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Sanskrit *nati*: phonetics, morphoprosody, origin and fate

1 Basic rule

(1a) *n* becomes *ṇ* when preceded at any distance by {*ṣ, r, r̥, r̥̄*}

dharmeṇa	'by dharma'
śr̥ṅgeṇa	'by horn'
viṣkambheṇa	'by prop'
rāghaveṇa	'by Rāghava'
tryaṅgeṇa	'by tripartite'
puṣpaugheṇa	'by flower heap'

(1b) Unless a coronal (excluding *y*) intervenes, e.g.

dentals	*t*	in	*pārṣatena*	'by antelope'
	th	in	*rathena*	'by chariot'
	d	in	*hr̥dayena*	'by heart'
	l	in	*vr̥ṣalena*	'by wicked'
retroflexes	*ṭ*	in	*virāṭena*	'by Virāṭa'
	ḍ	in	*garuḍena*	'by Garuḍa'
palatals	*c*	in	*mārīcena*	'by Mārīca'
	j	in	*rājyena*	'by royal'

(2) Always applies transparently for derived triggers

	/vi-skambh-ena/
(1) *ruki*	vi-ṣkambh-ena
(2) *nati*	vi-ṣkambh-eṇa
	[vi-ṣkambh-eṇa]

(3) Domain is usually the word, with no morphological restrictions on the trigger or target

(4) Target *n* must immediately precede a vowel, glide, or nasal, but this restriction follows from general phonotactics independent of *nati* (Schein and Steriade 1986)

(5) Thus, as an *SPE*-style rule:[1,2]

$$\begin{bmatrix} +cor \\ +nas \end{bmatrix} \rightarrow [-ant] \; / \; \begin{bmatrix} +cor \\ -ant \\ +cont \\ -lat \end{bmatrix} \; [-cor]_0 \; \underline{\quad}$$

[1]This assumes that [*cor*] is binary and *y* is [−*cor*]; if either isn't the case, disjunctions are required.

[2]For a recent constraint-based analysis, see Ryan (forthcoming).

2 A little background

(1) *nati* [nəti] refers to 'retroflexion' as a process (< *$n\underset{\circ}{m}$-*ti*, $\sqrt{}$*nam*, cf. *namaste*)

(2) Cf. *mūrdhanya*, 'retroflex (cerebral)' as a class

(3) By convention, *nati* refers only to *n*-retroflexion via harmony

(4) Pāṇini treats the phenomenon at length (8.4.1–39), but doesn't call it '*nati*'

(5) *nati* is also discussed (as such) in the Prātiśākhyas (e.g. RPr 5.61, VPr 1.42)

(6) Some notable descriptions: Wackernagel (1896: §167–74), Whitney (1889: §189–95), Macdonell (1910: §47), Allen (1951: 940–6), Renou (1952: §60–5; 1961: §17–8)

(7) 40+ references in the structuralist and generative literatures (see Ryan forthcoming)

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(8) Two *a priori* possible mechanisms for harmony:

(i) Spreading (gestural extension), e.g. Applecross Scottish Gaelic (Ternes 1973)

a.	/mã˞har/	[ˈmã˞h̃ãr̃]	'mother'
b.	/frĩa˞v/	[ˈf̃r̃ĩã˞ṽ]	'roots'
c.	/kʰɔ̃ispaxk/	[ˈkʰɔ̃ĩ̃spaxk]	'wasp'

(ii) Long-distance correspondence, e.g. Chaha (Semitic), in which plosives agree in voicing across a (voiced) vowel (Rose and Walker 2004) (cf. alliteration)

(9) Consensus holds *nati* to be type (a) (esp. Hansson 2010: 189ff; also Flemming 1995, Gafos 1999, Ní Chiosáin and Padgett 2001, Rose and Walker 2004, Jurgec 2011)

- Due to the nonoverlap of triggers and target, blocking, progressive directionality, and (occasional) phrasal domain
- *nati*-as-spreading will be reinforced by new evidence below

(10) A such, all segments between trigger and target are presumed retroflex

- e.g. *viṣkambheṇa* is [(ʋi̯ʂ̺kə̯mb̪ʱe̯ːɳ)ə]

(11) Orthography/orthoepy records retroflexion only on coronals, where it's contrastive

(12) As long recognized (e.g. Whitney 1889: §189a), retroflexion is compatible with non-coronals. In some languages (e.g. Badaga [Dravidian] and Kalasha [Dardic]), it's even systematically contrastive in the vowels.

