English Language and Linguistics 14.3: 321–345. © Cambridge University Press 2010
doi:10.1017/S1360674310000109

Laryngeal assimilation in Buchan Scots[1]

ISLAM YOUSSEF
University of Tromsø
(Received 31 January 2008; revised 22 January 2010)

Buchan Scots exhibits a unique phonological process in which mid vowels undergo raising that is triggered by both voiced consonants and stressed high vowels. The fact that the triggers of assimilation do not fall neatly into a single natural class under most feature theories makes it an interesting challenge to straightforward analysis. Given the phonological patterns and a variety of phonetic facts about Buchan, I propose a [Lowered Larynx] feature to explain both vowel height and consonant voicing in this language. I present an autosegmental analysis of the segment inventory and phonological patterns in the framework of the Parallel Structures Model of feature geometry (Morén 2003, 2006, 2007). This analysis provides a unified and minimal account of the assimilation facts and supports the claim that phonological activity is dependent on the structure of the contrast system of a given language (Dresher, Piggot & Rice 1994). Furthermore, the representational analysis fits neatly into a constraint-based model and contributes to the growing body of literature claiming that representations are important even to optimality-theoretic analyses.

1 Introduction

The Buchan dialect of Scots spoken in northeast Scotland exhibits a unique type of assimilation involving an interesting set of characteristics. First, it is directly connected with the distribution and nature of vowels in stressed and unstressed syllables. Second, the appearance of certain vowels is restricted by a set of adjacent consonants for which phonetic voicing appears to be the only unifying characteristic. Third, assimilation applies progressively or regressively depending on both the type of trigger and the number of syllables in the word. Finally, assimilation not only results in static phonotactic restrictions within morphemes, but also in productive alternations across morpheme or word boundaries, a cross-linguistically unusual pattern.

This interesting phenomenon has attracted a number of analyses (Dieth 1932; Wölck 1965; Kohler 1984; Trigo 1986; Fitzgerald 2002; Paster 2004).[2] The relevant facts in the literature can be summarized as follows: in closed (CV́C) monosyllables, the quality of the coda consonant influences the height of the preceding stressed vowel, as shown

[1] Many thanks to Bruce Morén-Duolljá, Patrik Bye, Mary Paster, Stuart Davis and two anonymous reviewers for their detailed comments and contributions, which greatly improved this article. I'm also grateful to audiences at the Phonological Bases of Phonological Features Workshop, the 15th Manchester Phonology Meeting and the phonology seminars at CASTL/ University of Tromsø and Indiana University. The usual disclaimers apply.

[2] Unless otherwise stated, all the data come from the dialect described in Wölck (1965) and Fitzgerald (2002). Note, however, that the pattern of assimilation is principally the same in the closely related variety characterized in Dieth (1932), Kohler (1984), Trigo (1986) and Paster (2004).

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

in (1a). In (CV́CV) disyllables, the quality of the unstressed vowel is determined by either stressed vowel height or the quality of the preceding consonant, as shown in (1b).

(1) (a) *Regressive assimilation in monosyllabic trochees*

Accented vowel	**Coda consonant**
high	(voiced obstruent or [l m n ŋ] + voiceless obstruent)
high or nonhigh	nasal consonant
nonhigh	any other consonant or sequence

(b) *Progressive assimilation in disyllabic trochees* (modified from Paster 2004: 360)

Accented vowel	**Intervening consonant**	**Unaccented vowel**
high	any consonant	high
nonhigh	(voiced obstruent or [l m n ŋ] + voiceless obstruent)	high
nonhigh	nasal consonant	high or nonhigh
nonhigh	any other consonant or sequence	nonhigh

The contribution of this article is twofold. First, instead of looking at a particular pattern in isolation, it considers all the possible interacting data of the language. By doing so, it provides the first analysis of Buchan Scots (henceforth Buchan) that characterizes the consonant–vowel distribution in monosyllables and disyllables as a single phonological process. In essence, what is sometimes described as progressive 'vowel height harmony' is actually more complex. It can be regressive, as well as progressive, and it can apply from consonant to vowel, as well as from vowel to vowel. Second, in trying to represent the triggers as a unified class of segments, the analysis ties in with some important issues in feature theory. The fact that consonants act as triggers of 'vowel height' assimilation is itself a challenge for particular phonological feature theories in which consonants and vowels use disjunct feature sets or where phonetic vowel height and consonant voicing are necessarily tied to different phonological features. The current analysis proposes that both consonant and vowel triggers are specified for the feature [Lowered Larynx] (Trigo 1991). This solution is attained by adopting a non-innatist model of feature geometry, the Parallel Structures Model (Morén 2003, 2006, 2007), in which features are learned based on language-specific contrasts and in which consonants and vowels have parallel structures and features.

The remainder of the article is organized as follows. Sections 2 and 3 establish the contrastive inventories of Buchan vowels and consonants, respectively, and examine data showing their distributional restrictions and interactions. Section 4 introduces the Parallel Structures Model of feature geometry, applies the model to the Buchan contrastive inventory and justifies feature specifications for each segment in the language. Section 5 provides a unified autosegmental and optimality-theoretic analysis of the assimilation pattern. Section 6 compares the present analysis to an alternative lowering account of Buchan assimilation (Paster 2004), and section 7 outlines some conclusions.

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

2 Buchan vowel inventory

2.1 Surface vowels

The Buchan vowel system has been described as having eight monophthongs and three diphthongs, as shown in (2). The chart is modified from Wölck's (1965: 21) in that [ɪ] is replaced with the more central [ɨ] since it behaves phonologically like a central vowel.

(2) *Phonetic descriptions of Buchan surface vowels*

	Front	Central	Back
high	i	ɨ	u
mid	e	ə	o
low	a		ʌ
Diphthongs	[ei]	[ai]	[au]

2.2 Contrastive vowels

2.2.1 Vowel distribution

All eight vowel qualities of Buchan are allowed in stressed syllables, as seen in (3) (Fitzgerald 2002: 63). Note, however, that the vowels [ɨ, ə, ʌ] cannot appear in open stressed monosyllables. This behavior suggests that they form a phonological natural class (see section 4).

(3) *Vowel contrasts in monosyllabic content (stressed) words*

	Open syllables		**Closed syllables**	
[i]	[li]	'lie'	[bin]	'bone'
[ɨ]	—		[bɨn]	'bind'
[u]	[su]	'sow (N.)'	[tun]	'town'
[e]	[se]	'sea'	[hen]	'hen'
[ə]	—		[bən]	'bin'
[o]	[θro]	'throw'	[don]	'Don'
[a]	[sa]	'sow (V.)'	[han]	'hand'
[ʌ]	—		[fʌn]	'when'

On the other hand, only the four vowels [i, ɨ, e, ə] can appear in post-tonic syllables and only [ɨ, ə] in pre-tonic syllables (Fitzgerald 2002: 64–5). The quality of unstressed vowels in initially stressed disyllables is at least partially predictable from the stressed vowel. As seen in (4) and (5), nonhigh unstressed vowels follow nonhigh vowels and high unstressed vowels follow high vowels in what seems like height harmony (Fitzgerald 2002).

