Cooperation at the Morpho-phonology Interface: An Argument for Phonological Locality

Eva Zimmermann

1. Introduction

This paper argues that doubly conditioned phonological effects (=DMP) are constrained by phonological locality. The famous case of French liaison consonants provides an excellent example: The presence of one particular word is not sufficient to predict the appearance of a liaison consonant, only the combination of two particular words is (e.g. *peti*[t]*ami* 'little friend' with a liaison consonant but *peti*[ø]*héro* 'little hero' and *joli*[ø]*ami* 'pretty friend' without it (Smolensky & Goldrick 2016: 10)) – and those two words need to be adjacent. It is argued in Smolensky & Goldrick 2016 that such a pattern is best analysed in a system with Gradient Symbolic Representations (=GSR): Liaison consonants are gradiently present in both morphemes but one gradient presence is not enough for them to surface. Only if two adjacent gradiently active consonants can join their forces, they will make it to the surface. In this paper, I will strengthen exactly this general argument that DMP are best analysed with GSR. In addition, I argue that a GSR account correctly predicts that DMP are constrained by phonological locality. This latter claim is a direct response to Sande 2020 where the opposite claim is made that DMP is constrained by phase-based locality and not phonological locality.

A DMP is taken to be any phonological effect that only surfaces in case (at least) two different specific morphemes are present and is absent if at least one of these morphemes is absent. It is hence a specific sub-type of morphologically conditioned phonological changes. Another example is full vowel harmony in Guébie (discussed in more detail in section 3.2) which is illustrated with a minimal set of examples in (1). Full vowel harmony to the initial root vowel applies in (1-a) where a third person enclitic is added to the root 'to hit' but neither in (1-b) where a first person enclitic is added to the same root nor in (1-c) where the third person enclitic is added to another root (note that there is additional vowel deletion to avoid a hiatus in (1)). Full vowel harmony in Guébie is hence only triggered by certain enclitics and only affects certain roots. Importantly, this property of being an exceptional undergoer or an exceptional trigger is not predictable on phonological or semantic grounds, it is an arbitrary property of morphemes (Sande 2017, 2020). Throughout the paper, I use the index 🔒 for morphemes that can be classified as exceptional undergoers and 🔑 for morphemes that can be classified as exceptional triggers.

(1) Full vowel harmony in Guébie as a DMP (Sande 2020: 466+7)

a.	bala$^{3.3}$🔒	=ɔ^{2}🔑	bɔl=ɔ$^{3.2}$	'hit him'
b.	bala$^{3.3}$🔒	=e^{3}	bal=e$^{3.3}$	'hit me'
c.	sijo$^{2.3}$	=ɔ^{2}🔑	sij=ɔ$^{2.32}$	'wipe'

It is argued in Sande 2020 that DMP as in Guébie is restricted by phase-based locality: The two morphemes that cooperatively enable the phonological effect must both be present within the same syntactic phase but must not be phonologically adjacent. For the Guébie example, this means that a root and an enclitic can co-trigger FVH even if other suffixes intervene as long as both are part of the same syntactic phase. This restriction follows in the model of Cophonology by Phase (=CbP; Sande & Jenks 2018, Sande 2019, Sande et al. 2020, Sande 2020) where phonological optimization applies at every phase boundary and all

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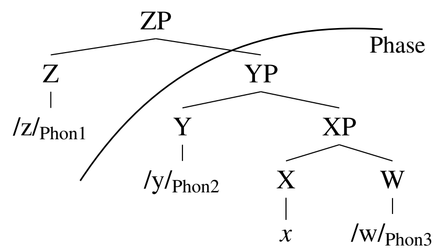
the morphemes that are part of the current phase can potentially influence the phonological grammar. This latter assumption is also part of classical Cophonology Theory (see Inkelas & Zoll 2007 for a summary and relevant literature) where every morphological construction is potentially associated with a different phonological grammar. The theory of CbP combines this assumption with a phase-based phonological evaluation where phonological optimization does not apply at every morphological layer but only at syntactic spell-out domains. In the abstract example (2), the phonological content of the vocabulary items /y/, /x/, and /z/ is optimized together, under the exclusion of /z/ that is only added in a later phase. Vocabulary items in CbP can be associated with a cophonology, formally modeled in Sande 2020 as constraint weight adjustments that apply to the base grammar of the language. Phonological optimization is thus based on the assumption of Harmonic Grammar where constraints are weighted and not ranked (Legendre et al. 1990, Potts et al. 2010). Every phase-based evaluation in CbP now takes into account all the cophonologies associated with all vocabulary items that are added in this current phase; multiple cophonologies can hence interact. In (2), the vocabulary items /y/ and /w/ are both associated with different cophonologies which means that the string /y-x-w/ is evaluated by a grammar that is adjusted by both Phon2 and Phon3. Importantly, /y/ and /w/ are not phonologically adjacent and still co-influence the grammar. In the next phase, the string /z-yxw/ is evaluated only by a grammar adjusted by Phon1 and the embedded vocabulary items and their potential cophonology instructions are unaccessible at this point. A DMP results in CbP if at least two grammar adjustments associated to two different vocabulary items are necessary to enable a certain process and all relevant vocabulary items are added within the same syntactic phase. A CbP account of Guébie is then based on the assumption that certain enclitics and certain roots adjust the base grammar and both these changes are necessary to allow full vowel harmony.

(2) Cophonology by Phase: Abstract structure



In contrast to CbP, an item-based account assumes that all morphologically conditioned phonological changes result from Generalized Nonlinear Affixation (=GNA) and hence the assumption that underlying morpheme representations can contain unassociated sub- or suprasegmental elements like segmental features or tones that need to associate and potentially overwrite underlying specifications (e.g. Lieber 1987, 1992, Stonham 1994, Saba Kirchner 2010, Trommer 2011, Bermúdez-Otero 2012, Bye & Svenonius 2012). DMP follows in such a model if realization of a Nonlinear Affix is dependent on another phonological representation with which it can cooperate. Sande 2020 explicitly rejects such an item-based account for DMP since it cannot account for instances where cooperating elements are not phonologically adjacent. More concretely, it is argued that Donno So, Guébie, and Amuzgo employ DMP patterns that are cooperatively enabled by elements that are not adjacent but within a single phase (as /y/ and /w/ in (2)) – indeed, a pattern that CbP can predict but a GNA account without reordering cannot.

I argue in this paper that neither of these three cases of putative non-local cooperation is problematic for a GNA account: In Donno So, the data shows a different empirical generalization than the one implied in Sande 2020 since the DMP process is indeed blocked if the cooperating morphemes are not phonologically adjacent, in Guébie, the DMP process creates phonological surface adjacency since the underlyingly intervening element simply participates in the relevant cooperatively triggered spreading process, and in Amuzgo, the phonological locality problem vanishes as soon as one of the cooperating morphemes is re-analysed as a suffix. The remainder of this paper is structured as follows: In section 2, I lay out my theoretical background assumptions of a GNA system with GSR before I turn to the three case studies in section 3 where GNAG accounts for Donno So (3.1), Guébie 3.2, and Amuzgo 3.3 are presented. Section 4 concludes.

2. Theoretical background: Generalized Nonlinear Affixation with Gradient Symbolic Representations

The specific GNA account I argue for in this paper is enriched with the assumption of Gradient Symbolic Representations and naturally predicts cooperation of elements with special activities. This theory, abbreviated 'GNAG' in the following, is based on the four assumptions in (3).

(3) Generalized Nonlinear Affixation with Gradient Symbolic Representations (=GNAG)

① Morpheme representations can be defective: They can lack certain elements (features, prosodic nodes, tones) on certain tiers or associations between elements on different tiers.

② All phonological elements have a certain activity.

③ Faithfulness and markedness constraints can be violated gradiently; in correlation to the activity of the phonological elements in their scope.

④ Harmony evaluation is based on weighted constraints.

The first assumption ① is the defining assumption of any GNA account and has already been introduced above in section 1. Morpheme-specific tonal overwriting, for example, follows in a GNA account from assuming that certain morphemes contain floating tones in their underlying representation that need to dock and hence overwrite underlying base tones. The existence of underlyingly defective morpheme representations means that constraints on proper prosodic integration become essential in any GNA account. They imply the standard autosegmental assumption that only elements that are dominated by the highest prosodic node (=the prosodic word node in all cases relevant here) are phonologically integrated or 'visible'; all other elements are floating and hence don't result in an immediate phonological interpretation[1]. In the following, I assume constraints like (4-a) demanding that phonological elements of a certain type should be associated to an appropriate host.

