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A Phonemic Overview and Phonological Analysis of Hungarian

1 Introduction

This paper will focus on the Hungarian language, specifically analyzing phonemic trends of the language and alternations regarding the /h/ phoneme. We analyzed voice recordings sent by our speaker using the PRAAT software, focusing on comparing the center of gravity and voicing of the fricative in different environments. We determined that our speaker realizes /h/ as [h̥] between front vowels, [ç] between a front vowel and a syllable boundary, [x] after a back vowel, and [h] everywhere else.

2 Background

2.1 Language Background

Hungarian is spoken primarily in Hungary, where it is the national language, but is also spoken in Slovakia, Romania, and Yugoslavia. It is also commonly spoken in immigrant communities around the world (“Hungarian,” n.d.). There are approximately 9,780,000 speakers in Hungary, and 12,538,370 speakers globally (“Hungarian,” n.d.).

There are eight main dialects of Hungarian: Western, Transdanubian, Alföld, Duna-Tisza, North-Western, North-Eastern, Trans-Királyhágó, and Székely (Siptár, 2000, 20-1). Western comprises primarily the inhabitants of Vas and Zala counties. Transdanubian encompasses most of Transdanubia except for those that speak Western. Alföld covers the middle part of the Great Hungarian Plain. Duna-Tisza comprises most of the territories between the rivers Danuba and

Tisza. North-Western encompasses Palóc and related varieties. North-Eastern covers the upper Tisza region and adjacent counties. Trans-Királyhágó covers Transylvania in present-day Romania, and Székely covers parts of Romania (Siptár, 2000, 20-1). A map of Hungary for reference can be seen in Figure 1 (“Administrative Map of Hungary,” 1998). While there is variation between dialects, it is minimal, and they only differ slightly from Standard Hungarian.

Figure 1

Map of Hungary



Hungarian is a Uralic language, and a member of the Finno-Ugric family (Harms, 2016). From the North-Central Urals where Proto-Uralic developed, Finno-Ugric spread south and west, to an area close to the confluence of Karma and Volga Rivers (Harms, 2016). From there, Hungarian separated from other Ugric languages, spreading south into the steppe region below the Urals (Harms, 2016). Hungarian has been written in a modified Latin alphabet since the 13th century,

and its orthography was stabilized around the 16th century with the introduction of printing (“Hungarian Language,” 2013).

2.2 Consultant Background

Our speaker is a 20-year-old female student who was born in Texas but grew up in upstate New York. Her mom speaks North-Western Hungarian, and her dad speaks the Transdanubian dialect. Her dialect is most likely a mix of the two, although she said that they sound very similar to begin with. She was educated largely in English, although she did not speak English at all before the age of four. She also speaks French. She uses a relatively informal variety of the language when speaking at home/with family, and does not tend to speak Hungarian outside of that context. This paper will be presenting information on Standard Hungarian, but Standard Hungarian and our speaker’s dialect are very similar to one another.