(13) Further supported by an instrumental study of retroflex harmony in Kinyarwanda (Walker et al. 2008)

3 Triggers

(1) Why are the triggers {*ʂ, r, ɾ̥, r̄̊*}, i.e., the retroflex continuants, $\begin{bmatrix} +cor \\ -ant \\ +cont \end{bmatrix}$?

(2) My proposal: Retroflex stops (*ʈ, ʈh, ɖ, ɖh, ɳ*) fail to trigger because they FLAP OUT

(3) Dialectal *ɭ, ɭh* also fail to trigger, possibly because they too flap out (more below)

(4) 'Flapping out' (Ladefoged 1964): the (near?) universal by which retroflex stops release in a more anterior position (e.g. [ʈ] is more narrowly [t͡ʈ])[3]

- Articulatorily, the front of the tongue shifts to the alveolar region during closure
- Acoustically, the cues for retroflexion (e.g. depressed F3, F4) are primarily realized on the preceding rather than following sonorant
- Phonologically, retroflex stops tend to interact with preceding as opposed to following vowels

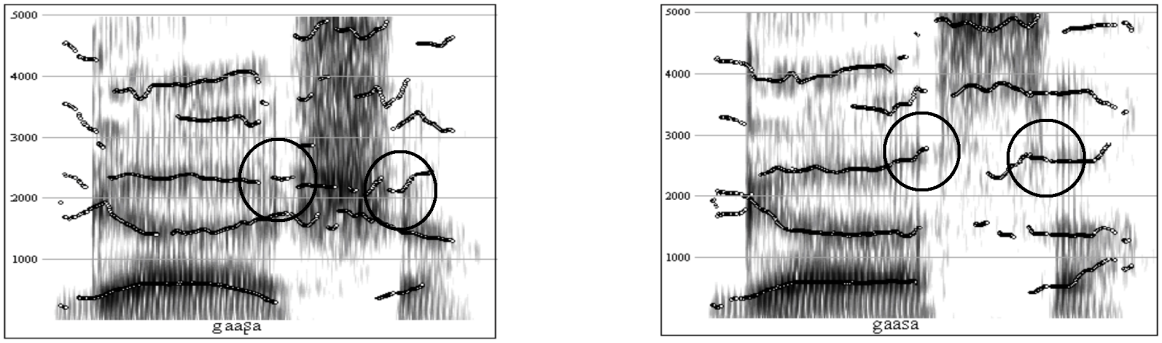
(5) If *nati* is spreading, this provides a simple explanation for non-triggering by stops

- FLAPOUT "penalize a retroflex stop that doesn't flap out"
- SPREAD([retro]) "penalize each segment excluded from each retroflex span"
- IDENT([retro]) "penalize each change to retroflexion"

	/mukuʈ-eːna/	FLAPOUT	SPREAD([retro])	IDENT([retro])
☞	a. (mᵘkᵘʈ)-eːnə		***	****
	b. (mᵘkᵘʈ-eːɳ)ə	*!	*	******
	c. muku(ʈ)-eːnə		****!***	

[3] *Ibid.*, Bhat 1973:47, Dave 1977, Simonsen et al. 2000, Dart 1991, Shalev et al. 1993, Butcher 1995, Krull et al. 1995, Steriade 1995:5f, Spajić et al. 1996, Dart and Nihalani 1999, Flemming 2003, Hamann 2003, Boersma and Hamann 2005, Arsenault 2012.

