Phonological underspecification gives rise to morphotactic and phonological exceptionalities in Mandan

McCann, Katie (Universität Leipzig)

Mandan's (Sioux, North America) 1pl affixes exhibit a correlation between phonological and morphological exceptionality. I argue that vowel deletion, the phonological exceptional behaviour, and the exceptional position of the 1pl affixes in the morphological word, derive from the same underlying source, namely phonological underspecification in the form of an unassociated, floating mora. The lack of an associated mora triggers exceptional phonological re-ordering and consequently vowel deletion. Despite the phonology handling both exceptionalities, the proposed analysis adds to a body of work that focusses on deriving phonologically conditioned affix order without resorting to a non-modular P≫M approach.

Keywords: exceptionality, underspecification, phonological re-ordering, autosegmental phonology, phonologically conditioned affix order

1 Exceptionality in Mandan

The object of study in this article are the affixes encoding 1pl in the Siouan language Mandan. The 1pl affixes reveal a correlation in exceptional behaviour concerning their morphological and phonological properties. In the morphology, the affixes surface in a position that differs from the rest of the person and number marking affixes. In the phonology, the affixes are exceptional concerning their behaviour in vowel hiatus contexts. I propose that the irregular phonology and irregular morphotactic placement of the 1pl affixes are conditioned by an underspecified phonological representation of these affixes. I adduce evidence that the exceptional position of Mandan's 1pl affixes constitutes a case of phonologically conditioned affix order (PCAO). True PCAO is predicted under a P≫M approach to morpho-phonology (McCarthy & Prince 1993b). P≫M allows the optimal placement of affixes to be determined by morphological and phonological constraints. However, Paster (2006, 2009) shows that allowing phonological constraints to directly interact and outrank morphological constraints makes predictions on the influence of phonology on the morphological component of grammar that are not clearly borne out. I show that the placement of the 1pl affixes in Mandan falls in line with what Paster (2009) identifies as apparent PCAO. Paster (2009) shows that prominent PCAO cases (i.e. Doyayo, Wiering & Wiering (1994); Fulaar, Arnott (1970); Paster (2005); Witsuwit'en, Hargus & Tuttle (1997); and Hamer, Lydall (1976); Zoll (1996)) do not require a P≫M analysis. Instead, their PCAO can apparently be captured by segmental re-ordering. Following Paster, I argue that an analysis of Mandan's 1pl affixation does not need to resort to a non-modular P≫M approach. Instead, this paper presents a full, detailed implementation of apparent PCAO as segmental, phonological re-ordering in the form of spreading and deletion, which captures the exceptional placement of the affixes. In detail, I show that phonological underspecification of an association line between mora and vowel, brings about local, phonological re-ordering and simultaneously

derives the exceptional phonological vowel hiatus resolution strategy, vowel deletion, in the 1PL affixes of Mandan.

Mandan is part of the Siouan language family, a language family that spans across central and southeastern North America (Rood 1979). Kasak (2015) shows that Mandan is most closely related to the languages Hidatsa and Crow, which are part of the Siouan subbranch labelled as Missoury Valley. The last L1 speaker of Mandan passed away in 2016 (Kasak 2019:35). Today, Mandan survives in the form of proficient heritage speakers.

The morphology and phonology of Mandan are described by Kasak (2019) based on his own fieldwork and previous descriptions and texts by Hollow (1973a,b) and Trechter (2012a,b). All data presented in this article come from Kasak (2019).

Mandan is a predominantly prefixing language that exhibits a small number of suffixes and a larger amount of enclitics. I focus here on the prefixal domain, which is where the 1PL affixes can be found. Prefix order is fixed, which prompts Kasak to describe the order of affixes with a template[1], shown in table 1 below[2].

REL	NEG	UNSP NMLZ	1PL	PV.IRR	PV.LOC PV.INS PV.TR	1SG	2	VOICE	ITER INCP	INS	VERB ROOT
ko	waː	wa waː	ɾũ/ɾo	o	o i aː	wa/wã	ɾa/ɾĩ	ki	ki ka/ki	ka, pa, ɾa, ɾaʔa, ɾu, waʔ	

Table 1: Mandan prefix template (adapted from Kasak (2019:173))

In this article, I focus on the affixes situated between the bold lines in the template. Affixes that encode either second person or first person singular are found preceding a VOICE affix and following the so-called preverbs (PV). The order of the two person and

[1]In this overview, I use the template as a descriptive device for affix order. Crucially, the template should not be interpreted as the theory of morphology advocated in this article, see the discussion in section 2.

[2]All abbreviations and glosses follow the Leipzig glossing rules with the addition of the following: A = agent argument/active marker, CONT = continuative, F = feminine, HAB = habitual, ITER = iterative, INCP = inceptive, M = masculine, P = patient argument/stative marker, PV = preverb, REL = relativiser; UNSP = unspecified non-subject.

number encoding affixes is fixed. First person singular always precedes second person, independent of what argument the affixes encode, shown in (1)[3,4]. Even though the order of affixes is fixed, the exponents differ depending on what argument they encode. In the glosses, this is indicated by the small script letters A for agent and P for patient. This type of alignment is known as active-stative alignment and is common among Sioux languages. Take example (1a), the agent of the clause is first person singular, and the recipient of the clause is second person singular. In (1b), the argument roles are reversed. The agent of the clause is second person singular, yet the first person singular affix, which encodes the recipient, is in a position where it precedes the second person affix, just as in example (1a). However, the exponents in (1a) compared to (1b) differ.

(1) Order is fixed: pv-1sg-2

a. [émĩnĩpeʔʃ]

e- wa- ɾĩ- pE =oʔʃ

pv- 1sg.A- 2P- say.1A =ind.m

'I said it to you' (p.198)

b. [émãnãteʔʃ]

e- wã- ɾã- tE =oʔʃ

pv- 1sg.P- 2A- say.2A =ind.m

'you said it to me' (p.198)

Both examples in (1) contain a preverb. The preverbs encode either extension of the verb's valency by functions of locativity, instrumentality or transitivity, or they encode irrealis mood. The irrealis preverb is the only preverb that can co-occur with other

[3] All page numbers in this and in future examples refer to Kasak (2019).

[4] Some notes are in order to understand the phonological surface forms of this and all following examples. According to Kasak, there are no underlying nasal consonants. Nasal consonants only surface adjacent to a nasal vowel. For example, in (1a) the nasality of the vowel in the 2P affix /ɾĩ/ spreads to the underlying consonant /ɾ/ leading to surface [n]. This regressive nasal spreading can cross multiple affixes. Thus, in example (1a) the 1SG affix /wa/ is also nasalised to [mĩ] on the surface by virtue of preceding the affix /ɾĩ/ containing a nasal vowel. Nasal spreading is blocked by mid vowels, as exemplified by the preverb in both examples in (1), and by voiceless consonants. Aside from nasalisation, there are additional morpheme-specific changes to underlying vowels. For example, the vowel of the 1SG affix is changed from /a/ to (nasalised) [i]. An uppercase letter in the underlying form indicates an ablauting vowel. Stress is also represented in the examples. It is predictable and falls on the second syllable, except if the first syllable is heavy, then stress falls on the first syllable. Preverbs exceptionally attract stress, as is revealed in the examples in (1).

preverbs. It is also described as the only preverb that is productive at the time of Kasak's (2019) illicitations. As indicated by the template, the preverbs precede all person and number affixes except the 1PL affixes[5]. This order is sketched in (2).