That floating elements usually associate to hosts that belong to another morpheme is taken to be a standard Derived Environment Effect: New association lines are preferably added between elements that are of different morphemic affiliation, ensured by the constraint ALTERNATION (e.g. van Oostendorp 2006). In all following analysis, this constraint is taken to have such a high weight that it excludes all candidates violating it. The assumption of ALTERNATION implies that phonological constraints are able to distinguish phonological elements that are affiliated with the same morpheme underlyingly from those that are underlyingly affiliated with a different morpheme. This assumption is implicit in many theoretical accounts and explicitly formalized as the theory of morphological colours in, for example, van Oostendorp 2006. In the floating tone account for Donno So discussed in 3.1, two other constraints will also refer to morphological colours.

The assumption of ② Gradient Symbolic Representations states that phonological elements can have different degrees of presence which are expressed as numerical activities (Smolensky & Goldrick 2016, Rosen 2016). In the original proposal, this claim is part of a larger research program where GSR are the data for Gradient Symbolic Computation, a computational architecture for cognition. For the phonology, the important prediction is that elements with different activities can behave differently in the phonology since they violate constraints to different degrees. GSR thus has the potential for being a general representational account of exceptional phonological behaviour where certain elements behave differently than expected from the general phonology of the language (e.g. Smolensky & Goldrick 2016, Rosen 2016, 2017, 2019, Kushnir 2019, Zimmermann 2018, 2019, 2021). I assume that phonological elements can be gradiently active both in the input and in the output – ③ both faithfulness and markedness constraints thus have the potential to be violated gradiently. An example is the gradient definition of the standard constraint against floating tones (4-a) that takes into account the activity of the non-associated tone that violates it. A floating high tone H_1 will induce -1 violations of T>TBU whereas a floating $H_{0.5}$ will only induce -0.5 violations – the latter is not as bad a markedness problem as the former. And the definition of a standard MAX constraint penalizing deletion is given in (4-b) in its gradient definition. Deletion of a tone T_1 will induce a -1 violation of MAX_T whereas deletion of a tone $T_{0.5}$ will only incur a violation of -0.5 – the

[1] The famous exception is the representation of downstep as a floating L (e.g. Hyman 1979, Pulleyblank 1986).

latter is 'cheaper' to delete than the former. In the following constraint definitions, activity is notated as a subscript variable $_x$ or $_y$.

(4) a. T>TBU
Assign -x violation for every tone T_x that is not associated to a TBU.
b. $\text{M}\textsc{ax}_T$
Assign -x violations for every input tone T_x without an output correspondent.

There are also additional constraint types that are only necessary in a GSR model: For one, there are faithfulness constraints penalizing any change of underlying activity; exemplified in (5-a) and secondly, there are markedness constraints that penalize any element with more (5-b) or less (5-c) than the default activity 1 that are prosodically integrated. All three constraints are specified for tones in (5) but exist for every phonological element.

(5) a. $\text{I}\textsc{d}(\text{A})_T$: Assign -Δ violation for every input tone(s) I with the sum of activity x that correspond(s) to output tone(s) O with the sum of activity y where Δ is the differential between x and y.
b. $*\text{W}\textsc{k}_T$: Assign -(1-x) violations for every tone T_x that is integrated under the highest prosodic node if x<1.
c. $*\text{S}\textsc{tr}_T$: Assign -(1-x) violations for every tone T_x that is integrated under the highest prosodic node if x>1.

As was already discussed in section 1, coalescence of two identical elements is one obvious phonological explanation for a cooperatively conditioned process within GNAG. As in standard correspondence theory, coalescence is taken to be a process that results in an output element with at least two corresponding input elements, violating Uniformity (6) (McCarthy & Prince 1995, McCarthy 1996). In a GSR model, the resulting output element's activity is taken to be the joint input activity of all corresponding elements. Crucially, the realization of this joint output activity does not induce a violation of Id(Act) since all the output activity was already present in the input. The next section will illustrate the effects and violations of these constraint types with concrete analyses. In all these accounts, coalescence is only possible between elements that are adjacent in the input. This implies that no reordering of elements is possible. Whether this is ensured by a high-weighted Linearity constraint in all these languages or whether this is in fact a built-in GEN restriction (as in most containment-based theories (e.g. Goldrick 2000, van Oostendorp 2003, Trommer & Zimmermann 2014)), is a question which is left open for future research.[2] The noteworthy outcome for the comparison between a phase-based and a phonological locality restriction on DMP patterns is that the latter holds even under the radical view that phonology is unable to manipulate the underlying order of elements in the three languages in section 3.

(6) $\text{U}\textsc{nf}_T$: Assign -1 violation for every pair of input tones that correspond to the same output tone.

The final background assumption is that the ⑤ harmony evaluation is based on Harmonic Grammar where constraints are weighted, not ranked (Legendre et al. 1990, Potts et al. 2010). Each candidate receives a harmony score (=$\mathcal{H}$) that is the sum of all constraint violations that are each taken times the respective weight of the constraint. The optimal candidate is the one with the lowest harmony score.

3. Case studies

In this section, three DMP case studies are presented, namely Donno So 3.1, Guébie 3.2, and Amuzgo 3.3. For each language, the data and generalizations are given before a GNAG account is discussed, based on the assumptions made in the previous section 2. Choosing these three case studies serves two main purposes. For one, they illustrate how different DMP patterns fall out in the proposed GNAG theory: These cases involve different phonological processes (tonal overwriting in Donno So and Amuzgo and

[2] In most existing OT-case studies, high-ranked Linearity excludes coalescence between non-adjacent elements (e.g. McCarthy & Prince 1995, Gnanadesikan 1997); notable exceptions are McCarthy 1996 or de Lacy 1999.

vowel harmony in Guébie) and either employ two exceptional co-triggers (Donno So and Amuzgo) or an exceptional trigger and an exceptional undergoer (Guébie). More importantly, however, these analyses prove that neither of these patterns is a problem for a phonological locality restriction on DMP patterns and hence no argument for phase-based locality can be made, contra the claim in Sande 2020.

3.1. Donno So: Blocking under non-adjacency

Tonal overwriting in Donno So, a Dogon language, is discussed in Sande 2020 as an example for cooperation between non-adjacent elements that is problematic in a GNAG account. As I will argue in this section, a closer inspection of the Donno So data actually reveals the opposite generalization that that DMP is blocked under phonological non-adjacency.

Syllables in Donno So can be realized with a high tone (=H), a low tone (=L), or the contours LH, HL, and rarely LHL (Heath 2016: 29). The relevant tonal overwriting applies within the nominal phrase. The overview in (7) shows the general order of elements within a (maximal) nominal phrase, separated into contexts with a preposed and a postposed possessor.

(7) a. Poss N Adj Num Det/Dem
 b. N Adj Num Poss Det/Dem

A numeral and adjective can potentially undergo inversion and hence surface in the order [N Num Adj] instead of the order [N Adj Num]. This reordering is only possible if an 'inversion licensor' is present, namely a possessor, a demonstrative, or a relative clause (Heath 2016: 88); a restriction that will become essential in the discussion of adjacency in DMP contexts below.

Before we turn to the DMP tonal overwriting, some background on 'simple' tonal overwriting is given. More concretely, all adjectives, demonstratives, preposed possessors, and relative clauses in Donno So trigger overwriting with an L. Examples for adjective L-overwriting are given in (8-ii+iii) where it can be seen that any adjective causes L-overwriting of a preceding noun and potentially a numeral. These overwriting examples are contrasted with the corresponding contexts without an adjective in (8-i). Example (8-b-iii) illustrates inversion between Adj and Num which is possible since an inversion licensor in form of a possessor is present. In such an inversion context, the L-overwriting expectedly affects both the noun and the numeral. All the following generalizations and data are taken from Heath 2015 and Heath 2016. I follow the data presentation in these sources where square brackets with a superscripted tonal melody indicate tonal overwriting in the surface forms. The position of this tonal superscript (left or right of the bracket) indicate the position of the triggering morpheme responsible for the overwriting. To ease readability, the overwriting patterns are marked in blue.

(8) L-Overwriting triggered by an adjective (Heath 2016: 76+79)

a.	i.	ìdú	'dog	N
	ii.	[ìdù]^{L} pílù	'white dog'	[N]^{L} Adj
b.	i.	ìdú tàːndú🔑 ù-mɔ̀	'your three dogs'	N Num Poss
	ii.	[ìdù]^{L} pílù tàːndú🔑 ù-mɔ̀	'your three white dogs'	[N]^{L} Adj Num Poss
	iii.	[ìdù tàːndù🔑]^{L} pílù ù-mɔ̀	'your three white dogs'	[N Num]^{L} Adj Poss (inv)

The data (9) illustrates that neither a definite (9-a+b) nor a numeral (9-c+d) trigger any tonal overwriting. The tonal overwriting that can be observed in (9-b) is caused by the adjective and only affects the noun.

