Welsh Vowel Mutation:
A New Optimality Theoretic Analysis

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Dec 22 2017

1 Introduction

Unlike its orthography that seems to tell a story otherwise, Welsh employs a full-size vowel inventory.

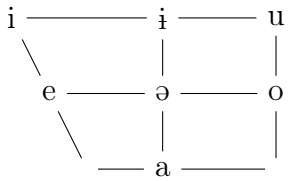

Figure 1

(Hannahs 2013)

A very interesting feature about Welsh is that ə can be appear as a stressed vowel, unlike in most languages where it is a reduced vowel in unstressed syllables. Stress in a Welsh word almost consistently falls on the penultimate syllable, with the exception of some English loanwords where the stress falls on the initial syllable (Hannahs 2013). A ə in the stressed penultimate syllable can sometimes alternate with other vowels when it is not penultimate as a result of morphology. This process is called vowel mutation, which is the subject of this study.

A penultimate ə alternates with ɨ in a non-penultimate syllable.

	IPA	Welsh	English		IPA	Welsh	English
(1)	bɨːð	*bydd*	'will.3SG'	(2)	bəðan	*byddan*	'will.3PL'
(3)	dɨːð	*dydd*	'day'	(4)	dəðja	*dyddiau*	'days'

ə can also alternate with u.

	IPA	Welsh	English				
(5)	kum	*cwm*	'valley'	(6)	kəmɔɨð[1]	*cym-oedd*	'valleys'
(7)	kuχ	*cwch*	'boat'	(8)	kəχɔd	*cychod*	'boats'

(Hannahs 2013)

Hannahs (2007, 2013) has analyzed the phenomenon using Optimality Theory (OT) on two occasions. But significant problems remain. The constraints are not naturally motivated enough. And vowels that do not participate in vowel mutation are not thoroughly considered as candidates. Some of these vowels would actually win against the surface form

[1] ɔ is the long version of o in Hannahs's transcription. It is equivalent to oː.

under Hannahs's analysis. In this paper, I will address these issues and try to come up with a new OT analysis of Welsh vowel mutation.

2 Underlying forms

Given the data in (1-8), it seems most natural to assume /ɨ/ and /u/ to be the underlying forms and that they reduce to [ə] in a penultimate syllable. Putting aside the question why a vowel would choose to reduce at a stressed position rather than at an unstressed position for now, there is another problem to this hypothesis. There is a non-alternating ɨ.

	IPA	Welsh	English		IPA	Welsh	English
(9)	pɨr	*pur*	'pure'	(10)	pɨro	*pur-o*	'purify'
(11)	bɨːð	*budd*	'benefit'	(12)	bɨðjɔn	*buddion*	'benefits'

(Hannahs 2013)

If /ɨ/ was the underlying form for both (1) [bɨːð] 'will.3SG' and (11) [bɨːð] 'benefit', there is no explanation as to why they would branch into (2) [bəðan] 'will.3PL' and (12) [bɨðjɔn] 'benefits' in the same phonological environment. The [ə] and [ɨ] in the penultimate syllables of (2) and (12) must have come from different underlying forms. And given (9-12) show [ɨ] in both penultimate and non-penultimate syllables, it seems natural to establish /ɨ/ as the underlying forms for these words (Hannahs 2013). This leaves /ə/ as the underlying forms for the [ə] ∼ [ɨ] alternation in (1-4) (Hannahs 2013).

As to the [u] ∼ [ə] alternation in (5-8), they cannot also have /ə/ as their underlying form for a similar reason as given above. If /ə/ was the underlying form for both (6) [kəmɔið] 'valleys' and (4) [dəðja] 'days', there is no way to explain why the /ə/ would diverge into a [u] in (5) [kum] 'valley', and a [ɨ] in (3) [dɨːð] 'day'. Therefore the underlying form for (5-8) must be /u/ (Hannahs 2013). The underlying forms and their allophonic distribution are illustrated in Figure 2, where the underlying forms that participate in vowel mutation are circled.

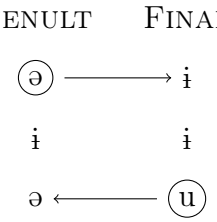

Figure 2

Given the opposing directions of change in Figure 2, it is clear to see that [ə] ∼ [ɨ] and [ə] ∼ [u] alternations are two distinct phonological processes, motivated by different constraints.