(4) *Stressed nonhigh vowels + unstressed nonhigh vowels*

(a) $V_{nonhigh}$ + $V_{nonhigh}$ [e]

[e]	[bé̞ke]	'*baikie* – container'	[ké̞re]	'carry'
[ə]	[skə́rle]	'*skirlie* – oat-meal'	[fə́fte]	'fifty'
[o]	[tó̞fe]	'toffee'	[ʤó̞ke]	'Jackie'
[a]	[táte]	'potato'	[sáte]	'salty'
[ʌ]	[bʌ́ke]	'*buckie* – whelk'	[fʌ́ske]	'whiskey'

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

(b) $V_{nonhigh}$ + $V_{nonhigh}$ [ə]

[e]	[fémlə]	'family'	[bérəks]	'barracks'
[ə]	[lɔ́tlən]	'*littlin* – infant'	[θɔ́rəp]	'*thirrap* – kink'
[o]	[slórəx]	'*slorach* – slobber'	[bórə]	'borrow'
[a]	[ʃálə]	'shell'	[bárə]	'barrow'
[ʌ]	[ʌ́ŋkə]	'uncouth'	[ʌ́mən]	'woman'

(5) *Stressed high vowels + unstressed high vowels*

(a) V_{high} + V_{high} [i]

[i]	[drí̱xi]	'*dreichy* – dreary'	[bí̱ri]	'bury'
[ɨ]	[sɨ́mɨtri]	'cemetery'	[twɨ́nti]	'twenty'
[u]	[búdi]	'*boodie* – ghost'	[túliz]	'Toolies (Club)'

(b) V_{high} + V_{high} [ɨ]

[i]	[hílɨnz]	'highlands'	[ʤílɨs]	'jealous'
[ɨ]	[wɨ́di]	'widow'	[gɨ́gɨt]	'big'
[u]	[húlɨt]	'owl'	[súrɨk]	'*sourock* – sorrel'

Wölck (1965) and Fitzgerald (2002) provide important evidence that this is harmony. First, in words with variable pronunciations, the vowels may switch between high or nonhigh as long as there is height agreement between the stressed and unstressed vowels (6a). Second, height harmony applies from roots into suffixes and clitics resulting in productive alternations. For example, the vowels of the productive diminutive suffix *-ie*/*-y* and the adverb-forming suffix *-ly* alternate between high [i] after high vowels and nonhigh [e] after nonhigh vowels (6b). Furthermore, the vowels of the (semi-)suffixes *-ful* and *-land* and some reduced function words (e.g. *it* and *him*) alternate between high [ɨ] after high vowels and nonhigh [ə] after nonhigh vowels (6c).

(6) *Height harmony in variable pronunciation and across boundaries*

(a)	V_{high} + V_{high}			$V_{nonhigh}$ + $V_{nonhigh}$	
	[krú̱ʃit]	~		[krɔ́ʃet]	'crocheted'
	[kú̱tɨr]	~		[kɔ́tər]	'cottar'
	[pí̱pɨr]	~		[pépər]	'paper'
(b)	V_{high} + V_{high} [i]			$V_{nonhigh}$ + $V_{nonhigh}$ [e]	
	[dím-i]	'dame (DIM.)'		[lém-e]	'loam (DIM.)'
	[klút-i]	'clout (DIM.)'		[kʌ́rn-e]	'corn (DIM.)'
	[lɨ́k-li]	'likely'		[fér-le]	'fairly'
(c)	V_{high} + V_{high} [ɨ]			$V_{nonhigh}$ + $V_{nonhigh}$ [ə]	
	[í̱s-fɨ]	'useful'		[á-fə]	'awful'
	[mú-fɨ]	'mouthful'		[pél-fə]	'pailful'
	[hí-lɨn]	'highland'		[skɔ́t-lən]	'Scotland'
	[θɨ́ŋk ɨt]	'think it'		[lɔ́st ət]	'lost it'
	[əbɨ́n ɨm]	'above him'		[ənéθ əm]	'beneath him'

An important observation is that while nonhigh vowels never follow high vowels, front high vowels [i, ɨ] can follow nonhigh vowels if certain consonants precede them,

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

as shown in (7). This set of consonants (marked as C^{Ψ}) will be discussed in detail in section 3.

(7) *Stressed nonhigh vowels + C^{Ψ} + unstressed high vowels*

[spéŋi]	'*spainyie* – Spanish'	[féʒin]	'pheasant'
[kə́lti]	'*kiltie* – kilt (DIM.)'	[brə́mstin]	'brimstone'
[pódli]	'*podlie* – coalfish'	[óvɨn]	'oven'
[brádi]	'*bridie* – meat pie'	[fáðɨm]	'fathom'
[krʌ́ni]	'*crannie* – cranny'	[rʌ́bɨt]	'rabbit'

The pattern discussed thus far can be summarized as follows: both within morphemes and across morpheme or word boundaries, post-tonic unstressed vowels must be high if the preceding vowel is high no matter what consonants intervene (5). On the other hand, if the stressed vowel is nonhigh, unstressed vowels can be either nonhigh (4) or high (7), depending on the intervening consonant. This pattern, schematized in (8), applies in disyllabic trochees (feet with initial prominence) and never in iambs.

(8) *Outline of vowel co-occurrence in Buchan*

	Allowed sequences			**Disallowed sequences**		
(a)	high	C	high	high	C	nonhigh
	high	C^{Ψ}	high	high	C^{Ψ}	nonhigh
(b)	nonhigh	C	nonhigh	nonhigh	C	high
	nonhigh	C^{Ψ}	high	nonhigh	C^{Ψ}	nonhigh

The fact that nonhigh vowels never follow high vowels regardless of intervening consonants suggests that unstressed vowels in Buchan undergo raising after stressed high vowels. The fact that nonhigh vowels never follow certain consonants (C^{Ψ}) regardless of the quality of the stressed vowel suggests that unstressed vowels in Buchan undergo raising after these consonants.

2.2.2 Summary of Buchan contrastive vowels

To sum up, the Buchan inventory of contrastive monophthongs comprises three high and five nonhigh vowels (recall (2)). All eight contrast in stressed syllables, while only four can occur in unstressed syllables. Unstressed nonhigh vowels become high following stressed high vowels and/or certain consonants.

3 Buchan consonant inventory

3.1 Surface consonants

The surface inventory of Buchan consonants is given in (9) based on Wölck (1965: 26–7).

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

(9) *Phonetic descriptions of the 27 Buchan surface consonants*

	Bilabial	Labio-dental	Inter-dental	Alveolar	Alveo-palatal	Palatal	Velar	Glottal	Labio-velar
Stop	p b			t d			k g		
Fricative		f v	θ ð	s z	ʃ ʒ	ç	x	h	ʍ
Affricate					ʧ ʤ				
Nasal	m			n			ŋ		
Lateral				l					
Trill				r					
Glide					j				w

3.2 Contrastive consonants

3.2.1 Consonant–vowel interactions in monosyllables

In section 2, I showed that the central vowels [ɨ] and [ə] are contrastive in some closed monosyllables. In the vast majority of closed monosyllables, however, they are found in complementary distribution. Interestingly, their distribution is determined by the nature of the coda consonant (Wölck 1965: 24–5).[3] Only [ɨ] occurs before voiced stops and fricatives, [ŋ] and nasal + voiceless obstruent clusters (10a). [ə] occurs before most voiceless obstruents, most singleton sonorants and most sonorant + obstruent clusters (10b). However, both vowels are found before surface [k] and [n] (10c, d).

(10) *[ɨ] versus [ə] in stressed monosyllables*

(a)	[sɨb]	‘sib’	[gɨd]	‘go & give’	[brɨg]	‘bridge’
	[dɨv]	‘do’	[hɨz]	‘his, us’	[sɨŋ]	‘sing’
	[skɨmp]	‘skimp’	[lɨmp]	‘limp’	[tɨnt]	‘tent’
	[bɨnʃ]	‘bench’	[bɨŋk]	‘*bink* – bench’	[lɨnθ]	‘length’
(b)	[pət]	‘pit’	[nəp]	‘nip’	[stəf]	‘stiff’
	[kəs]	‘kiss’	[səx]	‘sigh’	[kəl]	‘kill’
	[ʤəm]	‘Jim’	[fər]	‘fir’	[stərk]	‘stirk’

(c)	[wɨn]	‘wind’	[wən]	‘win’
	[bɨn]	‘bind’	[bən]	‘bin’
	[fɨn]	‘find’	[fən]	‘fin’
(d)	[stɨk]	‘*steek* – shut’	[stək]	‘stick’
	[sɨk]	‘seek’	[sək]	‘such’
	[brɨks]	‘breeches’	[brəks]	‘bricks’

The distribution of the central vowels [ɨ] and [ə] in closed monosyllables implies that the voicing of obstruents can influence vowel height and that nasal + obstruent clusters behave as if they form a natural class with voiced obstruents. On the other hand, the behavior of *surface* singleton nasals is less systematic: [m] conditions a preceding [ə], [ŋ] conditions a preceding [ɨ], while [n] allows both [ɨ] and [ə].

[3] Wölck notes that the diphthongs [ei] and [ai] are also in complementary distribution with regard to the coda consonant: [ai] occurs before voiced obstruents and [ei] before other consonants (1965: 25).

