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

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## 1 Introduction

Some descriptive work on Turkish (e. g. Göksel & Kerslake 2005:10) claims that the front mid vowel /e/ is lowered to [æ] in syllables with coda {r, m, n, l}; thus

| | | | | | |
|---|---|---|---|---|---|
| | | /sen/ | [sæn] | 'you' | |
| | (*but* | /sen-in/ | [se.nin] | 'your' | ***[sæ.nin]**) |
| (1) | | /erdem/ | [ær.dæm] | 'virtue' | |
| | | /gelmek/ | [gæl.mek] | 'to come' | |

The scope of this observation – e.g. generality and categoricity – is not apparent from the literature; if we can indeed diagnose this as phonological, then it presents novel issues for analysis. Although 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), and Faroese /e/ (Árnason 1999), the Turkish case appears to entail generalisation to all [+sonorant] codas – this raises both the question of the process's diachronic origin, and of its synchronic state.

**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/. For some speakers, /e/ is the only target of pre-sonorant lowering; for others, a significant effect appears in /ø/ (2), but categoricity is less convincing. The youngest speaker, 15 years younger than the median of the rest of the sample, appears to be significantly ahead – /ø/ -lowering for this speaker appears categorical. We suggest that the state of /ø/ represents an intermediate stage of phonologisation, and we note further that /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 indeed the phonetic precursor to this change.

| | | | |
|---|---|---|---|
| | /dørt/ | [dœrt] | 'four' |
| (2) | /tørpy/ | [tœr.py] | 'file' |
| | /kuafør/ | [kua.fœr] | 'hairdresser' |

- 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:

| | | |
|---|---|---|
| | [ær.dæm] | 'virtue' |
| *but* | | |
| | [**el**.bi.se] | 'dress' |
| | [**ʃem**.si.ye] | 'umbrella' |

[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; our very patient participants.

For a more complete set of visualisations and further details of the dataset, please see the appendices, which will be made available online at:
http://personalpages.manchester.ac.uk/staff/deepthi.gopal/24mfmappendices.pdf

(3) [**el**.di.væn] 'glove'
[**men**.te.ʃe] 'hinge'

But this does not appear to be the case in non-roots:

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

- Based on preliminary results from a perceptual experiment (forced-identification and same-different tasks performed on monosyllabic nonce word stimuli with sonorant codas), we note that the identification of [m] is significantly better after [æ], and the identification of [n] and [l] significantly better after [e].
- 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 and the synchronic behavior difficult to model, 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 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, underlying representation + orthography.

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). Rounding harmony is height-dependent – non-high vowels are not valid targets for RH, but high vowels are.

## 3 Production data

Data: 7 female and 2 male Turkish speakers, all resident at the time of experimentation in Manchester, England – length of residence outside Turkey ranged from 1 to 10 years.

- one speaker age 20, *treated separately*; rest aged 31–38, mean 34
  - 3 NW Turkey: Istanbul (2) and Bursa
  - 2 SW Turkey: Fethiye and Denizli
  - 3 Central Turkey: Ankara (3)
  - 1 NE Turkey: Kars

Speakers read a list of 190 items in isolation, and a further 35 sentences containing tokens of /e/ embedded in varied phonological and morphological environments; F1, F2 (at the mid-point of the vowel), and duration were measured.