(2) 1PL-[PV]-1SG-2-*VERB*

The order in (2) indicates that the 1PL affixes are misaligned with respect to the other person and number encoding prefixes. Concrete examples in (3) show that a 1PL affix will always precede a preverb and, by transitivity, the other person and number affixes, independent of its status as an agent in (3a) or as a patient (3b). As was the case for the other person and number affixes, the exponent, not the position, differs depending on the argument it realises.

(3) Order is fixed: 1PL-[PV]

a.	[ɾóːɾopxeʔɾe]		b.	[ɾóːɾahaːnĩtoʔʃ]		
	ɾũ-	[o]- ɾopxE =oʔɾe		ɾo-	[o]- ɾa- hEː =ɾĩt =oʔʃ	
	1PL.A-	[PV.IRR]- enter =IND.F		1PL.P-	[PV.IRR]- 2A- see =2PL =IND.M	
	'we will enter [the water]'			'you are going to see us' (p.233)		

The affix order of the person and number affixes and the preverbs falls under the phenomenon termed variable morphotactics (Crysmann & Bonami 2016). Crysmann & Bonami (2016) observe that languages may exhibit misaligned placement of affixes that stand in paradigmatic opposition. This is exactly what we observe in Mandan, where the 1PL affixes stand in paradigmatic opposition to the other affixes of the person and number paradigm, and their placement is misaligned compared to the other person and number

[5]The UNSP affix, which in the template precedes the 1PL affixes, could be treated as a person and number marking affix; however, its grammatical properties are different from the other person and number marking affixes. First, the UNSP affix is not specified for a particular person, and second, it does not follow the active-stative alignment that is observed for other person and number marking affixes. The UNSP only encodes non-subjects. I therefore leave the discussion of this affix and its position outside the scope of this article awaiting further study.

affixes. Additionally, because the 1PL affixes are the only affixes that are misaligned, I categorise this morophological misalignment as exceptional.

Interestingly, the 1PL affixes are not only morphotactically exceptional, they also exhibit phonologically exceptional behaviour. I follow Finley (2010) in defining phonological exceptionality as follows: a specific morpheme behaves phonologically exceptionally if its phonological behaviour can only be determined with reference to the specific morpheme. The exceptional behaviour of the 1PL affixes concerns vowel hiatus resolution. Across the board, the phonological grammar of Mandan does not tolerate a vowel hiatus. The resolution strategy that is observed across the affixal domain is to insert a glottal stop between the two vowels. In example (4), a vowel hiatus arises between the unspecified prefix and the preverb. The hiatus is resolved by the insertion of a glottal stop[6]

(4) [wa ʔ íwaseko ʔʃ]

wa-	i-	wa-	sek	=oʔʃ
UNSP-	PV.INS-	1SG.A-	make	=IND.M

'I am working' (p.238)

Glottal stop insertion is also observed at a suffix boundary. At an enclitic boundary, either vowel deletion without compensatory lengthening or ɾ-epenthesis breaks up a vowel hiatus[7]. The choice between the two is phonologically predictable. When the 1PL affixes appear in a vowel hiatus configuration, no glottal stop is inserted, instead, the vowel of the 1PL affix deletes and the remaining vowel is lengthened, as in (5). In (5a), the

[6] The NMLZ prefix /waː-/ can also undergo vowel deletion with compensatory lengthening to resolve a vowel hiatus. This process of deletion is optional for the NMLZ prefixes; elsewhere, glottal stop epenthesis is observed. Under the analysis that is proposed in section 2, it is unclear how the NMLZ may undergo optional vowel deletion instead of glottal stop epenthesis. I must leave it an open question how the optionality is resolved in this case.

[7] In general, the enclitics exhibit phonologically distinct behaviour compared to the prefixes and suffixes. For example, they are not included in the domain for stress, and they do not undergo unbounded regressive nasal spreading; merely a local nasal assimilation process is observed in enclitics. I will not be concerned with enclitics in this paper, yet it is clear that they are sensitive to a different phonological grammar. I refer the interested reader to Kasak (2019) for an OT analysis of the enclitic phonology.

1pl affix directly precedes a vowel-initial verb root. In (5b), the 1pl affix directly precedes a vocalic preverb. In both cases, the resulting vowel hiatus is resolved by deleting the vowel of the 1pl affix, which leads to a single long vowel on the surface.

(5) a. [ɾ íː sãːɾoʔʃ]
ɾũ- isãː =oʔʃ
1pl.a- be.in.a.hurry =ind.m
'we are in a hurry'

b. [ɾ íː hekĩnĩtʔʃ]
ɾũ- i- sek =ɾĩt =ʔʃ
1pl.a- pv.ins- know =2pl =ind.m
'We know it.' (p.230)

Indeed, a vowel hiatus is always created when the 1pl affix precedes a preverb, because all preverbs are vocalic. The only exception to this observation is the reflexive preverb. However, this preverb does not interact with the person and number affixes. Table 2 presents all preverbs and their grammatical function and phonological content.

transitive	pv.tr	aː
instrumental	pv.ins	i
locative	pv.loc	o
generic	pv	e
irrealis	pv.irr	o
(reflexive	pv.refl	ĩʔ)

Table 2: Preverbs in Mandan

To sum up the data, the 1pl affixes behave exceptionally in the morphology, where they show paradigmatic misalignment, and they behave exceptionally in the phonology, where they undergo vowel deletion instead of glottal stop insertion. From this, I conclude that there is a correlation between the phonological and the morphological behaviour of the 1pl affixes.

The rest of the article is structured as follows: Section 2 introduces the analysis of the observed correlation. In this section, I motivate a modular analysis of both exceptionalities based purely on phonological factors. The morphological exceptionality is shown to be a quirk of the phonological computation. I delve into the details of this quirk by

introducing phonological re-ordering in the framework of autosegmental containment theory in section 2.1. In section 2.2, I detail the proposed phonological underspecification and show how it gives rise to exceptional phonological re-ordering and vowel deletion. Section 3 introduces an alternative analysis of the observed correlation in a P≫M framework that can derive the exceptionalities of the 1pl affixes but makes incorrect predictions on the ordering properties of the rest of the affixes. The article concludes in section 4.

