Aitken's Law:

Investigating vowel duration in the 21st century





Andreas Weilinghoff

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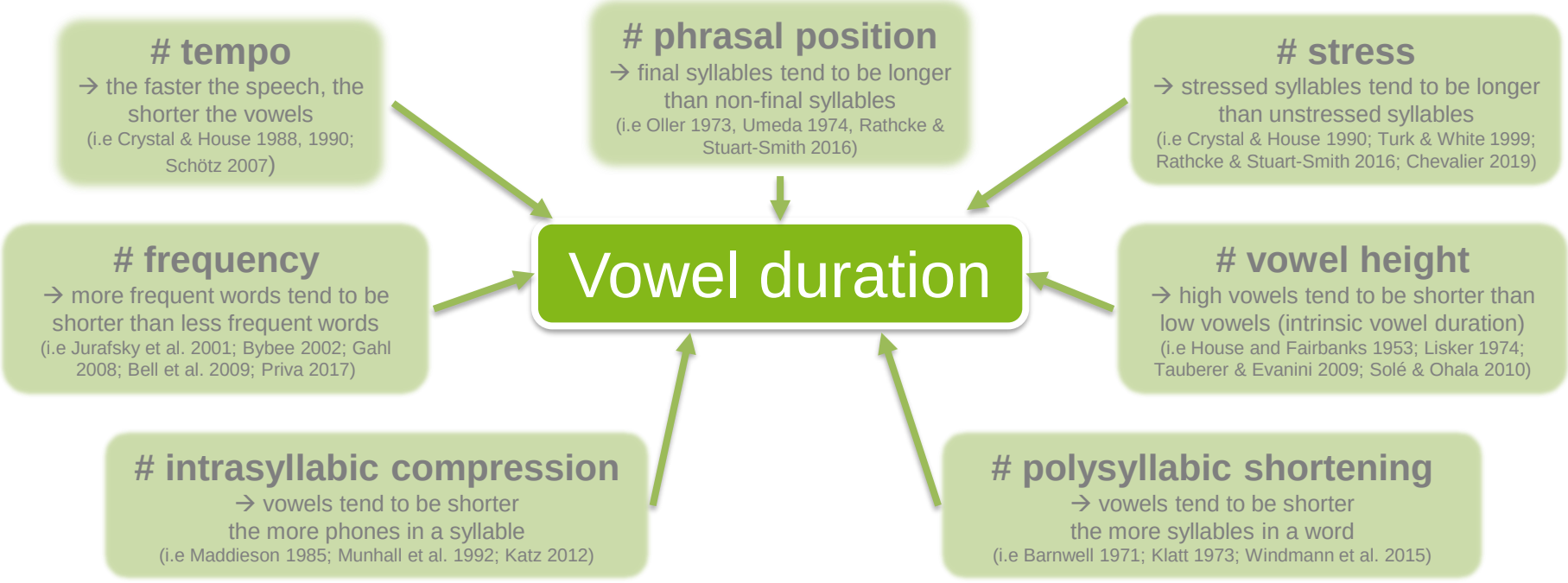
Slides

andreas-weilinghoff.com/docs/ISLK_talk.pdf

01 Introduction

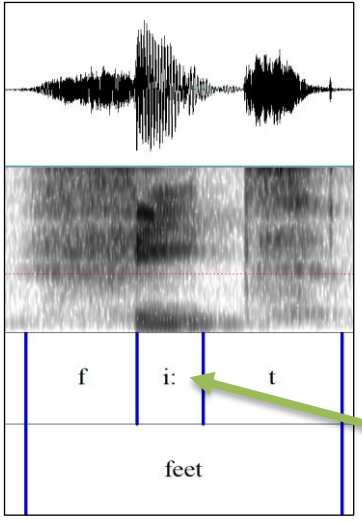
Introduction



Introduction

Voicing effect → vowels tend to be longer before voiced consonants than before voiceless consonants in most varieties of English

(i.e Sweet 1877; Heffner 1937; House and Fairbanks 1953; Peterson & Lehiste 1960; Chen 1970; Tauberer & Evanini 2009; Tanner et al. 2020)

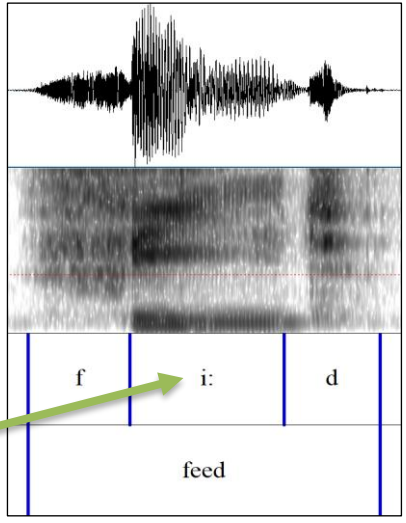


feet

vowel duration:
~ 130 ms

feed

vowel duration:
~ 300 ms



The Scottish Vowel Length Rule (SVLR) / Aitken‘s Law

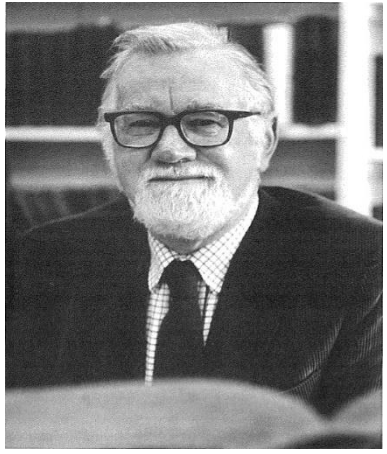
Table 1. Environments constraining durational allophony in varieties of British English.

Constraint	Examples	Scottish English	Anglo-English
Voiceless consonants	*beat, greet* *brute, cute*	short allophones	short allophones
Voiced (oral and nasal) stops and /l/	*bead, bean, beal* *brood, broom, gruel*	short allophones	long allophones
Voiced fricatives and /r/	*tease, beer* *bruise, smooth, cure*	long allophones	long allophones
Morpheme boundaries	*bee, bees, bee’s* *agree, agreed* *brew, brews, brewed*	long allophones	long allophones

(Retrieved from: Stuart-Smith and Rathcke 2016: 406)

The Scottish Vowel Length Rule (SVLR) / Aitken‘s Law

“All vowels and diphthongs are **long in stressed open syllables**, before **voiced fricatives** and **/r/**, and before **morpheme boundaries** and **short elsewhere**; with the two exceptions of **/ɪ/** and **/ʌ/** which are **invariably short**.“ (McClure 1977)

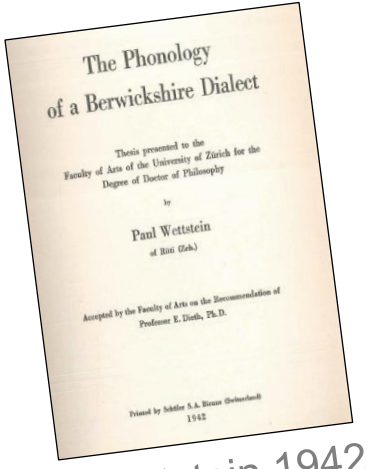


Adam Jack Aitken (1921-1998)

- Scottish lexicographer
- scholar of the Scots language
- formulator of the SVLR

02 Previous SVLR research

Early impressionistic accounts


The Phonology
of a Berwickshire Dialect

Thesis presented to the
Faculty of Arts of the University of Zürich for the
Degree of Doctor of Philosophy

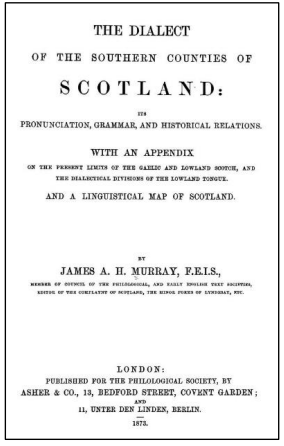
by

Paul Wettstein
of Rüti (Zch.)

