



# Vowel prothesis before /r/ revisited: acoustics and typology

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## ABSTRACT

Vowel prothesis is a phonological process by which a vowel is inserted at the beginning of a word. Vowel prothesis before a rhotic is attested in a number of languages of the world and has been discussed by Hall (2011), where the instantiation of this phenomenon in the Walliser dialect of Swiss German received a theoretical treatment couched in the framework of Optimality Theory (OT). In this paper, I revisit that process of vowel prothesis and discuss vowel prothesis before /r/ in light of the phonetics of such a development as well as the typology of such a change. It will be argued that vowel prothesis before a rhotic only comes about when that rhotic is a trill. This is because trilled rhotics in the world's languages are known to involve a brief vocalic period (roughly 50 ms) prior to the onset of vibration. Furthermore, all languages with an attested change of #rV- → #VrV- e.g. Walliser German, Campidanian Sardinian, Basque, Gascon and Sakha (Yakut) have an alveolar trilled /r/. In terms of OT, I analyze this as due to a high-ranking constraint against trills in the prosodic-word initial position, formulated as \*<sub>ω</sub>[Trill].

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## 1. INTRODUCTION

The process of epenthesis is a well-attested phonological process in the world's languages. In certain languages there are processes of epenthesis (synchronic or diachronic) at the beginning of a word. Some familiar examples include German glottal step epenthesis e.g. /a:l/ 'eel' → [ʔa:l] and vowel epenthesis before /sC/ clusters in Western Romance languages e.g. Latin *SPONSA* > Sp. *esposa*, Old French *espose* (see Alkire & Rosen 2010: 26–27 for a longer list of examples). This type of epenthesis is known in the literature as prothesis or prosthesis. The German example above would be a case *consonant prothesis*, whereas the Romance example would be identified as *vowel prothesis*. As a specific example of vowel prothesis, Hall (2011) identifies and provides an analysis of the phonological process in Walliser German, a Swiss variety of German, whereby the vowel /a/ is epenthesized before /r/ at the beginning of a word provided that the word is not preceded by an unstressed vowel. However, there are a few other languages that are known to epenthesize a vocalic element before word-initial /r/. In this paper I revisit the case of Walliser German vowel prothesis, putting it into a larger context of vowel prothesis before /r/ that includes data from languages such as Campidanian Sardinian, Basque, Gascon and Sakha.

Similar to Hall's (2011) analysis, I frame my analysis in Optimality Theory (OT). However, my analysis departs significantly from that analysis, since I do not use the fixed-ranked *Word-Edge Hierarchy Constraints* used in that analysis. Instead, I argue that an OT constraint \*<sub>ω</sub>[Trill better accounts for the facts observed in Walliser German and other languages. To my knowledge, this is the first time such a constraint has been proposed in the literature, meaning that it is particularly important to provide an in-depth motivation for such a constraint. Kager (1999: 11) discusses two ways to motivate universality in an OT constraint. These include *typological* and *phonetic* evidence, which are both addressed at length in this paper. Specifically, Section 3 establishes the universality of \*<sub>ω</sub>[Trill constraint in typological terms, whereas Section 4 established the phonetic evidence for this new constraint. Furthermore, the mere fact that classical OT places a strong emphasis on typological and phonetic evidence is one reason why it is particularly beneficial to frame this account in that theory.

A further advantage of my account is that it explains more succinctly why vowel prothesis does not take place before other sonorants in Walliser German. Hall's (2011) account argues that /j/ and /w/ are [-sonorant] and that this is why these segments are not subject to the *Word-Edge Hierarchy Constraints*. As I demonstrate below, this does not accord with the phonetic description of /j/ and /w/ given by Wipf (1908), the original source on Walliser German. As such, I argue that the cumulative weight of evidence speaks more in favor of my proposed constraint \*<sub>ω</sub>[Trill, rather the constraints given by Hall (2011).

This paper is structured as follows. Section 2 discusses the nature of the category *rhotic* and how previous approaches in phonology have modeled the category of rhotic. Section 3 provides data from a number of languages with a process of vowel prothesis before /r/ and explains some of the commonalities between these languages. Section 4 provides some support from the field of acoustics as to why vowel prothesis might take place before /r/ and not before other sounds. Section 5 then exemplifies how this can be accounted for in an OT analysis. Section 6 discusses the quality of the prothetic vowel. Finally, Section 7 concludes the paper.

## 2. BACKGROUND: WHAT IS A RHOTIC?

Many linguists, among them Lindau (1985), Walsh Dickey (1997), Wiese (2003, 2011) and Ladefoged & Maddieson (1996), have pointed out that it is difficult or perhaps impossible to define a phonetic classification for a rhotic. For example, Wiese (2011) speaks of 8 different rhotic sounds attested in the world's languages. These rhotic sounds are summarized in the table in (1).

(1) Typology of rhotics (cf. Wiese 2011)<sup>1</sup>

	Alveolar	Retroflex	Uvular
Trill	r		ʀ
Tap or Flap	ɾ	ɽ	
Fricative			ʁ
Approximant	ɹ	ɻ	(ʁ̥)
Lateral Flap	ɺ		

In the table in (1), we can see five different manners of articulation and three places of articulation for rhotics, although not all of the 15 logical possibilities are attested. In total, there are only 8. By place of articulation they are divided into 4 alveolar, 2 retroflex and 2 uvular, whereas by manner of articulation they can be divided as follows: 2 trills, 2 flaps, 1 fricative, 2 approximants and 1 lateral flap. Wiese (2011) notes, however, that the voiced uvular approximant, though present in both German and Danish, does not have a standard IPA symbol and must be built by adding a lowered diacritic to the fricative symbol. As such, it is placed in parentheses in (1).

Nonetheless, the sizeable amount of phonetic variation has led many linguists to question whether rhotics can be classified under any phonetic or featural criteria. Ladefoged & Maddieson (1996: 215), for instance, take the position that “the terms rhotic and r-sound are largely based on the fact that these sounds tend to be written with a particular character in orthographic systems derived from the Greco-Roman tradition, namely the letter ‘r’ or its Greek counterpart *rho*”. Given the variation in place and manner of articulation described above, some have looked for acoustic unity in the category of rhotics (cf. Ladefoged & Maddieson 1996: 244–245). One suggestion was the property of a lowered third formant, which is known to occur in the approximant rhotic found in English.<sup>2</sup> This generalization carries over to Italian (apical trill) and Toda (trill). However, the retroflex approximant of Hausa (Afro-Asiatic, Nigeria/Niger),<sup>3</sup> has a higher third formant; in Czech (Indo-European, spoken in Czechia) the famous fricative-trill r was found to have a third formant at around 3000 Hz; the uvular rhotic in Swedish (Indo-European, Sweden), French (Indo-European, France) and German (Indo-European, Germany/Austria/Switzerland) was likewise found to be around 2500 Hz. By comparison, schwa, a neutral tube, typically has a third formant of around 2500 Hz, making these values at or above the average for a neutral tube. Furthermore, Ladefoged & Maddieson found that the retroflex approximant of Arrernte (Pama-Nyungan, Central Australia) had a third formant of around 2200 Hz, a lower than neutral value. Thus, even articulations that are described as being similar can be quite different in their acoustic profile, as exemplified by Arrernte and Hausa’s retroflex approximant 2200 Hz as compared to the English approximant, which is considerably lower (for a more complete description, see Ladefoged & Maddieson 1996: 244 as well as Lindau 1985). Lindau (1985: 165) concludes that “[a] lowered third formant is in fact rather unusual and thus not a good candidate for a correlate of the rhotic feature”. Faced with the difficulty of defining the category of rhotics articulatorily or acoustically, many have looked toward other domains of linguistic inquiry. Lindau (1985: 166–7) speaks instead of a Wittgensteinian familial relationship as the defining property of rhotics. That is, each rhotic resembles some other member of the category of rhotics, but no one property can be adduced to include all of the rhotics in question. Wiese (2003, 2011), for instance, finds evidence for the category rhotic on the basis of phonotactics and sonority. First, Wiese (2011: 12) presents data from a dialect of German that demonstrate that a rhotic’s position in the syllable remains the same irrespective of segmental differences. Second, Wiese (2011) presents data concerning the distributional properties of rhotics as compared to other sonorants in German. Consider the data adapted from Wiese (2011) in (2).

<sup>1</sup> A reviewer points out that there are some other sounds that might be added to the list of rhotics e.g. the palatalized alveolar rhotic /rʲ/ of Russian, the “post-dental” trill in Toda (cf. Spajić et al. 1996) and the labiodental /ʋ/ rhotic found in some dialects of English. Thus, depending on how one counts, one may arrive at a higher total than 8.

<sup>2</sup> Note, however, that the English approximant rhotic may be articulated in a number of ways. Compare, for instance, the 8 different tongue profiles (measured by X-Ray motion pictures) found in Delattre & Freeman (1968: 41). See Zhou et al. (2008) for a more recent investigation of the acoustic properties of American English /r/, which specifically investigated the acoustic differences of bunched and retroflex rhotics found in F4 and F5.

<sup>3</sup> All language classifications listed here are done in accordance with their Glottolog classifications (cf. Hammarström et al. 2018).