(9) No tonal overwriting triggered by a definite or numeral (Heath 2016: 76+79)

a.	ìdú=gɔ̀🔑	'the dog	N=Def
b.	[ìdù]^{L} pílɔ̀=ɔ̀🔑	'the white dog'	[N]^{L} Adj=Def
c.	ìdú tàːndú🔑	'three dogs	N Num
d.	ìdú tàːndú🔑 ù-mɔ̀	'your three dogs'	N Num Poss

If now both a numeral and a definite are present within a nominal phrase, tonal overwriting with an LH-melody applies as can be seen in (10). The scope of this cooperative overwriting involves the numeral as one of the triggers and all material up unto and including the noun itself. The final TBU of this domain bears the H and all preceding TBU's within this domain are realized with an L. This LH-Overwriting is a DMP involving two co-triggers: It only applies in the presence of both a numeral and a definite morpheme.

(10) Cooperative LH-Overwriting triggered by adjacent numeral and definite (Heath 2016: 76+77)

a. [ìdù tàːndɔ́🔑]^{LH}=ɔ̀🔑 ‘the three dogs’ [N Num]^{LH}=Def

b. [ìdù pìlù tàːndɔ́🔑]^{LH}=ɔ̀🔑 ‘the three white dogs’ [N Adj Num]^{LH}=Def

c. séːdù [ìdù tàːndɔ́🔑]^{LH}=ɔ̀🔑 ‘Seydou's three dogs (def)’ Poss [N Num]^{LH} =Def

The important argument for CbP made in Sande 2020 is now the claim that this is a DMP pattern of potentially ‘non-linearly adjacent triggers like Num and Def’ (Sande 2020: 476). However, there is in fact no example given in Sande 2020 for such a context where the two cooperating morphemes are both part of the nominal phrase but are not adjacent. Given the restrictions on reordering of elements discussed above, there are in fact not too many possibilities for such contexts. It can only result from inversion of Num and Adj (11-a+c)[3] or from the presence of a postposed possessor that always precedes a definite marker as in (11-b+c). Example (11-c) in fact combines these two possibilities of non-adjacency that result in two elements intervening between the numeral and the definite. Crucially, there is no LH-overwriting in any of these contexts but only L-overwriting triggered by the adjective in all examples.[4]

(11) Cooperative overwriting blocked under non-adjacency (Heath 2016: 77+79)

a. séːdù [ìdù tàːndù]^{L} pílɔ̀-ɔ̀ Poss ^{L}[N Num]^{L} Adj=Def (inverted)
‘Seydou's three white dogs (def)’

b. [ìdù]^{L} pílù tàːndú ù-mɔ̀=gɔ̀ [N]^{L} Adj Num Poss=Def
‘your three white dogs’

c. [ìdù tàːndù]^{L} pílù ù-mɔ̀=gɔ̀ [N Num]^{L} Adj Poss=Def (inverted)
‘your three white dogs’

A GNAG account of tonal overwriting in Donno So is based on the representational assumptions in (12): The numeral and the definite marker contain a floating L that only has a partial activity of 0.5.[5] For ease of exposition, these depictions omit the TBU-level. This weakly active tone cannot be realized on its own but needs to gain additional activity via coalescence with an identical element. In addition, the definite contains a fully active H that follows the weakly active L. It will be shown below how a standard set of constraints predicts that this representation results in a cooperative LH-overwriting and not, for example, in H-overwriting in case the weak L can not cooperate. Crucially, since coalescence is only possible under adjacency, any tone intervening between a numeral and a definite will block the DMP. Recall that Donno So also has non-cooperative tonal overwriting: There are hence also floating tones with the full activity of 1 that can simply surface on their own. An example is the floating fully active L preceding any adjective (12-c). These depictions introduce some relevant notation that are used in all following autosegmental depictions: Correspondence-theoretic IO-indices are given as superscripted letters and activity as circled numbers below the respective element.

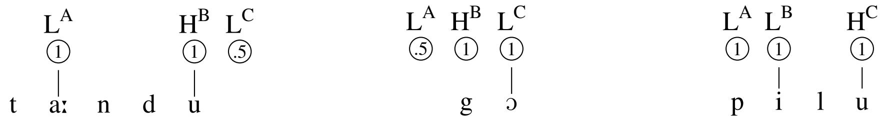
[3] Recall that a relative clause is also an inversion licensor. In a relative clause context, a numeral and definite are necessarily non-adjacent since they are at least separated by a verb. I was not able to find an example with a numeral and definite in a relative clause context but the description in Heath 2016 implies that no LH-overwriting takes place but rather L-overwriting that is triggered by the relative clause (Heath 2016: §2.6).

[4] Note that possessive L-overwriting never affects adjacent Adj and Def. Overwriting in (11)-a is hence ambiguous between being caused by the possessor or the adjective, notated as Poss ^{L}[N Num]^{L} Adj=Def in Heath 2016.

[5] This is a simplification. These floating tones are assumed to be the phonological representation of categorizing morphemes like Adj or Num that are added to category-less roots (e.g. Marantz 1998, Embick 2021). After the word-level phonology, all the phonological elements are neutralized to the same morphological ‘colour’ (=mirroring Bracket Erasure (Chomsky & Halle 1968, Orgun & Inkelas 2002)).

(12) Underlying representations: Morphemes with floating tones

a. Numeral ‘three’ b. Definite DEF c. Adjective ‘white’



That tonal overwriting applies to all TBU’s within a larger domain and not only to a single TBU follows from the prosodic phrasing within a noun phrase that groups, for example, nouns and adjectives into a larger prosodic constituent, termed prosodic phrase and marked with brackets $( )_\iota$. Adjectives and numerals are grouped into their own (potentially embedded) prosodic phrase together with the noun and all possessors head their own prosodic phrase, as in (13). The definite clitic is organized into the same prosodic phrase as a preceding word.

(13) $((\text{N Adj})_\iota \text{ Num })_\iota \; (\text{Poss Def})_\iota$

It has to be emphasized that assuming some prosodic domain as the locus of tonal overwriting is orthogonal to the formalization of the DMP in either a GNAG or a CbP account. The assumption that prosodic structure determines the domain for the DMP in fact follows the assumption in Sande 2020 and Sande et al. 2020 where it is also assumed that ‘the relevant domain of application is a prosodic constituent (prosodic phrase) within the phase being spelled out.’ (Sande 2020: p.476, FN.11). It is hence crucially not the case that the larger domain that is affected by tonal overwriting is co-extensive with a phase.

Most of the constraint types relevant for the HG implementation of cooperative tonal overwriting in Donno So were already introduced in section 2, all others are given in (14) and (17) together with an exemplifying weight for Donno So.[6] A first background assumption is that ID(A)_T penalizing any change in underlying activity for non-deleted elements has a very high weight (=500) and cannot be violated in Donno So. The weakly active L’s (12-a+b) can hence not be strengthened to fully active tones (outside of coalescence contexts). Such candidates and ID(A)_T are omitted in the following tableaux to ease readability. That floating tones affect all TBU’s within a prosodic phrase is triggered by the constraint $*2C_\iota$ (14-a) that penalizes prosodic phrases with phonetically realized tones of different morphological affiliation. The constraint $*T^{2AL}$ (14-b) penalizes any tone that is linked to TBU’s via different association lines where ‘different’ refers to the difference between underlyingly present and epenthetic association lines. That such a difference is detectable in the phonology follows from the assumption of morphological colours (cf. section 2). The high weight of $*T^{2AL}$ in Donno So predicts that underlyingly associated tones are never able to spread to new TBU’s in this language. Finally, the positional faithfulness constraint $\text{DAL-H}_\#$ (14-c) penalizes H’s that are newly associated to a word-initial position and will ensure that the floating H of the numeral cannot overwrite a prosodic phrase on its own without its preceding L.

(14)
a. $*2C_\iota$: Assign -x violation for every prosodic phrase ι_x that contains a pair of TBU’s $\tau_{a\neq0}\tau_{b\neq0}$ that are associated to tones $T_{c\neq0}T_{d\neq0}$ that don’t have the same morphological colour. (W=50)
b. $*T^{2AL}$: Assign -1 violation for every tone that is associated to TBU’s via different types of association lines. (W=500)
c. $\text{DAL-H}_\#$: Assign -1 violation for every new association line between a H and a TBU that is initial in a prosodic word. (W=500)

The first tableau (15) shows simple overwriting in a context where the nominal phrase only contains an adjective following a noun. In line with (12), the adjective contains a fully active floating L in its representation. Leaving this tone unassociated as in (15-a) induces a violation of L>σ. More fatal, however, is the violation of $*2C_\iota$ given that the output TBU’s within one phrase are associated to tones with different morphological affiliation. Deletion of the floating tone as in (15-b) hence avoids the violation of low-weighted L>σ but not of high-weighted $*2C_\iota$. Association of the floating tone to a single TBU

[6] For any GSR account in HG, the concrete constraint weights and activities are just one specific exemplification for the crucial weighting arguments that predict the correct phonological behaviour.

as in (15-c) is similarly helpful for L>σ but not for $*2C_\iota$. This shows that the need to associate floating tones alone is never enough to trigger tonal overwriting in Donno So: Both L>σ and H>σ have a lower weight than $\textsc{Max}_T$. Violations of $\textsc{Max}_T$ are hence only tolerated if this avoids a violation of $*2C_\iota$ as in candidate (15-d) where the originally floating L is associated to all TBU's of the noun. This candidate only induces two violations of $\textsc{Max}_T$. Since $*2C_\iota$ has a higher weight than $\textsc{Max}_T$, we could expect that tonal overwriting ensures phrases with only tones of the same morphological affiliation in all contexts. In the absence of a floating tone, the obvious repair to achieve this is the spreading of some underlyingly associated tone to all other TBU's of the phrase as in candidate (14-e). This, however, is excluded by $*T^{2AL}$, the constraint banning tones that are linked to TBU's via different (epenthetic and underlying) association lines. Association of a tone to multiple TBU's in candidate (15-d) does not induce a violation of $*T^{2AL}$ since these associations are all epenthetic and not 'different'. Only realization of a floating tone thus offers a chance to repair an otherwise expected $*2C_\iota$ violation in Donno So. In the following autosegmental depictions, epenthetic association lines that were not present underlyingly are given as dotted.

