CONSONANT STRICTURE HARMONY IN YABEM:
MANNER ASSIMILATION AT A DISTANCE[*]

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1.   Introduction

Interactions between non-adjacent segments, such as those seen in harmony processes of various kinds, have long been a topic of central interest to phonological theory, bearing on questions of locality and the formal properties of phonotactic constraints or (morpho)phonological relations. In recent years, consonant harmony has come under renewed focus in this context, for two reasons. First, it has become clear that at least some instances of consonant harmony involve featural agreement at a distance, rather than the local spreading/extension of a feature or articulatory gesture (Rose & Walker 2004, Hansson 2010a). Second, the non-adjacent interactions observed in consonant harmony raise certain challenges from the point of view of learnability (Heinz 2010) as well as theories of assimilatory sound change (Ohala 1993, Blevins 2004).

The cross-linguistic typology of consonant harmony phenomena, while quite diverse in terms of the possible featural bases for assimilation, displays a markedly skewed profile with regard to frequency of attestation. At the extreme end of high typological frequency is coronal harmony, in particular its instantiation as sibilant harmony, while other types are so rare as to being almost unattested. The list in (1), which is based on the survey in Hansson (2010a), arranges different types of consonant harmony roughly by relative frequency of attestation from most to least frequent.

(1)   Attested types of consonant harmony (Hansson 2010a)
   – Coronal harmony
      – Sibilant coronal harmony (e.g. [s z ts ts'] vs. [ʃ ʒ tʃ tʃ'])
      – Non-sibilant coronal harmony (e.g. [t̪ d̪ n̪] vs. [ʈ ɖ ɳ])
   – Dorsal harmony (e.g. [k k'] vs. [q q'])
   – Nasal consonant harmony (e.g. [m n] vs. [b d])
   – Liquid harmony (e.g. [l] vs. [r])
   – Laryngeal harmony (e.g. [p t k] vs. [pʰ tʰ kʰ])
   – Secondary-articulation harmony (e.g. [s z ts] vs. [sˤ zˤ tsˤ])
   – Stricture harmony (e.g. [t d] vs. [s z])

In this paper we focus our attention on a harmony type that lies at the extremely rare end of the typological continuum in (1). We examine the only robustly attested case of (active) consonant harmony in terms of *constriction degree* (essentially the phonological feature [±continuant]), namely stricture harmony in Yabem, an Oceanic language of Papua New Guinea. The essence of the Yabem sound pattern is that when a homorganic fricative and stop straddle an intervening vowel (in that order), the fricative becomes a stop. In other words, the process is /…SVT…/ → […TVT…]. We describe the relevant generalizations, and the various restrictions that the harmony is subject to, and de-

velop a formal constraint-based analysis in terms of agreement by correspondence (Rose & Walker 2004, Hansson 2010).

Typological outliers are often particularly valuable from the point of view of progress in the theoretical domain. For one thing, they often serve as crucial test cases, clinching the argument for one theory or hypothesis over another. For example, most cases of consonant harmony are ambiguous as to whether they involve feature *spreading* (temporal extension of an articulatory gesture) or a truly non-adjacent interaction in terms of featural *agreement*. Since "stopness" (oral closure) cannot possibly spread from one consonant to another through or via an intervening vowel, stricture harmony must by definition involve agreement rather than spreading. Secondly, cases that are typological outliers in one respect often turn out to be less remarkable when studied in greater detail. As we will see in §3 and §4 below, Yabem stricture harmony patterns with other more frequent types of consonant harmony in most respects. Finally, typological outliers often raise important questions as to the reason for their cross-linguistic rarity. These may lead to a shift in attention from the synchronic properties of the sound patterns in question to the various historical sources and mechanisms responsible for their emergence. We will briefly consider stricture harmony in Yabem from this diachronic perspective in §5.

2. Background

2.1 The Yabem language

Yabem is a language belonging to the vast Oceanic subbranch of the Austronesian language family. It is spoken in the North Huon Gulf area (Morobe province) of Papua New Guinea; three decades ago the number of first-language Yabem speakers was estimated at about 2,100 (Lewis et al. 2013). In addition, the language served as a local *lingua franca* in the area for much of the 20th century, thanks to having been adopted and advocated in that capacity by German missionaries and local evangelists from the 1880s onwards, although in that function it has now largely been replaced by Tok Pisin (Ross 1995).

The main data source on the Yabem language is the descriptive grammar by the great Austronesianist Otto Dempwolff (1939; page references below are to the 2005 English translation). In what follows, we primarily rely on this source, though we also draw upon more recent published work on the language by Bradshaw (1979) and Ross (1988, 1993, 1995).

2.2 Yabem phonology and morphology: the basics

The consonant and vowel inventories of Yabem are as shown in (2) on the next page. In addition, the language has a tonal contrast between high- and low-toned syllables. See below for the phonological status of voicing in stops and its relation to tone. Yabem syllable syllables are open, (C)V, but closed syllables (C)VC are allowed in word-final position; complex margins are not permitted. A restricted inventory of consonants can occur in the (word-final) syllable coda: the oral labial stop /p~b/, the glottal stop /ʔ/, and the nasals /m ŋ/. Prenasalized obstruents are limited to non-initial position, and hence can only occur in word-medial syllable onsets.

