VOICE ONSET TIME AND THE SCOTTISH VOWEL LENGTH RULE IN ABERDEEN ENGLISH

Dominic Watt & Jillian Yurkova

Centre for Linguistic Research, University of Aberdeen
d.watt@abdn.ac.uk r02jhy6@abdn.ac.uk

ABSTRACT

Voice Onset Time (VOT) was measured in word-initial /p t k b d g/ produced by 9 speakers of Aberdeen English (AE). The durations of /i e ɛ a ɔ o u/ and /ai/ were also measured to assess the extent to which the Scottish Vowel Length Rule (SVLR) [2] operates in the Aberdeen vowel system.

Keywords: VOT, Scottish English, vowel duration.

1. INTRODUCTION

Aberdeen English (AE) is a highly phonologically distinct variety which has hitherto received little attention in the literature on Scottish English (ScE). Existing descriptions of AE phonology lack detail or are based on very small samples [10, 13], are focussed on traditional dialects of rural north-east Scotland rather than AE itself [6, 8, 18], and/or are somewhat dated (e.g. [11, 17]). To our knowledge no quantitative or instrumental data on the phonetics of AE have previously been published. The current data come from a corpus of urban ScE (Aberdeen, Dundee, Edinburgh, Glasgow) gathered principally for forensic phonetic purposes.[i] We discuss here some initial descriptive statistics on durational properties of consonants and vowels in AE, focussing on VOT in stops and the extent to which SVLR operates in the variety.

The variables examined in this paper are well-described phenomena in the research literature on the phonetics of spoken English ([5, 7, 12] for VOT; [1, 13, 14, 19] for SVLR). For VOT the published results have typically related to standard varieties (General American English and British Received Pronunciation) while most previous studies of SVLR focussed almost exclusively on Scottish Standard English (SSE) and the accents of Glasgow and Edinburgh, although recent work on VOT and SVLR in Orkney and Shetland speech is a departure from this pattern [19, 20].

It is clearly crucial for forensic applications of phonetics that analysts have at their disposal as much detailed information about the acoustic properties of social and geographical varieties of a language as possible. Given that what holds in a reference accent such as Received Pronunciation will not necessarily apply to a non-standard accent even within the United Kingdom, there is a pressing need for further population statistics relating to sociophonetic variation to be gathered.

Our specific aims for this study were, first, to establish the VOT ranges for /p t k/, all of which, according to Catford [3], are typically unaspirated in Scottish and northern English English. If so, this might imply regular pre-voicing of /b d g/ so as to preserve the voicing contrast. The second aim was to assess the extent to which SVLR is operative in AE, as the very limited information on the topic in the existing literature is ambiguous or contradictory. We attempt here to provide some clarification of these issues.

2. VOICE ONSET TIME

2.1. Methods

VOT values for the stop series /p t k b d g/ were measured in milliseconds for each of 9 adult speakers (5 males, 4 females, age range 21-62).

Speakers read aloud (twice, in different orders) a word list containing 192 common words chosen to exemplify not just VOT differences and SVLR alternations, but also a wide range of other phonological features. Note that owing to a lack of examples of word-initial /g/ in the word list, 6 VOT values per subject were instead extracted from stressed /g/-initial content words (*got*, *goose('s)*, *gave*, *goat*) in subjects' recordings of a reading passage collected at the same time [9].

Each speaker provided at least 79 stop tokens, although the composition of the word list (specifically, the fact that it was not designed exclusively to elicit word-initial plosives) meant that the majority of each speaker's sample was

accounted for by tokens of /p t k/ (average sample 98 tokens, versus 13 tokens on average for /b d g/). Misreadings by speakers, and occasionally difficulties in identifying release bursts in spectrograms, accounted for variations in sample size from individual to individual. Approximately 900 VOT values were recorded in total.

Measurements were made by hand from time-aligned speech waveforms and wideband spectrograms using Sensimetrics *SpeechStation* 2 v.1.1.2 and *WaveSurfer* v.1.8.5.

2.2. VOT results

2.2.1 /p t k/

Figure 1 shows that average VOT values for all 9 speakers' /p t k/ productions fall into the long-lag range. Impressionistically, too, the majority of tokens are strongly aspirated.