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

Section 3.2.2 takes a closer look at nasals and provides an explanation for their behavior. As for the dual behavior of [k], I suggest that only one phonologically 'central' vowel, [ə], can surface in this context, and that [ɨ] is a phonetically retracted realization of phonological /i/. Support for this claim comes from two sources. First, it is simply a fact of the language that [i] never appears before [k] in closed monosyllables. This is a surface restriction that must be accounted for and is likely the result of a phonetic co-articulation effect. Second, words like [sɨk] 'seek' in (10d) suggest a historical relationship between a high central vowel [ɨ] and a long high front vowel [iː] before a coda [k].

To summarize, the consonants/clusters [b, d, k, ɡ, v, ð, z, ʒ, ʤ, n, ŋ, mp, nt, nθ, nʃ, ŋk] condition a preceding high stressed central [ɨ] in CVC trochees, whereas [p, t, k, f, θ, s, ʃ, x, ʧ, m, n, l, r] condition a preceding nonhigh central vowel [ə] in the same environment. Note the complementary distribution except pre-[k, n].

3.2.2 Consonant–vowel interactions in disyllables

As discussed earlier, unstressed high vowels follow nonhigh vowels only when certain consonants intervene. If we assume a raising analysis, then these consonants trigger vowel raising. (11a) shows *surface* singleton consonants and (11b) shows *surface* consonant clusters that trigger raising. Combinations involving voiced obstruents are omitted since a voiced obstruent in any part of a cluster will trigger raising.

(11) (a) *Raising triggers – surface single consonants*[4]

Voiced stop	b		d		ɡ
Voiced fricative		v	ð	z	ʒ
Voiced affricate					ʤ
Nasal			n		ŋ

(b) *Raising triggers – surface consonant clusters*

Nasal + voiceless stop	mp	nt	ŋk
/l/ + voiceless stop		lt	lk

Following the voiced obstruents [b, d, ɡ, v, ð, z, ʒ, ʤ], only high vowels can appear regardless of the nature of the preceding vowel. In (12a) it is unclear whether the high vowel or the voiced obstruent leads to raising of the unstressed vowel. In (12b) only the voiced obstruent can trigger raising since the unstressed vowel is nonhigh.

(12) (a) *Stressed high vowel + voiced obstruent + unstressed high vowel*

[blɨ́zɨr]	'blazer'	[brɨ́ðɨr]	'brother'
[pɨ́ʒɨn]	'poison'	[vɨ́zɨt]	'visit'
[wɨ́dɨ]	'widow'	[dɨ́zɨn]	'dozen'

[4] I found only two optional cases [lajɨr ~ lavjɨr] 'lawyer' and [kəʧi ~ kəʧe] 'kitchen' in which unstressed high vowels may appear after stressed nonhigh vowels with other consonants intervening. I believe, however, that this is not a case of assimilation. Rather, the palatal character of [j] and [ʧ] disfavors a low vowel following them.

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

(b) *Stressed nonhigh vowel + voiced obstruent + unstressed high vowel*

[kébɨk], *[kébək]	'*kebbock* – cheese'	[róbɨn], *[róbən]	'robbing'
[bódɨ], *[bódə]	'body'	[ládi], *[láde]	'lad (DIM.)'
[gérdɨn], *[gérdən]	'garden'	[kódlɨn], *[kódlən]	'codling'
[fégɨt], *[fégət]	'fagged'	[lózɨn], *[lózən]	'losing'
[klóvɨr], *[klóvər]	'clover'	[névɨ], *[névə]	'nephew'
[néðɨr], *[néðər]	'neither'	[bléðɨr], *[bléðər]	'blether'
[wáʤɨr], *[wáʤər]	'wager'	[féʒɨn], *[féʒən]	'pheasant'

Nasals influence the height of the following unstressed vowels in disyllabic trochees just as they influence the height of the preceding stressed vowels in monosyllabic trochees: [ŋ] conditions high vowels, [m] conditions nonhigh vowels and [n] allows either high or nonhigh. In order to explain this behavior, we must consider a historical process documented by Dieth (1932: 123) and Wölck (1965: 35). The claim is that both final and medial voiced stops [b, d, g] that were present at one point in the history of the language are synchronically absent after nasals. Diachronically, the first to be dropped was [b] followed by [g] and later [d]. This change is likely to be related to the disappearance of [b] and [g] of final *-mb* and *ŋg* clusters in the history of English more generally. (13) schematizes the relationship between Buchan and Standard English with respect to the phonetic realizations of historical nasal-voiced stop clusters, and (14) gives surface examples from Buchan.

(13) *Nasal +voiced stop = nasal*

Buchan Scots			***Standard English***		
-m	-mḷ	-mər	-m	-mbḷ	-mbə
-n[5]	-nḷ	-nər	-nd	-ndḷ	-ndə
-ŋ	-ŋḷ	-ŋər	-ŋ	-ŋgḷ	-ŋgə /-ŋə

(14)

(a)	[θəm]	'thumb'	[lam]	'lamb'	[wəim]	'womb'
	[brʌmḷ]	'bramble'	[ʧámər]	'chamber'	[tɨ́mər]	'timber'
(b)	[han]	'hand'	[len]	'lend, lane'	[ərún]	'around'
	[wɨn]	'wind (V.)'	[sani]	'sandy'	[hɨ́lɨn]	'highland'
	[kanḷ]	'candle'	[ʃʌ́nərz]	'cinders'	[stɑ́ndən]	'standing'
(c)	[hɨŋz]	'hangs'	[hʌ́ŋri]	'hungry'	[lɑ́ŋɨr]	'longer'
	[fɨ́ŋɨr]	'finger'	[ɨ́ŋlɨʃ]	'English'	[lɑ́ŋwɨʤ]	'language'

Considering this, we can account for the behavior of the Buchan nasals. The merger [-mb] > [m] probably took place before the raising pattern developed. As a consequence, only nonhigh vowels surfaced next to [m] and learners had no surface evidence for [m] as a raising trigger. The merger [-ŋg] > [ŋ] took place after the raising pattern developed and [ŋ] continued to trigger raising.[6] The merger [-nd] > [n] also happened after the raising pattern developed, creating a surface raising trigger. But unlike [ŋ], there were many words containing a plain [n] next to a nonhigh vowel, which generated ambiguous data for language learners. Given the lack of robust morphophonological

[5] Wölck (1965: 35) mentions two exceptions: [beindɨr] 'binder' and [wɨndɨ] 'window' (but: [bɨnɨn] 'binding' and [wɨni] 'windy'). The second is a borrowing from Standard English; the native form is [wɨnək] 'winnock'.

[6] This alludes to the controversial status of /ŋ/ in English. The view that it is underlyingly biphonemic (i.e. /ng/) is not pursued here although it is consistent with the analysis.

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

alternations reinforcing an analysis with underlying consonant clusters, this resulted in two underlying forms of [n] that look acoustically similar on the surface, but have different phonological behaviors. (In order to distinguish them, I transcribe [n] triggers of raising with a voice diacritic underneath.) The examples in (15a, b) show how [ŋ] and [n̪] trigger vowel raising while [m] and [n] do not (see 10a–c for monosyllabic trochees).

(15) (a) *Stressed nonhigh vowel + nasal + unstressed high vowel*

[sáṉi], *[sáṉe]	'sandy'	[spéŋi], *[spéŋe]	'*spainyie* – Spanish'
[kráṉi], *[kráṉe]	'cranny'	[láŋɨr], *[láŋər]	'longer'
[θʌ́ṉɨr], *[θʌ́ṉər]	'thunder'	[hʌ́ŋri], *[hʌ́ŋre]	'hungry'

(b) *Stressed nonhigh vowel + nasal + unstressed nonhigh vowel*

[ʧámər]	'chamber'	[móne]	'many'
[tɨ́mər]	'timber'	[bóne]	'bonny'
[kéməst]	'chemist'	[ménər]	'manner'
[léme]	'loam (DIM.)'	[dénər]	'dinner'

An interesting fact is that while voiceless stops, singleton liquids and some singleton nasals have no raising effect on vowels, sequences of voiceless stops following nasals and liquid [l] invariably behave as raising triggers. The effect of [mp, nt, ŋk, lt, lk] is exemplified in (16).[7]

(16) *Stressed nonhigh V + (nasal or /l/ + voiceless stop) + unstressed high V*

[krʌ́mpɨt]	'crumpet'	[grántɨt]	'granted'
[háŋki]	'hanky'	[háŋkɨt]	'hank'
[ʃʌ́lti]	'sheltie'	[ə́lki]	'*ilka* – each'

Taking these facts into account, it is difficult, at first glance, to explain how the surface sequences [mp, nt, ŋk, lt, lk] trigger raising. Two possible interpretations of these clusters are considered here: (1) sonorant + voiceless obstruent and (2) sonorant + voiced obstruent. The first option includes a phonological cluster which triggers raising but is composed only of individual non-triggers. Although it is closest to the phonetic facts, it must be ruled out because it leaves the phonological facts unexplained. The second option assumes that the obstruent is phonologically voiced, but phonetically plain. This may simply be a case of gesture overlap where the gesture associated with the laryngeal feature is timed so as to preclude its full acoustic realization on the second member of the sequence. This is clear in the lack of significant negative Voice Onset Time for the obstruents in these clusters. Given the historical loss of voiced obstruents before sonorants, the lack of acoustic marking of a phonological feature does not threaten to neutralize a contrast in this position. We conclude that the second option is more reasonable from a phonological perspective. However, using a [voice] feature is still problematic from a phonetic perspective.

