A first glance at the role of length in production and perception of diphthongs before Dutch coda *l*

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Botma, Sebregts & Smakman (2008, 2010, 2012) have shown that in Dutch there is variation in the neutralization of tense and lax vowels before coda *l*. In this study, we will extend the scope of their investigation by examining the effect of coda *l* on preceding diphthongs. A pilot production experiment shows that diphthongs can be completely neutralized in this context and may become monophthongs. A perception experiment reveals that length serves as an important cue for listeners in the identification of vowels followed by dark *l*.

Keywords: coda *l*, diphthongs, quality and quantity neutralization, phonological length

1. Introduction

It is well-known in Dutch phonology that *r* has an effect on preceding vowels. Booij (1981, 1995) observes that no diphthongs are allowed before coda *r*. Gussenhoven (1993: 47) states that the tense mid vowels [e, ø, o] are realized as centering diphthongs [eᵊ, øᵊ, oᵊ] before *r*. The domain in which this happens is the foot, which implies that both onset and coda *r* can affect preceding vowels. Van Oostendorp (1995) claims that the tense vowels are realized as lax vowels before coda *r*.

The effects of Dutch coda *l* on the precise realization of preceding vowels and diphthongs are less well known. Van der Torre (2003) argues that tense mid vowels are realized as long lax vowels before coda *l*. Botma, Sebregts & Smakman (2008, 2010) claim that 'laxing' is a misnomer for this process given that tense and lax vowels are both affected. That is, syllable-final *l* has a lowering effect on the F2 of both tense and lax vowels (retraction) and may neutralize the qualitative opposition between them.[1] Neutralization is a variable and gradual process.

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In their experiment, 8 out of 15 participants did not show any clear neutralizing effects neither for the quality distinction nor for the length distinction between lax and tense vowels before coda *l*. Four participants reduced length while maintaining a qualitative contrast, and even more striking is the fact that the remaining 3 speakers neutralized both the quality and the length distinction. This finding runs counter to the transcription of tense mid vowels before coda *l* as long lax vowels provided by van der Torre (2003) and is taken as evidence for the fact that length plays no phonological role, but is a matter of phonetic implementation. Botma, Sebregts & Smakman (2010, 2012) further assume (with van Oostendorp 1995 and Gussenhoven 2009) an underlying tense~lax distinction for Dutch vowels and argue that length is an enhancement of the feature [tense]. According to Botma, Sebregts & Smakman, this enhancement receives a straightforward explanation. Tense vowels have a greater "gestural magnitude", as their articulation involves a larger movement from the neutral position, and thus takes longer than the articulation of lax vowels. This explanation excludes the possibility of neutralizing the quality distinction while at the same time showing a length difference.

In this paper, we will take a closer look at the diphthongs before coda *l*. The effect of syllable-final *l* on diphthongs has not been studied yet and, given that diphthongs are considered to be underlyingly long (bimoraic) segments, the interesting question arises whether the findings for the tense~lax contrast equally hold for diphthongs. If quality turns out to be neutralized in diphthong~lax pairs before coda *l* as well, what happens to the underlying length difference?

This paper is organized as follows. Section 2 reports on a pilot production experiment set up to examine the effects of coda *l* on preceding vowels and diphthongs. The results of that experiment are partially in line with Botma, Sebregts & Smakman (2010, 2012), but differ in showing that qualitative neutralization without quantitative neutralization does occur. The experiment also shows that the effect of coda *l* in the case of diphthongs is more than a lowering effect on F2, as it involves a leveling effect on F1 as well. Furthermore, the pilot production experiment reveals an interesting opposite neutralization pattern between two participants for the qualitative and quantitative contrasts. Section 3 reports on a perception experiment set up to verify whether for listeners the remaining qualitative and/or quantitative differences are robust enough cues to differentiate between partially or completely neutralized diphthongs and lax vowels. Section 4 summarizes the main results, discusses the implications for the phonology of Dutch and indicates some directions for future research.

