# VOWEL DURATION IN SCOTTISH ENGLISH SPEAKING CHILDREN

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**ABSTRACT**

In most English accents vowel length is approximately 50% greater before a voiced consonant than before its voiceless cognate (the 'Voicing Effect'). In Scottish English it is conditioned by the 'Scottish Vowel Length Rule'. The lengthening environments of this rule overlap with those of the Voicing Effect. The phonetic details of the Scottish Vowel Length Rule and its relationship with the Voicing Effect are uncertain. Its influence on the speech of younger speakers is also not known. In this study, tokens of /i/ and /ʉ/ were measured in minimal pairs produced by seven Scottish English speaking children aged 6-9 years. Some pairs tested for a Voicing Effect, others for a Scottish Vowel Length effect. Results suggested a robust Scottish Vowel Length pattern for four of the subjects, with a minimal Voicing Effect. However, in children with two non-Scottish English speaking parents this pattern was either absent or less definite.

## 1. INTRODUCTION

### 1.1. The Voicing Effect

It is very well established in American English that a vowel tends to be longer before a voiced consonant than before a voiceless consonant [1,2]. In the results reported by Naeser [2], for eight adult speakers, vowels before voiced consonants were on average 46% longer than those before voiceless consonants. We will refer to this as the Voicing Effect (VE) and we quote it in terms of the percentage increase in vowel length preceding a voiced consonant as compared with a (corresponding) voiceless consonant.

Other aspects of a post-vocalic consonant also influence vowel length. Thus vowels before fricatives tend to be longer than vowels before stops. However, the *relative* increase due to voicing status would appear to be approximately similar for fricative contexts and stop contexts. Thus in Naeser's data the VE is 44% for vowels before stops and 47% for vowels before fricatives.

Lehman and Sharf's [3] measurements of vowel length in bead and beet, spoken by groups of 5 year olds, 8 year olds, 10 year olds and adults, show decreasing absolute vowel lengths with age in the three child groups and also a decrease in percentage VE. VE, calculated from their figures, was 71% for the 8 year old group, compared with a very large 175% for the 5 year olds on the one hand, and 55% for the 10 year olds and 64% for the adults, on the other.

Observation suggests that VE is similarly strong in many other accents of English, including accents of southern England [4]. Whether or to what extent it operates in northern accents, in particular in Scotland, is a matter of some contention and forms part of the topic of this paper.

### 1.2 The Scottish Vowel Length Rule

The Scottish Vowel Length Rule (SVLR) states that vowels (or some vowels) are long in open syllables and before voiced fricatives, /r/ and a morpheme boundary, and short elsewhere [5, 6]. The existence of such durational differences as that, for example, between bruise (long) and Bruce (short) is widely agreed — but their extent, the phonetics of their implementation and their similarity or otherwise to VE in other accents of English are matters of debate [7, 8].

Some aspects of morphologically-conditioned vowel duration in a corpus of Glasgow speech, including its phonetic characteristics, are discussed by Scobbie, Turk and Hewlett [9]. The present paper considers length conditioned by the phonological voicing status of a post-vocalic alveolar fricative in comparison with a post-vocalic alveolar stop.

### 1.3 Relationship between SVLR and VE

What is the relationship in Scottish English between SVLR and VE? The consonants which condition vowel lengthening under SVLR (voiced fricatives and /r/) form a subset of the consonants which condition lengthening under VE. So Bruce/bruise, to repeat the example above, would have a length distinction in all accents of English. To assert, for example, that /ʉ/ is significantly long in bruise as compared with Bruce (cf. brood as compared with brute) is to imply either that the vowel of bruise is extra-long (as a result of VE plus SVLR) or that VE is minimal or absent in Scottish English (rendering brood and brute of similar length). It may be, of course, that some combination of both these effects is at work, *minimizing* the effect of stop voicing as a conditioning factor for vowel duration while *maximizing* the difference conditioned by voiced and voiceless fricatives.

While Agutter [7] argues in effect that Scottish English operates with VE only, McMahon [8] asserts, on the basis of a reanalysis of Agutter's data, that Scottish English operates with a similar VE to that of southern accents of British English, while having SVLR operating additionally by conferring extra lengthening in the relevant environments. We have elsewhere [10] recorded our opinion that McKenna's unpublished data [11] are probably the most reliable among previous instrumental studies. This study was of monophthongs in the speech of four adult speakers. McKenna found that distinctively Scottish arrangements for vowel length were clear and consistent for the vowels /i/ and /ʉ/, but not for the others. /i/ and /ʉ/ lengthened significantly before a voiced fricative (SVLR environment) but negligibly if at all before a voiced stop. Scobbie et al [9], although pursuing a rather different goal, report results in a study of 32 Glasgow speakers which further support

McKenna's findings.

