the root of the head. However, in this case, the affected element is the root of the non-head element and not the nominalizer (corresponding to $\sqrt{\text{ROOT}}_2$ in (2)). Under Moskal's adjacency-free domain, this interaction is expected as the two roots ($\sqrt{\text{ROOT}}_1$ and $\sqrt{\text{ROOT}}_2$ in (2)) will be contained within the same domain. The sensitivity to the identity of $\sqrt{\text{ROOT}}_1$ is not expected under Bobaljik's domain. Embick's locality domain is less straight-forwardly evaluated as he assumes linear adjacency at PF, which is not relevant at LF. Replacing linear adjacency with Marantz's (2013) semantic adjacency (roughly similar to structural adjacency) would rule out this interaction, however, assuming no adjacency at LF would allow for this interaction under Embick's locality domain.[9]

Potential cases of allosemy triggered by the compound structure can also be found, such as the following examples from Icelandic. In (13) the stem *eitur* receives the meaning 'poison/venom' outside of compounds, 13a, whereas in certain adjectival compounds it serves as an intensifier, (13b–13c).

[8]A reviewer points out that this may be a matter of the head creating bias towards one interpretation rather than this being technically a case of contextual allosemy, as the alternative meanings may be available given the proper context, such as a room full of globes with a person trotting all over them. However, even if that were the case, the point remains the same. Under the typical adjunction analysis, the senisitivity to the identity of the head of the compound is not predicted to be possible as the non-head elements would have undergone spell-out and its meaning and phonological form would be fixed at the point of adjunction (cf. Nunes and Uriagereka 2000, Piggott and Travis 2013). In order for any kind of semantic or phonological interaction to be possible, the non-head cannot have undergone spell-out prior to merging with the head of the compound.

[9]It is worth noting, considering that for some speakers the meaning of *globe* is not fixed at the first categorial node, (11b), but is fixed at the second one, (11c), Moskal's (2015) approach may have some advantages over the alternatives. Under both Embick (2010) and Bobaljik (2012) the second category node would be excluded from the domain of contextual allosemy of the root, even under domain suspension (cf. Bobaljik and Wurmbrand 2013) whereas Moskal's proposal might include the second category node, as long as no morpheme intervenes (Moskal remains agnostic in the case of two category nodes of different types).

(13) Icelandic

| a. | b. | c. |
|---|---|---|
| eitur#slanga | eitur#hress | eitur#fljótur |
| poison#snake | poison#chipper | poison#quick |
| 'venomous snake' | 'very chipper' | 'very fast' |

The structural relationships between the elements in these compounds are analogous to the extended projections of $\sqrt{\text{ROOT}}_1$ and $\sqrt{\text{ROOT}}_2$. This indicates that $\sqrt{\text{ROOT}}_2$ is sensitive to the category of the element that the $n$ dominating it attaches to. This is not expected under Bobaljik's domain, but predicted to be possible under Moskal's domain. As was the case with (12) above, the question of whether Embick's locality constraints account for these interactions depends on whether adjacency is expected to hold at LF as well.

A potential counterargument might be that the compounds in (13b–13c) are in fact root-root compounds and as such a greater degree of interaction is to be expected (cf. Moskal 2015a, De Belder 2017). However, if that were the case, it would be expected to be reflected on the phonological side as well. As discussed in Harðarson (2016,2017), candidates for root-root compounding in Icelandic are exceedingly rare and can be identified by the application of (morpho-)phonological processes normally applied between stems and affixes (see Indriðason 1994:63,73 for examples). This sort of interaction is not observed in compounds such as those under discussion. For instance, when *eitur-* is followed by a vowel-intial suffix, the suffix triggers vowel deletion, (14a). This is not observed in compounds, (14b), indicating that the non-head elements in question are categorized stems and not bare roots.