Another possibility is that the feature involved here is not [voice] at all, but something else. After all, assuming [voice] raises difficulties when trying to explain how raising

[7] I am aware of only two counterexamples to this rule: [stʌmpərt] 'stump(ert)' and [kaŋkərt] 'cankert' in which the clusters do not seem to trigger harmony. Since both cases end in complex codas [rt], the trill cannot be extrasyllabic – and trills are known to have a lowering effect themselves in the syllable. Therefore, the unstressed vowels undergo vowel reduction before [r] in the unstressed syllable.

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

results from vowel harmony and voicing assimilation. It also forces us to claim (see above) 'invisible' voicing on some obstruents and covert voicing on some nasals. Another feature might not correspond directly to vocal fold vibration and thus a segment may have this feature without being phonetically voiced in all contexts. As we will see in section 3.2.3, there are reasons to suggest that Buchan actually makes use of a [lowered larynx] feature.

To summarize, the consonants/clusters [b, d, ɡ, v, ð, z, ʒ, ʤ, n, ŋ, mp, nt, ŋk, lt, lk] allow only high unstressed [i, ɨ] in CVCV trochees, whereas [p, t, k, f, θ, s, ʃ, x, ʧ, m, n, l, r] allow only nonhigh unstressed [e, ə] in the same environment. This reveals that the set of consonants that condition a nonhigh stressed central vowel in monosyllabic trochees (section 3.2.1) is identical to those that condition a nonhigh unstressed central vowel in disyllabic trochees. On the other hand, the consonants that condition a high stressed central vowel and those that condition a high unstressed central vowel are nearly identical. [k] aside, the difference is the existence of [nθ, nʃ] sequences only in the monosyllabic pattern and [lt, lk] only in the disyllabic pattern. However, each of these sequences is simply missing from the other environment (based on the available data).

This is a very important observation that, apart from Trigo (1986), has been overlooked in previous accounts of the language. I infer from this striking similarity that the consonants/clusters [b, d, ɡ, v, ð, z, ʒ, ʤ, n, ŋ, mp, nt, ŋk, lt, lk] not only trigger raising of the following unstressed vowels in CV̀CV disyllables, but also trigger raising of the preceding stressed vowels in CVC monosyllables. In addition, there must be a common phonological feature that makes these consonants and high vowels triggers of the same raising effect. In the next subsection, I will present some phonological properties of these consonants and high vowels and suggest a feature that unites them.

3.2.3 Voicing and Laryngeal Lowering

The trigger consonants correspond roughly to voiced obstruents and particular types of sonorants, which makes 'phonetic voicing' their most obvious unifying characteristic. The term 'phonetic voicing' is used to characterize vocal fold vibration and/or its acoustic and perceptual manifestations (Jansen 2007: 271). It is a source of confusion, however, when the feature label [voice] is used to classify phonological oppositions between /b, d, ɡ, etc./ vs /p, t, k, etc./, sometimes even in the absence of relevant phonetic cues (Kohler 1984: 152). In Buchan, voicing and aspiration cues are remarkably unusual. Buchan voiceless stops [p, t, k] have been described by Dieth (1932) as lacking aspiration. Paster (2004: 380) suggests that since voiceless stops are not aspirated, their Voice Onset Time (VOT) must be very small, thus obscuring the distinction between voiced and voiceless stops. Without positive VOT, negative VOT (voicing) is the only contrastive clue in stops. Since voicing requires a certain pressure differential across the glottis, and since stops require a complete closure neutralizing any pressure differential across the glottis, voicing in the stops must be augmented by other articulatory mechanisms. A number of researchers have argued that these mechanisms are larynx lowering and tongue root advancement (Kohler 1984; Trigo 1991; Vaux 1993; Paster 2004). I propose that a [Lowered Larynx] feature (Trigo 1991), and not [voice], is the relevant phonological feature for assimilation in Buchan.

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

As a consequence, voiced obstruents and sonorant triggers of raising are specified for [Lowered Larynx] (abbreviated [LL]), but not voiceless stops or sonorant non-triggers.

In addition to [LL] consonants, raising is also triggered by high vowels in stressed syllables, which target underlying unstressed nonhigh vowels. Phonetically, high vowels involve the tongue body raised from neutral position (Chomsky & Halle 1968: 304). The most reliable acoustic cue of tongue raising is a lowered F1, which is in part caused by increased pharyngeal cavity volume due to tongue root advancement. Effects of tongue raising and advancement correlate with lowering of the larynx since these gestures also increase pharyngeal cavity volume and lower F1 (Trigo 1991: 116). I suggest, therefore, that high vowels in Buchan have a [LL] feature, rather than [high]. This leads to one class of consonantal and vocalic triggers of assimilation. This conclusion is supported by the articulatory and acoustic connection between vowel height, [ATR] and voicing discussed above. In fact, such a correlation has been documented in several other languages, including Akan, Madurese, Sahaptian, Maasai, Jingpho and Armenian (listed in Vaux 1993).

Thus, a single phonological feature [LL] can account for Buchan vowel raising (hereinafter referred to as *[LL]* ASSIMILATION). I propose that the distribution of V_1 vowels in $\acute{V}_1C_{[LL]}$ contexts (monosyllabic trochees) and V_2 vowels in $\acute{V}_1\ C_{[LL]}\ V_2$ and $\acute{V}_{1[LL]}\ C\ V_2$ contexts (disyllabic trochees) is a consequence of [LL] assimilation. The [LL] feature spreads locally from $C_{[LL]}$ or long-distance from $V_{[LL]}$, to the following or preceding nonhigh vowel in the trochee. This bidirectional process results in raising the target vowels.

3.2.4 Outline of Buchan contrastive consonants

Following the above discussion, the contrastive consonant inventory of Buchan is shown in (17).

(17) *The 24 contrastive consonants of Buchan*[8]

	Labial		Interdental		Alveolar		Alveopalatal		Velar		Lab-vel
		LL		LL		LL		LL		LL	
Stop	p	b			t	d			k	g	
Fricative	f	v	θ	ð	s	z	ʃ	ʒ	x[9]		ʍ
Affricate							ʧ	ʤ			
Nasal	m				n	n̬				ŋ	
Lateral					l						
Trill					r						

[8] The glides [w] and [j] do not surface before the rounded vowels [o, u] and [i] respectively (Dieth 1932: 90). I take this as evidence that [w] and [j] are not separate consonants, but are vowels [u] and [i] in non-nuclear position.

[9] The fricatives [ç, x, h] exist in complementary distribution in Buchan. In final and medial positions [ç] and [x] are dependent on the preceding vowel (after [i, e] it is the palatal [ç] and after [a, o, ʌ, u] it is the velar [x]); in initial position [h] is mainly used (Dieth 1932: 122–3; Wölck 1965: fn. 11). I infer that [ç], [x] and [h] are allophonic variants of one phoneme in the language.

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

4 Feature analysis

This section begins by introducing the Parallel Structures Model of feature geometry, which serves as the theoretical framework for the feature analysis. It then proceeds to justify the feature specifications for each segment in the language based on the behavior of consonants and vowels discussed above.

