Phonological correlates of alienability

Marie-Luise Popp

Abstract

In this paper, I provide a crosslinguistic overview of phonological asymmetries between alienable and inalienable possessive constructions. For this purpose, I investigate languages in which two different phonological processes apply in the same phonological context. The choice of the phonological process depends on whether the root is alienable or inalienable. I argue that there are no direct phonological correlates of (in)alienability. Rather, pronominal affixes in alienable and inalienable possession are attached to the noun root in different positions: while pronominal affixes in inalienable possession typically appear close to the noun root, pronominal affixes of alienable possession attach in more peripheral positions. Based on a comparison of 13 different languages, I show that invasive phonological processes (e.g. deletion, processes affecting root material) apply exlusively to affixes in positions close to the noun root. This insight has immediate consequences for theoretical analyses modeling the interface between the underlying syntactic/semantic structure and the morphophonology of words. In this regard, I evaluate three different theories (CVCV theory, Stratal Optimality Theory and Harmonic Layer Theory) and conclude that none of the theories can successfully capture the crosslinguistic generalizations of this paper without additional assumptions.

Keywords: phonological typology, possession, alienability split, cyclic phonology

1   Introduction

Alienability contrasts refer to a phenomenon in which a language has more than one strategy to express adnominal possession, the choice of which depends on whether the noun is inalienable or alienable. In many languages, these splits coincide with the distinction between obligatorily possessed (=INALIENABLE) or optionally possessed (=ALIENABLE) nouns (Bickel & Nichols 2013). Alienability contrasts have mainly been discussed with respect to morphological differences between alienable and inalienable possessive constructions. The general crosslingustic conclusion is that inalienable possessive constructions typically require fewer morphological markers than alienable possession, an asymmetry which has been attributed to iconicity (Haiman 1983, 1985, Koch 1995) or frequency (Nichols 1988, Koptjevskaja-Tamm 1996, Dahl & Koptjevskaja Tamm 1998, 2001, Haspelmath 2008, 2017). This is exemplified in

(1) with two different possessive constructions from Abun, a language isolate spoken in Indonesia. With the inalienable body part noun *syim* 'arm', possession is expressed by juxtaposing the noun and a personal pronoun, as shown in (1-a). With alienable nouns, however, Abun requires a personal pronoun *and* a genitive marker between the pronoun and the alienable noun *nggwe* 'garden'. Thus, an additional morphological marker is needed to express the possession of alienable nouns.[1]

(1)   Alienability split in Abun

    a.   ji   syim
          1SG arm
          'my arm'   inalienable possession
          (Haspelmath 2017: 194, citing Berry & Berry 1999)

    b.   ji   bi   nggwe
          1SG GEN garden
          'my garden'   alienable possession
          (Haspelmath 2017: 194, citing Berry & Berry 1999)

While most typological work on alienability contrasts focuses on morphological marking, recent work by Newell & Piggott (2014), Newell et al. (2018) sheds light on phonological asymmetries between alienable and inalienable possessive constructions. As shown in the examples in (2), possession in Ojibwe (Algonquian, USA & Canada) is expressed by prefixing a pronominal possessive affix to the noun. Alienable nouns additionally require a possessive suffix *-im* in addition, which is absent with inalienable nouns (compare (2-a) to (2-b)). If the 1SG possessive pronoun *ni-* is attached to a vowel-initial noun root, vowel hiatus is resolved in two different ways depending on whether the noun is alienable or inalienable. If a vowel-initial alienable noun takes the pronominal possessive prefix *ni-*, the resulting vowel cluster is resolved through epenthesis of /d/, illustrated in (2-a). If the same pronominal affix is prefixed to an inalienable root, however, the vowel sequence is resolved by deleting the vowel of the prefix /i/ (see (2-b)). In simpler terms, the same set of pronominal possessive affixes is used for both alienable and inalienable nouns, yet the resulting sequence of two vowels is resolved differently depending on whether the noun root is alienable or inalienable.

(2)   Alienability split in Ojibwe

    a.   /ni-akweː-im/
          [nidakweːm]
          1-woman-POSS
          'my woman (wife)'   alienable
          (Newell et al. 2018: 1)

---

[1] 1 = first person; 2 = second person; 3 = third person; AL = alienable; CAUS = causative; CLF = classifier; EMPH = emphatic; GEN = genitive; INAL = inalienable; IND = indicative; INCL = inclusive; LOC = locative; NEG = negation; NON.FUT = non-future; PAT = patient; PFV = perfective; POSS = possessive; Q = question; REL = relative; SG = singular; TNS = tense; UNSPEC = unspecified

b. /ni-oːkomis/
    [noːkomis]
    1-grandmother
    'my grandmother'   inalienable
    (Newell et al. 2018: 1)

Newell (2022) describes pronominal affixes like *ni-* as QUANTUM AFFIXES: the same phonological material appears under different syntactic or semantic conditions.

In this paper, I investigate phonological asymmetries between alienable and inalienable possession crosslinguistically. To this end, quantum affixes provide the unique opportunity to compare similar phonological contexts across different syntactic and semantic conditions and hence contribute to the general question whether phonological domains correspond to morphosyntactic domains. Taking into account patterns from 13 different languages, I conclude that phonological correlates of alienability splits are rather indirect: there are no direct correlates of the underlying semantic and syntactic form but correlates of their relative position to the noun root. Thus, I argue that there is no direct link between the semantic properties and the phonological form of a noun but rather an indirect connection which is mediated through an independent morphological module in the grammar.

In the following, I examine three existing theories about the syntax-semantics/morpho-phonology interface (CVCV theory, StratalOT and Harmonic Layer Theory) and compare what assumptions are needed in order to derive the empirical generalizations drawn from phonological correlates of alienability splits.

2   Phonological correlates of alienability splits

Morphological asymmetries between alienable and inalienable possessive constructions are well-studied (see Haiman 1983, 1985, Haspelmath 2008, 2017, Bickel & Nichols 2013 for comprehensive overviews), while phonological correlates of alienability splits have only been highlighted in discussions of a few single languages (Newell & Piggott 2014, Newell et al. 2018). Hence, the primary goal of this paper is to provide an empirical overview of phonological asymmetries in possessive constructions across languages.

In order to do so, it is crucial to narrow down the language sample to languages in which the morphological means of alienable and inalienable possessive constructions are similar enough to form phonologically comparable contexts. As explained by the example from Abun in Section 1, it is crosslingustically common in languages with alienability splits that alienable nouns require a possessive morpheme in addition to the pronominal markers. Depending on the exact position and realisation of this additional marker, the resulting constructions are not phonologically comparable. Consider the examples in (3) for Kulina (Pano-Tacanan, culi1244). With inalienable nouns, possession is expressed by adding a pronominal possessive prefix to the noun.

If this structure results in a sequence of two vowels, hiatus is resolved via epenthesis (3-a) or deletion (3-b). With vowel-initial alienable nouns, such as *ehedeni* 'child', this situation never arises. Since alienable nouns require an additional possessive marker *kha* between the pronominal possessive prefix and the noun, such that there is no word-internal vowel hiatus to begin with. In simpler terms, the differences in the morphological make-up between alienable and inalienable possession create two different phonological contexts.

(3)   Possession in Kulina (Pano-Tacanan, culi1244)

      a.   /o-ebeno/
           [owebeno]
           1SG-tongue
           'my tongue'   inalienable
           (Dienst 2014: 17)

      b.   /ti-ebeno/
           [tebeno]
           2SG-tongue
           'your tongue'   inalienable
           (Dienst 2014: 218)

      c.   o-kha   ehedeni
           1SG-POSS child
           'my child'   alienable
           (Dienst 2014: 42)

In their crosslinguistic investigation of alienability splits, Bickel & Nichols (2013) show that the majority of languages (201 out of 244 languages in the sample) do not exhibit any asymmetries between alienable and inalienable possession. That being said, alienable and inalienable possession may behave entirely symmetrically in their phonological structures, as well: in most languages, there are no phonological differences between inalienable and alienable possession. These languages are not the concern of this paper, since this paper strives for a crosslinguistic comparison of phonological asymmetries between alienable and inalienable possession. This paper deals with languages in which similar phonological forms are mapped onto two different output forms depending on the semantic properties of the noun root. For this purpose, I closely examined the grammatical description of 61 languages with morphological alienability splits, 13 of which additionally exhibit phonological asymmetries. For reasons of space, I do not discuss every single language in the paper, yet all patterns are illustrated in the appendix. Three different types of phonological asymmetries between alienable and inalienable possession can be distinguished: one possible asymmetry refers to languages in which a certain phonological process takes place in inalienable possession but not in alienable possession. More specifically, a phonological process applies only in the context of inalienable roots, although alienable roots would provide exactly the same phonological context as well. The reverse picture is also conceivable: some phonological process is triggered only in combinations with alienable roots

but not with inalienable roots. A third possible asymmetry refers to languages like Ojibwe (see Section 1), in which two different phonological processes take place, the choice of which depends on whether the root is alienable and inalienable. The different patterns are summarized in 1. In the following three sections, I will discuss regularities of all three types of phonological asymmetries in possession.

pattern	INAL possession	AL possession
symmetric	process A / ∅	
more phonology in INAL possession	process A	∅
more phonology in AL possession	∅	process A
different phonologies	process A	process B

Table 1: Possible phonological patterns of alienability splits

2.1   More phonology in inalienable possession

In 8 out of 13 languages, phonological processes apply only in inalienable constructions. This is exemplified in (4) for the Austronesian language Warembori. In this language, voiced stops such as /b/ or /d/ lenite to [v] and [r] intervocally. Intervocalic lenition, however, does not take place in all morphological contexts but only in the context of inalienable possession and compounding. In (4-a), the inalienable body-part noun *boro* 'tongue' takes a pronominal possessive prefix *e-*. As a result, the root-inital stop /b/ is couched between two vowels and lenites to [v]. In contrast, the same process does not take place if the possessed noun is alienable, as shown in (4-b) for the noun *bo* 'coconut'. In this example, the quantum affix *e-* attaches to an alienable noun, thus creating the same phonological context in a different semantic environment. In this case, the underlying root-initial stop /b/ does not lenite but is mapped onto the surface as [b].