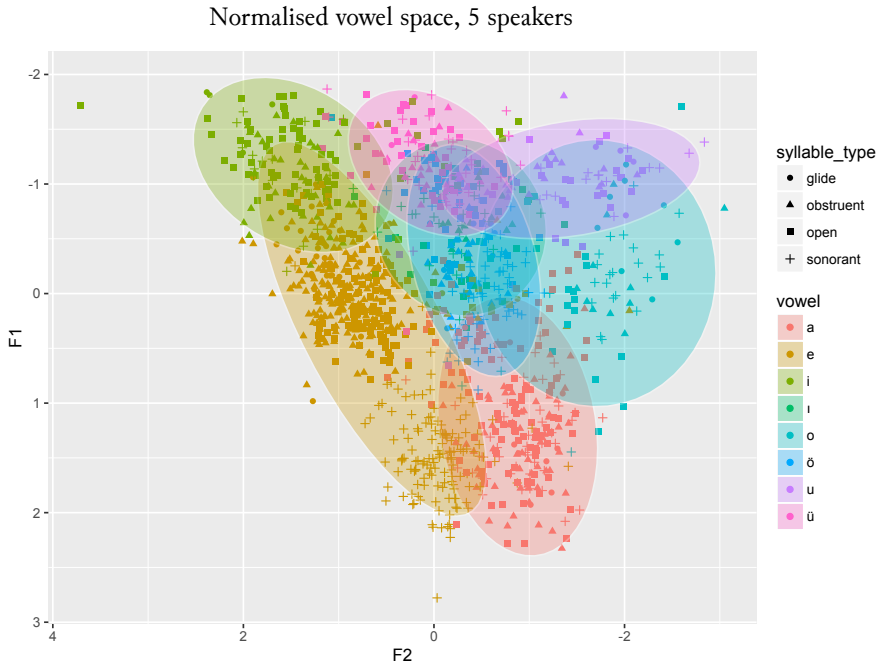



**Figure 1.** Lobanov-normalised F1 and F2 for 5 non-exceptional participants (Ankara 01, 02, 03; Istanbul 01; Bursa 01), shown with 95% confidence ellipses. /e/ clustering by coda type is visible.

***A tentative remark on geography.** Of course, we have a small number of participants, but: throughout our experimentation, we have found that speakers from Ankara, the capital, are the most consistent in all the phenomena we describe here – if we indulge ourselves prematurely and claim for this data the status of ongoing sound change, then the change is being led by speakers from Ankara (very closely followed by speakers from Istanbul). We don't find this implausible, as a reflection of perceived prestige – but as far as we are aware, relatively little sociolinguistic work of this type exists on Turkish.

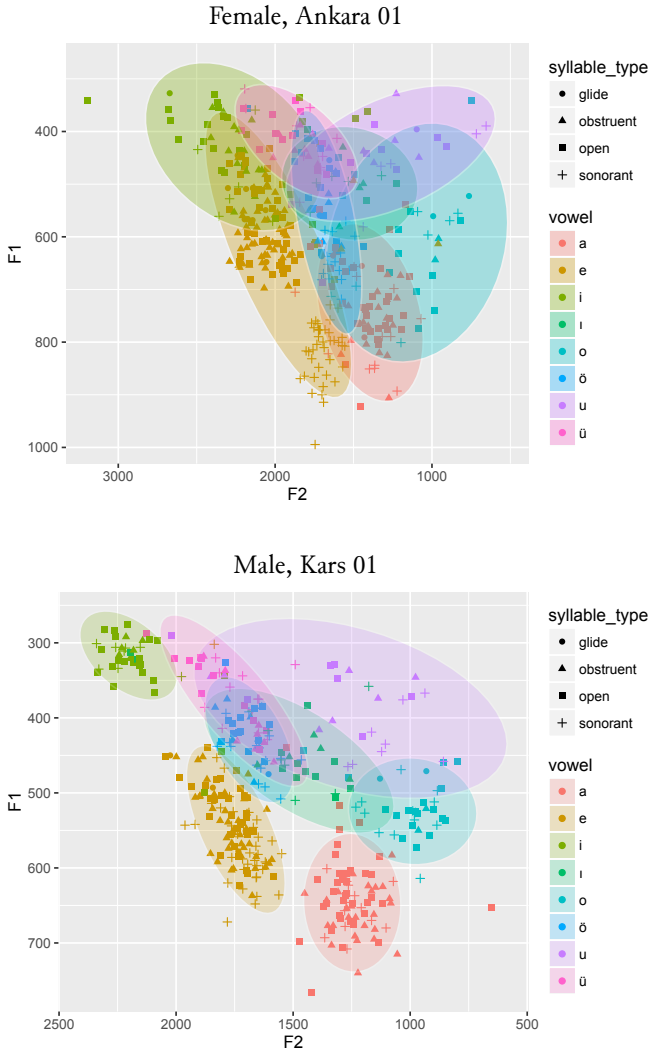



**Figure 2.** Non-normalised F1 and F2 for a representative speaker, Ankara 01, and for the most divergent speaker, Kars 01. Note for the Ankara speaker that the separation between pre-sonorant /e/ and other /e/ is very clearly visible; while clustering for the Kars speaker is not as drastic, some effect of coda sonorancy on /e/ appears present (which see the statistical analyses to follow).