3 Phonemic Overview

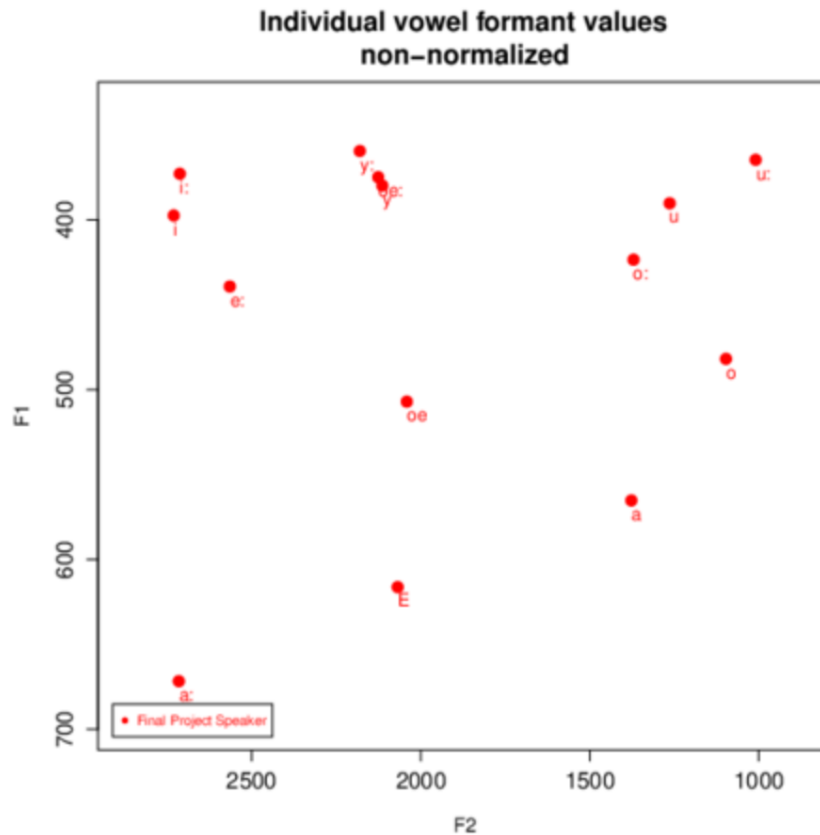
3.1 Vowels

Hungarian has seven basic vowel qualities that occur in distinctively long and short quantities (Szende, 1994, p. 92). These seven vowels are /ɔ/, /o/, /u/, /i/, /ø/, /y/, and /ɛ/. Each of these seven vowels has a long version. In the case of /ɔ/, whose paired long vowel is /a:/, and /ɛ/, whose paired long vowel is /e:/, the long vowels are different underlying vowels than the short vowels (Szende, 1994, p. 92). In the other cases, each vowel’s paired long version is the long version of the vowel (i.e. /ø:/ for /ø/) (Szende, 1994, p. 92). The vowel chart for the Hungarian vowels can be seen in Figure 2.

Figure 2

Hungarian Vowel Chart

1



All fourteen of these vowels are contrastive in Hungarian. For example, *á* ([a:] phonetically) refers to ‘the letter A’ as opposed to *a* ([a] phonetically), which refers to the definite article ‘a.’ Another example of this phonemic contrast across vowel pairs is *púp* ‘lump’ [pu:p] and *pap* ‘minister’ [pɒp] (“Hungarian-English dictionary,” n.d.).

The Hungarian vowel system also uses vowel harmony. In its vowel harmony system, vowels are classed into three groups: back vowels (ɒ, a:, o, o:, u, u:), front rounded vowels (ø, ø:, y, y:), and front unrounded vowels (ɛ, e:, i, i:). Front unrounded vowels function as “neutral” vowels, while back and front rounded vowels are “harmonic” (Siptár, 2000, p. 64). This means

¹ In this vowel chart, oe represents ø, oe: represents ø:, a represents ɒ, and E represents ɛ. All other symbols used are the IPA symbols for the vowels

that back vowels and front rounded vowels do not occur together in the same word, although front unrounded vowels can occur with any other vowel (“Hungarian Language,” 2013). Hungarian vowel harmony functions as “stem-controlled” vowel harmony, where the backness of the stem controls the backness of vowels in affixes, specifically suffixes, as the harmony is directional (left-to-right) (Siptár, 2000, p. 64). This can be seen in how suffixes are normally alternating, where their vowel has a front and a back alternant which is selected by which agrees with the stem vowel(s) (Siptár, 2000, p. 64). Non-alternating suffixes either only have front unrounded (neutral) vowels, or have a back-harmonic vowel that does not harmonize (Siptár, 2000, p. 65).

While in Standard Hungarian (and the Hungarian spoken by our speaker), speakers do not use [e] and there is no phonemic contrast between [e] and [ɛ], about fifty percent of the Hungarian speaking population uses a vowel system that distinguishes between [e] and [ɛ] (Szende, 1994, p. 93). In these dialects of Hungarian, the word written *mentek* ‘go.PL2.Pres’—in Standard Hungarian [mentek]—represents four different words: [mentek] ‘go.PL2.Pres’, [mentek] ‘go.PL3.Past’, [mentek] ‘save.SG1.Pres’, or [mentek] ‘to be exempt from.PL3.Pres’ (Szende, 1994, p. 93).

3.2 Consonants

The Hungarian Alphabet has 26 consonants in its alphabet, however you’ll notice that there are only 21 sounds documented in the phonetic alphabet. This is partially due to the presence of double and triple glyphs in the Hungarian alphabet that we touched upon earlier. The IPA representations for these glyphs are as follows - /ts/, /tʃ/, /dz/, /dʒ/, which are a combination of two phonetic elements. It’s debated as to whether these sounds are stop-fricative sequences or affricates. Sometimes the double or triple glyph is represented orthographically, such as with the

affr			tz dz	tʃ dʒ				
fricative		f v		s z	ʃ ʒ			h
latf								
aprox						j		
latap				l		(Λ)		

Table 2

Orthographic Representation of Hungarian Consonants

C /ts/	L /l/	V /v/
Cs /tʃ/	Ly /j/ (hey, ray)	Z /z/
D /d/	M /m/	Zs /ʒ/
Dz /dz/	N /n/	
Dzs /dʒ/	Ny /ɲ/	
F /f/	P /p/	
G /g/	R /r/	
Gy /j/	S /ʃ/	
H /h/	Sz /s/	
J /j/ (you,yes)	T /t/	
K /k/	Ty /c/	

3.2.1 Stops

Hungarian has three voiceless stops and three voiced stops. The voiceless stops include the /p/ bilabial stop, the /t/ alveolar stop, and the /k/ velar stop, while the voiced stops include the /b/ bilabial stop, the /d/ alveolar stop, and the /g/ velar stop. The voiceless stops /p/, /t/, and /k/ are also considered unaspirated, as these stops have a very short VOT compared to other languages with typical aspirated stops (Gósy, 1999). The average VOT value for typical aspirated stops in English tends to fall above 30 milliseconds (Anderson, 2018), and in Table 3, we see how the VOT values for /p/, /t/, and /k/ in Hungarian tend to fall close to or even below 30 milliseconds. /c/ and

/j/ in Hungarian are considered both palatal stops and affricates, as their closure duration is in between the two categories (Hungarian alphabet, 2021).

