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IVIP

Phonetic correlates of listeners' judgements of voice similarity within and across accents

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IVIP: Improving Voice Identification Procedures

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Project Team

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Improving Voice Identification Procedures (IVIP)

- Multi-disciplinary approach (psychology, linguistics, criminology & law)
- 4 different strands:

Strand 1: What are the optimal parameter values for voice parade procedures?

Strand 2: What are the psycho-phonetic underpinnings of voice distinctiveness?

Strand 3: How do social stereotypes affect voice identification?

Strand 4: How accurate are the normative assumptions of criminal justice practitioners in respect of voice identification procedures?

Outline

- Notion of Perceived Voice Similarity and previous research
- Experiment structure – stimuli, task, listeners
- Results – MDS and correlation analysis
- Main findings and discussion

Perceived Voice Similarity (PVS)

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- Principles for foil selection for voice parades still evolving
- Perceived voice similarity not well understood

- *What phonetic features contribute to certain speakers being judged as sounding more similar to or more different from each other?*
- *How do different accents affect judgements of voice similarity?*

Perceived Voice Similarity (PVS)

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- Within a group of speakers of same sex, age and accent background, listeners will perceive some speakers as more similar-sounding than others
- These similarity judgements are due to:
  - individual variation in vocal tract anatomy

    &

  - individual choices the speakers make in implementing their linguistic systems
- In the experiment to follow, we control the demographic characteristics (sex, age, accent) to enable us to examine this individual variation within each demographic profile

Previous research

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- Little previous (phonetically-informed) research (cf. Remez et al. 2007, Baumann and Belin 2010)
- Earlier study of PVS in Standard Southern British English (SSBE) (Nolan, McDougall and Hudson 2011, McDougall 2013)
    - developed from ESRC *VoiceSim* project with Francis Nolan and Toby Hudson
- Study by McDougall (2016) of SSBE versus York English

Summary of results - McDougall (2016)

- f0 important for SSBE, but less so York, possibly due to larger long-term f0 range for SSBE population
- Long-term formants playing key roles in PVS for both SSBE and York
- Limited role played by articulation rate, some significance for York
- Some agreement, but variation between SSBE/York listener groups on judgements of PVS

Cambridge (SSBE)

York

IVIP experiment on PVS

- 6 groups, 4 accents

Group	**Accent**	**Sex and age**	**No. speakers**
DyViS 1	SSBE (Standard Southern British English)	male, 18-25	15
DyViS 2	SSBE	male, 18-25	15
DyViS 3	SSBE	male, 18-25	15
YorViS	York English	male, 18-25	15
WYRED 1	Bradford English	male, 18-30	15
WYRED 2	Wakefield English	male, 18-30	15

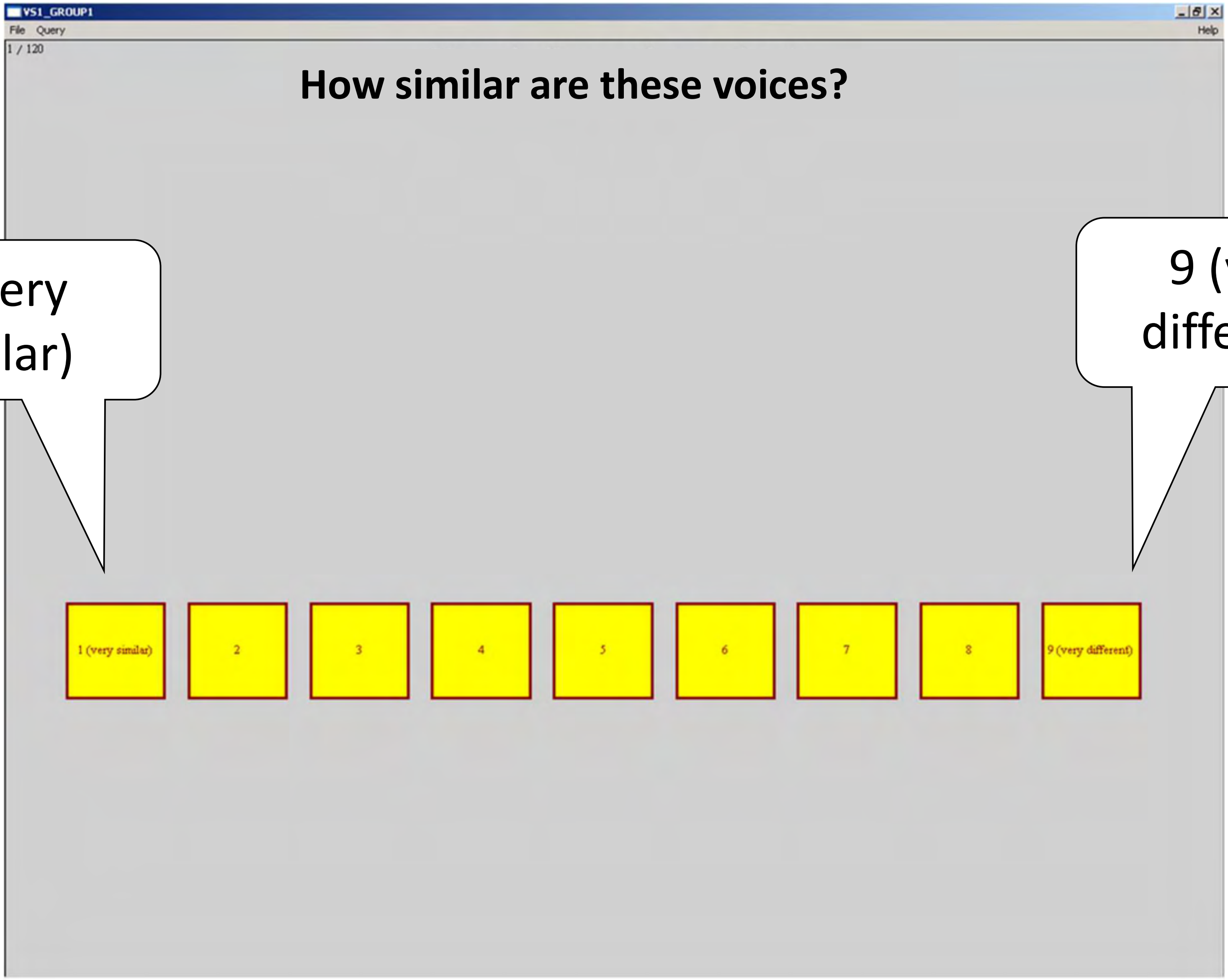
- *DyViS*, *YorViS* and *WYRED* databases – spontaneous speech, same elicitation technique