(4)   Possession in Warembori (Austronesian, Indonesia)

   a.   /e-boro-ro/
        [e-voro-ro]
        1SG-tongue-IND
        'my tongue'   inalienable
        (Donohue 1999: 29)

   b.   /e-bo-ro/
        [e-bo-ro]
        1SG-coconut-IND
        'my coconut'   alienable
        (Donohue 1999: 29)

Table 2 lists all languages in which phonological processes take place exclusively in inalienable possession. These languages have a higher DENSITY of phonological processes in inalienable possession than in alienable possession. With the term *phonological density*, I refer to the

number of phonological operations in a given domain. In short, the languages in 2 exhibit more phonological operations in inalienable possession than in alienable possession. Hence the phonological density in these languages is higher in inalienable possession. As shown in Table 2, it is a commonly attested pattern across languages that phonological processes take place only in the context of inalienable possession. Moreover, Table 2 further illustrates that this asymmetry is not restricted to lenition but comprises a variety of phonological processes: deletion, epenthesis and different assimilation processes such as vowel harmony and lenition. The value in the last column indicates the domain in which phonological material is modified or added: in the root, in the affix or between root and afix. Table 2 illustrates that phonological material of the pronominal possessive affixes may modify phonological material of the root in this type of asymmetry, as illustrated in (4) for Warembori.

Language	Code	INAL possession		AL possession
Ojibwe	otta1242	coalescence	affix	∅
Asmat	cent2117	vowel harmony	affix	∅
Ulwa	ulwa1239	vowel harmony	root	∅
		deletion	affix	∅
Kui	kuii1254	deletion	affix	∅
		reduction	affix	∅
Limbu	limb1266	lenition	root	∅
		deletion	root	∅
Warembori	ware1253	lenition	root	∅
Turkish	nucl1301	deletion	root	∅
Yucatec Maya	yuca1254	epenthesis	root	∅

Table 2: Languages with higher phonological density in inalienable possession

2.2 Different phonologies in both possession types

A different type of asymmetry between alienable and inalienable possession arises if a similar phonological context triggers two different phonological processes. A language exhibiting this type of asymmetry is Ojibwe, as already shown in Section 1. In this language, vowel hiatus between inalienable nouns and vowel-final prefixes is resolved through deletion, while vowel clusters between alienable nouns and vowel-final prefixes yield epenthesis. In short, the same phonological context yields two different output forms and the correct one can only be predicted when the semantic properties of the noun root are taken into account.

A similar picture arises in Abui, as shown in (5). Just as in Ojibwe, possession is marked by prefixing a pronominal affix to the noun root. In contrast to Ojibwe, however, alienable and inalienable roots make use of two different pronominal paradigms: alienable nouns require a pronominal prefix with a Cɛ- shape (see (5-a)) while inalienable nouns take a Cɑ-shaped prefix,

see (5-b). If any of these CV-shaped pronominal prefixes attaches to a vowel-initial root, the resulting vowel hiatus is resolved by two different phonological processes, the choice of which depends on the alienability of the noun root. In (5-c), prefixation of *nɛ-* to the alienable noun root *ʊra* 'sibling' yields a vowel hiatus /ɛʊ/, which is resolved by epenthesis of a glottal stop. In contrast, the vowel hiatus /ɑɔ/, which results from prefixing the pronominal marker *na-* to an inalienable root *ɔɪ* 'vagina', triggers deletion of the affix vowel, as illustrated in (5-d).

(5) Possession in Abui (Timor-Alor-Pantar, Indonesia)

    a. /nɛ-lʊɪ/
       [nɛlʊɪ]
       1SG-knife-POSS.CLF
       'my knife'   alienable
       (Kratochvíl 2007: 145)

    b. /nɑ-mɪn/
       [nɑmɪn]
       1SG-nose
       'my nose'   inalienable
       (Kratochvíl 2007: 141)

    c. /nɛ-ʊrɑ/
       [nɛʔʊrɑ]
       1SG-sibling
       'my sibling'   alienable
       (Kratochvíl 2007: 146)

    d. /hɑ-ɔɪ/
       [hɔɪ]
       3SG-vagina
       'her vagina'   inalienable
       (Kratochvíl 2007: 142)

In short, the phonological asymmetries in Ojibwe and Abui are similar in that vowel deletion applies in inalienable possesion while epenthesis applies in alienable possession. Table 3 lists all 4 languages in which similar phonological contexts trigger two different phonological processes. Table 3 allows the conclusion that deletion applies exclusively in inalienable possession, while epenthesis and assimilation take place exclusively in alienable possession.

Language	Code	INAL possession		AL possession	
Abui	abui1241	deletion	affix	epenthesis	between
Adang	adan1251	deletion	affix	epenthesis	between
Acholi	acol1236	deletion	affix	assimilation	affix
Ojibwe	otta1242	deletion	affix	epenthesis	between

Table 3: Languages with different phonologies

2.3   More phonology in alienable possession

The third type of asymmetry refers to patterns in which phonological processes apply exclusively in alienable possession. This pattern appears to be the rarest phonological asymmetry with only two attested languages following this pattern.

In Ineseño Chumash, consonant clusters of a simplex and a glottalized consonant trigger epenthesis of /i/. This is shown in (6-a) for the root *cˀiwis* 'rattle'. Whenever the 1SG prefix *s-* is prefixed to this root, the resulting sequence /scˀ/ is resolved through epenthesis of a vowel /i/. The example in (6-b) illustrates that these complex consonant clusters do not trigger epenthesis in all morphological contexts. With respect to nouns, it seems to be the case that only alienable nouns like 'rattle' trigger epenthesis. If an inalienable kinship term like *čˀɨyˀ* 'niece/nephew' is prefixed with a pronominal possessive marker, epenthesis does not apply although a similar complex consonant cluster is constructed through prefixation. It is worth noting that this empirical generalization is based on a rather limited set of nouns since only a small number of inalienable nouns start with a glottalized consonant or consonant clusters. Thus, it cannot be determined whether the asymmetry arises uniquely from the alienability of the noun.

(6)   Possession in Ineseño

    a.   /s-cˀiwis/
           [sicˀiwis]
           3SG-rattle
           'his/her rattle'   alienable
           (Applegate 1972: 99)

    b.   /k-čˀɨyˀ/
           [kčˀɨyˀ]
           1SG-niece/nephew
           'my niece/nephew'   inalienable
           (Applegate 1972: 99)

In the Arawakan language Ashéninka Apurucayali, the voiceless stops /k/ and /p/ lenite intervocally to [y] and [w], respectively. This is exemplified in (7-a) where root-initial consonant of the noun *porita* 'hen' becomes [w] when a 1SG pronominal prefix *no-* is attached to the noun. However, intervocalic lenition is restricted to combinations of pronominal prefixes and alienable noun roots. If the quantum affix *no-* attaches to an inalienable body-part noun *pori* 'thigh', intervocalic lenition does not apply, as shown in (7-b). Thus, Ashéninka Apurucayali exhibits the reverse picture of Warembori in Section 2.1, where intervocalic lenition is restricted to inalienable possession. In addition, noun roots starting with a sequence of /ki/ and a non-nasal consonant trigger deletion of the root-initial /k/. This is shown in (7-c), where the root 'needle' has the form *kitʰapi*. Whenever a pronominal possessive prefix *no-* appears in front of the root, deletion of the root-initial consonant takes place. Just as intervocalic lenition, deletion is restricted to alienable nouns in Ashéninka Apurucayali. Inalienable roots with a similar shape, such as the body-part noun *kiri* 'nose' do not trigger deletion, as shown in (7-d).

(7) Possession in Ashéninka Apurucayali (Arawakan, Peru)

    a.   /no-porita-ti/
        [noworitati]
        1SG-hen-POSS.CLF
        'my hen'   alienable
        (Payne 1981: 87)

    b.   /no-pori/
        [nopori]
        1SG-thigh
        'my thigh'   inalienable
        (Payne 1981: 87)

    c.   /no-kitʰapi-ti/
        [noitʰapiti]
        1SG-needle
        'my needle'   alienable
        (Payne 1981: 244)

    d.   /no-kiri/
        [nokiri]
        1SG-nose
        'my nose'   inalienable
        (Payne 1981: 89)

In sum, the phonological asymmetries in Ineseño Chumash and Ashéninka Apurucayali demonstrate that a variety of phonological processes are possible in alienable possession as well. In addition, Ashéninka Apurucayali shows that modification of root material triggered by pronominal possessive affixes is not restricted to inalienable possession. Nevertheless, a higher phonological density in alienable possession appears to be the rarest type of phonological asymmetry between alienable and inalienable possession. The two attested patterns are summarized in Table 4.

Language	Code	INAL possession	AL possession	
Ashéninka Apurucayali	ajyi1238	∅	lenition	root
		∅	deletion	root
Ineseño	ines1240	∅	epenthesis	between

Table 4: Languages with higher phonological density in alienable possession

2.4   The relative position of pronominal possessive affixes

Table 5 provides a summarized overview of phonological asymmetries in alienability splits. In essence, it seems that there are no phonological processes that take place exclusively in alienable or inalienable possession constructions. Rather, we find language pairs which display phonological mirror images of each other: in Yucatec Maya, epenthesis applies only in inalien-

able possession. In Ineseño, in contrast, epenthesis takes place only in the context of alienable possession. Similarly, intervocalic lenition is restricted to inalienable possession in Warembori but to alienable possession in Ashéninka Apurucayali.

Language	Code	INAL possession		AL possession	
Ojibwe	otta1242	coalescence	affix	∅	
Asmat	cent2117	vowel harmony	affix	∅	
Ulwa	ulwa1239	vowel harmony	root	∅	
		deletion	affix	∅	
Kui	kuii1254	deletion	affix	∅	
		reduction	affix	∅	
Limbu	limb1266	lenition	root	∅	
		deletion	root	∅	
Warembori	ware1253	lenition	root	∅	
Turkish	nucl1301	deletion	root	∅	
Yucatec Maya	yuca1254	epenthesis	root	∅	
Abui	abui1241	deletion	affix	epenthesis	between
Adang	adan1251	deletion	affix	epenthesis	between
Acholi	acol1236	deletion	affix	assimilation	affix
Ojibwe	otta1242	deletion	affix	epenthesis	between
Ashéninka Apurucayali	ajyi1238	∅		lenition	root
		∅		deletion	root
Ineseño	ines1240	∅		epenthesis	between

Table 5: Languages with higher phonological density in alienable possession

Phonological asymmetries suggest that there is more than one phonological domain such that phonological rules are connected and thus restricted to either of these domains. With respect to quantum affixes, it seems that they may attach at either phonological domain. An ongoing debate tackles the question whether these phonological domains correspond to morphosyntactic domains and how exactly this link is established (see Bermúdez-Otero 2011, Newell & Piggott 2014, Newell et al. 2018, Newell 2021, 2022, Fenger 2020 for recent discussions). In this paper, the emerging question is whether the semantic split between alienable and inalienable possession matches a phonological split. Table 5 illustrates that a direct match between the alienability of the root and phonological domains does not allow for any empirical generalizations. In simpler terms, if inalienable possession created a phonological domain that excluded alienable possession or vice versa, there would be no phonological rule specific to this domain. However, a closer look at the relative order of pronominal possessive affixes shows that there is a rather indirect link between phonological domains and the alienability of the root: affixes which attach in a position close to the root form a phonological domain to the exclusion of

affixes which attach in a more peripheral position. In short, the relative position of alienable and inalienable possessive affixes provides insights into the link between morphological and phonological domains. Since alienable and inalienable possession are in complementary distribution, it is not straightforward to determine a relative order of pronominal possessive affixes in inalienable and in alienable possession. However, some languages provide insights into the relative order of these affixes. In Abui, for example, there is one particular noun which Kratochvíl (2007) analyses as having both alienable and inalienable marking. The root /ɑɪ/ is used to construct the noun 'wife'. As Kratochvíl (2007) notes, the root /ɑɪ/ carries a variety of meanings, including 'side' and 'to be at side' and is also used to form the word 'wife'. Concretely, the Cɑ- shaped prefixes signaling inalienable possession attach directly to the noun. The resulting vowel hiatus causes deletion of the prefix vowel. Crucially, the Cɛ- shaped pronominal markers indicating alienable possesion attach outside the inalienable markers, as illustrated in (8).

