A Corpus Phonetic Study of Contemporary Persian Vowels in Casual Speech

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Penn


یا مقلب القلوب و الابصار یا مدبر اللیل و النهار حوّل حالنا الی احسن الحال
نوروز تون مبارک

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Contemporary Iranian Persian (CIP) has 6 phonemic vowels, however their exact characterization has been a source of controversy in the literature.

Contemporary Iranian Persian (CIP) has 6 phonemic vowels, however their exact characterization has been a source of controversy in the literature.
The goal of this project is to provide a **phonetic foundation** for the analysis of Persian, both for future sociolinguistic study to better inform phonological theorizing about CIP.

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Contemporary Iranian Persian has a relatively straightforward 6 vowel system, but with two sources of controversy:

- Are historical length distinctions preserved? Are they relevant for the phonology?
- What is the low back vowel?

One Vowel Space

i	u
e	o
æ	ɒ

Figure 1: Persian Vowels, according to Lazard (1992), Toosarvandani (2004), and Miller (2013).

Another Vowel Space

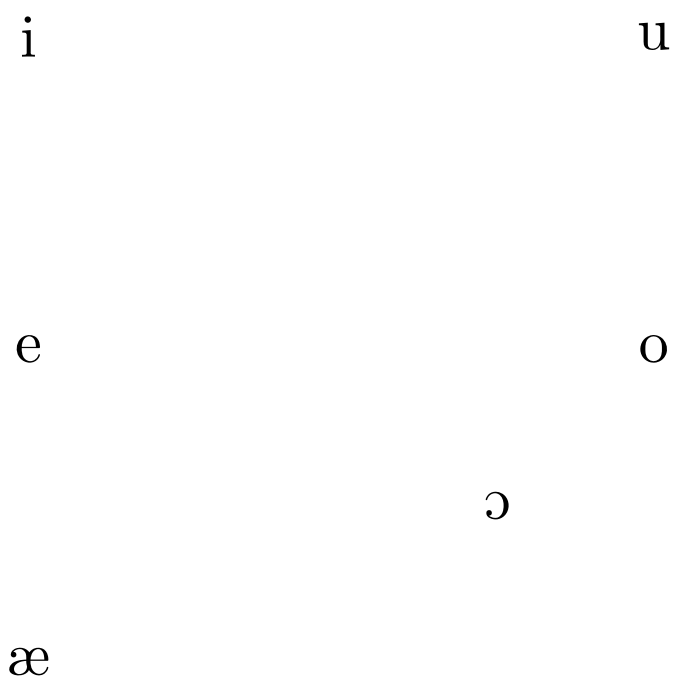

Figure 2: Persian Vowels, according to Ansarin (2004) and Aranow et al (2017).

A THIRD Vowel Space

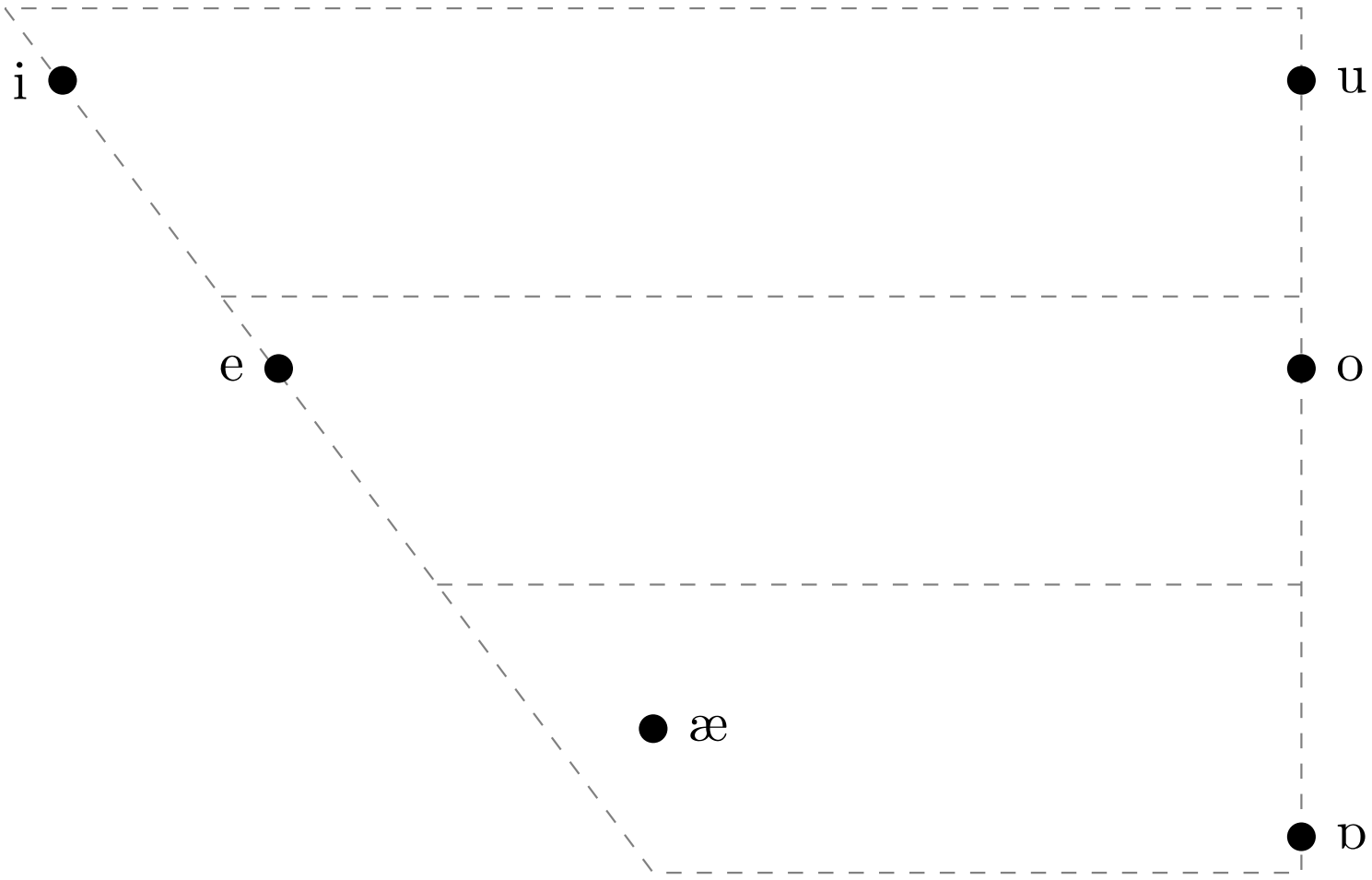

Figure 3: CIP Vowels according to the *JIPA*.

Middle Persian

i, ī	u, ū
e	o
æ	a, ā

Figure 4: Middle Persian Vowels

Importance

Why does this matter?

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- Persian vowel assimilation (sometimes called “harmony”)

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- Place or length?

Importance

Why does this matter?

- Persian vowel assimilation (sometimes called “harmony”)
- Place or length?
- if place, we need to know what the places are!

An example of "Assimilation"

1.	*devist*	*divist*	'two hundred'
2.	*forush*	*furush*	'sale'
	fozul	*fuzul*	'impertinent'
	sholuq	*shuluq*	'crowded
3.	*jahân*	*jâhân*	'world'
	maʔâsh	*mâʔâsh*	'livelihood'

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Length

The continued existence of a (historical) length contrast is still the subject of much debate in the Persian literature.

- Lazard (1992) claims length distinctions still obtain in speech.
- Toosarvandani (2004) and Rahbar (2009), among others, appeal to length distinctions to explain phonological processes of assimilation.

Evidence

None of the (phonological) works claiming length distinctions are relevant to the phonology empirically demonstrate the continued existence of such a distinction.

Phonetic Studies

There are only two phonetic studies of Persian Vowels.

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- Aronow et al (2017): 2 Tehrani speakers. Word lists.