(15) N Adj ((8)-a.ii) – L-overwriting for the noun

L^A ① H^B ① L^C ① H^D ① L^E ① i d u p i l u	$*T^{2AL}$ 500	$*\textsc{Wk}_T$ 500	DAL-$H_\#$ 500	$*2C_\iota$ 50	$\textsc{Max}_T$ 2	L>σ 1	H>σ 1	$\mathcal{H}$
a. L^A ① H^B ① L^C ① H^D ① L^E ① (i d u p i l u)$_\iota$				-1		-1		-51
b. L^A ① H^B ① H^D ① L^E ① (i d u p i l u)$_\iota$				-1	-1			-52
c. L^A ① L^C ① H^D ① L^E ① (i d u p i l u)$_\iota$				-1	-1			-52
☞ d. L^C ① H^D ① L^E ① (i d u p i l u)$_\iota$					-2			-4
e. L^C ① H^D ① L^E ① (i d u p i l u)$_\iota$	-1				-2	-1		-505

Now we can turn to the fate of weakly active L's. Tableau (16) optimizes a context where a definite is present but no numeral. Recall from (12) that the former contains a floating $L_{0.5}$ followed by a floating H_1. Since $\textsc{Id}(A)_T$ has a high weight of 500 in Donno So, the weakly active $L_{0.5}$ can not be strengthened to a fully active L_1. Realization of the floating L with its underlying activity (16-c) induces -0.5 violation of $*\textsc{Wk}_T$, a constraint that also has the high weight of 500. The weak floating L hence has no chance to be realized in the absence of a coalescence partner. Candidate (16-d) and (16-e) show that realization of the floating H is impossible without realization of the preceding L. Though (16-d) avoids a violation of H>σ, this constraint has a lower weight than $\textsc{Max}_T$ – as was already emphasized above, floating tones are only realized if this realization is helpful in avoiding a $*2C_\iota$ violation. This strategy is shown in (16-e) where the H overwrites both TBU's of the preceding noun. However, this fatally violates DAL-$H_\#$. Neither of the floating tones has thus a chance to associate and the choice between leaving them floating (16-a) and deletion (16-b) is made in favor of the former since L>σ and H>σ have a lower weight than $\textsc{Max}_T$.

(16) N Def ((9)-a) – No tonal overwriting triggered by a weak tone

L^A ① H^B ① L^C ⑤ H^D ① L^E ① / i d u g ɔ	$*T^{2AL}$ 500	$*W\text{KT}$ 500	DAL-$H_\#$ 500	$*2C_\iota$ 50	MAX_T 2	L>σ 1	H>σ 1	$\mathcal{H}$
☞ a. L^A ① H^B ① L^C ⑤ H^D ① L^E ① (i d u g ɔ)ι				-1		-0.5	-1	-51.5
b. L^A ① H^B ① L^E ① (i d u g ɔ)ι				-1	-1.5			-53
c. L^C ⑤ H^D ① L^E ① (i d u g ɔ)ι		-0.5			-2			-254
d. L^A ① L^C ⑤ H^D ① L^E ① (i d u g ɔ)ι				-1	-1	-0.5		-52,5
e. L^C ⑤ H^D ① L^E ① (i d u g ɔ)ι			-1		-2	-0.5		-502.5

The optimization of a context with a numeral but no adjacent definite of course mirrors (16): The weak floating tone cannot be realized (cf. (16-b)) and will remain floating (cf. (16-a)). We can now turn to the interesting DMP context where the weakly active L of a definite is directly adjacent to the weakly active floating L of a numeral (18). In this case, the weak L's finally have a chance to be realized since they can undergo coalescence and thus unite their underlying activity to the full activity of 1 in (18-b). This coalescence – detectable since LÉ̃,F bears two IO-indices – induces a violation of UNF_T but this faithfulness constraint has a rather low weight. Crucially, this candidate does not induce a violation of ID(A)_T: Though coalescence results in more surface activity, this activity has an input source and is not added (recall the definition (5-a) in section 2).

Realization of the L's, however, does not yet decide how to distribute the tones across the many TBU's that need overwriting in order to avoid a violation of $*2C_\iota$: Both (18-b) and (18-c) avoid a violation of $*2C_\iota$ and induce the same number of violations of UNF_T and MAX_T. This choice is made by the standard constraints against 'long' tones that are associated to multiple TBU's (17-a+b). The difference in their weight predicts that it is better to spread the L (18-b) rather than the H (18-c). Importantly, realization of the H in (18-b+c) avoids any violations of DAL-$H_\#$ that were fatal in (16-d) since the H is only newly associated to non-initial TBU's. As soon as the weak L of the definite can be realized, it hence provides the opportunity for the floating H to be realized as well. In tableau (18), *LONGH and *LONGL are added that were not decisive in any of the tableaux above and all constraints with weight 500 (and candidates excluded by them) are omitted for reasons of space.

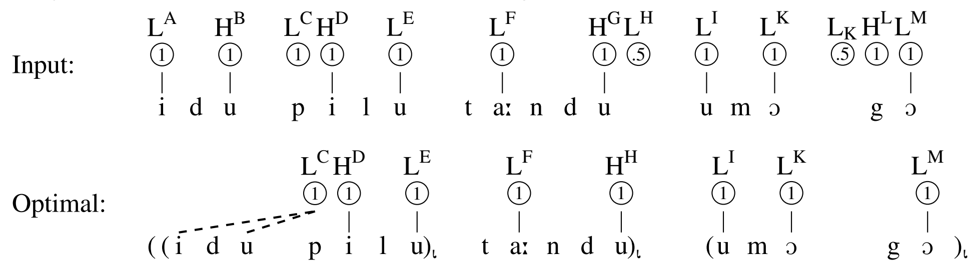
(17) a. *LONGH: Assign -1 violation for every H that is linked to more than one TBU. (W=5)
b. *LONGL: Assign -1 violation for every L that is linked to more than one TBU. (W=1)

(18) N Num Def ((10)-a) – Cooperative LH-overwriting

Input: $L^A\ H^B\ L^C\ H^D\ L^E\ L^F\ H^G\ L^H$ / i d u t aː n d ɔ ɔ	*2Cι 50	*LoᴎH 5	MaxT 2	L>σ 1	H>σ 1	*LongL 1	UnfT 1	$\mathcal{H}$
a. $L^A\ H^B\ L^C\ H^D\ L^E\ L^F\ H^H\ L_H$ / (i d u t aː n d ɔ ɔ)ι	-1			-1	-1			-52
☞ b. $L^{E,F}\ H^H\ L_H$ / (i d u t aː n d ɔ ɔ)ι			-4			-1	-1	-10
c. $L^{E,F}\ H^H\ L_H$ / (i d u t aː n d ɔ ɔ)ι		-1	-4				-1	-13

An intervention context where both a numeral and a definite are present but not adjacent (19) again mirrors the tableau in (16): The weak floating L's is deleted in the winning candidate since they cannot coalesce with an adjacent weak L and cannot be realized on their own since both strengthening and realization as a weak tone are impossible in Donno So.[7]

(19) N Adj Num Poss Def ((11)-b): No LH-overwriting



3.2. *Guébie: Intervening elements deleted on the surface*

Guébie is a Kru language described in detail in Sande 2017. Recall from (1) that the relevant doubly conditioned process is full vowel harmony (=FVH) that is triggered by only certain enclitics and only affects certain roots. More contexts where this DMP successfully applies are given in (20). In these examples, different roots are followed by a third person enclitic and the initial root vowel undergoes regressive FVH with the enclitic vowel. Note that the final root vowel is deleted; a regular hiatus-resolution strategy in Guébie. As we will see below, this vowel deletion never affects vowels that are the only exponent of a morpheme (Sande 2020: 465). The superscripted numbers notate contrastive tone (1=highest, 4=lowest).