(6) Crucially, however, continuants (aside from flaps themselves) never seem to flap out crosslinguistically (esp. Boersma and Hamann 2005; also Bhat 1973, Flemming 2003)



(Kinyarwanda [ʂ] vs. [s] from Walker and Mpiranya 2005; ellipses added by me)

(7) Retroflexion is therefore free to spread bidirectionally from them

	/puːsan-am/	FLAPOUT	SPREAD([retro])	IDENT([retro])
	a. (puːʂ)ən-əm		***!*	***
☞	b. (puːʂəɳ)-əm		**	*****
	c. puː(ʂ)ən-əm		***!***	*
	d. (puːʂəɳ-əm)	*!		*******

3.1 On non-triggering by retroflex laterals

(8) No previous discussion of *nati* has made explicit that {*ḷ, ḷh*} fail to trigger it, judging by 45 diagnostic tokens in the RV, e.g.

- *íḷānāḥ* 'invoking.PL'
- *áṣāḷhena* 'with invincible'

(9) If these are normal retroflex lateral approximants [ɭ̢ʱ], we'd expect them to trigger, being retroflex continuants that don't flap out

(10) Two possible solutions:

(i) Given the shallow origin of {*ḷ, ḷh*} in {*ḍ, ḍh*}, they were really retroflex lateral flaps [ɺ̢ʱ], as in Marathi

(ii) Opacity: *nati* is counterfed by lateralization

3.2 On triggering by rhotics and paleophony

(11) Since *r* (in all of its forms) triggers *nati*, it's often assumed to be retroflex

- The tradition is scattered: retroflex (PŚ, ĀpŚ, alphabetical order), alveolar (AP, VP, RT, TP, ĀpŚ), optionally dental (RP, RT); moreover, r̥, for its part, is sometimes characterized as velar (VP, RT, RP) (Allen 1953: 53ff)[4]

(12) Assuming spreading, this means that *r*, whatever it is, must remain 'flapped up'

(13) Therefore, *r* cannot be any kind of flap

(14) But most other rhotic types would be compatible with *nati*: a rhotic approximant [ɻ] can induce retroflexion, as can an alveolar tap or trill [ɾ∼r] (Cathcart 2012)

(15) It's unclear whether Vedic *r* was typically (i) smooth or (ii) tapped/trilled

(i) Pro smooth [ɻ]:

(a) A frequent assumption in the grammars, e.g. Whitney (1889), "**ṛ** is simply a smooth or untrilled *r*-sound" (§24); "seems to have been untrilled [...] no authority hints at a vibration as belonging to it" (§52)

(b) Taps/trills (as opposed to flaps) tend to be dental to alveolar, seemingly contrary to *nati* (but cf. Cathcart 2012), while rhotic approximants are typically more posterior (alveolar to retroflex)

(c) *r* collapsed together with *l* (lateral approximant) in pre-Vedic

(d) *s*-rhotacism is active in Vedic (e.g. *agnís tríṇi* vs. *agnír āsīt*), a change often assumed to progress through an approximant stage (e.g. z > z̬ > ɹ; Catford 2001), though it might not linger (cf. Latin; Painter 2011)

(e) Catford (2001): *o*-sandhi (*as* → *o* [əw] / _[+*voi*]) likely passed through [əʷɹ], perhaps əz > əz̬ > əɹ > əʷɹ > əw (*pace* Smith 2010)

(f) A trill is salient and easy to describe, as witnessed by even amateur accounts of it in Classical Latin. The Sanskrit grammarians were highly sophisticated (recognizing, e.g., the sulcalization of *ṣ* and the acceleration of airflow after aspirates), but don't describe anything like trilling[5]

(g) *r* was entirely glide-like phonologically

(h) *r* often metathesizes (e.g. *ásrāpsam* alongside *ásārpsam* 'crept.AOR')

(i) RP 14.26 refers to 'overcontact' as a barbarism: *atisparśo barbaratā ca rephe* (MW has *barbaratā* as "stammering pronunciation of the letter *r*"); Uvaṭa confirms this to be indelicate (*asaukumārya*)

(j) Kinyarwanda (Walker and Mpiranya 2005) has a similar process of retroflex spreading, except that [ɽ] is not a trigger; only [s̬] and [z̬]

[4]Of course, every *śākhā* might not preserve the phonetics under which *nati* naturally evolved.

