Individual Variation and Linguistic Innovation in the American Pacific Northwest

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The **Pacific Northwest English Study**

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Research Questions

Goal: Investigate low-front prevelar raising, (ɛ) BEG and (æ) BAG to (ey) BAKE in Pacific Northwest English.

1. Is there individual-level evidence that the changes in these two word-classes are interrelated?

2. Is inter-speaker variability leading to increasing group-wide uniformity?

3. Are there phonetic motivations for (ɛg)- and (æg)-raising? If so, when may we assert that a phonetic universal has become a sociolinguistic marker?

Preview of Conclusions

- Are the changes in these two word-classes interrelated?

  Yes. *We see systemic relatedness. Speakers' strategies serve to respect functional considerations.*

- Is inter-speaker variability leading to increasing group-wide uniformity?

  Cautious Yes. *Taken in generational cohorts, we see that individual patterns of variability are giving way to common pattern of raising in a broader range of phonetic environments for (æ).*

- Are there phonetic motivations for (ɛg)- and (æg)-raising? If so, when can we assert that a phonetic universal has become a sociolinguistic marker?

  Resounding Yes (to both). *Robust evidence that velars favor raising (esp. /ŋ/). However, we see increasingly that other environments may raise more than velar ones.*

- The PNW has been subject to ongoing variable linguistic input, with transnational settlement by travelers originating from Illinois, Iowa, Indiana, Ohio, New England, coastal routes including Vancouver, WA, and California. (Sale, 1976; Taylor, 2003)
- Reed (1965) likens Washington speech to that of southern Illinois and Iowa
- Reed (1952) noticed raising of (æ) in HANG
- Reed (1961) reported infrequent raising of (ɛ) EGG, and (æ) BAG
- Gordon (2004) asserts that The West shows no raising for (ɛ) or (ey)
- Labov, et al. (2006) "the West shows considerable mixing"

Problems:

- 1: Raising of (ɛ) and (æ) to (ey) means disrupting the symmetry of the vowel system, maintenance of phonetic distinctions (Martinet 1952)
  - (eyg) may be susceptible to phonetic crowding: low functional load "bagel", "vague", "plague", "pagan"
  - no (æg~eyg) minimal pairs
- 2: Inter-speaker variability in apparent time obscures the path of change (Gordon 2001)
- 3: Intra-speaker variability obscures the motivations for raising

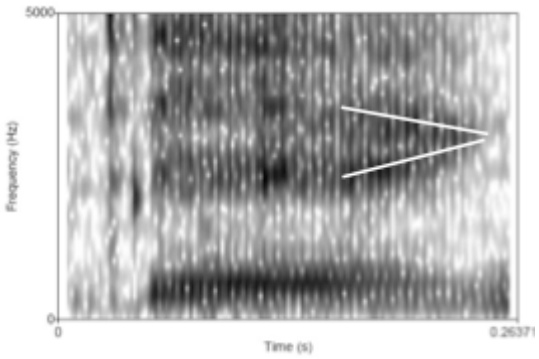
Continuing the (Actuation Workshop) Conversation

- Hualde: "How do we get from sporadic recategorization to sound change?"
- Gick: In a feed-forward system, talkers might adopt strategies optimizing the emergence of a more reliable cue.

Conventionalization vs. Recategorization?

Phonetic Motivations for Raising: Velar Pinch

- Def: visible approximation of F2 and F3 in transition from vowel (e.g., [a]) into a velar stop (oral or nasal).
- /ŋ/ as hyper-raising environment because two articulatory factors condition velarization (raising of tongue dorsum, lowering of the velum)
- Invoked to account for pre-velar raising in Wisconsin English (Purnell, 2008; Baker et al., 2008; Benson et al. 2011)



a. [g]: constriction by dorsum near velum

b. [ŋ]: constriction by dorsum *and* velum

source: Baker, Mielke, and Archangeli (2008)

Methods

Speakers: Apparent-time sample, 3 generational cohorts.

19 Females (Caucasian-American ethnicity)

Older: (eldest 100 y.o.a.) born 1900-1950
Middle: born 1951-1976
Younger: (youngest 21 y.o.a.) born 1977-1992

Materials: /æ, ɛ, ej/

Words in carrier: "Write ___ today."
Reading passage: Aesop's Fables "The Cat and the Mouse" (adapted)
Independent Variables: Vowel Class, Following Phone
4 levels: ŋ , g , k , "other" (bilabial, alveolar)
laterals, rhotics excluded

Methods, cont.

Recording Specifications:

M-Audio Microtrack 24/96 Compact Flash Recorder
Audio Technica 3031 microphone
44.1kHz sampling rate (downsampled to 11.025kHz)

Analysis Techniques:

Manual setting of onset and offset (300ms analysis window)
and Penn Phonetics Lab Forced Aligner (P2FA, Yuan and Liberman 2008)
Hand-correction of targets (300ms analysis window)

F1-F3 (Hz) measured using multiple-point spectral analysis: 20-50-80%
Automatic formant extraction: 0-5500Hz, 30dB, 4 or 5-pole LPC analysis (Praat script v. 4.2, 5.3.1)

Nearey-1 Normalization (R software)
SSANOVA: inferential statistical model of vowel trajectory contours (R software)
PhonR (R software)

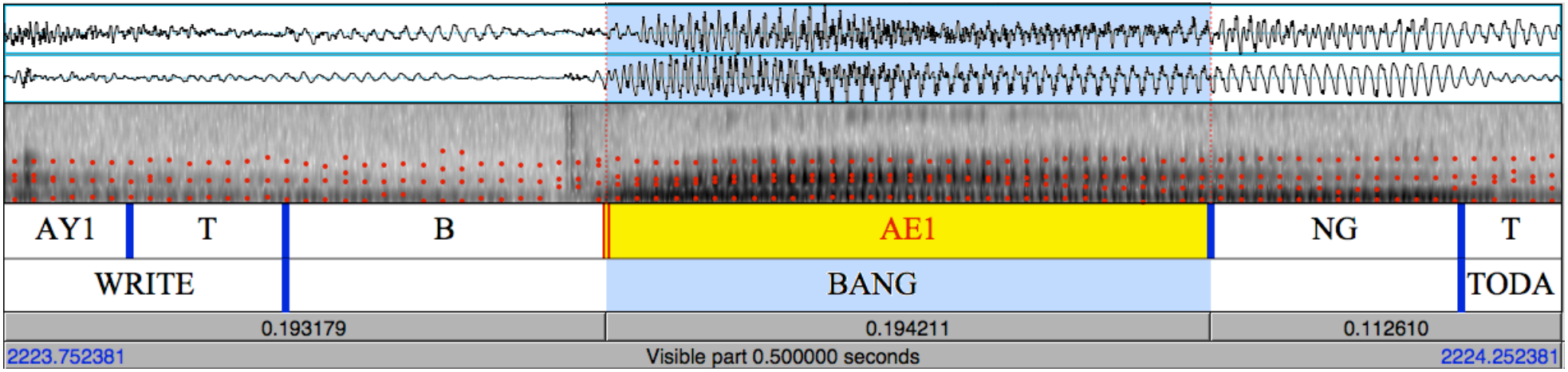
Overview of Results

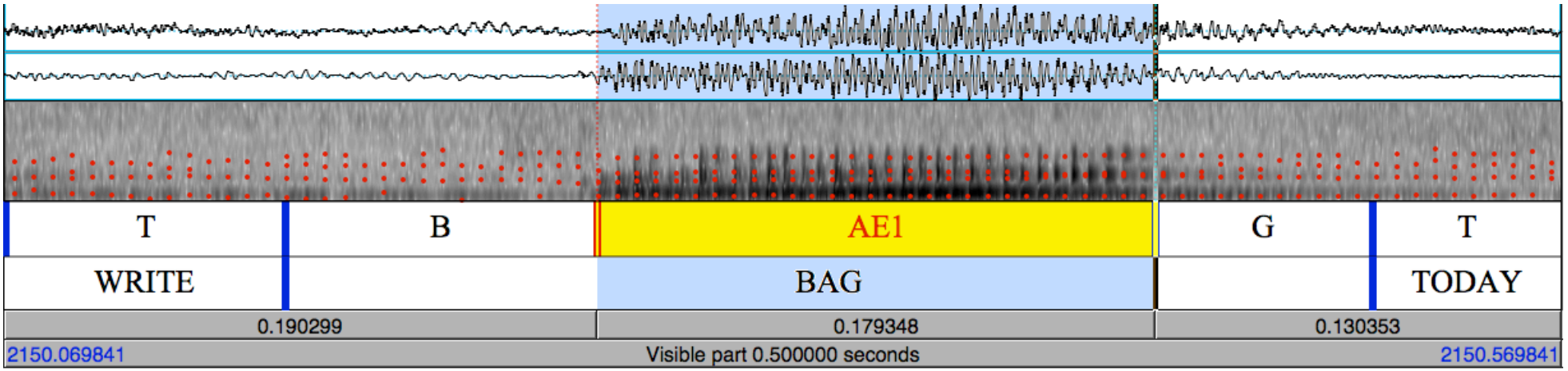
- /ŋ/ confirmed to be a hyper-raising environment (Baker et al. 2008)

  Predicted pattern:
  ŋ > g > k > other

- /æŋ/ often auditorily diphthongal
- /k, g/ robustly condition raising in /e, ɛ/

ex.



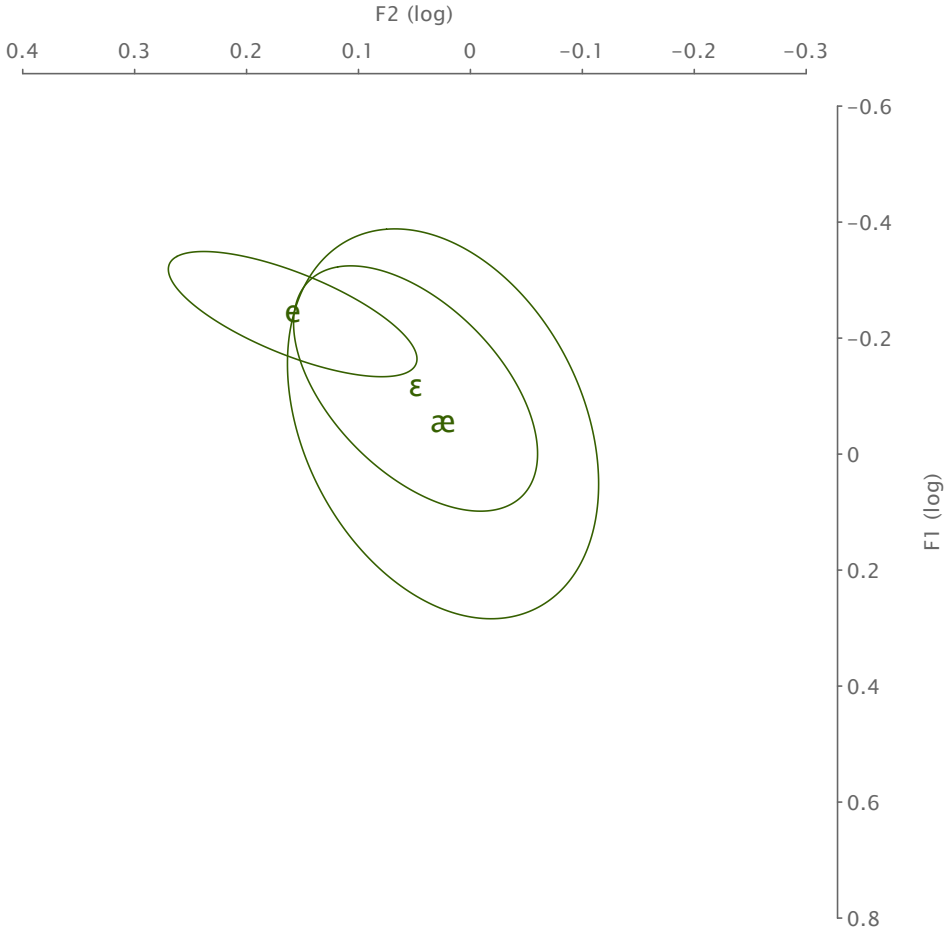


- Speaker 1: "bang" (top), "bag" (bottom)

