Sanskrit vowel hiatus*

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SUMMARY

Sanskrit has a number of processes that avoid vowel hiatus, such as vowel coalescence, glide insertion, vowel deletion, and glide formation, giving the appearance of a conspiracy. However, there are also a number of processes that create or maintain vowel hiatus. A phonological theory based on ordered rules accounts for these facts quite easily by ordering rules that create hiatus after rules that could resolve them (counterfeeding order). A theory based on constraints, such as Optimality Theory, cannot account for the facts, even with candidate chains. This example casts doubt on the claim that conspiracies constitute a linguistically significant phenomenon.

RÉSUMÉ

Le sanskrit a plusieurs strategies d'évitement des hiatus, tels que la coalescence vocalique, l'insertion de semi-voyelles, l'effacement vocalique, et la formation de semi-voyelles, ce qui apparaît être une conspiration. Néanmoins, il y a aussi des processus qui créent ou maintiennent le hiatus. Une théorie phonologique basée sur l'ordonnance des règles rend facilement compte de ces phénomènes par l'application des règles qui créent le hiatus après celles qui l'éliminent (ordre contre-alimentatif). Par contre, une théorie qui utilise des contraintes, telle que la théorie de l'optimalité, ne peut pas rendre compte de ces phénomènes, même si en ayant recours à des chaînes de candidats. Cet exemple rend improbable l'hypothèse que les conspirations constituent un phénomène linguistique significatif .

1. CONSPIRACIES

Calabrese (2005: 22) defines conspiracies as: "In…a conspiracy, a variety of different phonological processes have in common the avoidance of a given configuration." McCarthy (2002: 25, 93), in discussing conspiracies, refers to "Homogeneity of Target/Heterogeneity of Process."

Sanskrit has a variety of processes that avoid vowel hiatus:

1) Vowel coalescence: "Two similar simple vowels, short or long, coalesce and form the corresponding long vowel" (Whitney 1889: 43).

tvā Agne → tvāgne '(to) thee, O Agni' (Rig Veda i.1.7).
ati iva → atīva 'across as'
su uktam → sūktam 'well spoken'

2) Mid vowel: "An **a**-vowel combines with a following **i**-vowel to ए **e;** with an **u**-vowel to ओ **o**" (Whitney 1889: 43)

rājā indra → rajendra 'king Indra'

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gatā́ iti → gateti ‘gone (f.) thus’ (Perry 1936: 28).
yéna imā́ → yénemā́ ‘by whom these things’ (Rig Veda ii.12.4).
gatā́ utá → gatota ‘gone (f.) also’ (Perry 1936: 28).

3) Glide insertion
śi-śri-é → śiśriyé ‘resort (perfect middle 1, 3 sg.)’ (Calabrese 2005: 88)

4) Vowel deletion (short ă deletion): “After final ए **e** or ओ **o,** an initial अ **a** disappears” (Whitney 1889: 47).
vane atra → vane ’tra ‘in the forest here’ (Perry 1936: 46).
sas abravīt → so ’bravīt ‘he said (imperf.)’
bhāno átra → bhāno ’tra ‘O sun (voc.) here’ (Perry 1936: 46).

“Final अस् **as,** before any sonant consonant and before short अ **a,** is changed to ओ **o** — and the अ **a** after it is lost” (Whitney 1889: 59).
nṛpas jáyati → nṛpo jáyati ‘the king conquers’ (Perry 1936: 34).
nṛpas atra → nṛpo ’tra ‘the king here’ (Perry 1936: 34).

5) Glide formation: “The **i**-vowels, the **u**-vowels, and ऋ **ṛ,** before a dissimilar vowel or diphthong, are regularly converted each into its own corresponding semivowel य् **y** or व् **v** or र् **r.**” (Whitney 1889: 44).
strī asya → stryasya ‘his wife’
madhu iva → madhviva ‘honey like’
agni + as → agnayas ‘fires (nom.pl.)’ (Emeneau 1968: 3).

Conversely, Sanskrit has a variety of processes that *create* or *maintain* vowel hiatus:

1) y Deletion: “Of a diphthong, the final **i**- or **u**-element is changed to its corresponding semivowel य् **y** or व् **v,** before any vowel or diphthong: thus, ए **e** (really **ai: 28a**) becomes अय् **ay,** and ओ **o** (that is, **au: 28a**) becomes अव् **av;** ऐ **āi** becomes आय् **āy**, and औ **āu** becomes आव् **āv**.…In external combination …the semivowel…is in general dropped; and the resulting hiatus is left without further change” (Whitney 1889: 45–46).
vane iti /vana+i#iti/ → vana iti ‘in the forest thus’ (Perry 1936: 46).
bhāno iti → bhāna iti ‘O sun (voc.) thus’ (Perry 1936: 46).
striyāi uktam → striyā uktam ‘said to a woman’

2) “Final अस् **as** before any other vowel than अ **a** loses its स् s, becoming simple अ **a;** and the hiatus thus occasioned remains” (Whitney 1889:59).
nṛpas iccháti → nṛpa iccháti ‘the king wishes’ (Perry 1936: 34).

