How far can phonological properties explain rhythm measures?

Elinor Keane[1], Anastassia Loukina[1], Greg Kochanski[1], Burton Rosner[1], Chilin Shih[2]

[1] Oxford University Phonetics Laboratory, UK
[2] EALC/Linguistics, University of Illinois, Urbana-Champaign, USA

Introduction

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Phonological properties

?

↔

Rhythm measures

e.g.

complexity of consonant clusters

?

↔

variability in duration of consonantal intervals

Introduction

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How far can rhythm measures (RMs) be predicted from the phonological properties of texts?

How closely are phonological properties and RMs correlated?

→ text-dependence of RMs

How much variability in RMs is there between speakers?

→ speaker-dependence of RMs

How much variability in RMs is there between languages?

→ language-dependence of RMs

Corpus: speakers

- 62 speakers:
  - 24 British English (Southern England)
  - 10 Russian (Moscow/St.-Petersburg)
  - 10 Taiwanese Mandarin (Taipei)
  - 9 Modern Greek (Athens)
  - 9 French (Paris)
- 20-28 years old
- <4 years outside their home country

Corpus: texts

- 40 short texts for each language:
  - paragraphs from '*Harry Potter and the Chamber of Secrets*'
  - Aesop's fables
  - children's poetry

= 2730 recorded paragraphs

- sentences from '*Harry Potter and the Chamber of Secrets*' for each language

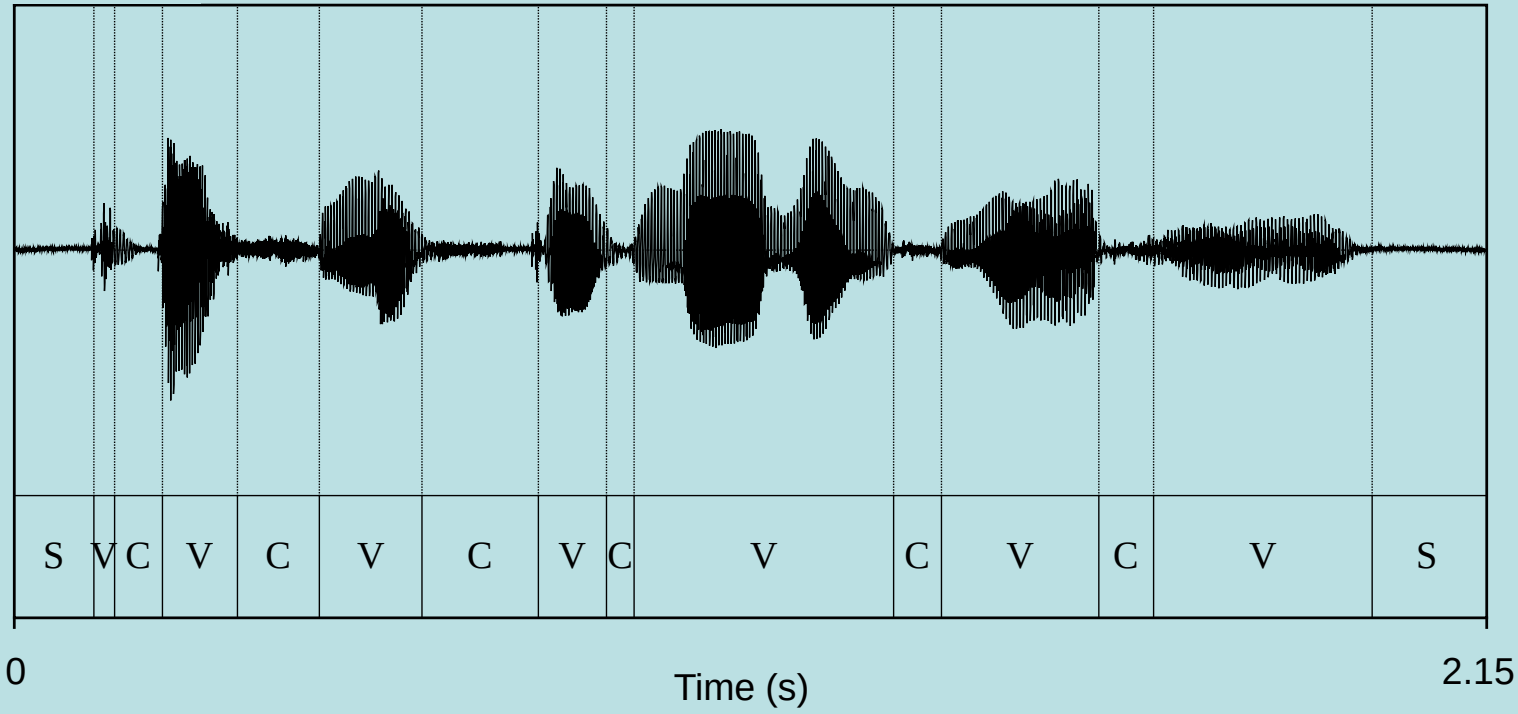
= 22,899 recorded sentences

Segmentation

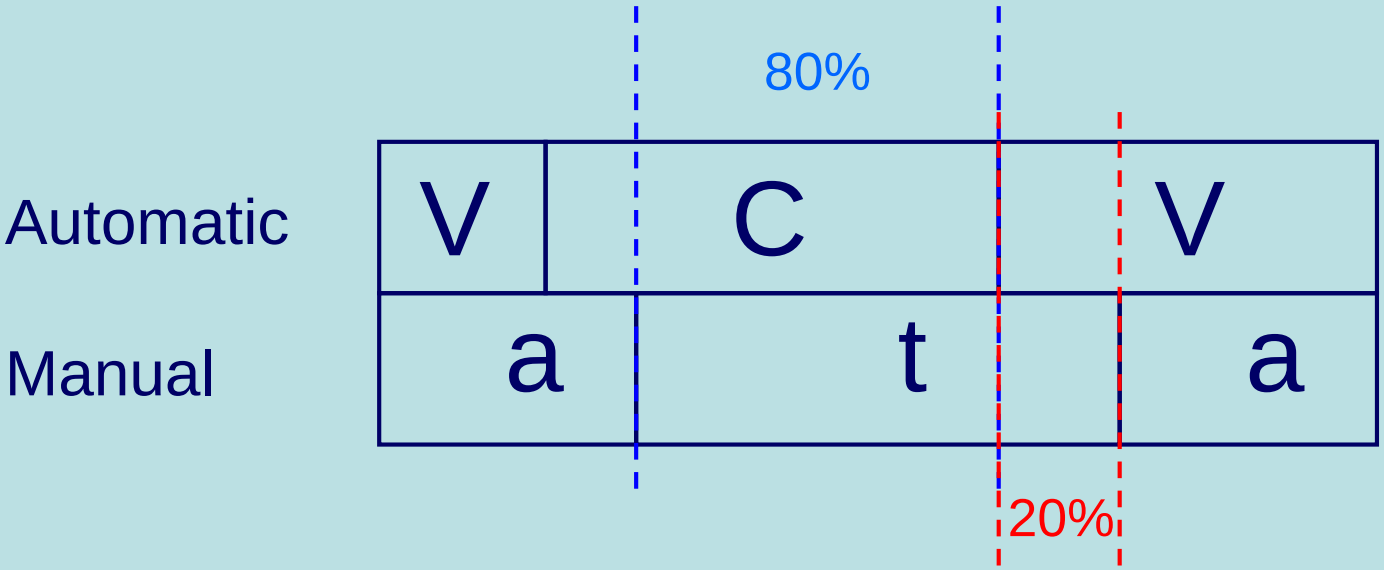
- automatic, using the HTK toolkit
- cross-linguistic
- divided speech into consonant-like, vowel-like and silent intervals