(2) Initial stop + sonorant clusters of German (Wiese 2011: 13)

	/r/	/l/	/n/	/m/
/p/	<i>Preis</i> 'price'	<i>Platz</i> 'place'	<i>Pneu</i> 'tire'	-----
/b/	<i>braun</i> 'brown'	<i>blau</i> 'blue'	-----	-----
/t/	<i>Traum</i> 'dream'	-----	-----	<i>Tmesis</i>
/d/	<i>drei</i> 'three'	-----	-----	-----
/k/	<i>Kreis</i> 'circle'	<i>klug</i> 'clever'	<i>Knie</i> 'knee'	<i>Khmer</i> 'Proper Name'
/g/	<i>grau</i> 'grey'	<i>Glaube</i> 'belief'	<i>Gnade</i> 'mercy'	<i>Gmünd</i> 'City name'

Table (2) shows that German rhotics are not subject to the same phonotactic restrictions as other sonorant consonants. For other sonorant consonants there is a ban on stop + sonorant clusters at the same position. That is, \*tl, \*dl, \*pm and \*bm are all unattested, but no such restrictions obtain for stop + rhotic clusters. Wiese interprets this to mean that rhotics do not have place features in the same way that other sonorant consonants do. As noted by Wiese, this analysis extends well to other languages such as English, Italian, Basque and Lithuanian.<sup>4</sup> On the basis of this evidence, Wiese argues:

...rhotics are defined as those sounds which bear a sonority value between that of vowels (including glides) and the next lower sonority class, is supported by the fact that the freedom of rhotics to combine with a preceding stop is independent of the particular type of the r-phoneme present in the respective variety of German – place features as well as manner features of the rhotic phoneme are always irrelevant (Wiese 2011: 13).

Thus, Wiese (2011) takes a strong position that the category of rhotics should be identified via phonotactic distribution and not via place or manner of articulation.

Another attempt at a phonological definition of the class of rhotics can be found in Walsh Dickey (1997, Chapter 3), who argues that rhotics are definable by their secondary [Laminal] node. This, she argues, is what accounts for the inability of rhotics to take on secondary palatalization. Of course, there are some challenges to this proposal, including the fact that secondarily palatalized rhotics do occur e.g. in Russian. Furthermore, it is difficult to see how a uvular rhotic could be characterized as laminal.

A more recent definition in the same vein comes from Chabot (2019). Chabot (2019), who works under the framework of substance-free phonology, argues that rhotics are to be defined based on their status as sonorants as well as their procedural and diachronic stability. Chabot (2019: 1) “identifies two properties independent of phonetics which characterize rhotics cross-linguistically [sic] PROCEDURAL STABILITY—rhotics that are implicated in phonological processes can vary in a phonetically arbitrary manner without perturbing the process itself—and DIACHRONIC STABILITY: the phonetics of rhotics can vary in diachronic evolution without impact on their phonotactics”. While I agree with the observation that the class of rhotics is to some extent arbitrary, I will provide evidence below that contradicts the procedural and diachronic stability. That is to say, only certain types of rhotics are subject to the process of vowel prothesis i.e. /r/, while others e.g. /ɹ ɻ ɻ/ are not.

Outside of the phonotactic and sonority-based definitions provided, some have attempted to define the rhotics featurally. T.A. Hall (p.c.) has suggested that rhotics can be classified as those sounds that are featurally [+son, +cons, +cont] (especially if the rhotic consonant is /r/ and the lateral is /l/). There are a number of advantages of this proposal. For instance, this would clearly delineate rhotics from both glides e.g. /j w/ and from laterals and nasals, which are both [-cont]. We may, however, note that Mielke (2005) shows that the [cont] specification of /l/ and nasals might be a language-specific phenomenon. Furthermore, the above specification would have the advantage of defining rhotics in such a way that the most (all?) of the sounds in the table in (1) could be easily classified as rhotics.

Finally, as further evidence for the existence of the category rhotic, there is an intriguing line of research that argues that rhotics can be identified perceptually as a distinct category, even

<sup>4</sup> Note that this phonotactic account would not transfer to many Slavic languages such as Russian, where /t/ and /d/ are attested initial clusters e.g. тле́ть [tʲlʲɛtʲ] ‘to smolder’ and для́ [dlʲa] ‘for’.

though there may not be a clear phonetic or phonological property that they all share. As Howson & Monahan (2019: 26) argue: “rhotics themselves are perceptually confusable within the class and not easily confused with other classes. The results suggest that there is an acoustic-perceptual correlate to rhotics as a natural class”.

With these thoughts on the phonological patterning of rhotics in mind, I would like to consider a test case for the phonology of rhotics, namely vowel prothesis before word-initial /r/ viz. #rV → #VrV. Herein, it is not my intention to dispute the phonological unity of rhotics; indeed, I agree with the research cited in this section that there is clear evidence for a phonological category of rhotics. However, it seems to me that not all of these rhotics behave the same way with regard to their phonological patterning and certain phonological processes involving rhotics may be sensitive to a specific type of rhotic. In this way, I argue that place and manner features can be relevant to the phonology and phonotactics of rhotics (pace Wiese 2011).

### 3. TYPOLOGY OF VOWEL PROTHESIS BEFORE /r/

Let us now consider a typology of vowel prothesis before /r/ in the world’s languages. In this section, I describe a number of prototypical examples of vowel prothesis before /r/, ultimately showing that vowel prothesis before /r/ is sensitive to trilled rhotics and not to other types of rhotics, e.g. approximants, voiced fricatives, taps/ flaps or lateral taps and flaps. The examples, listed in (3), are not intended to be exhaustive, but I do believe them to be representative of the phenomenon of vowel prothesis before /r/. In the table in (3), I also provide a brief summary of the exact shape that vowel prothesis takes in the language varieties in question.

(3) Languages attested with vowel prothesis before /r/<sup>5</sup>

Language	Process	Source(s)
Walliser German	/#r.../ → [ar ...]	Wipf (1908), Bohnenberger (1913)
Campidanian Sardinian	/#r.../ → [ar: ...]	Viridis (1978), Bolognesi (1988)
Barbagia and Ogliastra Sardinian	/#r.../ → [ar: ...] / [er: ...] / [or: ...]	
Basque	/#r.../ → [ar: ...] / [er: ...]	Hualde (1991: 12), Millar (2007: 82)
Gascon	/#r.../ → [ar: ...]	Roques (1977), Dictionnaire Français-Occitan (1998)
Sakha	/#r.../ → [V <sub>x</sub> rV <sub>x</sub> ]	Krueger (1962), Schönig (1988)

In the remainder of this section, I will consider the types of vowel prothesis before /r/ listed in the examples in (3) one by one. In all of these cases I have attempted to ascertain whether this rule of prothesis is synchronic or diachronic, although this was not always easy. In this aspect vowel prothesis may differ between the various languages and dialects under consideration in this section, but what the languages all have in common is that the rhotic in question is always a tongue-tip trill, [r].

#### 3.1. VISPER WALLISER GERMAN

The dialect of Walliser German spoken in Visp, Canton of Valais, Switzerland has received attention in the phonological literature. The dialect is a variety of Highest Alemannic (German *Höchstalemannisch*) and is intriguing for historical linguists in that it can be seen to have a number of highly conservative characteristics. For one, as also observed by Hall (2011: 948), the vowels in unstressed syllables (often the second syllable) have not been reduced to schwa as in the standard language and many other dialects e.g. Standard German *helfe* ‘I help’ [hɛlfə]

5 Armenian might also be considered to be a language with vowel prothesis before /r/, but there are several complications. For one, it is not clear that Armenian ever had one single synchronic rule of #rV → #VrV. Although the older literature often considered Armenian to have a prothetic vowel before initial /r/, it is now generally acknowledged that Proto-Indo-European did not have initial \*r (see Lehmann 1951). Therefore, many apparent cases of a prothetic vowel in Armenian can be shown to simply be the result of an inherited PIE laryngeal (\*h<sub>1</sub>\*h<sub>2</sub>\*h<sub>3</sub>), which is retained as a vowel. Still, however, initial \*r came to occur through other processes, including the following: loss of initial \*p \*t \*k, through metathesis and through simplification of \*sr sequences. Particularly in the metathesis cases e.g. \*drak’ > Armenian *artasu-k* ‘tears’, it is difficult to tell whether metathesis or epenthesis occurred first (see Beekes 2003: 158–160 for discussion). All of this results in Modern Armenian having relatively few examples of word-initial rhotics (/r/ or /r̄/), but it is not a good test case for epenthesis before an initial rhotic.

as opposed to Walliser German [hɪlf:u]. The dialect was described in detail by Wipf (1908). Recently, Hall (2011) provided a full OT analysis of vowel prothesis in this variety, whereby a vowel [a] is inserted at the beginning of words that would otherwise begin with a rhotic. As will become clear in the further discussion in this section, this process is quite clearly synchronic since there are still alternations in the language. Let us first consider the general data in (4), which demonstrate prothesis most clearly. Note that not all of the examples in (4) have clear cognates with /#r/ in Modern Standard German; in such cases I have provided the Old High German (OHG) cognate that does clearly demonstrate that prothesis has occurred. In this data set and in all others, I use ‘[...]’ to indicate original source transcriptions in cases where the original sources do not provide IPA transcriptions.

(4) Word-initial vowel prothesis in Walliser German (cf. Wipf 1908: 107, §174)<sup>6</sup>

Walliser German	IPA	Standard German	Gloss
arad	[arad]	<i>Rad</i>	‘wheel’
arūtsu	[ary:tsu]	(OHG <i>rūzan</i> )	‘to snore’
aripf	[aripf]	<i>reif</i>	‘to ripe’
areppo	[arep:o]	<i>Ruhe</i>	‘calmness’
aræba	[aræba]	<i>Rebe</i>	‘vine’

From (4) we see that all words that might otherwise begin with an /r/ receive an epenthetic vowel, which is always [a]. The original source, Wipf (1908: 105–106), describes this change in the following way: “In general, every initial r, which does not follow a preceding unstressed vowel, shows this development”.<sup>7</sup> On the other hand, however, prothesis does not occur with any other sonorant consonant. Representative data are given in (5) below.