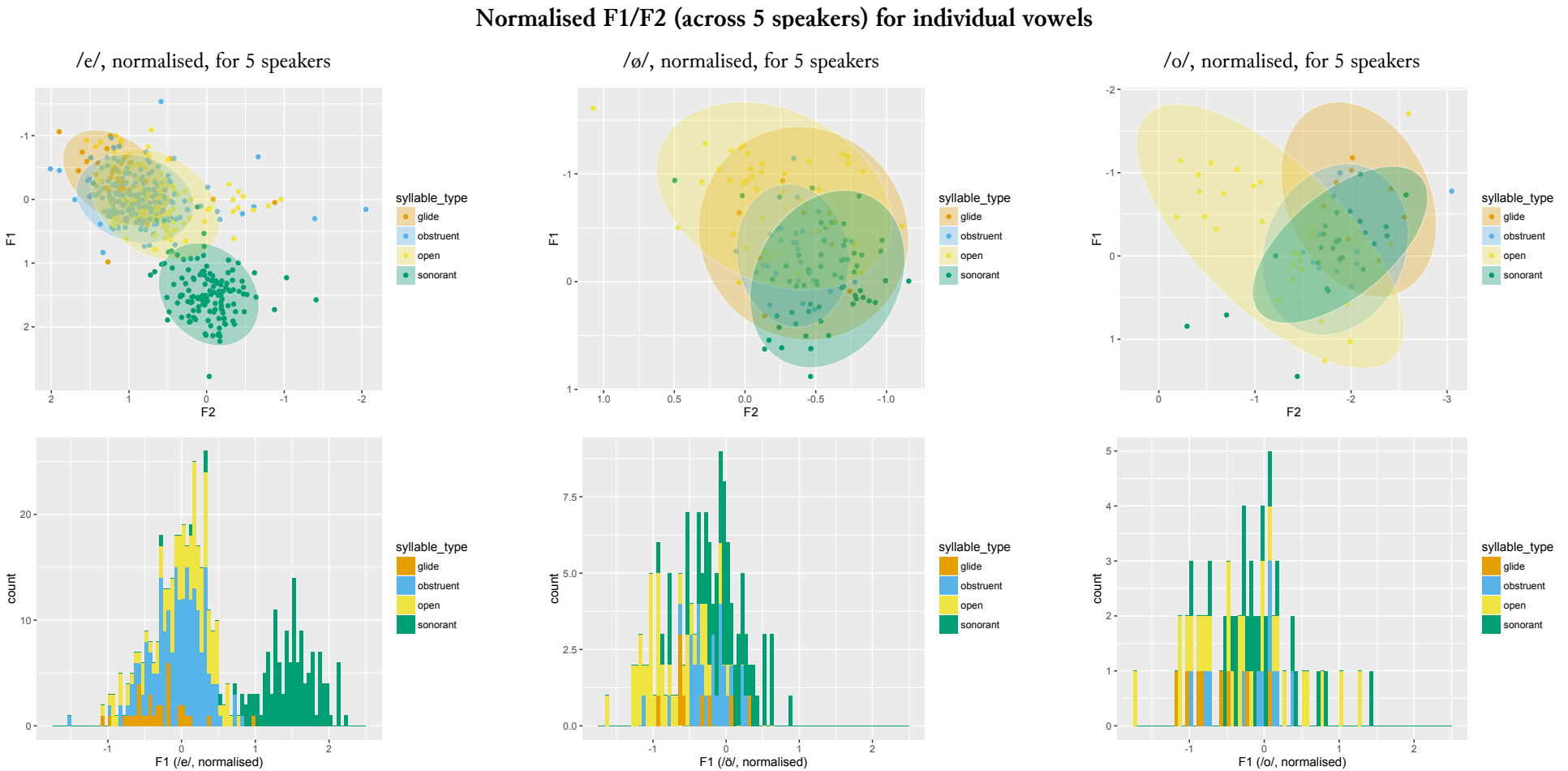



**Figure 3. Top row:** F1 and F2 of (left to right) /e/, /ø/, /o/, for 5 participants, Lobanov-normalised.
**Bottom row:** Histograms of normalised F1 for /e/, /ø/, /o/. Note the clear bimodality for /e/, and the presence of some apparent clustering (though no bimodality) for /ø/, versus the lack of any apparent effect in /o/.

**A note on glides.** Tokens coded 'glide' in the sample all involve the Turkish 'yumuşak ge' <ğ>, the orthographic representation of a (generally historic) deleted velar. Note that there seems to be some separation of pre-obstruent and open /e/ realisations, although no categoricity; this is much more pronounced for some speakers (see below). It may be possible to infer from this data that the glides are treated with the obstruents, and not the sonorants or empty codas – such a result would be appealing if we wished to claim that an underlying velar obstruent remains corresponding to <ğ>. But we caution that the sample size is very small, and the proposition of an obstruent/open split tentative.