2. Pilot production experiment

2.1 Design

Three female participants, randomly selected from a group of third year students from the Radboud University Nijmegen, were recorded in a pilot production experiment: RV (age 21, from Uden), FK (age 20, from Utrecht) and IH (age 56, from The Hague).[2] The production task consisted of reading aloud a randomized list of 21 stimuli, embedded in the carrier sentence *Ik ZEG … niet* ('I SAY … not'), with stress on *zeg* in order to control for any influence of stress and to avoid artificial realizations as much as possible. Our list contained items belonging to three minimal pairs, contrasting a lax and a tense vowel followed by syllable-final *l*, e.g. *kil~keel* (/ɪ/~/e/, 'chilly', 'throat'), *pol~pool* (/ɔ/~/o/, 'clump', 'pole'). Furthermore, 2 items with an underlying lax vowel followed by coda *l*, 2 items with diphthongs followed by syllable-final *l*, and 2 items where a diphthong was followed by heterosyllabic *l* were included, thus yielding 2 minimal series of the diphthongs [ɛi] and [ɑu], like *bel~bijl~bijles* (/ɛ/~/ɛi/~/ɛi/, 'bell', 'axe', 'coaching tutorial'). This yielded 12 test items, to which 9 items, where the vowel was followed by an obstruent (e.g. rok~rook, /ɔ/~/o/, 'skirt', 'smoke' (N)), were added. Given that front and back diphthongs were expected to show a clearer effect than the more central diphthong /œy/, the latter was left out of the experiment. In Botma, Sebregts & Smakman's experiment, main stress was on the target item (*Ik ga nu het woord X zeggen*, 'I will now the word X say'), whilst in our experiment the target word has deliberately not been put in focus position. This makes direct comparison evidently harder and less reliable, but on the other hand more insightful if similar results are obtained. The data, which were recorded in a sound-proof studio, have been acoustically analyzed by means of Praat (Boersma & Weenink 2010). The length of both the vowel and the vowel+*l* sequence was manually measured, and the first and second formants, the main correlates of vowel quality, were measured at 25%, 50% and 75% of the vowel.

2.2 Results

Before discussing the results of our production experiment, let us first review the findings presented by Botma, Sebregts & Smakman (2010), who grouped their 15 participants into four subsets, listed in Table 1.

Table 1. Botma et al's speaker subsets

	Length difference (ms)	**F2 difference at 25% (Hz)**
Neutralizing (3)	11	101
Length neutralizing (4)	-7	291
Non-neutralizing (4)	22	288
Strongly non-neutralizing (4)	54	439

As Table 1 shows, 8 out of 15 participants did not show neutralizing effects neither for the quality distinction nor for the length distinction between lax and tense vowels before coda *l*. Four speakers did neutralize length, but retained a qualitative difference. Strikingly, the 3 participants that did neutralize the quality distinction also neutralized the length, which led to the claim that qualitative neutralization of tense vowels before coda *l* is always accompanied by a neutralization of quantity.

Table 2 shows the average difference between the F2 values (in Hz) of underlying tense and lax vowels before coda obstruent and coda *l* for our participants. In pre-obstruent position, they maintain a qualitative contrast between the tense~lax pairs in terms of F2, which contrast is reduced, or even virtually absent before coda *l*. Furthermore, the F2 of both tense and lax vowels followed by coda *l* is lowered (as in Botma, Sebregts & Smakman 2010), while the F1 is not affected.

Table 2. Average F2 difference of tense and lax pairs

	Pre-obstruent			**Pre-coda *l***		
	25%	**50%**	**75%**	**25%**	**50%**	**75%**
FK	357	303	169	66	71	65
IH	163	187	230	48	92	121
RV	397	266	228	181	127	119

FK and IH neutralize the qualitative contrast between tense and lax before tautosyllabic *l*, whereas this contrast is maintained in pre-obstruent position. RV shows the largest F2 differences of the three participants, but still partially neutralizes quality, and falls in between the 3 neutralizing (≤ 101 F2 difference) and the 12 non-quality-neutralizing participants (≥ 288 F2 difference) in Table 1.

Let us next consider the effects of coda *l* on preceding diphthongs. Contrary to tense vowels, coda *l* not only has an effect on the F2 value (retraction), but turns out to affect F1 as well. When comparing the F1 values at 25%, 50% and 75% of the underlying diphthongs followed by a tautosyllabic and a heterosyllabic *l*, it can be observed that F1 makes a relatively large movement in the latter context, while its slope is flattened in the former. Table 3 shows the F1 and F2 values of [ɛ] and [ɛi] followed by coda *l*, and the same diphthong followed by heterosyllabic *l*.