Accepted by the Faculty of Arts on the Recommendation of
Professor E. Dieth, Ph.D.

Printed by Schüler S.A. Biene (Switzerland)
1942

Wettstein 1942


THE DIALECT

OF THE SOUTHERN COUNTIES OF

SCOTLAND:

ITS

PRONUNCIATION, GRAMMAR, AND HISTORICAL RELATIONS.

WITH AN APPENDIX

ON THE PRESENT LIMITS OF THE GAELIC AND LOWLAND SCOTCH, AND THE DIALECTICAL DIVISIONS OF THE LOWLAND TONGUE.

AND A LINGUISTICAL MAP OF SCOTLAND.

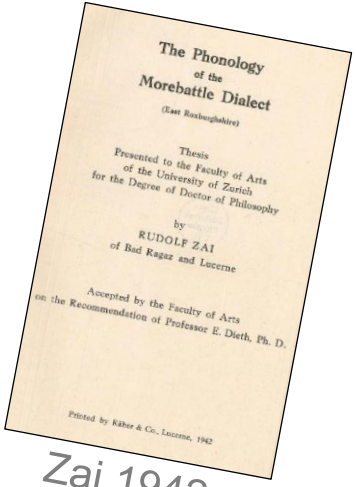
BY

JAMES A. H. MURRAY, F.E.I.S.,

MEMBER OF SOCIETIES OF THE PHILOLOGICAL, AND EARLY ENGLISH TEXT SOCIETIES, EDITOR OF THE COMPLAYNTE OF SCOTLANDE, THE MINOR POEMS OF LYNDESAY, ETC.

LONDON:
PUBLISHED FOR THE PHILOLOGICAL SOCIETY, BY
ASHER & CO., 13, BEDFORD STREET, COVENT GARDEN;
AND
11, UNTER DEN LINDEN, BERLIN.
1873.

Murray 1873


The Phonology
of the
Morebattle Dialect
(East Roxburghshire)

Thesis
Presented to the Faculty of Arts
of the University of Zurich
for the Degree of Doctor of Philosophy

by
RUDOLF ZAI
of Bad Ragaz and Lucerne

Accepted by the Faculty of Arts
on the Recommendation of Professor E. Dieth, Ph. D.

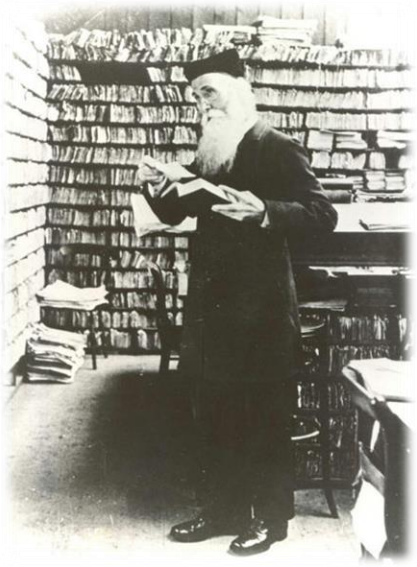
Printed by Käber & Co., Lucerne, 1942

Zai 1942

Douglas 1775 | Grant & Dixon 1921 | Watson 1923 | Grant 1931 | Dieth 1932

Wölck 1965 | Aitken 1962; 1975; 1977; 1979; **1981**; 1984 | Lodge 1984 | Mather & Speitel 1986

Early impressionistic accounts



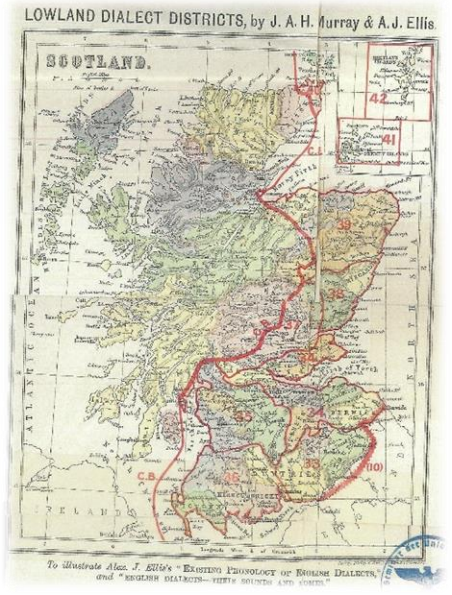
Sir James Murray (1837-1915)

- impressionistic reports of regional pronunciation in Scotland

- no empirical basis
  (e.g. phonograph only invented in 1887)

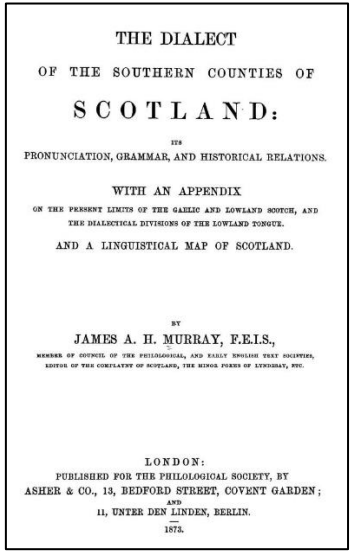
Very early recording by A. G. Bell in 1885:
"This record has been made by Alexander Graham Bell in the presence of Dr. Chichester A. Bell on the 15th of April 1885 at the Volta laboratory, 1221 Connecticut Avenue, Washington, DC. In the witness whereof HEAR MY VOICE; Alexander Graham Bell"

- different approaches to transcription
  (IPA only formed after 1886)



Scottish Lowland Dialects
(Ellis and Murray 1890)

Early impressionistic account



THE DIALECT

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1873.

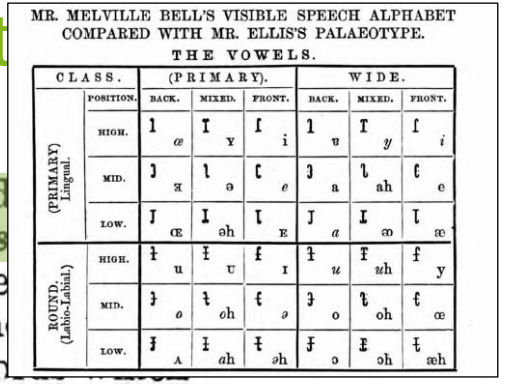
The dialect of the Southern Counties of Scotland
(Murray 1873)

1. A vowel at the end of a monosyllable, or accented
lable, is long; as *wee*, tiny, *day*; *faa*, fall; *gœ*, gave; *s*

The words *a*, *the*, can scarcely be looked upon as e
for, so far as pronunciation is concerned, they are not in
words, but mere prefixes, or initial syllables to the wo
they define, and are consequently brief (*i.e.* short in an open syllable). The same may be said of possessives and prepositions like *maa*, my; *tui*, to; *wui*, with; *frœ*, from; *î*, in; which have a long sound only when emphatic, but otherwise are brief, *mă*, *tă*, *wă*, *fră*, *ă*, like *a-* in *ă-bove*, *ă-mong*.