3 /ə/ → [ɨ] change

A change from /ə/ to [ɨ] is somehow counterintuitive because it is far more common in world languages for a non-schwa vowel to reduce to ə at unstressed positions. Welsh defies the typology by allowing ə in stressed syllables. What is it about stress in Welsh that makes a stressed ə possible in the first place?

Although Welsh speakers consistently identify the penultimate syllable of a word as the position for primary stress, English speakers are found to point to the final syllable when asked to identify the primary stress for a Welsh word they hear (Williams 1983). The reason for the conflicting judgement between Welsh and English speakers is due to the fact that the speakers of the two languages employ different cues for stress. In English, stress is cued by duration (Williams 1983). But Welsh stress is mostly cued by pitch (Williams 1983). What leads English speakers to perceive a stress in the final syllable of a Welsh word is the acoustic evidence that Welsh final vowels are longer in duration than penultimate ones (Williams 1983).

So despite Welsh ə's superpower to be able to be stressed, it is still a reduced vowel in terms of duration. All the other six vowels in the inventory have a length contrast in monosyllabic words, but ə can only be short in the same environment (Hannahs 2013). Observe (1-12), there is no ə in final syllables, because vowels in the final syllable are required to be long. To capture the generalization in constraints, I have:

***əː**: ə's cannot be long. Assign a violation if there is a əː in the output.

***V/Final**: Do not have short vowels in the final syllable of a word. Assign a violation if there is a short vowel in the final syllable of the output.

Note that almost all the polysyllabic words in (1-12) would violate *V/Final given their current transcriptions. But it seems to me the only reason why Hannahs (2013) decided to transcribe these final syllable vowels as short is because vowel length does not contrast in non-monosyllabic words. So it makes no sense to specify whether a vowel is short or long in the final syllable of a polysyllabic word. However, given the acoustic evidence that vowels in final syllables are long in duration (Williams 1983), I think the final vowels should be labeled as long to reflect the acoustic property. Similarly, penultimate stressed vowels ought to be specified as short. And a constraint to punish long vowels in penultimate syllables is:

***Vː**: Do not have long vowels. Assign a violation for each output long vowel.

A general *Vː constraint is chosen over a context-specific *Vː/Penult, because it is more naturally motivated and V/Final can counter its force (Flemming, p.c.).

A faithfulness constraint on length is also needed to retain the length information in monosyllabic words.

ID[Length]/Mono: Do not change the length of a vowel in a monosyllabic word. Assign a violation if there is a mismatch between the length of the input and output vowel of a monosyllabic word.

Note that *V/Final only applies to the final syllable of a polysyllabic word, not to the final and only syllable of a monosyllabic word.

To see the relative ranking between these four constraints, let us take a look at the tableau for (1) [biːð] 'will.3sg'. I have decided that its input form involves a /əː/. Had it been a short /ə/, and the constraint ranking has forced this short /ə/ to change into a [ɨː], it would entail that all short /ə/ input in monosyllabic words would have to surface as [ɨː]. There would be no monosyllabic short [ə] anywhere in the language.

*V/Final and ID[Length]/Mono need to be ranked above *Vː. The former to ensure long vowels to surface in final syllables, the latter to maintain a length contrast in monosyllabic words. *əː does not have a strict ranking with any of the other three constraints, but since it guards əː's from ever surfacing in the language, one can only imagine that it is extremely highly ranked.

Additional input-output faithfulness constraints on vowel positions are also needed, the relevant one here being ID[High].

/bəːð/	*əː	*V/Final	ID[Length]/Mono	*Vː	ID[High]
a. bəːð	*!			*	
b. bəð			*!		
☞ c. biːð				*	*
d. bɨð			*!		*

Tableau 1

These rankings can also make sure (2) [bəðaːn] 'will.3pl' surfaces, seen in Tableau 2.

/bəːðan/	*əː	*V/Final	ID[Length]/Mono	*Vː	ID[High]
a. bəːðaːn	*!			*	
☞ b. bəðaːn					
c. bɨːðaːn				*!	
d. bɨðaːn					*!

