Measuring Language Variation

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Overview

- Backgound
- Measuring dialect variation with Levenshtein distance
- The phonetic puzzle
- Levenshtein distance and perceptual distance
- SweDia2000
- Measuring dialect variation acoustically
- Visualizing results: Multidimensional scaling
- Future work

Background

- dialectometry = measuring dialect. Term invented buy Jean Séguy.
- aim: find dialect borders and explore dialect continua
- method: find a measure for measuring linguistic distance between dialects

Levenshtein distance

- edit distance, calculates the cost of changing one string to another
- applied for comparison of Irish dialects by Kessler 1995
- later applied to American English, Bantu languages, Bulgarian, Chinese, Dutch, German, Norwegian, Sardinian
- example Lyngby [ʔeːni] vs. Helsinki [eːnɪɑ] 'agreed'

Lyngby	ʔeːni	remove ʔ	1
	eːni	substitute i by ɪ	1
	eːnɪ	insert ɑ	1
Helsinki	eːnɪɑ		
			3

Levenshtein distance

Length normalization

	1	2	3	4	5
Lungby	ʔ	eː	n	i	
Helsinki		eː	n	ɪ	a
	del			sub	ins

non-normalized distance: 3
normalized distance: 3/5 = 0.6 or 60 %

Phonetic Puzzle

- theorem: given segment distances, Levenshtein algorithm finds optimal alignment
- what are good segment distances?
- various feature systems: Vieregge-Cucchiarini, Almeida-Braun
- "acoustic" distance
- stochastic learning procedure (Pair Hmms)
- very limited improvement over binary segmental table

Phonetic Puzzle

Why is detailed phonetic information not helping?

- hypothesis 1: transcriptions are phonetically unreliable
- hypothesis 2: previous attempts were too ambitious, trying to characterize *all* distinctions
- hypothesis 3: we are past the size where fine discrimination matters
- others?

Predicting intelligibility and perceived linguistic distance (Beijering, Gooskens and Heeringa 2008)

Research questions:

- How well can Levenshtein distance predict perceptive distance and intelligibility?
- How well can normalized Levenshtein distance predict perceptive distance in comparison to non-normalized Levenshtein distace?

Data:

- recordings of The North Wind and the Sun in 18 Scandinavian varieties
- phonetic transcriptions of cognates (on average 98 words)

Predicting intelligibility and perceived linguistic distance (Beijering et al. 2008)

Perceptual distance:

- listeners: 3 groups 15-19-year-olds from Copenhagen
- stimulus data: the whole recording of the fable in 6 varieties
- task: judge distance to Standard Danish on a scale from 1 to 10

Intellegibility:

- listeners: 18 groups 15-19-year-olds from Copenhagen
- stimulus data: 6 sentences in 6 varieties
- task: translate into Standard Danish

Predicting intelligibility and perceived linguistic distance (Beijering et al. 2008)

Correlation with Levenshtein distance:

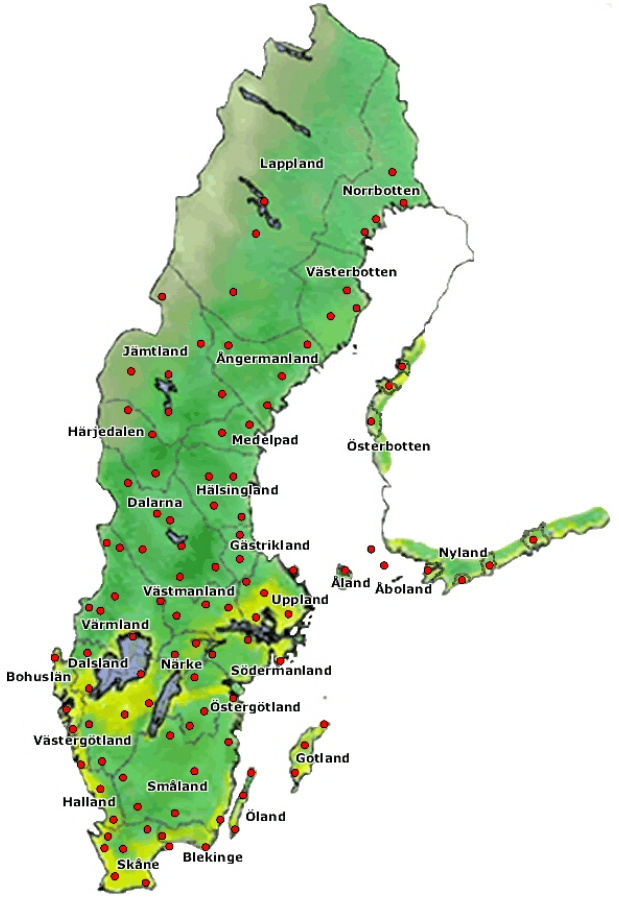
	normalized	non-normalized
Perceptual distance	0.52	0.62
Intellegibility	-0.86	-0.79

