

THE ACQUISITION OF THE WELSH LATERAL FRICATIVE

Martin J. Ball* and Nicole Müller†
 *University of Ulster, †Cardiff University

ABSTRACT

We report here on a study into the acquisition of Welsh phonology in bilingual Welsh-English children. We concentrate on the acquisition of the voiceless alveolar lateral fricative. This showed a wide range of substitutions, and differential patterns of development dependant on the subject's dominant language, and the position within the word of the target. Various substitution strategies are described, including fricatives, and fricatives plus lateral. It is noted that in these two categories, velar fricatives become increasingly common in later age ranges, especially with the English dominant speakers. It is argued that this is because, unlike front fricatives, the velar fricative shares several important acoustic characteristics with the lateral fricative: a formant-like structure and the same top limit to the noise spectra.

1. INTRODUCTION

In a study of the acquisition of Welsh and English phonology in bilingual children of both Welsh and English dominant backgrounds [4, 8], developmental patterns for the two languages were described. Of particular interest were the trends evident for the two groups of children in respect of the lateral fricative of Welsh. Not only were there noticeable differences in patterns of acquisition between the Welsh-dominant and the English-dominant children, but this sound showed the greatest variation of any investigated, with 20 different variants attested in the data. In this account, these results will be examined to see whether this variation is amenable to analysis in terms of both language dominance and developmental stage, and whether a phonetic account can explain why certain variant forms predominate in the data. In order to do this, we need first to provide some background to the phonology of Welsh.

Welsh is a Celtic language spoken by about half a million speakers throughout Wales, nearly all of whom are bilingual in English. The phonological system of Welsh consonants (described in [1]) differs from that of English in the fricative sub-system in particular. Welsh lacks voiced fricatives at the alveolar, and postalveolar places of articulation, but unlike English has a voiceless fricative at the velar place. Welsh also has a voiceless alveolar lateral fricative, which can be found at all places within the word. The vowel system also differs from that of English but this is not discussed here.

The lateral fricative enters into a system of morpho-syntactically triggered phonological changes, called 'consonant mutation' (see [3]). The 'soft mutation' involves the change \Ų to \l in word-initial position. In the data reported below, all instances of potential mutated forms have been ignored, and only instances where this change would not be expected are included.

2. THE STUDY

In seeking to describe the phonological development of Welsh-speaking children, the project team described in [4, 8] considered Welsh within a bilingual context as so many of the children acquiring Welsh are, at the same time, also mastering English. In South Wales (where the project was based) it would have been difficult to find sufficient numbers of monolingual Welsh-speaking children but, even if this had been possible, it

would have been unrealistic to ignore the predominant bilingual milieu.

The aims of the project, therefore, were to provide profiles of phonological acquisition which are typical enough to be generalizable to other regions of Wales, and to present methods of analysis which are sufficiently illuminating to be utilized in similar studies on children in Wales.

Subjects were divided into five age ranges with the aim to have 20 subjects in each group. Subjects were also divided, by means of a language background questionnaire, into Welsh-dominant and English-dominant bilinguals. Only Welsh-dominant bilinguals were found for the youngest age group. The make-up of the five groups is shown in Table 1.

Group	Age range	Welsh dominant		English dominant	
		males	females	males	females
A	2;6-3;0	3	3	0	0
B	3;0-3;6	4	5	5	3
C	3;6-4;0	3	7	5	4
D	4;0-4;6	5	5	7	4
E	4;6-5;0	5	4	5	6

Table 1. Subjects used in the Project

The sample collected from the subjects consisted of both single words and words in context, and the sample size was 50 words per language at the single word level and the same items within connected speech. High quality audio recordings were made of the sample for each subject, which were transcribed by members of the project team using the International Phonetic Alphabet and, where needed, the extensions to the IPA [5].

Groups	Position	English dom		Welsh dom	
		% correct [\Ų]			
Group A	Initial	69%			
	Medial	83%			
	Final	69%			
Group B	Initial	47%		46%	
	Medial	46%		12%	
	Final	20%		0%	
Group C	Initial	72%		51%	
	Medial	80%		42%	
	Final	67%		5%	
Group D	Initial	75%		68%	
	Medial	52%		57%	
	Final	50%		21%	
Group E	Initial	100%		81%	
	Medial	100%		67%	
	Final	100%		50%	

Table 2. Acquisition of \Ų

The study looked at the acquisition of the entire consonant systems of both Welsh and English, but in the following tables we give data on the lateral fricative of Welsh only. Table 2 gives the percentage use of the target [\Ų] form in word initial, word medial, and word final positions for the different age groups and two language dominance divisions, while Table 3

lists the number and type of variants used. It is clear from this table that the amount of variability, as well as the rate of acquisition, differs between the two dominance groupings, but that this variability does generally decrease over time.

