

Automatically identifying characteristic features of non-native English accents

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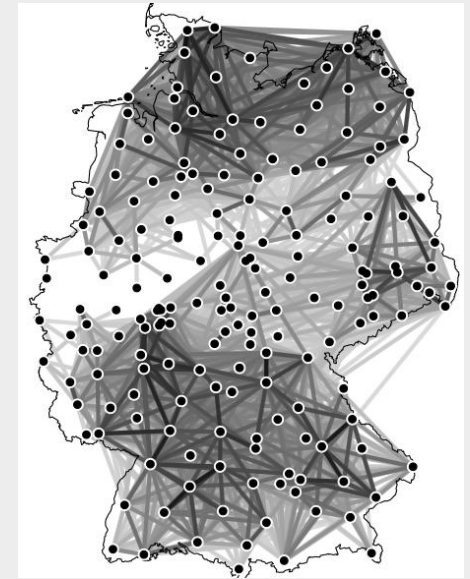
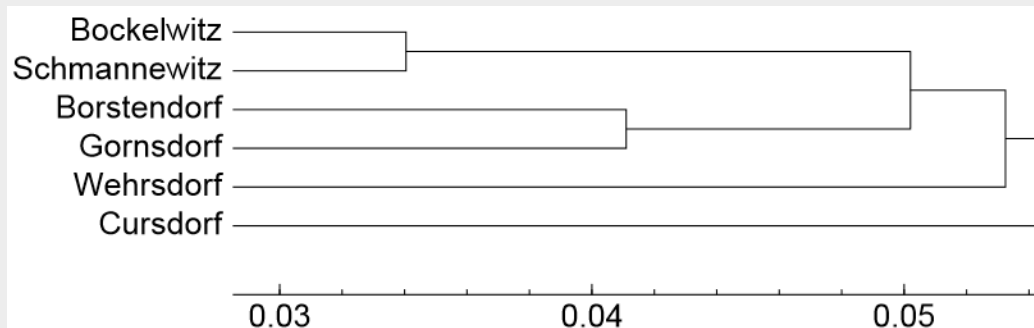
Outline

- Background
- Measure
- Material
- Results: Hungarian
- Results: Dutch
- Discussion

Background: Dialectometry

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w	ẽ	n	z	d	ɛ	ɪ
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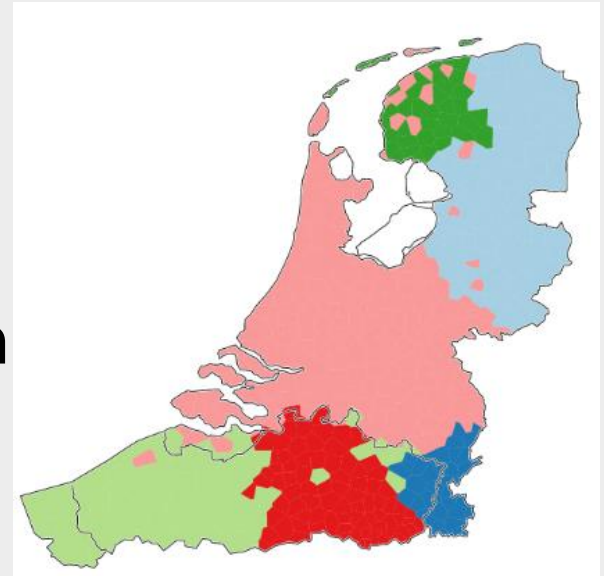
- The measurement of dialect differences
- Aggregates over features
 - Phonetic distance
- Tool: GabMap www.gabmap.nl



Dialectometry: Characteristic features

Prokić, Çöltekin & Nerbonne (2012)

- Which word is typical of each dialect area?
- Based on edit distance between transcriptions of the same word
- Apply to accents?



Levenshtein distance correlates with human native-likeness judgements ($r = -0.81$) (Wieling et al. 2014)

Accents: Characteristic features? Errors?

- Background of pronunciation training
- Errors likely to stem from L1 interference
- Some errors are ‘worse’ than others
- Certain features on which to concentrate in pronunciation training (Abercrombie, 1956):
 - Hierarchy of errors
- Severe is not necessarily characteristic

Dutch error hierarchy

(Van den Doel, 2006)

- Judgement task for native speakers
- 32 sentences, each contains 1 error
- Over 500 native speakers judged severity of errors
- From this, a hierarchy of errors was compiled
- Closest thing to ranking of characteristic features