4.1 Theoretical framework (the Parallel Structures Model)

The Parallel Structures Model (PSM; Morén 2003, 2006, 2007) is a non-innatist restrictive model of feature geometry in which consonants and vowels exhibit parallel structures for place, manner and laryngeal features. The model relies on three basic assumptions: the non-universality of features, parsimony and recursivity. Below I show how crucial these assumptions are to the analysis of Buchan laryngeal assimilation pursued here.

The PSM denies a one-to-one mapping between phonetic characteristics and phonological features and assumes no universality in terms of how features are employed in the representation of segments (Morén 2006). Unlike other representational models, e.g. Government Phonology, where it is typically assumed that a particular segment is represented in the same way across languages, feature specifications in the PSM are established entirely on the basis of language-specific contrasts and alternations. This follows a well-known research tradition stemming from de Saussure and extending to the Toronto school of contrast (Dresher, Piggot & Rice 1994; Avery 1996 *inter alia*). In the current study, the proposal that Buchan high vowels, certain obstruents and certain sonorants are specified for the feature [LL] reflects articulatory and acoustic similarities among these segments, but more importantly it reflects their phonological behavior as a natural class in this language.

An important principle that follows from non-universality is parsimony – both representational and acquisitional. By assuming that a given grammar has as few features as possible (given the contrasts directly observable in the surface data), the PSM eliminates those redundant features that make no difference in the phonological patterns. Furthermore, the model presupposes that each feature is in principle autonomous (Goldsmith 1976) and that more complex structures are built from less complex structures, à la Element Theory (Harris & Lindsey 1995) and Dependency Phonology (Anderson & Ewen 1987). By eliminating redundant features and building structures from less to more complex, contrastive feature combinations are maximized to ensure an effective degree of economy. This assumption is central to the mechanism of [LL] assimilation in that a non-[LL] segment (e.g. /ə/) acquires a [LL] feature to form a structurally more complex vowel (i.e. [ɨ]) (see section 5.1).

Finally, the structure of the PSM makes use of recursive class nodes, thus extending the idea of unified consonant and vowel place of articulation (Clements 1991; Clements & Hume 1995) to manner and laryngeal features. This unification of consonant and vowel features not only economizes the feature set to the greatest extent possible, but also helps to account for numerous parallelisms and interactions in consonant and vowel

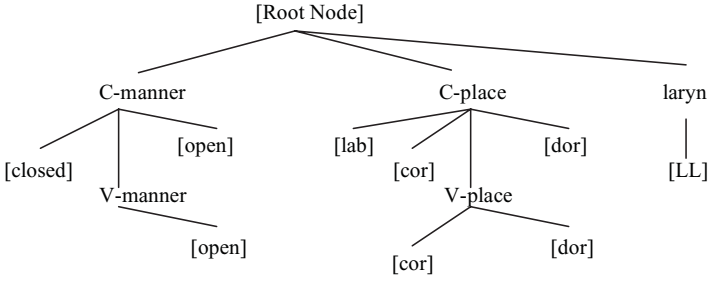
https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

constriction and laryngeal features, which makes this model different from Clements & Hume (1995). Crucial to the present analysis, this arrangement of features captures the articulatory similarity between consonant voicing and vowel height in an economical and straightforward manner that is not available in many other feature theories.

4.2 Buchan feature specifications

The feature geometric structure of Buchan is given in (18), assuming the PSM.

(18) *Buchan PSM geometry*



4.2.1 Laryngeal features

As mentioned above, the PSM assumes a restrictive grammar in which representational economy plays an important role and that every segment composed of more than one feature in a given language implies the presence of minimally different segments with a subset of those features – including segments composed of single features. I propose that the [LL] feature is minimally represented by the high vowel /ɨ/ and will show how this has some advantages below. The [LL] feature is also attached to all other consonantal and vocalic triggers of assimilation: voiced obstruents /b, d, ɡ, v, ð, z, ʒ, ʤ/, trigger sonorants /n̩, ŋ/ and high front vowels /i, u/.

4.2.2 Mannerless consonants

If Buchan makes use of three places of articulation for consonants, it is reasonable to hypothesize that the three consonants with the weakest constriction are those that are composed of just place features. I suggest that labial-velar /ʍ/ is C-place[lab] and that its velar character is a phonetic enhancement, not an indication of an additional place feature. Given phonotactic evidence that the trill /r/ is not sonorant in Buchan, I suggest that it is only C-place[cor]. Unlike the sonorant lateral /l/, the trill /r/ does not combine with stops to form [LL] sequences that trigger raising, i.e. /r/ + voiceless stop clusters are transparent to assimilation (Paster 2004: 384). Finally, /x/ is realized on the surface by three phonetic allophones, [ç, x, h], which all involve the tongue dorsum but have a range of constriction-related (i.e. manner) realizations (see fn. 9). Therefore, /x/ is just C-place[dor].

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

4.2.3 Manner consonants

If we assume that the minimal fricative, with just C-manner[open], is /s/, then all other fricatives except mannerless /x/ should have this feature. This means that /f, v/ have the addition of C-place[lab]. We are left with two sets of coronal fricatives, /θ, ð/ and /ʃ, ʒ/ that differ slightly in their place of articulation. In order to distinguish between them, I assume that the dentals /θ, ð/ have C-place[cor], while the alveopalatals /ʃ, ʒ/ have V-place[cor]. This captures the static inventory facts as well as an obvious relationship between alveopalatal consonants and front vowels. The difference between the plain and voiced fricatives is captured by the addition of the [LL] feature on the voiced fricatives.

Parallel to the fricatives, the stops are represented by a C-manner[closed] feature singled out in /t/, with /d/ its voiced counterpart. All other stops /p, b, k, g, ʧ, ʤ/ have C-manner[closed] in addition to place. /p, b/ are labial stops with C-place[lab] and /k, g/ are velar stops with C-place[dor]. Furthermore, the phonetic affricates /ʧ, ʤ/ are represented as the phonological stops corresponding to fricative /ʃ, ʒ/ respectively; thus they have a V-place[cor] feature.

The lateral and nasals are sonorants in Buchan. We know this because of their phonotactic distribution. I will assume that /l/ is placeless, thus having C-manner[closed] and V-manner[open] features. It follows that the labial /m/ has C-place[lab], the alveolar /n/ has C-place[cor] and the velar /ŋ/ has C-place[dor] in addition to the manner specifications mentioned. Moreover, the trigger sonorants /n̩, ŋ/ have an additional [LL] feature.

4.2.4 Vowel segments

I argued earlier that the high vowels /ɨ, i, u/ have a [LL] feature, thus they are the triggers and/or outcome of [LL] assimilation. I also suggested that the segment composed of just [LL] is the high central vowel /ɨ/. Given that the epenthetic vowel in Buchan is schwa and that the schwa raises to /ɨ/ under [LL] assimilation, it is logical to conclude that the schwa is phonologically featureless (Kenstowicz 1994: 159).

Recall that we made use of V-place[cor] to distinguish among coronal consonants. Assuming the PSM, there must be a segment composed of only this feature. There are two logical possibilities, /i/ and /e/. However, given that /i/ is both a trigger and result of [LL] assimilation, it must have at least the [LL] feature. This leaves /e/ as the appropriate segment. Thus we capture the alternation between /e/ and /i/ under [LL] assimilation as the addition of the feature [LL] to a V-place[cor] segment. Similarly, /o/ is composed of just a V-place[dor] feature and the alternation between /o/ and /u/ is captured via the addition of [LL] to a V-place[dor] segment.

/ʌ, a/ are low vowels involving a V-manner[open] feature. Since the articulation of both vowels does not involve rounding, /ʌ/ is composed of just V-manner[open] while front [a] has an additional V-place[cor] feature. We conclude that there are only two contrastive heights in Buchan vowels: low and nonlow. The low vowels have V-manner[open] and the nonlow vowels do not. There is no evidence for an independent [high] feature in this language, but the nonlow vowels are differentiated via the presence or absence of the [LL] feature.

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

Recall from (3) that the three vowels /ɨ, ə, ʌ/ stand out from other vowels in that they cannot appear in open monosyllables. We now have an account in which these form the natural class of placeless vowels.

The above discussion leads to feature specifications for Buchan consonants and vowels as shown in (19). Note that these feature specifications are maximally economical and are based on overt, positive evidence from contrasts and alternations.