Segmentation

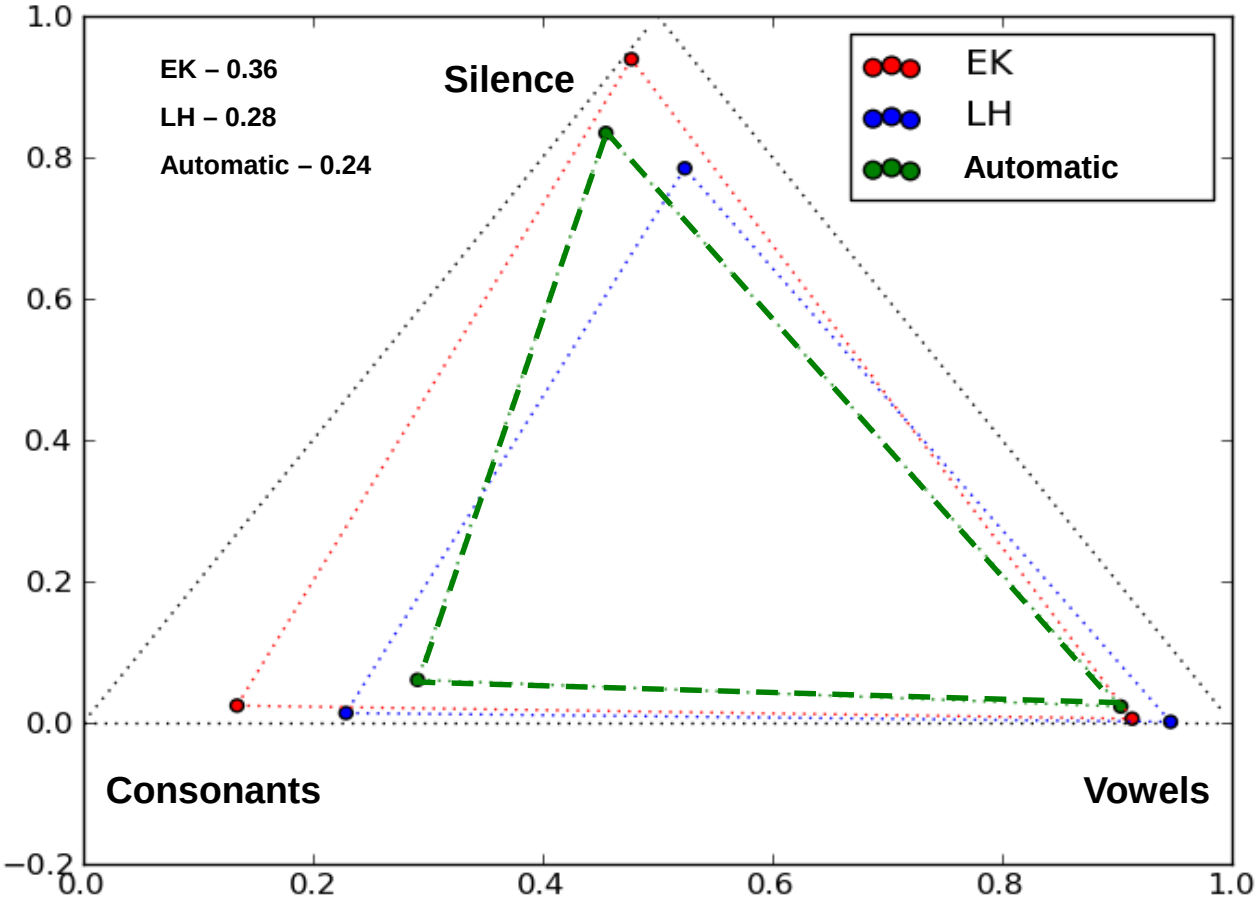
‘The basilisk was moving toward Harry.’