DyViS: Nolan et al. (2009);
YorViS: McDougall et al. (2015);
WYRED: Gold et al. (2018)

Stimuli

- two samples (approx. 3 secs) of spontaneous speech per speaker (telephone call, full bandwidth)
- within each 15-speaker group, samples paired, including same-speaker pairs (120 per group)
- task: to rate voices on 9-point distance scale from ‘very similar’ to ‘very different’

- DyViS 1, YorViS – in person (Praat)
- DyViS 2&3, WYRED 1&2 – online (Gorilla)



How similar are these voices?

1 (very similar)

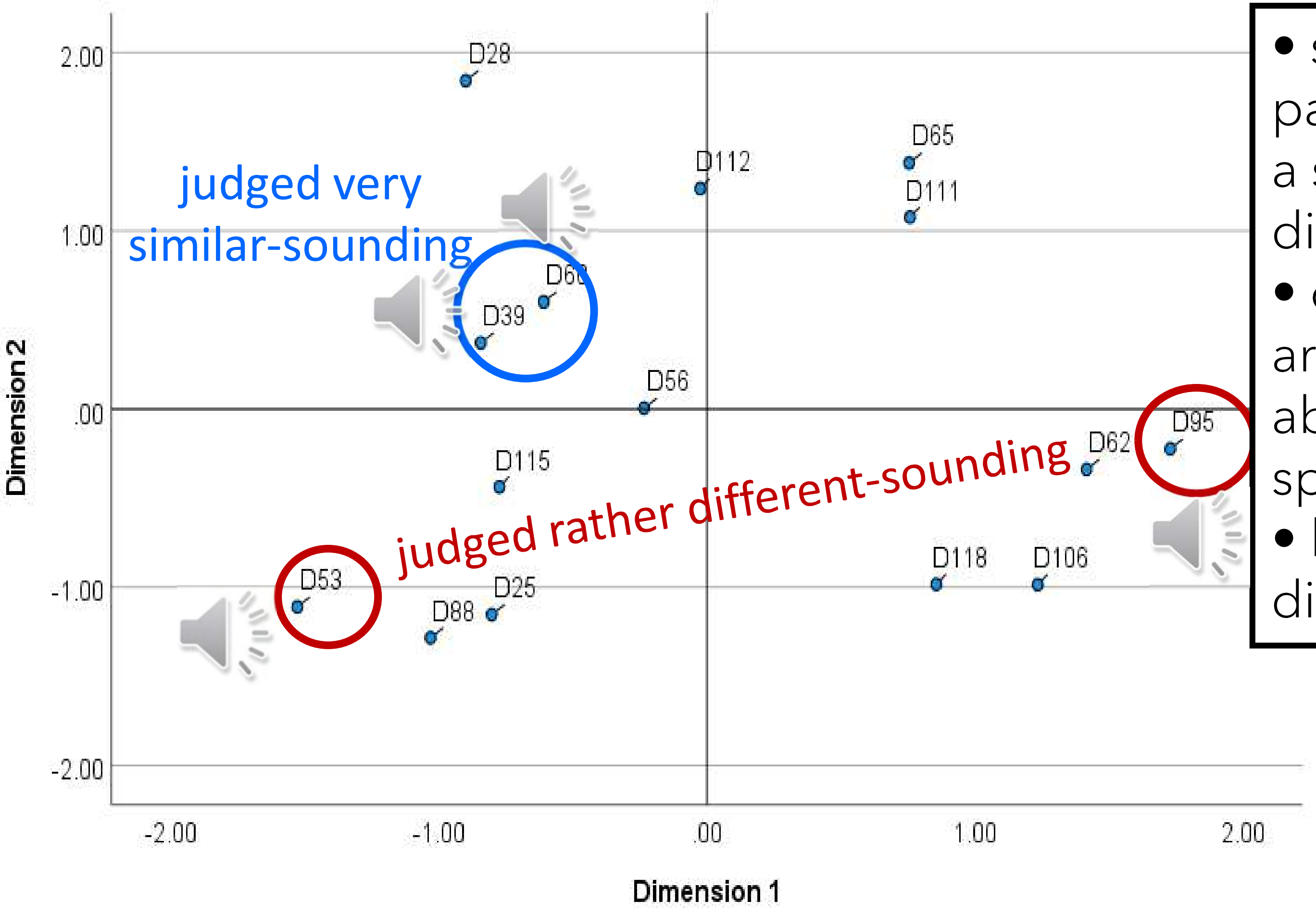
9 (very different)

