Abstractness or complexity? The case of Hungarian /aː/

The purpose of this paper is to see if Hungarian /aː/, a well-behaved back vowel in terms of vowel harmony and of its phonological properties in general, is indeed a proper back vowel phonetically, too. Native speakers of this language (including some Hungarian linguists) seem to have the impression that the vowel /aː/ is realised in present-day Hungarian more or less as a front vowel. However, there have been no reliable objective measurements to support or to contradict that impression so far. In the present investigation it turns out that there is a historical change going on in Hungarian in the articulation gesture of /aː/. The paper also offers some discussion as to whether that change in the phonetic makeup of this vowel should be reflected by its phonological analysis (feature composition). The dilemma we face is one between increased abstractness and increased complexity of analysis.

1. Introduction

Vowel systems in most languages of the world appear to be balanced and stable, at least at first sight. However, if we take a closer look either at the history of the vowel system of a sufficiently well-documented language, or at the dialect distribution of the exact phonetic realisations of some vowels in some (again, well-documented) languages, we find that vowels tend to move around in the vowel space either in what are known as chain shifts, or just one vowel at a time, sometimes in a clear pattern, sometimes with no apparent reason, sometimes even going back and forth as time passes. Take the example of the English vowel in *man*. As the alternation *man* ~ *men* suggests, this vowel must have been a proper back vowel in Old English (and before) as it participated in this umlaut-type alternation as its back term. Present-day dialects, on the other hand, show a mixed picture. In Scottish Standard English, the vowel in *man* is a central vowel (neutralised with the /ɑ/ of *father*) that could be symbolised as IPA /ɐ/ and is said to be a low unrounded vowel, often halfway between front and back but subject to considerable variation along the front–back dimension. In General American, the vowel in *man* is a low front unrounded vowel, somewhat higher than cardinal [a]; in Northern British English, it is very low and often slightly backed (but still clearly a front vowel). In Southern British English, on the other hand, this vowel (customarily symbolised as /æ/) exhibits considerable variation in height: conservative RP speakers may have realisations that are only slightly lower than cardinal [ɛ]. Australian, New Zealand and South African English speakers also tend to have realisations close to cardinal [ɛ]. (Of course, for all these speakers, the vowel in *men* is also a lot higher than in the case of General American.) But (at least for the purposes of the /æ/ ~ /ɛ/ alternation) all this variability need not concern the phonological analysis of /æ/ (or that of /ɛ/), given that the alternation in *man* vs. *men* is unproductive and rather peripheral anyway.

To take a more systematic example, consider the contrast between the vowels in *man* vs. *main*. Unlike in the previous case, this is now part of a larger pattern, the celebrated system of vowel shift alternations (as in *grade* ~ *gradual, metre* ~ *metrical, line* ~ *linear,* etc.). With respect to a set of alternations such as this one, the issue of abstractness of description arises. As is widely known, the SPE (Chomsky & Halle 1968), for instance, derives these pairs of vowels from single underlying forms (/ǣ/, /ē/, and /ī/, respectively), with laxing for [æ ɛ ɪ] and a complex vowel shift rule for [eɪ iː aɪ]. It is also possible, and somewhat less abstract (more plausible?), to go the other way: if we start from /ē/ for *grade* ~ *gradual* and from /ī/ for *metre* ~ *metrical,* etc., the surface tense vowels [eɪ iː] are derived without any further ado but the lax vowels now have to be not only laxed but also shifted (/ē/ → ɛ → [æ] *gradual,* /ī/ → ɪ → [ɛ] *metrical*; see Giegerich 1992: 308). Mixed analyses are also conceivable in which *grade* and *gradual* both come from /ē/ but (the second vowels in) *Canada* and *Canadian* both come from /æ/; in that case, vowel shift rules are required in both directions (for *gr**a**dual* and *Can**a**dian*, respectively), along with both laxing and tensing rules. This would be an example of an analysis that is perhaps less abstract but definitely a lot more complex than either of the two previous ones. However, degrees of abstractness and complexity aside, the question is whether analyses such as these are necessary or attractive at all, given that vowel shift alternations are unproductive/frozen in English, almost to the same extent as umlaut alternations are; a lexical solution with no phonological derivation involved appears to be more plausible and hence more desirable.

Nevertheless, it cannot be excluded *a priori* that a language should exhibit a completely regular and productive alternation, or even a set of interrelated alternations, all of them quite regular and productive, involving a vowel that shows historical instability (perhaps even symptoms of an ongoing change) and/or surface variation of the type English /æ/ does. In such a case, the problem cannot be simply dismissed by saying that no phonological solution is required at all. The choice is then restricted to two options: the description can either be made more abstract in order to be kept (relatively) simple, or else it can be made more complicated in order to be kept (relatively) concrete. In the present paper, we will consider a case of exactly that type: the case of /aː/ in Hungarian.