The above rule also holds good, where such a monosyllable is followed by *s* or *d*, in the process of noun- or verb-inflection, as *faa*, *faa's*, *day*, *days*, *preae*, *preaed*, *preaes*.

(Murray 1873: 97)



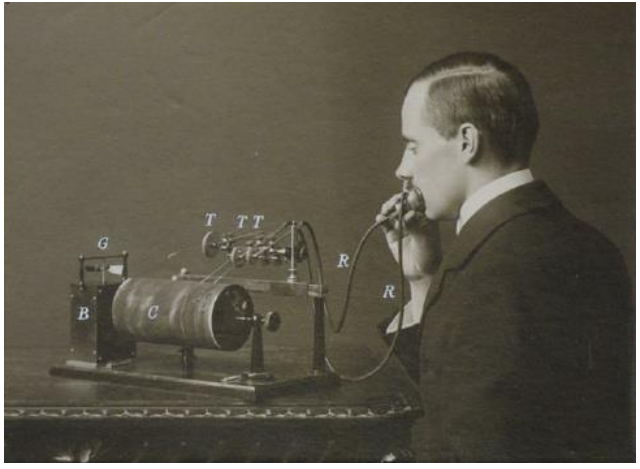
MR. MELVILLE BELL'S VISIBLE SPEECH ALPHABET COMPARED WITH MR. ELLIS'S PALAEOTYPE.

THE VOWELS.

CLASS.		(PRIMARY).			WIDE.		
	POSITION.	BACK.	MIXED.	FRONT.	BACK.	MIXED.	FRONT.
(PRIMARY) Lingual.	HIGH.	ɭ œ	ɪ ʏ	ɾ i	ɭ ʉ	ɪ y	ɾ i
	MID.	ɟ ɤ	ɭ ə	ɾ e	ɟ a	ɭ ah	ɾ e
	LOW.	ɾ œ	ɪ əh	ɭ ɛ	ɾ a	ɪ æ	ɭ æ
ROUND. (Labio-Labial.)	HIGH.	ɬ u	ɬ ʊ	ɬ ɪ	ɬ u	ɬ uh	ɬ y
	MID.	ɬ o	ɬ oh	ɬ ə	ɬ o	ɬ oh	ɬ œ
	LOW.	ɬ ʌ	ɬ ah	ɬ əh	ɬ o	ɬ oh	ɬ æh

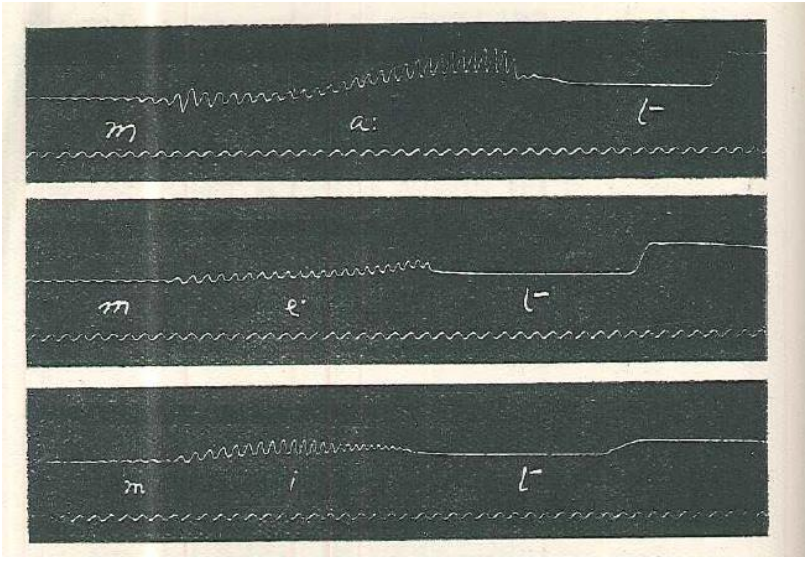
(Murray 1873: 99)

Early impressionistic accounts



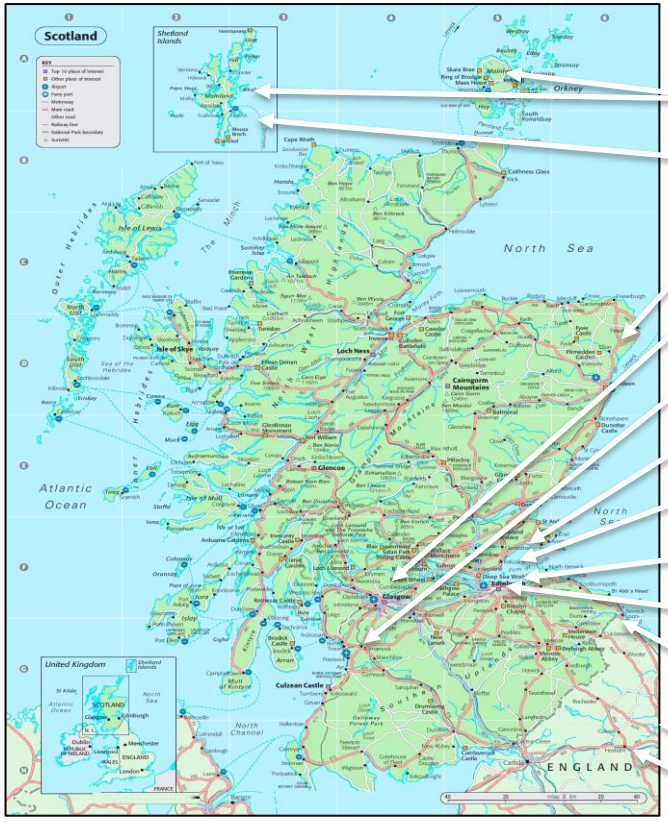
Kymograph recording by Daniel Jones (probably before 1914)

Kymograph measurements by Dieth (1932: 62)



Phonological / historical discussions

- Lass 1974
- Taylor 1974
- Ewen 1977
- Harris 1985
- Carr 1992
- Anderson 1993
- Kamińska 1995
- Kiełtyka 2003

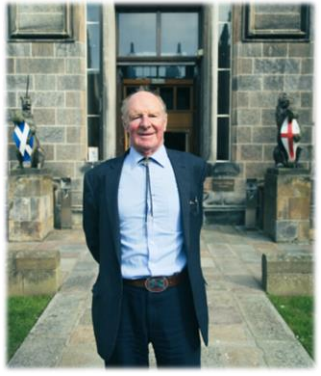


Empirical studies in controlled speech

- van Leyden 2002
- Scobbie 2005
- Watt and Yurkova 2007
- Scobbie et al. 1999
- Pukli 2006
- McKenna 1988
- Agutter 1988
- McMahon 1991
- Hewlett, Matthews and Scobbie 1999
- Watt and Ingham 2000
- Milroy 1995
- Llamas et al. 2011

First empirical studies in controlled speech

McClure 1977



Derrick McClure at the University of Aberdeen

- Investigation of most vowels of the Basic Scottish Vowel System in SVLR long and short contexts
- Word list and carrier sentence readings
  "I say [word] sometimes"
- used a four-channel electric kymograph for the durational measurements

Vowel duration in a Scottish accent

J. Derrick McClure

(*University of Aberdeen*)

A sixteenth-century sound change in Scots has resulted in the appearance in that language of a system of vowel-length variations strikingly different from the common Germanic system still visible in other West Germanic speech forms. The present situation is described by the set of rules known as Aitken's Law (Aitken 1962 and 1977; see also Lass 1974): all vowels and diphthongs are long in stressed open syllables, before voiced fricatives and /r/, and before morpheme boundaries; and short elsewhere; with the two exceptions of /ʌ/ and /ɔ/ which are invariably short.