Ansarin 2004

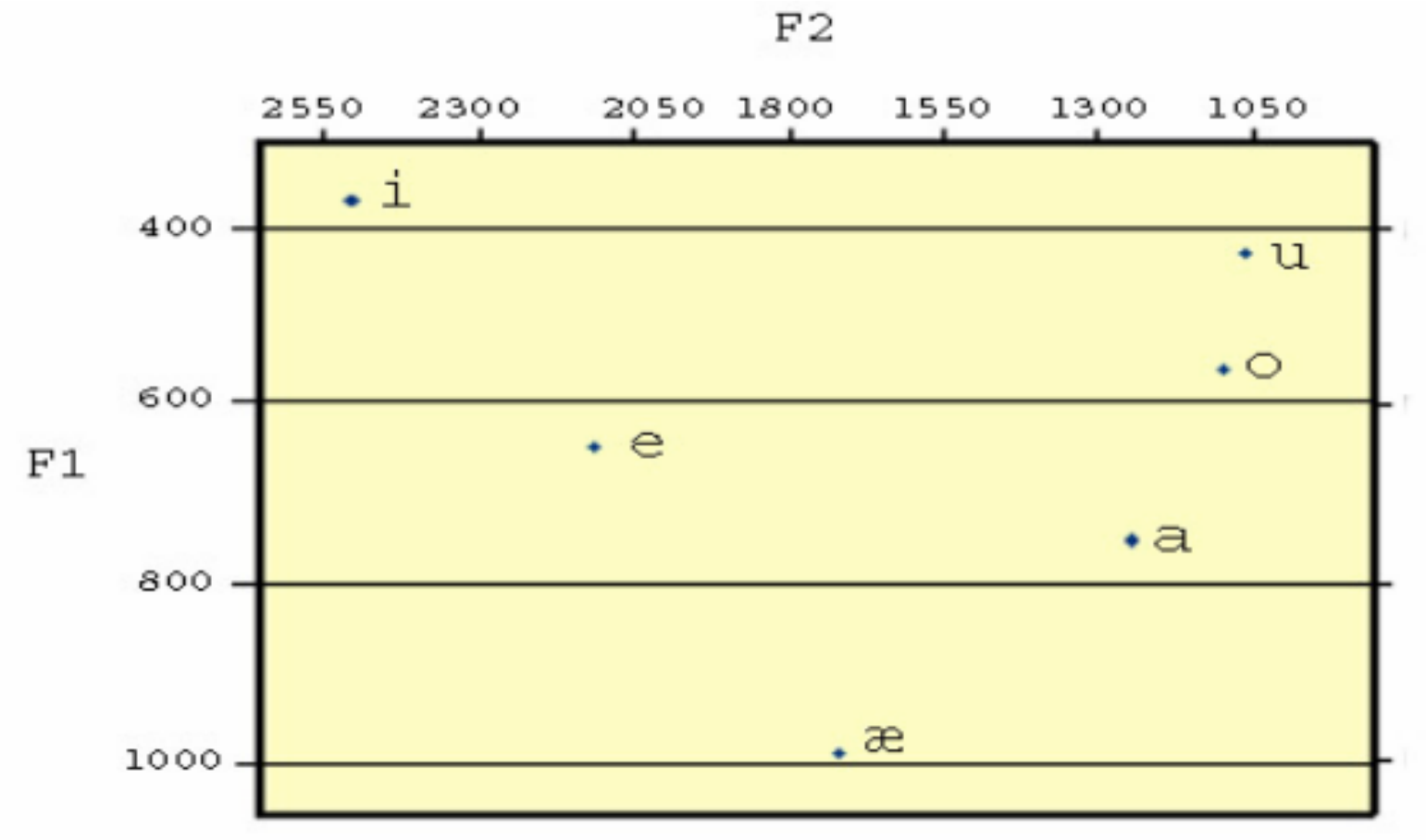

Figure 5: Persian vowels from Ansarin (2004)

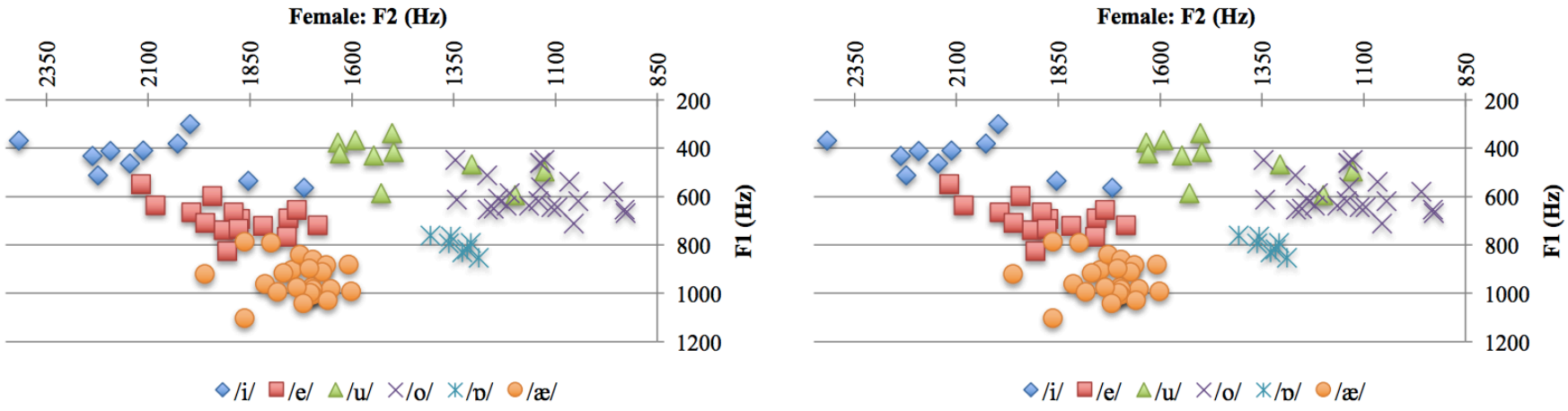

Figure 6: Persian vowels from Aronow (2017)

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The Corpus

The present study makes use of the Linguistics Data Consortium (LDC) Callfriend Farsi Corpus.

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- Over 60 hours of speech.

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- Casual telephone conversations between (and among) native Persian speakers.
- Multiple cities in Iran.
- 104 speakers.
- Over 60 hours of speech.
- Recorded at 8KHz.

