CHAPTER 4. SCOTS GAELIC

4.1. Introduction

The case studies in chapters 1 and 2 demonstrate that gestural phasing depends on two factors: the segments involved and the syllable structure. Heterorganic consonant clusters are more likely to have an acoustic release, and sonorants overlap better with vowels than other consonants do. Also, heterosyllabic clusters are often phased differently than tautosyllabic clusters.

Scots Gaelic and Hocank, discussed in this and the following chapter, show that gestural phasing is affected by a third factor: constituent structure within the syllable. A sonorant adjacent to a vowel can be placed in one of two structural positions, which differ in the "closeness" of the vowel and the sonorant, and this affects the phasing of the sonorant with respect to the vowel and other consonants. In the closer position, the vowel and the sonorant are adjoined into a single unit that I call α, which is essentially equivalent to the traditional idea of the syllable nucleus.

Two segments dominated by α are treated by certain alignment constraints as if they were in the same position. In effect, the two gestures compete to occupy the same stretch in time, and this causes them to be centered on the same timepoint. The sonorant gesture is roughly in the middle of the vowel gesture, resulting in an intrusive vowel that is unusually long. I call this "symmetrical vowel intrusion".

4.1.1. Background: dialects, transcription conventions

This section provides some background facts for the more detailed presentations of data that follow. Scots Gaelic has vowel intrusion, traditionally known as svarabhakti or epenthesis, in many but not all heterorganic RC clusters. A full chart of clusters with and without vowel intrusion is given in the appendix. The clusters that trigger vowel intrusion occur only after initial syllables, which are always stressed. The preceding vowel must be short for intrusion to occur. Vowel intrusion can also occur before hiatus or word boundaries, as discussed in section 3.1.

(133) Barra dialect — Borgstrøm 1940:153, 212

a.	/ʃaLk/	→	ʃaL<u>a</u>k	'hunting'
b.	/kɛN'p/	→	k^{h}ɛN'<u>ɛ</u>p	'hemp'

The intrusive vowel is a copy of the preceding vowel, except when it coarticulates with a secondary articulation on the sonorant, as in [tɤr'<u>e</u>v] "bulls" (see section 6). The intrusive vowel has about the same duration as the preceding vowel portion, and the overall VR<u>V</u> sequence is apparently longer than a short syllable. Intrusive vowel groups have a different pitch pattern than disyllables, making them recognizable even in words where they don't alternate. Intrusive vowels are not written in traditional orthography[14].

This chapter concerns mostly the 'archaic' dialects of the Outer Hebrides, particularly those spoken on the islands of Barra and Lewis (which includes the villages

[14] Borgstrøm 1940:15 mentions one exception, *anaceartes* [anak'æstəs] 'bad treatment'.

Bernera and Leurbost). Dialects of Scots Gaelic can be different enough to cause problems with mutual intelligibility, according to Ternes 1973:2 (quoting Dorian 1965:18). The conclusions reached here do not necessarily hold for other dialects. The data come mostly from Borgstrøm 1937, 1940, Oftedal 1956, and occasionally Holmer 1938, abbreviated as B37, B40, O, and H.

I use the traditional notation for Scots Gaelic's complex sonorant inventory, in which capitalization indicates tenseness and an apostrophe, palatality. Both are phonological rather than strictly phonetic classifications: they describe how the consonants interact in patterns of mutation. The phonetic realization of these contrasts differs from dialect to dialect.

The main sources, Borgstrøm 1937, 1940, and Oftedal 1956, all use slightly different systems of transcription. To standardize them, and to eliminate possible confusion, I have made the following changes: the high back unrounded vowel is [ɯ] rather than Borgstrøm's backward lambda, the mid back unrounded vowel is [ɤ] rather than [ø], aspiration is [ʰ] rather than a reversed apostrophe, the sound that Borgstrøm writes as [b̥] in 1937 and [b̯] in 1940 is simply [b] (likewise other voiced consonants). An apostrophe indicates palatalization.

4.2. Evidence for monosyllabicity

In a case like Scots Gaelic where the intrusive vowel is phonetically long, having the same duration as an ordinary stressed vowel, the claim that the intrusive vowel group (CVRV̲C) is monosyllabic can seem more surprising than it does in a language where the intrusive vowel is short and clearly transitional. However, there is evidence from speaker intuitions and phonology that Scots Gaelic intrusive vowel groups are indeed monosyllabic. Most of these arguments have been pointed out by Smith 1999, and by Bosch (n.d.), who proposes the first gestural analysis for Scots Gaelic.

4.2.1. Speaker intuitions

The early fieldworkers Borgstrøm, Holmer and Oftedal all suggest that CVRV̲C sequences with intrusive vowels are in some sense monosyllabic rather than disyllabic. They note that intrusive vowel sequences sound unlike normal disyllables and that speakers consciously differentiate the two. These linguists tend to be inconsistent, however, in their use of the term *syllable*. They sometimes refer to the first syllable and second syllable of an intrusive vowel sequence in the same discussion where they claim that the sequence is monosyllabic. This is because they distinguish between 'phonetic syllables', apparently meaning sonority peaks that the fieldworker hears as syllabic, and 'phonemic syllables', meaning the syllables recognized by native speakers and by the phonology. I use *syllable* only in the sense of 'phonemic syllable'. It is not impossible that phonetic syllables have some phonological status as well— for example, my impression is that people may use them in rhyming— but they are not units that ordinary phonological rules refer to.

Borgstrøm reports that speakers pause at a different place in intrusive vowel sequences than in normal disyllables. He marks intrusive vowel sequences with square brackets.

> In conclusion I give some remarks by Mr. Neil Sinclair, of Barra, regarding the two types *aran* and *m[ara]v*. Comparing the two words *fœëNak* "a crow" (feannag, type *aran*) and *ʃ[aLa]k* "hunting" (sealg, type *m[ara]v*) he said: In *ʃœëNak* there is a "space" between the two syllables, so that he could pronounce *fœëN – ak*. In *ʃ[aLa]k* the *L* and the following *k* are so "close together" that such a separation is impossible; the word is "nearly monosyllabic, but not quite monosyllabic". (B40:153)

The consultant's own explanation for why he can't pause in [ʃaLa̲k] is not right in a purely phonetic sense. Bosch & de Jong 1997 show that consonants flanking an intrusive vowel are *not* physically closer together than those flanking a non-intrusive vowel. But speakers generally find it easier to pause between syllables than within a syllable, so the speaker's difficulty with the task supports the idea that [ʃaLa̲k] is monosyllabic. His intuition that the [L] and [k] are 'close together' probably reflects their structural closeness as tautosyllabic segments. Incidentally, this passage is sometimes quoted as support for the idea (which originates with Borgstrøm) that intrusive vowel sequences are a type of disyllable with a special syllable cut: the theory is that a normal CVCVC sequence is syllabified CVC.VC, but a sequence with an intrusive vowel is syllabified CV.RV̲C. However, Borgstrøm does not say that the speaker preferred to pause before the sonorant; he does not give any indication that the speaker could pause anywhere in the sequence.

Although the consultant Mr. Sinclair balked at calling an intrusive vowel sequence a monosyllable, he treated it as one when asked to count syllables[15]:

> He declared that the word *ʃ[æra]-ətær'* "towel" (*ʃ[æra:]tær'*) contained three syllables, which he wrote down in the following manner: seara-ad-air, in phonetic spelling *ʃ[æra]-ət-ær'*; he said that the first "syllable" seara- is long and stressed. The ordinary spelling of the word is searbhadair or searadair. Miss Annie Johnston, unacquainted with Mr. Sinclair's views, also divided the word into the same three syllables. From this it is evident that for native speakers the type *m[ara]v* is equivalent to a monosyllable. (B40:153)

The speakers' comments, with their slight inconsistencies, are reminiscent of the debates that can be sparked among English speakers over the question of whether *fire* is one or two syllables. Ternes 1973:101 mentions another Barra speaker who describes intrusive vowel sequences as "lighter" than disyllables.

---

[15] [ʃæra̲.ət.ær] exhibits two peculiarities of Scots Gaelic intrusive vowels: they can appear without a synchronic trigger (in this case, there is no consonant after the sonorant), and the intrusive vowel is not always identical with the preceding vowel. Both characteristics are discussed at length in following sections.

Similarly, for the Leurbost dialect Oftedal claims that "in *aràm* and *faLà* there is one stress distributed on a monosyllabic group of vowel plus consonant plus vowel" (O27). Grave accents are his diacritic for intrusive vowels. He adds,

> To the possible objection that interpreting *aràm, faLà,* etc. as monosyllables means departing too far from the phonetic facts, it may be remarked:
> (1) that the only consonants which can appear between the two vowels of a svarabhakti group are the most sonorous consonants of the system (l-sounds, r-sounds, and nasals), and that the auditory impression (received by both Borgstrøm and myself) that *aràm* and *faLà* are phonetically disyllabic may be due to unconscious comparison with similar sound sequences in other languages.
> (2) That svarabhakti groups are recognized as monosyllabic by educated native speakers. This may be partly due to the spelling, where the second vowel of a svarabhakti group is left out (*orm, falbh*); but it is significant that in songs, even local *òrain* that have never been written down, a svarabhakti group is sung on one note." (p. 29)

Borgstrøm 1937:77 corroborates: "In songs the type *ma-rav* is sung on one note, as if monosyllabic." (The dash is another diacritic for intrusive vowel sequences).

It is interesting that Oftedal draws a distinction between 'auditory', 'phonetic' syllables and the type of syllables that are recognized by native speakers and the phonological system. He acknowledges that the syllable is a mental organization of sounds, which cannot be read directly from an acoustic record, and that a linguist's own language background can bias him to hear the syllable structure of another language incorrectly.

Poetry also treats intrusive vowel groups as monosyllabic. O'Rahilly 1932:201 observes that "in Scottish stress-verse…the epenthetic vowel is not recognized, and the vowel preceding the consonant group rimes either with a similar vowel followed by a similar group (much as in scholastic verse) or, less commonly, with a simple long vowel. Both usages are illustrated in the verse of Duncan Macrae, who, for example, rimes *folbh* at one time with *borb* (monosyllabic), at another time with *ól*." Apparently, CVRVC does not rhyme with disyllables.

Many linguists who have first-hand acquaintance with Scots Gaelic agree with Borgstrøm and Oftedal's observations. Holmer 1938:32 says of intrusive vowel sequences in the Skye dialect: "The first vowel generally carries the stress, but the 'svarabhakti' vowel is itself nearly as audible. Both vowels make only one syllable, and the duration of them together (including the consonant between them) is that of an ordinary syllable (consisting of a vowel and consonant of standard length)." Greene 1952:217 comments that "whereas in Irish this epenthetic vowel produces merely a new disyllable, in Scottish Gaelic it is felt rather to lengthen the syllable." Bosch (n.d.:2), who has done fieldwork on the Barra dialect, suggests that "the syllable formed by the epenthetic vowel is properly understood to be an extension of the original syllable, as opposed to a second, new syllable position, thus pointing to the need for a gradient rather than discrete understanding of the syllable as constituent." Ladefoged et al. 1998:2, in their phonetic study of the Leurbost dialect, also report that intrusive vowel sequences

"might be considered phonologically monosyllabic and certainly are so in the opinions of speakers."

This conclusion is not universal, however. Ternes 1973:99 regards intrusive vowel groups in the Applecross dialect as disyllabic, although he acknowledges that "there is a phonetic difference of some kind" between original disyllables and intrusive vowels groups. The Applecross dialect is distant from the Outer Hebrides dialects and could very well have diverged from them, but Ternes appears to reject the monosyllabicity analysis for other dialects as well. Clements 1986 follows Borgstrøm's suggestion that intrusive vowel sequences are disyllables with V.CV syllabification, as opposed to the default VC.V. Bosch & de Jong 1997 propose that intrusive vowel sequences are disyllables with second syllable stress; Green 1997:159 follows them.

Some theories essentially treat the sequences as both monosyllabic and disyllabic, by expanding the notion of the syllable. Bosch & de Jong 1998 argue for a structure consisting of two syllables dominated by a unit called a 'supersyllable'. Smith 1999 presents a related theory in which the intrusive vowels heads a 'recursive syllable' which can form the coda of another syllable (see chapter 2).

I argue that Borgstrøm, Oftedal, and Holmer were right to classify intrusive vowel sequences as monosyllables. Phonologically, they behave as monosyllables, just as the sequences with short intrusive vowels discussed in the previous chapters do. Furthermore, there is no need for recursive syllables, gradient syllables, or supersyllables. A CVRVC syllable is not structurally unusual except in that V and R are adjoined. Its segments have a special timing relation, but the syllable itself is simply a CVRC syllable, composed of four segments, and behaves as such. There is no syllable-like entity within the syllable. Although the intrusive vowel creates the auditory impression of a RVC sequence within the syllable, this sequence does not phonologically have any syllable-like behavior or functions.

4.2.2. Duration and pitch

Phonetic evidence concurs with speakers' impressions that intrusive vowel groups are monosyllabic. The syllable is a phonological entity which cannot be directly read from an acoustic record, but it is possible to compare intrusive vowel groups to clear-cut examples of monosyllables and disyllables to see which they resemble.

Intrusive vowel groups have a pitch pattern similar to that of long monosyllables and unlike that of disyllables. Ladefoged et al. 1998 compare the citation forms of intrusive vowel sequences, disyllables, and diphthongs in Lewis, and Bosch & de Jong 1997 present similar data from natural speech in Barra. Instrumental studies confirm fieldworker's observations that the difference in pitch between an intrusive vowel word like [paLak] and a disyllable like [paLak] is like the difference between monosyllabic [tuan] and disyllabic [tu.an]. The diphthong and intrusive vowel word have purely rising intonation, while pitch in the disyllables rises, then falls. (Placement of the syllable cut below follows Borgstrøm 1940).