Table 3. F1/F2 effects on /ɛi/

		lax+*l*]σ (*bel*)			diphthong+*l*]σ (*bijl*)			diphthong+]σ+*l* (*bijles*)		
		25%	**50%**	**75%**	**25%**	**50%**	**75%**	**25%**	**50%**	**75%**
FK	F1	569	628	680	481	529	645	915	723	467
	F2	1889	1851	1820	1869	1839	1753	1883	2027	2102
IH	F1	437	472	558	895	757	712	1007	1092	532
	F2	1786	1655	1560	1883	1976	1892	2033	2283	2059
RV	F1	616	624	603	644	626	596	845	670	573
	F2	1874	1837	1783	1874	1859	1797	1813	1864	1896

Table 4 shows the F1 and F2 values of [ɑ] and [ɑu] followed by coda *l*, and of [ɑu] followed by heterosyllabic *l*.

Table 4. F1/F2 effects on /ɑu/

		lax+*l*]σ (*pal*)			diphthong+*l*]σ (*Paul*)			diphthong+]σ+*l* (*Paula*)		
		25%	**50%**	**75%**	**25%**	**50%**	**75%**	**25%**	**50%**	**75%**
FK	F1	600	559	550	629	648	573	1016	780	539
	F2	1232	1207	1183	1241	1226	1193	1502	1465	1332
IH	F1	741	595	605	798	724	681	956	689	511
	F2	1278	1242	1211	1183	1139	1162	1271	1178	1130
RV	F1	757	787	761	621	602	608	727	656	601
	F2	1187	1174	1160	1218	1177	1164	1419	1389	1370

Tables 3 and 4 show that, although there is variation in the realizations of all speakers, the diphthong+*l*]σ context differs from the diphthong]σ+*l* context. The diphthong before coda *l* may even be realized as a monophthong. This is most clear for the shaded realizations: speaker FK completely neutralizes F1 and F2 of [ɑ]~[ɑu], but not of [ɛ]~[ɛi], whereas speaker RV shows the opposite pattern: complete F1 and F2 neutralization of [ɛ]~[ɛi], but not of [ɑ]~[ɑu].

For the quantitative distinction, again an interesting pattern arises. An overview of the average length differences between the underlying tense and lax tokens is given in Table 5.

Table 5. Average length differences of tense and lax pairs

	Pre-obstruent	Pre-coda *l* (V+*l*)
FK	40.1 ms	4.0 ms
IH	60.3 ms	8.6 ms
RV	24.9 ms	19.43 ms

In pre-obstruent position, all speakers clearly distinguish tense vowels from their lax counterparts by a difference in length, even though there are individual differences. Before coda *l*, speakers FK and IH strongly neutralize the length difference, whereas speaker RV maintains the contrast. With respect to the speaker subsets in Table 1, FK and IH would belong to the neutralizing speakers with a length difference smaller than or equal to 11 ms. RV, with her 19.43 ms difference, would rather belong to the non-neutralizing speakers. As a matter of fact, the pattern displayed by RV is not represented in Table 1. That is, as far as her qualitative difference at 25% is concerned, she belongs to the category of neutralizing subjects, but on the basis of her length difference, she is part of the 4 non-neutralizing speakers.

Let us next turn to the length difference between the underlying lax and diphthong vowels. Table 6 provides an overview of the average length differences between the lax+*l*]σ and diphthong+*l*]σ pairs, and between the lax+*l*]σ and diphthong]σ+*l* pairs.

Table 6. Average length differences of lax and diphthong pairs

	lax+*l*]σ ~ diphthong+*l*]σ	**lax+*l*]σ ~ diphthong]σ+*l***
FK	6.45 ms	48.7 ms
IH	9.35 ms	50.6 ms
RV	20.95 ms	37.5 ms

All three participants realize a quantitative difference between lax+*l*]σ and diphthong]σ+*l*, expressing the distinction between an underlying short (lax) and long (diphthong) vowel. Please observe that the durational difference for the three speakers is about equal to the tense~lax pre-obstruent difference in Table 5. The length of the diphthong+*l*]σ is shorter, and for some speakers nearly identical to the length of the lax+*l*]σ sequence, as for respondents FK and IH, who completely neutralize quantity, to the same extent as in the pre-*l* tense~lax situation in Table 5. RV does maintain a durational contrast between lax and diphthong before coda *l* (mean difference 20.95 ms for *bel*/*bijl* and *pal*/*Paul*), which is about equal to the mean difference of 19.43 ms this speaker maintains between tense and lax vowels before coda *l* (cf. Table 5). In other words, the duration of diphthong and tense vowel before coda *l* is treated similarly by our three participants: either neutralized (FK, IH) or maintained (RV).