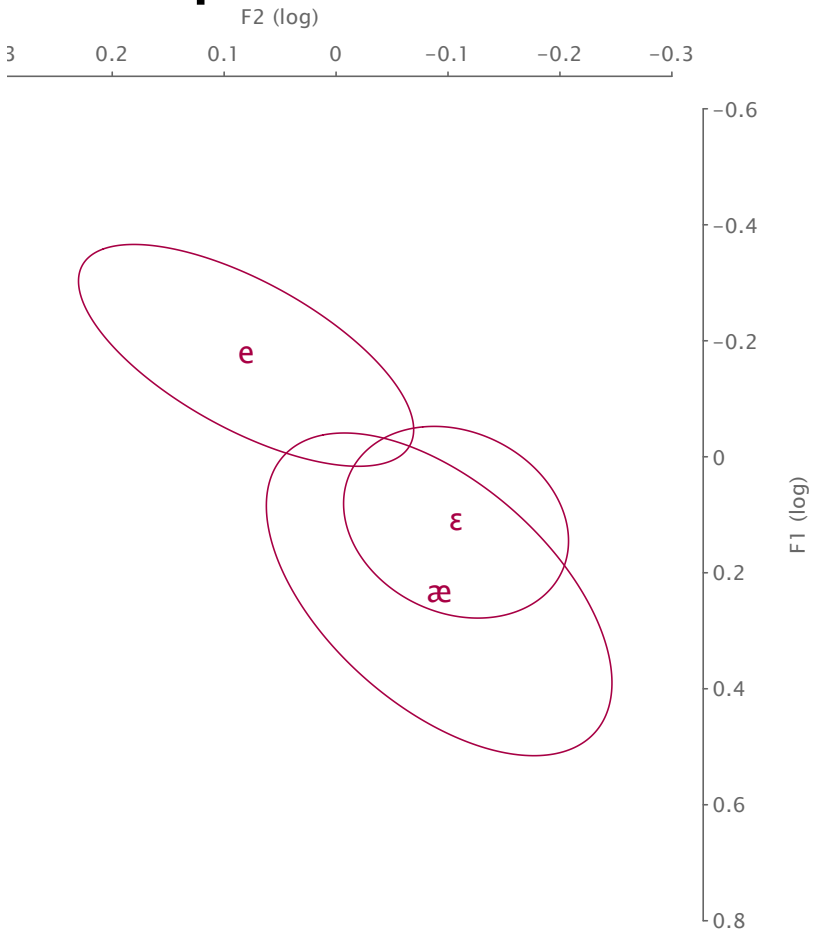
(æ)

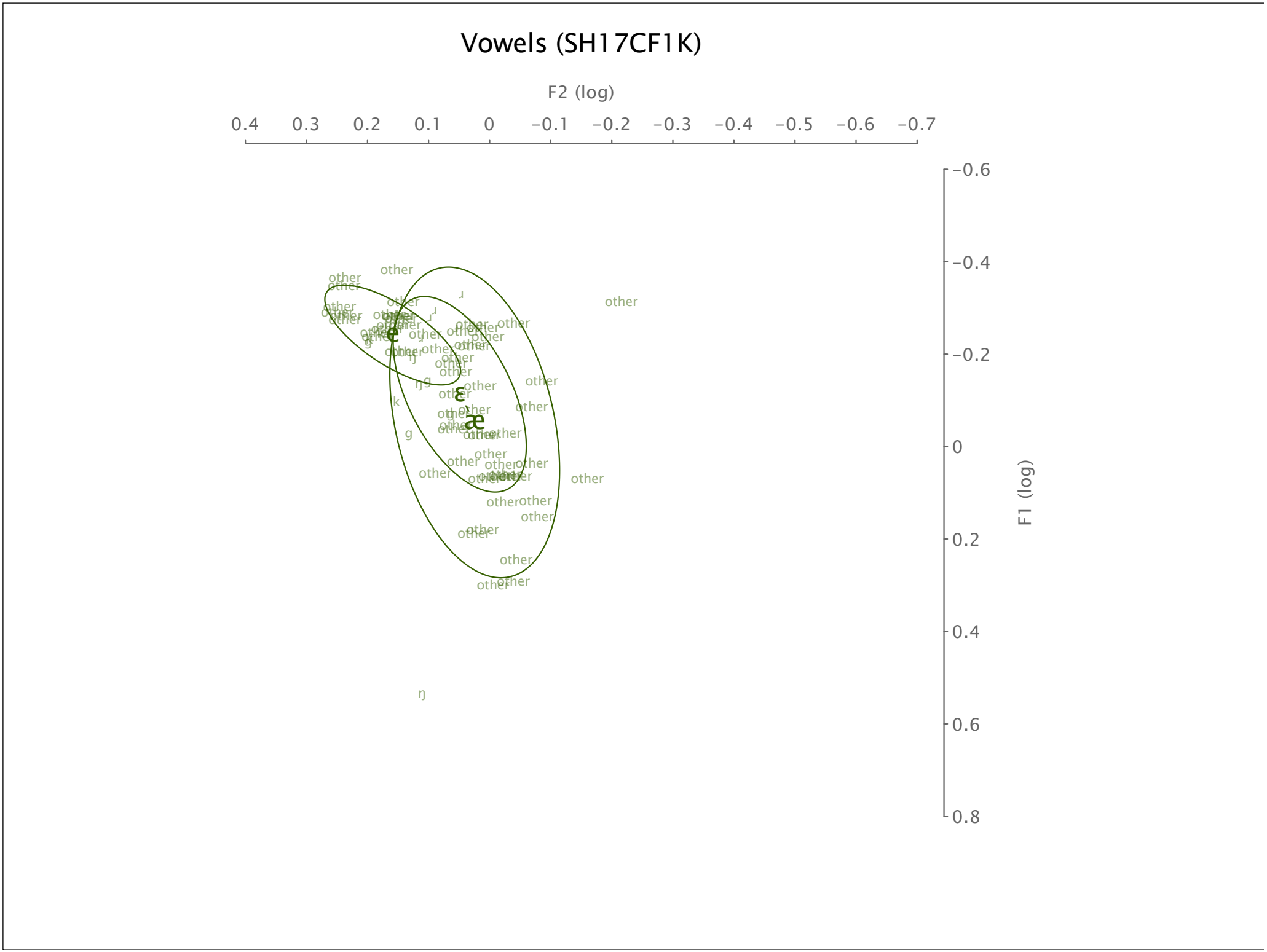
Generation 1 (Oldest)