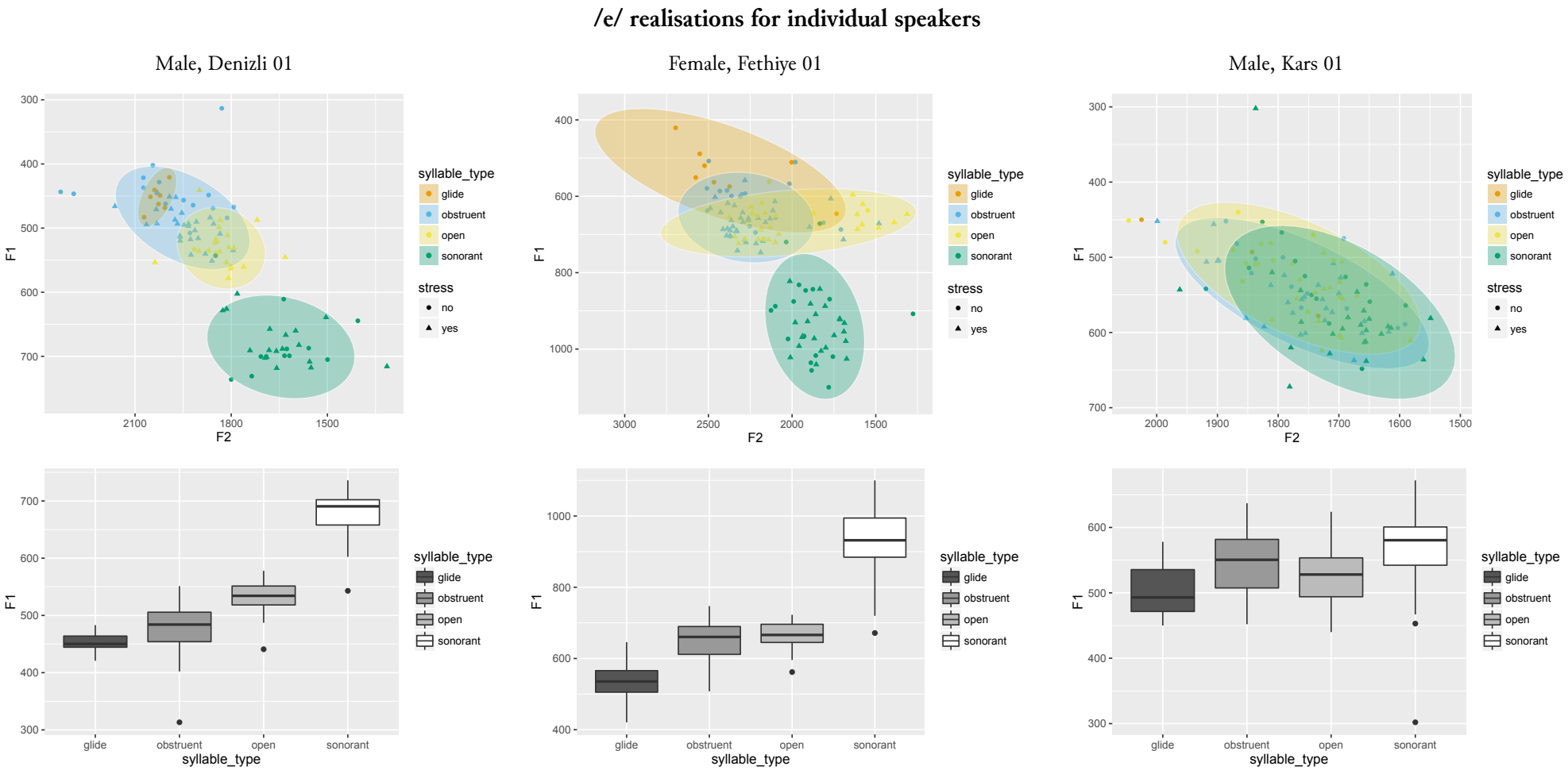



**Figure 4. Top row:** F1 and F2 of /e/ *only* for three speakers, shown with 95% confidence intervals: Denizli 01, Fethiye 01, Kars 01 Note for the Denizli and Fethiye speakers the clearly nonoverlapping clusters for pre-sonorant /e/ and /e/ followed by all other codas; note also the *lack* of such categoricity for the Kars speaker. **Bottom row:** F1 plotted against coda type, for the same speakers. Although the Kars speaker lacks strict separation between the realisations of /e/ in the various contexts, some sonorant-conditioned lowering is seen – this is statistically significant, but the lack of categoricity suggests that it is a non-phonological effect. ANOVA p-values (for F1 grouped by coda type) for these speakers are < 2e-16 for both the Denizli and Fethiye speakers (left, centre), and 0.0165 for Kars.

Although not categorical, there is a consistent effect in /e/ across all speakers: F1(obstruent) < F1(open) < F1(sonorant) (i. e. pre-obstruent /e/s are highest, pre-sonorant /e/s are lowest. Such a result is somewhat surprising, given general tendencies towards reduction in closed syllables / length in open ones. For some speakers (Ankara, Istanbul), /e/ in open syllables is anomalously high [ę] if followed in the word by a high vowel: [ek.mek] 'bread', but [sę.kiz] 'eight', [kę.di] 'cat', [dę.niz] 'sea', [tę.miz] 'clean'.