The paper will be structured as follows. In Section 2, the phonology of Hungarian /aː/, and in Section 3 the phonetics of Hungarian [aː], will be briefly introduced. Then, in Section

4, the methodology of our acoustic-phonetic measurements is described, and in Section 5 the results of those measurements are analysed. Finally, Section 6 offers some phonological discussion and Section 7 concludes.

2. The phonology of Hungarian /aː/ – alternations and feature composition

The traditional definition of /aː/ in Hungarian is that it is a "lowest back unrounded long vowel". Let us consider each term in this definition one by one. The term "lowest" is meant to suggest that this vowel is phonetically more open than the regular low vowels /ɛ/ and /ɔ/ are. This distinction is in fact quite superfluous and will not be followed here: we will take /aː/ to be a straightforward "low vowel". The term "long", on the other hand, refers to the fact that the fourteen vowels of Hungarian are organised into seven short/long pairs. Although not all of these pairs are qualitatively identical (in fact, none of them is *exactly* uniform apart from length), alternations such as the ones exemplified in (1) suggest that they are paired as shown:

(1) Long/short vowel pairs

iː	i	*víz*	'water'	*vizek*	'waters'
yː	y	*tűz*	'fire'	*tüzek*	'fires'
uː	u	*út*	'road'	*utak*	'roads'
øː	ø	*kő*	'stone'	*kövek*	'stones'
oː	o	*ló*	'horse'	*lovak*	'horses'
eː	ɛ	*tél*	'winter'	*telek*	'winters'
aː	ɔ	*nyár*	'summer'	*nyarak*	'summers'

The members of each of the three high vowel pairs are qualitatively almost identical (the short ones are slightly less high); those of the mid rounded pairs are less so (the long members are definitely higher than the short ones, but this is still within tolerable limits); but the members of the last two pairs are phonetically quite dissimilar. The long vowel /eː/ is mid, whereas the corresponding short vowel is low; and while the short vowel /ɔ/ is (slightly) rounded, its long counterpart is unrounded. These discrepancies can (should) be abstracted away from if the length alternations are not to be burdened by a phonological statement of the accompanying quality differences. One way to do this is to claim that /eː/ is underlyingly a low vowel ("/ɛː/") and that /ɔ/ is underlyingly an unrounded vowel ("/ɑ/"). This introduces some abstractness but leaves the length alternations as maximally simple (Siptár & Törkenczy 2000). Alternatively, it can be claimed that the feature [low] is not relevant (unspecified) for front vowels and the feature [round] is not relevant (unspecified) for back vowels. (The first of these options leaves us with /aː/ as an "unrounded" vowel, which is fine; the second leaves us with /aː/ as a vowel unspecified for roundness which is less optimal but still tolerable.)

The claim that Hungarian /aː/ is a "back" vowel is substantiated phonologically by the various alternations it participates in. As we just saw, it alternates lengthwise with the back vowel /ɔ/; if we disregard the phonetic rounding of the latter, the two form a straightforward pair as "long back low (unrounded)" and "short back low (unrounded)". In addition, the vowels of Hungarian also form vowel harmony pairs as follows:

(2) Front/back vowel pairs

yː	uː	*nagy fej-**ű***	'bigheaded'	*nagy láb-**ú***	'big-footed'
y	u	*kert-**ü**nk*	'our garden'	*ház-**u**nk*	'our house'
øː	oː	*kert-t**ő**l*	'from garden'	*ház-t**ó**l*	'from house'
ø	o	*tök-h**ö**z*	'to pumpkin'	*tok-h**o**z*	'to case'
ɛ	ɔ	*tök-n**e**k*	'for pumpkin'	*tok-n**a**k*	'for case'
eː	aː	*fej-n**é**l*	'at head'	*láb-n**á**l*	'at foot'

The first four of these pairs only differ in backness. (The fourth pair is actually part of a triplet *ø ~ o ~ ɛ*, but this is not at issue here.) The fifth additionally differs in rounding; but we have already seen that the rounding of /ɔ/ can be abstracted away from. The sixth pair differs in height; but, again, we said that the fact that /eː/ is phonetically mid need not disrupt its pairing with low vowels: with /ɛ/ in *kéz ~ kezek* 'hand ~ hands' and with /aː/ in *-nél ~ -nál* 'at'. (These two vowels, /eː/ and /aː/, also differ with respect to rounding if we take /aː/ to be unspecified for that feature; but this is irrelevant for our present purposes.) The only thing that remains to be seen is whether /aː/ is indeed a *back* vowel. If it is, its vowel harmony alternation with /eː/ ("/ɛː/") and its length alternation with /ɔ/ ("/ɑ/") fall out automatically.

But native speakers of Hungarian (as well as some Hungarian linguists) often have the impression that the vowel /aː/ is realised more or less as a front vowel. However, there have been no reliable objective measurements to support or to contradict that impression so far.

