To Achieve Harmony We Only Need One Tier

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Abstract

In this poster, I discuss vowel harmonies with spreading of more than one feature and present their accounts in terms of the subregular class of tier-based strictly local languages. I argue that in most of the cases, a single tier is enough to capture the desired pattern. Apart from being an interesting typological fact, this generalization could reveal new perspectives on the complexity of the vowel harmonic systems and natural languages in general.

Introduction

The approach of tier-based strictly local (TSL) phonology has shown itself as a good fit for the natural language phonology: it captures long-distance relations in a local fashion. Harmonic processes, where a feature is being spread among certain class of sounds, is an example of such long-distance processes.

But what about double vowel harmonies, namely, harmonic systems where vowels agree with respect to more than one feature? **The strong tendency is to fit double vowel harmony on a single tier!**

Starring in this poster:

- Brief introduction to subregular phonology;
- Double vowel harmony in KIRGHIZ;
- Double vowel harmony in BURYAT;
- Rules of fitting on the same tier;
- Conclusion.

1 Subregular Phonology

For many decades it was already known that regular languages are enough to capture natural language phonological patterns [3], but recent results show that even less power is required: *phonology is subregular* [1, 2]. Most phonological processes are strictly local and tier-based strictly local.

The Strictly Local (SL) grammar G consists of the alphabet Σ and the set of prohibited n-grams B.

Intervocalic *s* voicing in German (SL grammar)

- In GERMAN, /s/ is realized as [z] in-between two vowels:
  (1) Faser → fa[z]er 'fiber'
  (2) reisen → rei[z]en 'to.travel'
- Other consonants are unaffected:
  (3) Wasser → wa[ss]er 'water'
  (4) reiste → rei[s]te 'traveled'
- G_{SL} = <{s, a, e, i, ...}, {*ase, *ise, *ese, *isi, ...}>

ok r e i z e n * r e i s e n

The Tier-based Strictly Local (TSL) grammar G consists of the tier alphabet T and the set of prohibited n-grams B *over that tier*, i.e. only tier elements of the original string are projected on the tier, whereas non-tier items are ignored. This approach allows to analyze non-local processes locally over the tier.

ATR vowel harmony in Lokaa (TSL grammar)

- In LOKAA, non-high vowels harmonize in ATR:
  (5) èsìsɔ̀n 'smoke' (7) lèjìmə̀ 'matriclan' [+tense]
  (6) èsísɔ̀n 'housefly' (8) ɔ́tú:má 'need' [–tense]
- G_{TSL} = <{e, o, ə, ɛ, ɔ, a}, {*ɛɛ, *eɔ, *ea, *oɔ, *ɛo, ...}>

ok è s ì s ɔ̀ n (tier: ɛ ɔ) * è s ì s ò n (tier: ɛ o)

2 Double Harmony In Kirghiz (Turkic)

The rule of the double vowel harmony in KIRGHIZ (Turkic) is to spread features of frontness and rounding simultaneously: all vowels within a word must agree in these two features, see the rule in (A1).

(A1) $\begin{bmatrix} -\text{consonantal} \\ ?\ \text{front} \\ ?\ \text{round} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{consonantal} \\ \alpha\ \text{front} \\ \beta\ \text{round} \end{bmatrix} / \begin{bmatrix} -\text{consonantal} \\ \alpha\ \text{front} \\ \beta\ \text{round} \end{bmatrix} __$

Double harmony in Kirghiz [4]

(9)	kɪz-da 'girl-LOC'	(13)	kɪz-nɪn 'girl-GEN'
(10)	ot-to 'fire-LOC'	(14)	ot-tun 'fire-GEN'
(11)	kim-de 'who-LOC'	(15)	kim-din 'who-GEN'
(12)	üj-dö 'house-LOC'	(16)	üj-dün 'house-GEN'

- Both harmonies operate over the same set of vowels: T = {a, ɪ, e, i, o, ö, u, ü}
- Block all pairs of vowels that disagree in [front]:
  H_f = {*ai, *ae, *aö, *aü, *oi, *oe, *oö, *oü, *ɪi, *ɪe, *ɪö, *ɪü, *ui, *ue, *uö, *uü, *ia, *io, *iɪ, *iu, *ea, *eo, *eɪ, *eu, *öa, *öo, *öi, *öu, *üa, *üo, *üɪ, *üi}
- Block all pairs of vowels that disagree in [round]:
  H_r = {*oa, *oɪ, *ua, *uɪ, *öi, *öe, *üi, *üe, *ao, *au, *iö, *iü, *ɪo, *ɪu, *eö, *eü}

ok ü j d ö (tier: ü ö) * ü j d e (tier: ü e) * ü j d o (tier: ü o)

Both harmonies affect the same set of vowels, all vowels undergo both spreadings, the set of transparent items is the same, therefore only one tier is required to capture KIRGHIZ pattern.

3 Double Harmony In Buryat (Mongolian)

In BURYAT (Mongolian), all vowels within a word must agree in ATR. All tier-adjacent non-high vowels agree in rounding, unless there is an intervening high vowel that blocks this assimilation. Vowel /i/ is transparent for both harmonies. The rules in (B1-3) summarize this pattern.