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Cities

Figure 7: Cities represented in the Corpus

Population

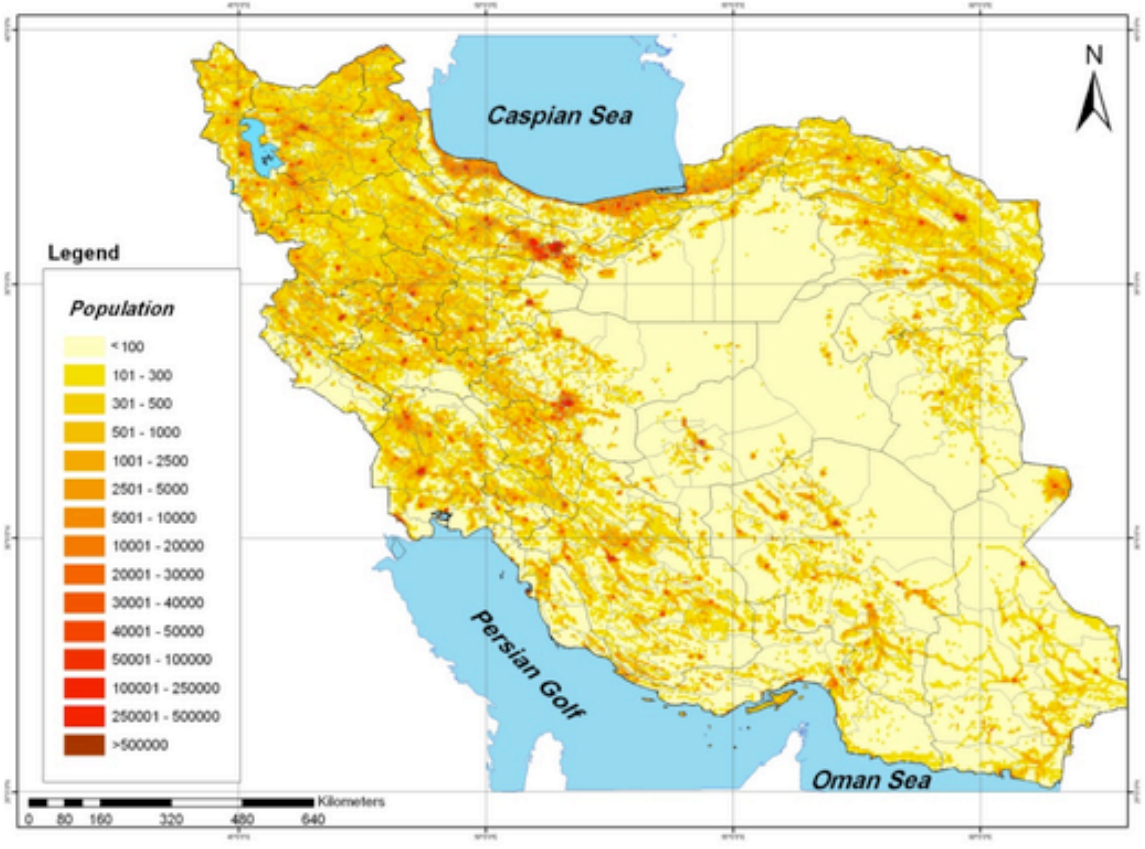

Figure 8: Population Density

Age and Gender

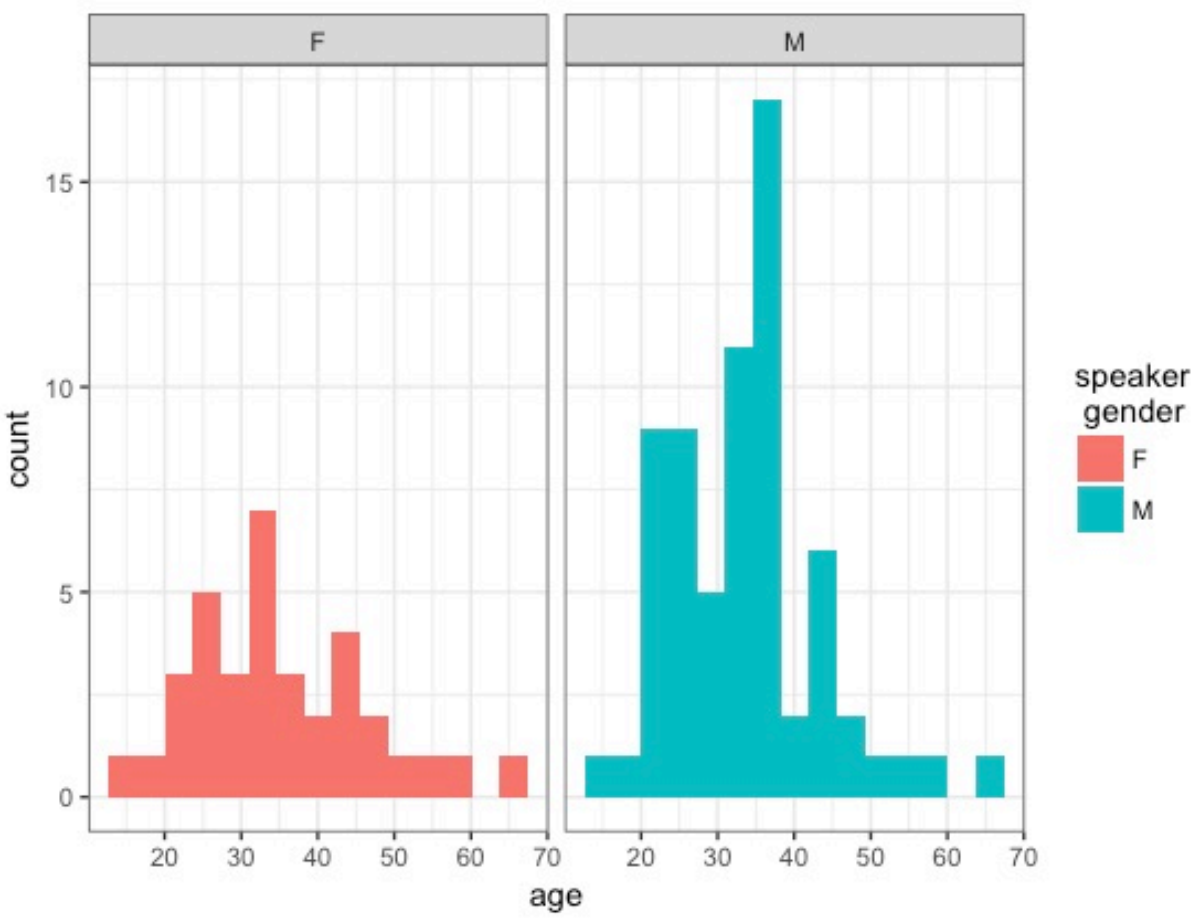

Figure 9: Distribution of age by gender

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Alignment

```
814.200 814.730 A:      AhAn
814.400 820.360 B:      %e se SHambe do SHambe in e ke u hamAn ruz tu KHune nist ^mahin sare kAr e
821.230 826.510 B:      ke madrese %e baCHCHehAye hamun protestAnihA ta'tili dArand
827.180 831.010 B:      in CHon unjA hast man miKHAm beram hafte do ruz
831.300 833.400 A:      AhAn ^mahin hanuz kAreSH ro dAre na
833.360 834.510 B:      Are dAre
835.560 837.780 B:      ham KHune kAr mikone ham unjA kAr mikone
839.060 840.160 B:      KHolAse in e
841.450 844.660 B:      dige be salAmati telefon intovri e
844.470 846.590 A:      Are ino Agahi zade budan tu ruznAme
846.800 847.250 B:      AhAn
847.040 848.720 A:      ke nim sA'at telefon konin
848.760 849.430 B:      CHerA
849.820 853.660 A:      ino ye dAneSHgAhi hast dArand CHiz nemunehAye
854.170 856.100 A:      zabunAye moKHtalef ro jam' mikonand
856.080 858.610 B:      AhAn AhAn
856.590 857.880 A:      ke yekiSH fArsi e
858.430 860.860 A:      miKHAn in in telefone mA al'An dAre zabt miSHe
860.850 863.160 B:      %eh %e
861.740 864.530 A:      Are Are telefone mA ro al'An dArand zabt mikonand
864.560 868.040 B:      bAbA pas %e harfe dige ro nazanim
867.140 871.110 A:      {laugh} Are age ^irAn bud migoftam movAzebe zabunetun bASHin
870.640 872.480 B:      ba'le {laugh}
871.180 878.020 A:      {laugh} na injA hame CHi miSHe goft hAlA ham ke miduni AGHAye ^kilinton CHAhAr ruz e da'vASH SHode bA jomhurikHAhA
878.080 880.990 B:      %eh CHerA
878.640 879.770 A:      mA KHuneneSHin SHodim
880.810 883.300 A:      {laugh} dowlat ro bastand dige KHabar nadAri mage
883.340 887.610 B:      na az kojA miduni begu
884.250 885.450 A:      kHabar nadAri %huh vAsat begam
885.990 887.100 A:      az da'-
887.500 889.830 A:      sare budje tavAfoGH nakardand bA ham
889.870 890.650 B:      AhAn
890.520 895.330 A:      AKHe bebin al'An jomhurikHAhA aksariyat dArand tuye majles va tuye sanA
895.390 896.290 B:      AhAn
896.150 899.810 A:      ba'd ra'is jomhur bAhASHun jur dar jur dar nayumad sare budje
899.820 900.390 B:      AhAn
900.200 902.660 A:      ba'd az zohre seSHambe
902.660 903.360 B:      AhAn
903.170 908.450 A:      dowlat ta'til SHod ya'ni GHeyr az AdamAyi ke hatman mibAyast sare kAr bASHand ke kArASHun
904.750 905.330 B:      (( ))
908.410 909.020 B:      AhAn
908.830 912.240 A:      vAjebe saddarsad e nazdike ye melyun nafar bikAr SHodand
912.250 914.310 B:      ey vAy
913.870 917.960 A:      na CHizi nist mituni morKHasi begiri ya'ni maj- puli az daste mA nemire
917.980 918.520 B:      AhAn
918.360 920.580 A:      montehA umadim KHune morKHasi ejbAri dArim migirim
920.580 921.710 B:      AhAn
921.560 924.040 A:      ba'd hiCHCHi dige messe al'An se ruz
923.080 925.120 B:      AKHareSH kojA KHAhad keSHid
925.870 929.750 A:      bAbA majbur and ye tavAfoGH konand ehtemAlan tA fardA pas fardA KHAhand kard
929.610 930.270 B:      %eh
930.070 933.720 A:      vali al'An se ruz o nim e ke dowlat dare dokkuneSH ro baste
934.000 934.330 B:      AhAn
934.120 937.740 A:      tamAme in CHiz masalan pArkhA inAye dowlati hame ta'til SHode
937.920 938.670 B:      'ajab
938.450 944.370 A:      in edAreye nemidunam mAliyAt o edAreye nemidunam komakhAye ejtemA'i hame darASH baste SHode
944.360 945.640 B:      'ajab
945.450 947.520 A:      Are al'An CHAhAr ruz e dowlat ta'til e
947.740 950.730 B:      man nemidunam ^huSHang az ^huSHang harf nemizane ke
950.540 951.040 A:      Are
951.430 954.350 A:      mA ro az zohre se SHambe ferestAdand KHune goftand KHodAhAfez
954.190 954.880 B:      AhAn
:
```