(2)   p~b   pʷ~bʷ   t~d   k~g   kʷ~gʷ   ʔ
        mb   mbʷ   nd   ŋg   ŋgʷ
                     s   i   u
                     ns   e   o
        m   mʷ   n   ŋ   ɛ   ɔ
                     l   a
           w   j

Although there is suffixation in the possessive morphology of nominals (e.g. [támá-m] 'your (sg.) father'), only the verbal morphology, which is entirely prefixing, will be relevant here. In terms of phonotactic shape, verb roots are either monosyllabic, CV(C) or disyllabic, CVCV(C). These are preceded by subject agreement prefixes, which all have the shape (C)V-, cf. [gà-dèŋ] 'I move towards (realis)'. In addition, the realis/irrealis distinction in verbs is marked on the one hand by a partly complementary set of agreement prefix allomorphs and on the other by a floating [+nasal] featural prefix, which docks onto any pre-nasalizable consonants in the stem: [jà-ndèŋ] 'I will move towards (irrealis)'.

Perhaps the most unusual aspect of Yabem phonology is the fact that voicing in obstruents is entirely predictable based on tone (Poser 1981, Ross 1993, Hansson 2004). Stops are voiceless in high-toned syllables, voiced in low-toned syllables; contrast [gà-dèŋ] 'I move towards (realis)' with [ká-tɛ́ŋ] 'I ask (realis)'. The sole fricative, /s/, is consistently voiceless and can occur in high- and low-toned syllables alike, due to a relatively recent merger of [s] and [z]; even as late as the early 20th century, Dempwolff (1939) described /s/ in low-toned syllables as being "somewhat voiced". Obstruent voicing is thus allophonic rather than contrastive in Yabem; we will emphasize this by representing obstruents in input forms with /P/, /T/, /S/, etc. Furthermore, there is tone spreading within the two final syllables of the word, and this results in an alternation in both tone and obstruent voicing in prefixes such as 1.SG.REALIS /Ka-/ → [ká-] ~ [gà-] when the following verb root is monosyllabic. Outside of this two-syllable window (and hence before disyllabic roots), prefixes are high-toned by default ([ká-màdòm] 'I break in two (realis)'). For a constraint-based analysis of the interplay of tone and voicing in Yabem, see Hansson (2004).

Since prenasalized stops are all voiced, the tone-voicing interdependence further entails that they too are limited to low-toned syllables. As a result, the floating irrealis [+nasal] prefix can only surface on low-toned bases: compare [jà-ndèŋ] 'I will move towards (irr.)' against [jà-tɛ́ŋ] I will ask (irr.)' (from /-Tèŋ/ 'move towards' and /-Tɛ́ŋ/ 'ask', respectively). Prenasalized [ns] reveals its origin in earlier *[nz] in that it too is limited to low-toned syllables. This further means that irrealis nasalization targets /S/ in low-toned roots but not high-toned ones, despite the fact that /S/ is voiceless in both cases: [jà-nsùŋ] 'I will shove (irr.)', but [já-sóm] 'I will speak (irr.)' (/-Sùŋ/ 'shove', /-Sóm/ 'speak').

2.3   Non-adjacent dependencies among consonants

At first glance, Yabem appears to display three types of assimilatory dependencies between non-adjacent obstruents, listed in (3). Each of these three phenomena could, at least in principle, be taken to reflect a consonant harmony requirement (agreement) of some kind.

(3)   a.   Voicing harmony?
             [**ká-tá**ŋ] 'I weep'   [**g**à-**d**èŋ] 'I move towards'

      b.   Prenasalization harmony?
             [-**dàbʷ**àʔ] 'untie (realis)'   [-**ndàmbʷ**àʔ] 'untie (irrealis)'

      c.   Stricture harmony
             ´t/d…t/d   ´s…s   ***s…t/d**

As we have seen above, the pattern in (3)a is simply the by-product of tone spreading and tone-induced voicing, rather than some separate demand for voicing agreement in co-occurring obstruents.[1] The prenasalization agreement pattern in (3)b is primarily evident from the multiple docking of the floating irrealis [+nasal] morpheme on any and all eligible targets within the verb root. Entwistle (2013) proposes an analysis which attributes this multiple docking to a phonological consonant harmony in the [±nasal] among co-occurring obstruents.

Our focus in this paper, however, is on the pattern mentioned in (3)c, whereby co-occurring coronal obstruents are, under certain conditions, required to agree with one another in degree of constriction: the fricative vs. stop distinction. This "stricture harmony", which among other things results in harmony alternations between [s] and [t]/[d] in prefixes, is typologically unique and hence of considerable theoretical interest (Rose & Walker 2004, Hansson 2010a).

