

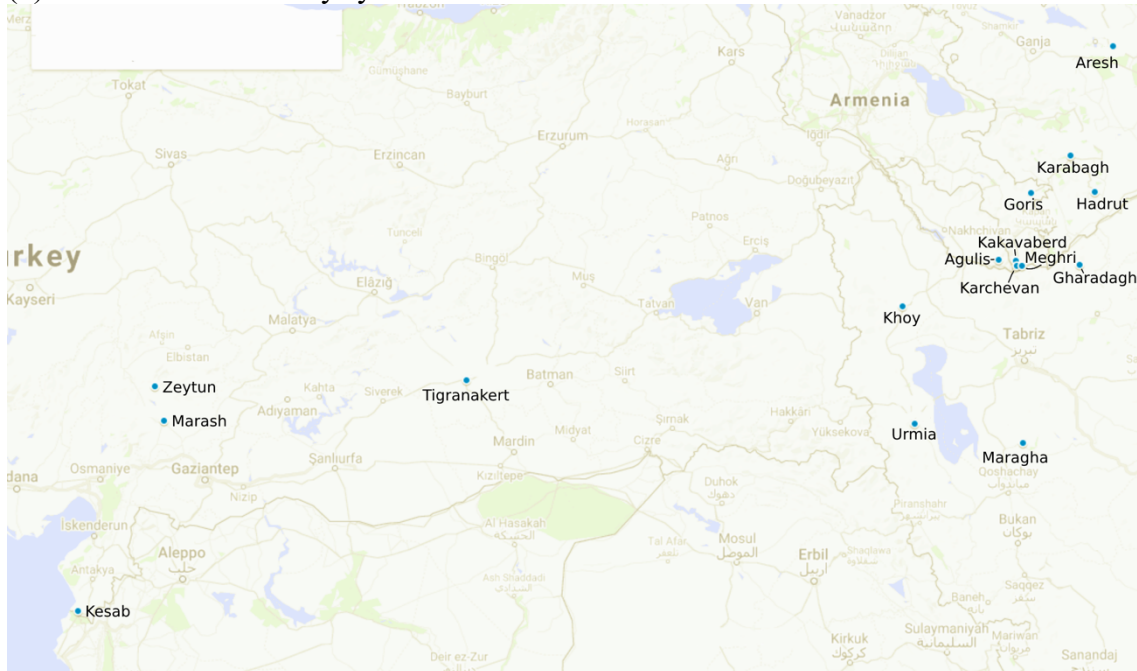
Vowel harmony in the Armenian dialect of Goris¹

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1. Introduction

Armenian (ISO arm, Indo-European) has two modern literary varieties (Standard Western Armenian, associated historically with Constantinople and the Ottoman Empire, and Standard Eastern Armenian, associated historically with Erevan and the Russian and Persian Empires), as well as some 120 non-standard varieties (Jahukyan 1972). The literary varieties do not possess synchronic harmony systems, but at least sixteen of the non-standard varieties do (Vaux 1998): Agulis, Aresh, Goris, Gharabagh, Gharadagh, Hadrut, Kakavaberd, Karchevan, Kesab, Khoy, Maragha, Marash, Meghri, Tigranakert, Urmia, and Zeytun. The development of harmony systems in Armenian dialects may be due in part to influence from neighboring Turkish and Azeri varieties (Sayeed and Vaux 2017, Scala 2018).

(1) dialects with harmony systems



All such systems include back harmony; some (e.g. Goris, Maragha, Zeytun) have round harmony as well.

In this article we outline the harmony system of the Goris dialect as described by Margaryan (1975, to which all page citations here refer), which illustrates many of the characteristic features of Armenian harmony systems. (For treatments of harmony systems in other varieties of Armenian see Baghramyan 1964, Khach‘atryan 2006, Vaux 1995, 1996, 1998, 2008. See also Mik‘ayelyan 1980 for more recent analysis of a variety of Goris dialect with front and back harmonic variants corresponding to Margaryan’s neutral vowels.) Because these facts are largely unavailable to those who cannot read Armenian, we focus on the empirical patterns, paying particular attention to phenomena of theoretical interest. Where possible we employ theory-neutral terminology and highlight exceptional behaviors.

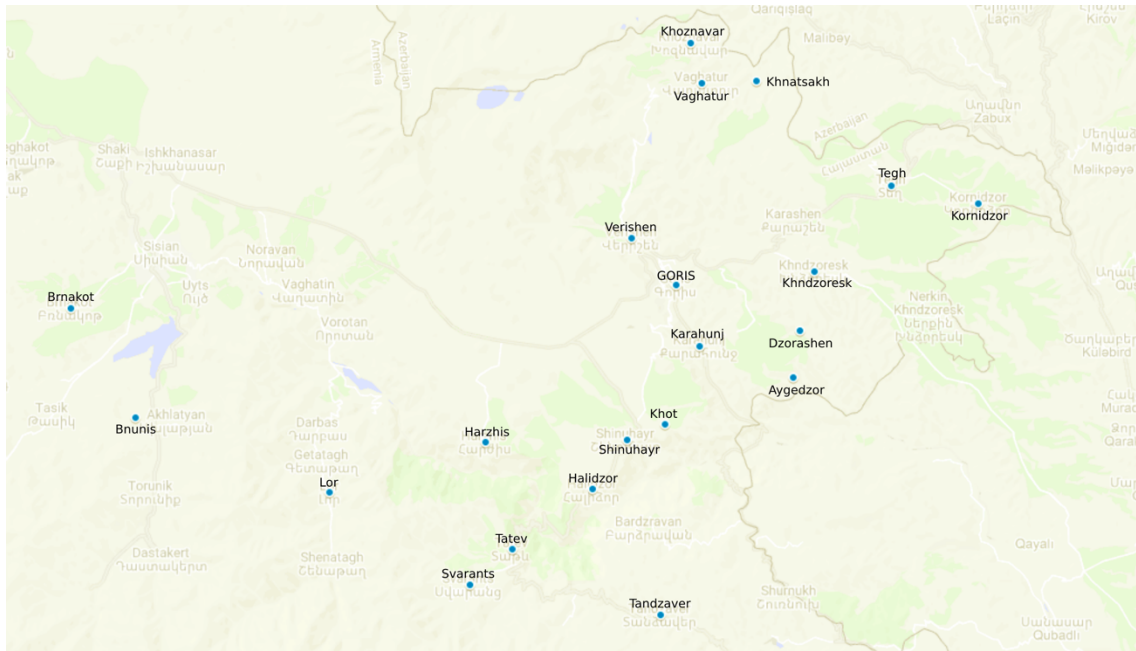
¹ A significantly shorter version of this article appears in the *Oxford Handbook of Vowel Harmony*. A = Arabic, Arm = Armenian, Az = Azeri, G = Goris, P = Persian, R = Russian, T = Turkish.