(134)

		Intonation
paLa̲k	‘belly’	Rising
paL.ak	‘skull’	Rising, then falling
tuan	‘song’	Rising
tu.an	‘hook’	Rising, then falling

Under the monosyllabicity hypothesis, the pattern is that pitch rises during the first syllable and falls during the second. Since [tuan] and [paLa̲k] are both monosyllables, they both have rising intonation. These pitch patterns are what allow speakers to recognize intrusive vowels in cases where there are no alternations; Bosch (n.d.:9) reports that speakers are quick to point out an incorrect pitch pattern.

Intrusive vowel groups also have different durational patterns than disyllables, according to Bosch & de Jong’s 1997 study of Barra. In a normal CV_1CV_2C disyllable, V_1 is longer than V_2, presumably because Scots Gaelic has initial stress. In a $CV_1R\underline{V_2}C$ sequence where V_2 is intrusive, V_2 tends to be the same length or even longer than V_1. This suggests that the vowel and sonorant gestures are centered roughly on the same point. An intrusive $\underline{V_2}$ is longer than a non-intrusive V_2, and V_1 is shorter if it precedes an intrusive vowel than if it precedes a non-intrusive vowel.

None of the instrumental studies compare the overall durations of intrusive vowel words and disyllables, but Borgstrøm 1937:77 states that words with intrusive vowels sound shorter than disyllables.

4.2.3. Positional licensing

Scots Gaelic phonology contains several patterns that count syllables or are sensitive to syllable structure, and these provide diagnostics for whether CVR̲VC is one syllable or two. For positional licensing, glottal stop epenthesis, mutations, and syncope, CVR̲VC patterns with monosyllables, lending additional support to the conclusions reached from speaker intuitions and phonetics.

Many languages, including Scots Gaelic, license a greater range of contrasts among segments in stressed or initial syllables than unstressed or non-initial syllables (Beckman 1998 and references therein). If intrusive vowels are part of the initial, stressed syllable in Scots Gaelic, we expect them to license the full inventory of vowel qualities, and they do, as noted by Bosch (n.d.:11).

In stressed syllables, Scots Gaelic allows nine short vowels.

(135) Stressed short vowels, Leurbost dialect (O43)

Front		Back
	-Round	+ Round
i	ɯ	u
e	ə	o
ɛ	a	ɔ

In unstressed syllables, the distinctions are far fewer. Oftedal states that the inventory of unstressed vowels is five, and that even these are in largely complementary distribution (147). Smith 1999 argues that there may be only a two-way contrast in unstressed syllables. However, intrusive vowels are not confined to this narrow inventory. All vowels except [o] are found in vowel intrusion groups; as Oftedal notes, the absence of [o] may be accidental.

To take one example, [ɯ] is not normally found in unstressed syllables. The only reported cases are [tɯrɯɣ] 'drought' and [tɯrɯs] 'journey, time', but Oftedal ascribes these to optional vowel harmony, since the words can also be pronounced [tɯrəɣ] and [tɯrəs] (O147). Yet intrusive [ɯ] is common, and does not have an alternate [ə] pronunciation.

(136)	a.	t'ɯmɯ̲nəɣ (Nũãɣ)	'(New) Testament'	O143
	b.	sɯðɯ̲j	'to court, woo'	O143
	c.	ɯrɯ̲xər	'a shot'	O142
	d.	ɯrɯ̲bəL	'tail'	O142

The presence of a stable [ɯ] quality makes these intrusive vowels unlike typical unstressed vowels.

This pattern can be captured with constraints proposed by Beckman 1998. Markedness constraints of the type *SEG, banning segment types, interact with constraints that specify positions of the word where faithfulness is stronger.

(137) *SEG
Segment S is not permitted.

(138) MAX-*Position*-SEGMENT (adapted from Beckman 1998 :131)
A segment S in a prominent position in the input has a correspondent in the output.

The ranking MAX-STRESSED SYLLABLE-[ɯ] >> *[ɯ] >> MAX restricts [ɯ] to initial position. This will eliminate all underlying [ɯ]s in non-initial syllables, for example by changing them to [ə] (I know of no alternations to show what repair the language actually prefers), while preserving underlying [ɯ] in initial syllables.

(139)

/CɯCɯ/	MAX-STRESSED SYLLABLE-ɯ	*ɯ	MAX
a. ˈCɯ.Cɯ		**!	
b. → ˈCɯ.Cə		*	*
c. ˈCə.Cə	*!		**

If intrusive vowels belong to the second, unstressed syllable, they should meet the same fate, but if they are not separate syllables, their ability to contain any vowel is explained. Intrusive [ɯ] is part of the stressed, initial syllable, so MAX-STRESSED SYLLABLE-[ɯ] preserves it.

(140)

/sɯðɣ'/	MAX-STRESSED SYLLABLE-ɯ	*ɯ	MAX
a. → ˈ.sɯðɯ̲ɣ'.		*	
b. ˈ.səð̲əɣ'.	*!		*

The monosyllabicity hypothesis thus correctly predicts the distribution of vowel qualities.

4.2.4. Glottal stop epenthesis

One dialect group has an epenthesis process that adds a coda to stressed open syllables. This epenthesis does not happen in CVRV̲C, supporting the theory that the whole sequence is one (closed) syllable.

In the Argyllshire dialects, short stressed open syllables (which are normally initial) are followed by an epenthetic glottal stop, unless the following consonant is an obstruent. The epenthetic [ʔ] is found before l/r/n sounds, vowels, and word boundaries.

(141) ʔ epenthesis after open stressed syllable, before l/r/n/ or vowel

a.	ˈpaʔlax	'boy'	H36,37
b.	ˈkʰaʔraxəɣ	'move, stir'	
c.	ˈʃiʔnjə	'older'	
d.	ˈljeʔuar	'half hour'	
e.	ˈpɛʔin	'beasts'	
f.	ˈkoʔur	'goat'	

ʔ epenthesis in open monosyllables

g.	ˈtʰjeʔ	'hot'
h.	ˈmɛʔ	'good'
i.	ˈuʔ	'egg'

The epenthetic [ʔ] does not appear if the following onset segment is an obstruent, as in [ljexrun] 'half crown'. I assume that this is blocked by a phonotactic constraint against such consonant clusters.

[ʔ]-epenthesis appears to have the function of making the stressed syllable heavy. For this reason, it does not happen after a long vowel or a diphthong, since a syllable containing one of these is heavy already.

(142) No ʔ epenthesis after a long vowel or diphthong

a.	ˈtʰiː	‘tea’	H28
b.	ˈhaː	‘there is, yes’	H27
c.	ˈsɔ̃ːr̃içt(j)ə	‘special’	H29
d.	ˈmɛːri	name	H41
e.	ˈtjɛːnəɣ	‘doing’	
f.	ˈtʰrai	‘beach’	H52
g.	ˈkʰuinjiç	‘remember’	H55

I analyze [ʔ] epenthesis as resulting from the constraint STRESS TO WEIGHT outranking the anti-epenthesis constraint DEP.

(143) STRESS TO WEIGHT Kager 1999
A stressed syllable is heavy.

Words with intrusive vowels do not have an epenthesized [ʔ] after their first vowel. The Argyllshire dialect has a shorter intrusive vowel than the other dialects mentioned in this chapter. Holmer usually transcribes it as [ə] or [i].

(144) No ʔ epenthesis within an intrusive vowel sequence

a.	ˈmen̲əv	‘fine, small’	H37
b.	ˈmar̲əv	‘dead’	H37
c.	ˈfɔl̲əv	‘go’	H37
d.	ˈtjal̲əvən	‘pictures’	H33

As Smith 1999:588-9 points out, this is evidence that the initial CV of an intrusive vowel sequence is not an open syllable, and supports the claim that the entire CVR<u>V</u>C is one syllable. [ʔ] epenthesis in this dialect is another way in which an intrusive vowel sequence patterns with CVRC words rather than CVRVC words.

4.2.5. Mutations

Intrusive vowel sequences also pattern with monosyllables in the system of ‘mutations’. Scots Gaelic realizes many inflections by changing segments in certain positions within the word. For example, some nouns form their plural by palatalizing their final consonant.

(145) Palatalization mutation, Bernera dialect

	singular	plural		
a.	baLəx	baLiç	‘boy’	
b.	fið’əNəx	fið’əNiç	‘man’	
c.	iəṚəN	iəṚiN’	‘iron’	
d.	sɔLəs	sɔLiʃ	‘light’	
e.	æx	eç	‘horse’	B40:87-88

The vowel that precedes the palatalized consonant often changes its quality as well. Below are three examples of [a] mutating into different vowels before palatalized consonants. The vocalic part of the mutation is unpredictable and must be lexically specified.

(146) Palatalization, Bernera dialect

	singular	plural		
a.	k^{h}a^{h}t	ke^{h}t’	‘cat’	
b.	ma^{h}k	mi^{h}k’	‘son’	
c.	aLt	ul’t’	‘knuckle’	B40:87

Labials, retroflexes and [h] can’t be palatalized in Scots Gaelic. When a word ends in one of these, the preceding vowel may mutate even though the consonant doesn’t change.

(147) Palatalization, Bernera dialect

	singular	plural		
a.	Rãːv	Rɛ̃ːv	‘oar’	
b.	k^{h}l’iəv	k^{h}l’eːv	‘basket’	
c.	t^{h}ɔːb	t^{h}ɛːb	‘bay’	B40:87

The reason that palatalization is a test for syllable structure is that it normally affects only rhymes. Onsets don’t palatalize, although they may be affected by other mutations, as in a) below. Furthermore, most mutations take place only in monosyllables. The main mutations that take place in unstressed syllables are ə → i (such as -əx → -iç, -əɣ ~ -i) and -ak → -æk’ (B40:85). If a word like [tar̲av] ‘bull’ is monosyllabic, it is predicted to be eligible to undergo mutation, and furthermore, the entire rhyme ([ar̲av]) should mutate. The vowels should both change together if they are one segment.

This is in fact the case. When a word with an intrusive vowel undergoes mutation, both the sonorant and the final consonant mutate, and the vowels both change together as well.

(148) Mutations with intrusive vowels, Bernera dialect B40:87

	singular	plural	
a..	tʰarav	tʰæð'æv	'bull'
b.	baLag	bul'ug'	'bellow'
c.	dɔrɔɣ	duð'uj	'fishing line'
d.	skarav	skɤð'ɤv	'cormorant'

Words with intrusive vowels thus pattern with monosyllables in the mutation paradigms. The entire VRVC sequence behaves as if it belongs to the final rhyme of the word, which is the normal location for mutations.

This argument for monosyllabicity is the weakest of those given here. As noted above, mutations involve unpredictable vowel changes: for example, [tʰarav] and [skarav] have the same rhyme yet take different vowels in the plural. This unpredictability means that at least some aspects of the mutated form must be lexically listed. It is possible that the whole pattern is a complex system of allomorphy, involving multiple lexically specified phonological forms for each word. The palatalized forms of intrusive vowels could be seen under this view as a historical artifact, left over from the time before the vowel intrusion occurred, rather than an indication that they synchronically have monosyllabic status. Moreover, a similar mutation pattern is found in Irish Gaelic with CVRəC words, where the [ə]s historically were intrusive, but now are certainly separate, syllabic segments.

Nevertheless, when added to the other phonological patterns here, the mutation paradigm provides another reason for speakers to classify vowel intrusion sequences pattern with monosyllables.

4.2.6. Syncope

The final phonological argument that intrusive vowel groups are monosyllabic concerns syncope. Vowel-initial inflectional suffixes trigger syncope when they attach to a disyllabic stem, provided that the syncope would not bring together two obstruents.

(149) Syncope, Leurbost dialect

a.	fiəkiʟ' + ən	→	fiəkLən	'teeth'	O194
b.	obəð + əx	→	obrəx	'work (gen.sg.)'	O189
c.	taxəR + i	→	taxri	'happen (ind. fut)'	O239
d.	darəs + ən	→	daRsən	'door (pl.)'	O194

Syncope and vowel intrusion show an interesting interaction. If the consonants flanking the syncopated vowel are a pair that triggers vowel intrusion, for example [r] and [g], then an intrusive vowel appears in the same place that the underlying vowel deletes from. In a derivational framework, the pattern would be analyzed with ordered rules of Syncope and Vowel Intrusion.

(150) Syncope

$V \rightarrow 0 / C_1\_\_\_C_2]_{stem}\ [V...]_{inflectional\ suffix}$

where the stem has 2 syllables, and at least one of C_1 and C_2 is non-obstruent.

Vowel intrusion

$V_iRC \rightarrow V_iRV_iC$ (for certain RC clusters)

Syncope feeds Vowel Intrusion, so that one vowel is deleted and another inserted in the same location.

(151)

	Syncope		Vowel intrusion			
a. /taRig'+ i/	→	/taRg'i/	→	taR<u>a</u>g'i	'pull (ind. fut.)'	O239
b. /taRəg + ən/	→	/taRgən/	→	taR<u>a</u>g'ən	'nail (pl.)	
c. /baLəx + u/	→	/baLxu/	→	vaL<u>a</u>xu	'boy (voc. pl.)'	
d. /k'ãNix' + əs	→	/k'ãNx'əs/	→	x'ãN<u>a</u>x'əs	'buy (rel.)'	
e. /kaL'əx + ən/	→	/kaL'xən/	→	kaL'<u>a</u>xən	'wife (pl.)'	O194

Under the view that intrusive vowel sequences are disyllabic, this phenomenon is problematic for Optimality Theory. It cannot be analyzed using only markedness and faithfulness constraints, as Smith 1999 and Bosch 1993 point out[16]. To demonstrate why not, let us assume that syncope is triggered by the constraint LAPSE.

(152) LAPSE

A sequence of two unstressed syllables is prohibited.

