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Labiovelar loss and the rounding of syllabic liquids in Indo-Iranian

John Clayton | ORCID: 0000-0002-0967-4197
University of California, Los Angeles, CA, USA
john.clayton.v@gmail.com

Abstract

This paper analyzes and supports the claim that Vedic Sanskrit preserves traces of the contrast between the Indo-European labiovelars and plain velars—a striking archaism in the Indo-Iranian family, which otherwise collapsed the two velar series. These labiovelar vestiges emerge because of the pervasive labialization of syllabic and consonantal rhotics at all attested stages of the Indo-Iranian family. Two rhotic labialization environments are examined in Indo-Aryan and Iranian: after labial(ized) consonants or before syllables containing *u* or *w*. Furthermore, this paper explains the unexpected development of bimoraic Proto-Indo-European $*\underset{\circ}{L}_{\mu}H_{\mu}.C$ to trimoraic Vedic $\bar{U}_{\mu\mu}r_{\mu}.C$ by examining the phonetic characteristics of the labializable Indo-Iranian rhotics.

Keywords

diachronic phonology – syllabic liquids – labiovelars – labialization – Indo-Iranian – Vedic Sanskrit

1 Introduction

Since Burrow (1957), the question has remained unresolved whether traces of the labiovelar series, $*K^{w}$, were retained in the outcomes of the Proto-Indo-European (PIE) $*K^{w}\underset{\circ}{L}H$[1] as Sanskrit *Kŭr*. Because Indo-Iranian shows uniform

1 The cover symbols are: *C* = any consonant; *T* = any obstruent; *V* = any vowel; *R* = any sonorant consonant; *L* = liquids (*r*, *l*); *H* = any laryngeal; *U* = any high vowel (*ĭ*, *ŭ*); *W* = any glide (*y*, *w*);

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satəm outcomes of inherited velar series (i.e., the PIE labiovelars merged exceptionlessly into the plain velars), only the anaptyxis of rounded vowels in **K^{w}ḷH* sequences enabled evidence of labiovelars to survive during the prehistory of Proto-Indo-Iranian (PIIr.). Under this view, Sanskrit and Proto-Indo-Iranian stand among the handful of PIE branches which retained (partially conditioned) reflexes of all three of the PIE velar series, alongside Albanian (Pedersen 1900; Orel 2000: 66–74 with refs.), Armenian (Stempel 1994), and Anatolian (Melchert 1987 & 2012). In this paper, I will reexamine the conditioned effects of PIE labiovelars on **-ḷH-*; specifically, I will argue that:

(1) a. The distinct reflexes of labiovelars appear only in closed-syllable **K^{w}ḷH.C-* sequences.
b. Adjacent rounded segments cause rounding of **ḷ*(*H*) not only in Vedic (Ved.) but also in Iranian.
c. The rounding of liquids provides insights not only into the chronology of **ḷ*(*H*) anaptyxis but also into the phonetics of **r̥* in Proto-Indo-Iranian.

This discussion will primarily concern the effects of various rounded segments on **ḷ* and anaptyctic **ə*.

1.1 *Previous discussion of* *ḶH

Beginning with the Indian grammarians, the problem of Ved. *Ǔr* vocalism has received a great deal of scrutiny without being solved. Pāṇini (7.1.100–103) already recognized that a root-final *-r̥̄-* produced *-ŭr-* when preceded by a labial consonant (e.g., √*pr̥̄-* 'to fill' → *pūrṇá-* 'full') and *-ǔr-* otherwise (e.g., √*str̥̄-* 'to scatter' → *stīrṇá-* 'scattered') though he noted the situation in Vedic was less predictable. The early Indo-Europeanists (Pott 1833: 51; Bopp 1871: 229–230*) adopted Pāṇini's findings and further attempted to explain the distribution of *Ǔr* sequences through regressive vowel assimilation in words like *gir-í-* 'mountain' and *gur-ú-* 'heavy' (Benfrey 1860: 87; Schleicher 1861: 17–20; Bartholomae 1885). This era of inquiry culminated in the compendious investigation of *Ǔr* forms by Wackernagel (1896: 22–31), who accepted Pāṇini's idea of a preceding labial producing *ŭr*, but he adduced several examples of *ŭ* vocalism unexplained by or contradicting previous accounts (e.g., *kūrmá-* 'tortoise', *jūryati* 'makes old', *táturi-* 'conquering'). These exceptions convinced him that the distribution of Ved. *Ǔr* remained unclear and partially contingent on dialect.

P = any labial consonant (*w*/*v*, *p*, *b*, etc.), *K* = any plain velar, *Ḱ* = any palatal velar, *K^{w}* = any labiovelar, *F* = any fricative.

The next major proposal came with the expansion of Pāṇini's $\sqrt{P\underset{\circ}{r}\text{-}} \rightarrow P\breve{u}r$- rule to include originally labiovelar-initial roots, $\sqrt{{}^{*}K^{w}\underset{\circ}{r}\text{-}}$. In an attempt to explain why $\sqrt{g\underset{\circ}{r}\text{-}}$ 'to welcome; proclaim' shows both *ĭ*- and *ŭ*-vocalism (3SG.AOR. MID.INJ *prá gūrta*, PPP *gūrtá*, root noun *gír*-, GD *-gíryā* (B)), Burrow (1957) proposed dividing the forms along semantic grounds, deriving *gŭr*- 'to welcome' from a labiovelar-initial root and *gĭr*- 'to sing' from a plain velar-initial root. Though Burrow's semantic differentiations were rightly rejected by Gotō (1987: 155) and Mayrhofer (1992: 468–469), the idea of labiovelars rounding the following vowel in ${}^{*}K^{w}\underset{\circ}{L}H$ became part of the doxa.[2,3]

Since Burrow, much of the research around ${}^{*}\underset{\circ}{L}H$ in Indo-Iranian has concerned the lengthening behavior of the laryngeal on the preceding vowel. While it has long been recognized that ${}^{*}\underset{\circ}{L}.HV$ > Ved. *U.rV* (${}^{*}g^{w}\underset{\circ}{r}h_{2}$-*ú*- > *gurú*- 'heavy') and ${}^{*}\underset{\circ}{L}H.C$ > Ved. *ŪrC* (${}^{*}p\underset{\circ}{l}h_{1}$-*nó*- > *pūrṇá*- 'full'), Lubotsky (1997 & 1998) argued that ${}^{*}C\underset{\circ}{L}HWV$ showed variable length in the new *CŬr* sequence based on accentuation: when ${}^{*}\underset{\circ}{L}$ was accented, the anaptyctic vowel was long (${}^{*}g^{w}\acute{\underset{\circ}{r}}h_{x}$-*yeh*$_{1}$ > GD °*gū́ryā* 'praising'); otherwise the anaptyctic vowel was short (*g*^{w}*e*-*g*$^{w}\underset{\circ}{r}h_{x}$-*yéh*$_{1}$-*t* > 3SG.PRF.ACT.OPT *juguryā́t* 'praise'). He accounts for this situation by proposing a PIIr. sound change ${}^{*}C\underset{\circ}{r}H.W\acute{V}$ > ${}^{*}C\underset{\circ}{r}.HU.(W)\acute{V}$ > Ved. *CUrWV́*.[4] The fact that this and other sound changes occurred at a (pre-)PIIr. stage shall become important in the present paper's analyses.

Though Lubotsky's theories do not directly concern the traces of ${}^{*}K^{w}$, he summarizes the two environments for Ved. *ŭr* adduced in the preceding literature; his rules are represented in (2).

(2) ${}^{*}\underset{\circ}{L}H$ > Ved. *ŭr* / $\left\{ \begin{array}{l} P__ \\ __\{w, u\} \end{array} \right.$ (Lubotsky 1997: 139[2])

Deviations from this distribution are of analogical origin: for instance, the vocalism of the prf. ptc. *titirvā́ṃs*- is due to the perfect stem *ti-tir*- (cf. 3PL *titiruḥ*), that of *tū́rya* is due to the present *tū́rvati*, etc. Synchronically, we

2 Mayrhofer (1986: 104–105 & 144–145); Szemerényi (1996: 66); Fortson (2010: 212); Kobayashi (2017: 327).

3 Szemerényi (1964: 201[3]) protested that he had shown previously in two unpublished presentations in 1948 and 1952 that Sanskrit *ŭr* preserved traces of the labiovelars. When Szemerényi corresponded with Burrow about the lack of acknowledgment, Burrow lamented that Szemerényi had not published his finding so Burrow could recall and cite the details.

4 As Anthony Yates suggested to me, it would also be conceivable to syllabify the laryngeal into the following syllable on the basis of the first round of syllabification before the deletion of unstressed vowels per Byrd (2015: 167–177): PIE ${}^{**}[CeL][HW\acute{V}]$ > ${}^{*}[C\underset{\circ}{L}][HW\acute{V}]$ > PIIr. *Cər.WV́* > Ved. *CUr.WV́*.

> have to do with two roots: *tar-*/*tir-* 'to cross' and *tūr(v)-* 'to overcome', and the choice between *ur*/*ūr* and *ir*/*īr* in the derivatives is generally dependent on the meaning. (Lubotsky 1997: 139[2])

His explanation above follows Burrow (1957: 141–142), who similarly explains the differing vocalism between RV and AV of $\sqrt{j\mathring{r}}$- 'to grow old' (3SG.PRS.ACT.IND *jī́ryati* (AV) vs. *jū́ryati* (RV), PPP *jīrṇá-* (AV) vs. *jūrṇá-* (RV)) as a product of conflation with $\sqrt{jūrv}$- 'to wear down'—though both come from formations *$ǵ\acute{r}h_2$-ye-ti* and *$ǵ\acute{r}h_2$-w-e-ti* to *$ǵerh_2$-* 'to wear down; to make old' (Rix & Kümmel 2001: 165–166). Further apparent counterexamples to (2) will be discussed in Section 2.

Using similar 'labial' environments to Lubotsky's theory in (2), Cantera (2001) argues that in Iranian unaccented *$\mathring{r}H$ > *$ər$ instead of the expected *ar (e.g., *$p\mathring{l}h_1$-nó-* > Av. *pərᵊna-* 'full', not ×*parᵊna-*; *(w)$\mathring{r}h_xd^h$-wó-* > Av. *ərᵊδβa-* 'upright', not ×*arᵊδβa-*). The environments of Cantera's Proto-Iranian (PIr.) rule in (3) differ crucially in two ways from those in (2): only *w is allowed to cause the regressive effect (not *u) but it may apply across intervening consonants.

(3) Cantera (2001: 16):
*$\mathring{L}H$ > PIr. *$ər$ / $\begin{cases} P__ \\ __C_0w \end{cases}$

Despite their slightly different formulations and very different diachronic stages, Lubotsky and Cantera's proposals are very similar in two respects: they both concern the development of *$\mathring{L}H$ in Indo-Iranian and they both share roughly the same set of environments (following a labial consonant or preceding a syllable containing a *w or *u). For this reason, I will propose the following rules for evaluating whether *$K^w\mathring{L}H$ shows consistent *ŭr* outcomes in Ved.:

(4) Vedic *ŭr* distribution rules:
a. *$\mathring{L}H$ > Ved. *ŭr* / $\begin{cases} \{P, K^w?\}__ \\ __C_0\{w, u?\} \end{cases}$
b. Roots that show both *ĭr* and *ŭr* forms may generalize one vocalism on the basis of semantics or dialect.

1.2 *Structure of this paper*

The remainder of this paper will have the following structure. Section 2 examines the Vedic evidence for the distribution of *(C)ĭr* and *(C)ŭr* < *(C)$\mathring{L}H$* to determine whether the heuristics proposed in (4) can account for the data. I will argue that in the limited environment of closed-syllable *$K^w\mathring{L}H.C$* sequences,

labiovelars do reliably provide rounded *KūrC* outcomes. Section 3 presents new evidence of similar rounding effects on **L̥(H)* by adjacent rounded segments in various Iranian languages. This is taken as evidence for an Indo-Iranian-wide phonetic rule which resulted in rounded vowels separately in most daughter languages. Section 4 will develop a more detailed chronology of the development of **L̥H* in PIIr. to account for the rounding effects of pre-PIIr. **Kʷ* on the pre-**L* anaptyctic vowel found throughout Indo-Iranian. Section 5 concludes.

2 The evidence for the rounding of **L̥H* in Vedic

The environments proposed in (4a) may be broken into four distinct subenvironments:

(5) a. Labial-initial (**PL̥H*)
b. Followed by **w* (**L̥HC₀w*)
c. Followed by **u* (**L̥HC₀u*)
d. Labiovelar-initial (**Kʷ L̥H*)

Before evaluating the more elusive environment (5d) in section 2.5, it is necessary to examine the other environments to remove all confounding examples. Accordingly, the evidence for these environments will be treated in sections 2.1–2.3. Before proceeding, however, Wackernagel (1896: 28–29) provides several examples of unexpected *ŭr* vocalism or *ĭr*~*ŭr* alternations, which get their *ŭr* vocalism from sources other than **L̥H* (to these, I have added further non-probative examples):[5]

(6) *ur* from inherited PIE **ur*:
a. *híruk* 'off; away': associated with forms *hurúk* 'apart', *huraḥ* 'secretly'. Apparently a dissimilation, *híruk* < **húruk*, from √*hvr̥-* 'go crookedly, deviate' < **ǵʰwer/l-* (Mayrhofer 1996: 817).

5 Some of Wackernagel's exceptional terms seem to show laryngeal-less **ur* sequences surfacing in Vedic as *ūr*, but Clayton (2022) has recently argued that all inherited sequences of **ur* lengthened to Ved. *ūr* in closed syllables, including the following mentioned by Wackernagel: **dʰur-tí-* > *dhūrtí-* 'harm', **mr̥ǵʰ-ur-tó-* 'briefness' > *muhūrtá-* 'moment', **surgʰ-se-te* > *mā sūrkṣata* 'do not worry'. This finding agrees with the explanation for **L̥H.C* > Ved. *Ūr.C* provided in Section 4. Wackernagel's other apparent exceptional terms remain without secure etymologies (with or without *L̥H*): *śúrpa-* 'winnowing basket' (Mayrhofer 1996: 651), *túrṇāśa-* 'waterfall?' (Mayrhofer 1992: 661).

(7) Probable Dravidian loanwords or non-inherited terms:
   a. *kūrcá-* '(grass) tuft': with onset voicing alternation in *guccha-* 'tuft' (Mayrhofer 1992: 386).
   b. $\sqrt{k\breve{u}rd\text{-}}$ 'to jump; to play': with onset voicing alternation in $\sqrt{g\breve{u}rd\text{-}}$ and $\sqrt{khurd\text{-}}$ beside Tamil *kuti*, Malayalam *kuti*, Kannada *gudi* 'to jump' (Burrow 1948: 375).
   c. *kŭrpāsa-* 'jacket; bodice': an Iranian borrowing (whence Gr. κυρβασία 'Persian bonnet') from Median borrowing from **kur-pāsya-* 'throat binding' (Hinz 1975: 154) or Southwest Old Persian **kr̥p-pāça-* < **kr̥p-pāϑra-* 'body protection' (Thieme 1937: 91; Mayrhofer 1956: 255)
   d. *kūrpara-* 'elbow': with varying vocalism and consonantism in *kaphaṇi-*, *kaphoṇi-*, *kuphaṇī-*, Pāl. *kappara-*, Prāk. *koppara-* (Mayrhofer 1956: 255).

With these forms eliminated, the remainder of this section will concern true examples of *L̥H* (non-)rounding.

2.1 *Vedic* ŭr *from* *PL̥H

The post-labial rounding environment **PL̥H* > *Pŭr*[6] in Ved. certainly owes its early recognition by Pāṇini to its exceptionless operation. Some representative examples of rounding are provided in (8). These forms contrast with the non-rounded forms in (9), which illustrate the unconditioned outcome of **L̥H* in Vedic.

(8) Rounding examples:
   a. *mūrdhán-* 'head' < **mḷh₃dʰ-ón-* (cf. Gr. βλωθρός 'grown high', OE *molda* 'upper part of the body')
   b. *pūrṇá-* 'full' < **pḷh₁-nó-* (cf. Lat. *plēnus*, Lith. *pìlnas* 'full')
   c. *ū́rṇā-* 'wool' < **h₂wl̥h₁-neh₂-* (cf. Hitt. *ḫulana-*, Lat. *lāna*, Lith. *vìlna* 'wool')
   d. *bhuránta* 'they dart' < **bʰr̥rhₓ-éntor* (cf. Hith. *parḫ-* 'to chase')

6 For this paper, I assume with Kobayashi (2004: 13 & 144–146) that PIE **L* became only **r* in Indo-Iranian. When using the symbol **L*, I give etymologies from a Proto-Indo-European or pre-Proto-Indo-Iranian perspective. Yet, there are some unexpected outcomes of **l̥H* > *ul* in otherwise unrounded environments (e.g., *tulā́-* 'scale, balance' < **tl̥h₂-éh₂-*, cf. MP ⟨tl'cwk'⟩ /tarāzūg/, Gr. τάλαντα 'scale, balance'; Mayrhofer 1992: 658–659). Until the conditions governing the distribution of *l*-ful terms in early Sanskrit are better understood, I treat the vocalism of these terms with caution.

(9) Non-rounding examples:
   a. *īrṣyá-* 'envy' < *$(h_1)\underline{r}h_x$*-s-yéh*$_2$- (cf. Hitt. *aršanēši* 'you envy')
   b. *dīrghá-* 'long' < *$d\underline{l}h_1g^hó$- (cf. OE *tulge* 'strongly', Lith. *ìlgas* 'long')
   c. *stīrṇá-* 'strewn' < *$st\underline{r}h_3$*-nó-* (cf. Gr. στρωτός, Lat. *strātus* 'spread')[7]
   d. *híraṇya-* 'gold' < *$\acute{g}^h\underline{l}h_3$*-en-yo-* (cf. OE *gold* 'gold', Gr. χλωρός 'bright green')

2.2 *Vedic* ŭr *from* *$\underline{L}HC_0w$

The case for rounding by a following **w* is somewhat more complex than for rounding from a preceding labial; not only is it unclear whether rounding occurs when a consonant intervenes between *$\underline{L}H$* and **w*, but also this environment is susceptible to leveling in a way in which *$P\underline{L}H$* avoids. For word-internal, non-alternating instances of *$\underline{L}Hw$*, however, *ŭr* appears uniformly, as shown in (10).