Let us summarize our findings so far. Like Botma, Sebregts & Smakman (2010) our data show that coda *l* has a lowering effect on the F2 and may neutralize quality. Our speakers FK and IH line up with their 3 neutralizing participants (cf. Table 1).[3] RV with the largest F2 differences of our participants, but still partially neutralizing quality, falls in between the 3 neutralizing (≤ 101 F2 difference) and the 12 non-neutralizing participants (≥ 288 F2 difference) in Table 1. Furthermore, it was shown that the effect of coda *l* on diphthongs is more than retraction, given that the F1 is targeted as well, as its slope (i.e. its rise) is flattened. This may lead to complete quantity and quality neutralization (shaded speaker FK in Table 4) and to complete quality neutralization (shaded speaker RV in Table 3). The present results differ from previous findings in showing neutralization of quality, while still maintaining a quantitative distinction (speaker RV), with the same durational differences between tense and lax, and lax and diphthong before coda *l*.[4]

As shown in Tables 3 and 4, speakers FK and RV display an opposite neutralization pattern of the two diphthong types. The next section discusses a perception experiment examining whether for listeners the remaining F1 and F2 differences and/or the remaining length difference in the completely qualitatively neutralized diphthong of the second speaker are robust enough cues to differentiate between partially or fully neutralized diphthongs and lax vowels.

3. Perception experiment

3.1 Design

Two separate experiments were conducted, the first with the production stimuli of RV, the second one with those of FK. In both experiments, the same, randomly selected, participants were involved: 14 female students, aged between 19 and 28 and originating from the region of Nijmegen. The stimuli were presented in the original carrier sentence. In a forced-choice task, participants had to judge 32 stimuli (23 items with vowel/diphthong followed by coda *l* and 9 items with vowel/diphthong followed by coda obstruent), every item played twice. In the second part of the experiment, they heard two stimuli directly in sequence and they had to indicate what they perceived, by choosing between 4 options (i.e. twice a lax vowel, twice a tense/diphthong vowel, a lax vowel followed by a tense/diphthong vowel, or the other way around). Additionally, the experiments contained manipulated stimuli. In the case of RV's tokens, the items with an underlying diphthong before tautosyllabic *l* were shortened to the length of the corresponding lax vowel in RV's speech, and the length of underlying lax vowels was made identical to the length of RV's diphthongs before coda *l*. In the case of FK's tokens, where no length distinction between underlying lax~tense/diphthong was realized, both the underlying lax and the underlying diphthong items were lengthened with 21 ms (corresponding to the average difference between lax-tense/diphthong) in RV's speech.[5]

3.2 Results

Discriminating between tense/diphthong and lax vowels before tautosyllabic *l* proved to be a difficult task for the participants. The 140 tense/diphthong items of speaker RV were correctly identified 117 times, while only 57 of the 140 lax items were correctly perceived. The 140 tense vowels/diphthongs of FK were correctly identified 74 times, and her 140 lax vowels 71 times.

As shown above, speakers RV and FK displayed an asymmetry with respect to the qualitative neutralization of the diphthongs before coda *l*. As far as the F1 trajectories are concerned, FK showed complete neutralization for /ɑu/~/ɑ/ but incomplete neutralization for /ɛi/~/ɛ/, whereas RV completely neutralized the /ɛi/~/ɛ/ pair but retained some F1 difference in the /ɑu/~/ɑ/ pair (cf. Tables 3 and 4). Let us now consider whether this asymmetry in the production also leads to asymmetry in the perception. If the remaining qualitative traces are still sufficiently salient, we would expect the /ɛi/~/ɛ/ pair to be better perceived than the /ɑu/~/ɑ/ pair in the case of FK, whereas the opposite is predicted to hold for RV. The results, both of the items in random order and in sequence, are given in Tables 7 and 8.

Table 7. Perception in random order

RV		*n* correct	FK		*n* correct
	bel /ɛ/	8/14 (57.14%)		*bel* /ɛ/	11/14 (78.57%)
	bijl /ɛi/	14/14 (100%)		*bijl* /ɛi/	4/14 (28.57%)
	pal /ɑ/	5/14 (35.71%)		*pal* /ɑ/	9/14 (64.29%)
	Paul /ɑu/	9/14 (64.29%)		*Paul* /ɑu/	12/14 (85.71%)

Table 8. Perception in sequence

RV		*n* correct	FK		*n* correct
	bel /ɛ/	7/14 (50%)		*bel* /ɛ/	11/14 (78.57%)
	bijl /ɛi/	13/14 (92.86%)		*bijl* /ɛi/	4/14 (28.57%)
	pal /ɑ/	2/14 (14.29%)		*pal* /ɑ/	2/14 (14.29%)
	Paul /ɑu/	5/14 (35.71%)		*Paul* /ɑu/	8/14 (57.14%)