(14) Icelandic

| a. | b. |
|---|---|
| **eitr-** að- | * **eitr#** erfið- |
| poison- a° | poison# difficult |
| 'poisonous/venomous' | Int. 'very difficult' |

Furthermore, although the intensification meaning is observed in compounding with adjectival stems, this meaning is not observed in all adjectival contexts. This is shown in (14a), where an adjective derived from *eitur* retains its meaning.[10] This means that Grammar must make a distinction between derivation and compounding for these processes. Hence, this has consequences for work in which the line between processes of compounding and derivation has been blurred, such as Lowenstamm (2010) and Creemers et al. (2018) where (certain) derivational affixes have been argued to be roots rather than affixes. Although there are cases that could be compatible (such as potential root–root compounds), it does run the risk of losing this generalization if assumed to apply across the board, as in Lowenstamm (2010).

To summarize this section, we have seen that contextual allomorphy/allosemy, at both PF and LF, is possible between elements in a compound. These interactions appear to be of two types: on one hand these appear to be the result of sensitivity to the compound structure itself, which can be interpreted as sensitivity to non-terminal nodes in the compound structure. On the other hand we also observe cases of sensitivity to the identity to

[10]Note also that this does open up the possibility for $\sqrt{\text{ROOT}_2}$ in (2) to be sensitive to elements beyond $n_2$ under Embick's locality domain, which is the projection of $n_1$ may not trigger spell-out of the complement of $n_2$.

the terminal nodes themselves, roots in particular. When three competing proposals for locality constraints on contextual allomorphy were compared with respect to their predictions and had varying success with accounting for the data. Overall, Moskal's proposal seems to account for the data observed, however not all interactions predicted to be possible by her domain have been observed so far.

# 4 Morphophonology

In this section, I discuss the (morpho-)phonological interactions between morphemes within the complex head. These are of two types. On one hand there are processes that only apply between elements within the same extended projection and seem to ignore locality restrictions of the type discussed above and do not apply between elements in compounds, exemplified by umlaut in Icelandic. This runs contrary to expectations if such processes are subject to the same locality restrictions as contextual allomorphy. On the other hand there are processes that apply specifically in compounds, indicating a layering of phonology (cf. Monahan 1982, Kiparsky 1982b).

Under Embick (2010:97ff), the locality of phonological processes differs depending on whether the trigger is phonological or morphological and whether the target is identified phonologically or by its morphological identity (see also Embick 2013, Embick and Shwayder 2018). When a process is triggered by morphosyntactic features and the target is morphologically identified, the process will not apply consistenly in every context and is constrained by the spell-out domain. If the target is phonologically identified, only linear adjacency matters and the application of the process is consistent within the proper environment and may apply beyond phase boundaries. Umlaut in Icelandic, however, appears to counter this claim.

There are two varieties of umlaut in Icelandic referring to different types of vowel alternations. We will first consider the i-umlaut, which refers to the vowel alternations shown in (15).[11]

(15) Vowel alternation in i-umlaut (adapted from Árnason 2011:240)

| | | |
|---|---|---|
| /a/, /ɔ/, /œ/ | → | /ɛ/ |
| /au/, /ou/ | → | /ai/ |
| /ʏ/, /ɔ/ | → | /ɪ/ |
| /u/, /ju/, /jou/ | → | /i/ |
| /œy/ | → | /ei/ |

This alternation applies in a variety of environments, both inflectional and derivational. This process does not apply consistently across every environment, where an undergoer in one environment does not undergo i-umlaut in every environment. Compare the dative singular forms in (16a–16b), where /artn/- 'eagle' undergoes umlaut but /hus/- 'house' does not. Note also that the i-umlaut is not phonologically triggered, as the dative singular suffixes

[11]For a more detailed discussion on the precise properties involved and diachronic perspectives see, e.g., Anderson (1969:55), Árnason (2011:240ff) and many, many others.

are homophonous for both stems, and they are also homophonous to the derivational suffix -/ɪ/, which does trigger umlaut on /hus/-.[12]

