

ASPIRATED STOPS IN SCOTS GAELIC

Henry Rogers
University of Toronto

ABSTRACT

Aspiration is the primary difference between the lenis and fortis stops in Scots Gaelic: postaspiration initially, and preaspiration medially and finally. With faster speech, the postaspirated stops show general shortening, and the preaspirated stops are shortened in the voiceless duration preserving the perceptual salience of the aspiration. The details of the aspiration and the shortening are viewed as controlled, language-specific behaviour.

INTRODUCTION

Recent research [1, 2] has emphasised the role of non-automatic, allophonic phonetic activity. This paper presents data on pre- and postaspirated stops in Scots Gaelic at different rates of speech and argues this aspiration is an example of such controlled, subphonemic activity.

In Scots Gaelic [3] the fortis stops /p t k/ have postaspiration [p^h t^h k^h] in initial position, and preaspiration [p^h t^h k^h] medially and finally. In the dialects analysed here, preaspiration before /k/ is realised as a velar fricative. The term 'fortis' is used for the phonemes /p t k/ and 'lenis' for the phonemes /b d g/; 'voiceless' and 'voiced' refer to activities of the vocal folds. The lenis stops are typically voiceless in all environments.

Two speakers read the material, consisting of 120 one- and two-syllable words in a frame of *Can X a nis /kan X ə*

nif/ 'Say X now', four times at a normal speed, and then twice at a fast speed. Speaker RM is from Harris and FS from Lewis; both women have lived in Toronto for several years.

Preaspiration

Preaspirated stops have aspiration preceding the closure as opposed to postaspirated stops with aspiration following the release of the stop. This is a rather rare phenomenon in the world, reported primarily in Northern Europe (Icelandic, Sami, Scots Gaelic) and in North America (Fox, Hopi, and Malecite/Passamaquoddy) [4-6]. Most of the research on preaspiration has been on Icelandic [7-12] with less on Sami [13-16]. Relatively little work has been done on preaspiration in Scots Gaelic [17-19].

Measurements

Preaspiration (Preasp), Closure Duration (CD), Voiceless Duration (VlessD), and Voice Onset Time (VOT) were measured [20]. VlessD is the entire period of voicelessness including VOT. Figure 1 *tobhta /totə/* [t^ho^htə] 'walls of a house' shows both postaspiration and preaspiration. The waveform is shown with the individual portions labelled. The breathy voice which has been mentioned in some research [17, 19] was only sporadically present and where found has been considered part of the aspiration.

Figure 1. Waveform of *tobhta /totə/* [t^ho^htə] 'walls of a house'.

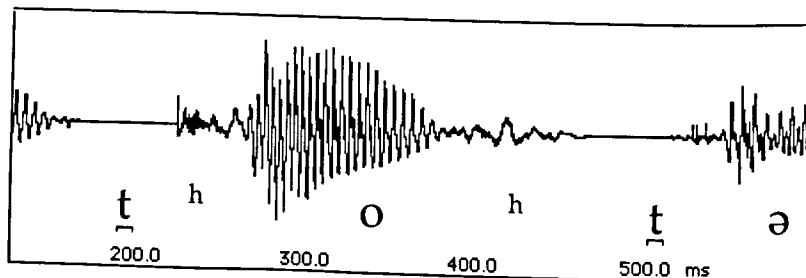


Table 1. Means of lenis and fortis stops in milliseconds. The means of all fortis-lenis pairs are significantly ($p < .05$) different except those in bold face; italics indicate pairs with a significant difference, but in the unexpected direction. In slow speech, FS paused at the end of the elicited word so that measuring the end of voicelessness was not possible.

| Slow | RM | | | | | FS | | | | |
|----------------|----|--------|-----------|--------|-----------|----|--------|------------|--------|------------|
| | N | Preasp | CD | VlessD | VOT | N | Preasp | CD | VlessD | VOT |
| <i>Initial</i> | | | | | | | | | | |
| lenis | 35 | | 202 | 172 | 27 | 54 | | 161 | 186 | 20 |
| fortis | 36 | | 142 | 191 | 77 | 65 | | 145 | 243 | 97 |
| <i>Medial</i> | | | | | | | | | | |
| lenis | 38 | | 114 | 117 | 47 | 41 | | 105 | 119 | 22 |
| fortis | 35 | 171 | 66 | 267 | 31 | 39 | 148 | 76 | 255 | 33 |
| <i>Final</i> | | | | | | | | | | |
| lenis | 75 | | 140 | 170 | 61 | 83 | | 133 | | |
| fortis | 25 | 181 | 81 | 349 | 73 | 36 | 220 | 90 | | |
| Fast | | | | | | | | | | |
| <i>Initial</i> | | | | | | | | | | |
| lenis | 45 | | 87 | 88 | 22 | 42 | | 77 | 95 | 17 |
| fortis | 39 | | 73 | 110 | 53 | 49 | | 89 | 162 | 75 |
| <i>Medial</i> | | | | | | | | | | |
| lenis | 17 | | 78 | 95 | 36 | 20 | | 86 | 97 | 2.2 |
| fortis | 11 | 94 | 66 | 189 | 28 | 20 | 102 | 65 | 187 | 2.6 |
| <i>Final</i> | | | | | | | | | | |
| lenis | 39 | | 86 | 96 | 33 | 38 | | 108 | 113 | 2.2 |
| fortis | 45 | 107 | 68 | 200 | 22 | 18 | 151 | 79 | 241 | 2.2 |