(8)   Inflection of /ɑɪ/ 'wife' in Abui

    a.   hɛ-hɑ-ɑɪ
        [hɛhɑɪ]
        3SG.AL-3SG.INAL-to.be.with.someone
        'his wife'
        (Kratochvíl 2007: 144)

    b.   ʔɛ-ʔɑ-ɑɪ
        [ʔɛʔɑɪ]
        2SG.AL-2SG.INAL-to.be.with.someone
        'your wife'
        (Kratochvíl 2007: 144)

    c.   nɛ-nɑ-ɑɪ
        [nɛnɑɪ]
        1SG.AL-11SG.INAL-to.be.with.someone
        'my wife'
        (Kratochvíl 2007: 144)

As already mentioned above in further detail, alienable and inalienable possessive constructions in Abui differ in the form of the pronominal markers: alienable nouns require markers of a Cɛ-shape, while inalienable ones require markers of a Cɑ- shape. The same set of pronominal prefixes is also used in the verbal domain, where these two sets of markers indicate different semantic roles of the argument they index. More specifically, Cɛ- shaped prefixes index locative arguments, while Cɑ- shaped prefixes index patient arguments. The verbal predicate *yei* 'fall' takes both a locative and a patient argument. In this case, the locative argument precedes the patient, thus indicating that alienable pronominal possessive affixes attach in a position external to inalienable affixes.

(9)   Order of verbal prefixes in Abui
        Buoka hɛ-hɑ-yei   naha
        be.far 3.LOC-3.PAT-fall NEG
        'it did not fall far'
        (Kratochvíl 2007: 80)

When these diagnostics are tested on other languages, it turns out that the agreement marker signaling alienable possession always attaches in a more peripheral position than the agreement marker for inalienable possession. As another example, Choctaw uses two different sets of agreement markers for alienable and inalienable possession, which Broadwell (2006) refers to as 'Set III' (for alienable possession) and 'Set II' (for inalienable possession). The relevant markers are summarized in 6.

	Alienable / Set III	Inalienable / Set II
1SG	am-	(s)a-
2SG	chim-	chi-
3SG	im-	i/∅-

Table 6: Form of pronominal affixes in Choctaw (Broadwell 2006: 60)

The examples in (10) illustrate that markers of the alienable paradigm (Set III) attach to alienable roots, such as *ofi'* 'dog', while markers of the inalienable paradigm (Set II) combine with inalienable roots like the kinship term *shki'* 'mother'.

(10)   Alienable vs. inalienable possession in Choctaw

        a.   Am-ofi'
              1SG.III-dog
              'my dog'
              (Broadwell 2006: 158)
        b.   Sa-shki'
              1SG.II-mother
              'my mother'
              (Broadwell 2006: 158)

The paradigms in Table 6 are used to index different verbal arguments as well. The sentences in (11) demonstrate that Set III markers, and hence the markers signaling alienable possession, precede Set II markers, which are also used to index inalienable possession. The opposite order is ungrammatical, as shown in (11-a).

(11)   Order of verbal prefixes in Choctaw

        a.   *Sa-chim-ahchiba-h-õ?
              1SG.II-2SG.III-to.be.tired-TNS-Q
              'Are you tired of me?'
              (Broadwell 2006: 145)

b.   Chĩ-sa-nokshopa-h.
    2SG.III-1SG.II-afraid-TNS
    'I am afraid of you.'
    (Broadwell 2006: 153)

Turning back to the example of Ashéninka Apurucayali, a detailed look at the verbal domain reveals that the causative prefix patterns with alienable possessive affixes phonologically: it also triggers intervocalic lenition. This is illustrated in (12), where the root-initial stop /p/ lenites to [w] whenever a causative prefix /o-/ is added.

(12)   Phonological properties of /o-/ 'CAUS'

    a.   /o-piiŋkaan͡tsʰi/
        [owiiŋkaan͡tsʰi]
        CAUS-submerge
        'to cause to submerge (to dunk)'
        (Payne 1981: 90)

    b.   /o-parʲaan͡tsʰi/
        [owarʲaan͡tsʰi]
        CAUS-fall
        'to cause to fall (to drop)'
        (Payne 1981: 90)

Verbal agreement markers, on the other hand, match the phonological behaviour of inalienable possessive affixes, as they do not trigger lenition. This is exemplified in (13), where the 1SG agreement prefix /no-/ combines with a root starting with a voiceless stop, yet the root-initial consonant does not lenite intervocalically.[2]

(13)   Phonological properties of verbal prefixes

    a.   /no-komatakiro/
        [no-komatakiro]
        1SG-paddle
        'I have paddled it'
        (Payne 1981: 91)

    b.   /no-kimitakiro/
        [no-kimitakiro]
        1SG-scrape
        'I have scraped it'
        (Payne 1981: 91)

    c.   /pi-iitʰoŋkiti/
        [p-iitʰoŋkiti]
        2SG-climb
        'You will climb'
        (Payne 1981: 241)

---

[2]Note that the morphemes which are glossed as roots in (13) are actually polymorphemic although Payne (1981) does not provide the morpheme boundaries.

In sum, causatives match alienable possessive affixes phonologically, while verbal agreement markers pattern with inalienable possessive affixes. When the causative prefix and agreement markers cooccur on the verb, verbal agreement marking strictly precedes the causative, as shown in (14). Thus, it can be inferred that alienable possessive affixes in Ashéninka Apurucayali are closer to the root than inalienable possessive affixes.

(14)   Relative position of CAUS and verbal prefixes
        Hi a-ri-ʧa   a-o-p-ak-a   maawoni
        yes Ø-REL-EMPH 1PL-CAUS-feed-PFV-NON.FUT all
        ´Yes, we have eaten it all.'
        (Payne 1981: 194)

Within the sample of this paper, we find independent evidence that alienable possessive prefixes attach in a position external to inalienable possessive prefixes for three languages: Abui, Ineseño and Limbu. In addition, a couple of languages excluded from the sample exhibit the same pattern: Choctaw, Navajo (Young & Morgan 1987: 3) and Acoma (Miller 1965: 160f.). Ashéninka Apurucayali, in contrast, is the only language in which alienable affixes seem to attach in a position internal to inalienable prefixes. In short, it seems to be the case that pronominal affixes in alienable possession generally attach in positions further away from the root than pronominal affixes in inalienable possession with Ashéninka Apurucayali being the counterexample to this generalization.

Unfortunately, I can only speculate about the origins of this alternative ordering in Ashéninka Apurucayali. A potential explanation is related to frequency. As already mentioned above, (Nichols 1988, Koptjevskaja-Tamm 1996, Dahl & Koptjevskaja Tamm 1998, 2001, Haspelmath 2008, 2017) relate morphological differences between alienable and inalienable possession to frequency. Let us assume that alienable roots are more frequent as unpossessed items while inalienable roots are more frequent as possessed items. That being said, we may turn to frequency as a crucial factor relating the relative order of affixes. Recent work by Hay (2002), Hay & Baayen (2002, 2005), Hay & Plag (2004), Plag (2002) and Plag & Baayen (2009) draws a link between the relative frequency of a complex word form and affix order. In their work, a crucial factor determining the order of affixes is the relative frequency of a complex form (consisting of a root and an affix) with respect to the frequency of the root. If the derived form is more frequent than its base, it is assumed to be stored as a whole. In contrast, if the base is more frequent than the derived form, the word is likely to be parsed in smaller units. As a general rule, affixes that are harder to separate from its base cannot be realized in a position outside affixes that are easier to parse. From this generalization, it seems to be the case that pronominal affixes in inalienable roots are closer to the stem than their alienable counterparts, since they are harder to separate from their root. Is there a reason to believe that this generalization does not hold for Ashéninka Apurucayali? As noted by Aikhenvald (2021), a common property of possessive constructions in Arawak languages is the existence of a suffix signaling

14

non-specified possession on inalienable nouns. For Ashéninka Apurucayali, the usage of this marker is illustrated in (15-a). The suffix -t͡sʰi attaches to the inalienable noun *pori* 'thigh' signaling an unspecified possessor. This construction is typically used when referring to the meat and body parts of animals. In this case, pronominal prefixes are absent. Crucially, prefixes and the unspecified possessor suffix are in complementary distribution: an inalienable noun occurs either with a pronominal prefix indexing the possessor or with the suffix signaling unspecified possession.

(15)   Nonspecified possession in Ashéninka Apurucayali

     a.   pori-t͡sʰi
           thigh-UNSPEC.POSS
           'someone's thigh'
           (Payne 1981: 87)

     b.   no-pori
           1SG-thigh
           'thigh'
           (Payne 1981: 87)

In short, inalienable roots are used with prefixes when referring to human body parts but with the unspecified possessive suffix when referring to the body parts of animals. Due to this dual usage of inalienable nouns in Ashéninka Apurucayali, it is conceivable that inalienable roots appear frequently without prefixes. Note that this assumption can hardly be verified without a corpus and is therefore rather tentative. As a consequence, it is possible that the prefixes are in fact more frequent in alienable possession than in inalienable possession, which would explain the difference in the ordering of the affixes in Ashéninka Apurucayali.