3) "Final आस् ās before any sonant, whether vowel or consonant, loses its स् s, becoming simple आ **ā;** and a hiatus thus occasioned remains" (Whitney 1889 :60).

nṛpās icchánti → nṛpā icchánti 'the kings wish' (Perry 1936: 34).

These facts are easily accounted for in a system based on ordered rules. It is only necessary to order the rules that create hiatus after the rules that could resolve them (a counterfeeding order). Our rules are based on Zwicky (1965), modified by including rules of syllabification to replace the manipulation of features [±vocalic], [±consonantal].

2. RULES IN ORDER OF APPLICATION

Syllabification. Create a core syllable C_0V where V is the locally most sonorous segment and C_0 is the maximal onset by the sonority hierarchy and the dispensation to allow syllable-initial s before stops. Onsets are attached directly to the syllable node. Leftover consonants (including high vowels) are added in syllable codas. Applies lexically to individual words. Applies postlexically to provide an onset to a vowel-initial word by resyllabifying the consonant or glide at the end of the preceding word as an onset.

External Voicing Assimilation. $\begin{bmatrix}+\text{cons}\\-\text{nas}\end{bmatrix} \rightarrow [\alpha\text{voice}] / \_\_\_\_ \#(\#)[\alpha\text{voice}]$

(Note: the feature [voice] applies equally to vowels and consonants.)

Coalescence of like vowels:

$$\begin{matrix}\text{m}\ (\text{m}) & \text{m}\ (\text{m}) & \text{m m}\\ |\ (/) & |\ (/) & |\ /\end{matrix}$$
$$\begin{bmatrix}\text{V}\\ \alpha\text{round}\\ \beta\text{high}\end{bmatrix}\ \begin{bmatrix}\text{V}\\ \alpha\text{round}\\ \beta\text{high}\end{bmatrix} \rightarrow \begin{bmatrix}\text{V}\\ \alpha\text{round}\\ \beta\text{high}\\ +\text{tense}\end{bmatrix} \quad / \text{C}\_\_\_\_$$

(C=consonant or nonmoraic high vowel)

z → u

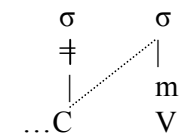
$$\begin{matrix}\text{m}\\ |\end{matrix}$$
$$\text{z} \rightarrow \text{u} / \text{ă}\ \_\_\_\_\#\#(\text{ă})\text{C}$$

(Williams 1857: 33 says, Final s, "when preceded by short अ a, before all soft [i.e., voiced] consonants, it is treated as if liquefied into उ u, and blends with the a into ओ o.")

ă Deletion

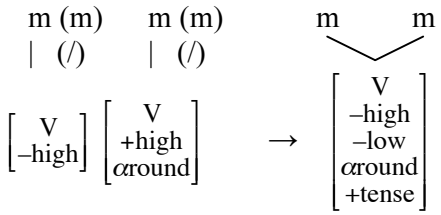
$$\text{ă} \rightarrow \emptyset / \text{ă}\ \begin{bmatrix}\text{V}\\ -\text{low}\end{bmatrix}\ \#(\#)\ \_\_\_\_$$

Resyllabification (Zwicky's Prevocalic Glides)

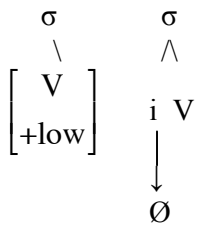


(where C may be a consonant or high vowel; associated moras are pruned)

Mid Vowels



y-Deletion (after Resyllabification)



z-Deletion

z → Ø

3. SAMPLE DERIVATIONS

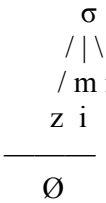
/nṛpas atra/ 'the king here'

	Postlexical
z	External Voicing Assimilation
———	Coalescence
u	z → u
Ø	ă-Deletion (bleeds Resyllabification)
———	Resyllabification
o	Mid Vowels
	(no other rules apply)

[nṛpo 'tra]