Scottish English, because of Scots influence,[1] exhibits the same phenomenon: this is one of several respects in which the Scottish forms differ conspicuously from other accents of Standard English. In order to confirm this experimentally, and also to test the investigator's impression that the above account of the situation is in fact somewhat over-simplified, an instrumental examination was carried out using the four-channel electric kymograph at Edinburgh University, with the kind co-operation of the Linguistics Department.[2] A set of word-lists was compiled, and each word was read by the investigator three times, twice in isolation and once in the sentence '*I say*—sometimes' (the tonic accent being on *say*). The duration of the vowel in each utterance was measured from the kymograms, and the figures tabulated.

The word-lists were designed to exhibit most of the vowel and diphthong phonemes in the investigator's accent (educated Ayrshire; but the segmental phoneme system is characteristic of many forms of Scottish English) in the following positions: 1. stressed open syllable; 2. before /t/; 3. before /s/; 4. before /tʃ/; 5. before /s/; 6. before /r/; 7. before inflectional /d/; 8. before inflectional /s/.

[1] These terms ought to be kept clearly distinct, though they generally are not. *Scots* refers to the language, or group of dialects, descended ultimately from Northumbrian Anglo-Saxon with extensive influence from Scandinavian, Dutch, French and Gaelic: still the normal speech of a large part of the population of Scotland and the vehicle for a distinguished literature. *Scottish English* is the group of forms which the international language anachronistically known as English takes in Scotland: basically it results from the adoption of English as a learned language by a Scots-speaking population, though it has now the status of an independent and fully-institutionalized form of the language. For discussion and description of Scottish English, see McClure 1975 and Aitken and McArthur forthcoming

[2] I am indebted to Mr. D. Crailsham and Mr. R. Motherwell for technical assistance, and to Mr. J. D. M. H. Laver for advice on the format of the experiment.

Vowel duration in a Scottish accent (McClure 1977)

McClure 1977

/i/	/ɪ/	/e/	/ɛ/	/a/
1 PEA	1 —	1 PAY	1 —	1 PA
2 PEAT	2 KIT	2 PATE	2 PET	2 PAT
3 PEACE	3 KISS	3 PACE	3 TESS	3 PASS
4 (IM)PEDE	4 KID	4 CADE	4 TED	4 PAD
5 TEASE	5 HIS	5 (U)KAZE	5 DES	5 DAZ
6 PEER	6 GIRR	6 PAIR	6 KERR	6 PARR
7 TEE'D	7 —	7 PAID	7 —	7 BAA'D
8 TEES	8 —	8 PAYS	8 —	8 BAAS

/ʌ/	/ɔ/	/o/	/u/	/ae/	/ʌu/
1 —	1 PAW	1 TOW	1 COO	1 TIE	1 COW
2 CUT	2 POT	2 TOTE	2 COOT	2 TIGHT	2 POUT
3 CUSS	3 TOSS	3 —	3 PUSS	3 DICE	3 HOUSE (n.)
4 CUD	4 POD	4 TOAD	4 COULD	4 TIDE	4 —
5 BUZZ	5 PAUSE	5 POSE	5 BOOZE	5 GUISE	5 HOUSE (vb.)
6 CUR	6 TOR	6 POUR	6 POOR	6 TIRE	6 POWER[4]
7 —	7 PAWED	7 TOWED	7 COOED	7 TIED	7 COWED
8 —	8 PAWS	8 TOWS	8 COOS	8 TIES	8 COWS

Word list by McClure (1977)

Phonological / historical discussions

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- Kiełtyka 2003

Perception study

- Smith and Rathcke 2016

Empirical studies in uncontrolled speech

- Warren 2018
- Stuart-Smith and Rathcke 2016
- Chevalier 2019
- Stuart-Smith et al 2019

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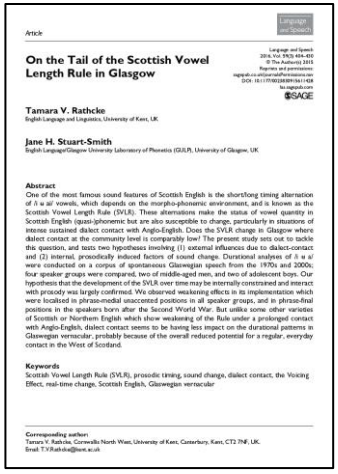
- Watt and Ingham 2000
- Milroy 1995
- Llamas et al. 2011

First empirical studies in uncontrolled speech

Jane Stuart-Smith | me

Rathcke & Stuart-Smith 2016

- investigation of /i/, /u/ and /a/ in spontaneous Glaswegian Scots from the force-aligned *Sounds of the City corpus*
- data taken from 1970s and 2000s (diachronic perspective of the SVLR); only male speakers
- Statistical analysis applies linear mixed-effects modelling with a backward fitting procedure



Article

On the Tail of the Scottish Vowel Length Rule in Glasgow

Tamara V. Rathcke

Jane H. Stuart-Smith

Abstract

One of the most famous sound features of Scottish English is the short/long timing alternation of /ɪ u a/ vowels, which depends on the morpho-phonemic environment, and is known as the Scottish Vowel Length Rule (SVLR). These alternations make the status of vowel quantity in Scottish English (quasi-)phonemic but are also susceptible to change, particularly in situations of intense sustained dialect contact with Anglo-English. Does the SVLR change in Glasgow where dialect contact at the community level is comparably low? The present study sets out to tackle this question, and tests two hypotheses involving (1) external influences due to dialect-contact and (2) internal, prosodically induced factors of sound change. Durational analyses of /ɪ u a/ were conducted on a corpus of spontaneous Glaswegian speech from the 1970s and 2000s; four speaker groups were compared, two of middle-aged men, and two of adolescent boys. Our hypothesis that the development of the SVLR over time may be internally-constrained and interact with prosody was largely confirmed. We observed weakening effects in its implementation which were localised in phrase-medial unaccented positions in all speaker groups, and in phrase-final positions in the speakers born after the Second World War. But unlike some other varieties of Scottish or Northern English which show weakening of the Rule under a prolonged contact with Anglo-English, dialect contact seems to be having less impact on the durational patterns in Glaswegian vernacular, probably because of the overall reduced potential for a regular, everyday contact in the West of Scotland.