Tableau 2

In Hannahs's OT analysis, a single constraint *ə/Final is used to accomplish the same goal as my *əː and V/Final combined. *ə/Final is quite an unnatural constraint, but both *əː and V/Final can find their root in phonetic evidence.

4 /u/ → [ə] change

Compared with /ə/ → [ɨ], /u/ → [ə] is a much more common phonological process. One would expect it to be easier to motivate. However, this is not the case. There are two major puzzles surrounding this change.

First of all, why, out of all vowels, only /u/ changes into a [ə] in penultimate syllables? If /u/→[ə] is a process of reduction caused by the shortening of the vowel's length, then why do not other vowels undergo the same change? In most other languages where reduction to ə is observed, it usually involves multiple input vowels, spread across the vowel space.

The second puzzle is why the target vowel of /u/ is [ə]. Why does /u/ not change into [ɨ] or [o]? For /u/ to change into [ɨ], it only needs to change its backness. And for /u/ to change into [o], it only needs to change its height. But for /u/ to change into [ə], it needs to change both its backness and height, as seen in Figure 3.

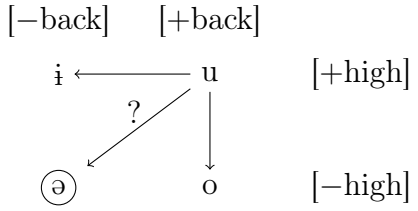

Figure 3

This is where the OT analysis in Hannahs (2007, 2013) falls short of predicting the correct surface form. Neither [ɨ] nor [o] is considered as a potential target vowel. The constraints and ranking are able to select [ə] from the faithful candidate [u], repeated here in Tableau 3, but fail to do the same when all four candidates are considered (Tableau 4). (6) [kumɔið] 'valleys' is used for illustration in the tableaux.

/kumɔið/	*ə-FINALσ	*CENTRAL-ROUND	*U-NONFINALσ	IDENT-IO
a. kumɔið			*!	
☞ b. kəmɔið				*

Tableau 3

/kumɔið/	*ə-FINALσ	*CENTRAL-ROUND	*U-NONFINALσ	IDENT-IO
a. kumɔið			*!	
b. kəmɔið				*
c. kɨmɔið				*
d. komɔið				*

Tableau 4

To remedy this, I am writing a completely new set of constraints. First, to stop /u/ from changing into [o], there is a markedness constraint against all back vowels in penultimate syllables.

***BACK/PENULT**: Do not have back vowels in penultimate syllables. Assign a violation if there is a penultimate back vowel in the output.

Only having this markedness constraint runs into the trouble of not letting any underlying /o/ surface in penultimate syllables, when there is plenty of Welsh words that have penultimate [o]. Judging by the double feature change in /u/→[ə], it seems to be the case that if a [+back] vowel wants to change into a [−back] vowel, it wants to change its value of [high] as well.

Δ[High]/Δ[Back]: If there is a change in the value of [back] from the input vowel to the output vowel, there must also be a change in its value of [high]. Assign a violation if an [αback, βhigh] vowel in the input corresponds to a [$-\alpha$back, βhigh] vowel. In other words, assign a violation if a vowel has changed its backness but not its height.

Δ[High]/Δ[Back] also helps ensure that /u/ does not change into [ɨ]. But another problem arises. /o/ will now change into [ɨ] to bypass a violation at *Back/Penult. This process needs to be stopped.

A general *ɨ is out of the question, because we want penultimate [ɨ] to surface for the [ɨ] ∼ [ɨ] alternation in (9-12). Here, I borrow McCarthy's New vs. Old markedness constraint distinction. A markedness constraint labeled as Old assigns violations like regular markedness constraints. But a markedness constraint labeled as New only assigns a violation to a form if it is not already present in the input (McCarthy 2003). In other words, only newly created forms can violate a New markedness constraint. Applying this distinction to *ɨ, I write:

New*ɨ: If the input vowel is not ɨ, do not have a ɨ as the corresponding output.

And if the input form is already ɨ, a ɨ candidate incurs no violation, as shown in Tableau 5.

/pɨo/	New*ɨ	ID[High]
☞ a. pɨroː		
b. pəroː		*!