2 A phonological analysis

In this section, I propose an analysis that derives all exceptional behaviour of the 1pl affixes purely in the phonology. Two assumptions are necessary to derive both exceptions. First, phonological underspecification in the form of an absent association line, and second, phonological re-ordering akin to metathesis. I sketch the analysis in the following paragraphs. The detailed technical implementation is presented in sections 2.1 and 2.2.

In order to derive the position of the 1pl in the phonology, I assume that the 1pl affixes are not misaligned in the morphology. This allows a morphological framework to treat the linearisation of all person and number affixes in Mandan the same. No additional statement needs to be made about the 1pl being misaligned in the morphology, and the resort to a template to accommodate the position of the misaligned affixes is not necessary. I couch the analysis in an architecture of grammar where morphology strictly precedes phonology. A morphological representation of the word is built without consideration for its phonological form. I remain agnostic as to which specific theory of morphology to assume, as many morphological theories a priori derive the fact that person and number marking affixes should surface in the same position. To illustrate this point, take Distributed Morphology (DM, Halle & Marantz (1993, 1994)) as an example.

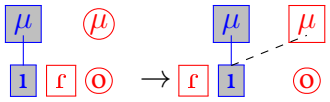
In DM, person-number affixes spell out agreement heads from the syntax. These heads will always be in the same position in the syntactic tree and therefore will also, without further assumptions, be linearised in the same position. Under no circumstances is it expected that a head will move because it agrees with 1pl but refrain from moving because it agrees with 1sg, which would be necessary to derive the misalignment.

I argue that the 1pl affixes become misaligned in the phonology to provide an onset consonant for the vocalic preverb. This constitutes PCAO, the 1pl affixes precede another affix for phonological reasons. However, the following paragraphs establish that it is only the consonant of the 1pl affixes that precedes the preverb. I propose that it undergoes phonological re-ordering, akin to metathesis (McCarthy & Prince 1995; Hume 1998; Canfield 2015; Mooney 2023), with the vowel of the preverb. In order to restrict re-ordering to the 1pl affixes, the 1pl affixes are analysed as phonologically underspecified, see Inkelas (1994); Tebay & Zimmermann (2020); Newell (2021); Jaker (2022) a.o. for analyses making use of underspecification in the phonology. In detail, I propose that the 1pl affixes lack an association from their mora to their vowel. This lack of association in combination with an OT grammar that disfavours onsetless syllables leads to phonological re-ordering and, as a byproduct, vowel deletion and compensatory lengthening. Crucially, because the phonology only re-orders segments and never full affixes, the analysis does not make reference to morphological identity and the position of the 1pl affixes is merely apparent PCAO, see Paster (2009) for further discussion.

The analysis is sketched in (6) below. The example in (6a) shows the verb *go away* inflected for 1pl.p and the instrumental preverb pv.ins. Contrary to the surface linearisation, the 1pl affixes are assumed to follow the preverb, just like any other person and number affix. This is indicated by the glossed example in (6a) and the input to the phonology in (6b) where the preverb i linearly precedes the 1pl.p affix ɾo. The surface from is represented on the right side of the arrow in (6b). To arrive at this surface form, the vowel of the preverb, i, and the consonant of the 1pl.p affix, ɾ, re-order to provide

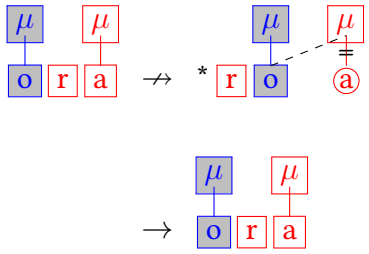
the word-initial syllable with an onset. Further, due to re-ordering, the previously floating mora of the 1PL.P affix associates with the vowel of the preverb, and the vowel of the 1PL.P affix is deleted to avoid a vowel hiatus. A notational remark is in order; I box all phonetically realised material and circle all material that is unpronounced in the output form.

(6) a. [ɾíːɾuksahãmĩka]
i-ɾ*o*-ɾ*u-ksah=awĩ=ka*
PV.INS-1PL.P-INS-go.away=CONT=HAB
'[...], leaving us behind.'
(p.233)

b. 

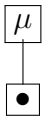
Crucially, I claim that it is the lack of an association line that causes the extreme change to the input phonological form. Compare the derived form in (6b) to that of a fully specified affix in (7b). Here, the grammar disprefers the output form, which has undergone re-ordering and vowel deletion, and prefers the faithful candidate. The reason for this discrepancy is the association line of the fully specified affix, which after re-ordering would need to be deleted to avoid a vowel hiatus (indicated by the dashed lines through the association line). I argue that it is this deletion of the association line that rules out re-ordering in fully specified affixes.

(7) a. [óɾaɾaʔktoʔɾe]
o-ɾa-ɾaʔk=kt=oʔɾe
PV.LOC-2A-make.fire=POT=IND.F
'[...] you can build a fire [...]' (p.223)

b. 

2.1 Phonological re-ordering

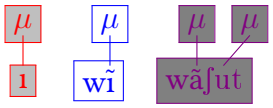
The analysis is couched in the framework of autosegmental coloured containment theory (Trommer & Zimmermann 2014; Trommer 2015; Paschen 2018; Zaleska 2018). The framework follows Prince & Smolensky's (1993) original proposal of OT in assuming that unrealised material is not deleted, but rather rendered phonetically invisible. Rendering an element phonetically invisible is not direct manipulation of that element but removal of association lines (Trommer 2024), as shonw by the schema in (8). The input structure in (8a) represents a root node with an associated mora. In the output in (8b) the association line is removed, which is depicted by the two dashed lines. The removal of the association line renders the mora and the segmental node phonetically invisible, because they are no longer structurally integrated. Similarly, rendering an element phonetically visible is insertion of association lines.

(8) a. input: 

b. output: 

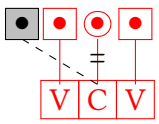
Further, I assume that the phonology has minimal information available on morphological structure represented as morphological colours (van Oostendorp 2006; Revithiadou 2007). At the morphology-phonology interface, every morpheme M receives a unique, arbitrary colour. This means that the phonology can differentiate between morphemes but, crucially, has no information on the morpheme's identity. Example (9a) visualises the effect of coloured containment. The morphology of (9a) is translated into the phonological representation in (9b) where each morpheme is mapped to an arbitrary colour. The phonology can differentiate between the colours; for example, it knows that 1 is morphologically distinct from wĩ but the phonology can neither identify 1 as the instrumental preverb nor wĩ as the 2sg.p prefix.

(9) a. i- wĩ- wãʃut
PV.INS- 2SG.P- clothes
'my clothes' (p.226)

b. 

Colours do not play an integral role in deriving the basic patterns tackled in this paper. Relevant to the upcoming analysis is that epenthetic material is rendered colourless, as it has no morphological identity.