Goris harmony displays a number of interesting features. We find intricate variation in the patterning of neutral vowels, e.g. variability in transparency and opacity (Sect. 5). Weak vowels exhibit a distinct locally optional bidirectional harmony pattern, with [round] harmony parasitic on [back] harmony (Sect. 6). Furthermore, we find complex ordering interactions between vowel harmony and processes such as Vowel Reduction and Epenthesis (Sect. 7).

2. Overview of the Goris dialect

The dialect is spoken in the town of Goris and neighboring villages in southern Armenia.

(2) locations where Goris dialect is spoken (Margaryan 1975:10-11)



Goris possesses the nine vowel phonemes in (3):

(3) Goris vowels

	[-back]		[+back]	
	[-round]	[+round]	[-round]	[+round]
[+high]	i	y	ə ²	u
[-high, -low]	e	ø		o
[+low]	æ		ɑ	

In our analysis the dialect also possesses four underlying archiphonemic vowels, [+low] /A/, [+round, -high] /O/, and [+round, +high] /U/.

The processes in (4) will be relevant throughout our discussion.

² We follow Armenological practice in rendering this vowel as ə, but place it in the cell for u as it patterns phonologically with the [+high] vowels.

(4) relevant processes

- i. Epenthesis (E):** In general, onset clusters, final C+sonorant clusters, and sometimes initial rhotics trigger insertion of [ə]. We refer to the vowels produced by Epenthesis and Vowel Reduction (see (iii) below), along with unstressed lexical /ə/, as “weak vowels”, and to all other vowels as “strong vowels”.
- ii. Stress Assignment (SA):** Stress is assigned to the penultimate strong vowel if not followed by an epenthetic vowel in the next syllable, otherwise to the final strong vowel (cf. Vaux 1998:141-144). Schwa is not stressed unless a word contains no strong vowels.³
- iii. Vowel Reduction (VR):** Pre-tonic vowels tend to become [+high]: /a æ e o ø/ → ə i i u y. Vowels that have raised in this way may undergo further unrounding (u y → ə i) and centralization (i → ə). Weak vowels may optionally undergo Weak Vowel Harmony (Sect. 6).
- iv. Vowel Deletion (VD):** Under certain conditions, including prevocally in polysyllabic words not ending in u/y, vowels may delete. (See (11) for examples and Vaux 1998:148-9 and Dolatian 2019 for more detailed discussion.)

Goris Back Harmony requires vowels within the harmonic domain to agree in backness; it consists of Stem Harmony (Sect. 3), Suffix/Enclitic Harmony (SEH; Sect. 4, 6.1, (21)), and Weak Back Harmony (WBH; Sect. 6, (33)). Collectively, these divide the vowel inventory into three classes (5):

(5) harmonic classes

- | | |
|------------|-------|
| a. [+back] | a o u |
| b. [-back] | æ ø y |
| c. neutral | i e ə |

Unlike harmonic vowels (5a-b), neutral vowels (5c) generally do not display harmonic alternations; their behaviour is further discussed in Sect. 5.

3. Stem harmony

Native stems are normally harmonic: all vowels in a stem are either back (5a) or front (5b), though neutral vowels (5c) can co-occur with both back and front vowels. In the first three pages of Margaryan’s glossary (pp311-313), 109 of the 118 non-compound forms (92%) are harmonic. For comparison, Harrison, Dras, and Kapicioglu (2002) report that 75% of contemporary Turkish roots are harmonic.

Disharmonic native stems exist, e.g. ælur ‘flour’ (p311), ապրբ ‘fountain’ (p312), zænk^hoɟ^h ‘wife’s mother’ (p318). Disharmony is more common in loans, e.g. A-P azān > æz:an ‘islamic call to prayer’ (p502), P āsmān > asmæn ‘sky’ (p504), Az görä > gjøra

³ Turkic loans, e.g. alabalæb ‘trout’ (p502) < Azeri alabalıq, may be exceptions to this rule, though this is unfortunately not possible to determine from the unaccented forms provided by Margaryan. Note that other Armenian dialects do allow Turkic schwas to be stressed, e.g. Agulis məftələki ‘praise.GEN/DAT’ (Acharean 1935) < Azeri mıştılığ ‘praise’; Maragha badzə ‘sister’ (Davt’yan 1966:500) < Azeri bacı, ɟ^harbaə ‘shoelace’ (ibid.:485; compare Azeri ayaqqabı bağı).

‘according to’ (p508), R⁴ *plastinka* [plɛ'sitʲinkə] > pɛlastinkæ ‘(phonograph) record’ (p556). Margaryan’s glossary of c. 1800 loanwords contains instances of all combinations of front and back vowels except for {o...y} and {ø...u}.

4. Suffix/Enclitic Harmony

Harmonizing vowels in suffixes and enclitics may alternate for backness due to SEH. SEH obligatorily spreads contrastive [back] values rightwards within the harmonic domain, which we identify with the Clitic Group (Vaux 1998) or recursive Prosodic Word (Dolatian 2021a): root + suffixes + enclitics (see sections 4.1 and 4.3 for further details). As in Hungarian, prefixes and compound lexical components normally form independent harmonic domains (Törkenczy 2011). Consonants generally neither block nor initiate harmony, and are transparent to it.

Suffixes and enclitics can contain harmonizing vowels, represented as /A/ [ɑ ~ æ], /O/ [o ~ ø], and /U/ [u ~ y]. The data in (6) show how the [back] values of the /A O U/ archiphonemes are controlled by the preceding vowel. The neutral vowels /i e ə/ also occur in suffixes and clitics, but normally do not alternate. Their behaviour with respect to SEH is too complex to summarize here. For now, suffice it to say that /e/ is generally opaque, and following harmonic vowels surface as [+back]. Harmonic vowels following /i/ and /ə/ usually surface as [-back] and [+back] respectively. However, we find instances of transparency, where [back] appears to spread across intervening neutral vowels. These issues are discussed in more detail in Sect. 5.

(6) Suffix harmony (the shaded cells are accidental gaps in Margaryan 1975)

Final V	Suffix V	INS /-Av/	LOC /-Um/	GEN/DAT.PL /-Ots ^h /
[+back]	[+back]	t ^h umb-av 'dam'	t ^h umb-um 'dam'	t ^h ut ^h v-ots ^h 'acid'
		tsov-av 'sea'	tsov-um 'sea'	mokn-ots ^h 'mouse'
		art-av 'field'	art-um 'field'	ʃamb-ots ^h 'cane field'
[-back]	[-back]	pærts ^h -æv 'pillow'	pærts ^h -ym 'pillow'	ʃinæts ^h -øts ^h 'villager'
		ʃør-æv 'clothes'	ʃør-ym 'clothes'	(no ø forms given)
		tsyn-æv 'snow'	tsyn-ym 'snow'	lyzv-øts ^h 'tongue'

⁴ Some Russian loans show stem harmony: *čemodan* [tɕɛimə'dan] 'suitcase' > tɕ^hamadan (p554), *košel'jok* [kəʃi'l'jək] 'purse' > kəʃil'jək (p519), *kostjum* [kɔ'stʲum] 'costume' > kəstym (p519).