Listeners

- N = 120 participants recruited at University of Cambridge, Nottingham Trent University and via Prolific (20 per group)
  - born in and lived most of their pre-18 lives in Great Britain
  - 1st language English
  - No hearing loss or hearing difficulties
  - Aged 18-40
  - Approx. half male, half female

Multidimensional scaling

SSBE group 1

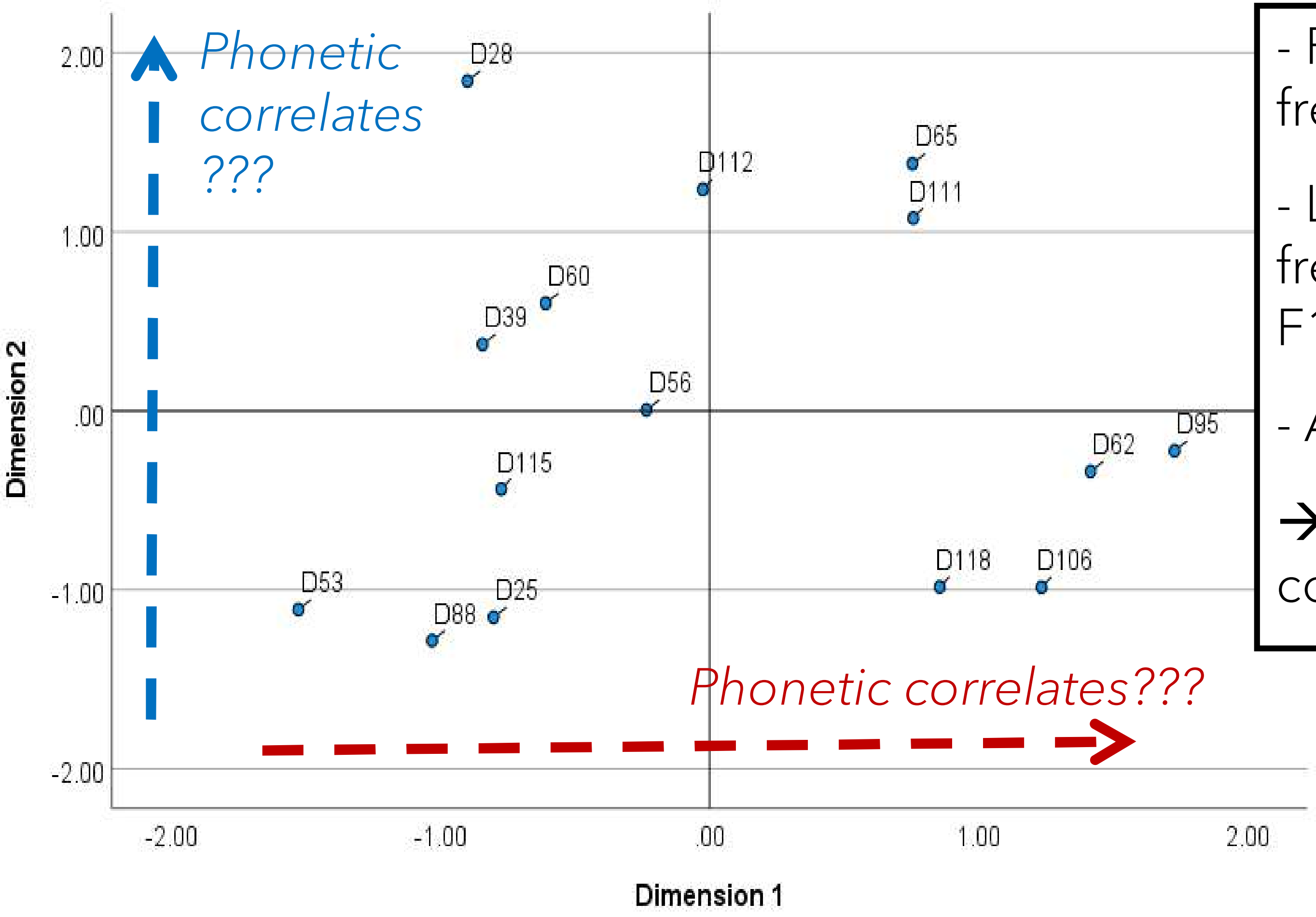


- summarises many pairwise distances in a smaller no. of dimensions
- objects (speakers) are placed in an abstract perceptual space
- here: 1st two of five dimensions shown

INSCAL, 5D solution: Stress = 0.17430, RSQ = 0.27713

Multidimensional scaling

SSBE group 1



- Fundamental frequency (f0)