Keywords

Scottish Vowel Length Rule (SVLR), prosodic timing, sound change, dialect contact, the Voicing Effect, real-time change, Scottish English, Glaswegian vernacular

On the tail of the Scottish Vowel Length Rule in Glasgow (Rathcke and Stuart-Smith 2016)

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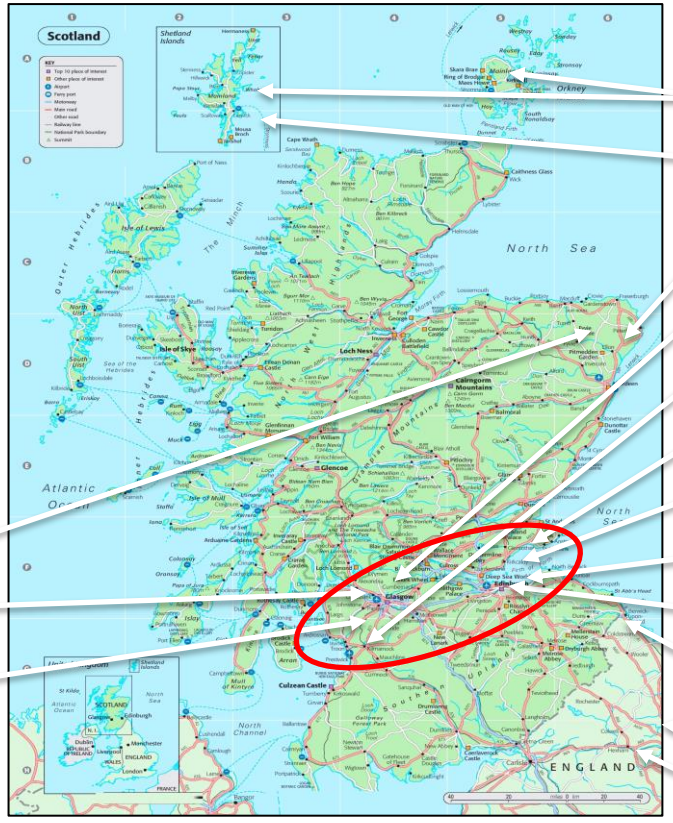

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Previous findings

- SVLR applies most consistently in the vowels

/i/
McClure 1977
McKenna 1988
McMahon 1991
Hewlett et al. 1999
Scobbie et al. 1999
Watt & Ingham 2000
van Leyden 2002
Scobbie 2005
Pukli 2006
Llamas et al. 2011
Rathcke & Stuart-Smith 2016
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Stuart-Smith et al. 2019

/ʉ/
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Scobbie 2005
Pukli 2006
Llamas et al. 2011
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Stuart-Smith et al. 2019

/aɪ/
Agutter 1988
McMahon 1991
Milroy 1995
Scobbie et al. 1999 Watt & Ingham 2000
Pukli 2006
Llamas et al. 2011

- Anti-Voicing Effect reported by SPADE study (Stuart-Smith et al. 2019)

Previous findings – Remaining issues

→ geographical scope of the SVLR?

(e.g. McClure 1977 | Aitken 1981) vs. (Lodge 1984 | Agutter 1988 | Watt & Yurkova 2007 | Warren 2018)

→ age-related variation?

(Agutter 1988 | Milroy 1995 | Watt and Ingham 2000 | Warren 2018) vs. (Scobbie et al. 1999; Llamas et al. 2011)

→ gender-related variation?

(Agutter 1988 | Watt and Ingham 2000 | Stuart-Smith and Rathcke 2016; Chevalier 2019)

→ SVLR in naturally spoken SSE? → emerging VE patterns in SSE?

03 Investigating vowel duration in the 21st century

PhD Project – RQs and aims

RQ1: **Which vowels** are affected by Aitken's Law / the VE in 21st century spoken SSE?

RQ2: What is the **effect of regional, age- and gender-related variation** on Aitken's Law / the VE in 21st century spoken SSE?

RQ3: **Which prosodic factors** have an influence on Aitken's Law / the VE in 21st century spoken SSE?

→ all vowels of the *Basic Scottish Vowel System* (Abercrombie 1979)

→ representativeness for the whole of the country in terms of age, gender and regional background

→ accounting for all possible prosodic factors, implementing scripted and unscripted speech

PhD Project Dataset

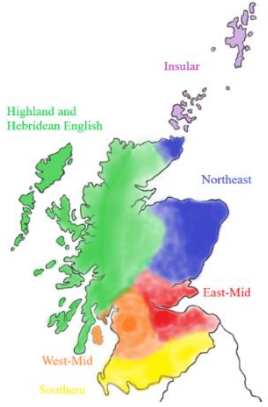
→ Two data sources: ICE Scotland + Self-collected data

(Schützler et al. 2017)

- 130 (64 f) speakers from 3 age groups & 6 dialect regions

→ 150995 words

Variable	Level	Number of words
Regional background	East-Mid	27199
	HHE	23604
	Insular	26147
	Northeast	18007
	South	24412
	West-Mid	31626
Gender	female	67726
	male	83269
Age group	old (60+)	33165
	middle (31-60)	94683
	young (18-30)	23147
Style	scripted	85044
	unscripted	65951
Total		150995



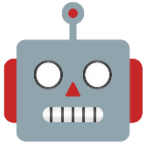
PhD Project – Data preparation

Large speech dataset

- How to precisely measure the vocalic durations?
- What should be the transcription format?
- How to identify the vowels and postvocalic contexts?
- How to account for all relevant segmental and suprasegmental factors?
- How to analyse the data?

PhD Project – Data preparation

Solution:



Human + Technology

Transcription software:

Praat

ELAN

Forced aligners:

WebMAUS

MFA 2.0

Data preparation

Python

R

Statistical analysis

R

Other tools:

Watson STT

ProsoBox

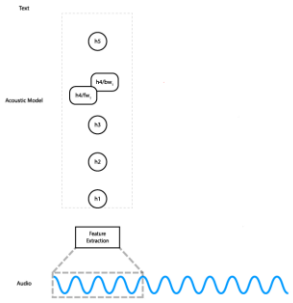
Data preparation - Demonstration

STEP 01 Automatic transcription with **IBM Watson STT** via an API in Python + manual check (and correction)

STEP 02 **Forced alignment** with **MFA 2.0** (McAuliffe et al. 2017) via a Linux subsystem + manual check

STEP 03 Automated data processing with **self-designed script** in Python using the library *textgrids* (Nieminen, 2019)