(5) No vowel prothesis before other sonorants (cf. Wipf 1908, page as indicated)

	Walliser German	IPA	Standard German	Gloss	Page
/j/	jagu	[jagu] *[ajagu]	<i>jagen</i>	‘to hunt’	p. 100, §161
	jütsu	[jy:tsu] *[ajy:tsu]	<i>jauchzen</i>	‘to cheer’	p. 100, §161
/w/	wago	[wago] *[awago]	<i>Wagen</i>	‘car, wagon, carriage’	p. 101, §163
	wīl	[wi:l] *[awi:l]	<i>Weile</i>	‘while’	p. 101, §163
/l/	ladu	[ladu] *[aladu]	<i>laden</i>	‘to load’	p. 103, §168
	leittu	[leit:u] *[aleit:u]	<i>leiten</i>	‘to lead’	p. 103, §168
/m/	māl	[ma:l] *[ama:l]	<i>Mal</i>	‘time, occasion’	p. 109, §176
	miəd	[miəd] *[amiəd]	<i>müde</i>	‘tired’	p. 109, §176
/n/	niks	[niks] *[aniks]	<i>nichts</i>	‘nothing’	p. 111, §181
	næt	[næt] *[anæt]	<i>nett</i>	‘nice’	p. 111, §181

<sup>6</sup> In the original source (Wipf 1908), the vowel prothesis is described as a consistent process, but in some places in the text it is not transcribed.

<sup>7</sup> German original: *Im allgemeinen [sic] zeigt jedes anlautende r, welches sich nicht an einen vorausgehenden unbetonten Vokal anlehnen kann, diese Vokalentwicklung.*

From the data set provided in (5), it is apparent that prothesis does not occur with any other word-initial sonorant, including /j w l m n/. Crucially, according to Wipf (1908: 13, §12), both /j/ and /w/ are semi-vowels that are not produced with any hint of spirantization, meaning that both should be considered sonorants in the language (pace Hall 2011). Therefore, it is quite clear that /r/ stands along among the sonorants in that it cannot appear in word-initial position. This observation will prove quite crucial in the formal account in Section 5.

However, prothesis does not occur in all prosodic instances, meaning that there are productive alternations within the language. The author describes vowel prothesis before /r/ to occur after a pause, after a word-final consonant and after a preceding stressed vowel, but prothesis does not occur when the preceding vowel is unstressed. Consider the data in the data in (6), which summarize these generalizations.

(6) Vowel prothesis in its various contexts (Wipf 1908: 106)

	Context	Example	IPA	Standard German	Gloss
a.	After a pause	arad	[arad]	<i>Rad</i>	‘wheel’
b.	After final consonant	ds arōtta	[ds aro:tta]	<i>das Rote</i>	‘the red one’
c.	After a stressed vowel	dü müošt óï aredu	[dy: myøʃt 'øj̥ aredu]	<i>du musst auch reden</i>	‘you also have to speak’
d.	After an unstressed vowel	ir miəst öi rédu	[ir miəst øi 'redu]	<i>ihr müsst auch reden</i>	‘you all also have to speak’

In the table in (6), it can be seen that vowel prothesis occurs in the context after a pause (as in a), after a word ending in a final consonant (as in b) and after a word ending in a stressed vowel (as in c). However, no vowel is epenthesized in d, where the preceding word ends in an unstressed vowel. This means that there are active alternations in the language i.e. *reden* ‘to speak’ may appear as [redu] or as [aredu] according to whether or not preceding word is stressed (for further evidence of a synchronic process at the time Wipf’s grammar was written, see discussion in Hall 2011: 952–953).

With these epenthesis examples in mind, it is critical for the present analysis to understand that the rhotic articulation in this dialect is a “stark gerolltes alveolares r” [strongly rolled (trilled) alveolar r] (Wipf 1908: 14, §13). As we will see throughout this section, this property is shared by the other languages with vowel prothesis before /r/.

Although I focus here on the data provided by Wipf (1908), the generalization that prothesis is only seen before an alveolar trill in Walliser German is also seen in other sources on the dialectal region of the Wallis. Two other sources that describe this are: Bohnenberger (1913) and Werlen (1977). Bohnenberger (1913), who provides a grammatical description of the entire Walliser region, also provides data with a prothetic vowel before /r/. These data include: [arɛχt] [arɛçt] *recht* ‘right’, [ariŋk] [ariŋk] *Ring* ‘ring’, [aröt] [aro:t] *rot* ‘red’ (cf. Bohnenberger 1913: 156, §89). Werlen (1977: 209–211) briefly reports on the occurrence of rhotics in the speech of two informants from Brig, Switzerland (Canton *Valais*) from whom data were collected in the 1950’s for the *Sprachatlas der deutschen Schweiz* (for a description of how the data were collected and evaluated, see Werlen 1977: 38–41). In those two speakers, prothesis before /r/ occurs, but it is not categorical. For example, one of the speakers produced a prothetic vowel in 68 out of a possible 129 /r/-initial tokens (= 52.7%), whereas the other speaker produced a prothetic vowel in 39 out of a possible 105 /r/-initial tokens (= 37.1%). I discuss the second speaker (Speaker S<sub>2</sub>) in more detail in 4.2.

### 3.2. CAMPIDANIAN SARDINIAN

Campidanian Sardinian is a dialect of Sardinian spoken on the southern half of the island of Sardinia. It is a Romance language that is closely related to Italian and a direct descendant of Latin. It is one of three main varieties of Sardinian spoken on the island, the others being Logudorese and Nuorese. Sardinian dialects as a whole, and especially Logudorese, are often regarded as some of the most conservative varieties of Romance, as many have not undergone

any form of palatalization of /k/ before front vowels (cf. map in Mensching & Remberger 2016: 273). Thus, Latin *CENTUM* ‘hundred’ is realized as [ˈkentu] in the Nuorese and Logudorese varieties of the northern half of the island, but as [ˈtʃentu] in the Campidanian varieties of the southern half of the island (cf. Mensching & Remberger 2016: 274).

However, the property that is of interest here is the fact that this dialect is well-known for its epenthesis of [a] in (otherwise) r-initial words. As I discuss below, the status of this as a synchronic or diachronic rule is somewhat uncertain. Nonetheless, it is clear that this innovation is peculiar to the Campidanian varieties of the south. Before introducing the data, I would like to briefly comment on the quality of the rhotic in Campidanian Sardinian. The sources on Campidanian are not always so explicit about the phonetic quality of the rhotics, but it is classified as a “vibrant” by Mensching & Remberger (2017: 275). In addition, it is consistently transcribed as [r] in the sources that I have consulted (for another source that transcribes IPA [r], see Frigeni 2005: 21). A table of some relevant examples as well as their Latin (or Italian) forms for comparison are presented in the table in (7). The Latin and Italian data are provided in standard orthography, whereas the Campidanian data are presented in IPA.

(7) Campidanian vowel prothesis before /r/ (Modified from Bolognesi (1998: 42))

Latin	Italian	Campidanian	Gloss
ROSA	rosa	[ar:ɔza]	‘rose’
RIVUS		[ar:iu]	‘river/creek’
RANA	rana	[ar:ana]	‘frog’
ROTA	ruota	[ar:ɔða]	‘wheel’
	ricco	[ar:iku]	‘rich’
	radio	[ar:aðiɯ]	‘radio’

From the data in (7), it can be seen that the vowel /a/ has been epenthesized before a historically word-initial \*r, as is still attested in Latin and still found in Standard Italian, at the beginning of a word. This process has been described by Virdis (1978: 58) as “Initial /r/ remains unaltered [with respect to Latin], extremely often, however, but we could even say generally and constantly, a prothetic vowel is inserted and the consonant [r/] is strengthened. [...] The vowel is [a] in most of the Campidanian area”.<sup>8</sup>

Note here that the vowel in Sardinian also consistently appears even when such words are used in a larger phrase e.g. [s: ar:aðiɯ], \*[s:u r:aðiɯ] ‘this radio’, [kust ar:amini], \*[kustu r:amini] ‘this copper’, [ũ ar:ɔɣu], \*[ũ r:ɔɣu] ‘a piece’ (Bolognesi 1998: 43, see also Virdis 1978: 59). This puts Campidanian Sardinian in stark contrast with Walliser German, where there are still active alternations conditioned by the word-stress of the preceding word.<sup>9</sup>

In the examples in (7), the sources always transcribe a long [r:] in cases of prothesis. I assume that this method of transcription is used in order to clearly represent that the rhotic is a trill, rather than a tap. Under this interpretation, the length mark used in these examples does not indicate consonantal length in the phonological sense. Thus, we once again see that prothesis is clearly correlated with trilling and not any other type of rhotic. For further discussion on trills and taps in Standard Italian, see Rogers & d’Arcangeli (2004: 118) and Ladefoged & Maddieson (1996: 219).

In contrast to the data listed in (7), all other sonorant consonants may appear in word-initial position. Consider the data in (8).

<sup>8</sup> “La /r/ iniziale rimane inalterata, ma è uso frequentissimo, per non dire generale e costante, premettere una vocale prostetica e rafforzare la consonante. [...] La vocale è, nella maggior parte del dominio campidanese -a” (Translation by Bolognesi 1998: 42).

<sup>9</sup> In this sense, one might conclude that Campidanian Sardinian vowel prothesis is no longer a synchronic rule, which would mean that the prothetic vowel is simply part of the underlying representation of these words. However, recently coined lexical items such as the word for radio, an object that was invented in 1895, also occur with vowel prothesis, which attests to the productivity of the rule, even in the modern era. Thus, the synchronic/diachronic status of prothesis in Campidanian Sardinian is not entirely clear.



