

# Dimensions of Phonemic Contrast in Romance Vowels



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# Phonemic contrast

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- In a language, two sounds are separate **phonemes** if they signal a difference in lexical meaning across two words

- English

*bait* vs. *bet*  
[bet] [bɛt]

*boat* vs. *bought*  
[bot] [bɔt]

- /e/, /ɛ/, /o/, /ɔ/ are separate phonemes

# Allophones

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- Two sounds are **allophones** if they don't signal a lexical difference, and if at least one has a predictable distribution

- English

pit  
[p<sup>h</sup>ɪt]

vs. spit  
[spɪt]

appalled  
[ə. 'p<sup>h</sup>ɑːld]

vs. apple  
vs. ['æ.pəl]

- [p<sup>h</sup>], [p] are allophones: [p<sup>h</sup>] is syllable-initial, stressed

# Phoneme vs. allophone: Not so simple

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- Italian has phonemes /e, ε/:

*venti* [venti] ‘twenty’      [vɛnti] ‘winds (n.)’

- but two speakers might choose different vowels:

*cento* [tʃɛnto]      **or**      [tʃɛnto] ‘one hundred’

- What if speakers disagree on which phoneme to use?

# Phoneme vs. allophone: Not so simple

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- Romanian [i] vs. [ʌ]

['vɨna] 'vein (def.)'

['kasʌ] 'house'

['lina] 'wool (def.)'

['sutʌ] 'hundred'

['kɨnd] 'when'

[pʌ'tuts] 'bed (dim.)'

- but [riw] 'river' vs. [rʌw] 'bad'

- What if a sound is predictable... most of the time?

# Today's talk

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- Phonological contrastiveness is complex
- Phonemic contrast has multiple dimensions
- Acoustic, perceptual & phonological data from Romance
  - Marginal contrast in Romanian
  - Phonological closeness in Italian
  - How many vowel phonemes does a language have?

# Marginal contrast in Romanian

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# What is the nature of contrast?

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- What affects whether a sound is phonemic?
- Lexical contrast in minimal pairs
- Some sounds are more phonemically robust than others
  - Lack of phonological conditioning
  - High functional load
  - Usage frequency
- Phonetic and perceptual distinctness & stability

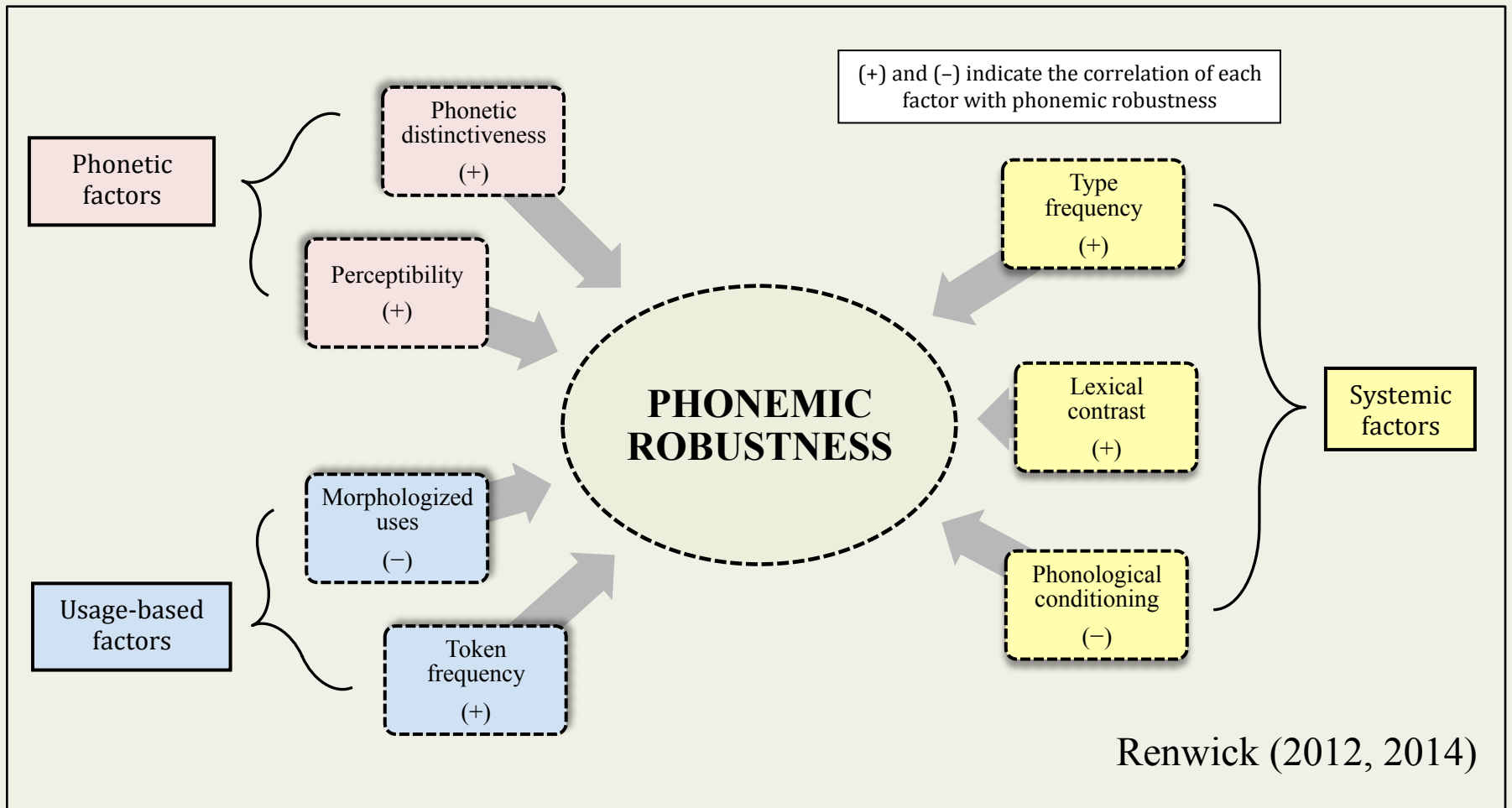


# Characterizations of intermediate contrastiveness

- Phonological closeness among sounds (Trubetzkoy 1969)
- Five-point scale of contrastiveness (Goldsmith 1995)
- Quasi-phonemic contrasts (Hualde 2004, Ladd 2006)
- Fuzzy phonemic contrasts (Scobbie & Stuart-Smith 2008)
- Probabilistic Phonological Relationship Model (Hall 2009)

# The Multidimensional Model of Phonemic Robustness

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# Romanian

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- Heavy non-Romance influence
- Active morpho-phonological alternations
- Vowels unique to the Romance family
- Paucity of phonetic & phonological study

# Romanian vowels

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	Front	Central	Back
High	/i/	/ɨ/	/u/
Mid	/e/	/ʌ/	/o/
Low	/ɛ̃/	/a/	/õ/

Chitoran (2003) analyzes the diphthongs as phonologically low vowels.

/ʌ/ is often transcribed as /ə/.

# Romanian central vowels

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/ʌ/

- Unstressed
  - /'apʌ/ 'water'
  - /'kasʌ/ 'house'
  - /'kumpʌrʌ/ 'buys'
- Stressed
  - [kumpʌ'rʌm] 'we buy'

/i/

- Stressed
  - Pre-nasal
    - ✦ /'kɪmp/ 'field'
    - ✦ /'lɪnʌ/ 'wool'
  - Liquid-adjacent
    - ✦ /'rɪw/ 'river'
- Unstressed
  - /tɪr'ziw/ 'late'

# Marginally contrastive phonemes

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- Phones which are not easily classified as strictly allophonic or contrastive
- Romanian /ʌ/ and /i/
  - Distribution *nearly* predictable and complementary
  - Minimal pairs exist
  - Low type frequency

Renwick (2011a), *On the origins of /i/ in Romanian*

Renwick (2011b), *Phoneme Type Frequency in Romanian*

# Contrast between /ʌ/ and /i/

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	/ʌ/		/i/
/rʌw/	‘bad’	/riw/	‘river’
/tsʌrʲ/	‘lands’	/tsirʲ/	‘sea mackerels’
/vʌr/	‘cousin’	/vir/	‘I thrust’

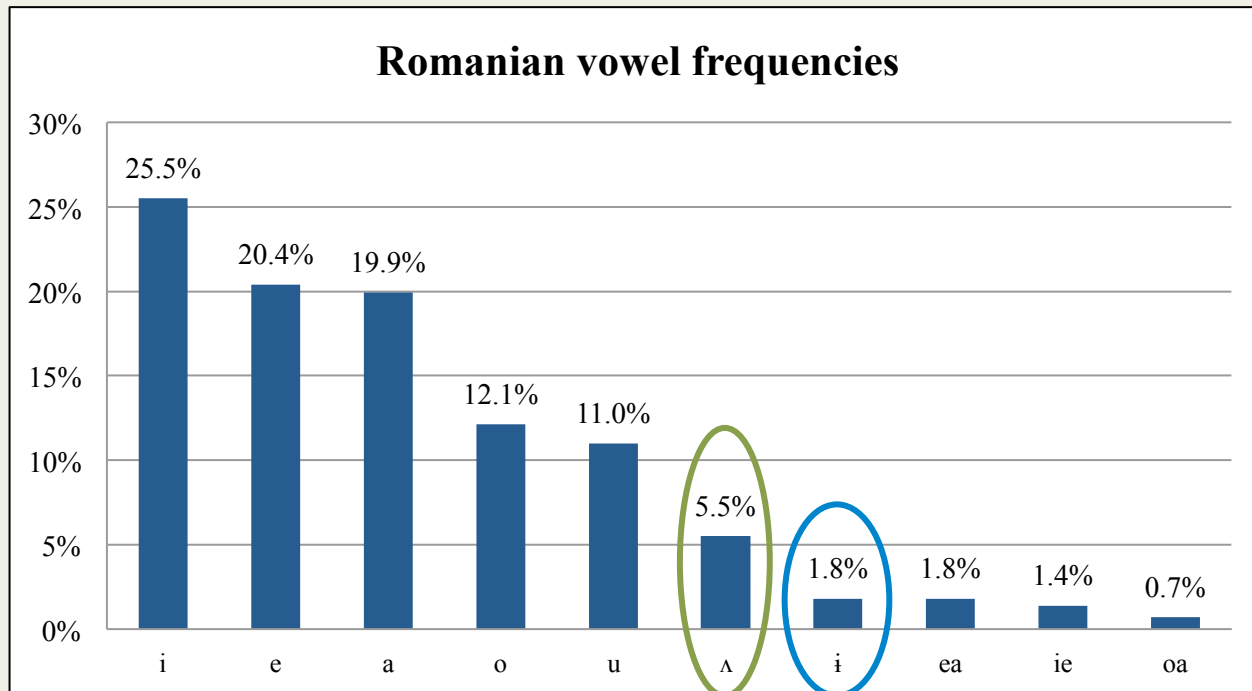
Minimal pairs demonstrate that although Romanian central vowels were historically allophonic, they are now separate phonemes.

