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The Non-neutralizing Nature of Hungarian Voicing Assimilation

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0. Introduction[1]

In this paper we report on a pilot experiment designed to assess whether the process of regressive voicing assimilation in Hungarian applies in a categorically neutralizing manner, as implied by recent phonological analyses, e.g. Szigetvári (1998), Ritter (2000), Siptár & Törkenczy (2000), or whether it is better modelled as a gradient, phonetic rule (cf. Ernestus 2000 and Jansen 2001 on Dutch).

Our results, based on acoustic data from two speakers, indicate that Hungarian regressive voicing assimilation is not a neutralisation phenomenon. Whilst there is clear evidence of assimilation on the phonetic voicing of target obstruents and the preceding vowels, underlying distinctions in obstruents targeted by the process are still detectable in some of these features. In addition, we observe mismatches between the behaviour of voicing and segmental duration in obstruent clusters that contradict the predictions of the phonological accounts mentioned above.

Hungarian is a Uralic (Finno-Ugric, Ugric) language spoken by around 15 million people in Hungary and (as a minority language) in several of the surrounding states. The obstruent system of Hungarian is bifurcated into a set of *tense* and *lax* sounds in a manner that is similar to that of the surrounding Slavonic languages and Romanian (Kenesei *et al.* 1998; Siptár & Törkenczy 2000).[2] Unlike many of these languages, however, Hungarian maintains laryngeal contrast word finally before sonorants and prepausally, as in (1).

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[2] The terms *tense/fortis*, *lax/lenis*, and [+/-tense] are used here as descriptive labels instead of *(phonologically) voiceless* vs. *(phonologically) voiced* and [+/-voice]. The latter represent more common terminology, but they obscure the difference between phonetic voicing (the acoustic result of vocal fold vibration) and lexical 'voicing' contrast, which is normally supported by a host of phonetic cues in addition to voicing.

In mixed tense + lax and lax + tense sequences, Hungarian word-final obstruents are subject to a process of *regressive voicing assimilation* (RVA). This process devoices lax obstruents followed by a tense plosive or fricative (2), and voices fortis obstruents before a lax plosive or fricative (3). As long as no pause intervenes, regressive assimilation is said to apply in sandhi clusters created by the morphology, by compounding (e.g. *rabszolga* 'slave', from *rab* 'prisoner', and *szolga* 'servant', in which underlying /bs/ assimilates to [ps]), and between independent words (e.g. *nyolc gyerek* 'eight children', with medial [d͡ʒɟ] from underlying /t͡sɟ/). The majority of researchers claim that this process is both obligatory and neutralising, and is not dependent on speech rate.[3]

(1)	nád	/naːd/	[naːd] *[naːt]	reed
	rág	/raːg/	[raːg]*[raːk]	he chews
	láz	/laːz/	[laːz]*[laːs]	temperature
	lágy	/laːɟ/	[laːɟ]*[laːc]	soft

(2)	rabtól	/rɔb/+/toːl/	[rɔptoːl]	from (a) prisoner
	kádtól	/kaːd/+/toːl/	[kaːtːoːl]	from (a) bathtub
	habszifon	/hɔb/+/sifon/	[hɔpsifon]	cream-maker
	hadsereg	/hɔd/+/ʃɛrɛg/	[hɔtʃɛrɛg]	army

(3)	kalapban	/kɔlɔp/+/bɔn/	[kɔlɔbːɔn]	in (a) hat
	kútban	/kuːt/+/bɔn/	[kuːdbɔn]	in (a) well
	szép zenész	/seːp/+/zɛneːs/	[seːbzɛneːs]	beautiful musician
	vak zenész	/vɔk/+/zɛneːs/	[vɔgzɛneːs]	blind musician

It would thus appear that the basic facts of laryngeal contrast and voicing assimilation in Hungarian are straightforward. Indeed Sauvageot (1951:27) typifies many commentators on this phenomenon when he states of Hungarian that "L'assimilation désonorisatrice et sonorisatrice est d'un mécanisme fort simple". The experiment reported below was designed to put this assertion to the test.