(8) Campidanian Sardinian: No vowel Epenthesis before /l m n/ (Viridis 1978, page as indicated)

	Latin	Campidanian	Gloss	Page
a.	LUCE(M)	lùz'i ['luʒi]	'light'	p. 55
	LOCU(M)	lòg.u ['loɣu]	'place'	p. 55
	LIGNA(M)	lìnna ['lin:a]	'wood'	p. 55
b.	NASU(M)	nàzu ['nazu]	'nose'	p. 53
	NASCERE	nàs'iri ['nafiri]	'to be born'	p. 53
	NEPTA(M)	nèta ['neta]	'grandchild, nephew'	p. 53
c.	MAXILLA(M)	massìdha [ma'si:ɖɖa]	'jawbone'	p. 52
	MARE	màri ['mari]	'sea'	p. 52
	MANU(M)	mànu ['manu]	'hand'	p. 52

In a, we see that no vowel prothesis takes place with word-initial /l/; in b, we see that there is also no prothesis with word-initial /n/; finally, in c, we also see that there is no prothesis with word-initial /m/. Thus, we may conclude that Campidanian Sardinian does not insert a prothetic vowel before other sonorant consonants such as /l n m/. It should be noted that there are other sonorant consonants that appear in Sardinian such as [ɣ], but that consonant does not appear in initial position and is largely an allophone of /l/.<sup>10</sup>

Thus, we may conclude that in Campidanian Sardinian, the sonorants /l m n/ may freely occur in word-initial position, but /r/ may not. In all cases where /r/ could appear in word-initial position, a prothetic vowel is inserted.

### 3.3. BASQUE VOWEL PROTHESIS

Basque is famous for being a language isolate, meaning that it has no known linguistic relatives. This makes it one of the few languages spoken on the continent of Europe that does not belong to the Indo-European family. It is primarily spoken in northern Spain and southwestern France and is estimated to have roughly 700,000 native speakers, most of whom are bilingual in either Spanish or French (cf. Hualde 1991: 8). However, in addition to being of interest to historical and comparative linguists, Basque is interesting due to its vowel prothesis before /r/. For starters, it is important to recall that Basque (as described in Hualde 1991), like its Iberian neighbor Spanish, is known to have two rhotic consonants: namely, the alveolar trill [r] and the alveolar flap [r̄]. However, the distribution of these two rhotics differs slightly from Standard Spanish. For one, in both pre- and post-consonantal position only the trilled [r] is found e.g. *arto* [arto] 'corn' and *andre* [a<sup>ndre</sup>] 'woman'. The only position where there is a contrast is in intervocalic position e.g. *ere* [ere] 'also' vs. *erre* [ere] 'to burn', with this later property being found also in Spanish e.g. *pero* [pero] 'but' vs. *perro* [pero] 'dog'. However, there is one property of Basque rhotics that is significantly different from Spanish rhotics. This concerns the distribution of [r] and [r̄] in word-initial position. In Spanish, only [r̄] may appear in word-initial position, but in Basque neither [r] nor [r̄] are permitted in word-initial position (see the table in (11) for a summary of this information). Furthermore, Spanish loanwords with initial [r̄] are adapted into Basque with an epenthetic vowel. Some examples of these loanwords are presented in the table in (9).

(9) Spanish loanwords with word-initial [r̄] in Basque (cf. Hualde 1991: 12)

	Spanish	Basque	Gloss
a.	república	errepublika	'republic'
	respuesta	errespuesta	'answer'
	respeto	errespeto	'respect'
	romería	erromeria	'pilgrimage'

<sup>10</sup> See Frigeni (2005) for a more in-depth analysis of the phonology of /l/ in Campidanian Sardinian. In particular, she argues that /l/ patterns as an obstruent in Campidanian Sardinian. This need not concern us here, since it is still clear that /r/ patterns differently than the remaining sonorants i.e. /n/ and /m/, meaning that the generalization established by the data in (8) stands even if /l/ is not considered a sonorant.

b.	ratón	arratoi	'mouse' (Sp), 'rat' (Ba)
	raza	arraza	'race'
	ropa	arropa	'clothes'

Thus, we see in (9), that there are two types of epenthetic vowel in Spanish loanwords into Basque: /e/ as in (9) and /a/ as in (9).

In addition to the data in (9), it should be noted that Hualde does discuss some differences across dialects with respect to word-initial /r/. For instance, he (1991: 54) cites some examples of word-initial [r] in the Gernika dialect of Basque, referring to these examples as unassimilated loans, e.g. [raðižoa] 'the radio' [rašie] 'the race'. However, the epenthetic vowel, [e], is found in assimilated loans e.g. [ereβolušijnoa] 'the revolution', [eropie] < Sp. *ropa* 'clothes', [eramue] < Sp. *rama* 'the bunch', [erekaðue] < Sp. *recado* 'the errand', [eruβeðie] < Sp. *rueda* 'the wheel'. Apparently, the epenthetic vowel is more consistently [e] in this dialect.<sup>11</sup> To this list, we also add the examples adduced by Millar (2007: 82), which include more recent coinages such as *erradio* 'radium',<sup>12</sup> *errubi* 'ruby' and *Errusia* 'Russia'. Since prothesis does appear to have some limitations, conditioned in part by the dialect in question, it is uncertain whether prothesis is still synchronic. If it is in fact diachronic rather than strictly synchronic, then the OT analysis that I pursue in Section 5 would apply to the moment that prothesis entered the language.

By contrast, other coronal sonorant consonants do occur in Basque in initial position. This is exemplified by the data in (10).

(10) No prothesis before /l/, /m/ or /n/ (Hualde 1991, page as indicated)

	Basque	Gloss	Page
a.	<i>lan</i> [lan]	'work'	p. 13
	<i>latz</i> [latʂ]	'rough'	p. 13
b.	<i>maiz</i> [maĩʂ]	'often'	p. 13
c.	<i>negua</i> [neɣua] / [neɣu.a]	'the winter'	p. 11

As the data in (10) demonstrate, other sonorant consonants such as /l m n/ may appear in word-initial positions. Nonetheless, there are other restrictions on word-initial sonorant consonants, including the palatal sounds /ʎ/ and /ɲ/, which like /r/ are mostly blocked from initial position. In contrast with /r/, these sounds are also blocked from word-final position, whereas /r/ is not (cf. Hualde 1991: 12–13). For this reason, one may conclude that the lack of /r/ in initial position really appears to be a property particular to the trill.

To summarize the distribution of Basque [r] and [r̄], I have provided the following table, which compares the distribution in Basque with the distribution in the more familiar Spanish in (11).

(11) Basque distribution of [r] and [r̄] as compared to Spanish: A Summary

	Spanish <sup>13</sup>		Basque	
	[r]	[r̄]	[r]	[r̄]
#__V	√	×	×	×
C__V	×	√	√	×
V__V	√	√	√	√
V__C	×	√	√	×
V__#	×	√	√	×

<sup>11</sup> In Chapter 2, Hualde (1991) investigates four varieties of Basque: Baztan, Arbizu (Navarre), Ondarroat (Biscay) and Gernika (Biscay). The discussion described in this paragraph above is the only mention of cross-dialectal differences regarding the phenomenon of vowel prothesis.

<sup>12</sup> The chemical element Radium was discovered in 1898, meaning that the lexical item for Radium must have entered the Basque language at a later point than 1898. Thus, like the case of Campidanian Sardinian above, there is evidence that this epenthesis was still productive into the modern era.

<sup>13</sup> Shelton (2013: 137) reports that the post-consonantal environment can be further divided into heterosyllabic viz. -C.r- in which only a trilled [r̄] may occur and tauto-syllabic viz. -Cr- in which only the tapped [r]. Furthermore, in emphatic speech some speakers use trilled [r̄] in absolute final position.

Thus, it can be seen that in Basque, unlike Spanish, neither rhotic may occur in absolute word-initial position. The trilled rhotic, /r/, however, is always the rhotic used when words in Spanish that have word-initial /r/ are borrowed into Basque. In such cases, Basque, like Campidanian Sardinian and Walliser German above, inserts a prothetic vowel before a potential word-initial /r/.

### 3.4. GASCON VOWEL PROTHESIS

Gascon, a Romance variety spoken in Southwestern France, near the border with Spain, also exhibits a process of vowel prothesis conditioned by an etymologically word-initial \*r. It should be pointed out here at the outset that Gascon vowel prothesis before /r/ is not always consistently transcribed in the sources that I have consulted. The process is mentioned in many sources (e.g. Séguy et al. 1954, Roques 1977 and in the *Dictionnaire Français-Occitan* 1998), but is not explicitly mentioned in Kelly (1973) or Mooney (2014). Kelly (1973) used data primarily collected in the town of *Donzac* in the *département* of Tarn-et-Garonne, whereas the *Dictionnaire Français-Occitan* has as its primary source of data the *département* of *Haute-Pyrénées*. Thus, there is a slight difference in the exact dialect in question. In the maps produced by Séguy et al. (1954: Maps 2129 and 2130), prothesis is found in the entirety of the *départements* of *Bas-Pyrénées* and *Landes* and in parts of *Gironde*, *Gers*, *Haute-Pyrénées*, *Haute Garonne*, with only very limited occurrences in *Ariège*. However, the sources agree on one important fact: that <rr> is articulated as a tongue tip trilled [r] (cf. Roques 1977: 55, Kelly 1973: 32).<sup>14</sup> Roques (1977: 55) describes the vowel epenthesis in his dialect in the following manner: “In Gascon initial r attracts an a in front of it: *ram, arram; rasin, arrasin, rebasti, arrebasti*”.<sup>15</sup>

The *Dictionnaire Français-Occitan* (1998: 16) considers vowel prothesis before /r/ as a general phenomenon of Gascon and typically encodes vowel prothesis before /r/ in its orthography as <arr...>, provided that the form is general throughout the Gascon speaking territory. If it is more typical of the mountainous regions, but less commonly found outside of that area, then it is encoded as <(ar)r...>. The data I have collected are listed in (12).