Gestures

In the postaspirated stops, the oral gesture begins before the laryngeal gesture begins and ends before the laryngeal gesture ends. With the preaspirated stops, the laryngeal gesture completely overlaps the oral gesture extending beyond it at both ends. From the acoustic data, the measurements are consistent with the hypothesis that, with aspirated stops, the peak of the glottal gesture is coordinated with the end of the oral gesture [7]. The acoustic activity of the preaspirated stops suggests, however, that the peaks of the glottal and oral gestures cooccur, but that the glottal gesture is larger.

RESULTS

Lenis v. fortis

Table 1 compares the lenis and fortis stops. The lenis stops have a voiceless closure followed by a short period of aspiration. The fortis stops have a voiceless closure with longer aspiration, postaspiration initially and preaspiration elsewhere. As expected, the fortis stops

often have a longer closure duration than the lenis stops; in two cases, however, the difference is not significant, and in one, the fortis closure is longer. The lenis stops always have a significantly shorter voiceless duration than the fortis stops. The VOT is longer for the fortis stops in initial position, as we would expect; otherwise, it is erratic.

If slow and fast rates of speech are compared (Table 2), the lenis stops show a general shortening in all portions of the consonant, except for FS medial lenis VOT. The fortis stops show a similar general shortening in initial position; in medial and final position, however, the closure duration and VOT are not always significantly different, especially with RM.

DISCUSSION

Lenis Fortis

Aspiration is the feature which always serves to distinguish fortis and lenis stops: postaspiration initially, and preaspiration medially and finally. Closure duration is not a reliable cue in distinguishing the stops. The total amount of voicelessness

Table 2. Means of low and fast rates of speech in ms. The means of all slow-fast pairs are significant ($p < .05$) except for those in bold face. In slow speech, FS paused at the end of the elicited word so that measuring the end of voicelessness was not possible.

| Initial | RM | | | | FS | | | | | | |
|---------------|--------------|--------|-----|-----------|-----|-----------|--------|-----|-----------|-----|----|
| | N | Preasp | CD | VlessD | VOT | N | Preasp | CD | VlessD | VOT | |
| <i>lenis</i> | slow | 35 | | 202 | 172 | 27 | 54 | | 161 | 186 | 20 |
| | fast | 45 | | 87 | 88 | 22 | 42 | | 77 | 95 | 17 |
| <i>fortis</i> | slow | 36 | | 142 | 191 | 77 | 65 | | 145 | 243 | 97 |
| | fast | 39 | | 73 | 110 | 53 | 49 | | 89 | 162 | 75 |
| Medial | <i>lenis</i> | | | | | | | | | | |
| | slow | 38 | | 114 | 117 | 47 | 41 | | 105 | 119 | 22 |
| fast | 17 | | 78 | 95 | 36 | 20 | | 86 | 97 | 22 | |
| <i>fortis</i> | slow | 75 | 171 | 66 | 267 | 31 | 39 | 148 | 74 | 255 | 33 |
| | fast | 39 | 94 | 66 | 189 | 28 | 20 | 102 | 65 | 187 | 26 |
| Final | <i>lenis</i> | | | | | | | | | | |
| | slow | 75 | | 140 | 170 | 61 | 83 | | 133 | | |
| fast | 39 | | 86 | 96 | 33 | 38 | | 108 | 113 | 22 | |
| <i>fortis</i> | slow | 25 | 181 | 81 | 349 | 73 | 36 | 220 | 88 | | |
| | fast | 45 | 107 | 68 | 200 | 22 | 18 | 151 | 79 | 241 | 22 |

is distinctive; however, the aspiration, produced with an open vocal tract, is the most audible and perceptually the most salient part of this voiceless period. The unsystematic variation of VOT in noninitial position is not important since preaspiration serves to distinguish lenis and fortis stops in those positions.

Kingston & Diehl [2] have argued that postaspiration in English is a controlled allophonic aspect of production. Their arguments would apply equally well to Scots Gaelic. Further, the argument that preaspiration is also nonautomatic can be made even more strongly, given its rarity in the world.

Rate of speech

In faster speech, in contexts where there is no preaspiration, a general shortening occurs. With the preaspirated stops, all shortening tends to be in the VlessD. The relative stability of the CD at different rates of speech implies that the

major adjustments for rate of speech are made during the adjacent pre- and postaspirated periods.