3.   Stricture harmony

3.1   The basic pattern

The essence of Yabem stricture harmony is the phonotactic generalization that homorganic fricative…stop sequences are not allowed. Since [s] is the only fricative in the language, what this means in practice is that *[s…t] and *[s…d] are not permitted. (The situation with prenasalized [ns] and [nd] is complicated, a point to which we will return in §3.2 below.) As Dempwolff (1939) puts it, "[t]he consonant sequences *s...t* and *s...d* do not appear in the same word" (p. 8).

Morpheme-internally, this harmony takes the form of a static prohibition: roots of the shape /SVTV(C)/ are simply absent from the lexicon. There is no shortage of morphemes containing non-homorganic fricative…stop sequences, however, as illustrated in (4) below. ("D" + page number refers to the 2005 English translation of Dempwolff 1939.)

(4)   sápá   'fence'   D7
         -sép   'to go down, to move downward'   D15, D39
         sàbʷà 'potsherd; spleen'   Ross (1995)
         sìb   '[his] nephew (sister's son)'   D25
         sákíŋ 'service'   D29
         sàgù   'boy eligible for circumcision rites' D30
         -sègà (suffix denoting socially elevated position) D29

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[1] It appears, however, that non-adjacent obstruent voicing agreement did play some role in the historical tonogenesis process in Yabem (Bradshaw 1979, Ross 1993), and that the current dependence of voicing on tone to some extent is the result of "rule inversion".

In heteromorphemic contexts, stricture harmony manifests itself dynamically in the form of fricative/stop alternations. The one place where this can be observed directly is in the 3.PL subject agreement prefix /Se-/ (used in realis and irrealis paradigms alike). As shown in (5), this prefix normally surfaces as [se-] (or as [sɛ-] by vowel harmony with a /ɛ/ or /ɔ/ root vowel), either high- or low-toned depending on context. If the root begins with a coronal stop [t] or [d], however, the /S/ of the prefix surfaces as a stop instead, either [t] or [d] as dictated by the tonal context, as we see in (6).

(5)	sè-wì	'they leave'	D30
	sé-jàndà	'they hunt'	D39
	sé-láʔ	'they sail'	D39
	sé-mʷà	'they stay'	D36
	sé-níŋ	'they'll eat'	D38
	sɛ́-sɔ́	'they fail'	D14
	sɛ̀-mbɛ̀ŋ	'they'll incise, notch'	D16
	sé-bàlàŋ	'they carried, hoisted'	D63
	sɛ́-kɔ́lɔ́ŋ	'they shake'	D18
	sɛ́-gɛ̀lɛ̀ʔ	'they drum'	D18
	já-sé-kájɔ́	'they (went and) built'	D36

(6)	té-táŋ	'they cried'	D77
	té-túlú	'they change'	D30
	té-tákú	'they took fright'	D37
	tɛ́-tɛ́ŋ	'they ask'	D14
	tɛ́-tɔ́	'they paint'	D14
	dè-dèŋ	'they reached'	D41
	dɛ̀-dɛ̀ʔ	'they disapprove, do not like'	D16
	té-dàgùʔ	'they follow'	D18

Cases like the last example in (6) show that the prefix consonant (the harmony target) need not surface as completely identical to the root consonant (the harmony trigger). If the two consonants in the underlying /S…T/ sequence find themselves in syllables that differ in tone—as will always happen when the root is disyllabic and low-toned, since tone spreading is confined to the final two-syllable window—then the two will surface with different voicing: [t…d].

3.2 Limitations of stricture harmony

We have already seen how stricture harmony is limited to homorganic fricative…stop sequences (e.g. /Se-Túlú/ → [té-túlú] 'they change' vs. /Se-Pàlàŋ/ [sé-bàlàŋ] 'they carried, hoisted'). This can be interpreted as a *similarity effect*: a pair of co-occurring consonants will only interact if the two fall above a certain threshold of relative similarity (Rose & Walker 2004, Hansson 2010a). Prior agreement in place of articulation thus seems to contribute to the definition of what constitutes sufficient similarity. The trigger and target are also both required to be obstruents; the nasal stop /n/ does not trigger harmony ([sé-níŋ] 'they'll eat'). At the time of Dempwolff (1939), agreement in prenasalization was also a prerequisite for interaction, in that prenasalized [nd] (whether under-

lying or the product of irrealis formation) is explicitly described as not triggering stricture harmony. This can be seen in examples like (7).

(7) sè-ndèŋ   'they'll move toward'   D16   (← /Se-[+nas]-Tèŋ)
     sè-ndὲʔ   'they'll disapprove, not like' D16   (← /Se-[+nas]-Tὲʔ)
     sé-ndàŋgùʔ   'they'll follow'   D18   (← /Se-[+nas]-TàKùʔ)

This particular similarity restriction appears to have been relaxed, in that Ross (1995) describes prenasalized [nd] as triggering harmony no less than its oral counterparts [d] or [t]. For example, the first form in (7) is given as [dè-ndèŋ] by Ross (1995:51). However, stricture harmony has also become an optional process, and the unharmonized [sè-ndèŋ] of Dempwolff's day thus also remains as a possible output even in present-day Yabem. We will return to the optionality at the end of this section.