(19) *Feature specifications for the 32 underlying segments in Buchan*

		C-place			V-place		C-manner		V-manner	V-laryn
	UR	**lab**	**cor**	**dor**	**cor**	**dor**	**closed**	**open**	**open**	**LL**
Mannerless	/ʍ/	✓								
	/r/		✓							
	/x/			✓						
Stop	/t/						✓			
	/d/						✓			✓
	/p/	✓					✓			
	/b/	✓					✓			✓
	/k/			✓			✓			
	/g/			✓			✓			✓
	/ʧ/				✓		✓			
	/ʤ/				✓		✓			✓
Continuant	/s/							✓		
	/z/							✓		✓
	/f/	✓						✓		
	/v/	✓						✓		✓
	/θ/		✓					✓		
	/ð/		✓					✓		✓
	/ʃ/				✓			✓		
	/ʒ/				✓			✓		✓
Sonorant	/l/						✓		✓	
	/m/	✓					✓		✓	
	/n/		✓				✓		✓	
	/ŋ/		✓				✓		✓	✓
	/ŋ/			✓			✓		✓	✓
Nonlow Vowels	/ə/									
	/ɨ/									✓
	/e/				✓					
	/i/				✓					✓
	/o/					✓				
	/u/					✓				✓
Low Vowels	/ʌ/								✓	
	/a/				✓				✓	

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

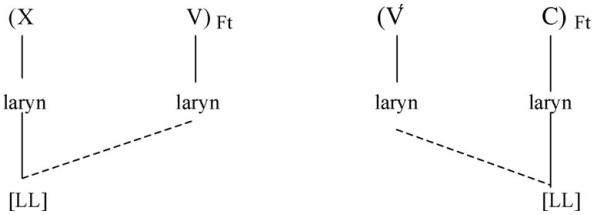
5 Laryngeal assimilation – synchronic analysis

This section provides a synchronic analysis of [Lowered Larynx] assimilation in Buchan based on the behavior of two participating classes of segments. Trigger segments, whether vowels or consonants, are specified for the laryngeal feature [LL]. Target segments are vowels unspecified for [LL]. These are unstressed nonhigh vowels in disyllabic trochees and stressed nonhigh vowels in monosyllabic trochees. Section 5.1 provides a representational account and section 5.2 incorporates the representational account into a constraint-based evaluation system.

5.1 Autosegmental representation of [LL] assimilation

The diagrams in (20) describe the two assimilation patterns discussed above. Note that *X* is placeholder for consonant or vowel triggers; *V́* – *V* indicate a stressed and an unstressed vowel respectively; and *C* indicates a consonant.

(20) (a) */X[LL] V/* → *[X[LL] V[LL]]* (b) */V́ C[LL]/* → *[V́[LL] C[LL]]*

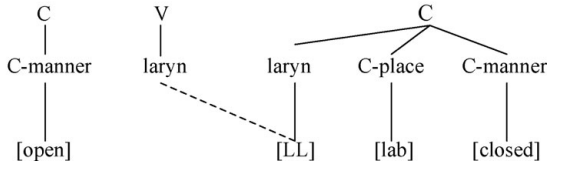


The [Lowered Larynx] feature on the trigger consonant or vowel spreads to a potential landing site, whether on the following unstressed nonlow vowel (20a) or on the preceding stressed nonlow vowel in monosyllables (20b).

5.1.1 Leftward spreading from consonant triggers (monosyllabic trochees)

Since no consonant can acquire a [LL] feature through spreading, any surface consonant with this feature must be underlyingly specified for it. Assuming that the vowel preceding this consonant in monosyllabic trochees is underlyingly nonlow, the [LL] consonant causes raising of that vowel if it was underlyingly unspecified for [LL]. The representation in (21) shows the [LL] feature spreading to unstressed featureless /ə/, which consequently raises to high [ɨ].

(21) */sə́b/* → *[sɨ́b]* *'sib'*

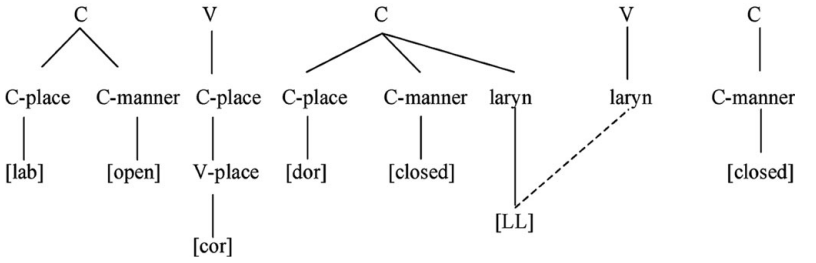


https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

5.1.2 Rightward spreading from consonant triggers (disyllabic trochees)

Recall that only high vowels surface after [LL] consonants. If the stressed vowel is nonhigh, an underlyingly unstressed vowel that is nonlow and non-[LL] raises to high by acquiring a new [LL] feature from the consonant, as shown in (22).

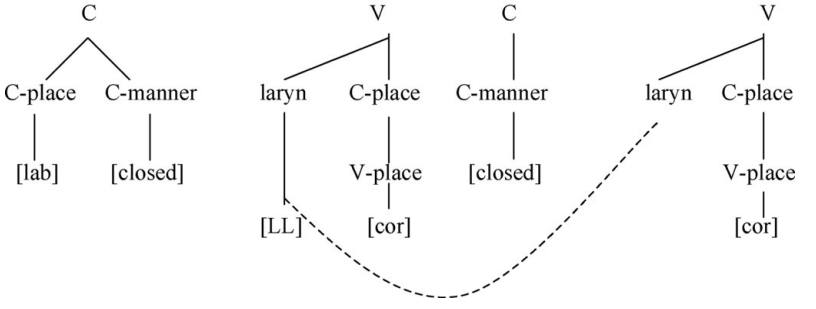
(22) */fégət/ → [fégɨt]* *'fagged'*



5.1.3 Vowel triggers

There is also a restriction in the language that stressed high vowels must be followed by unstressed high vowels even if the intervening consonant is not a raising trigger. This is the only situation in the language which can be called *vowel harmony*. Consonants that are underlyingly non-[LL] do not acquire this feature due to a restriction in this language against adding [LL] to a consonant (see section 5.2). Thus, these consonants are transparent to assimilation and the result is long-distance assimilation (i.e. harmony). An example is given in (23).

(23) */píte/ → [píti]* *'pity'*



To summarize, we have seen a representational account of [LL] assimilation from consonants to preceding stressed vowels and to following unstressed vowels, and from stressed vowels across consonants to following unstressed vowels.

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

5.2 *Optimality-Theoretic account of [LL] assimilation*

This section captures [LL] assimilation in Buchan using Optimality Theory (OT; Prince & Smolensky 1993/2004). Because rule-based theory has no means to formalize the functional unity of processes, a rule-based analysis of [LL] assimilation would require two or more distinct rules for raising in monosyllabic and disyllabic trochees. The formalism of OT, however, allows a markedness constraint to trigger various types of structural changes, depending on its interaction with other constraints (Kager 1999: 55). This makes an account of Buchan [LL] assimilation in OT unified and economical. Furthermore, it underlines the role of representations in constraint-based grammars.

The constraint most relevant to our analysis is the one that drives the assimilation process. Since the main point of this article is not to investigate the assimilation constraints in the literature, I restrict myself to one possibility, LINK[FEATURE]. This constraint requires a [LL] feature on one segment to link to other segments, and it may be thought of as producing the reverse effect of the widely used NO-LINK constraints. Note that this constraint does not specify directionality, but it does specify the domain of application.

(24) *LINK[LL]*
A [LL] feature on a segment must be linked to at least one non-sponsor segment in the trochaic foot domain.

In conflict with the constraint in (24) is an anti-spreading constraint against associating features to segments that do not have those features in the input (25). I call this general constraint DEP-LINK[LL], following Akinlabi (1994) and Morén (2001). This constraint may be violated in multiple loci. That is, it assigns a violation mark to every new association of the [LL] feature in the output.

(25) *DEP-LINK[LL]*
Do not associate the feature [LL] to a segment that did not have it underlyingly.

To avoid violations of both LINK[LL] and DEP-LINK[LL], a candidate may delete an underlying [LL] feature. In order to rule this out, I propose the highly ranked faithfulness constraint against feature deletion in (26) (McCarthy & Prince 1993).

(26) MAX[LL]
Every [LL] feature in the input has a correspondent [LL] feature in the output.