Comparing segmentations



Comparison between segmentations



Rhythm measures

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- statistical indices based on temporal properties (Ramus et al. 1999; Grabe & Low 2002)
- acoustically defined
- typically rely on manual segmentation into vocalic and consonantal intervals

Examples

- global measures, e.g:
  - %V – percentage of vocalic intervals
  - ΔC – standard deviation of consonantal intervals
  - Vdur/Cdur – ratio of vowel to consonant duration
- PVI-like measures, e.g:
  - CrPVI – raw consonantal pairwise variability index
  - PVI-CV – PVI of consonant+vowel group

Phonological properties

- computed from roughly phonemic transcriptions of the texts
- cross-linguistically defined
- plausibly have a direct effect on rhythm measures

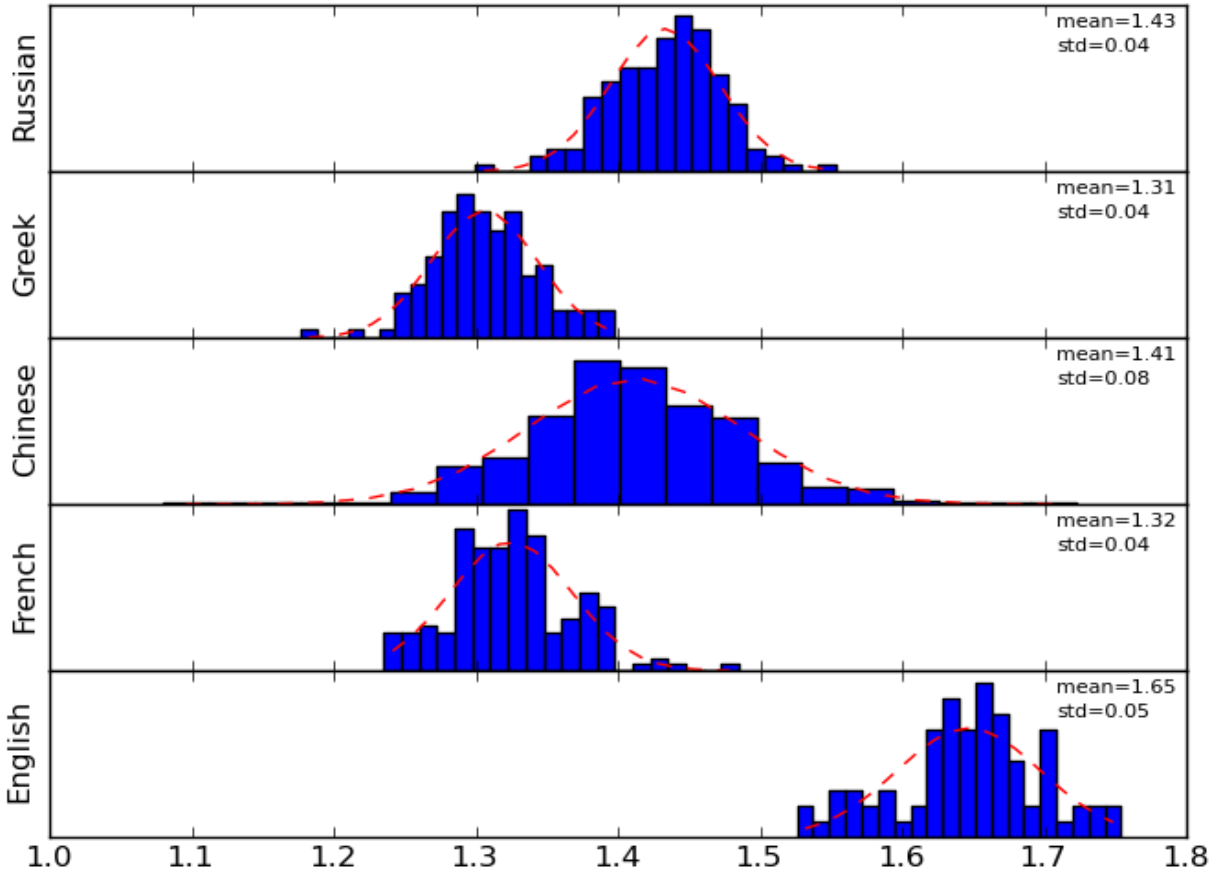
Examples

- **ccluster** – mean number of consonants between vowels
- **voiced** – fraction of voiced segments in total number of segments
- **sonority** – mean sonority index based on scale:

  [stops, fricatives, affricates] – 1
  [nasals, liquids] – 2
  [glides, vowels] – 3

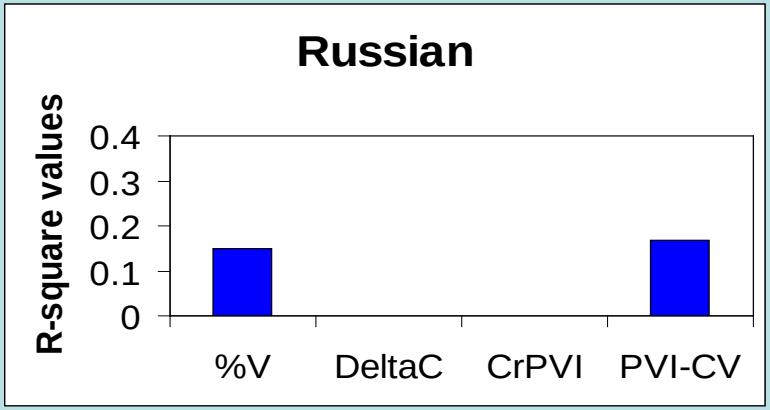
- **pvi-variants**, e.g. ccluster_pvi – mean-square difference between numbers of consonants on adjacent inter-vowel gaps