LAPSE, or any similar constraint, cannot interact with MAX and DEP in any way that will produce deletion and insertion in the same place, as shown in the tableau below. The intrusive vowel candidate (c) is harmonically bounded by the faithful candidate (a), because (a) has a subset of (c)'s violation marks. No ranking can cause (c) to win.

(153)

/taRig'/ + /i/	LAPSE	CONSTRAINTS CAUSING VOWEL INTRUSION	DEP	MAX
a. ˈtaR.ig'.i	*			
b. ˈtaR.g'i		*		
c. ˈta.R<u>a</u>g'.i (actual winner)	*		*	*

[16] An alternative, not explored here, is that the system could also be simply irregular and memorized. There are instances of the phenomenon discussed here, vowel intrusion combined with syncope, that happen in cases where there is no synchronic trigger for the vowel intrusion: [mãLə] 'eyebrow' pluralizes to [mãL<u>ã</u>.ən], with vowel intrusion, although no consonant cluster would be formed otherwise. Oftedal gives other examples where unpredictable changes such as metathesis or depalatalization accompany the syncope (194).

Such a mapping, with gratuitous deletion and insertion, is a challenge to the OT premise that phonological patterns can be explained purely through markedness constraints on outputs and faithfulness constraints on input – output mappings.

Under the view that intrusive vowel sequences are monosyllabic, this problem disappears, because the nature of the phenomenon is quite different. What happens is not simultaneous deletion and insertion, but deletion accompanied by vowel intrusion. The intrusive vowel candidate (d) wins under the ranking shown below, because it does not violate LAPSE.

(154)

/taRig'/ + /i/		LAPSE	CONSTRAINTS CAUSING VOWEL INTRUSION	DEP	MAX
a.	ˈtaR.ig'.i	*!			
b.	ˈtaR.g'i		*!		*
c.	ˈtaR.**a**g'.i	*!		*	
d. →	ˈta.R<u>a</u>g'.i				*

Thus, the monosyllabicity hypothesis makes the phenomenon analyzable in Optimality Theory, and captures the insight that intrusive vowel sequences are patterning with monosyllables rather than disyllables for syncope.

This problem illustrates how gestural representations can deal with part of the problem of opacity, which is generally one of the most difficult patterns for non-serial frameworks like Optimality Theory to handle. In many of the textbook cases of opacity, the rule that counter-feeds or counter-bleeds previous rules has the hallmarks of a gestural phenomenon: for example, it applies optionally, or only at certain speech rates. Treating intrusive vowel sequences as monosyllabic eliminates quite a broad swath of apparent cases of opacity; it is possible that extending gestural representations will eliminate others.

4.3. Evidence for subsyllabic structure

Scots Gaelic intrusive vowels are similar to those of Dutch, Finnish, etc. in that they are non-syllabic. As Bosch (n.d.) has proposed, these sequences appear to involve gestural overlap: a vowel gesture fully overlaps a sonorant and is heard in two parts. Yet in other ways, Scots Gaelic intrusive vowels stand apart from all others discussed so far. I argue that vowel intrusion happens in Scots Gaelic for a different reason than in other languages.

Scots Gaelic intrusive vowels are phonetically longer than would be expected under the account presented in previous chapters. I have proposed that vowel intrusion in other languages results from two pressures: the pressure to keep a space between consonants in a cluster, preserving their perceptibility, and the pressure to have a vowel gesture fully span its syllable (including the period of release within the consonant

cluster). This spacing usually results in only a brief vocalic period. But in Scots Gaelic, the sonorant gesture appears to be more or less in the middle of the vowel gesture: an extremely wide spacing of the consonant cluster. Furthermore, vowel intrusion occurs in a peculiar set of circumstances: it only happens with a monomoraic vowel, and it can be lexically specified to happen or not happen, unlike the cases described in previous chapters.

Over the next two sections, I develop the theory that symmetrical vowel intrusion is a gestural organization triggered by a special type of subsyllabic structure, in which a vowel and sonorant are adjoined into a structure I will refer to as α. To be a member of α, a segment must be moraic. This section shows that positing α can account for how vowel intrusion is lexically specified, and for why intrusion interacts with vowel length. In section 4 I argue that α is similar to the traditional notion of a nucleus and that intrusive vowel sequences are structurally similar to diphthongs, or coalesced vowel sequences.

4.3.1. Lexical specification

Unlike all languages discussed up till now, Scots Gaelic has synchronically unpredictable vowel intrusion. At an earlier stage of the language's history, vowel intrusion apparently happened only and always in certain consonant clusters. Since then, diachronic changes have altered many of the original clusters, either by changing or deleting consonants. The intrusive vowels remained as the clusters underwent these changes, and now appear in contexts where they would not synchronically be triggered.

For example, vowel intrusion happens in the [aLp] sequence in a) below, but not in the same environment in b) or c).

(155) Unpredictable vowel intrusion, Leurbost dialect O140

a.	kaL̪ap(ə)	'calf of the leg'
b.	sgaLpaj	island name
c.	sg'aLpiç	'dandruff'

The historical chain of events that led to this situation are as follows. Originally, vowel intrusion happened in [Lb] clusters but not [Lp] clusters. [kɑL̪ap] (*colbthae*) once contained a [b], which later devoiced to [p] due to the influence of a following [h] (B40:213). When the [b] devoiced, the intrusive vowel remained even though it now precedes a consonant that would not synchronically trigger vowel intrusion. In [Lp] clusters that do not derive from historic [Lb], no vowel intrusion occurs.

Intrusive vowels do not even have to occur in consonant clusters. In many words, one of the original triggering consonants has disappeared historically, and yet the intrusive vowel remains, now preceding a hiatus or a word boundary. The orthography reflects the original cluster. In some of the examples below, the intrusive vowel appears to have an imperfectly copied quality due to coarticulation with the sonorant (see section 4).

(156) Intrusive vowels before hiatus or word boundaries

Lewis dialects				
a.	faL$\underline{a}$	*falbh*	‘go away!’ (sg)	O140
b.	faL$\underline{a}$-u		‘go away!’ (pl)	
c.	mãL$\underline{\tilde{a}}$.ən	*mailghean*	‘eyebrows’	O143
d.	mar$\underline{a}$.əɣ	*marbhadh*	‘to kill’	
e.	ɯnɯ̲.əs	*Oéngus*	name	B40:35
Barra dialect				
f.	ʃær$\underline{a}$.ətær’	*searbhadair*	‘towel’	B40:153
g.	mar$\underline{a}$.i	*marbhaidh*	‘will kill’	B40:212
h.	sær’$\underline{æ}$.əs	*soirbheas*	‘fair wind’	
i.	sɯr’$\underline{i}$.ð	*suirge*	‘wooing’	
j.	ar$\underline{a}$.ur	**arbor*	‘corn’	
k.	gɛN’$\underline{ɛ}$.ðx	*gainmheach*	‘sand’	
l.	ɛN’$\underline{ɛ}$.i	*aithnichidh*	‘will recognize’	B37:140
m.	t^{h}aL$\underline{a}$.ənð		‘of the earth’	B37:78
n.	fur’$\underline{i}$-i	*fuirchidh*	‘will stay’	B40:211
o.	dɯr’$\underline{i}$	*duirgh*	‘fishing lines’	

It is reasonable to wonder whether in words like [faL$\underline{a}$], the intrusive vowel has simply been reanalyzed as an ordinary, segmental vowel. There is evidence that it has not. Words like [kaL$\underline{a}$p] and [faL$\underline{a}$] have the special pitch pattern that is associated only with intrusive vowels; they pattern as monosyllables in the phonology in the ways described in section 2 (for example, note that [ɯnɯ̲.əs] has a non-initial [ɯ] sound) and Borgstrøm reports that his consultants intuitively treat such sequences as monosyllabic. The passage quoted early on syllable judgments actually involved one of these unpredictable intrusive vowels:

> He declared that the word *ʃ[æra]-ətær’* “towel” (*ʃ[æraː]tær’*) contained three syllables, which he wrote down in the following manner: seara-ad-air, in phonetic spelling *ʃ[æra]-ət-ær’*; he said that the first “syllable” seara- is long and stressed. Miss Annie Johnston, unacquainted with Mr. Sinclair’s views, also divided the word into the same three syllables. (B153)

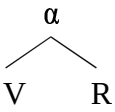
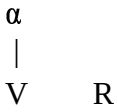
Sequences like [ʃær$\underline{a}$] also show a type of sonorant-vowel coarticulation, attributable to gestural overlap, which happens only with vowel intrusion, as discussed in section 6. All evidence points to the conclusion that these sequences are monosyllabic and involve gestural overlap. In some way, it must be possible to lexically specify whether the overlap happens or not.

(157) Conjecture #1
Symmetrical vowel intrusion can be (directly or indirectly) lexically specified.

How should vowel intrusion be lexically specified? One possibility is that the phasing of two segments is lexically specified, and faithfulness constraints preserve this underlying phasing. However, I have argued in chapter 1 that faithfulness to phasing is an undesirable extension to the theory. It allows too many unattested types of contrasts. As a rule, vowel intrusion and other effects of inter-segmental phasing, such as release, are fully predictable. In dozens of languages, vowel intrusion is fully conditioned by phonological structure: it is always possible to predict whether intrusion is possible in a given cluster in a given word. Rather than throw away this generalization for one language, it is better to consider whether Scots Gaelic vowel intrusion could be conditioned by some "hidden" structure, more subtle than segmental ordering or syllable affiliation.

I propose that symmetrical vowel intrusion is conditioned by a type of structural adjunction between the vowel and sonorant. This adjunction structure can be lexically specified, and is preserved by faithfulness constraints. Segments which are adjoined are subject to special phasing constraints that do not apply to ordinary VR sequences. The unit produced by adjunction will be called α. In ordinary syllables, α dominates only vowels. Placing a sonorant under α in a sense incorporates it into the vowel.

(158)

Vowel intrusion	No vowel intrusion
	
Heard as [VRV]	Heard as [VR]

Symmetrical phasing is the preferred realization $[VR]_{\alpha}$ in Scots Gaelic, for reasons discussed in section 4.

The phasing of V and R is not subject to faithfulness constraints, but the presence of α is. Thus, vowel intrusion is not directly lexically specified, but a structure producing vowel intrusion is lexically specified. This theory allows us to keep the generalization that inter-segmental phasing is not contrastive. The unit α will also help explain another characteristic unique to Scots Gaelic: that vowel intrusion cannot follow long vowels or diphthongs.

4.3.2. Interaction of vowel intrusion and vowel length

The second way in which intrusive vowels in Scots Gaelic are unusual is that they appear only in syllables with (underlyingly) short vowels. Clusters like [rf], [rx], [mr], and [rb] normally have vowel intrusion, but appear without it when preceded by a long vowel or diphthong, as shown below. In each group, the final example shows vowel intrusion being blocked.

(159) Vowel intrusion blocked after long Vs, diphthongs, Leurbost dialect

rf				
	a.	bar̲afas	village name	O140
	b.	mĩ̃ərfaL’	‘miracle’	
rx				
	c.	mərə̲xəɣ	Murdoch (name)	O140
	d.	dɔrə̲x	‘dark’	O142
	e.	ɯru̲xər	‘a shot’	
	f.	moːrxuʃ	‘proud, haughty’	O140
mr				
	g.	imi̲rɑɣ	‘to mention’	O143
	h.	eːmriç	‘lowing of cow’	O52
rb				
	i.	kara̲bɑd	‘wagon’	O142
	j.	ɯru̲bəL	‘tail’	
	k.	L’uːrbɔsd	village name	O51

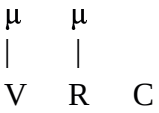
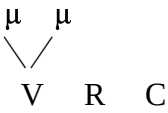
This restriction is not typical of languages with vowel intrusion: generally vowel intrusion happens after long vowels just as easily as after short vowels, as shown by words like Saami [aːjːə̲pmuː] ‘air’, or Dutch [horə̲n] ‘horn’, where [o] is bimoraic.

It is not likely, incidentally, that the location of the syllable boundary is a factor in this pattern. Clusters like [mr] should be heterosyllabic regardless of whether they follow a short or long vowel, since [mr] is not a possible onset in Scots Gaelic, never being attested in initial position (O48-49). Borgstrøm states that all intervocalic CC clusters are heterosyllabic after both long and short vowels (B37:77). Thus, phasing constraints that refer to syllable affiliation, like those proposed in chapter 2, cannot explain why vowel length matters in conditioning vowel intrusion.

A more plausible interpretation of these facts is that vowel intrusion happens in a VRC sequence only if the sonorant is moraic. In most theories, syllables are limited to bearing two moras; a short vowel is monomoraic while a long vowel or diphthong is bimoraic. Postvocalic consonants bear moras in some languages. When the vowel bears only one mora, as in a CVC syllable, it is possible for a following consonant to also bear a mora. But if the syllable contains a long vowel or diphthong, both moras are borne by the vowel(s) and none is available for the consonant.

I propose, therefore, that symmetrical vowel intrusion is connected with the moraicity of the sonorant involved. The situations where intrusion is blocked are precisely those where the sonorant could not be moraic.

(160)

V intrusion possible	V intrusion not possible	
		
Heard as:		
[VRV̲C] / [VRC]	[V:RC]	[VVRC]

(161) Conjecture #2
In symmetrical vowel intrusion, the sonorant is moraic.

Several facts support the above conjecture. First, a minimal word augmentation pattern indicates that postvocalic consonants can in fact be moraic in Scots Gaelic. Scots Gaelic does not permit (C)V words, although CVC, CV: and CVV are acceptable. This type of restriction is usually attributed to a requirement that lexical words be bimoraic (i.e., large enough to be a stress foot). Languages typically repair such words by adding a segment that can make the CV word bimoraic (McCarthy & Prince 1993). In Scots Gaelic, the repair chosen is to epenthesize an [h] after the vowel (B40:74). Since consonant epenthesis is sufficient to satisfy the bimoraicity criterion, postvocalic consonants in Scots Gaelic must be capable of being moraic.