**1.4 Do Scottish children have SVLR and/or VE?**

The incidence of SVLR in the speech of children, who have recently acquired their local accent, should provide a good indicator of its current status and salience. Scottish English is naturally undergoing historical change, some of it influenced by wider exposure to other accents of English. SVLR is essentially an allophonic rule (all the patterns investigated in this experiment are phonologically predictable) of a typologically marked kind for English. Furthermore the precise phonetic characteristics of the rule cannot be obvious or they would not have been so much debated. If it does indeed operate in conjunction with a VE, then its functional (perceptual) role in distinguishing among different lexical items is probably small. The combination of these factors might be thought to make its survival into the next generation of Scottish English speakers a matter of descriptive and theoretical interest.

The experimental data described and analysed below (part of a larger data set from the same subjects) were designed to address the question of whether, and if so in what way, SVLR operates in the speech of Scottish English speaking primary school age children. We wished to discover :

1. whether or to what extent VE operates in Scottish children's speech;
2. whether, and if so to what extent, SVLR operates;
3. whether there are any differences according to parental accent.

## 2. METHOD

**2.1. Subjects**

Seven children (five boys and two girls), aged 6-9 years (mean age = 8;5 years) acted as informants. All lived in the same district of Edinburgh and all had lived in Edinburgh all their lives and attended local state primary schools. All were judged to be acquiring the local accent of Scottish English.

Two of the children, LS and LB, had two Scottish English speaking parents; two, LM and CE, had one Scottish English speaking parent and one parent who spoke another accent of English (Northern English in the case of LM and southern Irish English in the case of CE). The remaining three had parents neither of whom spoke Scottish English. One of CH's parents spoke Anglo English, the other Southern Irish English. Both parents of FC and RC (who were siblings) spoke Southern Irish English. Five of the children, LS, LB, LM, CE and CH, lived in the same group of houses and associated on a daily basis.

**2.2. Data collection**

The experimental words are reproduced in Table 1. They consisted of four minimal pairs (or near-minimal in the case of please/fleece). Two pairs (one containing /i/, the other /ʉ/) differed by final /t/ versus /d/ and two pairs (again one with /i/, the other with /ʉ/) differed by final /s/ versus /z/. Note that in Scottish English foot/food is a minimal pair ([fʉt], [fʉd]), there being no ʉ/ʊ (i.e. u/ʊ) distinction in Scottish English.

The pairs in the stop environment (left hand pairs of Table 1) were designed to test for the influence of VE while the pairs in the fricative environment (right hand) pairs were designed to test for an SVLR effect.

| ***VE items*** | | ***SVLR items*** | |
|---|---|---|---|
| *voiceless C* | *voiced C* | *voiceless C* | *voiced C* |
| seat | seed | fleece | please |
| foot | food | loose | lose |

Table 1. The experimental items.

Tokens were elicited using pictures with the words written beneath. Five tokens of each item were collected giving a total of 60 tokens from each child. The experimenter who collected the data had an American English accent. Data collection sessions took place in a sound proofed studio and recordings were made on DAT tape.

**2.3 Analysis.**

Acoustic analysis was carried out using Kay CSL and Kay Multispeech software. Measurements were made of the duration of each vowel, from linked waveform and spectrographic displays on screen. Onset of the vowel was determined from the onset of the first formant; offset of the vowel was determined from the offset of the second formant. This meant that in the cases of the items please, fleece, lose, loose the interval measured included in fact the lateral consonant preceding the vowel. It is important to bear this mind when considering the absolute durational values, since for convenience we use 'vowel length' to refer to this interval in all the experimental items.

## 3. RESULTS

**3.1 Group results.**

| | *stop environment (VE)* | *fric. environment (SVLR)* |
|---|---|---|
| *Mean __ +voice* | 147ms | 294 ms |
| *Mean __ -voice* | 120ms | 198ms |
| *Difference* | +27ms | +96ms |
| *Significance* | t=2.05, df=74, p<0.05 | t=4.57, df=64 p<0.0001 |
| *% effect* | 23% | 48% |

Table 2. Mean length of /i/ in the VE environment (preceding a stop) and the SVLR environment (preceding a fricative).

| | *stop environment (VE)* | *fric. environment (SVLR)* |
|---|---|---|
| *Mean __ +voice* | 155ms | 401ms |
| *Mean __ -voice* | 116ms | 223ms |
| *Difference* | +38ms | +178ms |
| *Significance* | t=2.81, df=75, p<0.01 | t=5.46, df=51 p<0.00001 |
| *% effect* | 33% | 80% |

Table 3. Mean length of /ʉ/ in the VE environment (preceding a stop) and the SVLR environment (preceding a fricative).