	Welsh dominant	English dominant
Group A	O, s, F, T, x, k, l, sl, kl (9)	
Group B	O, s, T, x, l, sl, xl, kl, tl (9)	O, s, T, f, v, x, ç, k, g, l, h, sl, Tl, xl, tl, Ok (16)
Group C	O, T, x, l, xl, çl, kl, kO (8)	O, s, F, T, f, S, x, k, l, sl, fl, Tl, xl (13)
Group D	O, s, T, x, k, sl, Tl, xl (8)	O, s, F, T, D, v, Sj, x, t, l, @, h, sl, Tl, xl, kl, st (17)
Group E	O (1)	O, T, x, fl, xl (5)

Table 3. Realizations of target /O/

To examine the substitution patterns more closely, the variants were assigned to six categories: LL - [O], F - any fricative except velar, X - the voiceless velar fricative [x], FL - fricative plus lateral clusters (except velar), XL - velar fricative plus lateral clusters, O - others. The velars were separated from other fricatives, because they occurred often for some speaker groupings and, from an articulatory viewpoint, they seem unexpected substitutions. The results are given in Tables 4 and 5.

		LL	F	X	FL	XL	O
A	I	33	12	2	0	0	1
	M	10	1	0	0	0	0
	F	11	3	0	1	0	1
B	I	26	19	0	6	0	4
	M	11	6	4	2	1	0
	F	4	14	0	2	0	0
C	I	48	0	0	15	1	3
	M	20	0	0	4	1	0
	F	18	2	0	7	0	0
D	I	44	9	0	6	0	0
	M	12	3	5	1	2	0
	F	10	6	0	2	0	2
E	I	35	0	0	0	0	0
	M	10	0	0	0	0	0
	F	14	0	0	0	0	0

Table 4. Variant Usage. Welsh Dominant Subjects

		LL	F	X	FL	XL	O
B	I	16	12	1	2	0	4
	M	2	3	1	4	2	4
	F	0	3	0	7	0	2
C	I	20	7	4	1	2	5
	M	5	1	2	0	2	2
	F	1	6	0	2	0	9
D	I	50	4	1	6	5	7
	M	12	1	1	3	3	1
	F	6	9	0	6	0	8
E	I	34	0	2	4	2	0
	M	10	0	0	1	4	0
	F	7	2	0	5	0	0

Table 5. Variant Usage. English Dominant Subjects

3. VARIANT USAGE AND LANGUAGE DOMINANCE

3.1 English dominant subjects

In word initial position, English dominant subjects in Groups B and C use of [O] is about the 50% level, though this improves considerably in Groups D and E two-thirds and four-fifths respectively. The most commonly occurring category of substitution is the fricative group, and it is interesting to note that the velar fricative increases its portion of the fricative category throughout the age range, such that only velar fricatives are found here in Group E. Fricative plus lateral clusters increase somewhat with Groups C and D, and are on a par with fricatives in Group E. Again, the use of the velar fricative increases in fricative plus lateral clusters, at least through the first three age groups. The 'other' category with these subjects consists mainly of stops (interestingly, the most common stops are [k] and [g]), [l], and clusters such as [kl].

The overall trend in initial position is a gradual increase of target [O]; and with substitutions, a gradual move away from front fricatives towards the velar fricative, either singly or in a cluster with [l] (the clusters gradually becoming as common as single fricatives).

In word medial position numbers of potential \O\ targets were much fewer than in initial position (reflecting to some extent the patterns of frequency in the adult phonology). Correct use of the target increases from a very low point in Group B to just under and just over 50% in Groups C and D respectively to about two-thirds in Group E.

Substitutions are split more or less evenly between fricatives and fricative plus lateral. As with initial position, the numbers of velars found in these categories increase across the age groups, such that with Group E only velars are found in fricative and fricative plus lateral substitutions. The 'other' category reduces across the age ranges, and is absent in Group E. Typical realisations for this category include [k], [g] and [l] as singletons, and [tl], [kl] and [Ok] as clusters.

The trend in word medial position across the age ranges was a gradual increase in target pronunciations coupled with a move towards velar or velar plus lateral substitutions. These substitutions accounted for half the realisations by Group E.