What is the nature of this contrast?

# Frequency and Distribution

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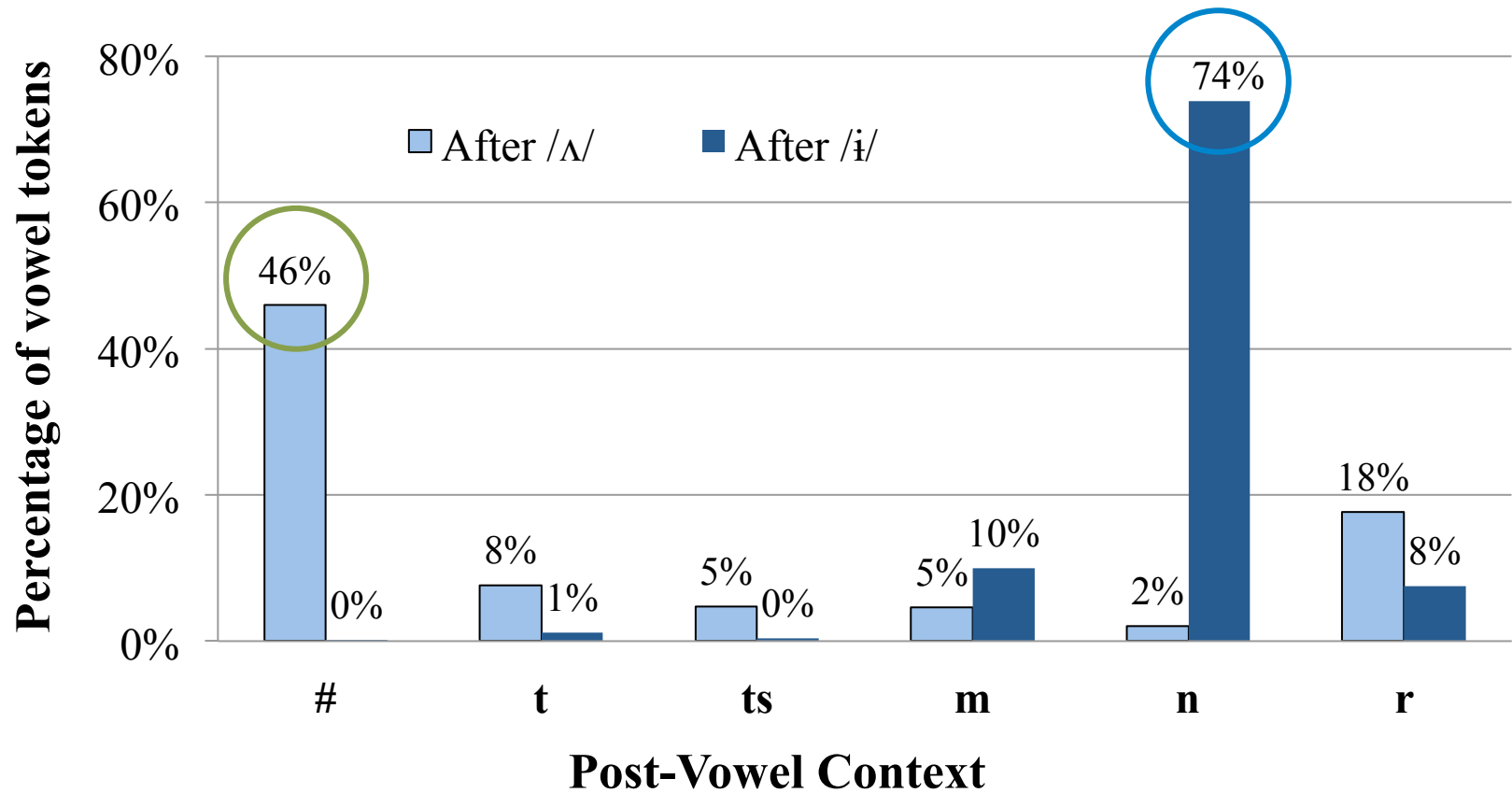
- Corpus study of phoneme type frequency
  - Romanian spell-checking word list (88,000 wordforms)
  - Distribution of vowels vs. flanking phonological context





# Contexts following central vowels

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# Acoustic implications: /ʌ/ vs. /ɪ/

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- Evidence for marginal contrastiveness
  - Few minimal pairs
  - Nearly-complementary distribution
  - Low type frequency
- Phonetic realization of /ʌ/ and /ɪ/
  - Evidence of marginal *acoustic* contrast?
  - Overlap in the vowel space?

## Romanian vowels: A brief phonetic introduction

17 native speakers

Lexical items

60 monophthongs

Stressed and unstressed vowels

3 repetitions/speaker

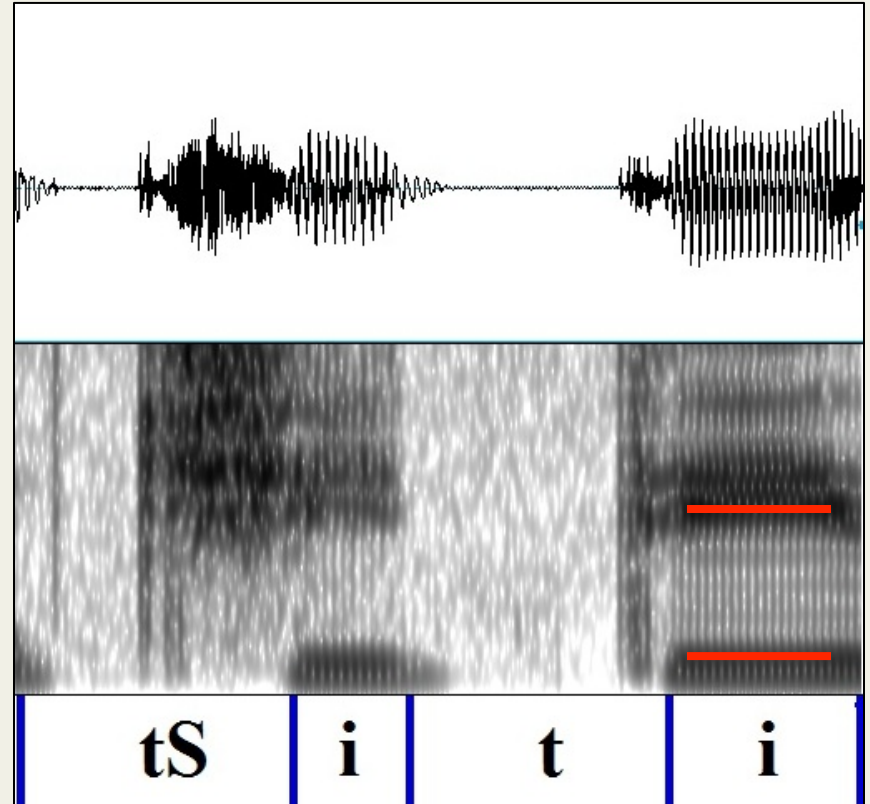
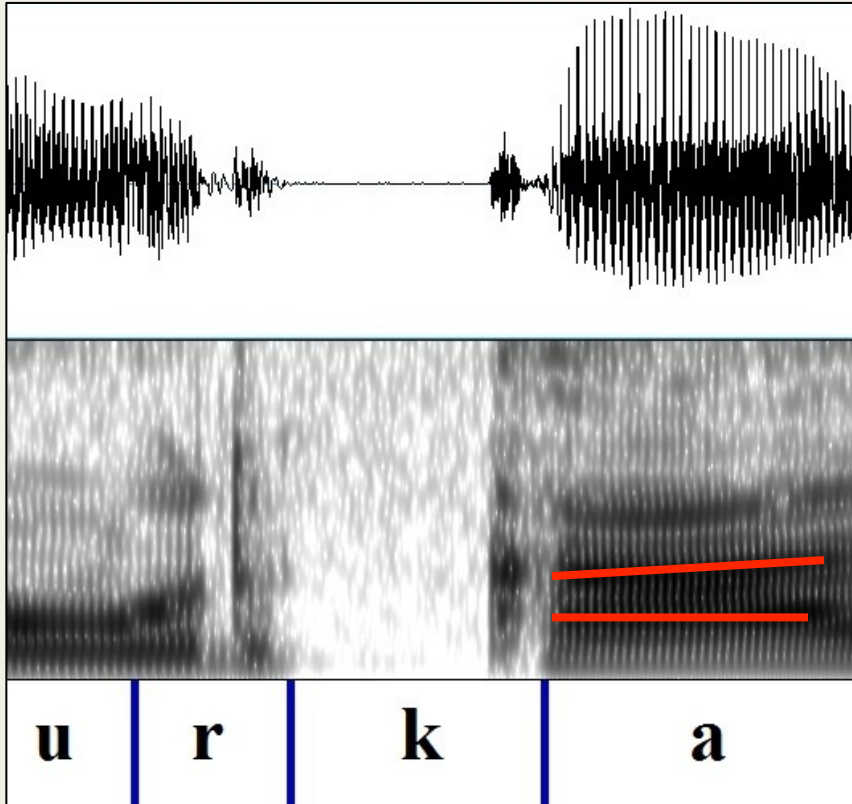
	Front	Central	Back
High	/i/	/ɨ/	/u/
Mid	/e/	/ɤ/	/o/
Low	/e̞/	/a/	/o̞/