In addition to such similarity effects, there is also a *locality effect*, in that the trigger and target may be separated by at most a vowel; in other words, they must occupy adjacent-syllable onsets. (Recall from §2.2 that coronals cannot occur in coda position.) This is seen in cases like (8), where harmony is not triggered by a root-medial /T/. In the terminology of Hansson (2010a), Yabem stricture harmony is a *transvocalic* consonant harmony, not an unbounded one.

(8) sé-métóʔ   'they straighten'   D30
     sé-kátóŋ   'they make a heap'   Ross (1995) [inferred from disc.]

A third limitation is that Yabem stricture harmony also displays a *directionality effect*: whereas [s…t/d] sequences are prohibited (and repaired by regressive assimilation), their mirror-image [t/d…s] sequences are permitted and not subject to harmony. This is seen most clearly with the 1.PL.INCL. subject prefix /Ta-/, which surfaces consistently as either [tá-] or [dà-] but never undergoes nor triggers stricture harmony.

(9) tá-sóm   'we (incl.) speak'   D14   (*tá-tóm, *sá-sóm)
     tá-séwá   'we pour'   D39   (*tá-téwá, *sá-séwá)
     tá-séléŋ   'we (incl.) travel'   D33   (*tá-téléŋ, *sá-séléŋ)
     dà-sùŋ   'we (incl.) shove'   D15   (*dà-dùŋ, *sà-sùŋ)

Stricture harmony is thus unidirectional (regressive only: /T…S/ ↛ [t…t] or [d…d]) as well as being featurally asymmetric (fricative assimilates to stop, not vice versa: /T…S/ ↛ [s…s]).

As mentioned earlier, stricture harmony has become *optional* in present-day Yabem. Ross (1995) describes it as such (e.g. [té-táŋ] ~ [sé-táŋ] 'they weep') and argues that the optionality is a recent development. In a footnote to the 2005 English translation of Dempwolff (1939), the editors make a similar comment about the use of [te-]/[de-] instead of [se-] for the 3.PL. prefix with /T/-initial roots, citing a local missionary linguist: "[t]his restriction seems to be fading out (Rev. Karl Holzknecht, pers. comm.)" (p. 14). It appears, then, that the stricture harmony alternations are in the process of becoming levelled out in favour of the unharmonized prefix alternants.

It is easy to understand the historical change in the status of prenasalized [nd] in stricture harmony—that is, the apparent *generalization* of harmony from

[t]- and [d]-initial stems to [nd]-initial ones—against the backdrop of this general development. Consider /T/-initial verb roots like /-Táŋ/ 'cry' or /-Tèŋ/ 'reach'; the initial consonant of the latter, but not the former, is a possible target for irrealis prenasalization. In Dempwolff's day, stricture harmony affected the 3.PL. prefix /Se-/ before /-Táŋ/ in both the realis and the irrealis paradigms, but before /-Tèŋ/ only in the realis paradigm, resulting in the pattern shown in the "Stage I" column of (10). The general change of stricture harmony to an optional process led to unharmonized forms being introduced alongside any harmonized ones. Since the irrealis of low-toned roots like /-Tèŋ/ had only ever had an unharmonized form in the first place, no change occurred there, resulting in the state of affairs shown in the "Stage II" column.

(10) | | | *Stage I* | *Stage II* | *Stage III* |
|---|---|---|---|---|
| /-Táŋ/ | realis | té-táŋ | **sé-táŋ** ~ té-táŋ | sé-táŋ ~ té-táŋ |
| | irrealis | té-táŋ | **sé-táŋ** ~ té-táŋ | sé-táŋ ~ té-táŋ |
| /-Tèŋ/ | realis | dè-dèŋ | **sè-dèŋ** ~ dè-dèŋ | sè-dèŋ ~ dè-dèŋ |
| | irrealis | sè-ndèŋ | sè-ndèŋ | sè-ndèŋ ~ **dè-ndèŋ** |

The pattern at the (hypothetical) Stage II is inherently unstable from a language acquisition perspective. To preserve that system intact, a learner needs to be able to detect, upon encountering unharmonized 3.PL. forms of /T/-initial roots like [sè-ndèŋ], [sè-dèŋ] and [sé-táŋ], that the first of these is unharmonized due to a *special* restriction on the conditioning environment of stricture harmony, whereas the others are merely due to the general optionality of stricture harmony. To accomplish this, learners would need to appeal to implicit negative evidence, in that they would have to find the comparatively low (in fact, zero) frequency of occurrence of forms with [dè-] in the irrealis of roots like /-Tèŋ/ (as compared to the realis of those roots) surprising and notable enough to require some independent explanation. The transition to "Stage III", which is Yabem as described by Ross (1995), can thus be understood as a simple and straightforward case of analogical change by imperfect learning.

