# Sonorant-conditioned mid vowel lowering in Turkish[1]

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## 1 Introduction

In Turkish, the realisations of the front mid vowels /e/ and /ø/ are conditioned by the following coda, with sonorant codas causing a preceding vowel to lower:

(1) /e/ → [æ] *pre-sonorant*:

| | | |
|---|---|---|
| /sen/ | [sæn] | 'you' |
| /sen-in/ | [se.nin] | 'your' |
| /erdem/ | [ær.dæm] | 'virtue' |
| /gel-mek/ | [gæl.mek] | 'to come' |

(2) /ø/ → [œ] *pre-sonorant*:

| | | |
|---|---|---|
| /dørt/ | [dœrt] | 'four' |
| /tørpy/ | [tœr.py] | 'file' |
| /tʃøp/ | [tʃøp] | 'rubbish' |

Although this pattern is acknowledged in the descriptive literature on Turkish (e.g. Göksel & Kerslake 2005), we are unaware of work investigating its generality, categoricity, or phonological status. Vowel lowering before a rhotic coda is attested widely, e.g. in French, Catalan /e/ (Bradley 2010), Swedish /ɛ/ and /ø/ (Riad 2014), in various Swiss German varieties in /o/ (Keel 1982, Janda & Joseph 2001, inter alia) and Faroese /e/ (Árnason 1999): the Turkish case presented in this work is distinct in appearing to entail generalisation to all [+sonorant] codas.

**In this talk, we will:**

- Provide experimental evidence that for the majority of speakers, /e/ is systematically, categorically lowered before coda {r, m, l, n} – /e/-realisations preceding a coda sonorant do not overlap with /e/s in other environments.
- Discuss the variable status of /ø/ and its implications for the overall trajectory of the change. For some speakers, /e/ is the only target of *categorical* pre-sonorant lowering; for others, a significant effect appears in /ø/. Speakers for whom /ø/-lowering is non-categorical show instead an apparent *raising* in open syllables; it appears that this is an initial state of the system, transitioning (particularly in the youngest speakers in our sample, for whom /ø/-lowering seems more likely to be categorical) to a copy of the /e/-pattern. We suggest thus that the situation of /ø/ represents an intermediate stage of phonologisation. For speakers for whom /ø/-effects appear non-negligible but non-categorical, /ø/-lowering is most significant before coda /r/: this may be partly an effect of relative lexical frequency, but may also indicate that pre-rhotic lowering is the ultimate phonetic precursor to this change.
- Discuss exceptions to the rule, which take two major forms:

i. *High-frequency items* may optionally escape lowering: /ken.di/ [ken.di] *or* [kæn.di] 'oneself', /ben/ [ben] *or* [bæn] 'I', [hæm] *or* [hem] 'both'.

ii. /e/ in word-initial sonorant-coda syllables resists lowering, in trisyllabic or longer roots; thus:

(3) [ær.dæm] 'virtue'
*but*
[**el**.bi.se] 'dress'

[1] We'd like to thank: Fernanda Barrientos Contreras for extensive help with scripting and experimental setup; Yuni Kim, Ricardo Bermúdez-Otero, Wendell Kimper for advice, support and feedback; Beste Kamali for comments; our very patient participants

| | |
|---|---|
| [**ʃem**.si.je] | 'umbrella' |
| [**el**.di.væn] | 'glove' |
| [**men**.te.ʃe] | 'hinge' |

But this does not appear to be the case in non-roots – affixation does not induce exceptionality:

| | | | | |
|---|---|---|---|---|
| (4) | /erdem-i/ | [ær.de.mi] | 'hope.ACC' | *[**er.de.mi**] |
| | /kendi-miz-e/ | [kæn.di.mi.ze] | 'to us' | *[**ken.di.mi.ze**] |

- Comment on the overall status of mid-vowel lowering as a change in progress in Turkish: although the system seems at first glance quite chaotic, the process in fact behaves quite systematically, seems to have recognisable precursors and confirms theoretical expectations about the trajectory of an ongoing change.

## 2 The Turkish system (a very quick reminder)

This will be familiar to many phonologists! In the literature: eight vowel phonemes (Hulst & Weijer 1991:12, Kabak 2011:2832). Although the system is phonetically rather asymmetric, its symmetric phonological behaviour is well-known:

| | **[-back]** | | **[+back]** | |
|---|---|---|---|---|
| | **[-round]** | **[+round]** | **[-round]** | **[+round]** |
| **[+high]** | <i> i | <ü> y | <ı> ɯ | <u> u |
| **[-high]** | <e> e | <ö> ø | <a> ɑ | <o> o |

**Table 1:** Turkish vowels, orthography and underlying representation

There is further (marginally) phonemic distinction between short and long vowels. In native vocabulary, this is due to the effects of orthographic <ğ> (*yumuşak g* 'soft g', the result of velar deletion – arguably /ɣ/, for discussion see Zimmer & Abbott 1978, Sezer 1981, Inkelas 2009) but long vowels are also seen in certain loan words of Arabic and Persian origin (Comrie 1997:884). However, the number of short-long contrasts that are present varies between speakers; contrastive length is most common with the back vowels (Comrie 1997:884–5).

In Turkish, vowel harmony involves two separate processes: backness harmony and rounding harmony. Broadly speaking, both act from left to right within the (non-compound) word to determine the quality of vowels found in (non-initial syllables and) suffixes attached to root words (Clements & Sezer 1982, Kabak 2011) – it's relevant here that /e/ and /ɑ/ are treated as front/back counterparts by the system. Rounding harmony is height-dependent – non-high vowels are not valid targets for rounding harmony, but high vowels are.

Previous analysis, or even descriptive mention, of any height effects in Turkish /e/ is very limited. Lewis's (1967:14) description claims that orthographic <e> may have 'a closer pronunciation, verging on the sound of **i**, especially in the first syllables of [...] **gece** 'night'' but contains no mention of any lower allophone. Göksel & Kerslake's (2005) grammar claims: [æ] before sonorants, [ɛ] in stressed open syllables and [e] elsewhere. We note here the massive disparity between these accounts – neither represents a detailed phonological discussion but seem to describe two very different systems.

## 3 Production data

Data: 12 native speakers of Turkish (10 female, 2 male), resident at the time of experimentation in Manchester, England – length of residence outside Turkey ranged from 1 to 10 years. Male speakers are excluded from the averaged data presented in this talk due to the asymmetry of the sample (ongoing!) but significant differences did not seem evident.