2. Methods

2.1 Speakers

Two subjects, K9 and M15, both female, took part in the experiment. The first speaker was 26 years old and had been a resident of Budapest for approximately 8 years at the time of recording. This subject grew up in Heves county and describes her own accent as 'standard Hungarian'. She is fluent in English. The second subject was 30 years old at the time of recording and although having

[3] See, for example, Hall (1944), Sauvageot (1951), Kálmán (1972), Lotz (1988), Kenesei, Vago and Fenvyesi (1988), Olsson (1992), and Siptár & Törkenczy (2000). A small number of authors, however, have suggested that voicing assimilation is not entirely obligatory: Kolmár (1821) and Vago (1980) suggest it is speech rate dependent, whilst Tompa (1961) believes that it can be suspended in foreign words and when the trigger consonant belongs to a contrastively stressed word.

moved frequently around Hungary describes her own accent as 'standard Hungarian'. She is fluent in English and French. Both speakers report normal hearing.

2.2 Stimuli

The stimuli for the experiment consisted of consonant clusters combining a /k, g, ʃ, ʒ/ C_1 and a /t, d, s, z/ or liquid /l/ or /r/ C_2. Stimuli containing a sonorant consonant were included to create baseline conditions for the comparison of the relative effects of fortis vs. lenis C_2 on the properties of a preceding obstruent. C_1 consonants were preceded by a long vowel or short vowel + glide sequence (phonetic diphthong) from the set /eː, aː, uː, ɔj/, or one of the following short vowels: /i, ɔ, o/. For reasons of space we will only consider clusters starting with /k, g/ here. The behaviour of clusters starting with a fricative is documented in Jansen & Toft (2002) and Jansen (submitted).

The clusters were located at subject noun + verb boundaries in carrier sentences. Subject + noun boundaries were chosen over other possible word boundary environments on grounds of the available carriers for C_1, which had to be similar in overall phonological make-up whilst exhibiting a robust contrast between /k, g/ (and therefore had to be unsuffixed). It was impossible to construct all carrier sentences according to the neutral word order for the propositions they expressed. This raised the possibility that the subjects would assign different prosodic structures to different stimulus sentences. However, all responses were pronounced with a F_0 peak on the subject noun carrying C_1, whilst the verb acting as the C_2 carrier never received any pitch prominence. Two sample stimuli appear in (4).

(4) a. A va*k d*arabolta a húst
/ɔ vɔ*k d*ɔrɔboltɔ ɔ huːʃt/
The blind man minced the meat

b. A rák zabálta a kis halacskát
/ɔ raː*k z*ɔbaːltɔ ɔ kis halat͡ʃkaːt/
The crab wolfed down the little fish

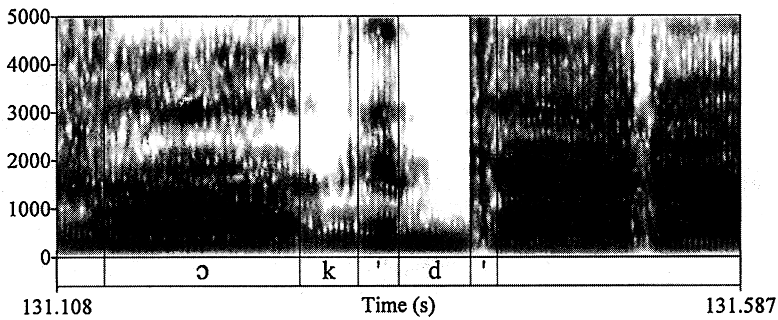
2.3 Procedure

The stimuli were presented to the subjects in a quasi-randomised order to avoid consecutive stimuli with identical consonant clusters. Each subject read the list of stimuli three times and was asked to read a stimulus again if she produced a mistake or hesitation that was clearly audible to the experimenter. In total, 2 (C_1) * 5 (C_2) * 6 (stimuli) * 3 (repetitions) * 2 (speakers) = 360 utterances with a plosive C_1 were recorded.