(10) Rounding examples:
   a. *urvárā* 'arable land' < *$h_2\underline{r}h_3$*-wér-eh*$_2$- (cf. Myc. ⟨a-ro-u-ra⟩, Gr. ἄρουρα 'acreage', MIr. *arbor* 'crops')
   b. *kulva-* 'bald' < *$k\underline{l}h_x$*-wó-* (cf. Lat. *calvus* 'bald', YAv. *kauruua-* 'thin-haired')
   c. *dŭ́rvā-* '*Cynodon dactylon*' < *$d\underline{r}h_x$*-weh*$_2$- (cf. Lith. *dirvà* 'field', MDu. *tarwe* 'wheat', Gr. δάρατος 'bread')

(11) Non-rounding examples:
   a. *īrmá-* 'arm' < *$h_2\underline{r}h_x$*-mó-* (cf. OE *earm* 'arm', Lat. *armus* 'forequarter')

Note on the other hand that the *-m-* in (11) does not trigger rounding, but the regular *ī* vocalism occurs.[8] Of the consonants with labial place of articulation,

7 It is hard to say what to do with the vocalism of the form *ni-ṣtúr-* 'throw down' (Aufrecht 1870: 205). Narten (1964: 278–279[881]) separates this root into *seṭ* ($\sqrt{st\underline{r}}$- < *$sterh_3$-) and *aniṭ* ($\sqrt{st\underline{r}}$- < *ster-*) forms. Given the related *aniṭ* adjective *á-niṣṭṛta-* 'not thrown down', one might expect the same here, but **ni-st\underline{ŕ}-* should give ×*ni-st\underline{ŕ}t-* (cf. °*k\underline{ŕ}t-*, °*bh\underline{ŕ}t-*). This could be interpreted as an extremely archaic reflex of **ni-st\underline{ŕ}-s*, which escaped the remodeling of syllabic-sonorant-final root nouns with *-t-* by analogy with the *-stŭr-* found elsewhere in the derivatives of the *seṭ* $\sqrt{st\underline{r}}$- (*stīrṇá-* 'strewn', *upa-stír-* 'ceiling', *vi-ṣṭír-* 'strewn asunder'). The existence of a third root variant **strew-* (cf. OHG *streuwen* 'strew'; Mayrhofer 1996: 755) could provide ** *ni-st\underline{ŕ}w-s* > **ni-stúr-s* > *ni-ṣṭúr**, but the absence of **strew-* elsewhere in Indo-Iranian leaves it doubtful. Scarlata (1999: 642–643) discusses the Padapāṭha analysis *niḥ-túr-* 'hinaus gelangend, überwindend' < **nis-t\underline{r}h$_2$-*, but the absence of other *niṣ-* + $\sqrt{t\underline{r}}$- collocations is not promising. If $\sqrt{t\underline{r}}$- is related, see section 2.2 for discussion of its vocalism.

8 To my knowledge, there are no other certain word-internal examples of *$\underline{L}H$* followed by a

it seems only a following **w* possesses a strong enough rounding cue to trigger *ū*-vocalism. Contrast the behavior of **w* with (8), where any preceding labial consonant triggered *u*-vocalism. This suggests that **w* (and perhaps **u*) had a [+ round] feature with an associated stronger rounding cue which was not shared by the labial stops.[9]

Some superficial exceptions to **Ḷ̊Hw* > *ŭrv* appear already in Wackernagel (1896: 29) as in *titirvā́ṃs-* 'having crossed, overcome' or the converse overapplication of rounding *jūryati* 'grows old'. Yet as mentioned in Section 1.1, the alternation between *ĭr* and *ŭr* in $\sqrt{t\bar{r}}$- and $\sqrt{j\bar{r}}$- stems from a conflation of the regular unrounded forms with rounded ones from the **-w-e-*presents *tū́rvati* 'overcomes' < **tŕ̥h₂-w-e-ti* and *jū́rvati* 'wears down' < **ǵr̥h₂-w-e-ti*. The fact that these two roots were already becoming confused in the RV indicates the extent to which the relationship between the rounding rules and the distribution of *Ŭr* forms had already become partially opaque by Vedic.[10] In the RV, the only other seeming counterexamples with *ĭrv* occur at transparent compound boundaries and were thus subject to leveling of their vocalism. On the one hand, *gír-*[11] 'praise' < **gʷŕ̥hₓ-* 'to praise; welcome' appears in *gír-vaṇas-* 'praise-desiring' and *gír-vāhas-* 'praise-conveyed'. Note here that we never find the phonologically expected long vowel in *×gī́r-C-* < **gʷŕ̥hₓ-C-*, indicating these compounds were synchronically formed.[12] On the other hand, *āśī́r-vant-* 'having admixtures (of milk for soma)' from **ḱerh₂-* 'to mix' (Mayrhofer 1996: 665–666) stands beside a well attested simplex *āśír-* 'admixture (of milk for soma)', whose vocalism would not be affected by the addition of the productive suffix *-vant-*.

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labial stop but not preceded by another labial. The terms *ūrmí-* 'wave' < **wḶ̊hₓ-mí-*, *sūrmí-* 'pipe' < *su-ūrmí-* '*curvature ⇐ *well-waved' < ?**h₁su-wl̥hₓ-mí-* (Mayrhofer 1996: 742), and *tuvi-kūrmí-* 'powerfully ranging' < **tuhₓ-i-kʷl̥hₓ-mí-* are discluded due to their preceding labial or labiovelar. The uncertainty about the character of the initial velar, **k⁽ʷ⁾*, in *kūrmá-* 'tortoise' < **k⁽ʷ⁾Ḷ̊H-mó-* also disqualifies it from the current discussion (Mayrhofer 1992: 386).

9 Alternatively, the effects of following **w* could be considered as a type of vowel harmony consistent with the traditional view that the Indo-European high vowels **i* and **u* were only allophones of underlying */y/ and */w/. Such an analysis would require a theory of how regressive rounding harmony interacted with the vocalization or non-vocalization of underlying glides, which exceeds the scope of this article.

10 For discussion concerning the non-original derivation of *jívri-* RV/*jírvi-* 'old, decrepit' from **ǵerh₂-* and concerning the distributions of *Ŭr* in $\sqrt{t\bar{r}}$- and $\sqrt{j\bar{r}}$-, see Pinault (1988). Stephanie Jamison (p.c. 21 July 2021) further mentions the view of Stanley Insler that the *tŭr-* forms of $\sqrt{t\bar{r}}$- were either partially influenced by or wholly imported from $\sqrt{tvr̥̆}$- 'to hurry, rush' < **twer-* (Mayrhofer 1992: 684–685; Clayton 2022).

11 For the vocalism of the root noun *gír-*, see Section 2.5.

12 Compare *pūr-bhíd-* 'destroying strongholds' < **pl̥h₁-bʰíd-* with *pūr°*, not *×pur°*.

The only potential candidate of **ḷ̥HCw* in the RV is *ūrdhvá-* 'upright' < **(w)ṛ̥hₓdʰ-wó-*, but the reconstruction of this term is notoriously difficult (see discussion in Schrijver 1991: 312–313).[13] Hackstein (2018), however, argues cogently that the root should be reconstructed as **werhₓdʰ-* with initial **w*, which would render *ūrdhvá-* non-probative because the Ved. *u*-vocalism may be attributed to the preceding **w*. As such, it is difficult to say whether **ḷ̥HCw* acts as a regular rounding environment in Vedic, and so only **ḷ̥Hw* remains certain.

2.3 *Vedic* ŭr *from* *ḷ̥HC$_0$u

In contrast to the easily adduced cases for rounding in **ḷ̥Hw*, the evidence remains scarce whether **ḷ̥Hu* acts similarly; indeed, this sequence faces even more difficulties than the one discussed in the preceding section. In this section and in 2.4 and 2.5, I will support **ḷ̥Hu* as a rounding environment on the basis of indirect evidence from elsewhere in Vedic and from Middle Indo-Aryan. As for direct evidence, **ḷ̥Hu* lacks probative Vedic data for rounding effects. The most obvious candidates, **-u-*stem adjectives of the type *R(∅)-*ú-* given in (12), are all compromised by having a labial or labiovelar before the **ḷ̥Hu*.

(12) a. *purú-* 'much, many' < **pḷ̥h₁-ú-* (cf. Gr. πολύς, OE *feolo* 'much, many', OIr. *oll* 'great; vast')
b. *urú-* 'broad, wide' < **h₁wṛ̥(h₁)-ú-*[14] (cf. Gr. εὐρύς, Av. *voᵘru* 'broad, wide')
c. *gurú-* 'heavy' < **gʷṛ̥h₂-ú-* (cf. Gr. βαρύς, Goth. *kaurus* 'heavy')

In particular, *gurú-* has long been the *Paradebeispiel* for the claim that Vedic inherited traces of the labiovelar series in the environment **Kʷḷ̥H* (as in Mayrhofer 1986: 104; Szemerényi 1996: 66; Fortson 2010: 212; Kobayashi 2017: 327). If indeed **ḷ̥Hu* did regularly result in *ur*, it would mean that *gurú-* is not probative for labiovelar rounding, but again, each of these examples is confounded. For potential counterexamples, PRF.ACT.PTCP *titirus* < **te-tṛ̥h₂-us* is disqualified as counter-evidence by the variable *Ŭ* vocalism of $\sqrt{t\bar{r}}$- discussed in Section 2.2. Otherwise, there are no secure cases of **ḷ̥Hu* in RV.[15] Surface *iru* from an inher-

13 The only other forms in RV which possess the necessary phonological structure to be candidates, *ŪLCv*, are *ūrṇvánt-*, *ūrṇvānáⁿ-* (participles to $\sqrt{vṛ̥}$- 'to cover' < **hₓwer-*; Lubotsky 2000) and *īrṣva* (imperative to $\sqrt{īr}$- 'set in motion' < **h₃i-h₃r-*, reduplicated present to **h₃er-*), but both of these lexemes get their surface *Ūr* from **UHL*, not **ḷ̥H*.

14 For the arguments against this root's *seṭ* character, see Mayrhofer (1992: 227).

15 Debrunner (1954: 484) proposes a suffix *-udh-* found in $\sqrt{iṣudhy}$- 'to implore; request; crave for', *kṣudh-* 'hunger', and *śurudh-* 'hero; strengthening drink' or 'winnings; gifts'. One ety-

ited *$\underset{\circ}{L}H$ appears in 3SG.INTENS.ACT.IMP *adardirur* < *$der\text{-}d\underset{\circ}{r}h_x\text{-}\underset{\circ}{r}s$ to $\sqrt{d\breve{\underset{\circ}{r}}\text{-}}$ 'to rend' < *$der(h_x)$-, but this form should also be discounted. Firstly, the *seṭ* character is non-original (Mayrhofer 1992: 701–702). Furthermore, the *i*-vocalism in *adardirur* could easily have spread from other intensive forms like 3SG.INJ.ACT *dardirat*. And finally, the desinence *-ur* < *$\text{-}\underset{\circ}{r}s$ must have developed *u*-vocalism within Indo-Aryan[16] and thus may not have even have occurred before the Indo-Aryan resolution of *$\underset{\circ}{L}H > \breve{U}r$.

While the inherited evidence does not provide any support for this rounding environment, Lubotsky (1994: 95–96 & 2000: 321–322) has suggested that dissimilation within Indo-Aryan does show similar properties. He proposes that $\underset{\circ}{r}$ sometimes dissimilated to a vowel *a*, *i*, or *u* when preceded or followed by another *r*. For example, he proposed the class V present *$\underset{\circ}{k}\underset{\circ}{r}\underset{\circ}{n}$óti* from $\sqrt{k\underset{\circ}{r}\text{-}}$ 'to make' underwent a progressive assimilation to *$\underset{\circ}{k}\underset{\circ}{r}$róti*. Then the *$\underset{\circ}{r}r$ cluster dissimilated with an outcome dependent on the following vowel: When followed by *-o-* or *-av-* < *-*aw-*, *$\underset{\circ}{k}\underset{\circ}{r}$ro-/$\underset{\circ}{k}\underset{\circ}{r}$rav-* becomes *karo-/karav-*, but but when followed by *-u-* or *-v-*, *$\underset{\circ}{k}\underset{\circ}{r}$ru-/$\underset{\circ}{k}\underset{\circ}{r}$rv-* becomes *kuru-/kurv-*. Similarly, *$m\acute{\underset{\circ}{r}}\acute{g}^h$-ur* did not give the expected ×*$m\acute{\underset{\circ}{r}}$hur*, but instead dissimilated to *múhur* 'suddenly'. Both *kuru-/kurv-* and *múhur* would then show that within Vedic $\underset{\circ}{r}$ produced a round vowel when followed by *u* or *v*. Of course, *múhur* could take its rounding from the initial **m-*, but if Lubotsky's etymology of *Tvā́ṣṭar-* < **Tv$\underset{\circ}{r}$ṣṭar-* < **tw$\acute{\underset{\circ}{r}}\acute{k}$-tor-* is correct, then a preceding labial was not sufficient to round $\underset{\circ}{r} > u$. These proposed developments of $\underset{\circ}{r}$, however, look very much like the developments in Middle Indo-Aryan to be discussed in section 2.4, and thus I prefer to take *kuru-/kurv-* and *múhur* as Middle Indicisms. Also, one cannot discount the older etymology that *Tvā́ṣṭar-* < **Tvárṣṭar-* < **twérḱ-tor-* (with expected root full-grade; Mayrhofer 1992: 685–686) simply dissimilated away the extra **-r-* with the assistance of the semantically associated root $\sqrt{takṣ\text{-}}$ 'to fashion'. Because of the limited nature of the proposed dissimilation effect in Vedic and the potential for Middle Indo-Aryan influence,[17] these data do not prove secondary $\underset{\circ}{r}C_1u > uC_1u$.

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mology takes these terms as compounds of *-udh-* < **wed^h-* 'to convey' (Mayrhofer 1992: 200–201): *$h_2is\text{-}ud^h\text{-}y$-* 'to convey desire', *ǵs-úd^h-* 'conveying starvation', and *$\underset{\circ}{k}\underset{\circ}{r}h_2$-úd^h-* 'conveying crushing force', respectively. The last compound *$\underset{\circ}{k}\underset{\circ}{r}h_2$-úd^h- > śurudh-* could in principle provide an example of *$\underset{\circ}{L}Hu$* rounding if correct, but these **wed^h*-compound etymologies are correctly rejected by Jamison (2020), who favors the etymology of Thieme (1941) for *śurudh-*.

16 Compare Av. 3PL.PRS/AOR.ACT.OPT *-ar^{ə}š* < *$\text{-}\underset{\circ}{r}s$* and 3PL.PRF.ACT.IND *-ar^ə* < *$\text{-}\underset{\circ}{r}$*, which do not contain *u*-vocalism. See Pinault (1989), Jasanoff (1997 & 2003: 32–34), and Frotscher (2012).

17 For further examples of the Middle-Indo-Ayran developments of $\underset{\circ}{r} > u$ in RV, see Werba (1992: 16–17).

Given the uncertainty about inherited *$\underset{\circ}{L}Hu$ > *uru*, it should come as no surprise that no secure evidence exists for *$\underset{\circ}{L}HC_1u$. The general dearth of probative forms could argue both for Lubotsky's proposal of *u as a source of regressive rounding and against *gurú-* as an example of labiovelar rounding, but even that is too confident of an interpretation of these data. Before beginning the labiovelar discussion, the environments set out in (4a) may now be narrowed to (13) with certainty.

(13) *$\underset{\circ}{L}H$ > Ved. *ŭr* / $\begin{cases} P___ \\ ___w \end{cases}$

*$\underset{\circ}{L}HC_1w$ and $\underset{\circ}{L}HC_0u$ still remain uncertain for Vedic on the basis of this evidence.

2.4 *Rounding of* $\underset{\circ}{\text{r}}$ *in Middle Indo-Aryan*

Before I move onto the evidence for rounding caused by labiovelars, the striking continuation of *r̥*-rounding in Middle Indo-Aryan deserves discussion, particularly because the earliest stages of Middle Indo-Aryan existed already at the time of the composition of the Vedas and likely represented the household dialects of their composers. As such, the phonetics of Middle Indo-Aryan can shed light on the phonetic milieu of early Sanskrit articulation. The vowel *r̥* did not survive as such into Middle Indo-Aryan but was normally replaced by *a*, *i*, or *u* depending on the environment and the dialect.[18] In fact, all periods of Middle Indo-Aryan show very similar behavior both to one another and to Sanskrit, namely that *r̥* produces *u*-vocalism after a labial or before a syllable containing *u*. Some representative examples are given in (14)–(16).

(14) Early Middle Indo-Aryan:
  a. Pāli (Berger 1955; Oberlies 2001: 50–51):
    r̥ > *u* / *P*___ (Pāl. *pucchati* < OIA *pr̥cchati*)[19]
    r̥ > *u* / ___C_1u (Pāl. *utu* < OIA *r̥tu-*)
  b. Gāndhārī (Burrow 1937: 2; Baums 2019: 2):
    r̥ > *u* / *P*___ (Gān. *puchaṃti* < OIA *pr̥cchanti*)
    r̥ > *u* / ___C_1u (Gān. *uju* < OIA *r̥ju-*)

18 Against the preservation of *r̥* in the Apabhraṃśas, see Tagare (1948: 39–40).

19 The situation with *v* and *m* is slightly more complicated. Berger (1955: 57) asserts that these two phonemes were spoken without lip rounding when in absolute initial or intervocalic position (e.g., OIA *āvr̥ta* > Pāl. *āvata*, but OIA *nirvr̥ta* > Pāl. *nibbuta*).

(15) Dramatic and Jain Prakrits (Pischel 1900: 50–51, 54–55; Woolner 1928: 25–26):
   a. Ardhamāgadhī:
      r̥ > *u* / *P*___ (AMāg. *pucchaï* < OIA *pr̥cchati*)
      r̥ > *u* / ___C_1*u* (AMāg. *uu* < OIA *r̥tu-*)
   b. Māgadhī:
      r̥ > *u* / *P*___ (Māg. *puśchai* < OIA *pr̥cchati*)
   c. Māhārāṣṭrī:
      r̥ > *u* / *P*___ (Māh. *pucchaï* < OIA *pr̥cchati*)
      r̥ > *u* / ___C_1*u* (Māh. *udu* < OIA *r̥tu-*)
   d. Śaurasenī:
      r̥ > *u* / *P*___ (Śaur. *pucchadi* < OIA *pr̥cchati*)
      r̥ > *u* / ___C_1*u* (Śaur. *udu* < OIA *r̥tu-*)

(16) Apabhraṃśas (Tagare 1948: 39–48):
   a. Eastern Apabhraṃśa:
      r̥ > *u* / *P*___ (EAp. *pucchaï* < OIA *pr̥cchati*)
   b. Southern Apabhraṃśa:
      r̥ > *u* / *P*___ (SAp. *puhaï* < OIA *pr̥thavī*)
      r̥ > *u* / ___C_1*u* (SAp. *uḍu* < OIA *r̥tu-*)
   c. Western Apabhraṃśa:
      r̥ > *u* / *P*___ (WAp. *pucchai* < OIA *pr̥cchati*)

The Middle Indo-Aryan data argue strongly in favor of the remaining OIA *r̥* being rounded after labials and before *u*. Moreover, because Middle Indicisms were already making their way into Vedic language (Werba 1992), the Middle Indo-Aryan regularity of this development suggests that similar phonetic factors could cause the sequence **-L̥Hu-* to become *-uru-* regardless of its preceding consonant in the contemporary Vedic language. Whether ___C_0*w* acted as a rounding environment in Middle Indo-Aryan requires future investigation beyond the standard grammars.

2.5 *Vedic* ŭr *from* *K^{w}L̥H

As demonstrated in the preceding sections, the choice between *Ŭr* reflexes in Vedic is by no means arbitrary, a fact which has made the distribution of *Ŭr* after velars all the more baffling, in particular near minimal pairs like *gurú-* < **g^{w}r̥h$_2$-ú-* vs. *girí-* 'mountain' < **g^{w}r̥h$_x$-í-*.[20] This problem begs for a new solution, and to that end I propose the formulation in (17):

20 The labiovelar in **g^{w}r̥h$_x$-í-* is reconstructed on the basis of Alb. *gur* 'stone' < PAlb. **guri* (Demiraj 1997: 51).