Neutral	[+back]	kʲet-av 'river'	kʲet-um 'river'	(no e forms given)
	[-back]	kʲind-æv 'earring'	kʲind-ym 'earring'	kʰjɪtʰ-øtʰ 'nose'
	[+back]	(no ə forms given)		tekʰər-øtʰ 'husband's brother'

SEH applies left-to-right, as suggested by two facts. First, prefixes and proclitics generally do not participate in SEH (4.3). Second, we find forms like /tes-Ats=i/ 'I would have seen' → [tesətʰi] (p224), where preceding /e/ does not spread its non-contrastive [-back] value; /A/ is then assigned [+back] via default rule (5.2.1). If SEH were able to apply right-to-left, we might expect the unvalued /A/ to harmonize with following [i], giving *[tesətsi].

4.1 Distribution of harmonic suffixes and enclitics

All suffixes containing harmonic vowels appear to be able to alternate. Sequences of root + multiple suffixes also undergo SEH (7):

(7) SEH with suffix sequences

a. AOR /-Atʰ-/ + 1SG.AOR /-A/ (p188)

mur-atʰ-a 'I forgot'

tʰyl-ætʰ-æ 'I allowed'

b. ABSTR /-OtʰUn⁵/ + INS /-Av/ (p135)

məts-utʰun-av 'by size'

pitsʰr-ytʰyn-æv 'by height'

Compounds, as in (8), are formed by concatenating two stems with a linking vowel (or connective) /-A-/, as in Standard Eastern and Western Armenian (Donabédian 2004). Dolatian 2021b argues that in the standard lects this linking vowel is a Prosodic Word-internal suffix that forms part of the morphological stem; the same can be safely assumed for Goris.

(8) connective /-A-/

yrygyn 'evening' + A + dem 'face' → yrygyn-æ-dem 'dusk' (279)

αβ 'salt' + A + tʰyr 'water' → əβ-a-tʰyr 'salt water' (312)

Most enclitics contain neutral vowels and therefore do not undergo SEH (9a-c). Those that do contain harmonic vowels alternate for backness (9d).

(9) harmonic and disharmonic enclitics

a. 1SG.PRS COP/AUX /=e-m/ (p190)

kantʰum=e-m 'I call'

kʰjɪnym=e-m 'I go'

b. 1SG.IPFV COP/AUX /=i/ (p190)

kantʰum=i 'I was calling'

⁵ Note that /O/ undergoes VR here.

- k^hiny^m=i ‘I was going’
 c. DEF.ART /=n/⁶ (p272)
 t^hot^h=ə ‘the mulberry’
 tsø^r=ə ‘the valley’
 d. 3SG.PRS COP/AUX /=A/
 χos-um=ɑ ‘speaks’ (p270)
 k^hyn-ym=æ ‘goes’ (p282)

The morphosyntax of Goris (and Armenian generally) can assemble a harmonic root + derivational suffix + inflectional suffix + enclitic sequence, e.g. notional /pæ^rt^s^hr-Ot^hUn-Av=A/ ‘high-ABSTR-INS=is’ → [pɪt^s^hryt^hynævæ] ‘it is by height’. No such forms happen to be provided by Margaryan.

4.2 Antiharmonic stems

Some stems with final [-back] vowels exceptionally select the [+back] variant of harmonic suffixes (10):⁷

(10) antiharmonic roots

UR	Surface form	gloss	source
/k ^j ø ^r (:)-Al/	k ^j ø ^r (:)al	rumble	p177
/tø ^ɤ -Al/	tø ^ɤ al	tremble	
/k ^j y ^r ynk ^h -AnAl/	k ^j y ^r ynk ^h anal	become spring	
/k(j)y ^ɤ -AnAl/	k(j)y ^ɤ anal	rob	
/k(j)y ^ɤ -Ot ^h Un/	k(j)y ^ɤ ot ^h un ~ k(j)y ^ɤ ø ^t hyn	theft	p320

For examples of these harmonic suffixes harmonizing as expected with harmonic stems, cf. e.g. /dindʒ-Ot^hUn/ ‘rest-ABSTR’ → [dindʒøt^hyn] (15), /je^f-Al/ ‘look-PST.PPL’ → [je^fæl] (21a).

We also find stems ending in [-back] vowels that surface with the [+back] variant of harmonic suffixes due to VD (4iv) preceding SEH, as in (11).

⁶ For the conditions under which the definite article surfaces as [n] vs. [ə] vs. [ən] see Vaux 1998 ch. 3.

⁷ These are not to be confused with *disharmonic* stems, which contain a mix of both [+back] and [-back] non-neutral vowels (5). The behaviour of disharmonic stems in SEH is somewhat unclear; many suffixed forms undergo neutralising vowel reduction, e.g. /dæl:ək-Ot^hUn/ ‘barber-abstract.noun’ → [dɪl:ikot^hun] ‘barbering’ (p244). Margaryan provides a single example which may illustrate SEH with a disharmonic stem: /ar^zabær-Um=n/ ‘Arzabär-LOC-DEF’ → ar^zabæ^rymə, suggesting that in such forms the closest harmonic vowel determines the backness value of the suffix, in line with most understandings of phonological locality.

(11) VD precedes SEH

/ʃori-OtAnk^h/ ‘mule-PL’ → ʃərotank^h (p122)

/hərsanik^h-Av/ ‘wedding-INS’ → hərsank^hav (p295)

(12) Derivation with VD preceding SEH

UR	/ʃori-OtAnk ^h /	/hərsanik ^h -Av/	Notes
VD	ʃor-OtAnk ^h	hərsank ^h -Av	
SEH	ʃorotank ^h	hərsank ^h -av	
SR	[ʃərotank ^h]	[hərsank ^h av]	For /ʃori-/, VR applies to underlying /o/ at some point in the derivation.

The inverse ordering SEH > VD, shown in (13), produces incorrect results: the suffix vowels harmonize with the final /i/ of the stem, and are expected to surface as [-back].

(13) counterfactual derivation with SEH preceding VD

UR	/ʃori-OtAnk ^h /	/hərsanik ^h -Av/	Notes
SEH	ʃori-ətänk ^h	hərsanik ^h -æv	
VD	ʃorətänk ^h	hərsank ^h -æv	
SR	*[ʃərotänk ^h]	*[hərsank ^h æv]	For /ʃori-/, VR applies to underlying /o/ at some point in the derivation.

4.3. Harmony in prefixes and proclitics

We find only one example of harmony spreading to a prefix. The privative prefix is usually invariant [ən]-, but Margaryan gives two exceptional cases of loan stems with [æn-]: sæs (p536) → æ(n)sæs ‘silent’ (p376) (Az säs ‘sound’), dærd (p509) → ændærd ‘having no pain’ (p375) (P dard ‘pain’).

Prefix vowels derived via epenthesis can undergo Weak Vowel Harmony (Sect. 6), but only in the future prefix /k-/ (k-aseṃ ‘I will say’, kə-χosam ‘I will speak’, kə-kḷirem ~ ki-kḷirem ‘I will write’, kə-suvori ~ ku-suvori ‘I will study’, kə-kḷyβana ~ ky-kḷyβana ‘s/he will steal’ (pp198-199).