Table 3

Stop VOT and Closure Duration Values

Word Initial	Word Medial	Stop	VOT - Word Initial (s)	Closure Duration - Word Medial (s)
Bagózik [ˈbɒgoːzik]	Kabinet [ˈkɒbinɛt]	b	0.008648	0.061314
Babrál [ˈbɒbrɒ:l]	Sebesség [ˈʃɛbɛʃːɛːg]		0.015873	0.056645
Begipszez [ˈbɛɡɪpsɛz]	Gabona [ˈɡɒbɒnɒ]		0.007070	0.065669
Tyúkhúsleves [ˈcuːkhuːʃlɛvɛʃ]	Sarkantyú [ˈʃɒrkɒŋcuː]	c	0.104696	0.097925
Tyúkölő [ˈcuːkˈyløː]	Kártyákat [ˈkaːrcaːkɒt]		0.122550	0.081497
Tyő [ˈtyø]	Dobhártya [ˈdɒphaːrcɒ]		0.108077	0.076476
Dalol [ˈdɒlɒl]	Gadolinium [ɡadɒlɪnɪʊm]	d	0.019041	0.023820
Domináló [ˈdominaːloː]	Badarság [ˈbɒdɒrʃaːg]		0.023784	0.020628
Derce [dɛrtɕɛ]	Radírgumi [ˈrɒdiːrˈɡumi]		0.019267	0.016263
Galacsin [ˈɡɒlɒtʃin]	Tagok [ˈtɒɡok]	g	0.042861	0.028320
Gabonanemű [ˈɡɒbɒnɒnɛmyː]	Segédlet [ˈʃɛɡɛːdlet]		0.033148	0.022255
Gallér [ˈɡɒlːɛːr]	Kagylóhéj [ˈkɒɟlɒːhɛːj]		0.028972	0.042823
Gyémánt [ˈjɛːmaːnt]	Bejegyzés [ˈbɛjɛɟzɛːʃ]	j	0.050869	0.049234
Gyümölcsle [ˈjymøltʃlɛː]	Egyenlete [ˈɛjɛnlet]		0.062024	0.036084
Gyullad	Mogyorósi		0.047601	0.028717

[ˈjʉl:ɒd]	[ˈmo.jo.ro:ʃi]			
Kadét [ˈkɒde:t]	Takárosan [ˈtɒkɒroʃɒn]	k	0.063149	0.040097
Kamra [ˈkɒmrɒ]	Gliptika [ˈgliptikɒ]		0.038273	0.043080
Kalamajka [ˈkɒlɒmɒjkɒ]	Dajkál [ˈdɒjka:l]		0.045049	0.057898
Padlás [ˈpɒdla:ʃ]	Operál [ˈopɛra:l]	p	0.019040	0.023092
Pajkosan [ˈpɒjkoʃɒn]	Eperfa [ˈɛpɛrfɒ]		0.036670	0.027069
Pajzs [ˈpɒjʒ]	Epekedve [ˈɛpɛˈkɛdvɛ]		0.033591	0.033502
Takarmány [ˈtɒkɒrma:n]	Katalizál [ˈkɒtɒliza:l]	t	0.021597	0.037370
Targonca [ˈtɒrgontsɒ]	Dettó [ˈdet:o:]		0.021792	0.026432
Tagolt [ˈtɒgolt]	Basztat [ˈbaʃ.tat]		0.029604	0.026910

Table 4

Averages and Standard Deviations for VOT and Closure Duration

Stop	Mean VOT	St. Error - VOT	Mean Closure Duration	St. Error - Closure Duration
b	0.01053033	0.0027099	0.06120933	0.00260553
c	0.11177433	0.00547552	0.08529933	0.00647709
d	0.02069733	0.00154471	0.020237	0.00219026
g	0.03499367	0.00411424	0.03113267	0.00610175
j	0.053498	0.00436614	0.03801167	0.00600066
k	0.04882367	0.00742496	0.047025	0.00550428
p	0.029767	0.00543665	0.02788767	0.00303286
t	0.024331	0.0026371	0.03023733	0.003569

3.2.2 Fricatives

Table 5

Orthographic Representation of Hungarian Fricatives:

F /f/	S /ʃ/
V /v/	Zs /ʒ/
Sz /s/	H /h/
Z /z/	

Table 6

Fricative Word List (Word List for Hungarian, n.d.):