# Measuring vowel quality

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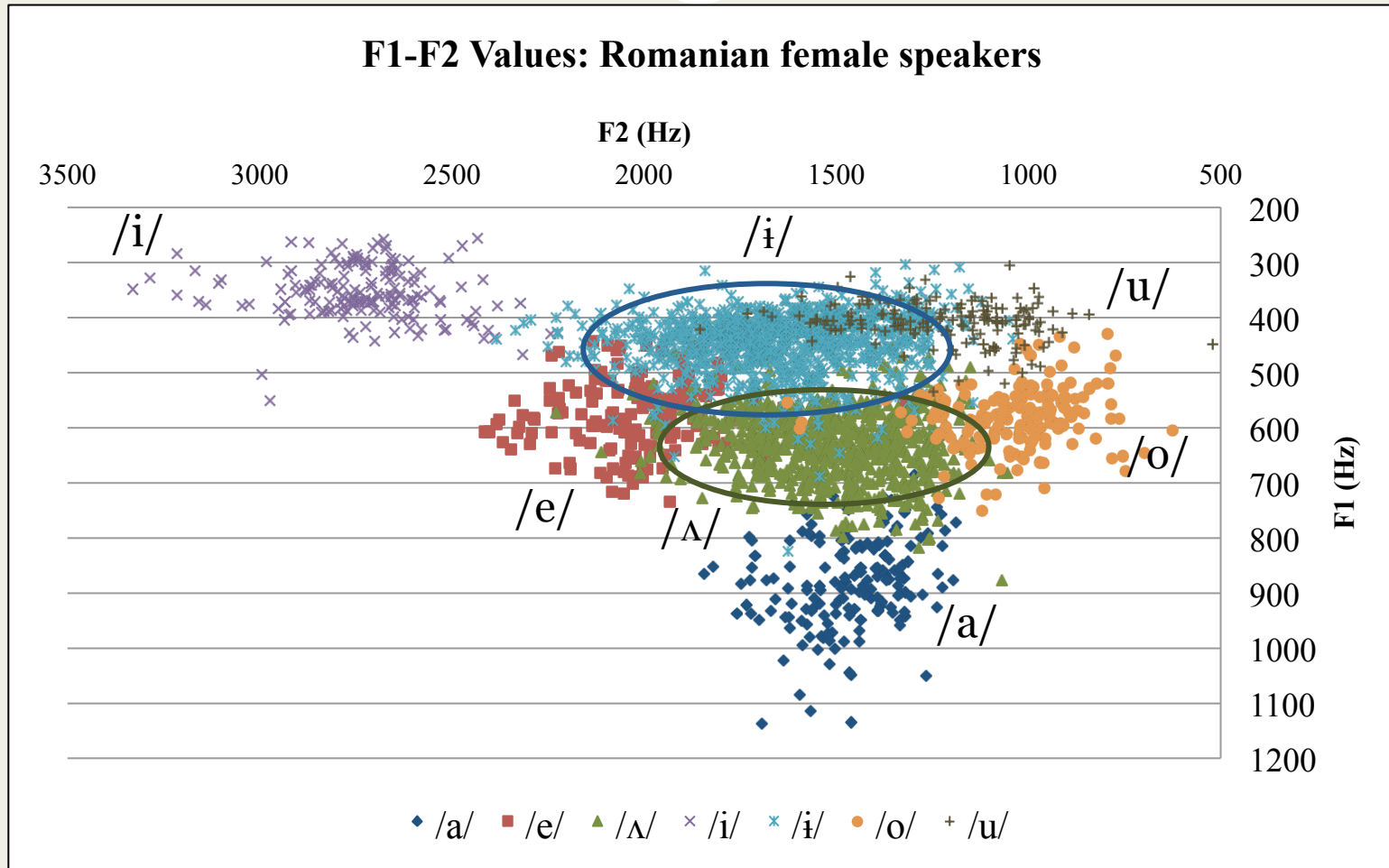
Spune urca de trei ori

Spune citi de trei ori



# the Romanian vowel space

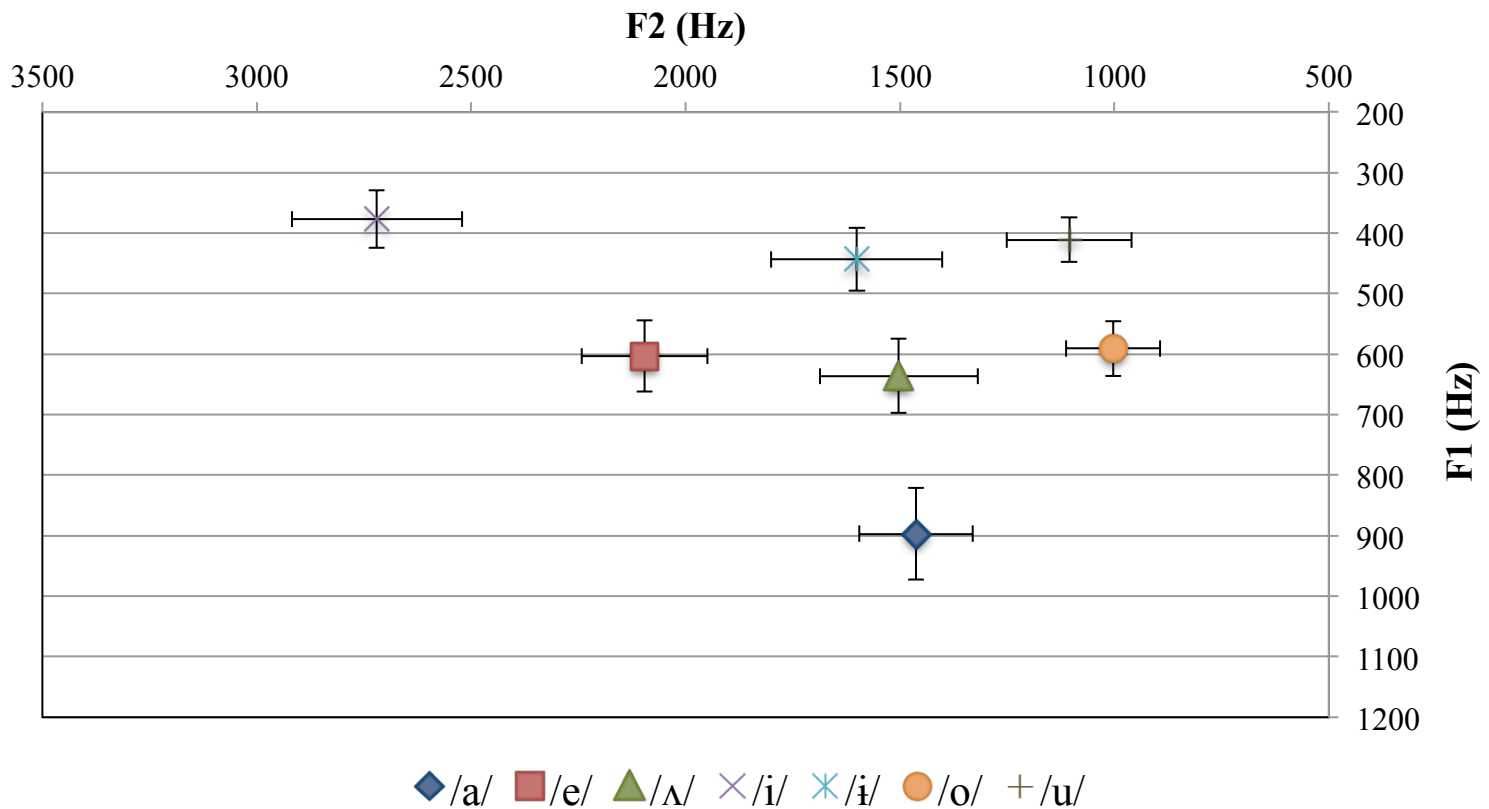
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# the Romanian vowel space

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Mean F1-F2 by Vowel: Female Romanian Speakers



# Perception of Marginal Contrast

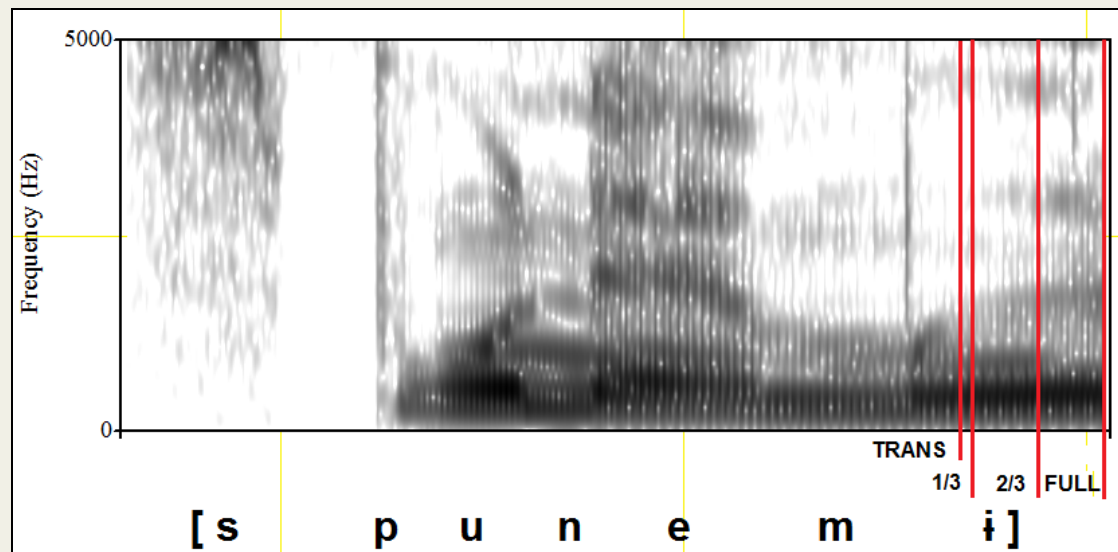
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- What is the effect of a near-complementary distribution on perception?
- Perception studies
  - Do listeners depend on context for /ʌ/ vs. /ɪ/?
  - Are marginally-contrastive vowels more difficult to identify?