Measure

- Representativeness

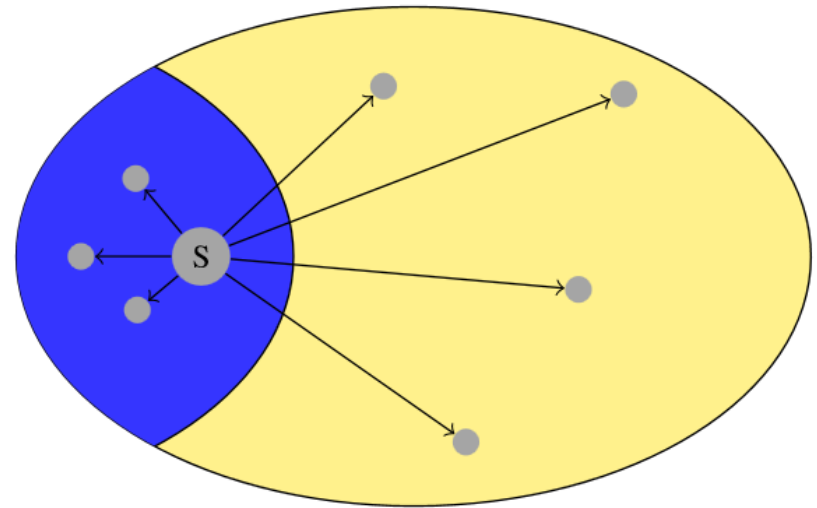
- Difference within the L1 group is small

- Distinctiveness

- Difference between L1 and native groups is large

Mean difference over speaker pairs for some feature

- Final score is the difference between the z-scores of distinctiveness and representatives



From Prokić et al. (2012)

Material: Speech Accent Archive

<http://accent.gmu.edu/>

the speech *accent* archive

**how to
browse
search
resources
about**

The speech accent archive uniformly presents a large set of speech samples from a variety of language backgrounds. Native and non-native speakers of English read the same paragraph and are carefully transcribed. The archive is used by people who wish to compare and analyze the accents of different English speakers.

last updated: 20 november 2014 2023 samples

Material: Speech Accent Archive

<http://accent.gmu.edu/>



the speech *accent* archive

[how to](#) [browse](#) [search](#) [resources](#) [about](#)

language/ speakers
dutch
atlas/ regions
native phonetic inventory

Biographical Data

birth place: almelo,
netherlands ([map](#))
native language: **dutch**
(**nld**)
other language(s): german
french
age, sex: 68, female
age of english onset: 12
english learning method:
academic
english residence: usa
length of english
residence: 3 years

dutch9 Elicitation Paragraph:



Please call Stella. Ask her to bring these things with her from the store: Six spoons of fresh snow peas, five thick slabs of blue cheese, and maybe a snack for her brother Bob. We also need a small plastic snake and a big toy frog for the kids. She can scoop these things into three red bags, and we will go meet her Wednesday at the train station.

Key:

blue = potential areas for this generalization
red = actual areas for this generalization

Phonetic Transcription:

[plɪs kəl stɛlə æsk hɜː tu bʌɪŋ ɔː
θɪŋks vɪs hɜː frɔːm ðə stɔːr sɪks
spʊːnz ɒf frɛʃ snəʊ pʰiːs faɪf θɪk
sleɪps ɒf bluː tʃiːz ɛn meɪbi ə snek
fɔː hɜː brʌðə bɒp wiː ɔːlsoʊ niːd ə
smɔːl plɛstɪk sneɪk ɛnd ə bɪk tɔɪ
frɔːk fɔː də kɪts ʃiː kɔːn skup diːs
θɪŋz ɪntu θɪː rɛd bæɪɡz ɛnt viː wɪl
ɡoʊ mɪt hɜː vɛnzdeɪ æt ðə tɹeɪn
steɪʃən]

Generalizations [about](#)

[Clear](#)

Consonant:

Vowel:

Syllable Structure:

Segmented transcriptions

[p^hlii:z k^hal^y stɛlə æsk ə rə bɪŋ ðii:z θiŋz wɪθ ə flɪm ðə stɔɪ] (*English*)

[plis kol stalʌ æsk hɜ tu brɪŋ ɖis t̪iŋz wɪt̪ hɛr frɔm ɖə stɔr] (*Hungarian*)

[pli:s kɔl stɛla ask hɜ tu bɪŋ ʔðis ʔθiŋs wɪθ hɜ flɔm ɖə stɔz] (*Dutch*)

[p^hliz k^hɔl stɛla æsk hɜɪ tu bɪŋ zɪs θi:ŋks wɪθ hɜɪ flɪm ɖə stɔɪ] (*French*)

- Can observe some characteristics from examples
- But: individual variation
- Production errors possible
- > Better to study aggregate data

Results

■ Hungarian

- “Background to English pronunciation.” (Nádasdy, 2006)

■ Dutch

- Perception study (Van den Doel, 2006)

■ French

- French sound structure (Walker, 2001)

Hungarian

cf. Nádasdy (2006)

- Has dental sounds and fricatives, but no dental fricatives
- Perceived /v/, produced /d/