Word	IPA	Meaning
<i>fegy</i>	[fɛɟ]	discipline
<i>a fajta</i>	[ɔfɔjto]	the kind
<i>varr</i>	[vɔr]	he sews
<i>var</i>	[vɔr]	scab
<i>vese</i>	[vɛʃɛ]	kidney
<i>vesse</i>	[vɛʃ:ɛ]	throw away (imp.)
<i>vesz</i>	[vɛs]	he buys
<i>sérve</i>	[ʃɛ:rve]	his hernia
<i>eszés</i>	[ɛsɛʃ]	brainy
<i>vesszl</i>	[vɛs]	go mad
<i>zöm</i>	[zøm]	bulk
<i>ázik</i>	[a:zik]	he gets wet
<i>Úz</i>	[úz]	chase
<i>dohos</i>	[dohɔʃ]	mildewy
<i>had</i>	[hɔd]	army
<i>házal</i>	[hazɔl]	he goes selling door to door
<i>tehát</i>	[ˈteɦa:t]	so
<i>ihlet</i>	[ˈiçlet]	inspiration
<i>doh</i>	[dox]	musty

The sound /f/ appears initially and medially following a back vowel. The sound ʃ also appears initially, medially, and finally, and is typically adjacent to a vowel. The sound /v/ almost always

appears initially with a consonant following (at least based on this word set). The only allophone that exists among the fricatives is /h/ presenting as [h] between two vowels, [ç] syllable-finally after front vowels, and [x] in the final position after a back vowel (Szende 1994). /f/ and /z/ appear to be in contrasting distribution as well.

3.2.3 Affricates

Affricatives

There is debate among linguistics as to whether the sounds that I have labeled as affricatives in the IPA chart are actually affricatives or are forms of stop-fricative sequences. For our purposes, and for thoroughness in this project, I will discuss them as if they are affricatives.

/dʒ/ appears both medially and initially. We see this with Cs as well, thus we can say that they are in contrastive distribution with each other. They are certainly within distinct phonemes as well. We see /dz/ as opposed to /dʒ/ which would appear phonetically similar based on the orthography are also relatively similar phonetically with both the /z/ and /ʒ/ sounds being voiced fricatives with a slight difference in placement of articulation. Additionally, we see c appearing initially, medially and finally typically adjacent to a lower open vowel. /tʃ/ demonstrates a similar pattern.

Table 7

Orthographic Representation of Hungarian Affricates

C /ts/	Cs /tʃ/	Dz /dz/	Dzs /dʒ/
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Table 8

Word List (Word List for Hungarian, n.d.):

<i>ecet</i>	[etset ^h]	vinegar
<i>dac</i>	[dɔts]	spite
<i>vicc</i>	[vits:]	joke
<i>csempe</i>	[tʃempɛ]	tile
<i>dzsem</i>	[dʒɛm]	jam
<i>dedzett</i>	[ɛdzet ^h :]	he trained
<i>cél</i>	[tsel]	goal
<i>edzŐ</i>	[ɛdzø]	coach
<i>csak</i>	[tʃpk]	only
<i>dzsezz</i>	[dʒɛz:]	jazz

3.2.4 Nasals

Hungarian has three nasals, which include the voiced bilabial nasal [m], the voiced alveolar nasal [n], and the voiced palatal nasal [ɲ] (*Hungarian Phonology*, 2021). While there is no allophony for Hungarian nasals, there are several trends of nasal place assimilation in the language.

Hungarian nasals will always assimilate to the place of articulation of the following consonant within a word and sometimes occur across a word boundary. For example, nasals will assimilate to the voiced velar nasal [ŋ] before the velar consonants [k] and [g]: angol “English” → [ɒŋɡol]. Nasals will also assimilate to the palatal nasal [ɲ] before the palatal consonants [ç], [ɲ], and [j]: magannyomozó “private detective” → [mɔgɑ:ɲ:omozo:]. Nasals will additionally assimilate to the voiced labiodental nasal [ɱ] before the labiodental affricates [f] and [v]: különféle “various” → [kylømfɛ:lɛ]. Finally, nasals will assimilate to the voiced bilabial nasal [m] before the bilabial consonants [p], [b], and [m]: sínpad “stage” → [si:mpɔd] (*Hungarian Phonology*, 2021).

3.2.5 Approximants

Hungarian has two approximants, each with a long and short variety: /l/ and /l:/, and /j/ and /j:/. These four are all contrastive. For example, hal [hɔl] ‘fish’ and hall [hɔl:] ‘hallway’

(“Hungarian-English dictionary,” 2021). Or, for a contrast between /j/ and /l/, look at jó [jo:] ‘good’ and ló [lo:] ‘horse’ (“Hungarian-English dictionary,” n.d.). It is difficult to find minimal pairs for /j/ and /j:/, but theoretically the word ingujj [inguj:] ‘shirt-sleeve’ would contrast with an imagined word inguj [inguj] (“Hungarian-English dictionary,” n.d.).

While there is no allophony for /l/, /l:/, and /j:/, there is allophony for /j/. The phoneme /j/ becomes [ç] if it is between a voiceless obstruent and a word boundary, and becomes [j] between voiced obstruents (Siptár, 2000, 205). For example, /j/ becomes [ç] in words like lopj [lopç] ‘steal’ and becomes [j] in phrases like dobj be [dobj be] ‘throw (one/someone) in’ (Siptár, 2000, 205).