Step 01: Automatic speech recognition



I n @ w i k @ n d i S @ n

Acoustic model

inner week condition

in a week condition

in a weak condition

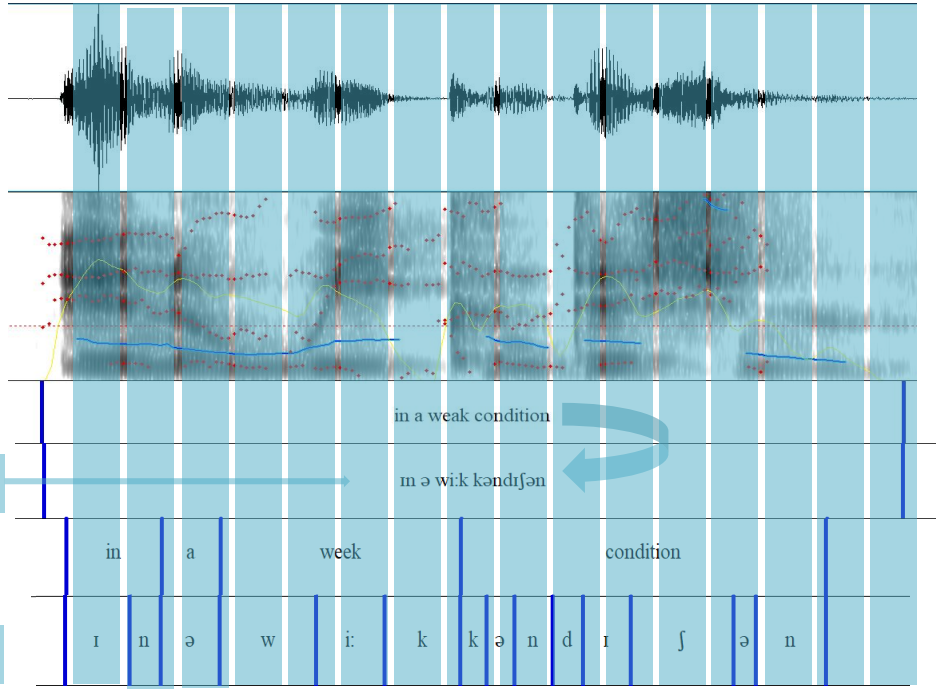
Language model

More info

(Yu and Deng 2015: 4)

Step 02: Forced alignment

The automatic identification and segmentation of phones based on the input audio and a corresponding broad transcription.



Waveform

Spectogram

Broad transcription

G2P conversion

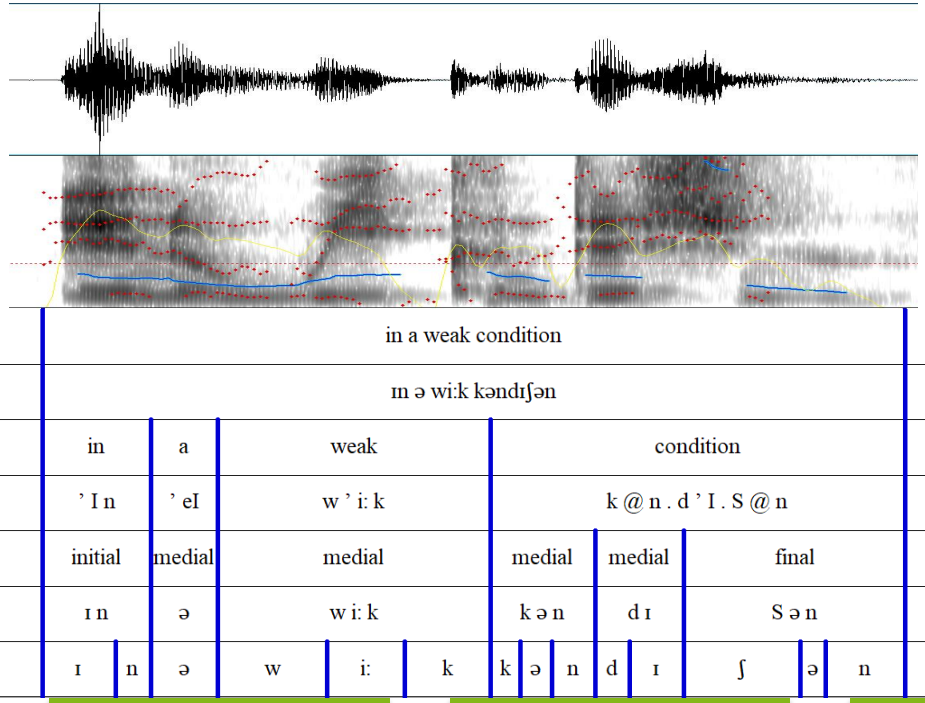
Forced aligner

Acoustic model

Step 03: Data processing

Code
andreas-weilinghoff.com/#code

Scripts



PhD Project – statistical analysis

- Linear mixed effects modelling on log-transformed vowel duration with *lme4* and *lmerTest* packages (Bates et al., 2015; Kuznetsova et al., 2017)

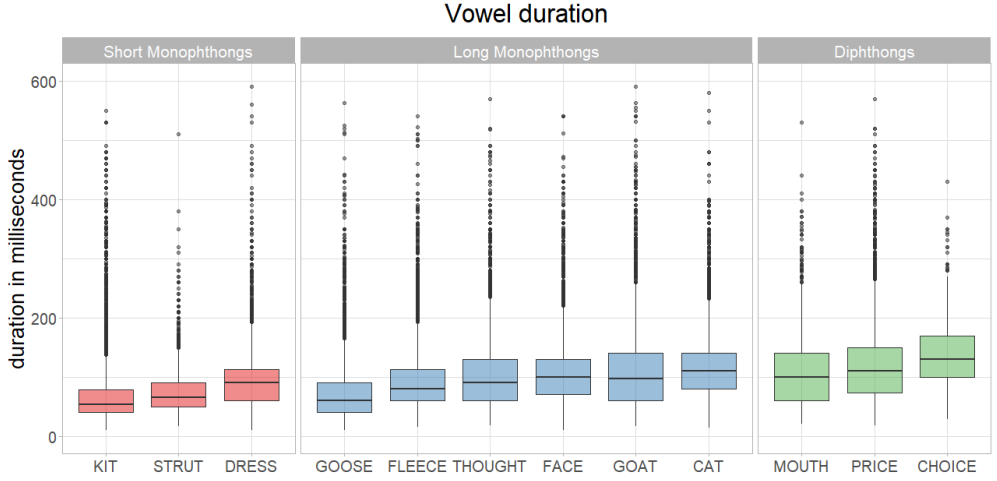
  Random factors: speaker, word
  Fixed factors: SVLR / VE categorization, phrasal position, stress, word frequency, local articulation rate, syllable phone count, word syllable count, style, age, gender, region + all possible interactions

→ stepwise regression with backward selection (AIC | R2) & subsampling technique PrInDT for automatic model generation for the sample including all vowels (Weihs & Buschfeld 2021; Weihs & Weilinghoff forthcoming)

- vowels analyzed collectively and independently; different models for different SVLR and VE classification schemes → avoid collinearity

Findings – vowel overview

Vowel(s)	Lexical Set	Type	Tokens	Mean duration (ms)	Standard deviation (ms)
/ɪ/	KIT	Short monophthong	44382	64.71	41.14
/ʌ/	STRUT	Short monophthong	6467	71.72	35.70
/ɛ/	DRESS	Short monophthong	13714	91.76	47.27
/u/	GOOSE	Long monophthong	6351	92.33	55.55
/i/	FLEECE	Long monophthong	9146	100.42	53.91
/ɔ/	THOUGHT	Long monophthong	7762	112.64	55.79
/ʌʊ/	MOUTH	Diphthong	9394	114.90	56.95
/e/	FACE	Long monophthong	6708	113.00	57.34
/o/	GOAT	Long monophthong	10868	119.10	70.32
/a/	CAT	Long monophthong	2992	119.71	51.23
/ʌɪ/ /ae/	PRICE	Diphthong	9540	125.02	60.52
/ɔe/	CHOICE	Diphthong	480	140.74	59.09