It follows from Tables 7 and 8 that the predictions formulated above are not borne out. In random order, RV's /ɛi/~/ɛ/ pair is better perceived than her /ɑu/~/ɑ/ pair, even in the absence of any qualitative cues. When the lax and diphthong items are presented in direct sequence, the picture does not change and the /ɑu/~/ɑ/ pair with incomplete qualitative neutralization is again less often correctly identified than her qualitatively fully neutralized /ɛi/~/ɛ/ pair. In the case of FK, the /ɛi/~/ɛ/ pair with the F1 traces does not get a substantially higher number of correct identifications in comparison with the fully neutralized /ɑu/~/ɑ/ pair. In random order, *pal-Paul* is slightly better identified than *bel-bijl*, in sequence it is the *bel-bijl* pair that is slightly better perceived (with exactly equal correct identifications in sequence and in random order), but in any case, the asymmetry that was found in the production is not reflected in the perception. In perception, especially when looking at the *bel-bijl* pair, it seems to be the case that RV's realizations tend to be heard as diphthongs (40 out of the total of 56), whereas FK's realizations are preferably interpreted as lax vowels (42 out of 56).

The purpose of the perception experiment was not only to verify whether the remaining qualitative F1 traces were meaningful cues for listeners, but also to test the perceptual relevance of the length distinction displayed by speaker RV. As described in the preceding section, the stimuli also contained manipulated items. FK's lax and diphthong tokens, where no length difference was present in the original realizations, were all lengthened with a total of 21 ms per token. In RV's stimuli, the diphthong items were shortened to her corresponding lax tokens and the length of her lax tokens was made equal to her diphthongs. The scores of these items are given in Table 9.

Table 9. Perception of manipulated items

RV	*bel* lengthened to *bijl*	*bel*: 1 *bijl*: 13	FK	*bel*+21 ms.	*bel*: 1 *bijl*: 13
	bijl shortened to *bel*	*bel*: 6 *bijl*: 8		*bijl*+21 ms.	*bel*: 1 *bijl*: 13
	pal lengthened to *Paul*	*pal*: 4 *Paul*: 10		*pal*+21 ms.	*pal*: 7 *Paul*: 7
	Paul shortened to *pal*	*pal*: 9 *Paul*: 5		*Paul*+21 ms.	*pal*:1 *Paul*: 13

The scores in Table 9 are only informative if we compare them to the scores obtained on the original items (cf. Table 7). Both the experiment with RV's stimuli and the one with FK's speech show a number of interesting results. Lengthening RV's *bel* to *bijl* makes that listeners hear it 13 times as *bijl* and only once as *bel*, whereas the original *bel* token was correctly identified 8 times. Even stronger is the effect when the original diphthong in *bijl* is shortened to its lax counterpart. The original *bijl* token received 14/14 correct identifications, but the shortened token only yields 8 perceptions of *bijl* while 6 speakers perceive it as *bel*. Manipulating the length of RV's neutralized *bel-bijl* tokens (cf. Table 3) thus clearly brings about a shift in listener's perceptions. For RV's *pal-Paul* pair the pattern is less neat, but it still shows influence of change in length. The scores obtained on lengthened *pal* are about equal to the scores on original *pal*, but shortening the diphthong in *Paul* to its lax counterpart yields 9 perceptions of *pal* and only 5 of *Paul*, whereas original *Paul* was identified 9 times as *Paul*. The pattern thus is completely reversed.

For FK, where no quantitative distinction was present in the original stimuli, the influence of length is observable as well. Lengthening of *bel*, which was originally perceived correctly by 11 out of the 14 participants, yields only a single perception of *bel*, but 13 perceptions of *bijl*. The same holds for *bijl*, which was heard only 4 times correctly in its original form. Lengthening of this token also yields 1 identification as *bel* but 13 as *bijl*. Recall from above that for speaker FK, the quality of the *bel-bijl* pair was not completely neutralized. In spite of these remaining F1 traces, however, manipulating the length of the two tokens leads to similar results, which strongly suggests that the quantitative cue is more salient than the remaining qualitative cue. As in the case of RV, the effect of the manipulation is less strong in the case of the *pal-Paul* pair, and in both cases, the scores on the manipulated items do not deviate crucially from the original tokens.