- Long-term formant frequencies:
F1, F2, F3, F4

- Articulation rate

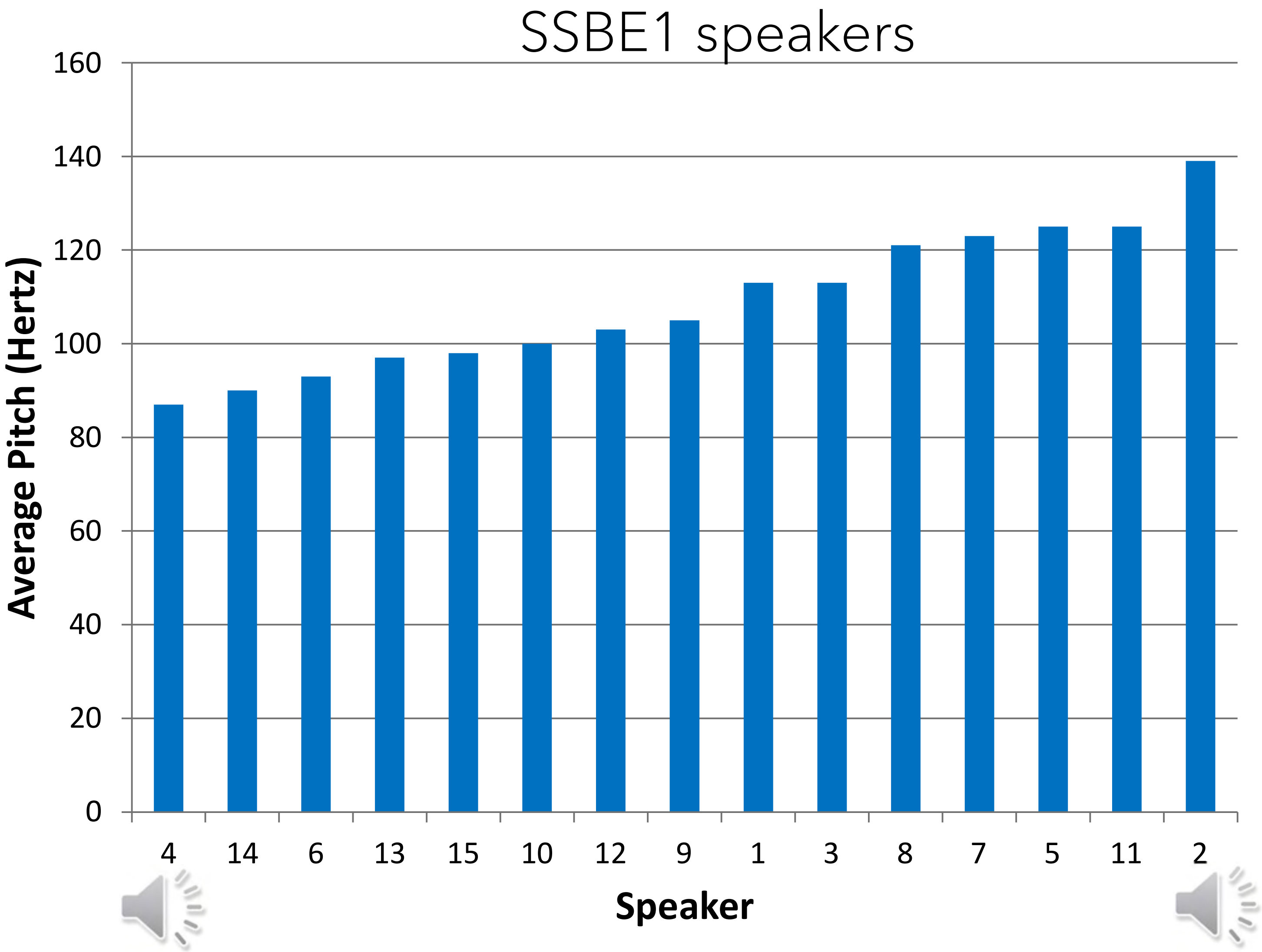
→ Test with Pearson correlation

INSCAL, 5D solution: Stress = 0.17430, RSQ = 0.27713

1. Long-term f0

- Long-term f0 calculated for each speaker using 6s speech from the 2 x 3s stimuli
- *Praat* script

1. Long-term f0



2. Long-term formants

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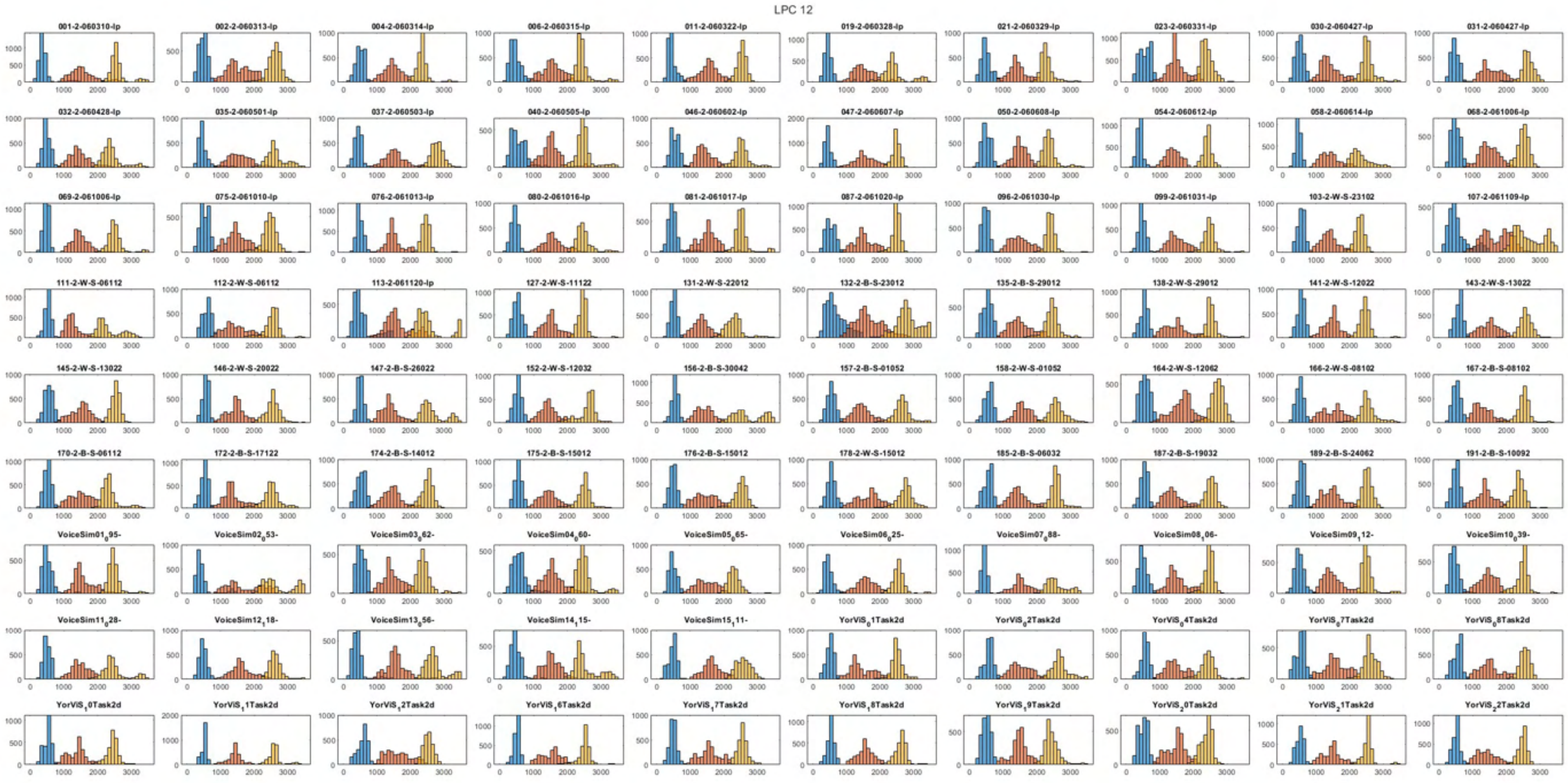
- Vowel/approximant material segmented from telephone task manually
  → 30s per speaker
- Snack Sound Toolkit (Sjölander, 1997)
- LTF for F1 to F4 - stable profiles achieved (except 5 speakers, excluded)
- Mean LTF values F1 to F4 calculated per speaker