3. The phonetic pattern of Hungarian /aː/ – back or front?

Hungarian /aː/ has been treated as a "back" vowel for centuries, ever since its first descriptions (see Vértes 1980). However, some authors, from Wolfgang von Kempelen (1791/1989) onwards, have claimed that the vowel [aː] is not articulated as far back in the oral cavity as other Hungarian back vowels are (e.g., Bolla 1995, Szende 1999, Kovács 2004, Gósy 2004). As a consequence, several different IPA-symbols can be found to refer to the articulatory configuration of this vowel in the Hungarian linguistic literature, demonstrating the diverse views of the authors. Since there is only one "lowest" vowel in the Hungarian vowel inventory, the symbol [aː] is just as good for its transcription as [ɑː] is.

Speakers tend to articulate speech sounds or words differently, depending on various factors like dialect, phonetic context, prosody, speech style, speaking tempo, gender, emotions, and so on. Inter-speaker and intra-speaker variability has been discussed in terms of various types of fine-grained phonetic analysis during the past decades (e.g., Johnson 1997, Pierrehumbert 2001, Dankovičová & Nolan 1995, Mooshammer et al. 2008, Shiller et al. 2002, Gelfer & Mikos 2005, Recasens & Espinosa 2006, Lindblom et al. 2009, Brunner et al. 2011). The uncertainty concerning the tongue position of Hungarian [aː] in the oral cavity may be rooted either in large individual differences in articulation or in an ongoing change of that tongue position.

Lindblom (1990)'s H & H theory claims that speech output varies along a hyper- vs. hypospeech continuum, a fact by which sound changes can also be explained. Ohala (1993, 2012)'s view is that pronunciation variations could be particularly responsible for sound change. An additional factor is claimed by Wardhaugh (2006) to be social pressure and the interaction of that pressure with existing variations. Although speakers try to approach an assumed target speech sound in their pronunciations, they may or may not reach the intended target for several reasons. Ohala (2012)'s assumption is that sound changes are initiated by listeners as they may perceive some speech sounds erroneously and interpret the speaker's articulation gesture differently from what is intended. Listeners continuously map the acoustic-phonetic patterns of all speech sounds they hear to the supposed targets, an exercise that requires a flexible, modifiable 'neural spectrogram' stored in the brain (Obleser et al. 2003). There are differences in the articulation gestures of most speech sounds but, for some reason, some sounds are more sensitive to those differences than others. Therefore, their articulation is more liable to modifications than that of other segments. The slight initial changes of articulation would slowly become robust, an increasing number of speakers would follow the pattern, and the listeners gradually adapt to the modified articulation configuration. The result is an almost unnoticeable historical change of the speech sound at hand. If we can compare the articulation patterns of a speech sound to those measured in the past then, in this way, it becomes possible to evaluate the extent and the direction of change (Pettigrew 1990).

Generally there is no possibility to make reliable judgements about the pronunciation of a vowel in the past, unless we happen to have objective data for such an evaluation. If we disregard the methodological differences, we are able to make comparisons about the acoustic features of Hungarian [aː]'s articulated decades ago and at present. What do we know about the formants of the vowel [aː] pronounced about half a century ago? Traditionally, the first two formants (F1 and F2) are used to define all Hungarian vowels where the first one indicates the vertical tongue position and the second one indicates the horizontal tongue position in the oral cavity. A higher value of F1 shows a lower tongue position while a higher value of F2 shows that the tongue is placed more to the front of the oral cavity (e.g., Fant 1973, Slifka 2005). Formant measurements of the Hungarian vowels go back to the sixties of the past century (Tarnóczy 1965, Magdics 1965) but the authors mainly used read speech and studied just one or two speakers (Vértes 1982, Olaszy 1985, Bolla 1995, etc.).

The mean values of the first formant of [aː] were about 950 Hz in the case of female subjects and about 780 Hz in the case of males while the mean value of the second formants was about 1500 Hz in the case of female speakers and about 1300 Hz in the case of male speakers in the papers published in the sixties and eighties of the past century (Tarnóczy 1965, Magdics 1965; Vértes 1982, Olaszy 1985). These formant values indicate that the vowel [aː] was articulated at the back of the oral cavity both in the case of females and males and that its tongue position was somewhat lower than that of the short low vowels [ɛ] and [ɔ].

At the beginning of the 21st century the mean value of second formants for female speakers' [aː] vowels was defined as 1740 Hz (Kovács 2004). In another study the F2 value turned out to be 1690 Hz in females and 1410 Hz in males (Abari & Olaszy 2012). Acoustic-phonetic measurements conducted in the recent past seem to support unambiguously the forward shift of the tongue in articulating this vowel (Gráczi & Horváth 2010, Beke & Gráczi 2010). However, these latter investigations focused either on female speakers' articulation or on certain positions only, on the one hand, and they considered *all realisations* of the phoneme /aː/, on the other. Since the vowel /aː/ can also be pronounced as a neutral vowel [ə] in certain positions and syllables in spontaneous speech, their formants might be mixed up with those of the [aː] realisations.