2.5 Empirical generalizations

In the previous section, I have shown that pronominal possessive affixes in alienable possession typically attach in positions outside of inalienable possessive affixes. Ashéninka Apurucayali is a counter-example to this generalization: in this language, evidence from the relative order of verbal affixes suggests that alienable possession is closer to the root than inalienable possessive marking. Taking this evidence into account, we may now observe the data collection from a different perspective and shift the focus from comparing alienable and inalienable possession to comparing inner and outer possessive affixes and shortly, the relative positions of affixes within a morphological word. This is shown in Table 7, where the phonological asymmetries of all 13 languages of the sample are not ordered according to the type of possession but the relative position of the affixes. Thus, Table 7 allows a comparison of phonological correlates of relative affix positions.

Table 7 allows for the following empirical generalizations: first, only inner affixes may modify phonological material of the root. Second, a variety of phonological processes apply between

inner affixes and the root, whereas only a subset of these processes (epenthesis and assimilation) take place in the outer phonological domain. Third, deletion and intervocalic lenition take place exclusively in the inner phonological domain.

Language	Code	Inner affixes		Outer affixes	
Abui	abui1241	deletion	affix	epenthesis	between
Adang	adan1251	deletion	affix	epenthesis	between
Acholi	acol1236	deletion	affix	assimilation	affix
Ojibwe	otta1242	deletion	affix	epenthesis	between
		coalescence	affix	∅	
Asmat	cent2117	vowel harmony	affix	∅	
Ulwa	ulwa1239	vowel harmony	root	∅	
		deletion	affix	∅	
Kui	kuii1254	deletion	affix	∅	
		reduction	affix	∅	
Limbu	limb1266	lenition	root	∅	
		deletion	root	∅	
Ashéninka Apurucayali	ajyi1238	lenition	root	∅	
		deletion	root	∅	
Warembori	ware1253	lenition	root	∅	
Turkish	nucl1301	deletion	root	∅	
Yucatec Maya	yuca1254	epenthesis	root	∅	
Ineseño	ines1240	∅		epenthesis	between

Table 7: Phonological correlates of affix distance

In short, the possessive constructions alone cannot explain the distribution of phonological processes, while the relative order of affixes can. The schema in (16) sketches a direct relationship between the types of possession and their phonological patterns. In this scenario, no phonological pattern is exclusive to a possessive construction.

(16)   Schematic representation of direct link between construction and phonology
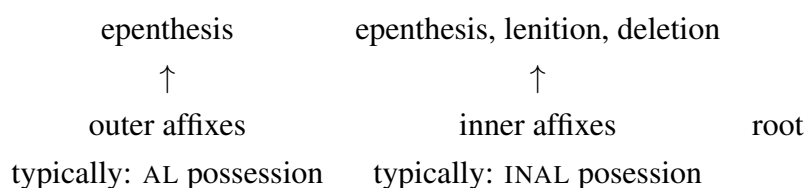   INAL possession   →   deletion, lenition, epenthesis
        AL possession   →   deletion, lenition, epenthesis

The crucial empirical insight of this paper is that phonological correlates in languages with alienability splits are indirect in the sense that the two types of possessive constructions are associated with two different morphophonological domains. Morphologically, pronominal affixes of inalienable possession tend to belong to the inner morphological domain, whereas pronominal affixes of alienable constructions attach in a more external position and belong to the outer morphological domain. Phonological rules are associated either with the inner domain only or

to the entire structure including inner and outer level. The indirect link between possessive constructions and phonological rules allows to capture the distribution of phonological processes: all sorts of phonological rules are possible in the inner domain, while phonological processes in the outer domain are limited to epenthetical processes. This idea is illustrated in (17). Observant readers will notice that the indirect link hits a snag: it is possible to predict phonological patterns from the relative position of an affix, but we cannot predict the position of an affix from the type of possession, since Ashéninka Apurucayali is a counter-example to the generalization that inalienable possession is typically closer to the root than alienable possession. Hence, the degree of predictability is similar to a scenario in which Ashéninka Apurucayali is assumed to be a counter-example to a direct link between possession construction and phonology. The important distinction here is that the indirect link has predictable and testable morphological effects, such as the relative order of affixes. Thus, we can infer the exceptionality of Ashéninka Apurucayali from the order of affixes, while the exceptionality has to be stipulated if we assume a direct link.

(17)   Schematic representation of indirect link mediated through position

epenthesis	epenthesis, lenition, deletion	
↑	↑	
outer affixes	inner affixes	root
typically: AL possession	typically: INAL posession	

These generalizations are strongly reminiscent of the empirical generalizations typically adduced in the framework of Lexical Phonology (Siegel 1974, Mohanan 1982, Kiparsky 1982, 1985, Myers 1991). In their work, Kiparsky (1985), Myers (1991) conclude that a variety of phonological rules may apply at the earliest level of the phonological derivation. These rules may in principle hold in later stages as well. However, no phonological rules may exclusively apply at later phonological levels. This observation is captured in the STRONG DOMAIN HYPOTHESIS, which is stated here in (18).

(18)   The Strong Domain Hypothesis   (Myers 1991: 383)
    a.   All rules are available at the earliest level of the phonology.
    b.   Rules may cease to apply, but may not begin to apply, at a later level by stipulation.

The empirical generalizations that can be drawn from Table 7 differ slightly from the predictions made by the Strong Domain Hypothesis: languages with two different phonological processes at different domains demonstrate that phonological rules may in fact begin at a later phonological cycle. Yet, a wide range of different phonological rules apply exclusively in the inner domain, while phonological processes of the outer domain are restricted to rules that do not modify existing phonological material of the noun root. In this sense, phonological rules of the inner domain are more *invasive* than processes applying exclusively in the outer domain.

3 Analytical options

So far, I have demonstrated that there are no direct phonological correlates of splits: no phonological process takes place exclusively in alienable or inalienable possession. Rather, phonological rules correspond to morphological domains, and hence the relative order of affixes within a morphological word. The empirical generalizations made in Section 2.5 are highly relevant for theoretical models discussing how syntactic structure is reflected in the phonology. In the following, I will elaborate on the phase-based approach by Newell & Piggott (2014), Newell et al. (2018), Newell (2021, 2022) framed in CVCV theory (Lowenstamm 1996, Scheer 2004, Scheer & Szigetvári 2005, Ségéral & Scheer 2008). Second, I will discuss what kind of assumptions are necessary in the framework of Standard Stratal Optimality Theory (Kiparsky 2000, Bermúdez-Otero & Luís 2009, Bermúdez-Otero 2011, 2016) in order to derive the empirical observations I make in this paper. Third, I will capitalize on Harmonic Layer Theory, a new cyclic version of Optimality Theory, which has recently been introduced by Trommer & Zimmermann (2021) and Zimmermann & Trommer (2022).
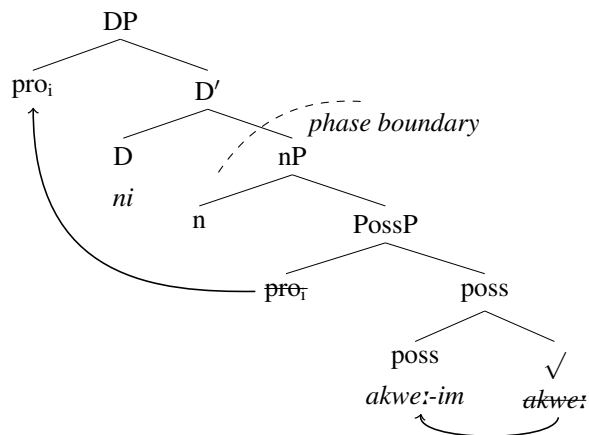
3.1 CVCV theory

Newell & Piggott (2014), Newell et al. (2018) discuss different hiatus resolution strategies in alienable and inalienable possession constructions in Ojibwe, which have already been discussed in Section 1. Crucially, the vowel hiatus between the vowel of the affix /i/ and the root-initial vowel is resolved through epenthesis in alienable possession but through deletion of the affix vowel in inalienable possession.

Newell & Piggott (2014), Newell et al. (2018) account for the different hiatus resolution strategies by stating the phonology makes reference to syntactic structure: in inalienable possession, possessor and possessum are interpreted within the same cycle, since the noun root undergoes head-movement to the possessor in D, illustrated here in (19).

(19)   Syntactic structure of inalienable possession   (Newell & Piggott 2014)
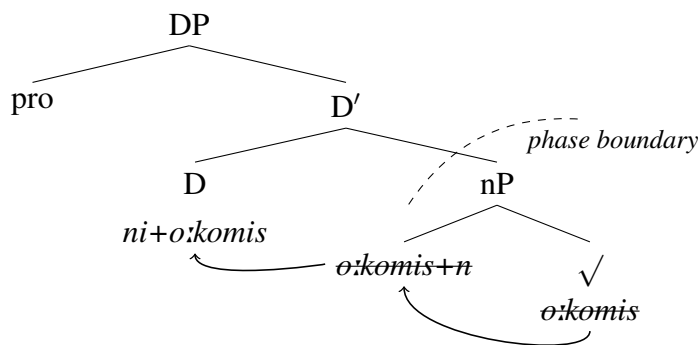

Alienable nouns have a different syntactic structure with a phase boundary between the position of the noun root and the position of the pronominal possessor, as shown in (20).

(20)   Syntactic structure of alienable possession   (Newell & Piggott 2014)

Newell (2021, 2022) makes a concrete suggestion on how syntactic structure is mapped onto phonological structure and frames her analysis in CVCV theory (Lowenstamm 1996, Scheer 2004, Scheer & Szigetvári 2005, Ségéral & Scheer 2008). In this theory, the phonological elements of phonological words are arranged along two different tiers: the timing tier and the melodic tier. Moreover, all phonological words consist exclusively of CV sequences, which are the only licit phonological items of the timing tier. This is exemplified in (21), where the timing tier consists of three consecutive CV sequences. The CV elements of the timing tier are generally associated with segments on the melodic tier. In (21), four positions of the timing tier are connected to segments on the melodic tier. Syntactic structure is crucial for the structure of the timing tier: at the edge of a phase, an empty CV sequence is attached to the left edge of the word, thus replacing the diacritic # edge marker in SPE (Chomsky & Halle 1996). In CVCV theory, two phonological elements can undergo a binary, asymmetrical relationship labelled GOVERNMENT. A crucial assumption made in CVCV theory is that non-empty vowels can govern maximally one element. Within CVCV theory, a position on the timing tier does not have to be associated with an overt phonological element on the melodic tier but may remain unpronounced if it can be governed by a following non-empty element. In (21), the empty V position at the left edge of the word can be governed by the first vowel of the root /papi/, thus resulting in a licit phonological object.