/nṛpas iccháti/ 'the king wishes'

	Postlexical
z	External Voicing Assimilation
	(Coalescence, z → u, ă-Deletion, inapplicable)



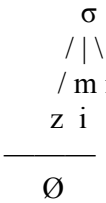
Resyllabification
Mid Vowels
z-Deletion (counterfeeds Mid Vowels)

[nṛpa iccháti]

/nṛpās icchánti/ ‘the kings wish’

Postlexical

External Voicing Assimilation
(Coalescence, z → u, ă-Deletion inapplicable)



Resyllabification
Mid Vowels
z-Deletion (counterfeeds Mid Vowels)

[nṛpā icchánti]

/nṛpās jáyanti/ ‘the kings conquer’

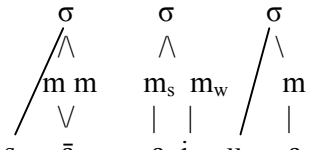
Postlexical

External Voicing Assimilation
(Coalescence to y-Deletion inapplicable)
z-Deletion

[nṛpā jáyanti]

/sā aiua/ ‘she just’

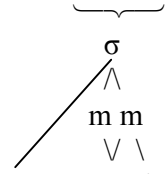
Lexical



Syllabification of individual words

Postlexical

External Voicing Assimilation

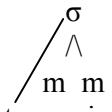


Coalescence (here m_s dominating *a* is lost and m_w is pruned, *i* is no longer moraic)
(z→u to z-Deletion inapplicable)

[sāyva]

/tai/ ‘they masc. nom. pl.’

Lexical



Syllabification

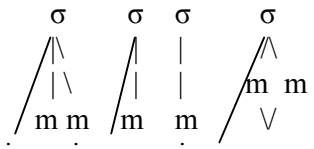
Postlexical

Mid Vowels

[te]

/iaina imā́/ ‘by whom these things (Rig Veda ii.12.4)

Lexical



Syllabification

Postlexical

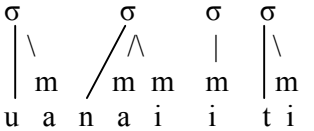
Ext VA, Coalesce, z→u, ă-Deletion, Resyll., y-Del, z-Del NA)

Mid Vowels

[yénemā́]

/uana+i iti/ ‘in the forest thus’

Lexical



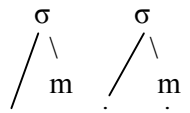
Syllabification

Postlexical

———

External Voicing Assimilation, Coalescence z→u, ă-Deletion NA

———



Resyllabification (bleeds Mid Vowels)

———

Mid Vowels

Ø

y-Deletion (counterfeeds Mid Vowels)

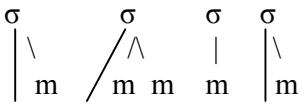
———

z Deletion

[vana iti]

/vana+i atra/ ‘in the forest here’

Lexical



Syllabification

Postlexical

——— (Ext. V.A., Coalescence, z→u NA)

Ø ă-Deletion (bleeds Resyllabification)

——— Resyll.

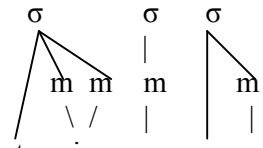
e Mid Vowels

——— y-Del, z-Del inapplicable

[vane ’tra]

/strī asia/ ‘his wife’

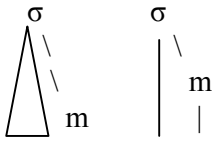
Lexical



Syllabification

Postlexical

——— (Ext VA.Coalesc, z→u, ă-Del. NA)

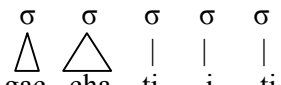


Resyllabification

[stryasya]

gácchati iti ‘s/he goes thus’

Lexical



Syllabification

Postlexical

——— Ext VA

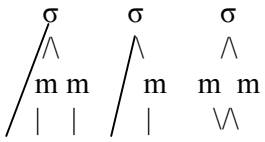
Coalescence

——— (z→u to z-Deletion NA)

[gacchatīti]

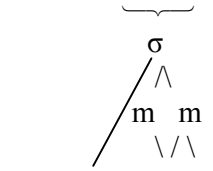
daiu +a + āu ‘gods (dual)’

Lexical



Syllabification

Postlexical



Coalescence

e Mid Vowels

[devāu]

/ta +āu upa/ ‘they two toward’

Postlexical

ā — Coalescence

[tāu upa]