Figure 10: A typical transcription file

Alignment

```
861.740 864.530 A:      Are Are telefone mA ro al'An dArand zabt mikonand
864.560 868.040 B:      bAbA pas %e harfe dige ro nazanim
867.140 871.110 A:      {laugh} Are age ^irAn bud migoftam movAzebe zabunetun bASHin
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885.990 887.100 A:      az da'-
```

Figure 11: A closer look

Alignment

The McGill Prosodylab-Aligner wrapper for HTK was used after some data processing:

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- split into utterances.

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- split into utterances.
- utterances with English words or code-switching were discarded.
- {laugh}, {cough} etc. were discarded.

Alignment

The Farsi language model was trained on 21,002 sentences.

Alignment

Alignment was essentially perfect at the word level, and excellent at the phone level.

Alignment

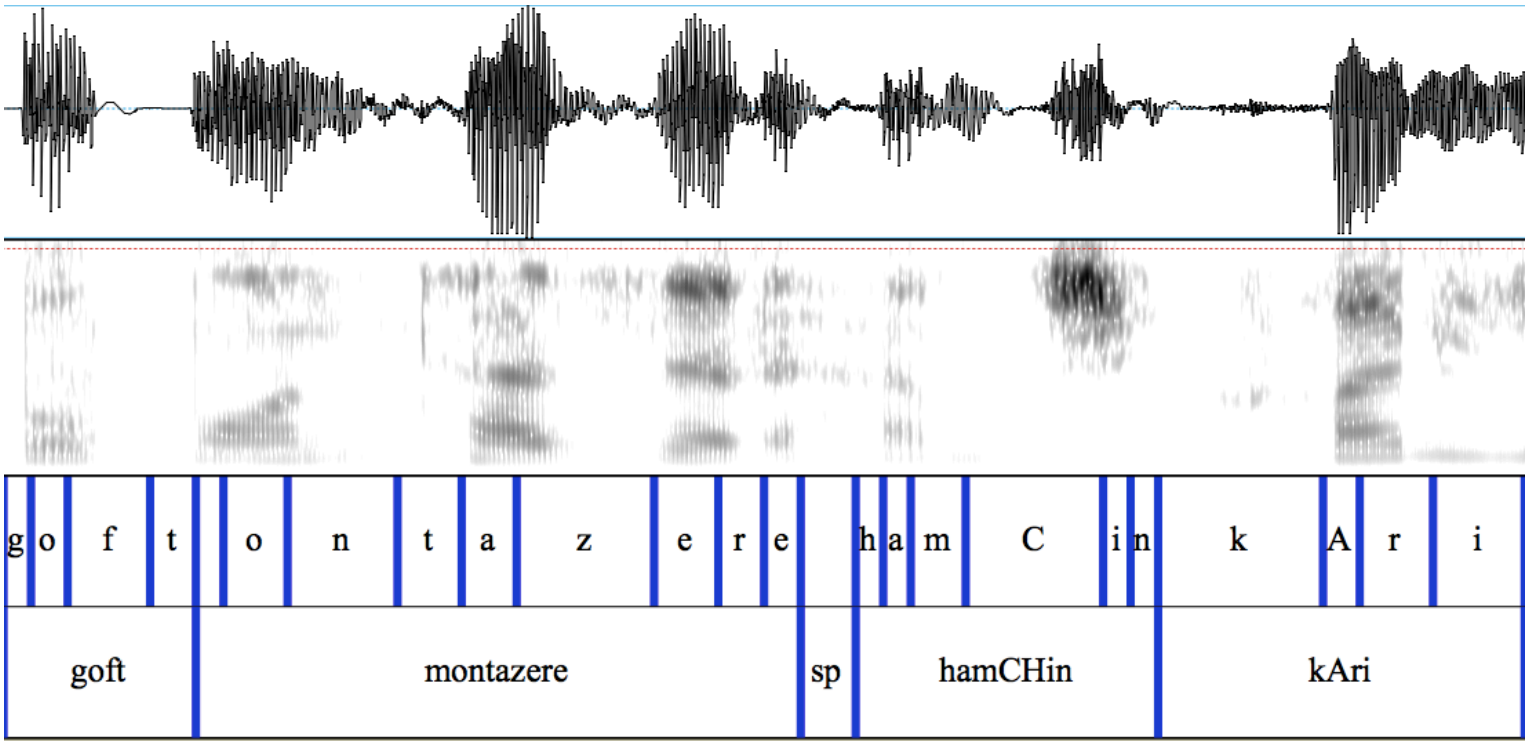

Figure 12: A sample alignment

Alignment

The end result was **70,711** vowels.

Extraction

Two methods were used for vowel extraction:

- Praat scripts
- R scripts

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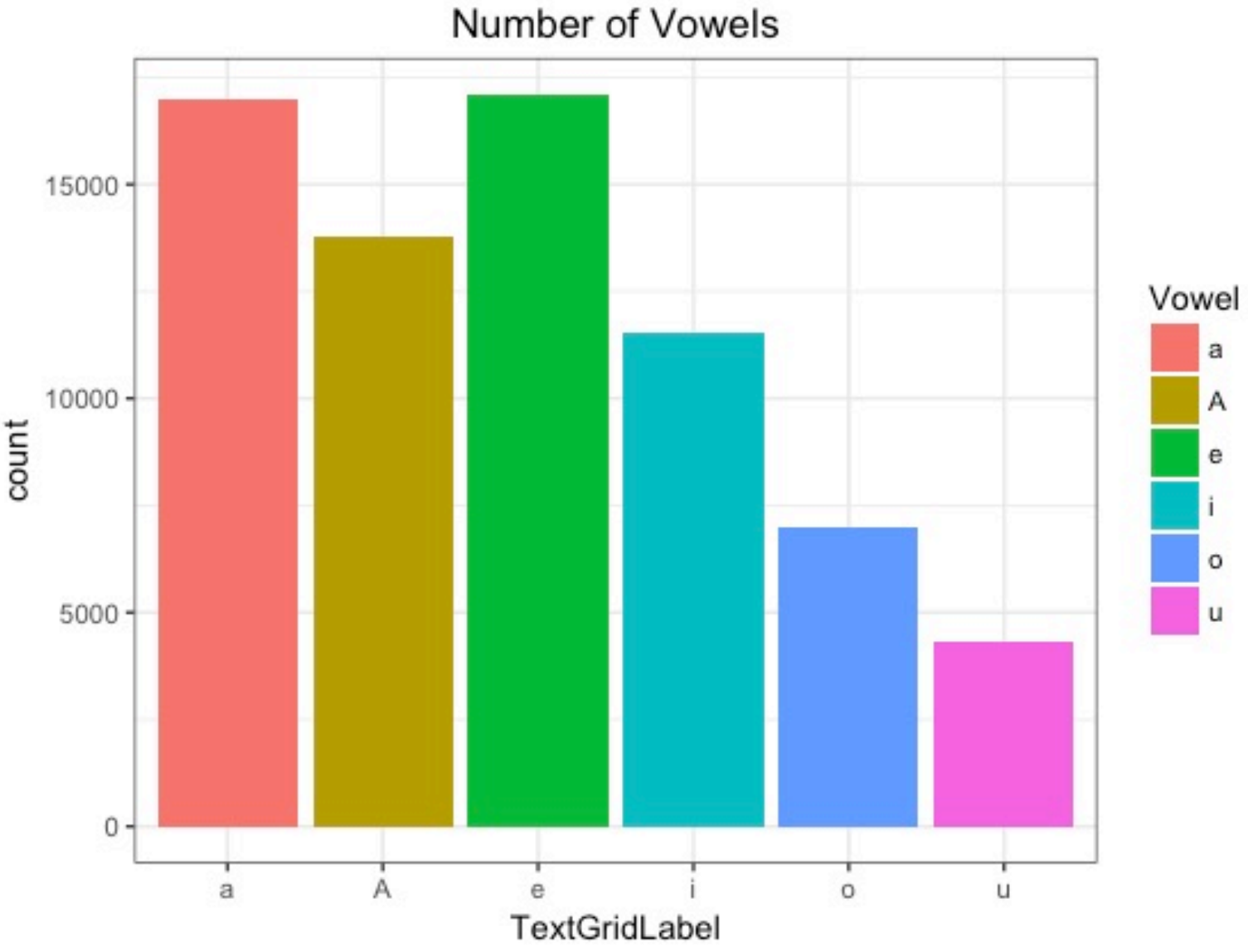
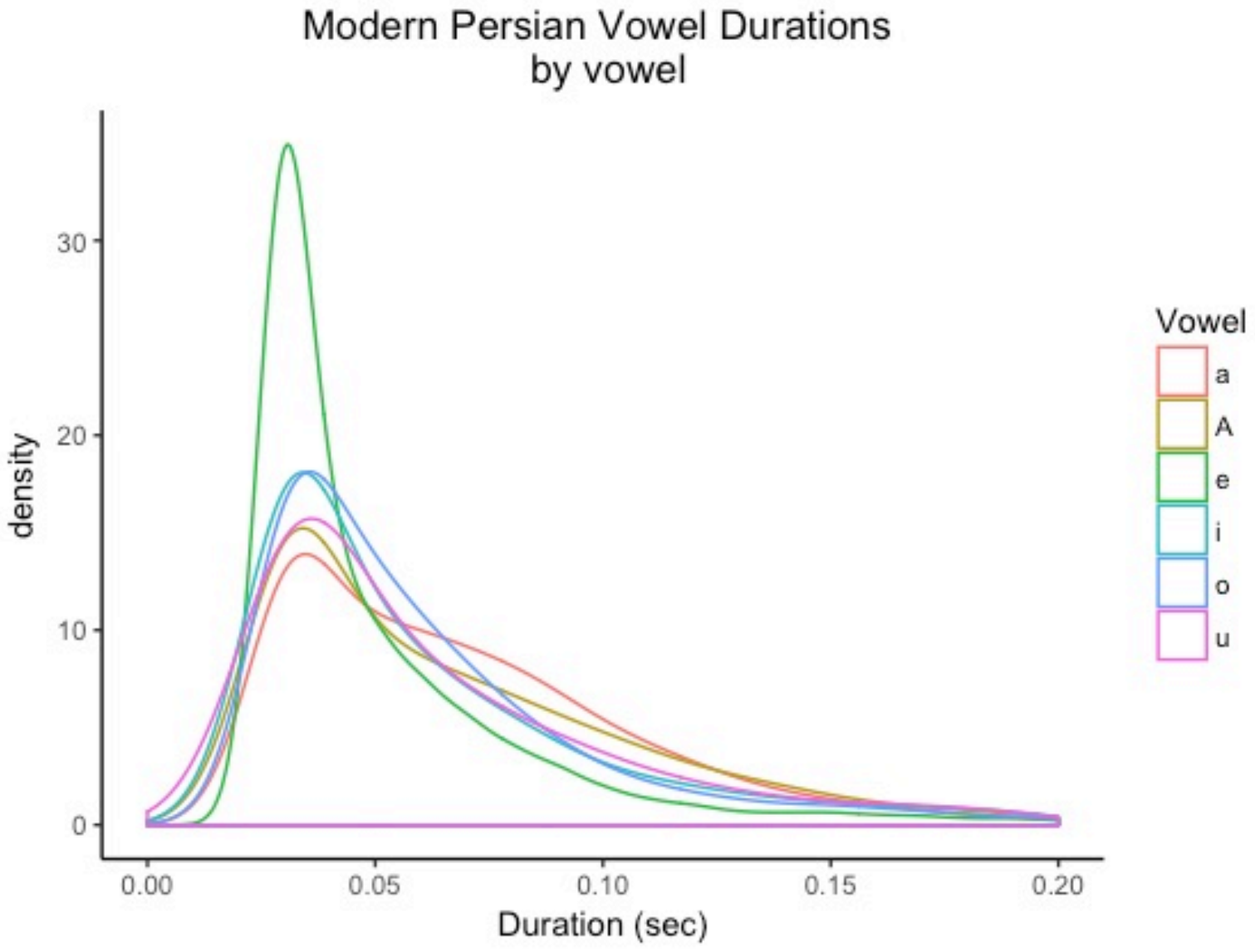
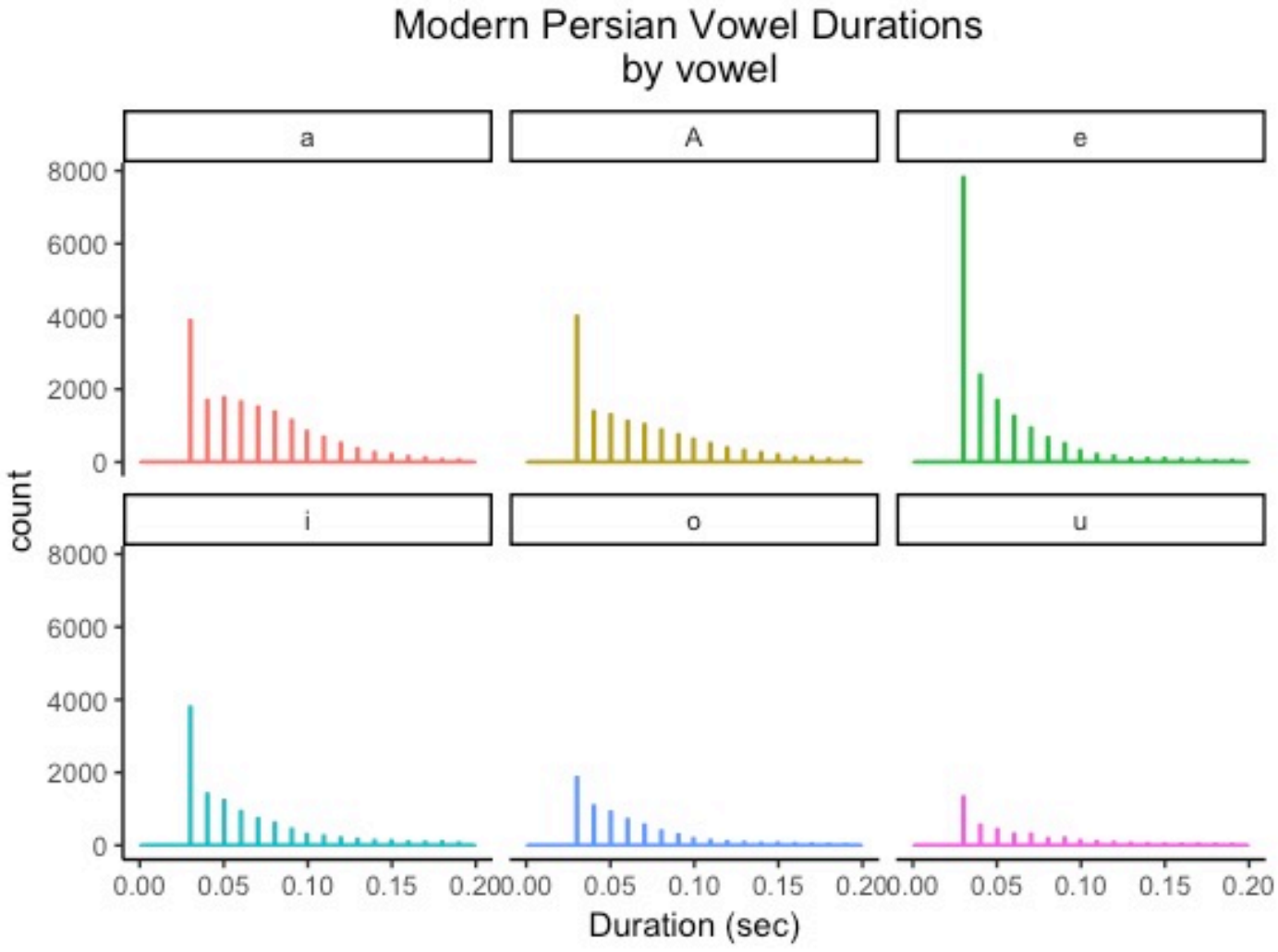
Summary