Speaker information follows:

| Speaker | Age | Origin |
|---|---|---|
| F01 | 20 | Istanbul |
| F02 | 21 | Istanbul |
| F03 | 28 | Izmir |
| F04 | 29 | Istanbul |
| F05 | 30 | Fethiye |
| F06 | 33 | Bursa |
| F07 | 35 | Ankara |
| F08 | 35 | Istanbul |
| F09 | 38 | Ankara |
| F10 | 39 | Ankara |
| M01 | 31 | Denizli |
| M02 | 26 | Kars |

**Table 2:** Participants by index, age and area of origin

Speakers read a randomised list of 190 (mostly monomorphemic) items in isolation and a further 35 sentences containing tokens of /e/ embedded in varied phonological and morphological environments. Analysis: manual mark-up and auditory coding, formant measurement with Praat – F1, F2 (at 25%, 50% and 75% of the duration of the vowel, averaged) and duration.

We note here that we restrict our larger discussion to the speech of respondents from major urban centres – we briefly provide an overview of the speech of M02 (Kars) as a point of interest but this represents a fairly clear instance of dialectal divergence and should be handled as representing a distinct phonological system.

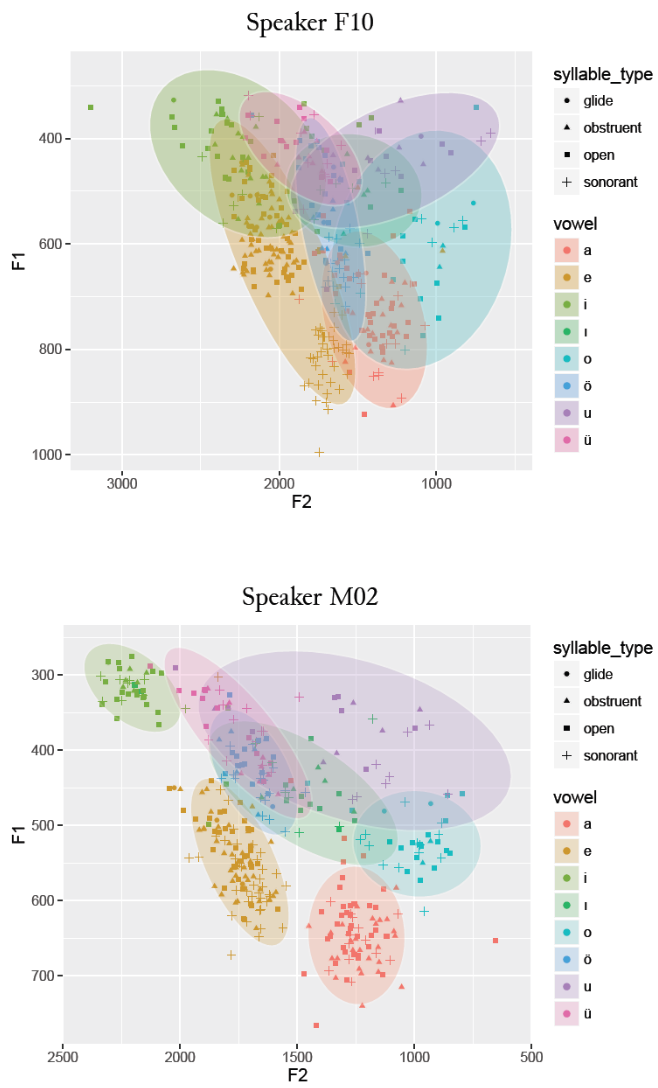



**Figure 1:** Non-normalised F1 and F2 for a representative speaker, F10 (Ankara) and for the most divergent speaker, M02 (Kars). Note for the Ankara speaker that the separation between pre-sonorant /e/ and other /e/ is very clearly visible; while clustering for the Kars speaker is not as drastic, some effect of coda sonorancy on /e/ appears present (for which see the analysis that follows).

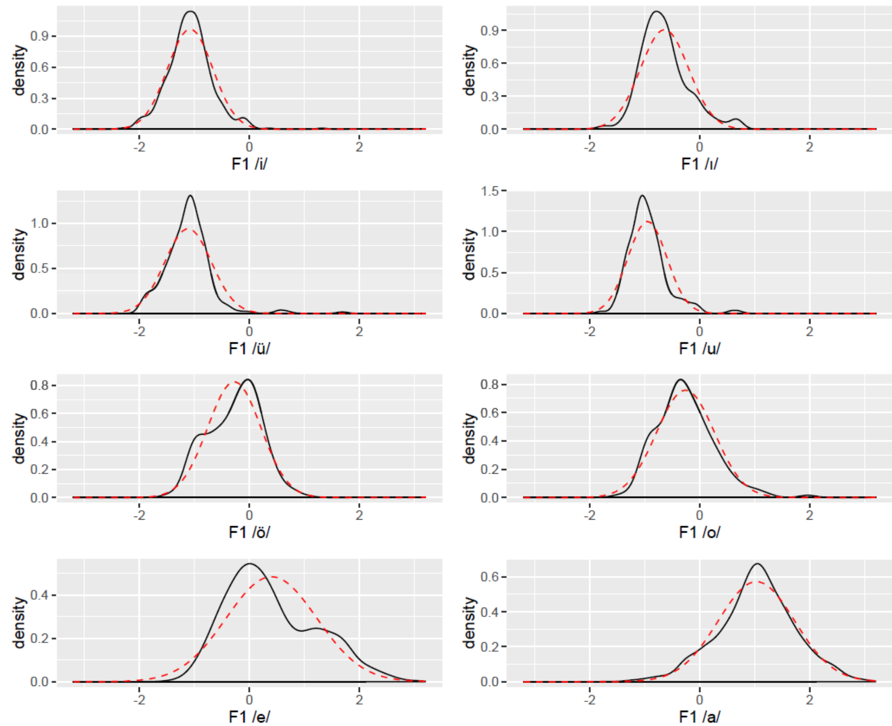



**Figure 2:** Density plot of F1 for each of 8 underlying vowels, Lobanov-normalised across 10 speakers: shown with notional Gaussian distributions of identical mean and standard deviation. For the high vowels /i/, /ɯ/, /y/, /u/, distribution is unimodal and close to normal; it's clear here that for /e/ and /ø/, distribution is non-normal and potentially multimodal.

Note also the spread in /o/ and /ɑ/. We'll suggest in this talk that /o/ may be in the incipient stages of the process already well underway in /ø/ and largely complete in /e/. The distribution of /ɑ/ F1 has a larger apparent standard deviation seemingly due to reduction/centralisation in unstressed open syllables and drift towards a prototypical [ɑ] in stressed open syllables.