DEP-LINK[LL] is low-ranked because it is always violated by the assimilating candidate, as shown in tableau (27). The [LL] segment in candidate (a) does not spread its [LL] feature at all, which incurs a fatal violation of LINK[LL]. Candidate (c) deletes its [LL] feature to avoid LINK[LL] violations, but in doing so it violates the highly ranked faithfulness constraint MAX[LL].

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

(27) *Link[ll], Max[ll] >> Dep-Link[ll]*

	f é g ə t [10] [LL]	PHONETIC FORM	Link[ll]	Max[ll]	Dep-Link[ll]
a	f é g ə t [LL]	[fegət]	*!		
b	☞ f é g ɨ t [LL]	[fegɨt]			*
c	f é k ə t	[fekət]		*!	

The Dep-Link[ll] constraint is unable to rule out two potential candidates: (1) those in which [LL] spreads regressively from consonants to stressed nonhigh vowels in disyllabic trochees, and (2) those in which [LL] spreads from a stressed vowel to a following non-[LL] consonant in disyllabic trochees. In order to achieve this, I propose two specific Dep-Link constraints that penalize inserting a new [LL] association to a stressed vowel (28a) or to a consonant (28b), following Beckman (1998) and Morén (2001).[11]

(28) (a) *V́-Dep-Link[LL]*
Do not associate the feature [LL] to a stressed vowel that did not have it underlyingly.
(b) *C-Dep-Link[LL]*
Do not associate the feature [LL] to a consonant that did not have it underlyingly.

In tableau (29), there is no evidence with which to rank the two Dep-Link constraints. If there is a potential unstressed vowel target, the constraint V́-Dep-Link[LL] will rule out spreading to stressed vowels as in (b) or to both stressed and unstressed vowels as in (c).

[10] In these tableaux, solid lines in the autosegmental representations indicate underlying associations to [LL] features in the input and dashed lines indicate inserted associations to [LL] features in the output.

[11] We may also consider candidates that spread [LL] from the *strong* foot-initial onset position. A high-ranking Link-faith constraint (excluded here for simplicity) eliminates these candidates.

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

(29) *V́-DEP-LINK[LL]*, *DEP-LINK[LL]*

	f é g ə t | [LL]	PHONETIC FORM	V́-DEP-LINK[LL]	DEP-LINK[LL]
a	f é g ɨ t ☞ | [LL]	[fegɨt]		*
b	f í g ə t | [LL]	[figət]	*!	*
c	f í g ɨ t [LL]	[figɨt]	*!	**!

Tableau (30) shows that the same constraint ranking holds for vowel-to-vowel harmony. Again there is no evidence with which to rank C-DEP-LINK[LL] and DEP-LINK[LL]. Candidates (d) and (e), in which [LL] spreads to the medial consonant, are *harmonically bounded* by the optimal candidate (b).

(30) *LINK[LL]*, *MAX[LL]* >> *C-DEP-LINK[LL]*, *DEP-LINK[LL]*

	n í p ə r | [LL]	PHONETIC FORM	LINK[LL]	MAX[LL]	C-DEP-LINK[LL]	DEP-LINK[LL]
a	n í p ə r | [LL]	[nipər]	*!			
b	n í p ɨ r ☞ | [LL]	[nipɨr]				*
c	n é p ə r	[nepər]		*!		
d	n í b ə r [LL]	[nibər]			*!	*
e	n í b ɨ r [LL]	[nibɨr]			*!	**!

Finally, tableau (31) applies the same constraint ranking to account for regressive [LL] assimilation in monosyllabic trochees. It also provides evidence for the relative

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

ranking of the V́-DEP-LINK[LL] constraint in relation to LINK[LL] and MAX[LL]. The optimal candidate (b) fails to satisfy V́-DEP-LINK[LL], meaning that it is ranked lower than the other inviolable constraints. Note that stressed vowels are resistant to [LL] assimilation *except* when another way of satisfying a high-ranked constraint (Link[LL]) is not available. The violable nature of OT constraints allows for a 'last resort' sort of phenomenon such as this one, which is a clear advantage over a rule-based analysis.

(31) *LINK[LL]*, *MAX[LL]* >> V́-*DEP-LINK[LL]*, *DEP-LINK[LL]*

	s ə́ b | [LL]	PHONETIC FORM	LINK[LL]	MAX[LL]	V́-DEP-LINK[LL]	DEP-LINK[LL]
a	s ə́ b | [LL]	[səb]	*!			
b	s ɨ́ b ☞ ↘ [LL]	[sɨb]			*	*
c	s ə́ p	[səp]		*!		

To summarize, a single constraint ranking defines progressive vowel-to-vowel and consonant-to-vowel spreading in disyllabic trochees as well as regressive consonant-to-vowel spreading in monosyllabic trochees – without explicit reference to the differences in the formulation of the constraints.

6 Comparison with a lowering analysis

Paster (2004) characterizes the assimilation pattern in Buchan as lowering harmony: unstressed high vowels lower to nonhigh following stressed nonhigh vowels. This characterization bears two implications. First, lowering harmony is blocked by intervening [LL] consonants. Second, all unstressed vowels are underlyingly high. There are at least two reasons to reject a lowering analysis.

The first objection is that it misses the fact that Buchan nonhigh vowels never follow high vowels even within morphemes. A lowering analysis fails to account for this because an underlying nonhigh vowel after a stressed high vowel would have to remain nonhigh, thus forming an illicit non-harmonizing case. In order to resolve this, Paster is obliged to assume a morpheme structure constraint requiring that all unstressed vowels are underlyingly high, even in monomorphemes. This is an otherwise unjustifiable

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

abandonment of the Richness of the Base hypothesis that is central to classic OT. A raising analysis, on the other hand, can account for all observed patterns regardless of the underlying nature of the unstressed vowel, as summarized in (32).

(32) *Raising vs lowering analysis and vowel co-occurrence*

Stressed V		High		Nonhigh	
Underlying unstressed V		/high/	/nonhigh/	/high/	/nonhigh/
Surface unstressed V	*(a) Raising analysis*	√[high]	√[high]	√[high]	√[nonhigh]
	(b) Lowering analysis	√[high]	*[nonhigh]	√[high]	√[nonhigh]

The second objection is that a lowering analysis misses the connection between the types and distribution of consonants affecting unstressed and stressed vowels. Recall that the consonants that condition a high central vowel in monosyllabic trochees are identical to those that condition a high unstressed vowel in disyllabic trochees. A lowering analysis argues that these consonants are blockers of assimilation. If they are only blockers, why do they participate in co-occurrence restrictions with high vowels in monosyllabic words?[12] In the present analysis, these consonants are actually participants in both types of co-occurrence restrictions, i.e. they trigger raising of both unstressed and stressed target vowels (depending on the domain).

Paster (2004) puts forth three challenges to a raising analysis, all of which are resolved in the present account. The first is that while the lowering analysis involves a single process of lowering that is blocked by voiced obstruents and certain sonorants, the raising analysis would require two distinct rules: one rule for raising unstressed front vowels following stressed high vowels and another for raising unstressed front vowels following consonant triggers (2004: 368). However, this challenge is only valid for a particular type of feature theory in which vowels and consonants necessarily make use of different sets of features. The present account explains Buchan assimilation in terms of a single feature [Lowered Larynx] that is relevant for both consonants and vowels, and as a single process in OT. In fact, a raising account is more economic than a lowering one in that it does not require a blocking mechanism.

A second reason Paster (2004) favors a lowering analysis is that raising would require us to posit that the diminutive and adjectival suffixes correspond to underlying nonhigh vowels. She argues that this analysis, while possible, is unlikely because 'the vowel of these suffixes was historically /i/ and remains /i/ in other modern dialects of Scots and English'. Although this may appear plausible, it does not justify her assumption that all unstressed vowels are underlyingly high in monomorphemes as well. Paster discusses another reason for assuming an underlying /i/ for these suffixes, namely that they surface as [i] in trisyllabic non-harmonizing forms as in (33).

[12] Note that the effect of [LL] consonants on stressed vowels in monosyllabic trochees is identical in Dieth/Paster's dialect (Dieth 1932: 39ff.; Trigo 1986).