[5]Except RP does hint at a single tap/flap (see below).

(ii) Pro tapped/trilled [ɾ∼r]:

(a) Other authorities assume a trill, e.g. Chatterji (1952), "r appears to have been always a tongue-tip trill"

(b) Allen (1953) likewise implies that *r*'s name, *repha* ('ripping, growling, snarling'), implies rolling[6]

(c) Several prescriptions give an alveolar or even (optionally) dental place

(d) One or two suggest that r̥ is flanked by vowels (ᵊrᵊ), clearly suggesting a tap[7]

(e) Avestan correspondent of r̥ is *ərə*

(f) Often assumed to be a trill in PIE (but cf. Catford 2001, Painter 2011)

(g) Taps and trills have much higher typological priors (UPSID)

(h) The Middle/Modern reflexes have this quality

(16) At any rate, dialectal and positional variation are esp. common with rhotics

- "In Fula, **/r/** is realized as an approximant ɹ before a consonant, as a trill elsewhere. In Palauan, **/r/** is generally a tap in intervocalic and postvocalic environments but an approximant in initial position; the constrasting orthographic 'rr' is most commonly an approximant with some frication, but its range of variation encompasses trills" (Ladefoged and Maddieson 1996: 216)

(17) As long as *r* doesn't flap out, there's no problem here

4 Directionality

(1) The vast majority of consonant harmonies are regressive or bidirectional, including anteriority harmonies, e.g.

(i) Kinyarwanda (Walker and Mpiranya 2005)

	1.	/sas-i/	→	s̪as̪-i	'bed maker'
	2.	/sáaz-i-e/	→	s̪áaz̪-e	'became old.PERF'
	3.	/zímagiz-i-e/	→	z̪ímagiz̪-e	'misled.PERF'
cf.	4.	/síitaaz-i-e/	→	síitaaz̪-e	'made stub.PERF'

(ii) Navajo (Martin 2005)

	1.	/sì-téːʒ/	→	ʃì-téːʒ	'they two are lying'
	2.	/tsé-tʃéːʔ/	→	tʃʰé-tʃéːʔ	'amber'
	3.	/tʃaː-néːz/	→	tsaː-néːz	'mule'
cf.	4.	/ji-s-tiz/	→	ji-s-tiz	'it was spun'

[6]Incidentally, early Latin descriptions liken trilled *r* to a dog's growl (Painter 2011: 62). But cf. the English sound symbolism: *gr̲r̲*, *r̲oof*, *gr̲owl*, *snar̲l*, *bar̲k* (*R̲over*?, *R̲oy*?, *R̲ex*?), Scooby-Doo's voice, etc.

[7]But the same give l̥ as ᵊlᵊ, rendering this inference less obvious, and at any rate it's not intended for consonantal *r*.

(2) My proposal: *nati* spreading was likely bidirectional (like Gaelic above), but because of flapping out, we only see evidence for it in the progressive direction

(3) Spreading leftwards into the nasal stop would violate FlapOut

	/ʋaːnaɻa/	FlapOut	Spread([retro])	Ident([retro])
☞	a. ʋaːn(ə̣ɻə̣)		***	**
	b. ʋaː(ɳə̣ɻə̣)	*!	**	***
	c. (ʋa̤ːɳə̣ɻə̣)	*!		*****

(4) Meanwhile, FlapOut doesn't apply to systems like Kinyarwanda and Navajo,[8] since the triggers and targets are continuants (sibilants), not stops