Number of Vowels
count
15000
10000
5000
0
a
A
e
i
o
u
TextGridLabel
Vowel
a
A
e
i
o
u

Summary


Modern Persian Vowel Durations
by vowel
density
30
20
10
0
0.00
0.05
0.10
0.15
0.20
Duration (sec)
Vowel
a
A
e
i
o
u

Summary


Modern Persian Vowel Durations
by vowel
a
A
e
i
o
u
count
8000
6000
4000
2000
0
0.00
0.05
0.10
0.15
0.20
Duration (sec)

Vowel Reduction

Persian has (normally) final stress. Stressed vowels are longer in duration.

Vowel Reduction

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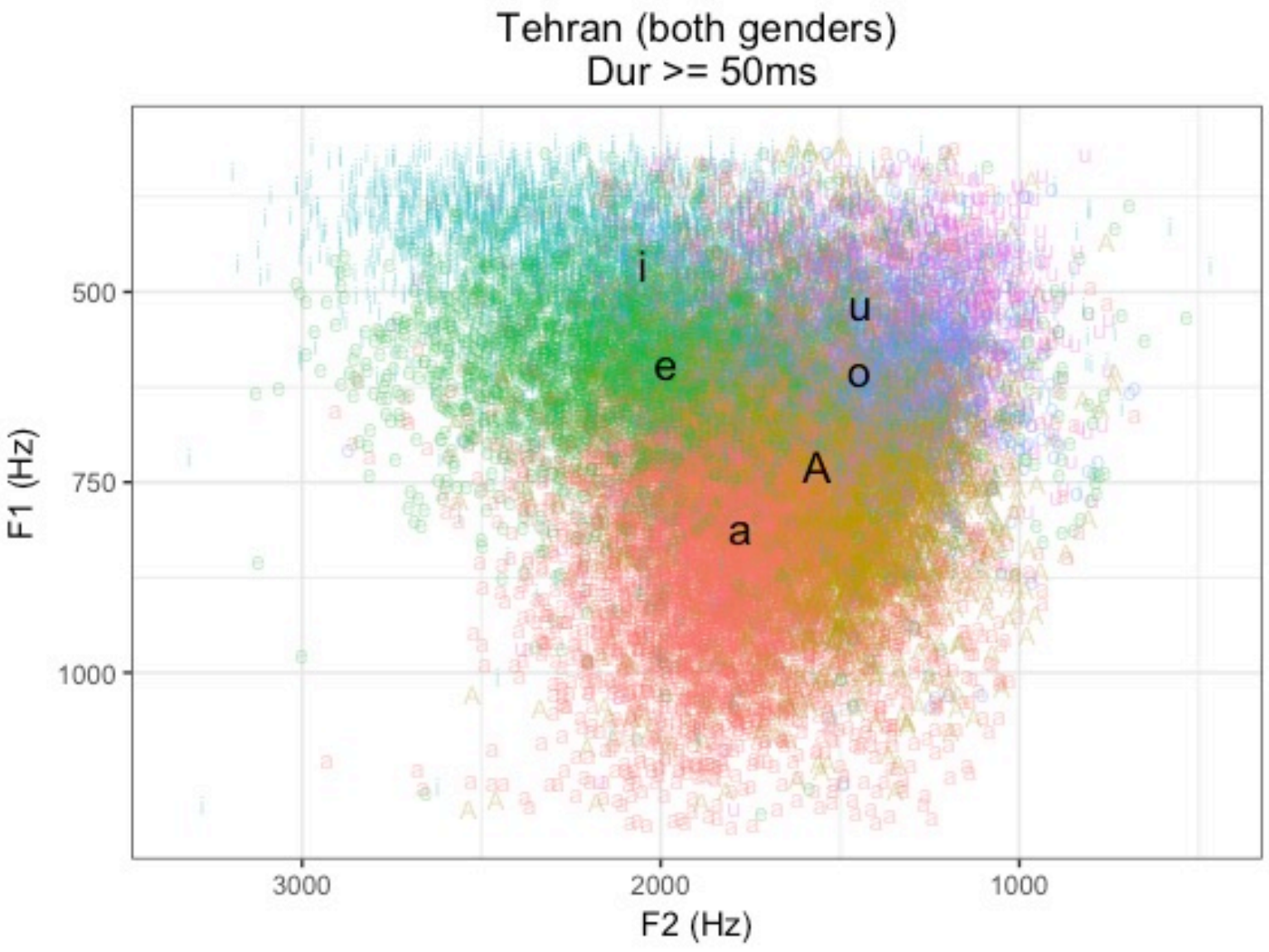
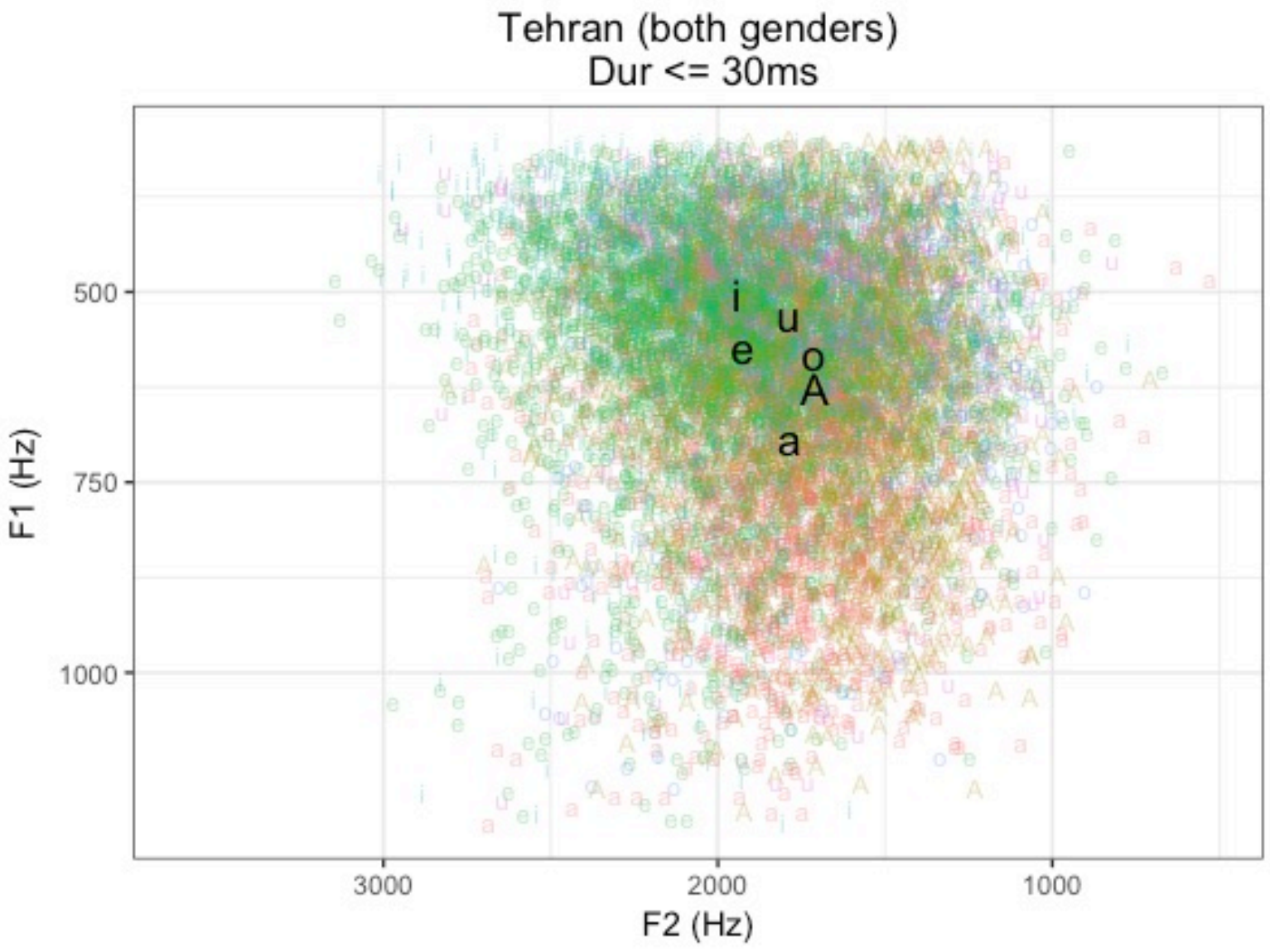
One fact that emerged from the corpus is that Contemporary Iranian Persian vowels significantly reduce in unstressed position.