(17) The development of *$K^{w}\underset{\circ}{L}H$:
  a. In open syllables: *$K^{w}\underset{\circ}{L}.HV$ > Ved. *KirV*
  b. In closed syllables: *$K^{w}\underset{\circ}{L}H.C$ > Ved. *KŭrV*

This proposal, which separates the reflexes of *$\underset{\circ}{L}H$ in open and closed syllables, goes a long way toward explaining the data. The phonological motivations for the proposed sound changes will be discussed in Section 4. First, I shall establish the empirical basis for this claim.

Unlike the reflexes of *$\underset{\circ}{L}H$ preceded by *K^{w}, the palato- and plain velars do not show any *ŭr* forms in either *$\overset{(\smile)}{K}\underset{\circ}{L}HV$ or *$\overset{(\smile)}{K}\underset{\circ}{L}HC$ environments.[21] Derivatives of the roots in (18)–(20) show consistent *ĭ* vocalism throughout, as they contain no environment in which rounding is expected.

(18) *$kerh_{x}$- ~ *$kreh_{x}$- > $\sqrt{k\underset{\circ}{r}\bar{\imath}}$- 'honor'
  (cf. OHG *hruom* 'fame' < *$hrōma$- < *$kreh_{x}$-*mo*-)[22]
  a. *carkiran* (3P.INT.PRS.ACT.SBJV) < *$ker(h_{x})$-$k\underset{\circ}{r}h_{x}$-*ent*
  b. *kīrtí-* 'praise' < *$k\underset{\circ}{r}h_{x}$-*tí*-

(19) *$kerh_{x}$- > $\sqrt{k\underset{\circ}{r}\bar{\imath}}$- 'scatter; pour out'
  (cf. OIr. -*cuirethar* 'throws' < *$korh_{x}$-*éye*-)
  a. *kiráte* (3SG.PRS.MID.IND) < *$k\underset{\circ}{r}h_{x}$-*é*-
  b. *kīryáte* (3SG.PRS.PASS.IND, B) < *$k\underset{\circ}{r}h_{x}$-*yé*-
  c. *kīrṇá-* (PPP, B) < *$k\underset{\circ}{r}h_{x}$-*nó*-

(20) *$\acute{k}erh_{2}$- > $\sqrt{ś\underset{\circ}{r}\bar{\imath}}$- 'to crush'[23]
  (cf. Gr. ἀ-κέραιος 'unhurt' < *$\underset{\circ}{n}$-$\acute{k}erh_{2}$-)
  a. *ā-śīrta-* (PPP) < *$\acute{k}\underset{\circ}{r}h_{2}$-*tó*-

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21 $\sqrt{h\underset{\circ}{r}\bar{\imath}}$- 'to be angry' < *$\acute{g}^{h}eLh_{x}$- (Indo-Iranian only) does not provide any useful forms, as *hṛṇīte*, *hṛṇānáⁿ*, etc. all have a nasal infix disrupting the *$\underset{\circ}{L}H$* sequence. I follow Jamison (2015–), who takes RV perfect *juhur-* (see, e.g., § I.173.11) to $\sqrt{hv\underset{\circ}{r}}$- ~*hru*- 'to go crookedly, go astray' and not to $\sqrt{h\underset{\circ}{r}\bar{\imath}}$- 'to be angry' (pace Insler 1968).

22 And perhaps *kīrí-* 'singer' < *$k\underset{\circ}{r}h_{x}$-*rí*-. The word has much debate around its meaning, however, with an alternative view taking it to mean 'humble, mere, poor' (Pischel & Geldner 1889: 216–228; Geldner 1951: 39; Mayrhofer 1956: 215; Jamison 1991: 251–252) on contextual grounds. The meaning 'praiser' is preferred by Grassmann (1873: 327), Monier-Williams (1899: 285), and Mayrhofer (1992: 357).

23 Against the communis opinio, the form *śūrtá-* found in RV I.174.6d does not belong here. I modify a suggestion by Hopkins (1892: 6[1]) that *śūrtá-* came from the same root as *śū́ra-* 'hero'. He did not realize that *śū́ra-* did not come from a root $\sqrt{śūr}$- but from *$ku\underset{\circ}{h}_{1}$-ro*-, a *-*ro*-stem derivative to *$\acute{k}ewh_{1}$- 'to swell' (Mayrhofer 1996: 623–624, 650–651) or to *$\acute{k}ewd$- 'to be powerful (?)' (van Beek 2016). Yet Hopkins had the right idea: *śūrtá-* was created to

b. *śīrṇá-* (PPP, AV) < **ḱr̥h₂-nó-*
c. *-śī́ryā* (GD, B) < **-ḱr̥h₂-yó-*
d. *śīryáte* (3SG.PRS.PASS.IND) < **ḱr̥h₂-yé-*

Turning to the labiovelar-initial cases, two etyma, *girí-* and $\sqrt{c\bar{r}\text{-}}$, attest forms containing only one of **K^{w}ḷHV* or **K^{w}ḷHC* and therefore show consistent *i-* or *ū*-vocalism respectively.[24] The development of *girí-* < **g^{w}r̥h$_x$-í-* is now reg-

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a pseudo-root $\sqrt{śūr\text{-}}$ which was extracted secondarily from *śū́ra-*. This etymology is confirmed both by morphological parallels and by poetic motivation for this form's creation. The development of *śū́ra-* → $\sqrt{śūr\text{-}}$ → *śūrtá-* is mirrored by the development of *sū́ra-* 'sun' → $\sqrt{\text{*}sūr\text{-}}$ → *(a)sū́rta-* '(un)sunlit' (X.82.4c). Though *(a)sū́rta-* retains the original barytone accentuation of *sū́ra-*, *śūrtá-* becomes oxytonic due to its function in RV I.174.6d as a verbal substitute, completing its conversion to participial accentuation. The creation of the hapax PPP *śūrtá-* leads to the later Sanskrit $\sqrt{śūr\text{-}}$ 'to hurt; to be firm; to be valiant' found in *śūryate* and *śuśūre* and recognized by Indian grammarians (*Dhātupāṭha* IV.D.1.49). Furthermore, the wily poet Agastya invents *śūrtá-* in service of the hymn's skewed ring composition: *śūrtá-* in 6d falls in the middle of two terms referring to Indra, *śū́ra-patnī-* 'champion-lord' in 3a and *śū́ra-* in 9c. Indra solidifies his position as *śū́ra-* by the progression from an indirect reference *śū́ra-patnī-* through the new participle *śūrtá-* describing his feat to the straightforward vocative address *śūra*. *śūrtá-* probably meant 'destroyed by a *śūra*' or 'conquered' in the context, perhaps playing off the meaning of *śīrtá-* 'crushed' as a reference to *jaghanvā́n* 'having smashed' earlier in the verse.

RV I.174.6
jaghanvā́ṁ ind^{a}ra mitrérūñ codápravr̥ddho harivo ádāśūn |
*prá yé páśyann aryamáṇaṃ sácāyós tváyā **śūrtá́** váhamānā ápatyam ‖*
'Once you had smashed those who rout their allies, and had smashed the impious when you were strengthened by the stimulant, o Indra of the fallow bays,
those who saw before them Aryaman in company with these two [=Mitra and Varuṇa], they were **conquered** by you, taking their progeny along.' (modified from Jamison & Brereton 2014: 374)

Agastya uses the same technique of blending terms for the sake of ring composition elsewhere in the same poem, when he balances the description *śéṣan … sásmi yónay* 'They [= enemies] will lie … in this womb' in 4a with a hapax blend *duryoṇa-* in *duryoṇé kúyavācam mr̥dhí śret* '[Indra] has embedded the one speaking evil in scorn in an ill womb' in 7d. Although playing off of the preceding description of the earth as a womb for Indra's foes, *duryoṇa-* does not come from *dur-* 'bad' + *yóni-* 'womb' but from a blend of *duroṇá-* 'house' and *dúrya-* 'pertaining to the doors; the house'. Through his masterful wordplay, Agastya created two new terms, *śūrtá-* and *duryoṇa-*, to satisfy the poetic structure of the hymn. I thank Stephanie Jamison (p.c. 27 December 2018) for her suggestions about ring composition in I.174 and the accentuation of *śūrtá-* vs. *(a)sū́rta-*.

24 The etymology of *cūrṇa-* 'dust' (ĀR.+) remains too uncertain to include here (see Mayrhofer 1992: 547). Likewise, I consider the AV desiderative forms to $\sqrt{kr̥\text{-}}$ like *cikīrṣati* from a theoretical **k^{w}í-k^{w}r̥-h$_1$se-ti* to have been created secondarily according to the standard desiderative morphological template after the merger of the labio- and plain velars made the distribution of *-Ǔr-* forms opaque.

ular since it has the structure *$K^{w}\underset{\circ}{L}HV$. Conversely, $\sqrt{c\bar{r}}$- 'to move oneself' < *$k^{w}elh_1$- (cf. Gr. πέλομαι 'move oneself') contains only closed-syllable *$k^{w}\underset{\circ}{l}h_1C$ with expected *ū*-vocalism in RV: *tuvikūrmí-* 'powerfully ranging' < *-$k^{w}\underset{\circ}{l}h_1$-mí-* (Mayrhofer 1992: 659) and *carcūryámāṇam* (INT.PRS.MID.PTCP) < *$k^{w}el$-$k^{w}\underset{\circ}{l}h_1$-*yé-mh*$_1$*no-*. In defense of his rule that *$C\underset{\circ}{L}HW\acute{V}$- should come out as Ved. *CurẂV*-, Lubotsky (1997: 141) appeals to analogy to explain the length of *ū* in *carcūryámāṇam* (as well as *tartūryante* < *ter-$t\underset{\circ}{r}h_2$-*yé-ntoy*) instead of expected ×*carcuryámāṇam* (and ×*tarturyante*). As proof of *carcūryámāṇam*'s nonce status, he convincingly points to the unetymological *c* in *-cūr-* < *-$k^{w}\underset{\circ}{l}h_1$-* and its membership in the later productive class of *-ya*-intensives. If correct, *ūr* must come from an unattested verb form since $\sqrt{c\bar{r}}$- attests no other *Ūr* forms in RV. This tendency for intensives to borrow their vocalism from elsewhere in the paradigm will reappear with *jalgulas* (2SG.INT.PRS.ACT.SBJV) and *járgurāṇas* (INT.PRS.MID.PTCP) below.[25]

Under the proposed theory of *$K^{w}\underset{\circ}{L}H$, the *u*-vocalism of *gurú-* < *$g^{w}\underset{\circ}{r}h_2$-*ú-* cannot come from the labiovelar but must come from another source. In the absence of evidence against *$\underset{\circ}{L}Hu$ as a rounding environment, I prefer to accept *gurú-* as confirmation for this environment on theory-internal grounds. Another possibility is to take the *u*-vocalism of *gur-ú-* as analogical to the feminine *gurvī-* < *$g^{w}\underset{\circ}{r}h_2$-*wíh*$_2$-, since *$\underset{\circ}{L}Hw$ reliably produces *ŭrv*. Though *gurvī-* appears first in AV, it does show the short vowel in *ŭr* predicted by Lubotsky for unaccented *$\underset{\circ}{L}H$ in *$C\underset{\circ}{L}HW\acute{V}$.[26] Whether the vocalism of *gurú-* originates from its feminine *gurvī-* or the *$\underset{\circ}{L}Hu$ environment, the confounded circumstances should disqualify this form from its long-held position as evidence of labiovelar rounding.

25 The above discussion means that *kūrmá-* 'tortoise' should now be interpreted as containing a labiovelar *$k^{w}\underset{\circ}{L}H$-*mó-* purely on the basis of the rule *$K^{w}\underset{\circ}{L}H.C$- > Skt. *KūrC*—-that is, if *kūrmá-* is inherited at all (see Mayrhofer 1992: 386 for a similar discussion and literature).

26 In RV, the expected feminine for a primary *-*u*-stem is the *devíˊ*-formation in *-*w-ih*$_2$ (see Debrunner 1954: 413–414). The apparent *-*u-h*$_2$-feminines found in *a-grúˊ-*, YAv. *aγrū*° 'unmarried' < *$\underset{\circ}{n}$-*grh*$_2$-*ú-h*$_2$- 'unburdened' appear chiefly in non-primary *-u*-stems and compounds (Debrunner 1954: 429–494; Cantera 1999: 46–49). To account for the *grŭ-* in *a-grúˊ-*, along with *gru-muṣṭí-* 'heavy handful' < *$g\underset{\circ}{r}h_2$-*u-mus-tí-*, instead of ×*gurŭ-*, Cantera appeals to laryngeal loss in composition, which causes the *$\underset{\circ}{r}$ to lose its syllabicity. Balles (2012: 21), on the other hand, prefers to derive *a-grúˊ-* by metathesis of **$\underset{\circ}{n}$-$g^{w}\underset{\circ}{r}h_2$-*ú-s* > *$\underset{\circ}{n}$-$g^{w}r$-*ú-h*$_2$*-s* and *gru-muṣṭí-* by syncopation of **$g^{w}\underset{\circ}{r}h_2u$-*mus-tí-* > **$g^{w}\underset{\circ}{r}$*ru-mus-tí-* > *$g^{w}ru$-*mus-tí-*. On the other hand, the single TS attestation, semantics, and odd syncopation of *gru-muṣṭí-* could point to a low-register borrowing. Neither etymology contradicts *gurvī-* as the original feminine to the the primary adjective *gurú-*.

There remain the two homophonous roots $\sqrt{g\mathring{r}\bar{-}}$ 'to praise; welcome' < *$g^{w}erh_{x}$- (whence Osc. **brateís** 'grace, mercy') and $\sqrt{g\mathring{r}\bar{-}}$ 'to swallow' < $g^{w}erh_{3}$- (whence Gr. ἔβρως 'you ate'), which show variable $\breve{\imath}$~$\breve{u}$ vocalism. Within its verbal paradigm, $\sqrt{g\mathring{r}\bar{-}}$ 'to praise; welcome' shows exclusively $\breve{u}$-vocalism, the majority of which are the expected *$K^{w}\mathring{L}HC$ > $\breve{u}r$ outcomes:

(21) Predicted $\breve{u}$-vocalism in $\sqrt{g\mathring{r}\bar{-}}$ 'to praise; welcome' in closed syllables[27]
  a. *gūrtá-* (PPP) < *$g^{w}\mathring{r}h_{x}$-tó-*
  b. *prá gūrta* (3SG.AOR.MID.INJ) < *$g^{w}\mathring{r}h_{x}$-to*
  c. *-gū́r$^{(i)}$yā* (GD) < *$g^{w}\mathring{r}h_{x}$-yeh$_{1}$*
  d. *juguryās* (2SG.PRF.ACT.OPT), *juguryā́t* (3S) < *$g^{w}e$-$g^{w}\mathring{r}h_{x}$-yéh$_{1}$-[28]
  e. *gūrdhayā* (2SG.PRS.ACT.IMP) '(give) praise!' < *$g^{w}\mathring{r}h_{x}$-$d^{h}h_{1}$-eye-*

Most striking among the forms in (21) are *gūrtá-* and *-gū́r$^{(i)}$yā*, whose non-ablauting environments best preserve the development of *$K^{w}\mathring{L}HC$ > *KūrC*. On the other hand, *gūrdhayā* stands outside of the normal verbal paradigm of $\sqrt{g\mathring{r}\bar{-}}$ yet still shows *ū*-vocalism.

Beside the well-behaved examples in (21), some forms exist that might appear to be counterexamples at first glance. The 3SG.PRF.ACT.SUBJ *jugurat* (RV VII.81.5) shows what would seem to be unanticipated *u*-vocalism from a theoretical *$g^{w}e$-$g^{w}\mathring{r}h_{x}$-e-t*. Yet the word exhibits another morphophonological anomaly, namely the unexpected zero-grade in its root syllable, since the per-

27 While the form *jugurváṇi-* 'offering welcome' could show the expected outcome of *-$g^{w}\mathring{r}h_{x}wé$- > *-gurvá-*, it clearly arose within Vedic. The proposed meaning of 'preislustig' in Grassmann (1873: 494) suggests a compound of $\sqrt{g\mathring{r}\bar{-}}$ 'to praise; welcome' and $\sqrt{van^{i}}$- 'to desire' (approximately *$g^{w}e$-$g^{w}\mathring{r}h_{x}$-$wénh_{x}$-i-*), a reading adopted by Geldner and Griffith, but the semantics of the one attestation (RV I.142.8a) are not sufficient to motivate this reading and do not explain the odd reduplicated first member. I follow Jamison & Brereton (2014: 318), who supply 'offering welcome', omitting the desire element from the translation. *jugurváṇi-* is a Vedic-internal formation, on the basis of *turvaṇi-* ('conquering', ×9), *bhurvaṇi-* ('quivering', ×2), and the hapaxes *tuturváṇi-* ('continually victorious'), *dadhṛṣváni-* 'daring; overcoming', and *śuśukváni-* 'blazing'. Per a suggestion by Stephanie Jamison (p.c. 9 February 2019), the non-hapax *turváṇi-* acts as the starting point from which the ever-wily Agastya created the reduplicated *tuturváṇi-* as part of an āmdeḍita-ridden line (RV I.168.1) to emphasize the repetitious nature of the ritual (Jamison 2015–: §I.168.1). *tuturváṇi-*, in turn, served as the examplar from which *jugurváṇi-* was created. The original development of *turváṇi-* and *bhurváṇi-*, however, remains obscure.