Recordings were made onto minidisk in a sound-proofed room using a Brüel and Kjær condenser microphone (Type 4165) and measuring amplifier (Type 2609), and digitised at 22.5 kHz. Segmentation and acoustic measurements were carried out using PRAAT version 4.0, as, for example, in (5). 36 utterances had to be discarded because they contained small speech errors, (hesitation) pauses between C_1 and C_2, or because the target cluster could not be internally segmented (plosive + plosive clusters with unreleased C_1). Note that our aim is to investigate the phonetic properties of Hungarian RVA, not the contexts in which it occurs. As most descriptions of the process assert that it is blocked by a physical pause this meant that it was important to exclude tokens with a pause intervening between C_1 and C_2: a failure to do so would have introduced a potential bias towards incomplete neutralisation in our corpus.

In addition, all 29 responses to stimuli that contained the C_1 carrier word *jog* 'law, right' were excluded from the analysis below because the mean duration of its vowel was felt to be exceptionally low. Tokens of this word were segmented such that nearly all of the F_2 fall from the palatal approximant into the mid back vowel was included with the latter, but nevertheless the mean duration of its vowel across C_2 environments was 75 ms, which is more than 2 standard deviations below the overall mean for the remaining lexically short vowels (cf. 8 below). This left 295 utterances for further analysis.

(5) Sample broad brand spectrogram of a /kd/ cluster. Speaker: K9 (female)



2.4 Segmentation and measurements

Segment boundaries and voicing intervals were determined by visual inspection of waveforms and broadband spectrograms. Voicing intervals were determined on the basis of periodicity in the waveform and the presence of a voice bar in the spectrogram. The closure and release phases of plosives were labelled separately (cf. 5). In the (few) instances in which the release phase of a plosive C_1 was visually completely obscured by the onset of a following fricative C_2, all of the aperiodic noise signal was assigned to the fricative, even if a release was (faintly) audible in it. The most important segmental boundaries were defined as follows:

- V_1 - plosive C_1: rapid decrease of higher frequency energy in the spectrum
- Plosive C_1/C_2 closure phase - plosive C_1/C_2 release phase: onset of release burst (defined as initial transient + following friction noise)
- Plosive C_1/C_2 release phase - C_2/V_2: end of release burst

- Onset and offset of C_2 fricative: onset and offset of aperiodic noise that could not be assigned to the release burst of a preceding stop

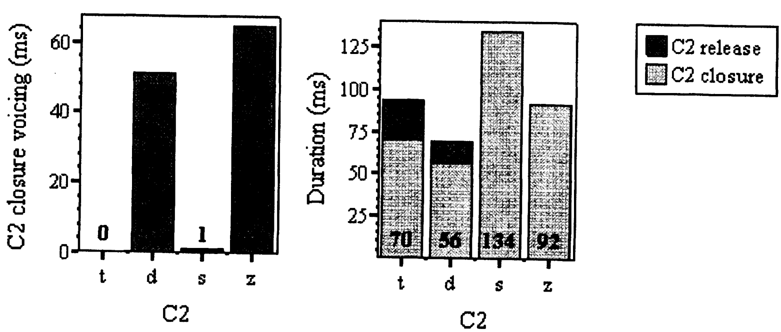
The following measurements were made on the basis of the hand-segmented speech samples: V_1 duration, C_1 closure duration, C_1 release duration and C_2 duration (closure and release separately for /t, d/) ; duration of voiced intervals during C_1 and C_2.[4] Obstruent duration, obstruent voicing duration and preceding vowel duration are all uncontroversial phonetic correlates of the tense-lax contrast in postvocalic contexts, although they are not always used to the same extent in different languages (see Keating 1984; Kingston & Diehl 1994 for overviews and references).

3. Results

3.1 Phonetic features of C_2 (the triggers)

Hungarian /t, d, s, z/ behave as might be expected on the basis of the phonetic literature on the realisation of tense-lax contrasts: the lax obstruents /t, d/ contrast with their tense counterparts in terms of voicing/VOT, and (closure and release) duration. The set of C_2 obstruents thus exhibits the same inverse behaviour of segmental duration and voicing duration that was found for C_1 obstruents in the baseline context (see below). In (6), C_2 voicing is expressed as closure voicing to facilitate comparison of fricatives (for which VOT is rarely used as a descriptive measure) and plosives.