All other prefixes and proclitics contain only neutral vowels and do not harmonize. The evidence for harmony in prefixes and proclitics is therefore ambiguous; in the few cases that do show harmony, this behaves quite distinctly from SEH.

4.4. Productivity

Harmony applies productively in loan suffixes. Of the four borrowed from Turkic, two undergo SEH (14a-b). The other two differ from Turkish and Azeri, but pattern with native Goris /i/, in not alternating harmonically (14c-d).

(14) harmonic alternations in suffixes of Turkic origin

a. Plural /-lAr/ with collectives and plural family names (pp268-269)

αα-lar ‘the Aghas’ : χilø-lær ~ χylø-lær ‘the Khilos’

b. Appertinative /-lU/ (p269)

æmæl-ly ‘trifling’ : kʲøɤ-ly ~ kʲøɤ-lu ‘hidden’ (p422)

c. Agentive /-ʃʰi/ (p268)

tʰalan-ʃʰi ‘robber’ : ʒeʃtæn-ʃʰi ‘jester’

d. Ordinal /-indʒi/ (p269)

erku-indʒi ‘second’, otʰ-indʒi ‘eighth’, mæn-indʒi ‘first’

Harmony applies productively to loan stems, which participate in SEH in the same manner as native forms, in both derivation (15) and inflection (16).

(15) loan stems with native abstract nominalizer suffix /-OtʰUn/ (p244)

Final V	Stem	Derived form ⁸	Source
[-back]	dindʒ	dindʒotʰyn ‘peacefulness’	T-Az dinc ‘peaceful’
	dyz	dyzotʰyn ‘correctness’	T düz ‘correct’
	nøkʰær	nykʰyrøtʰyn ‘servitude’	P naukar ‘servant’
	dʒæhil	dʒihiløtʰyn ‘youth’	A-P jāhil ‘ignorant’
[+back]	dæl:ak	dil:ikotʰun ‘barbering’	A-P dallāk ‘barber’
	haram	hærəmotʰun ‘dirtiness’	A-T haram ‘dirty’
	ʃʰiban	ʃʰəbunotʰun ~ ʃʰubunotʰun ‘boilness’	Az çiban ‘boil (n)’

(16) loan stems with inflectional affixes (pp272, 293)

Final V	UR	Inflected form	Source
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⁸ Note that derived forms can undergo VR (4iii) and Weak Vowel Harmony (Sect. 7).

[+back]	/lot ^h ka-Av/	lut ^h kav ⁹ 'boat-INS'	R lodka [ˈlotkə] 'boat'
[-back]	/kænts ^h ilær-Um=n/	kænts ^h ilærymə 'office-LOC-DEF'	R kancel'arija [kənts ^h iˈlærɨjə] 'office'

Epenthetic vowels in loanwords can undergo back and round harmony (section 6; (33-34)): R bljudo [ˈblʲudə] 'dish' > bylyd (p546), R gruz [grus] 'cargo' > guruz ~ gəruz (p546).¹⁰

5. Neutral vowels

The neutral vowels /i e ə/ share two key properties: they do not alternate in suffixes or clitics, and they can be tautomorphic with [+back] and [-back] harmonic vowels. The first property can be seen for the genitive/dative and plural (17) and the causative infinitive (18).¹¹

(17) Invariant /i e/ in suffixes (pp129, 298)

Final V	Stem	GEN/DAT /-i/	PL /-er/	gloss
[+back]	art	arti	arter	field
	tsov	tsovi	tsover	sea
	t ^h umb	t ^h umbi	t ^h umber	dam
[-back]	pærts ^h	pærts ^h i	pærts ^h er	pillow
	ʃør	ʃøri	ʃører	clothes
	tsyn	tsyni	tsyner	snow
neutral	kiet	kieti	kjeter	river
	kjind	kjindi	kjinder	earring
	sert ¹²	særte ¹³	særter	heart

⁹ The [a] in this form is part of the suffix, rather than the root; cf. forms such as /hili-Av/ 'mirror-INS' → [hilæv] (140) and /k^hæt^hæ-Um/ 'cake-LOC' → [k^hit^hym] (137), all of which show that stem-final [-round] vowels delete before vowel-initial inflectional suffixes.

¹⁰ Of the main donor languages, only Russian contains roots with the requisite consonant clusters for epenthesis (and thus Weak Vowel Harmony).

¹¹ Neutral vowels are invariant in enclitics (4.1, (9a-c)).

¹² Underlying /e/ reduces to ə in the genitive and plural forms. In either case, we would usually expect the [+back] alternant if the suffix vowel were harmonic.

¹³ By virtue of being stressed, historical -i normally becomes -e in forms of this sort, independent of the workings of vowel harmony.

(18) Invariant underlying /ə/ in suffixes (p206)

Final V	causative infinitive /-əʦ ^h -ən-e-l/	gloss
[+back]	mut-əʦ ^h ənel	make approach
[-back]	lys-əʦ ^h ənel	illuminate
neutral	ləs-əʦ ^h ənel	make listen
	hiʃt-əʦ ^h ənel	make easy

The schwas in the causative /-əʦ^h-ən-e-l/ are analysed as underlying; if they were epenthetic, we would expect Epenthesis (4i) to produce at most one schwa, e.g. */lys-ʦ^h-n-e-l/ → *[lysəʦ^hənel] or *[lyʃʦ^hənel].

The second property of neutral vowels, the ability to occur freely with tautomorphemic [+back] and [-back] harmonic vowels, is exemplified in (19).

(19) neutral vowels can occur before and after [±back] vowels

	V	Environment (co-occurs with)	Examples
a.	/i/	[+back] vowel	korindʒ ‘seed’ (p339) dirdotvel ‘suffer’ (p510) pərikam ‘friend’ (p317)
		[-back] vowel	pilør ‘all’ (p318) kiøti ‘belt’ (p321) ærin ‘blood’ (p315) irik ^h næk ‘sun’ (p315)
b.	/e/	[+back] vowel	/korindʒ-Aven/ → kurindʒaven ‘little seed’ (p395)
		[-back] vowel	pembæk ‘cotton’ (p240) /irgin-Aven/ → irginæven ‘a little long’ (p395)
c.		[+back] vowel	dərnæk ‘hoof’ (p509) dəmæzlæk ‘lineage’ (p508)
		[-back] vowel	gilənærnə ‘cherry’ (p507)

5.1. Neutral vowels in SEH

Despite the above similarities, each neutral vowel behaves differently with respect to SEH. Underlying /i/ is normally followed by front vowels (20a), whereas underlying /e/

and /ə/ are normally followed by back vowels (20b-c).¹⁴ The more complex behavior of [i] and [ə] derived via VR is covered in section 7.