28 The short *-ur-* in *juguryās* and *juguryā́t* again seem to follow the phonological distribution proposed by Lubotsky (1997).

fect subjunctive normally shows full-grades (e.g., *jaghánat*). Kümmel (2000: 35–36) explains the examples of perfect subjunctives with zero-grade roots as reinterpreted perfect middle injunctives, but admits that some of the examples (including *jugurat*) lack attested injunctives to serves as models. To understand the strange stem shape in *jugurat*, it is important to analyze the derivatives of $\sqrt{gr̥̄}$- 'to praise; welcome' generally. The RV attests only four stems for this verb: the frequent present stem *gr̥ṇắ/ī-* (*gr̥ṇắti*, *gr̥ṇīmási*, *gr̥ṇánti*, PRS.ACT.PTCP *gr̥ṇát-*, PRS.MP.PTCP *gr̥ṇāná-*), the uncommon aorist stem *gŭr-* (*prá gūrta*, *gurasva*), the innovative *iṣ*-aorist to the present stem with the only the form 1SG.MED. *gr̥ṇīṣé* with present indicative meaning, and the perfect stem *jugur-* with only modal forms (*juguryās*, *juguryắt*, *jugurat*). As described by Jamison (2009), the athematic optative most frequently appears on the perfect stem and tends not to compete with optatives in other stems, which is the case with the regular *lautgesetzlich* optatives *juguryās* and *juguryắt*. On the other hand, Jamison (2017) notes that subjunctives are built from the perfect stem only when the present and aorist cannot be used. Her prediction holds here too; the subjunctive *jugurat* uses the perfect stem because Class IX presents cannot distinguish subjunctives with primary endings from indicatives or those with secondary endings from subjunctives and because the two aorist stems, *gŭr-* and *gr̥ṇīṣ-*, were clearly not productive. As such, the perfect stem is the only viable choice for a subjunctive, and the RV poet used the only perfect stem available to *jugurat*: the *jugur-* found in the optatives *juguryās* and *juguryắt*. Additionally, all three modal perfects appear pāda-finally (*juguryās* RV I.140.13, *juguryắt* RV I.173.2, *jugurat* RV VIII.81.5) and both *jugurat* and *juguryās* appear with the preverb *abhí*. The zero-grade *jugurat* is very unlikely to be a reinterpreted perfect injunctive (per Kümmel's theory) since it is coordinated with three clear aorist subjunctives:

(22) RV VIII.81.5:
prá stoṣad úpa gāsiṣac chrávat *sắma gīyámānam* | ***abhí*** *rádhasā* ***jugurat*** ‖
'**He will start up the praise**; **he will join in the singing**; **he will listen** to the sāman being sung. **He will greet** it with generosity.' (tr. Jamison & Brereton 2014: 1180)

Taken together, *jugurat* is best understood as analogical to the other pāda-final perfect optatives. A full-grade perfect stem *jagar-* does not appear until the forms *saṃjagára* (TĀ II.4.1b = $^{+}$MS IV.14.17b [an emendation])/*saṃjagắrā* (TB III.7.12.3b) 'I have promised' 1SG.PF.ACT.IND, which is a variant of the form *saṃgr̥ṇắmi* 'I swear' 1SG.PRS.ACT.IND (AVP XVI.50.6b = AVŚ VI.119.1b, VI.71.3b).

Kümmel (2000: 194–196) correctly suggests these perfects to be an 'ad-hoc-Neubildung' and not an inherited stem first attested so late and only in one mantra.

Likewise the 2SG.PRES/AOR.ACT.IPV *gurasva* appears to contain unexpected *u*-vocalism in an open syllable, but the thematic present appears only once in RV:

(23) RV III.52.2b:
***juṣásva** indra **á gurasva** ca*
'**enjoy it**, Indra, and **welcome it**' (tr. Jamison & Brereton 2014: 535)

Gotō (1987: 155) cogently argues for deriving *gurasva* from an aorist imperative **gūrsva* via analogy to *juṣásva*. From this one usage, *gurasva* later expands into the present paradigm *guráte* found in the B. Once *jugurat* and *gurasva* have been identified as analogical formations, the only verbal form not to follow the rule in (17) is the RV hapax *apa-járgurāṇa-* ('repeatedly taunting', V.29.4)[29] instead of ×*apa-járgirāṇa-*. For this isolated form, I attribute its *u*-vocalism to leveling in keeping with (4b) to match the rest of the verbal paradigm.

ĭ-vocalism only appears outside the verbal paradigm of $\sqrt{g\bar{r}}$- 'to praise; welcome', specifically in the root noun *gír ~ gíram ~ girá́* 'praise'.[30] If one reconstructs the ablaut of this form as **g*^{w}*érh*$_x$*-s ~ *g*^{w}*érh*$_x$*-m̥ ~ *g*^{w}*r̥h*$_x$*-éh*$_1$, the instrumental singular **g*^{w}*r̥h*$_x$*-éh*$_1$ provides *girá́* regularly in a **-K*^{w}*L̥HV-* environment, whose *i*-vocalism would be used for the rest of the paradigm. If, on the other hand, one reconstructs zero-grade throughout (**g*^{w}*ŕ̥h*$_x$*-s ~ *g*^{w}*ŕ̥h*$_x$*-m̥ ~ *g*^{w}*r̥h*$_x$*-éh*$_1$) as no full-grade is ever attested in this noun, the nominative should give ×*gúr*. In the RV, the cases with vowel-initial endings attested (ACC.PL **g*^{w}*ŕ̥h*$_x$*-n̥s* > *gíras* 79×, NOM/VOC.PL **g*^{w}*ŕ̥h*$_x$*-es* > *gíras* 68×, INS.SG **g*^{w}*r̥h*$_x$*-éh*$_1$ > *girá́* 65×, ACC.SG **g*^{w}*ŕ̥h*$_x$*-m̥* > *gíram* 7×, GEN.PL **g*^{w}*r̥h*$_x$*-óh*$_x$*om* > *girám* 3×, DAT.SG **g*^{w}*r̥h*$_x$*-éy* > *giré* 1×, total 223×) outnumber the cases with consonant-initial endings (INS.PL **g*^{w}*r̥h*$_x$*-b*^{h}*ís* > *gīrbhís* 81×, NOM.SG **g*^{w}*ŕ̥h*$_x$*-s* > *gír* 20×, LOC.PL **g*^{w}*r̥h*$_x$*-sú* > *gīrṣú* 1×, total 102×) both in types (6:3) and in tokens (223:102). This trend holds even when the cases whose root zero-grade may be secondary (if originally

29 For the assignment of *apa-járgurāṇa-* to $\sqrt{g\bar{r}}$- 'to greet' instead of $\sqrt{g\bar{r}}$- 'to swallow', see Schaefer (1994: 116–122). I find unconvincing the argumentation of Hintze (2005: 252–257) that *apa-járgurāṇa-* and *apa-gúryā* (RV V.32.6) meant 'to raise (one's hand or weapon preparatory to striking)' from the root **g*^{w}*elh*$_1$- 'to throw' (whence also Gr. βάλλω 'to hit (by throwing)').

30 The GD *-gírya* appears only in the Brāhmaṇas and may represent a dialect that levels towards *ĭ*- instead of *ŭ*-vocalism.

NOM.SG *g^{w}érh$_{x}$-s*, ACC.SG *g^{w}érh$_{x}$-m̥*, NOM/VOC.PL *g^{w}érh$_{x}$-es*) are removed, giving 4:2 types and 148:82 tokens.[31] Since *-ir-* ~ *-ur-* alternations are nowhere attested within a single nominal paradigm, the stem may then have been leveled to *gir-* on the basis of type and token frequency.[32] As mentioned in Section 2.2, the first members of *gír-vaṇas-* 'praise-desiring' and *gír-vāhas-* 'praise-conveyed' are not attested as ×*gír*° in RV, indicating that the *i*-vocalism when in the first member of compounds is also not necessarily original. Therefore, regardless of the ablaut reconstructed for this root noun, paradigm-internal leveling can explain the outcome of *gir-*. Crucially, the root noun's *i*-vocalism may differ from the *u*-vocalism in the other forms of $\sqrt{gr̥̄}$- 'to praise; welcome' because the root noun stands on the periphery of the verbal system.

Finally, $\sqrt{gr̥̄}$- 'to swallow' possess only three hapaxes containing outcomes of the zero-grade *g^{w}r̥h$_{3}$-, and each requires some attention. The root noun appearing in *muhur-gír* ('swallowing instantaneously', RV I.128.3) may have its *ī*-vocalism via paradigm-internal leveling in the same way as *gír-* 'praise' in the preceding paragraph. The PPP *gīrṇám* would appear to be a counterexample to (17) as the closed syllable in *g^{w}r̥h$_{3}$-nó-* should have resulted in ×*gūrṇá-*. Here I propose that this late-appearing form (RV X.88.2) takes its vocalism analogically from the present stem. Though no presents appear in RV, the forms *giráti* (AV) and *gilati* (B) develop exactly as expected from *g^{w}r̥h$_{3}$-é-ti*. If $\sqrt{gr̥̄}$- 'to swallow' selected one vocalization for its verbal paradigm as did $\sqrt{gr̥̄}$- 'to praise; welcome' and $\sqrt{jr̥̄}$- 'to grow old', then a late Vedic PPP would level to the *i*-vocalism of the present stem. The *gir/gil-* form of the stem became so standardized that later Indian grammarians report an innovative intensive stem *jegilya-* built to a new root $\sqrt{gil}$- (Schaefer 1994: 115–116). Also, as Lubotsky (2007: 233) suggests, the **-nó-* participles probably spread from the **Ced-* to the **CeLH-* roots later in Indo-Iranian—in this case after the adoption of *i*-vocalism in the Rigvedic dialect. Indeed, the only attested *u*-vocalism found in RV form of $\sqrt{gr̥̄}$- 'to swallow' appears in the 2SG.INTENS.PST.ACT.SUBJ. *jalgulas* (I.28.1–4). This form does not appear to belong to the dialect of RV, however, having both *u-*

31 Grassmann (1873: 400–401)

32 One may well object that other text types may have different distributions of cases, but the hymns of RV represent the oldest material preserved and show pervasive influence on each other. If other texts or dialects preferred *ŭ*-vocalism for this noun, Vedic poets would be unlikely to import them against the uniform *ĭ*-vocalism (that may have overcome an original **á-* ~ ∅-ablaut) only to create an *-ĭr-* ~ *-ŭr-*alternation otherwise unattested in the nominal system. Furthermore, because this noun is unlikely to appear in the dual with any appreciable frequency, the only pre-consonantal zero-grades in an ablauting paradigm would come from a subset of the oblique plurals (**-bʰis*, **-bʰyas*, **-su*), an improbable source for paradigm-wide leveling.

vocalism and *l*-consonantism found nowhere else within the verbal paradigm. Instead, *jalgulas* resembles the intensive *-jalgulīti* found in the TS. Thus, all the forms of $\sqrt{g\mathring{r}}$- 'to swallow' in the RV may be explained by assuming the RV adopted *i*-vocalism throughout its verbal paradigm and that *jalgulas* was borrowed from a different dialect which regularized *u*-vocalism. Note further that *jalgulas* appears in a hymn of racy and popular character and recurs 4 times as the last word of the verse-final refrain *ulū́khalasutānām ávéd u indra jalgulaḥ* 'you, Indra, will keep gulping down the mortar-pressed (soma drops)' (tr. Jamison & Brereton 2014: 126–128). The striking *u*'s and *l*'s of *jalgulas* may have phonetically mirrored the refrain's first word, *ulū́khala-suta-* 'mortar-pressed', especially since the hymn generally concerns the mortar (*ulū́khala-*).

In the above section, I have shown that all the outcomes of the velar-initial *L̥H* may be explained by applying a simple phonological generalization, (17), with the modification that a given Vedic dialect selected one vocalism for all its verbal forms. Crucially, under this analysis, all *$\overset{(\breve{})}{K}$-initial forms show only *ĭ*-vocalism, and isolated nominal forms *girí-* < *$g^{w}\mathring{r}h_{x}$-í-* and *gír-* < *$g^{w}\acute{\mathring{r}}h_{x}$-* no longer act as exceptions.

3 The evidence for the rounding of *$\mathring{L}$(*H*) in Iranian

Having demonstrated the tendency of *$\mathring{L}H$ to produce *ŭr* in rounded contexts in Indo-Aryan, I will turn to the Iranian evidence for this same process. If labiovelars left traces through the rounding of syllabic liquids in Indo-Aryan, it is necessary to show that these rounding effects occurred in the early stages of Indo-Iranian, and to that end, we require a survey of the Iranian data to show the convergence of phonological effects. While Iranian does not show rounding from inherited labiovelars, as shall be shown, it does match Indo-Aryan in most other environments. Hübschmann (1895: 143–150) and Gray (1902: 35–36) recognized that *$\mathring{r}$ produces *u*(*r*) in the Iranian as well as Indo-Aryan languages. More comprehensively, Bartholomae (1925) made an extensive survey of the Iranian reflexes of PIIr. *$\mathring{r}$ and *$\bar{\mathring{r}}$ (now *$\mathring{r}H$), in which he observed many instances of rounding after labials. His study, however, follows many now abandoned etymologies and the 'Andreas Theory'—the discredited belief that the Avestan manuscripts were transcribed from Pahlavi-script originals and that the vowels were subsequently interpolated between the consonants. For these reasons, Bartholomae struggles with the behavior of *$\mathring{r}$(*H*) in Avestan and elsewhere. To my knowledge, Cantera (2001) first investigates both the Indo-Aryan post-labial and pre-*u*/*w* rounding environments of *$\mathring{r}H$ in Iranian, but he limits himself to Avestan. As such, it is necessary to revisit Iranian as a whole

with an eye towards the Indo-Aryan rounding environments. Given the breadth of archaic and modern Iranian languages and data available, I will only summarize evidence from a few Iranian languages. The following investigation, however, will establish clear patterns of *$\underset{\circ}{L}(H)$-rounding which mirror those in Indo-Aryan. Grammars of various languages were consulted for evidence of *$\underset{\circ}{L}$-rounding in the environments listed in (5). This article will investigate Avestan, Bactrian, Khotanese, Ormuri, Ossetic, Pashto, Old and Middle Persian, Sogdian-Yaghnobi, Wakhi, and Widgha-Munji.[33]

3.1 *Avestan*

First, I turn to Avestan. Admittedly, it does not provide certain evidence for rounding of syllabic *$\underset{\circ}{L}(H)$. As discussed in (3), Cantera (2001) proposed that unstressed *$P\underset{\circ}{L}H$ and *$\underset{\circ}{L}HC_0w$ produce different vocalic outcomes from *$\underset{\circ}{L}(H)$ in unrounded environments (YAv. *ərᵊδβa-* < PIr. *$(w)\underset{\circ}{r}Hdwá$- vs. OAv. *darᵊga-* < PIr. *$d\underset{\circ}{r}Hgá$-). His arguments, however, remain controversial (de Vaan 2003: 506–507[648]; Kümmel 2007: 276–277).[34] Nevertheless, Avestan '*u*-epenthesis' does provide evidence for rounding of non-syllabic liquids. The sequences *$r\breve{u}$ and *rw had the grapheme *u* inserted beforehand when found word-initially or after *$\breve{a}$ or *$ə$ (e.g., Av. *ᵘruuan-* 'soul' < PIr. *$ruwan$-, YAv. *haᵘruua-* 'whole' < PIr. *$hárwa$-; Hoffmann & Forssman 2004: 51–52). This inserted *u* never affected the metrical shape of the forms and appeared consistently into Younger Avestan as in *gəᵘruuaiia-* 'to seize' < *$gərβāya$- < PIr. *$g\underset{\circ}{r}bāya$-. This *ᵘr* has been correctly interpreted as representing a labialized [rʷ] (de Vaan 2003: 561–562; Kümmel 2014a: § 2.4[35]) in line with Avestan '*i*-epenthesis' (OAv. *aⁱbī* [abʲiː] 'to' < PIIr. *ab^hi).[36] In contrast to *i*-epenthesis, which affected a wide variety of conso-

33 The languages Balochi (Geiger 1891: 409; Korn 2005: 142–148), Parachi (Morgenstierne 1929: 26–27), Sanglechi-Ishkashmi (Morgenstierne 1938: 329), and Shughni (Morgenstierne 1928: 37) were also examined, but each shows a default outcome of *$\underset{\circ}{L}$ as *$\breve{u}r$*, which obscures any potential evidence of rounding effects.

34 In light of the evidence presented in this article for systematic *$\underset{\circ}{r}$-rounding throughout Indo-Iranian, the findings of Cantera (2001) seem likely to be correct. In particular, de Vaan's concerns about *ərᵊδβa-* are not cogent since Hackstein (2018) has bolstered the reconstruction *$w\underset{\circ}{r}h_xd^hwó$-. Even if the initial *$w$- had dissimilated already in PIr. *$(w)\underset{\circ}{r}Hdwá$-, the following *$-w$- may have been enough to round the *$-\underset{\circ}{r}$-.

35 I intentionally cite the preprint here as the published version (Kümmel 2014b) contains only a subset of the relevant material.

36 When claiming that *u*-epenthesis must have occurred after Avestan ceased to be spoken, de Vaan (2003: 561–562) seems to follow the belief that *u*- and *i*-epenthesis represented actual epenthesis of [u] or [i] vowel into the forms. Because this article seeks to show that rounding of *r was a property inherited from PIIr., I subscribe to the view that *u*- and *i*-epenthesis merely represented phonetic labialization and palatalization respec-

nants and clusters (*t*, *θ*, *d*, *δ*, *p*, *b*, *β*, *n*, *r*; *ṇt*, *rm*, *db*; Hoffmann & Forssman 2004: 52–54 & 64; de Vaan 2003: 547–560), only *r* underwent *u*-epenthesis, implying that *r* was particularly susceptible to labialization above all other Avestan consonants.[37] These data show that at least in the environments ___*ŭ* and ___*w*, Avestan *r* possessed a rounded allophone.[38] The rounding of non-syllabic *r* does not exactly match to the situation in Indo-Aryan, but allophonic rounding of rhotics is crucial to the development of syllabic rhotics, as I will show in section 4.[39]

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tively during the composition of the Avesta. For this reason, the traditional names '*u*-epenthesis' and '*i*-epenthesis' should be used with caution, as no epenthesis may have actually occurred. For further discussion, see Morgenstierne (1973: 47) and Kümmel (2007: 277–278).

37 Avestan '*u*-mutation' of **a* > *o* only occurred between a labial consonant and a labialized *r*, *š*, *γ*, and *h* (e.g., *po*^{u}*ru* 'much' < **paru*, *mošu* 'soon' < **mašu*, *moγu-* 'magician' < **mayu-*, *vohu-* 'good' < **wahu-*; de Vaan 2003: 415–418; Kümmel 2014a: § 2.4). De Vaan rightly argues that all of *r*, *š*, *γ*, and *h* may be expected to undergo labialization, but it is striking that only *r* also undergoes *u*-epenthesis. It seems that the rounding of *r* was much more salient and required specific marking in all positions. Of course, the Avestan script possessed specific signs *ŋ*^{v}*h* and *x*^{v} for the labialized outcomes of **h*, implying that **h* also was very saliently rounded. Typologically, /h/ tends to assume the features of the following vowel (Stemberger 1993), so the presence of rounded allophones should come as no surprise.

38 There is also a marginal sound change of **ər* > *ōr*^{ə} when preceded by a labial and followed by a consonant (e.g., *θβōr*^{ə}*štar-* 'creator' < PIIr. **twr̥ć-tar-*; de Vaan 2003: 510; Hoffmann & Forssman 2004: 64), but many instances of non-application exist (e.g., *pər*^{ə}*na-* 'full' < PIIr. **pr̥H-ná-*, not ×*pōr*^{ə}*na-*). As such, the status of *PV*___ as a rounding environment remains uncertain for *r* in synchronic Avestan.

39 It is hard to say what to do with initial #(*H*)*r̥HwV́-* sequences. Lubotsky (1997: 144–148) posits the PIr. outcome **CruwV́-* < PIE **CL̥HwV́* but admits that the Middle Iranian reflexes of PIE *h*$_2$*r̥h*$_3$*-wér-eh*$_2$- (whence Skt. *urvárā* 'arable land', cf. (10a)) seem to point to PIr. **r̥warā-*. As such, the vocalization of OAv. *uruuarā-* 'plant' remains uncertain. The stem *uruuarā-* must be read trisyllabic in Y.51.7, since the Vohuxšaθra Hāitiš have consistent heptasyllabic halflines:

Y.51.7
× × × × × ×× | × × × × × × × |
dāidī mōi yə gąm taṣō | apascā **uru**uaråscā |
'Give to me, you who fashioned the cow and the waters and the plants …'

It is impossible to decide whether *uruuaråscā* ought to be read as *ᵘruwarås-cā* or *urwarås-cā*. Lubotsky argues in favor of *ᵘruwarås-cā* on the basis of the non-initial *C̥rHwV́-* > *CruwV-* seen in *zruuānəm* < PIE **ǵr̥h*$_2$*-wén-m̥*, but the development when **(H)r̥Hw-* was in initial position may have been different. If *urwarås-cā* is the correct syllabification, it would be an example of PIIr. **r̥H* being rounded to Av. [ur] before *w*.