In sum, the problem is that we cannot be sure if /aː/ is indeed a back vowel *phonetically* as well. Thus, the question arises whether there is indeed a historical change underway. The rest of the present paper will investigate that issue. In principle, the phonetic study to be reported on here can yield three different kinds of outcomes. (1) If the vowel under investigation turns out to be a real back vowel [ɑː] (like that it English ***fa**ther* or that in

Old English *mann*), nothing further needs to be done. (2) If it turns out to be a roughly central and highly variable vowel [ɐː] (like that in Scottish Standard English *man*), we can say that it is phonologically still a back vowel, with some latitude in backness in its phonetic implementation – given that its height is actually "lowest", such variability and centralising tendency are natural and expected, in fact. However, (3) if /aː/ turns out to be a low *front* vowel (as its symbol, if taken literally in IPA terms, indeed suggests), like the [a] in General American *man*, then we have a dilemma: should we conclude that this vowel is phonetically front but phonologically back, thus making our description more abstract, or else should we conclude that this vowel is a front vowel phonologically as well as phonetically, thus making our description of Hungarian vowel harmony maximally surface-true at this point but also hopelessly complex and complicated? We will return to this vexing question in Section 6 of the present paper.

4. Method, material, and subjects

Spontaneous speech samples were selected from the Hungarian BEA Speech Database (Gósy 2012a). All recordings were made in the same room, under identical technical circumstances: in the sound-proof booth of the Phonetics Department of the Research Institute for Linguistics of the Hungarian Academy of Sciences, specially designed for the purpose. The recording microphone was AT4040. Recording was made digitally, direct to the computer, with GoldWave sound editing software, with sampling at 44.1 kHz. Storage: 16 bits, 86 kbytes/s, mono.

Subjects were asked to speak about their work and hobbies and to give their opinions about some current issues (families and children, taxes, computer and children, smoking habits, new driving rules in the country, adults' reading habits, preparations for Christmas, and so on). The duration of the recorded speech samples varied across speakers depending on the required number of [aː] vowels we could use in the analysis (the mean sample duration per speaker was 26 minutes). 20 to 40 vowels were analysed in the narratives of 14 females and 14 males (aged between 22 and 28), altogether 614 realisations in the females' speech samples and 695 realisations in the males' speech samples.

The first two formants of the vowel [aː] were measured in the first and second syllables of the words (both in monosyllables and in polysyllables). The following criteria were taken into consideration when selecting the vowels: (i) the vowel should be perceived without doubt as a Hungarian [aː] vowel as in the word *vár* 'castle', which means that other vowel quality realisations, for example the neutral vowels, were excluded from the analysis, and (ii) the vowels should occur both in content words and in function words (without any further selection). The quality of the [aː] vowels was defined by the first author and another phonetician (in a few cases of disagreement, the vowels in question were excluded).

Statistical analysis confirmed that there was no difference in the first two formant values of the speakers (either females or males) between the monosyllables and polysyllables on the one hand, and between the first and second syllables of the polysyllabic words, on the other. Therefore, all values were used in further analysis. Examples of words in the samples that contained this vowel: *f**á**k* 'trees', *m**á**r* 'already', *l**á**togatókkal* 'with visitors', *t**á**mad* 'attack' (v.), *b**á**rmelyik* 'any of them'; *ór**á**kban* 'in hours', *kuty**á**m* 'my dog', *ink**á**bb* 'rather', *tal**á**lkoztunk* 'we met', *egym**á**shoz* 'to each other'.

Measurements of the formants were carried out manually in the middle of the steady-state phase of the vowel based on visual inspection of both the spectrograms and oscillograms as well as repeated audition of the vowel in question (using the Praat software: Boersma & Weenink 2011), see Fig. 1. The following settings were used in the Praat software: frequency range: 0–5000 Hz, window length: 0.005 s, window shape: Gaussian, dynamic range: 50 dB; pitch range: 70–350 Hz, number of frequency ranges: 513, mean energy: 40–100 dB. In some cases we also used the automatic formant curves generated by the software. In addition, the energy spectra of the vowels were also used (Fast Fourier Transformation analysis) in all vowels to support the formant values.