An adequate formal analysis of stricture harmony as a synchronic sound pattern within the phonological grammar of Yabem needs to account not only for the basic assimilatory interaction as such but also for the specific limitations to the harmony discussed in this section. The constraint-based analysis developed in §4 (building on Entwistle 2013) attempts to capture in a coherent way the observed similarity effects and the locality and directionality restrictions, while also offering a principled account of the difference between the systems at "Stage I" (Dempwolff 1939) and "Stage III" (Ross 1995) with respect to the treatment of prenasalized obstruents.

4.   Yabem stricture harmony as correspondence-based agreement

In this section we develop a formal analysis of stricture harmony, couched in the Agreement by Correspondence (ABC) model of long-distance consonant assimilation (Rose & Walker 2004, Hansson 2010a) and dissimilation (Bennett 2013). The central assumption of the ABC model is that such long-distance interactions are driven by constraints that demand featural *agreement* rather than feature spreading (though see Hansson 2010b on how spreading can emerge as the op-

timal means of achieving agreement). Furthermore, interaction between non-adjacent segments is assumed to be mediated by an abstract *correspondence relation* (C↔C correspondence) which links co-occurring output segments provided that they meet certain criteria. Agreement then results from IDENT[F] constraints that operate over this C↔C correspondence dimension.

4.1   CORR-C↔C and IDENT[F]-CC constraints

In the ABC analysis of consonant harmony, the presence of a C↔C correspondence relation between the interacting consonants is not given a priori (as is the case for Input↔Output or Base↔Reduplicant correspondence); rather, C↔C correspondence is put in place through the effects of ranked and violable constraints. The motivating factor is relative *similarity* between C_1 and C_2: the more similar they are (the more features they share), the stronger the demand that the two be linked by a correspondence relation. The family of constraints in question is referred to as CORR-C↔C, and individual constraints can be defined as per the template in (11) below (Rose & Walker 2004).

(11)   CORR-X↔Y
         Let *S* be an output string of segments and let X, Y be segments that share
         a specified set of features *F*. If X, Y ∈ *S*, then X is in a relation with Y;
         that is, X and Y are correspondents of one another.

         Here we will follow a labelling convention whereby "X" and "Y" are represented by segments that are maximally different from each other while still sharing the required feature set *F*. For example, in accounting for interactions among sibilants in a coronal harmony system, CORR-Z↔Č would require correspondence between sibilants that share the features [coronal, +strident] (but potentially differ in any or all of [±continuant, ±voice, ±anterior]), whereas its counterpart CORR-Z↔Š has a higher similarity threshold, pertaining only to those sibilant pairs that have matching [±continuant] values as well (that is, fricative…fricative and affricate…affricate pairs). CORR-C↔C constraints thus form similarity-based hierarchies, owing to subset-superset relations among the shared feature sets *F* that they stipulate.
         For the analysis of stricture harmony in Yabem as described by Dempwolff (1939; that is, "Stage I" in (10) above), the pivotal constraint is CORR-S↔D as defined in (12):

(12)   CORR-S↔D
         If X and Y are segments in the output and X, Y are both specified as
         [αconsonantal, βsonorant, γnasal, δPlace], then X, Y are correspondents
         of one another.

This constraint, when sufficiently high-ranked, forces the presence of a correspondence relation between the members of a co-occurring obstruent…obstruent pair (as well as in sonorant…sonorant pairs), provided that these are homorganic ([δPlace]) and either both oral or both prenasalized ([γnasal]).[2] For instance, (12)

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[2] For simplicity, we assume that prenasalized obstruents such as [mb] or [ns] are specified as [–sonorant, +nasal], whereas nasals are [+sonorant, +nasal]. The distinction be-

will induce correspondence among members of the sets { t, d, s }, { nd, ns }, { p, b, p^w, b^w }, and so forth.

In terms of its effects (/S/ → [t] or [d]), Yabem stricture harmony affects the two features [±continuant] and [±strident]. As [s] is the only segment in Yabem that is [+continuant, +strident], we will for convenience use the privative cover feature "[stop]" to represent the combination [–continuant, –strident]. The constraint that enforces agreement—and hence *assimilation*—between corresponding consonants is IDENT[stop]-CC. This constraint checks for feature mismatches in terms of the [stop] feature (i.e. [–continuant, –strident]). To fully account for the directionality asymmetry, to be addressed in §4.3 below, we build reference to the *linear order* of the two consonants into the definition of this constraint, following Rose & Walker (2004; for a somewhat different approach to directionality asymmetries, see Hansson 2010a):

(13)   IDENT[stop]-$C_R C_L$
        Where C_L and C_R are corresponding segments in the output, and C_L precedes C_R in the output string, if C_R is [stop], then C_L is also [stop].

Note that { t d s } and { nd ns } are the only groupings demarcated by the constraint CORR-S↔D whose members can in principle differ in [stop] specifications. Therefore, these are the only classes that can potentially be affected by the demands of the IDENT[stop]-$C_R C_L$ constraint.

In order for the combined effects of CORR-S↔D and IDENT[stop]-$C_R C_L$ to result in overt stricture harmony, both constraints must outrank the faithfulness constraint in (14), which penalizes the change /S/ → [t] or [d]. The basic ranking schema is illustrated by the tableau in (15). In candidate outputs in tableaux, the presence of a CC correspondence relation is indicated by matching subscript indices; the absence of such a relation in competing candidates is shown by mismatched subscripts between the same two consonants.