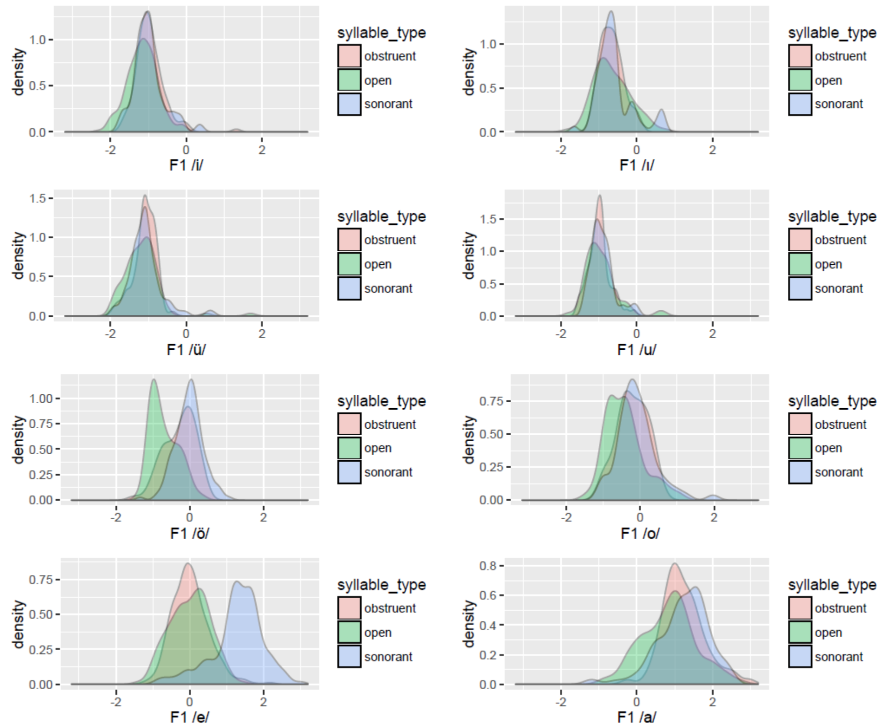
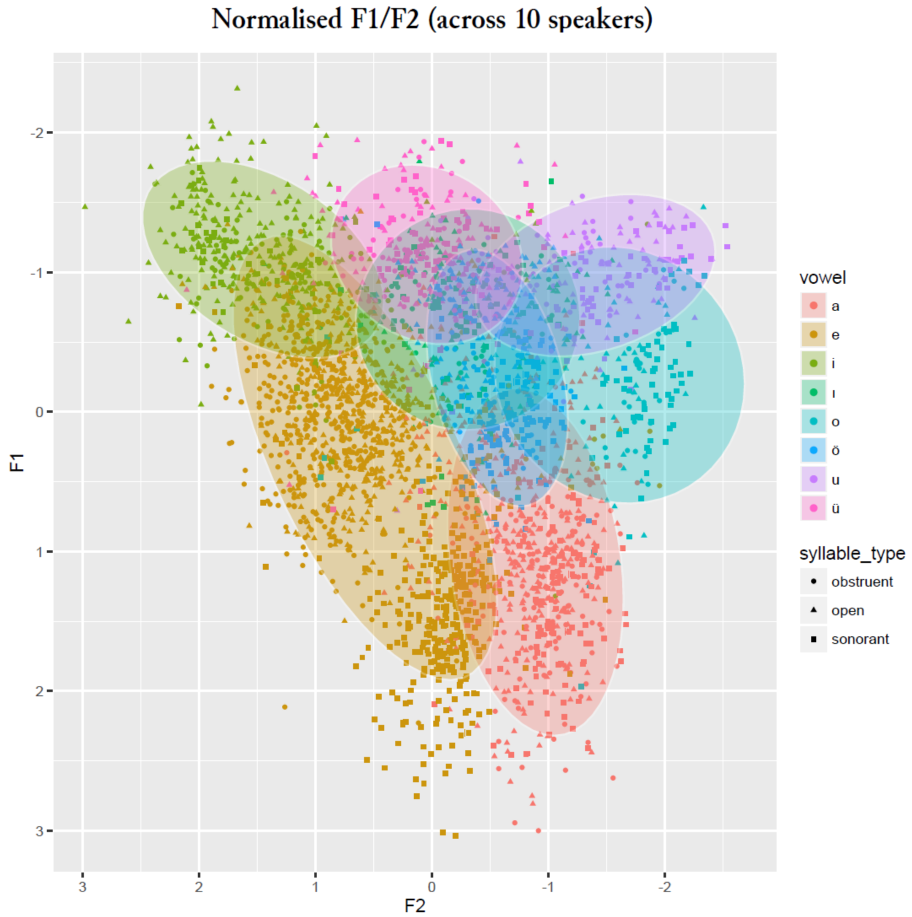



**Figure 3:** Density plot of F1 for each of 8 underlying vowels, decomposed by coda (obstruent, zero, sonorant).

Note the lack of dependence on coda type for the high vowels and several further features of the mid vowels: a clear split arises between sonorant-context /e/ and /e/ in other environments. /ø/ is clearly near-categorically raised in open syllables. /o/ shows some possible effect in open syllables, to be discussed and statistically evaluated further.