(16) Sample of context for i-umlaut

a. /hus/- ∅ ∼ /hus/- /ɪ/ ∼ /his/- /ɪ/
house -NOM.SG house -DAT.SG house -n
'house' 'house' 'a small house'

b. /artn/- /ar/ ∼ /ɛrtn/- /ɪ/ ∼ /ɛrtn/- /ɪ/- /r/
eagle -GEN.SG eagle -DAT.SG eagle -n NOM.SG
'eagle' 'eagle' 'eagle (name)'

Hence, following Embick (2010:97ff), the i-umlaut fulfills the criteria of readjustment rules and should i) be subject to the same cyclic domain restriction as contextual allomorphy, but ii) not be subject to linear adjacency. Of these two predictions, ii) is borne out, as we'll see below, but i) is not (see also Harðarson op. cit.). Consider the case of -/ʏɣ/ suffix, which forms adjectives from nouns. A subset of -/ʏɣ/ adjectives can be further nominalized using the -/ɪ/ nominalizer as is the case with /maul/- 'speech' in the triplet in (17). In (17c), the -/ɪ/ nominalizer conditions the /k/ form of the adjectivizer and also triggers i-umlaut on the root, across the adjectivizer.[13] The structure for (17c) is shown in (18) where the predicted domain of the root is enclosed by the dotted line.[14]

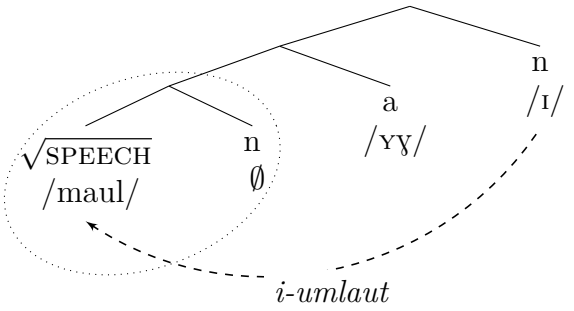
(17)

a. /maul/- ∅-
speech- n-
'speech'

b. /maul/- ∅- /ʏɣ/-
speech- n- a
'talkative'

c. /mail/- ∅- /k/- /ɪ/-
speech- n- a- n
'talkativeness'

(18)




[12]Derivations using the affix -/ɪ/ are also very commonly used in compounds referring to a subcategory of the head of the compound, such as *skrauthýsi* 'well decorated house/palace' (lit. 'decoration house').

[13]The /ʏɣ/∼/k/ alternation can also be observed outside nominalizations, as in the synonymous minimal pair: /soulœyðʏɣʏr/∼/soulœyðkʏr/, meaning 'sunny' (lit. 'sun rich').

[14]A reasonable question might be whether the sequence -/kɪ/ is really a realization of the two morphemes -/ʏɣ/ and -/ɪ/ and not a single morpheme, the nominalizer -/kɪ/. It is true that it is not the case that for every -/ʏɣ/ adjective there is a corresponding -/kɪ/ nominalization; however, it is the case that for every -/kɪ/ nominalization there is an -/ʏɣ/ or /k/ adjective. Furthermore, this split seems to correlate with subtle differences in meaning of the adjectivizer, where the -/kɪ/ nominalizations derived from -/ʏɣ/ adjectives seem to denote internal attributes, such as /kœvʏɣ/- 'noble' and /fjœrʏɣ/- 'spirited', and others seem to denote external attributes /drʏtlʏɣ/- 'dirty' (lit. muddy) or /k$^{h}$aumʏɣ/- 'smudgy'. The -/k/- form also occurs in verbalizations, such as /œð/-/ʏɣ/- 'rich' and /œð/-/k/-/a/ 'enrich'. Hence assuming a distinct nominalizer -/kɪ/ misses the connection between -/ʏɣ/ adjectives and the -/kɪ/ nominalizations and -/ka/- verbalization.