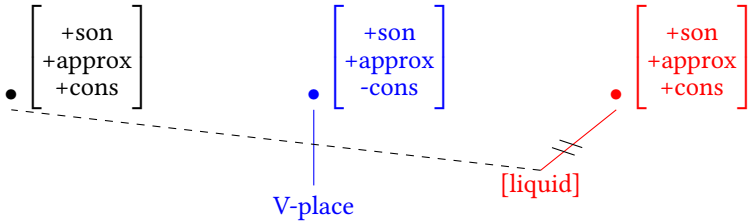
In containment theory, re-ordering in the form of real transposing metathesis poses a problem. As pointed out by McCarthy (1995) on data from Rotuman and further discussed in van Oostendorp (2006), GEN in containment theory cannot produce a candidate such as *puer* from an input string *pure* because *puer* $\not\subseteq$ *pure*, *pure* is not contained in *puer* (McCarthy 1995:14). McCarthy (1995) mentions that the only output candidate that would derive re-ordering in containment theory is *puEr<e>* where the vowel is copied into a position where it linearly precedes the final consonant. This is essentially how I propose to derive phonological re-ordering in containment theory in Mandan. I follow Besnier (1987); Zimmermann (2009); Takahashi (2018, 2019); Mooney (2023) a.o. in assuming a type of re-ordering which entails feature spreading and deletion. Concretely, I assume epenthesis of a root node via association line epenthesis and deletion of the underlying root node via deletion of the underlying association line. This is schematised in (10) where the underlying structure is a simple VCV string. Each vowel and consonant is associated with a root node via an association line. V-C re-ordering is now simply spreading of the consonant features to an epenthetic root node and removal of the input association line. The pronunciation is determined by the linear order of the root nodes.

(10) Phonological re-ordering in Containment Theory:
underlying: VCV structure: 

pronounced: CVV

In (10) phonological re-ordering seems to violate the No Crossing Constraint (NCC) (Goldsmith 1976). I follow Goldsmith's (1976) assumption that the NCC is a universal and inviolable constraint. In order to maintain the derivation in (10) of V-C metathesis without violating the NCC, I adopt feature geometry, following Clements & Hume (1995), where features on distinct tiers can spread without directly crossing. For the case of Mandan, the features of the initial consonant of the 1pl affixes, /ɾ/, must spread across a vocalic element. I adopt an underspecified version of Walsh Dickey's (1997) featural representation of a rhotic consonant, which posits a feature [liquid][8], represented in red colours in (11). I depart minimally from Walsh Dickey by assuming that the feature [liquid] is associated seperately to the root node (comparable to the feature [nasal]). This allows [liquid] to spread to or over any segment that is not specified for it, such as vowels or other non-liquid consonants. Crucially, a simple [liquid] feature suffices to minimally identify the rhotic flap, as Mandan has no additional liquid or rhotic consonants, see Kasak (2019:57). I assume that the full feature specification of the rhotic flap is supplied by the phonetics. Mandan's phonological re-ordering in feature geometry is presented in (11). The "original" /ɾ/ root node in red, is rendered phonetically invisible, whereas the epenthetic root node in black is fully specified due to the spread feature [liquid] and root internal epenthetic features [+son, +approx, +cons] and it is therefore pronounced.

(11) Phonological re-ordering of /Vɾ/ → [ɾV] in feature geometry:



For the OT analysis of phonological re-ordering, I assume several max and dep faith-

[8]Walsh Dickey's (1997) feature structure for rhotics is more complex than simply positing a [liquid] feature, she also proposes an apical, coronal C-place geometry with a secondary laminal place feature, see Walsh Dickey (1997) for arguments for this representation.

fulness constraints presented in (12) that refer to different tiers of the representation and the association lines connecting the tiers. Further, I propose the constraint $F^{2\bullet}$ in (12e) which prohibits spreading but allows "copying" of features.

(12) a. $\textsc{max}^{\bullet}_{|F}$: Assign a violation * to every phonetically invisible coloured association line linking a ●-node (root node) and a F-node (feature node).

b. $\textsc{dep}^{\bullet}_{|F}$: Assign a violation * to every colourless association line linking a ●-node and a F-node.

c. MAX●: Assign a violation * to every phonetically invisible segmental node.

d. DEP●: Assign a violation * to every colourless segmental node.

e. $F^{2\bullet}$: Assign a violation * to every feature-node that is phonetically associated with 2 ●-nodes.

In Mandan, the assumption is that the consonant of the 1PL affixes re-orders with the vowel of the preverb to provide and onset. This is implemented in OT with a high ranked ONSET constraint. Any preverb that enters the phonological computation causes an ONSET violation in the faithful candidate because all preverbs are underlyingly onsetless. An onset is provided if the [liquid] feature spreads to an epenthetic root node, thereby leading from /Vɾ/ to [ɾV]. In order to arrive at an OT grammar that derives re-ordering to provide an onset, the constraints ONSET and the constraint that penalises spreading $F^{2\bullet}$ in (12e) are ranked above the MAX and DEP constraints in (12) that are violated by re-ordering. Further, I introduce the high-ranked constraint DEP-F in (13), which penalises epenthetic features[9].

(13) DEP-F: Assign a violation * to every colourless F-node (feature-node).

[9]Crucially, I assume that the constraint DEP-F is not violated by epenthetic features directly associated to the root tier. This allows epenthesis of [+son,+approx,+cons] ro realise the rhotic ɾ when re-ordered, as in (11).

The ultimate ranking is presented in (14) below.

(14) $F^{2\bullet}$, DEP-F ≫ ONSET ≫ DEP● ≫ MAX●, $\text{MAX}^{\bullet}_{|\text{F}}$, $\text{DEP}^{\bullet}_{|\text{F}}$

Consider the tableau in (15), which is the computation of re-ordering. I collapse the representation of feature geometry in this and all following tableaux for ease of interpretation. The optimal candidate (15c) violates all proposed MAX and DEP constraints except high-ranked DEP-F, by virtue of association line and root node epenthesis and deletion. Crucially, the violations are not fatal because the higher-ranked ONSET constraint is violated by the faithful, non-re-ordering candidate (15a). $F^{2\bullet}$ is violated by the alternative candidate (15b) which spreads the [liquid] features to provide an onset without removing the underlying association line. Candidate (15d) epenthesises a glottal stop in order to abide by the constraint ONSET, which violates high ranked DEP-F.

(15) OT computation of metathesis in autosegmental containment theory:

	/ o ɾ o /	$F^{2\bullet}$	DEP-F	ONSET	DEP●	MAX●	$\text{MAX}^{\bullet}_{\text{F}}$	$\text{DEP}^{\bullet}_{\text{F}}$
a.	o ɾ o			*!				
b.	o ɾ o	*!			*			*
☞ c.	o ɾ o				*	*	*	*
d.	ʔ o ɾ o		*!		*			*

In addition to the PV, 1PL configuration, Mandan provides evidence that re-ordering must be available to the phonology. C-V re-ordering is necessary to derive the surface

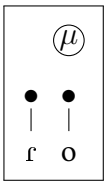
forms of 1sg and 2nd person affixes when they precede a vowel-initial verb root. In this configuration, the 1sg and 2nd person affixes are realised with an allomorph that exhibits re-ordering with the vowel of the root. Example (16) shows the allomorph of the 1sg prefix /w̃ʔ-/ (in consonant initial roots the allomorph /we/ surfaces). On the surface, the glottal stop of the allomorph linearly follows the initial vowel of the root. This re-ordering is derived by the proposed OT grammar under the assumption that a constraint mitigating against onset consonant clusters is ranked above the max and dep constraints violated by re-ordering.

