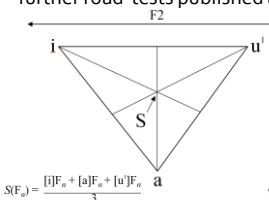


1. Watt & Fabricius S-centroid normalization

- a vowel extrinsic, formant intrinsic centroid-based normalization algorithm (Watt & Fabricius 2002; Fabricius, Watt & Johnson 2009)
- built into the NORM normalization and plotting suite (Thomas & Kendall 2007)
- has been applied to a broad range of data from varieties of English and other languages (Kamata 2006; Winn *et al.* 2008; Mesthrie 2010; Bigham 2010; Simonet 2010)
- further road-tests published and in progress (Clopper 2009; Flynn 2011)

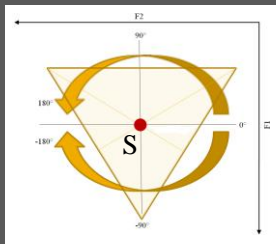


- centroid (S) of triangular vowel space is means of F1 and F2 values for [i], [a] and (hypothetical) [u] vowel
- F1, F2 of [u] = F1 of [i]

- all original Hz values then expressed relative to S

2. S-centroid angle method

- makes vowel space configurations more easily comparable across speakers
- angles on F1-F2 plane relative to S
- S (with co-ordinates 1,1) is common to all speakers in sample when using W&F (or modified W&F) method



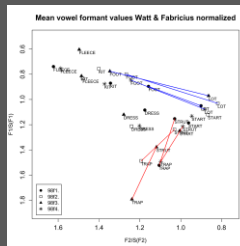
Advantage: unlike real vowels, S does not move over time because it is a product of the normalization algorithm

- angles are positive above horizontal line, and run counterclockwise from 0° to 180°; negative and clockwise below it (0 to -180°)

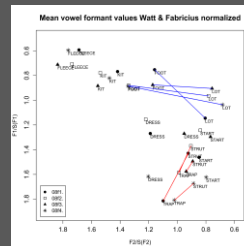
3. S-centroid anchor method

- documents interspeaker variation and change over time by measurements in degrees relative to a stable point, rather than eyeball judgments of relative vowel locations (measured in Fabricius 2007)
- can be used in combination with Euclidean/Cartesian distances (as in Fabricius 2007; Richards, Haddican & Foulkes 2009)
- quantification enables further statistical testing

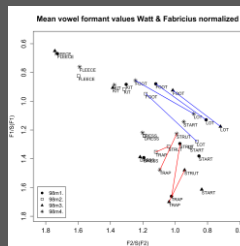
Illustrated here with RP generational data from Hawkins & Midgley (2005), Moreiras (2006) (oldest and youngest age groups); template for spiderweb diagrams (see below) available from Anne Fabricius: fabri@ruc.dk



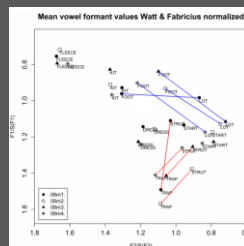
Female speakers aged 20-23 in 1998 (all data here from Fabricius' Cambridge corpus)



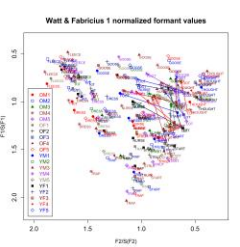
Female speakers aged 20-23 in 2008



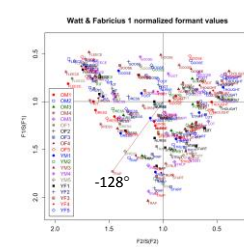
Male speakers aged 20-23 in 1998



Male speakers aged 20-23 in 2008



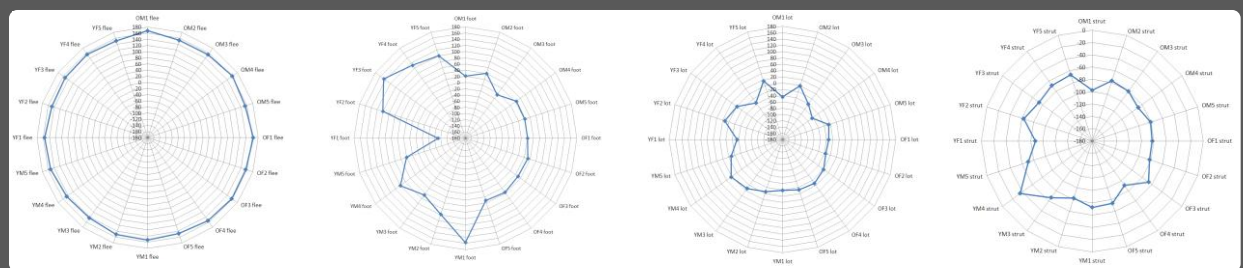
Variation in LOT/FOOT configurations, RP data



Same data, with centroid overlaid

4. Future directions

- can we use these methods to make a principled distinction between the Centre and Periphery of a vowel space (Labov 1994)?
- what will be the value of adding angle measurements to the set of criteria used to gauge the efficacy of normalization algorithms?
- how can angle measurements be adapted to deal with clouds of tokens rather than average points, as at present?
- what statistical models are optimal for data of this kind?



FLEECE
stability over apparent time

FOOT
fronting among younger speakers

LOT
some variability in OM and YF groups

STRUT
variability -40° ~ -80°

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Acknowledgments

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