Under the domains proposed by Bobaljik and Embick, any category node beyond the first one is excluded from interacting with the root. A possible remedy might be domain extension along the lines of Bobaljik and Wurmbrand (2013), where the domain is extended when the head of the domain (the complement of the cyclic head) depends on a higher node for its interpretation. However, this would still exclude the root as it does not seem to depend on anything beyond its spell-out domain for its interpretation. Analyzing this as a case of i-umlaut targeting a phonologically identified target (cf. Embick 2013, 2014, Embick and Shwayder 2018) is not a viable analysis either as the umlaut clearly targets particular roots, as is evidenced by its non-application in (19) despite the presence of a potential undergoer.

(19) Non-application of i-umlaut in nominalization.

| | | | |
|---|---|---|---|
| a. | /œyð/- /ʏɣ/-<br>wealth- a<br>'rich' | /œyð/- /k/- /ɪ/<br>wealth- a- n<br>'wealth' | * /eið/- /k/- /ɪ/<br>wealth- a- i |
| b. | /scaul/- /k/-<br>crosseyed- a-<br>'crosseyed' | /scaul/- /k/- /ɪ/<br>crosseyed- a- n<br>'crosseyedness' | * /scail/- /k/- /ɪ/<br>crosseyed- a- n- |

Predictions are less clear in terms of Moskal's domain, which assumes domain extension when a cyclic node is immediately dominated by another cyclic node of the same category (Moskal 2015a:35–38). However, she does not discuss whether the same would apply in cases of nodes of distinct categories. Although the predictions are not entirely clear, the domain of morphophonology does seem to extend beyond the domain that is traditionally assumed for contextual allomorphy.

Regardless of whether a pattern such as (17) can be accommodated under the proposals discussed here, the expectation is that if contextual allomorphy and morphophonology are subject to the same locality constraints, morphophonology would be expected to apply between two elements in a compound whenever applicable. This, however, does not seem to be the case. As the i-umlaut only applies to a single vowel adjacent to the trigger and does not apply throughout the word, this cannot be tested in compounds. The u-umlaut, however, offers an opportunity to test this prediction.[15]

Unlike the i-umlaut, the u-umlaut can apply throughout a (single-stem) word as long as there is a chain of potential undergoers, i.e., the vowel *a* (see, e.g., Anderson 1969 and many others). The alternation shown in (20a) applies to the leftmost undergoer and (20b) applies to the rest.[16]

[15]Note that the u-umlaut is less straight-forwardly classified as either readjustment processes or phonological processes in terms of Embick 2010. It applies in many cases arbitrarily and is often without an overt trigger, however, it is applied consistently to all stems in the presence of the DAT.PL and 2p.PL suffixes -/ʏm/ and ignores adjacency (e.g., *vak-n-a* vs. *vök-n-um* 'wake up (INF/1p.PL)'). This could be taken to indicate that the u-umlaut in some cases references morphosyntactic identity of the target and phonological identity in others (cf. Shwayder 2015). See Ingason (2016) for an analysis along those lines.

[16]For some speakers, some median /a/ become /ɔ/ rather than /ʏ/ (see, e.g., Jónsson 1959:95, i.a.). This variation is not well understood. See also Rögnvaldsson (2006) for further examples of variation in u-umlaut.

(20) Vowel alternations in u-umlaut

a. /a/ → /œ/
b. /a/ → /ʏ/ or /ɔ/

(21) U-umlaut in single-stem words

a. /pak/- /ar/- /ɪ/
bake- er- NOM.SG
'baker'

b. /pœk/- /ʏr/- /ʏm/
bake- er- DAT.PL

c. /panan/- /ɪ/
banana- NOM.SG
'banana'

d. /pœnʏn/- /ʏm/
banana- DAT.PL

If it were, in fact, the case that contextual allomorphy and morphophonology were bound by the same locality constraints, the expectation is that there would be some degree of interaction corresponding to the Icelandic data discussed in the previous section, i.e., it would at least affect the genitive suffix of the non-head element. This is not the case (Harðarson 2016,2017).