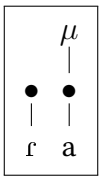
(16) [míʔnisoʔʃ]
w̃ʔ- iɾĩs =oʔʃ
1sg- be.alive =ind.m
'I am alive' (p.224)

Given the analysis presented thus far, re-ordering is predicted to apply to any affix that follows the preverb. This prediction is evidently not borne out by the data in Mandan. It is only the 1pl affixes that surface "preceding" the preverb; all other person and number affixes remain in a position where they follow the preverbs. In order to derive this dichotomy, re-ordering must be restricted to apply only in the configuration of preverb + 1pl. This is achieved by attributing a representational difference to the 1pl affixes.

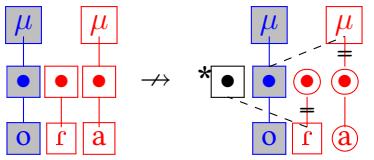
2.2 Phonological underspecification

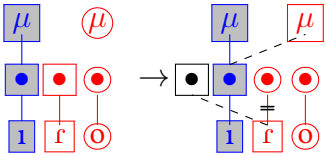
In order to restrict re-ordering in Mandan to the 1pl affixes, I assume that these affixes are representationally different; they are underspecified. I argue that the 1pl affixes lack the association line that connects a mora to a vowel. The underlying representation of the 1pl.p affix is given in (17a). Compare this to the underlying representation of a fully specified affix, for example the 2a affix in (17b).

(17) a. 

b. 

The only difference between the 1PL affixes in (17a) and the other person and number affixes in (17b) is the presence or absence of the line associating the mora to the root node that hosts the vowel. It is precisely this association line that blocks re-ordering in a configuration where the preverb precedes a fully specified affix, shown in (18a). Crucially, the lack of an association line in the 1PL affixes facilitates re-ordering when they are preceded by a preverb, shown in (18b).

(18) a. 

b. 

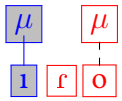
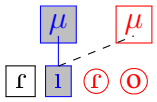
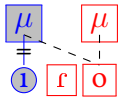
The reason why re-ordering is blocked in (18a) but not in (18b) is the removal of the underlying association line in (18a). This association line needs to be removed because V-C re-ordering in (18a) creates a vowel hiatus between the preverb vowel and the left-over vowel of the person and number affix. A simple way to resolve the vowel hiatus is by deleting a vowel, which in autosegmental containment theory means removing an association line. The deletion of a vowel, hence the removal of an association line that connects a mora to a root node, is highly penalised in Mandan, established by the constraint MAX$^{\mu}_{|\bullet}$ defined in (19). Thus, in fully specified affixes, re-ordering does not arise because it creates a less optimal surface structure due to the underlying full specification.

(19) MAX$^{\mu}_{|\bullet}$: Assign a violation * to every phonetically invisible coloured association line linking a μ-node and a $\bullet$-node.

Crucially, re-ordering in the 1pl in (18b) never creates a phonetically visible vowel hiatus due to the fact that the vowel is never fully integrated into the structure because of the lack of an association line. No association line needs to be removed, and thus re-ordering becomes most optimal. Additionally, the exceptional phonological properties of the 1pl follow from the same underspecification. 1pl affixes exceptionally undergo vowel deletion and compensatory lengthening to resolve a vowel hiatus construction. The lack of an association line between the mora and the vowel causes the vowel to remain phonetically invisible in potential vowel hiatus contexts without penalising MAX$^{\mu}_{\bullet|}$, and the mora freely associates to the phonetically realised vowel, as presented in (18b).

Tableau (20) derives the configuration where a preverb and a 1pl.p are phonologically computed. In all following tableaux, I refrain from representing the root node tier so as not to overcroud the tableaux.

(20) OT computation of pv + 1pl

	/1 ɾ o/	MAX$^{\mu}_{\bullet\|}$	ONSET	DEP●	MAX$^{\bullet|}_{F}$	DEP$^{\bullet|}_{F}$
a.			*!			
☞ b.				*	*	*
c.		*!				

The faithful output (20a) violates the constraint ONSET because the preverb lacks an onset. This is repaired by candidate (20c) which deletes the preverb vowel altogether but, by doing so, violates the high-ranked MAX$^{\mu}_{\bullet|}$ constraint. The optimal output (20b) has re-ordered the segments, which violates many low-ranked DEP and MAX constraints

but crucially does not violate high-ranked MAX$^{\mu}_{\bullet|}$.

Tableau (21) shows the configuration where the preverb is followed by a fully specified 1SG.A affix. Here, the faithful candidate in (21a) is most optimal despite violating ONSET. The ONSET violation is tolerated because any change to the input form that avoids the violation leads to violations of higher-ranked constraints. Take candidate (21b) which is the re-ordering candidate. It avoids a violation of ONSET; however, as was established in the preceding paragraphs, this leads to the removal of an assocaition line to compensate for the created vowel hiatus. The concequent violation of MAX$^{\mu}_{\bullet|}$ is fatal for this candidate. Candidate (21c) which also employs V-C re-ordering in order to satisfy ONSET, resolves the created vowel hiatus by epenthesising a glottal stop, the general strategy of vowel hiatus resolution. However, doing this violates DEP-F which outranks ONSET[10].

(21) OT COMPUTATION OF PV + 2ND PERSON

	/ o ɾ a /	MAX$^{\mu}_{\bullet\|}$	DEP-F	ONSET	MAX$^{\bullet}_{\|\text{F}}$	DEP$^{\bullet}_{\|\text{F}}$
☞ a.	o ɾ a			*		
b.	ɾ o ɾ a	*!			*	*
c.	ɾ o ɾ ʔ a		*!		*	*

The two tableaux represent the computation of a purely phonological account of phonologically conditioned affix placement of 1PL in Mandan. The behaviour of the 1PL

[10]The general strategy of glottal epenthesis for vowel hiatus resolution is optimal outside of re-ordering once we assume that a constraint *HIATUS outranks DEP-F.

affixes is derived by assuming local, phonological re-ordering induced by phonological underspecification. Re-ordering applies to create an onset for onsetless preverbs. Underspecification of 1pl restricts re-ordering to only those cases where a created vowel hiatus can be resolved by vowel deletion. Vowel deletion in Mandan is only possible due to underspecification in the form of an absent association line. Thus, underspecification of the 1pl affixes derives the exceptional phonological deletion properties, and in addition, it also derives the exceptional linearisation properties.