# Methodology

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- Vowel identification task
- Forced selection with confidence ratings
- Romanian words in a frame sentence ('Spune [mΛrul] de trei ori')
- Four vowels: /Λ/, /i/, /e/, /i/ (e.g., mΛ(rul), mi(rij), me(re), mi(re))
- Stimuli of four varied lengths





# Results

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- Study #1 (Romania):  
32 x 5 identifications by 39 participants
- Study #2 (Cornell):  
112 x 5 identifications by 7 participants

	STUDY #2 RESPONSES			
Vowel	i	ɨ	ʌ	e
i	99%	<1%	<1%	<1%
ɨ	<1%	89%	4%	7%
ʌ	<1%	10%	87%	3%
e	<1%	4%	4%	92%

# Perception results: short vs. long stimuli

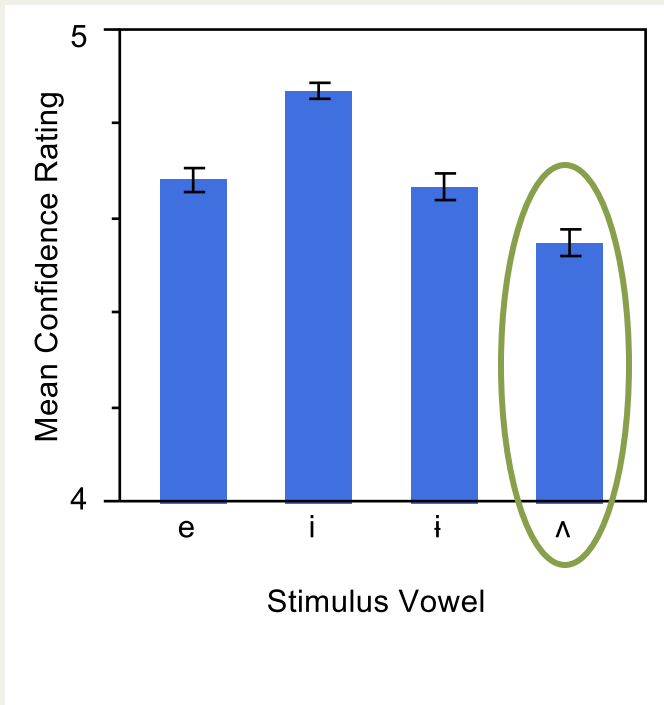
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1/3	RESPONSE			
Vowel	/i/	/ɪ/	/ʌ/	/e/
i	99%	<1%	0%	<1%
ɪ	<1%	89%	4%	6%
ʌ	0%	12%	83%	5%
e	0%	4%	4%	92%

FULL	RESPONSE			
Vowel	/i/	/ɪ/	/ʌ/	/e/
i	99%	0%	0%	<1%
ɪ	0%	89%	2%	9%
ʌ	<1%	6%	91%	3%
e	0%	3%	5%	92%

# Perception results: Confidence ratings and statistics

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*Confidence ratings: 1 (low) to 5 (high)*

- Modeling accuracy

- Fixed effects

- ✦ Vowel (\*\*)
- ✦ Word[Vowel] (\*\*)
- ✦ Length (\*)

- Random effects

- ✦ Participant
- ✦ Block

- /i/ most easily identified

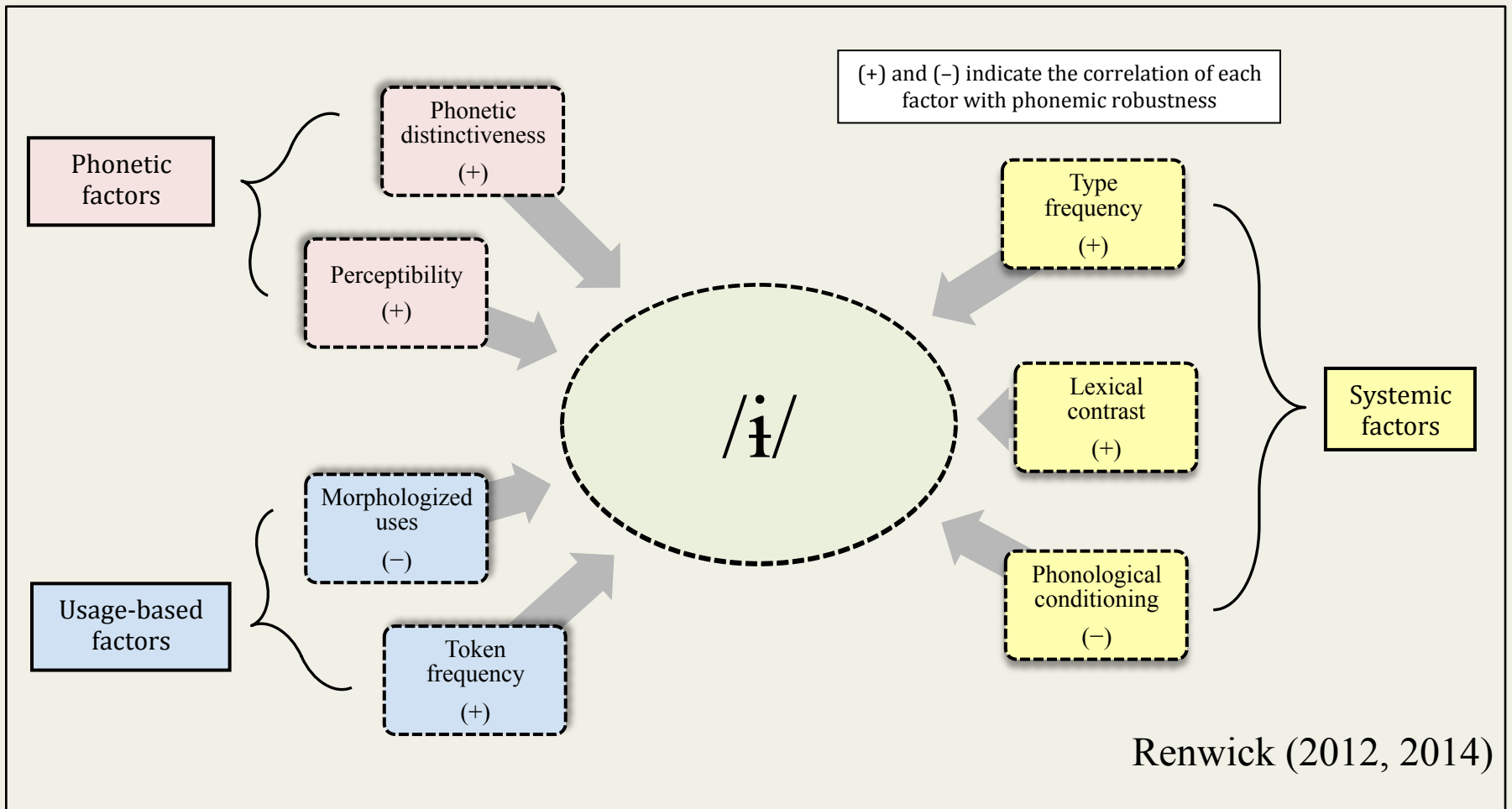
# Marginal contrastiveness in Romanian

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- Romanian /i/ and /ɒ/
  - Former allophones
  - Low type frequency & functional load
  - Nearly-complementary distribution
  - Acoustically distinct
  - Perceptually (mostly!) distinct

# Phonemic contrast is multidimensional

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# Phoneme vs. Allophone: Not so simple

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- Romanian /i/ vs. /ɪ/
  - Distributionally, **near-allophonic**
  - Phonetically distinct
  - Perceptually, /ɪ/ may be confused with /i/
- Next: What if speakers disagree on phoneme selection?

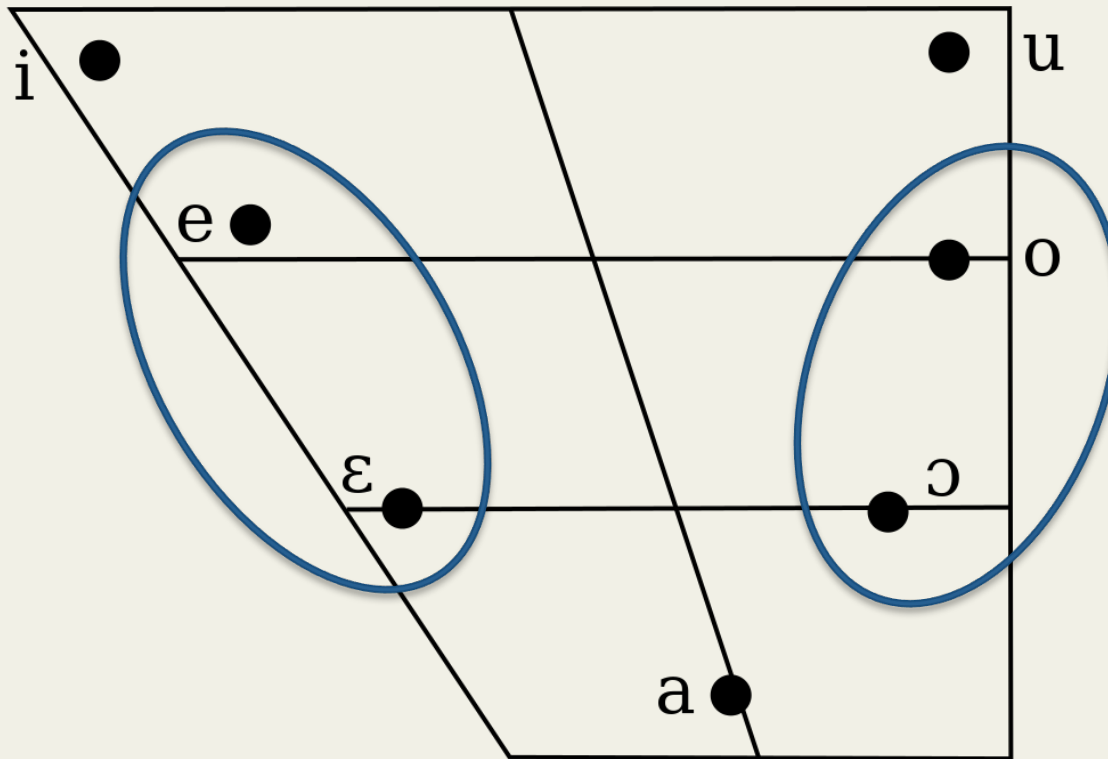
# Phonological closeness in Italian

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**COLLABORATOR:  
D. R. LADD, UNIVERSITY OF EDINBURGH**

# Vowel contrasts in Italian

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Rogers & d'Arcangeli (2004)



# Italian mid vowel contrasts

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- Minimal pairs

- e and o *chiuso*: /peska/ **pesca** ‘fishing’

- /foro/ **foro** ‘hole’

- ε and o *aperto*: /pɛska/ **pesca** ‘peach’

- /fɔro/ **foro** ‘forum’

- No orthographic distinction
- Marginal contrast between high & low mids (Vincent 1988)
- Prescriptive works describe proper pronunciation...
- ...But it's non-problematic to ignore the distinction (Rebora 1958)
- Stressed mid vowel quality may be variable

## A “particular closeness”

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“[T]here is a special relation of partial similarity between higher and lower mid vowels. Somehow these vowels do not contrast with each other as completely as most other pairs of phonemes.”

- Ladd (2006: 16)

“From a purely phonetic point of view, the difference between French *i* and *e* is not greater than the difference between *e* and  $\epsilon$ . But the closeness of the relationship between *e* and  $\epsilon$  is apparent to any Frenchman, while in the case of *i* and *e* there can be no question of any particular closeness.”

- Trubetzkoy (1969: 78)

# What kind of contrast does Italian have?

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- /e, ε/ and /o, ɔ/ neutralize to /e, o/ in unstressed position
  - Is the “particular closeness” a product of neutralization?
  - Not necessarily: cf. pretonic neutralization in Catalan, Portuguese
- Is it a near-merger (Labov, 1994)?
- Is it a case of allophone awareness (cf. German [x]/[ç])?
- Where do these vowels fit in phonemic theory?