Table 2 shows mean durations for /i/ for all subjects in the two different environments,[1] together with the difference, in milliseconds, between the voiced and voiceless consonant

environment, the statistical significance (t-test) and the mean
percentage increase due to VE and SVLR, respectively.
Table 3 shows the same information for /ʉ/.

The results presented in Tables 1 and 2 suggest that a following voiced consonant induces lengthening in a previous vowel in both cases, that is where the consonant is a stop and where the consonant is a fricative. However, it is also noticeable that the percentage increase is considerably larger in the fricative environment than in the stop environment. This difference provides some evidence, then, in support of a claim that the effect of the voiced fricative is different from the effect of the voiced stop and that therefore an SVLR effect is present in addition to VE.

However, as the standard deviations in Tables 1 and 2 show, there was large variability in the vowel lengths measured. We now turn to a comparison of individual subject performances.

### 3.2 Individual subjects.

Figures 1 and 2 show the vowel durations of /i/ and /ʉ/, respectively, for each subject. Squares represent the fricative context (following /z/ versus following /s/) and triangles the stop context (following /d/ versus following /t/). As the graphs illustrate, four subjects (LS, LB, LM and CE), at least, show little lengthening before the voiced as compared with the voiceless stop (with perhaps the exception of LB's /i/ productions). All the subjects showed considerably longer vowels before voiced fricatives than before voiceless; this would be expected of course, since this is in fact a VE environment as well as a SVLR environment. To support a conclusion that SVLR exists in the speech of (any of) these children we need to demonstrate greater lengthening in the fricative than in the stop environment. We examine this point on a subject by subject basis below.

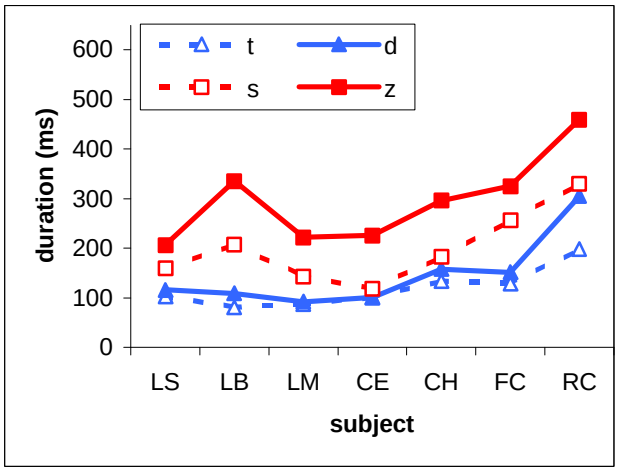


Figure 1. Duration of /i/

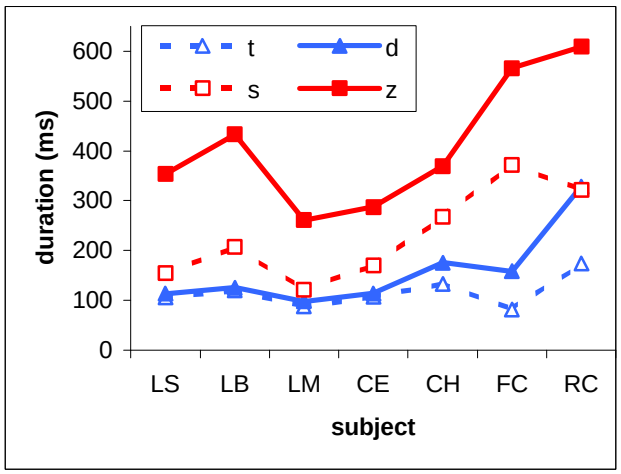


Figure 2. Duration of /ʉ/

**3.2.1. Percentage lengthening in the two contexts.** Table 4 shows the percentage increase in vowel length (combining data for both vowels) in the two contexts. For subjects LS, LB, LM, and CE there was a large SVLR effect (62-77%) but little VE effect (3-16%). The remaining three subjects, CH, FC and RC, showed a much larger VE effect (24-70%) and the tendency to a lower SVLR effect (48-64%); in the case of FC and RC percentage lengthening was greater in the VE environment than in the SVLR environment.

| *Subject* | *stop context (VE)* | *fricative context (SVLR)* |
|---|---|---|
| LS | 10% | 62% |
| LB | 16% | 85% |
| LM | 8% | 82% |
| CE | 3% | 77% |
| **CH** | **24%** | **48%** |
| **FC** | **47%** | **40%** |
| **RC** | **70%** | **64%** |

Table 4. VE and SVLR effect in each subject's productions. Those subjects with a more pronounced VE associated with a more modest SVLR effect are highlighted.