Secondly, the proposal in (161) predicts that a VRV̲ sequence should behave like a bimoraic group. This prediction holds true; Borgstrøm and Oftedal both note that svarabhakti groups pattern with long vowels and diphthongs. For example, in the Leurbost dialect, only long vowels and diphthongs occur before word-final or pre-consonantal [m]; short vowels cannot (O38). Yet an intrusive vowel group can precede [m]:

(162) Leurbost dialect

a.	bəð’ə̲m	‘yeast’	O38
b.	ãnã̲m	‘name’	O143
c.	kuð’u̲m	‘to celebrate’	

This fact supports the theory that a VRV̲ sequence is bimoraic, and also that it is different from a sequence of two short vowels. CVCV[m] words do not exist, but CVCV̲[m] do.

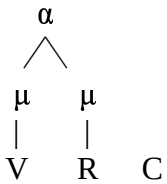
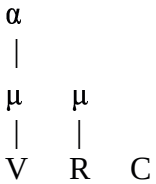
The [ʔ]-epenthesis pattern of the Argyllshire dialect, discussed above, also indicates that VRV̲ is bimoraic. [ʔ] is epenthesized after every monomoraic stressed syllable, presumably to make the stressed syllable heavy (due to STRESS TO WEIGHT). Since no epenthesis occurs after a stressed VRV̲ syllable, the syllable must be heavy already. In a similar way, when an intrusive vowel group appears without a coda, as in

[faLa] “go away!”, no [h] is epenthesized as would happen in a monomoraic syllable. Oftedal notes that “svarabhakti groups behave in this respect like long vowels” (117).

Other evidence for the bimoraicity of the sequences comes from metrics and speaker intuitions. According to O’Rahilly 1932, in poetry intrusive vowel groups rhyme with similar groups or with long vowels. Also, speakers consciously identify such groups as long syllables. Borgstrøm quotes his consultant as saying that the syllable [ʃæra] is “long and stressed” (153). (Stress, incidentally, provides no information about syllable weight since it always falls initially).

Vowel intrusion happens only with moraic sonorants, but it does not happen to all moraic sonorants. Presumably in all CVR(C) words the sonorant bears a mora, but there are many CVR(C) words without vowel intrusion. For example, [sgaLpaj] has no vowel intrusion while the similar [kaLap(ə)] does. Some other underlying distinction must account for the difference between these cases; I propose that this underlying distinction is the presence or absence of α. Only a moraic sonorant dominated by α is subject to the timing constraints (elaborated below) that produce vowel intrusion.

(163)

	Vowel intrusion	No vowel intrusion
		
Heard as:	[VRVC]	[VRC]

The evidence in this section shows that α must be a type of unit that organizes only moraic segments. In this way, α is similar to the traditional notion of the syllable nucleus. The three basic claims about the structure involved in vowel intrusion are as follows:

(164) Proposal
1. Symmetrical vowel intrusion is conditioned by a structure α.
2. α adjoins moraic segments.
3. α can be underlyingly specified, and is preserved by faithfulness constraints.

The purpose of positing α is twofold. First, it is the structure responsible for requiring the sonorant to be moraic. Second, it provides a way to *indirectly* specify which words have vowel intrusion. There are no faithfulness constraints that preserve underlying phasing relations between gestures, but there is faithfulness to the presence or absence of α. Phasing is completely predictable from the structural organization of segments, but the structural organization of a string of segments is not predictable just from their linear order.

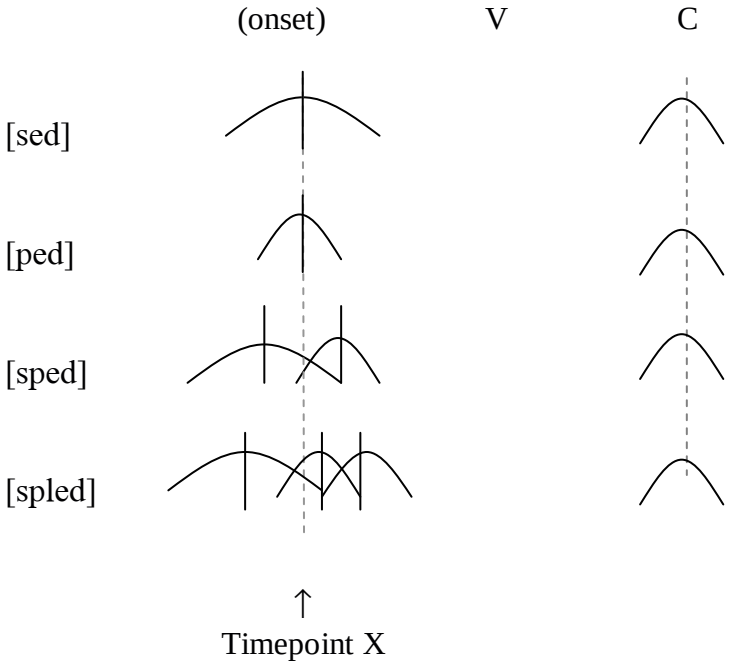
4.4. Structure α and timing

4.4.1. Subsyllabic structure and symmetrical timing: the C-center effect

In this section, I propose an explanation for why "adjunction" of a vowel and sonorant into the unit α should produce symmetrical timing. In recent literature on gestural timing, linguists have suggested that multiple segments which occupy similar structural positions (namely, consonants within a single onset) actually compete to occupy the same time period. I claim that the same is true of two segments within an α structure. They want to have their centers aligned at the same point- and in fact they achieve this, because placing a sonorant in the middle of a vowel is less marked than placing one consonant in the middle of another. For background, I will first discuss the centering phenomenon found in onset clusters.

Browman & Goldstein 2001 argue that all the consonants within an English onset cluster try to achieve the same phasing with respect to the following vowel. They base this claim on a timing phenomenon known as the C-center effect (Browman & Goldstein 1988, Honorof & Browman 1995, Byrd 1995). Roughly, the C-center effect is the tendency of all onset consonants to gravitate towards a certain timepoint. In syllables like [sed] and [ped], there is a consistent relation between the center of the onset gesture and the point of maximal constriction of the coda gesture. Although [s] and [p] have different durations, each of their centers falls at a timepoint (call it X) that is the same distance from the coda, as shown below.

(165) Alignments of onset Cs (approximated from Browman & Goldstein 2001)



Presumably the onset is actually phased primarily with respect to the vowel, but the coda is used as a reference point in instrumental studies because it is easier to measure. The C-center effect is support, of course, for the idea that gestures are phased with respect to landmarks such as the center.

When an onset contains both an [s] and a [p] as in [sped], neither of their centers falls on timepoint X. Rather, their centers deviate equally, in opposite directions, from X. In other words, if the timepoints of the [s]'s and [p]'s centers are averaged, the result is the same timepoint that the center of the [s] in [sed] falls on. This average is called the C-center. The same effect occurs if there are three onset consonants, as in [spled]. When the timepoints for the centers of [s], [p], and [l] are averaged, the result is X.

Browman & Goldstein 2001 propose that the C-center effect derives from the fact that each onset consonant wants to have the same phasing relation with respect to the vowel. Each wants to be phased as if it were the only consonant in the onset. The grammar cannot achieve this ideal phasing for both consonants, so instead it gives a slightly imperfect phasing to each consonant. This strategy minimizes the distance of any one consonant's center from timepoint X.

Within Optimality Theory, this insight can be formalized simply by assuming that constraints on C-V phasing do not distinguish between the first and second consonants in an onset.

(166) ALIGN (C, LANDMARK^1, V, LANDMARK^2)
If C and V belong to the same syllable, and C precedes V (not necessarily directly), landmark^1 of C is simultaneous with the landmark^2 of V.

In a C_1C_2V sequence, this constraint applies both to C_1 and C_2. The only way to fully satisfy the constraint would be to make landmark^1 of the two consonants simultaneous, which would in effect make the two consonants simultaneous. But this is a very marked phasing of two consonants. In the universal hierarchy of constraints on overlap, *C IN C ("a consonant does not fully surround another consonant") is high-ranked. English chooses a repair in which each consonant has a somewhat sub-optimal phasing with the following vowel.

The importance of the C-center effect is that it suggests that two segments, despite being linearly ordered in the segmental string, may in effect try to occupy the same position in time. In the case of two consonants, it's unlikely that this complete simultaneity will ever happen, since it requires a very marked C-C phasing. However, if two segments that are more capable of overlap, such as a vowel and sonorant, were to compete for simultaneous timing, it is possible that some languages would allow them to be simultaneous. I claim that this is precisely what constitutes symmetrical vowel intrusion: the centering of a vowel and sonorant on the same timepoint due to a phasing constraint that does not distinguish between them.

4.4.2. Symmetrical vowel intrusion as vowel / sonorant centering

I propose that segments dominated by α are subject to identical phasing constraints with respect to preceding and following segments, and hence want to be centered at the same point. Since vowels are able to fully overlap sonorants under some

constraint rankings, this centering actually happens in some languages, causing the vowel to be heard in two approximately equal pieces.

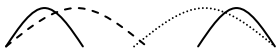
Such a phasing can be derived through adjustment of the constraint in (166). As proposed in chapter 1, phasing constraints prefer that each vowel fully span its syllable. These need to be changed to refer to all segments dominated by α, rather than only vowels.

(167) ALIGN ([SEG]$_\alpha$, OFFSET, SYLL, OFFSET)
The offset of every segment dominated by an α node is aligned with the offset of the rightmost segment that belongs to the same syllable as that segment.

(168) ALIGN ([SEG]$_\alpha$, ONSET, SYLL, ONSET)
The onset of every segment dominated by an α node is aligned with the onset of the leftmost segment that belongs to the same syllable as that segment.

When there are two segments under α, these constraints prefer that both segments fully span the syllable, and in effect be simultaneous. Constraint ranking determines whether this happens, as shown below. If the constraints in (167) and (168) are ranked above *R IN V ("a vowel does not fully overlap a sonorant"), simultaneous phasing of V and R is chosen, as in candidate b). *R IN V would prefer an output with sequential phasing of V and R, as in candidate a).

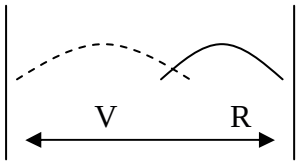
(169) Symmetrical vowel intrusion (preliminary)

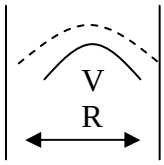
/CVRC/	ALIGN [SEG]$_\alpha$, OFFSET, SYLL, OFFSET)	ALIGN ([SEG]$_\alpha$, ONSET, SYLL, ONSET)	*R in V
a.  C [V R]$_\alpha$ C	*!	*	
b. →  C [V R]$_\alpha$ C			*

This ranking selects symmetrical phasing of the two segments in a [VR]$_\alpha$ structure. The V and R are centered on the same point.

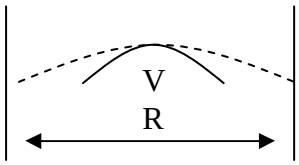
4.4.3. Timing within α: duration

Centering the vowel and sonorant gestures on the same point is part of the desired result, but there are still several problems concerning the timing of segments within the α structure. In the tableau above, the winning candidate b) would be heard as a single short blend of a sonorant and vowel. The phonetic VR<u>V</u> heard in Scots Gaelic differs from this in two ways. First, it is apparently longer. If symmetrical vowel intrusion simply involved two gestures overlapping while each maintained its usual duration, then a $[VR]_{\alpha}$ structure would have the duration of a single short vowel or sonorant, as in b) below. It would be shorter than a VR sequence without overlap, as in a).

(170) a. 

b. 

From the descriptions and phonetic evidence available, it appears that intrusive vowel groups have a longer duration than a single short vowel. Apparently the vowel articulation lengthens to compensate for the overlap with the sonorant, so that the total duration of the group remains is the same as it would be without overlap.

(171) a. 

The overall timing of the syllable seems to reflect a requirement that the whole α unit maintain a certain duration.

I assume that this is a type of compensatory lengthening phenomenon. The segments within α appear to pool their moras, so that the structure maintains an overall length reflecting the number of moras within it. This is stated as a general principle below; I do not develop a more specific theory of the mechanisms involved. (The relation between moras and gestural timing is yet not well understood.)

(172) Principle of α timing
The duration of an α structure reflects the number of moras associated with segments within α.

As for why the vowel gesture but not the sonorant gesture lengthens to stretch the full distance, this is probably related to the fact that Scots Gaelic has long vowels but not geminate (long) consonants. Constraints limit consonant gestures to a one-mora length.

4.4.4. Timing within α: symmetricality

The different lengths of the vowel and sonorant gestures create a problem for satisfying the phasing constraints. The alignment constraints in (167)-(168) would prefer the two gestures to have simultaneous offsets and onsets, but this isn't possible when the vowel gesture is longer than the sonorant. In a $[VR]_{\alpha}$ structure it is not possible to satisfy both ALIGN ($[SEG]_{\alpha}$, ONSET, SYLL, ONSET) and ALIGN ($[SEG]_{\alpha}$, OFFSET, SYLL, OFFSET) for both the V and R. One option would be to have R achieve one of these alignments while missing the other dramatically, as in a) below. But in Scots Gaelic, it appears that R is placed in the center of the vowel, so that it misses both desired alignments by the same margin, as in b).

(173) a. b.

This pattern is in one way reminiscent of the C-center effect in CC onsets, in that two smaller violations of alignment are preferred to one larger violation. In a CC onset cluster, English chooses to move each C's center slightly off the desired timepoint X, instead of giving one C an ideal phasing with respect to the vowel and the other a very marked phasing. In symmetrical vowel intrusion, R's offset and onset both miss the syllable edges, rather than one edge having ideal alignment and the other edge a very marked alignment.