(22) a. /pakar/-/a/#/pœnʏn/-/ʏm/
baker-GEN#banana-DAT.PL
'a baker's banana'

b. /panan/-/a/#/pœkʏr/-/ʏm/
banana-GEN#baker-DAT.PL
'a banana baker'

c. * /pœkʏr/-/ʏ/#/pʏnʏn/-/ʏm/
baker-GEN#banana-DAT.PL

d. * /pœnʏn/-/ʏ/#/pʏkʏr/-/ʏm/
banana-GEN#banana-DAT.PL

Hence, although the umlauts do not seem bound by cyclic domains within single-stem words, they are still limited by the compound structure, which Harðarson (op. cit.) argues references the extended projection of the root. How this can be achieved is discussed in the following subsection.[17]

It is worth noting that it is not always the case that elements in compounds cannot interact in this respect. An example of this is found in Yoruba where [ATR] harmony is known to apply between two elements in certain cases, (23a), where elsewhere it is blocked, (23b) (e.g., Archangeli and Pulleyblank 1989:189–191). The undergoer is shown in boldface and the trigger is underlined.

(23) Yoruba (Adapted from Archangeli and Pulleyblank 1989:190)

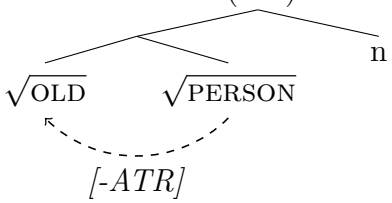
a. /ògbó/ + /ɛ̱ni/ → [ògbɛ́ni]
'old' 'person' 'sir'

b. /ewé/ + /ɔbɛ̱̀/ → [ewébɛ̀]
'leaf' 'soup' 'any pot herb used for making soup'

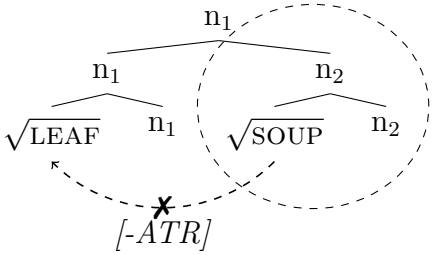
[17] I set aside the question of what mechanism is underlying the umlauts here, as it lies far beyond the scope of this article. It is true, as an anonymous reviewer points out, that the umlaut processes themselves could be analyzed in a number of ways, such as floating features as the reviewer suggested (see, e.g., Gibson and Ringen 2000, Wood 2015, Ingason 2013, 2016). Regardless of how exactly the process occurrs, there must be a way to limit the application of this process in a way that allows it to apply throughout a single-stem word but respect the boundaries between two compound elements.

Fọlarin (1990) proposed that the difference is due to compounding taking place at different lexical strata, i.e., that in the case of (23a), the compounding occurs at a lower stratum, i.e., earlier in the derivation, allowing for the [-ATR] specification to spread to the left element. In (23b), the compounding has taken place at a higher stratum, i.e., later in the derivation, and vowel harmony is no longer applicable as it is specified to apply at the lower stratum. An analysis along these lines can straight-forwardly be translated into a non-lexicalist framework. Following, e.g., Marantz (1997) and Marvin (2002), these strata can be taken to correspond to the structural domains assumed here: a) the lower stratum corresponds to the first domain, that of the root, and b) the higher stratum corresponds to the second domain, beyond the first category node. If this is correct, the effects observed here would be expected under the layered approach to compounding that is adopted here (see Moskal 2015:255ff, Harðarson 2016, De Belder 2017). Compounds such as the ones in (23a) involve compounding of bare roots, and hence the non-head element does not form a domain, and vowel harmony can apply freely between the two elements. In the case of (23b), the non-head element presumably contains a category node (cf. Moskal 2015 and De Belder 2017), hence the non-head element will form a domain to the exclusion of the head and vowel harmony is blocked. The structures are shown below.