Tehrani Vowel Space



Reduction


Tehran (both genders)
Dur <= 30ms
F1 (Hz)
500
750
1000
3000
2000
1000
F2 (Hz)
i
u
e
o
A
a

Reduction

- *ruz* →[rz] 'day'
- *hich* →[htʃ] 'any'
- *chiz* →[tʃs] 'thing'
- *pul* →[pʰl̥] 'money'
- *miforusham* →[mifrʃæm] 'I am selling'
- *miforushin* →[mifrʃn] 'you (pl.) are selling'
- *pas* →[pʰs] 'so'

Assimilation? Reduction? Harmony?

More work is needed to tease apart what is happening with vowel assimilation.

Assimilation? Reduction? Harmony?

More work is needed to tease apart what is happening with vowel assimilation. So far, little phonetic evidence for the phenomenon.

A Wrinkle

The mysterious low back vowel may not be a single steady vowel for all speakers.

A Wrinkle

The mysterious low back vowel may not be a single steady vowel for all speakers. In fact, it looks (and sounds) like a diphthong for many speakers.

A Wrinkle

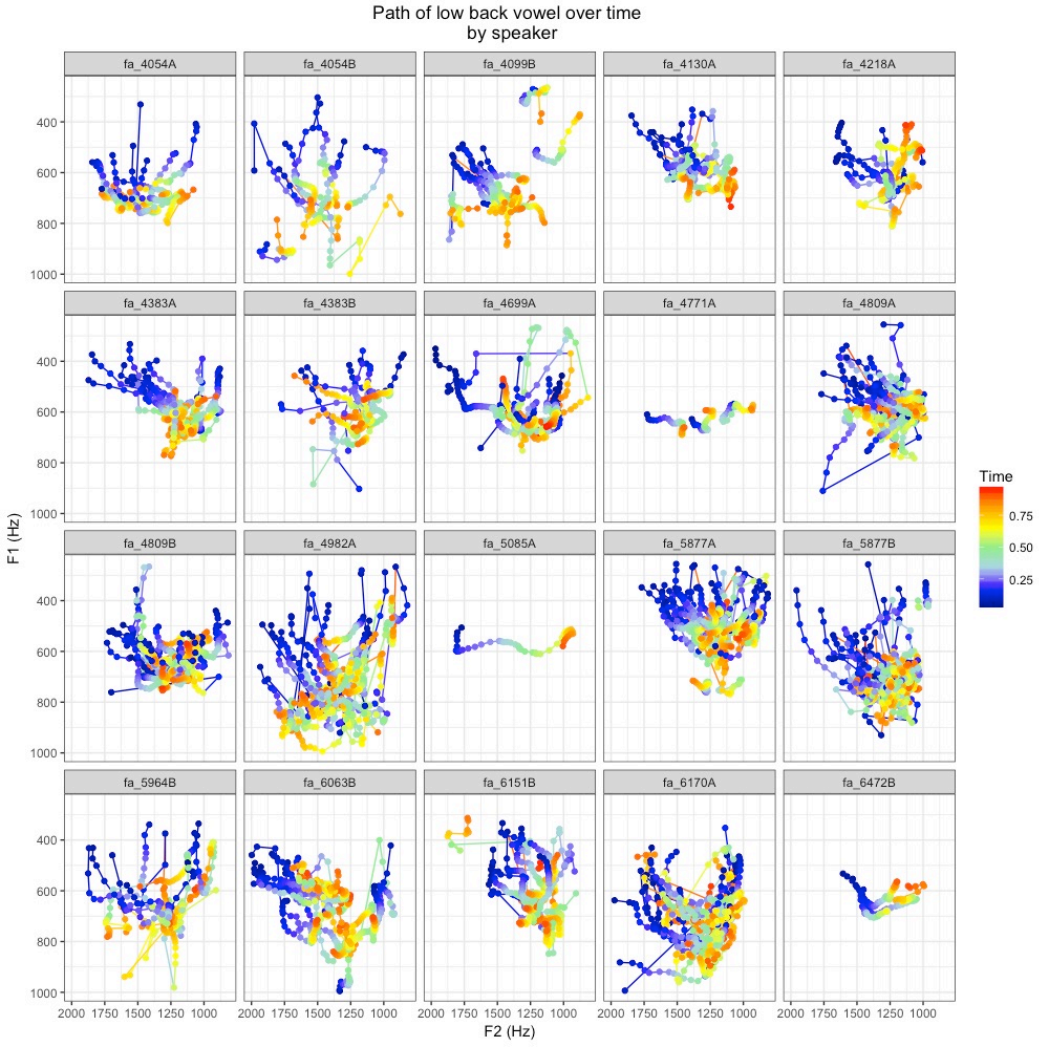


Figure 13: Diphthong? Off-glide?