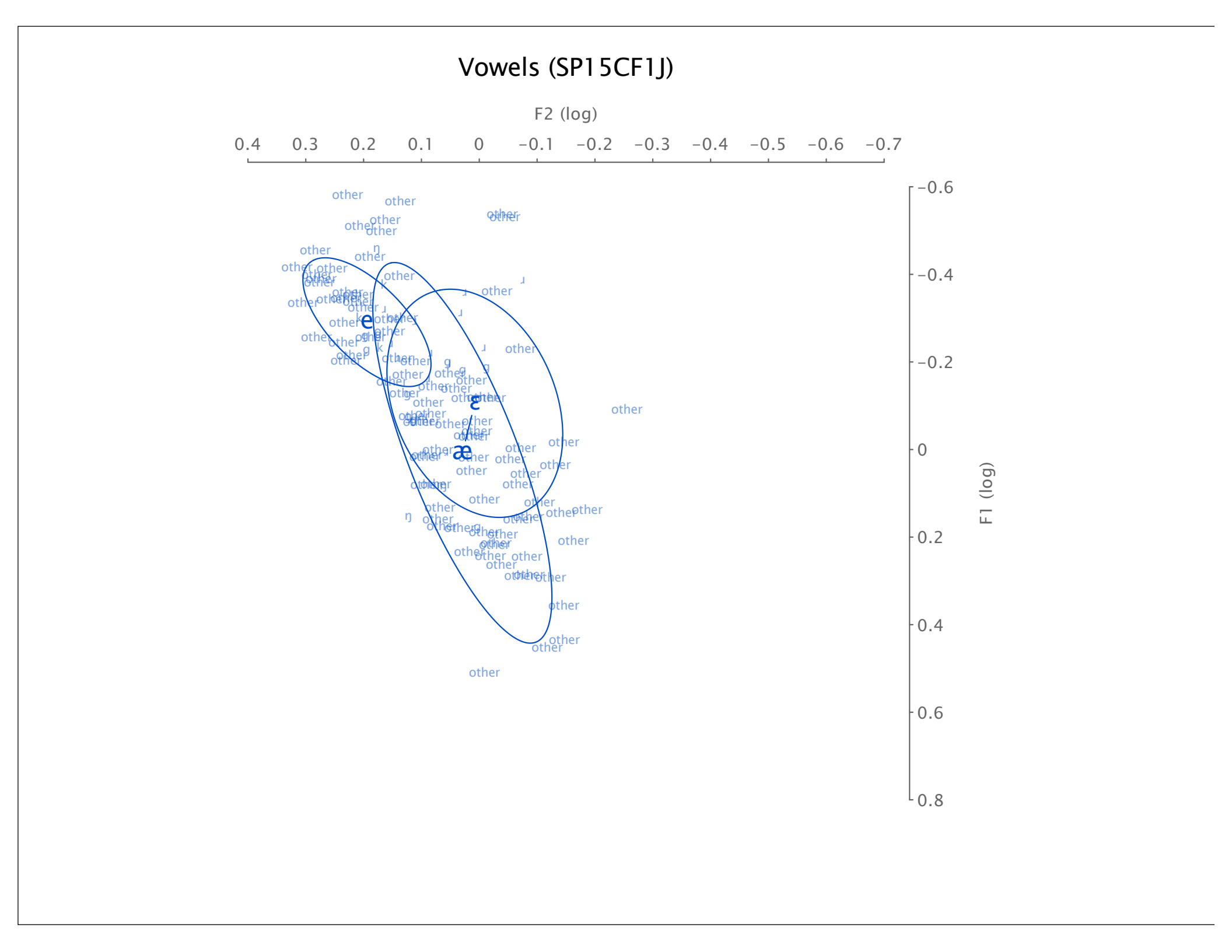
Speaker 17

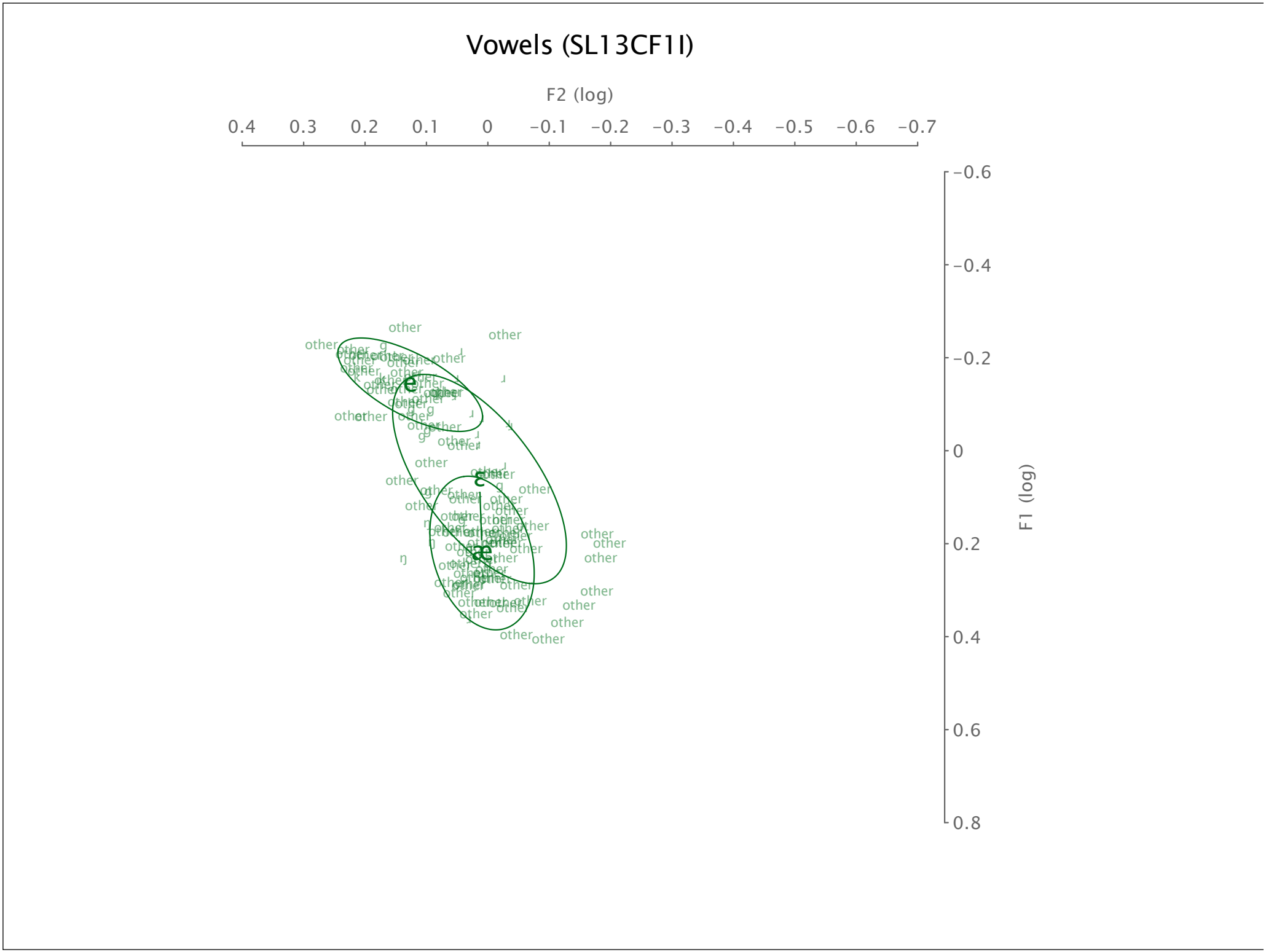


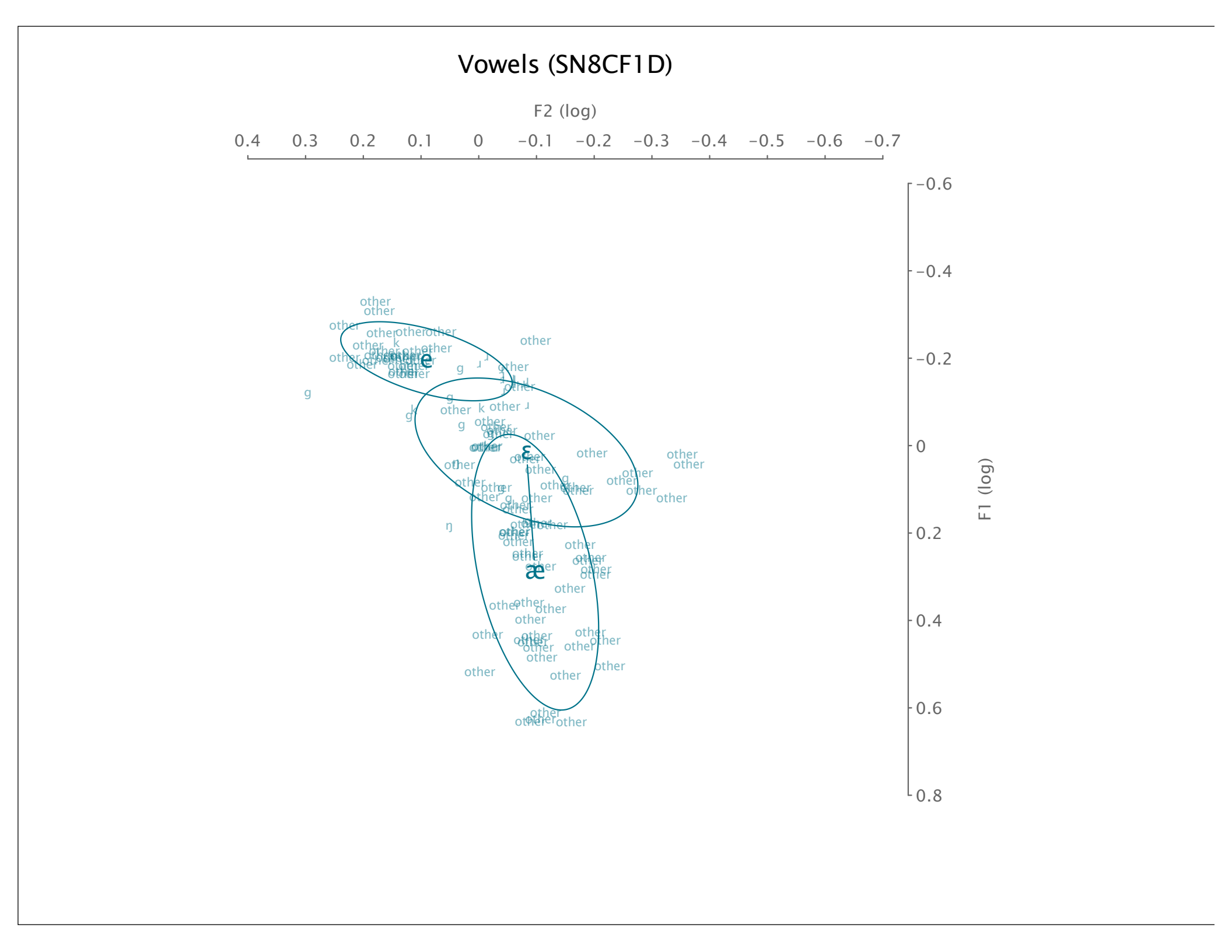
Speaker 24

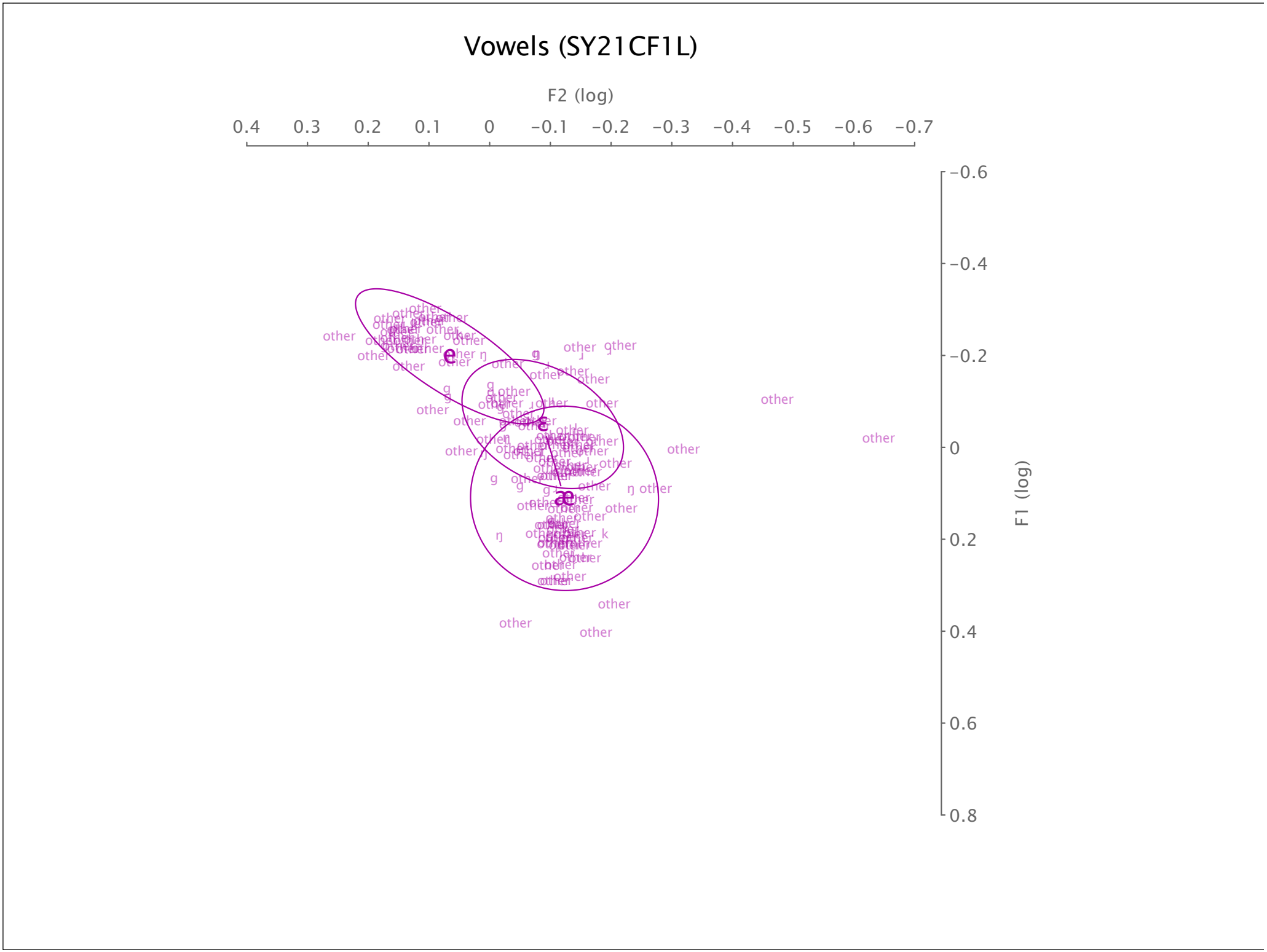


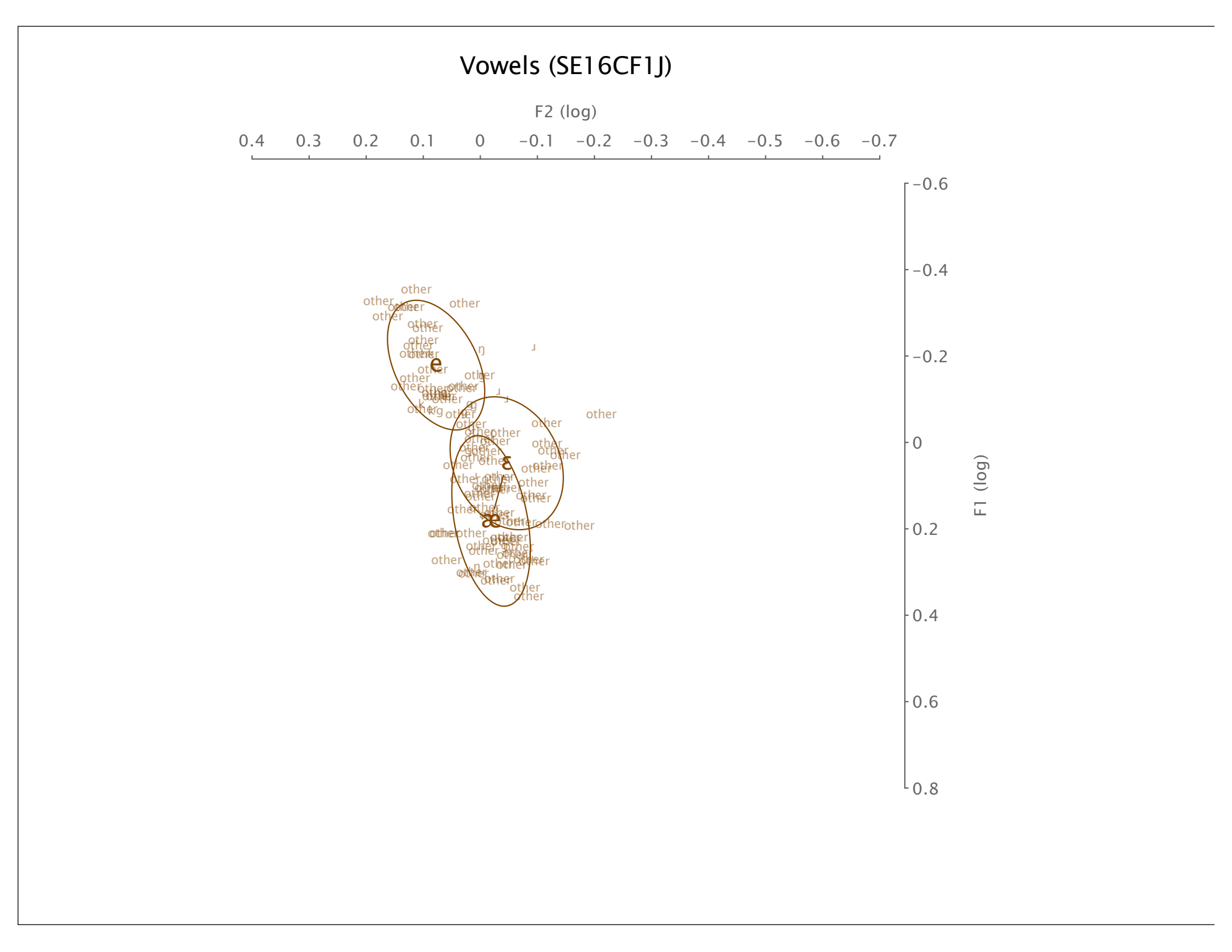

Vowels (SH17CF1K)
F2 (log)
0.4
0.3
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
F1 (log)
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
e
ɛ
æ
other
ɹ
k
g
ŋ

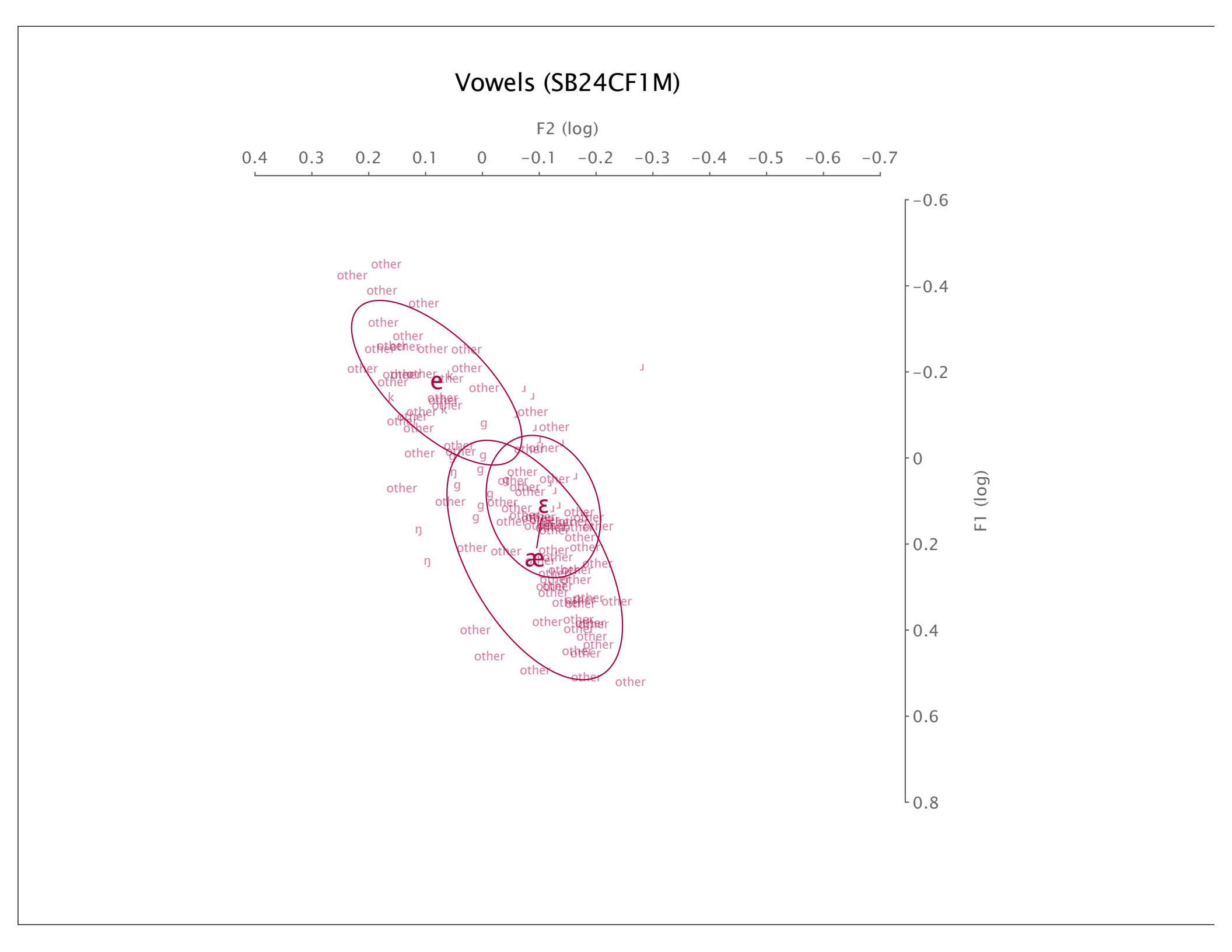

Vowels (SP15CF1J)
F2 (log)
0.4
0.3
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
F1 (log)
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
e
ɛ
æ
other