(12) Gascon words prothetic vowel before /r/ (cf. *Dictionnaire Français-Occitan*, page as indicated)

	Gascon	French	English	Page
a.	arremóler	rabâcher	‘to harp on about’	p. 116
	arrat	rat	‘rat’	p. 117
	arregaudir-se	se réjouir	‘to be pleased’	p. 119
b.	(ar)respectar	respecter	‘to respect’	p. 121
	(ar)religar	relier	‘to link’	p. 120
	(ar)retardar	retarder	‘to delay’	p. 122
c.	rabin	rabbin	‘rabbi’	p. 116
	raqueta	raquette	‘racket’	p. 117
	realisme	réalisme	‘realism’	p. 118

In the table in (12), the examples are divided into three types (as is done directly in the dictionary itself). The first data set, in a, represents the examples where <arr...> was found more uniformly across the Gascon-speaking territory. The second data set, printed in b, represents those words for which vowel prothesis was commonly found in the more isolated and mountainous regions, but was less uniformly found elsewhere. Finally, the third set, printed in c, contains examples in which vowel prothesis was never found under any circumstances. The examples in c are striking in that those words are typically words that belong to a highly specialized subset of

<sup>14</sup> It should be noted that Kelly (1973: 30, 32) lists a trilled [r] as the primary form of Gascon rhotic, though does leave open the possibility of uvular [ʀ], acquired through contact with Standard French. Intriguingly, this source does not indicate vowel prothesis at all (it is, after all, outside of the prothesis area given by Séguy et al. 1954). Thus, it might be the case that vowel prothesis was eliminated when language contact with Standard French spread uvular r amongst the local varieties. If this is correct, then this would represent a case of procedural and diachronic *instability* in a rhotic (*contra* Chabot 2019).

<sup>15</sup> Original: “r initial attire en Gascogne un a devant lui: *ram, arram; rasin, arrasin; rebasti, arrebasti*”.

the vocabulary and are therefore words that would likely be encountered first in a scholastic setting, rather than in the home. In order to consider this in more detail, I have consulted all examples with initial /r/ in the *Dictionnaire Français-Occitan* cited above. Unfortunately, this dictionary is only a unidirectional dictionary. Thus, I have tabulated the results here of all words that begin with initial <r> in French and either have <arr...>, <(ar)r...> or <r...> in Gascon. In this sense, the statistical distribution here is not exhaustive, but they provide a preliminary insight into vowel prothesis in Gascon. These data are presented in the table in (13). Due to rounding, the percentage total is slightly lower than 100%.

(13) Frequency of Gascon vowel prothesis

	Category	Number of examples	Percent
a.	<arr...>	34	8.8%
b.	<(ar)r...> <sup>16</sup>	310	80.5%
c.	<r...>	41	10.6%
	Total	385	99.9%

Thus, it can be seen from the data in (13) that the great majority of Gascon cognates of French words with initial /r/ exhibit variable vowel epenthesis, as seen in b. Comparatively, few words exhibit initial /r/ across the board, as seen in a, and still fewer exhibit an epenthetic vowel across the board, as seen in c. Given these irregularities, it is unclear to what degree prothesis is still synchronic.

Although prothesis varies from dialect to dialect or even from person to person, the vowel is consistently <a> and not some other vowel. Interestingly, some hypothesize (e.g. Pereltsvaig 2017: 42) that there is a link between this change in Gascon and the vowel prothesis before /r/ described above for Basque, as these languages are geographically quite close to one another. However, the Basque vowel prothesis varies between epenthetic /e/ and epenthetic /a/, whereas the Gascon examples are consistently /a/. I will leave this question open to further research.

### 3.5. SAKHA (YAKUT) VOWEL PROTHESIS

The final case of vowel prothesis before /r/ that I will describe here is found in the Turkic language Sakha, which is spoken in the Russian Republic of Yakutia. The language, which is referred to as Sakha by its speakers, is described by Pakendorf (2007: 1) as a highly divergent Turkic language that has been influenced by the nearby Mongolic and Tungusic languages. At the time of her work, there were 443,852 native Sakha speakers. The phonology of this language has been discussed in some detail by Baertsch (2002).

Baertsch (2002: 123–124, citing Schönig 1988) discusses the fact that Sakha regularly bans /r/ and /j/ from initial position. Before considering the data sets with such examples, let us first discuss the quality of the rhotic in question. Korkina et al. (1982: 57, §33) describe the rhotic in Sakha as an “apical trilled sonant” (Russian: *переднеязычный дрожащий сонант*). This trill, however, does not occur in initial position. Instead, one finds that a vowel is epenthesized in such cases where /r/ might otherwise appear.<sup>17</sup> A particularly instructive example of this comes in Russian loanwords with initial /r/. Such loanwords are realized with a prothetic vowel in Yakut. This is demonstrated in the data set in (14). See Yanushevskaya & Bunčić (2015) for transcription of Russian.

(14) Sakha vowel prothesis (Schönig 1988: 134)<sup>18</sup>

	Russian	Sakha	IPA	English
a.	<i>ритм</i> [rʲit̪m]	iriitm	[iri:tm]	‘rhythm’
b.	<i>рента</i> [rʲent̪ə]	eriente	[eriente]	‘rent’

<sup>16</sup> Under this category I have grouped together all examples listed with <(ar)r...> with examples listed <r...> in one form and <arr...> in another form. In essence, this category thus amounts to any word in Gascon that could occur either with vowel prothesis or without vowel prothesis regardless of how exactly that was coded in the dictionary.

<sup>17</sup> Krueger (1962: 257) lists six words with initial /r/ (spelled <р> in Cyrillic). These words include (likely) Russian loans such as *revolution*, *republic* and *rhombus*. Since most other Russian loans are adopted with a prothetic vowel, I consider these examples exceptional and I do not discuss them further.

<sup>18</sup> It should be noted that prothesis also occurs before Russian /sC/ clusters in words borrowed into Sakha e.g. *скатерть* [ʲskatʲɪrtʲ] ‘tablecloth’, *стена* [sʲtʲɪˈnə] ‘wall’ and *список* [ʲspʲisək] ‘list’ are borrowed as [yskaatar], [listiene] and [ispʲihek] (cf. Schönig 1988: 134). I assume that this type of prothesis is unrelated to the prothesis before /r/.

c.	<i>расписка</i> [rɐ'spiskə]	araspyyska	[araspi:ska]	'receipt'
d.	<i>разбойник</i> [rɐz'bɔjn'ik]	orospuñnuk	[orospu:nuk]	'robber'
e.	<i>ремонт</i> [rɐ'mont]	örömüön	[øømyøn]	'repairs'
f.	<i>рюмка</i> [r'jumkə]	ürüümke	[yry:mke]	'wine-glass'

In (14), we see that word-initial /r/ in Russian is always borrowed into Sakha with a prothetic vowel. The prothetic vowel, which may appear as /i e a o ø y/, is usually identical in quality to the vowel following the rhotic. The lone exception is found in [eriente] 'rent', where the vowel following the rhotic has a diphthongal quality that is not found in the prothetic vowel. This is hardly surprising since Sakha, along with most other Turkic languages, has a consistent process of vowel harmony.

Crucially, prothesis does not appear in cases where the Russian initial consonant is /l/, /n/ or obstruents. This is demonstrated in (15).

(15) No prothesis before /l/, /n/ or obstruents (Schönig 1988: 127)

	Russian	Sakha	IPA	English
a.	<i>лист</i> [lʲist]	liis	[li:s]	'sheet of paper'
	<i>лук</i> [luk]	luuk	[lu:k]	'onion'
b.	<i>население</i> [nəsəl'ʲenʲje]	nehilieñne	[nehilieŋ:e]	'population'
	<i>налог</i> [nə'lək]	noluok	[noluok]	'tax'
c.	<i>пар</i> [par]	paar	[pa:r]	'steam'
	<i>сорт</i> [sort]	suort	[suort]	'type'
	<i>бутылка</i> [bu'tilkə]	bytyylka	[biti:lka]	'bottle'

Thus, as can be seen in (15), there is no prothesis in words beginning with /l/, /n/ or any other consonant in the language. However, this does not tell us the full story. As Baertsch (2002) points out, this language also adapts initial Russian /j/ as /d͡ʒ/, which leads her to suggest that highly sonorous sounds such as /j/ and /r/ are banned from initial position. The data for Russian loanwords with /j/ are given in (16).

(16) Segmental change with initial /j/ (Schönig 1988, page as indicated)

	Russian	Sakha	IPA	English	Page
a.	<i>якорь</i> [ˈjakərʲ]	jaakyr	[d͡ʒa:kir]	'anchor'	p. 128
b.	<i>ящик</i> [ˈjaʃʲ:ɪk]	jaahyk	[d͡ʒa:hik]	'box'	p. 128

Words of Russian origin that begin with [j] are adapted with the affricate [d͡ʒ]. Such words are rendered in Sakha Cyrillic as <дь> and are transcribed as [j] by Krueger (1962). In the data set in (16), I have followed Baertsch's (2002) interpretation in transcribing this as the affricate [d͡ʒ].<sup>19</sup> Ultimately, Baertsch (2002: 123–126) interprets the data in (16) as evidence that segments that are more sonorous than /l/ are banned from word-initial position. However, the repair to instances of initial /j/ (segmental change) is different than the repair to instances of initial /r/ (vowel prothesis). Therefore, I view these two processes as distinct, rather than as one process motivated by sonority.

In sum, then, we can see that Sakha systematically bans rhotics from word-initial position. Other sonorants, with the exception of /j/, appear with no modification in word-initial position. Although [j] is banned from initial position, the repair strategy to such sequences is quite different than the repair strategy (hardening to [d͡ʒ]) for potential [r]-initial words. For this reason, I consider the motivation for avoidance of [j] in initial position to be quite different from the motivation for avoidance of [r] in initial position.

<sup>19</sup> Online recordings (cf. [https://www.omniglot.com/soundfiles/sakha/bonvoyage\\_sakha.mp3](https://www.omniglot.com/soundfiles/sakha/bonvoyage_sakha.mp3)) seem to confirm this interpretation.

## 4. ACOUSTICS OF VOWEL PROTHESIS BEFORE /r/

Having demonstrated in Section 3 that vowel prothesis before /r/ is usually typified by an apical trilled rhotic, this section investigates the phonetic explanation for why such a change would be likely to occur. This explanation is provided in Section 4.1. Then, in Section 4.2, I consider some reasons why the change is generally restricted to apical trills and excludes uvular trills.