A Wrinkle

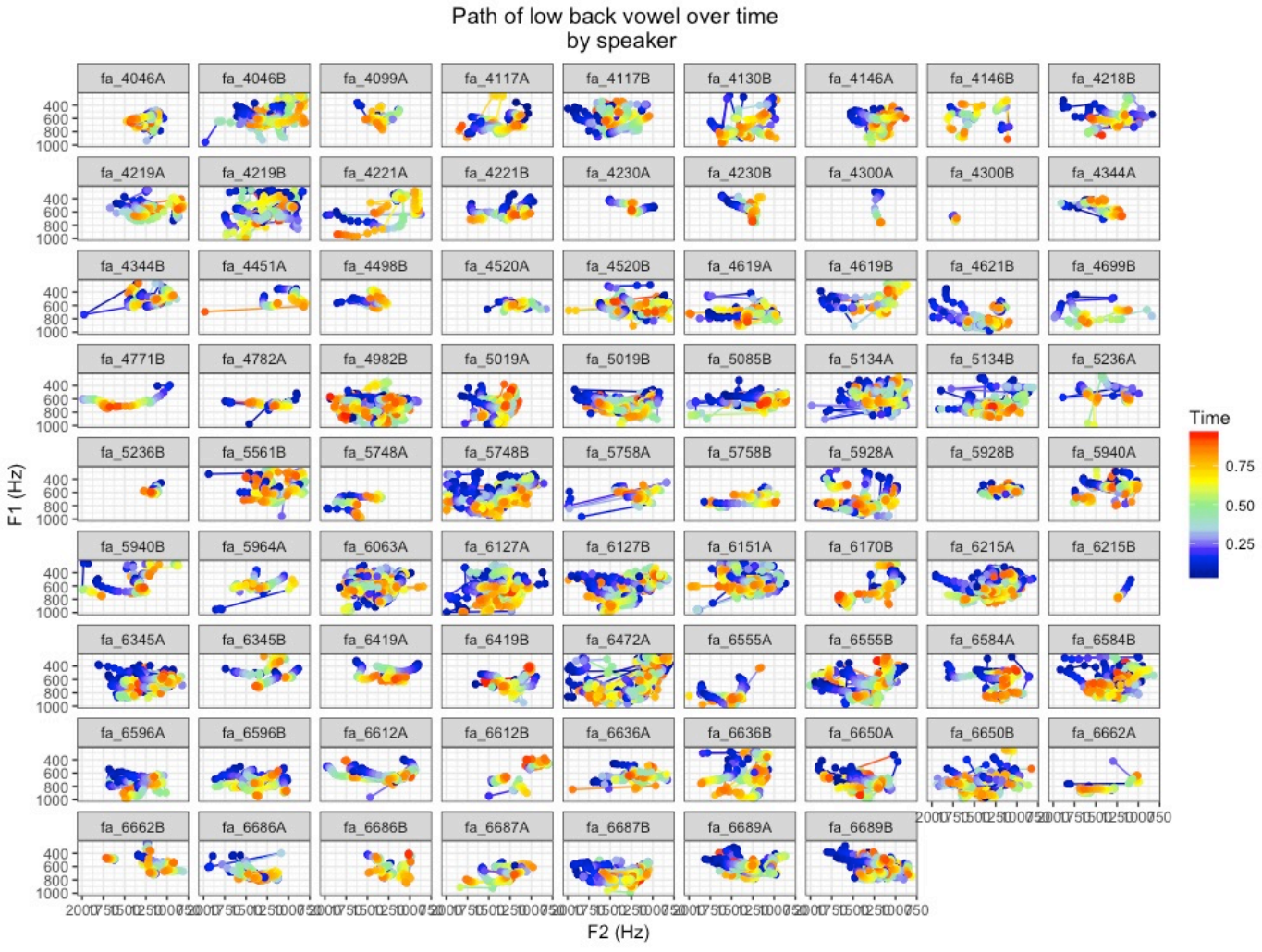
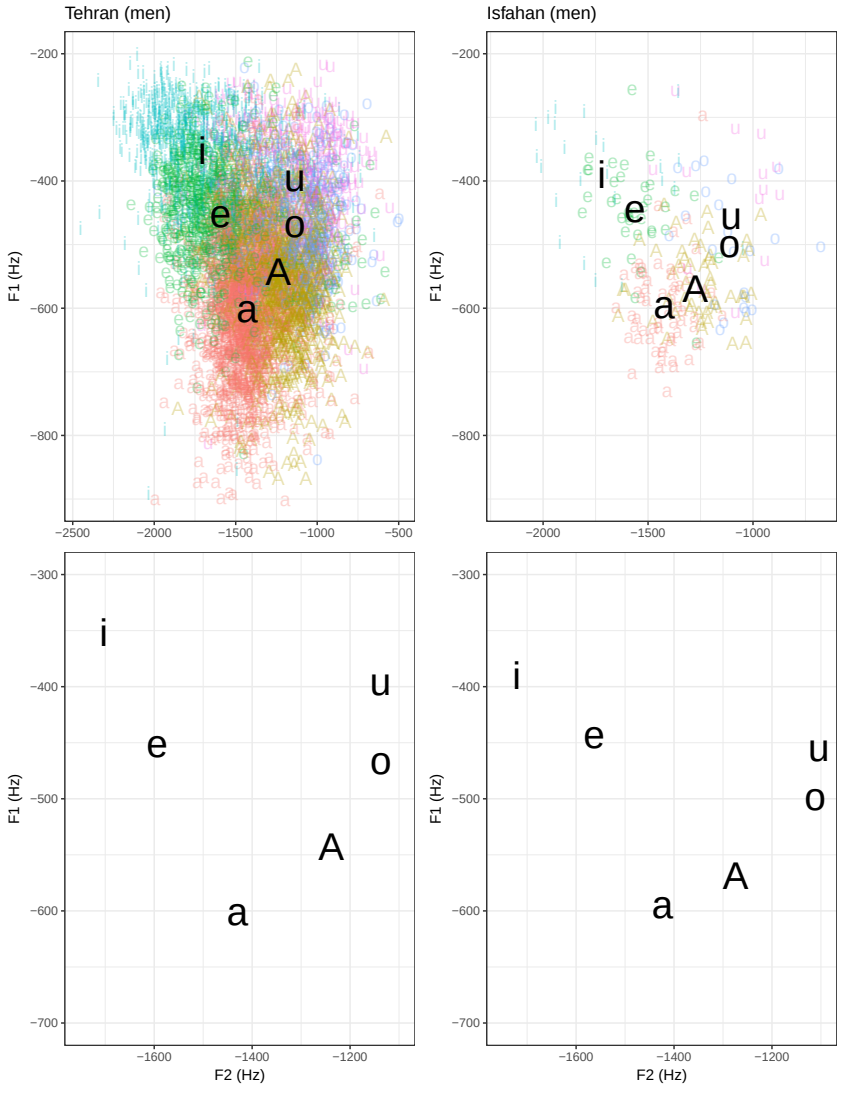


Figure 14: Other Speakers

Regional Variation



Gender Variation

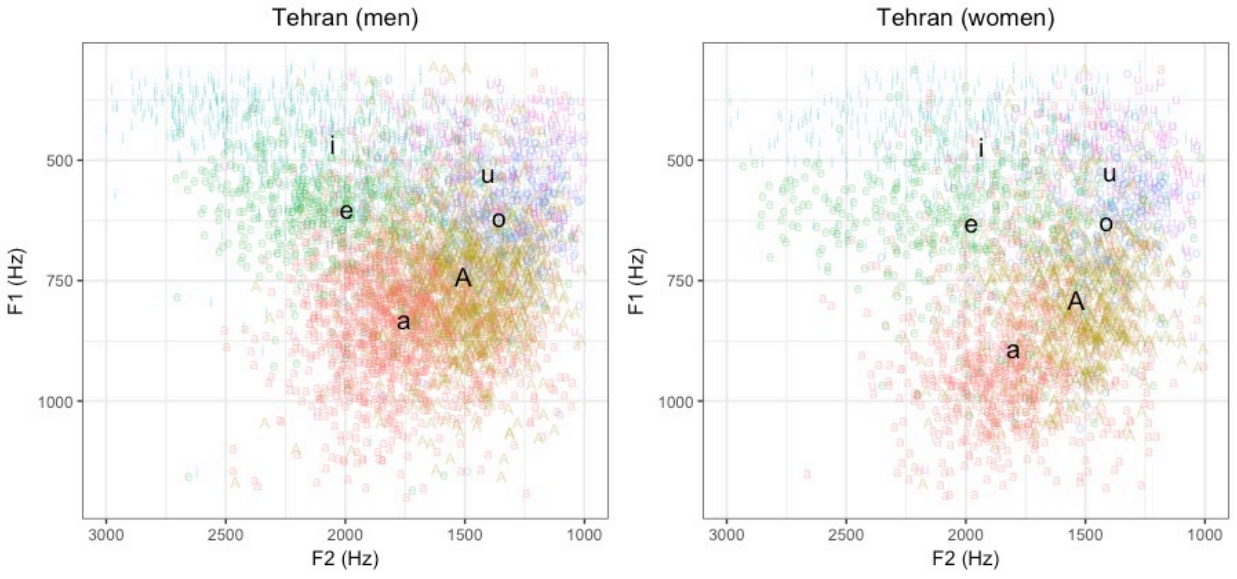


Figure 15: Vowel plots for Tehrani speakers by gender

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Future reseach

Big Question (1):

Future reseach

Big Question (1): How empirically real, and distinct from normal reduction processes, is the phenomenon of vowel assimilation in casual Contemporary Iranian Persian?

Future reseach

Big Question (2):

Future reseach

Big Question (2):

Assuming assimilation is empirically supported, do the phonetic patterns here inform our thinking about the phonological explanation?

Future reseach

Big Question (3):

Future reseach

Big Question (3): Given a corpus with such a good balance of age, gender, education, and location, is there evidence of sociolinguistic variation in the vowelspace of Contemporary Iranian Persian?

The End

Thank you!

Special thanks to Mark Liberman, Jianjing Kuang, Kyle Gorman, and the Linguistics Data Consortium.

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