**Figure 5. Top row:** F1 and F2 of /ø/ for three speakers, shown with 95% confidence intervals: Ankara 01, Fethiye 01, and Istanbul 01. Note for Ankara speaker that although there is some overlap between /ø/ realisations for the various coda types, the pre-sonorant /ø/ tokens are largely distinct. The Fethiye speaker seems to represent an intermediate between the patterns of the Ankara and Istanbul speakers. **Bottom row:** F1 plotted against coda type, for the same speakers. Note the significant separation of sonorant-coda syllables from other types for the Ankara speaker here, and the lack thereof for the Istanbul speaker. The Fethiye speaker seems to be somewhere in between. ANOVA p-values for these speakers (F1 grouped by coda type): Ankara 7.7e-9, Fethiye 0.000232, Istanbul 0.264. Distribution: *the 3 Ankara speakers showed the most advanced cases of /ø/-lowering.*

Although, again, not categorical (and suffering somewhat from the lack of data points), we see that for speakers showing /ø/-lowering F1: open (>>) > obstruent > sonorant, unlike e (for which we had obstruent > open > sonorant) – in fact, there appears to be raising for /ø/ in an open syllable. But, notice that this raising is much less drastic for the Ankara speaker than the others: the current /ø/ pattern for this speaker seems to be a superposition of the 'original' pattern of open-syllable raising, and the 'new' /e/ pattern – we hypothesise that with time, the overall /ø/ pattern will move further towards the /e/ pattern. (And we will show this for a younger speaker, in this talk.)

**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's known (e. g. Zsiga 2013) that front round vowels are marked, and perceptually 'worse'.

**Individual codas.**

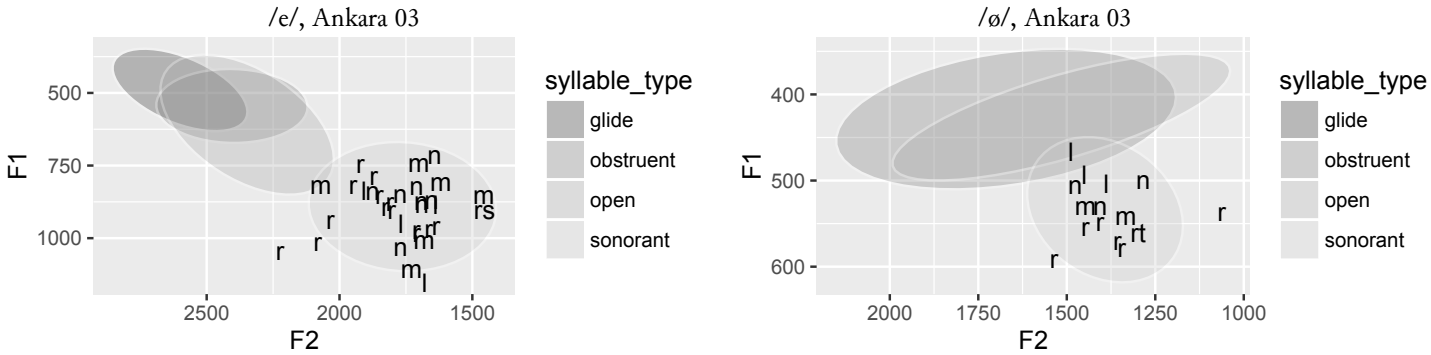



**Figure 6.** (sonorant only) codas for each individual token, plotted with 95% confidence ellipses. For /e/, we don't see any particular clustering in codas; for ø, we see that *pre-rhotic* /ø/s cluster together with the lowest realisations. (For the Kars speaker above, no phonological lowering in /e/, but we see coda clustering like this.) – this is possible evidence for the rhotic as precursor.

