Quantity-quality interactions in Welsh vowels: Phonologization across dialects

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Quantity-quality interactions in Welsh

Phonologization across dialects

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1 Quantity and quality in Welsh

1.1 A contrastivist conundrum

The Contrastivist Hypothesis
The phonological component of a language \( L \) operates only on those features which are necessary to distinguish the phonemes of \( L \) from one another (D. C. Hall 2007, p. 20)

- Question here: how do you decide the set of phonemes to be distinguished by features?
- A well-known problem for phonemic theory: mutually predictable distributions
- North Germanic, e. g. Norwegian: [taːk] ‘roof’ vs [takː] ‘thanks’
- If vowel length is phonemic, then consonant length is allophonic
- If consonant length is phonemic, then vowel length is allophonic
- English key: /kiː/ or /ki/?
- English kit: /kit/ or /kt/?
- Or even syllable cuts?

The problem
Any contrastivist approach appears forced to make a choice, even when purely empirical adjudication is difficult

- See, for example, and among many others:
1.2 Quantity and quality in Welsh

The received view

- Descriptions of Welsh argue it to be essentially like English
- Mutually predictable distribution of length and quality
  - Long vowels are tense [iː uː eː oː]
  - Short vowels are lax [ə i o ɛ ɔ]
  - Disagreement about [a]/[ɑː]


The evidence: quality is phonemic

- English borrowings like ['brɔːn] brawn: length does not predictably lead to tenseness
  - Unclear status in the grammar
  - Not empirically shown that borrowed [ɛːɔː] qualitatively identical to native [ɛ ɔ]
  - Unclear whether [a]/[ɑː] are distinct qualitatively
- Difficult to account for patterning

The evidence: quantity is phonemic

For the details of this analysis, see Iosad (2012b)

- Distribution within ‘short-long’ or ‘lax-tense’ pairs is largely predictable
  - Long before [b d ɡ f ɔ ɣ v ð]
  - Short before (most) clusters (but always predictable in any case)
  - Short before [p t k s j l m ɲ]
  - [ə] is always short
  - Lexical contrast before [n l r]

(1) South Welsh

a. ['tʰoˑne] tonau ‘tunes’
b. ['tʰɔnˑe] tonnau ‘waves’

- Partially predictable distribution of quantity driven by quality of surrounding vowels: mix of coerced and distinctive weight (Morén 2001)
- Analysis: general bimoraicity requirement moderated by lexical moraicity and constraints on what can and can’t acquire a mora
  - Metropolitan New York English (Morén 2001)
  - Latvian (Bye & de Lacy 2008)
  - Friulian (Iosad 2012a, Torres-Tamarit forthcoming[a],[b])
Dialect variation in length

- All dialects: long and short vowels in stressed monosyllables
  - *ton* 'wave' [tʰɔnˑ] ≠ *tôn* [tʰoːn] 'tune'
- South Welsh: long and short vowels in stressed penults
  - [tʰɔnˑɛ] *tonnau* 'waves' ≠ [tʰɔˑnɛ] *tonau* 'tunes'
- North Welsh: only short vowels in penults
  - [tʰɔnˑa] *tonnau* = [tʰɔnˑa] *tonau*
- Mid Welsh and NE (Awbery 1984): ‘free variation’ in penults

1.3 South-West Welsh

A different pattern

- Description: mid long vowels are lax before a high vowel

(2) a. [ˈɛːdɛ] edau ‘thread’
   b. [ˈoːɡɔv] ogof ‘cave’

(3) a. [tʰɛːbɪɡ] tebyg ‘similar’
   b. [ˈkʰɔːdi] codi ‘rise’

(4) Alternations [kʰoːdɔð] cododd ‘((s)he) rose’

- This could be construed along the same lines as the borrowing argument
- But the distribution is still predictable!