(5) Directionality of *nati* is stipulated by all previous analyses

5 Impermeability of target *n*

(1) *nati* cannot spread through a target

e.g. /prān-ena/ → *prāṇena*, **prāṇeṇa*

(2) Here, this follows trivially from FlapOut

	/pɻaːn-eːna/	FlapOut	Spread([retro])	Ident([retro])
☞	a. (pɻa̤ːɳ)-eːnə		***	***
	b. (pɻaːɳ-e̤ːɳ)ə	*!	*	*****

(3) Yet a bugaboo for previous constraint-based analyses, which lack FlapOut[9]

6 Why is the nasal the only target?

(1) One can imagine a process like *nati* targeting all coronals (e.g. *ratha* > *raṭha*, etc.)

(2) Why does actual *nati* only affect the nasal?

(3) Here, I adopt a version of the 'P-map' approach previously advocated (Steriade 1995, Ní Chiosáin and Padgett 1997, Gafos 1999): Changing anteriority is less perceptually salient for the nasal than it is for other coronals

[8]Navajo, for its part, is moot anyway, since it probably doesn't involve spreading.

[9]It's stipulated through additional constraints or ranking in Jurgec (2011) and Ní Chiosáin and Padgett (1997), misanalyzed by Gafos (1999) (see Hansson 2010: 186ff), and left unanalyzed elsewhere.

(4) Indeed, *n* vs. *ɳ* is often the first retroflexion contrast to be lost (Prākrits,[10] Hindi, Nepali, Bengali, etc., all of which preserve constrastive retroflexion in plosives)

(5) Crosslinguistically, nasals assimilate more readily than obstruents in anteriority

(6) Projecting this fact onto a ranking:

$\textsc{Ident}_{OrCor}([\text{retro}]) \gg \textsc{Ident}([\text{retro}])$

	/ɻatʰas/	FlapOut	$\textsc{Ident}_{OrCor}$([retro])	Spread([retro])	Ident([retro])
☞ a.	(ɻə̣)tʰəh			***	*
b.	(ɻə̣tʰ)əh		*!	**	**

7 Why do coronals block?

(1) Dental and palatal orals block (without undergoing) due to $\textsc{Ident}_{OrCor}$ (§6)

(2) Retroflex orals block (remaining retroflex) due to FlapOut (§3)

(3) Dental and retroflex nasals block (while undergoing) due to FlapOut (§5)

(4) Same in Kinyarwanda (Walker and Mpiranya 2005): coronal stops (including /n/) block retroflex spreading

8 Why does retroflexion spread, but not dentality?

(1) Dentality ($[+ant]$) evidently doesn't spread like retroflexion does

e.g. /sa-gaɳa/ → *sagaɳa*, **sagana*

(2) Binary $[\pm ant]$ is often nowadays rejected in favor of a privative [retro] autosegment (Gafos 1999, Ní Chiosáin and Padgett 2001; cf. also McCarthy 2011, Walker 2014); thus, theory-internally, spreading is not predicted to be symmetric

(3) NB. retroflex is the marked anteriority

- much less frequent than dentality
- underlyingly confined to roots; etc.

(4) Kaun (1994) *et seq.*: Marked values spread in order to facilitate their perceptibility

(5) E.g. take a minimal pair such as *pāna* 'drinking' vs. *pāɳa* 'stake'

	pāna	*pāɳa*	distinctiveness
1. no harmony	[paːnə]	[paː(ɳ)ə]	weak
2. dental spreading	[paːnə]	[paː(ɳ)ə]	weak
3. retroflex spreading	[paːnə]	[(pa̤ːɳ)ə]	strong

[10] E.g. Gāndhārī maintains all three sibilants but loses *n* vs. *ɳ*.

9 Root boundary attenuation

(1) A new proposal for morphological conditioning: *nati* applies to a target that is

(i) immediately post-plosive, or
(ii) pre-retroflex

unless the span would have to penetrate $\surd$ (a left root boundary)

9.1 Post-plosive targets

(2) As the grammars report, *nati* sometimes fails when the target is immediately post-plosive, e.g.