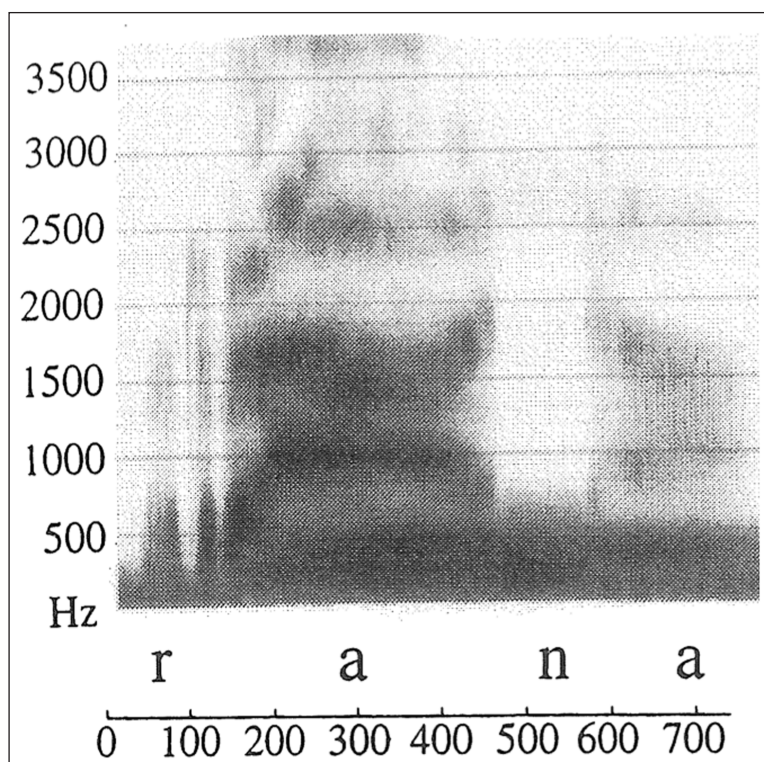
### 4.1. VOWEL PROTHESIS BEFORE /r/

In discussing the motivation for vowel prothesis before apical trills, let us begin by considering the phonetics involved in producing an apical trill. As described by Ladefoged & Maddieson (1996: 217), trilling is in many ways a similar process of modal voicing. In essence, there is no active muscle control of each vibration cycle involved in either. Instead, both involve placing two surfaces close to one another and allowing air to pass through, creating a series of vibrations. For this process, it is important to recall the gas law, known as Boyle's Law, which is represented mathematically as  $P * V = K$  (read as 'pressure times volume equals a constant'). Furthermore, airflow proceeds from high pressure to lower pressure. Therefore, adequate airflow across the glottis to produce modal voicing (and likewise through the aperture between the tongue and the alveolar ridge to produce a trill) requires a disparity in pressure between the cavities. This also means that trills require two of these pressure disparities: one, for the subglottal cavity in relation to the supra-glottal cavity and another at the constriction between the tongue tip and alveolum. In this way, it can be said that trills are articulatorily complex.

Therefore, it is not surprising that it can sometimes be difficult to produce a trill from a standstill. Consider the following quote from Ladefoged & Maddieson (1996: 219):

First, the contacts are preceded by a short approximant or **vowel-like sound of about 50 ms duration**. Secondly, after the contacts there is another approximant interval, lasting over 50 ms...the approximant phases flanking this trill indicate that the tongue was not consistently held close enough to the upper surface of the mouth for trilling to be sustained. **Approximant phases at the end of trills occurred on some occasions in all the languages with trills studied by Lindau (1985).**

Furthermore, in [Figure 1](#), the brief sonorant periods before and after the production of the rhotic can be seen. It appears very natural, then, that approximant/vowel periods immediately preceding and following trills represent a natural cross-linguistic development that appears to relate to the property that trills are articulatorily complex.

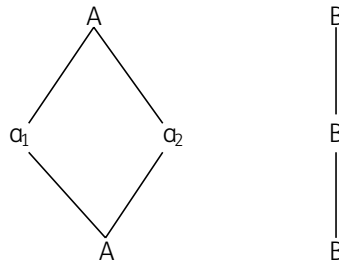


**Figure 1** Word-production of Italian word-initial /r/. Originally in Ladefoged & Maddieson (1996: 220), reproduced with permission from John Wiley & Sons Books.

Returning to vowel prothesis, we can consider how this phonetic evidence may contribute to phonological process. Ohala (1993 and elsewhere) has argued that language change can be explained nicely by the idea that certain properties of the phonetic string might be “misperceived” by the listener as being part of the speaker’s “intended phonetic string” and not simply as a byproduct of natural tendencies of the human vocal tract. Consider the schematics in (17) and (18), which represent this. Here, ‘A’ and ‘B’ stand for a string of two speech segments in which ‘A’ proceeds ‘B’.

(17) Listener correctly perceiving speaker’s intended phonetic string (adapted from Ohala 1993: 157)

Speaker’s Intended Phonetic String

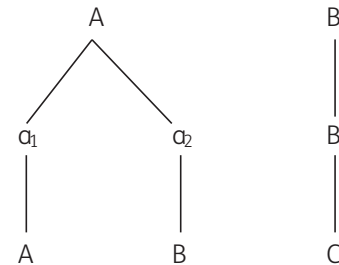


What is produced phonetically:

Listener parse:

(18) Listener incorrectly perceiving speaker’s intended phonetic string (adapted from Ohala 1993: 157)

Speaker’s Intended Phonetic String



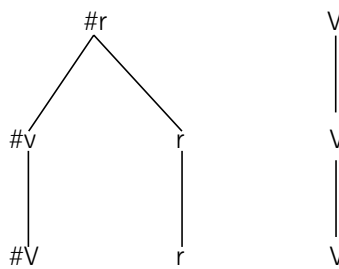
What is produced phonetically

Listener parse:

In (17), the listener correctly parses the production of  $a_1$  and  $a_2$  as merely a natural manifestation of A and does not make any necessary amendment to his/her underlying representation. However, in (18), the speaker incorrectly assumes that  $a_2$  represents its own independent speech sound and posits B as part of the underlying representation. Transferring this to our own test case here, we arrive at the schematic in (19).

(19) Schematic for vowel prothesis before /r/

Speaker’s Intended Phonetic String



What is produced phonetically

Listener parse:

In (19), the speaker intends to produce a word-initial alveolar trill, but inevitably produces a slight vocalic period before the /r/ (represented as lower case v, since this period would likely be around 50 ms). The listener hears this and incorrectly assumes that this vocalic period was intended by the speaker and therefore parses this sequence as #VrV instead of #rV as the speaker intended. This is phonetic mechanism for the phonological rule of vowel prothesis under discussion here.

#### 4.2. POSSIBILITY OF VOWEL PROTHESIS BEFORE /R/?

Under the thesis developed in this paper, epenthesis is predicted to be conditioned by the occurrence of word-initial trills, but so far, I have only discussed cases of prothesis with initial /r/. The reason for this is that all of the cases of vowel prothesis before an otherwise word-initial rhotic that I have found all involve the tongue-tip trill. Thus, the question remains whether prothesis occurs in languages with a uvular /R/. To this end, Werlen (1977: 209–212)

discusses data from a speaker (Speaker  $S_2$ ) from Brig, Canton Valais, Switzerland, who uses a uvular r (Werlen's *velar*) who does still have a prothetic vowel in a minority of examples. According to Werlen (1977), this speaker's use of uvular r is an idiosyncrasy of that speaker and is apparently not generalizable to the population-at-large. Nonetheless, it is striking that this speaker, clearly uses a prothetic vowel much less frequently than the other speaker (Speaker  $S_1$ ), who used an apical trill. Speaker  $S_2$  produced a prothetic vowel at a rate of 37.1%, whereas Speaker  $S_1$  produced a prothetic vowel at the significantly higher rate of 52.7%. In addition, an anonymous reviewer also reports some recordings of initial /ʀ/ with a prothetic vowel that is apparently similar to [a] in quality. Still, however, it seems that cases of prothetic vowel in languages/speakers with uvular /ʀ/ are infrequent, based also on the observation that I made in Footnote 14.

I see two primary reasons why this kind of prothesis might not be as common as prothesis before word-initial /r/. First, uvular consonants, and in particular uvular trills, are simply much more sparsely attested in the world's languages. The WALS survey (Maddieson 2013) finds that 80.9% (470 of 569 languages surveyed) of the languages surveyed do not have uvular consonants. Among the languages with uvular sounds, by far the most common manners of articulation are stop e.g. /q ɣ/ and ejective /qʔ/. Much rarer are the uvular continuants such as /χ ʁ/, which are reported in a total of 51 languages in the WALS survey. Rarer still is the uvular trill, /ʀ/, which accounts for less than 1% of trills in Maddieson (1984). Second, languages that do have a uvular trill often permit a great deal of phonetic variability in its realization. For example, the uvular trill, /ʀ/, which is known from the standard varieties of French and German as well as in some dialects of Dutch, Danish and Swedish, often varies quite extensively. Realization as a fricative /ʁ/ or an approximant /ʁ̥/ is not uncommon in Standard German, for instance. Lindau (1985: 161) also found a great deal of variation in Southern Swedish, where the rhotic is usually uvular. In that study, it was found that uvular trills were produced by only three of the ten speakers in question. Conversely, Spanish speakers consistently use the apical trill for <r> (see the above discussion on Spanish rhotics). So, languages with a uvular trill, /ʀ/, have a "built-in" strategy for avoiding trills in initial position that is distinct from the process of epenthesis of a vocalic period before the initial trilled /r/. This topic will be revisited below in the OT analysis below (see (27)). German speech a uvular trill is common in intervocalic position, but uncommon in initial position.

## 5. A NEW OT ANALYSIS

Hall (2011) presents a formal analysis of vowel prothesis for the Walliser German dialect described in Section 3.1. Herein, I will largely carry over that analysis with one significant alteration. In that work, a series of word-edge hierarchy constraints figures prominently in the analysis. Such constraints are listed in (20).