This pattern can be captured by allowing not only constraints that penalize deviation from the preferred alignment, but also constraints on the degree of non-alignment. Gafos 2002:316-322, in his analysis of the C-center effect, introduces the idea that a constraint may penalize more than a certain level of "displacement" from a certain alignment. He formalizes such constraints as self-conjoined constraints (CONSTRAINT^2), a mechanism introduced by Smolensky 1993 to capture the fact that grammars often prefer two non-local violations of a constraint over two local violations. A constraint of the form CONSTRAINT^2 penalizes a large violation in alignment of a single landmark.

(174) $\text{ALIGN}([SEG]_{\alpha}, \text{ONSET}, \text{SYLL}, \text{ONSET})^2$
If C and V belong to the same syllable, and C precedes V, the onset of V is not more than one "displacement" from the onset of C.

(175) $\text{ALIGN}([SEG]_{\alpha}, \text{OFFSET}, \text{SYLL}, \text{OFFSET})^2$
If V and C belong to the same syllable, and V precedes C, the offset of V is not more than one "displacement" from the offset of C.

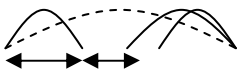
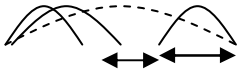
These constraints presuppose that there is some abstract size of displacement that can be counted. In the tableau below, units of displacement are shown with ⟷ .

Candidates a) and c) place the sonorant gesture all the way to one side or the other. This allows a) to satisfy ALIGN ($[SEG]_{\alpha}$, OFFSET, SYLL, OFFSET), and c) to satisfy ALIGN (SYLL, ONSET, $[SEG]_{\alpha}$, ONSET). However, perfectly satisfying alignment for one edge of R requires moving the other edge more than one displacement from its ideal

alignment. This is penalized by the higher ranked ALIGN ([SEG]$_\alpha$, ONSET, SYLL, ONSET)^2 and ALIGN ([SEG]$_\alpha$, OFFSET, SYLL, OFFSET)^2.

Candidate b) places the sonorant gesture halfway between the two syllable edges. It misses both edges, but not by more than one displacement. Although this entails violations of both ALIGN ([SEG]$_\alpha$, OFFSET, SYLL, OFFSET) and ALIGN (SYLL, ONSET, [SEG]$_\alpha$, ONSET), these constraints are lower ranked and candidate b) wins. Hence, when the conjoined constraints are ranked higher than the non-conjoined ones, the grammar prefers two small violations of alignment rather than one large violation.

(176) Symmetrical vowel intrusion

/CVRC/	ALIGN (SYLL, ONSET, [SEG]$_\alpha$, ONSET)^2	ALIGN ([SEG]$_\alpha$, OFFSET, SYLL, OFFSET)^2	ALIGN (SYLL, ONSET, [SEG]$_\alpha$, ONSET)	ALIGN ([SEG]$_\alpha$, OFFSET, SYLL, OFFSET)	*R in V
a.  C [V R]$_\alpha$ C	*!		*		
b. →  C [V R]$_\alpha$ C			*	*	*
c.  C [V R]$_\alpha$ C		*!		*	

In this way, the constraints are capable of choosing symmetrical phasing for all and only those VR sequences that are adjoined into structure α. Other rankings of the same constraints, of course, would produce α structures without symmetrical phasing.

4.4.5. Motivating vowel intrusion synchronically

In this section I show how α structures and the resulting vowel intrusion are currently enforced in the grammar. The structure α can arise in two ways. It may be specified in the input and preserved by faithfulness constraints, or it may not be specified in the input, but be added to the output to satisfy markedness constraints.

The faithfulness constraint MAX-α demands that underlying α structures be preserved.

(177) MAX-α
If two segments are adjoined into an α structure in the input, they are adjoined into an α structure in the output.

MAX-α competes with a constraint against the adjunction of segments into α. There may actually be a set of *α constraints regulating the adjunction of different segment types, but I will use only one constraint for the present.

(178) *α
Segments are not dominated by α.

In Scots Gaelic, MAX-α outranks *α, so underlying α structures are preserved. This ranking allows α, and the resulting vowel intrusion, to occur unpredictably in Scots Gaelic, as shown below. Any word that underlying has a sonorant dominated by α will have vowel intrusion.

(179) Preservation of underlying α

α / f a L /	MAX-α	*α
a. α → f a L [faLa] (*in Sc.G.)*		*
b. α | faL [faL]	*!	

Faithfulness to underlying α structures causes vowel intrusion to occur unpredictably in some segment strings. But there are also segment strings in which vowel intrusion does happen predictably. Intrusive vowels are always present in certain clusters when they follow short vowels, and intrusion is apparently productive in loans, like [tarag̲ad'] from *target* (O55) (I say only "apparently" because the ages of the loans are not clear from the sources.)

To explain why vowel intrusion occurs in loanwords, we must assume that some markedness constraints force the construction of α structures in these cases. I suggest that these are simply constraints against the overlap of certain types of overlapping consonant

sequences, which take the form of *C^1C^2 OVERLAP. Notice that these constraints refer to linear order:

(180) *C_xC_y OVERLAP
In a C_1C_2 sequence, C_1 belonging to the class C_x and C_2 belonging to the class C_y, there is no overlap between the gestures of C_1 and C_2.

The high ranking of constraints like these in Scots Gaelic is likely connected to the unusually large number of phonological constrasts it maintains among sonorants. Borgstrøm points out the relation between phasing and contrast maintenance:

> ...we must look for a special condition within the Gaelic sound-system which caused this tendency to be realized. That was the complicated system of lenited and non-lenited, palatal and non-palatal forms of l, n, r, m. The distinction of these four qualities necessitated a particularly clear and accurate articulation; this led to an increase of the interval between the consonants... and determined the insertion of a vowel. (B37:130)

Although not all 16 sonorants still exist, Borgstrøm still found three coronal nasals, three laterals, and three rhotics. Keeping them physically distant from following consonants gives them clearer formant offsets and likely helps to maintain the contrast among them.

When a word like *target*, which contains an [rg] sequence, is encountered, there are several options for repairing it. [r] or [g] could be deleted, or a vowel could be epenthesized between them. It is also possible to remove the overlap by creating a $[VR]_\alpha$ structure, since such a structure has symmetrical phasing in Scots Gaelic. This repair violates the constraint DEP-α, which penalizes the construction of a non-underlying α structure.

(181) DEP-α
A segment that is dominated by α in the output is dominated by α in the input.

If a constraint like *rg OVERLAP is ranked above at least one faithfulness constraint, it can be repaired through violation of that constraint. In the tableau below, candidates b), c) and d) show different possible repairs of [rg]. The epenthesis in b) and the deletion in c) are ruled out by high-ranked DEP and MAX. The faithful candidate a) is ruled out by *rg OVERLAP. Candidate d), with vowel intrusion, wins because it violates only the lowest ranked faithfulness constraint, that against adding segments under α nodes.

(182) Adaptation of English *target*

/tɑrgət/	DEP	MAX	*rg OVERLAP	DEP-α
a. targad			*!	
b. taragad	*!			
c. tagad		*!		
d. α → ⌒ t a r gad [tar͡agad]				*

When a prohibited cluster follows a bimoraic vowel, the VR adjunction repair is not available. An α structure must organize moraic segments and a syllable is limited to two moras. In this case, the cluster surfaces with overlap, as in (159).

There are some indications that the creation of α is not only used in the clusters that historically triggered vowel intrusion. Borgstrøm 1941:90 reports that in some non-Hebridean dialects, a svarabhakti vowel also occurs in *initial* [dl] and [tl] clusters, as in [dɯ̲l'iɔx] 'lawful' (*dligheach*) and [dɔ̲rɔhət'] 'bridge' (*drochaid*). Once the option of creating α is available, it is predicted that the grammar may use this repair for breaking any marked cluster to which it is applicable, not only the clusters that originally triggered vowel intrusion.

This analysis crucially relies on the idea that constraints on gestural phasing and constraints on other types of structure exist in the same level of the grammar. α nodes are not added in order to remove a marked non-gestural structural configuration; rather, adding α nodes is a strategy for avoiding overlap of certain gesture types. The α structure is chosen because it produces the best possible gestural phasing. The phasing is not merely an automatic interpretation of a structure that is determined at an earlier stage of the derivation; it is a factor influencing the choice of structures. The part of the grammar that decides on the α structure has to know that in this particular language, such a structure will result in symmetrical vowel intrusion.

4.5. What is α? Parallels to vocalic structures

In this section I argue that vocalic diphthongs also consist of two segments dominated by α, and that this is what distinguishes diphthongs from sequences of short vowels (with which they contrast in Scots Gaelic). α defines the gestural anchor of the syllable, the gesture or group of gestures with respect to which the preceding and following gestures, and perhaps the preceding and following syllable nuclei, are phased. When two vowels are under the same α node, they comprise one syllable. α is essentially equivalent to the traditional nucleus.

The idea that VR͡V sequences are similar to diphthongs or long vowels has never to my knowledge been formally fleshed out, but it is much hinted in early descriptive

work. Oftedal comments, for example, that “In svarabhakti groups, both vowels are always short, but it is convenient to regard the whole svarabhakti group as equivalent to a long vowel.” (38) Borgstrøm 1940 uses the same notation, square brackets, for both intrusive vowel groups and diphthongs. He notes that “The same stress and intonation as that of the diphthongs is characteristic of the complex [*ara*]” (15). In his classification of syllable types, “the type *m[ara]v* is united with the unquestionably monosyllabic diphthongs (type *d[ua]n* “poem”) to form the class of “double accented vowels.” (153)

4.5.1. Lexical specification of diphthongs

Diphthongs in Scots Gaelic are similar to vowel intrusion groups in two ways: they consist of two moraic segments, and they can be lexically specified. We can capture these similarities between the two types of segment groups by analyzing both as dominated by α.

In Scots Gaelic, diphthongs and monophthong- monophthong sequences are contrastive, as shown by the following examples.

(183) Contrastive VV sequences

	Monosyllabic	Disyllabic		
a.	fiəx	fi.əx	‘debt’, ‘raven’	O25
b.	ian	N’i.an	‘bird’, ‘girl’	C319
c.	Ruəɣ	Ru.əɣ	‘red’, ‘flush in the face’	B37:149
d.	biəɣ	bi.əɣ	‘food’, let (him) be’	
e.	duan	du.an	‘song, hook’	B40:56
f.	ɣaiv	ga.i	‘to them, will take’	B40:129

The syllabification of a VV sequence is not predictable simply from the segmental string. In the words above, it must be underlyingly specified which VV strings surface as diphthongs and which don’t.

I propose that diphthongs are lexically specified in the same way that unpredictable vowel intrusion is: by the presence of an α node in the underlying representation. A sequence of two vowels normally becomes two syllables on the surface in Scots Gaelic, as in a) below; but two vowels that are underlyingly dominated by the same α node form the nucleus of a single syllable, as in b). In the same way, a sonorant is ordinarily phased to be only partially overlapped by neighboring vowels. But when a sonorant is united with a vowel under an α node, it is subject to the same phasing constraints as the vowel. The two segments together form the gestural nucleus of one syllable, as in d).

(184)

	Input		Output	
a.	/ f i ə x /	→	fi.əx	‘raven’
b.	α ⌒ / f i ə x /	→	fiəx	‘debt’
c.	/ s g a L p i ç/	→	sgaL.piç	‘dandruff’
d.	α ⌒ / k a L p /	→	kaLap	‘calf of leg’

Under this account, the presence of both unpredictable vowel intrusion and unpredictable diphthongs in Scots Gaelic is not coincidental: both are preserved by the same faithfulness constraint, MAX-α, repeated here.

(185) MAX-α
If two segments are adjoined into an α structure in the input, they are adjoined into an α structure in the output.

Diphthongs and intrusive vowel groups are not similar, of course, in their phasing. $[VR]_{\alpha}$ structures have symmetrical phasing, while the two vowels in a $[VV]_{\alpha}$ diphthong are phased sequentially, with little overlap. In the following section I show how this difference can be analyzed as resulting from the ranking of the different constraints on V-V overlap and V-R overlap.

4.5.2. Typology of α: coalescence, “VR diphthongs”

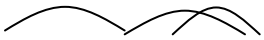
The different phasings of $[VR]_{\alpha}$ and $[VV]_{\alpha}$ (intrusive vowel groups and diphthongs) result from the fact that different phasing constraints apply to vowels and sonorants. However, it is also possible for $[VR]_{\alpha}$ to be phased non-symmetrically, or $[VV]_{\alpha}$ to be phased symmetrically, in other languages. Such phasing results in “VR diphthongs” and vowel coalescence, respectively.

As argued in chapter 1, there are different constraints on heavy gestural overlap, depending on the segment types involved. While *R IN V prohibits a vowel from fully overlapping a sonorant, *V IN V prohibits a vowel from fully overlapping another vowel.

(186) *V IN V
A vowel gesture does not fully surround another vowel gesture

In Scots Gaelic, *V IN V is ranked above the alignment constraints that prefer symmetrical phasing within α. Hence, symmetrical phasing does not happen in $[VV]_{\alpha}$ structures. The gestures remain side by side.

(187) [iɑn] 'bird'

α / i a n /	*V IN V	ALIGN ([SEG]α, OFFSET, SYLL, OFFSET)	ALIGN ([SEG]α, ONSET, SYLL, ONSET)	*R IN V
a.  i n [eːn] a	*!			
b. →  i a n [ian]		*	*	

*R IN V, on the other hand, is ranked below the alignment constraints, and hence is violated to produce symmetrical phasing in $[VR]_{\alpha}$, as shown in (169).