Tableau 5

Both Δ[High]/Δ[Back] and New*ɨ need to be ranked above *Back/Penult to stop all unwanted changes from happening. *Back/Penult in turn needs to be ranked above the relevant faithfulness constraints to compel /u/ to change into another vowel. In Tableaux 6 and 7, I am throwing in abstract penultimate back vowels as input forms to show how the ranking works. /u/ changes into [ə] in Tableau 6, and /o/ remains [o] in Tableau 7.

Penult /u/	Δ[High]/Δ[Back]	New*ɨ	*Back/Penult	ID[Back]	ID[High]
a. u			*!		
☞ b. ə				*	*
c. ɨ	*!	*		*	
d. o			*!		*

Tableau 6

Penult /o/	Δ[High]/Δ[Back]	New*ɨ	*Back/Penult	ID[Back]	ID[High]
a. u			*		*!
b. ə	*!			*	
c. ɨ		*!		*	*
☞ d. o			*		

Tableau 7

5 /u-u/ sequences

There is a complication to the [u] ∼ [ə] alternation. Observe what happens when there are two /u/'s in neighboring syllables.

	IPA	Welsh	English
(13)	kumul	*cwmwl*	'cloud'
(14)	kəməla	*cymylau*	'clouds'

(Hannahs 2013)

In the current analysis, (13) would surface as *[kəmuːl] instead of [kumuːl]. When there are two underlying /u/'s next to each other, it seems to be the case that the first /u/ will not change into a [ə] unless the second /u/ undergo the change as well (Hannahs 2013).

Phenomena similar to this have been surveyed by Steriade (2016, draft). There, a Contour Correspondence constraint is introduced. The constraint stipulates that the relation between two neighboring segments in the input is preserved in the output, where an individual segment's faithfulness or markedness might be end up being compromised (Steriade 2016, draft). Extending the principle to the behavior of /u-u/ sequences in Welsh, it can be said that maintaining the identity between the neighboring /u/'s in the output is prioritized over the need to root out a penultimate back vowel. And here is the constraint defined for Welsh.

ContourCorr[u]: If there are two /u/'s in neighboring syllables in the input, the two corresponding output vowels need to be identical as well. Assign a violation if a /u-u/ sequence in the input appears as [u-ə] or [ə-u] in the output.

ContourCorr[u] ranks above *Back/Pen to ensure identity preservation is prioritized over assigning markedness violations. In Tableau 8, a penultimate /u/ does not change into [ə] when there is another /u/ in the final syllable. And in Tableau 9, an antepenultimate /u/ unusually surfaces as [ə] when preceding another /u/ in the penultimate syllable. ContourCorr[u] is abbreviated as CnCorr for displaying purposes.

/kumul/	*əː	*V/Fin	Δ[Hi]/Δ[Bk]	N*i̯	CnCorr	*Bk/Pen	ID[Bk]	ID[Hi]
☞ a. kumuːl						*		
b. kuməl		*!			*	*	*	*
c. kəmuːl					*!		*	*
d. kəməl		*!					**	**
e. komoːl						*		*!*

Tableau 8

/kumula/	*əː	*V/Fin	Δ[Hi]/Δ[Bk]	N*ɨ	CnCorr	*Bk/Pen	ID[Bk]	ID[Hi]
a. kumulaː						∗!		
b. kuməlaː					∗!		∗	∗
c. kəmulaː					∗!	∗	∗	∗
☞ d. kəməlaː							∗∗	∗∗
e. komolaː						∗!		∗∗

Tableau 9

6 Conclusion

In this paper, I have developed an OT analysis for Welsh vowel mutation. It is in some way an improvement on Hannahs's OT analysis (2007, 2013) for two reasons. For the [ə] ∼ [ɨ] mutation, my analysis has constraints that better reflect the phonetic basis of the mutation. For the [ə] ∼ [u] mutation, Hannahs fails to consider non-mutating vowels as candidates, which is remedied by my analysis. But at the same time, the natural motivation behind the [ə] ∼ [u] mutation still evades me. All three markedness constraints employed, Δ[High]/Δ[Back], New*ɨ, and *Back/Penult, are built for the data, and solely for the data. They are grotesquely pieced together just so each underlying form can map on to its surface form. Clearly, there remain many questions that need to be answered by further research on Welsh vowel mutation.

References

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