Viewing accent variation from a large corpus perspective

Rhoticity in Scottish English

Jane Stuart-Smith* Rachel Macdonald
James Tanner+ & The SPADE Consortium

Glasgow University Laboratory of Phonetics (GULP),
McGill University

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Text over time and space

Google Books Ngram Viewer

Japanese, Korean, Linguistics

1800 - 2019

Japanese

Korean

linguistics
Some big questions

• Does ‘English’ phonetics exist?

• Why do the same sounds keep changing and being used for social meaning, not others?
  • English: rhoticity; /s/ vs /ʃ/; GOOSE vs FLEECE

• What defines a ‘speech community’/’dialect’?
Huge amounts of annotated speech exist...

Scientific and/or professional user questions, e.g.

- How variable are ‘English’ sounds across space/time?
- $\$ \£$
- Software
- Ethics

Goal: overcome barriers and **scale up** scientific study of speech
Canada PI: Morgan Sonderegger

US PI: Jeff Mielke

2017-2021...

http://spade.glasgow.ac.uk/
Project goals

**Software** large-scale speech analysis

**Data** from ~40 datasets (socio)linguistic surveys

**Research** ‘English’ sounds over time and space
Datasets

https://spade.glasgow.ac.uk/the-spade-consortium/

- 44 collected: public/private, 4 countries, 115 years
- 42 measured: ~8600 speakers, ~2200 hours
Ethics and credit

• For private datasets **ethics** complex: GDPR + US laws

• Data Transfer Agreement
  – data use in keeping with original permissions

• Credit
  – When possible: ‘The SPADE consortium’ author
  – Always: cite individual datasets used

• Datasets of measures
  – OSF repository: [https://osf.io/4jfrm/](https://osf.io/4jfrm/)
  – Data Guardians
SPADE case studies

Sibilants
Stuart-Smith et al. 
*Proc. ICPhS 2019, LabPhon 2020*

Vowels: formants
Mielke et al. *Proc. ICPhS 2019*

Vowels: voicing effect
Tanner et al. (2020) *Frontiers in AI*

Vowels: dynamic
Tanner (2020): PhD thesis

r/l: Scottish rhoticity

Stops

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**SPADE case studies**

**Sibilants**
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  - *Proc. ICPHs 2019*
  - *LabPhon 2020*

**Vowels: voicing effect**
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**r/l: Scottish rhoticity**

**Vowels: Scottish vowel duration**

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Case study

What (more) can be learned about Scottish English using large-scale speech corpus analysis?
Rhoticity in Scottish English

- Scottish English typically ‘rhotic’, 
  /r/ produced in e.g. car, card, better (Wells 1982)
- coda /r/ weakening began in late 19th Century in Glasgow (Stuart-Smith/Lawson 2017)
- weak/absent /r/ now typical of working-class Central Belt speech (Stuart-Smith et al 2014)
- contrasts with auditorily-strong /r/ in middle-class speakers (Lawson et al 2018)
Rhotics in Scottish English

- taps and trills still used by older Scots speakers, and between vowels in Scottish Standard English (Johnston, 1997; Jauriberry et al 2015; Meer et al 2019)


- retroflex [ɻ] found in some Northern, Highland and Insular dialects (Mather & Speitel, 1986)
Acoustics of (Scottish) rhotics

• approximants show lowering/low F3
• taps and trills show high/flat F3
• weakened taps, also uvularised vowels, show high/rising F3 (Lawson et al 2018)
Research questions

• How is Scottish word-final /r/ influenced by linguistic, social, and dialectal factors?

• Is Scottish English word-final /r/ changing over time?
Decades of birth: 1910-1990

SCOTS corpus only (for now)

Glasgow
25: 11m, 14f; 1612 obs

Highlands, Islands and Insular
15: 5m, 10f; 731 obs

Northern
21: 10m, 11f; 1203 obs

Edinburgh
31: 13m, 18f; 2120 obs

South
12: 7m, 5f; 1386 obs

104 speakers
7052 tokens

www.google.com/maps/
Integrated Speech Corpus ANalysis (ISCAN)

McAuliffe et al. *Proc. ICPhS 2019*

**Implementation**
- Python API
- Graphical User Interface

**Diagram**

Datasets (speech corpora, lexicons) -> Database -> Set of linguistic objects -> Data file (CSV)

- *import*
- *querying*
- *export*

- *add measures & structure*
Data analysis using Integrated Speech Corpus ANalysis (ISCAN)

• formant tracks taken using ISCAN (Thomas et al 2019)

• speed of this scaled-up automated analysis is impressive:

  the 107-hour SCOTS corpus took < 1 hour to extract formant tracks for 10,477 tokens from 135 speakers
Acoustic analysis

• all instances of word-final /r/ > 49ms
• 21-point tracks of segmented /r/ for F1, F2, F3; B1, B2, B3
• removed likely erroneous measures with reference to max/min hand-measured formants (Lawson et al 2018)

- 7052 tokens from 104 speakers
‘with the door and’ (Edinburgh woman)
Discrete Cosine Transformation (DCT)