(6) Duration and voicing of /t, d, s, z/. Left: closure voicing (ms); bottom: closure duration and (for plosives only) release duration (ms)



However, since it is a very common measure of plosive voicing we also calculated the VOTs for /t/ (23 ms, standard deviation = 7 ms) and /d/ (-51 ms, standard deviation = 11 ms).[5] These values put Hungarian firmly in the class of

[4] In addition, we measured F_0 at 10 ms intervals between 50 and 10 ms before C_1 onset and between 10 and 50 ms after C_2 (release) offset. For reasons of space we cannot comment on the behaviour of this parameter here, but note that it does not affect our overall conclusions.

[5] The VOT of /d/ may seem somewhat small in the light of the values reported elsewhere for lenis stops of the prevoiced type (e.g. Lisker & Abramson 1964; Keating 1984) but note that these

languages that realise the contrast between tense and lax plosives as *voiceless unaspirated* vs. *prevoiced* (cf. Lisker & Abramson 1964; Keating 1984), and this is consistent with the literature on Hungarian.

T-tests confirm that all observed differences are highly significant: plosive C_2 closure duration, $t(115) = 5.81$, $p <. 001$; plosive C_2 release duration, $t(115) = 7.81$, $p < .001$; plosive C_2 VOT, $t(115) = 43.45$, $p <.001$; fricative C_2 duration, $t(114) = 14.71$, $p < .001$; fricative C_2 voicing, $t(114) = -17.94$, $p < .001$.

3.2 Duration and voicing of C_1 (the targets)

The table in (7) below provides the overall duration and the duration of the voiced intervals for the closure and release phases of /k, g/ across C_2 contexts. The patterning of C_1 phonetic voicing shows unmistakable signs of regressive voicing assimilation to both tense and lax obstruents, and there is evidence that C_1 release duration is subject to assimilation too, albeit to a lesser extent. However, it is hard to interpret the behaviour of C_1 closure duration in assimilatory terms, and there is some indication that both this parameter and C_1 (release) voicing maintain the underlying distinction between /k/ and /g/ when followed by a lax obstruent.

Consider first the phonetic contrast between the tense and lax velar stop in the baseline pre-liquid context. Here, all of the parameters represented in (7) contribute to the phonetic expression of the lexical opposition between /k/ and /g/ in the expected fashion: the closure and release of /k/ are considerably longer than those of /g/, whilst its voiced intervals are shorter (the difference in overall voicing is 28 ms). T-tests confirm that the differences between the means for /kL/ and /gL/ are statistically significant: C_1 closure duration, $t(60) = 11.16$, $p < .001$; C_1 release duration, $t(60) = 4.62$, $p < .001$; C_1 closure voicing, $t(60) = -4.83$, $p < .001$; C_1 release voicing, $t(60) = -8.16$, $p < .001$; C_1 overall voicing, $t(60) = -11.52$, $p < .001$.

Of these parameters, those related to C_1 voicing show the clearest sign of assimilation to a following obstruent. Thus, before the lax obstruents /d, z/ the voicing of /k/ increases vis-à-vis its voicing in the baseline context, and there is a decrease in the voicing of /g/ compared with the relevant baseline values. As far as obstruent clusters are concerned, there appears to be little trace of the underlying distinction between /k/ and /g/: differences within the minimal pairs /kt/ - /gt/, /kd/-/gd/, /ks/-/gs/ are all equal to or smaller than 4 ms, whilst /g/ has 6 ms more closure voicing than /k/ when /z/ follows. Before a tense C_2 differences in C_1 release voicing are also virtually neutralised, but when a lax obstruent follows /k/ has 8 ms less voicing than /g/. Added to the differences in voicing during the closure stage this yields differences in overall voicing between the tense and lax velar stop of 10 ms before /d/, and 14 ms when the lax fricative /z/ follows. This suggests that whilst Hungarian word final stops are subject to RVA, this process is not completely neutralising across C_2 environments.

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values often concern postpausal or utterance initial plosives. On aerodynamic grounds the presence of a preceding obstruent is likely to have had some negative influence on the amount of voicing of /d, z/, whilst the relatively short mean closure duration of /d/ naturally places an upper bound on its mean VOT.