# Acoustics vs. Intuition

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- Acoustics from vowel production data
- Intuitions from speakers' vowel judgments
- Comparison: prescriptive mid vowel quality (six-volume dictionary by De Mauro 2000)
  
- Does vowel quality match the dictionary?
- Does vowel quality match across speakers?
- Do speakers' productions match their own intuitions?

# Methods: Acoustics

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	Context	Example word
1	'CVCVCV	/'dɛtʃimo/ <i>decimo</i> 'tenth'
2	CV'CVCV	/ba'lena/ <i>balena</i> 'whale'
3	'CVCV	/'sɔdo/ <i>sodo</i> 'compact'
4	'CVNCV	/'punto/ <i>punto</i> 'point'
5	'CVTCV	/'talpa/ <i>talpa</i> 'mole'
6	CV'CVCV	/te'nute/ <i>tenute</i> 'held (f. pl.)'

Mid vowel quality based on De Mauro (2000).  
We excluded any words acknowledged as variable by De Mauro.

# Methods: Acoustics

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- 7 vowels x 5 items x 6\* contexts
- 200 total target vowels
- Items randomly embedded in 5 prosodically similar frame sentences, e.g. “Scrivete *decimo* sul foglio.”
- 3 repetitions per item
- 17 speakers (14F, 3M)
- Phone boundaries aligned with SPPAS (Bigi 2013)
- First & second formant (F1, F2) values extracted
- 10,161 tokens (5,571 mid vowels)

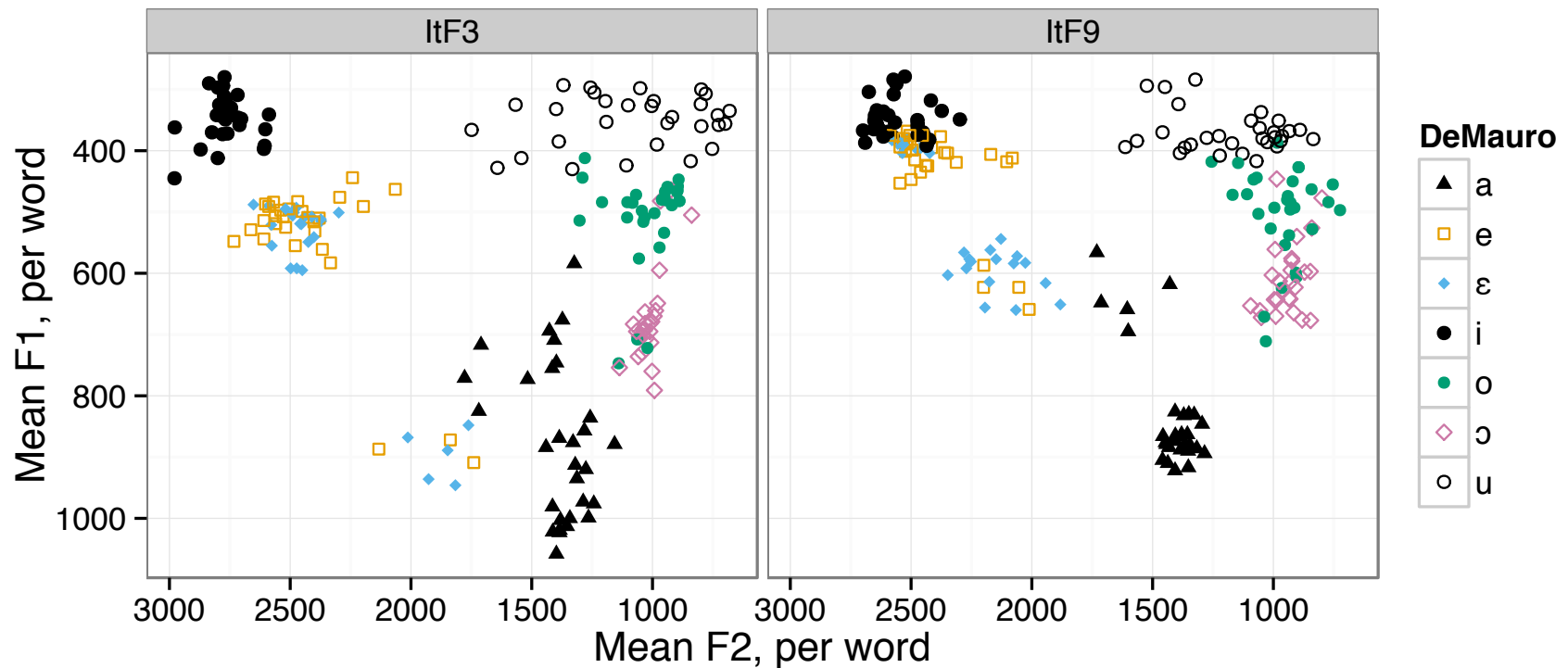
# Methods: Intuitions

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- Word list: 100 words containing a stressed mid vowel
  - All words also used in acoustic study
  - Balanced for prescriptive mid vowel quality (25 each)
- Speakers labeled each stressed vowel as *chiuso* or *aperto*
- Responses compared with
  - Prescriptive quality: Rate of agreement with prescriptive quality
  - Speaker's own acoustics: Captures speaker's awareness of usage

# Vowel acoustics don't match prescriptive expectations

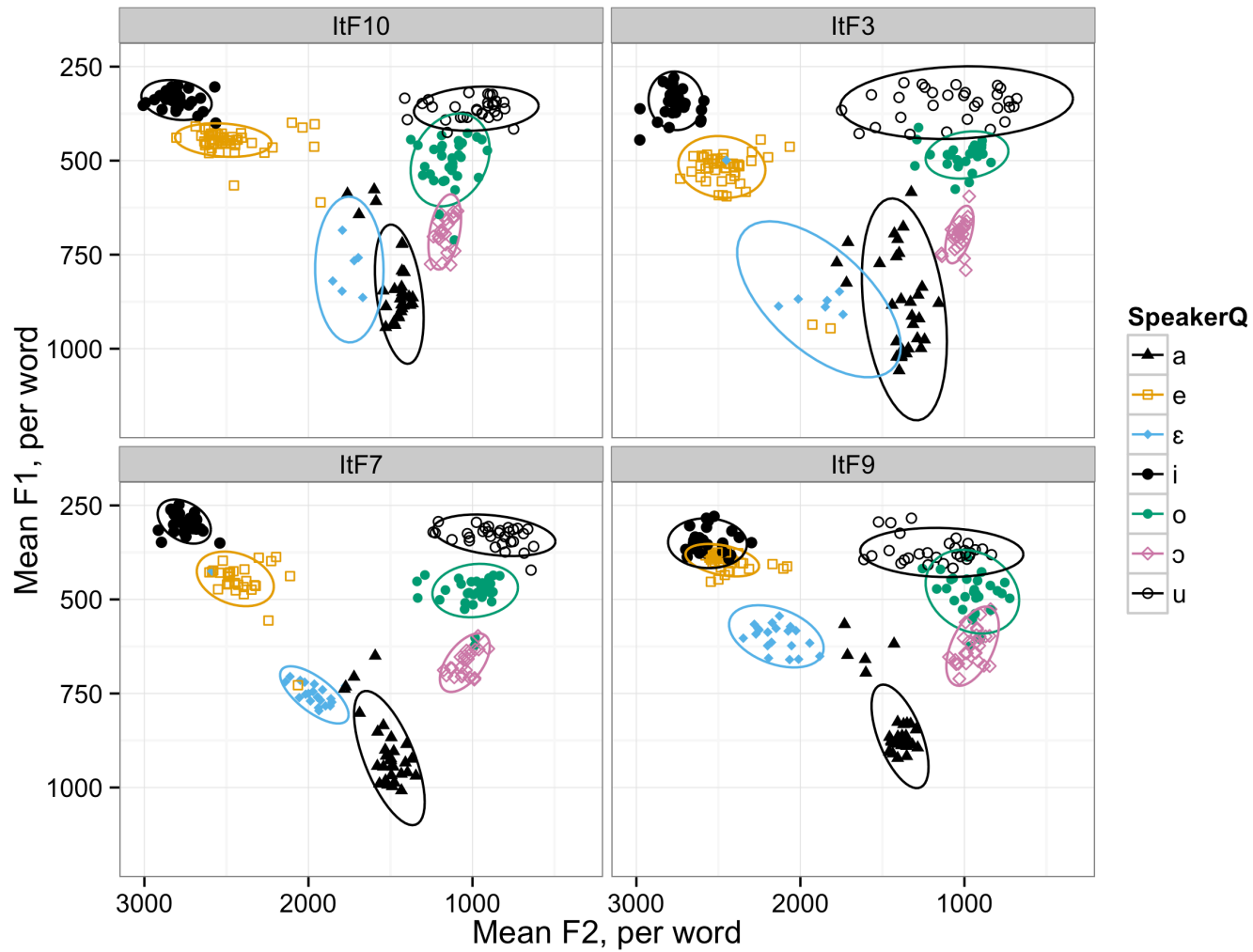
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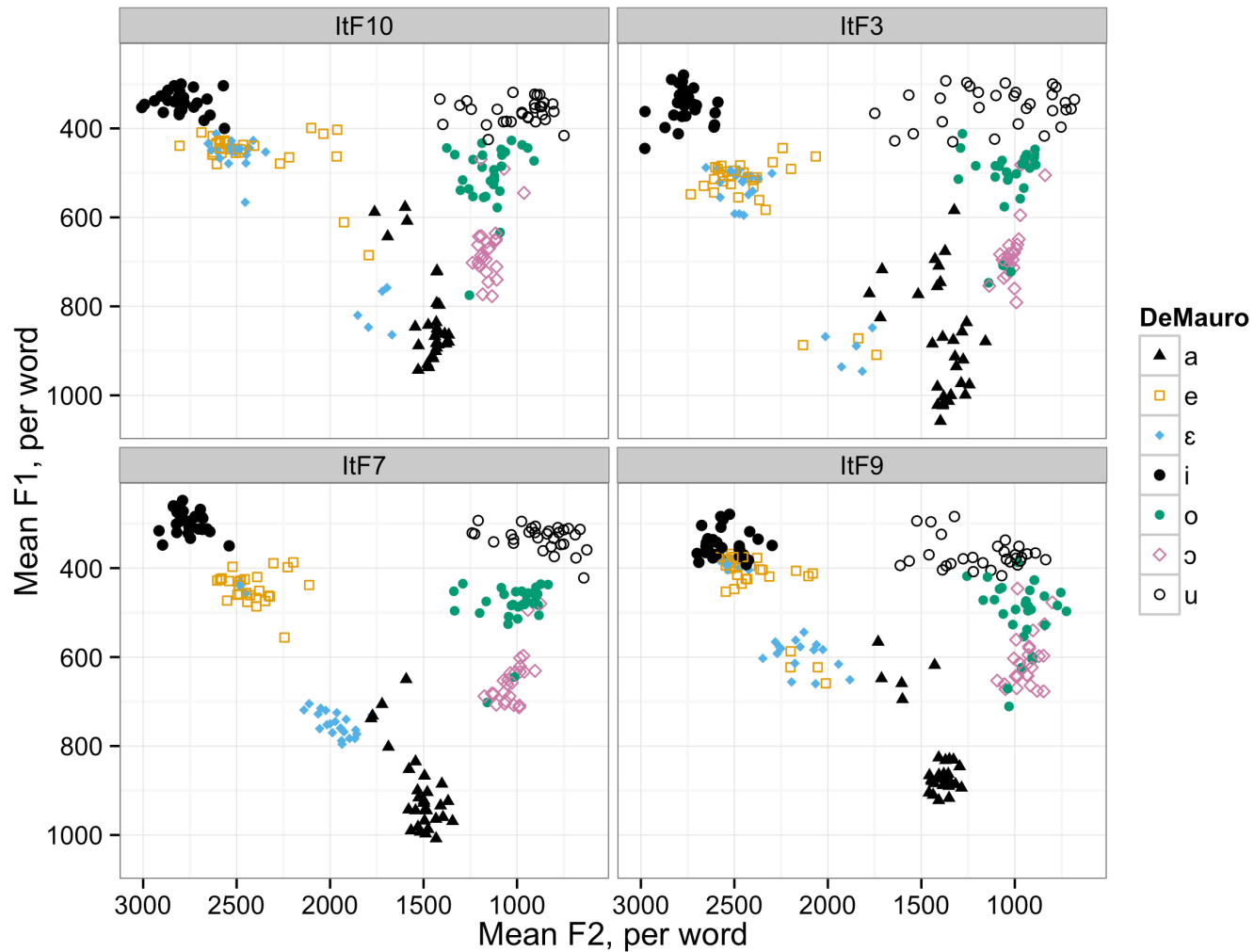
# Acoustics by speaker vowel judgment