The results presented in this section clearly show that the remaining qualitative cues of FK and RV are insufficient for listeners to perceive a vowel either as lax or diphthong and that perceptually there seems to be complete neutralization. It turned out that in the absence of reliable F1/F2 cues, quantitative cues may facilitate the perceptual task. Despite the fact that the identification of diphthongs and lax tokens as such appears to be quite a challenge for listeners, lengthening and/or shortening of the vocalic tokens leads them to shift their perception either to the diphthong or lax vowel respectively.

4. Summary and discussion

The present study has shown that coda *l*, besides having an effect on mid tense and lax vowels, also affects diphthongs, which may be realized and perceived as monophthongs. One of our speakers, contrary to the Botma, Sebregts & Smakman (2010) patterns, maintained a durational contrast between tense and lax vowels in the absence of a qualitative contrast and did exactly the same in the case of a diphthong followed by syllable-final *l*. A perception experiment showed this durational contrast to be a reliable cue for listeners. Let us briefly conclude by pointing out some potential theoretical implications of the present study.

Botma, Sebregts & Smakman (2010) assume, like van Oostendorp (1995) and Gussenhoven (2009), an underlying tense~lax distinction for Dutch vowels, but contrary to Gussenhoven (2009), they argue that length should be seen as an enhancement of the feature [tense]. Tense vowels have a greater gestural magnitude, as their articulation involves a larger movement from the neutral position, and thus takes longer than the articulation of lax vowels. Length is thus merely seen as a matter of phonetic implementation.

The pattern of RV, however, cannot be accounted for in a similar way. There is quality neutralization, but without the expected concomitant durational neutralization and, given that the quality of the vowel is neutralized, the articulatory motivation for length is absent both in the case of the tense vowels and the diphthongs before coda *l*. The length in her neutralized realizations has to come from somewhere, and given that it cannot come from phonetic implementation, it has to be part of her grammar.

Gussenhoven (2009) presents an analysis of Dutch word stress in which tense~lax is the underlying distinction for vowels and in which length is derived by constraint interaction. He presents the following argument to show that vowel duration cannot be a matter of phonetic implementation alone. The high vowels [i, y, u] are lengthened before [r] in the same foot, as in *wier* [(ˈʋiːr)] 'algae' or *giro* [(ˈxiː.ro)] 'giro', but not in *piraat* [pi.(ˈraːt)] 'pirate' or *admiraal* [(ɑt.mi).(ˈraːl)] 'admiral', where [r] is in the next foot. Lengthening is blocked whenever a tetramoraic syllable would occur. On the assumption that final [t] does not project a mora, this is not the case in *viert* [viːrt] 'he celebrates' with lengthened [i], where long [iː] and [r] together constitute 3 moras. Lengthening of [i] is blocked in *wierp* [ʋirp] 'threw', where [i], [r] and [p] together project 3 moras, and where lengthening of [i] would create a tetramoraic syllable. This [i] remains short even if the context for lengthening is met after inflectional affixation has removed the labial obstruent from coda to onset, as in *wierpen* [ʋirpə] 'threw PLUR'. Compared to phonologically underived forms, like *Kierkegaard* [ˈkiːr.kə.ˌxaːrt] 'proper name' with long [iː], this pattern is taken as an argument that quantity differences are involved in lexical representations. Phonetic implementation would not be able to differentiate between the two phonologically comparable [ir] contexts.

Our speaker RV's results thus provide corroborating evidence for Gussenhoven's claim that the duration of Dutch vowels cannot be merely the effect of phonetic implementation, but does play a phonologically active role. Her underlying diphthong length and her tense vowel length which originate in the phonology, survive the neutralization effects of coda-*l*. We plan to replicate the production experiment with larger groups of participants from different regional backgrounds, in order to determine whether the RV pattern is a representative one, and also for which variety of Dutch.

Notes

1. For a more detailed derscription of degrees of neutralization and different thresholds, we refer to Rietveld & van Heuven (2001).

2. The main difference between FK, IH and RV is that in the speech of the latter, tense vowels are not realized as closing diphthongs.

3. Apparently, the prosodic position of the stimulus does not influence the patterns of neutralization.

4. The present results also seem to indicate that Booij's (1995) constraint excluding diphthongs before coda *r* is in the process of being extended to all liquids: *DIPHTHONG+*r*/*l*]σ.

5. The token was lengthened in PRAAT in three equal portions, at 25%, 50% and 75% of the vowel.

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