Fortis-lenis or voiced-voiceless – features of Welsh consonants

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ABSTRACT

The aim of this paper is to challenge the often-claimed phonological voiced-voiceless distinction of Welsh consonants [6]. This concept was recently challenged by Asmus/Grawunder [5], who revealed that final /b/ and /d/ are devoiced in monosyllables, but still distinct from /p/ and /t/, e.g. *brat* 'rag' vs *brad* 'treachery', *cip* 'glimpse' vs *cib* 'husk'. Further indicative are minimal pairs with final /m/ vs /f/, e.g. *trem* 'glance' vs *tref* 'town' as well as initial /s/ vs /h/, e.g. *sil* 'seed' vs *hil* 'breed'. Applying the fortis-lenis divide links Welsh phonetics better to Welsh grammar, which features a fully developed morpheme-initial consonant mutation system for morphological, syntactical and semantic marking [5]. In order to confirm our hypothesis, this paper discusses two potential phonetic correlates of a phonological fortis-lenis distinction, i.e. articulatory timing via the holding phase and aspiration of initial and final stops in Welsh.

Keywords: fortis-lenis distinction of consonants, aspiration, Welsh, Irish

1. INTRODUCTION

Describing its phoneme inventories should be basic to any language taught [9], but is essential when researching its phonology [8]. A lack of a properly identified and characterised phoneme inventory may result in identifying erroneous working principles of a language or its relationship to other tongues [8].

When describing consonants, major distinctions are based on the identification of their place of articulation and often the absence or presence of voicing. Such descriptions are frequently driven by assumptions of universal language features or in the search thereof [17], which affects the terminology used. This becomes obvious when looking at the descriptions of Welsh consonants [6] [13] [14], which normally postulate a phonological distinction between voiced and voiceless consonants. However, such views seem to hamper the understanding of complex phenomena of Welsh, like morpheme-initial consonant mutations (henceforth mICM), whose basic distinction is the fortis-lenis divide [1].

In phonetic literature, the voiced-voiceless and fortis-lenis distinction are often seen synonymously [5]. Recent research, however, points to differences between voicing and non-voicing languages [18]. Consequently, the aim of the research conducted here is a contribution to this discussion by (a) suggesting that the voiced-voiceless distinction is inappropriate for Welsh, (b) proposing the fortis-lenis divide as phonologically distinctive and fully language-structuring as well as (c) offering the first two phonetic correlates of such a fortis-lenis distinction of Welsh plosives.

2. PROBLEMS RESULTING FROM THE USE OF THE VOICED/VOICELESS DISTINCTION FOR WELSH CONSONANTS AND SOLUTIONS OFFERED BY THE FORTIS-LENIS DISTINCTION

When describing Welsh consonants along the voiced-voiceless distinction, three problem areas arise. These are lacking explanations for minimal pairs of the type depicted above, inconsistencies in the description of the system of Welsh mICM and misconceptions about the interplay between vowel and consonant length in Welsh monosyllables [4].

In languages with a phonological voiced-voiceless distinction, /z/ is the voiced counterpart of voiceless /s/. In Irish (and reduced also in Welsh [4]), /s/ forms minimal pairs with /h/. This opposition cannot be explained by the voiced-voiceless distinction, because both sounds are considered voiceless. The same holds true for Welsh /m/ vs /v/ and, indeed, these opponents occur in that opposition in its mICM system in order to mark grammatical properties in Welsh. Whereas the change of the fortis stop /m/ into lenis /v/ may be seen within the frame of classical lenition [16], i.e. changing a plosive into a homorganic fricative (complemented by further diachronic developments, adjusting the place of articulation), the change of /s/ to /h/ is referred to as debuccalisation, i.e. a subtype of lenition resulting in losing the original place of articulation and moving it to the glottis [1].

Insisting on the voiced-voiceless distinction detaches phonetic properties of Welsh from basic phonological processes, which lead to its specific grammatical system, part of which are the mICM.

Such mutations are here defined as systematic and grammaticalised changes that affect morpheme-initial phonemes yielding those that are phonetically different [5]. Considering the fortis-lenis distinction of Welsh consonants as basic allows to present mICM as a phenomenon based on predominantly two phonological processes, i.e. lenition and nasalisation [1]. Such a view makes Welsh and Irish comparable when describing their mICM.

In addition, Asmus and Grawunder revealed that there is a clear correlation between vowel and coda length in Welsh monosyllables along the fortis-lenis divide. Contrary to common assumption, it is the consonant length which determines that of the preceding vowel, thus identifying Welsh as a consonant-driven language [5].

To sum up, using the fortis-lenis distinction for the analysis of Welsh may offer new insights into working principles of the language and its resulting structures. It would also show how close Welsh and Irish are genealogically despite their allocation to p-Celtic (Welsh) and q-Celtic (Irish).