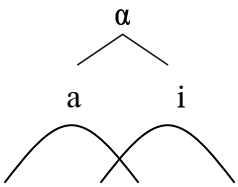
In Optimality Theory, every ranking of the constraints should be a possible grammar. Other rankings of the constraints above would have other results, and I claim that these results are attested. If *V IN V were ranked below the alignment constraints, $[VV]_{\alpha}$ would be phased symmetrically, with full overlap between the vowels, as in candidate a) above. In the task dynamic model, when two gestures overlap, any contradictory gestural specifications are "blended", which means their parameter values are averaged. Thus, two coextensive vowels should be heard as a single vowel that is articulatorily between the two component vowel segments. For example, if the parameter values of [a] and [i] were averaged throughout, this would result in a sound between [a] and [i], such as [e].

Furthermore, it is predicted that the two gestures should be heard as a single *long* vowel. I have proposed above, in (172), that an α structure maintains a length reflecting the number of moras in it. Therefore, a $[VV]_{\alpha}$ structure, even if the vowels are symmetrically phased, should have a the duration of a bimoraic vowel. If [a] and [i] are dominated by α, they will be heard as [eː].

This is, in fact, a good description of what happens in vowel coalescence. In many languages, adjacent vowels may merge into one long vowel that combines features of the two. For example, in Tokyo Japanese the word 'red' can be pronounced [akai] or [akeː] (Kawahara 2000). According to de Haas 1988:169, coalescence preserves mora counts: "the quantity of the output is identical to the sum of the input vowels." In the present theory, coalescence is almost identical to symmetrical vowel intrusion, in being the symmetrical phasing of two vowels within an α structure. Diphthongs and coalesced

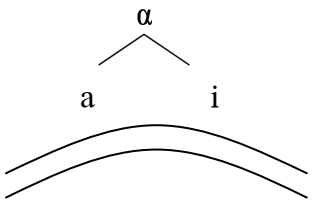
vowel sequences are structurally identical, both consisting of $[VV]_{\alpha}$. They differ only in the phasing of the gestures involved.

(188) Diphthongs



Heard as [ɑi]

Coalescence



Heard as [e:]

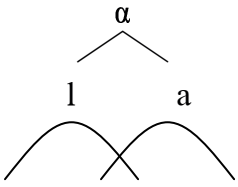
The tableau in (187) demonstrates how constraint ranking chooses between the phasing possibilities in (188).

Just as there are two possible phasings of $[VV]_{\alpha}$, it is predicted that there should be a second possible phasing of $[VR]_{\alpha}$. If *R IN V were ranked above the alignment constraints on α structures, this would produce $[VR]_{\alpha}$ without symmetrical phasing. In effect, these would be VR or RV diphthongs.

Kaye 1985 has proposed that such structures exist in certain African languages. Some sonorants appear to be structurally linked to the syllable nucleus rather than to the onset or coda. For example, in the Kru language Vata, C[l]V syllables occur, but only with short vowels: [ple] is a possible word but *[ple:] or *[plɪa] is not. Kaye argues that this is because [l] is not structurally part of the onset, but part of the nucleus, which is limited to containing two moras: a long vowel, two short vowels (a diphthong), or a short vowel and consonant. Furthermore, there are no cooccurrence restrictions between C_1 and [l] in a C_1[l] sequence. Languages typically have restrictions on what consonants may combine in an onset, but rarely have restrictions on which nuclei can follow a particular onset. In this way as well, [l] behaves like part of the nucleus.

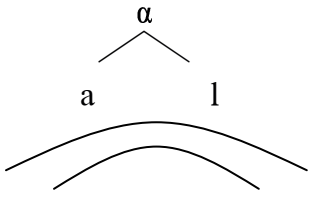
I propose that Kaye's "RV diphthongs" are $[RV]_{\alpha}$ structures without symmetrical phasing. They are structurally identical to intrusive vowel groups in Scots Gaelic, except in the linear order of vowel and sonorant. The segments are only phased differently.

(189) "RV diphthongs"



Heard as [la]

Symmetrical vowel intrusion



Heard as [al̲a]

Under this view, there are four basic types of bisegmental, bimoraic syllable nuclei: VV diphthongs, RV or VR diphthongs, coalesced vowel sequences, and symmetrical vowel intrusion groups. All are dominated by α nodes, and the differences in their phasing result from the conflict between constraints on gestural alignment and constraints against gestural overlap.

(190) Typology of bisegmental syllable nuclei

Constraint ranking	Result
*V IN V >> CONSTRAINTS ON PHASING α	VV diphthongs
CONSTRAINTS ON PHASING α >> *V IN V	Coalescence
*R IN V >> CONSTRAINTS ON PHASING α	RV or VR "diphthongs"
CONSTRAINTS ON PHASING α >> *R IN V	Symmetrical vowel intrusion

If all of these phenomena involve α structures, it is predicted that there should be some typological correlation between them. I have proposed a single faithfulness constraint preserving α, MAX-α. If MAX-α is ranked highly in a language, it will preserve both $[VV]_{\alpha}$ and $[VR]_{\alpha}$ structures (although some other constraint may rule one of them out). While only a few cases of symmetrical vowel intrusion and VR / RV diphthongs are known to me, they do seem to exhibit this correlation. Scots Gaelic and Hocank, the two languages I claim to have symmetrical vowel intrusion (Hocank is discussed in the following chapter), both have unusually large numbers of vocalic diphthongs as well. Oftedal lists sixteen contrastive diphthongs for the Lewis dialect of Scots Gaelic (O87-98). Hocank has twenty-three diphthongs (Susman 1943:27). Vata, one of the languages for which Kaye 1985 proposed RV diphthongs, also has ten VV diphthongs (Kaye 1981). This tendency of languages with $[VR]_{\alpha}$ or $[RV]_{\alpha}$ structures to license vocalic diphthongs supports the theory that these nucleus types are structurally similar.

4.5.3. Licensing of gestures within α: the case of nasality

The Barra dialect shows another similarity between intrusive vowel groups and diphthongs, involving the licensing of nasality. Rules for the distribution of nasality can be stated most simply if it assumed that intrusive vowel groups and diphthongs involve the same structure.

Most vowels in the Barra dialect are contextually nasal before or after nasal consonants, and can also be independently nasal. For example, mutations are a source of independent vowel nasality. Words that begin with [m] change the [m] to [v] in initial mutations, which are used to realize morphemes such as the definite article or vocative case. The vowel following the [m] is nasalized due to its environment, as in (a), but the nasality is also present in the mutated form in b) where the [m] is absent.

(191)	a.	mũxk	'pig'	
	b.	ə vũxk	'the pig'	B37:79

This independent nasality shows that nasalization cannot result only from overlap of a consonant's velum lowering gesture onto the vowel. Rather, a nasal vowel must be associated with an independent velum lowering gesture, at least in cases like b) above.

Intrusive vowel sequences never contain independently nasal vowels. When a nasal-initial word has vowel intrusion, as in a) below, it may have the purely contextual nasalization expected after nasals (it is not clear, because Borgstrøm never transcribes nasalization next to nasal consonants). But when a word like [mara̲.əɣ] undergoes the [m~v] mutation, the nasality does not show up in the [v]-initial form, contrary to the pattern in (191).[17]

(192)	a.	mara̲.əɣ	'to kill'	
	b.	vara̲v	'killed'	B37:79

For some reason, intrusive vowel groups are not compatible with independent nasality on vowels. (An intrusive vowel group involving a nasal sonorant will presumably be nasal in the context above, but in this case it is impossible to tell whether the nasality is independent or contextual, since vowels are nasal before and after nasal consonants anyway. Only VR̲V groups with non-nasal sonorants concern us here).

Certain vocalic diphthongs also cannot be nasal in Barra, namely those that contain a mid vowel, such as [ɤi], [iə] (=[iɤ]), or [uə] (=[uɤ]). There is a simple generalization about licensing nasality that encompasses both intrusive vowel groups and diphthongs.

(193) Licensing of nasality (Barra)
Complex α structures do not license independent nasality unless both of their constituent segments are segments that can be independently nasal.

The mid-vowels [o], [ɤ], and [e] cannot be independently nasal in Barra (B40:129); nor can the sonorants [l' L L' r r' R]. The diphthongs and vowel intrusion groups that cannot be independently nasal are precisely those that contain one of these segments. This suggests that there are licensing constraints that prohibit one segment in α from being associated with a nasal gesture if such a gesture is not compatible with the other segment in α.

The generalization in 193) would also predict that nasal consonants do not occur in vowel intrusion with vowels that cannot license nasality; i.e. mid vowels. Among the data in Borgstrøm 1940, this is true except for one function word, [ɤnɤ̲] 'one'. All other examples of VNV̲ contain high or low vowels: /an/, /aN'/, /æn/, /æm/, /im/, /in/, /ɯn/, and /uN/. This generalization has not to my knowledge been noted before.

A full analysis of these restrictions is beyond my scope here, but I note this as one more way in which diphthongs and vowel intrusion groups pattern together.

[17] The Lewis dialect is different: Oftedal 42 states that svarabhakti "seems to have counteracted the development of nasal vowels to a certain degree... But this is only a tendency, not a strict rule; there are many instances of nasal vowels... in svarabhakti."

4.5.4. Cooccurrence restrictions

As a final note, Scots Gaelic VRVC sequences do not fully meet one of the diagnostics Kaye 1985 suggested for recognizing RV nuclei. This could be seen as a challenge to the view that both involve $[RV]_{\alpha}$ or $[VR]_{\alpha}$ structures, but it can be explained as an artifact of the way the structures historically developed in the two languages.

In the West African languages that Kaye proposes to have RV diphthongs, there are no cooccurrence restrictions at all between the C and R of a CRV sequence. Cooccurrence constraints are frequent within onsets but rare between an onset and nucleus, so this freedom of CR combinations supports the theory that the R is in the nucleus. In Scots Gaelic, on the other hand, $[VR]_{\alpha}$ structures do not exist before all types of consonants. They mostly precede consonants that historically triggered vowel intrusion. However, this difference is likely a historical artifact. In at least some West African languages, CRV derives from earlier CVRV (Mensah & Tchagbale 1983, quoted in Leben & Fujimura 2000). A great variety of CR sequences developed when the intervening vowel disappeared, because there are typically no cooccurrence restrictions on onsets of adjacent syllables. In Scots Gaelic, the development of the $[VR]_{\alpha}$ structures was apparently mediated by a stage of more conventional vowel intrusion, which took place only in certain heterorganic RC clusters. For this reason, $[VR]_{\alpha}$ structures now tend to precede only a limited number of consonants.

Nevertheless, subsequent changes to codas in Scots Gaelic have greatly increased the number of environments that $[VR]_{\alpha}$ structures now occur in. They now occur in clusters with voiceless stops, which do not require vowel intrusion, and even before hiatus or word boundaries. It appears that in principle they could precede any coda. I conclude that, as in Kaye's African examples, there are actually no synchronic cooccurrence restrictions between Scots Gaelic $[VR]_{\alpha}$ nuclei and following or preceding consonants (aside from the general restrictions on C-V and V-C sequences in this language).

4.6. Intrusive vowel quality: sonorant-vowel blending

The final section of this chapter concerns cases where an intrusive vowel is transcribed with a different quality than the preceding vowel portion. I argue that this difference results from coarticulation with the sonorant, due to the overlap of their gestures. Although this phenomenon has been treated before, I show that the data are more complicated than usually assumed. Analyses which treat the intrusive vowel as a separate segment, and claim that it shares some features with the sonorant, do not account for all of the data.

4.6.1. Vowel backing after [r], [n] in Barra

Scots Gaelic intrusive vowels, especially in the Barra dialect, do not always have exactly the quality of the preceding vowel: they strongly coarticulate with the sonorant that is phased in the middle of the vowel gesture. This coarticulation is stronger than that which occurs in normal CV sequences, supporting the theory that a greater degree of gestural overlap is involved.

The vowel inventory is given below.

(194) Stressed syllable short vowel inventory, Barra dialect B37:79-89

front		back
	-round	+ round
i	ɯ	u
e	ɤ	o
æ (ɛ)	a	ɔ

In Barra, when certain combinations of vowel and sonorant form an intrusive vowel group, the intrusive vowel does not have the same quality as the non-intrusive portion of the vowel. After [r] or [n], the intrusive front vowels [æ] and [i] back and / or lower, as shown below ([ɛ] is an allophone of [æ]).

(195) Barra Gaelic non-identical vowel qualities

æra	ʃæravˠ	'bitter'	B40:134
	dʲˇæramət	'omission, mistake'	B40:134
	ʃæra.ətær'	'towel'	B40:153
	ʃærak	'to fade'	B37:149
	færak	'anger'	B37:162
	ʃæravanð	'female servant'	B37:234
	færamət	'envy'	B37:121
ɛna	mɛnavˠ	'small'	B37:116
	ʃɛnaxəs	'conversation'	B37:127
	ʃɛnavar	'grandmother' gen.	B37:171
inɤ	inɤxiNʲð	'brain'	B37:116

We can generalize that backing and lowering occur in combinations of non-palatal sonorants with front vowels. There are no other examples attested in Borgstrøm 1940 where non-palatalized sonorants ([n], [r], [l], [R], [N], and [L]) follow front vowels in a vowel intrusion sequence[18]. This is not surprising, given that the non-palatalized sonorants tend to occur with back vowels throughout the language.

The reason that the sonorant affects the intrusive vowel appears to be that the gestures of [r] and [n] involve a slightly more retracted position of the tongue than the front vowels. The articulations of [r] and [n] are described by Borgstrøm as relatively neutral; neither strongly palatalized nor strongly velarized. According to Borgstrøm 1940:132-3, the Barra [a] is not strongly backed, but "a kind of "flat front" articulation, during which the tongue is not much retracted," so that "before non-palatal consonants it is sometimes difficult to distinguish *æ* from *a*." Thus, probably does not take a very large influence on [æ]'s articulation to make it sound like [a].

This type of coarticulation (as I will analyze it) happens only with intrusive vowels; non-intrusive vowels are not affected in the same way by preceding sonorants. The sequences [ræ], [nɛ], and [ni] are attested, where the vowels are not intrusive.