3 PCAO in P≫ M

In this section, I present an alternative analysis of the placement of 1pl affixes in Mandan in a P≫M appraoch to morphophonology (McCarthy & Prince 1993a)[11].

[11] Another alternative would be to treat the correlation as coincidental and instead introduce a separate mechanism in morphology to derive the exceptional placement of the 1pl affixes. There exists a plethora of morphological mechanisms and frameworks that can derive the misplacement of the 1pl affixes. To name just a few: position class morphology (Inkelas 1993; Nordlinger 2010); information-based morphology as presented in Crysmann & Bonami (2016) or morphological metathesis (Harris & Halle 2005). I briefly present an exemplary analysis using Harris & Halle's (2005) morphological metathesis. Harris & Halle couch the operation of morphological metathesis into the framework of DM, suggesting that metathesis is a postsyntactic, post-vocabulary-insertion morphological operation akin to readjustment rules. They base morphological metathesis on the operation of morphological reduplication. Thus, metathesis arises in the morphology by first selecting an underlying morphological string, shown in (22a) for Mandan's pv-1pl order. Then the selected string is copied, akin to reduplication, shown in (22b). In order to arrive at metathesis, the representation is enriched with juncture brackets in (22c) that indicate which part of the string is deleted.

(22)	a.	i*ɾo*ɾu*ksah	underlying morphological string
	b.	[i*ɾo]*ɾu*ksah	[X] = reduplicating subsequence
	c.	[~~i~~>*<ɾo][i>*<~~Ro~~]*ɾu*ksah	angle brackets trigger deletion
	d.	ɾoiɾuksah	surface string

I believe there are two points to be made about an analysis of Mandan using morphological metathesis as compared to shifting the displacement to the phonology. The first point is that morphological metathesis does not follow from anything. The reason why it is precisely the 1pl affix and the preverbs which are targeted as metathesising strings is simply a stipulation. Further, an analysis making use of morpholog-

This alternative analysis does not make use of segmantal, phonological re-ordering but instead analyses the placement of the 1pl affixes as displacement of the entire affix. Within P≫M this means that phonological constraints outrank morphological constraints and thereby lead to affix orders that are purely phonologically motivated. In such a framework, the modules morphology and phonology directly interact. Thus, violating strict modularity.

I base the analysis in this section on McCarthy & Prince's (1993b) analysis of phonologically driven affix placement in the closely related language Dakota. Although the person and number affixes in Dakota behave strikingly similar to Mandan, McCarthy & Prince's (1993b) analysis cannot be readily extended to Mandan. Their analysis works only in Dakota because the exceptionally placed affix has the shape VC and all other person and number affixes have the shape CV. It is this different shape which causes exceptional placement that optimises the phonological surface structure. However, the exceptionally placed 1pl affixes in Mandan have the same syllable shape as the other person and number affixes, namely CV[12]. Thus, in a P≫M approach, the 1pl affixes in Mandan must have an alternative special phonological representation that drives their exceptional placement. This is the lack of an association line, as presented in the previous sections. In addition to this, the computational component of the morphophonology

ical metathesis or any other morphological framework that handles morphological displacement, can derive the placement of 1pl affixes in Mandan without further issues. However, such an analysis fails to accommodate for the phonological properties by treating the two problems as independent of each other.

[12]The analysis of McCarthy & Prince (1993b) has two crucial assumptions that cannot be applied to Mandan. First, it relies on treating the preverbs as being morphologically part of the root. Kasak (2019) convincingly shows that the preverbs are distinct morphological entities, despite them being semantically and in many cases lexically dependent on the verbal root. Second, the exceptional placement comes from the syllable structure of the affixes. In Dakota, the syllable structure of the 1du affix is VC and it is crucially this shape that ensures that the affix does not end up in an infixal position, it remains outside the preverb-root complex. Other affixes are CV, which can infix and thereby allow the preverb-root complex to be leftmost in the word. In Mandan, the syllable structure of the 1pl affixes is the same as for all other person and number affixes, namely CV. In a McCarthy & Prince style analysis, the 1pl of Mandan would never resist infixation in order to appear as a prefix (for more details on this point see Kasak (2019)).

must have a morphological constraint, LEFTMOSTNESS, which requires that affixes are aligned with the left edge of the word as prefixes, defined in (23).

(23) LEFTMOSTNESS: Assign a violation * for every morpheme X that seperates an affix Y from the left edge of a word.

Further, I assume the same set of constraints as in section 2.2 with the exception of the re-ordering-specific constraints. Crucially, the phonological constraints MAX$^{\mu}_{\bullet}$ must outrank the morphological constraint LEFTMOSTNESS in order to arrive at the phonologically conditioned affix order, where the 1PL affixes precede the preverbs.

The tableau deriving the order of 1PL preceding a preverb is presented in (24) and that of non-1PL following a preverb in (25). To save space, I represent the underspecification of the 1PL affix as a superscripted floating mora $^{(\mu)}$. If the mora is integrated into the structure, it is no longer visually represented or only represented as length ː. I assume that the input is a set of unordered morphemes which become ordered in the output.

Tableau (24) shows the input unordered set consisting of the verb /ksah/ *go away* with an instrumental preverb /i/ and the 1PL.P affix, realised by /ɾo$^{(\mu)}$/[13]. Three output candidates are considered[14], the first candidate in (24a) orders the preverb in a leftmost position, which fatally violates ONSET due to the onsetless syllable created by the word-initial preverb. The second and optimal candidate (24b) orders the 1PL.P affix in a leftmost position of the word. Due to the underspecification of the 1PL its vowel deletes, violating low-ranked MAX• and the floating mora lengthens the preverb vowel. This results in a phonological output form that no longer violates ONSET. Both candidates (24a,b) violate LEFTMOSTNESS once by virtue of always having at least one affix in a non-leftmost position. Candidate (24c) violates LEFTMOSTNESS thrice, the second violation being fatal

[13](6a) shows the full example. I omit the instrumental prefix /ɾu/ from the derivation in order to save space; note that it will not end up preceding the preverb because it is fully specified. See tableau (25) for this case. I also omit the clitics; their order is at least in part semantically determined.

[14]One candidate not considered is the output [ɾo-i-ksah], where the vowel hiatus is not resolved. This output is ruled out by violating ONSET and also violating an even higher ranked constraint *HIATUS.

because two affixes are further removed from the left edge by ordering the root *ksah* in a leftmost position.