- 21-point F3 track compressed into three DCT coefficients:
  - $F3k0$, reflecting the mean value for the track
  - $F3k1$, reflecting the degree and direction of the slope of the track
  - $F3k2$, reflecting the curvature of the trajectory
Discrete Cosine Transformation (DCT)

/r/ in door

original F3 Hz track

DCT k0/k1/k3

DCT smoothed track (over original Hz track)
Linear mixed effects modelling of $k_0$, $k_1$, $k_2$

DCT coefficients in R

Fixed factors:

• speech Rate (deviation from mean), (log)Duration, (log word)Frequency;
• Stress, Following context
• Gender; Dialect; Decade of Birth
• all possible interactions

Random intercepts: Word and Speaker
A broader (acoustic) perspective on Scottish rhotics/rhoticity
F3: Following context and gender

female speakers show higher mean F3 trajectory than males
F3: Following context and gender

rising F3 trajectory for prepausal and preconsonantal context
F3: Following context and gender

but flatter trajectory for prevocalic context especially for male speakers
F3: Following context and gender

- flattening of the F3 trajectory, if also high, is consistent with taps, and also with weakened, and/or uvularised, tap gestures
F3: Dialect area by stress and gender

Stressed
e.g. *car*, *door*

Unstressed
e.g. *better*

Glasgow unstressed shows slightly flatter F3 trajectory
F3: Dialect area by stress and gender

Stressed
- e.g. car, door

Unstressed
- e.g. better

Southern F3 trajectory low rising more for males than females
F3: Dialect area by stress and gender

Northern males also show more low rising F3 trajectories than females
F3: Dialect area by stress and gender

Edinburgh males show higher, rising F3 trajectory than females, and males from other dialect areas.
F3: Dialect area by stress and gender

Highland-Island-Hebrides females show higher F3 trajectories than females from other dialect areas.
F3: Dialect area by stress and gender

- Stressed: e.g. car, door
- Unstressed: e.g. better

- Subtle differences in articulation by dialect
- And different rhotic gestures arising from different implementation of stress by dialect
F3: Decade of Birth and gender

female F3

male F3

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1910-1940
F3: Decade of Birth and gender

Speakers born after World War II show similar F3 trajectory to those born after World War I.
F3: Decade of Birth and gender

Speakers born most recently show lower/rising F3 trajectories, especially the females.
F3: Decade of Birth and gender

- shift in Scottish English from trills/taps (higher F3) to more approximants (lower F3) over the century, especially in females (Johnston 1997)
What do we learn (so far) from a large corpus perspective on Scottish English rhotics?
How are the acoustics of Scottish rhotics influenced by...

**Linguistic factors?**

- All aspects of F3 trajectory are sensitive to duration, and slope also to speech rate
- unstressed rhotics show less humped trajectories
- prevocalic word-final /r/ show flatter trajectories
- flattening of the F3 trajectory, if also high, is consistent with taps, and also with weakened, and/or uvularised, tap gestures
How are the acoustics of Scottish rhotics influenced by...

**Dialectal factors?**

• Dialect differences are evident in the mean and slope of the rhotic trajectory

• and also interact with syllable stress

  ➢ likely reflect subtle differences in articulation by dialect

  ➢ and different rhotic gestures arising from different implementation of stress by dialect
How are the acoustics of Scottish rhotics influenced by...

**Social factors?**

- overall female speakers show higher mean F3 rhotic trajectory than males
- but there are also gendered differences by dialect, following context and time

➤ rhotics provide yet another example of how speakers align with and overcome the expected acoustic patterning from physiological constraints
What is the evidence for change in Scottish rhotics over time?

• mean of F3 trajectory drops in speakers born in/from 1980s
• across all dialects of Scottish English
• especially in female speakers

➢ consistent with a general shift in Scottish English from trills/taps (higher F3) to more approximants (lower F3) over the century as proposed by Johnston 1997
Reflection on large-scale corpus perspective

• How much does corpus content impact our perspective?
• In what ways does scaling up affect our phonetic data and our analyses?
• How does large-scale corpus analysis shift our analytic perspectives?
• What are the key questions? For Scottish English? And other languages too...
Thank you!
Data Guardians in the SPADE Consortium and our teams of assistants

http://spade.glasgow.ac.uk/

Try out our prototype Shiny app – to look at time/space visualisation of SPADE data:

http://152.1.64.33/spade/latest
Investigators

http://spade.glasgow.ac.uk/
SPADE
SPEech Across Dialects of English

Postdocs & Doc

Rachel Macdonald
Project manager

Michael McAuliffe
Software development

Dr James Tanner
Project PhD

http://spade.glasgow.ac.uk/
and many more!

Stacey Harkin
Kirsty McCahill
Mitchell McGee
Edward Marshall
Julia Moreno
Jo Pearce
Niamh Walker
Ewa Wanat

Arlie Coles (U. de Montréal)

Elias Stengel-Eskin (Johns Hopkins)

Michael Goodale,
Sarah Mihuc (McGill)

Vanna Willerton (McGill)

Jordan Holley
Peter Andrews
Kaylynn Gunter

United States American flag

Scottish flag

Canadian flag
References