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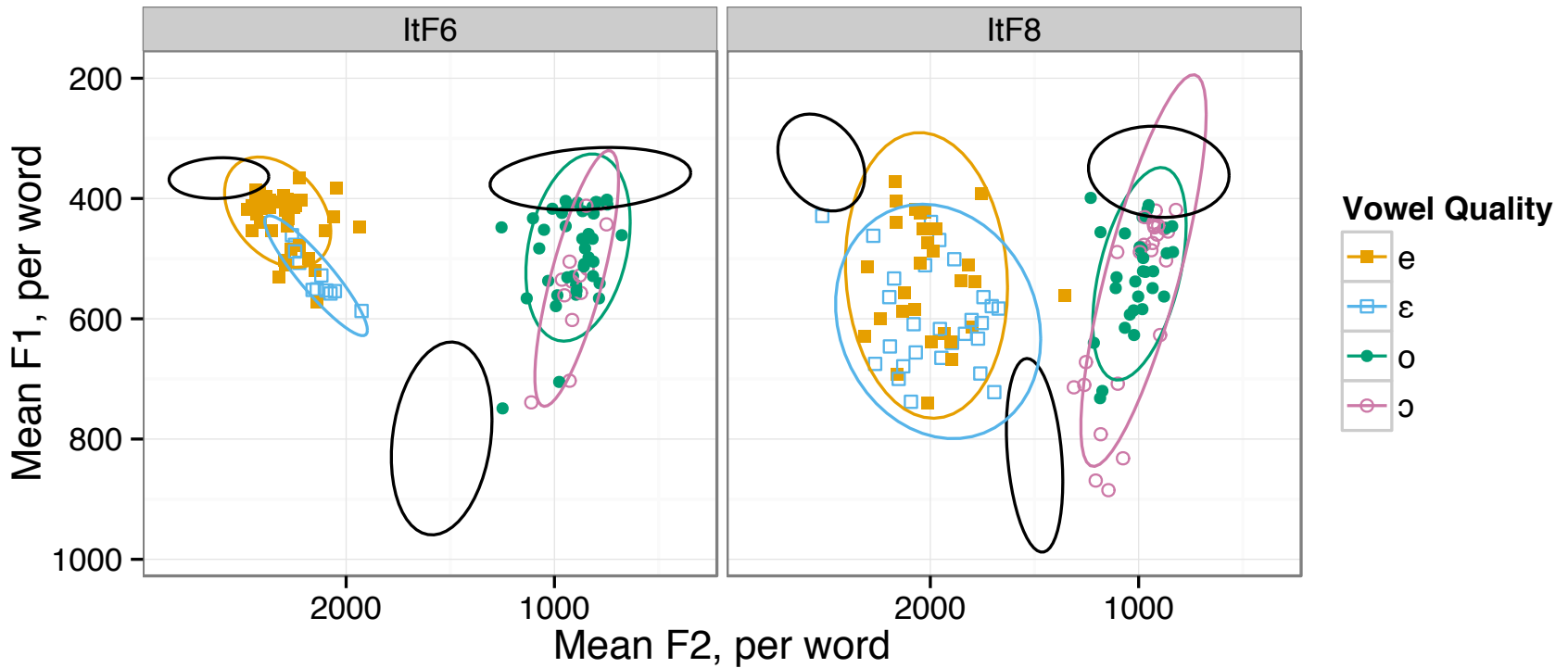
# Italian has 7 distinct vowel categories

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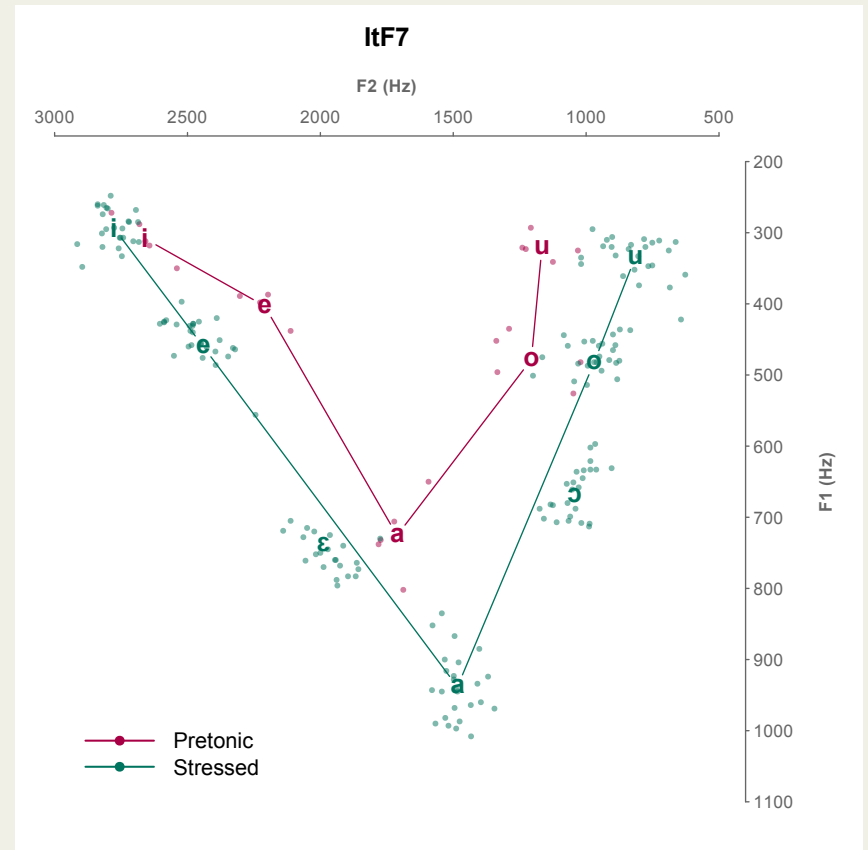
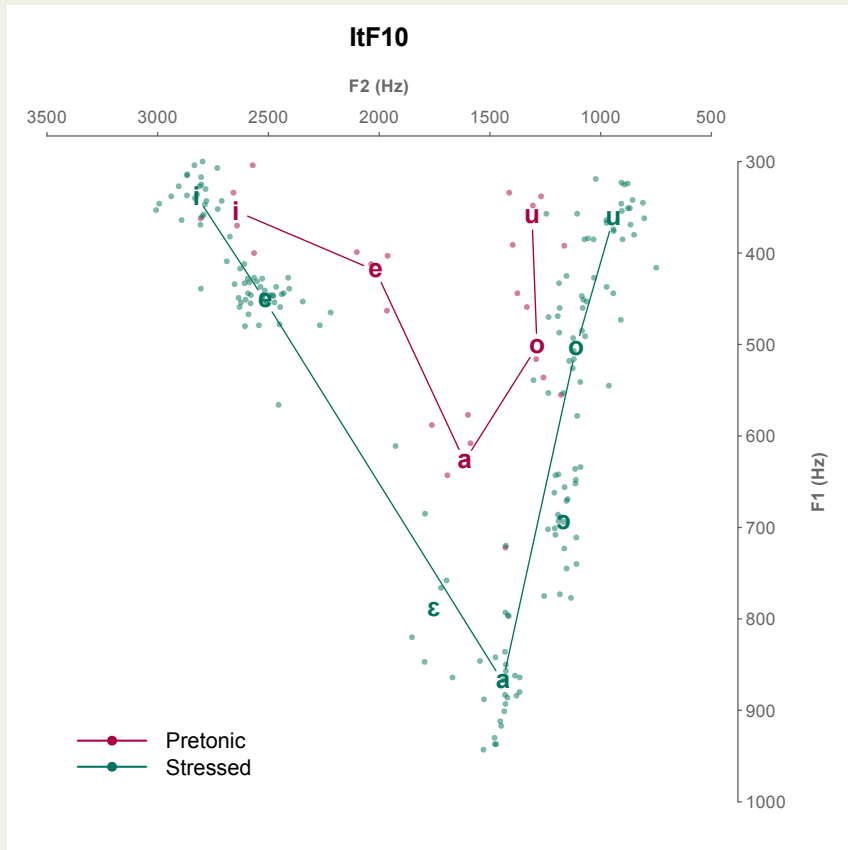
# Speakers with vowel cloud overlap