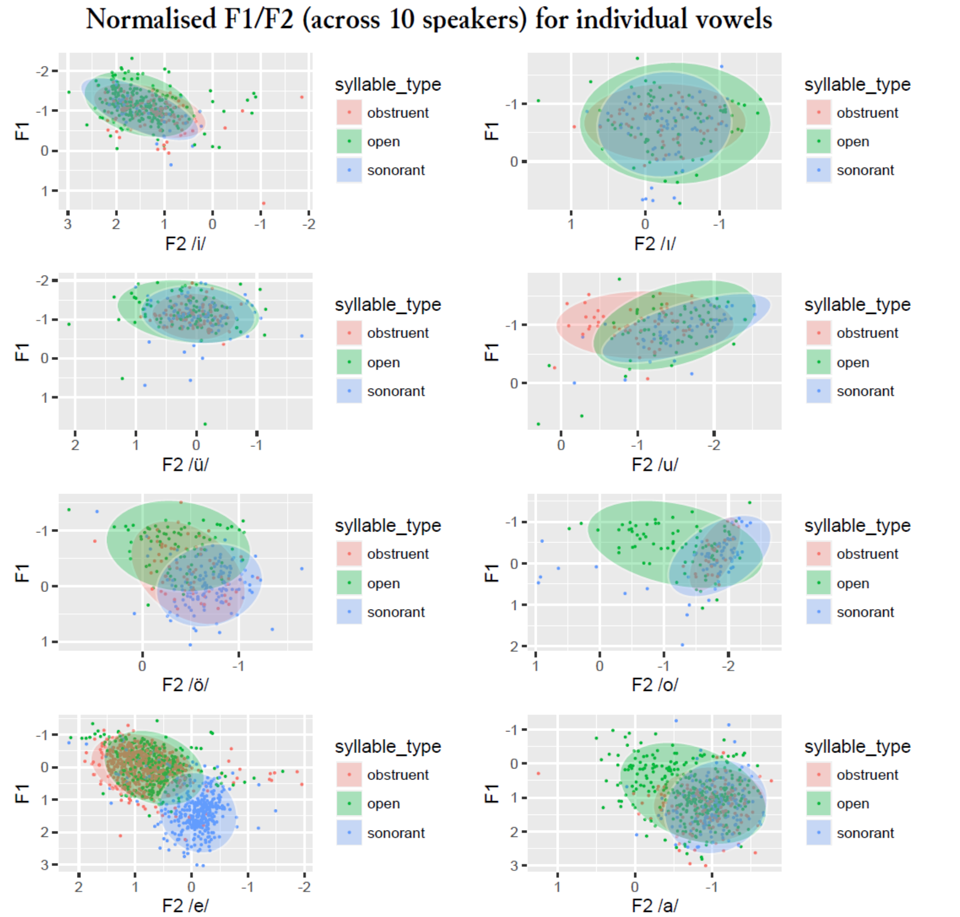




**Figure 4:** Lobanov-normalised F1 and F2 for 10 speakers (all female participants), shown with 90% confidence ellipses. /e/ clustering by coda type is visible – note the clear separation of the pre-sonorant /e/s from others and the partial overlap of this set with /ɑ/.

So far: something strange is definitely happening in this space. To be investigated further: how homogeneous, etc. is the sample?

**Figure 5:** Lobanov-normalised F1 and F2, 10 speakers, individual vowels – showing coda type. Several properties of interest appear in this overall sample:

1. Categorical separation between pre-sonorant /e/ and other
2. /ø/: the sets of /ø/ in open syllables and in sonorant-coda syllables are close to disjoint, with the obstruents intermediate; we'll show later that there is significant cross-speaker variation here, representing an apparent intermediate state between two endpoint systems.
3. /o/: sample size is smaller but it appears that /o/ in open syllables behaves similarly to /ø/: that is, undergoes some non-negligible raising.

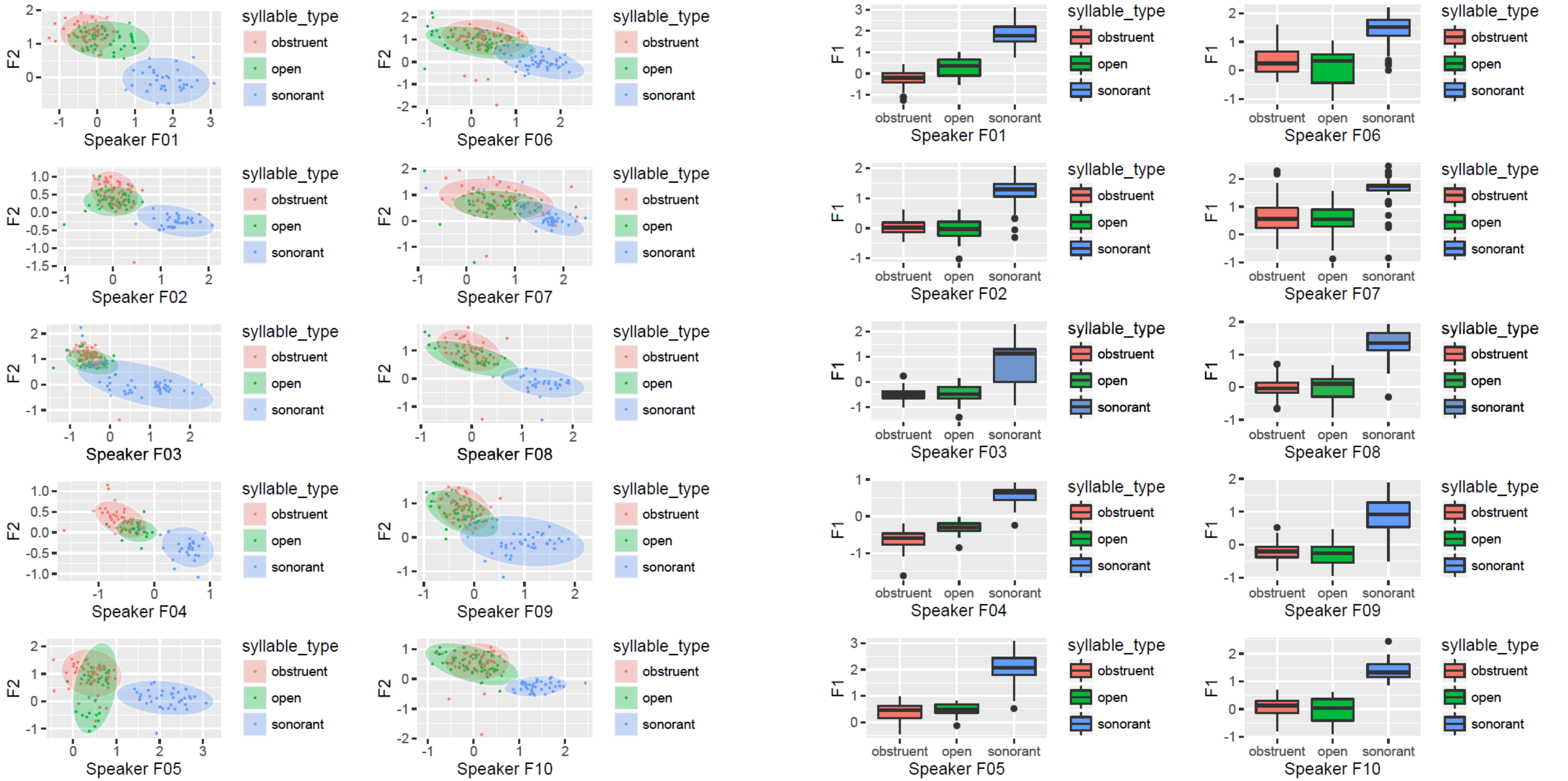



**Figure 6:** Realisations of /e/ for each of 10 female speakers. **Left:** F1-F2 plot (Lobanov-normalised). **Right:** F1 box-plot for each speaker. Speakers are ordered from youngest to oldest (sequentially by index; top to bottom, left to right). This allows us to note:

1. There is inter-speaker variation in the state of the system. Although all speakers show well-established separation between tokens of /e/ pre-sonorant and tokens of /e/ in other environments – ANOVA $p$-values (for F1 grouped by coda type) for these speakers are $< 2e\text{-}16$ in all cases – there is variation in the state of pre-obstruent and pre-# /e/.