[7] A weak floating L can also coalesce with a fully active adjacent L; a context that can, for example, arise if the definite follows a noun with a final L. This would violate *Strt since a tone with an activity higher than 1 would result. Since such a candidate is surface-identical to a candidate where the weak floating L remains floating, there is no a-priori way to decide whether *Strt has a high weight in Donno So or not.

(20) Undergoer roots and triggering clitics: FVH (Sande 2020: 466)

	Verbs	3.Obj enclitics	Surface	
a.	jili$^{2.3}$🔒	=ɔ^{2}🔑	jɔl=ɔ$^{2.32}$	'steal him'
		=ɛ^{2}🔑	jɛl=ɛ$^{2.32}$	'steal it'
b.	jɪla$^{3.2}$🔒	=ɔ^{2}🔑	jɔl=ɔ$^{3.2}$	'ask him'
		=ɛ^{2}🔑	jɛl=ɛ$^{3.2}$	'ask it'
c.	bala$^{3.3}$🔒	=ɔ^{2}🔑	bɔl=ɔ$^{3.2}$	'hit him'
		=ɛ^{2}🔑	bɛl=ɛ$^{3.2}$	'hit it'

This FVH proceeds only leftwards and, for example, never affects a following affix (e.g. the nominaliser suffix following the enclitic in /bala$^{3.3}$🔒 =ɔ^{2}🔑 =li^{2}/ –> [bɔl=ɔ=li$^{3.2.2}$], *[bɔl=ɔ=lɔ$^{3.2.2}$] 'hit', (Sande 2020: 467)). That FVH in Guébie is a DMP becomes clear from the data in (21) and (22). The same roots that underwent FVH in (20) are combined with a first person object enclitic in (21-a) and with the passive suffix that is in fact homophonous with the triggering third person singular enclitic in (21-b). Since there is no FVH in any of these examples, it can be concluded that it is indeed an arbitrary lexical property of enclitics/suffixes to either trigger FVH or not.

(21) Undergoer roots and non-triggers: No FVH (Sande 2020: 466+467)

a.	jili$^{2.3}$🔒	=e^{3}	jil=e$^{2.3}$	'steal me'	+ 1.SG Obj enclitics
	jɪla$^{3.2}$🔒	=e^{3}	jɪl=e$^{3.23}$	'ask me'	
	bala$^{3.3}$🔒	=e^{3}	bal=e$^{3.3}$	'hit me'	
b.	bala$^{3.3}$🔒	-ɔ^{2}	bal-ɔ$^{3.2}$	'be hit'	+ PASS suffix
	jɪla$^{3.2}$🔒	-ɔ^{2}	jɪl-ɔ$^{3.2}$	'be asked'	

And (22) adds contexts where a triggering third person enclitic is combined with different roots that are non-undergoers for this process and hence surface with their underlying vowel.[8]

(22) Non-undergoer roots and triggering clitics: No FVH (Sande 2020: 467)

	Verb	3.Obj enclitic	Surface	
a.	tɛlɪ$^{3.3}$	=ɔ^{2}🔑	tɛl=ɔ$^{3.2}$	'carve'
b.	sijo$^{2.3}$	=ɔ^{2}🔑	sij=ɔ$^{2.32}$	'wipe'
c.	ɲɛpɛ$^{3.1}$	=ɔ^{2}🔑	ɲɛp=ɔ$^{3.12}$	'sweep'

A final empirical fact about the undergoer roots deserves mentioning that will turn out to be a strong independent argument for the GNAG account presented below: All the roots that undergo FVH optionally undergo initial vowel deletion that is impossible for non-undergoer roots (Sande 2017: §5.2). The examples in (23) contrasts undergoer roots (23-a) with non-undergoer roots (23-b) in isolation and in contexts with a third person object enclitic and it can be seen that only the former can optionally loose their initial vowel. As becomes clear in (23-a), initial vowel deletion also optionally applies in the DMP contexts; the examples in (20) are thus only one possible surface form for those contexts.

(23) Optional vowel deletion for undergoer stems (Sande 2017: 137)

	Verb		Surface form(s)			Surface form(s) with 3.Obj enclitic🔑		
a.	bala$^{3.3}$🔒	'hit'	bala$^{3.3}$	~	bra^{3}	bɔl=ɔ$^{3.2}$	~	br=ɔ^{2}
	jɪla$^{3.2}$🔒	'ask'	jɪla$^{3.2}$	~	jra^{3}	jɔl=ɔ$^{3.2}$	~	jr=ɔ^{32}
	tulu$^{4.4}$🔒	'chase'	tulu$^{4.4}$	~	tru^{4}	tɔl=ɔ$^{4.2}$	~	trɔ^{42}
b.	tɛlɪ$^{3.3}$	'carve'	tɛlɪ$^{3.3}$			tɛl=ɔ$^{3.2}$		
	sijo$^{2.3}$	'wipe'	sijo$^{2.3}$			sij=ɔ$^{2.32}$		
	ɲɛpɛ$^{3.1}$	'sweep'	ɲɛpɛ$^{3.1}$			ɲɛp=ɔ$^{3.12}$		

[8] There are a few phonological factors that make it more likely that a root is an undergoer (cf. especially §5.2.2 in Sande 2017) but being an undergoer root nevertheless remains an arbitrary lexical property for at least some roots.

The crucial FVH context that is discussed as a problem for a GNAG account in Sande 2020 is given in (24) and involves an intervening suffix between a triggering enclitic and an undergoer root. In (24-a), it is the non-triggering applicative suffix /-lI/[9] and in (24-b), the non-triggering causative suffix.

(24) FVH across an intervening suffix (Sande 2017: 140)

a.	e^{4}	bɔlɔ-l=ɔ$^{3.3.2}$	nuni$^{2.3}$	mɛ^{3}
	1.SG.NOM	hit.PFV-APPL=3.SG.ACC	spoon	with
	‘I hit him with a spoon’			
b.	e^{4}	jɔl-ɔ=ɔ$^{3.2.2}$		
	1.SG.NOM	ask-CAUS=3.SG.ACC		
	‘I ask him’			

The underlying and surface forms of the relevant two words in (24-b+c) are given in (25) (to ease readability, the tones are omitted). In both these examples, the exceptional undergoer root and the exceptional triggering enclitic are indeed separated by an intervening suffix and FVH nevertheless applies. Note that one vowel is deleted in both examples to avoid a hiatus: The vowel of the applicative suffix in (25-b) and the root-final vowel in (25-b). In the latter context, there still is a hiatus since vowel deletion in Guébie never affects a vowel that is the only representation of a morpheme.

(25) Non-adjacency between triggering clitic and undergoer root: FVH

a.	bala🔒	-lI	=ɔ🔑	→	bɔlɔ	-l	=ɔ
b.	jɪla🔒	-A	=ɔ🔑	→	jɔl	-ɔ	=ɔ

Although it is indeed the case that the undergoing root and the triggering object enclitic are not adjacent in the examples in (25), it is argued in this subsection that it is too hasty to classify these contexts as a locality problem for a GNAG account. The crucial observation is the fact that all vowels that intervene between the exceptional undergoer and trigger simply participate in the spreading process. This means that there is autosegmental adjacency between the relevant elements: Spreading of the triggering enclitic vocalic features in (25) can reach the undergoer root vowel without any crossing association lines. However, this is only one part of the argument that there is no locality problem for a GNAG account. The second question is whether and how the phonology can in fact "decide" that the process is cooperatively triggered if the two cooperating elements are not underlyingly adjacent. In Sande 2020, this problem is described as follows: "It is not clear why, in an autosegmental or other item-based approach (e.g. Gradient Symbolic Representations; Rosen 2016, Smolensky & Goldrick 2016), intervening affixes should alternate when an alternating root and object marker are present, but not when a non-alternating root and object marker are present" (Sande 2020: 488). As is shown below, this apparent visibility problem between trigger and undergoer vanishes as soon as a parallel OT architecture is assumed where there are two independent reasons that 1) the undergoer’s vocalic features want to be deleted and 2) the triggering vocalic features want and are able to spread. Spreading only applies if both these preferences can be fulfilled at once. Whether there is an additional vowel participating in the spreading is in fact irrelevant for the optimality of the DMP pattern as long as both the undergoing and the triggering vocalic feature bundles get their preference fulfilled.