3.2 *Old and Middle Persian*

Unlike in Avestan, **r̥*-rounding is found throughout Old and Middle Persian, though OP cuneiform obscures the early situation somewhat. The OP reflexes of Iranian **r̥* differed from those of **ar* despite both being written with ⟨a-rᵃ-⟩ initially and ⟨-rᵃ-⟩ internally. The phonemic difference between **r̥* and **ar* in OP is confirmed by loans into Elamite and reflexes in MP: **r̥* gives Elamite ⟨ir⟩ and MP *ir*/*ur* whereas **ar* gives Elamite ⟨ar⟩ and MP *ar*. Kent (1950: 15–16) prefers to reconstruct OP as having phonemic syllabic *r̥* (often transcribed in OP as *ar̥*) < **r̥*, and there are several reasons to believe that this **r̥* was phonetically rounded in OP. Diachronically, the reflexes of *r̥* in MP differ in rounding environments: **r̥* normally becomes MP *ir* (OP *kr̥ta-* > MMP *kird-* 'made', OP **kr̥mi-* > MP *kirm* 'worm'), but after labial consonants, it becomes MP *ur* (OP *mr̥ta-* > MP *murd* 'dead', OP *pr̥sa-* > MP *purs-* 'to ask'; Durkin-Meisterernst 2014: 138–139; Baghbidi 2017: 40–41).

Synchronically, the best potential evidence of *r̥*-rounding appears in the nasal-infix present ⟨kᵘ-u-n-u-t-i-y⟩ *ku⁽ʳ⁾nautiy* 3SG.PRS.ACT.IND < PIr. **kr̥náwti* of the verb *kar-* 'do, make' < PIE **kʷer-*. Kent (1942) argues against an older view that *r̥* > *u* / ___*n*, citing forms like ⟨v-r-n-v-a-t-i-y⟩ *vr̥navataiy* 'he believes' 3SG.PRS.MID.IND < **(*hₓ*)*wr̥-naw-a-tay* and ⟨k-r-nᵘ-u-v-k-a⟩ *kr̥nuvakā* 'stonecutters' NOM.PL < PIr. **kr̥t-nu-ak-āh* from **kart-* 'to cut', which do not show the change. He instead prefers to take *ku⁽ʳ⁾nautiy*'s *u*-vocalism by analogy to *tunu-* 'to be strong' < PIr. **tu-ná-H-* and the reconstructed OP form **çunautiy* 'he hears' 3SG.PRS.ACT.IND < **ćru-naw-ti*, which he reconstructs on the basis of YAv. *surunaoⁱti* 'he hears' and Modern Persian *šonidan* 'to hear'. Yet these Iranian comparisons require that the nasal-present **ḱl̥-né-w-ti* have been reformed to **ćru-náw-ti* in Proto-Iranian, since Vedic has the expected form *śr̥ṇóti*.[40] Hoffmann & Forssman (2004: 52) suggest the development of YAv. *surunaoⁱti* only occurred in Avestan by analogy with forms like the YAv. PPP *sruta-* 'heard', but the Modern Persian *šonidan* leaves open the possibility that **ćru-naw-ti* was an earlier innovation. If Iranian did have rounded **r̥ʷ* as I suggest, both the odd shape of PIr. **ćrunáwti* and OP *ku⁽ʳ⁾nautiy* could be explained by misperception by speakers of a rounded **r̥ʷ* caused by the **-na-w-* ~**-n-u-*. The effects of the rounding cue in **Cr̥ʷ-n-u-* nasal-infix presents would have further been augmented by analogy with other Iranian *Cu-n-u-* nasal-infix presents. In this way, the analogical account proposed by Kent and the phonological account of this article may function together to produce the Iranian *u*-vocalism found in nasal-

40 The claim by Kent (1942: 80) that Sanskrit rebuilt *śr̥ṇóti* by dissimilation of *u* from **śruṇóti* is unlikely.

infix presents. Furthermore, the OP reflex of **kr̥naw-/kr̥nu-* closely mirrors not only the change from Ved. **kr̥ṇu-/kr̥ṇv-* > Skt. *kuru-/kurv-* discussed in section 2.3, but also the change from PIr. **kr̥naw-/kr̥nu-* > Sogd. *kwn-* to be discussed in section 3.6.

The diachronic evidence of MP rounded *ur* reflexes of OP *r̥* after labials and synchronic evidence of intrusive *u* in **-naw-* presents argues strongly in favor of OP having an allophonic rounded *r̥*^{w} in the environments *P*___ and ___*Cu*.

3.3 *Ossetic*

The Ossetic evidence for rounding of PIr. **r̥* is very strong. While the unconditioned outcome of **r̥* is Oss. *ær* or *ar*, **r̥* gave Digor *ur* and Iron (*w*)*yr* after labials (e.g., D *urs* / I *wyrs* 'stallion' < PIr. **wr̥šan-*, D *æmburd* / I *æmbyrd* 'gathering, assembly' < PIr. **ham-br̥-ta-*, D *urg* / I *wyrg* 'kidney' < PIr. **wr̥ʕka-*) and before syllables containing *u* (e.g., D *urz* / I *wyrz* 'fingertip' < PIr. **ǰ́u-*; Cheung 2002: 24, Kim 2005: 148–152). Kim argues that D *urdug* / I *wyrdyg* 'upright, standing, steep' < PIr. **r̥dwa-ka-* < PIE **wr̥h$_x$d^{h}wó-* proves that **w* in the following syllable also rounds a preceding **r̥*, but the presence of **w* preceding **r̥* in PIE **wr̥h$_x$d^{h}wó-* muddies the situation. Without an in-depth study into the Iranian reflexes of PIE **wr̥h$_x$d^{h}wó-* to see whether the initial **w* had been deleted by dissimilation already in PIr., I cannot say whether the rounding of **r̥* in Ossetic is triggered by the following or preceding **w*.[41] The details of Oss. rounding are still not fully explained, as some examples of **r̥* following labials show the default outcome (e.g., D/I *bærzond* 'high; height' < PIr. **br̥ǰ́ant-*, D/I *marγ* 'bird' < **mr̥ga-*), but this does not disprove Ossetic rounding. Digor *ur* and Iron (*w*)*yr* from **r̥* only appear in the neighborhood of labial segments, meaning that *P*___, ___*C$_0$u*, and perhaps ___*C$_0$w* were productive rounding environments in Proto-Ossetic.

3.4 *Ormuri*

Morgenstierne (1929: 325) describes the rules governing the distribution of **r̥* reflexes in Ormuri as unclear, but Efimov (2011: 78–81) divides the outcomes between *u*-vocalism after labials (e.g., Log. / Kan. **mr-** *mur-*[42] 'to die' < PIr. **mr̥-ya-*, Log. **wólok** / Kan. **wúlak** 'brought' < PIr. **a-br̥-ta-ka-*) and *i*-vocalism elsewhere (e.g., Kan. **dir-** 'to reap, cut' < **dr̥-ya-*, Log. **zle**, **zli** / Kan. **zli** 'heart' < PIr. **ǰ́r̥daya-*). In Efimov's example of **rb* > *r* in Kan. **gurű** 'kid' < PIr. **gr̥bu(š)*, it is hard to know whether the **r̥*-rounding comes from the following **b* or **u* or

41 See also the discussion of Ved. *ūrdhvá-* in section 2.2.

42 Boldface represents the transcription system of Efimov (2011) and italics, the transcription system of Grierson (1918).

both. The most likely explanation under my account would be that the following *u* caused rounding of **r̥* which then caused **b* to be lost via dissimilation: PIr. **gr̥bu-* [gr̥ʷbu] > **gurʷbu-* > **gurʷu-* > Kan. **gurú-**. Ormuri might therefore add ___C_0*u* as a rounding environment along with the secure instances of *P*___.[43]

3.5 *Pashto*

The situation in Pashto is opaque due to a regular process that lowered stressed **ĭ* and **ŭ* to *ə́* in open syllables (Cheung 2011: 199). Nevertheless, Cheung describes how PIr. **r̥* has several different outcomes depending on Pashto stress, syllable structure, and *i*- and *u*-umlaut (Cheung 2011: 187–188 & 196–197):

(24) In synchronically stressed, open syllables, **r̥* > *ər*:
  a. PIr. **mr̥tá-* > Pash. *məṛ* 'dead'
  b. PIr. **str̥tá-* 'thrown' + *-ay* > Pash. *stáṛay* 'tired, weary'

(25) In synchronically unstressed syllables, **r̥* > *ṛ*:
  a. PIr. **ɟr̥daya-* > Pash. *zṛə* 'heart'

(26) In a synchronically closed syllable preceding a syllable originally containing **i*, **r̥* > *iṛ*:
  a. PIr. **kr̥mi-čī-* + *-ay* > Pash. *činjáy* 'worm'

(27) In synchronically closed syllables preceding a syllable originally containing **u*, **r̥* > *uṛ*:
  a. PIr. **mr̥gá-* > Pash. *muryə́* / *maryə́* / *māryə́* / *məryə́* 'bird'
  b. PIr. **pr̥sa-* > Pash. *puxt-* 'to ask'
  c. PIr. **pr̥sú-kā-* > Pash. *puxtáy* 'rib'
  d. PIr. **br̥ǰn-* > Pash. (*w*)*úǧa*, Wan. *murža* 'garlic'
  e. PIr. **br̥ɟa-* > Pash. *uǧd*, f. *uǧdá*, Waz. *wīžd*, f. *wužda* 'long'

Yet Cheung's proposed *i*- and *u*-umlaut rules do not predict his own data. For examples (27b), (27d), and (27e), he provides no explanation of why the

43 The traditional etymology given for the name 'Ormur' comes from a Pashto compound *ormər-* [ormə̆ɻ] 'extinguisher of fire' < PIr. **āϑr-* 'fire' + **mr̥-* 'to die', supposedly referring to the Ormuri people's fire-worship (Efimov 2011: 1). The fact that this term is borrowed with *u*-vocalism could mean either that Ormuri's *r*-rounding process was productive quite late into the language's phonology or that Pashto had a rounded **-muṛ-* which was obscured by the **ŭ* > *ə* lowering rule described in section 3.5.

proto-forms should be interpreted as containing *u* in the syllable following **r̥*. For (27a), he explains the various root vowels by proposing *muryə́* < **múryu* < **mr̥yu* < **mr̥gám* ACC.SG and taking the other forms from the other cases. Such an appeal to the effects of the case endings, however, would not work for (27b). In analyzing the data, Cheung missed a possible generalization: all of the forms in (27) begin with a labial consonant. Under his analysis, the lowering of stressed **ĭ* and **ŭ* to *ə́* must have taken place after the after **r̥* produced **ir* and **ur*. A parsimonious solution to this data would be to say that **r̥* became **ur* after labials and **ir* elsewhere. Then, after the application of syncope rules **u* and *i* were only retained in closed syllables.[44] The explanation using *P*___ does a much better job with (27), but it unfortunately leaves ___C_0u uncertain as a **r̥*-rounding environment. Alternatively following Cheung's *u*-umlaut solution, **r̥* would be rounded in ___C_0u but not necessarily in *P*___. I prefer *P*___ as the correct environment, but either solution leaves Pashto with clear evidence for **r̥*-rounding.

3.6 *Sogdian-Yaghnobi*

Sogdian and Yaghnobi straightforwardly show rounding of **r̥* as in *pw(r)n-* [puʷn-] 'full' < PIr. **pr̥ná-*, *m(w)rt* [muʷt-] 'dead' < PIr. **mr̥-tá-*, and *β(w)rt-* [βuʷt-] 'borne' < PIr. **br̥-tá-* (Gauthiot 1913: 90–95; Kümmel 2006: § 4.2.4; see Gershevitch 1954: 19–22, for examples). The unconditioned outcome of **r̥* is *r* [əʷ].[45] Strikingly, Sogdian shows the same development of the nasal present to **kar-* 'to do, make' as Old Persian: PIr. **kr̥-nu-* > Sog. *kwn-* [kun-] (or [kuʷn-]?), Yagh. *kun-* alongside the past stem in Sog. *krt-* [kəʷt-], Yagh. *iktá-* < **kr̥-tá-*. Gauthiot (1913: 94–95) already suggested that the **-u-* in the nasal suffix was the culprit, saying:

44 The vacillations in (27a) could potentially be due to lowering of vowels before *r* in unstressed syllables, but Cheung does not provide enough examples to be certain.

45 Sims-Williams (1984: 209–210) following Gershevitch (1954: 72) distinguishes two types of vocalism before *-r-*. The outcomes of PIr. **Vr* sequences were diphthongs, *r* [aəʷ], *yr* [iəʷ], *wr* [uəʷ], which acted as heavy for the Sogdian rhythmic law (e.g., *mrγ-* 'wood, meadow' [maəʷɣ-] < PIr. ?**marga-*, *zyrn* 'gold' [ziəʷn-] < PIr. **ǰərHanya-*, *kwrδ'k-* 'shirt, tunic' [kuəʷθaːk-] < PIr. ?**kurat-āka-*). On the other hand, the outcomes of PIr. **r̥* were rhoticized monophthongs, *r* [əʷ], *yr* [ɨʷ], *wr* [uʷ], which acted as light for the Sogdian rhythmic law (e.g., *mrg-* 'bird' [məʷɣ-] < PIr. **mr̥gá-*, *kyrm-* 'snake' [kɨʷm-] < PIr. **kr̥mi-*, *pwrn-* 'full' [puʷn-] < PIr. **pr̥ná-*). It is difficult to tell why *mrγ-* does not show rounding as compared to a words like *m(w)rt-* 'to die' PST < PIr. **mr̥tá-* or *mwrzk-* 'short' < PIr. **mr̥ʃu-ka-*, but perhaps we simply lack attestations of the spelling ×*mwrγ-*.

> Il est bien difficile de ne pas voir dans la présence du morphème *-nau-* : *-nu-* le point de départ de la naissance du timbre de la voyelle *-u-* qui s'est substituée à *-r̥-* dans la syllabe radicale; en effet le thème du participe passé, dépourvu du morphème *-nau-* : *-nu-*, oppose régulièrement **-r-*, ou ses représentants normaux, à l'*-u-* du présent.

The fact that both Sogdian-Yaghnobi and Old Persian undergo this exact same change from **kr̥-nu-* > *kun-* implies that ___*Cu* was indeed a rounding environment in both languages for the same reasons discussed in section 3.2.[46]

3.7 *Bactrian*

Bactrian also has clear evidence for rounding of **r̥*. The unconditioned outcome of **r̥* in Bactrian was ιρ [ir] (e.g., κιρδο PST stem of 'to do' < PIr. **kr̥tá-*, γιρλ- 'to call' < PIr. **gr̥da-*), but after labials **r̥* becomes ορ [ur] (e.g., βορδο PST stem of 'to bring' < PIr. **br̥tá-*, πορσ- 'to ask' < PIr. **pr̥sa-*; Gholami 2009: 30–31). Here again, the details remain to be fully worked out. For one, it seems that a following labial stop could cause rounding, as in πιδοροβ- 'to receive' < **pati-gr̥bắya-*, which would represent an extension of the environment found elsewhere in Indo-Iranian. Furthermore, a preceding labial does not always round the outcome (e.g., μιργο 'chicken; bird' < PIr. **mr̥ga-*, μιρ- 'to die' < PIr. **mr̥-ya-*). Once again, however, the Bactrian outcomes in ορ only appear near labials, which confirms at least *P*___ as a rounding environment in Bactrian.

3.8 *Wakhi*

Morgenstierne (1938: 481) reports from his informants that the general outcome of **r̥* in Wakhi was *ər ~er* but that after *p*, *f*, and *w*, **r̥* came out with a rounded vowel (e.g., *purs- ~pörs- ~pərs-* 'to ask' < PIr. **pr̥sa-*, *furz* 'birch' < PIr. **br̥Hjá-*, *wurzg* 'right' < PIr. **(w)r̥dwá-*). This points to Wakhi having **r̥*-rounding after labials.

3.9 *Yidgha-Munji*

Morgenstierne (1938: 97–98) directly states that **r̥* was rounded '[i]n the neighborhood of labials', but only provides examples of the type *P*___ (e.g., *wurγ* 'wolf' < PIr. **wŕ̥ka-*, *muṛ* 'died' < PIr. *mr̥-tá-*, *urzuγ* 'straight' < PIr. **(w)r̥dwá-*).

46 One could argue that Sogdian borrowed *kun-* from Old or Middle Persian or vice versa, since other borrowings are attested. Yet borrowing the present stem of such basic vocabulary items seems very unlikely.

TABLE 1 *$\mathring{r}$-rounding environments in Iranian

Language	Environments		
	*$P\mathring{r}$	*$\mathring{r}C_0u$	*$\mathring{r}C_0w$
Avestan	✓?	✓	✓
Old and Middle Persian	✓	✓?	✓?
Ossetic	✓	✓	✓?
Ormuri	✓	✓?	
Pashto	✓	✓?	
Sogdian-Yaghnobi	✓	✓?	
Bactrian	✓		
Wakhi	✓		
Yidgha-Munji	✓		
Khotanese	✓		

3.10 *Khotanese*

Khotanese has a wide array of reflexes for *$\mathring{r}$, namely *arr*, *ir*, *il*, *ur*, *urr*, *ul*, and *ri* (Emmerick 1989: 211–212). The forms with *u*, however, are almost entirely limited positions after labials (e.g., *muḍa-* 'dead' < PIr. *$m\mathring{r}$-*tá-*, *purr-* 'to overcome' < PIr. *$p\mathring{r}$na-*, puls-* 'to ask' < PIr. *$p\mathring{r}$sa-*).

3.11 *The situation in Proto-Iranian*

The variety of different rounding effects across the Iranian daughter languages indicates that there was no unitary development of rounded *$\mathring{r}$ in Proto-Iranian, but the evidence (summarized in Table 1) shows that *$\mathring{r}$ was certainly phonetically rounded after labial consonants, and probably also before syllables containing *u or *w.