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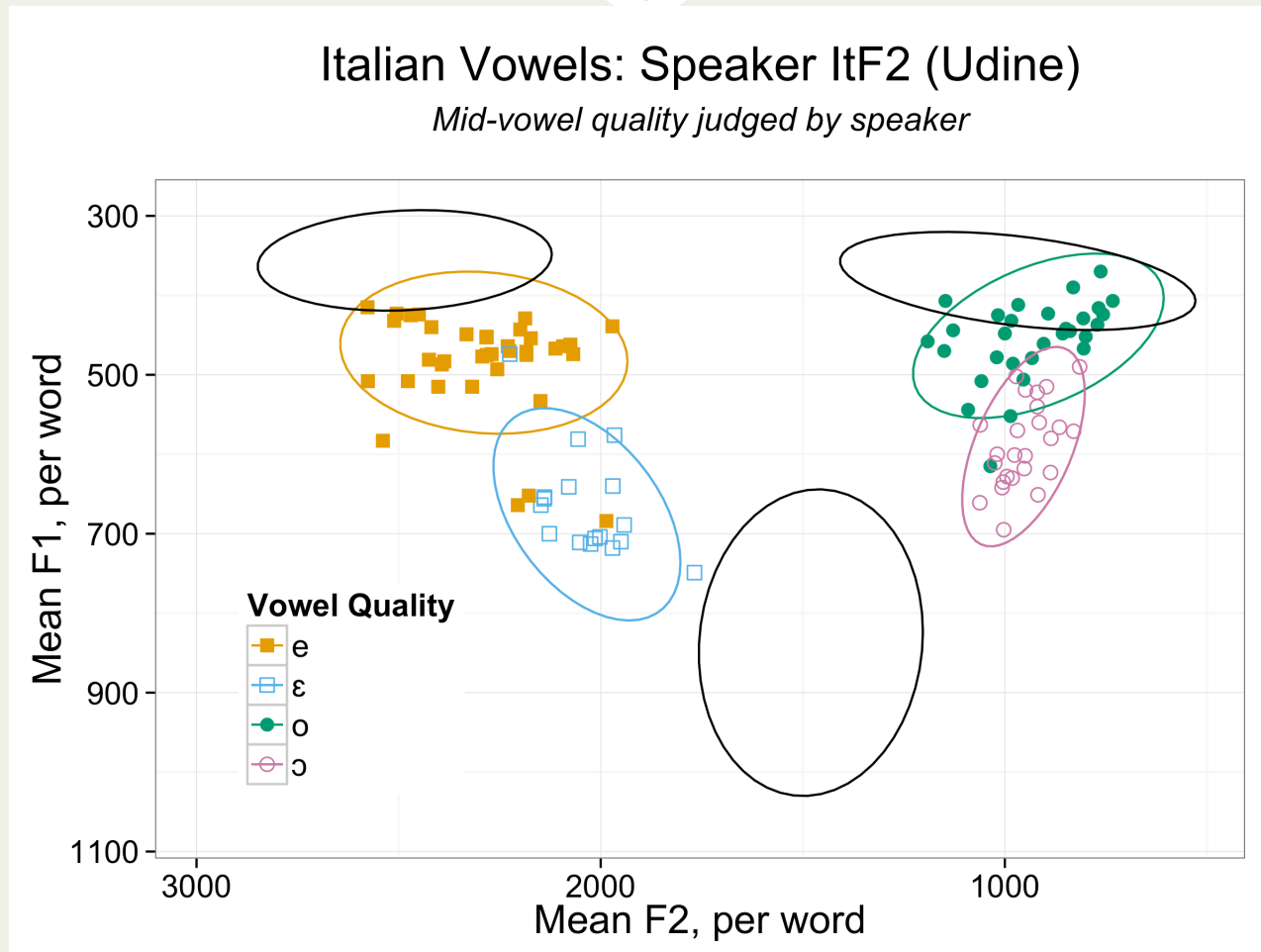
# Pretonic mid vowels are [e] and [o]

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# Speakers are aware of the vowel they produce

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# Phonological effects on vowel quality

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- Regional variation in mid vowels is widespread
- Does a speaker's dialect region affect mid vowel acoustics and judgments?



# Regional variation in mid vowel judgments

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## Front vowel judgments

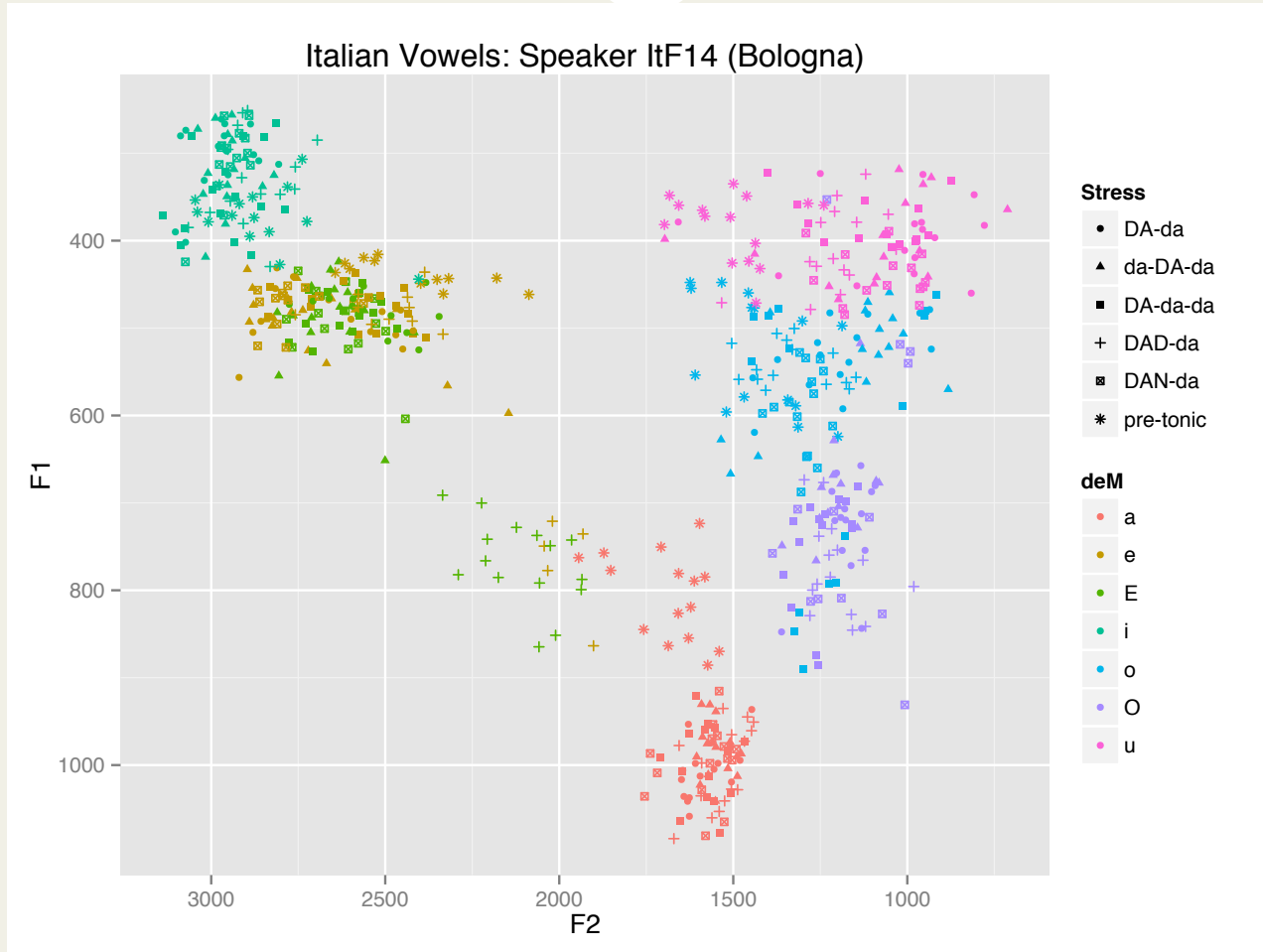
Region	/e/	/ɛ/
North-Central	84%	16%
Tuscany	49%	51%
Rome	56%	44%

## Back vowels

Region	/o/	/ɔ/
North-Central	55%	45%
Tuscany	53%	47%
Rome	59%	41%

# Evidence from acoustics

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# Regional variation in mid vowel judgments

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## Front vowel judgments

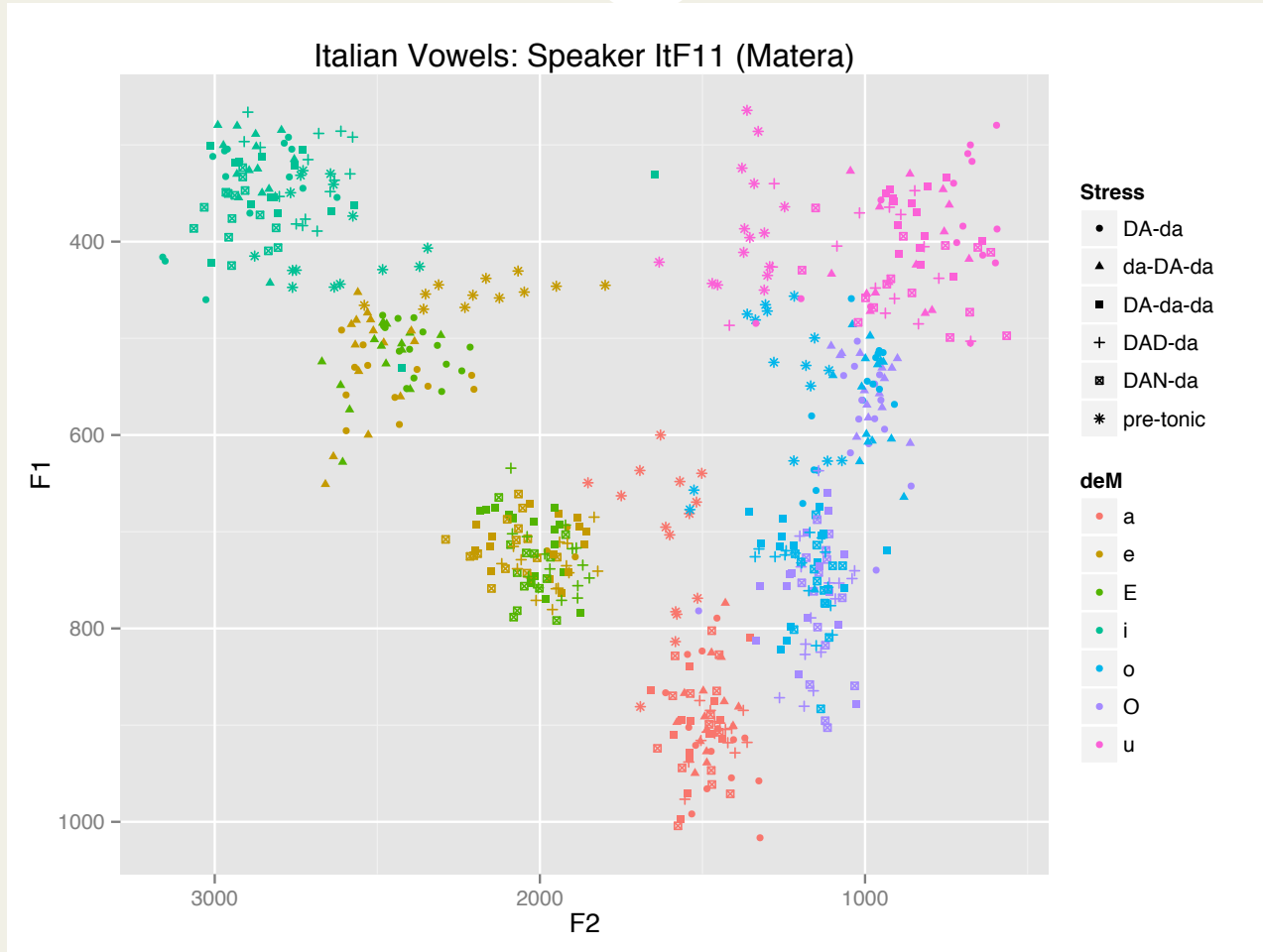
Region	/e/	/ɛ/
South	43%	57%
Tuscany	49%	51%
Rome	56%	44%