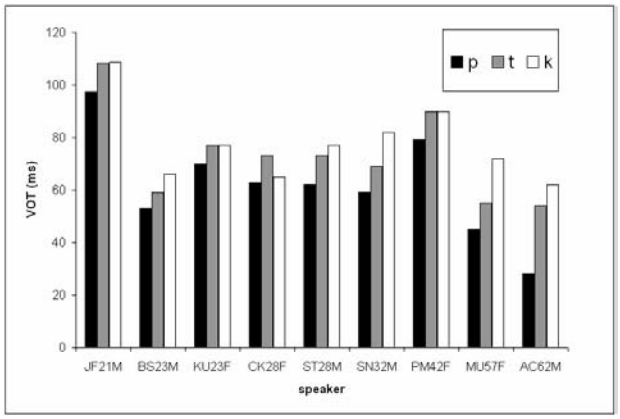

Figure 1: VOT values (ms) for word-initial /p t k/ in wordlist readings by 9 AE speakers, in ascending order of age (L to R). Subject identifiers are initials, age, then gender.

Predictably, the mean values conceal a high level of variation even within individual speakers' samples, but there is nonetheless substantial agreement in the average VOT values from speaker to speaker. The /p/ < /t/ < /k/ place of articulation effect described in previous studies [5, 7, 12] is clearly in evidence for 5 of the 9 speakers. For 3 the average VOT of /t/ and /k/ is approximately equal; but for one speaker (CK28F) average VOT for /t/ exceeds that for /k/. The VOT for /p/ across the subject group as a whole is inversely correlated with speaker age, in that older speakers in this sample show a tendency to have shorter VOT for this plosive than younger ones (r = -0.686; df = 7; $p < .05$).

2.2.2 /b d g/

The average VOT values shown in Figure 2 indicate that /b/ and /d/ are frequently pre-voiced in AE. This is especially true for the oldest subject, AC62M, who it will be recalled also had the shortest average VOT values for /p t k/. This may be the outcome of a need on the part of this speaker to maintain contrast between the voiced and voiceless series in a reading task of this type, especially as many of his /p/ tokens have VOT values in the range associated with his (and other speakers') /b/.

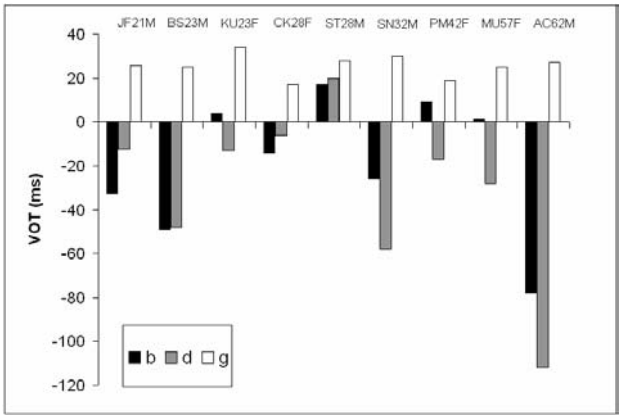

Figure 2: VOT values (ms) for word-initial /b d g/ in wordlist readings by 9 AE speakers, in ascending order of age (L to R).

Average VOT values for /g/ are positive across the board, and fall within a fairly narrow range for all 9 subjects, although it should be remembered that all /g/ tokens are drawn from text passage readings rather than word list readings. It is possible that VOT values for this consonant might be somewhat different in /g/-initial words read in isolation.

The place of articulation effect mentioned in §2.2.1, which we might expect to result in /b/ having the largest negative (or smallest positive) value, followed by /d/, is not consistently found in the sample; only 4 of the 9 subjects exhibit this pattern. For all but one subject, /d/ is on average pre-voiced, and for 5 subjects the VOT for /d/ has the largest negative value of all three plosives.

As in Scobbie's Shetland data [19] we find a correlation between the average VOT values for /p/ and /b/ such that speakers having longer VOT for /p/ tend to have shorter pre-voicing in /b/ (r = 0.754; df = 7; $p < .05$). A similar effect is observed for /t/ and /d/, though this does not achieve significance at the 5% level.