(14)   IDENT[stop]-OI
        If X is a segment in the output and Y is a correspondent of X in the input, then if X is [stop], Y is [stop].

(15)   /Se-Táŋ/ → [té-táŋ] 'they cry'

	/Se-Táŋ/	CORR-S↔D	IDENT[stop]-$C_R C_L$	IDENT[stop]-OI
	a. s_xé-t_yáŋ	*!		
	b. s_xé-t_xáŋ		*!	
☞	c. t_xé-t_xáŋ			*

4.2   The similarity restriction

The fact that stricture harmony does not apply to heterorganic fricative…stop sequences is due to the low ranking of those CORR-C↔C constraints that define somewhat broader equivalence classes, such as that in (16):

tween oral [b] and prenasalized [mb] is thus one of [–nasal] vs. [+nasal] alone. Our analysis can be easily adapted to other representational assumptions about prenasalization.

(16)   CORR-S↔B
   If X and Y are segments in the output and X, Y are both specified as [αconsonantal, βsonorant, γnasal], then X, Y are correspondents of one another.

Specifically, such constraints must be outranked by Input-Output faithfulness in the guise of IDENT[stop]-OI (14):

(17)   /Se-Pá/ → [sé-pá] 'they chop'

	/Se-Pá /	IDENT[stop]-C_RC_L	IDENT[stop]-OI	CORR-S↔B
☞	a. s$_x$é-p$_y$á			*
	b. s$_x$é-p$_x$á	*!		
	c. t$_x$é-p$_x$á		*!	

   The same applies to obstruent pairs which are homorganic, but differ in nasality (i.e. prenasalization). The relevant constraint here is CORR-S↔ND, defined in (18). The ranking of this constraint below IDENT[stop]-OI results in the absence of harmony in such sequences as well, as illustrated in (19).

(18)   CORR-S↔ND
   If X and Y are segments in the output and X, Y are both specified as [αconsonantal, βsonorant, γPlace], then X, Y are correspondents of one another.

(19)   /Se-[+nas]-Tèŋ/ → [sè-ndèŋ] 'they will reach' (Dempwolff 1939)

	/Se-[+nas]-Tèŋ/	IDENT[stop] -C_RC_L	IDENT[stop] -OI	CORR-S↔ND
☞	a. s$_x$è-nd$_y$èŋ			*
	b. s$_x$è-nd$_x$èŋ	*!		
	c. d$_x$è-nd$_x$èŋ		*!	

   We now also have a formal account of the difference between the stricture harmony pattern as described by Dempwolff (1939), in which prenasalized stops categorically fail to trigger harmony, and the present-day pattern as described by Ross (1995), in which the class of harmony triggers has been generalized to encompass prenasalized stops as well. The difference lies in the relative ranking of CORR-S↔ND vis-à-vis the faithfulness constraint IDENT[stop]-OI. The widening of the scope of stricture harmony to [s…nd] pairs reflects a promotion of the former constraint over the latter, as depicted in (20).

(20) /Se-[+nas]-Tèŋ/ → [dè-ndèŋ] 'they will reach' (Ross 1995)

/Se-[+nas]-Tèŋ/	IDENT[stop]-C_RC_L	CORR-S↔ND	IDENT[stop]-OI
a. s$_x$è-nd$_y$èŋ		*!	
b. s$_x$è-nd$_x$èŋ	*!		
☞ c. d$_x$è-nd$_x$èŋ			*

4.3 The directional and featural asymmetries

In order to account for the fact that stricture harmony is regressive only, the agreement-triggering constraint in (13) has been defined in such a way as to specify a right-to-left (anticipatory) dependency of C_1 ("C_L") on C_2 ("C_R") in a $C_1…C_2$ sequence of the relevant type. The mirror-image counterpart of that constraint, IDENT[stop]-C_LC_R, must be lower ranked. We can see this from the lack of harmony in forms where the 1PL.INCL. prefix /Ta-/ precedes an [s]-initial root, as shown in (21).

(21) /Ta-Séwá/ → [tá-séwá] 'we (incl.) pour'

/Ta-Séwá/	CORR -S↔D	IDENT[stop] -C_RC_L	IDENT[stop] -OI	IDENT[stop] -C_LC_R
a. t$_x$á-s$_y$éwá	*!			
☞ b. t$_x$á-s$_x$éwá				*
c. t$_x$á-t$_x$éwá			*!	

Secondly, we need to explain why disharmonic sequences are never repaired by changing the stop into [s] rather than vice versa. In terms of our privative "[stop]" feature (= [–continuant, –strident]), we need to distinguish between on the one hand the gain of that feature, which is penalized by IDENT[stop]-OI as defined in (14) above, and on the other the loss of that feature, such as by the change /T/ → [s]. The latter instead constitutes a violation of IDENT[stop]-IO:

(22) IDENT[stop]-IO
 If X is a segment in the *input* and Y is a correspondent of X in the *output*, then if X is [stop], Y is [stop].