[18] The Bernera dialect does have some combinations of /i/ with /r/ in vowel intrusion, and these undergo coarticulation as well, as in [iᵒruxəð] 'a shot' and [iᵒrubəL] 'tail', where [iᵒ] means a slightly rounded [i] (B40:209).

(196) Non-coarticulation with non-intrusive vowels, Barra dialect

ræ	k^hræçk'əN	'skin'	B40:164
	dræx	'appearance, look'	B37:136
nɛ	bɛkan də nɛxkð	'a little snow'	B37:115
ni	foːni	'is of use'	B37:86

Bosch & de Jong 1998 confirm instrumentally that sonorants have a stronger effect on intrusive vowels than on regular vowels. They compare CVC_2V_2C words and $CVC_2\underline{V_2}C$ words for the effect of C_2 on V_2 in each. Palatalization or velarization on C_2 affects both the F2 value (corresponding to backness) and also the F1 value (corresponding to height) of following intrusive vowels more than that of following non-intrusive vowels.

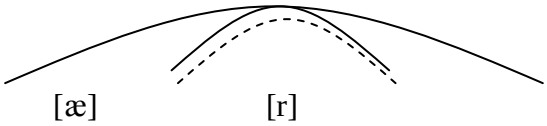
Within articulatory phonology, consonant-vowel assimilation has been analyzed as a result of overlap between their gestures (see, for example, studies on palatalization by Zsiga 1995 and Cho 1998). The gestural theory straightforwardly explains why an intrusive vowel coarticulates more than a normal vowel with the preceding consonant: there is more gestural overlap involved. The intrusive vowel is actually part of a gesture that fully overlaps the sonorant, and hence the sonorant has a greater effect on the vowel's trajectory than it would on a vowel that overlapped with it less.

There is phonetic evidence from other languages that secondary articulations on consonants disrupt vowel articulations. Ohman 1966 shows that there is vowel-to-vowel coarticulation in VCV sequences in Swedish and English, but this coarticulation is blocked in Russian (see also Purcell 1979). The reason appears to be that Russian, like Scots Gaelic but unlike Swedish or English, has secondary articulations of palatalization or velarization on consonants. The palatalization or velarization is a vowel-like gesture itself, and interferes with any overlapping vowel gestures.

The same effect seems to happen in Barra Gaelic. To see how this happens, let us take the case of [færa̲k] 'anger'. This word contains an [æ], which consists of the gesture [tongue body wide pharyngeal]. It also contains an [r], which consists of two gestures: [tongue tip narrow alveolar] and [tongue body mid pharyngeal]. Since [r] is phased in the middle of [æ], there is a period when the tongue body is being instructed to assume both a mid pharyngeal and narrow pharyngeal constriction.

(197) færak ‘anger’

Gestures
[r] : Tongue tip narrow alveolar (———)
Tongue body mid pharyngeal (- - - - -)
[æ]: Tongue body wide pharyngeal



I suggest that the middle of the [æ] gesture undergoes blending with the tongue body gesture of the [r]. Blending is the averaging of conflicting parameter values that occurs when gestures involving the same articulators overlap. The realization of the [r]’s tongue body backing disrupts the trajectory of [æ], and it does not recover its original target constriction value, so that the portion heard after [r]’s release sounds like a more back vowel, [a]. The phonetic [æ] and [a] are really one gesture, which is influenced by a competing gesture during only part of its duration.

4.6.2. Vowel fronting: mutations, verb forms in Barra

There are also a number of cases where intrusive vowels are fronted or raised after [r’] or [l’]. However, this does not happen consistently. Most of the examples of raising and fronting are either forms that have undergone the palatalization mutation, or certain verb forms. I propose that in these forms, the intrusive vowel is affected not only by the sonorant but by an additional gesture that is overlaid on the whole end of the syllable.

As shown in section 2.5, certain inflections cause a final consonant cluster to become palatalized, and the preceding vowel changes as well. Palatalization affects both the intrusive and non-intrusive portions of the vowel, supporting the theory that they are one gesture. Yet palatalization does not affect the two vowel portions in exactly the same way: in the Barra dialect, intrusive vowels that undergo palatalization are always heard as higher or fronter than the preceding vowel portion (B40:176). Examples are given below.

(198) Intrusive vowels in mutation, Barra

	Basic form	Mutated form		
ɯr'i̲	dɔrɔ̲xð	nɑs dɯr'i̲çə	'dark / comp.'	B40:211, 2
	dɔrɔ̲ɣ	dɯr'i̲	'fishing line / pl.'	B40:211
ɯl'i̲	dɤr'e̲v	dɯl'i̲-ð	'difficult / comp.'	B37:175
er'i̲	færa̲k	fer'i̲k'	'anger / gen.sg.'	B40:178
ul'i̲	baLa̲k	bul'i̲k'	'bellows/ gen.sg.'	B37:161
ur'i̲	Luru̲k-ð	Lur'i̲k'N'ən	'leg / pl.'	B37:154
ør'e̲	t^hara̲v	t^hɤr'e̲v	'bull / pl.'	B40:141
	skara̲v	skɤr'e̲v	'cormorant / pl.'	
	mara̲v	nə mɤr'e̲v	'the dead / pl.'	
	gara̲v	gɤr'e̲vð	'rough / comp.'	B37:175

In many of these cases, the non-identical vowel qualities could simply be attributed to coarticulation of the vowel with the sonorant, but in a few cases this explanation cannot hold. Near-minimal pairs show that in forms like singular nouns, where mutation is not involved, intrusive vowels do not sound raised or fronted in similar environments.

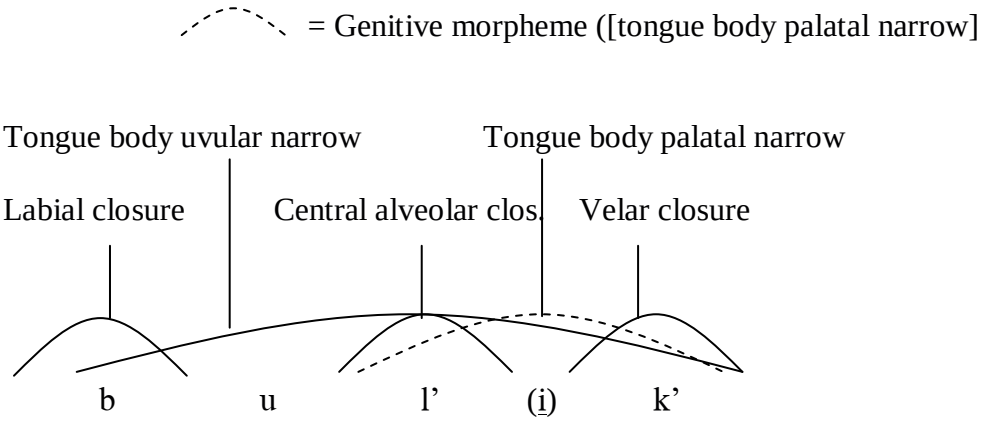
(199)

Mutated (see above)		Non-mutated		
fer'i̲k'	vs.	mer'e̲k'	'rust'	B37:82
t^hɤr'e̲v	vs.	gɤr'ɤ̲m	'to crow, cry'	B40:141
dɯl'i̲-ð	vs.	fɤl'ɤ̲m	'helm'	B40:212

This suggests that the palatalization mutation itself contributes to the raising or fronting of the intrusive vowel, and the fact that *all* intrusive vowel groups in mutated forms have non-identical vowels supports this conclusion.

I propose that the mutation-causing morpheme is a single gesture, such as [tongue body narrow palatal], which spans the final two consonants. Since spanning these consonants requires it to span the intrusive portion of the vowel as well, that part of the vowel undergoes blending. Hence, it sounds more like a [narrow palatal] vowel.

(200) Gestural score of a ‘mutated’ word ([bul’ik’] ‘bellows- gen. sg.’)



This approach to mutations explains why the intrusive vowels in palatalized words always sound higher or fronter than the preceding vowel portion, and why there is a difference between intrusive vowels in mutated and non-mutated words.

Similar cases of raising or fronting occur in certain verbal forms, as below.

(201)	ɯr’i	sɯr’i-ð	‘wooing’	B40:212
	er’i	tʃ’er’ik’əxkiN’	‘to end’	B40:195
		tʰʃ’er’ik’i	‘will end’	B40:211
		her’ik’	‘ended’	B40:195
		(cf. [mer’ek’] ‘rust’)		
	ur’i	fur’içi / fur’i-i	‘will stay’	B40:211

These words are problematic. Borgstrøm and Oftedal do not analyze them as palatalized, so they should not involve a single [narrow palatal] gesture spanning two consonants and the intrusive vowel. Yet they do have an intrusive vowel that sounds raised, unlike the morphologically simple examples in 199).

However, while linguists do not analyze these forms as involving palatalization, it is possible that speakers do. Verb paradigms often do include palatality-related alternations. In particular, a verb’s infinitive may have non-palatal consonants where the finite forms have palatals. Oftedal analyzes this as a “depalatalization” mutation occurring in the infinitive (together with another mutation affecting the initial consonant).

(202) “Depalatalization”, Leurbost dialect

Infinitive	Past	
faLəx	ɣaLiç	‘hide’
fuLəg	ɣulig’	‘suffer’
fu.aL	ɣu.al	‘sew’
kur	kuð	‘put’[19]

I suggest that speakers may analyze these forms differently: rather than viewing the infinitive as a depalatalized form, they may choose to regard the finite forms as palatalized, a mutation type familiar to them from so many nouns and adjectives. The forms in 201) certainly look at a glance like palatalized words, since the consonants flanking the intrusive vowel are palatalized.

Indeeed, from the data given in Oftedal, it is not clear to me why he identifies the infinitives as depalatalized rather than analyzing the finite forms as palatalized (unless perhaps for etymological reasons). In either case, the mutation would have to be seen as irregular, since not all infinitives with a final non-palatalized consonant correspond to palatalized finite forms, and not all palatalized finite forms correspond to non-palatalized infinitives. It seems quite plausible that speakers would analyze these alternations as an irregular application of a mutation type (palatalization) that occurs frequently in other parts of speech. In other words, I propose that the examples in 201) have a representation like that in (200).

I also propose that there is one adjective that involves an exceptional palatalization mutation: [dɤr’e̲v] ‘difficult’. This word is not expected to be palatalized, since it is a simple adjective and palatalization normally happens only in the comparative. However, [dɤr’e̲v] is also unusual in that it is formed from a different stem than its comparative, as shown below.

(203)				
	a.	dɤr’e̲v	‘difficult’	B40:141
	b.	dɯl’i̲-ð	‘difficult- comp.’	B37:175

I suggest that speakers analyze [dɤr’e̲v] as an irregular adjective involving the palatalization mutation in the non-comparative. (Some languages have non-comparative adjectives that are etymologically comparatives, like English *near* from *nigher*; I do not know if [dɤr’e̲v] has such a history).

4.6.3. Exceptions

The analysis above accounts for almost all cases where intrusive vowels are not identical to the preceding vowel, but there are still three exceptional words[20].

[19] [ð] acts as the palatalized version of [r] in Leurbost.

In one word, the intrusive vowel's quality appears to be influenced by the quality of the following vowel. [ʃɛn̲avar] shows the normal backing of intrusive [æ / ɛ] after [n], but in [ʃɛn̲ɛvɛr'] the expected backing fails.

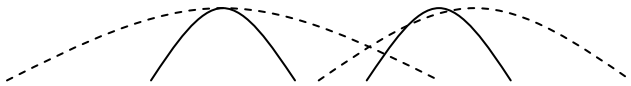
(204) a. ʃɛn̲avar 'grandmother' gen. B37:171

vs.

b. ʃɛn̲ɛvɛr' 'grandmother'

Clements 1995 suggests that [ʃɛn̲ɛvɛr'] is affected by analogy to [ʃɛnɛr'] 'grandfather' (which does not involve vowel intrusion). I propose instead that there is an influence of the following vowel. If the intrusive vowel has some slight level of overlap with the following vowel, this should help it recover from the disruption to its trajectory caused by the [n]. The [ɛ] gesture is weakened in the middle by blending with [n], but the intrusive portion of the vowel gesture includes the beginning of the following [ɛ] gesture as well. (Note that none of the cases 195) where [æ] is backed after [n] have a following front vowel).

(205)



ɛ n (ɛ̲) v ɛ

A more precise modeling of this effect will require adjustment of the phasing constraints, which currently do not allow a vowel gesture to extend beyond its own syllable, but the important point is that vowel-to-vowel coarticulation can be modeled in gestural phonology. The sporadic vowel harmony attested in Scots Gaelic (as in [tɯrɯɣ] / [tɯrəɣ] 'drought' and [tɯrɯs] / [tɯrəs] 'journey, time' (O147)) supports the idea that adjacent vowels do affect one another.

While [ʃɛn̲ɛvɛr'] has less sonorant-vowel coarticulation than expected, there are two function words that have more. The words below show exceptional levels of raising or fronting of the intrusive vowel, when compared to [mɛr'e̲k'] "rust".

(206) a. ʏr'i̲N' 'on us' B37:18

b. ʏr'e̲v 'on you (pl)' B37:183

I suggest that there are two factors at work in these cases. First, function words are often prosodically reduced compared to lexical words. Prosodic reduction may lead to a greater level of overlap between gestures, and hence to more coarticulation. Secondly, the fact

[20] Ní Chiosáin 1994 gives two more exceptional words besides those below: [karæ̲t'] 'friend' and [dɯl'i̲x'] 'sorry'. However, Borgstrom does not transcribe these vowels as svarabhakti vowels, so I assume they are not intrusive (B37:97,226).

that the intrusive vowels is only fronted in [ɤr'ev] but fronted and raised in [ɤr'iN'] is probably due to the influence of the following [N'], which is very strongly palatal. Borgstrøm 40:161 reports that "For *N'*… the middle part of the tongue is energetically raised towards the palate, so that *N'* is strongly palatal, and often seems to be followed by a very short *j* before back and mixed vowels." [N']'s influence on the intrusive vowel is especially strong because it involves a more extreme position of the tongue body than other palatalized consonants.