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

(33) [bʌ́bəli], *[bʌ́biɨli] 'bubbly'
[fɜ́ngəri], *[fɜ́ngɨri] 'small finger'
[bʌ́təri], *[bʌ́təre] 'buttery'
[snɜ́kəri], *[snɜ́kəre] 'snicker (DIM.)'

Note, however, that these roots are easily claimed to have syllabic sonorants. What is described as unstressed [ə] in [bʌ́bəli] and [fɜ́ngəri] are most likely post-lexical epenthetic vowels, in which case the medial [LL] obstruents [b] and [g] will trigger raising in the suffix vowel as expected and not trigger raising in the post-lexical 'schwa'.

The final challenge Paster (2004: 369) poses to a raising analysis is a marginal set of counterexamples (34) showing stressed nonhigh vowels followed by unstressed nonhigh vowels with intervening [LL] consonants. In a raising account, these unstressed vowels are expected to raise.

(34)	(a)	[énʤəl],[13]	*[énʤɨl]	'angel'	[pródəkt], *[pródikt]	'product'
		[sə́vən],	*[sə́vɨn]	'seven'	[óbʤəkt], *[óbʤɨkt]	'object'
	(b)	[θə́rsde],	*[θə́rsdɨ]	'Thursday'	[fráide], *[fráidɨ]	'Friday'
		[sʌ́nde],	*[sʌ́ndɨ]	'Sunday'	[kɜ́rkde], *[kɜ́rkdɨ]	'Kirkday'

All the words in (34b) contain the non-reduced morpheme *-day*. Unlike the reduced suffixes and clitics, these forms could be treated as compounds, which, according to Dieth (1932: 77), do not participate in [LL] assimilation. The words [éndʒəl] and [sə́vən] in (34a) are similar to the above cases of [bʌ́bəli] and [fɜ́ngəri] in that they are easily claimed to contain syllabic sonorants and post-lexical epenthetic schwas. As the result of post-lexical epenthesis, they are not necessarily expected to undergo vowel raising. The last two cases [pródəkt] and [óbʤəkt] can be explained given that they are composed of two feet. Since [LL] consonants in foot-initial position do not trigger raising (e.g. [béke], *[bíki] '*baikie* – wooden vessel'), high vowels are not expected to surface after them.

Following these counterarguments, we conclude that a lowering analysis of Buchan assimilation is not justifiable based on a handful of marginal forms that are open to a variety of alternative explanations. In the face of robust generalizations discussed earlier in this section, assimilation in this dialect is best analyzed as one of raising.

7 Conclusions

The distribution of vowels in Buchan Scots provides evidence that this dialect exhibits a unique type of assimilation otherwise unknown to English. Since unstressed nonhigh vowels never follow high vowels in trochees, the assimilation must be one of raising. Furthermore, the parallel effect of voiced obstruents and certain sonorants on stressed vowels in monosyllabic trochees and unstressed vowels in disyllabic trochees suggests that raising is triggered by these consonants in both environments.

[13] The schwa [ə] in my transcription corresponds to [ɛ] in Paster's transcription.

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

Using the Parallel Structures Model, we have been able to capture these conclusions in an elegant and straightforward manner. Feature specifications for all segments are established on the basis of language-specific phonological contrasts and alternations, and abstracting away from both phonetic details and some assumptions of traditional feature theories. The resulting abstract features can then be treated as autosegments in the grammar. All triggers (whether consonants or vowels) are underlyingly specified for the laryngeal feature [Lowered Larynx] which targets nonhigh vowels. These structurally simple nonhigh vowels acquire a [LL] feature to form a more complex segment. In other words, the feature specifications for underlying targets /ə, e/ are equal to the features of their respective surface forms [ɨ, i] minus [LL], a correspondence that directly explains the mechanism of assimilation.

An account of Buchan [LL] assimilation within OT has a major advantage over a rule-based one. The violable nature of OT constraints allows for a 'last resort' sort of phenomenon, which captures both types of assimilation through a single constraint ranking. Furthermore, the analysis supports the need for structural representations in OT. Assimilation in the Eval(uation) function can be viewed in terms of constraints that tend to favor certain types of feature geometric structure. The interaction of these constraints with faithfulness constraints captures phonological asymmetries in the grammar.

Author's address:
Center for Advanced Study in Theoretical Linguistics
University of Tromsø
NO - 9037 Tromsø
Norway
islam.youssef@uit.no

References

Akinlabi, Akinbiyi. 1994. Alignment constraints in ATR harmony. *Studies in the Linguistic Sciences* 24(1), 1–18.

Anderson, John & Colin Ewen. 1987. *Principles of dependency phonology*. Cambridge: Cambridge University Press.

Avery, Peter. 1996. The representation of voicing contrasts. PhD dissertation, University of Toronto.

Beckman, Jill. 1998. Positional faithfulness. PhD dissertation, University of Massachusetts. [ROA 234].

Chomsky, Noam & Morris Halle. 1968. *The sound pattern of English*. New York: Harper & Row.

Clements, George N. 1991. Place of articulation in consonants and vowels: A unified theory. *Working Papers of the Cornell Phonetics Laboratory* 5, 77–123.

Clements, George N. & Elizabeth V. Hume. 1995. The internal organization of segments. In John Goldsmith (ed.), *The handbook of phonological theory*, 245–306. Cambridge, MA: Blackwell.

Dieth, Eugen. 1932. *A grammar of the Buchan dialect (Aberdeenshire): Descriptive and historical*. Cambridge: Heffer.

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press

Dresher, B. Elan, Glyne Piggott & Keren Rice. 1994. Contrast in phonology: Overview. In Carrie Dyck (ed.), *Toronto Working Papers in Linguistics* 13(1), 3–17.
Fitzgerald, Colleen M. 2002. Vowel harmony in Buchan Scots English. *English Language and Linguistics* 6, 61–79.
Goldsmith, John A. 1976. Autosegmental phonology. PhD dissertation, MIT. Circulated by IULC, Bloomington, IN.
Harris, John & Geoff Lindsey. 1995. The elements of phonological representation. In Jacques Durand & Francis Katamba (eds.), *Frontiers of phonology: Atoms, structures, derivations*, 34–79. Harlow, Essex: Longman.
Jansen, Wouter. 2007. Phonological 'voicing', phonetic voicing, and assimilation in English. *Language Sciences* 29 (special issue, ed. Philip Carr & Patrick Honeybone), 270–93.
Kager, René. 1999. *Optimality Theory*. Cambridge: Cambridge University Press.
Kenstowicz, Michael. 1994. *Phonology in generative grammar*. Oxford: Blackwell.
Kohler, Klaus J. 1984. Phonetic explanation in phonology: The feature fortis/lenis. *Phonetica* 41, 150–74.
McCarthy, John J. & Alan Prince. 1993. Generalized alignment. *Yearbook of Morphology* 1993, 79–154.
Morén, Bruce. 2001. *Distinctiveness, coercion and sonority: A unified theory of weight*. New York: Routledge.
Morén, Bruce. 2003. The Parallel Structures Model of feature geometry. *Working Papers of the Cornell Phonetics Lab* 15, 194–270.
Morén, Bruce. 2006. Consonant-vowel interactions in Serbian: Features, representations and constraint interactions. *Lingua* 116(8), 1198–1244.
Morén, Bruce. 2007. The division of labor between segment-internal structure and violable constraints. In Silvia Blaho, Patrick Bye & Martin Krämer (eds.), *Freedom of analysis?* Berlin and New York: Mouton De Gruyter. [ROA 845].
Paster, Mary. 2004. Vowel height harmony and blocking in Buchan Scots. *Phonology* 21, 359–407.
Prince, Alan & Paul Smolensky. 1993/2004. *Optimality Theory: Constraint interaction in generative grammar*. MS, Rutgers University and University of Colorado / Oxford: Blackwell Publishing.
Trigo, Loren. 1986. Voicing and pharyngeal expansion: ATR harmony in Buchan and Madurese. MS, MIT.
Trigo, Loren. 1991. On pharynx-larynx interactions. *Phonology* 8, 113–36.
Vaux, Bert. 1993. Is ATR a laryngeal feature? Presented at the Linguistic Society of America Annual Meeting, Los Angeles (8 Jan 1993).
Wölck, Wolfgang. 1965. *Phonematische Analyse der Sprache von Buchan*. Heidelberg: Carl Winter.

https://doi.org/10.1017/S1360674310000109 Published online by Cambridge University Press