Vowels (SL13CF1I)
F2 (log)
0.4
0.3
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
F1 (log)
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
e
ɛ
æ
other


Vowels (SN8CF1D)
F2 (log)
0.4
0.3
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
F1 (log)
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
e
ɛ
æ
other


Vowels (SY21CF1L)
F2 (log)
0.4
0.3
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
F1 (log)
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
e
ɛ
æ
other


Vowels (SE16CF1J)
F2 (log)
0.4
0.3
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
F1 (log)
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
e
ɛ
æ
other


Vowels (SB24CF1M)
F2 (log)
0.4
0.3
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
F1 (log)
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
e
ɛ
æ
other
g
k
ŋ
ɹ

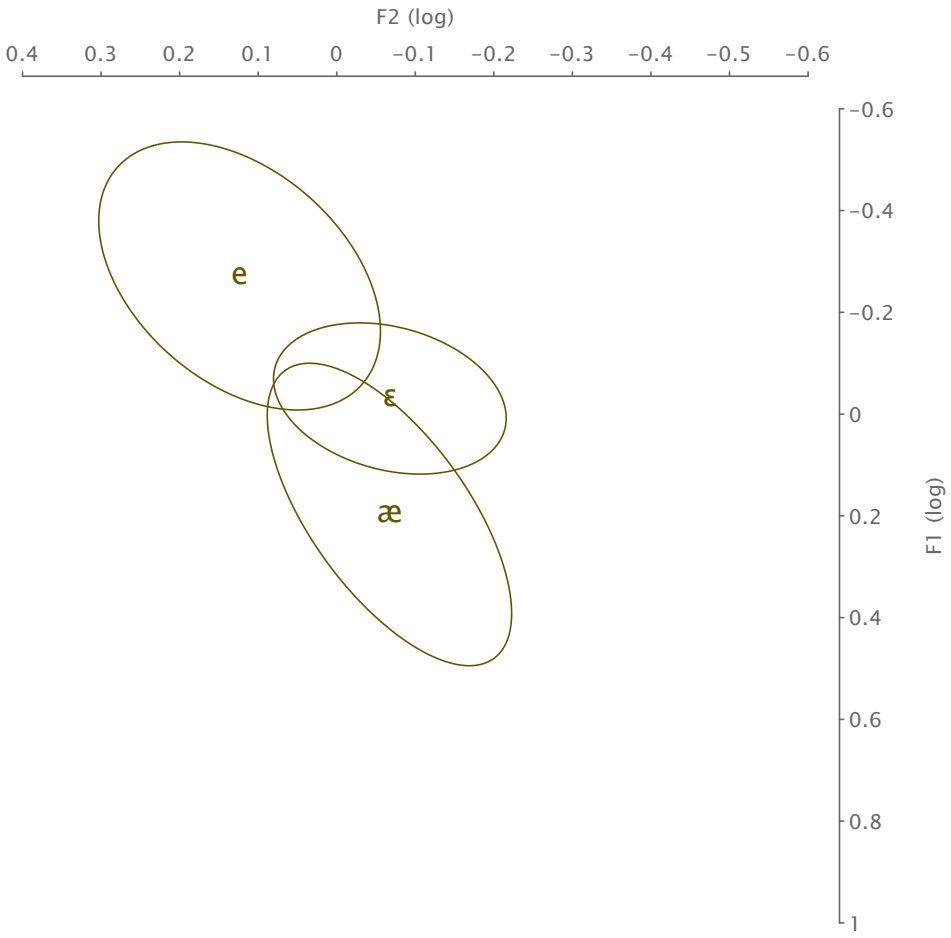
Gen 1 (æ only)		
ŋ ≥ g > other > k	g > ŋ > other > k	g > other > ŋ > k
Speaker 8 Speaker 15 Speaker 21	Speaker 24 Speaker 16 Speaker 13	Speaker 17

Predicted pattern:

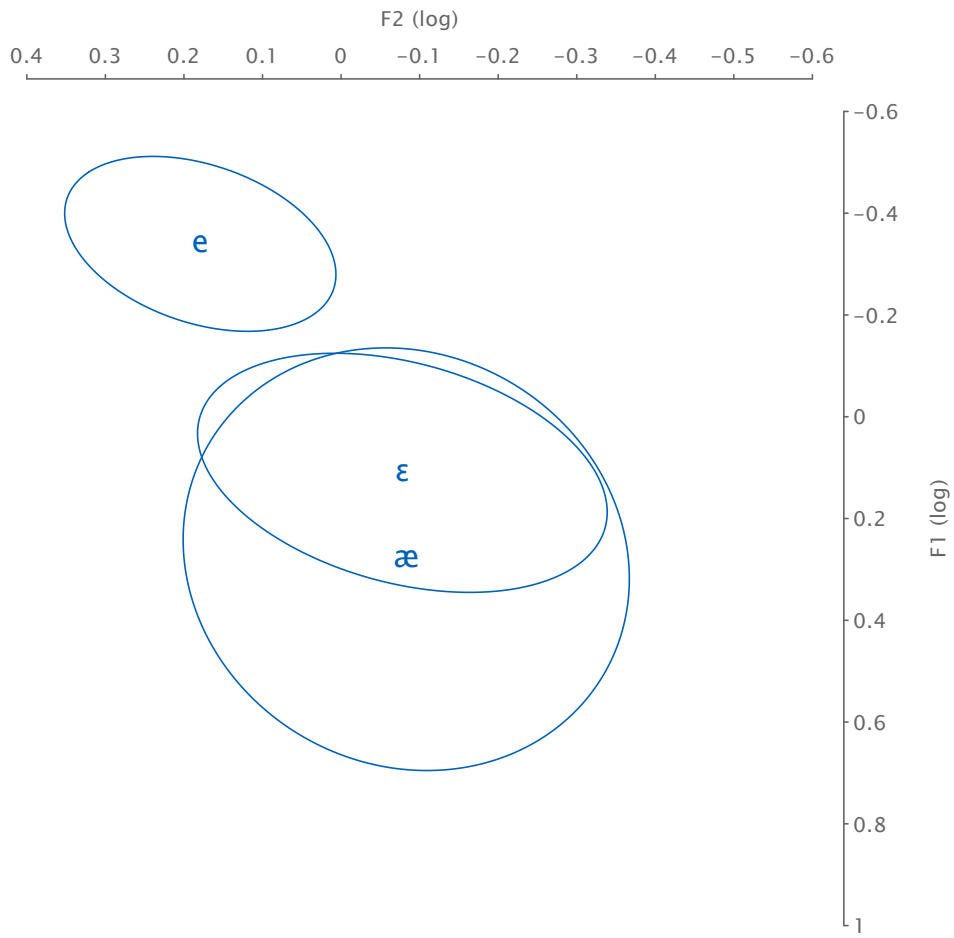
ŋ > g > k > other

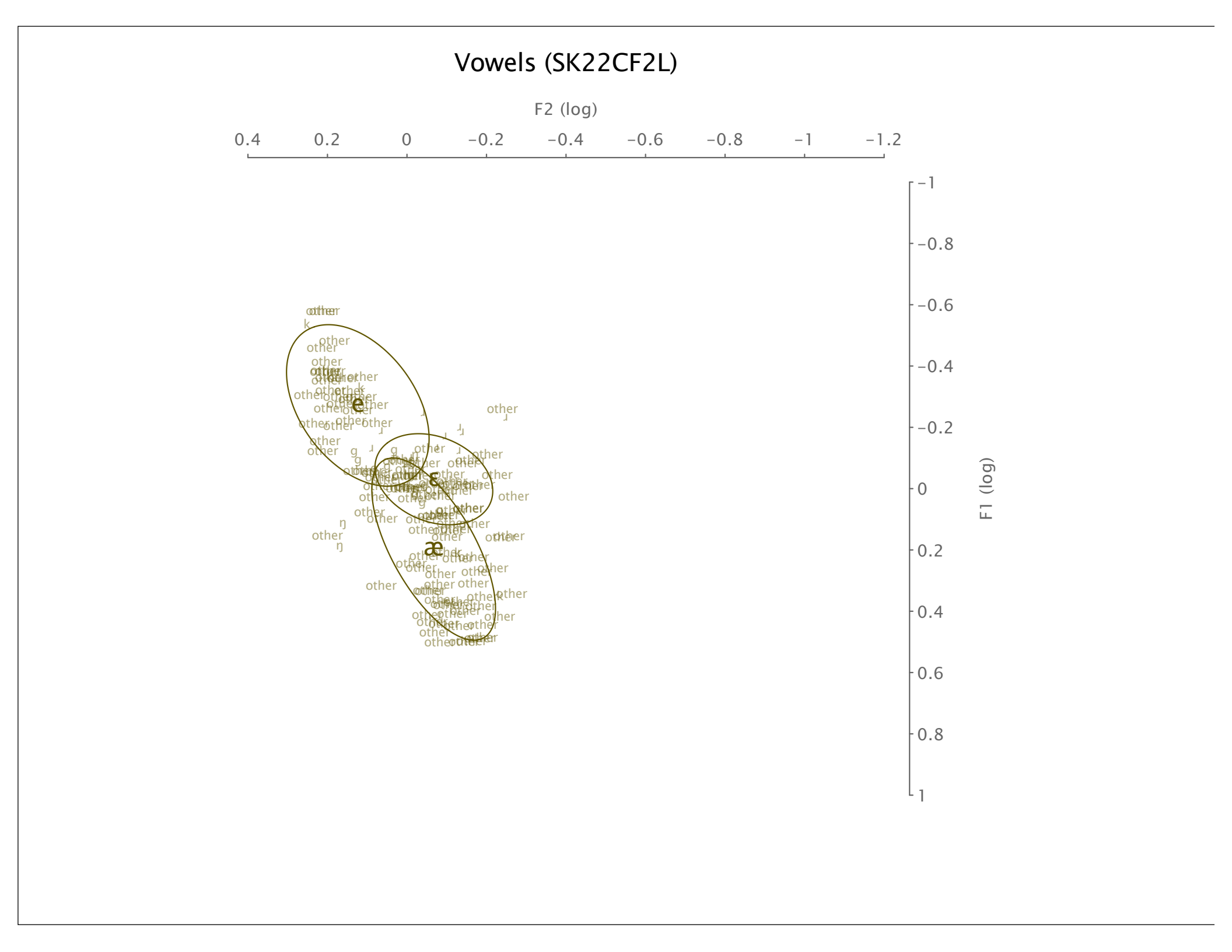
Generation 2 (Middle)