3.2.6 Trills

Hungarian has a singular trill consonant which is the sound /r/. Interestingly, longer rhotic sounds will occur as trills (such as a double r spelling), however, shorter rhotics will have less of a trill and present more as a tap (Tar 2017). Meaning that there are certainly allophones that exist for /r/ within the Hungarian language which are similar to /r/.

4 Analysis

4.1 Introduction

When doing our phonetic analysis, we decided to examine the /h/ alternation that occurs intervocalically, in syllable final positions after front vowels, and word-finally. Following the Tamás Szende’s 1994 illustration of IPA we hypothesized that our speaker would realize /h/ as [h] intervocalically, as [ç] in the syllabic-final position after a front vowel, and as [x] in the word-final position after a back vowel (Szende 1994). Based on our hypothesis we gathered a word list which we thought would allow our speaker to demonstrate these alternations and engaged in phonetic and phonological analysis via PRAAT software. Our results ended up differing from the

hypothesis we had previously laid out and there is a question as to whether this represents solely the idiolect of the speaker or perhaps a greater phonetic and phonological realization in the Hungarian language.

4.2 Methods

We created our elicitation list by identifying several environments that we wanted to study for the phoneme /h/: word-initial, word-final after a back vowel, intervocalic between non-front vowels, intervocalic between a front vowel and a non-front vowel, and intervocalic between front vowels. Some of these categories overlap, but we made sure our word list had at least two words per category to make sure it was not an isolated incident. The exception to this is that we had one word to represent the environment “syllable-final following a front vowel.” We only had one due to the late addition of this category and the speaker’s lack of time available to record in a quiet space. The word list was given to the speaker in several chunks, which she then recorded either in her dorm room or her room at home on her phone, using the voice memo app. The voice memo app provides a sample rate of 44.1KHz. While we could not find the exact bit depth of recordings taken using the voice memo app, it is likely that it uses either a 16 or 24-bit setting (“Knowing Your Digital Audio Recorder,” 2014).

4.3 Phonetic Analysis

We measured the duration of each fricative, the standard deviation of each fricative to use as an indicator of dispersion, and the center of gravity of each fricative through analyzing the spectral slice of the fricative in PRAAT. We also made note of whether there was a voicing bar present. For each possible environment, we calculated the average standard deviation/dispersion

and the average center of gravity. Additionally, we calculated what percent of the sounds in that environment were voiced.

Table 9

Averages and % Voiced for /h/ Acoustic Measurements

Environment	Average Dispersion (Hz)	Average Center of Gravity (Hz)	% Voiced
Between Front Vowels	1506.85	1244.15	100%
Word-Final After a Back Vowel	1051.43	819.73	0%
Word-Initial	2309.38	1619.20	0%
Intervocalic—Non-Front Vowels	840.17	699.67	0%
Intervocalic—One Front One Non-Front	1612.25	1244.15	50%
Syllable-Final After a Front Vowel	2866.5	3788.7	0%

These results were a bit surprising. Looking at Table 9, the values for and word-final /h/ after a back vowel and /h/ between two non-front vowels, /h/ is mostly unvoiced, and its center of gravity is fairly low compared to that of /h/ between front vowels, after a front vowel, and word-initially. This indicates that our speaker may have the [x] alternation not only word-finally but also between two non-front vowels. The word-final alternation seems natural, as [x] is a little bit easier to hear, and so speakers would put in that extra effort to make sure the listener understood there was an /h/ at the end of the word. This could also be how the intervocalic alternation emerged, although it seems less natural than a voicing assimilation rule to make the /h/ easier to pronounce.

The centers of gravity for /h/ in all the other environments are closer to one another than they are to those in the “Word-Final After a Back Vowel,” “Syllable-Final After a Front Vowel,”

or “Intervocalic—Non-Front Vowels” categories, indicating this is probably the same sound. The only difference is that /h/ is always voiced between front vowels. This indicates that our speaker has the [h̥] alternation only between front vowels, as opposed to all vowels as we expected. In the category “Intervocalic—One Front one Non-Front,” the /h/ is voiced 50% of the time, so it could go either way. Going forward in our analysis we will treat it as though the /h/ is realized as unvoiced since some of the syllable boundaries are a bit unclear, which would make a rule for an [h̥] alternation that occurs after front vowels difficult to distinguish from the [ç] alternation that also happens after front vowels but only syllable-finally.

The centers of gravity for /h/ in all the other environments are closer to one another than they are to those in the “Word-Final After a Back Vowel” or “Intervocalic—Non-Front Vowels” categories, indicating this is probably the same sound. The only difference is that /h/ is always voiced between front vowels. This indicates that our speaker has the [h̥] alternation only between front vowels, as opposed to all vowels as we expected. Our word list only had one word where the /h/ was in between a front vowel and a consonant, and that one was not only unvoiced, but had an extremely high center of gravity (3788.7 Hz). This indicates that the /h/ in this instance is realized as [ç] as expected syllable-finally after a front vowel.