A series of ANOVAs was carried out on the C_1 voicing data to gauge to what extent these impressionistic observations are supported by statistical tests. First, a three-way ANOVA for *C_1 laryngeal specification* (/k/ vs. /g/) * *C_2 laryngeal specification* (/t, s/ vs. /d, z/) * *C_2 manner* (/t, d/ vs. /d, z/) was performed on the C_1 closure voicing data (pre-liquid baseline environments excluded). This ANOVA reveals a highly significant effect of *C_2 laryngeal specification*, $F(1,225) = 69.16$, $p < .001$, but only a weakly significant effect of *C_1 laryngeal specification*, $F(1,225) = 5.74$, $p < .02$, which implies that regressive assimilation is near-neutralising with regard to this parameter (there were no other significant effects).

(7) Duration and voicing of C_1 (all measures in ms; standard deviations in brackets)

C_1C_2	C_1 closure duration (ms)	C_1 release duration (ms)	C_1 closure voicing (ms)	C_1 release voicing (ms)	N
/kt/	57 (13)	31 (10)	28 (7)	0 (2)	31
/kd/	57 (19)	28 (8)	40 (11)	17 (11)	31
/ks/	56 (10)	16 (7)	27 (7)	0 (0)	30
/kz/	59 (20)	22 (14)	37 (11)	14 (15)	29
/kL/	75 (12)	31 (11)	29 (9)	2 (3)	32
/gt/	52 (12)	32 (10)	29 (11)	1 (5)	30
/gd/	43 (11)	24 (8)	43 (11)	25 (8)	25
/gs/	50 (11)	14 (10)	31 (14)	0 (0)	28
/gz/	44 (10)	23 (12)	43 (10)	22 (13)	29
/gL/	42 (11)	19 (10)	41 (12)	17 (10)	30

However, three-way ANOVAs for *C_1 laryngeal specification* * *C_2 laryngeal specification* * *C_2 manner* on the C_1 release voicing and C_1 overall voicing data (baseline environment excluded) show stronger effects of *C_1 laryngeal specification* which indicate that the underlying distinction between /k/ and /g/ is retained before lax obstruents even if RVA does apply. Thus, the ANOVA on the C_1 release voicing data shows significant main effects of *C_1 laryngeal specification*, $F(1,225) = 11.89$, $p < .005$, *C2 laryngeal specification*, $F(1,225) = 284.63$, $p < .001$, and an interaction of *C_1 laryngeal specification* * *C_2 laryngeal specification*, $F(1,225) = 10.04$, $p < .005$. Unsurprisingly, the ANOVA on the C_1 overall voicing data shows the same set of significant effects: *C_1 laryngeal specification*, $F(1,225) = 16.10$, $p <.001$; *C_2 laryngeal specification*, $F(1,225) = 289.63$, $p < .001$; C1 laryngeal specification * *C_2 laryngeal specification*, $F(1,225) = 6.38$, $p <.015$.

As before, the effects of C_2 laryngeal specification indicate that the voicing of Hungarian word-final stops is subject to assimilation to a following obstruent, but the highly significant effects of *C_1 laryngeal specification* indicate that assimilation does not erase all the distinctions between underlying /k/ and /g/. The latter conclusion must be qualified somewhat in light of the significant interactions of the two main factors, which are most likely due to the fact that there are no differences in C_1 release and overall voicing between underlyingly tense and lax velar stops before /t, s/ whilst there are differences when a lax obstruent follows. These interactions support the idea that Hungarian RVA is non-neutralising in a subset of environments (i.e. before lax obstruents only). Finally, the absence of any effect related to C_2 manner of articulation indicates that Hungarian RVA is symmetric with respect to the plosive-fricative distinction: both classes of obstruent appear to trigger assimilation in equal measure.[6]

Now if regressive assimilation affects C_1 (release and closure) duration as well as C_1 voicing, this would result in a decrease of the duration of /k/ before /d, z/ vis-à-vis the baseline environment, and an increase in the duration of /g/ before the tense obstruents /t, s/. As can be gleaned from (7), this expectation is only borne out by the C_1 closure duration data. First, the closure stage of /k/ is considerably shortened before both lax and tense obstruents relative to the 75 ms observed in the pre-liquid context, and second, the [±tense] value of an obstruent seems to have little impact on the closure duration of a preceding /k/. Only the behaviour of /g/, which exhibits lengthening before /t, s/ is suggestive of regressive assimilation. Another partial parallel between C_1 closure duration and C_1 (overall) voicing is that the underlying distinction between /k/ and /g/ is better preserved before /d, z/ where there is a 14-15 ms contrast, than before /t, s/, where the difference in closure duration is 4-5 ms. Nevertheless the behaviour of C_1 closure duration fails to match that of C_1 (closure) voicing, which shows tense-symmetric assimilation to a following obstruent. This indicates that these two acoustic parameters reflect distinct (phonological and/or articulatory) control mechanisms.