Differences between normalized and non-normalized Levenshtein distances are not significant.

Conclusion: Levenshtein distance a better predictor of intelligibility than of perceived linguistic distances

Swedish vowel data

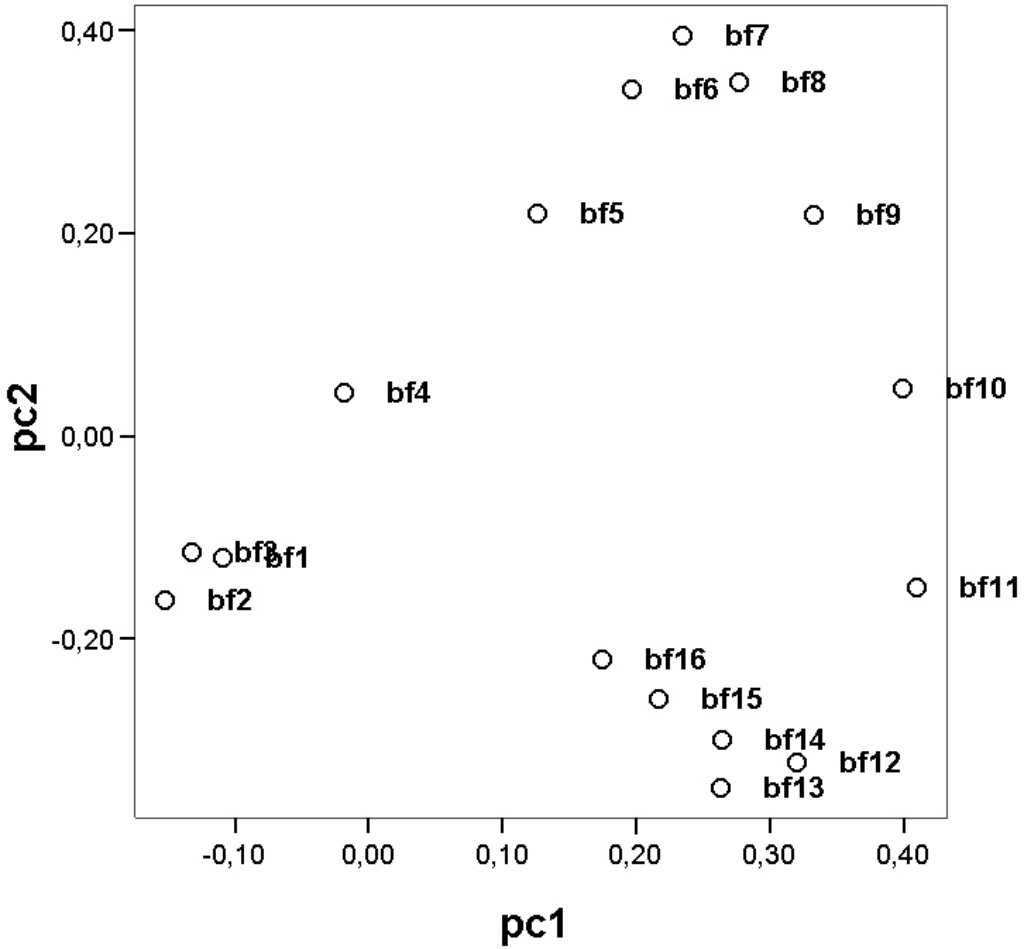
- SweDia2000: project carried out by the universities of Lund, Stockholm and Umeå 1998-2001 (Bruce, Elert, Engstrand and Eriksson 1999)
- 105 sites in Sweden and Swedish-speaking Finland
- 12 speakers from each site: 3 elderly women, 3 elderly men, 3 young women, 3 young men
- vowels elicited with existing one-syllable words with the target vowel in a coronal consonant context
- 19 words of which the vowels cover the standard Swedish vowel space