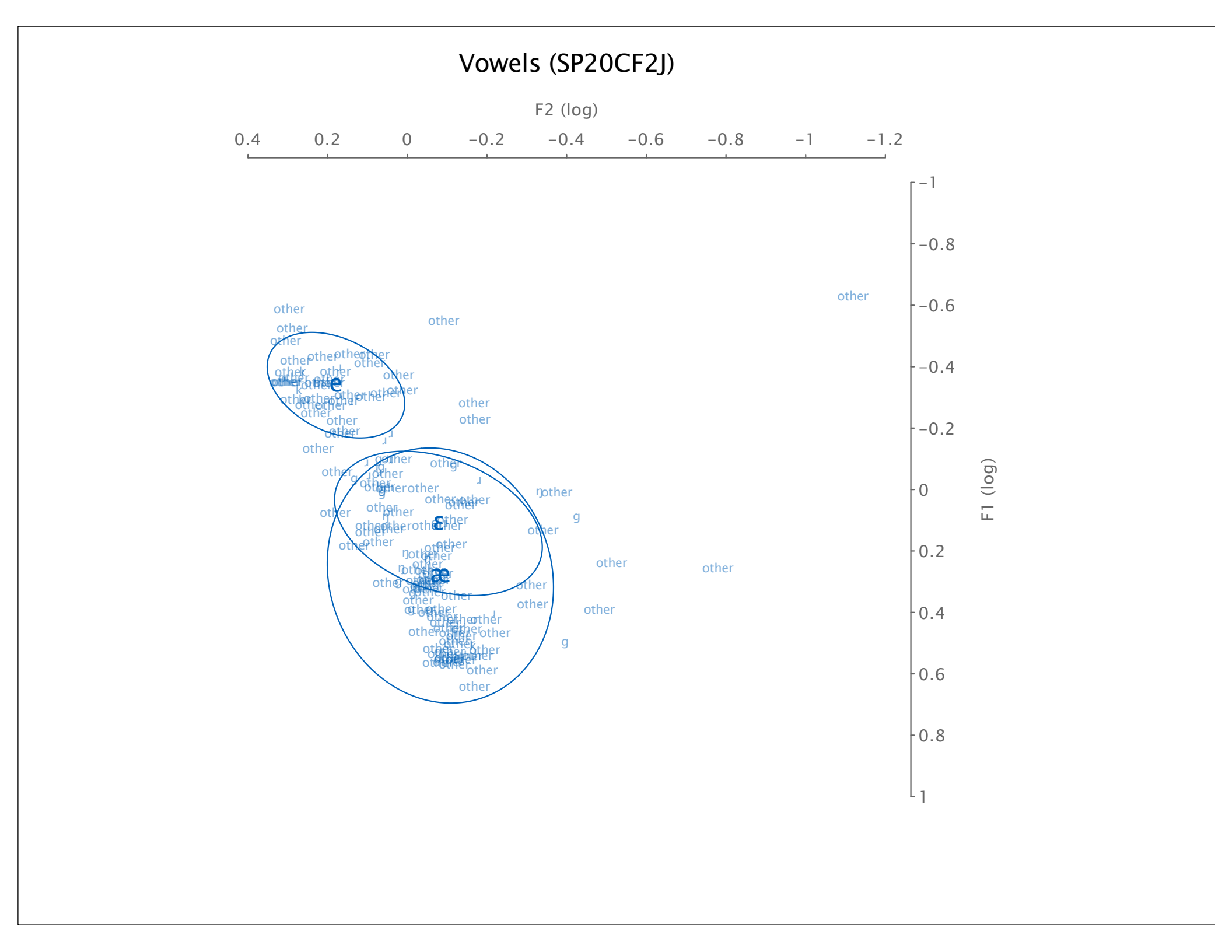
Speaker 22

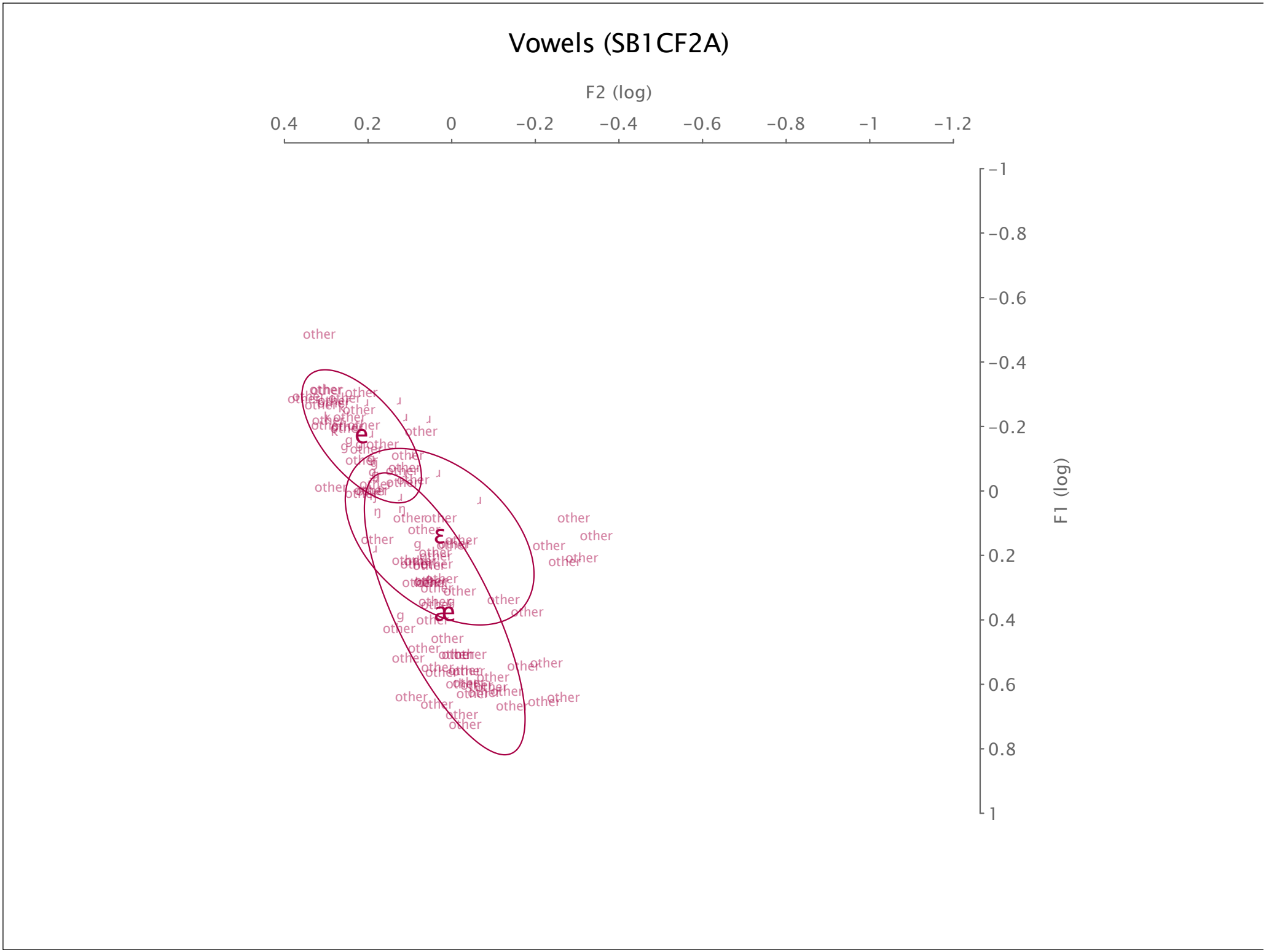


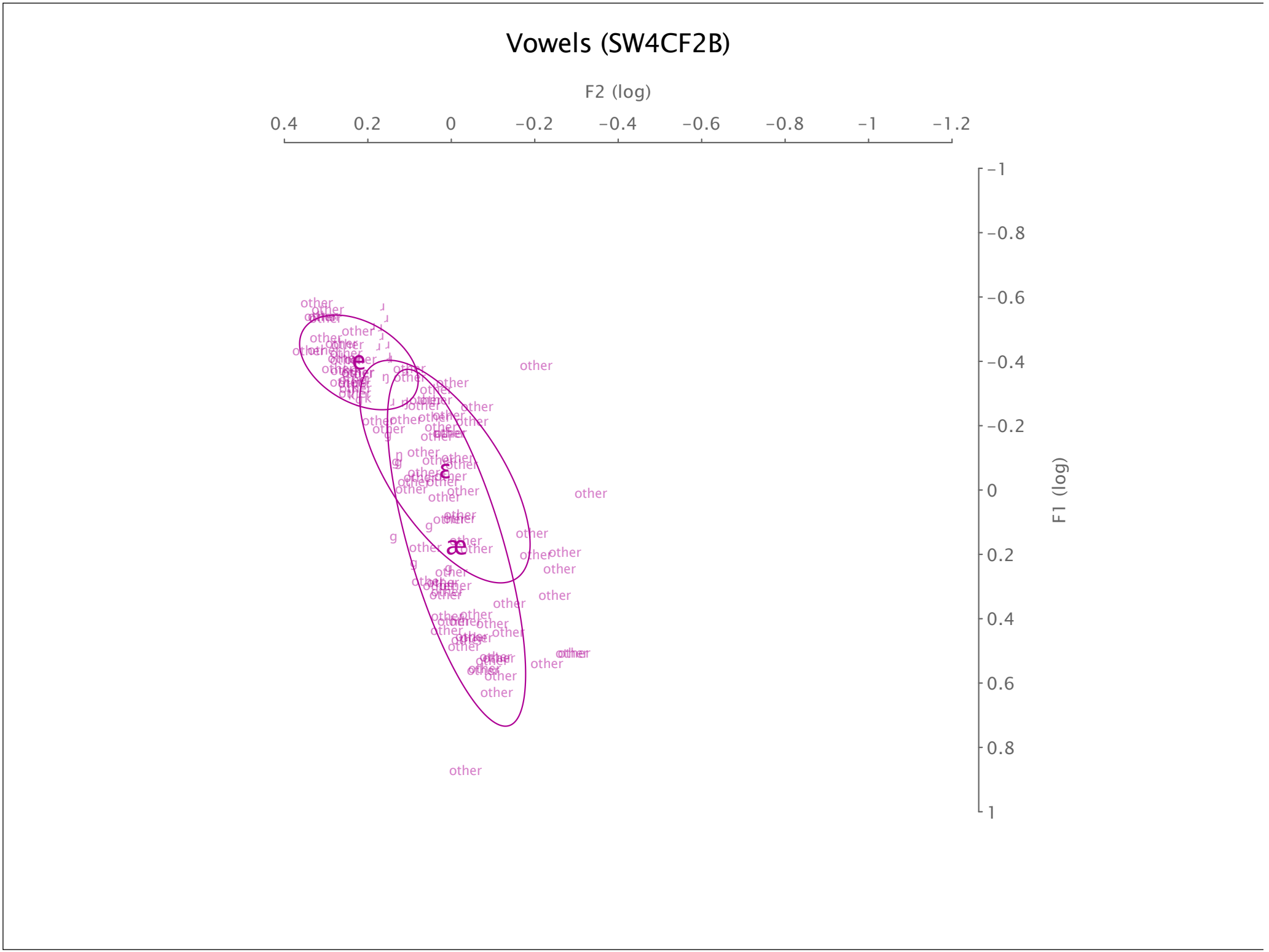
Speaker 20

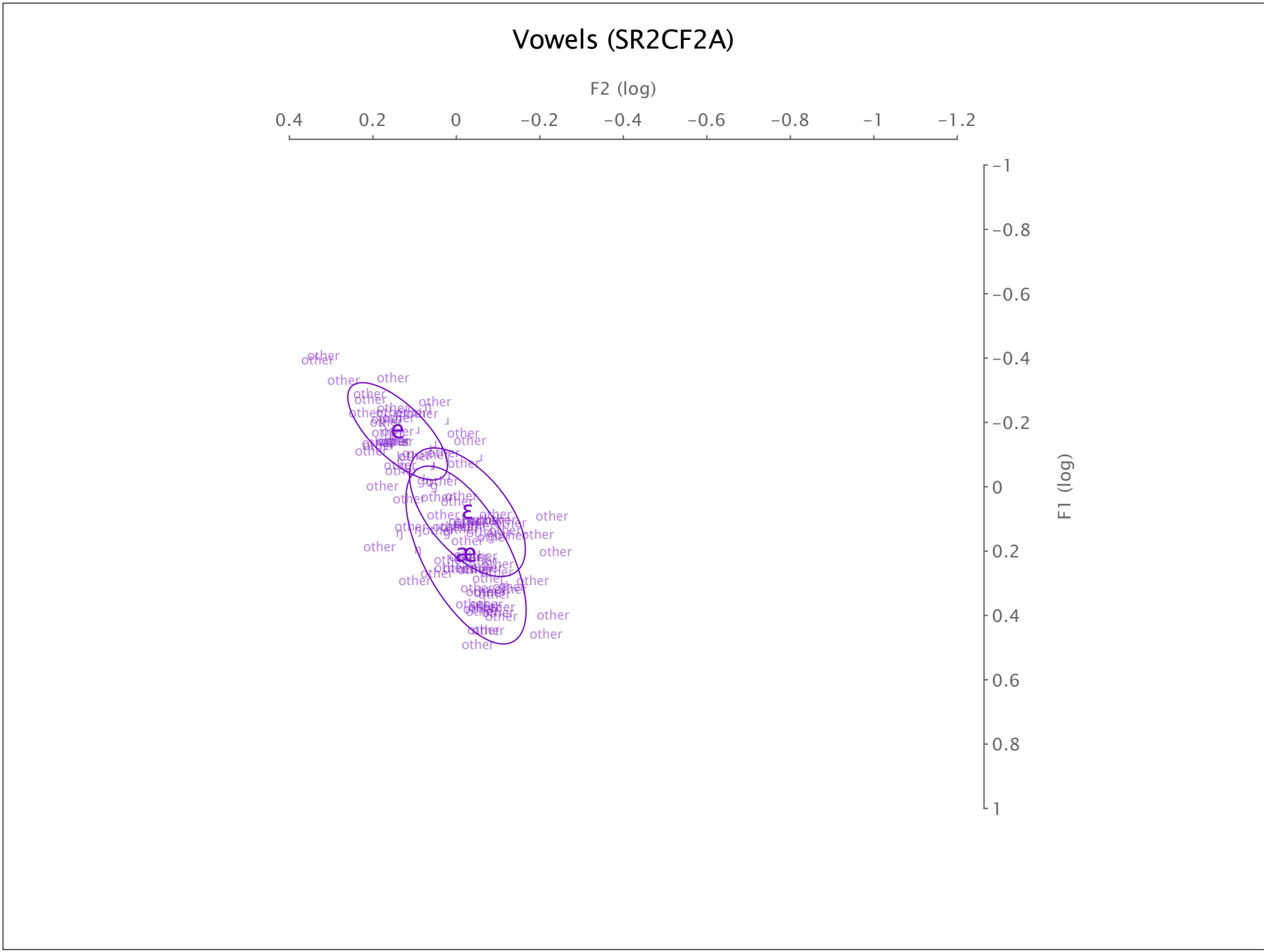



Vowels (SK22CF2L)
F2 (log)
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1.2
F1 (log)
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1
e
ɛ
æ
other