I take FVH in Guébie to be spreading of the Vocalic node (=V-node) that dominates all vocalic features that contrastively specify vowels; organized into a V-place (=V-pl) and an Aperture (=Ap) node (as in Unified Feature Theory; cf. e.g. Clements 1991, Clements & Hume 1995). This V-node associates to a segmental root node that is abbreviated with ‘•’ in the following.[10] The GNAG account of the DMP in Guébie is based on the representational contrast that triggering enclitics contain an exceptionally strongly active V-node and undergoing roots an exceptionally weak initial V-node: The former has an activity of 3

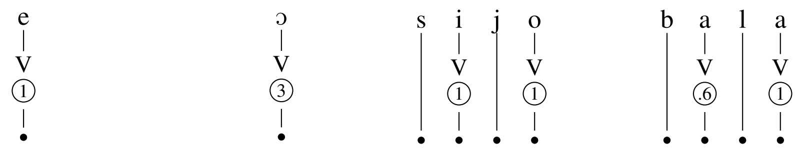
[9] The underlying forms of the causative and applicative suffix are notated with underspecified vowels /I/ and /A/ since their underlying [ATR]-value cannot be determined. As all other affixes, they undergo regular bidirectional root-triggered ATR-harmony. This harmony was not relevant in the examples above since object enclitics do not participate in this harmony (Sande 2017: 28+29).

[10] It is left open whether this segmental root node actually corresponds to a segmental feature or to an abstract timing unit (e.g. McCarthy 1988) since the approach is easily compatible with both views.

(26-b) and the latter an activity of 0.6 (26-d). It has to be emphasized again, though, that only the relative differences in activity matter, the concrete numbers are just an exemplification. These exceptional V-place activities are contrasted with the default activities in non-undergoer roots and non-triggering enclitics in (26-a) and (26-c). The full autosegmental structures are abbreviated in (26) and the phonological feature bundles specifying each segment are abbreviated with the IPA symbol. In addition, only the activities for the V-nodes are given since those are the only ones that are relevant in the following.

(26) GNAG representations for Guébie

a. Non-trigger root b. Trigger c. Non-undergoer d. Undergoer



The most important consequences from these lexical activity differences are 1) that a strongly active V-node violates the constraint demanding FVH more and the constraint against spreading less and 2) that a weakly active V-node is less protected by faithfulness constraints and is also marked if it is realized. DMP only surfaces if all these gradient constraint violations come together within a single context. Besides predicting the DMP pattern correctly, the representational contrast between a non-undergoer and undergoer root (26-a+b) also predicts that only the latter are subject to optional vowel deletion: Their V-node is weak and is hence easier to delete since it is not protected by faithfulness constraints as much as a fully active V-node.

An account with weighted constraints as the one in this paper can easily be super-imposed with a MaxEnt model where harmony scores correlate with probabilities of surface forms to correctly model optionality. The constraint weights below were hence tested with the MaxEnt grammar tool (Hayes 2009) and all candidates with a probability above 49% were marked with "☞" in the following. All constraints relevant for the analysis that were not already introduced in their general form in section 2 are given in (27) together with their weight assumed for Guébie. The constraint favoring regressive spreading of every V-node is taken to be the positional licensing constraint #V! (27-a)[11] demanding that all V-nodes should be associated with the initial vowel of a word. Taking this to be the trigger of FVH immediately explains why spreading of vocalic features will always be rightwards and never, for example, affect a following suffix. There are two strategies to avoid a violation of #V! in a word with multiple vowels that will become relevant in Guébie: Either one of the V-nodes spreads and hence associates to all root nodes or all vowels but one are deleted. Four faithfulness constraints penalizing these strategies will become relevant in the analysis below. Complete deletion of a vowel violates Max• (=M•) in addition to Max$_V$ (=M$_V$). The positional version Max$_{\#V}$ (27-b) specifically protects the initial V-node. A new association of a V-node to a root node, on the other hand, also incurs a violation of Dep$_{AL}$ (27-c), the faithfulness constraint against inserting new association lines. There is also a markedness constraint that potentially penalizes spreading, namely *Spread$_V$ (27-d), penalizing V-nodes that are associated to multiple root nodes. Importantly, this constraint is relativized to the activity of the V-node: A multiply associated V-node with a higher activity violates *Spread$_V$ to a lesser degree than a multiply associated node with less activity. This gradient violation is one ingredient into the threshold that predicts DMP in Guébie since it predicts that strongly active V-nodes can spread more easily. Finally, the markedness constraint against weak elements specified to V-nodes *Wk$_V$ is violated if an undergoing root vowel with its underlying activity is realized – an important part of its FVH undergoing property.

[11] An extension of positional faithfulness (Beckman 1998) argued for in, for example, Zoll 1998 or Kaplan 2018.

(27) Constraints

a. #V!: Assign -x violations for each Vocalic node V_x that is not associated to the initial root node of the PrWd. (W=64)

b. MAX$_{\#V}$ (=M$_{\#V}$): Assign -x violations for every input Vocalic node V_x that corresponds to output Vocalic node V_0 that is initial in a PrWd. (W=245)

c. DEP$_{AL}$ (=D$_{AL}$): Assign a violation mark for every association between a root node • and a Vocalic node V that is present in the output but not in the input. (W=0)

d. *SPREAD$_V$ (=*SP$_V$): For every configuration where a Vocalic node V_x is associated with *n* number of root nodes:
Assign (x-n) violations if (x-n)<0. (W=128)

In Guébie, both MAX• and DEP$_{AL}$ have a weight of 0 and hence do not contribute to the harmony score of a candidates. Those constraints are nevertheless included in the tableaux below since they show that spreading and deletion candidates still have different violation profiles. As in the GNAG account of Donno So in section 3.1, the relevant constraint penalizing any change in activity ID(ACT)$_V$ is taken to have a very high weight (e.g. 500). In the following discussion, all candidates which change the underlying activity of a (non-deleted) V-node are thus excluded from the consideration. The derivation of the predictable vowel hiatus resolution is excluded from the current analysis since it is completely orthogonal to the DMP. That the first of two otherwise adjacent vowels is deleted follows from a high-weighted *VV constraint and some independent reason that the first of two otherwise adjacent vowels is deleted (cf., for example, Casali 2005: for discussion and further references). In the tableaux below, these constraints are omitted and all candidates delete the vowels that never surface to avoid a hiatus.

Tableau (28) optimizes what can be regarded as the default context: A non-undergoer root combines with a non-triggering suffix. In such a context, all V-nodes have the default activity of 1 underlyingly and no constraint is violated gradiently. The constraint weights assumed for Guébie predict that the initial root vowel surfaces faithfully as in candidate (28-a). This structure induces one violation of #V! since the V-node of the enclitic is not associated with the initial vowel of the word. This violation is avoided in the FVH candidate (28-b) where the V-node of the initial root vowel is deleted and the V-node of the enclitic associates to the initial vocalic root node. This violates both MAX$_{\#V}$ and MAX$_V$. In addition, *SPREAD$_V$ is violated by -1 once since a V-node with activity 1 is associated to two vowels. These violations result in a worse harmony score than the one violation of #V!. The violation of *SPREAD$_V$ induced by FVH in (28-b) is avoided in (28-c) where the initial root vowel is deleted altogether. Since only a single V-node remains realized in this structure, #V! is again not violated. However, this candidate violates MAX$_{\#V}$, MAX$_V$, and MAX• since a whole initial vowel with its V-node remains unrealized. The line below the autosegmental structure in (28) introduces an abbreviated notation that will be used in the following tableaux for Guébie instead of the full autosegmental representations. It notates the activity of the V-nodes as a subscript to the vowel symbol and spreading of a V-node is notated as underlining. Deleted vowels are given with a grey background and the resulting phonetic surface string next to the phonological structure.

(28) Non-underger + non-trigger: Underlying initial root vowel surfaces

$si_1jo_1e_1$	*W_{K_V} 312	$M_{\#V}$ 245	*S_{P_V} 128	M_V 70	#V! 64	M• 0	D_{AL} 0	$\mathcal{H}$
☞ a. $si_1jo e_1$ [sije]				-1	-1	-1		-134
b. $se_1jo e_1$ [seje]		-1	-1	-2		-1	-1	-513
c. $sejoe_1$ [sje]		-1		-2		-2		-385

The next two tableaux show that there is still no FVH if only one of the cooperating morpheme types – namely only an undergoer root or a triggering suffix – is present. Tableau (29) replaces the non-triggering suffix in (28) with a triggering suffix that has an exceptionally strong V-node. There are two crucial violation differences to (28) resulting from this activity difference: For one, #V! is violated more in candidate (29-a) since a more active V-node is not associated with the initial vowel. And on the other hand, spreading of the strong suffix vowel in (29-b) does not induce a *SPREAD$_V$ violation simply because the V-node has enough activity to be distributed across multiple root nodes (cf. the definition (27-d)). The harmony scores of (29-a) and (29-b) are hence closer to each other than the ones of (28-a) and (28-b) but (29-b) is still sub-optimal and only (29-a) is predicted as a possible surface structure.