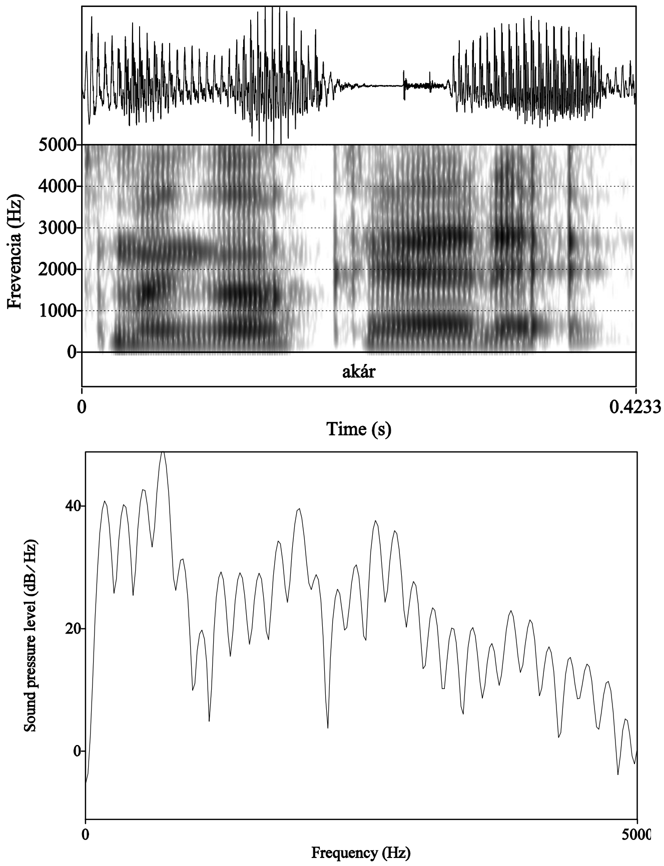

Figure 1

Spectrogram (top) and FFT-curve (below) illustrating the formant measurement method

Statistical analysis was carried out by the SPSS 17 software (one-way ANOVA, Tukey's post-hoc tests). Fuzzy clustering technique and a hierarchical clustering method were used for automatic classifications.

5. Results

The first-formant data do not show large differences between males and females (see Table 1). As expected, because of the gender differences in the fundamental frequencies, the mean values of F1 are higher in females than in males. The difference is about 80 Hz which can be explained by the consequences, in formant values, of the anatomical differences of vocal cords between females and males (Fant 1973). The range of the values is about 500 Hz in both females and males indicating large individual differences for the first formants. This means that tongue height varies in all speakers within a relatively large range indicating that the vertical position of the tongue is either "lowest" (as expected) or just "low", similarly to the back vowel [ɔ] or the front vowel [ɛ], or they are realised between these two positions. Most of the speakers, however, articulated the vowel [aː] with the "lowest" tongue position.

Statistical analysis confirmed significant differences in first formant values among female speakers (one-way ANOVA: $F(13, 651) = 373.521$; $p = 0.001$). The detailed data of Tukey's post-hoc tests show that our female speakers differ from each other in various ways. Five female speakers were found whose first formant values were significantly different from those of six or more other subjects. The first formant values demonstrate significant inter-speaker differences among males as well (one-way ANOVA: $F(13, 694) = 9.718$; $p = 0.001$). Post-hoc Tukey's tests, however, did not show as large inter-speaker variability as seen with the females. Five speakers differed significantly only from one or two other speakers.

Table 1: The first two formant values of the vowel [aː] in females' and males' articulation (std. dev. = standard deviation)

Speakers	Formant data			
	F1 (Hz)		F2 (Hz)	
Females	mean	766	mean	1841
	std. dev.	81	std. dev.	96
	minimum	500	minimum	1600
	maximum	998	maximum	2200
Males	mean	687	mean	1481
	std. dev.	68	std. dev.	114
	minimum	488	minimum	1180
	maximum	1180	maximum	1773

The statistical analyses revealed significant differences in the *second formants* of female speakers (one-way ANOVA: $F(13, 651) = 1297.202$; $p = 0.001$). Tukey's post-hoc tests showed as many statistically relevant inter-speaker differences for the F2 values as in the case of the F1 values. The second formant values shed light on the fact that our female speakers articulated [aː] as a front vowel (Fig. 2). In the case of three speakers (1, 7 and 9), where the mean F2 values were under 1800 Hz, there were only a few vowel tokens whose F2s appeared at frequencies that indicated a front-retracted position of the tongue in the oral cavity; the rest of their [aː]'s were regular front vowels.