- (20) Word-Edge Hierarchy Constraints (cf. Hall 2011: 958)  
 $*_{\omega}$ [Glides > >  $*_{\omega}$ [Rhotics > >  $*_{\omega}$ [Laterals > >  $*_{\omega}$ [Nasals > >  $*_{\omega}$ [Obstruents

The constraints in (20) place bans on glides, rhotics, laterals etc. in the initial position of a prosodic word. In Hall 2011, these constraints stand in fixed ranking with one another and crucially interact with the following markedness and faithfulness constraints, listed in (21).

- (21) Markedness and Faithfulness constraints (Hall 2011: 958):
- ONSET: A syllable must have an onset
  - DEP-V: Don't insert a vowel
  - DEP-C: Don't insert a consonant
  - MAX-V: Don't delete a vowel
  - MAX-C: Don't delete a consonant
  - IDENT: Don't change the features of an input sound

These latter constraints interact with the word-edge hierarchy constraints by having a ranking of  $*_{\omega}$ [Rhotics over the faithfulness constraint DEP-V as well as ONSET. Of course, the constraint  $*_{\omega}$ [Rhotics must be ranked above  $*_{\omega}$ [Laterals. Consider the following provisional tableaux for the (hypothetical) inputs /rad/, lad/ and /jad/ in (24) through (23), respectively.



(22) Epenthesis before /r/ (cf. Hall 2011: 958, to be revised below)

/rad/		* <sub>ω</sub> [Glides	* <sub>ω</sub> [Rhotics	ONSET	DEP-V	* <sub>ω</sub> [Laterals
a.	<sub>ω</sub> [rad]		*!			
b.	<sub>ω</sub> [arad]			*	*	

(23) No epenthesis before /l/ (to be revised)

/lad/		* <sub>ω</sub> [Glides	* <sub>ω</sub> [Rhotics	ONSET	DEP-V	* <sub>ω</sub> [Laterals
a.	<sub>ω</sub> [lad]					*
b.	<sub>ω</sub> [alad]			*!	*	

(24) Epenthesis predicted before /j/

/jad/		* <sub>ω</sub> [Glides	* <sub>ω</sub> [Rhotics	ONSET	DEP-V	* <sub>ω</sub> [Laterals
a.	<sub>ω</sub> [jad]	*!				
b.	<sub>ω</sub> [ajad]			*	*	

In tableaux (24) through (23), it can be seen that the ranking of these constraints must be \*<sub>ω</sub>[Glides >> \*<sub>ω</sub>[Rhotics >> ONSET, DEP-V >> \*<sub>ω</sub>[Laterals. This derives the expected outputs [lad] and [arad]. However, this ranking fails to predict the correct output form for /jad/ in (24). Hall (2011) argues that the apparent glide /j/ is in fact a [-sonorant] segment and therefore does not violate the constraint \*<sub>ω</sub>[Glides. As I detailed in 3.1, however, this conclusion is not supported by the phonetic description provided in the source. For these reasons, I believe it is necessary to seek an alternative analysis.

As I have shown in Sections 3–4, languages with #rV → #VrV all have an alveolar trill, [r]. Furthermore, this vocalic epenthesis follows from natural phonetic tendencies involving the difficulties of producing a trill in word-initial position. Therefore, in the remainder of this section, I will dispense with the *Word-Edge Hierarchy Constraints* in (20) and instead will use the constraint in (25).

(25) \*<sub>ω</sub>[Trills: Trills are banned from prosodic-word initial position.

The constraint in (25) militates against words appearing as <sub>ω</sub>[rad], since they have a trill in prosodic-word initial position. Though the constraint is to the best of my knowledge my own creation, I argue that it has ample support from the observations in phonetics in Section 4, as well as the typological considerations in Section 3, where it can be seen that all of the known languages with vowel prothesis before /r/ at the beginning of a word have an alveolar trilled /r/. Additionally, though my constraint is more specifically geared towards trills, other papers written under an OT framework such as Hall (2011) and Zukoff (2012: 6–7) have argued for similar constraints, although those were geared towards banning “rhotics” and “r” in word-initial position.<sup>20</sup>

Thus, in my revision of the analysis, I do not wish to argue against the existence of the other constraints used in Hall 2011, namely: \*<sub>ω</sub>[Glides, \*<sub>ω</sub>[Laterals, \*<sub>ω</sub>[Nasals and \*<sub>ω</sub>[Obstruents. Rather, I argue here that there is a better account available that makes use of the constraint \*<sub>ω</sub>[Trills. By extension, this means that my analysis does not have any bearing on the question of whether fixed ordered constraints are necessary or desirable within the mechanics of OT. For example, it is possible that \*<sub>ω</sub>[Trill is but one in a series of constraints against specific types of rhotics in prosodic word initial position. These constraints could be argued to have a fixed ranking. However, it is also possible that \*<sub>ω</sub>[Trill is the only constraint of this type. I encourage further research to address this question.

Nonetheless, I carry over the other markedness and faithfulness constraints from (21) in my revised tableaux below, beginning with (26).

<sup>20</sup> Further evidence for the existence of such a constraint can be found in Lehmann (1951), who argues that Proto-Indo-European did not allow \*r in a word-initial position.

(26) Prothesis before /r/ (Walliser German, Campidanian Sardinian, Basque, Gascon, Sakha)

/rad/		* <sub>ω</sub> [Trill]	MAX-C	DEP-C	IDENT	ONSET	DEP-V
a.	<sub>ω</sub> [rad]	*!					
b. $\text{r} \rightarrow \text{ar}$	<sub>ω</sub> [arad]					*	*
c.	<sub>ω</sub> [lad]				*!		
d.	<sub>ω</sub> [ad]		*!			*	
e.	<sub>ω</sub> [trad]			*!			

Thus, the final ranking for a language with vowel prothesis at the beginning of a word is \*<sub>ω</sub>[Trill, MAX-C, DEP-C, IDENT >> ONSET, DEP-V]. This ranking will hold for all of the the clear cases of vowel prothesis in Section 3: namely, Walliser German, Campidanian Sardinian, Basque, Gascon and Sakha.

Finally, I would like to present a carry-over of this analysis to the issue discussed in Section 4.2, namely the treatment of word-initial uvular trills in the world’s languages. Recall from that section above that vowel prothesis before uvular r is at best uncommon, but that many of those languages with uvular r tend to have some variation in their articulation of that rhotic. Usually, that variation will result in the production of a voiced uvular fricative, [ʁ] or a voiced uvular approximant, transcribed [ʁ̥]. This has, for example, been observed for German by Kohler (1995: 165–166). On these grounds, I would like to present a revised tableau like that in (26) for languages with uvular /r/. Similar to the argument above, word-initial trills will be ruled out by \*<sub>ω</sub>[Trill, but unlike the treatment above, the repair strategy will be segmental modification. Consider the following tableau in (27).

(27) Segmental change of initial /r/ (Standard German)<sup>21</sup>

/rad/		* <sub>ω</sub> [Trill]	MAX-C	DEP-C	DEP-V	ONSET	IDENT
a.	<sub>ω</sub> [rad]	*!					
b.	<sub>ω</sub> [arad]				*!	*	
c. $\text{r} \rightarrow \text{ʁ}$	<sub>ω</sub> [ʁad]						*
d.	<sub>ω</sub> [ad]		*!			*	
e.	<sub>ω</sub> [trad]			*!			

It should be noted that on the basis of the tableau in (27), some of the ranking arguments change slightly. For one, the evidence of the crucial ranking of ONSET disappears, since the reranking of DEP-V now obscures the ranking argument for ONSET. All we know for certain is that IDENT must be low-ranked, since the winning candidate violates that constraint. Thus, the final ordering of constraints is the following: \*<sub>ω</sub>[Trill, MAX-C, DEP-C, DEP-V, ONSET >> IDENT.

It bears some mentioning that the winning candidate in tableau (27) is in fact optional in Standard German. The form in (27) is also an acceptable form of Standard German. However, in a strict form of Classic OT, where constraint ranking is constant within a language’s grammar, this is difficult to model. For that reason, I will not consider this variation in any more detail. In any event, it can be seen that there are two primary strategies for satisfying the \*<sub>ω</sub>[Trill, namely vowel prothesis or segmental change. This is summarized in the display in (28).

(28) Summary of strategies to satisfy \*<sub>ω</sub>[Trill

- i /r/ to [VrV]
- ii /r/ to [ʁ], [ʁ̥] or (more rarely) to [VRV]

<sup>21</sup> As an anonymous reviewer points out, this tableau implies that there are German speakers who use a fricative/approximant in initial position and a trill elsewhere. I do not have any direct empirical evidence confirming this (see also my discussion in Section 4.2 above), although my person impression is that German speakers tend not to use a uvular trill in initial position. I encourage further empirical research into this topic.

## 6. WHAT IS THE PROTHETIC VOWEL?

In the account above, I have not discussed what conditions the quality of the prothetic vowel. Of course, as the data for Walliser German, Campidanian Sardinian, Gascon, Basque and Sakha show, the epenthetic vowel can have a number of different forms. In Walliser German, Gascon and Campidanian Sardinian (though see below for more on this) it is [a], but in Basque it is usually [e], but is sometimes realized as [a]. The data in Basque are interesting, since they seem to indicate that the prothetic vowel can be influenced by a vowel harmony-like process. Consider once again the data from Basque in (29), in which the data from (9) above are reprinted and slightly reorganized.