Next, the first generalisation to emerge from (7) concerning the behaviour of C_1 release duration is that the release of /k/ and /g/ is relatively short before fricatives. As hinted in section 2 above, this is likely to be a labelling artefact caused by the overlap of release and frication noise in the acoustic signal, and it therefore seems safer to exclude cases involving a fricative C_2 from further analysis. This leaves the obstruent sequences ending in a /d/ or /t/. The data for these clusters seem to show a (small) effect of regressive assimilation: on average the release of /k, g/ is 8 shorter before /d/ than before /t/.

A three-way ANOVA for *C_1 laryngeal specification* * *C_2 laryngeal specification* * *C_2 manner* on the C_1 closure duration data (baseline context excluded) confirms the impression that this parameter behaves differently from the C_1 voicing measures: it reveals a highly significant main effect of *C_1 laryngeal specification*, $F(1,225) = 31.79$, $p < .001$ as well as an interaction between *C_1 laryngeal specification* and *C_2 laryngeal specification*, $F(1,225) = 6.84$, $p < .001$, but no other significant effects. The main effect of *C_1 laryngeal specification* indicates that C_1 closure duration maintains the distinction between /k/ and /g/, whilst the absence of a main effect of *C_2 laryngeal specification* supports the observation that, unlike C_1 voicing, this phonetic feature is not subject to RVA. Finally, the interaction between *C_1 laryngeal specification* and *C_2 laryngeal specification* is likely to be due to the fact that the difference

[6] Using (closure and release) *voicing ratio* (voicing duration divided by overall duration) instead of absolute voicing duration as an index of voicing assimilation leads to very similar conclusions.

between /k/ and /g/ is larger before tense obstruents than before lax obstruents, and this, therefore, confirms the impression that incomplete neutralisation of the contrast between these two plosives is again restricted to one particular class of C_2 obstruents.

By contrast, a two-way ANOVA for *C_1 laryngeal specification* * *C_2 laryngeal specification* on the C_1 release duration data (only cases with a C2 plosive included) yields a highly significant main effect of *C_2 laryngeal specification*, $F(1,113) = 11.87$, $p < .001$ but no other effects, indicating that this variable is subject to neutralising regressive voicing assimilation.

3.3 V_1 duration

The table in (8) presents mean values for V_1 duration by $C_1 + C_2$ context and separately for lexically long (/eː, aː, uː, ɔj/) and short (/i, ɔ, o/) vowels. Although long and short vowels were balanced across C_1 and C_2 contexts in the stimulus set, the fact that a number of responses had to be discarded resulted in some slight imbalances in the corpus. For example, there were more tokens of C_1 = /g/ + C_2 = /L/ preceded by a short vowel (12) than tokens of C_1 = /k/ + C_2 = /L/ (14). Since this might distort the value for V_1 duration in the second context to an artificially low value, they are presented separately here.

The behaviour of V_1 duration is different from the phonetic features discussed above in that at least in the corpus under consideration here, and with respect to plosive C_1 consonants, it is the only correlate of [tense] that assimilates in neutralising fashion across C_2 contexts.[7]

(8) V_1 duration (ms) for lexically short and long vowels/diphthongs (standard deviations in brackets)

C_1C_2	V_1 duration (ms)			
	Short vowels	N	Long vowels	N
/kt/	101 (14)	14	128 (20)	17
/kd/	115 (11)	16	138 (27)	15
/ks/	106 (14)	13	135 (22)	17
/kz/	109 (12)	12	134 (35)	17
/kL/	98(13)	14	125 (22)	18
/gt/	105 (20)	12	129 (21)	18
/gd/	115 (13)	8	148 (34)	17
/gs/	105 (15)	11	137 (23)	17
/gz/	114 (7)	11	148 (28)	17
/gL/	111 (8)	12	153 (33)	18