(24) The structure of (23a)




(25) The structure of (23b)




Under Harðarson's (2016) definitions of the domain of morphophonology the domain is defined by the highest functional head in the extended projection of the root. Under a structure like (24), there is no functional head dominating the root $\sqrt{\text{OLD}}$, and hence it does not form a domain for morphophonology on its own and gets incorporated into the domain of $\sqrt{\text{PERSON}}$. Under a structure as in (25), both roots include a functional head in their extended projections and hence form separate domains.

Finally, there are also a number of processes known to apply specifically between two elements in a compound. This is illustrated by final vowel lengthening in Hausa below.

(26) Final vowel lengthening in Hausa (adapted from McIntyre 2006:32)

a. /b**ì**/ + /bango/ → [b**ì:**bango]
'follow' 'wall' 'leakage along the wall'

b. /k'a**:**rè/ + /dangì/ → [k'à**:**rè**:**dangì]
'finish' 'relative' type of arrow poison

This is not a general property of compounds or even verbs in compounds as this only applies to certain verbs, hence this process makes reference to both the compound structure and the identity of the undergoer.

Some other examples of compound-specific processes include: gemination, nasal deletion, and final vowel lengthening in Malayalam (Monahan 1982:36–45); tone-lowering and phonological reduction in Hausa (McIntyre 2006:32ff); nasal assimilation in Marathi (Pandharipande 1997:563); vowel deletion and vowel change in Swedish (Josefsson and Platzack 2004:12–13); and compound stress (see, e.g., Árnason 1985 for Icelandic and Gouskova and Roon 2009, Gouskova 2010 for Russian).

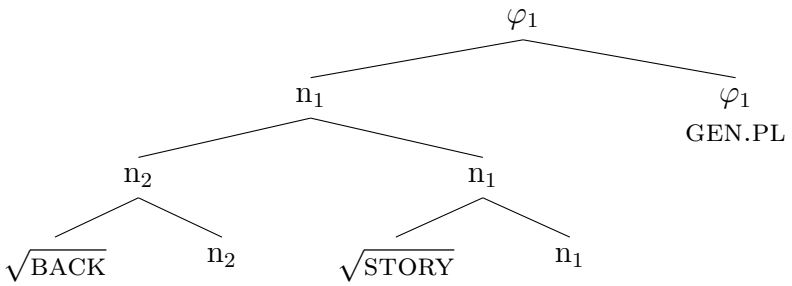
The existence of these processes then indicates that phonology makes reference to two domains within the complex head, i.e., i) within the extended projection of the root, and ii) between extended projections, echoing the layering of the derivation in, e.g., Lexical Phonology Kiparsky (1982b), Monahan (1982) and its decendants. Hence, when this is combined with the discussion from the previous section, the conclusion is twofold: i) contextual allomorphy and morphophonology are subject to distinct locality constraints, and ii) the compound structure can serve as context for both contextual allomorphy and morphophonology.

## 4.1 Spelling out the structure

Although all the processes that have been discussed so far appear to be constrained by the morphosyntactic structure, they do not seem to make reference to the same points in the structure. Following up on Harðarson (2016), I will outline an approach that allows us to establish these two domains from the morphosyntactic structure.

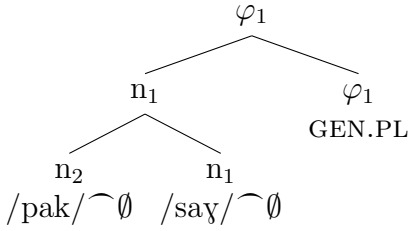
This is illustrated in the derivation of the compound *baksagna* 'backstories (GEN)', the structure of which is provided in (27). Following the discussion in section 3, the spell-out domain seems to include the entire structure in (27).