**3.2.2. Influence of parental accent.** CH, FC and RC were those subjects neither of whose parents were Scottish English speakers. There was a difference, then, between on the one hand the children from households in which either both parents or one parent spoke Scottish English and on the other those children from households in which neither parent was a Scottish English speaker. Thus for the former group the values for relative lengthening before a fricative were greater by at least 52 percentage points than those for relative lengthening before a stop. In the latter group, the difference was actually reversed for two of the subjects (FC and RC), who could therefore be said to show a strong VE with little if any apparent influence from SVLR. CH showed an intermediate pattern. While this child exhibited a modest VE, the relative difference in vowel length was considerably greater (by 24 percentage points) in the SVLR

environment.

## 4. DISCUSSION

### 4.1 SVLR and VE

From these results one can conclude that SVLR continues to operate and is firmly established in the speech of children who have a family background of Scottish English. So far as the phonetics of its implementation are concerned, it is clear that lengthening due to SVLR does not have to operate on top (so to speak) of lengthening due to VE, because, as these results confirm, VE operates to only a minimal degree in the high vowels of Scottish English. Our results therefore contradict both Agutter and McMahon, in finding, *contra* Agutter, differential lengthening in SVLR and VE environments and, *contra* both, only very modest lengthening in the VE environment.

SVLR, then, over the sort of data considered here, appears to have the character of a strong voicing effect which operates on the vowels /i/ and /ʉ/ in a more restricted set of phonetic contexts than in most other accents of English.

### 4.2 Influence of parental accent.

The conclusions of 4.1, above, only apply (or only entirely apply) to four of the subjects, LS, LB, LM and CE, these being the subjects with at least one Scottish English speaking parent. The results suggest no difference between those subjects with one and those subjects with two, Scottish English speaking parents.

The remaining three subjects, CH, FC and RC, were judged to speak with a Scottish English accent but their detailed phonetic implementation was 'less Scottish' in showing an influence from accents containing a strong VE and no SVLR. The pattern of results for FC and RC, in fact, conformed well to this latter pattern; their vowels lengthened considerably before voiced as compared with voiceless stops and the percentage lengthening was no greater in the fricative environment than in the stop environment. However, comparing the results for /i/ and /ʉ/ for these two subjects reveals that perhaps in retrospect foot/food was ill-chosen as a test pair. The VE for /ʉ/ was 93% and 89% for FC and RC respectively, compared with 18% and 54% respectively for /i/. It is possible that the influence of VE was compounded in the case of foot/food by the existence of the u/ʊ vowel distinction in the parents' speech (/u/ is intrinsically longer than /ʊ/). But this too of course would testify to competing influences being at work on the children's production patterns.

The remaining subject in this group, CH, is an intermediate case. Similar cases of intermediate values between two alternative phonetic targets is attested in the area of L2 learning. Flege [12] reports that native Spanish speakers who were late learners of English exhibited voice onset times for English plosives which were intermediate between normal Spanish and normal English values.

CH's case suggests that something similar may happen in the case of first language acquisition where there is significant exposure to two accents: phonetic implementation, it seems, does not necessarily require an all or none choice between two accents in that the phonetic system of a Scottish English speaker may fall midway on a continuum between the voicing effect familiar from other accents and the more specific Scottish system.

## 5. CONCLUSIONS

1. SVLR remains a robust feature of Scottish English in the speech of primary school age children.
2. VE operates minimally (if at all) on the vowels /i/ and /ʉ/ in Scottish English.
3. Significant exposure to both an SVLR and a non-SVLR accent may lead to 'compromise values' for these vowels in the relevant environments.


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### NOTES

1. No direct comparison can be made between stop and fricative environment because in the case of the fricative environment the /l/ of please and fleece was included in the "vowel length" measurement (cf. the remarks immediately above). Informally, judging from the values in these tables, the vowels before fricatives were longer than vowels before stops, in agreement with previous studies.

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