4. DIFFICULTIES WITH OT ANALYSIS

An analysis in OT, including OTCC, is unable to account for all the facts. OT has some success in accounting for conspiracies, in that a number of rules with a common effect can be attributed to the effects of a single output condition. Sanskrit exhibits a constraint against vowel hiatus, yet instances of hiatus are produced or maintained in some output forms, resulting in opacity. These are easily accounted for in a theory with ordered rules. OT with candidate chains (McCarthy 2007) purports to account for opaque forms by, in effect, incorporating derivations in the candidates for a given input, called chains. In a chain, each step may introduce one unfaithful mapping with overall improvement in harmony at each step. Such a system can account for the notorious opacity observed in the interaction of vowel harmony, vowel lowering, and vowel shortening in Yawelmani.

We will use *MID to express the constraint penalizing mid vowels. This stands for a complex of faithfulness constraints (based on Casali 1996: 64, where F′ = [round], [back], [low]). The constraint *VV disfavours a sequence of vowels.

			*MID			
/a_i + i_j/		*VV	Id [–hi]	Id [+hi] V_j	Id(F′)V_j	Id(F′)
a.	i_{ij}		*!			**
b.	a_{ij}			*	*!*	**
☞ c.	e_{ij}			*		**
d.	$a_i i_j$	*!				

The following tableaux demonstrate the basic rankings of the constraints we are assuming.

*VV » *MID (*te* ‘they masculine plural nominative’)

/tai/		*VV	*MID
a.	$ta_i i_j$	*!	
☞ b.	te_{ij}		*

*VV » ID[Syl]
agnayas ‘fires nom. plural’

/girai+as/		*VV	ID [Syl]
a.	agnaias	*!*	
☞ b.	agnayas		*

Max » *MID *yenemā́* ‘by whom these things’

/yéna$_i$ i$_j$mā́		Max	*MID
a.	yeni$_j$mā	*!	
☞ b.	yene$_{ij}$mā		*

*VV » Max *vane ’tra* ‘in the forest here’ /vana ‘forest’; +i ‘locative’ /atra/ ‘here’

/vana$_i$+i$_j$ # atra/		*VV	Max	*MID
a.	vanaiatra	*!*		
b.	vane$_{ij}$ atra	*!		*
☞ c.	vane$_{ij}$ tra		*	*

ID[syl] » *MID *te* ‘they masc. pl. nom.’

/$ta_i i_j$/		*VV	ID[Syl]	*MID
a.	tai	*!		
b.	tay		*!	
☞ c.	te_{ij}			*

Max » ID[Syl] *stryasya* ‘his wife’

/strī # asya/		*VV	Max	ID[Syl]
a.	strī asya	*!		
b.	strasya		*!	
☞ c.	stryasya			*

*VV» R-anchor (stem, σ) *agnayas* 'fires nom.pl.'
"R-Anchor(Stem; σ) — the rightmost segment of a stem in the input has a correspondent at the right edge of a syllable in the output" (Łubowicz 2002; 257).

/agna$_i$i$_j$+as/	*VV	R-anchor (stem, σ)	Max	ID[Syl]	*MID
a. agnaias	*!*				
☞ b. agnayas		*		*	
c. agne$_{ij}$as	*!				*
d. agne$_{ij}$s		*	*!		*

The forms *vana iti* 'in the forest thus' and *vane 'tra* 'in the forest here' are composed of the same stem /vana+i/ followed by an adverb *iti* 'thus' and *atra* 'here.' Although they have the same syntactic structure, *vana iti* is opaque, with a hiatus where the rule Mid Vowels should apply, while *vane 'tra* is transparent with respect to Mid Vowels. The following two tableaux, using a classic OT analysis, successfully account for *vane 'tra* but not for *vana iti.*

R-anchor » Max *vane 'tra* 'in the forest here'

/vana$_i$+i$_j$ # atra/	*VV	R-anchor (stem, σ)	Max	ID[Syl]	*MID
a. vanai atra	*!*				
b. vanay atra		*!		*	
c. vane$_{ij}$ atra	*!				*
☞ d. vane$_{ij}$ 'tra			*		*
e. vanai 'tra	*!		*		
f. va[n a]$_\sigma$tra		*!	**		

vana iti 'in the forest thus'

/vana$_i$+i$_j$ # iti/	*VV	R-anchor (stem, σ)	Max	ID[Syl]	*MID
a. vanai iti	*!*				
b. vanay iti		*!		*	
c. vane$_{ij}$ iti	*!				*
☹ d. vane$_{ij}$ 'ti			*		*
→ e. vana iti	*!	*	*		
f. vana 'ti		*!	**		