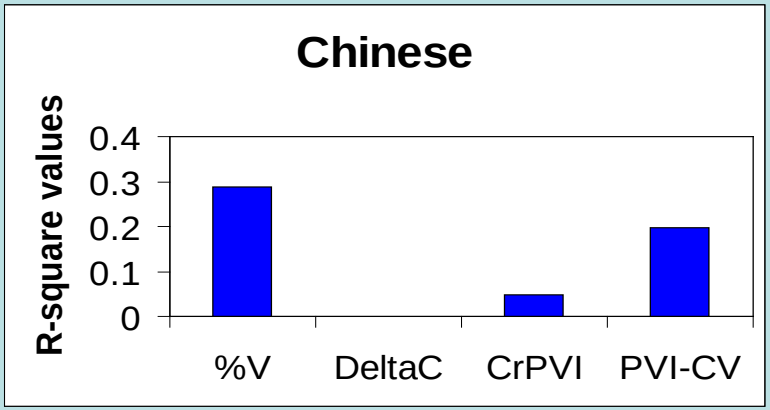
Ccluster for ‘Harry Potter’ paragraphs

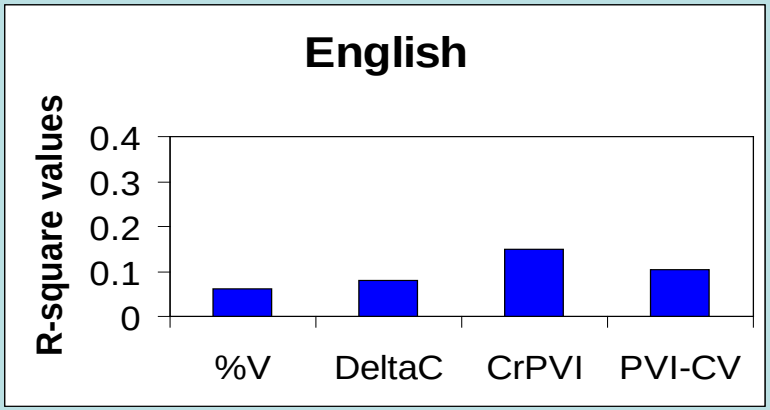


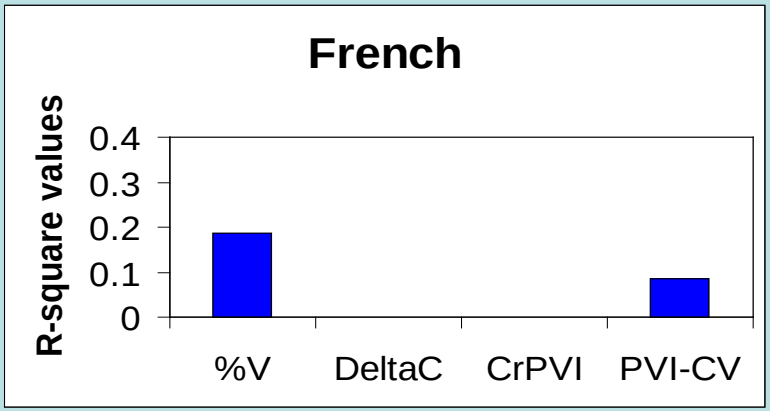
Results

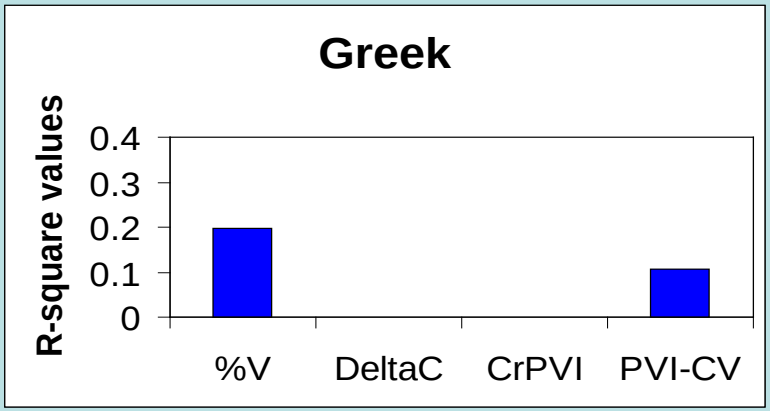
Multiple regression analyses of rhythm measures on all 11 phonological properties