3. SCOTTISH VOWEL LENGTH RULE

SVLR is a vowel duration-conditioning effect similar to the Voicing Effect (VE) [4]. The VE (or pre-fortis clipping), results in vowels having somewhat longer durations where they precede voiced consonants as compared to voiceless ones. SVLR, on the other hand, affects those vowels participating in the alternation such that they are long preceding the voiced fricatives /v ð z ʒ/, /r/, and in open syllables. Elsewhere, they are short. Vowel length is thus generally predictable if one knows the voicing *and* the manner of articulation of a following consonant. Moreover, a tautosyllabic morpheme boundary also predicts a long vowel: thus *crude* has short /u/, but *crewed* has long /u/ (see further [15] on difficulties created by this phenomenon for various theoretical phonological accounts).

Recent descriptions of SVLR (see [19]) in SSE demonstrate, furthermore, that it most markedly and consistently applies to /i u ai/.

Table 1: Target word-list items exemplifying /i e ɛ a ɔ o u ai/ in a range of SVLR-relevant contexts. Several contexts were exemplified by a variety of different words.

Vowel	__/t/	__/d/	__/s/	__/z/	__#	__#/d/
i	*feet*	*feed*	*lease*	*please*	*Lee*	*fee'd*
e	*mate*	*made*	*mace*	*maze*	*may*	*played*
ɛ	*pet*	*red*	*Tess*	*fez*	-	-
a	*pat*	*lad*	*lass*	*jazz*	*spa*	*baa'd*
ɔ	*cot*	*rod*	*Ross*	*because*	*paw*	*sawed*
o	*coat*	*road*	*close (adj.)*	*rose*	*whoa*	*rowed*
u	*coot*	*brood*	*Bruce*	*bruise*	*brew*	*brewed*
ai	*tight*	*ride*	*mice*	*rise*	*why*	*tied*

SVLR in AE was investigated in the present study by expressing as ratios the duration difference for /i e ɛ a ɔ o u/ and /ai/ preceding /t/, /d/, /s/, /z/, in open syllables, and before a morpheme boundary (see Table 1). In each case the ratio allows us to normalise and thus compare the relative durations of vowels preceding voiced and voiceless homorganic consonants sharing a manner of articulation.

The 192-item word list used was designed in part to elicit minimal and near-minimal pairs differing only in the voicing of their final consonant (e.g. *feet* vs. *feed*), and pairs of monomorphemic and bimorphemic quasi-homophones (e.g. *brood* vs. *brewed*). A selection of the 86 target forms for each of the 8 vowels tested are listed in Table 1.

The 9 subjects for this part of the study were with one exception the same individuals who provided the data discussed in §2. Vowel duration measurements were derived from the word list material using methods comparable to those used for gathering the VOT data. In cases where segmentation was difficult, e.g. in words containing vowel-adjacent [ɹ]), repeated auditory judgments were used to isolate the vocalic portion as accurately as possible.

3.1. SVLR results

The results for this part of the analysis are shown in Tables 2 (for the tautomorphemic pre-consonantal conditions) and 3 (for the comparison of the effect of a morpheme boundary in the __(#)/d/ condition). Note that ratios for /ɛ/ are missing from Table 3 owing to lexical gaps for this vowel in the open syllable and __#/d/ contexts.

Values greater than 1 demonstrate that the VE appears to apply almost categorically for all vowels for all speakers (exceptions are for /u/ and /o/ for JF21M and ST28M respectively). We assume that a ratio with a value *greater* than that of the VE for a particular vowel indicates that SVLR conditioning also affects that vowel. The SVLR results are, however, somewhat ambiguous. There is only one subject (PM43F) for whom the VE and SVLR appear consistently to condition vowel duration in tandem. The magnitude of the SVLR effect is approximately equal for each of this subject's vowels, however, with no indication that, as per existing descriptions of SSE, /i u ai/ are especially strongly affected. The latter point seems to be true of the sample as a whole – indeed, and perhaps unexpectedly, the vowel which appears to conform most consistently to VE and SVLR is /e/, while /ai/, of all 8 vowels, conforms least.

By contrast, the figures shown in Table 3 indicate the reverse pattern: across the sample, /e/ is least sensitive to vowel lengthening as a function of the presence of a morpheme boundary, while /ai/ (like /a/ and /ɔ/, contra [16]) is without exception longer in bimorphemic words than in monomorphemic ones. /u/ conforms to the expected pattern in all but one case. The figures for /i/ are more mixed, although it should be borne in mind that in many cases the ratios are very close to 1:1.