(21)   Example of licit phonological word in CVCV theory
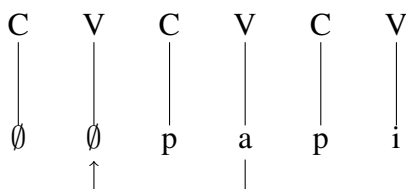

With respect to the phonological structure of possessive constructions, CVCV theory predicts that an empty CV sequence reflects the phase boundary between pronominal possessive affixes and alienable roots but not between pronominal affixes and inalienable nouns. Consequently, the presence or absence of this marker accounts for phonological asymmetries between the two

constructions. Recall the examples from Warembori, presented earlier as (4). In Warembori, root-initial stops lenite intervocalically in the context of the 1SG prefix /e/ only if the root is inalienable. Compare (4-b) where the first consonant of the inalienable root *boro* 'tongue' becomes [v] and (4-a) where the first consonant of the alienable root *bo* 'coconut' does not lenite in the same phonological context.

In CVCV theory, this asymmetry follows automatically from the different underlying syntactic structures of the two constructions. In inalienable possession, there is no phase boundary between the pronominal affixes and the root, and hence no empty CV sequence between the two elements, as shown in (22). Recall that vowels may only govern one element at at time. Since there are no empty vowels that have to be governed, the root-initial vowel has the chance to govern its own onset /b/, which consequently lenites to [v].

(22)   CVCV analysis of /e-boro/ → [evoro] in Warembori

```
C    V    C    V    C    V
|    |    |    |    |    |
|    |    |    |    |    |
∅    e    b    o    r    o
          ↑____|
```
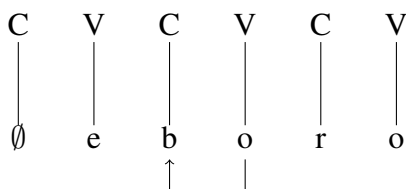
Alienable nouns, in contrast, have a different underlying syntactic structure with a phase boundary between the affix and the noun root. This phase boundary maps onto an empty CV sequences between the affix and the root, as shown in (23). Since empty vowels have to be governed by the first vowel of the root, the onset of the root *bo* remains ungoverned and does not lenite.
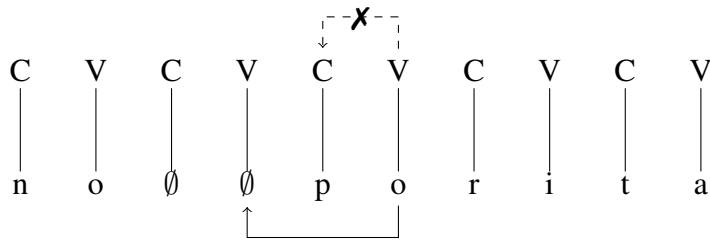
(23)   CVCV analysis of /e-bo/ → [ebo] in Warembori

```
C    V    C    V    C    V
|    |    |    |    |    |
|    |    |    |    |    |
∅    e    ∅    ∅    b    o
               ↑_____|
```
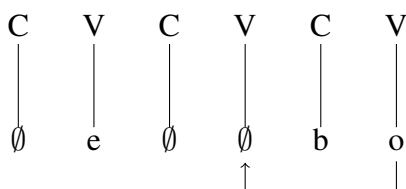
In Table 5, we have seen that Ashéninka Apurucayali displays the mirror image of Warembori in the sense that intervocalic lenition takes place only in the context of alienable noun roots. Crucially, the consonant of the alienable root *porita* 'hen' lenites to [w] whenever a CV-shaped pronominal prefix is attached. In inalienable nouns, however, the root-initial consonant remains a stop in the same context.

In fact, this pattern is highly problematic for CVCV theory. Under the assumption that alienable possession has a uniform syntactic structure across language, alienable possession involves a phase boundary and hence, an empty CV sequence on the timing tier. As a consequence, the first vowel of the root has to govern this empty vowel such that the first consonant of the root has to remain ungoverned and does not lenite. However, the example in (7-a) demonstrates that it is exactly this context in which lenition takes place.

(24)   CVCV analysis of /no-porita/ → [noworita] in Ashéninka Apurucayali

```
          ┌─✗─┐
          ↓    
C   V   C   V   C   V   C   V   C   V
│   │   │   │   │   │   │   │   │   │
│   │   │   │   │   │   │   │   │   │
n   o   ∅   ∅   p   o   r   i   t   a
        └───────┘
         ↑
```

In contrast, root-initial consonants are expected to lenite in inalienable possession constructions. Since there is no edge-marking CV sequence in this structure, the first vowel of the root *pori* has no governing duties with respect to empty vowels. Instead, it governs its own onset which is then expected to lenite. Again, this is the opposite of the pattern demonstrated in (7-b).

(25)   CVCV analysis of /no-pori/ → [nopori] in Ashéninka Apurucayali

```
C   V   C   V   C   V
│   │   │   │   │   │
│   │   │   │   │   │
n   o   p   o   r   i
        └───┘
         ↑
```
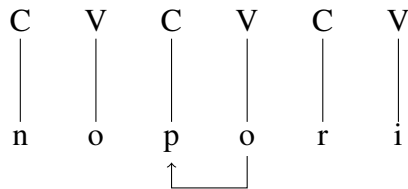
In sum, it seems that CVCV theory easily predicts that there are phonological differences between alienable and inalienable constructions, which are assumed to arise from different underlying syntactic structure. An analysis like this seems appealing as long as there is independent, phrase-structural evidence for a uniform underlying syntactic structure of alienable possession on the one hand and inalienable possession on the other hand. While Newell et al. (2018) provide independent evidence for the syntactic structure of the two possessive constructions in Ojibwe, evidence for a similar syntactic structure in other languages is not always given. In Warembori, for example, there is no overt POSS head. Moreover, CVCV theory cannot derive the empirical picture found in Ashéninka Apurucayali. As an avenue of escape, it could be assumed that the underlying syntactic structure in Ashéninka Apurucayali is different such that there is a phase boundary in inalienable possession rather than in alienable possession. As of today, there is no justified reason for this assumption, as the alienability split in Ashéninka Apurucayali fully patterns with the possession constructions found in other languages in morphological and semantic terms.

3.2   Standard Stratal Theory

The pattern found in Ashéninka Apurucayali vividly demonstrates that theoretical models like CVCV theory (Lowenstamm 1996, Scheer 2004, Scheer & Szigetvári 2005, Ségéral & Scheer 2008, Newell 2021, 2022) which establish a *direct* link between syntax and phonology undergenerate, since they are not able to predict languages in which intervocalic lenition apply across phase boundaries. A possible theoretical model which captures this phenomenon is Standard

Stratal Optimality Theory (SSOT) (Kiparsky 2000, Bermúdez-Otero & Luís 2009, Bermúdez-Otero 2011, 2016). As a derivational variant of Standard Parallel Optimality Theory (Prince & Smolensky 1993), phonological rules are implemented through a set of violable, rankable and universal rules, which are referred to as CONSTRAINTS. The grammars of each individual language results from an individual ranking of these constraints. In SSOT, the crucial assumption is the division of computational labour into three consecutive domains, which are referred to as STRATA. In contrast to Standard Parallel OT, the ranking, and thus the output of the phonological grammar, may change from one stratum to the next, a mechanism which allows to capture phonological asymmetries between inner affixes and outer affixes. Affixes may enter the morphophonological derivation at any stratum. The membership of a given affix to a specific stratum is lexically determined and arbitrary, although suggestions in Bermúdez-Otero (2011, 2016, 2019) aim to provide a systematic explanation for the connection of syntactic structure and phonological strata. A concrete suggestion with respect to the number of domains comes from Bermúdez-Otero (2011), who assumes three different levels:

1. the STEM-LEVEL comprises the root and some derivational affixes
2. the WORD-LEVEL comprises the stem and inflectional affixes
3. the PHRASE-LEVEL comprises entire utterances and clitic-like affixes

Let me refer back to intervocalic lenition in Warembori to explain how the mechanisms of SSOT work. As mentioned in Section 2.5 in (17), pronominal affixes in alienable constructions attach at a later morphological level than pronominal affixes in inalienable constructions. In SSOT, this split is implemented by connecting inalienable possession to the stem level, whereas alienable affixes would be associated with word-level computation. The phonological computation of the stem-level in Warembori is exemplified in (27). In order to derive intervocalic lenition, I assume the following set of constraints:

(26)   Constraints involved in intervocalic lenition

   a.   *VC$_{[-\text{CONT}]}$V: Assign a * for each [-cont,-son] segment between two [-cons] segments.

   b.   MAX: Assign a * for each input segment which has no corresponding segment in the output.

   c.   DEP: Assign a * for each output segment which has no corresponding segment in the input.

   d.   ID(ENT): Assign a * for each input feature which has a different value in the output.

Four different output candidates are conceivable. In candidate a), the input is mapped straightforwardly onto the surface. Since it includes a stop between two vowels, *VC$_{[-\text{CONT}]}$V is fatally violated. Candidate b) includes a variant of the input in which the stop lenites to [v]. This candidate violates ID, but becomes optimal, since ID is the lowest-ranked of the faithfulness

constraints constraints. Candidate c) does not include an intervocalic stop either but violates MAX, which is higher ranked than ID. Similarly, candidate d) epenthesizes a homorganic nasal to resolve the intervocalic stop, however, it violates DEP. As a result, the high ranking of the markedness constraint *VC$_{[\text{-CONT}]}$V and the low ranking of ID predicts the observed process of intervocalic lenition at the stem-level in Warembori.

(27)   SSOT analysis of stem-level possession for *boro* 'tongue' in Warembori

/e-boro-ro/	*VC$_{[\text{-CONT}]}$V	MAX	DEP	ID
a. ebororo	*!			
☞ b. evororo				*!
c. bororo		*!		
d. embororo			*!	

In alienable possession, affixes attach at word-level. Crucially, the universal constraints have a different ranking than at stem-level: the markedness constraint *VC$_{[\text{-CONT}]}$V is lower-ranked than all faithfulness constraints. This is illustrated in (28). Since the markedness constraint is now the lowest-ranked constraint, candidate a), in which the input is mapped directly onto the output, becomes optimal, while modified variants of the input in candidates b) to d) violate one of the higher ranked faithfulness constraints.

(28)   SSOT analysis of word-level possession for *bo* 'coconut' in Warembori

/e-bo-ro/	MAX	DEP	ID	*VC$_{[\text{-CONT}]}$V
☞ a. eboro				*!
b. evoro			*!	
c. boro	*			
d. emboro		*!		