**Duration.**

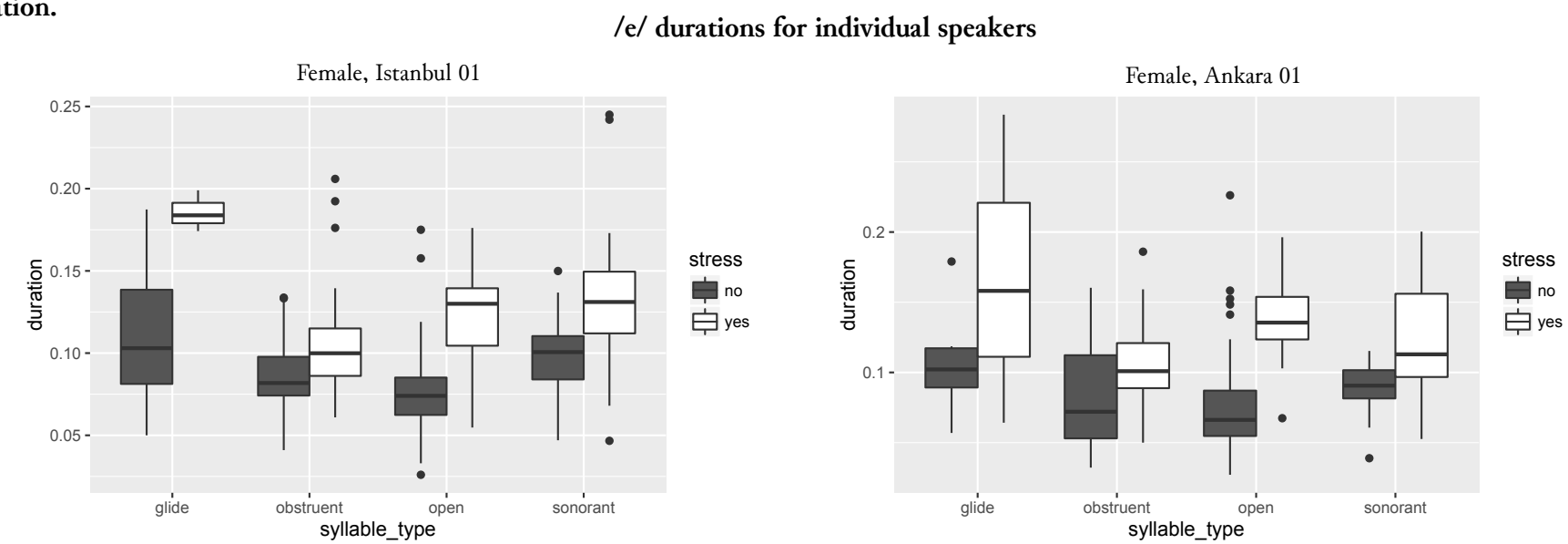
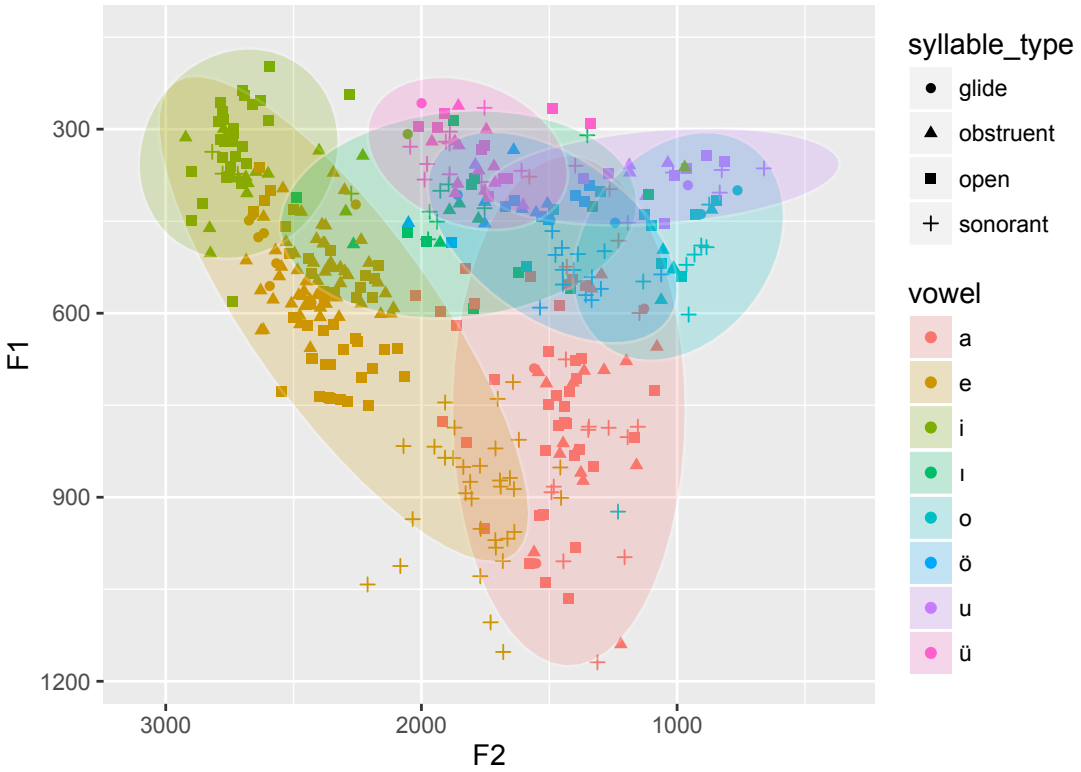



**Figure 7.** /e/-durations for individual speakers. Note that the distribution in stressed positions mirrors the distribution of the /e/ itself, i. e. obstruent < open < sonorant. When unstressed, open syllables have the shortest duration – this is perfectly consistent with the fact that 'unstressed' 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.)