While the above is far from an exhaustive survey, I believe this nontrivial correspondence between Iranian languages (and Sanskrit) to show that Proto-Iranian *r and *$\mathring{r}$ were highly susceptible to the spreading of rounding gestures from adjacent rounded vowels and labial consonants.[47]

In my investigation of Iranian, nowhere did I find evidence of rounding caused by labiovelars, though very few probative examples of *$K^w\mathring{L}H.C$ ap-

47 It is striking that if we were certain that PIE *$w\mathring{r}h_xd^hwó$- > PIr. *$(w)\mathring{r}dwá$- 'upright' had lost its initial *w by dissimilation already in Proto-Iranian, several languages would have *$\mathring{r}C_0w$ confirmed as a rounding environment. As noted above, this word requires future study.

peared. Of the Iranian verbal roots which could have derivatives in *$K^{w}\underset{\circ}{L}H.C$, only *$g^{w}erh_{x}$- provided an example of *$K^{w}\underset{\circ}{L}H.C$ in an Old Iranian language: YAv. *ā-γaⁱriiāṯ* (Yt.13.50, 3SG.PRS.PASS.SBJV) < **-$g^{w}\underset{\circ}{r}h_{x}$-yé́-t*. Because it does not show the outcome he predicts (×*ā-γriiāṯ*), Lubotsky (1997: 144[17]) states that *ā-γaⁱriiāṯ* was rebuilt by analogy to passives in *$C\underset{\circ}{L}$-yé-* (e.g., *x^{v}aⁱriia-*, *baⁱriia-*). On the other hand, if labiovelars did cause rounding in Iranian, then Cantera (2001) would predict ×*ā-γəⁱriiāṯ*.[48] I am inclined to take this form at face value and say the Avestan offers no support for *$K^{w}\underset{\circ}{L}H.C$ as a rounding environment, but the sparse evidence leaves the situation uncertain.

4 The diachrony of *$\underset{\circ}{L}H$ in Proto-Indo-Iranian

In the previous sections, I have shown the environments for rounding of PIE *$\underset{\circ}{L}(H)$ both in Indo-Aryan and Iranian. The formal identity between three of the rounding environments P___ and ___C_0{*u, w*} across both Indo-Aryan and Iranian leaves little doubt that this rounding is an inherited feature. Yet we still need a theoretical discussion of *$\underset{\circ}{L}$-rounding in Indo-Iranian. In the following section, I will describe the development of PIE *$\underset{\circ}{L}H$ in Indo-Iranian. Next, I will propose several potential explanations why labiovelars rounded *$\underset{\circ}{r}$ in Indo-Aryan.

4.1 *The development of PIE* *Ḷ̊H *in Indo-Iranian*

In the preceding discussion, most data has been presented from a bottom-up perspective, showing that the evidence in the daughter languages supports reconstructing rounding effects on *$\underset{\circ}{r}$ in Indo-Iranian. To get a better understanding of the situation in Proto-Indo-Iranian, we must examine the development of PIE *$\underset{\circ}{L}H$ into Proto-Indo-Iranian and its descendants. The development of PIE *$C\underset{\circ}{L}C$ > PIIr. *$C\underset{\circ}{r}C$ gives little difficulty; between consonants, PIIr. *$\underset{\circ}{r}$ does not change in Indo-Aryan and Iranian.[49] Take, for example, PIE *$k^{w}\underset{\circ}{r}$-tó- 'done; made' > PIIr. / PIA / PIr. *$k\underset{\circ}{r}$-tá- > Ved. *kṛtá-*, Av. *kərᵊta-*, OP ⟨k-r-t-⟩ *kṛta-*. PIE *$\underset{\circ}{L}H$, on the other hand, shows more interesting behavior. Before both vowels and consonants, PIIr. *$\underset{\circ}{r}H$ produces an anaptyctic vowel before the liquid, as seen in (28).

48 It is also possible that the palatalization of the following *-*ya*- blocked any rounding effects inherited from the labiovelar, but there is no way to know.

49 When either of the consonants in PIIr. *$C\underset{\circ}{r}C$ is *y or *w, the outcomes become somewhat more complicated (see for instance Lubotsky 1997: 148–149 and Byrd 2015: 142–143).

(28) Development of PIE *$\underset{\circ}{L}H$ in Indo-Iranian:

a. *$\underset{\circ}{L}HC$: PIE *$d\underset{\circ}{l}h_1g^{h}$ó- 'long' > PIIr. *$d\underset{\circ}{r}Hg^{h}$á- > {Ved. *dīrghá-*; OAv. *darᵊga-*, YAv. *darᵊγa-*; OP ⟨d-r-g-⟩ *darga-*; Khot. *dāra-*; Oss. *darγ-*}

b. *$\underset{\circ}{L}HV$: PIE *$ǵ^{h}\underset{\circ}{l}h_3$-*en-yo-* 'gold' > PIIr. *$ǰ^{h}\acute{r}\underset{\circ}{r}H$anya- > {Ved. *híraṇya-*; YAv. *zarańiia-*; OP ⟨d-r-n-y°⟩ *daraniya°*; Khot. *ysīrra-*; Oss. *zærin*}

The example (28a) shows a very interesting problem, namely that PIE *$\underset{\circ}{L}HC$ results in a superheavy syllable *$\bar{U}r.C$ in Indo-Aryan, but a heavy syllable *$ar.C$ in Iranian. This inter-branch discrepancy in syllable weights has never been adequately explained to my mind. Some scholars (e.g., Gamkrelidze & Ivanov 1995: 176–178) have sought to explain the weight discrepancy by continuing the pre-laryngealist practice of reconstructing a 'long resonant' phase of Indo-European and Indo-Iranian (*$\underset{\circ}{R}H$ > *$\bar{\underset{\circ}{R}}$). Yet the theory of long resonants does not in itself explain the data so much as hide the problem behind a series of phonemes (*$\bar{\underset{\circ}{m}}$ < *$\underset{\circ}{m}H$, *$\bar{\underset{\circ}{n}}$ < *$\underset{\circ}{n}H$, *$\bar{\underset{\circ}{r}}$ < *$\underset{\circ}{r}H$, *$\bar{\underset{\circ}{l}}$ < *$\underset{\circ}{l}H$) that do not survive in any of the daughter languages. While scholars often reconstruct unattested intermediate phonemes, the long resonants provide no explanation of why long liquids and nasals behave differently (*$\bar{\underset{\circ}{L}}$ > *$\breve{\bar{V}}r$ but *$\bar{\underset{\circ}{N}}$ > *$\bar{a}$), why the height of epenthetic vowels before liquids differs (*$\bar{\underset{\circ}{L}}$ > PIA *$\breve{\bar{U}}r$ but > PIr. *ar), why *$\bar{\underset{\circ}{L}}.C$ becomes superheavy *$\bar{U}r.C$ in Indo-Aryan, but not in Iranian, or why *$\bar{\underset{\circ}{L}}$ always results in a prevocalized *$\breve{\bar{V}}r$ in all branches of Indo-Iranian.

To achieve a proper explanation for the development of PIE *$\underset{\circ}{R}H$ in Indo-Iranian, we must propose theories which predict the specific outcomes in the daughter languages. Because of the uniform appearance of the vowel before the liquid, Kümmel (2017: 9) and Cantera (2017: 489) propose the rule in (29). Under a moraic approach, the prevocalization of *$\underset{\circ}{L}H$ actually produced a moraic increase (bimoraic PIE *$\underset{\circ}{L}_{\mu}H_{\mu}.C$ > trimoraic PIIr. *$ə_{\mu}r_{\mu}H_{\mu}.C$), a step on the way to the trimoraic weight of PIA *$\bar{U}_{\mu\mu}r_{\mu}.C$. This moraic increase may just be a side effect of Proto-Indo-Iranian no longer allowing syllabic liquids before laryngeals; the split of *$\underset{\circ}{L}$ into two segments, *$ə$ and *r, happened to increase the

morae by one.[50] One might complain that the addition of an extra mora by (29) would be part of a 'Duke of York' sound change from an Iranian perspective: bimoraic PIE $*\underset{\circ}{L}_{\mu}H_{\mu}.C$ becomes trimoraic PIIr. $*ə_{\mu}r_{\mu}H_{\mu}.C$ becomes bimoraic PIr. $*a_{\mu}r_{\mu}.C$ again. Iranian, however, has other evidence for the deletion of coda laryngeals from PIIr. **VrH.C-* (30a) and **VNH.C-* (30b) syllables.

(29) PIE $*\underset{\circ}{L}$ > PIIr. **ər* / ___{*H*, *V*}

(30) PIIr. **H* > PIr. ∅/ *VR*___*.C*
  a. PIIr. *VrH.C* > PIr. *Vr.C*
    i. OAv. *°jarᵊtar-* 'praiser' < PIE **gʷérhₓ-tor-* (cf. Ved. *jaritár-* 'singer')
  b. PIIr. *VNH.C* > PIr. *VN.C*
    i. YAv. *tąϑra-* 'darkness' < PIE **temhₓs-ro-* (cf. Ved. *támisrā-* 'dark night'; Lubotsky 2018: 1883)
    ii. OAv. *vərᵊṇtē* 'chooses' < **wṛnhₓ-tóy* (cf. Ved. *vṛṇīté* 'chooses'; Werba 2005: 700–701)
    iii. YAv. *vaⁱṇti* 'vomits' < **wémhₓ-ti* (cf. Ved. *vámiti* 'vomits'; Kellens 1984: 14[12])

(31) **ə* > PIr. **a* / ___*r*

Indeed, Indo-Aryan also repairs superheavy PIIr. $V_{\mu}R_{\mu}H_{\mu}.C$ syllables in a different way: with an epenthetic *ĭ* (Jamison 1988; Kümmel 2016: 217–218). The Vedic comparanda in (30) show that the trimoraic root syllable of PIE $*g^{w}é_{\mu}r_{\mu}h_{x\mu}.tor$- was repaired to Ved. $ja_{\mu}.ri_{\mu}.tár$-.[51] The fact that superheavy PIIr. $V_{\mu}R_{\mu}H_{\mu}.C$ sylla-

50 But see the discussion of mora-less *ə* in Byrd (2016).

51 A reviewer points out the existence of apparent counterexamples showing laryngeal deletion, citing Ved. *pótar-*/*potár-* (RV, AV), a title of one of the sacrificial priests, beside *pavitár-* (AV), both apparently from **péwhₓ-tor-*/**pewhₓ-tér-* 'purifier' (though indeed *×pūtár-* < **puhₓ-tér-* with root zero-grade would be expected for a hysterokinetic **-tér-*stem). These forms show both *-tar-* and *-tār-* and both root- and suffix-accentuation, consistent with Sanskrit's pervasive conflation of (allegedly) amphikinetic **-tor-*stems and hysterokinetic **-tér-*stems: NOM.SG *pótā* (RV I.94.6 [=AVP XIII.5.5], II.5.2, IV.9.3, VII.16.5), NOM.SG *potā́* (RV IX.67.22), NOM.SG *pavitā́* (AVŚ VI.199.3), NOM.PL *pavitāras* (AVP VI.3.11 [an accentless text]). Mayrhofer (1963: 347) following Debrunner (1954: 676) tentatively explains the unexpected *pótar-*(/*potár-*) as analogical to the priestly title *hótar-* (< **gʰéw-tor-* 'pourer' or **gʰéwhₓ-tor-* 'invoker') and *stotár-* 'praiser' (< **stéw-tor-*). There are two reasons to favor this explanation. First, the root-accented *pótar-* occurs in 3 of its 4 RV attestations in verses also containing *hótar-* and describing priestly titles:
  – RV I.94.6ab [=AVP XIII.5.5ab]:

bles were eliminated separately in Iranian and Indo-Aryan suggests that the constraint *Superheavy proposed by Byrd (2015: 107–109 & 243) continued through Proto-Indo-Iranian but was reranked higher in certain daughter branches.

In the following, I will assume that (29) is correct, and in doing so, the developments from PIIr. **ərH.C* to PIr. **ar.C* fall out naturally. The laryngeal following **r* deleted without moraic preservation according to the broader Iranian laryngeal deletion rule given in (30). Then before PIr. **r*, **ə* lowers to **a* (Cantera 2001; Kümmel 2017: 9–10), as in (31). The change of **ə* > **a* may represent the typologically common phenomenon where vowels lower before rhotics.

---

tvám adhvaryúr utá ***hótā****si pūrviyáḥ praśāstá́* ***pótā*** *janúṣā puróhitaḥ* |
'You [=Agni] are the Adhvaryu and the primordial Hotar, the Praśāstar and the Potar, by birth the one placed in front [/Purohita].' (tr. Jamison & Brereton 2014: 231)

– RV IV.9.3:
sá sádma pári ṇīyate ***hótā*** *mandró dáviṣṭiṣu* | *utá* ***pótā*** *ní ṣīdati* ‖
'He [=Agni] is led around his seat as the Hotar, gladdening at the rituals of day(break), and he sits down as the Potar.' (tr. Jamison & Brereton 2014: 572)

– RV VII.16.5:
tᵘvám agne gṛhápatis tᵘváṃ ***hótā*** *no adhvaré* | *tᵘvám* ***pótā*** *viśvavāra prácetā yákṣi véṣi ca vā́riyam* ‖
'Agni, you are the houselord; you the Hotar in the rite; you the attentive Potar, o you who grant all wishes—sacrifice and seek out a desirable reward (for us).' (tr. Jamison & Brereton 2014: 901)

Second, the creation of the seemingly *aniṭ pótar-* from *seṭ* $\sqrt{pū-}$ may also parallel the derivational ambiguity of *hótar-* from *aniṭ* $\sqrt{hu-}$ 'pour' < **ǵʰew-* and *seṭ* $\sqrt{hū-}$ 'invoke' < **ǵʰewhₓ-*. The suffix-accented *potár-*, on the other hand, appears only in RV IX.67.22, where it takes part in an elaborate *figura etymologica* at the beginning of an embedded purification spell (RV IX.67.22–27; Jamison & Brereton 2014: 1295–1296; Jamison 2015–: § IX.67.22).

– RV IX.67.22:
pávamānaḥ *só adyá naḥ* ***pavítreṇa*** *vícarṣaṇiḥ* | *yáḥ* ***potá́*** *sá* ***punātu*** *naḥ* ‖
'The one who purifies himself through our filter today, the limitless one who is the purifier, let him purify us.' (tr. Jamison & Brereton 2014: 1297)

Here the suffixal accent perhaps highlights the function of *potár-* as an agent noun 'purifier' (like *stotár-* 'praiser') and not as a priestly title.

Debrunner (1954: 675–676) mentions other unexpected *-tā́r-*stems to *seṭ* roots (e.g., *vánitar-* vs. *vántar-* 'enjoyer' < **wénhₓ-tor-* both in RV) and even unexpected *-itā́r-*stems to *aniṭ* roots (e.g., Ved. *véditar-*/*veditár-* vs. CSkt. *vettar-* 'knower' < **wéyd-tor-*). It is clear that the distribution of *-i-*insertion was already breaking down by the Vedic period. For the **-tor-* and **-tér-*stems in particular, this distributional collapse may have been exacerbated by *lautgesetzlich* laryngeal deletion of Lex Schmidt-Hackstein (**CH.CC* > **C.CC*; Byrd 2015: 88–95 with lit.) before vowel-initial oblique endings (e.g., DAT.SG ***péwhₓ-tr-ey* > **péwtrey* > *pótre**; cf. ***pewhₓ-tr-ó-* > **pewtró-* > Ved. *potrá-* 'the *pótar-*'s cup/position').

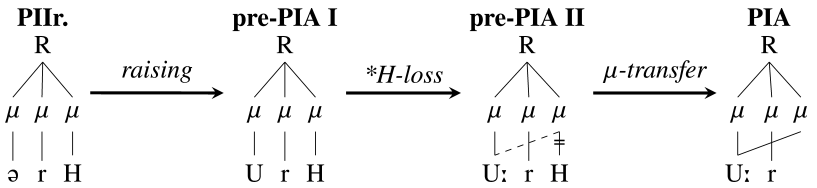
In this way, the theory that PIE *$\underset{\circ}{L}H.C$ > PIIr. *$\partial rH.C$ easily explains the facts of Iranian, but the details of how PIA *$\bar{U}r.C$ occurred require further discussion. As stated above, the PIIr. reconstruction *$\partial rH.C$ has the advantage of being trimoraic like PIA *$\bar{U}r.C$, but no account exists for why *∂ should raise to *U before *r or how *U became lengthened. Even in the extensive discussion of the distribution of Ved. *CUrWV* and *CŪrWV* from PIE *$C\underset{\circ}{L}HWV$ by Lubotsky (1997), nowhere does he propose explanations for the height or weight of *$C\acute{U}rWV$ except to say that Ved. *Ú* occurs when accented. Regarding only the question of length, he proposes that even inherited PIE *$\acute{U}rW$ lengthened under accent to Ved. *ÚrW*, but each of his examples has complications (pp. 143–144). All of this suggests that Lubotsky thinks the Vedic pitch accent also had a durational component which affected only *UrW sequences, but he never explicitly states as much. Since I know of no other Vedic examples of vowel lengthening under pitch accent, such a phonetic motivation seems unlikely, especially because cases of *$\underset{\circ}{L}H.C$ where *$C \neq$ *W show consistent $\bar{U}r.C$ outcomes regardless of accentuation (e.g., PIE *$d\underset{\circ}{l}h_1g^hó$- > Ved. *dīrghá-*).[52] Therefore, I will discuss what methods can be used to explain the problems of *∂ raising and lengthening in Indo-Aryan.

4.2 *The 'crossed lines' account of PIE* *$\underset{\circ}{\text{L}}$H.C > *PIA* *$\bar{\text{U}}$r.C

At first glance, the easiest way to realign the morae of *$\partial_\mu r_\mu H_\mu.C$ to *$\bar{U}_{\mu\mu} r_\mu.C$ would be to delete the laryngeal and reassign the mora to the vowel, as shown in (32). When the syllable-final laryngeal deletes, its mora 'leaps over' the intervening liquid to lengthen the preceding vowel.[53] Yet this simple explanation faces several theoretical hurdles. First, any explanation which involves the crossing of autosegmental association lines runs afoul of the Well-Formedness Condition (33).

52 Confusing the topic yet further, inherited PIE */$WLH.C$/ sequences provide no insight into this issue, as they should always be vocalized as *[$W\underset{\circ}{L}H.C$], not ×[$ULH.C$-], yet still develop into Ved. $\bar{U}r.C$ (Ved. *jūrṇí-* 'blaze' < PIE *$\acute{g}w\underset{\circ}{r}h_x$-ni-*). Under the traditional account, PIE *$W\underset{\circ}{L}H.C$ became (pre-)PIA *$W\bar{U}r.C$ which then dissimilated to *$\bar{U}r.C$, but as Sihler (1977) has shown, the Vedic metrical evidence does not generally support readings of *$WUr.C$* over *$\bar{U}r.C$*. He interprets the dissimilation *$W\bar{U}r.C$ > *$\bar{U}r.C$ as predating the composition of the Vedas, meaning there is no way to adjudicate between the traditional view (PIE *$W\underset{\circ}{L}H.C$ > PIIr. *$W\underset{\circ}{r}.C$ > pre-PIA *$W\bar{U}r.C$ > PIA $\bar{U}r.C$) or any other view (PIE *$W\underset{\circ}{L}H.C$ > PIIr. *$W\partial rH.C$ > pre-PIA *$UrH.C$ > PIA $\bar{U}r.C$).

53 For the sake of argument, I assume *∂ raised to *U before the mora realignment, since there is not good reason to posit an extra phoneme *$\bar{\partial}$ in the history of Indo-Aryan.