In the baseline pre-liquid environment, the speech of our two subjects conforms to the near-universal generalisation that vowels are longer before lax obstruents than before tense obstruents (Chen 1970; Kluender et al. 1988): note

[7] This conclusion may have to be modified once a larger set of contexts and speakers is taken into account. See Jansen & Toft 2002 and Jansen (submitted) for details

that the difference appears to be somewhat larger for lexically long vowels (28 ms) than for short vowels (13 ms). A two-way ANOVA for *V_1 lexical length* (short vowels vs. long vowels) * *C_1 laryngeal specification* confirms that lexical distinctions in vowel length and the distinction between /k/ and /g/ both affect the phonetic duration of V_1. There are highly significant main effects of *V_1 lexical length*, $F(1,58) = 34.69$, $p < .001$ and *C_1 laryngeal specification*, $F(1,58) = 12.85$, $p < .005$, but there is no significant interaction, which indicates that contrary to appearances, lexically long and short vowels mark the [tense] contrast on following obstruents in essentially the same way.

However, when C_1 is followed by an obstruent, V_1 duration seems to signal [tense]-contrasts in C_2 rather than in C_1: except in /k/ + fricative sequences V_1 is consistently longer before a lax C_2 than before a tense C_2. It is true that, on average, lexically long vowels are somewhat longer when followed by /g/ (140 ms) than when followed by /k/ (134 ms), but a four-way ANOVA for *V_1 lexical length* * *C_1 laryngeal specification* * *C_2 laryngeal specification* * *C_2 manner of articulation* shows that this difference is not statistically significant. The only significant effects revealed by this analysis are main effects of *V_1 lexical length*, $F(1,217) = 91.05$, $p < .001$, and *C_2 laryngeal specification*, $F(1,217) = 9.67$, $p < .005$, which indicates that before obstruent clusters, phonetic vowel duration is controlled by phonological length and regressive assimilation.

This result might be interpreted as evidence for the idea that there is a unitary mechanism of regressive voicing assimilation (or more appropriately tense-assimilation) that governs the behaviour of all phonetic exponents of [tense]. Current generative analyses of regressive voicing assimilation propose that this unitary mechanism consist of the spreading or 'agreement' of the phonological feature that represents the contrast between tense and lax obstruents at the lexical level (e.g. autosegmental [voice]). However, such analyses predict that all the individual cues to [tense] behave in parallel, and this prediction is not supported by the current data: C_1 (overall) voicing assimilates across contexts, but in non-neutralising fashion before lax obstruents whereas V_1 duration assimilates in neutralising fashion across contexts and C_1 closure duration does not assimilate at all.

4. Discussion and conclusions

Hungarian RVA has typically been described as a process that neutralises underlying fortis-lenis distinctions in the obstruents it targets. The aim of the pilot experiment reported in this paper was to assess to what degree this view can be supported by quantitative acoustic data. The results of this experiment indicate that voicing and the closure duration of plosives partially preserve underlying tense-lax distinctions in assimilation, despite the presence of a clear assimilation effect on voicing and on the duration of preceding vowels. Furthermore, different cues participate in different ways in the assimilation process. These observations raise questions about the viability of models that represent RVA as a single lexical-feature-spreading operation and support the more phonetic view of the phenomenon as alluded to in our introduction. Thus, this study contributes to a growing body of instrumental research demonstrating incomplete neutralisation effects of voicing assimilation rules (O. Thorsen 1966; N. Thorsen 1971; Charles-Luce 1993; Burton & Robblee 1997; Barry & Teifour 1999).

Nevertheless, we want to emphasise that the data reported above should be treated as preliminary observations that need to be supported by a larger-scale study of the phonetics of Hungarian obstruent clusters. Moreover, a number of empirical issues need to be explored before a more robust verdict can be delivered on the nature of the Hungarian regressive voicing assimilation rule. We think it is possible, for example, that this rule may be sensitive to juncture strength and operates in a neutralising fashion at relatively weak morphosyntactic or prosodic boundaries (e.g. in sandhi clusters created by the morphology). It is also important to establish whether the residual traces of underlying tense-lax distinctions in assimilation targets that we observe in the acoustic signal are perceived as cues to lexical phonological representations by listeners.

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