Table 2: Duration ratios for /i e ɛ a ɔ o u ai/ in ___[±voice] stop and __[±voice] fricative contexts. Speakers are ranked by age in ascending order. Shading indicates pairs of cases in which the expected SVLR length conditioning is not in evidence.

Sbjct.	Cntxt.	i	e	ɛ	a	ɔ	o	u	ai
JF21M	__stop	1.3	1.3	1.6	1.28	1.36	1.57	0.8	1.5
	__fric	2.58	1.34	1.71	1.33	1.39	1.28	1.62	1.7
KU23F	__stop	3.46	1.62	1.93	2.37	1.61	2.29	1.91	1.52
	__fric	2.84	1.7	1.52	1.31	1.1	2.42	2.06	1.49
ST28M	__stop	1.29	1.17	1.16	1.12	1.14	0.53	1.23	1.36
	__fric	1.25	1.27	1.57	1.76	1.48	1.06	1.6	1.18
CK28F	__stop	1.3	1.15	1.18	1.28	1.11	1.55	1.3	1.44
	__fric	2.06	1.46	1.42	1.39	1.21	1.09	1.66	1.3
SN32M	__stop	1.84	1.25	1.64	1.52	1.34	1.21	1.73	1.65
	__fric	1.68	1.3	1.41	1.43	1.62	1.06	1.46	1.43
PM42F	__stop	1.47	1.23	1.32	1.42	1.11	1.42	1.3	1.6
	__fric	1.61	1.52	1.51	1.52	1.52	1.57	1.93	1.91
JM56F	__stop	1.7	1.47	1.56	1.66	1.41	1.35	1.84	1.67
	__fric	2.34	1.53	1.37	1.53	1.59	1.1	1.88	1.84
MU57F	__stop	2.15	2.1	1.16	2.02	2.29	2.13	2.22	1.85
	__fric	2.69	1.75	1.54	1.78	1.64	2.52	0.73	1.71
AC62M	__stop	1.5	1.41	1.22	1.31	1.21	1.18	1.32	1.38
	__fric	1.36	1.53	1.48	1.42	1.51	1.19	1.71	1.45
mean	**_stop**	**1.78**	**1.41**	**1.42**	**1.55**	**1.4**	**1.47**	**1.52**	**1.55**
	_fric	**2.05**	**1.49**	**1.5**	**1.5**	**1.45**	**1.48**	**1.63**	**1.56**

Table 3: Duration ratios for /i e a ɔ o u ai/ in bimorphemic (__#/d/) contexts relative to monomorphemic (__/d/) contexts. Speakers are ranked by age in ascending order. Shading indicates cases in which the vowels of bimorphemic items have shorter durations than those of monomorphemic ones.

Subject	i	e	a	ɔ	o	u	ai
JF21M	1.15	0.56	1.32	1.13	1.11	1.66	1.12
KU23F	0.72	1.04	1.19	1.27	1.02	1.44	1.39
ST28M	1.44	0.78	1.52	1.22	1.14	1.38	1.09
CK28F	1.10	1.14	1.28	1.35	0.93	1.21	1.21
SN32M	0.97	1.05	1.33	1.24	1.07	1.11	1.02
PM42F	0.98	1.17	1.23	1.48	0.98	1.18	1.24
JM56F	1.11	0.98	1.46	1.36	1.08	1.06	1.04
MU57F	0.88	0.99	1.15	1.11	0.98	1.27	1.19
AC62M	1.08	0.87	1.34	1.30	1.28	0.91	1.21
mean	**1.05**	**0.95**	**1.31**	**1.27**	**1.07**	**1.25**	**1.17**

4. SUMMARY AND CONCLUSIONS

The results for both variables exhibit a great deal of intra- and interspeaker variability, and it is always possible that the use of averaged data can obscure patterns which may be linguistically meaningful. Nonetheless, there are strong indications that, at least in read speech, /p t k/ in AE have long-lag and /g/ short-lag VOT, and /b d/ are pre-voiced, a pattern Scobbie describes as 'linguistically highly-marked' [19]. It appears also that SVLR applies to certain vowels in AE – notably /e/ in monomorphemic forms and /a ɔ ai/ and probably /u/ in bimorphemic forms – but in a way quite unlike the system of alternations reported for other ScE and Shetlandic varieties. Larger samples of data will allow us to address these issues with greater clarity.

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