While CVCV theory faces problems with the fact that Warembori and Ashéninka Apurucayali are mirror images of each other, since intervocalic lenition applies only in inalienable possession in Warembori but in alienable possession in Ashéninka Apurucayali, this observation is not problematic for SSOT at all. Following the observation that alienable affixes are closer to the root than inalienable affixes in Ashéninka Apurucayali, it is reasonable to assume that alienable possessive affixes attach at stem-level in Ashéninka Apurucayali, while inalienable affixes attach at word-level. In short, the derivations of the patterns in Ashéninka Apurucayali and Warembori are similar, since the relative positions of the affixes are similar. Since the membership of affixes to a particular stratum is lexical, SSOT can easily capture the exceptionality of Ashéninka Apurucayali. Nonetheless, the question arises how SSOT derives the crosslinguistic tendency that a higher number of phonological processes take place in the inner domain. In fact, SSOT does not derive this generalization in its original form, since constraint reranking from

one stratum to the next is not restricted at all. Thus, the phonological grammars between two strata are not related. In order to capture the crosslinguistic tendencies set up in Section 2.5, it is therefore necessary to impose restrictions on reranking. The concrete suggestion I make in this paper is that markedness constraints can only be lowered across faithfulness constraints from one stratum to the next one. In this sense, the rankings of different strata within one language are related since the word-level and phrase-level rankings are derived from the ranking of the stem-level. As a consequence, reranking can only stop the application of processes at a later level but not initiate a process at a later level, thus deriving the Strong Domain Hypothesis in (18). However, I conclude in Section 2.5 that epenthetis may in fact apply exclusively in outer domains. In order to derive this pattern, reranking of the epenthesis-preventing constraint DEP has to be regulated as well. Crucially, I assume that markedness constraints and DEP may lower across other faithfulness constraints such as MAX or IDENT, while MAX or IDENT cannot be lowered. These assumptions derive patterns like Abui, where epenthesis resolves vowel hiatus at word-level (alienable possession), while deletion prevents vowel sequences in inalienable possession.

I will illustrate the exact implementation of the restrictions on reranking in the tableaux in (29) and (31). In Abui, vowel hiatus causes deletion of the affix vowel at the stem-level. In (29), the constraint *VV penalizes each sequence of two vowels with a violation mark *. The input-faithful candidate a) is ruled out, since it fatally violates the top-ranked markedness constraint *VV. Candidates b) to d) are variants of the input, in which vowel hiatus is resolved through deletion (candidate b), epenthesis (candidate c) or a shift from vowel to consonant (candidate d). Out of these candidates, candidate b) becomes optimal, since it violates the lowest-ranked markedness constraint MAX.[3]

(29)   SSOT analysis of stem-level possession for ɔɪ 'vagina' in Abui

/nɑ-ɔɪ/	*VV	DEP	ID	MAX
a. nɑɔɪ	*!			
☞ b. nɔɪ				*!
c. nɑʔɔɪ		*!		
d. nɑʔɪ			*!	

At word-level, constraints are reranked. As illustrated in (30), the markedness constraint *VV and DEP are ranked across the two faithfulness constraints MAX and ID.

---

[3]The constraints in (29) do not ensure that it is the affix vowel and not the stem vowel which gets deleted. In this study, both root vowel deletion and affix vowel deletion are attested vowel hiatus resolution strategies. Hence, an orthogonal constraint, which does not make reference to morphological categories like root or affix, is necessary. A possibility would be a constraint which referred to the phonological context of the deleted vowels, such as $MAX_{[-CONS]/[-CONS]\_\_}$ which penalizes the deletion of vowels after another vowel. This constraint would then rank above $MAX_{[-CONS]/[+CONS]\_\_}$, a constraint which penalizes the deletion of vowels after consonants.

(30)   Reranking of constraints from stem-level to word-level in Abui

~~*VV~~ ~~DEP~~   ID   MAX *VV DEP

As a result of this restricted reranking, deletion is not the optimal hiatus resolution strategy, as candidate b) with a deleted vowel now fatally violates a high-ranked constraint MAX. Due to the low ranking of DEP, candidate c) with a epenthesized ʔ becomes optimal.

(31)   SSOT analysis of word-level possession for *ʊra* 'sibling' in Abui

/nɛ-ʊra/	ID	MAX	*VV	DEP
a. nɛʊra			*!	
b. nʊra		*!		
☞ c. nɛʔʊra				*
d. nɛʔa	*!			

As we have seen in Section 2.5, phonological asymmetries across different domains are restricted to patterns where deletion cannot be initiated at the outer phonological domain. This observation is fully captured by stipulating restrictions on reranking. Moreover, restricted reranking also accounts for the fact that root material is never deleted by processes initiated in a later domain, since constraints referring to existing material cannot be ranked lower, thus protecting material of earlier phonological domains.

3.3   Harmonic Layer Theory

Harmonic Layer Theory (HLT) is a derivational variant of Standard Parallel OT which has recently been introduced by Trommer & Zimmermann (2021), Zimmermann & Trommer (2022). Following the assumptions of Standard Stratal OT, it hits upon the idea that affixes are connected to one of three different morphophonological domains (stem, word and phrase), which are called LAYERS. In contrast to SSOT, the difference in the phonological behaviour of affixes across domains is not assumed to arise from a reranking of constraints but from a change in the ACTIVITY of phonological elements. In particluar, linguistic elements have gradient activities (Rosen 2016, Smolensky & Goldrick 2016, Zimmermann 2018a,b, Trommer & Zimmermann 2021, Zimmermann & Trommer 2022) that result in gradient constraint violations. Hence, phonological elements become weaker or stronger from one layer to the next in the sense that, due to a change in activity, one and the same phonological item may behave differently in the same phonological context. In short, different phonological behaviour results from a single phonological grammar, i.e. the same constraint ranking, as opposed to SSOT, in which optimizations apply at different strata with potentially different rankings. The advantage of HLT over SSOT lies in its restrictedness: reranking within SSOT (at least in its original form) is not restricted, while a gradient change of activities makes testable predictions.

Tableau (33) illustrates how intervocalic lenition at the stem layer in Warembori is derived in HLT. Crucially, all phonological items are born with a certain activity. In this paper, I assume the default activity to be 1.0. Since the pronominal affixes of inalienable possession are assumed to attach already at stem level, their segments will have the same activity as the segments of the root. Following the ideas of Harmonic Grammar (Legendre et al. 1990, Smolensky & Legendre 2006, Potts et al. 2010), constraints are not strictly ranked but weighted. In Harmonic Grammar, each constraint violation the different candidates receive are multiplied with the respective constraint weight. All violations of one and the same candidate are then summed up to form a HARMONY SCORE, which is marked as $\mathcal{H}$. The candidates with the best harmony score becomes optimal. At stem-level, all segments have an activity of 1.0. In order to derive intervocalic lenition, the markedness constraint *VC$_{[-\text{CONT}]}$V works slightly differently: it penalizes each [–cont] segment couched between two vowels. This is illustrated in (32), which offers HLT-specific constraint definitions.

(32)   Constraint definitions in HLT

   a.   *VC$_{[-\text{CONT}]}$V: For each [-cont, -son] segment which appears between two [-cons] segments, assign -X violations for the first [-cons] segment with an activity of X and -Y violations for the second [-cons] segment with an activity of Y.

   b.   MAX: Assign -X violations for each input segment with an activity of X which has no corresponding segment in the output.

   c.   DEP: Assign -X violations for each output segment with an activity of X which has no corresponding segment in the input.

   d.   ID(ENT): Assign -X violations for each input feature of a segment with an activity of X which has a different value in the output.

The numerical value of the violation *VC$_{[-\text{CONT}]}$V is the sum of the activity of these vowels. In (33), candidate a) violates this constraint, since it includes a stop between two vowels. Both vowels have an activity of 1.0, so the resulting violation value for a stop between two vowels is -2. Since *VC$_{[-\text{CONT}]}$V has a weight of 2, the harmony score of candidate a) is -4. The faithfulness constraints DEP, MAX and ID operate in a traditional fashion. In HLT, deleted segments are assumed to have an activity of 0.0. In the tableau in (33), candidate b) with a lenis consonant becomes optimal, as it has the highest cumulative harmony score, since it reaches a harmony score of only -3.8 due to a -1 violation of ID with a weight of 3.8. Candidate c) with a deleted initial vowel and candidate d) with an epenthesized nasal consonant are ruled out, since they violate constraints with a relatively high weight.

(33)   HLT analysis of stem-layer possession for *boro* 'tongue' in Warembori

$/e_{1.0}\text{-}b_{1.0}o_{1.0}r_{1.0}o_{1.0}\text{-}r_{1.0}o_{1.0}/$	MAX w=10	DEP w=10	ID w=3.8	$*VC_{[-CONT]}V$ w=2	$\mathcal{H}$
a. $e_{1.0}b_{1.0}o_{1.0}r_{1.0}o_{1.0}r_{1.0}o_{1.0}$	0	0	0	-2	-4
b. ☞ $e_{1.0}v_{1.0}o_{1.0}r_{1.0}o_{1.0}r_{1.0}o_{1.0}$	0	0	-1	0	-3.8
c. $e_{0.0}b_{1.0}o_{1.0}r_{1.0}o_{1.0}r_{1.0}o_{1.0}$	-1	0	0	0	-10
d. $e_{1.0}m_{1.0}b_{1.0}o_{1.0}r_{1.0}o_{1.0}r_{1.0}o_{1.0}$	0	-2	0	0	-20

In contrast to SSOT, there is no constraint reranking or reweighting at the word-level. However, the activity of segments changes. In this paper, I assume that the activity of phonological elements of the stem-level is reduced by 0.2. A derivation of the word-level in Warembori is illustrated in (34). Crucially, the segments of the root *bo* already entered the derivation at stem-level with full activities of 1.0. At word-level, their activities are now reduced to 0.8. Elements which are attached at word-level, however, like the alienable pronominal affix *e*, have a full activity of 1.0. As a consequence, the structure of a stop couched between two vowels causes a violation of only -1.8. At this point, HLT as proposed by Trommer & Zimmermann (2021), Zimmermann & Trommer (2022) faces a problem. Not only is the markedness constraint violated less, but also the faithfulness constraint ID, since changing features of the root-initial consonant with a reduced activity of 0.8 would yield a harmony score of -3.04. Consequently, candidate b) with intervocalic lenition becomes optimal, although candidate a) is the observed output.