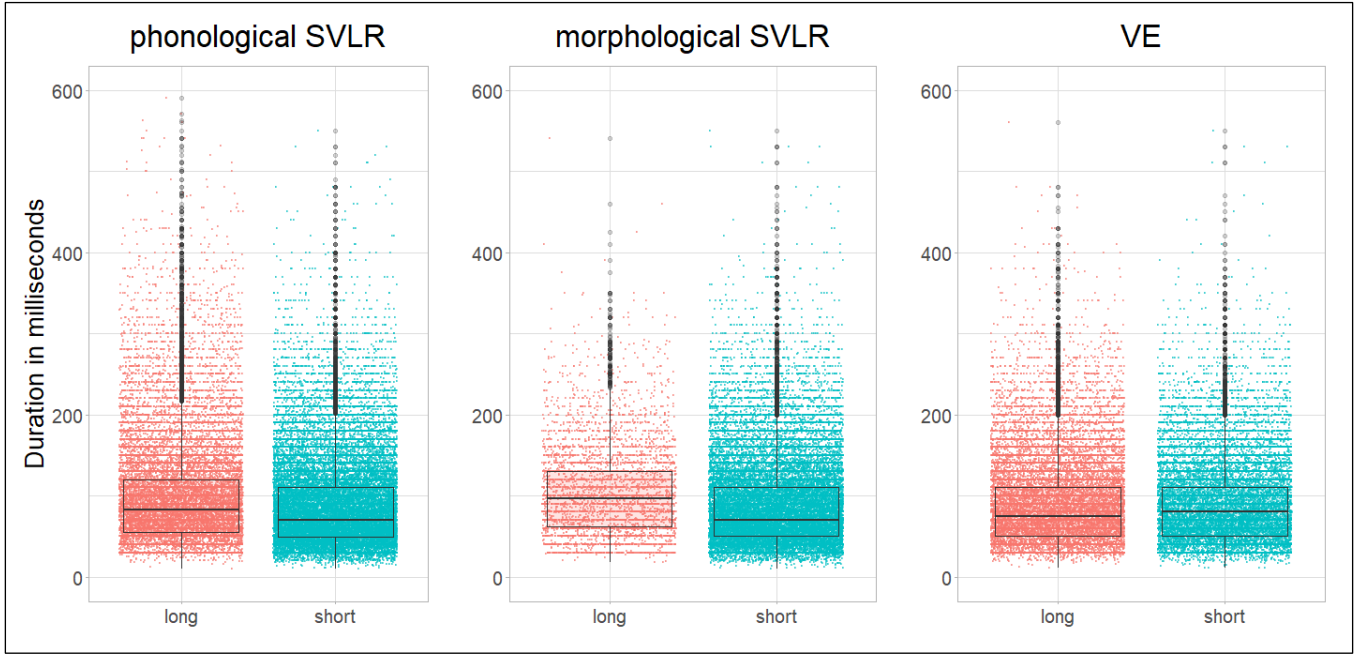


Findings – All vowels

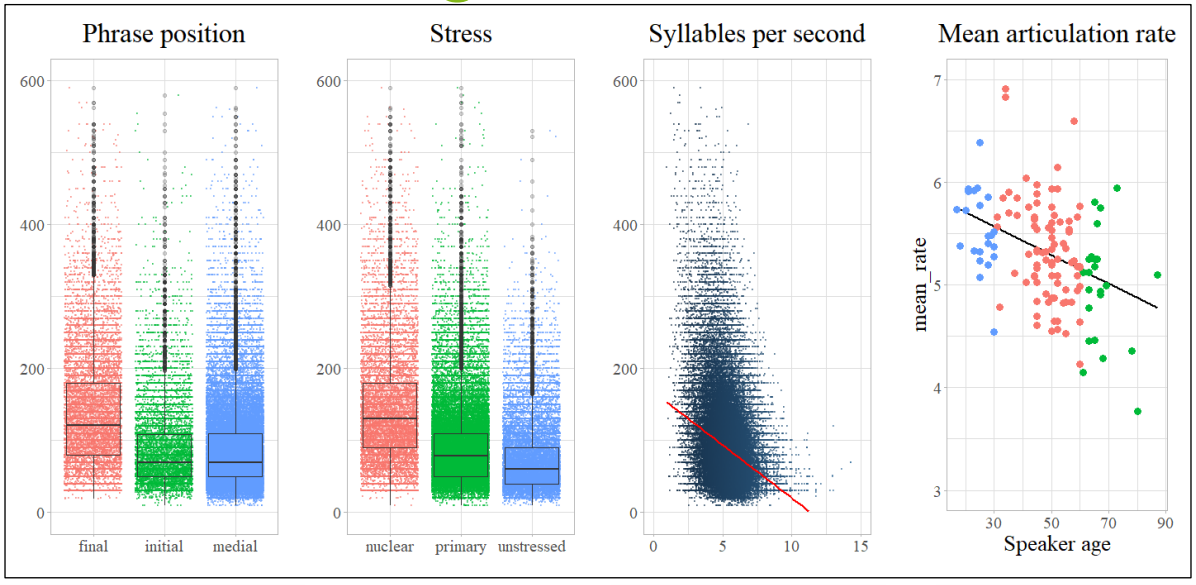
Phonological SVLR: freeze vs. feed

Moprhological SVLR: agreed vs. greed

VE feed vs. feet



Findings – All vowels



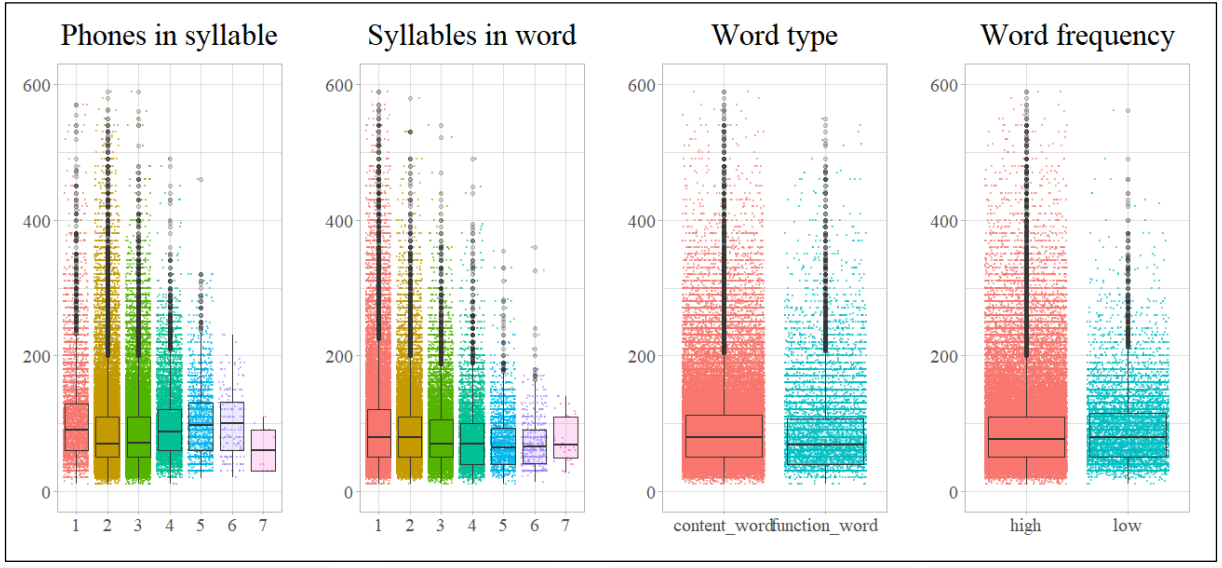
pre-pausal / phrase-final lengthening

nuclear stress

the faster the speech, the shorter the vowels

the older the speaker, the slower the speech

Findings – All vowels



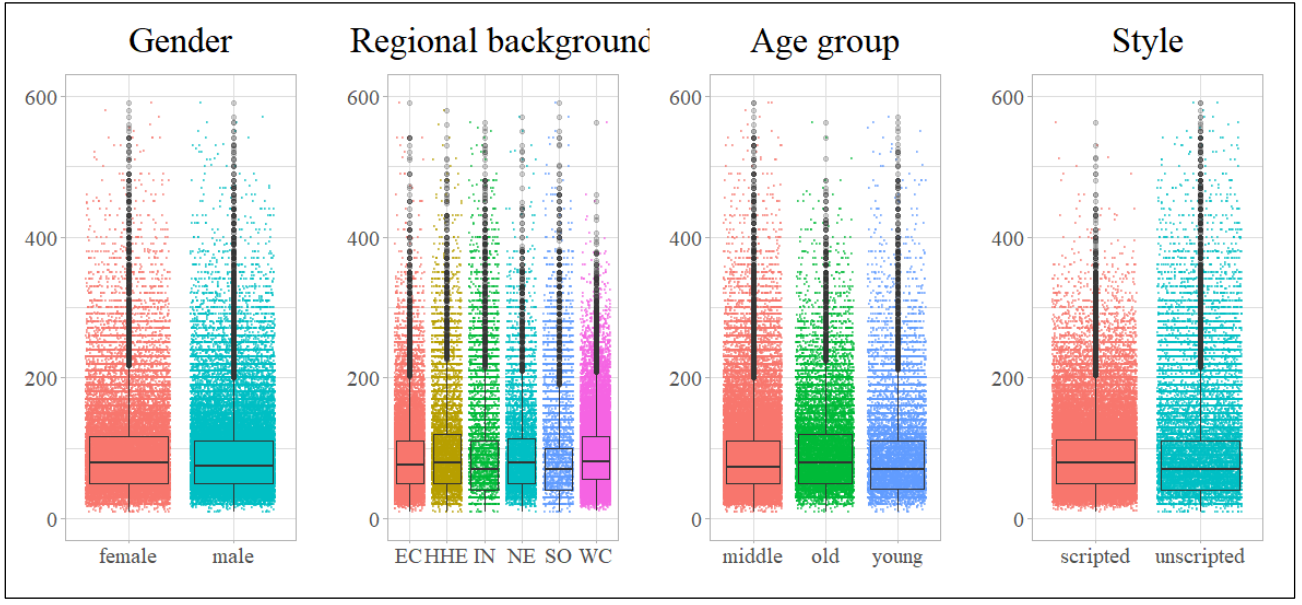
intrasyllabic compression?

polysyllabic shortening?

word category effects?

word frequency effects?

Findings – All vowels



extralinguistic variables?

Findings - Individual vowels

Lexical Set	Vowel(s)	Aitken's (1981) SVLR status	Phon SVLR	Morph SVLR	VE	VE (plosive contexts)	Highest cond. R^2	Other important observation
KIT	/ɪ/	no	no	no	no	no	0.36	shortest before nasals
STRUT	/ʌ/	no	no	no	opposite	opposite	0.42	shortest before nasals, anti-VE
DRESS	/ɛ/	yes	opposite	no	opposite	no	0.42	shortest before voiced fricatives
GOOSE	/u/	yes	yes	yes	yes	no	0.40	VE1 significant but not VE2; shortest before nasals
FLEECE	/i/	yes	yes	yes	yes	yes	0.49	shortest before nasals
THOUGHT	/ɔ/	regional variation	weak	weak	opposite	no	0.53	shortest before nasals; anti-VE
FACE	/e/	yes	yes	yes	yes	yes	0.49	shortest before laterals
GOAT	/o/	regional variation	yes	yes	yes	yes	0.41	shortest before voiceless fricatives
CAT	/a/	yes	no	weak	no	yes	0.48	shortest before voiced fricatives
MOUTH	/ʌʊ/	yes	yes	no	opposite	no	0.47	shortest before nasals
PRICE	/ʌɪ/ /ae/	yes	yes	yes	yes	yes	0.46	shortest before voiceless fricatives