3. POTENTIAL PHONETIC CORRELATES OF THE FORTIS-LENIS DISTINCTION

Various authors have tried to identify factors that are crucial for the fortis-lenis distinction [10], [11]. Apart from one- and two-factor approaches, as found for instance in Malecot [21] and Stetson [22], who typically refer to glottal aperture and articulatory timing as identifying features, we assume here that the fortis-lenis distinction results from a multidimensional feature combination. Hence, the difference between the fortis and lenis series of sounds is seen as a combination of four parameters, namely: peak glottal aperture/peak intraoral pressure, articulatory timing, voicing and aspiration. In this investigation, we look at voicing and aspiration first.

A focus on the onset of voicing seems to be advocated by the fact that it usually occurs within the aspiration phase, which is not typical of English. Based on the research introduced by Asmus and Grawunder [5], it is expected that voicing, i.e. any state in which vocal folds vibration occurs [20], does not seem to be a necessary phonetic correlate of the fortis-lenis distinction, because we find devoiced /b/ and /d/ with long preceding vowels just as it would be expected from voiced consonants.

The second feature to be investigated here is aspiration because it differentiates phonologically between the Welsh stops /p, t, k/ and /b, d, g/ [7] as well as /l/ and /ɬ/ [3] and /r/ and /r̥ʰ/ in mICM [2]. In addition, the attraction of aspiration by fortis sounds constitutes an important element of spirantisation in Welsh, understood as a phonological process during which fortis plosives change into homorganic fortis fricatives potentially attracting secondary aspiration. As such /p, t, k/ change into /f, θ, x/ [1]. This secondary aspiration is not observed in the change of lenis stops into lenis fricatives nor is it seen in Irish *séimhiú* of /p, t, k/.

In brief, there are four potential phonetic features that should be measured in order to identify correlates that account for the distinction between the fortis and lenis consonants of Welsh. Articulatory timing, peak intraoral pressure/peak glottal aperture, voicing and aspiration offer potentially conclusive research. To start with, aspiration and voicing are looked at in this paper by investigating the aforementioned ratios.

4. METHODOLOGY

The research outlined here began with an acoustic analysis of the Welsh plosives, i.e. /p, b, t, d, k, g/. 31 native speakers, male and female aged 19-71, from North and South Wales, who use their language at home and at work, were interviewed between 2013 and 2018. The analysis was undertaken both in the onset and coda of monosyllabic native lexemes currently in use. The lexemes were taken from previous corpora, but further amended [5]. An occasional English loan word was used as a control item. The tokens were then placed in the carrier phrase *Dw i heb ddweud X ond Y!* [I didn't say X but Y] and were ordered in a way that every lexeme appears in the recording twice in a strong and twice in a weak prosodic position. Selected native lexemes were also recorded in normal sentences. Then, the target items were analysed with the help of the Praat software (version 5.3.85). The holding phase duration (potential voicing) and aspiration were measured for the consonants under review. With respect to aspiration, we assume that is a period of friction extending from the release of a plosive to the onset of modal voicing (see Fig. 1). In the case of Welsh lenis plosives, the presence of friction following release is an indicator of aspiration. It is also assumed that friction following an initial lenis plosive may be partially voiced. Therefore, both parameters were measured in order to establish whether their relative durations distinguish fortis plosives from their lenis counterparts. The collected temporal data were subjected to a statistical analysis by means of a mixed-design ANOVA, which takes into consideration the influence of random effects, which include speakers and the phonological contexts.

5. FINDINGS/DISCUSSION

The preliminary results of the analyses suggest that the fortis-lenis dichotomy in Welsh is a function of the aspiration-voicing combination. In word-initial position, the lenis plosives /b, d, g/ seem to follow the pattern found in other languages [20]. In word-final position, however, where aspiration of lenis plosives is cross-linguistically uncommon, the same duration pattern was formed, with /g/ followed by the longest and /b/ by the shortest period of aspiration (see Table 1 and Table 2). However, periods of aspiration in the Welsh initial lenis plosives tend to be partially voiced. A token of this type is presented in Figure 1, which depicts the spectrogram of the word *dŵr* 'water'. The second half of the 25-millisecond aspiration period is voiced as indicated by the pulses of vocal fold activity. In the case of /b/ and /d/, it is not uncommon for voicing to be present not only throughout the aspiration, but also during the preceding holding phase.

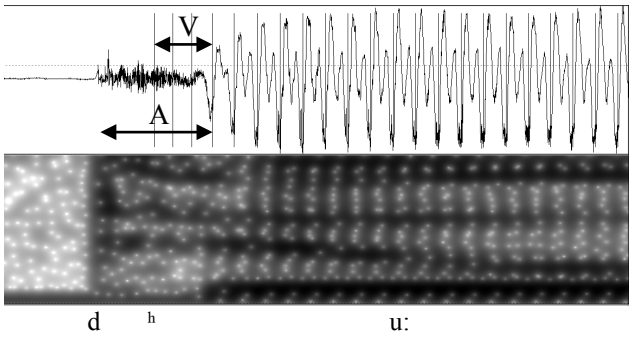

Figure 1: Partially voiced period of aspiration in the word *dŵr* 'water'.