Overall, our speaker seemed to have different forms of the [h̥] and [x] alternations than we expected, although they were easy to make patterns for, indicating that while her alternations are different than expected, they still seem natural and predictable.

4.4 Phonological Analysis

As discussed above, we went with three rules: a voicing rule in between front vowels, a palatization rule after a front vowel before a syllable boundary, and a velarization rule after a

back vowel. These rules are written out in Table 10. We briefly discussed the first rule occurring after any front vowel, but it was both unclear if /h/ between a front vowel and a non-front vowel was voiced, and due to syllable boundaries being slightly unclear, it was unclear how we would distinguish between that rule and rule 2.

While rule 3 does not have to come before or after either rule 1 or 2, rule two must come after rule 1, as if a word has a syllable boundary between the /h/ and a front vowel after it, the /h/ should still be realized as [h̥]. These rules seem relatively complex, since one only occurs between front vowels, as opposed to all vowels, which we have seen examples of more often. This alternation is also complex since there are three rules and four different realizations of the /h/ phoneme. However, it does make sense that these rules would depend on the backness of the vowel(s) surrounding it, since Hungarian has vowel backness harmony, so it would make sense that other alternations depend on the backness of vowels, as opposed to, for example, the height of the vowels.

Table 10

Rules for /h/ alternation

IPA	Feature Rules
(1) /h/ → [h̥]/front v ___ front v	[-cons - syl] → [+voi] / [+syl +front] _____ [+syl +front]
(2) /h/ → [ç]/front v ___ σ	[+ cont, - str, -dor] → [+dor +bk]/ [+syl +front] _____ σ
(3) /h/ → [x]/ non-front vowel _____	[+cont - str - dor] → [+ dor - bk] / [+syl + bk] _____

5 Appendices

Table 11

Vowel Word List

Vowel	Word	IPA	Gloss
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i	ide	[idɛ]	'here'
	igaz	[igəz]	'true'
	indít	[indi:t]	'start'
	alkudozik	[ɔlkudozik]	'bargain'
	katalizál	[kətəlizál]	'to catalyze'
i:	indít	[indi:t]	'start'
	atívak	[ɔkti:vək]	'assets'
	csípős	[tʃi:pø:ʃ]	'eager/shrewd/caustic'
	radírgumi	[rədi:rgumi]	'rubber'
	sír	[ʃi:r]	grave
y	üveg	[yveg]	'glass'
	dühös	[dyhøʃ]	'furious'
	megőszül	[mɛgø:syl]	'go grey'
	tyúkülő	[cu:kylø:]	'roost'
	gyümölcslé	[jymøltʃle:]	'juice'
y:	hűvös	[hy:vøʃ]	'cold/cool'
	fű	[fy:]	'grass'
	betű	[bety:]	'character'
	gyűrű	[jy:ry:]	ring
	gabonanemű	[gəbonəny:]	'cereal'
u	buta	[butə]	'dumb'
	fut	[fut]	'course/race'
	tud	[tud]	'know'
	gyullad	[jul:əd]	'to ignite'
	radírgumi	[rədi:rgumi]	'rubber'
u:	fűj	[fu:j]	'blow/bluster'
	bús	[bu:ʃ]	'cheerless/dejected'
	púp	[pu:p]	'hump/lump'
	sarkantyú	[sərkəncu:]	'spurs'
	tyúkülő	[cu:kylø:]	'roost'
ɛ	ide	[idɛ]	'here'
	mereven	[mɛrɛvɛn]	'rigidly'
	becsületes	[bɛtʃylɛtɛʃ]	'honest/straightforward'
	egyenlete	[ɛjɛnletɛ]	'equation'
	derce	[dɛrtʃɛ]	'seconds'
e:	beszéd	[bɛsɛ:d]	'manner of speaking'
	délelőtt	[de:lɛlø:t:]	'morning/forenoon'

	eléggé	[ɛle:g:e:]	'fairly/sufficiently'
	kadét	[kɔde:t]	'cadet'
	sebesség	[sebɛsse:g]	'pace/speed'
ø	sötét	[ʃøtɛt]	'black/dark'
	hűvös	[hy:vøʃ]	'cold/cool'
	öreg	[øɾɛg]	'old man'
	gyümölcslé	[ɟymøltʃle:]	'juice'
	zöm	[zøm]	'bulk'
ø:	megőszül	[mɛgø:syl]	'go grey'
	délelőtt	[de:lɛlø:t:]	'morning/forenoon'
	csípős	[tʃi:pø:ʃ]	'eager/shrewd/caustic'
	tyúkülő	[cu:kylø:]	'roost'
	<u>tyó</u>	[cø:]	'work'
o	rossz	[ros:]	'bad/evil'
	holnap	[holnɔp]	'tomorrow'
	olaj	[olɔj]	'oil/lube'
	tagolt	[tɔgolt]	'articulate'
	takarosan	[tɔkɔrosɔn]	'tidily'
o:	jó	[jo:]	'good'
	disznó	[disno:]	'pig'
	óra	[o:rɔ]	'clock/hour'
	bagózik	[bɔgo:zik]	'to chew'
	mogyorósi	[moɟoro:si]	'hazelnut'
ɔ	ravasz	[rɔvɔs]	'astute/cunning'
	sápadt	[ʃa:pɔdt]	'wan'
	holnap	[holnɔp]	'tomorrow'
	targonca	[tɔrgontsɔ]	'trolley/cart'
	tagolt	[tɔgolt]	'articulate'
a:	hibás	[hiba:ʃ]	'faulty/bad'
	sápadt	[ʃa:pɔdt]	'wan'
	ás	[a:ʃ]	'burrow/delve'
	operál	[opera:l]	'operate'
	takarmány	[tɔkɔrma:n]	'feed/fodder/storage'