- *prāpnoti* 'attains'
- but cf. *rekṇas* 'inheritance'

(3) Proposal: these exceptions are systematic: *nati* fails iff $\surd$ intervenes

- *pr*$\surd$*āpnoti* 'attains'
- $\surd$*rekṇas* 'inheritance'

(4) My corpus studies cover:

Period	Genre		Text	Words
Vedic	Vedas	(**v**)	Ṛg-Veda	164,767
			Sāma-Veda	19,019
			Atharva-Veda	85,021
	Brāhmaṇas	(**b**)	Śatapatha	127,255
			Pañcaviṃśa	42,700
			Gopatha	31,267
			Kauṣītaki	39,060
	Early Upaniṣads	(**u**)	Bṛhadāraṇyaka	16,502
			Chāndogya	13,968
Epic		(**e**)	Mahābhārata	1,258,457
			Rāmāyaṇa	213,773
				Total: 2,011,789

(5) All cases in the corpus in which post-plosive *nati* applies

(a)	√gr̥bhṇV-	'grasp (pres. stem)'	(v33 b15 vs. 0)
(b)	√rugṇá	'break (pass. part.)'	(v2 e40 vs. 0)
(c)	√vr̥kṇá	'cut off (pass. part.)'	(v4 b7 u7 e2 vs. 0)
(d)	√rékṇas	'inheritance'	(v14 vs. 0)
(e)	√tr̥pṇV-	'be satisfied (pres. stem)'	(v7 vs. v1; AV 20.136.5)
(f)	√tīṣkṇa	'sharp (cf. √tīkṣṇa, *id.*)'	(e5 vs. 0)
(g)	√pr̥gṇa	'unite (pass. part.)'	(v1 vs. 0)
(h)	√r̥kṇa	'wound (pass. part.)'	(b1 vs. 0)

(6) All cases in which (otherwise expected) post-plosive *nati* fails

(a)	pr√āpnV-	'attain (pres. stem)'	(v2 b62 u4 e510 vs. 0)
(b)	(√)X-√agni	'X-fire/Agni'	(v161 b195 u2 e104 vs. 0)
(c)	(√)X-√ghna	'X-killer'	(v27 b38 e379 vs. 0)
(d)	X-√bhagna	'preverb-break (pass. part.)'	(b1 e90 vs. 0)
(e)	d(a)u(ḥ)√ṣvápnya	'bad sleep'	(v35 b1 e12 vs. 0)
(f)	X-√ghna-	'preverb-kill (3pl forms)'	(v5 b14 vs. 0)
(g)	hári√knika	'bay-colored'	(v2 vs. 0)
(h)	páry√akna	'turned around'	(b2 vs. 0)
(i)	nir√vigna	'unshaken'	(e1 vs. 0)
(j)	vi√ṣkabhna	'fix (pres. stem.)'	(v1 vs. 0)
(k)	√kṣepnóḥ	'springing (gen. sg.)'	(v1 vs. 0)
(l)	√tr̥pnV-	'be satisfied (pres. stem)'	(v1 vs. v7; see (5))

(7) The root boundary condition cross-classifies these data almost perfectly (99.9%)

	nati applies	*nati* fails
√ intervenes	0	1,777
no √ intervenes	138	2

(8) The generalization is robust across all periods

(9) Only two exceptions in this corpus: one token of *kṣepnóḥ* (RV) and one of *tr̥pnu-* (AV) (against seven of *tr̥pṇu-*, including all six RV tokens)

(10) Yet previous accounts fail to express this generalization[11]

[11] E.g. Whitney (1889: §195a) is representative: "The immediate combination of **n** with a preceding guttural or labial seems in some cases to hinder the conversion to **ṇ**: thus, **vṛtraghnā́** etc., **kṣubhnāti**, **tṛpnoti** (but in Veda **tṛpṇu**), **kṣepnú**, **suṣumnā́**."