**Younger speakers.**

We have speculated on a possible change in progress in /ø/. Our sample was very tightly clustered in age:



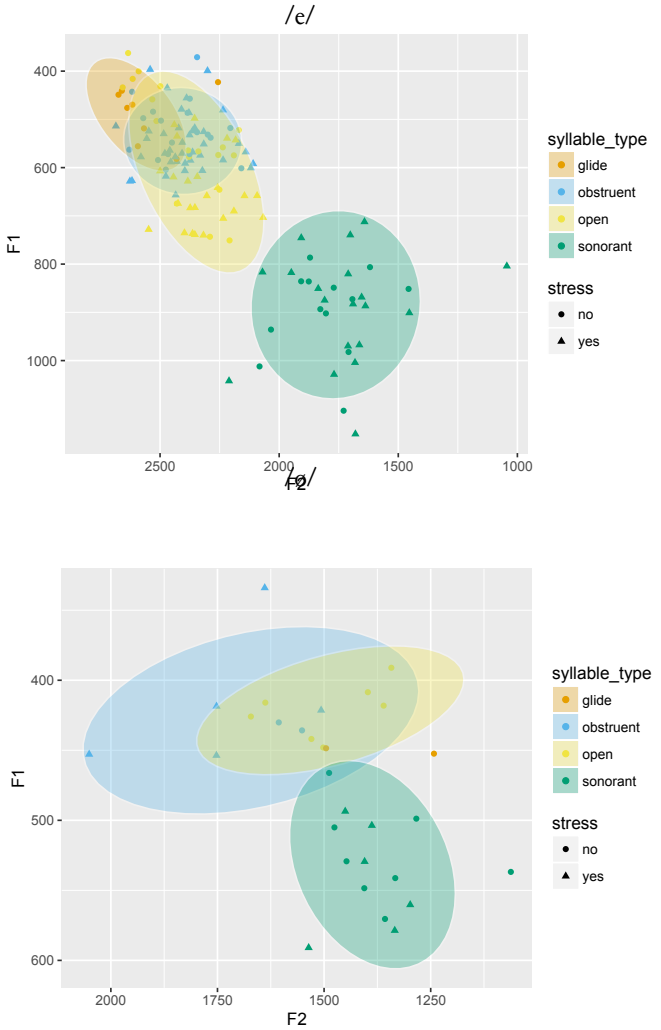




**Figure 8. Left**: entire vowel space for a 20-year old speaker (Istanbul 02), plotted with 95% confidence ellipses. Notes: /y/–/u/ overlap, and /ø/–/o/ overlap are significant, and are not present to this degree for other speakers. Many tokens of pre-sonorant /e/ fall outside the /e/ ellipse, and instead encroach on /a/. **Right:** /e/ and /o/ F1/F2 plots, as before.

**What's different about this speaker?** Although sample size is small, it seems not unreasonable to claim a categorical split between pre-sonorant /ø/ and other positions – note that this was not as clear even with the Ankara speakers above (who showed the greatest effect in /ø/). Note that the previous state in which F1 (open) >> F1 (obstruent) has entirely vanished, as has any /ø/-raising. So: we have a significantly younger speaker who shows categoricity in /ø/-lowering, shows tighter clustering in the obstruent–open–sonorant split in /e/, and shows much more overlap between lowered /e/ and /a/.

Are we seeing the beginnings of /o/-lowering?

## 4 Exceptions

We see two robust sets of exceptions to the /e/-lowering rule: the first frequency-based, and the second apparently determined by prosodic structure. A third case involves *zerre* [zerre] 'particle' and *cerrah* [ʤerrah] '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].

**Frequency.** In a few very high-frequency items, we see some optionality (given below, with corpus[3] frequency per million words, and overall rank within the corpus), which is entirely absent from lower-frequency items not governed by the prosodic exception;

| | | | |
|---|---|---|---|
| *en* | 'most' | [en] >> [æn] | 2581 per million words (rank 18) |
| *ben* | 'I' | [ben] ~ [bæn] | 1740 per million words (rank 24) |
| *kendi* | 'myself' | [kæn.di] ~ [ken.di] | 1285 per million words (rank 36) |
| *önemli* | 'imp.' | [ø.nem.li] ~ [ø.næm.li] | 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 speaker 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):

| | |
|---|---|
| [ær.dæm] | 'virtue' |
| [gæl] | 'come' |
| | |
| [**el**.bi.se] | 'dress' |
| [**ʃem**.si.ye] | '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:

| | | | | |
|---|---|---|---|---|
| | /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] | 'he will not give' | ***[ver.me.je.dʒek]** |
| | /gel-di-ler/ | [gæl.di.lær] | 'they came' | ***[gel.di.lær]** |

When exceptional items undergo affixation, the exceptional syllables remain exceptional:

| | | | | |
|---|---|---|---|---|
| | /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. Janda 1998, 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/.