2. Younger speakers show greater (non-categorical) raising in /e/ preceding obstruents – for all speakers:

$$\textbf{F1(obstruent)} < \textbf{F1(open)} < \textbf{F1(sonorant)}$$

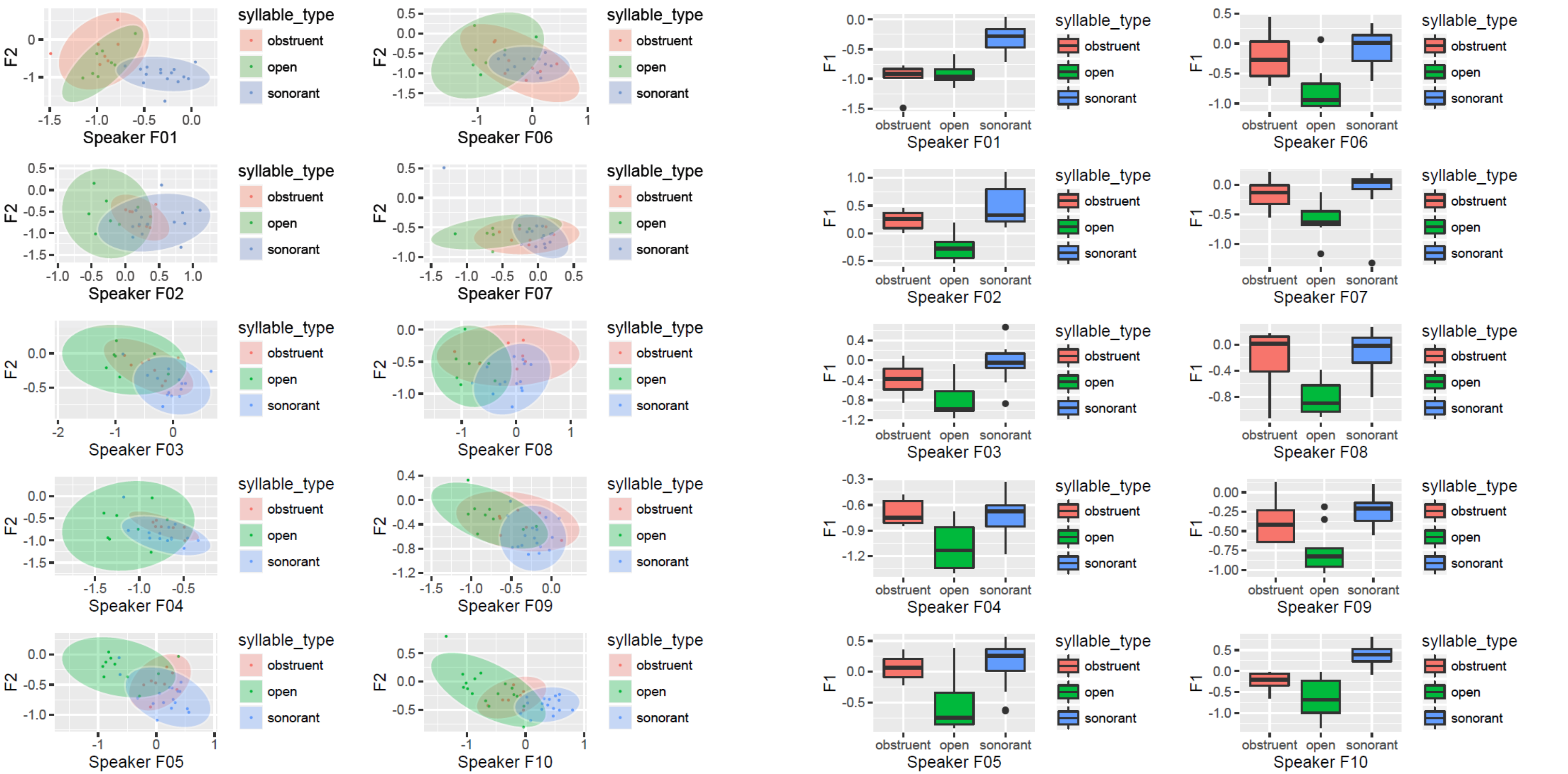



**Figure 7:** Realisations of /ø/ for each of 10 female speakers. **Left:** F1-F2 plot (Lobanov-normalised). **Right:** F1 box-plot for each speaker. Speakers are ordered from youngest to oldest (sequentially by index; top to bottom, left to right). This allows us to note:

1. Unlike the situation in /e/: we do not see apparent categoricity here for /ø/, for most speakers. We do however see that pre-sonorant F1 is generally higher than pre-obstruent and pre-# F1.
2. Again, not categorical (and suffering somewhat from the lack of data points) but we see that for speakers showing /ø/-lowering pre-sonorant:
   **F1: open (<<) < obstruent < sonorant**, <u>unlike</u> /e/ (for which we had obstruent < open < sonorant).
3. This looks like a superposition of two states:

   State 1, in which F1(obstruent) ~ F1(sonorant) and F1(open) is distinct

   State 2, in which F1(sonorant) >> F1(obstruent) ~ F1(open)

We then hypothesise that State 1 is the 'original' pattern and State 2 the 'new' pattern (more closely matching /e/). **Why would /ø/ be behind /e/?** There are some plausible comments – systems with multiple height contrasts in front unrounded vowels are far more common than systems with extensive front rounded contrasts. It is known (e.g. Zsiga 2013) that front round vowels are marked and perceptually 'worse'.