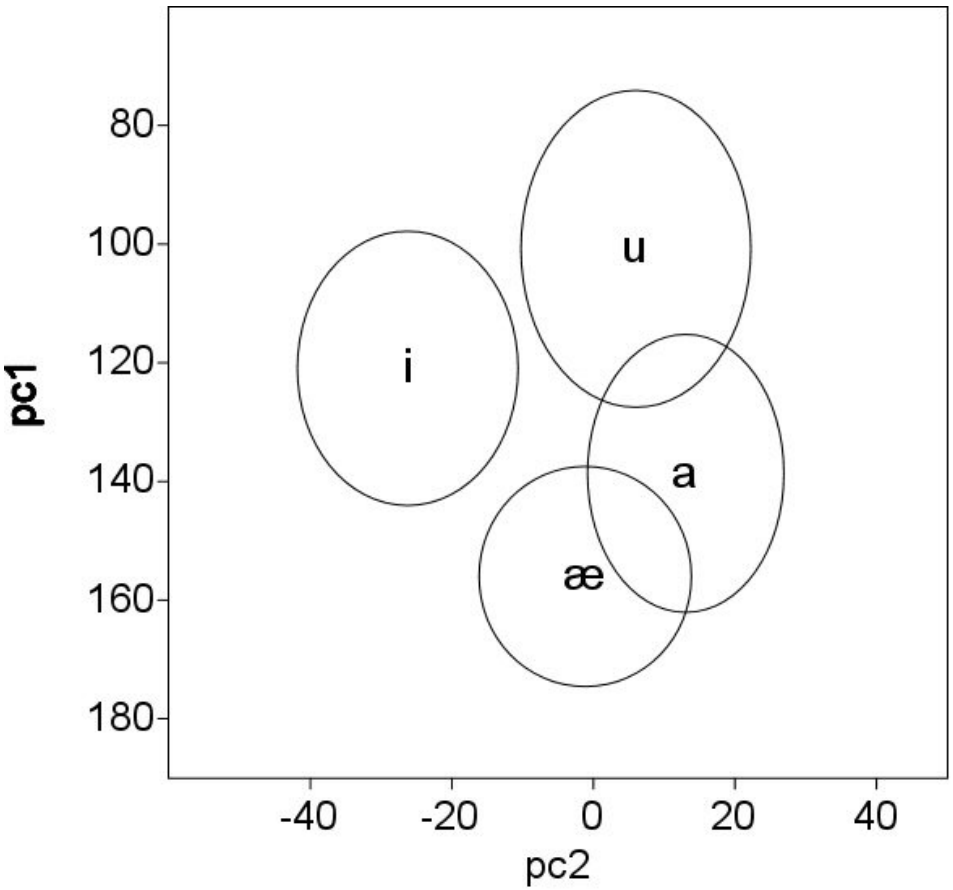
Acoustic method

- principal component analysis (PCA) on bandfiltered spectra (Jacobi, Pols and Stroop 2005, Pols, Tromp and Plomp 1973)
- vowel spectra filtered up to 18 Bark
- PCA built on 4 anchor vowels ([i], [æ], [a] and [u]) of equally many men and women from every site (in total 300 speakers from 83 sites)
- two first principal components (85.6 % of total variance explained) used as acoustic measure of vowel quality
- creaky voice is a problem for the method: F0 controll