(11) When the target is not post-plosive, *nati* freely penetrates √

(12) E.g. a preverb normally triggers *nati* across √, e.g.

(a)	prā√hiṇot	'incited (3s)'	(e82 vs. 0)
(b)	pra√mīṇāti	'frustrates (3s)'	(b5 vs. 0)
(c)	pra√yāṇa	'setting out'	(v5 b1 e21 vs. 0)

But never if its target is post-plosive, e.g.

(d)	pr√āpnoti	'attains (3s)'	(v1 b21 u1 e183 vs. 0)
(e)	(abhi)pra√ghnanti	'kill (3pl)'	(v2 b2 vs. 0)
(f)	pra√bhagna	'broken'	(b1 e72 vs. 0)

(13) Similarly, *nati* usually applies across a compound (esp. in Vedic), e.g.

(a)	√vr̥tra√háṇa	'Vr̥tra-killing'	(v16 b2 e7 vs. 0)
(b)	√vīra√háṇa	'hero-killing'	(b1 e3 vs. 0)

But never if its target is post-plosive, e.g.

(c)	√vr̥tra√ghná	'Vr̥tra-killer'	(v6 b5 vs. 0)
(d)	√vīra√ghná	'hero-killer'	(v3 e23 vs. 0)

(14) Ryan (forthcoming) analyzes this as a GANG EFFECT: *nati* fails when constraints against post-plosive retroflexion and cross-√ spans are simultaneously violated, but not when either is individually violated

9.2 Pre-retroflex targets

(15) *nati* always applies to a pre-retroflex target within the stem-suffix complex, e.g.

(a)	√brāhmaṇéṣu	'Brahmins (loc. pl.)'	(v2 b1 e67 vs. 0)
(b)	√gr̥hṇīṣva	'grasp (2s imp.)'	(e15 vs. 0)
(c)	√kr̥ṇuṣvá	'do/make (2s imp.)'	(v26 b1 vs. 0)
(d)	√pr̥ṇakṣi	'unite (2s)'	(v8 b2 vs. 0)
(e)	√prāṇiṣu	'breathers (loc. pl.)'	(e7 vs. 0)
(f)	√purāṇa√rṣi	'ancient rishi'	(e6 vs. 0)
(g)	√ráṇiṣṭana	'rejoice (2pl aorist)'	(v1 vs. 0)
(h)	a√rāṇiṣuḥ	'rejoice (3pl aorist)'	(v1 vs. 0)

(16) But only rarely so (<5%) when the trigger is outside of √, e.g.

(a)	(vi)pra√naṣṭa-	'vanished (past pass. part.)'	(e91 vs. e9)
(b)	pra√naṣṭum	'to vanish (inf.)'	(0 vs. 0; MW: 659)
(c)	pra√naṅkṣyati	'will vanish (3s fut.)'	(0 vs. 0; Allen 1951: 946)
(d)	pra√nr̥t-	'dance forth'	(v1 e32 vs. 0)
(e)	pari√nr̥t-	'dance around'	(v3 e1 vs. 0)
(f)	pra√nard-	'roar'	(e1 vs. 0)
(g)	pra√nakṣ-	'approach'	(0 vs. 0; MW: 681)
(h)	pari√nakṣ-	'encompass'	(0 vs. 0; Macdonell 1910: §47)

(17) Once again, this is not because *nati* wouldn't otherwise cross √; cf.

(a)	pra√ṇaśyati	'vanishes (3s)'	(e53 vs. 0)
(b)	pra√ṇaśyanti	'vanish (3pl)'	(b2 e3 vs. 0)
(c)	pra√ṇāśinī	'destroyer (fem.)'	(e5 vs. 0)
(d)	prá√ṇak	'reach (aorist)'	(v4 b1 u1 vs. 0)
(e)	pra√ṇāśayet	'destroy (3s caus. opt.)'	(e2 vs. 0)
(f)	pra√ṇāśa	'disappearance'	(e17 vs. 0)