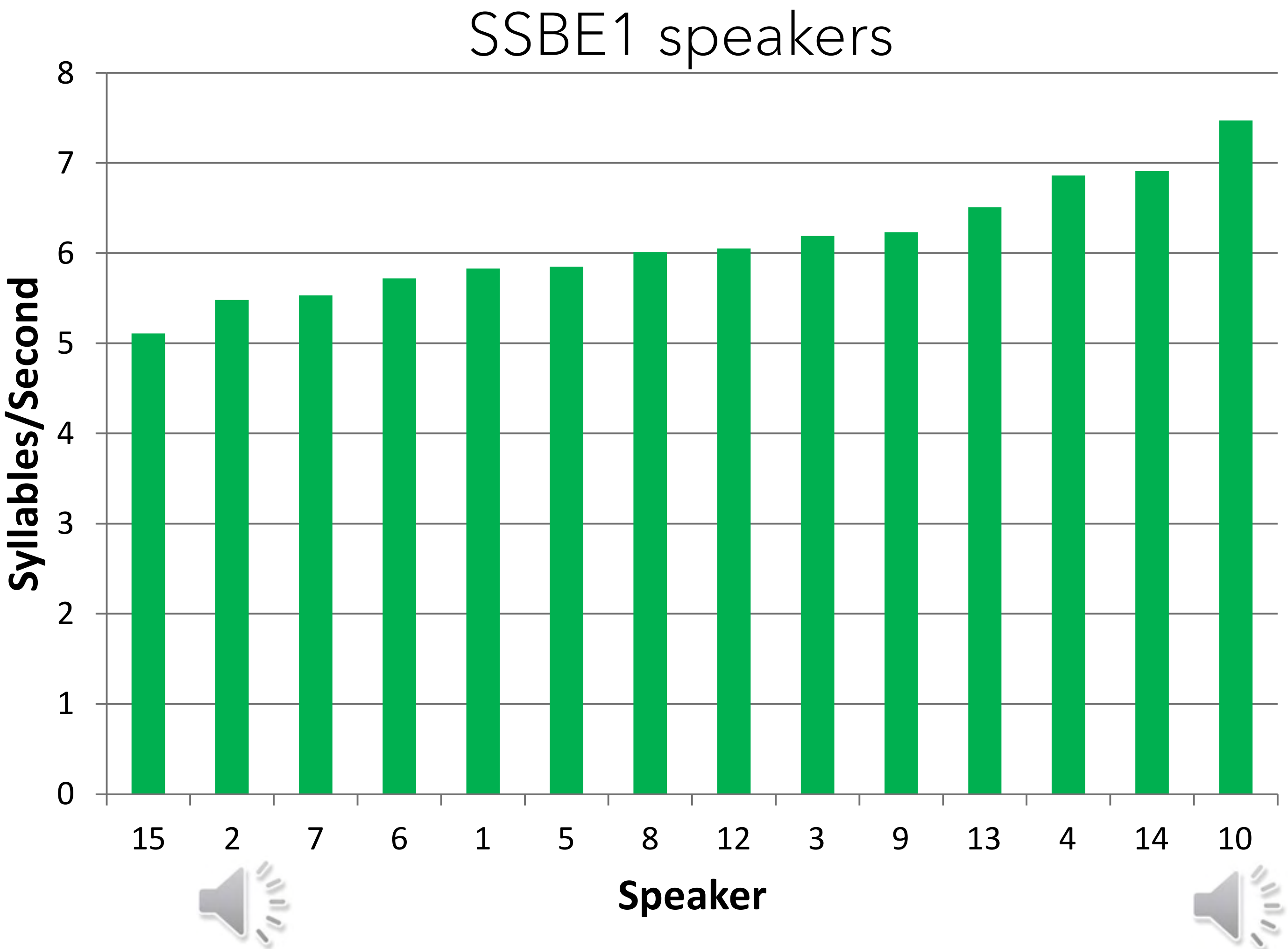
2. Long-term formants



3. Articulation rate

- Articulation rate (AR) calculated using telephone task recordings
- Jessen (2007) procedure for ‘global’ AR
- 30 ‘memory stretches’ of 5-20 phonetic syllables analysed, syllables determined auditorily