(20) harmonizing vowels after neutral vowels

	V	following V	Examples
a.	/i/	[-back]	/pir-Aɬs/ ‘bear-PST.PTCP’ → [piræɬs] (p195) /dindʒ-Ot ^h Un/ ‘rest-ABSTR’ → [dindʒøt ^h yn] (p510) /tʃ ^h im-Unk ^h / ‘DEF.PRN-PL’ → [tʃ ^h imynk ^h] (p167)
b.	/e/	[+back]	/tes-Aɬs/ ‘see-PST.PTCP’ → [tesəɬs] (p195) /jek-Oɤ/ ‘come-PRS.PTCP’ → [jekoɤ] (p267) /hinger-Unk ^h / ‘friend-PL’ → [hing ^h erunk ^h] (p122)
c. 15	/ə/	[+back]	/dəngəl-Aven/ ‘crazy-SIM’ → [dəngələven] (p509) /dəngəl-Ot ^h Un/ ‘crazy-ABSTR’ → [dəngəlɔt ^h un] (p509)
	[ə]		/sks-Um/ ‘begin-IPFV.PPL’ → [əskəsʊm] (p290)

Each of the above generalizations has a limited number of exceptions (21).

(21) exceptions to the normal behavior of neutral vowels

a. /e/

i. some morphemes surface as [-back] after /e/:

/-Ot^hUn/: lerp^høt^hyn ‘impudence’ (p330)

ii. some /e/-roots select [-back] suffixes:

/jef-/: /jef-Um/ ‘look-IPFV.PPL’ → [jefym] (p125)

/jef-Aɬ/ ‘look-PST.PPL’ → [jefæɬ] (p186)

/eʃ/: /eʃ-Av=n/ ‘donkey-INS=DEF’ → [eʃævə] (p289)

/ver-/: /ver-Av/ ‘which.one-INS’ → [veræv] (p165)¹⁶

b. /i/

some roots select [+back] suffixes:

/im-A-n-A-l/ ‘know-INF’ → [imanal] (p328)

/indʒ-An-Av/ (1SG-OBL-INS) ‘by me’ → [indʒanav] (p159)

/tsi-Ank^h/ ‘horse-PL’ → [tsijank^h] (p123), /tsi-Av/ ‘horse-INS’ → [tsijav] (p131)¹⁷

/t^hi-Ank^h/ ‘shovel-PL’ → [t^hijank^h] (p123)

c. /ə/¹⁸

i. some morphemes surface as [-back] after [ə]:

¹⁴ Note that in neighboring Azeri, which has the same nine-vowel system as Goris and likely played an indirect role in the development of its harmony system, one finds [-back] vowels after /e/, e.g. ev-lär ‘house-PL’.

¹⁵ /ə/ refers to underlying lexical schwa and [ə] to epenthetic schwa.

¹⁶ But Margaryan gives the plural ‘which ones’ as /ver-Unk^h/ → verunk^h, not *verynk^h.

¹⁷ Margaryan gives ABL /tsi-A(n)/ → [tsijæn] (p272) ~ [tsijan] (p131); it is possible that this reflects (sub)dialectal variation.

¹⁸ In both cases, [ə] is epenthetic and not preceded/derived from underlying [-back] vowels; this rules out the possible factors of [ə] being transparent and issues arising from process ordering.

/k^h-n-A-t^h-i-nk^h/ ‘go.AOR1PL’ → [k^hənæts^hink^h] (p290) (but the more normal form appears to be [k^hiənæts^hink^h] (p192))

ii. some morphemes surface as optionally [+back] or [-back] after [ə]:

/ls-O_B-Ot^hUn/ (listen-SBJV.PPL-ABSTR) ‘hearing’ → [ləsɔ_But^hun] ~ [ləsɔ_Byt^hyn] (p330)

The behavior of /i/ and /ə/ vs. /e/ suggests that Goris Back Harmony operates on (pairwise) contrastive [back] values. The phoneme inventory in (3) yields the system of minimal [back] contrasts in (22):

(22) minimal contrasts for [back]

[-back]	[+back]
æ	ɑ
i	ə
ø	o
y	u
<i>e: not contrastive</i>	

Suffix/Enclitic Harmony can be formulated as in (23):

(23) *Suffix/Enclitic Harmony (SEH)*: Spread contrastive [back] values iteratively rightwards within a Prosodic Word to vowels lacking a [back] specification.

This formulation correctly predicts /æ i ø y/ to condition [-back] and /ɑ ə o u/ to condition [+back] in neighboring alternating vowels. By contrast, harmonizing vowels following /e/ do not receive its [-back] value, because it is not contrastive. The same holds if the stem does not contain any vowels, e.g. /mn-A-t^h-i/ ‘I stayed’ → [mənɑts^hi] (p186).¹⁹ If we assume that harmonizing vowels are underlyingly unspecified for [back], they fail to obtain a [back] value via SEH in such cases; at the end of the derivation, [+back] is then assigned by redundancy rule.

5.2 Opacity and transparency

Given the proposed role of contrast in SEH, we might expect /e/ but not /i ə/ to be transparent to propagation of [back] values. The facts are more complex: while there are instances of transparent /e/, it is usually opaque and neutral. Likewise, while most /i ə/ are opaque and active, there are possible cases of transparency. We consider each neutral vowel in turn.

¹⁹ A reviewer points out that it should also be possible for the epenthetic schwa to condition [+back] harmony, e.g. (20c). Under the assumption that Epenthesis feeds SEH, this is indeed the case. However, the precise ordering of Epenthesis and SEH is somewhat unclear, as we discuss in Sect. 5.2.3 (32). Some evidence favours the ordering SEH > E, but some forms suggest E > SEH.

5.2.1 /e/

/e/ generally appears to be opaque and inert: it blocks propagation of [-back] from a preceding vowel to a following harmonizing vowel, which then surfaces as [+back] (24):

(24) /e/ is opaque and inert

a. /y...e/

/tsyn-er-Av/ 'snow-PL-INS' → [tsynerav] (p129) (cf. SG.INS [tsynæv])

/yʃyntʰ-ner-Av/ 'curse-PL-INS' → [yʃyntʰnerav]

b. /i...e/

/kind-er-Av/ 'earring-PL-INS' → [k'inderav] (p130) (cf. SG.INS [kiindæv])

/hinʃʰ-er-A=n/ 'what-PL-ABL=DEF' → [hinʃʰeran]

There are, however, instances where /e/ appears to act transparently (25).²⁰

(25) transparent /e/

/læv-er-A=n/ 'good-PL-ABL=DEF' → [liveræn] (p151) (cf. [hinʃʰeran] (24b))

/peræn-ner-Av=s/ 'mouth-PL-INS=1POSS' → [perin:erævəs] (p309)

/in-el-Av/ 'be-PPL-INS' → [inelæv] (p293)

According to (23), we expect /e/ to not spread its own [-back] value, but also to block propagation of [-back] from the root vowel to the suffixal /A/.