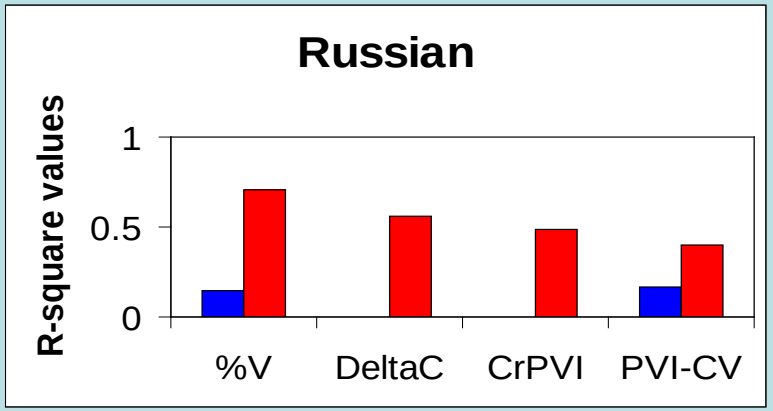


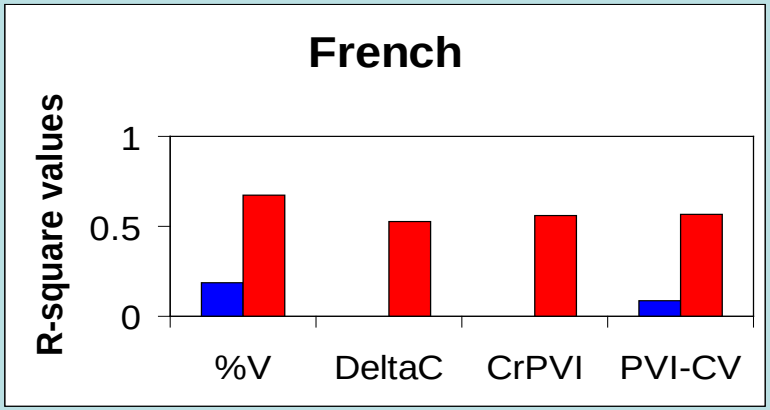


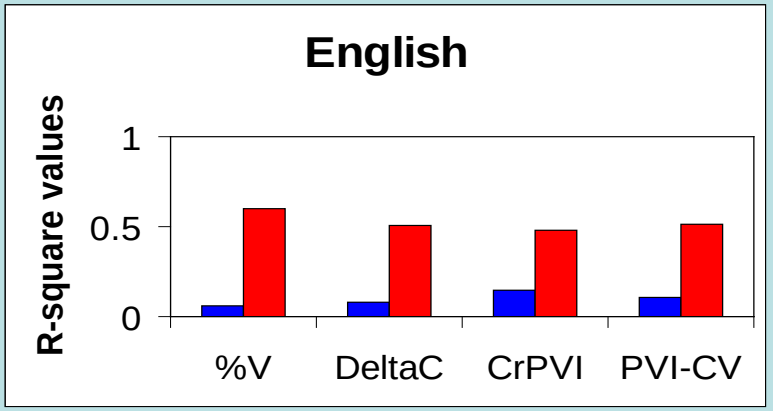
Results

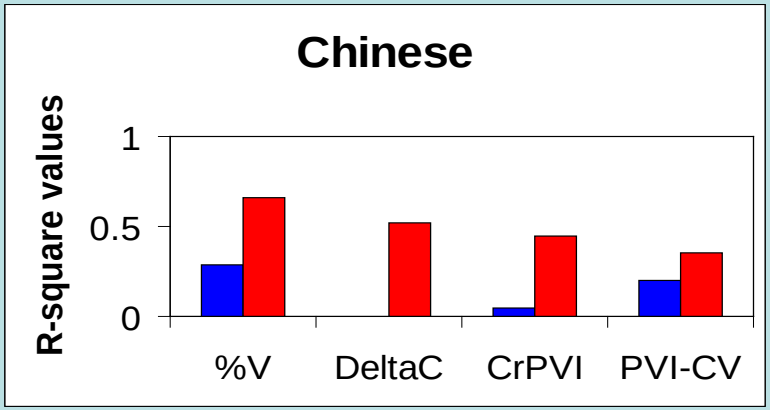
Multiple regression analyses on:

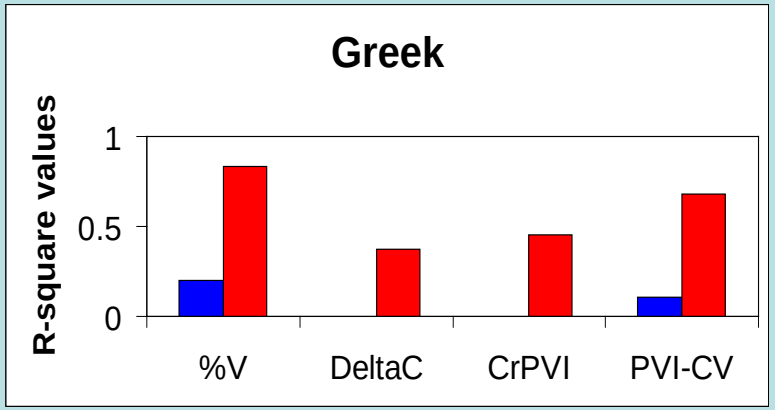
- phonological properties only
- phonological properties & speaker