R	Word	Score	Characteristic forms	Native forms
1	these [1]	2.06	ɖis (5/7 : 3/181) ɖiz (2/7 : 0/181)	ɕi:z (0/7 : 35/181) ɕiz (0/7 : 19/181)
2	please	1.70	plis (4/7 : 1/181) phli:s (2/7 : 5/181)	phli:z (0/7 : 39/181) phli:z̥(0/7 : 31/181)
3	big	1.69	bik (5/7 : 0/181) bɪk (1/7 : 1/181)	bɪg(0/7 : 77/181)
4	these [2]	1.55	ɖis (4/7 : 1/181) ɖiz (1/7 : 1/181)	ɕiz (0/7 : 59/181) ɕi:z (0/7 : 38/181)
5	the [1]	1.52	ɖə (6/7 : 3/181) də (1/7 : 0/181)	ɕə (0/7 : 97/181) nɛ (0/7 : 64/181)

Hungarian

cf. Nádasdy (2006)

- Regressive assimilation
- Take voicedness of next C, even across word boundaries

R	Word	Score	Characteristic forms	Native forms
1	these [1] “these things”	2.06	ɖis (5/7 : 3/181) ɖiz̥ (2/7 : 0/181)	ɔ̃i:z (0/7 : 35/181) ɔ̃iz (0/7 : 19/181)
2	please “please call”	1.70	plis (4/7 : 1/181) phli:s (2/7 : 5/181)	phli:z (0/7 : 39/181) phli:z̥(0/7 : 31/181)
3	big “big toy”	1.69	bik (5/7 : 0/181) bik (1/7 : 1/181)	bɪg(0/7 : 77/181)
4	these [2] “these things”	1.55	ɖis (4/7 : 1/181) ɖiz̥(1/7 : 1/181)	ɔ̃iz (0/7 : 59/181) ɔ̃i:z (0/7 : 38/181)
5	the [1]	1.52	ɖə (6/7 : 3/181) də (1/7 : 0/181)	ɔ̃ə (0/7 : 97/181) n̩ə (0/7 : 64/181)

red bags: 100% /d/

Dutch: Error hierarchy

Van den Doel (2006)

Severity	British (RP)	American English
> 3.5		Fortis/lenis neutralization Use of uvular-r /R/
2.2-3.5	Fortis/lenis neutralization Use of uvular-r /R/ /θ, ð/ ~ /t, d/ Glottalization of final /d/ Epenthetic [ə] in /lm/ /v ~ w/ confusion /æ ~ e, ʌ ~ ɒ, ʊ ~ u:/ Unaspirated [t]	/θ, ð/ ~ /t, d/ Glottalization of final /d/ Epenthetic [ə] in /lm/ /v ~ w/ confusion /æ ~ e/ confusion Inappropriate post-vocalic r

■ Use of /R/

Dutch

cf. Van den Doel (2006)

R	Word	Score	Characteristic forms	Native forms
1	big	1.92	bɪk (13/16 : 1/181)	bɪg (0/16 : 77/181) bɪgʰ (0/16 : 41/181)
2	to	1.22	tu (10/16 : 11/181) tə (3/16 : 21/181)	rə (0/16 : 112/181)
3	slabs	1.12	slæps (5/16 : 0/181) slæps̥ (3/16 : 1/181)	slæbz (1/16 : 66/181) slæ:bz (0/16 : 38/181)
4	bags	1.08	bæks (4/16 : 0/181) bæ:gs̥ (3/16 : 2/181)	bægz (1/16 : 39/181) bæ:gz (0/16 : 33/181)
5	of [1]	1.06	ɔf (7/16 : 7/181) əf (7/16 : 46/181)	əv (0/16 : 58/181) əf (7/16 : 46/181)

Dutch

cf. Van den Doel (2006)

- Use of /R/

19. for [2]: Only /ɹ/ or Ø

- In fact, /R/ is never used

Dutch

cf. Van den Doel (2006)

■ Fortis/lenis neutralization
(in Dutch, basically devoicing of
final consonant cluster)

R	Word	Score	Characteristic forms	Native forms
1	big	1.92	bɪk (13/16 : 1/181)	bɪg (0/16 : 77/181) bɪgʰ (0/16 : 41/181)
2	to	1.22	tu (10/16 : 11/181) tə (3/16 : 21/181)	rə (0/16 : 112/181)
3	slabs	1.12	slæps (5/16 : 0/181) slæbs (3/16 : 1/181)	slæbz (1/16 : 66/181) slæ:bz (0/16 : 38/181)
4	bags	1.08	bæks (4/16 : 0/181) bæ:gs (3/16 : 2/181)	bægz (1/16 : 39/181) bæ:gz (0/16 : 33/181)
5	of [1]	1.06	ɔf (7/16 : 7/181) əf (7/16 : 46/181)	əv (0/16 : 58/181) əf (7/16 : 46/181)