(29) Spanish Loanwords with word-initial [r] adapted into Basque (cf. Hualde 1991)

	Spanish	Basque	Gloss
a.	república	errepublika	'republic'
	respuesta	errespuesta	'answer'
	respeto	errespeto	'respect'
b.	ratón	arratoi	'mouse' (Sp), 'rat' (Ba)
	raza	arraza	'race'
c.	romería	erromeria	'pilgrimage'
	ropa	arropa	'clothes'

The data in (29) show the epenthetic vowel as [e] before /e/ in the following syllable. Similarly, the data in (29) show [a] before /a/ in the following syllable. Based on this one might conclude that vowel harmony is active in this process. However, the final data set in (29) does not entirely fit with this theory, since we find both epenthetic [e] and [a] when the following vowel is /o/. There is thus an apparent inconsistency in the nature of the epenthetic vowel in roots with /o/. However, /e/ is both a mid and a front vowel and /a/ is a low and (presumably) back vowel. In addition, /o/ is mid and back. Thus, based on the data in (29), the rule of vowel epenthesis could target either the vowel height or vowel backness. It is only when we come to the data in (29) that these two properties conflict. I suggest that an epenthesis of [e] would be used by speakers who construct the rule based on vowel height and an epenthesis of [a] would be used by speakers who construct the rule based on vowel backness.

In Campidanian Sardinian the data are also a bit more complex. The original source (Viridis 1978) on the Campidanian dialects indicates that there is some dialectal variation in the quality of the epenthetic vowel. Viridis (1978: 58) writes: "the vowel is, in most of the Campidanian area a-, in *Barbagia* and *Ogliastra* this varies according to the vowel that follows (a- with an r followed by a, e- with an r followed by e or i, o- with an r followed by o or u)." <sup>22</sup> Translating this generalization back into the data presented for Sardinian, one arrives at the table in (30).

(30) Campidanian vowel epenthesis before word-initial /r/

	General Campidanian	Barbagia and Ogliastra <sup>23</sup>	Gloss
a.	ar:ana	ar:ana	'frog'
	ar:ađiu	ar:ađiu	'radio'
b.	ar:iu	er:iu	'river/creek'
	ar:iku	er:iku	'rich'
c.	ar:ɔza	or:ɔza	'rose'
	ar:ɔđa	or:ɔđa	'wheel'

<sup>22</sup> Italian original: "la vocale è, nella maggior parte del dominio campidanese a-, nella Barbagia e nell'Ogliastra essa varia a seconda della consonante che segue (a- se alla r segue a, e- se alla r segue e od i, o- se alla r segue o od u)" (Viridis 1978: 58).

<sup>23</sup> Bolognesi (1998: 42) notes that it is not clear whether the epenthetic vowel in Barbagia and Ogliastra is high-mid (e.g. [e] or [o]) or low-mid (e.g. [ɛ] or [ɔ]). For this reason, I have transcribed the vowels in the table as [e] or [o].

In (30), both varieties show epenthesis of [a], since General Campidanian uniformly epenthesizes [a] and the dialects of *Barbagia* and *Ogliastra* epenthesize [a] when the following vowel is /a/. The data in (30) and (30), however, show where the dialects diverge. In (30), the dialects of *Barbagia* and *Ogliastra* shows epenthetic [e] before /i/ in the following syllable and in (30), we find [o] before /ɔ/ in the following syllable. The discussion in Bolognesi (1998: 42) also indicates, however, that the *Barbagia* and *Ogliastra* dialects are more in-line with historical Campidanian documents. This would imply that General Campidanian has undergone a change from an epenthetic vowel that is conditioned by a vowel harmony process to a uniform epenthetic [a].

Although the evidence from Basque and Campidanian seems to support a vowel harmony analysis of vowel prothesis before /r/, the vowel harmony process is not categorical and appears instead to be slightly irregular. Therefore, I am not in a position to provide a definitive explanation of the quality of the epenthetic, but I will provide some thoughts that I believe play a role in this vowel epenthesis in the remaining paragraphs below.

As I outlined in Section 4, I see vowel prothesis before /r/ as a byproduct of natural phonetic tendencies involving the articulation of trills in initial position. Due to difficulties in maintaining a series of vibrations, trills in initial position are often flanked on both sides by brief vocalic periods. It is the vocalic period to the left, which in our example has a period of roughly 50 ms, that then becomes reinterpreted as a vowel. Since this vowel is very short, it seems that it might be hard for a listener to recover the vowel quality. However, there is, of course, another vowel following the /r/, which is considerably longer. Since this root vowel is considerably longer, a listener might consider the epenthetic vowel to be of the same quality as that vowel.

Another important observation about the epenthetic vowel is that it is always an existing phoneme of the language.<sup>24</sup> This is the case for example in Walliser German, where the listed monophthongs include /a a: æ æ: ε ε: e e: i i: o o: u u:/ (Wipf 1908: 9–11). The epenthetic vowel in that variety is the short low vowel, /a/. This also obtained in Gascon, where the prothetic vowel is always /a/, as seen in (12). In Basque, the vowel phonemes are /i e a o u/, with only the Arbizu dialect standing out for its contrastive vowel length viz. /i i: e e: a a: o o: u u:/ (cf. Hualde 1991: 24, 39, 53, 62).<sup>25</sup> In Basque, the epenthetic vowel is either /e/ or /a/, as detailed in (29). Campidanian Sardinian possesses a basic seven vowel system: /i e ε a ɔ o u/. Distributionally, all vowels may appear in initial position, but only /a i u/ may appear in final position, excepting “weak” function words and truncated vocatives and verbal forms, which may end in mid-vowels (cf. Bolognesi 1998: 16–17). As detailed in (30), the epenthetic vowel is always from the set of /a e o/. As elsewhere, these vowels are all part of the set of occurring phonemes in the language. Nonetheless, the epenthetic vowel is either /e/ or /a/ and is never outside of the existing vowel system. In Sakha, the prothetic vowel is conditioned by the language’s vowel harmony process, appearing as any of the following [i e a o ø y]. As I noted in the discussion above, it is usually identical in quality to the vowel following the rhotic. The language also possesses an unrounded back vowel, transcribed as [ɨ] by Krueger (1962: 46), and written in Cyrillic as <ы>. I have not found any examples of vowel prothesis with this vowel, but I see no reason that it should be banned from occurring.

These generalizations are important, since the brief 50 ms vocalic period before trills is so short that one might hypothesize that a relatively neutral vowel would be epenthesized e.g. a schwa. However, in none of the varieties described above does the epenthetic vowel appear as schwa. Thus, it seems that the listener is most likely to parse the epenthetic vowel as a vowel that already occurs in the system. In the sense that the resulting vowel is always an already existing phoneme in the language, vowel prothesis before /r/ may be characterized as *structure preserving*.

## 7. CONCLUSION

The category of rhotic includes a large and diverse set of sounds. While it is difficult to provide a single definition that can fit all of these sounds to the exclusion of all others, it seems that r-sounds behave in remarkably similar ways in the world’s languages. In this paper, I do not

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<sup>24</sup> Thanks to T.A. Hall for pointing this out to me.

<sup>25</sup> Hualde (1991: 11) also makes brief mention to the dialect of Soule, located in French Basque Country, which has an additional /y/ and contrastive nasal vowels. Contact with Standard French would seem to be a likely explanation for these additional vowels.

dispute the necessity for the category known as rhotic. Instead, I have shown that for a certain phonological phenomenon it is necessary and indeed informative to split up the category of rhotic. That process is vowel prothesis before /r/, which has been referenced in descriptive sources and the phonological literature for a few languages (Walliser German, Campidanian Sardinian, Basque, Gascon and Sakha). In all of those languages, it is an alveolar trilled rhotic, [r̥], that triggers epenthesis at the beginning of a word. Furthermore, phonetic research has shown that trilled r's are often produced with a brief vocalic period prior to the onset of vibration. It is this brief vocalic period that is reinterpreted as a full vowel and then becomes incorporated into the listener's speech behavior (following Ohala 1993). Therefore, languages such as American English with an approximant r, usually transcribed as [ɹ] or [ɹ̥], are not likely to epenthesize a vowel before r at the beginning of a word. This means that a rhotic's manner of articulation can have an effect on its phonotactic patterning (*contra* Wiese 2011).

Following Hall (2011), I couch my analysis of vowel prothesis before /r/ in OT. However, rather than using *Word-Edge Hierarchy Constraints* whose ranking is fixed, as found in Hall (2011), I instead use a constraint against trills in prosodic-word initial position, which I call \*<sub>ω</sub>[Trill]. This constraint is motivated by the typological and phonetic data collected together in Sections 3 and 4. Since this constraint does not occur in a fixed hierarchy, it is also advantageous in that it does not predict that epenthesis should also occur in glide-initial words. Furthermore, I argue that vowel prothesis is not the only pathway to satisfy the constraint \*<sub>ω</sub>[Trill]. In languages with a uvular trill (French, Dutch, German, Danish, Southern Swedish, Norwegian), segmental change in manner from a trill to approximant [ɣ] or fricative [χ], rather than vowel prothesis, can be exploited in order to satisfy the constraint militating against trills in initial position. Therefore, phonotactic patterning of rhotics can also be influenced by the rhotic's place of articulation (*contra* Wiese 2011).

Finally, before concluding this paper, I would like to make one final observation about vowel prothesis before /r/. It is striking that the languages with vowel prothesis before /r/ are mostly highly isolated languages spoken in geographically distinct areas e.g. the Pyrenees, the Alps, the island of Sardinia, Eastern Siberia etc. These languages are comparatively isolated and generally less standardized. I hypothesize that a standardized orthography (such as that found in Italian or Spanish) is likely to influence a speaker's mental conception of certain lexical items. That is, a speaker of a language with a standardized orthography will be aware of the fact that a word is written <rV> as opposed <VrV> and this may influence that speaker's linguistic behavior. This may also play a role in preventing vowel prothesis before /r/ from becoming a fully-fledged phonological process complete with productive alternations.

## ABBREVIATIONS

IPA = International Phonetic Alphabet, OHG = Old High German, OT = Optimality Theory, V = Vowel, WALs = The World Atlas of Language Structures.

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## COMPETING INTERESTS

The author has no competing interests to declare.

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