(☹ = selected but incorrect candidate; → = desired candidate not selected)

5. OT WITH CANDIDATE CHAINS

The tableau below is an analysis of opaque *vana iti* using candidate chains. We first list the harmonically improving chains from /vana+i # iti/ and their localized unfaithful mappings (LUMs).

a. <vanai iti> < >
b. <vanai iti, vanay iti> <ID[syl]@5>

c. <vana$_i$i$_j$ iti, vane$_{ij}$ iti> <*MID@4/5>
d. <vana$_i$i$_j$ iti, vana$_i$ iti> <Max@5>
e. <vana$_i$i$_j$ iti, vana$_i$ iti, vana$_i$ ti> <Max@5, Max@5>
f. <vana$_i$i$_j$ iti, vane$_{ij}$ iti, vane$_{ij}$ ti> <*MID@4/5, Max@5>
g. <vana$_i$i$_j$ iti, vana$_i$i$_j$ti, vane$_{ij}$ ti> <Max@6, *MID@4/5>

/vana$_i$+i$_j$#iti	*VV	R-Anchor (Stem, σ)	Max	PREC (*MID, Max)	ID[Syl]	*MID
→ d. vana$_i$ iti {Max@5}, Ø	*!	*	*	*		
a. vanai iti Ø, Ø	*!*					
b. vanay iti {ID[Syl]@5}, Ø		*!			*	
c. vane$_{ij}$ iti {*MID@4/5},Ø	*!					*
e. vana ti {Max@5, Max@5}, Ø		*!	**	**		
☹ f. vane$_{ij}$ ti {*MID@4/5, Max@5}, Ø			*	*		*

Max » PREC(*MID, Max) by the Metaconstraint on the ranking of PREC constraints: B»PREC(A, B) (McCarthy 2007: 99)

With the output candidate of each chain we list in curly brackets the sequence of faithfulness constraints violated by the chain. In candidate (d), {Max@5} indicates that Max is violated at the fifth position of the input in the chain (d). The following Ø indicates that there is no crucial order of Localized Unfaithful Mappings (LUMs).

The intended winner is (d) and the transparent competitor is (f), which actually represents a convergence of (f) and (g). The chains (f) and (g) both include a Max violation with respect to the same segment and a *MID violation, but in different orders. Neither order is crucial since both give the same output. We represent these convergent chains as the single candidate (f), which gives the LUMs in curly brackets; the Ø again indicates a lack of crucial order of LUMs.

The Precedence constraint (*MID, Max) would distinguish the transparent candidate (f) from the opaque candidate (d) if (f) had a crucial ordering Max followed by *MID, but (g) shows that this order is not crucial, since (f) and (g) are convergent chains (even though (g) has an LUM sequence of a Max violation followed by a *MID violation). Consequently the Precedence constraint does not favour opaque (d) over transparent (f).

Given the chains <vana$_i$ i$_j$ iti, vana$_i$ y iti, vana$_i$ iti> <ID[syl]@5, Max@5> (one violation of PREC (*MID, Max)) and <vana$_i$ i$_j$ i$_k$ti, vana$_i$ y i$_k$ti, vana$_i$ i$_k$ti, vane$_{ik}$ ti> <ID[syl]@5, Max@5, *MID@4/5> (two violations of PREC (*MID, Max), the precedence

constraint would distinguish opaque *vana iti* from transparent *vane ti*; however neither chain is licit since neither chain is harmonically improving.

McCarthy (2007: 25ff) suggests that counterfeeding opacity could be treated with a special faithfulness constraint. The Sanskrit case we are considering would require a faithfulness constraint ID[ai] ranked above *VV for opaque *vana iti,* but the opposite ranking for transparent *vane 'tra.* The only way to have different rankings for different inputs is to use lexically specified ranking, but this is not applicable in this case because these processes are general for phrases with the relevant phonological structure and do not depend on specific lexical items. A stratal OT approach might rank ID[ai] over *VV on stratum 1, with the opposite ranking on stratum 2. This accounts for *vane 'tra* but fails for *vana iti.* There is furthermore no independent justification for a division into two strata.

6. CONCLUSION

The Sanskrit example casts doubt on the claim that conspiracies constitute a linguistically significant phenomenon requiring a special theory to account for. The fact that OT was set up to account for conspiracies makes it difficult to account for partial conspiracies such as the one in Sanskrit. In Sanskrit, undominated *VV would disallow all instances of vowel hiatus, and invoking candidate chains with precedence constraints is unable to improve the situation.

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