**Duration.**

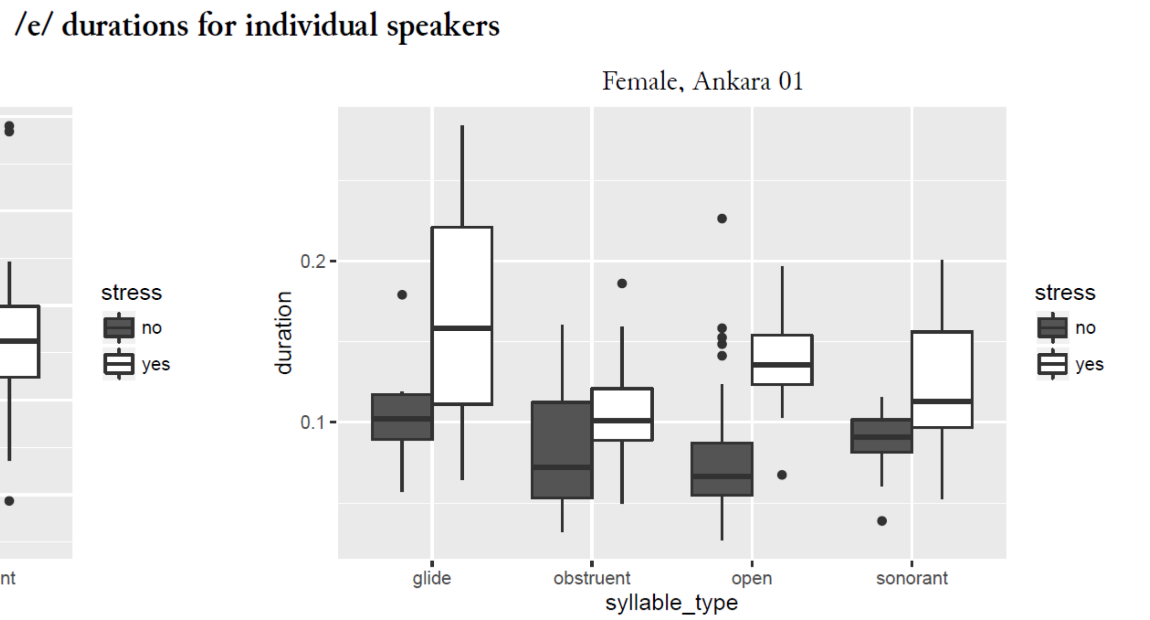



**Figure 7:** /e/-durations for individual speakers. Note that the distribution in stressed positions mirrors the distribution of the /e/ itself, i.e. obstruent < open < sonorant. When unstressed, open syllables have the shortest duration – this is perfectly consistent with the fact that 'unstressed' syllables in this sample are necessarily non-final syllables and thus may be prone to reduction (Turkish stress is typically final; we did not test exceptionally-stressing items).

**Individual codas.**

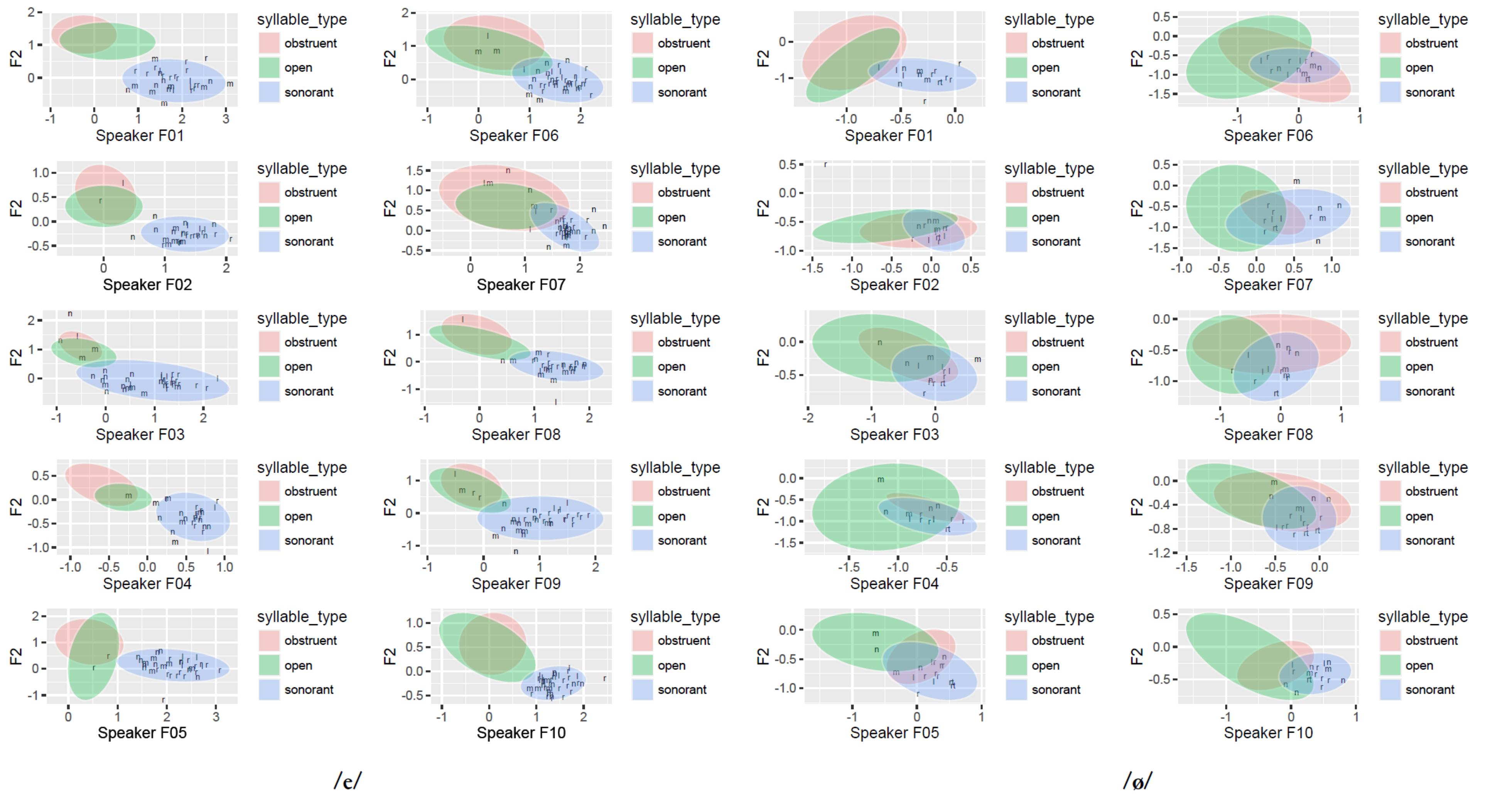



**Figure 8:** Sonorant only codas for each individual token and by speaker, plotted with 90% confidence ellipses. **Caution:** small sample sizes! For /e/, we don't see any particular clustering in codas for younger speakers and some clustering for older speakers; for ø, we see that pre-*rhotic* /ø/s cluster together with the lowest realisations. (For M02, the Kars speaker mentioned above, it transpires that there is no phonological lowering in /e/, but we see coda clustering like this.) – this is possible evidence for the rhotic as precursor.