(29) Non-underger + trigger: Underlying initial root vowel surfaces

$s_1i_1j_1o_1 - ɔ_3$	*W_{K_V} 312	$M_{\#V}$ 245	*S_{P_V} 128	M_V 70	#V! 64	M• 0	D_{AL} 0	$\mathcal{H}$
☞ a. $si_1joɔ_3$ [sijɔ]				-1	-3	-1		-262
b. $sɔ_3joɔ_3$ [sɔjɔ]		-1		-2		-1	-1	-385
c. $sijoɔ_3$ [sjɔ]		-1		-2		-2		-385

The gradient constraint violations induced by an undergoer root in the absence of a triggering suffix are illustrated in (30). The presence of a weakly active V-node in the initial root vowel causes two gradient constraint violations: Realization of the initial vowel with its underlying V-node in candidate (30-a) induces a -0.4 violation of *W_{K_V} and deletion of the initial V-node in (30-b) and (30-c) violates MAX$_{\#V}$ and MAX$_V$ only by 0.6. Whereas (30-a) hence has a worse harmony score than its counterpart candidate (28-a), both (30-b) and (30-c) have slightly better harmony scores than their counterparts (28-b) and (28-c). For the comparison between (30-a) and (30-b), the harmony score difference is still grave enough to predict (30-b) to be sub-optimal. But for the comparison between (30-a) and (30-c), actual optionality is predicted since both harmony scores are near-identical. Assuming that an undergoer root has a weakly active V-node associated to its initial vowel hence predicts that this vowel can optionally be deleted in all contexts: Realization of a weakly active V-node is as bad/good as deleting it.

(30) Underger + non-trigger: Faithful vowel realization or initial vowel deletion

$b_1a_{0.6}l_1a_1 - e_1$			*W$_{KV}$ 312	M$_{\#V}$ 245	*SP$_V$ 128	M$_V$ 70	#V! 64	M• 0	D$_{AL}$ 0	$\mathcal{H}$
☞ a.	$ba_{0.6}lae_1$	[bale]	-0.4			-1	-1	-1		-258.8
b.	be_1lae_1	[bele]		-0.6	-1	-1.6		-1	-1	-387
☞ c.	$balae_1$	[ble]		-0.6		-1.6		-2		-259

Tableau (31) finally optimizes a context where both an undergoer root and a triggering suffix are combined. As can be seen, the combined effect of the gradient constraint violations in (29) and (30) finally crosses the threshold for making FVH possible and candidates (31-b) and (31-c) are predicted to optionally alternate as optimal outcome. Faithful realization of the initial root vowel in (31-a) is sub-optimal since it both induces a -0.6 violation of *W$_{KV}$ and a -3 violation of #V! Spreading of the suffix vowels V-node in (31-b) avoids these violations but does not add a violation of *SPREAD$_V$ since this V-node has enough activity to be distributed across multiple root nodes. This option results in the same optimal harmony score than complete deletion of the initial vowel in (31-c) that only differs from (31-b) by trading DEP$_{AL}$ violation with a M• violation – two constraints with an identical weight.

(31) Underger + trigger: FVH or initial vowel deletion

$ba_{0.6}la_1 - ɔ_3$			*W$_{KV}$ 312	M$_{\#V}$ 245	*SP$_V$ 128	M$_V$ 70	#V! 64	M• 0	D$_{AL}$ 0	$\mathcal{H}$
a.	$ba_{0.6}laɔ_3$	[balɔ]	-0.4			-1	-3	-1		-386.8
☞ b.	$bɔ_3laɔ_3$	[bɔlɔ]		-0.6		-1.6		-1	-1	-259
☞ c.	$balaɔ_3$	[blɔ]		-0.6		-1.6		-2		-259

This account of Guébie shows that within a GNAG account, DMP can not only result from coalescence, it can also result if only the gradient constraint violations of two different gradiently active elements cross a threshold to enable a certain process.

Tableau (32) finally adds the relevant non-local DMP context where a suffix intervenes between an undergoer root and a triggering suffix.

(32) Undergoer and trigger, with intervener: FVH or initial vowel deletion

$ji_{0.6}la_1 - a_1 - ɔ_3$			*W$_{KV}$ 312	M$_{\#V}$ 245	*SP$_V$ 128	M$_V$ 70	#V! 64	M• 0	D$_{AL}$ 0	$\mathcal{H}$
a.	$ji_{0.6}laa_1ɔ_3$	[jilaɔ]	-0.4			-1	-4	-1		-450.8
☞ b.	$jɔ_3laɔ_3ɔ_3$	[jɔlɔɔ]		-0.6		-2.6		-1	-2	-329
c.	$jilaa_1ɔ_3$	[jlaɔ]		-0.6		-1.6	-3	-2		-451
☞ d.	$jilaɔ_3ɔ_3$	[jlɔɔ]		-0.6		-2.6		-2	-1	-329
e.	$ja_1laa_1ɔ_3$	[jalaɔ]		-0.6	-1	-1.6	-3	-1	-1	-579

As was already emphasized in the discussion above, FVH in this context creates no locality issue in a GNAG account. Even though the exceptionally triggering V-node is not adjacent to the exceptionally undergoing V-node it simply spreads to all intervening vocalic root nodes and can hence reach its target position without crossing any association lines. This is shown in (33) which gives the autosegmental structure for optimal FVH in candidate (32-b). Note that the apparent "crossing" of association lines in (33-b) is only due to the shortcomings of two-dimensional paper: The V-node and the nodes specifying consonantal features are on different tiers and an association between a segmental root node to the former is hence on another plane than an association of a segmental root node to the latter.

Tableau (32) also shows that the weighting relations in the proposed analysis correctly predict that a strongly active V-node can overwrite two underlying V-place specifications if this ensures that it reaches the preferred initial position and if a weak V-node is overwritten in initial position.

(33) FVH with an intervener between undergoer and trigger

a. Input b. FVH (candidate (33-b))

3.3. Amuzgo: Morphological reanalysis creates adjacency

The third example for a non-local DMP in Sande 2020 comes from Amuzgo, an Otomanguean language. As all of the languages from this family, it employs an extremely complex system of morphological tone. Amuzgo has five level tones (H, M, M+, L, L+; M+ and L+ showing a longer rime duration and a slight rise) and three contour tones (HM, HL, MH). The examples in (34) give a small illustration of the complex tonal inflectional system that marks subject person features. The three verbs all surface with an M-tone in the third person singular which is assumed to show the underlying tones of a verb root (Kim 2016) but differ in the tonal melodies in the first and second person singular. These tones can not be predicted from the underlying tonal specification but are dependent on idiosyncratic class-membership of the verb roots. In contrast to the singular forms, the plural formation is rather systematic and involves a surface MH in the first person plural exclusive and the underlying verb tone in all other plural forms for most verbs (Kim 2016: 213). 'Person' tones in the following hence only imply the irregular singular person tones.

(34) Person tone overwriting (Kim 2016: 206)

	'sing'	'enter'	'eavesdrop'
3.SG	ʔ^{H}-ta^{M}	ʔ^{H}-βa^{M}	ʔ^{H}-nda^{M}
1.SG	ma^{M}-ta^{HM}	ma^{M}-βa^{HM}	ma^{M}-nda^{M}
2.SG	ma^{M}-ta-ʔ^{M}	ma^{M}-βa-ʔ^{HM}	ma^{M}-nda-ʔ^{M}

Table (35) summarizes the surface tones of 1SG and 2SG forms that Kim 2016 found in 133 monosyllabic verbs, sorted according to frequency.[12] Note that (34) illustrate classes A/I, B/J and E.

(35) Inflectional tone classes (Kim 2016: 215)

CLASS	A/I	B/J	D	K	G	N	E	F	L	O	C	H	M
1.SG	HM	HM	HL	M	L	M	M	L+	L+	L	HM	L	HL
2.SG	HM	M	L	HL	HM	L	M	L+	L	L	L+	M	HL

This exemplifies a DMP pattern: Both the root and the person morphemes co-trigger tonal overwriting with one of the various tonal patterns. The causative is now the context that is relevant for the question of whether cooperating morphemes need to be phonologically adjacent. The causative in Amuzgo is marked with a prefix /si^{H}-/ and tonal overwriting for some forms as in (36).

(36) Causative forms: no person tone overwriting (Kim 2018: 10-13)

a. 'Higher' tones: HM in 1/2

	'shrink'	'beat, stir'	'widen'
3.SG	si^{H}-chho^{H}	si^{H}-n^{j}ʔen^{MH}	si^{H}-to^{M+}
1.SG	si^{H}-chhɔ^{HM}	si^{H}-n^{j}ʔɛn^{HM}	si^{H}-tɔ^{HM}
2.SG	si^{H}-chhoʔ^{HM}	si^{H}-n^{j}ʔenʔ^{HM}	si^{H}-toʔ^{HM}

b. 'Lower' tones: Underlying tone

	'level'	'dissolve'	'char'
3.SG	si^{H}-su^{M}	si^{H}-nda^{HM}	si^{H}-nʔen^{L+}
1.SG	si^{H}-suʔ^{M}	si^{H}-nda^{HM}	si^{H}-nʔɛn^{L+}
2.SG	si^{H}-su^{M}	si^{H}-ndaʔ^{HM}	si^{H}-nʔenʔ$^{L+}$

[12]This list abstracts away from the fact that some of the patterns are only found for vowel-final and some only for /ʔ/-final stems. See Kim 2016 for a detailed discussion and also for the explanation how a predictable tonal lowering process for /ʔ/-final stems reduces the number of inflectional classes.