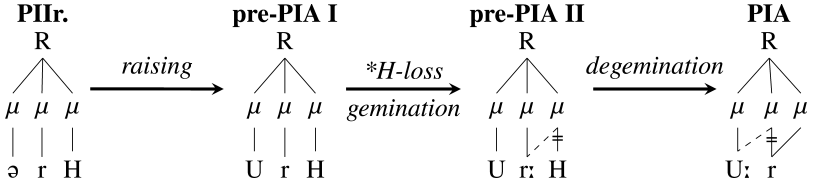
(32) 

(33) Well-Formedness Condition (Goldsmith 1979: 48; rev. Sandell & Byrd 2014: 34–35 & 2015: 3)
   a. All segments are associated with at least one prosodic unit. All prosodic units are associated with at least one segment.
   b. Association lines do not cross.

Szemerényi's Law (word-final fricative deletion with compensatory lengthening; e.g., pre-PIE ***ph₂tér-s* > PIE **ph₂tḗr*; Szemerényi 1962: 12–13) might seem to provide a parallel example of the sort of crossed line effect proscribed by (33), but Sandell & Byrd (2014 & 2015) have cogently argued the extrametricality of word-final consonants may be used to explain Szemerényi's Law better. Indeed, they correctly predict that PIE should not have 'medial Szemerényi's Law' (***VRF.C* > **V̄R.C*), suggesting that the Indo-Aryan change from **ərH.C* > **Ūr.C* would be better explained differently from Szemerényi's Law.

4.3 *The 'phonemic geminate' account of PIE* *L̥H.C > *PIA* *Ūr.C

If we cannot simply reassign the laryngeal's mora directly to the preceding vowel as in (32), we might try proposing that **rH* temporarily became a geminate **rr* before degeminating with compensatory lengthening due to the Sanskrit proscription on geminate *r*. A schematic version of this account is shown in (34).

(34) 

Sanskrit has an initially attractive parallel for the creation and immediate loss of geminate **rr* with compensatory lengthening, as when /r/ and /s/ in *ruki* contexts delete with lengthening of the preceding vowel before *r* (e.g., *pátis* + *rayīṇā́m* (→ **pátir rayīṇā́m*) → *pátī rayīṇā́m*; Kobayashi 2004: 99–100). This external sandhi rule (/Us#r/ → [Ū#r]) is not a good parallel for **ərH.C* > **Ūr.C*

precisely because the sandhi rule functions heteromorphemically and heterosyllabically. Since sandhi applied to synchronically derived sequences, no temporary geminate *r* phase must have existed: the underlying *s* following a high vowel would normally become *r* before a voiced consonant (since *z* and *ž* were not phonemes in Sanskrit), but because a geminate *r* would result, the underlying *s* was instead deleted and its mora transferred to the preceding vowel. At no point in this synchronic process did the illicit *-*r r*- necessarily exist. Even if this geminate did exist at some phase in the prehistory of Sanskrit, it would have appeared heterosyllabically. Keydana (2014: 277–278) argues in his discussion of Szemerényi's Law that the explanations that analyze ***ph₂tér-s* as going through an intermediate geminate phase ***ph₂térr* fail because there is no evidence that Proto-Indo-European ever allowed tautosyllabic geminates in codas.

4.4 *The 'phonetic geminate' account of PIE* *L̥H.C > *PIA* *Ūr.C

If, however, we set aside the idea of a phonemic geminate resulting from the unmotivated assimilation of $*U_{\mu}r_{\mu}H_{\mu}]_{\sigma} > *U_{\mu}r_{\mu}r_{\mu}]_{\sigma}$, Present Day General American English provides a typological parallel for phonetic gemination of coda *r* and *l*. When English monosyllables contain a high tense vowel or diphthong followed by a coda liquid, speakers frequently disagree whether the resulting word is mono- or disyllabic, an effect which Lavoie & Cohn (1999) term 'sesquisyllabicity'.

(35) General American English sesquisyllabicity:

/V/	ɹ̈]$_{\sigma}$	1σ	2σ	l]$_{\sigma}$	1σ	2σ
/i/	*peer*	[pɪɹ̈]	[pi:.ɹ̈]	*peel*	[pi:ɬ]	[pi:.ɬ]
/u/	*lure*	[lʊɹ̈]	[lu:.ɹ̈]	*pool*	[pu:ɬ]	[pu:.ɬ]
/aj/	*fire*	[fajɹ̈]	[faj.ɹ̈]	*file*	[fajɬ]	[faj.ɬ]

As the examples in (35) show, underlying coda liquids may be realized as either codas or syllabic nuclei, but coda [ɹ̈] has the further effect of making tense vowels lax when tautosyllabic, as in [pɪɹ̈] and [lʊɹ̈]. Walker & Proctor (2019) explain this behavior as a result of conditioned bimoraic production of the General American bunched or 'molar' [ɹ̈].[54] The articulation of [ɹ̈] involves a constric-

54 No official symbol exists in the IPA for the bunched *r*. Laver (1994: 302) proposed to use the

tion of the tongue body at the pharynx and a constriction of the tongue tip at the palate. According to Walker & Proctor, coda [ɹ̈] has the pharyngeal tongue body constriction sequentially timed before the palatal tongue tip constriction. When the [ɹ̈] follows a high vowel or diphthong, which involve a palatal tongue body constriction, the initial pharyngeal tongue body constriction of [ɹ̈] may not overlap with the preceding vowel, resulting in bimoraic coda [ɹ̈]. The length of the coda [ɹ̈] is only further increased when another consonant is added (e.g., *peered*, *lured*, *fired*). Because English has a constraint against syllables with more than three morae and because English high tense vowels and diphthongs are phonetically bimoraic, quadrimoraic forms like [piːˌμμɹ̈ˌμμ] are repaired by making the vowel lax ([pɪˌμɹ̈ˌμμ]) or the coda syllabic ([piːˌμμ.ɻ̈ˌμ]).[55] If the Indo-Iranian **r* also involved a dorsal constriction, a similar explanation could be used to explain the lengthening of PIIr. **ərH.C* > PIA **Ūr.C*. When PIIr. **ə* raised to a short high vowel in pre-PIA, the coda **r* would prevent its dorsal gesture from overlapping the preceding high vowel and thus become phonetically bimoraic. The laryngeal, now preceded by three morae and followed by another consonant, would then be deleted by stray erasure since extrasyllabicity is not possible word-medially (PIIr. $*ə_{\mu}r_{\mu}H_{\mu}.C$ > $**U_{\mu}r_{\mu\mu}\langle H\rangle.C$ > $*U_{\mu}r_{\mu\mu}.C$; for discussion of similar laryngeal deletions in Indo-European, see Byrd 2015: 105–123).

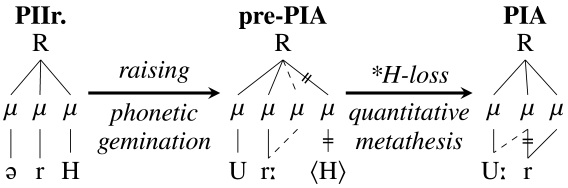
Yet simply following the *r* of an already trimoraic syllable cannot have been sufficient to delete a laryngeal, as seen in the *-iṣ-*aorists where the laryngeal is not deleted (**h₁é-tērh₂-s-t* > $*á.tā_{\mu\mu}r_{\mu}Hst$ » Ved. *átārīt* 'overcome' 3SG.AOR.ACT.IND). Since the PIIr. laryngeal likely had a dorsal articulation, the preceding bimoraic, dorsal **r* could have led to a dissimilatory loss of the laryn-

character [Ψ], but Ball (2017) rightly argues that [Ψ] looks very little like the other rhotics. Instead, Ball prefers the approximate symbol [ɹ] with the addition of the IPA double dot diacritic 'because the tongue is bunched up to a central position along the tongue roof: [ɹ̈]' (807).

55 In what follows, I treat morae as surface temporal increments, following Walker & Proctor (2019: 457) when they say that '[m]ora assignment is computed over sequencing of subsegments, predicting that complex segments may be bimoraic.' Thus, a coda [ɹ̈] with two sequential gestures, one dorsal and one coronal, may receive two timing units during production, one for each gesture. If, however, the dorsal gesture is allowed to overlap with the preceding vowel (as in *car* [kɑɹ̈]), the dorsal gesture does not provide a temporal increment or mora separate from those of the vowel. In this way, the notion of morae functions as a convenient way of describing the phonetically observable sequencing of gestures and the timings they impart. If the reader finds issue with this usage of 'mora', mentally convert all mentions above to 'timing units'.

geal (*$U_{\mu}r_{\mu\mu}\langle H\rangle.C$ > *$U_{\mu}r_{\mu\mu}.C$) not found after monomoraic *r (*$\breve{a}_{\mu(\mu)}r_{\mu}H.C$ > *$\breve{a}_{\mu(\mu)}r_{\mu}.Hi.C$ or *$\breve{a}_{\mu(\mu)}r_{\mu}.iH.C$). Crucially for this Indo-Aryan account (just as in English), the extra mora of *$U_{\mu}r_{\mu\mu}.C$ is never phonemic but merely a phonetic effect when competing dorsal gestures in high vowels and coda liquids are not allowed to overlap. The morae would then represent, in sequence, the dorsal gesture of the high vowel, the dorsal gesture of the coda *r, and the coronal gesture of the coda *r. After the laryngeal was lost, the *$U_{\mu}r_{\mu\mu}.C$ underwent a quantitative metathesis to *$\bar{U}_{\mu\mu}r_{\mu}.C$, giving the Indo-Aryan outcome. This quantitative metathesis would result from speakers reassigning the phonetic extra mora of the coda *r to the preceding vowel. English does not have a parallel to the quantitative metathesis *$U_{\mu}r_{\mu\mu}.C$ > *$\bar{U}_{\mu\mu}r_{\mu}.C$, but this is unsurprising as English high tense vowels are already bimoraic, a fact which precipitated the repair of quadrimoraic ×[pi:$_{\mu\mu}$ɪ̈$_{\mu\mu}$] to [pɪ$_{\mu}$ɪ̈$_{\mu\mu}$] or [pi:$_{\mu\mu}$.ɪ̈$_{\mu}$]. The whole Indo-Aryan process is shown in (36).

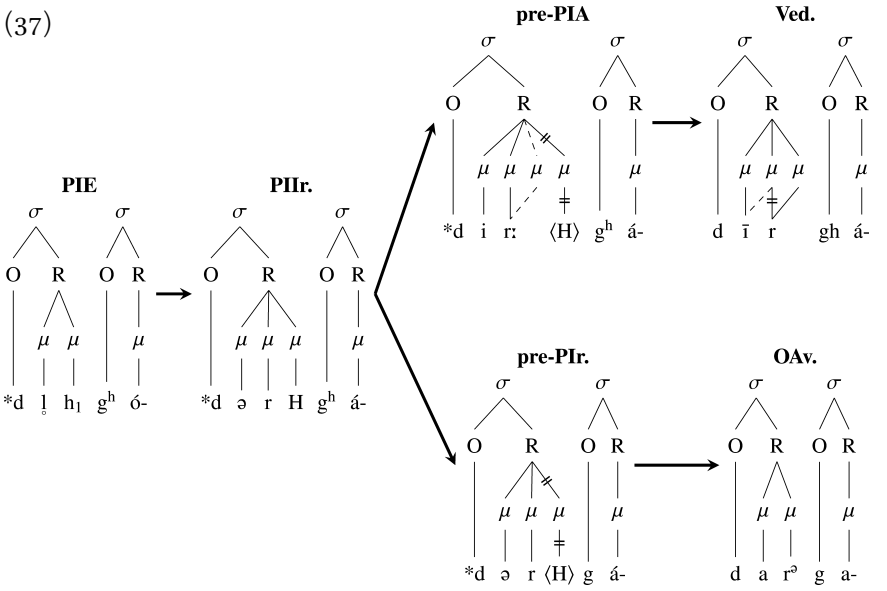
(36)



Thus, when Indo-Aryan raised the epenthetic *$ə$, the resulting high vowel conditioned the phonetically bimoraic *r.[56] For this analysis to work, much depends on the Indo-Iranian *r having dorsal articulation similar to General American English [ɹ̈], which is exactly what will be argued in Section 4.7. For the moment though, let us assume that Indo-Iranian *r had the requisite characteristics to allow the lengthening shown in (36). Then the development of PIE *$dl̥h_1g^hó$- 'tall' to Ved. *dīrghá-* and OAv. *dar^{ə}ga-* may be summarized in (37).

56 Note that under this analysis, the same lengthening of PIIr. *$Ur.C$ > PIA *$\bar{U}r.C$ should occur even without a laryngeal, a theory recently explored and confirmed by Clayton (2022).

(37)



4.5 *The rounding environments of PIIr.* *r̥H

We still require an account of why the vowels produced before **r* rounded in labial environments. The crucial phonological insight to explaining this phenomenon in Indo-Iranian is the fact that PIIr. **r̥* was phonetically rounded in the environments discussed above:

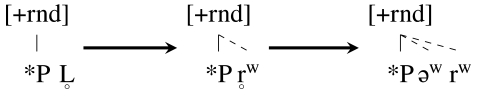
(38) Indo-Iranian **r̥* rounding:

$$/{*}\mathrm{r}/ \rightarrow [{*}\mathrm{r}^{\mathrm{w}}] \begin{cases} \{P, K^{w}\}__ \\ __C_{0}\{w, u\} \end{cases}$$

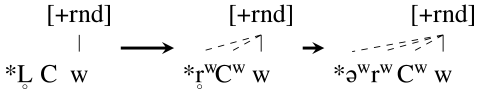
This phonological rule continued to function not only into Indo-Aryan and Iranian but even later if OP *ar̥* and Ved. *r̥* really represented [r̥] ~ [r̥ʷ]. The conditioned rounding cue associated with following **r* would then be associated with a preceding anaptyctic vowel by speakers. Operstein (2010: 77–81) gives several examples of anaptyptic vowels developing from syllabic consonants which borrow the secondary articulation from adjacent segments. She provides examples from the Pacific Northwest language Quileute, which shows anaptyctic [ʊ] after labio-uvulars (e.g., /qʷɻ̩/ [qʷʊɻ̩] 'doorknob; shirt'), and from Tashlhiyt Berber, which shows anaptyctic [ʊ] near /u/ (e.g., /jugl̩/ [jugʊl] 'he hung'). Looking at the examples of Quileute and Tashlhiyt Berber, one might object that a preceding labial or following **u* or **w* could have rounded the anaptyctic vowel without first rounding the **r*. Fortunately, Indo-Iranian gives

several other examples of anaptyxis, none of which shows rounding effects. Most relevantly, the vocalization of laryngeals produced a high vowel, *ĭ*, in Sanskrit just as **r̥* did, but the vocalized laryngeals never show rounding of the anaptyctic vowel (e.g., Ved. *pitár-* 'father' < PIE **ph₂tér-*, not ×*putár-*; Lubotsky 2018: 1882–1883). Likewise, **n̥(H)* comes out as **ă* in Indo-Iranian even in the rounding environments reconstructed for **r̥* (e.g., Ved. *pūrvajā́varī-* 'born of old' F < PIE **pr̥h₂-wo-ǵn̥h₁-wer-ih₂-*, not ×*pūrvajúvarī*).[57] Because anaptyctic vowels before other segments do not show variable roundedness, it stands to reason that some particular property of **r* played a role. Therefore, I propose that the lip rounding of a preceding labial or following **w*/**u* spread to the **r̥* and then to its anaptyctic vowel. These two effects are shown in (39) and (40), respectively.

(39) /*r/ → [*r^{w}] / {*P, K^{w}*}___



(40) /*r/ → [*r^{w}] / ___*C*$_0${*w, u*}

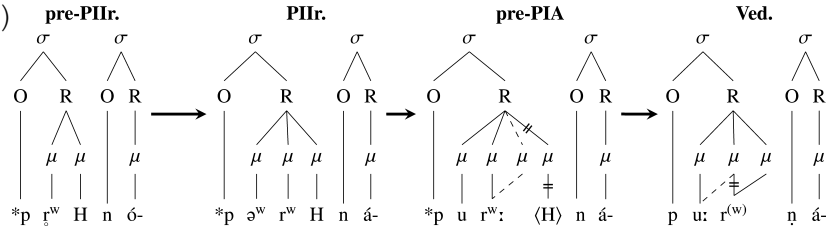


57 There is some evidence that the development of **n̥HC* in Indo-Iranian was not uniform. The outcomes **n̥HC* and **m̥HC* have traditionally been unified in the single outcome **ā* (Wackernagel 1896: 14–17; Forssman 1986; Hoffmann & Forssman 2004: 70). Kobayashi (2004: 95–97), however, follows the view that **m̥HC* becomes *ām* in Vedic, unlike **n̥HC* > *ā*:
- **ḱremh₂-* > Ved. √*śram*^{i}- 'be weary': *śrā́myati* < **ḱrm̥h₂-yé-ti*, *śrāntá-* < **ḱrm̥h₂-tó-*
- **temhₓ-* > Ved. √*tam*^{i}- 'faint': *tā́myati* (B) < **tm̥hₓ-yé-ti*, *tāntá-* (B) < **tm̥hₓ-tó-*
- **kremhₓ-* > Ved. √*kram*^{i}- 'stride': *krāntá-* < **krm̥hₓ-tó-*, *krāntvā́* (B) < **krm̥hₓ-tw-éh₁*
- **wemh₁-* > Ved. √*vam*^{i}- 'vomit': *vāntá-* (B) < **wm̥h₁-tó-*
  > YAv. √*vam-* 'vomit': °*vaṇtīm* < **wm̥h₁-tí-m*

  Kobayashi postulates the following account for the differing outcomes of **n̥* and **m̥* in PIIr.: **Ṇ* epenthesized a vowel before it, [**ṼN*]. For **n̥*, the nasalization cue became reinterpreted as part of the vowel, leading to the loss of the nasal stop and resulting in **Ṽ*. **Ṽ* was then denasalized to *a* (cf. Greek **Ṇ* > *α*). For **m̥*, however, the lip rounding cue was perceptible enough to require a labial segment to motivate it, and so **m* remained. Thus, **n̥HC* > **ṼnHC* > **ṼHC* > **āC*, but **m̥HC* > **ṼmHC* > **āmC*. Crucially, however, it is the phonetics of the labial **m* segment that causes the differing outcome, not the phonetics of the other adjacent segments. Yet, the change **ṼmHC* > **āmC*, with the laryngeal compensatorily lengthening the vowel at a distance over the intervening *m*, would run afoul of the same crossed lines and phonemic geminate issues mentioned in Sections 4.2–4.3. Overall, the *lautgesetzlich* Vedic outcome of **m̥HC* remains problematic.

In the data presented for Indo-Aryan and Iranian, it is striking that rounding from a preceding labial functions across the board, while rounding from a following **w/u* functions less consistently. A possible explanation is shown in (40), where the spread of lip rounding passes through any intervening consonants, phonetically rounding them in the process. Depending on the particular phase of PIIr. developing into its daughters, the ability of particular intervening consonants to be rounded may vary.[58] Contrast this with (39), where, at any phase, the lip rounding need only travel to the immediately adjacent **r̥* without passing through any other segments which could potentially block the effect. As such, the model of roundedness feature spreading predicts the stability of *P*___ and the instability of ___C_0{*w, u*} as rounding environments. Under this view, the development of PIE **pl̥h₁-nó-* into Ved. *pūrṇá-* 'full' proceeds as in (41).