3. Articulation rate



Linking Voice Similarity to Phonetic Features

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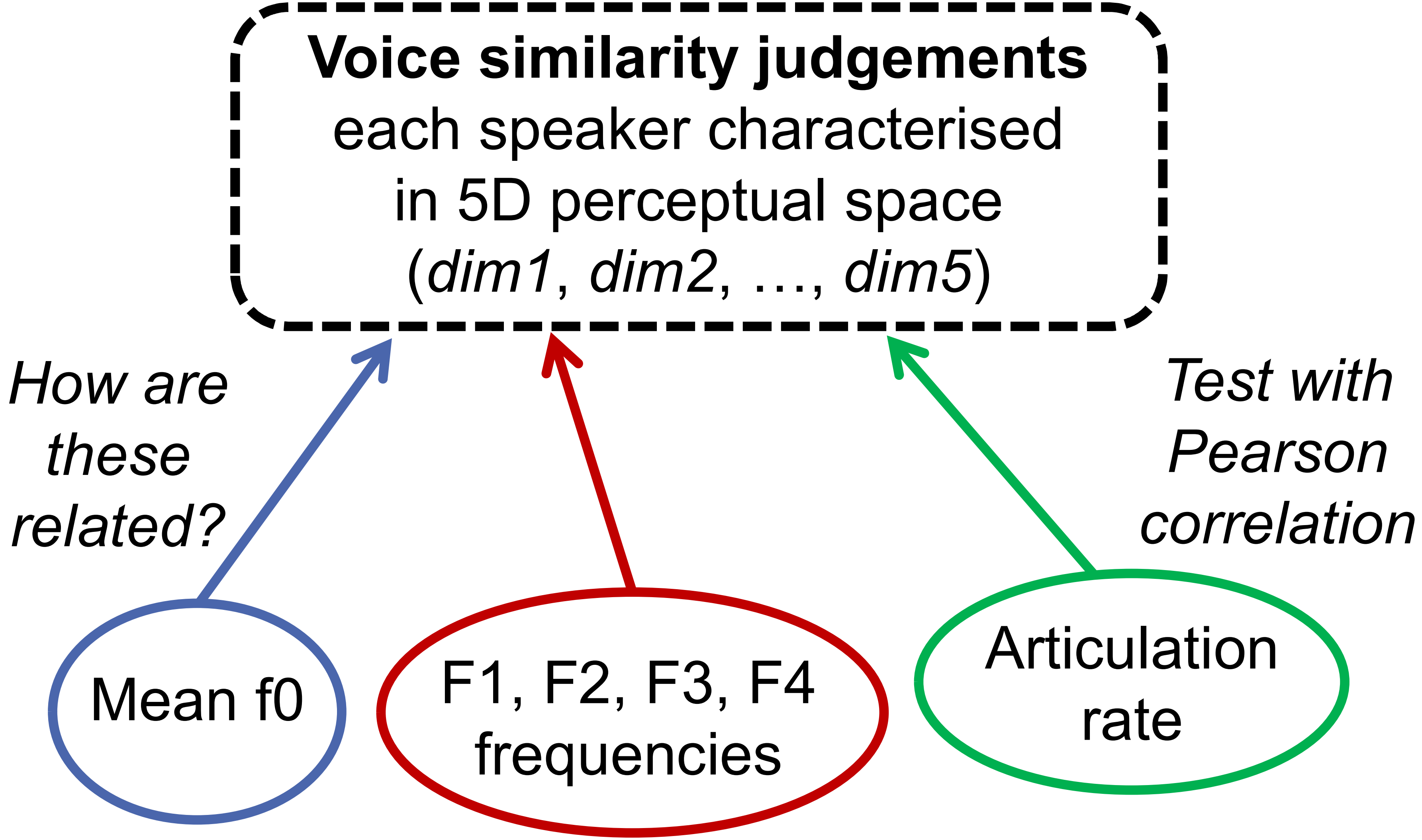


Voice similarity judgements
each speaker characterised
in 5D perceptual space
(*dim1*, *dim2*, …, *dim5*)

How are these related?