Factor loadings



Factor scores

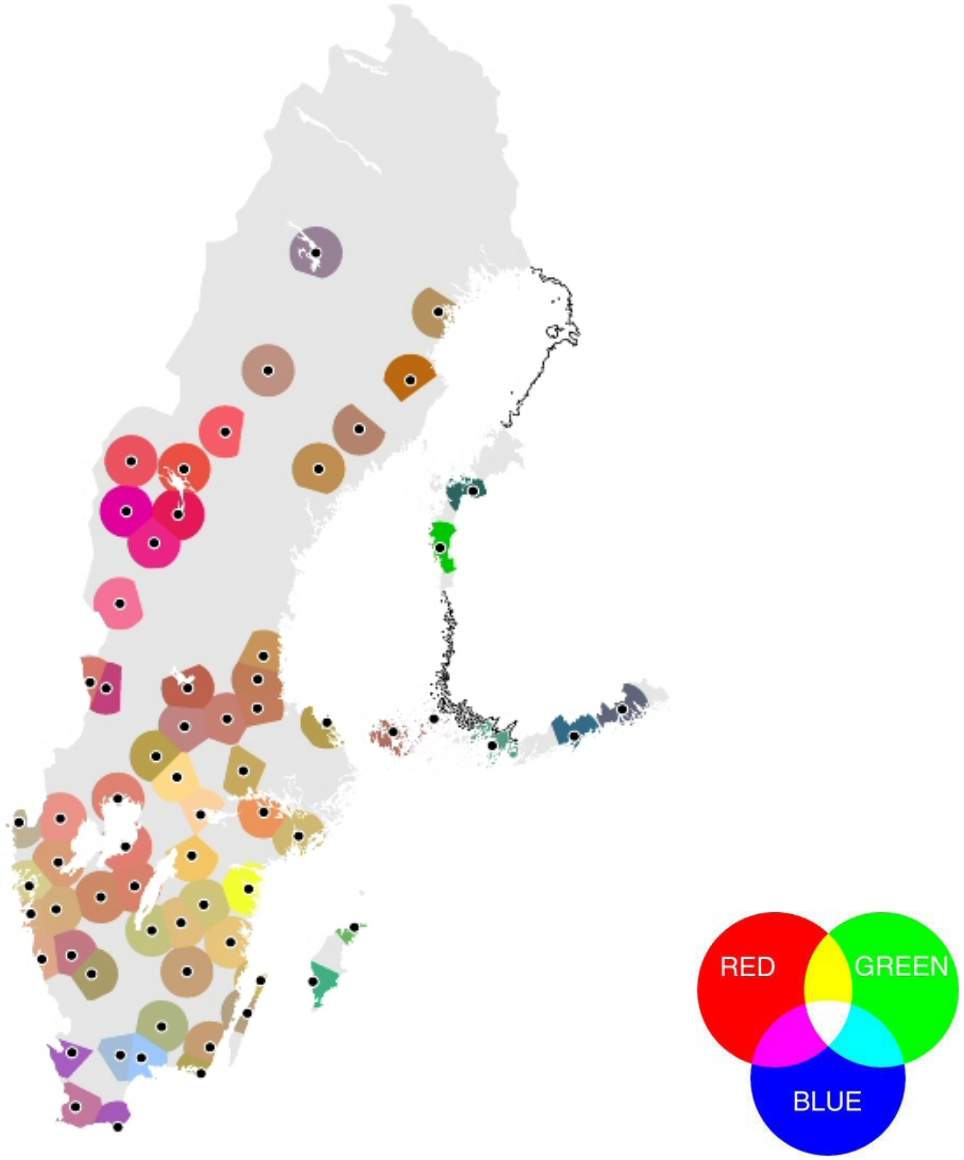


Dialect distances

- linguistic distances measured for all pair of sites: Euclidean distances of pc1 and pc2 of all words (averages per site) $\sqrt{\sum_{i=1}^{n}(p_i - q_i)^2}$
- distances analyzed with multidimensional scaling (MDS): vizualisation of distances in a low dimensional space
- visualizing three dimensions with RGB-colours gives maps that can show a dialect continuum (Heeringa 2004)

MDS: dimensions 1 and 2

MDS: dimensions 3, 4 and 5



MDS: dimensions 3-5

Future work

- work on the acoustic method (rotation)
- include more measuring points within a segment (diphthongization)
- extracting underlying linguistic structure (PCA)

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