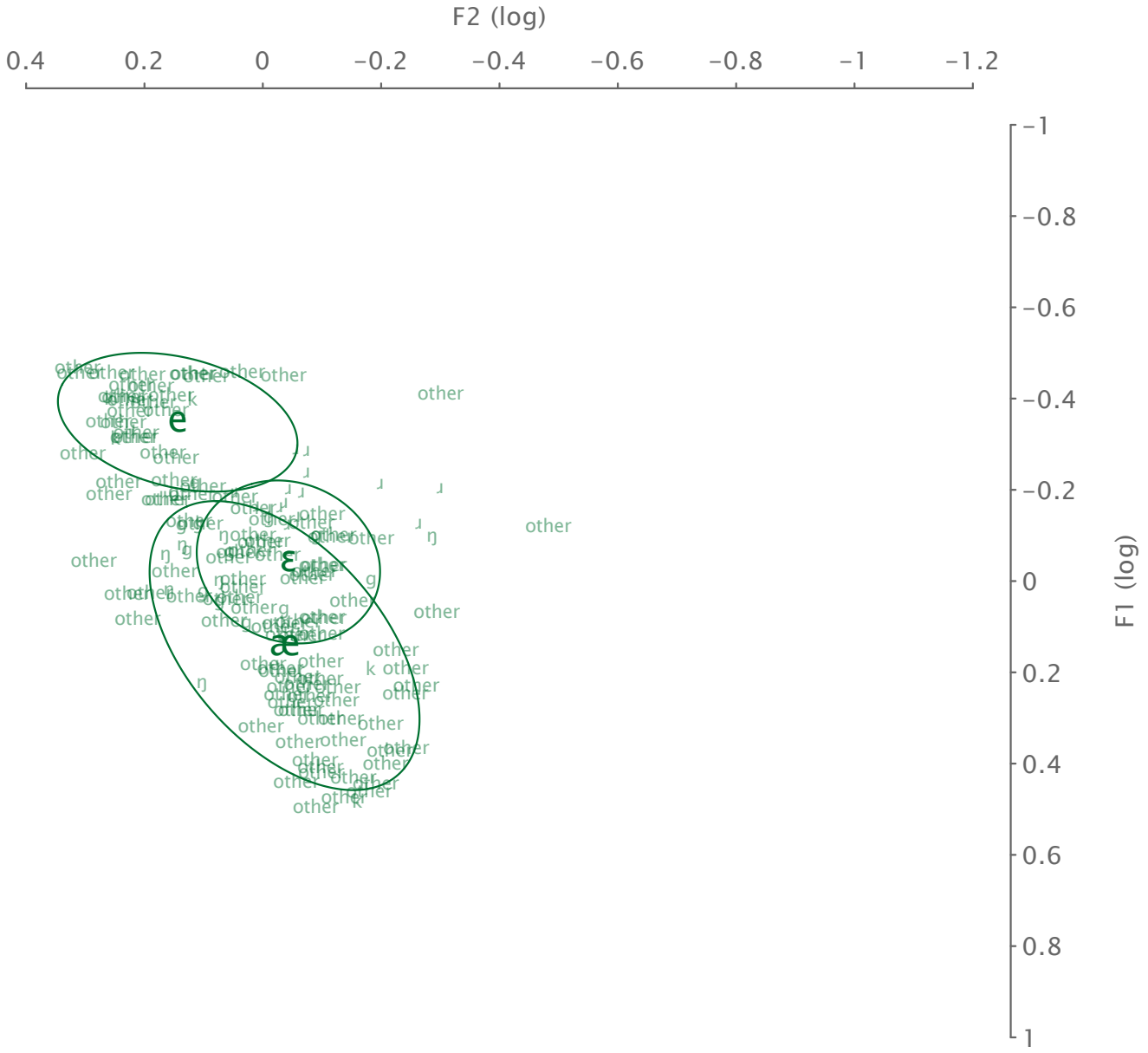

Vowels (SP20CF2J)
F2 (log)
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1.2
F1 (log)
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1
e
ɛ
æ
other

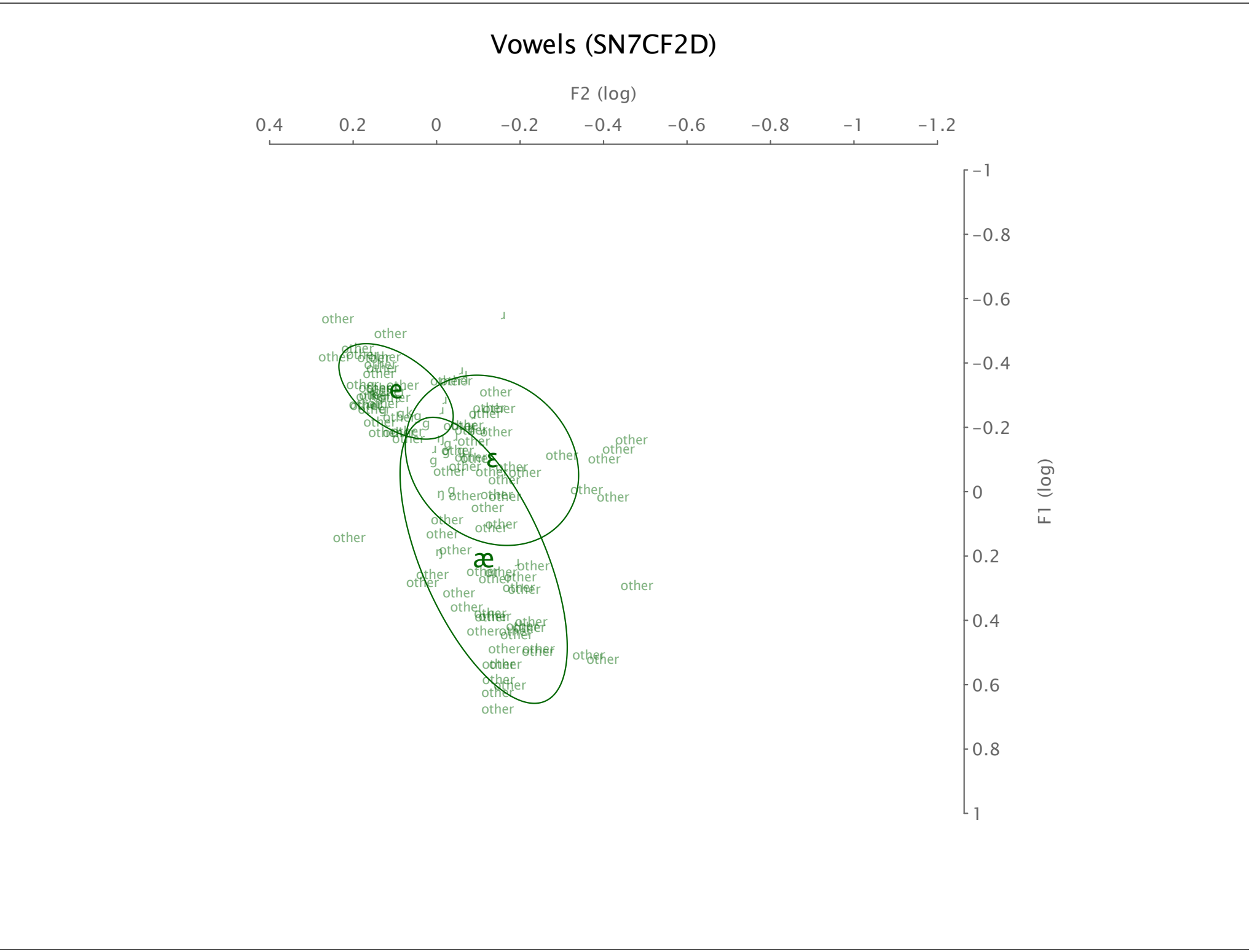

Vowels (SB1CF2A)
F2 (log)
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1.2
F1 (log)
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1
e
ɛ
æ
other

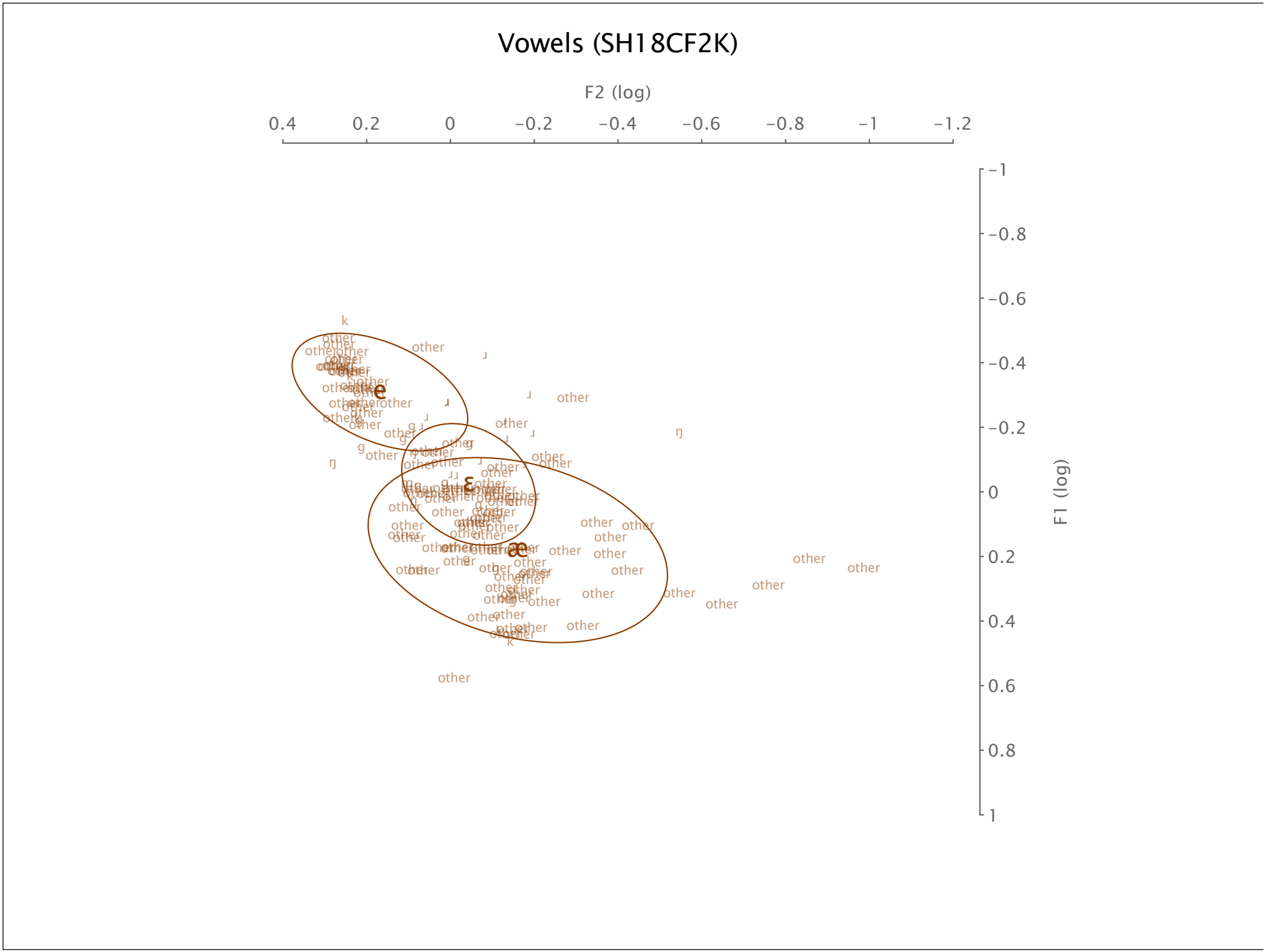

Vowels (SW4CF2B)
F2 (log)
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1.2
F1 (log)
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1
æ
ɛ
æ
other


Vowels (SR2CF2A)
F2 (log)
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1.2
F1 (log)
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1
e
ɛ
æ
other

Vowels (SO23CF2L)