Test with Pearson correlation

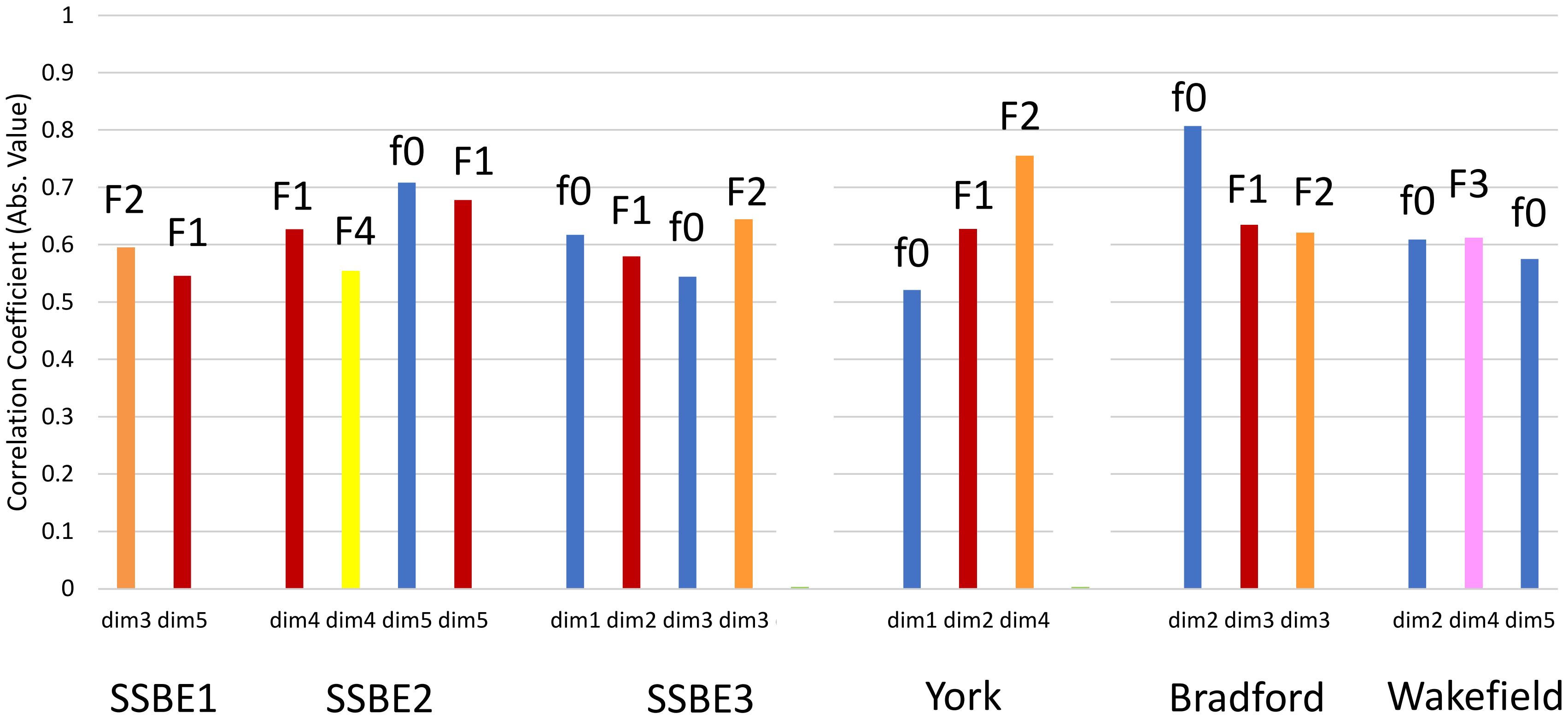
Mean f0

F1, F2, F3, F4 frequencies

Articulation rate

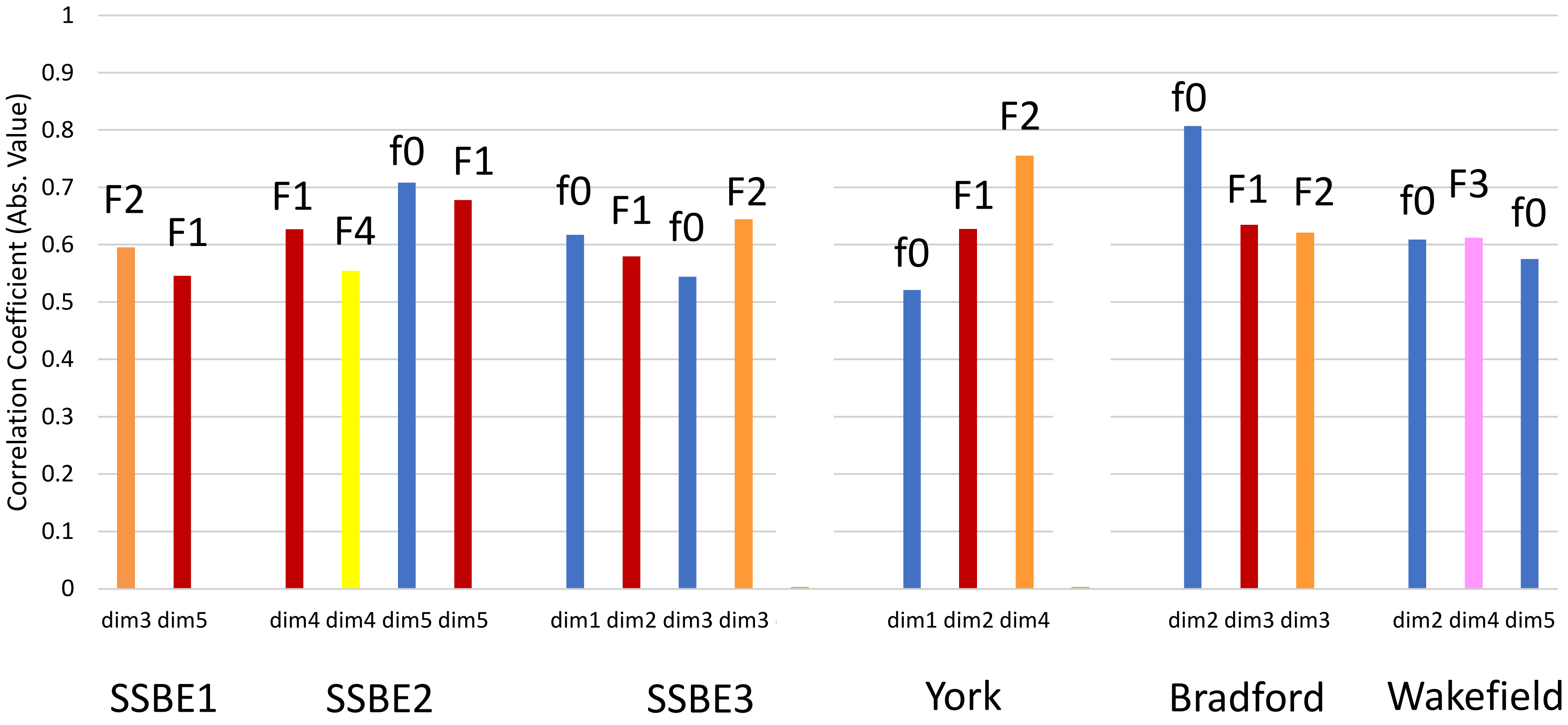
Correlation results – f0 & LTF

- Phonetic features yielding a significant correlation with a perceptual dimension are shown
- The lower the dimension number, the more important the feature



Correlation results – f0 & LTF

- f0 important for all groups except SSBE1
- Long-term formants playing differing roles in each accent
- Varying patterns within SSBE across the 3 groups



Correlation results – f0, LTF & AR

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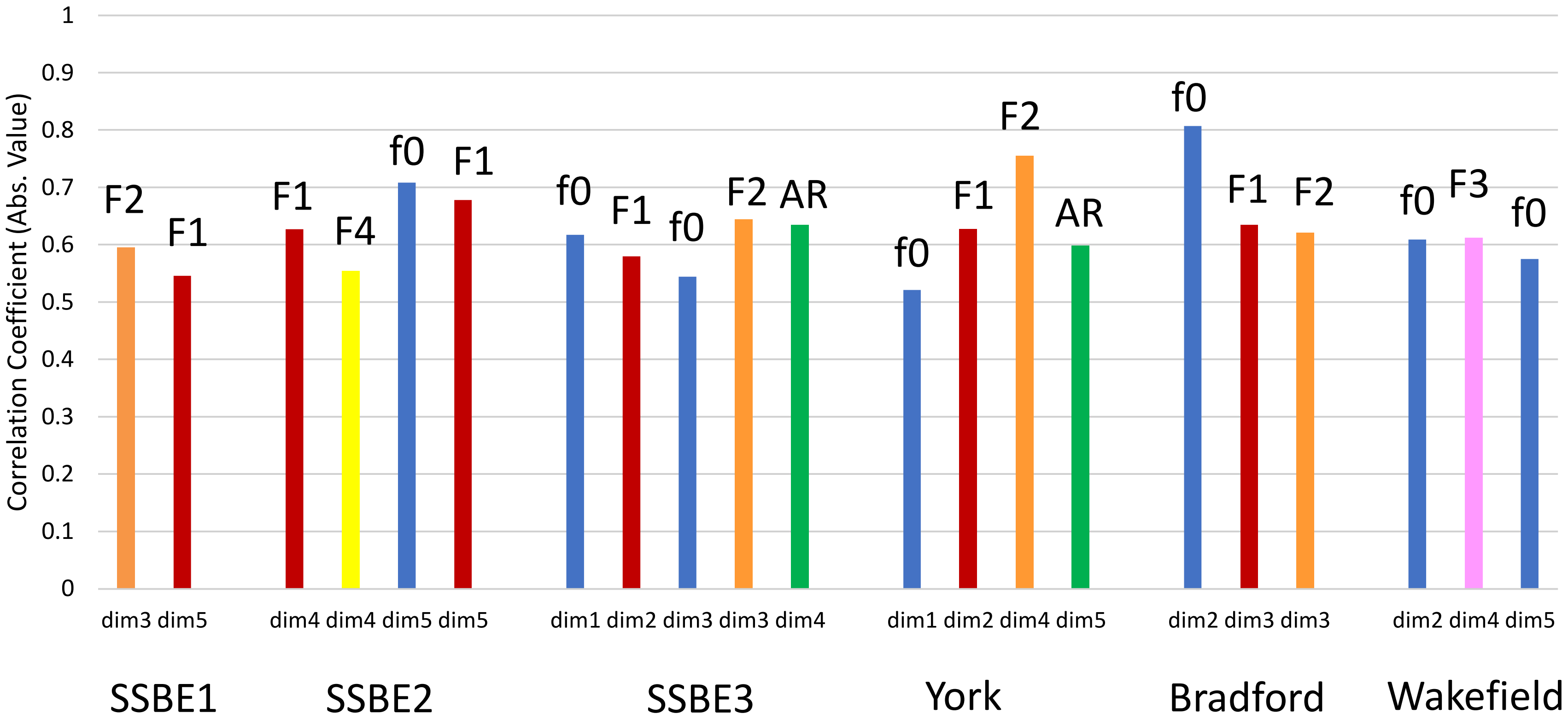
- Articulation rate (AR) playing some role for SSBE3 and York
- Further experiments needed to investigate AR re sample duration (3 sec samples here)



Discussion and further work

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- f0 playing a key role
  - most important feature for each accent (except group 1 in SSBE)
- Long-term formants also playing a role, correlating with higher dimensions for each accent in different ways
- Some role for AR in SSBE and York – more data needed
- These results are for listeners from Britain broadly
- Also need to investigate judgements of mixed-accent groups
- Also Linda Gerlach's PhD research on the relationship between human-judged and ASR-assessed similarity of voices…. (15.30 today!)

See IVIP website for updates

https://www.phonetics.mmll.cam.ac.uk/ivip/

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