The final case of apparent /e/-transparency is more systematic. The future participle for certain conjugations is formed by adding /-elU/ to the verb stem. Given (24), we should expect this to surface as [-elu], regardless of the [back] value of the final stem vowel: /e/ should block propagation of [±back] from the stem to /U/, and /U/ should receive [+back] by default. Instead, we find numerous future participles where stems ending in [-back] vowels take [-ely] (26).

(26) possible transparent /e/ in future participles

[pizinely] 'apportion' (p181)

[inely] 'be' (p229)

[jifely] 'remember' (p190)

One interpretation of these examples in isolation would be that /e/ spreads its own [-back] value. However, when /-elU/ follows [+back] stem vowels it surfaces as [-elu] (27), suggesting that /e/ does *not* spread [-back]:

(27) future participles after [+back] vowels

[kəntʰelu] 'call' (p190)

[pʰuxelu] 'change' (p181)

Taken together, (26-27) suggest that /e/ is transparent to SEH in certain idiosyncratic cases. (The fact that some i-verbs select -elu rather than -ely, in contrast to the forms in (26), suggests that we are in fact dealing with idiosyncrasy. See for example /pir-elU e-m/ 'carry-fut.ppl be-1sg' → [pirelu vem] 'I will carry' (278).)

²⁰ One might analyse Goris as having two underlying /e/, one transparent and the other opaque and inert. However, both the opaque and transparent instances of /e/ occur with the same suffix, pl /-er/; this makes a multiple-/e/ analysis unlikely, unless we are willing to postulate two surface-identical allomorphs of the plural suffix.

5.2.2 /i/

We might expect /i/ to be opaque since it is contrastive for [back] and able to spread its own [-back] value. This expectation is consistent with what we find in most cases (28); for example, if /i/ were transparent in /ɑχʃ^hik=A/ (28a) we would expect stem-initial [ɑ] to spread [+back] through /i/ to the clitic, producing *ɑχʃ^hik=a.

(28) examples of opaque and active /i/

a. root + enclitic copula /=A/

ɑχʃ^hik=æ ‘she is a girl’ (p235)

pepik=æ ‘he/she/it is barefoot’ (p272)

b. infinitive + past participle /-Aɬs/

vendilæɬs [meaning unknown] (p272)

c. infinitive + instrumental /-Av/

/kart^h-il-Av=s/ ‘read-INF-INS=1.POSS’ → [kərt^hilævəs] (p174)

However, there are some examples of [i] being transparent. The future participle /-elU/, already discussed in 5.2.1, optionally surfaces with initial [i] upon undergoing VR (29):

(29) apparent transparency of [i] in future participle /-elU/

/t^hχ-elU/ ‘bake’ → [t^həχelU] ~ [t^həχilU] (p181)

/kant^h-elU/ ‘call’ → [kənt^helU] ~ [kənt^hilU] (p190)

The pattern in (29) suggests, in combination with (26) and (27), that the first vowel of the future participle suffix /-elU/, regardless of whether it surfaces as [e] or [i], is transparent to SEH.

There are a number of other instances where /i/ appears to be transparent (30):

(30) assorted transparent /i/

a. /korindz-Aven/ (seed-SIM) → [kurindzaven] ‘like a seed’ (p263)

b. /jegekets^hi=n=A/ (church=DEF=is) → [jegekets^hina] ‘it is the church’ (p273)

c. /vɑrib-Ot^hUn/ ‘emigration’ → [vɑribot^hun] ~ [væribøt^hyn] (p523)²¹

The form in (30a) has base by-forms in both [e] and [i]: korindz ~ korendz (p339). If the [i] form is derived (by VR) from underlying /e/, the seeming transparency can be accounted for if we assume that SEH is counterfed by VR. We return to this possibility in 7.2.

However, this ordering analysis will not extend to the loans in (30b-c), jegekets^hi ‘church’ (p323; Standard Eastern Armenian jekekets^hi) and vɑrib (A-P għarīb ‘foreigner’), where there is no evidence for the final [i] being anything other than /i/ underlyingly. We may therefore want to consider the possibility that roots are able to bear unpredictable specifications for harmonic features in their lexical entries, similar to Clements and Sezer’s (1982) analysis of Turkish disharmony.²²

The evidence for transparency vs. opacity of /i/ is therefore mixed. It is possible that this variation in behavior is similar to that documented in Finnish and Hungarian

²¹ Note that /ɑ/ alternates with /æ/ in this stem, possibly due to Stem Harmony (Sect. 3), so there may be two distinct URs. Regardless, /i/ seems to be transparent in both stem forms.

²² Another possibility is a lexical diacritic marking the relevant roots as exempt from SEH (cf. Kiparsky 1982:129).

(Anttila 2018), but it is difficult to draw conclusions before properly controlled study of the systems of individual Goris speakers is carried out.

5.2.3 /ə/

As with *e* and *i*, the evidence for transparency of *ə* is mixed. Lexical /ə/ is generally opaque, triggering [+back] harmony, as seen in (31) for the causative /-əts^hən-/:

(31) underlying /ə/ is opaque

/dyz-əts^hən-Um/ (correct-CAUS-IPFV.PPL) → [dizits^hənum]²³ ‘correct something’ (p280)

/li-t^həts^hən-Um/ (full-CAUS-IPFV.PPL) → [lits^həts^hənum] ‘fill’ (p180)

However, epenthetic [ə] patterns somewhat distinctly. The forms in (32a) show the [-back] value of the root vowel propagating to the /A/ of the enclitic copula, across epenthetic [ə]. By contrast, the forms in (32b) appear to show [ə] behaving opaquely.

(32) transparency vs. opacity with epenthetic [ə] in the definite article /=n/

a. /hyr=n=A/ (whose=DEF=is) → [hyrənə] ‘is whose’ (p279)

/lys=n=A/ (light=DEF=is) → [lysənə] ‘is the light’ (p293)

/p^his=n=A/ (bad=DEF=is) → [p^hisənə] ‘is bad’ (p235)

/læv=n=A/ (good=DEF=is) → [lævənə] ‘is good’

b. /k^hu pæn=t=A/ (your thing=2POSS=is) → [k^hu pænətə] ‘it’s your thing’ (p293)

/min=n=A/ (one=DEF=is) → [minənə] ‘it is one’ (p275)

One might be inclined to account for the forms in (32a) by ordering Epenthesis after SEH. However, word-internal epenthetic vowels can undergo both back and round harmony. We therefore assume that Goris possesses separate processes governing vowel harmony in weak vowels, one which optionally propagates the feature [back] and one which propagates [round]; these are discussed in further detail in section 6. This analysis does not account for the contrast with (32b); it is possible that these forms come from idiolects (or subdialects) that order E before SEH.

In summary, schwa seems to be opaque in cases where ordering interactions are irrelevant, e.g. when it is underlyingly present. All cases of apparent transparency have possible explanations in terms of rule ordering, e.g. SEH preceding E in (32a). There are also apparent cases of transparent schwa derived from VR, discussed in sect. 7.