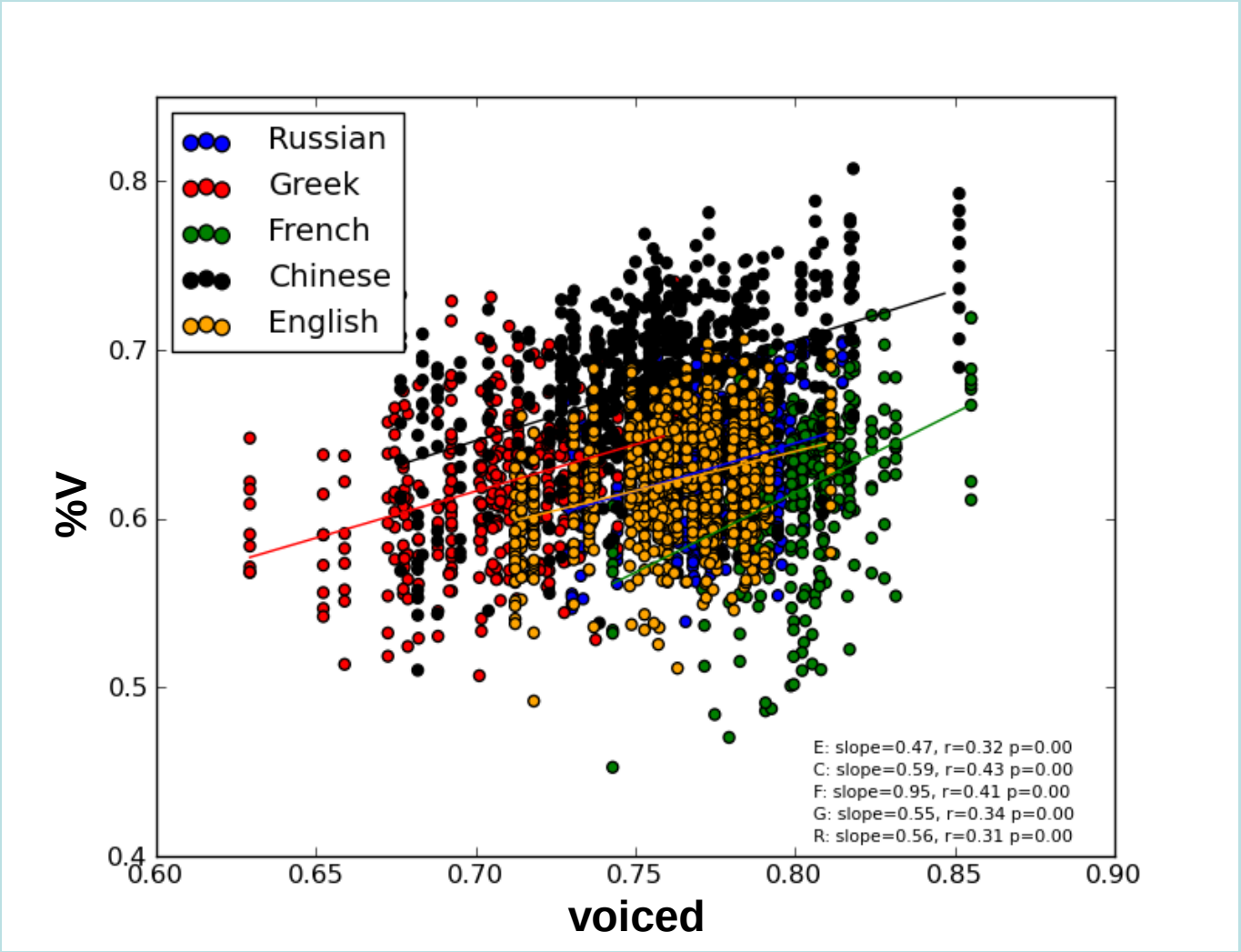








Results


Russian
Greek
French
Chinese
English
0.8
0.7
0.6
0.5
0.4
%V
0.60
0.65
0.70
0.75
0.80
0.85
0.90
voiced
E: slope=0.47, r=0.32 p=0.00
C: slope=0.59, r=0.43 p=0.00
F: slope=0.95, r=0.41 p=0.00
G: slope=0.55, r=0.34 p=0.00
R: slope=0.56, r=0.31 p=0.00

Conclusions

How far can rhythm measures (RMs) be predicted from the phonological properties of texts?

Text-dependence: low

Speaker-dependence: high

Acknowledgements

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Thank you!