(27)

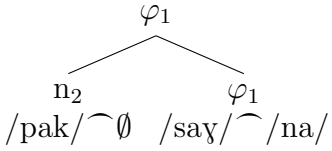



I follow Noyer (1997) in assuming that linearization and concatenation immediately follow vocabulary insertion and that vocabulary insertion applies incrementally from the root outward (Bobaljik 2000). I also assume that morphophonology applies immediately at the point of concatenation (following Monahan 1982, Kiparsky 1982a, Pak 2008). Furthermore, drawing on Pak (2008), I assume that concatenation applies in two layers, early and late. Early concatenation applies to elements in a selectional relationship, i.e., the extended projection, and late concatenation applies to the two extended projections. Processes are specified for application during early or late concatenation. The relevant steps in the spell-out of (27) are shown in (28–30). Vocabulary insertion and early concatenation proceed simultaneously for both roots, initially yielding (28). Vocabulary insertion subsequently applies to $\varphi_1$, yielding (29). Occlusion is now applicable between /saɣ/ and /na/, yielding /sakna/. At this point early concatenation is completed and late concatenation applies, yielding (30).

(28)




(29)




(30) /pak/⌒/sakna/

At the point of late concatenation in (30) the phonological environment for fricativization of /k/ is satisfied. However, as fricativization is specified to apply at early concatenation it is hence not applicable. Hence (30) yields /baksakna/ and not */baxsakna/.

In the case of the phonological domains extending beyond the spell-out domain, I assume that the phonological string created at each cycle is included in the computation of subsequent cycles. Hence the phonological string is accessible for processes triggered by elements beyond its spell-out domain, although its internal structure is not. Following Bobaljik (2000), I assume that vocabulary items replace morphosyntactic heads, although morphosyntactic features of the highest head are visible. Hence any process applying to the phonological string must target its edge or apply throughout the string (cf. Kaisse 1985, Sande and Jenks 2018). This can be observed with the umlauts discussed above, where the i-umlaut targets the adjacent syllable, the edge of the string, and the u-umlaut targets every contiguous undergoer within the string, potentially applying throughout the string.[18]

This approach offers the possibility to compute the effects of distinct domains from a single structure, where the phonological domain can appear either larger or smaller than the spell-out domain, depending on the context.

# 5 Conclusions and prospects for future study

To summarize this paper, we saw that when contrasting the predictions made by the three locality approaches to contextual allomorphy in compounds the results differed in a number of ways. Embick does not predict the compound specific contextual allomorphy whereas Bobaljik and Moskal do, and Bobaljik does not predict the root-triggered contextual allomorphy observed in Dutch, whereas Embick and Moskal do. However, although Moskal's approach manages to account for all the cases observed, it also predicts a number of interactions not attested in the data discussed here, hence more research is needed before this can be properly evaluated.

The data presented here provide clear evidence that a compound can consist of a single spell-out domain, however when contextual allomorphy is contrasted with morphophonology, we observe a dissociation between the domain of morphophonology and contextual allomorphy. Contextual allomorphy operates within the spell-out domain, which for morphophonology can be either too small or too large. Morphophonology appears to operate at two levels, i) within the extended projection of the root, and ii) between two extended

[18]The i-umlaut would presumably require a diacritic identifying the vocabulary item as a potential undergoer.

projections within the same complex head. I outlined an approach that achieves the effects of multiple domains while computing these effects from a single morphosyntactic structure, obviating the need for an intermediate structure.

As this approach computes apparent domain mismatches directly from the morphosyntactic structure, the question inevitably arises, whether this can be extended beyond the complex head. A number of domain mismatches have been discussed extensively where the typically assumed syntactic domains appear to be either too large or too small, such as penultimate vowel lengthening in Durban Zulu (e.g., Cheng and Downing 2016, for a preliminary extension of this approach, see Harðarson 2020). Delving into this topic goes far beyond the scope of this paper, and so I leave this for further research.

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