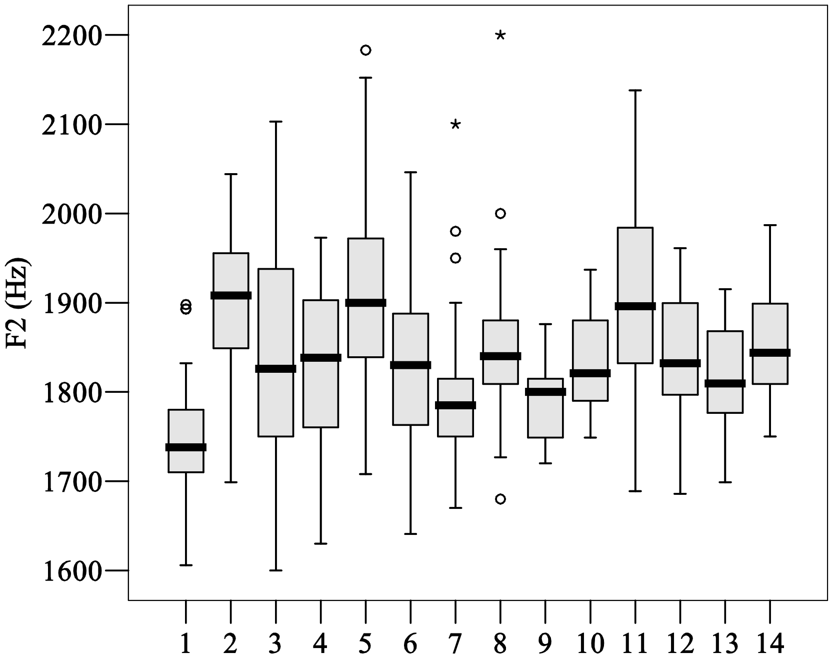

Figure 2

Female speakers' second formant values of the vowel [aː]

The male speakers' second formant values are much lower than those of the female speakers which cannot be explained by the fundamental frequency differences (see Table 1). Figure 3 shows the male speakers' second formant values where statistical analysis also revealed significant differences across speakers (one-way ANOVA: $F(13, 694) = 21.972$; $p = 0.001$). Tukey's post-hoc test confirmed more significant differences among speakers than in the case of first formants. All male speakers differed from at least 4 other speakers, while 9 speakers differed from 5 or more other participants.

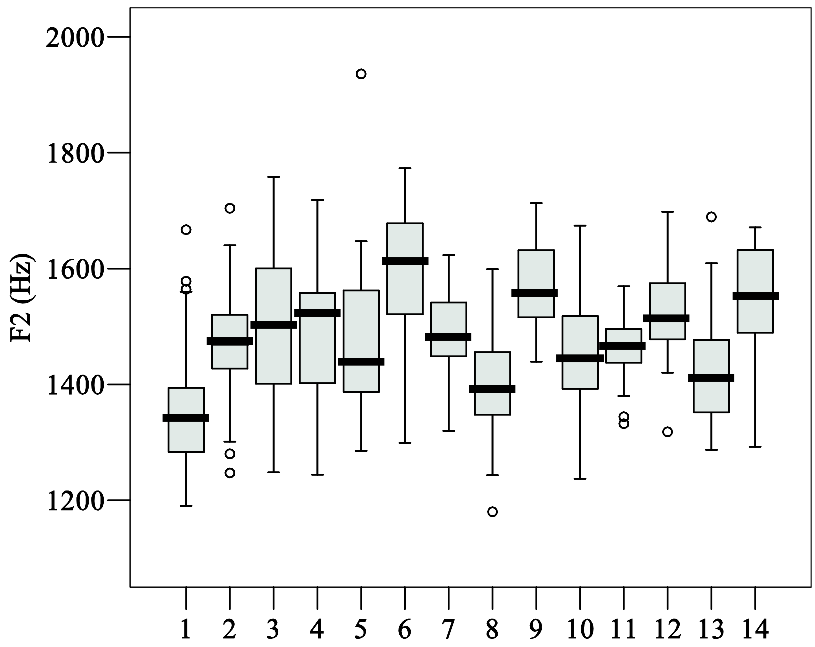

Figure 3

Male speakers' second formant values of the vowel [aː]

The difference of the mean F2 values between females and males is 360 Hz which indicates a large horizontal difference in the tongue position in the oral cavity, and this large difference cannot be explained by the fundamental frequency differences depending on gender. The mean F2 value of the female speakers corresponds to a front vowel's second formants while that of the male speakers corresponds to a central vowel's second formants. Comparing the mean values of [aː] to front [ɛ] and back [ɔ], the difference is really spectacular. For females, the mean F2 for the front low vowel is 1912 Hz while for the back low vowel it is 1442 Hz. For males, the mean values of the second formants are 1714 in the case of the front vowel and 1170 in the case of the back vowel (Gósy 2012b). These data support the claim that the tendency is not for *any* back vowel to be articulated in the forward part of the oral cavity but it is a specific property of the [aː] vowel.

Although the frequency range is, again, large both in females and in males (about 600 Hz), their values clearly show that the tongue position of an overwhelming majority of the female speakers' [aː] vowels is in the front part of the oral cavity while that of the male speakers' [aː]'s is located in the central-back part of the oral cavity. A much smaller group of the female speakers produce some of their [aː]'s as central-front vowels while fewer male speakers articulate this vowel as a clear-cut back vowel than as a central vowel. In other words, females articulate the vowel [aː] unquestionably as a front vowel while male speakers articulate it as a central vowel where the tongue is positioned in the middle of the oral cavity. Looking at all the formant data of all speakers, it is clearly seen that the difference in the articulation of the analysed vowel is remarkable (Fig. 4). In addition, the figure demonstrates that females' values are more dispersed in the F1/F2 space than those of males.