6. Schwa and Weak Vowel Harmony

Like most Armenian dialects Goris exhibits widespread vowel epenthesis (cf. (4i)), e.g. /mexr/ ‘honey’ → [mexər] ~ [mexrə] (p348), P rang ‘color’ → G [əræŋ] (p513). There are at least two reasons to think that the schwas in such forms are epenthetic rather than underlying. First, they can be unstressed in positions where one would expect them to be stressed, e.g. brinj ‘rice’ > pərindz ~ pirindz (p26); by SA (4ii) we would expect *pírindz if the first *i* were underlying rather than the product of epenthesis followed by harmony. Secondly, the location of epenthetic [ə] can vary within a given lexical item,

²³ Note how underlying /ə/ (the first vowel of the causative) → [i], potentially constituting a counterexample to the idea that [ə] is neutral and invariant in suffixes. However, it is more likely that this is a case of WBH (33). Like WBH (and unlike SEH), this /ə/-fronting is optional; the other /ə/ fails to become [i], and /ə/ remains invariant in forms like [lits^həts^hənum].

as seen with ‘honey’. Further arguments for most Armenian schwas being epenthetic are presented in Vaux 1998, chapter 3.

Unstressed schwas and reduced vowels (henceforth weak vowels) may undergo Weak Back Harmony (33) and Parasitic Weak Round Harmony (34):

(33) *Weak Back Harmony (WBH)*: a medial [+high] weak vowel optionally receives its [back] specification from a vowel in an adjacent syllable within the same Lexical Word (root + affixes, excluding clitics).

(34) *Parasitic Weak Round Harmony (PRH)*: a vowel that has undergone WBH can optionally receive its [round] specification from the same vowel that provided its [back] value.

WBH and PRH, which (like SEH) are sensitive only to contrastive specifications for the relevant harmonic features (cf. Calabrese 1995, Nevins 2010), together account for the facts in (35).

(35) harmonic alternations with epenthetic vowels

	neighbor	epenthetic vowel	Classical spelling	Goris	gloss	source
i.	ɑ	[ə]	draxt	təɾɑχt(ə)	paradise	322
ii.	ə		cungn	tsongəɾə	knee	335
iii.	e		amaɾn	ɑmer(n)ə	summer	312
iv.	o	[ə] ~ [u]	(R stolb) nōsr	əstolba ~ ustolba nosrə ~ nosur	pillar thin	548 353
v.	u	[ə] ~ [u]	aławneak	jəʁunik ~ juʁunik	young pigeon	312
vi.	y	[ə]~[i]~[y]	brut	pəryt ~ piryt ~ pyryt	potter	318
vii.	ø	[ə]~[i]~[y]	xnjor	χəndzər ~ χindzər ~ χyndzər	apple	332
viii.	æ	[ə] ~ [i]	džuar	təzær ~ tizær	difficult	322
ix.	i	[ə] ~ [i]	brinj	pəɾindz ~ pirindz	rice	318

Unlike SEH, WBH/PRH are bidirectional, e.g. L→R in (35iv) nosur and R→L in (35vii) χəndzər ~ χindzər ~ χyndzər. We have not found cases of an epenthetic vowel located between vowels of opposite harmonic polarity (e.g. hypothetical æCəCə) that would reveal whether the left neighbor or the right neighbor of an epenthetic vowel has priority in determining its harmonic value.

Examples like (35vii) show that WBH and PRH are optional. Furthermore, this optionality is calculated locally, as seen from forms containing multiple weak vowels (here derived via VR rather than E): /ært^hær + Ot^hUn/ → irt^hirøt^hyn ~ irt^hyrøt^hyn ‘justice’ (p324). Not every weak vowel in the word must undergo each process; if optionality were calculated on a global basis, we would expect all weak vowels to be affected identically by WBH/PRH: irt^hirøt^hyn ~ yrt^hyrøt^hyn but not *irt^hyrøt^hyn.

WBH and PRH are subject to positional requirements: the epenthetic vowel cannot be word-initial or final, and must be within the same Lexical Word as the donor vowel. These restrictions capture the generalization that epenthetic vowels at word edges are invariably [ə], regardless of the neighboring vowels. Contrast for example k^(l)ærnə ‘lamb’ and əræng ‘color’ (35viii) with tizær (35viii). The variants nosrə ~ nosur (35iv) illustrate the edge constraint particularly clearly. Likewise, the epenthetic schwa of the enclitic definite article does not alternate despite being in the same Phonological Word (e.g. /lys=n=A/ → [lysənæ] in (32)) because it is not in the same Lexical Word.

We have found only three exceptions to this generalization: /stibel/ ‘to force’ → [əstibel] ~ [istibel] (p364), R stolb ‘pillar’ > [əstolba] ~ [ustolba] (p548) and T ruz > əruz ~ uruz ‘daily sustenance’ (p538).

PRH is parasitic on WBH: spreading of [round] to a weak vowel entails spreading of contrastive [back], but not the reverse. It is possible to have forms like /χndzør/ → [χindzør] with spreading of [-back] and not [+round], but not /plyr/ → *[pulyr], where the epenthetic vowel has received [+round] but not [-back] from the following vowel. (Compare Kaun 2004 on the idea that rounding harmony tends to be parasitic on some sort of tongue body harmony).

7. Process interactions

In this chapter we have identified a variety of phonological processes relevant to the description of vowel harmony in Goris (36):

(36) relevant phonological processes (see (4) for formulations)

- a. Stress Assignment
- b. Epenthesis
- c. Vowel Reduction
- d. Vowel Deletion
- e. Suffix/Enclitic Harmony ((23), section 4)
- f. Weak Back Harmony and Parasitic Weak Round Harmony ((33-34), section 6)

Trivially, Stress Assignment precedes VR; E precedes WBH/PRH. The interaction between E and SEH was discussed in 5.2.3, with ambiguous results; the ordering VD > SEH was covered in 4.2. This leaves us with the ordering of VR vs. WBH/PRH, and of VR vs. SEH.

7.1. Vowel Reduction vs. Weak Vowel Harmony

That VR precedes WBH/PRH is suggested by forms like /nøk^hær-Ot^hUn/ → [nyk^hyrøt^hyn] (15), where underlying /æ/ must raise to [i] before it can undergo rounding. The necessary ordering is depicted in (37).

(37) derivation of [nyk^hyrøt^hyn] with VR >> WBH/PRH

	/nøk ^h æɾ-Ot ^h Un/	Notes
VR	nyk ^h ir-Ot ^h Un	Underlying /æ/ raises to [i]; /ø/ raises to [y].
WBH/PRH	nyk ^h yr-Ot ^h Un	Derived [i] undergoes rounding.
SEH	nyk ^h yr-øt ^h yn	
SR	[nyk ^h yrøt ^h yn]	

The inverse ordering WBH/PRH >> VR, as shown in (38), yields incorrect results.²⁴

(38) derivation of *[nyk^hirøt^hyn] with WBH/PRH >> VR

	/nøk ^h æɾ-Ot ^h Un/	Notes
WBH/PRH	nøk ^h æɾ-Ot ^h Un	No weak vowels; rule applies vacuously.
VR	nyk ^h ir-Ot ^h Un	/æ/ raises to [i], /ø/ raises to [y].
SEH	nyk ^h ir-øt ^h yn	
SR	*[nyk ^h irøt ^h yn]	

7.2. Vowel Reduction vs. Suffix/Enclitic Harmony

For VR vs. SEH, the key diagnostics are cases where VR changes the [back] value of a potential harmony trigger. Consider the raising of /e/ to [i] by VR. If VR precedes SEH, we expect derived [i] to be followed by [-back] vowels; if SEH precedes VR, we expect [+back] alternants in these environments. There is evidence for each ordering (39).