The ranking of this constraint above IDENT[stop]-OI ensures that the enforcement of harmony in the kinds of [s…t] or [s…d] sequences that are penalized by IDENT[stop]-C_RC_L is always achieved by means of (regressive) "stopping" of /S/ and never by (progressive) "fricativization" of /T/:

(23) /Se-Táŋ/ → [té-táŋ] 'they cry'

/Se-Táŋ/	IDENT[stop]-C_RC_L	IDENT[stop]-IO	IDENT[stop]-OI
a. s$_x$é-t$_x$áŋ	*!		
☞ a. t$_x$é-t$_x$áŋ			*
b. s$_x$é-s$_x$áŋ		*!	

4.4 The locality restriction

Finally, our analysis must capture the fact that stricture harmony only takes place when the trigger and target are separated by no more than a vowel—that is, when the two obstruents occupy the onsets of adjacent syllables. While much is yet unclear about the nature of the locality restriction that defines "transvocalic" consonant harmony systems (see Hansson 2010a:175–178 for discussion), we will here adopt a relatively conventional interpretation in terms of *syllable adjacency* (Odden 1994, Rose & Walker 2004, Bennett 2013).

The idea is that a high-ranked constraint requires correspondents to be in adjacent syllables—and hence bans correspondence relations from holding across greater distances than that. Following Rose & Walker (2004), we will refer to this constraint as PROXIMITY, defined here as in (24).

(24) PROXIMITY
If X and Y are correspondent output segments, then X and Y are located in the same syllable or in adjacent syllables.

When ranked above the crucial CORR-C↔C constraint, PROXIMITY has the effect of preventing correspondence, and hence circumventing the need for agreement (harmony), between consonants that are more than a syllable apart:

(25) /Se-méTóʔ/ → [sé-métóʔ] 'they straighten'

/Se-métóʔ/	PROXIMITY	CORR-S↔D	IDENT[stop]-$C_R C_L$
☞ a. s_xé-mét$_y$óʔ		*	
a. s_xé-mét$_x$óʔ	*!		*
b. t_xé-mét$_x$óʔ	*!		

Importantly, PROXIMITY must outrank not just the most general of the CORR-C↔C constraints that define eligible trigger-target pairs, but even the narrowest, most stringent one. For example, CORR-S↔T requires correspondence between homorganic obstruents that agree in nasality *and voicing*; it thus takes scope over [s…t] pairs while ignoring [s…d] pairs. As shown in (26), this constraint too must be outranked by PROXIMITY.

(26) /Se-méTóʔ/ → [sé-métóʔ] 'they straighten'

/Se-métóʔ/	PROXIMITY	CORR -S↔T	CORR -S↔D	IDENT[stop] -$C_R C_L$
☞ a. s_xé-mét$_y$óʔ		*	*	
a. s_xé-mét$_x$óʔ	*!			*
b. t_xé-mét$_x$óʔ	*!			

Were the ranking instead CORR-S↔T >> PROXIMITY >> CORR-S↔D, the result would be a hybrid system in which stricture harmony is unbounded for [s…t] sequences, but transvocalic for [s…d] sequences. That is, we would find long-distance stricture harmony enforced in /Se-méTóʔ/ → (26)c *[té-métóʔ]

(cf. (26)a [sé-métóʔ] in real Yabem), but not with an analogous low-toned root, such as the hypothetical /Se-mèTòʔ/ → [sé-mèdòʔ].

5. Cross-linguistic typology and the emergence of stricture harmony

In the preceding section we demonstrated how a correspondence-based agreement analysis can be applied to Yabem stricture harmony. Despite its uniqueness within the typology of consonant harmony systems (Hansson 2010a), this case displays many of the same traits that other more common, types of harmony exhibit, such as similarity effects, directionality effects and locality restrictions. However, it still behooves us to ask why it is that stricture harmony is so strikingly rare among the world's languages. If there is nothing remarkable about the *synchronic* grammar-internal mechanism for this type of consonant harmony, does the key perhaps lie in the *diachronic* mechanisms responsible for its emergence? What are those mechanisms? How does stricture harmony arise?

Questions such as these reflect a reorientation of the study of cross-linguistic typological patterns towards diachronic ("evolutionary") explanations (e.g. Blevins 2004; see Hansson 2008 for an overview). In this vein, for example, Hansson (2007) studied another extremely rare type of consonant harmony, that involving secondary articulations like palatalization or pharyngealization, and found that the attested cases tend to have come into being by rather fortuitous and indirect routes. Importantly, none of these appear to involve a historical process of non-local assimilation in the relevant secondary-articulation feature. For example, consonant palatalization harmony in Karaim represents an inherited Turkic front/back vowel harmony that has been "transposed" onto the surrounding consonants (in part for reasons of contact with neighbouring Baltic and Slavic languages). Consonant pharyngealization harmony in Tsilhqot'in turns out to have originated in a straightforward sibilant harmony system, where the relevant contrasts in the sibilant inventory have eventually shifted into a radically different featural dimension (from [s]:[ʃ] via [s̠]:[s] to [sˤ]:[s]).