To summarize, the combinations of vowels and sonorants attested for Barra Gaelic vowel intrusion in Borgstrøm 1940's data are the following.

(207) VCV groups, Barra

	i	e	æ/ɛ	u	ɯ	ɤ	ɔ	a
l'	il'i			ul'i	ɯl'i	ɤl'ɤ		
L								aLa
l								
m	imi	æmæ						
n	inø	ɛnɑ			ɯnɯ	ɤnɤ		ana
N				uNu				aNa
N'		ɛN'ɛ						
r		ærɑ		uru			ɔrɔ	ara
r'	ir'i	er'e	ær'æ	ur'i	ɯr'i	ɤr'ɤ		
		er'i				ɤr'e		
						ɤr'i		
R								aRa

The analysis presented above differs from previous approaches to this problem in that I do *not* attribute raising or fronting of the intrusive vowel to the influence of the sonorant alone—at least not in Barra, where the words [mer'ek'], [gɤr'ɤm], and [fɤl'ɤm] show that in morphologically simple environments, intrusive vowels are not affected by palatalized sonorants. Fronting or raising of intrusive vowels after [r'] and [l'] is a result of an additional gesture being overlaid on the end of the word, as part of the palatalization mutation. Only the backing of front vowels after [n] and [r] is a result purely of coarticulation of the vowel and sonorant.

4.6.4. Coarticulation or feature spreading?

Non-identical intrusive vowel qualities have been analyzed by Clements 1986 and Ní Chiosáin 1994 as involving feature-spreading. A feature-spreading analysis is, of course, incompatible with the theory that the intrusive vowel and previous vowel are together one segment: a single vowel cannot bear two different sets of features. I will

argue that a coarticulation analysis accounts for more of the data than the feature-spreading approach.

Clements 1986:331 claims that "the epenthetic vowel is a copy of the preceding vowel in all respects, except that…if the intervening consonant is specified for backness, the epenthetic vowel copies this feature specification from the consonant." In Clements' analysis, the intrusive vowel is a separate, epenthetic segment. It copies its [±back] feature from the preceding sonorant and all other features from the preceding vowel. This process is unusual because it appears to be an example of 'non-constituent spreading': only [±back] is spreading, without the other features that are dominated by the Place node, [±round] and [±high] (Halle 1995, Ní Chiosáin 1994).

The first difficulty with this analysis is that it does not describe all the data. There are many cases where the intrusive vowel does not share the [±back] feature of the preceding sonorant, and also cases where the vowel shares the [±high] feature of the sonorant. Examples are repeated below.

(208) Vowels differ in height

a.	t'^{hʃ}er'i̲k'i	'will end'	B40:211
b.	ɤr'i̲N'	'on us'	B37:183
c.	in̲ɤ̲xiN'ð	'brain'	B37:116

Vowel and sonorant differ in backness

a.	fɤl'ɤm	'helm of a boat'	B37:227
b.	ʃɛn̲ɛ̲vɛr'	'grandmother'	B37:171
c.	gɤr'ɤ̲m	'to crow, cry'	B40:141

It seems difficult for any approach to account for all these cases without acknowledging the role of the palatalization mutation, and other factors such as following consonants and vowels, in determining intrusive vowel quality. However, these factors could undoubtedly be built into the feature-sharing analysis in a similar way to the gestural analysis.

The area where the gestural approach and the featural approach really differ is in their ability to take into account the physical magnitude of a gesture as a factor. Features have only two settings, [+] and [-]. But physically, a given feature may or may not have a strong phonetic realization. For example, [r'] in Barra Gaelic is featurally [+palatal], and phonetically "the sound of *r'* is strongly palatal" (B40:165). The cognate sound in the Lewis dialects, transcribed [ð] or [ð'], is also featurally [+palatal] in the sense that it alternates with [r] in the palatalization mutation, but phonetically "the front of the tongue is raised towards the palate, but apparently not so much… as for *r'* in the southern dialects, so that *ð*' has not a very strongly palatal sound." (B40:72)

Since Lewis [ð'] does not involve a strong tongue-raising movement, the palatalization mutation in Lewis must work differently than in Barra: there must not be a [narrow palatal] gesture overlaid on the end of the word. Either there is a less extreme gesture such as [mid palatal], or else speakers simply substitute [+palatal] phonemes in

the mutated words, without actually adding a gesture. In either case, we expect the palatalization mutation to have less effect on intrusive vowels. This is in fact the case. The following is a list of the vowel-sonorant combinations found in Borgstrøm 1940's Bernera data.

(209) Intrusive vowel groups, Bernera dialect

	i	e	æ/ɛ	u	ɯ	o	ɤ	ɔ	a
l'	il'ə			ul'u			ɤl'ɤ		
L									aLa
l									
m	imi								
n	inə		ænæ		ɯnɯ		ɤnɤ	ɔnɔ	ana
			ænä						
N				UNU					aNa
N'									
r	i^{o}ru		ærä	UrU		oro	ɤrɤ	ɔrɔ	ara
ð'		eð'e		uð'u			ɤð'ɤ		
		eð'i							
R									aRa

In Bernera, intrusive vowels are not raised or fronted after [ð'] in mutated forms, as shown below.

(210)		Lewis	Barra & southern dialects		
	a.	nəs duð'uç(ə)	nas dɯr'içə	'darker'	B40:211
	b.	duð'uj	dɯr'i	'fishing lines'	
	c.	fuð'uçi	fur'içi / fur'i.i	'will stay'	
	d.	skɤð'ɤv	skɤr'ev	'cormorants'	
	e.	t^{h}æð'æv	t^{h}ɤr'ev	'bulls'	

The featural account cannot explain the correlation between the strength of the phonetic realization of the sonorant's features, and the spreading of these features to the intrusive vowel. Features are only present or absent; they do not have degrees of strength. So it is not clear from the featural analysis why there is less feature-spreading in dialects where the features have less extreme phonetic realizations.

4.6.5. An alternate strategy: removal of secondary articulations

Some dialects deal with conflicts between the vowel and sonorant in vowel intrusion differently: instead of allowing the vowel articulation to be disrupted, they alter the consonant. Borgstrøm 1941 reports that in the non-Hebridean dialect of Ross-shire,

words that have vowel intrusion with a palatal [r'] and a back vowel tend to depalatalize the /r'/. For the words below, he gives two pronunciations: one in which /r'/ is depalatalized to [r] and the intrusive vowel has the same quality as the preceding vowel, and one in which /r'/ is realized as [r'] and the intrusive vowel is raised. (Note that /ar'/ combinations do not occur in vowel intrusion in Borgstrøm 1940's Barra data; the Barra cognates of the words below are [ær'æ̲kət] 'silver' and [tɤr'e̲v] 'bulls').

(211) Ross-shire depalatalization B41:140

a.	ara̲kət /	ar'i̲ːkət	'silver'
b.	t^hara̲j /	t^har'i̲ː	'bulls'
c.	duru̲j /	dɯr'i̲ː	'fishing-lines'

This optional depalatalization does not occur in normal combinations of a back vowel and [r'], where vowel intrusion is not concerned. In that situation, there is instead an allophone of /r'/ that Borgstrøm describes as "a sound which can resemble a *ž* ... or a *j* modified by an apical articulation." (99) He transcribes this sound differently than the [r] in the words above.

This depalatalization is simply another response to the conflict between the articulatory specifications of the sonorant and surrounding vowel gesture. Either the trajectory of the vowel must change, producing a raised intrusive vowel, or the trajectory of the consonant must change, losing its secondary articulation. In Ross-shire, the two strategies are evidently both present, in variation.

4.6.6. Intrusive [ə]

There is one more circumstance in a vowel that is historically intrusive does not have the same quality as the previous vowel. The intrusive vowel in Barra is transcribed as [ə] between [m] and [l'] or [r]. Borgstrøm normally transcribes [ə] only in unstressed, reduced, syllables, suggesting that this intrusive vowel has an unusually short duration.

(212) Barra intrusive [ə]

a.	imə̲l'ak	'naval'	B37:128
b.	imə̲l'iç	'to lick'	
c.	imə̲raɣ	'mention'	

Bosch (n.d.) states that "the epenthesized schwa does not exhibit the atypical stress and pitch pattern of the full epenthetic vowel—instead, the inserted schwa is unstressed." Borgstrøm 1937, who treats intrusive vowels as involving special syllabification, also comments that "the syllabic division is not so clear as otherwise" (128). I assume that this vowel intrusion does not involve a $[VR]_{\alpha}$ structure. Either the vowel has been reanalyzed a segment, and hence is no longer intrusive, or else it is the type of intrusion resulting from C-C phasing constraints. There are also a few cases of intrusive schwa in the

Bernera dialect: [ʃinə̲vadə] “old stick”, [sk’il’əb] ‘chisel’ (B40:212, 83); I do not know whether these are of the same type as in Barra.

4.7. Conclusion

Scots Gaelic vowel intrusion illustrates how gestural phasing can interact with aspects of phonological structure different than segmental ordering, or syllable affiliation. I have argued that symmetrical vowel intrusion depends on the existence of a particular subsyllabic constituent, α, which is equivalent to the traditional notion of a nucleus. Two segments joined under an α node are subject to identical phasing constraints, which pressures them to be simultaneous. A similar pressure for simultaneity has been argued to exist in onsets, by Browman and Goldstein 2001. These patterns suggest that the traditional constituents of the syllable- onset, nucleus, and coda- may be definable in gestural terms, as segments that are subject to particular types of phasing constraints.

I have proposed a place for symmetrical vowel intrusion groups within the typology of heavy nuclei. When the constraints that cause symmetrical vowel intrusion are reranked, they produce α structures with the characteristics of vocalic diphthongs, “RV diphthongs”, or vowel coalescence. All of these are ways in which two segments join to form a single bimoraic syllable nucleus. In the theory presented here, they are structurally very similar. The difference between RV diphthongs and symmetrical vowel intrusion is only one of phasing, as is the difference between vocalic diphthongs and vowel coalescence.

The next chapter will show that Hocank has symmetrical vowel intrusion similar to that of Scots Gaelic, but involving a different linear order of segments: Hocank has symmetrical vowel intrusion in $[RV]_{\alpha}$ structures rather than $[VR]_{\alpha}$.

4.8. Appendix: consonant cluster charts

The chart below summarizes Oftedal’s lists of clusters that occur postvocalically in the Leurbost dialect, and clusters that trigger vowel intrusion. He cautions that “the following list cannot be regarded as complete. Many of the gaps in the list are purely accidental” (O47). Clusters that trigger vowel intrusion are shaded; clusters that surface intact are unshaded. Some clusters trigger vowel intrusion only in certain circumstances. These clusters are written twice, once with and once without shading. A dash ‘-’ after a cluster indicates that it is found only word-medially; the absence of a dash indicates that the cluster is found only word-finally; a dash in parentheses indicates that the cluster is found both word-medially and word-finally.

(213) Scots Gaelic $C_1C_2(C_3)$ clusters, Leurbost dialect

(a) Clusters where C_2 is a stop

	p	b	t	d	t’	d’	k	g	k’	g’
p,b,t,d,t’,d’,k,k’,g’										
g				gd-						
f				fd						
v										
ç						çd’(-)				
ǰ										
x								xg(-)		
ɣ										
s		sb-		sd(-)				sg(-), sgL-		
ʃ						ʃd’(-)			ʃg’(-)	
h										
m	mp-	mb								
N			Nt(-), Ntr-	Nd(-)			Nk(-) Nk	Ng(-)		
N’					N’t’-	N’d’(-)				N’g’(-)
n	np									
L	Lp- Lp	L-b	Lt(-)				Lk	Lg		
L’					L’t’(-)					
l									lk’	lg’
R			Rt	Rd(-)			Rk			Rg’
r	rp(-)	rb-, rb					rk(-)	rg		
ð (r’)					ðt’(-)		ðkn-		ðk’(-)	ðg’
j	jp									

(b) Clusters where C_2 is a fricative or affricate

	f	v	ç	ǰ	x	ɣ	s	ʃ	h	j
p,b,t,d										
t’								t’ʃ(-)		
d’								d’ʃ(-)		
k										
g		gv-						g’ʃ(-)		
k’, g’										
f										
v									vh-	
ç, ǰ, x, ɣ, s, ʃ, h										
m			mç					mʃ		
N			Nç		Nx		Ns-			
N’					N’x			N’ʃ-		
n		nv	nç		nx					
L		Lv			Lx				Lh-	
L’					L’x					
l	lf-	lv							lh-	lj
R							Rs(-), Rsb-, Rsd(-)		Rh-	
r	rf- rf	rv			rx- rx	rɣ			rh-	
ð (r’)		ðv	ðç		ðx				ðh-	ðj
j									jh-	

(c) Clusters where C_2 is a sonorant

	m	N	N’	n	L	L’	l	R	r	ð
p									br-	bð-
b										
t									tr-	
d									dr-	
t’										t’ð-
d’										d’ð-
k					kL-				kr-	
g					gL-				gr-	
k’										
g’										g’ð-
f									fr-	
v									vr-(?)	
ç				çn-						
ǰ										
x				xn-	xL-				xr-	
ɣ				ɣn-						
s		sN-					sl-		sr-	
ʃ			ʃN’-			ʃL’-				ʃð-
h										
m				mn					mr- mr	
N										
N’										
n	nm								nr-	
L	Lm									
L’										
l	lm									
R				Rn(-)			Rl-			
r	rm									
ð (r’)	ðm									
j										