## Back vowels

Region	/o/	/ɔ/
South	96%	4%
Tuscany	53%	47%
Rome	59%	41%

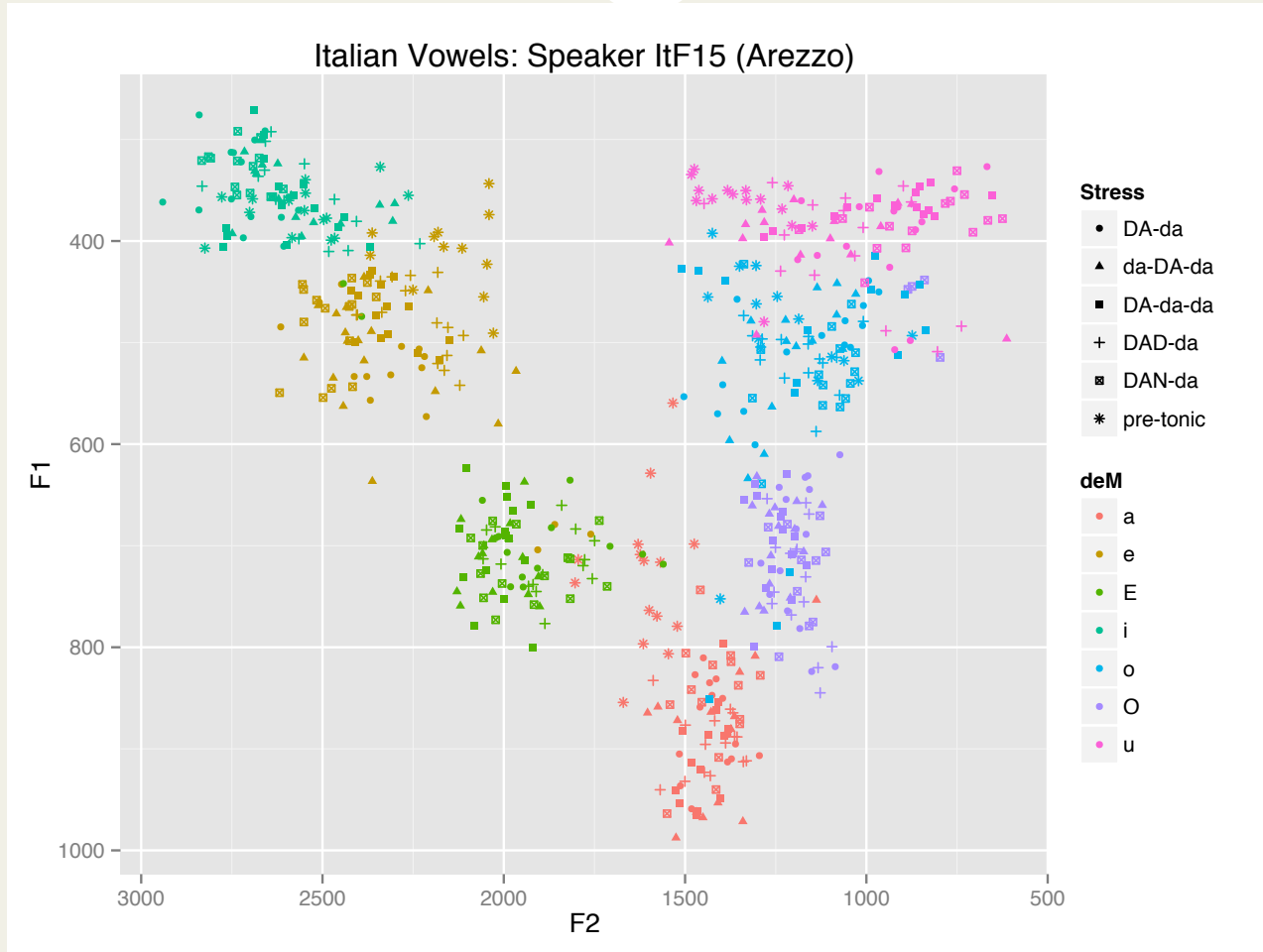
# Speaker from the South

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# But compare...

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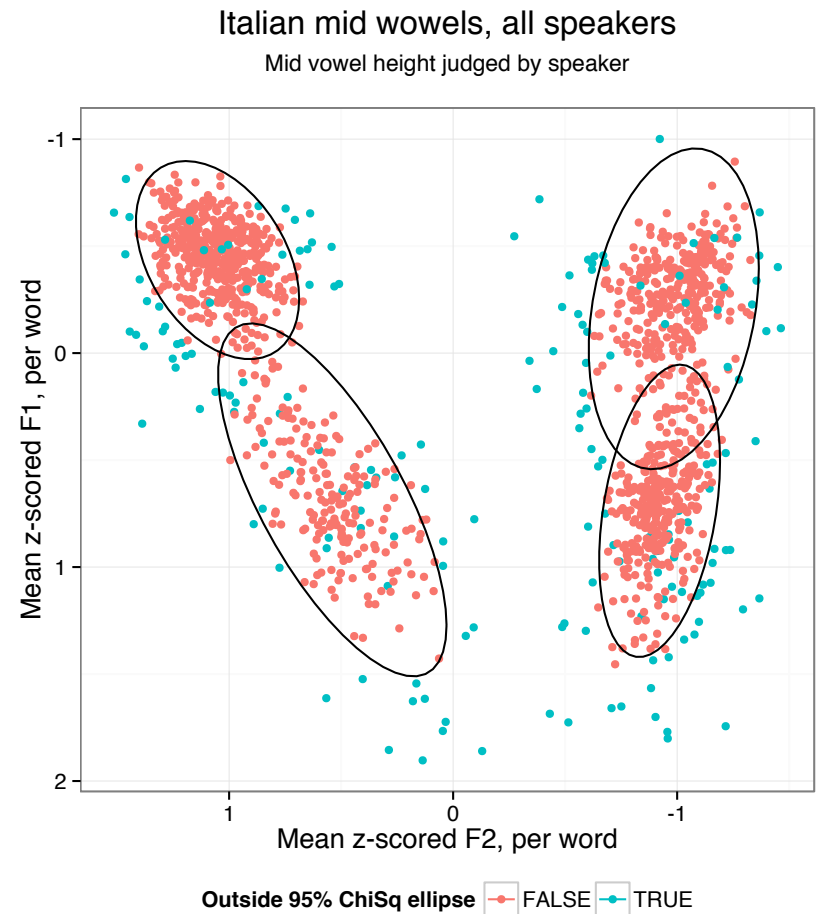




# Speaker misclassifications

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- Cases of mismatch between speaker judgment and vowel acoustics
- All speakers make at least 1 misclassification
  - Some are widespread, e.g. in Southern/Sardinian speakers
  - Some are “random” or rare
- Therefore *mid vowels are confusable for native speakers: /i, a, u/ are not!*



# Conclusions

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- Lexical variability in production and judgment
  - Difficult to reconcile with standard versions of phonological contrast
- cf. Kiparsky's (2014) classification:

	<i>contrastive</i>	<i>non-contrastive</i>
<i>distinctive</i>	<b>phoneme</b>	<b>'quasi-phoneme'</b>
<i>non-distinctive</i>	<b>'near contrast'</b>	<b>allophone</b>

# Where do Italian mid vowels fit?

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- Italian /e, ε/ and /o, ɔ/
  - Vowels are distinctive and apparently contrastive, *per speaker*
  - No evidence for a (near) merger
  - Possible, regionally-restricted change in progress
  - Distinctions are *stable* within a speaker, yet *variable* across speakers
- A phonemic contrast that makes few lexical distinctions
  - May indicate regional accent
  - Few minimal pairs & low functional load

# Conclusions

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**DIMENSIONS OF PHONEMIC CONTRAST IN  
ROMANCE VOWELS**



# Insights from Romanian vowels

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- Marginal contrast in Romanian vowels: /i/ vs. /ɤ/
  - Gradient phonological, lexical contrast
  - Acoustically, perceptually distinct
  - Implications for models of phonemic contrast
- How does phonological context affect perception?

# Contrast among Italian mid vowels

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- Italian /e, ε/ and /o, ɔ/ **are** contrastive
  - Minimal pairs exist
  - Most speakers of Standard Italian distinguish [e] – [ε] and [o] – [ɔ]
  - Speakers are (generally) aware of their own productions
- For a particular word, speakers' vowel choice can vary
  - Speakers disagree with prescriptive vowel quality & each other
  - Some effects of regional variation
- The 'particular closeness' among mid vowels remains

# Dimensions of phonemic contrast

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- Romanian /i/ is marginally contrastive with /ɘ/
  - (+) Clear acoustic & perceptual differences
  - (−) Low type frequency, high predictability, low functional load
- Italian /e, o/ vs. /ɛ, ɔ/
  - (+) High frequency, phonetic distinctiveness (for some speakers)
  - (−) Phonological conditioning ([e, o] w/o stress), low functional load
- Phonological contrasts are complex
  - For speakers & listeners, multiple factors may affect the sounds we select in production, and those we decode in perception.

**Thank you.**

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Questions?

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