Table 12

Formant Values for Vowels

Word	F1 (Hz)	F2 (Hz)	F3 (Hz)
ide	391	2712	3283
igaz	404	2880	3164
indít	415	2861	3303
alkudozik	377	2644	3053
katalizál	400	2555	3039
indít	369	2862	3224
aktívak	350	2825	3212
csípős	353	2799	3302
radírgumi	398	2424	2940
sír	394	2652	3313
üveg	419	2303	2890
dühös	375	2070	3172
megőszül	325	1996	3093
tyúkülő	360	2088	2827
gyümölcsle	420	2110	2871
hűvös	347	1914	3384
fű	332	2299	3748
betű	352	2358	3001
gyűrű	387	2247	2921
gabonanemű	379	2082	2852
buta	370	1275	2824
fut	414	1229	2749
tud	388	1387	2818
gyullad	381	1262	2751
radírgumi	398	1164	2762
fúj	371	783	2808
bús	337	1095	2907
púp	342	866	2808
sarkantyú	406	1023	2604
tyúkülő	367	1279	2866
ide	561	2114	3073
mereven	580	2006	2967
becsületes	603	1974	3074
egyenlete	623	2339	3218
derce	714	1907	2923
beszéd	457	2606	3031
délelőtt	485	2519	3052

eléggé	359	2663	3252
kadét	427	2620	3103
sebesség	468	2414	3193
sötet	376	2193	3138
húvös	521	1988	2913
öreg	558	2053	2893
gyümölcsle	604	1899	3045
zöm	476	2071	2841
megószül	393	2314	2915
délelött	488	2116	3064
csípös	251	2083	2562
tyúkülő	363	1890	2713
tyő	379	2225	3463
rossz	487	1125	2421
holnap	476	919	3003
olaj	427	1173	2924
tagolt	497	986	2909
takarosan	522	1282	2524
jó	470	1416	3103
disznó	431	1334	3236
óra	397	1611	3069
bagózik	378	1261	2995
mogyorósi	441	1230	2656
ravasz	598	1475	2132
sápadt	524	1324	2873
holnap	580	1627	3185
targonca	543	1209	3105
tagolt	581	1249	2877
hibás	736	1557	2810
sápadt	684	1656	2766
ás	597	1711	2510
operál	718	1713	2788
takarmány	623	1709	2702

Table 13

Mean and Standard Error for Vowel Formant Values

Vowel	Mean F1 (Hz)	Mean F2 (Hz)	Mean F3 (Hz)	Standard Error F1 (Hz)	Standard Error F2 (Hz)	Standard Error F3 (Hz)
i	397.4	2730.4	3168.4	6.392	62.450	55.377
i:	372.8	2712.4	3198.2	10.027	80.430	67.630
y	379.8	2113.4	2970.6	18.126	51.1223	68.037
y:	359.4	2180.0	3181.2	10.260	80.837	168.958
u	390.2	1263.4	2780.8	7.499	36.385	16.587
u:	364.6	1009.2	2798.6	12.315	87.183	52.124
ε	616.2	2068.0	3051.0	26.592	75.551	51.158
e:	439.2	2564.4	3126.2	22.164	44.286	42.068
ø	507.0	2040.8	2966.0	38.941	48.539	54.584
ø:	374.8	2125.6	2943.4	37.834	71.690	155.545
o	481.8	1097.0	2756.2	15.670	65.111	118.045
o:	423.4	1370.4	3011.8	16.275	68.181	97.142
ɔ	565.2	1376.8	2834.4	13.665	77.305	186.120
a:	671.6	1669.2	2715.2	26.815	30.011	54.382

Table 14

Stop Word List

Stop	Word	IPA	Gloss
/p/	Padlás	['pɔdlɑːʃ]	'attic'; 'loft'
	Pajkosan	['pɔjkoʃɒn]	'playfully'
	Pajzs	['pɔjʒ]	'shield'
	Operál	['ɔperaːl]	'operate'
	Eperfa	['ɛperfɔ]	'mulberry'