(24) *P≫M derives 1PL-PV-root*:

	{i,ro$^{\mu}$,ksah}	MAX$^{\mu}_{\bullet}$	LEFTMOSTNESS	ONSET	MAX●
	a. i-ro-ksah		*	*!	
☞	b. r-iː-ksah		*		*
	c. ksah-i-ro		**!*		

The second tableau tackles the order of a non-1PL affix and a preverb in (25). The input set includes the verb root /hek/ *know*, as well as the instrumental preverb /i/ and a 1SG.A affix /we/. This derivation essentially follows the logic of the analysis presented in the previous sections. Candidate (25a), which has ordered the preverb in a leftmost position, is most optimal despite violating ONSET. Candidate (25b) orders the 1SG.A affix in a leftmost position, followed by the preverb, which triggers hiatus resolution and a violation of MAX$^{\mu}_{\bullet}$ because a fully specified vowel is deleted[15]. Again, candidate (25c) is non-optimal because both prefixes are further removed from the leftmost position due to the root intervening.

(25) *P≫M derives PV-¬1PL-root*:

	{o,ra,raʔk}	MAX$^{\mu}_{\bullet}$	LEFTMOSTNESS	ONSET	MAX●
☞	a. o-ra-raʔk		*	*	
	b. r-oː-raʔk	*!			*
	c. raʔk-o-ra		**!*		*

The P≫M analysis and the analsis which makes use of phonological, local re-ordering make different predictions on possible affix orders in Mandan. I focus on one incorrect

[15]The candidate where the hiatus is not resolved [ɾa-o-raʔk] is not considered in the tableau; this candidate is crucially non-optimal by violating a higher-ranked *HIATUS constraint.

prediction that the P≫M analysis makes for Mandan. Given the analysis presented in tableaux (24) and (25), the only prefix that can ever precede the preverbs should be one that also has exceptional phonological properties concerning vowel hiatus resolution. All other prefixes should pattern with the 1sg.a prefix in following the preverb in order not to violate the constraint $\text{MAX}^{\mu}_{\bullet}$. However, there are at least four other prefixes that can precede the preverbs. These are rel, neg, nmlz and unsp. They all have the phonological shape CV(ː) and they all undergo a process of glottal stop epenthesis in order to resolve a vowel hiatus[16]. If these prefixes are part of the unordered set in the input, it is completely unclear why they end up preceding the preverb and inserting a glottal stop while the non-1pl affixes end up following the preverb[17].

In the phonological re-ordering analysis proposed in this paper, affixes are ordered in a separate module of morphology prior to the phonological component. All prefixes that precede the preverb and cause glottal epenthesis are simply ordered preceding the preverb in the morphological component. This is expected under semantic considerations too. The position of rel, neg and nmlz prefixes is semantically transparent, as these affixes should be high in the semantic structure, and therefore also in the morphological structure, in order to take the entire inflected verb in their scope[18] (see Manova & Aronoff (2010); Rice (2011) a.o. for an overview on scope determining affix order).

[16]Though see footnote 6 for a caveat to this generalisation shown by the nmlz affix

[17]It is conceivable that the four prefixes preceding the preverb are situated in another stratum. Indeed, McCarthy & Prince (1993b) make use of distinct strata to derive different phonological behaviour of affixes in the same language. While this is a possible solution to the problem, it adds another layer of complexity to the computation, one that is not necessary in the account using phonological re-ordering. Further, the phonological domains of Mandan do not coinside with the stratal distinction that is necessary to derive the attested affix order in a P≫M approach. Mandan has a process of nasal spreading that never extends to the preverb despite some of them havng the correct phonological form to be nasalised. This indicates that the preverbs would be in a different stratum to the person and number affixes. This runs counter to the stratal distinction that is necessary for the proposed P≫M approach, where the preverb and all person and number affixes must be in the same stratum, as this is where phonologically conditioned affix order arises.

[18]How the unsp prefix comes to be ordered preceding the preverb unlike all other person affixes is more difficult to motivate. I must leave it up to future research to find an answer to this question. However, remember that the unsp is morphosyntactically different to the other person and number prefixes, thus it might expone an element that is expected to outscope the preverb.

To conclude this section, I have shown that a P≫M analysis can derive the order of the person and number affixes and the preverb. However, it does so by weakening strict modularity and by making predictions on affix order in Mandan that are not borne out. These issues are sidelined by the phonological re-ordering analysis because affix order is determined prior to phonology and re-ordering in the phonology is local and highly restricted.

4 Conclusion

In this paper, I tackle a particularly compelling correlation between morphological order and phonological exceptionality that is observed for the 1pl affixes in the language Mandan. I argue that the correlation is traced back to the phonological representation of the 1pl affixes, which leads to apparent phonologically conditioned affix order and exceptional phonology. The 1pl affixes are argued to be phonologically underspecified; they lack an association between their mora and their vowel. This underspecification leads to local re-ordering in the phonology, computed as feature spreading and deletion (Besnier 1987; Zimmermann 2009; Takahashi 2018, 2019; Mooney 2023), and it leads to vowel deletion as opposed to ʔ-epenthesis. Thus, phonological exceptions are derived without resorting to morpheme-specific phonology in the form of, for example, co-phonologies (Orgun 1996; Inkelas 1998; Sande *et al.* 2020). Additionally, what seems to be a cross-modular correlation and a case of PCAO is merely a quirk of the phonology, supporting Paster's (2006) claims on PCAO. Under such an analysis, it follows that there is no need to assume an additional morphological operation that derives the position of the 1pl affixes. Unlike proposals in P≫M which must abandon strict modularity, the analysis retains strict modularity in the form of coloured containment theory. The phonology need not refer to morphological information directly; the exceptionality of the 1pl affixes is their phonological underspecification, not their status as affixes encoding 1pl.

References

Arnott, David W. (1970). *The nominal and verbal system of Fula.* Claredon Press.

Besnier, Niko (1987). An autosegmental approach to metathesis in Rotuman. *Lingua* **73**, 201–223.

Canfield, Tracy A. (2015). *Metathesis is real, and it is a regular relation.* Ph.D. thesis, Washington DC: Georgetown University.

Clements, G. N. & Elizabeth V. Hume (1995). The Internal Organization of Speech Sounds. In *The Handbook of Phonological Theory*, 245–306. Cambridge: Blackwell.

Crysmann, Berthold & Olivier Bonami (2016). Variable morphotactics in Information-based Morphology. *Journal of Linguistics* **52**, 311–374.

Finley, Sara (2010). Exceptions in vowel harmony are local. *Lingua* **120**, 1549–1566.

Goldsmith, John Anton (1976). *Autosegmental phonology.* Ph.D. thesis, Cambridge, MA: Massachusetts Institute of Technology.

Halle, Morris & Alec Marantz (1993). Distributed morphology and the pieces of inflection. In Francis Katamba (ed.), *Morphology: Critical Concepts in Linguistics*, volume 1, 111–176. London, New York: Routledge.

Halle, Morris & Alec Marantz (1994). Some key features of Distributed Morphology. In Andrew Varnie, Heidi Harley & Tony Bures (eds.), *Papers on Phonology and Morphology*, 175–288. Chamridge, MA: MIT.