(39) VR vs. SEH

a. VR precedes SEH

/mef^h-Um=n/ ‘inside-LOC=DEF’ → [mit^hymə] (p231)

/k^harɔʃen-Av/ ‘Karashen-INS’ → [k^harɔʃinæv] (p141)

/p^hed-A-n-A-l/ ‘wood-become’ → [p^hidænæɪ] (p177) ~ [p^hədɑnɪ] (p369)

/hers-Ot/ ‘anger-ADJ’ → [hersot] ~ [hirsøt] ‘irascible’ (p521)

b. SEH precedes VR

/t^hit^hev-Ot^hUn/ ‘lightness’ → [t^hit^hivot^hun] (p326)

/ært^hæɾ-Ot^hUn/ ‘right-ABSTR’ → [irt^hyrøt^hyn] ~ [ært^hərøt^hyn] (p315)

/dæl:ak-Ot^hUn/ ‘barber-ABSTR’ → [dil:ikot^hun] ‘barbering’ (pp244, 510)²⁵

²⁴ This assumes that WBH/PRH apply only once in the derivation; should both rules apply cyclically, then we might expect nyk^hirøt^hyn → nyk^hyrøt^hyn to be possible. However, we do not have sufficient evidence to argue either for or against this possibility.

²⁵ This form suggests that the optionality of VR (like WBH/PRH: section 7) is calculated locally, in that vowels may be reduced to varying degrees even in the same word. In this case, the [-back] value of /æ/ must not be deleted by VR, so that it can surface as [i] and to spread [-back] to the following /a/ (which presumably reduces to [ə], then undergoes WBH, becoming [i]).

/tʰχ-elU/ ‘incubate-FUT.PPL’ → [tʰəχelu] ~ [tʰəχilu] (p181)
 /æχpyr-Otʰ-A=n/ ‘fountain-OBL.PL-ABL=DEF’ → [əχpərøtʰæn] (p291)
 /dʒih-Um=A/ ‘meets’ → [dʒəhymæ] ~ [dʒyhymæ] (pp291, 292)
 /hindz-Oɤ/ ‘reap-PRS.PPL’ → [həndzøɤ] (p290)²⁶

The data in (39a) present two arguments for VR >> SEH:

(40) Forms that require VR >> SEH

VR >> SEH	/kʰarɑfɛn-Av/	Notes	/pʰed-A-n-A-l/	Notes
VR	kʰarɑfɛn-Av	In all forms, VR feeds SEH by raising inert /e/ → [i], which then spreads [-back].	pʰid-A-n-A-l ~ pʰəd-A-n-A-l	Outcome of SEH depends on whether VR produces a [-back] or [+back] vowel.
SEH	kʰarɑfɛn-æv		pʰid-æ-n-æ-l ~ pʰəd-a-n-a-l	
SR	[kʰarɑfɛnæv]		[pʰidænæl] ~ [pʰədɑnəl]	

However, data from (39b) suggest the opposite ordering:

(41) Forms that require SEH >> VR

SEH >> VR	/tʰitʰev-OtʰUn/	Notes	/æχpyr-Otʰ-A=n/	Notes
SEH	/tʰitʰev-otʰun/	SEH counterfered by VR.	æχpyr-øtʰ-æ=n	SEH counterbled by VR.
VR	tʰitʰiv-otʰun		əχpər-øtʰ-æ=n	
SR	[tʰitʰivotʰun]		[əχpərøtʰæn]	

In sum, we appear to have evidence for the ordering arguments in (42):

(42) summary of ordering arguments

- a. SA >> VR, SA is cyclic VR crucially refers to stress; reduced vowels that have undergone WBH/PRH can optionally receive stress.
- b. E, VR >> WBH, PRH Many instances of WBH and PRH require the prior presence of epenthetic/reduced vowels.
- c. VD >> SEH /tʰori-OtAnkʰ/ → [tʰərotankʰ] (11)
- d. VR vs SEH VR>>SEH: /hers-Ot/ → [hersot] ~ [hirsøt] (39a)
SEH>>VR: /tʰitʰev-OtʰUn/ → [tʰitʰivotʰun] (39b)
- e. E vs SEH SEH>>E: /pʰis=n=A/ → [pʰisənæ] (32a)
E>>SEH: /min=n=A/ → [minənɑ] (32b)

²⁶ The infinitive is həndzel ~ hindzel (344), suggesting that the underlying form of the verb root may be /hindz/-, which then optionally undergoes VR.

8. Summary

The Goris dialect of Armenian exhibits rightward Suffix/Enclitic Harmony, which propagates contrastive [back] values to suffixes, connectives, and enclitics. Weak vowels not located at word edges are optionally subject to bidirectional [back] and [round] harmony.

We have identified a number of interesting properties of the Goris harmony system. (i) SEH and WBH/PRH seem to obey distinct locality domains: SEH applies within Prosodic Words (Root-Suffix-Enclitic), while WBH/PRH occurs in the Lexical Word (Prefix-Root-Suffix, excluding clitics). This poses questions for morphosyntax-phonology interactions: can the differences be captured in a Direct Reference approach (e.g. Samuels 2011), or is a more articulated theory of prosodic constituency required? Furthermore, the exceptionality of word-initial/final weak vowels, which almost never undergo WBH/PRH, requires explanation. Similar patterns are attested in some Turkic languages; cf. Uyghur *kulup* ‘club’ (R klub) vs. *isport* ‘sports’ (R sport), Tomski (R Tomsk) (Hahn 1991:87).

(ii) Optionality and variation are present throughout the system. WBH/PRH show local optionality, which has implications for local vs global models of phonological computation (cf. Riggle and Wilson 2005). The neutral vowels /i e ə/ show variability in transparency and opacity, which are problematic under most accounts. The neutral vowel /e/ is particularly problematic: while it is usually opaque and inert (24), there are cases where it seems to be transparent (25-27), and even examples of it being opaque and active (21a). While two-way contrasts in neutral behavior are attested (e.g. Uyghur transparent and opaque+active /i/, Vaux 2000), Goris is unusual in displaying this three-way contrast.

(iii) The processes of Vowel Reduction and Epenthesis show complex ordering interactions with SEH; both orderings seem to be required (40-41). Again, this raises issues of variability, either within or across individuals²⁷; for example, individual speakers may entertain different rule orderings.

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²⁷ Margaryan does not specify whether these variable outputs are from the same speakers.

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