Word final patterns are characterised by a generally low target usage, higher use of the 'other' category than elsewhere in the word, and total absence of fricative plus lateral clusters. Use of [O] is absent in Group B, negligible in Group C, reaches to just over a fifth in Group D and a half in Group E.

Substitutions are predominantly in the fricative category (with velar fricatives common for all but Group C). Interestingly, the 'other' category, strong for both Groups C and D, is predominantly [l] (though [k], [t], [O] and [st] also appear). It could be that [l] is the positional variant of fricative plus lateral in word final position for these speakers.

The trend in word final position, therefore, is a very gradual increase in target pronunciations, with velar fricatives as the main alternative together with a certain amount of use of the non-fricative lateral.

3.2 Welsh dominant subjects

With the Welsh-dominant subjects, Group A shows over two-thirds use of target [O] in word-initial position, though this drops to just under half for Group B, climbing again to around three-quarters for both Groups C and D, and 100% for Group E. The dominant substitution patterns in Groups A to D involve the use of fricatives (fricative plus lateral is virtually absent for these subjects). The usual fricatives used by Group A are [F] and [s]; in Group B [s] is the normal fricative though use of [x] is also found. In Group C [x] is the only fricative found, though in contrast to the English dominant subjects, [x] usage recedes with Group D (where [s] and [T] are also found). The 'other' category includes a few examples of [l], and clusters like [tl], [kl] and [kO].

Overall, the developmental pattern with these subjects differs from the English dominant speakers through the overall higher use of the target form, the lack of the fricative plus lateral substitution category, and the earlier ‘peaking’ of velar substitutions.

In word medial usage there is again no smooth progression in the acquisition of [Ō]. Group A speakers use the target form over 80% of the time, but this drops to under half in Group B; goes back up to 80% in Group C, but dips back to just over half for Group D, before reaching 100% with Group E. It is difficult to say whether this pattern is due to subject numbers, the tendency for variability after initial success referred to for example in [6, 7], or whether it is linked to the rise and then fall of velar forms that we refer to below.

Unlike word initial and word final position, these subjects do make use of the fricative plus lateral as well as the fricative category in their substitutions, although it only occurs in Groups B, C and D. [s] is the usual fricative substitution in Groups A and B, [x] only is found in Group C, but [T] is the usual fricative for Group D. As well as [xl], [sl] and [Tl] are the common fricative plus lateral substitutions. The overall trend for this word position would appear to show an increase in velar usage up to the middle age range, followed by its decrease, and competing fricative and fricative plus lateral strategies. However, we must stress that the number of tokens in this word position is not large, and so we cannot be as confident in our conclusions as we were for word initial position.

As with the previous two word positions, in word final position there is a decrease in target pronunciations between Group A, with over two-thirds use of [Ō], and Group B with only a fifth. This rises in Group C to two-thirds once more, with Group D at 50%, and Group E 100%. The reasons mooted above for this pattern can be applied here as well.

Substitutions in word final position are similar to the English dominant speakers in that the fricative plus lateral category is not made use of, but differ in that the ‘other’ category is virtually absent in the Welsh dominant subjects. This means that nearly all substitutions are of fricatives: and again, we see an increase in velar fricatives up to Group C, after which they are less important. The fricatives [s] and [T] are the dominant substitutions in Groups A, B and D, while [x] is dominant in Group C. Overall, then, this word position shows movement between target lateral fricative, and fricative substitutions, with the velar fricative ‘peaking’ in the middle age grouping.

4. DISCUSSION

We do not intend to consider the differences between the Welsh and English dominant subjects in any detail in this section. The fact that the Welsh dominant subjects achieved higher rates of target pronunciations sooner than the English dominant is predictable, and the differential substitution patterns have been discussed in detail above. We have also noted the overall number of different realisations found with each subject group, and how this number alters across the age ranges.

More interesting, however, are the possible motivations for the choice of substitution categories. In particular, we will examine the choice between a fricative and a fricative plus lateral, and that between a front fricative and a velar. At first sight, it might appear that subjects who do not have consistent control over a lateral fricative realization of target /Ō/ are resorting to a variety of articulatorily related alternatives. So, we could claim that by producing [s] or [T] (the two commonest front fricative substitutions), subjects are reproducing the fricative part of /Ō/ at more or less the correct place of articulation. Further, when they produce fricative plus

lateral combinations, they are demonstrating a deconstruction of the target /Ō/ into its fricative and lateral components; and, again, we could argue that this is a strategy to simplify the target articulation.