(B1) $\begin{bmatrix} -\text{consonantal} \\ ?\ \text{tense} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{consonantal} \\ \alpha\ \text{tense} \end{bmatrix} / \begin{bmatrix} -\text{consonantal} \\ \alpha\ \text{tense} \end{bmatrix}$ (/i/) __

(B2) $\begin{bmatrix} -\text{consonantal} \\ -\text{high} \\ ?\ \text{round} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{consonantal} \\ -\text{high} \\ \beta\ \text{round} \end{bmatrix} / \begin{bmatrix} -\text{consonantal} \\ -\text{high} \\ \beta\ \text{round} \end{bmatrix}$ (/i/) __

(B3) $\begin{bmatrix} -\text{consonantal} \\ -\text{high} \\ ?\ \text{round} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{consonantal} \\ -\text{high} \\ -\text{round} \end{bmatrix} / \begin{bmatrix} -\text{consonantal} \\ +\text{high} \end{bmatrix}$ (/i/) __

Double harmony in Buryat [6]

(17)	ɔr-ɔ:d	'enter-PERF'	*ɔr-a:d
(18)	ɔr-ʊ:l-a:d	'enter-CAUS-PERF'	*ɔr-ʊ:l-ɔ:d
(19)	to:r-o:d	'wander-PERF'	*to:r-e:d
(20)	to:r-u:l-e:d	'wander-CAUS-PERF'	*to:r-u:l-o:d
(21)	mɔrin-ɔ:	'horse-POSS'	*mɔrin-a:
(22)	o:rin-go:	'group-POSS'	*o:rin-ge:

- Both harmonies operate over the same set of vowels: T = {a, e, ɔ, o, ʊ, u}
- Block all pairs of vowels that disagree in [tense]:
  H_t = {*ɔo, *oɔ, *ʊu, *uʊ, *ae, *ea, *ʊo, *oʊ, *ʊe, *eʊ, *ɔu, *uɔ, *ɔe, *eɔ, *oa, *ao, *au, *ua}
- Block any pair of non-high vowels that disagree in [round], and also prohibit rounded non-high vowels after the high ones:
  H_r = {*ɔa, *aɔ, *eo, *oe, *ʊɔ, *uo}

ok t o: r u: l e: d (tier: o u e) * t o: r u: l ö: d (tier: o u ö) * t o: r u: l o: d (tier: o u o)

The set of vowels involved in both harmonies is the same, although the high vowels are undergoers for the ATR agreement while being blockers for the labial spreading, therefore one tier is sufficient for BURYAT double vowel harmony.

4 Double Harmony In Pseudo-Buryat

Consider a non-existent language PSEUDO-BURYAT, where all vowels agree in ATR, and all non-high vowels harmonize in rounding.

(C1) $\begin{bmatrix} -\text{consonantal} \\ ?\ \text{tense} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{consonantal} \\ \alpha\ \text{tense} \end{bmatrix} / \begin{bmatrix} -\text{consonantal} \\ \alpha\ \text{tense} \end{bmatrix}$ __

(C2) $\begin{bmatrix} -\text{consonantal} \\ -\text{high} \\ ?\ \text{round} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{consonantal} \\ -\text{high} \\ \beta\ \text{round} \end{bmatrix} / \begin{bmatrix} -\text{consonantal} \\ -\text{high} \\ \beta\ \text{round} \end{bmatrix}$ __

Double harmony in Pseudo-Buryat

(23)	ɔr-ʊ:l-ɔ:d	*ɔr-ʊ:l-a:d
(24)	to:r-u:l-o:d	*to:r-u:l-e:d

- One tier would not be sufficient: non-high vowels are not local anymore over the vowel tier;
- Separate tier for labial assimilations is required;
- To the best of my knowledge, such patterns are not attested among vowel harmonies.

ok t o: r u: l o: d (tier: o u o) * t o: r u: l ö: d (tier: o u ö) * t o: r u: l e d (tier: o u e)

One tier is sufficient only if the two harmonies operate over the same tier alphabet. If the alphabet differs (see [5] for examples of such consonantal harmonies), projection of more than one tier is nesessary.

5 Rules For Fitting On The Same Tier

Two abstract harmonies A and B can fit on the same tier iff:

- The set of transparent items for the harmonies A and B is identical;
- Both blockers and undergoes for the harmony A play some role in the harmonic process B, i.e. they are either blockers or undergoers.

Conclusion

In this poster, I showed that the strong tendency, at least among double vowel harmonies, is to fit both harmonies on the same tier. This result is important both from typological and computational points of view because limiting vowel harmonies to one tier puts strong restriction on how such systems can look like, thereby providing the possibility for a new typological universal.

Questions to be answered:

- What about double consonantal harmonies (IMDLAWN TASHLHIYT, SLOVENIAN)?
- What about separate vowel and consonantal harmonies in the same language (KIKONGO, BUKUSU)?
- More generally, *what are the natural language limitations on the choice of the tier alphabets?*

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