Outline of argument

- Are there criteria we can use beyond surface predictability?
  - Yes: modularity
  - If a distinction participates in a pattern that involves proprietary phonological information, it should be phonological
  - ‘Tenseness’ is likely phonologized both in SW Welsh and other varieties
  - Predictable distribution of distinct categories is an expected result of the life cycle, not a problem for the Contrastivist Hypothesis
  - Contrastivity is defined as non-redundancy in feature assignment along the lines of the contrastive hierarchy
Quantity-quality interactions in Welsh

2 Dialect variation

2.1 South-West Welsh

Acoustic study

- 8 speakers in study: 6 show the system described for the south-west
- Carmarthen, rural W Carmarthenshire, Pembrokeshire
- 149 items × 3 repetitions, controlled for consonantal context, vowel length, height of following vowel
- Carrier phrase Glywes i'r gair ... dde 'I heard the word ... yesterday'
- Basically: descriptions are correct

- Figure 2a: robust durational distinction, as expected for South Welsh
- Figure 2b: clearly bimodal pattern in the mid long vowels but not in high vowels
- ‘Lax’ long vowels seem fairly similar to short vowels
- Quantitative results: generalized additive hierarchical models using R package mgcv (Wood 2006), speaker and word as random effects
- Improved fit with three-way interaction between vowel quality, vowel length and height of following vowel
- In this model, the height of the following vowel has a significant effect (95% CI excludes zero) only on long /eːoː/, again as expected from descriptions
The ‘tense-lax’ distinction in *mid* vowels is sensitive to the ‘high-nonhigh’ distinction among *all* vowels.

- The height specification of vowels is a proprietary phonological feature.
- Hence, the ‘tense-lax’ distinction in mid vowels is phonological.
- Emergent/substance-free feature theory (e.g., Mielke 2007, Morén 2007): these two distinctions pattern together, so they are encoded by the same feature.
- Important fact: patterning of vowels in unstressed (post-tonic) syllables
  - [i u] in open syllables, [i o] in closed syllables
  - Only [ɛ ɔ] for mid vowels

- Parallel Structures Model of feature geometry (e.g., Morén 2003, 2006, 2007, Youssef 2010)
- Different implementation of ‘tenseness’ in high and mid vowels
  - High vowels: ‘lax’ [i o] are more marked, pattern with [ə] in that this is the class of vowels that can never be long
  - Mid vowels: ‘tense’ [e o] are more marked
    * Only [ɛ ɔ] in post-tonic syllables
    * Tense [e o] phonologically active: targeted by dissimilation process
    * The feature V-manner[closed] covers both high vowels and tense mid vowels
    * Dissimilation within the final disyllabic domain responsible for alternations

Figure 3: Contrastive hierarchy for South-West Welsh
Table 1: Featural specifications for vowels: South-West Welsh

<table>
<thead>
<tr>
<th>Segment</th>
<th>V-place</th>
<th>V-manner</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[coronal]</td>
<td>[labial]</td>
</tr>
<tr>
<td>/i/</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>/ɪ/</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>/u/</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>/o/</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>/a/</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>/ɛ/</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>/ɛ/</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>/a/</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Phonologization in South-West Welsh

- The ‘tenseness’ distinction shows signs of *phonologization* (Hyman 1976, 2013) or *stabilization* (Bermúdez-Otero & Trousdale 2012, Bermúdez-Otero 2014, Ramsammy 2015): reference to phonological information
  - Distribution in high vowels is sensitive to the presence of a coda
  - Modelling shows this is not a durational effect
  - Distribution in mid vowels is sensitive to contrastive phonological specification
  - We return to possible continuous effects below

- Most speakers consistently show unexpected [ɛː] in *ffenestr* [ˈfɛːnɛst] ‘window’

2.2 Standard system

- This system is exemplified in the data by a single speaker
- Figure 6a: robust distinction in duration
- Figure 6b: ‘tense’ when long and ‘lax’ when short
- Similar to findings for monosyllables in Mayr & Davies (2011)
- Post-tonic syllables
  - Lax [ɪ o] when closed, tense [i u] when open
  - Lax [ɛ ɔ] in all contexts

- Overall distribution:
  - High vowels: lax in closed syllables (unstressed or short before moraic coda), tense in open syllables
  - Mid vowels: lax when monomoraic, tense when bimoraic
Summary on standard system

- ‘Tenseness’ probably phonologized: sensitive to phonological information
  - High vowels: presence of codas
  - Mid vowels: moraic structure
    - Not a duration effect
- The features used for the ‘tenseness’ distinction do not interact with anything else or with each other
- No evidence this is the same feature