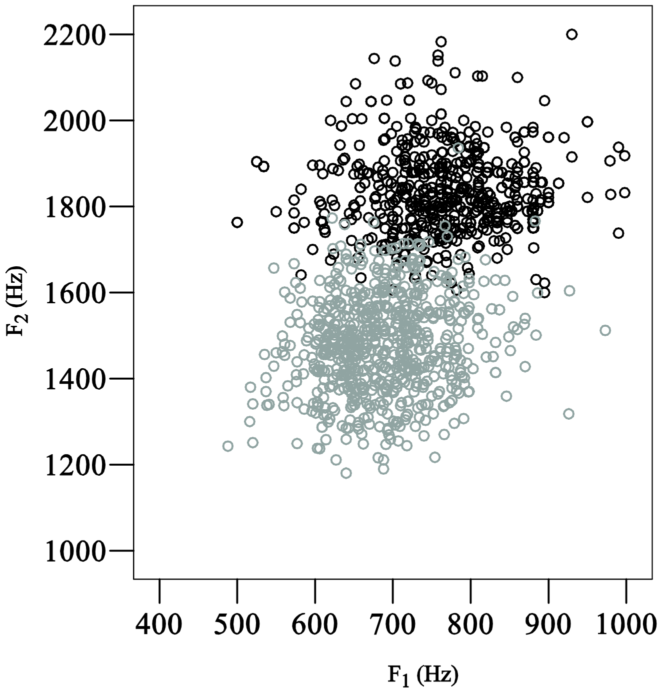

Figure 4

The distribution of the first two formants of the vowel [aː] in females (black circles) and males (grey circles)

We supposed that diverse subgroups of vowels could be found both among those produced by females and among the ones uttered by males. The fuzzy clustering technique was used to verify that assumption. The fuzzy C-means (FCM) algorithm (see Bezdek 1981) is an unsupervised method used to partition the data elements into homogeneous subgroups based on a similarity distance measure. By means of this method the vowels were clustered into four subgroups where each one represents a bunch of typical realisations of the vowel [aː]. The elements (which are the first two formant values in our case) in the FCM were normalised between 0 and 1. In the FCM algorithm each element has a degree that represents the similarity of one or more clusters. These results identified four groups of vowels both in females and males based on the first formant and second formant values of the vowels. This means that the articulation gestures of the vowels [a:] can be classified into at least four types depending on their first two formants.

Another type of cluster analysis (hierarchical) was used to identify the number of possible subgroups of speakers depending on their articulation of the vowel [a:]. While the previous cluster analysis shed light on the variety of the vowels analysed, this method would show the variety of the speakers themselves in articulating the vowel. This kind of cluster analysis is based on the assignment of a set of observations (which are the speaker dependent formants in our case) to subsets called clusters. Hierarchical cluster analysis was carried out taking all the analysed formant values into consideration. The results show that four groups of female speakers could be differentiated as opposed to three groups of males (Fig. 5). These clustering results demonstrate that males' articulation in the case of [a:] is less variable than that of females.