Hargus, Sharon & Siri G. Tuttle (1997). Augmentation as affixation in Athabaskan languages. *Phonology* **14**, 177–220.

Harris, James & Morris Halle (2005). Unexpected plural inflections in Spanish: Reduplication and metathesis. *Linguistic inquiry* **36**, 195–222.

Hollow, Robert C. (1973a). Mandan texts. Box 3: Robert C. Hollow materials (A set of 22 texts recorded, transcribed, and translated by Robert C. Hollow held at the North Dakota State Historical Society.) .

Hollow, Robert C. (1973b). Mandan texts. Box 5: Robert C. Hollow materials. (A set of Edward Kennard's (1933-1934) 22 texts re-elicited, transcribed, and translated by Robert C. Hollow held at the NorthDakota State Historical Society.) .

Hume, Elizabeth (1998). Metathesis in phonological theory: The case of Leti. *Lingua* **104**, 147–186.

Inkelas, Sharon (1993). Nimboran position class morphology. *Natural Language & Linguistic Theory* **11**, 559–624.

Inkelas, Sharon (1994). *The consequences of optimization for underspecification.* GLSA (Graduate Linguistic Student Association), Dept. of Linguistics ....

Inkelas, Sharon (1998). The theoretical status of morphologically conditioned phonology: a case study of dominance effects. In *Yearbook of morphology 1997*, 121–155. Springer.

Jaker, Alessandro (2022). Tetsǫ́t'ıné prefix vowel length: Evidence for systematic underspecification. *Natural Language & Linguistic Theory* 1–43.

Kasak, Ryan M. (2015). A computational approach to Siouan phylogenetics. Yale University.

Kasak, Ryan M. (2019). *Affix ordering and templatic morphology in Mandan.* Ph.D. thesis, New Haven, CT: Yale University.

Lydall, Jean (1976). Hamer. In M. Lionel Bender (ed.), *The non-Semitic languages of Ethiopia*, 393–438. East Lansing, MI: African Studies Center.

Manova, Stela & Mark Aronoff (2010). Modeling affix order. *Morphology* **20**, 109–131.

McCarthy, John J. (1995). Extensions of faithfulness: Rotuman revisited. *Linguistics Department Faculty Publication Series* 36.

McCarthy, John J. & Alan Prince (1993a). Generalized alignment. In *Yearbook of morphology*, 79–153. Springer.

McCarthy, John J. & Alan Prince (1993b). *Prosodic morphology: Constraint interaction and satisfaction.* Ms. University of Massachusetts, Amherst, and Rutgers University, NewBrunswick, NJ.

McCarthy, John J. & Alan Prince (1995). Faithfulness and reduplicative identity. In Jill N. Beckman, Laura Walsh Dickey & Suzanne Urbanczyk (eds.), *Papers in Optimality Theory*, 249–384. Amherst: GLSA.

Mooney, Kate (2023). Phonology cannot transpose: Evidence from Meto. *Phonology* **39**, 293–343.

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

Nordlinger, Rachel (2010). Verbal morphology in Murrinh-Patha: Evidence for templates. *Morphology* **20**, 321–341.

van Oostendorp, Marc (2006). A theory of morphosyntactic colours. *Ms., Meertens Institute, Amsterdam* .

Orgun, Cemil Orhan (1996). *Sign-based morphology and phonology with special attention to Optimality Theory.* Ph.D. thesis, Berkeley, CA: University of California.

Paschen, Ludger (2018). *The interaction of reduplication and segmental mutation: A phonological account.* Ph.D. thesis, Leipzig: Universität Leipzig.

Paster, Mary (2005). Pulaar verbal extensions and phonologically driven affix order. In *Yearbook of morphology 2005*, 155–199. Springer.

Paster, Mary (2006). *Phonological conditions on affixation.* Ph.D. thesis, Berkeley, CA: University of California.

Paster, Mary (2009). Explaining phonological conditions on affixation: Evidence from suppletive allomorphy and affix ordering. *Word structure* **2**, 18–37.

Prince, Alam & Paul Smolensky (1993). Optimality Theory: Constraint interaction in generative grammar. Technical report 2 of the Rutgers University Center for Cognitive Science and University of Colorado.

Revithiadou, Anthi (2007). Colored turbid accents and containment: A case study from lexical stress. In Sylvia Blaho, Partik Bye & Martin Krämer (eds.), *Freedom of analysis?*, volume 149. Berlin: De Gruyter Mouton.

Rice, Keren (2011). Principles of affix ordering: An overview. *Word Structure* **4**, 169–200.

Rood, David S. (1979). Siouan. In *The languages of Native America: Historical and comparative assessment*, 236–298. University of Texas Press.

Sande, Hannah, Peter Jenks & Sharon Inkelas (2020). Cophonologies by ph (r) ase. *Natural Language & Linguistic Theory* **38**, 1211–1261.

Takahashi, Chikako (2018). No Metathesis in Harmonic Serialism. In *Proceedings of the Annual Meetings on Phonology*, volume 5.

Takahashi, Chikako (2019). No transposition in Harmonic Serialism. *Phonology* **36**, 695–726.

Tebay, Sören Eggert & Eva Zimmermann (2020). Exceptionality in Assamese vowel harmony: A phonological account. *Glossa: a journal of general linguistics* **5**, 102.

Trechter, Sarah (2012a). In the Words of Our Ancestors: The M andan Language and Oral Traditions PreservationProject. (Transcriptions that accompany two DVDs of Edwin Benson relaying traditiond Mandannarratives.).

Trechter, Sarah (2012b). Mandan texts. (A set of 16 narratives collected by Sarah Trechter in Twin Buttes,ND w ith Edwin Benson and Cory Spotted Bear between 2007 and 2010.).

Trommer, Jochen (2015). Moraic affixes and morphological colors in Dinka. *Linguistic Inquiry* **46**, 77–112.

Trommer, Jochen (2024). The concatenative structure of tonal overwriting. *Linguistic Inquiry* **55**, 95–151.

Trommer, Jochen & Eva Zimmermann (2014). Generalised mora affixation and quantity-manipulating morphology. *Phonology* **31**, 463–510.

Walsh Dickey, Laura (1997). *The phonology of liquids*. Ph.D. thesis, Amherst, MA: University of Massachusetts Amherst.

Wiering, Elisabeth & Marinus Wiering (1994). *The Doyayo language: selected studies*. Arlington,Texas: Summer Institute of Linguistics, Inc. and University of Texas at Arlington.

Zaleska, Joanna Krystyna (2018). *Coalescence without coalescence*. Ph.D. thesis, Leipzig: Universität Leipzig.

Zimmermann, Eva (2009). *Metathesis without reordering*. Master's thesis, Universität Leipzig.

Zoll, Cheryl Cydney (1996). *Parsing below the segment in a constraint-based framework*. Ph.D. thesis, Berkeley, CA: University of California.