(34)   HLT analysis of word-layer possession for *bo* 'coconut' in Warembori

$/e_{1.0}\text{-}b_{0.8}o_{0.8}\text{-}r_{0.8}o_{0.8}/$	MAX w=10	DEP w=10	ID w=3.8	$*VC_{[-CONT]}V$ w=2	$\mathcal{H}$
a. ✗ $e_{1.0}b_{0.8}o_{0.8}\text{-}r_{0.8}o_{0.8}$	0	0	0	-1.8	-3.6
b. ☞ $e_{1.0}v_{0.8}o_{0.8}\text{-}r_{0.8}o_{0.8}$	0	0	-0.8	0	-3.04
c. $e_{1.0}b_{0.8}o_{0.8}\text{-}r_{0.8}o_{0.8}$	-1	0	0	0	-10
d. $e_{1.0}m_{1.0}b_{0.8}o_{0.8}\text{-}r_{0.8}o_{0.8}$	0	-1.8	0	0	-18

In short, a general problem is that gradient constraint violations do not only cause markedness constraints to become less relevant, but they also cause faithfulness constraints to be violated more cheaply. Hence, phonological repairs affecting root material become more likely at a later layer, since modification or deletion of the root material becomes cheaper. As a consequence, I deviate from the original version of HLT suggested by Trommer & Zimmermann (2021), Zimmermann & Trommer (2022) in assuming that not all constraints can be violated gradiently

but only markedness constraints and DEP. Other faithfulness constraints can only be violated categorically as in SPOT or SSOT, which is implemented by assuming that each * creates a violation of -1. Consequently, markedness constraints and DEP will be sensitive to changes in activity, while other faithfulness constraints are blind to the activity of phonological elements. The updated constraint definitions are listed in (35).

(35)　　Updated constraint definitions in HLT

    a.　$*VC_{[-CONT]}V$: For each [-cont, -son] segment which appears between two [-cons] segments, assign -X violations for the first [-cons] segment with an activity of X and -Y violations for the second [-cons] segment with an activity of Y.

    b.　MAX: Assign a * for each input segment which has no corresponding segment in the output.

    c.　DEP: Assign -X violations for each output segment with an activity of X which has no corresponding segment in the input.

    d.　ID(ENT): Assign a * for each input feature of a segment which has a different value in the output.

In the end, these assumptions will have a similar effect as imposing restrictions on reranking. This is illustrated in (36), where gradiently violated constraints are marked by numerical violation marks (e.g. -1), whereas categorically violated constraints are marked by the violation mark *. At the stem-layer, this assumption makes the same predictions as the original version of HLT, since all segments have the full activity of 1.0 and will yield -1 violations independent of whether a constraint is gradually or categorically violated.

(36)　　HLT of stem-layer possession for *boro* 'tongue' in Warembori (revised)

$/e_{1.0}\text{-}b_{1.0}o_{1.0}r_{1.0}o_{1.0}\text{-}r_{1.0}o_{1.0}/$	MAX w=10	DEP w=10	ID w=3.8	$*VC_{[-CONT]}V$ w=2	$\mathcal{H}$
a.　　$e_{1.0}b_{1.0}o_{1.0}r_{1.0}o_{1.0}r_{1.0}o_{1.0}$	0	0	0	-2	-4
b.　☞　$e_{1.0}v_{1.0}o_{1.0}r_{1.0}o_{1.0}r_{1.0}o_{1.0}$	0	0	*	0	-3.8
c.　　$e_{0.0}b_{1.0}o_{1.0}r_{1.0}o_{1.0}r_{1.0}o_{1.0}$	*	0	0	0	-10
d.　　$e_{1.0}m_{1.0}b_{1.0}o_{1.0}r_{1.0}o_{1.0}r_{1.0}o_{1.0}$	0	-2	0	0	-20

At the word-layer, the distinction between the gradually violated constraints $*VC_{[-CONT]}V$ and DEP on the one side and categorically violated constraints ID and MAX on the other becomes relevant. Since $*VC_{[-CONT]}V$ is sensitive to the reduced activity of the root-initial consonant $/b_{0.8}/$, the harmony score of the input candidate a) in (37) is -3.6. However, ID is blind to activities and is always violated with -1 for each segment with a featural change. Thus, candidate b) has the same harmony score of -3.8 at word-level in (37) as it has at stem-level in (36). Since

the VCV sequence becomes less marked due to the reduced activities at word-level, candidate a) becomes optimal.

(37) HLT analysis of word-layer possession for *bo* 'coconut' in Warembori (revised)

$/e_{1.0}\text{-}b_{0.8}o_{0.8}r_{0.8}o_{0.8}\text{-}r_{0.8}o_{0.8}/$	MAX w=10	DEP w=10	ID w=3.8	$*VC_{[-CONT]}V$ w=2	$\mathcal{H}$
a. ☞ $e_{1.0}b_{0.8}o_{0.8}\text{-}r_{0.8}o_{0.8}$	0	0	0	-1.8	-3.6
b. $e_{1.0}b_{0.8}o_{0.8}\text{-}r_{0.8}o_{0.8}$	0	0	*	0	-3.8
c. $e_{1.0}b_{0.8}o_{0.8}\text{-}r_{0.8}o_{0.8}$	*	0	0	0	-10
d. $e_{1.0}m_{1.0}b_{0.8}o_{0.8}\text{-}r_{0.8}o_{0.8}$	0	-1.8	0	0	-18

In short, this modified version of HLT captures the link between the relative position of the affixes and phonological density by associating affixes with morphophonological layers in the lexicon. The distinction between gradually violated constraints and categorically violated constraints captures the observation that, since phonological markedness is more relevant at early layers, more phonological processes occur in the inner domain

4   Conclusion

In this paper, I provide an exhaustive empirical overview of the phonological patterns of alienability splits in possession. I argue that there are no direct correlates of alienability splits: no phonological pattern applies exclusively in alienable or inalienable possession. Instead, I argue that alienable possessive affixes typically attach in positions external to inalienable possession and demonstrate that we find phonological correlates of the relative distance of affixes. Concretely, a higher number and variety of phonological processes applies in affixes attaching in earlier domains, while phonological processes in outer domains are restricted to less invasive processes like epenthesis or assimilation. In Section 3, I compare three different analyses of the syntax-morphophonology interface, concluding that none of the theories can derive the empirical pattern without additional assumptions. The results of the case study presented in this paper open a few questions that remain open: Does the empirical generalization established in this paper hold for the relative order of affixes in the verbal domain? Is it possible to substantiate and explain the concept of PHONOLOGICAL INVASIVENESS? Further studies on phonological asymmetries between different types of affixes and their relative positions will have to contribute to the question which of the existing frameworks proves to make the most realistic predictions.

Appendix

(38)   Possession in Ojibwe   (Valentine 2001: 199f), (Newell et al. 2018: 1)

    a.   /ni-akweː-im/
        [nidakweːm]
        1-woman-POSS
        'my woman (wife)'   alienable

    b.   /ni-emkwaːn/
        [ndemkwaːn]
        1-spoon
        'my spoon'   alienable

    c.   /ni-oːkomis/
        [noːkomis]
        1-grandmother
        'my grandmother'   inalienable

    d.   /ni-iːbid/
        [niːbid]
        1-tooth
        'my tooth'   inalienable

(39)   Possession in Asmat   (Voorhoeve 1965: 134, 144, 150, 159)

    a.   /no cí/
        [no cí]
        1   canoe
        'my canoe'   alienable

    b.   /no ém/
        [no ém]
        1   drum
        'my drum'   alienable

    c.   /no   wís/
        [nur wís]
        1   sister-in-law
        'my sister-in-law'   inalienable

    d.   /no   ém/
        [nor ém]
        1   wife
        'my wife'   inalienable

(40)   Possession in Ulwa   (Green 1999: 79)

    a.   /waiku-ma/
        [waikuma]
        moon-2SG
        'your moon'   alienable

    b.   /asuŋ-ni/
        [asiŋ-ni]
        liver-1INCL

        'our (incl.) liver'   inalienable

c.   /asuŋ-ki/
      [asiŋ]
      liver-1SG
      'my liver'   inalienable

(41)   Possession in Kui   (Windschuttel & Shiohara 2017: 123)

a.   /ga-alor/
      [ga.a.lor]
      3SG-side
      'his side'   alienable

b.   /na-o/
      [na.o]
      1SG-house
      'my house'   alienable

c.   /ga-en/
      [gen]
      3SG-eye
      'his eye'   inalienable

d.   /ga-nei/
      [gənei]
      3SG-name
      'his name'

(42)   Possession in Limbu

a.   /kɛ-sapla/
      [kɛsapla]
      2SG-book
      'your book'   alienable

b.   /a-waʔ/
      [awaʔ]
      1SG-chicken
      'my chicken'   alienable

c.   /a-pa/
      [amba]
      1SG-father
      'my father'   inalienable

d.   /kɛ-phonaʔ/
      [kɛmbhonaʔ]
      2SG-uncle
      'your uncle'   inalienable

(43)   Possession in Turkish   (Erdal 2010)

a.   //koyun-Vn//
      [koyunun]
      sheep-2/3SG.POSS
      'your/his/her sheep'   alienable

    b.   /kayın/-Vn
       [kaynının]
       beech-2/3SG.POSS
       'your/his/her beech'   alienable

    c.   //koyun-Vn//
       [koynun]
       bosom-2/3SG.POSS
       'your/his/her bosom'   inalienable

    d.   /kayın/-Vn
       [kaynın]
       brother-in-law-2/3SG.POSS
       'your/his/her brother-in-law'   inalienable

(44)   Possession in Yucatec Maya   (Lehmann 1998)

    a.   /u   k'ab/
       [u   k'ab]
       3SG hand/arm
       'his/her hand/arm'   inalienable

    b.   /u   íicham/
       [u   yíicham]
       3SG spouse
       'his/her spouse'   inalienable

(45)   Possession in Acholi   (Bavin 1995: 852f)

    a.   /bad-na/
       [badda]
       leg-1SG
       'my leg (of a slaughtered animal)'   alienable

    b.   /buk-na/
       [bukka]
       book-1SG
       'my book'   alienable

    c.   /bad-na/
       [bada]
       leg-1SG
       'my leg'   inalienable

    d.   /obo-ni/
       [oboni]
       lung-2SG
       'your lung'

References

Aikhenvald, Alexandra Y. 2021. Removing the owner: Non-specified possessor marking in arawak languages. *Studia Linguistica* 75(2). 175–233.

Applegate, Richard Brian. 1972. *Ineseño chumash grammar*: University of California at Berkeley dissertation.

Bavin, Edith L. 1995. Body parts in Acholi: alienable and inalienable distinctions and extended uses. In William McGregor Hilary Chappell (ed.), *The grammar of inalienability: A typological perspective on body part terms and the part-whole relation* Empirical Approaches to Language Typology 14, 841–864. Berlin/New York: Mouton de Gruyter.

Bermúdez-Otero, Ricardo. 2011. The architecture of grammar and the division of labour in exponence. In Jochen Trommer (ed.), *The morphology and phonology of exponence*, vol. 41, 8–83. Oxford: Oxford University Press.