	Epekedve	['ɛpɛ'kɛdvɛ]	'languorously'
/t/	Takarmány	['tɔkɔrma:n]	'feed/fodder'; 'storage'
	Targonca	['tɔrgontsɔ]	'trolley'; 'cart'
	Tagolt	['tɔgolt]	'articulate'
	Katalizál	['kɔtɔliza:l]	'catalyze'
	Dettó	['det:o:]	'ditto'
	Basztat	['baʃ.tat]	'nag'
/k/	Kadét	['kɔde:t]	'cadet'
	Kamra	['kɔmrɔ]	'chamber'; 'closet'
	Kalamajka	['kɔlɔmɔjka]	'ruckus'
	Takárosan	['tɔkɔrɔʃɔn]	'tidily'
	Gliptika	['gliptika]	'glyptic art'
	Dajkál	['dɔjka:l]	'nurse'
/b/	Bagózik	['bɔgo:zik]	'chew'
	Babrá	['bɔbra:l]	'fidget'
	Begipszez	['begipsez]	'plaster'
	Kabinet	['kɔbinet]	'administration'
	Sebesség	['ʃɛbɛʃ:e:g]	'pace'; 'speed'
	Gabona	['gɔbonɔ]	'grain'; 'corn'
/d/	Dalol	['dɔlɔl]	'carol'; 'chant'
	Domináló	['domina:lo:]	'rampant'
	Derce	[dɛrtʃɛ]	'seconds'
	Gadolinium	[gadɔlɪniəm]	'gadolinium'
	Badarság	['bɔdɔrʃa:g]	'bilge'
	Radírgumi	['rɔdi:r'gumi]	'rubber'
/g/	Galacsin	['gɔlɔtʃin]	'pellet'
	Gabonanemű	['gɔbonɔnɛmy:]	'cereal'
	Gallér	['gɔlɛ:r]	'neck'; 'collar'
	Tagok	['tɔgok]	'ranks'
	Segédlet	['ʃɛge:dlet]	'aid'; 'assistance'
	Kagylóhéj	['kɔjlo:he:j]	'scallop'; 'seashell'
/c/	Tyúkhúsleves	['cu:khu:ʃlɛvɛʃ]	'chicken soup'
	Tyúkülő	['cu:k'ylø:]	'roost'
	Tyó	['tyø]	'work'
	Sarkantyú	['ʃɔrkɔncu:]	'spurs'
	Kártyákat	['ka:rca:kɔt]	'cards'
	Dobhártya	['dɔpha:rɔ]	'eardrum'
/ʃ/	Gyémánt	['je:ma:nt]	'diamond'
	Gyümölcslé	['jymøltʃle:]	'juice'

	Gyullad	['jul:ɒd]	'ignite'
	Bejegyzés	['bejɛjzɛ:ʃ]	'registration'
	Egyenlete	['ɛjɛnlet]	'equation'
	Mogyorósi	['mo.jo.ro:ʃi]	'hazelnut'

Table 15

Word list for /h/ alternation

Word	Expected IPA	Speaker IPA (According to Rules)	Gloss
ihlet	[içlet]	[içlet]	'inspiration'
peches	[peħes]	[peħes]	'unlucky'
tehát	[teħɒt]	[teħɒt]	'so'
léha	[le:ħɒt]	[le:ħɒt]	'frivolous'
téhen	[te:ħɛn]	[te:ħɛn]	'cow'
dohos	[doħos]	[doxoʃ]	'mildewy'
coho	[coħo]	[koxo]	[made up word]
uhu	[uħu]	[uxu]	'owl'
doh	[doħ]	[dox]	'dohos'
fatah	[fɒtɒħ]	[fɒtɒx]	[made up word]
sah	[ʃɒħ]	[ʃɒx]	'shah'
hólnap	[ho:lnɒp]	[ho:lnɒp]	'tomorrow'
hét	[he:t]	[he:t]	'seven'
hal	[hɒl]	[hɒl]	'fish'
hajnal	[hɒjnɒl]	[hɒjnɒl]	'dawn'

Table 16

Values for /h/ Alternation

Word	Environment	Duration (sec)	Dispersion/standard deviation (Hz)	Center of gravity (Hz)	Voicing bar?
peches	between front vowels	0.04404	1784.5	1334.3	yes
téhen	between front vowels	0.048005	1120.4	489.7	yes
ihlet	after front vowel	0.165658	2866.5	3788.7	no
dohos	intervocalic non front	0.0667	1231.6	943.7	no
coho	intervocalic non front	0.068028	682	307.1	no
uhu	intervocalic non front	0.091487	606.9	848.2	no

doh	word-final	0.172559	1191.9	1013.3	no
fatah	word-final	0.041759	1034.7	853.7	no
sah	word-final	0.058461	927.7	592.2	no
hólnap	word-initial	0.111265	2844.8	1371.8	no
hét	word-initial	0.094257	2803.8	2120.2	no
hal	word-initial	0.111616	1507.4	1244.6	no
hajnal	word-initial	0.096699	2081.5	1740.2	no

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