CHOICE	/ɔe/	yes / regional variation	no	no	opposite	unclear	0.61	shortest before nasals

Findings

- consistent SVLR patterns in GOOSE, FLEECE, PRICE, FACE, GOAT (/ʉ/, /i/, /aɪ/, /e/ and /o/)
- Aitken's Law does not operate in KIT, STRUT, DRESS, THOUGHT or CHOICE (/ɪ/ /ʌ/ /ɛ/ /ɔ/ /ɔe/)
- SVLR patterns less stable in the Highlands and Southern Scotland
- weak influence of *age* and *gender*

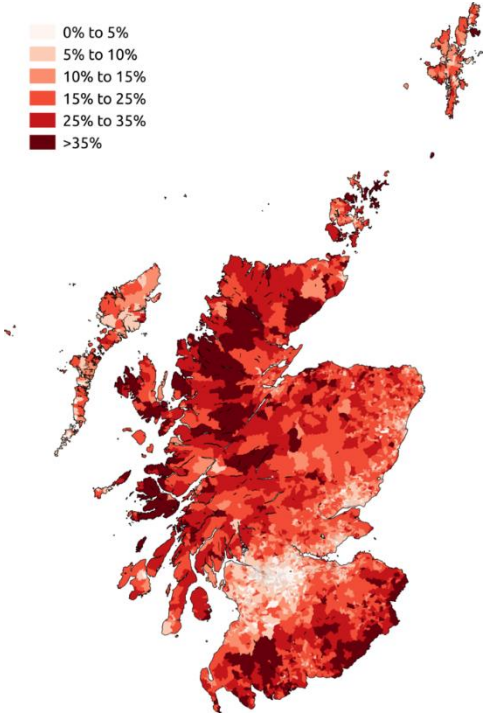
Discussion

- SVLR operates in 21st century Scottish Standard English

→ no sign of weakening (increase of VE patterns)

→ stable across genders and age groups

→ slight regional differentiation (weaker in Highlands and South)



Percentage of population born in England

Findings

- all vowels are significantly influenced by *tempo*, *stress* and *phrasal position*
- strong interactions between Aitken‘s Law and the factors *stress* and *phrasal position*

→ SVLR is amplified in prominent prosodic contexts

- Anti-voicing effect (Stuart-Smith et al. 2019) found in STRUT, DRESS, THOUGHT, MOUTH, CHOICE

→ **strong shortening before nasals**

Discussion

- Strong influence of prosodic factors

→ General patterns than can be observed in controlled speech are heavily influenced by prosody in spontaneous speech

- Anti-Voicing effect corroborated

→ contradicts established phonological classifications (House and Fairbanks 1953)

Vowel durational patterns differ in controlled and uncontrolled speech settings.

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Thanks for your attention!

Slides
andreas-weilinghoff.com/˜docs/ISLK_talk.pdf

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