There is speaker-specific variation regarding the amount of aspiration. Predictably, the speaker effect turned out to be significant ($p < .0001$). It is worth pointing out that the Welsh lenis plosives have considerably more aspiration than their counterparts in non-aspiration languages, e.g. Polish, but also in English [20]. The difference seems to relate to the amount of friction noise, which includes intensity and/or duration, following the release; an aspect that will be further investigated.

With respect to the final lenis plosives, they are regularly aspirated to a greater extent than initial ones. Importantly, the aspiration noise is never voiced, yet a certain amount of voicing may occur in the holding phase [cf. 5]. The amount of aspiration following final /b, d, g/ forms the same pattern as in initial position.

By comparison, the fortis plosives /p, t, k/ are characterised by significantly longer periods of aspiration and relatively shorter periods of voicing in the holding phase. The data in Table 1 and Table 2 indicate that this finding refers to both prosodic positions investigated in this study.

Table 1: Average durations (in ms) of holding phases (HP), periods of aspiration (A) and periods of voicing of lenis plosives /b, d, g/ in prosodically weak position.

	Weak initial		Weak final		
	A	V	HP	V	A
b	17.3 (± 3.1)	9.5 (± 2.5)	74.6 (± 13.7)	22.7 (± 7.8)	47.3 (± 18.6)
d	21.8 (± 4.64)	13.7 (± 3.1)	83.4 (± 14.2)	29.4 (± 6.3)	56.6 (± 17.1)
g	33.4 (± 5.1)	17.1 (± 4.4)	97.3 (± 15.6)	40.1 (± 7.2)	66.2 (± 17.9)
p	90.3 (± 16.6)	14.2 (± 2.2)	157.3 (± 20.2)	24.6 (± 5.9)	82.4 (± 19.4)
t	113.4 (± 20.7)	16.9 (± 3.3)	177.8 (± 26.4)	19.2 (± 6.8)	96.9 (± 22.5)
k	138.6 (± 25.8)	13.8 (± 3.1)	195.7 (± 34.4)	17.3 (± 2.7)	120.1 (± 28.8)

Table 2: Average durations (in ms) of holding phases (HP), periods of aspiration (A) and periods of voicing of lenis plosives /b, d, g/ in prosodically strong position.

	Strong initial		Strong final		
	A	V	HP	V	A
b	19.9 (± 3.1)	11.3 (± 2.8)	96.2 (± 28.9)	21.2 (± 5.3)	66.8 (± 25.4)
d	22.8 (± 4.2)	12.1 (± 2.5)	109.5 (± 38.7)	20.4 (± 4.6)	89.6 (± 19.7)
g	33.4 (± 3.7)	13.8 (± 3.6)	123.3 (± 42.2)	22.1 (± 3.9)	95.9 (± 22.3)
p	117.6 (± 24.5)	13.4 (± 2.6)	208.2 (± 39.8)	17.4 (± 3.1)	119.6 (± 27.7)
t	129.3 (± 34.6)	12.2 (± 2.1)	203.6 (± 46.3)	13.4 (± 2.4)	124.7 (± 39.4)
k	148.2 (± 41.4)	13.5 (± 1.9)	226.9 (± 49.5)	16.1 (± 2.6)	142.6 (± 40.8)

6. CONCLUSIONS

In this paper, the consideration of the fortis-lenis distinction instead of the voiced-voiceless divide as the dominant feature for Welsh consonants is suggested. This proposal is based on issues such as the identification of minimal pairs, the explanation of regular patterns of mICM and the correlation between the length of coda consonants and preceding vowels in monosyllables.

Employing the fortis-lenis distinction makes the phonological system of Welsh very regular. It is clearly governed by consonants and, in particular, their fortis-lenis divide which developed into a fully grammaticalised mICM system.

Ideally, the proposed consonant distinction should be identified by a set of phonetic correlates in order to be seen as separate from the voiced-voiceless distinction. Based on a literature review, four main

phonetic properties seem to be relevant, out of which two were investigated in this study.

The collected data point to the conclusion that both voicing and aspiration contribute to differentiating between fortis and lenis plosives. The period of aspiration following the lenis plosives is significantly shorter than that of their fortis counterparts in both word-initial and word-final position. The findings also indicate that the two groups of plosives differ with respect to the amount of voicing present in the aspiration period in initial position. Although present in both series, the ratio between the length of the voiced section and the total duration of aspiration is significantly higher in the case of /b, d, g/. A similar relationship can also be established in word-final position, where the voiced part of the holding phase of the lenis plosives appears to be relatively longer than that of fortis /p, t, k/. In brief, the acoustic investigation of the first two phonetic features offers promising phonetic evidence for a potentially phonological fortis-lenis divide as indicated by grammatical and semantic pattern.

7. REFERENCES

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