To speak faster, something has to be shortened. This shortening is not necessarily done evenly in all parts of the utterance [18, 21]. In previous work, I have shown that languages use a variety of language-specific strategies to shorten elements in order to talk faster. In Mongolian [22-24], the VlessD for fortis stops remains steady at different rates of speech; in French [23], the VOT remains unchanged, but the voiceless portion of the closure is shortened; in Turkish (Rogers, 1994) the fortis stops show general shortening. Now, in Scots Gaelic, the stops without preaspiration show general shortening, but the preaspirated stops show a shorter voiceless duration.

These findings are consistent with the position of Docherty [1] and Kingston and Diehl [2] that considerable allophonic

variation must be accounted for in the grammar of the language, and not by recourse to automatic processes.

CONCLUSION

Aspiration has been shown to be the primary difference between the lenis and fortis stops: postaspiration in initial position, and preaspiration elsewhere. Both types of aspiration are produced by controlled activity at an allophonic level. With an increased rate of speech, a language-specific observation was made that stops with postaspiration show general shortening, and those with preaspiration are shortened in the voiceless duration.

REFERENCES

- [1] Docherty, Gerard, (1992), *The timing of voicing in British English obstruents*, Berlin, New York: Foris Publications.
- [2] Kingston, John and Randy Diehl, (1994), "Phonetic knowledge", vol. *Language*, pp. 419-54.
- [3] Rogers, Henry, (1972), "The initial mutations in modern Scots Gaelic", *Studia Celtica*, vol. 7, pp. 63-85.
- [4] Hurch, B., (1988), *Über Aspiration: Ein Kapitel aus der natürlichen Phonologie*, Tübingen: G. Narr.
- [5] Laver, John, (1994), *Principles of Phonetics*, Cambridge: Cambridge University Press.
- [6] Rogers, Henry, (1991), *Theoretical and Practical Phonetics*, Toronto: Copp Clark Pitman.
- [7] Löfqvist, Anders and Hirohide Yoshioka, (1981), "Laryngeal activity in Icelandic obstruent production", *Nordic Journal of Linguistics*, vol. 4, pp. 1-18.
- [8] Pétursson, Magnús, (1972), "La préaspiration en islandais moderne: Examen de sa réalisation phonétique chez deux sujets", *Studia Linguistica*, vol. 26, pp. 61-80.
- [9] Pétursson, Magnús, (1976), "Aspiration et activité glottale", *Phonetica*, vol. 33, pp. 169-98.
- [10] Pind Jürgen, (1994), "Constancy and normalization in the perception of voice offset time as a cue for preaspiration", *Acta Psychologica*, to appear.
- [11] Pind, Jürgen, (1994), "Perception of aspiration and preaspiration in Icelandic", draft.
- [12] Thráinsson, Höskuldur, (1978), "On the phonology of Icelandic preaspiration", *Nordic Journal of Linguistics*, vol. 1, pp. 33-54.
- [13] Engstrand, Olle, (1987), "Preaspiration and the voicing contrast in Lule Sami", *Phonetica*, vol. 44, pp. 103-116.
- [14] Kylstra, A.D., (1972), "Die Präaspiration im Westskandinavischen und im Lappischen", *Orbis*, vol. 21, pp. 367-82.
- [15] McRobbie, Zita, (1991), "Preaspiration in Skolt Sámi", *SFU Working Papers*, vol. 1, pp. 77-87.
- [16] McRobbie, Zita (1993), "The role of pre-aspiration duration in the voicing contrast in Skolt Sámi", *International Congress on Spoken Language*, Banff.
- [17] Chasaide, Ailbhe Ní, and Cathair Ó. Dochertaigh, "Some durational aspects of pre-aspiration," in *Topics in Linguistic Phonetics: In Honour of E.T. Uldall*, J.-A.W. Higgs and R. Thelwall, Editor. 1984, New University of Ulster: pp. 141-57.
- [18] Rogers, H., (1994), "Preaspiration in Scots Gaelic", *Proceedings of the 1994 Annual Conference of the Canadian Linguistic Association*, vol. 465-76.
- [19] Shuken, Cynthia, "[?], [h], and parametric phonetics," in *Topics in Linguistic Phonetics: In Honour of E.T. Uldall*, J.-A.W. Higgs and R. Thelwall, Eds, 1984, New University of Ulster: pp. 111-39.
- [20] Brown, W.S., Jr., R.J. Morris, and R. Weiss, (1993), "Comparative methods for measurement of VOT", *Journal of Phonetics*, vol. 21, pp. 329-336.
- [21] Löfqvist, Anders, (1991), "Proportional timing in speech motor control", *Journal of Phonetics*, vol. 19, pp. 343-50.
- [22] Rogers, Henry, (1992), "Laryngeal timing in Mongolian", *Proceedings of the 1992 Canadian Linguistic Association Conference*, pp. 241-8.
- [23] Rogers, Henry, (1993), "A revised theory of articulatory binding", *Proceedings of the 1993 Canadian Linguistic Association Conference*, pp. 573-84.
- [24] Rogers, Henry, (1995), "The effect of rate of speech on laryngeal timing in medial stops in Mongolian", to appear.