Can we account for this? Perhaps not yet, but we do notice a systematic pattern in intonation:

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

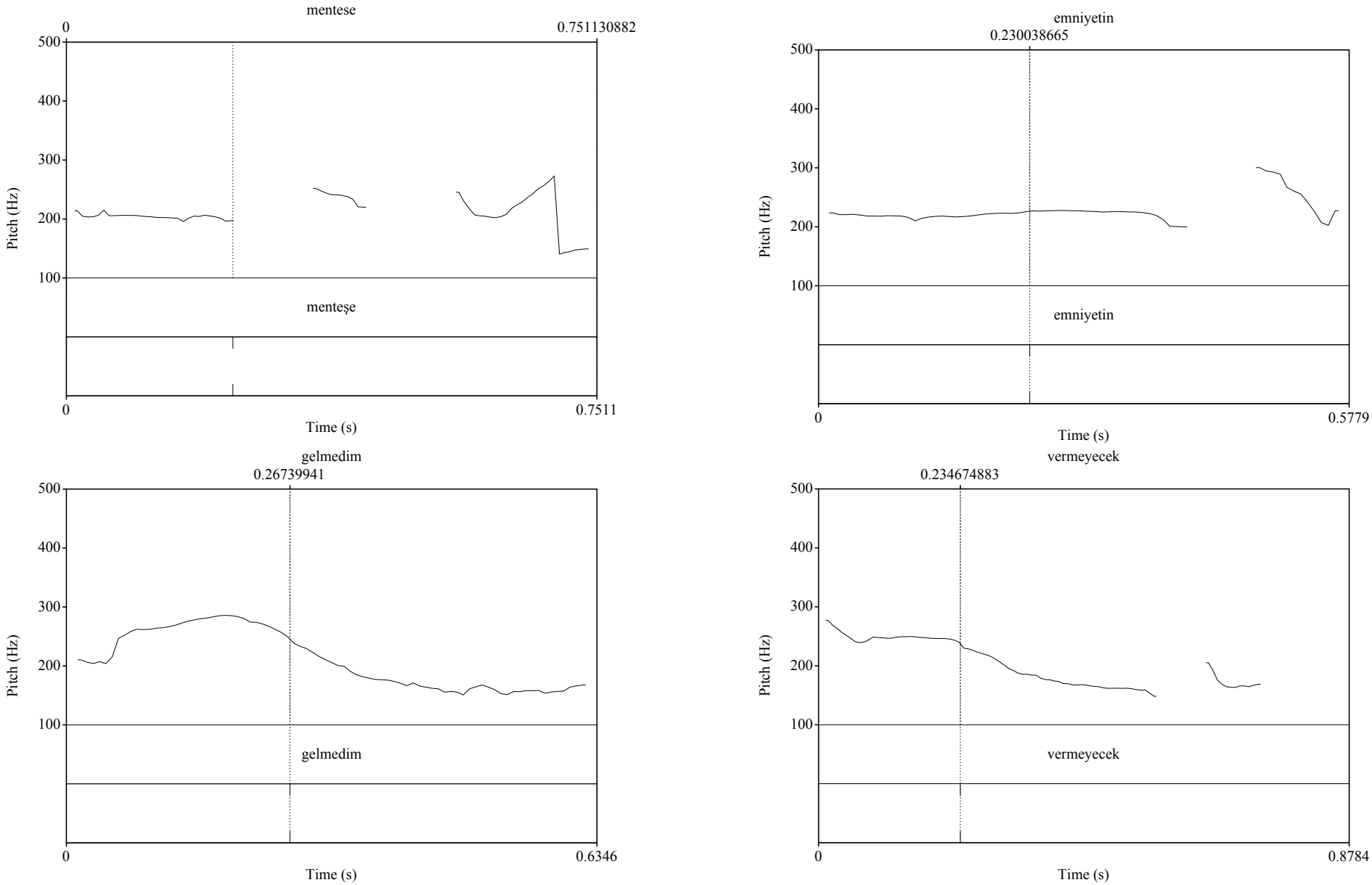



**Figure 9. Top row:** /menteʃe/ [**men.**te.ʃe] 'hinge', /emnijet-n/ [**em**.ni.jet.in] 'your safety'. **Bottom row:** /gel-me-d-m/ [**gæl.**me.dim] 'I didn't come', /ver-me-edʒek/ [**vær.**me.je.dʒek]. Marker placed after the first syllable. Notice the difference in contour!

## 5 (a very brief note on) Perception

Ongoing work on perpeption. 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 l, m, n). 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.)

## 6 Conclusion

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 and of itself.

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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