(41)



4.6 *The development of PIE* *KʷL̥H.C- > *Ved.* Kūr.C-

With the analysis of the development of **L̥H* described above, the retention of the effects of labiovelars has yet to be explained. There are three main hypotheses, (42), about how labiovelars could be preserved into Vedic such that PIE **Kʷl̥H.C-* > Ved. *Kūr.C-* but PIE **Kʷl̥.HV-* > Ved. *Ki.rV-*.

(42) Hypotheses for retention of rounding in **Kʷl̥H.C-*:
- a. **r̥* split into two phonemes, **r̥* and **r̥ʷ*, in Proto-Indo-Iranian
- b. **H* split into two phonemes, **H* and **Hʷ*, in Proto-Indo-Iranian
- c. Before **ərH]σ*, **Kʷ* did not merge with **K* until Proto-Indo-Aryan

All of the hypotheses in (42) work by trying to find somewhere to attach the phonemic [+labial] feature so that it may continue rounding **r̥*. Perhaps

58 A system like Revised Articulatory Theory of Halle, Vaux, & Wolfe (2000) could produce this analysis. Under their system, the visibility of features to phonological rules may change from generation to generation. An intervening segment may block or permit feature spreading depending on whether a speaker perceives that segment as requiring specification in a given feature.

the simplest of these is Hypothesis (42a). Yet the notion that Proto-Indo-Iranian would gain a short-lived *$*r̥^{w}$* phoneme which then became phonetic in all the daughter languages is not a parsimonious solution. Furthermore, phonemic labiality contrasts in rhotics are in themselves uncommon. Looking at rhotics using the cross-linguistic database of phonological inventories PHOIBLE (Moran & McCloy 2019), a clear trend emerges. In the languages which contrast coronal rhotics with their rounded variants, /rʷ/ appeared 17 times, /ɻʷ/ 10 times, and /ɾʷ/ 4 times. Each of these languages, however, also has a full series of contrastive labialized coronal stops (/tʷ/, /dʷ/, etc.). Since no archaic Indo-Iranian language contrasts rounded and unrounded coronal stops, proposing a labiality contrast in coronal rhotics seems typologically implausible. On the other hand, the dorsal rhotic /ʁʷ/ occurs in 20 languages, but in 12 of them, it appears as part of series of labialized dorsals.[59] The potential for a dorsal place of articulation of PIIr. *$*r̥$* will become important in section 4.7. For the purposes of Hypothesis (42a), however, I see no reason to propose that Indo-Iranian lost its velar-labiovelar contrast while transferring it to a marginal phoneme *$*r̥^{w}$*. In particular, it is unclear why *$*r̥$* would not become *$*r̥^{w}$* in open syllables as well (PIE *$*g^{w}r̥h_{x}$*-*$*éh_{1}$* > *$*gr̥^{w}$*.*HáH* > ×*gurá́* instead of *girá́* 'praise' INS.SG).

Another segment which could become the anchor for a [+labial] feature is the labialized laryngeal *$*H^{w}$* of Hypothesis (42b). Indeed, others have proposed that Proto-Indo-Iranian had the contrast between *$*H$* and *$*H^{w}$* before. Khoshsirat & Byrd (2018) and Khoshsirat (2018) argue that the Gilaki causative in -*bĕ*- and the Vedic causative in -*āpaya*- could go back to the sequence PIE *-*oH-éye*- > pre-PIIr. *-*oH^{w}éye*- > PIIr. *-*āH^{w}áya*- */-aːʍája-/ > Ved. -*āpáya*-, Gil. -*bĕ*-. In support of their proposal, they provide a possible typological parallel for *$*H$* > *$*H^{w}$* / *o*___, in which *-*óHe#* produces Ved. -*au* (PIE *$*dedóh_{3}$*-*e* > Ved. *dadáu* 'gave' 3SG.PRF.ACT.IND; Jasanoff 2003: 61–62). For Khoshsirat & Byrd's argument to work, the *$*H^{w}$* must have become phonemic in Proto-Indo-Iranian when *$*o$* lost its [+round] feature when it became *$*ă$*. The reconstruction of a phonemic PIIr. *$*H^{w}$* would provide perhaps the most elegant solution to PIE *$*K^{w}l̥H.C$*- > Ved. *Kūr.C*-. When PIE *$*K^{w}l̥H$* appeared in a closed syllable, *$*K^{w}l̥H.C$*-, the tautosyllabic laryngeal would labialized by the preceding phonetically rounded *$*r^{w}$* and then provide a new anchor for the [+round] feature.[60] On the other hand, when

59 When taking the data from PHOIBLE, I collapsed entries for different dialects of the same language in an attempt to get a more representative count.

60 For this hypothesis, I see no way of determining whether the creation of phonemic *$*H^{w}$* occurred chronologically before or after *$*r̥$* > *$*ər$*. If it occurred after, rounding would have to spread through the intervening *$*ə$* to *$*r$* and then to *$*H$*. If it occurred before, then the

TABLE 2 *$*K^{w}\underline{l}H$* development according to (42b)

*$*K^{w}\underline{l}H.C$-	>	*$*K^{w}\underline{r}H.C$-	[*$*K^{w}\underline{r}^{w}H^{w}.C$-]	>	*$*KərH^{w}.C$-	[*$*Kə^{w}r^{w}H^{w}.C$-]	>	*$*Kūr.C$-
*$*K^{w}\underline{l}.HV$-	>	*$*K^{w}\underline{r}.HV$-	[*$*K^{w}\underline{r}^{w}.HV$-]	>	*$*Kər.HV$-	[*$*Kər.HV$-]	>	*$*Ki.rV$-

$*K^{w}\underline{l}H$ appeared in an open syllable, *$*K^{w}\underline{l}.HV$-, the *$*H$* would not be rounded and the [+round] feature would be lost.

While the previous proposal does get the distribution very nicely, it encounters two drawbacks. First, the labialization of *$*H$* would only occur tautosyllabically after *$*\underline{r}^{w}$*, but heterosyllabically after *$*o$* (PIE *$*$-o.Hé.ye$- > PIIr. *$*$-ā.H^{w}á.ya$-). Secondly, there is much to be worked out in Khoshsirat & Byrd's account of the causatives in *$*$-āH^{w}áya$-, which leaves the support for phonemic PIIr. *$*H^{w}$* uncertain. Neither drawback kills Hypothesis (42b), but further investigation of PIIr. *$*H^{w}$* is required.

Finally, Hypothesis (42c) simply allows labiovelars to stick around in one very limited environment. Fortson (2010: 212) has already proposed this idea:

> Particularly interesting are words like *gurú-* 'heavy' < *$*g^{w}\underline{r}h_{2}$-u$-, where the labialization that induced the *u*-quality was that of the preceding labiovelar. In other words, at the time of the split of *$*\underline{r}H$* or its immediate descendant into *ir* and *ur*, which happened only in Indic (Iranian has a different outcome), the labiovelars were still distinct from the plain velars in at least this environment.

The preceding discussion has shown that *gurú-* is not a reliable witness of its labiovelar (section 2.3), yet Fortson's suggestion about the conditioned retention of labiovelars is a good one. Since *$*\underline{r}$* must have been phonetically rounded in labial environments already in Proto-Indo-Iranian, the roundedness of the [*$*\underline{r}^{w}$*] could have served to 'reinforce' the labiality of the labiovelars after they disappeared in other environments. Indeed, there is a parallel type of retention found elsewhere in Indo-European. In Luvo-Lycian, the palatal velars collapse together with the plain velars except when followed by a fronting environment (Melchert 2012). The examples are mirrored: Luvo-Lycian marginally preserves palatovelars in a *centum* language while Sanskrit marginally preserves labiovelars in a *satəm* language, but conversely the palatovelars collapse with the plain

diphthongization would need to occur in front of both *$*H$* and *$*H^{w}$*. Since neither of these two situations seems particularly problematic, the matter remains unsettled.

velars in the other Anatolian languages just as the labiovelars collapse with the plain velars in Iranian. Philologically, the remnant labiovelars of Indo-Aryan would have escaped detection because they left traces in the vocalism of *$\mathring{L}H$, while remnant Luvo-Lycian palatovelars appeared as alterations to the consonants themselves.[61]

If adopting the conditioned labiovelar retention theory, the question remains why they would only be retained in closed *$K^w\mathring{L}H.C$- syllables. A possible solution comes from gestural overlap. Onset consonants are known to have heavy gestural overlap with their nuclear vowels (Browman & Goldstein 1988: 98); in the case of labiovelars, this means the lip rounding gesture of the labiovelar 'spills over' into the following *-*ər*- sequence. Indo-European has another example where different levels of gestural overlap cause different featural outcomes in vowels. Specifically, Vine (2002: 293–295) proposes that Eichner's Law, the observation that *h_2 and *h_3 fail to color long *$\bar{e}$, resulted from a failure of the laryngeal coloring gestures to overlap the *$\bar{e}$ completely.[62] In a similar way, it is possible that the labiovelar's lip rounding gesture failed to overlap an open *K^w*ər.H*- syllable fully. In closed syllables like *K^w*ərH.C*-, however, each of the three morae would be commensurately shorter as also found in Hungarian, where the initial vowel of *VCC* rimes shows the shortest duration of any syllable shape (Cohn 2003: 85–87). In Indo-Iranian, the inherited labiovelar would only be reinforced when its lip rounding gesture fully covered not only the intervening *$ə$ but the following *r.

A second, more promising approach to the conditioned labiovelar retention theory appears in the typology of coda liquids. Gick et al. (2006) conducted an articulatory survey of liquids using ultrasound to map the timings of labial, coronal, and dorsal gestures, and they found that all languages surveyed (Western Canadian English, Quebec French, Serbo-Croatian, Korean, Beijing Mandarin, and Squamish Salish) showed dorsal constriction in coda liquids regardless of the liquids' phonemic velarity or palatality. Furthermore, the dorsal ges-

61 I would like to clarify that I do not think the labiovelars were preserved in all other environments. Parsimony suggests that before palatalizing environments *K and *K^w had already merged in Indo-Iranian. It is conceivable that labiovelars were also preserved in other rounding environments, namely before *-*u*- and *-*w*-, but that no difference was shown in the already round vowel.

62 The formulation of Eichner's Law is confusing in terms of the gestural explanation. As an artifact of the history of its discovery, the law is stated negatively: laryngeal coloring fails to affect *$\bar{e}$. From the perspective of the gestural overlap explanation, it would be better to formulate the rule inversely: laryngeals only succeed at coloring in a limited environment, namely when *e is short. Thinking of Eichner's observation in this way may be useful for considering the situation in Vedic.

TABLE 3 *$K^{w}\underset{\circ}{L}H$ development according to (42c)

*$K^{w}\underset{\circ}{L}H.C$-	>	*$K^{w}\underset{\circ}{r}H.C$- [*$K^{w}\underset{\circ}{r}{}^{w}H.C$-]	>	*K^{w}ə$r(H).C$- [*K^{w}ə$^{w}r^{w}(H).C$-]	>	*$K\bar{u}r.C$-
*$K^{w}\underset{\circ}{L}.HV$-	>	*$K^{w}\underset{\circ}{r}.HV$- [*$K^{w}\underset{\circ}{r}{}^{w}.HV$-]	>	*Kə$.rV$- [*Kə$.rV$-]	>	*$Ki.rV$-

tures of the coda liquids frequently occur before the coronal gestures. In onset liquids by contrast, not all languages showed dorsal gestures, and those dorsal gestures that did occur were not significantly before or after the coronal gestures. Assuming that Indo-Iranian behaved similarly and had a dorsal gesture associated with coda *r but not with onset *r, the preservations of the labiovelar rounding gesture could stem from differing syllabifications. Before another consonant, the leading dorsal gesture of coda *r in *Kə$r\langle H\rangle.C$- would allow the rounding gesture to spread over the entire nucleus of the syllable, preserving the rounding until Indo-Aryan. Before a vowel, the onset laryngeal could have been deleted early, resulting in the *r resyllabifying into the onset and losing its dorsal gesture. The presence of the dorsal gesture in coda *r would play a crucial role in retaining the rounding gesture, as schematized in Table 3.

Following the discussion above, I am inclined to support Hypothesis (42c) since it has a nice typological parallel in Luvo-Lycian. Furthermore the next section will show that there is good reason to believe that Vedic coda and syllabic rhotics had dorsal articulation. While Hypothesis (42b) works very elegantly by providing a new rounded phoneme, *H^{w}, to take up the standard from the disappearing labiovelars, the existence of *H^{w} remains highly speculative. Yet two plausible explanations for PIE *$K^{w}\underset{\circ}{L}H.C$- > Ved. $K\bar{u}r.C$- definitely provide sufficient theoretical support for the Vedic data itself.

4.7 *The phonological character of PIIr.* *r

Throughout the preceding discussion, I have been using the traditional symbol *r to represent all the rhotics in the Indo-Iranian languages, but it is implausible to assume that *r represented the apical trill [r] of the IPA throughout the development of Indo-Iranian. I shall remain agnostic about when the PIE *r gained the retroflex /ɻ/ articulation assumed by Ryan (2017) among others. As discussed above, the presence of a dorsal gesture would be sufficient for Indo-Iranian coda *r to serve as a host for a lip rounding gesture in Indo-Iranian and to cause lengthening of a preceding high vowel in Indo-Aryan. Fortunately, the native Sanskrit grammatical tradition provides evidence for the presence of a dorsal gesture. The earliest grammarians describe Vedic $\underset{\circ}{r}$ not as retroflex but as *jihvā-mūlīya* 'produced at the root of the tongue' (e.g., *Ṛgveda-Prātiśākhya* 1.41; *Vājasaneyī-Prātiśākhya* 1.65) and as using the jaws and with the tongue tip near

the upper back gums (*Taittirīya-Prātiśākhya* 2.18; Deshpande 1979: 282; Hock 1991: 124–128).[63] On the other hand, the Prātiśākhyas describe consonantal *r* as having a (post)dental place of articulation different from syllabic *r̥*'s velar articulation, another comparable feature to English phonology. Walker & Proctor (2019: 6–9) note that, while General American English coda liquids have their dorsal tongue body constriction sequenced before their palatal tongue tip constriction, onset rhotics reach the pharyngeal and palatal constrictions synchronously and onset laterals have the palatal constriction first (which agrees with the findings of Gick et al. 2006). Thus, the differing characterizations of the Sanskrit syllabic and consonantal liquids might represent the grammarians prioritizing whichever articulatory gesture came sequentially first: for consonantal liquids, which would be most commonly described in onsets, the (post)dental target would be reached first, but for syllabic liquids, which would behave more like coda liquids, the dorsal target would be reached first. The

63 The most explicit discussion of the Prātiśākhyas' frequent and unexpected description of *r̥* and *l̥* as 'velar' comes from Hock (1992), who explains away this issue as an accident of evolving phonetic theory. Several of the Prātiśākhyas describe *r̥* as equivalent to the postdental or alveolar *r* surrounded by two quarter-moraic *a* vowels (*r̥* = $^{a}r^{a}$ = [^{ə}r^{ə}] = $\frac{a}{4}+\frac{r}{2}+\frac{a}{4}$). Hock proposes that, in the earlier phonetic tradition (represented by the *Taittirīya-Prātiśākhya*), the *a* vowel would be considered velar by default since it lacked labial, dental, retroflex, or palatal coloring. He then describes the rise of a new 'glottalic theory' (for instance, in the *Ṛgveda-Prātiśākhya*), in which *a*, *h*, and *ḥ* were recategorized as glottal. Because of the phonetic descriptions of their surrounding *a* vowels, *r̥* and *l̥* received a velar classification that went unamended when *a* was reclassified as glottal.

Yet Hock admits the speculative nature of his account, as no treatise preserves the alleged diachronic stage in which *a* is classified as velar. Furthermore, it seems plausible to me that the surrounding quarter-moraic *a* vowels described in the treatises could be transitional vocoids perceived on the way to the rhotic articulatory targets. Indeed, the *Taittirīya-Prātiśākhya* 2.18 describes *r̥̆* as articulated with the jaws close together and the tongue tip near the upper back gums (*jihvāgram … barsveṣūpasaṃharati*), which sounds like a rhotic approximant, not an occlusive, meaning the rhotic target could serve as the syllabic nucleus and not as a consonant as Hock seems to prefer. Also, the *Ṛgveda-Prātiśākhya* 14.38 (& 46) proscribes labial (or palatal) pronunciations of the quarter-moraic vowels surrounding *r̥̆*, which shows that *r̥̆* could be labialized (and palatalized) in the relevant contexts (as this paper has demonstrated as an Indo-Iranian-wide feature). The fact that the *Ṛgveda-Prātiśākhya* explicitly prohibits these coarticulations may indicate that the $^{a}r^{a}$ [^{ə}r^{ə}] pronunciation of the treatises was overly mathematical and idealized. Indeed, Whitney (1862: i. 37.) doubts the entire notion of $^{a}r^{a}$, saying 'The Tâitt. Pr. does not, any more than the Rik Pr. in the earlier and more genuine part of its text, take any notice of the presence of heterogeneous elements in the *r̥* and *l̥* vowels'. The phonetic comparison by Allen (1953: 62) of $^{a}r^{a}$ [^{ə}r^{ə}] to Av. *ərə* < PIIr. **r̥* may just be a coincidental attempt by Sassanid scribes to represent Av. *r̥* in a new alphabet adapted from Pahlavi, which had only consonantal *r*.

ability of the Sanskrit grammarians to provide minute phonetic detail has previously been noted by Catford (2001: 181–183), who also claims that Sanskrit had a dorsal *r*, though he prefers to reconstruct an English-like [ɹ̈]. My account does not require [ɹ̈] for the Indo-Aryan phonological processes under discussion, only the typologically common inclusion of a dorsal gesture in coda liquids.

5 Conclusions

In the preceding discussion, I have laid out evidence the Indo-Iranian reflexes of PIE $*\underset{\circ}{L}(H)$ undergo phonetic coarticulation of lip rounding gestures from nearby labial segments. This behavior shows itself not only in the oldest daughter languages, but extends well into the middle and modern languages. The widespread appearance of this rounding behavior allows us to reconstruct the rounding environments $P___$ and $___C_0\{u, w\}$ to Proto-Indo-Iranian and helps to describe the likely phonetics of PIIr. $*r/*\underset{\circ}{r}$. Among these phonological explanations, the environment of Vedic labiovelar traces was further narrowed and clarified, providing insight into the phonological processes of early Indo-Iranian. The finding that Indo-Aryan shows limited reflexes of all three velar series casts further doubt on the use of *centum-satəm* distinction as a phylogenetically probative category as in Kortlandt (2017).[64]

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64 Even without the testimony of languages which show evidence of three-way velar contrast, I do not understand how *centum-satəm* can be used as a trait for phylogenetic inference. For instance, if one reconstructs satəmization, the merger of $*K$ and $*K^w$, as an innovation that defines a clade (approx. Thraco-Armeno-Daco-Albano-Balto-Slavo-Indo-Iranian), then the other remaining Indo-European branches must independently undergo centumization as they branch off at higher nodes. Each of these individually centumizing higher clades (Anatolian, Tocharian, Italo-Celtic, and Germanic) represents undesirable homoplastic innovations. What's worse, traces of the three way distinction of the velars appear both in the *centum* languages (Anatolian) and the *satəm* languages (Armenian, Albanian, and Indo-Aryan).

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