Could something similar be the case for Yabem stricture harmony? Interestingly, the answer appears to be yes, although as yet the details of the historical development are not fully understood and have not been investigated systematically. In his article on Yabem tonogenesis, Bradshaw (1979) comments, in a footnote regarding the stricture harmony, that "[t]his 'realization' of *s* as *t* and *s̀* [= s in a low-toned syllable] as *d* may actually be *preservation of an earlier stage* before *d* … became *s̀* and *t* became *s* before the upper-mid front vowel in the 3rd person plural subject prefix, ê [= /e/]" (Bradshaw 1979: 201, n. 7; emphasis added). The scenario that Bradshaw describes can be depicted as in (27):

(27) Pre-Yabem: té-kátóŋ   dè-wì   té-táké   dè-dèŋ
      {t,d} > {s,z} / __ e   s   z   *blocked*   *blocked*
      Yabem: sé-kátóŋ   zè-wì   té-táké   dè-dèŋ
                                          (> sè-wì)

If this is correct, then the observed instances of stricture harmony (that is, agreement in [±continuant, ±strident]) did not arise by means of any assimilatory sound change at all. Rather, consonant harmony emerged by means of the selective *blocking* of an otherwise regular sound change in just those cases where that change would have turned an already agreeing [t/d…t/d] sequence

into a disagreeing sequence [s…t/d]. (One might perhaps refer to this by the somewhat tongue-in-cheek term "prophylactic" consonant harmony.) This notion raises intriguing questions for models of historical sound change as listener-based misperception (on which see Hansson 2008).

Interestingly, this kind of historical scenario is not without parallels, in that reported cases exist that have at least a superficial resemblance to the apparent Yabem development. For example, Kinkade (1973) discusses the sporadic failure of sound changes consisting of the palatalization /k k' x/ > /tʃ tʃˀ ʃ/ in Cowlitz (before /i/, and also as dissimilation to an upcoming /q q' χ/) in the vicinity of a sibilant from the /ts ts' s/ set. That is, a sound change producing /tʃ tʃˀ ʃ/ tends to fail in words where this *would have* resulted in disharmonic sequences like /ʃ…s/ or the like. The difference here is that a sibilant harmony restriction of the relevant kind appears to have already existed in Cowlitz at the time of the sound change(s) in question. Furthermore, there exist cases where the /k k' x/ > /tʃ tʃˀ ʃ/ did take place and in turn triggered harmony in the nearby /ts ts' s/ (which consequently also changed into /tʃ tʃˀ ʃ/).

Another case in point is the ubiquitous (though mostly gradient rather than categorical) retroflex harmony documented in numerous languages of the Indian subcontinent by Arsenault (2012), in particular in the Dravidian family. In Proto-Dravidian, retroflex stops (/Ṭ/) were absent root-initially. Subsequently, in many of the daughter language, instances of root-initial /Ṭ/ develop from a variety of sources (borrowing, sound change). However, this happens significantly less often—or not at all—precisely in roots where a non-retroflex coronal (i.e. dental) stop /T/ followed; that is, /ṬVK/ sequences do arise by various means, but /ṬVT/ sequences remain conspicuously unattested or underrepresented. This goes hand in hand with (sporadic) historical changes of the mirror-image inherited "disharmonic" sequences /TVṬ/ > /ṬVṬ/, where retroflexion harmony was induced by active assimilation.

As noted above, much remains unclear about the origins and development of the sound patterns that are the synchronic manifestation of stricture harmony in Yabem. It appears, however, that this is yet another case in which a synchronic pattern of non-adjacent consonant assimilation (in the input-output mapping) did not arise by a historical process of active assimilation of that same kind, but rather by the reanalysis of identity patterns that had a somewhat different origin.

6.   Conclusions

We have shown that Yabem stricture harmony is a well behaved and unremarkable instance of consonant harmony in most respects. The featural basis for the harmony is indeed highly unusual from a typological perspective; its other aspects, however, are not. Consequently, the Yabem case is amenable to the same kind of synchronic analysis, in terms of correspondence-based agreement, as has been developed for other types of systems. This also applies to the apparent historical change in the behaviour of prenasalized [nd] (from non-trigger to trigger), which is easily modelled in the grammar as a change in constraint ranking.

Interestingly, Yabem can be said to fill an otherwise unexpected typological gap. Recent work on long-distance consonant *dissimilation* as resulting from the same kind of correspondence-based constraint machinery as consonant harmony (Bennett 2013) predicts that long-distance agreement in the feature [±continuant] should be possible. This is exactly what the Yabem harmony pattern appears to instantiate.

Finally, we commented on the unusual historical origins of this unusual case, which seem to have involved the blocking of (accidental) appearances of "disharmonic" consonant pairs due to other sound changes. However, the relevant details still require much investigation, for example regarding the full range of historical sources of Yabem /s/ and the extent to which it is a historical reflex of earlier */t/ or */d/.

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