## 4 Exceptions

We see a few particularly robust sets of exceptions to the /e/-lowering rule. Two are most widespread: the first frequency-based, the second apparently determined by prosodic structure. A third case involves a few geminates: *zerre* [zerre] 'particle' and *cerrah* [dʒerrah] 'surgery', neither of which show lowering in the initial syllable – but compare *gömmek* 'to bury', which does. This seems to be a difference in syllabification, possibly due to the morpheme boundary at *-mek* – [ze.rre] but [gœm.mek]. Some N+stop clusters also behave exceptionally: *renk* 'colour' generally [reŋk] *[ræŋk], *ahenk* 'harmony' [a.heŋk], *yengeç* 'crab' [jeŋ.getʃ].

**Frequency.** In a few very high-frequency items, we see some optionality (given below, with corpus[2] frequency per million words and overall rank within the corpus), which is entirely absent from lower-frequency items not governed by the prosodic exception:

| | | | | |
|---|---|---|---|---|
| (5) | *en* | 'most' | [en] » [æn] | 2581 per million words (rank 18) |
| | *ben* | 'I' | [ben] ~ [bæn] | 1740 per million words (rank 24) |
| | *kendi* | 'myself' | [kændi] ~ [kendi] | 1285 per million words (rank 36) |
| | *önemli* | 'imp.' | [ønemli] ~ [ønæmli] | 1077 per million words (rank 46) |

Although we have a small sample and cannot make a particularly robust claim, we note that speakers who showed the highest frequency of lexical exceptions were those speakers who seemed to be least advanced in the change itself (i.e. speakers with no /ø/-lowering). The youngest speakers showed no high-frequency exceptions.

**Prosodic structure.** /e/ in word-initial sonorant-coda syllables resists lowering but only in a word of sufficient size (trisyllable, or larger):

| | | |
|---|---|---|
| (6) | [gæl] | 'come' |
| | [ær.dæm] | 'virtue' |
| *but* | | |
| | [**el**.bi.se] | 'dress' |
| | [**ʃem**.si.je] | 'umbrella' |
| | [**el**.di.væn] | 'glove' |
| | [**men**.te.ʃe] | 'hinge' |

We are aware of very few *morphologically simple* trisyllables in which pre-sonorant /e/ in an initial syllable may undergo lowering – *pencere* 'window' was produced with [æ] by one speaker and *Perşembe* 'Thursday' seems to be generally produced with [æ]. Affixation does not *generally* induce exceptionality, suggesting that we *do not* have a straightforward case of positional faithfulness:

| | | | | |
|---|---|---|---|---|
| (7) | /erdem-i/ | [ær.de.mi] | 'virtue.ACC' | ***[er.de.mi]** |
| | /kendi-miz-e/ | [kæn.di.mi.ze] | 'to us' | ***[ken.di.mi.ze]** |
| | /ver-me-edʒek/ | [vær.me.je.dʒek] | 'to us' | ***[ver.me.je.dʒek]** |
| | /gel-di-ler/ | [gæl.di.lær] | 'to us' | ***[gel.di.lær]** |

When exceptional items undergo affixation, the exceptional syllables remain exceptional:[3]

| | | | | |
|---|---|---|---|---|
| (8) | /elbise-i/ | [el.bi.se.ji] | 'dress.ACC' | ***[æl.bi.se.ji]** |
| | /ʃemsije-lik/ | [ʃem.si.je.lik] | 'umbrella stand' | ***[ʃæm.si.je.lik]** |

We find no exceptions of this type with /ø/, which we could see as further evidence that /ø/ trails /e/ here: cf. e.g. Janda & Joseph (2001) – if we assume that a phonological innovation begins as phonetic conditioning then we may conclude that regularity is necessarily a condition of the early stages of such a change and morphological or lexical conditions must arise only later. The prosodic exceptions in /e/ were much more consistent for the youngest speaker and least consistent for the speakers who showed no effect in /ø/.

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[2] Frequencies here are drawn from the Turkish National Corpus (Aksan et al. 2012).

[3] Lowering is also avoided in less transparently derived environments. *emretmek* 'to order, command' does not undergo lowering (thus [emretmek]) as it is derived from *emir* 'command(er)', which does not contain the correct sonorant-coda closed syllable for lowering, and the verb *etmek* 'to do'. Similarly, the exceptionality of the high frequency item *el* 'hand' is preserved in the verb *ellemek* 'to handle' (i.e. [ellemek]), which is derived using the verbaliser *-le* and the infinitive suffix *-mek*.

Can we account for this? Perhaps not, but some intonational correlate:

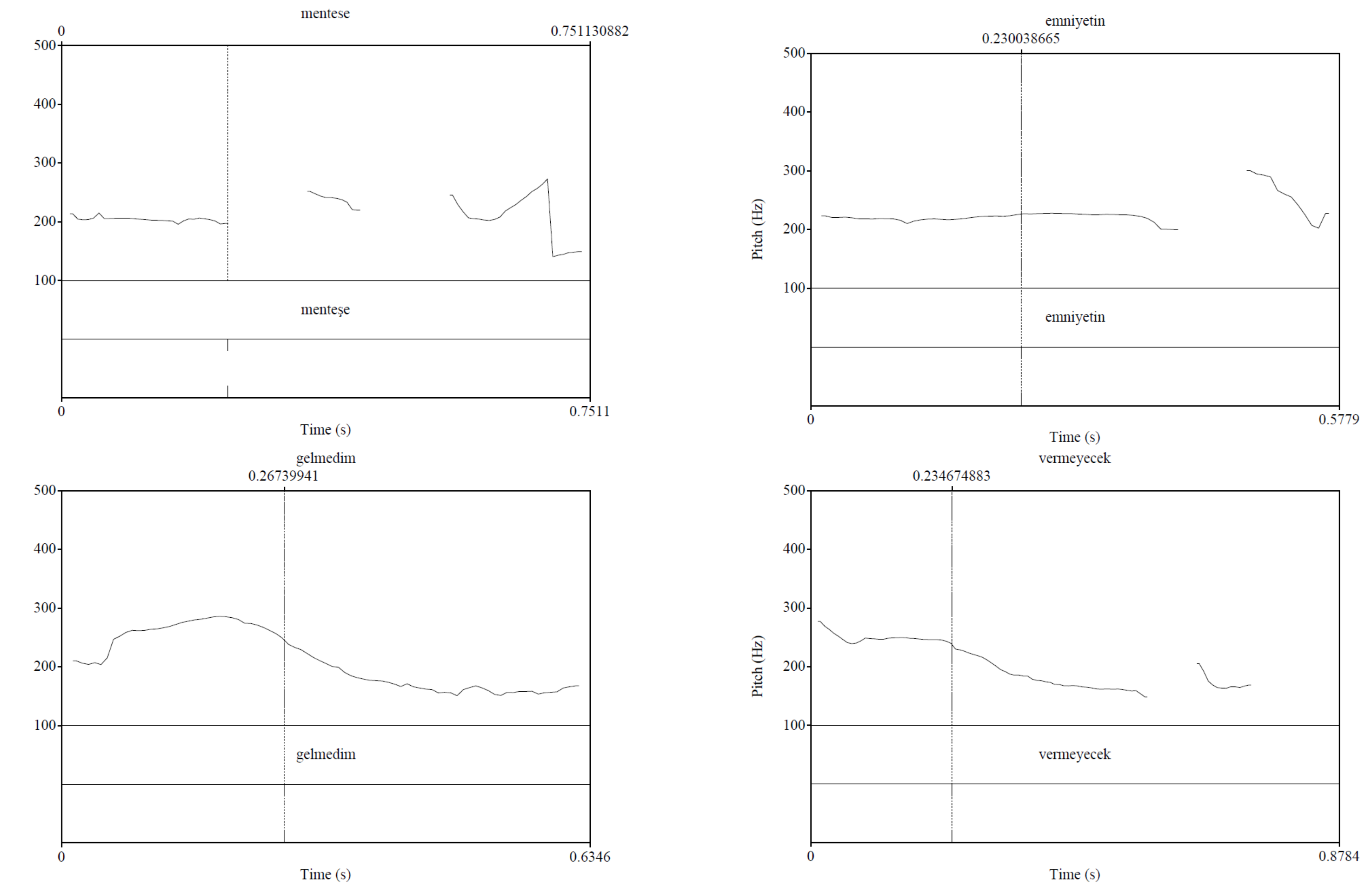


**Figure 9: Top row:** /menteʃe/ [**men**.te.ʃe] ‘hinge’, /emnijet-n/ [**em**.ni.jet.in] ‘your safety’. **Bottom row:** /gel-me-d-m/ [**gæl**.me.dim] ‘I didn’t come’, /verme-edʒek/ [**vær**.me.je.dʒek]. Marker placed after the first syllable. Notice the difference in contour!

## 5 Conclusion(s)

We started out with an observation of uncertain scope attested briefly in the descriptive literature on Turkish. At the bare minimum, we hope to have convinced the listener that sonorant conditioned mid-vowel lowering in Turkish is phonological and that this is interesting in itself.[4] Several observations, resummarised:

1. The state of /e/: clear categorical behaviour before sonorants, some evidence for pre-obstruent raising (possibly in progress).
2. The state of /ø/: *behind* /e/, a *decaying* system of raising in open syllables is being replaced by an /e/-like system.
3. Some evidence exists that, although /e/-lowering shows a categorical sonorant/non-sonorant split, this may have been originally rhotic-triggered: slight clustering of pre-rhotic /e/ relative to other pre-sonorant /e/; for speakers who show less /ø/-lowering, it's most prominent in pre-rhotic /ø/; evidence from divergent Kars speaker, who has no categorical /e/-lowering but a little pre-rhotic lowering.

   **Pre-rhotic laxing.** Articulatory reasons, of course: /r/ forces dorsum lowering/retraction (see Bradley 2010 for a summary).

4. So we have an overall trajectory: suggest that the mid vowels begin in a state in which they are *raised* in open syllables (note also the descriptive literature and the disparity in descriptions 50 years apart) and end in a state in which they are *lowered* in pre-sonorant position. Further questions: why raising? Why generalisation?

Despite the general chaos of the system, this seems to be a change in progress that is clear and reconstructible – inter-speaker variation corresponds to plausible sociolinguistic variables involved in that change. The remaining challenge is understanding exactly why and how the generalisation from the phonetic precursor/conditioning factor we predict (i.e. gradient lowering before a rhotic) to the set of sonorants arose. We might consider Janda & Joseph's 'big bang' model of sound change, in which a change originates in a very small, highly-localised context governed purely by phonetics, but rapidly substitutes phonological conditions for the original phonetic ones. This series of successive generalisations is what (we believe) we seem to be watching happen here.

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[4] We have a final note on the status of certain non-sonorants. The suffix *-mez* e.g. *sen yemezsin* 'you do not eat' is [mæz], but this does not hold for other instances of coda /z/ of which we are aware (our thanks to Filiz Mutlu for observations here). Bjorndahl (2016) anecdotally reports that some speakers have e.g. [mæv.zu] rather than [mev.zu] with coda /v/ – we note in this case the possibility of reanalysis driven by the frequent realisation of /v/ as the labio-dental approximant [ʋ].

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## Appendix: (A very brief note on) Perception

Ongoing work on perception. We've discussed our patterns as categorical phonological processes and remarked on possible phonetic precursors but we can look at the question in another way: does /e/-lowering confer any perceptual advantage?

To answer this, we're running a series of experiments. Pilot study: 28 subjects, presented with 36 monosyllabic nonce-word stimuli, spliced from the productions of a native Turkish speaker (F0, duration manipulated) with coda {n, m, l} paired for vowel: [lel]~[læl]/[len]-[læn]/[lem]~[læm], etc. and given a forced-identification task (select one of {n, m, l}). A rather baffling result:

| **context [æ]_** | stimulus l | stimulus m | stimulus n |
|---|---|---|---|
| response l | **45.83%** | **27.38%** | **26.79%** |
| response m | 0.60% | **97.02%** | 2.38% |
| response n | 0.60% | **52.38%** | **47.02%** |

| **context [æ]_** | stimulus l | stimulus m | stimulus n |
|---|---|---|---|
| response l | **98.21%** | 0.00% | 1.79% |
| response m | 0.60% | **52.38%** | **47.02%** |
| response n | 1.79% | 2.38% | **95.83%** |

M-identification is best after [æ]; l- and n-identification is best after [e]. Cue? [e]-lowering interacting with sonorancy perception? Lexical frequency bias? (In the case of [el], we suspect that the obligatory palatalised production of front [l] in Turkish – which was, of course, present in the stimuli – might be more perceptible here.) Also ongoing: further work on the perception/identification of front vowels before {r, n, m, l} codas.