More concretely, verbs with underlying H, M+, or MH tones surface with HM in the causative, highlighted in blue in (36-a), whereas verbs with underlying M, L+. HM, and HL tones show their underlying tone throughout in the causative, highlighted in red in (36-b). Note that additional non-concatenative changes like vowel lowering and glottal changes can be observed for some verbs in addition to the tonal overwriting.

Importantly, the tones marking first and second person in non-causative contexts are blocked in causative forms. This is emphasized again in (37) with a contrast between causative and non-causative forms for the verb 'run' that shows its underlying M-tone in the causative, again highlighted in red. The person tones surfacing in the non-causative are highlighted in blue.

(37) No person tones in the causative (Kim & Sande 2020: 4)

	'run' COMPL	'cause to run' COMPL
3.SG	hna^{M}-nɔ̃^{M}	si^{H}-na^{M}-nɔ̃^{M}
1.SG	hna^{M}-nɔ̃^{HM}	si^{H}-na^{M}-nɔ̃^{M}
2.SG	hna^{M}-nɔ̃ʔ$^{L+}$	si^{H}-na^{M}-nɔ̃ʔ^{M}

The causative is hence a context where the DMP between the person agreement morphemes and the root does not surface. Sande 2019 argues that this blocking of a DMP follows in a CbP account from the assumption that the voice head hosting the causative introduces a phase boundary and thus blocks the cooperation between the root and the higher person feature co-phonologies. In contrast, Sande 2020 argues that an account based on floating tones, on the other hand, faces a locality problem. In such an account, blocking of DMP in the causative would follow if the tone of the causative prefix intervenes between the floating root tones and the floating person tones, shown in (38).

(38) Prefix tones block cooperation in one context but not the other?

a. CAUSATIVE b. POTENTIAL

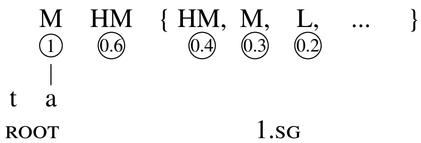
However, as Sande 2020 correctly points out, this results in a conundrum since there are other verbal prefixes like the incompletive marker /ma^{L}-/ or the potential marker /n^{L}-/ that do not block realization of person tones on the verb as can be seen in (39), depicted in (38-b). It is hence an apparent mystery why some prefix tones create non-adjacency and block cooperation while others don't. A CbP account, on the other hand, can predict the asymmetry in (39) from the simple assumption that the causative introduces a phase boundary but the potential does not.

(39) Incompletive and potential prefixes do not block DMP (Sande 2020: 487)

	INCOMPLETIVE	POTENTIAL	
3.SG	ʔ^{H}-k^{w}heʔ^{MH}	n^{H}-k^{w}heʔ^{MH}	/k^{w}heʔ^{MH}/ 'arrive (here)'
1.SG	ma^{M}-k^{w}hɛ^{L}	n^{H}-k^{w}hɛ^{L}	
2.SG	ma^{M}-k^{w}heʔ^{L}	n^{H}-k^{w}heʔ^{L}	

As already implied above in (38), a GNAG account of Amuzgo is similar to the two-trigger account of tonal overwriting in Donno So in section 3.1: All verbal roots contain floating tone(s) that cannot surface on their own but have to coalesce with the floating tone(s) of a person morpheme. Since there are so many tonal allomorphs of the first and second person, the floating tones of the person morphemes are assumed to be part of a blended representation with multiple gradiently active tones (Smolensky & Goldrick 2016, Rosen 2016, 2017, 2019). The illustration in (40) shows that the floating tones of the person morpheme are all weakly active and can't surface on their own – only coalescence with an identical weakly active floating tone of a root will allow that.

(40) Illustration: The person morpheme as a blended floating tone representation



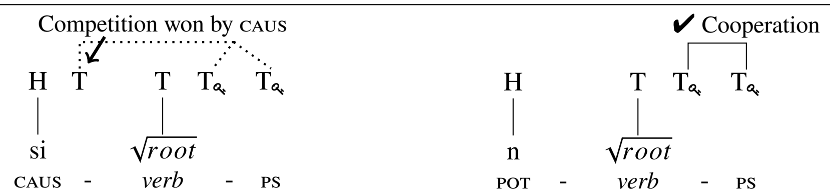
It is indeed true that the co-existence of the configurations in (38) poses a challenge for a GNAG account that disallows any reordering of tones. However, this structure is based on only one possible morphological analysis of person morphemes, namely the assumption that person agreement morphemes are prefixes, an assumption which is implicit in Sande 2020.

However, since the only surface effect of the relevant person morphemes is tonal overwriting (and potentially other non-concatenative processes) on monosyllabic bases, there is of course no surface evidence for the underlying position of these morphemes. Interestingly, the only segmental singular person morpheme that is described in Kim 2016, namely 2.SG /-ʔ/, is in fact a suffix (Kim 2016: 205). In line with this, I will assume that all person morphemes are suffixed to the verb base in Amuzgo. The relevant DMP structures in the causative and potential are consequently rather the ones in (41) where the floating tone of the verb root that (potentially) cooperates with the floating person tone is taken to be ordered after the associated root tone.

This re-analysis easily explains why cooperation is possible in the potential since the prefix tone obviously does not intervene between the root and the suffixed person tones (41-b). Conversely, however, this means that the absence of DMP in the causative can also not be due to intervention. However, if we recall that the causative has its own tonal effects on a verb form, the reasonable explanation for the absence of DMP in causative contexts is the simple fact that the causative triggers tonal overwriting that is 'more important' than the DMP overwriting.[13] There is hence no blocking of DMP by phonological intervention, there is competition between two tonal overwriting patterns and only the causative tonal effect surfaces. Crucially, the floating tone of the causative morpheme is not part of a DMP but can be realized on its own. In a GNAG account, this difference could already predict why the causative tone wins over the DMP-tone of the person morpheme: Its realization is 'cheaper' since it does not induce the faithfulness violations that are induced by coalescence.

(41) No phonological intervention between suffixed person tones and the root

a. CAUSATIVE b. POTENTIAL



[13]Recall that the causative has two tonal allomorphs: Overwriting with the tonal melody HM for 'upper' base tones and appearance of the underlying base tones for the 'lower' ones. An assumption which allows to predict these different surface effects from a single underlying representation for the causative is the sub-segmentation of tonal features into register and tone features like [±Upper] and [±raised] (e.g. Yip 1980, Pulleyblank 1986, Bao 1999, Snider 2020). The causative is then taken to consist of a a floating [+Upper -Upper] sequence that is unspecified for [±raised]. TBU's specified for [+Upper] will be overwritten by these floating [+Upper][-Upper] tones that – after insertion of default [±raised] values – result in a surface HM sequence. Due to faithfulness, underlying TBU's that are specified for [-Upper], however, cannot loose this specification. In such contexts, only the floating [-Upper] from the causative associates resulting in a redundant double specification. Crucially, at least some causative tones associate in these contexts even though the underlying verb tone surfaces. And this association can block any further tonal overwriting with the competing floating person tones.

4. Conclusion

I showed that DMP in Donno So, Guébie, and Amuzgo can all be predicted in a purely phonological account where morpheme-specific phonology is predicted from Non-Linear Affixation of elements that can be gradiently active (=GNAG). Such a system restricts DMP patterns by phonological locality: Cooperation between phonological elements is only possible if they are adjacent, i.e. if there is no unaffected element intervening between them. In Guébie, the underlying non-adjacency between a trigger and a target becomes adjacency on the surface since all intervening vowels simply participate in the harmony process. In Donno So, any tone that intervenes between the two co-triggering tones indeed blocks the doubly conditioned tonal overwriting. And in Amuzgo, the relevant cooperating tones become adjacent under the assumption that the first and second person morphemes are suffixing rather than prefixing.

The reply to the claim in Sande 2020 is hence that no argument for phase-based locality and against phonological locality can be made based on these cases. So far, DMP hence offers no new insightful argument in the long-standing debate between item-and-process accounts (exemplified by CbP) and item-and-arrangement accounts (exemplified by GNAG) to morpheme-specific phonology. Future research needs to show whether the argument for phonological locality holds across a broader typology of DMP patterns cross-linguistically.

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