2.3 The non-enhanced system

- Again, just a single speaker: notably, this speaker is from Aberystwyth in the Mid Wales area
- Figure 8a: small but robust difference in duration by vowel category
  - This contradicts the descriptions claiming ‘free variation between “short” and “long” vowels’
- Figure 8b: no difference in formant values by length category: all stressed vowels are ‘lax’
- Figure 10: longer duration does lead to some gradient tensing in stressed vowels
- Same post-tonic system as elsewhere
Figure 7: Contrastive hierarchy for the standard system

<table>
<thead>
<tr>
<th>Segment</th>
<th>V-manner</th>
<th>V-place</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[closed]</td>
<td>[open]</td>
</tr>
<tr>
<td>/i/</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>/ɪ/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/a/</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>/ʊ/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/e/</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>/ɛ/</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>/o/</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>/ɔ/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/a/</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Featural representations for the standard system
Figure 8: Duration and vowel quality for Sp8

Figure 10: Effect of vowel duration on F1, Sp8
Summary for non-enhanced system

- No evidence for a phonological ‘tenseness’ distinction in mid vowels
- Some evidence for a distinction in high vowels sensitive to codas, but only apparent word-finally
- Note the broader domain of the requirement compared to the standard system
- No analysis here due to lack of data from stressed monosyllables
- Potentially: ‘free variation’ in quantity really means ‘(some) continuous variation in quality’
- Some descriptive literature can be interpreted to agree with this (Wmffre 2003, Rees 2013)

3 Phonologization across dialects

3.1 Diachronic interpretation

- Suggested diachronic interpretation for stressed vowels
  - No difference in quality within vowel categories
  - Length is enhanced by (continuous) tensing (Stevens & Keyser 1989, 2010, Keyser & Stevens 2006) ≈ non-enhanced system
  - All short-long pairs are interpreted as featurally distinct, but the features are inert otherwise ≈ standard system
  - Features used for the tenseness distinction participate in alternations involving other segments ≈ south-western system
  - Tenseness becomes phonemicized (see also Iosad 2014 for another scenario)

Where does contrast come from?

- If features are emergent, they must be extracted from categorical distributions in the data
- Categorical distributions arise from phonetic processes with predictable outcomes via the life cycle
- At early stages of the life cycle, the categories will be in predictable (‘complementary’) distribution
- Some learning models are biased to collapse such distinctions (e.g. Peperkamp et al. 2006, Dillon, Dunbar & Idsardi 2012)
- But the distribution may also be interpreted to be driven by the grammar (K. C. Hall 2013, Kiparsky 2014)

3.2 Rule scattering in South-West Welsh

The origin of height dissimilation
· Height dissimilation: phonologization of a trade-off in inherent length
· Irish: synchronically (Munster; Ó Sé 1989) and diachronically (Connacht; Ó Sé 1984) ⇒ categorical (?)
· East Slavic: categorical (Crosswhite 2000) or continuous (Kasatkina & Ščigel’ 1996, Kniazev & Shaulskiy 2007), potentially coexisting
· Kera: continuous? (Pearce 2007)

· The following model was used to estimate the effect of post-tonic vowel duration on the ratio between the duration of the stressed and post-tonic vowel

```r
fit <- gam(v1h.v2h.ratio ~ s(v2h.dur, by=v1, k=5) + v1 + v1.is.long + s(speaker, bs='re') + s(word, bs='re'), data=sw.data)
```

· Figure 11 shows that the relationship is consistent with the existence of a trade-off
· The coexistence of a continuous pattern and its categorical congener in the grammar is major prediction of the theory of the life cycle: rule scattering
· South-West Welsh is an interesting example of rule scattering, since the cognate processes are rather different in nature (unlike t/d-deletion, [l]-darkening etc.)

3.3 Emergent features and phonologization
Phonologization and labelling
Quantity-quality interactions in Welsh

- Emergent/substance-free feature theory is compatible with theories of the life cycle
- Entities to be labelled emerge from categorical distributions in the data
- Categorical distributions in behaviour may be generated by underlyingly non-categorical processes (cf. Ladd 2006)
- Phonologized distinctions participate in ‘narrowly phonological’ patterns even when the evidence for their exact nature is weak

Emergent features and contrast

- Phonologization in this sense is an alternative to surface contrast as a criterion for ‘redundancy’
- Features like ‘tenseness’ in systems like Welsh are not ‘redundant’ even if they may be predictable on the surface from the context
- The Contrastivist Hypothesis is worth pursuing with a revised definition of ‘redundancy’
- Consistency with the Successive Division Algorithm (Dresher 2009) is a good candidate criterion (cf. Dresher 2014)

References


Iosad, Pavel. 2014. The ATR/Laryngeal connection and emergent features. MS., University of Edinbrgh. in preparation.