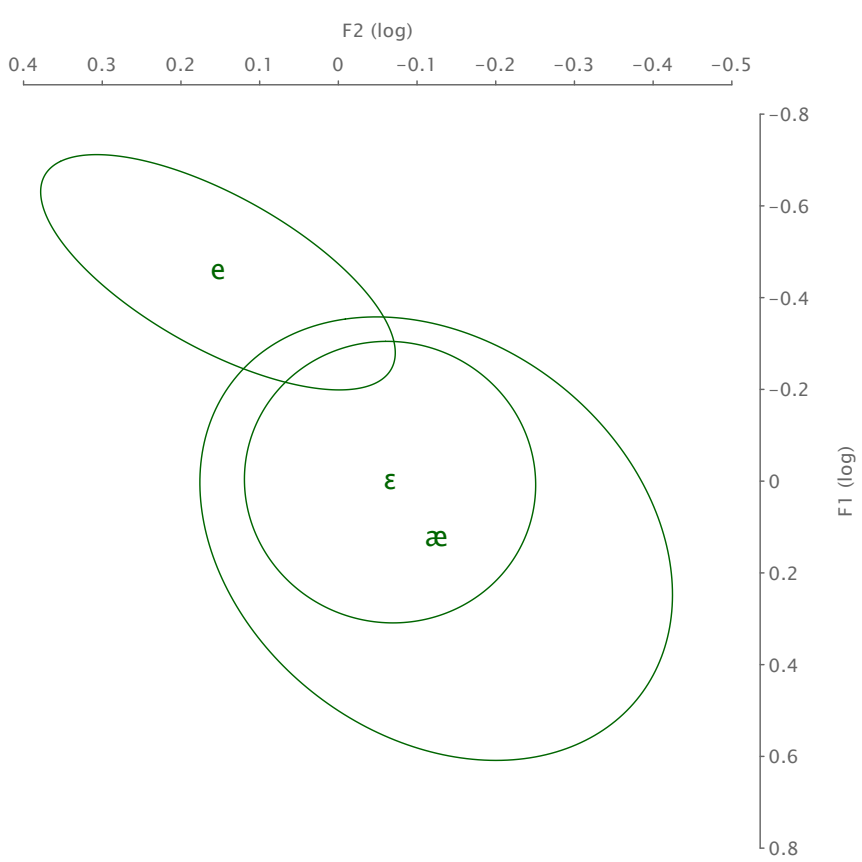

Vowels (SN7CF2D)
F2 (log)
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1.2
F1 (log)
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1
e
ɛ
æ
other


Vowels (SH18CF2K)
F2 (log)
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1.2
F1 (log)
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1
e
ɛ
æ
other

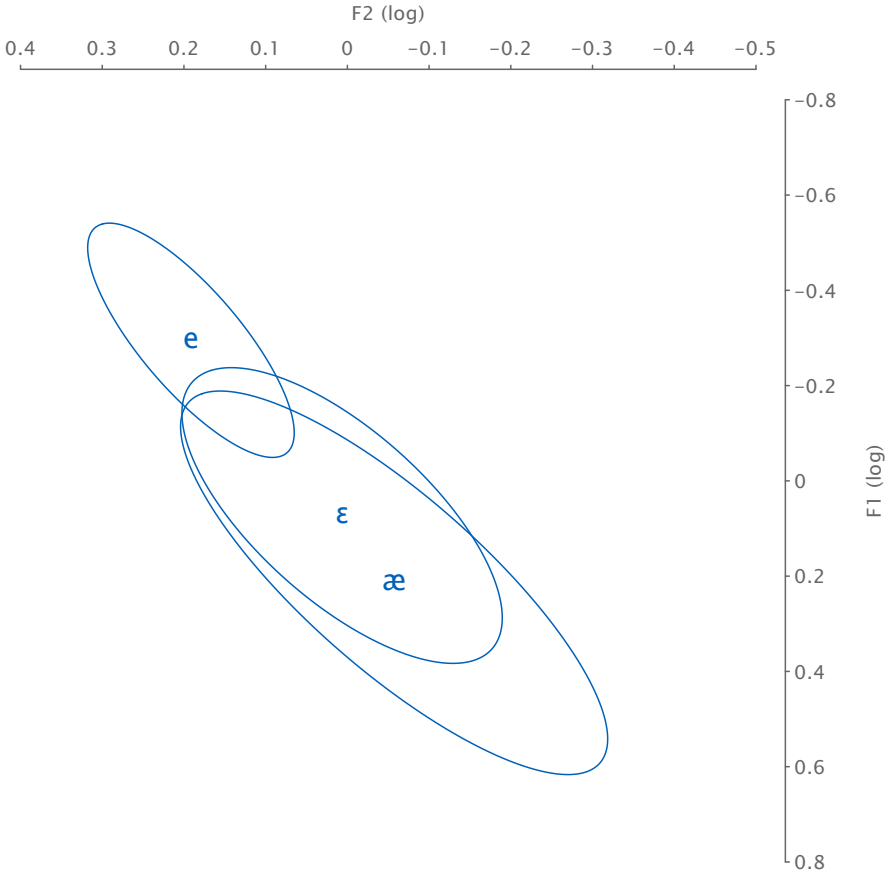
Gen 2 (æ only)		
ŋ > g > other > k	g > ŋ > other > k	ŋ > other > g > k
Speaker 1 Speaker 4 Speaker 18 Speaker 19 Speaker 23	Speaker 7 Speaker 22	Speaker 20

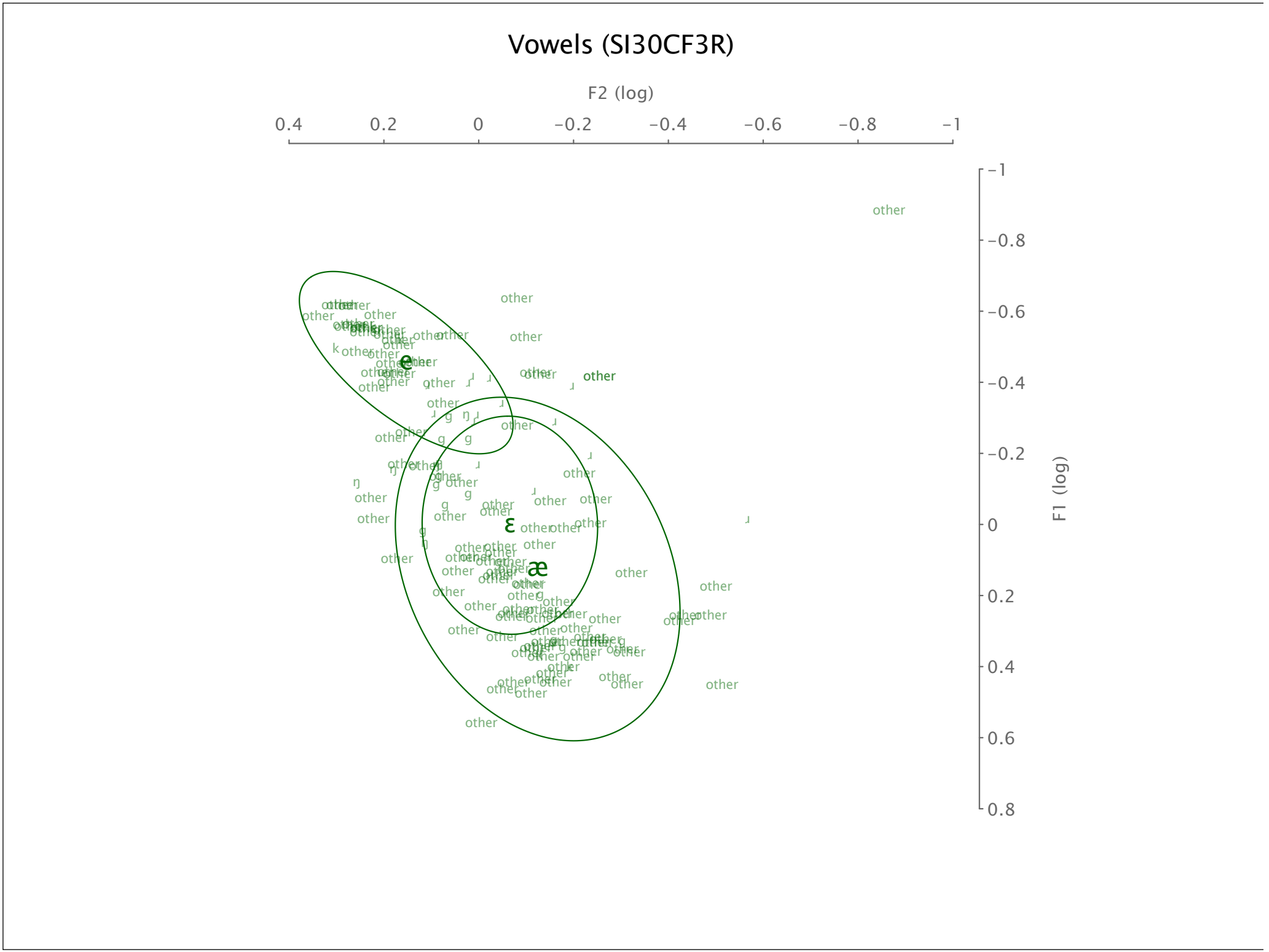
Generation 3 (Youngest)