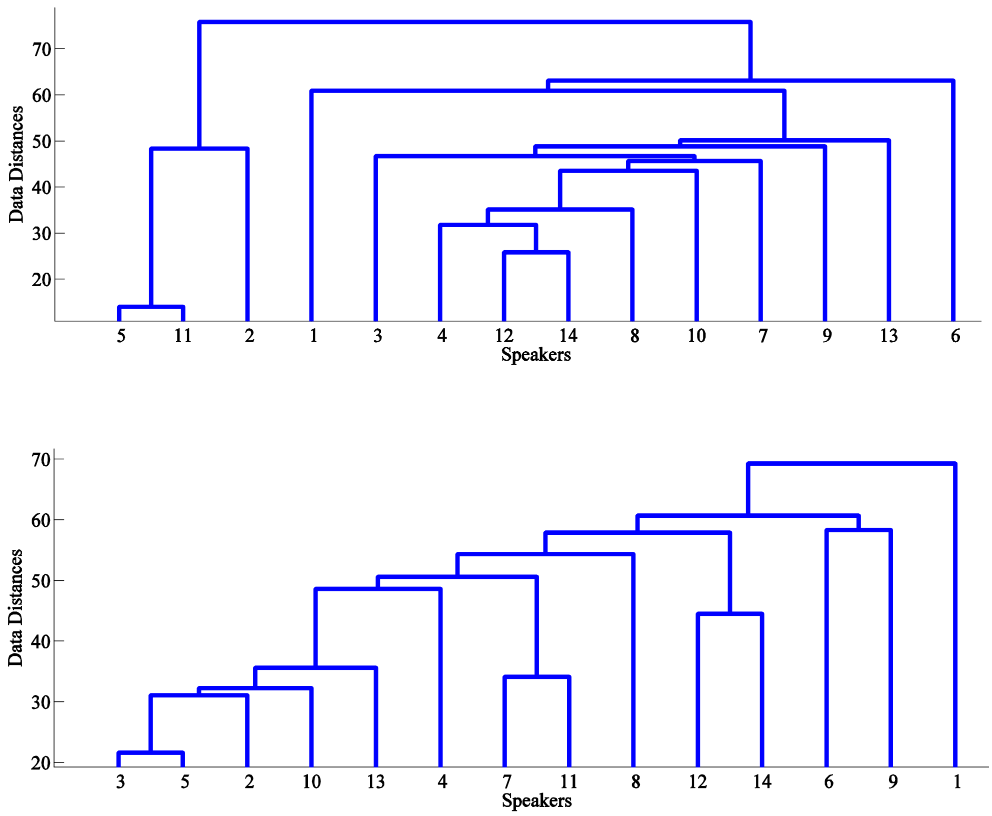

Figure 5

Clustering results of speakers depending on the first two formants of their [a:] vowels (females above and males below)

Considering all the results of the acoustic-phonetic analysis of the first two formants of [aː] we have to accept the fact that this traditionally back vowel is typically articulated in the centre of the oral cavity by males and in the front of the oral cavity by females. Differences between the articulation of the same vowel between females and males can be interpreted in a number of ways. Some research results suggest the supposed "open" articulation of female speakers, their faster reaction to newly invented articulation patterns as possible explanations for their different articulation behaviour, and there is a controversial view that males follow the "articulation norm" more than females do (see Eckert 1989, Labov 1994, Henton 1995, Diehl et al. 1996).

6. Discussion

The rules of Hungarian vowel harmony are rather complex (Hayes et al. 2009; Törkenczy 2011; Rebrus et al. 2012; Törkenczy et al. 2013). Without going into details, let us simply note here that the existing complexities would turn into a *complete chaos* if we assumed that /aː/ is to be phonologically defined as befits its phonetic character, that is, as a front vowel that occurs in a back context and whose alternant occurring in a front context differs from it in height rather than in backness. On the other hand, if we carry on analysing the vowel /aː/ as a back vowel despite its phonetic properties, we do not make the system of Hungarian vowel harmony alternations even more complex than it is now – but we buy this relative simplicity at the cost of increasing the *distance* between the phonetic properties and the phonological feature values of this vowel, making the description at this point more abstract, perhaps *too abstract*.

The question is then what we would prefer to have: increased *complexity* or increased *abstractness.* Neither option appears to be attractive at first sight. Table 2 shows what the vowel system of Hungarian would look like if we took the first option and decided to stick to the phonetic facts as much as possible.

Table 2: The Hungarian vowel system according to the first option described in the text

	Front unrounded		Front rounded		Back (rounded)	
High	i	iː	y	yː	u	uː
Mid		eː	ø	øː	o	oː
Low	ɛ	aː			ɔ	

As can be seen, length alternations would be fairly straightforward except for the familiar height distinction between /ɛ/ and /e:/ that can be ignored as was pointed out earlier (except that we would somehow have to block the putative – but non-attested – length alternation between /ɛ/ and /a:/). A more problematic bit of the length alternations would be that between /ɔ/ and /a:/ – here, a lengthening rule as applied to /ɔ/ would also turn this vowel front (and unrounded, if we decide to characterise /ɔ/ as rounded to begin with; but crucially, lengthening would imply fronting). This would be rather unnatural in itself – but the real problem comes with vowel harmony alternation between /a:/ and /e:/.

We would have to claim that the low vs. mid distinction between these two vowels, front vowels as they are both of them, accounts for their harmonic behaviour such that the *mid* alternant occurs in a *front* context and the *low* alternant occurs in a *back* context. This sounds completely unprecedented and implausible. This would make the rules of vowel harmony not only complex and chaotic but also unmotivated and *ad hoc*.

Therefore we had better go back to the other possibility and rest content with the claim that the distinctive feature values of this language should be allowed to become *more abstract* than they used to be in that the "low *front* unrounded long vowel" [a:] should simply go on to be phonologically classified as "low *back* unrounded".

7. Conclusion

Based on objective measurements we can conclude that there is a historical change going on in Hungarian in the articulation gesture of /a:/. The change in horizontal tongue movement would not be perceived by listeners since the vowel [a:] is the only vowel articulated with what is called the "lowest" tongue height, so there is no possibility to misperceive it or to confuse it with another vowel. Large variability in articulation has been found both among speakers and within the same speaker's articulation; however, the tendency of the change is clear. Hungarian [a:] vowels tend to move forward in the oral cavity and are now articulated as front vowels (at least by female speakers).

Until and unless the ongoing change in terms of phonetic properties should, at some point in the future, actually overthrow the system of harmonic alternations, a possible but not very likely outcome, the best thing we can do is *pretend* that the vowel /a:/, despite its changing phonetic character, is still a back vowel as far as the phonology of the Hungarian vowel system and its harmonic alternations are concerned.

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