Quantity-quality interactions in Welsh


Torres-Tamarit, Francesc. Forthcoming(b). Length and voicing in Friulian and Milanese. *Natural Language & Linguistic Theory*. 

14


AIC 2098.91 2091.54 2074.06  
BIC 2762.91 2753.46 2672.18  
Log Likelihood -931.50 -928.18 -930.77  
R^2 0.79 0.79 0.79  

<table>
<thead>
<tr>
<th></th>
<th>No height effect</th>
<th>No interaction</th>
<th>Model with interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-1.01* ([-1.24; -0.77])</td>
<td>-1.06* ([-1.29; -0.83])</td>
<td>-1.00* ([-1.18; -0.82])</td>
</tr>
<tr>
<td>//a//</td>
<td>0.71* (0.44; 0.98)</td>
<td>0.65* (0.39; 0.90)</td>
<td>0.79* (0.57; 1.00)</td>
</tr>
<tr>
<td>//e//</td>
<td>1.55* (1.28; 1.82)</td>
<td>1.42* (1.17; 1.68)</td>
<td>1.58* (1.34; 1.82)</td>
</tr>
<tr>
<td>//o//</td>
<td>1.59* (1.26; 1.91)</td>
<td>1.50* (1.19; 1.82)</td>
<td>1.54* (1.26; 1.81)</td>
</tr>
<tr>
<td>//u//</td>
<td>0.26</td>
<td>0.14</td>
<td>0.29</td>
</tr>
<tr>
<td>Long vowel</td>
<td>-0.22</td>
<td>-0.29* ([-0.09; 0.61])</td>
<td>-0.29* ([-0.20; 0.48])</td>
</tr>
<tr>
<td>Long /e/</td>
<td>-0.26</td>
<td>-0.16</td>
<td>-0.83* ([-0.50; 0.06])</td>
</tr>
<tr>
<td>Long /o/</td>
<td>0.00</td>
<td>0.08</td>
<td>-0.38* ([-0.36; 0.37])</td>
</tr>
<tr>
<td>Long /u/</td>
<td>0.34</td>
<td>0.34</td>
<td>0.35</td>
</tr>
<tr>
<td>Duration smooth</td>
<td>1.86</td>
<td>2.37</td>
<td>2.13</td>
</tr>
<tr>
<td>F2 smooth</td>
<td>3.33</td>
<td>3.50</td>
<td>3.79</td>
</tr>
<tr>
<td>Speaker (random)</td>
<td>4.41</td>
<td>4.43</td>
<td>4.35</td>
</tr>
<tr>
<td>Word (random)</td>
<td>98.37</td>
<td>96.29</td>
<td>76.98</td>
</tr>
<tr>
<td>High post-tonic vowel</td>
<td>0.27* ([-0.10; 0.77])</td>
<td>0.27* ([-0.07; 0.75])</td>
<td>-0.16; 0.85</td>
</tr>
<tr>
<td>//e// before high</td>
<td>-0.08</td>
<td>-0.08</td>
<td></td>
</tr>
<tr>
<td>//o// before high</td>
<td>-0.02</td>
<td>-0.02</td>
<td></td>
</tr>
<tr>
<td>//u// before high</td>
<td>-0.18</td>
<td>-0.18</td>
<td></td>
</tr>
<tr>
<td>Long vowel before high</td>
<td>0.03</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Long //e// before high</td>
<td>1.06* ([-4.04; 10.70])</td>
<td>1.06* ([-4.06; 11.05])</td>
<td>-0.35; 0.42</td>
</tr>
<tr>
<td>Long //o// before high</td>
<td>0.82* ([-5.39; 14.21])</td>
<td>0.82* ([-5.37; 14.23])</td>
<td>0.34; 1.30</td>
</tr>
<tr>
<td>Long //u// before high</td>
<td>0.05</td>
<td>0.05</td>
<td></td>
</tr>
</tbody>
</table>

* o outside the confidence interval  

Table 3: Models for normalized F1, south-western speakers