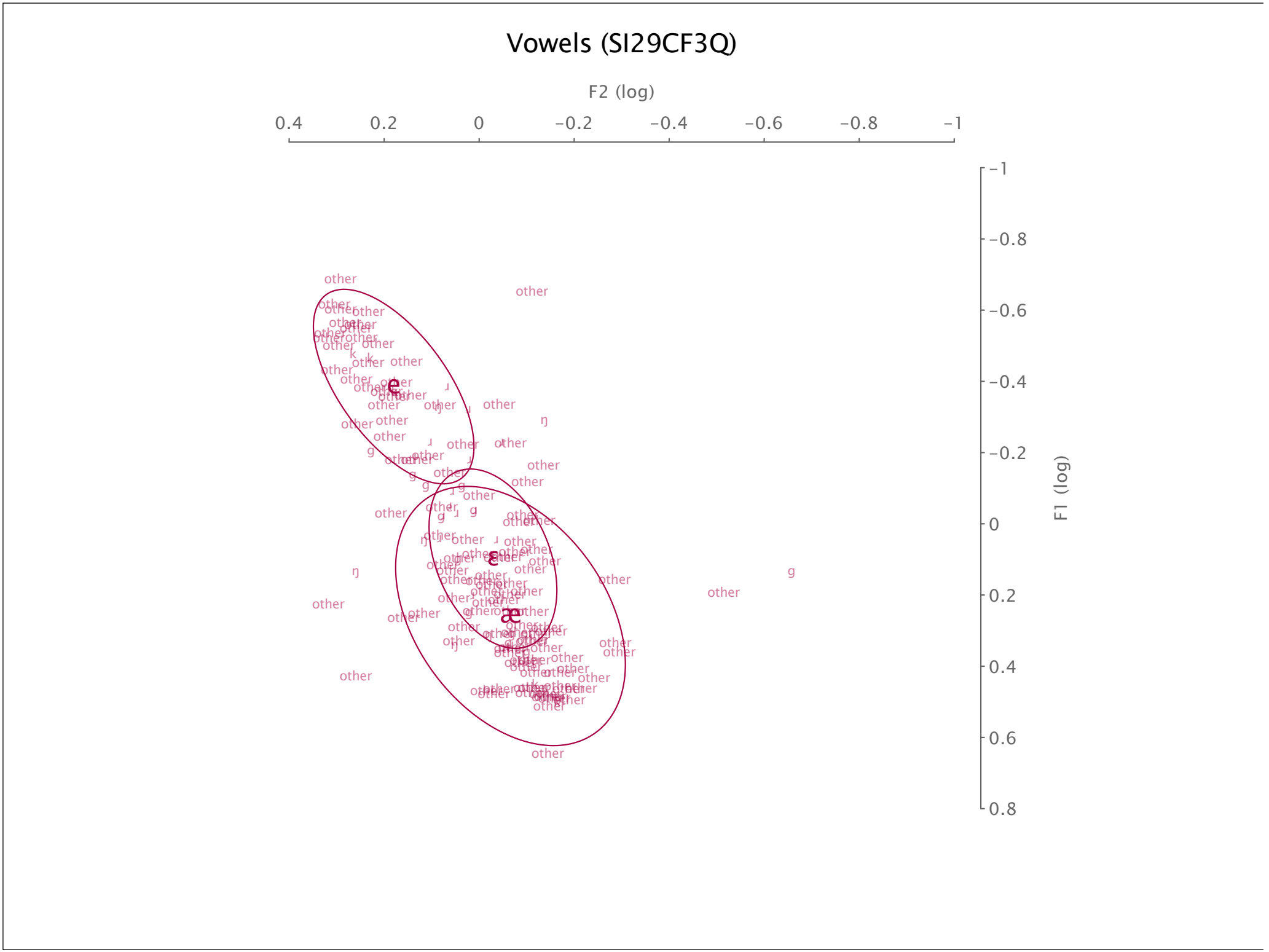
Speaker 30

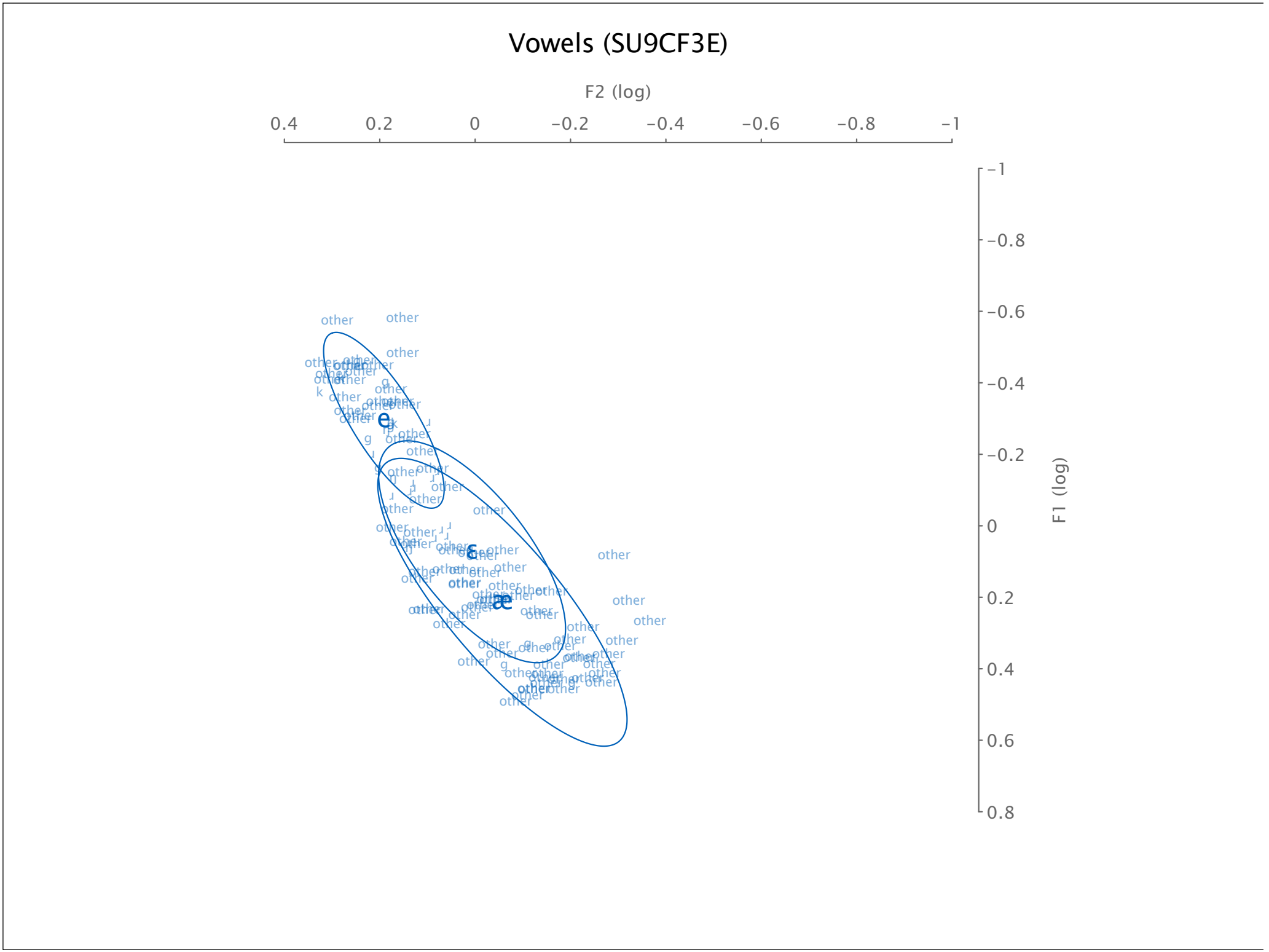


Speaker 29




Vowels (SI30CF3R)
F2 (log)
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
F1 (log)
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
æ
ɛ
ɐ
other


Vowels (SI29CF3Q)
F2 (log)
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
F1 (log)
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
e
ɛ
æ
other


Vowels (SU9CF3E)
F2 (log)
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
F1 (log)
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
e
ɛ
æ
other

Gen 3 (æ only)		
ŋ > g > other > k	ŋ > other > g > k	g > other > ŋ > k
Speaker 29	Speaker 30 Speaker 9	

- (æ)-raising in "other" (bilabial and alveolar) environments advancing
- (ey) higher in system than Older, Middle generations
  - Two SSANOVAs confirm significant positive association

    MODEL: Foll.Phone ~ F1Mean (R^2F1 (æG~eyC)=0.77, R^2F1 (ɛG~eyC)=0.84)

Phonetic motivations (interim summary)

- Predicted phonetic pattern (ŋ > g > k > other) decreases as age decreases.
- Gen 3 - (æ)'s in hyper-raising environment still highest (184-338 Hz), but bilabial & alveolar environments can be raised, too.
- Why?

(ε)

Lexical Variation in (ɛ)

[ɛ]	[eː] or [ɛ]
excited	*egg*
pen	*peg*
ten *(pre)tend* *dead*	
let	*leg(s)*

egg>leg>peg

Speaker 21 (Gen 1)
[eɪg] [leɪg] [peɪg]

Speaker 30 (Gen 3)
[eɪg] [leɪg] [pɛg]

Speaker 23 (Gen 2)
[eɪg] [lɛg] [pɛg]

"Excited by her new scheme, she climbed up the wall and let herself hang down by her back legs from a peg and pretended to be dead."

Becoming a sociolinguistic marker

- Raising is not strictly phonetically predictable.
- Instead, it functions to indicate social differentiation, or register/task features of the setting.
- Weakening of the predictive power of the velar environment provides possible evidence of the weakening of the "universal". (ɛ, æ)-raising may increasingly function as a marker of age (and of region, as dialect focusing occurs in the PNW).

Concluding remarks

- Are the changes in these two word-classes interrelated?

  Yes. *1) Temporal relatedness: continuation of changes first noted by Reed (1952,1961). 2) Systemic relatedness: Older speakers raise (æG) to (eyC) but achieve differentiation via gliding. Youngest speakers raise (ey) away from the raising (ɛg, æG). Strategies serve to respect functional considerations. 3) Social relatedness: Apparent-time evidence of different patterns in maintaining distinction taken as evidence of social relatedness.*

- Is inter-speaker variability leading to increasing group-wide uniformity?

  Cautious Yes. *Taken in generational cohorts, we see that individual patterns of variability are giving way to raising in a broader range of phonetic environments for (æ). Gen3 raising of (ey) not seen in older cohorts.*

- Are there phonetic motivations for (ɛg)- and (æg)-raising? If so, can we assert that a phonetic universal has become a sociolinguistic marker?

  Resounding Yes. *Robust evidence that velars favor raising (esp. /ŋ/). However, we see increasingly that other environments may raise more than velar ones.*

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	Formant	Min	1Q	Median	3Q	Max	R^2
Generation 1 (Older) Females							
æG, æC	F1	-220.56	-52.33	-10.30	9.78	816.6	0.00
	F2	-128.42	-79.92	24.20	50.92	157.85	0.24*
ɛG, ɛC	F1	-69.41	-15.05	3.48	27.13	47.53	0.06
	F2	-125.46	-76.18	13.68	77.37	155.92	0.22*
ɛG, æG	F1	-71.18	-15.86	2.81	26.85	50.09	0.06
	F2	-129.33	-78.11	15.92	73.40	156.98	0.22*
æG, eyC	F1	-78.48	-14.95	5.99	24.66	58.78	0.04
	F2	-137.55	-81.87	6.11	67.01	206.95	0.20*
ɛG, eyC	F1	-77.35	-35.09	8.07	30.78	56.90	0.04
	F2	-132.76	-82.37	-11.39	81.08	206.62	0.19
Generation 2 (Middle) Females							
æG, æC	F1	-46.51	-25.84	-2.11	19.34	82.93	0.14
	F2	-116.45	-33.88	3.20	42.11	140.75	0.14
ɛG, ɛC	F1	-44.95	-25.70	-4.98	24.33	69.09	0.13
	F2	-120.06	-46.39	-6.94	44.12	203.02	0.11
ɛG, æG	F1	-46.43	-28.01	-8.81	23.88	85.27	0.10
	F2	-122.75	-49.89	-13.38	43.99	201.04	0.09
æG, eyC	F1	-61.94	-29.99	-9.50	20.66	86.10	0.09
	F2	-127.96	-52.47	-18.47	41.62	201.67	0.08
ɛG, eyC	F1	-57.14	-28.04	-12.34	23.35	83.21	0.08
	F2	-128.17	-81.40	-26.21	51.92	198.84	0.07
Generation 3 (Youngest) Females							
æG, æC	F1	-7.57	-5.66	-3.88	6.67	16.00	0.70*
	F2	-91.93	-54.11	-17.56	49.20	49.19	0.04
ɛG, ɛC	F1	-9.24	-4.54	-1.82	4.85	13.80	0.78*
	F2	-93.33	-55.50	-18.92	51.85	104.16	0.05
ɛG, æG	F1	-8.98	-5.40	-2.76	4.74	17.93	0.71*
	F2	-93.70	-53.89	-18.08	52.58	105.01	0.04
æG, eyC	F1	-7.38	-4.57	-1.40	1.27	17.25	0.77*
	F2	-91.14	-52.13	-21.59	58.36	112.04	0.04
ɛG, eyC	F1	-6.88	-4.11	-0.94	2.03	13.12	0.84*
	F2	-99.04	-56.11	-23.78	56.42	109.22	0.04

*Note: by convention, R^2= 0.10, 0.30, 0.50 are interpreted as small, medium and large associations, respectively. R^2 ranges from 0 to 1.

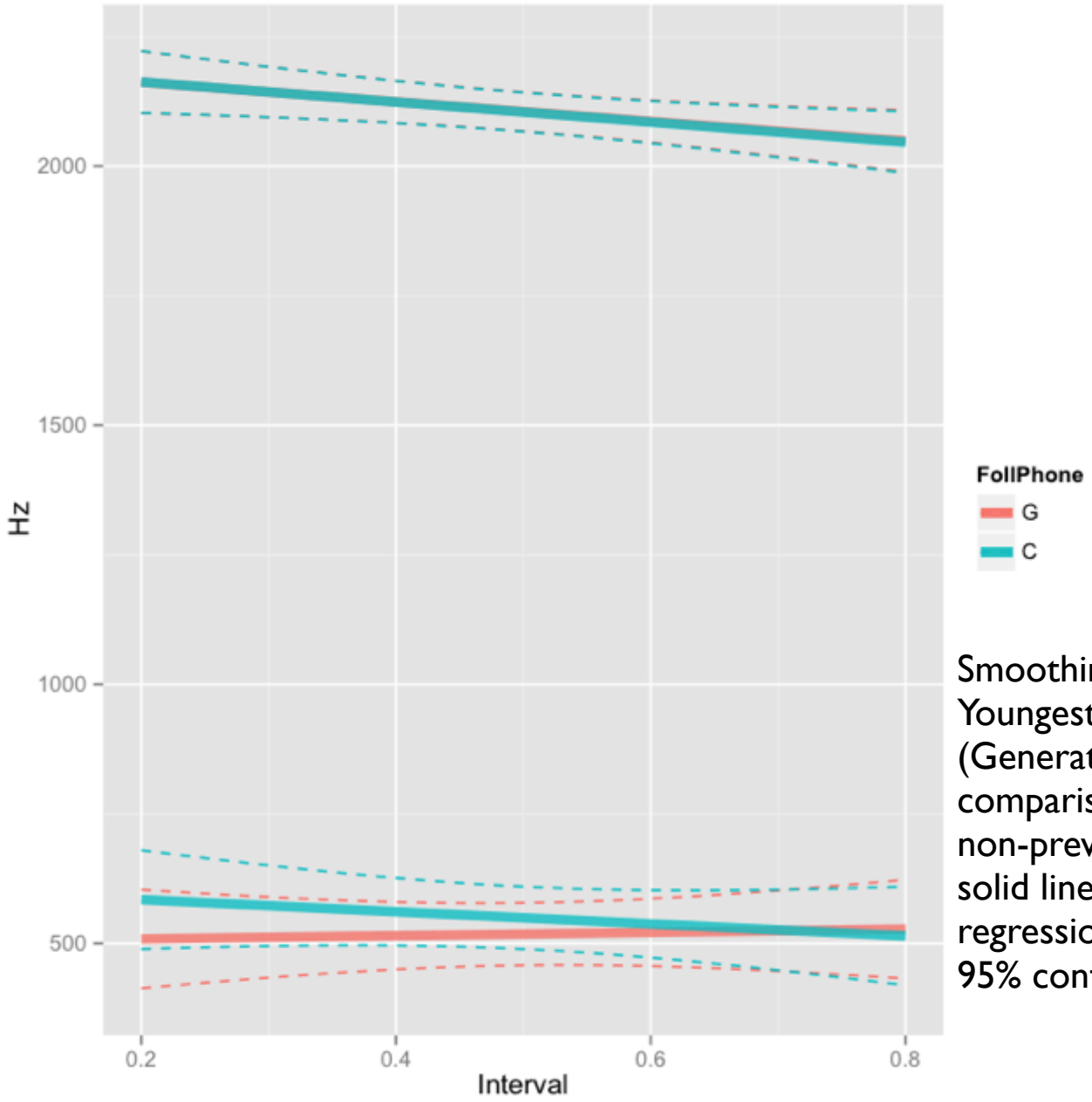
Smoothing Spline ANOVA trajectory comparison data. R^2 multiple regression coefficients for F1 and F2. Three generational cohorts (Female speakers only).

Within-Vowel: (æG) vs. (æC)
Between-Vowel: (æ) vs. (ɛ)

Gen1:
-F2 differentiates (æG) vs. (æC).
-While (æG) raises to (eyC), (æG) is phonetically diphthongal.

Gen2:
-Trajectories are similar, in location and contour, regardless of following environment.

Gen3:
-F1 differentiates (æG) vs. (æC).
-unexpected: (ey) is raised in the system.



Smoothing Spline ANOVA for Youngest Female cohort (Generation 3). Within-Vowel comparison of prevelar (æG) vs non-prevelar (æC). Model displays a solid line for best-fit formant mean regression line, and dotted lines for 95% confidence intervals.