(18) Previous accounts mention exceptions such as *pranaṣṭa*, but fail to mention the crucial role of √[12]

(19) Ryan (forthcoming) analyzes this as a gang effect of OCP([retro]) and the penalty on cross-√ spans: Retroflexion must retract from a retroflex if √ intervenes

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(20) Summarizing, *nati* applies to an immediately post-plosive or pre-retroflex target, unless the trigger and target straddle a root boundary

[12]Even Allen (1951) implies that a following retroflex always blocks, ignoring the far more numerous cases of non-blocking, as in (15) (likewise Macdonell 1910, Hansson 2010, Graf 2010, Jardine 2014).

10 Some closing remarks on typology and history

(1) *nati* is said to be fairly unique in the world

- "In the context of the 120 or so long-distance assimilations surveyed here, [*nati*] stands out as a sore thumb, showing properties that are otherwise unattested in the database" (Hansson 2001: 81)
- *nati* is "knotty, naughty, and nutty" (Benjamin Fortson, p.c.)

(2) I've argued that all of its properties are phonetically sensible. If so, why are similar harmonies so rare?

(3) Not an issue of the requisite inventory being rare: Hundreds of languages have the necessary phones.

(4) Within South Asia

(a) In archaic Dravidian, rhotics don't induce retroflexion on following nasals (not even as a statistical tendency, judging by Old Tamil)

(b) Arsenault's (2012) survey of retroflex harmony in South Asia gives only a handful of cases that I take to be in any way reminiscent, viz.

(i) **Kalasha**: retroflexion optionally spreads bidirectionally across vowels, e.g.

1. /aˇŋgu/ [aˇŋguˇ] 'finger'
2. /sirãˇ/ [siˇrãˇ] 'wind'
3. /aˇin/ [aˇiˇɳ] 'millet' (only attested case of a nasal undergoing)

(ii) **Sherpa**: progressive retroflexion, e.g.

1. /ʈi-ni/ [ʈi-ɳi] 'having asked'
2. /rul/ [ɻul] 'snake'
3. /ʈi-tu/ [ʈi-ʈu] 'ask (interrogative)'

(iii) **Burushaski**: progressive retroflexion triggered only by continuants (but only evident for the non-past suffix, tentatively /-tʃ/ here), e.g.

1. /ʂi-tʃ/ [ʂi-ʈʂ] 'eat (non-past)'
2. /giɻ-tʃ/ [gi-ʈʂ] 'enter (non-past)'
3. /gaʈ-tʃ/ [gaʈ-itʃ] 'bite (non-past)'

(5) Outside of South Asia

(a) Kinyarwanda (above) seems closest, but it's regressive and only triggered and targeted by sibilants

(b) 'Typical' Australian inventory has the right sounds (viz. ɾ∼r, ɻ, n, ɳ); I checked ten grammars (including lexicons) and found nothing[13]

(c) Rhotics are famously metathesizable (e.g. Malinaltepec Tlapanec; Suárez 1983)

[13]Except one isolated example in Gooniyandi: *gardngin-rooni* → *gardngoondoorni* (McGregor 1990: 102).

(d) For a rhotic to induce retroflexion on an immediately following segment is fairly common (e.g. Swedish, Norwegian, Pashto, Hebridean English; Cathcart 2012)

(6) Within Old Indic

(a) *nati* is trivially post-IIr (unlike, say, *ruki*)

(b) No reason to suppose it was present in the Ur-RV (Deshpande 1993: §8)

(c) But in the surviving (Śākalya) recension of the RV, it's at its most productive in all of Old Indic, often crossing compounds and (less often) word boundaries

(d) Signs of decline by Epic (still prescriptively required, but, e.g., less common across compounds and preverbs)

(e) Lost in most if not all Middle Indic

- sometimes due to the lack of a supporting inventory
- often retained in lexemes due to inheritance, but apparently unproductive (e.g. Pāli *karaṇaṃ*, *pariṇata*, etc., but *aparena*, *kenākārena*, etc.)

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