However, this does not seem to account for the common usage of [x] and [xl] which, for the English dominant subjects at least, seems to increase over the age ranges. It appears to us that an alternative, acoustic, explanation accounts for the developmental patterns more convincingly than an ease of articulation proposal. We would argue that the children are attempting to produce a target form that has both friction (with noise in a particular frequency range), and a clearly defined formant pattern. Early attempts to reproduce this concentrate on the noise component, whereas later attempts try to marry the noise component with formants. To examine this idea in more detail, we need to look at the acoustic structure of Welsh fricatives.

Ball and Williams [2] report on the acoustic characteristics of fricatives in the southern variety of Welsh, and we reproduce the relevant data in Table 6.

	lowest frequency	energy peaks / formants	highest frequency
[s]	3500	random, over 1000 apart	8000+
[x]	1367	3634, 5900	7334
[Ō]	5567	234, 1500, 2400	7334

Table 6. Fricative spectra in Hz.

What Table 6 makes clear is that there is considerable similarity between the acoustic make-up of /x/ and /Ō/. Figure 1 clearly demonstrates that /x/ has formant-like peaks of energy (not found with /s/, which has random peaks of energy across the noise spectrum), similar to the formant-like structures found with /Ō/. (Ball and Williams [2], note that the formants of /Ō/ are very similar to those found with /l/). Furthermore, while the noise spectrum of /x/ is much more diffuse than that of /Ō/, the two sounds have the same top limit (just over 7000 Hz), and the bottom limit of the noise spectrum for /Ō/ coincides with the top formant-like energy peak of /x/, and the lower limit of the noise spectrum of /x/ is close to the middle formant of /Ō/. On the other hand, /s/ has a higher upper limit for its noise spectrum, has no clear formant-like energy peaks, and the lower limit of its noise spectrum does not coincide with any prominent acoustic event for /Ō/.

The three fricatives /s/, /T/ and /x/ are all part of the phonological system of Welsh consonants. It is not surprising, therefore, that [s] as a default fricative and [T] as its articulatory neighbour, are early substitutions for /Ō/. However, speakers soon move towards [x] (which, unlike the velar stops, is virtually completely acquired in age-range A by both Welsh dominant and English dominant subjects), and we claim this is for acoustic reasons, in that [x] is perceptually closer to [Ō] than are the other fricatives.

An alternative strategy to produce a fricative with formant-like structure is to deconstruct the target into its component acoustic parts. So we see the use of fricative plus lateral, giving us a noise component and accurate formant values (as noted above, /l/ has similar formant structure to /Ō/). Many of the subject groupings, however, show a move to [xl] as the favoured fricative plus lateral combination and, again, we would argue as we did above that this is for acoustic reasons. Fricative plus lateral combinations do not occur frequently with the Welsh dominant speakers; and these speakers also move away from singleton velar usage. We argue that this is because their ability to produce target [Ō] is

stronger, and occurs earlier than that of the English dominant subjects. Therefore, they do not need to develop the cluster strategy, and do not need to maintain the velar strategy beyond about age 4;0.

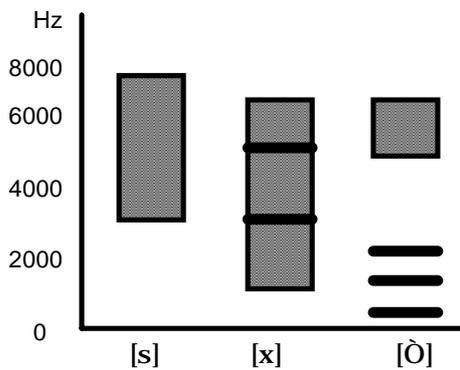


Figure 1. Acoustic Characteristics of [s], [x] and [Ø]

5. CONCLUSION

In this study we have attempted to demonstrate that much of the apparent widescale variability in the acquisition of the Welsh lateral fricative can be accounted for if we examine the acoustic characteristics of the variants concerned. Differences in rate of acquisition and amount of variability is clearly linked to the dominant language of the subjects, but the use of velar and velar plus lateral substitutions appears to derive from their acoustic similarity with the target lateral fricative.

These results clearly suggest that perception rather than production is the dominant feature in the acquisition of the Welsh lateral fricative: it will be illuminating to see whether similar patterns are found in other languages with lateral fricatives.

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