Dental fricatives: /θ, ð/ ~ /t, d/

Dutch

cf. Van den Doel (2006)

R	Word	Score	Characteristic forms	Native forms
1	big	1.92	bɪk (13/16 : 1/181)	bɪg (0/16 : 77/181) bɪg ^ɾ (0/16 : 41/181)
2	to	1.22	tu (10/16 : 11/181) tə (3/16 : 21/181)	rə (0/16 : 112/181)
3	slabs	1.12	slæps (5/16 : 0/181) slæp̥s (3/16 : 1/181)	slæbz (1/16 : 66/181) slæ:bz (0/16 : 38/181)
4	bags	1.08	bæks (4/16 : 0/181) bæ:ɡs (3/16 : 2/181)	bægz (1/16 : 39/181) bæ:gz (0/16 : 33/181)
5	of [1]	1.06	ɔf (7/16 : 7/181) əf (7/16 : 46/181)	əv (0/16 : 58/181) əf (7/16 : 46/181)

Dental fricatives: /θ,ð/ ~ /t,d/

Dutch

cf. Van den Doel (2006)

17. the [2]:

Phoneme	Frequency
[d]	7
[ɖ]	4
[ð]	3

Not representative, but distinctive!

Dental fricatives: /θ, ð/ ~ /t, d/ Sorted by distinctiveness

Dutch

cf. Van den Doel (2006)

R	Word	Distinctiveness score	Characteristic forms	Native forms
1	slabs	1.43		
2	the [2]	1.24		
3	the [3]	1.11		
4	big	1.02		
5	these [2]	0.98		

Dutch

cf. Van den Doel (2006)

- Epenthetic [ə] in /lm/: No /lm/ in paragraph
- /v ~ w/ confusion: very rare, 1 or 2 speakers
- Glottalization of final /d/: not in *red bags*
- /æ ~ e/ confusion (*slabs*):

Phoneme	Frequency
[æ]	12
[ɛ]	1
[a]	1

Dutch: Error hierarchy

Van den Doel (2006)

Severity	British (RP)	American English
> 3.5		Fortis/lenis neutralization Use of uvular-r /R/
2.2-3.5	Fortis/lenis neutralization Use of uvular-r /R/ <u>/θ, ð/ ~ /t, d/</u> Glottalization of final /d/ Epenthetic [ə] in /lm/ /v ~ w/ confusion /æ ~ e, ʌ ~ ɒ, ʊ ~ u:/ Unaspirated [t]	<u>/θ, ð/ ~ /t, d/</u> Glottalization of final /d/ Epenthetic [ə] in /lm/ /v ~ w/ confusion /æ ~ e/ confusion Inappropriate post-vocalic r

- “Severe” and “characteristic” are different things
- Characteristic features measure provides new information

Conclusions

- Statistical evidence for characteristic features
- Characteristic features are L1 interference
- Measure of characteristicness only somewhat overlaps with perception of severity
- Distinctiveness can also identify some errors
- New source of information on accents
- Can be applied to other languages (if transcribed)

Homework: Polish

R	Word	Score	Characteristic forms	Native forms
1	kids	1.24	kɪts (5/13 : 7/181) kɪds (2/13 : 7/181)	kɪdz (0/13 : 24/181) kʰɪdz (0/13 : 16/181)
2	please	1.11	plɪs (5/13 : 1/181) əplɪs (2/13 : 0/181)	pʰliːz (0/13 : 39/181) pʰliːz̥ (0/13 : 31/181)
3	these [1]	0.87	ɖɪs (3/13 : 0/181) ɖɪs (3/13 : 3/181)	ðiːz (0/13 : 35/181) ðiz (1/13 : 19/181)
4	call	0.80	kɔl (6/13 : 12/181) kɔlʷ (2/13 : 6/181)	kʰalʷ (0/13 : 48/181) kʰɔlʷ (1/13 : 13/181)
5	for [1]	0.78	fɔɹ (7/13 : 24/181) fɔɹ (2/13 : 7/181)	fə (0/13 : 60/181) fə (0/13 : 26/181)

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Measures: detail

$$\bar{d}_f^l = \frac{2}{|l|^2 - |l|} \sum_{s, s' \in l} d_f(s, s')$$

Representativeness

$$\bar{d}_f^{-l} = \frac{1}{|l|(|G| - |l|)} \sum_{s \in l, s' \notin l} d_f(s, s')$$

Distinctiveness

$$\frac{\bar{d}_f^{-l} - \bar{d}_f}{sd(d_f)} - \frac{\bar{d}_f^l - \bar{d}_f}{sd(d_f)}$$

Score

l = native language under consideration, consisting of $|l|$ speaker samples

G = larger group of languages, $|G|$ speaker samples

s = speaker

f = feature

d = measure of between-speaker difference with respect to a feature f