Bermúdez-Otero, Ricardo. 2016. Stratal phonology. In *The Routledge handbook of phonological theory*, 100–134. London: Routledge.

Bermúdez-Otero, Ricardo. 2019. Nonanalytic listing and the theory of the stem level. Lecture given at Leipzig University.

Bermúdez-Otero, Ricardo & Ana R Luís. 2009. Cyclic domains and prosodic spans in the phonology of European Portuguese functional morphs. In *Workshop on the division of labour between morphology and phonology & fourth meeting of the network 'core mechanisms of exponence'. meertens instituut, amsterdam*, vol. 16, .

Berry, Keith & Christine Berry. 1999. *A description of abun: a west papuan language of irian jaya*, vol. 115 Pacific Linguistics: Series B. Canberra: Research School of Pacific and Asian Studies, Australian National University.

Bickel, Balthasar & Johanna Nichols. 2013. Obligatory possessive inflection. In Matthew S. Dryer & Martin Haspelmath (eds.), *The world atlas of language structures online*, Leipzig: Max Planck Institute for Evolutionary Anthropology. https://wals.info/chapter/58.

Broadwell, George Aaron. 2006. *A Choctaw reference grammar*. U of Nebraska Press.

Chomsky, Noam & Morris Halle. 1996. *The sound pattern of English*. New York: Harper & Row.

Dahl, Östen & Maria Koptjevskaja Tamm. 1998. Alienability splits and the grammaticalization of possessive constructions. In *Papers from the xvith scandinavian conference of linguistics*, Turku: University of Turku and Åbo Akademi.

Dahl, Östen & Maria Koptjevskaja Tamm. 2001. Kinship in grammar. In Irène Baron, Michael Herslund & Finn Sørensen (eds.), *Dimensions of possession*, vol. 47 Typological studies in language, 201–226. Amsterdam/Philadelphia: John Benjamins.

Dienst, Stefan. 2014. *A grammar of Kulina*. Berlin/Boston: De Gruyter Mouton.

Donohue, Mark. 1999. *Warembori*, vol. 341 Languages of the World/Materials. München: Lincom.

Erdal, Marcel. 2010. Inalienability and syncopation in Turkish. *Turcology in Mainz-Turkologie in Mainz* 147–153.

Fenger, Paula. 2020. *Words within words: The internal syntax of verbs*: University of Connecticut dissertation.

Green, Thomas Michael. 1999. *A lexicographic study of Ulwa*: Massachusetts Institute of Technology dissertation.

Haiman, John. 1983. Iconic and economic motivation. *Language* 781–819.

Haiman, John. 1985. *Natural syntax. iconicity and erosion* (Cambridge Studies in Linguistics London 44). Cambridge: Cambridge University Press.

Haspelmath, Martin. 2008. Frequency vs. iconicity in explaining grammatical asymmetries. *Cognitive Lingustics* 19(1). 1–33. doi:doi:10.1515/COG.2008.001. https://doi.org/10.1515/COG.2008.001.

Haspelmath, Martin. 2017. Explaining alienability contrasts in adpossessive constructions: Predictability vs. iconicity. *Zeitschrift für Sprachwissenschaft* 36(2). 193–231.

Hay, Jennifer. 2002. From speech perception to morphology: Affix ordering revisited. *Language* 527–555.

Hay, Jennifer & Harald Baayen. 2002. Parsing and productivity. In *Yearbook of morphology 2001*, 203–235. Dordrecht: Springer.

Hay, Jennifer & Ingo Plag. 2004. What constrains possible suffix combinations? On the interaction of grammatical and processing restrictions in derivational morphology. *Natural Language & Linguistic Theory* 22(3). 565–596.

Hay, Jennifer B & R Harald Baayen. 2005. Shifting paradigms: Gradient structure in morphology. *Trends in cognitive sciences* 9(7). 342–348.

Kiparsky, Paul. 1982. Lexical phonology and morphology, 3–91. Hanshin.

Kiparsky, Paul. 1985. Some consequences of lexical phonology. *Phonology* 2(1). 85–138.

Kiparsky, Paul. 2000. Opacity and cyclicity. *The Linguistic Review* 17(2-4). 351–366.

Koch, Harold. 1995. The creation of morphological zeroes. In Geert Booij & Jaap van Marle (eds.), *Yearbook of morphology 1994*, 31–71. Springer.

Koptjevskaja-Tamm, Maria. 1996. Possessive noun phrases in Maltese: Alienability, iconicity and grammaticalization. *Rivista di Linguistica* 1(8). 245—-274.

Kratochvíl, František. 2007. *A grammar of Abui*: Universiteit Leiden dissertation.

Legendre, Géraldine, Yoshiro Miyata & Paul Smolensky. 1990. *Harmonic Grammar: A formal multi-level connectionist theory of linguistic well-formedness: Theoretical foundations*. Citeseer.

Lehmann, Christian. 1998. *Possession in yucatec: structures - functions - typology*, vol. 4 LINCOM Studies in Native American Linguistics. München: Lincom Europa.

Lowenstamm, Jean. 1996. Cv as the only syllable type. In Jacques Durand & Bernard Laks (eds.), *Current trends in phonology: Models and methods*, vol. 2, 419–441. ESRI Salford, University of Salford.

Miller, Wick R. 1965. *Acoma grammar and texts*, vol. 40 University of California Publications in Linguistics. Berkeley: University of California Press.

Mohanan, Karuvannur Puthanveettil. 1982. *Lexical phonology*: Massachusetts Institute of Technology dissertation.

Myers, Scott. 1991. Structure preservation and the strong domain hypothesis. *Linguistic Inquiry* 22(2). 379–385. http://www.jstor.org/stable/4178728.

Newell, Heathe, Glyne Piggott & Lisa Travis. 2018. The possessive structure of Ojibwe: Support from cupeño. In *Proceedings of the workshop on the structure and constituency of languages of the Americas*, vol. 21, 169–184.

Newell, Heather. 2021. Deriving Level 1/Level 2 affix classes in English: Floating vowels, cyclic syntax. *Acta Linguistica Academica* 68(1-2). 31–76.

Newell, Heather. 2022. Syntax, phonology, specifiers, and underspecification. Talk given at IGRA colloquium on July 6, 2022.

Newell, Heather & Glyne Piggott. 2014. Interactions at the syntax–phonology interface: Evidence from Ojibwe. *Lingua* 150. 332–362.

Nichols, Johanna. 1988. On alienable and inalienable possession. In William Shipley (ed.), *In honor of mary haas*, 557–610. Berlin: De Gruyter Mouton.

Payne, David L. 1981. *The phonology and morphology of Axininca Campa*, vol. 66 Summer Institute of Linguistics Publications in Linguistics. Dallas: Summer Institute of Linguistics.

Plag, Ingo. 2002. The role of selectional restrictions, phonotactics and parsing in constraining suffix ordering in English. In Geert Booij & Jaap van Marle (eds.), *Yearbook of morphology 2001*, 285–314. Dordrecht: Springer.

Plag, Ingo & Harald Baayen. 2009. Suffix ordering and morphological processing. *Language* 85(1). 109–152.

Potts, Christopher, Joe Pater, Karen Jesney, Rajesh Bhatt & Michael Becker. 2010. Harmonic grammar with linear programming: from linear systems to linguistic typology. *Phonology* 27(1). 77–117.

Prince, Alan & Paul Smolensky. 1993. Optimality Theory: Constraint interaction in generative grammar. Tech. rep. RuCCS-TR-2 at Rutgers University.

Rosen, Eric. 2016. Predicting the unpredictable: Capturing the apparent semiregularity of rendaku voicing in Japanese through Harmonic Grammar. In Emily Clem, Virginia Dawson, Alice Shen, Amalia Horan Skilton, Geoff Bacon, Andrew Cheng & Erik Hans Maier (eds.), *Proceedings of bls 42*, 235–249. Berkeley: Berkeley Linguistic Society.

Scheer, Tobias. 2004. *A lateral theory of phonology: What is CVCV, and why should it be?* Berlin/New York: Walter de Gruyter.

Scheer, Tobias & Péter Szigetvári. 2005. Unified representations for stress and the syllable. *Phonology* 22(1). 37–75.

Ségéral, Philippe & Tobias Scheer. 2008. The Coda Mirror, stress and positional parameters. In Joaquim Brandão de Carvalho, Tobias Scheer & Philippe Ségéral (eds.), *Lenition and fortition*, 483–518. Berlin: Mouton de Gruyter.

Siegel, Dorothy Carla. 1974. *Topics in english morphology*: Massachusetts Institute of Technology dissertation.

Smolensky, Paul & Matthew Goldrick. 2016. Gradient symbolic representations in grammar:

The case of French liaison. *Rutgers Optimality Archive* 1552. 1–37.

Smolensky, Paul & Géraldine Legendre. 2006. *The harmonic mind: From neural computation to Optimality-Theoretic grammar*. Cambridge, MA: MIT Press.

Trommer, Jochen & Eva Zimmermann. 2021. Getting stronger or weaker at every stratum: A new approach to tonal morphophonology. Poster presented at Manchester Phonology Meeting on May 26th, 2021.

Valentine, J. Randolph. 2001. *Nishnaabemwin reference grammar*. Toronto: University of Toronto Press.

Voorhoeve, Clemens L. 1965. *The Flamingo Bay dialect of the Asmat language*. 's-Gravenhage: Rijksuniversiteit te Leiden dissertation.

Windschuttel, Glenn & Asako Shiohara. 2017. Kui. In Antoinette Schapper (ed.), *Papuan languages of timor-alor-pantar: Sketch grammars volume 2* Asia-Pacific Linguistics, 109–183. Berlin: Mouton de Gruyter.

Young, Robert W. & William Morgan. 1987. *The Navajo language: A grammar and colloquial dictionary*. Albuquerque: University of New Mexico Press. Revised edition.

Zimmermann, Eva. 2018a. Being exceptional is being weak: Tonal exceptions in San Miguel el Grande Mixtec. In Gillian Gallagher, Maria Gouskova & Sora Heng Yin (eds.), *Proceedings of amp 2017*, .

Zimmermann, Eva. 2018b. Gradient symbolic representations in the output: A case study from Moses Columbian Salishan stress. In Sherry Hucklebridge & Max Nelson (eds.), *Proceedings of nels 48*, 275–284.

Zimmermann, Eva & Jochen Trommer. 2022. Getting weaker across layers: The tonal phonology of Shona without stratal re-ranking. Talk given at the linguistics colloquium at University of Warsaw on June 17, 2022.