# QUANTITY VS DURATIONAL ENHANCEMENT OF TONE IN THE MAASTRICHT VOWEL SYSTEM

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## ABSTRACT

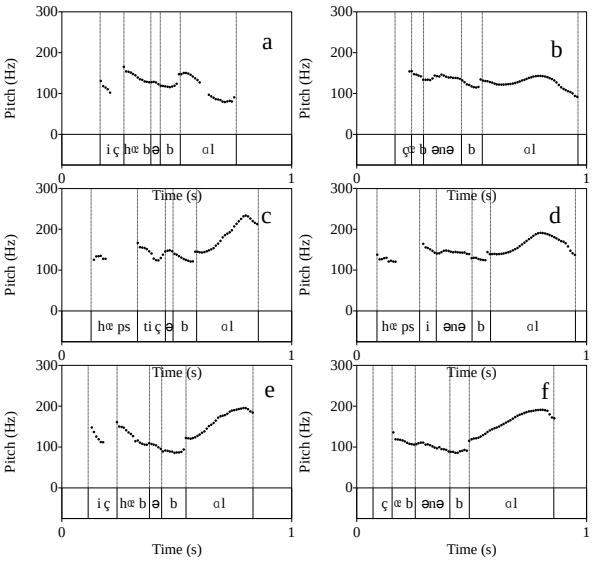
Duration measurements of long and short high vowels in the Limburgish dialect of Maastricht show that these vowels have a relatively context-free durational difference compared to the durational difference found between members of tonal minimal pairs in the dialect. The latter have a substantial duration difference in intonation-phrase final position, but a much reduced difference in phrase-internal positions. These data support the position that the high vowels contrast for quantity, not for tone.

**Keywords:** lexical tone, vowel quantity, Maastricht dialect, enhancement

## 1. INTRODUCTION

Dialects with the Central Franconian tone contrast use duration to enhance the tonal distinction between Accent 1 and Accent 2. This tone contrast is located in the stressed syllable of words. Since these dialects have a quantity contrast in the vowel system, a given pair of vowels that differ in duration could in principle do so because they have different phonological lengths (a quantity contrast) or because they differ in that the shorter vowel occurs in a syllable with Accent 1 and the longer one in a syllable with Accent 2 (a tonal contrast) (e.g. [6]). Maastricht Limburgish minimal word pairs like [zi] 'sea' and [ziː] 'she; they', [brytʃə] 'bread-DIM' and [bryːtʃə] 'bride-DIM', or /brut/ 'bread' and /bruːt/ 'bride', were characterized by [5] as tonally distinct. By contrast, while acknowledging the general tonal character of the dialect, [4] claim that the difference for high vowels is due to a quantity contrast. The explanation of this analytical difference is that the tonal contrast is generally realized through a difference in duration, while the difference between the pitch contours for the two word tones is not salient. In Figure 1, we compare the two word tones on a final syllable in the intonational phrase (IP), with declarative (panels a and b), interrogative (panels c and d) and continuative intonation (panels e and f). There is a consistent duration difference, the syllable with Accent 2 being longer. In the continuative intonation, there is no difference in the shape of the pitch contours. A pitch difference does appear in the declarative contours (a fall for Accent 1 and a rise-fall for Accent 2) and the interrogative contours (a rise for Accent 1 and a rise plus half-fall for Accent 2). In IP-internal position, the pitch differences leave no doubt that words like these contrast for tone.

**Figure 1:** IP-final pronunciations of [bɑl[1]] 'dance party' (panels a, c, e) and [bɑl[2]] 'ball' (panels b, d, f) with declarative (panels a, b), interrogative (c, d) and continuative intonation (panels e, f).




The quantity contrast is shown in (1). In addition, the diphthongs /ɛi, œy, ɔu/ and weak /ə/ exist [4].

| | | | | | | |
|---|---|---|---|---|---|---|
| (1) | i | y | u | iː | yː | uː |
| | ɪ | ʏ | ʊ | eː | øː | oː |
| | ɛ | œ | ɔ | ɛː | œː | ɔː |
| | æ | | ɑ | | | aː |

The aim of this contribution is to support the claim by [4] that high vowels contrast for quantity,

not for tone. It does that by comparing the duration difference between vowels in uncontroversially tonal minimal pairs with that between long and short high vowels. If the duration differences between the two classes of high vowels are phonetically and distributionally comparable to those between the non-high vowels, the phonological origin of the duration differences must be the same: tone enhanced by duration. However, if the duration difference between the two sets of high vowels does not pattern like that between vowels in tonal minimal pairs, the difference between them must have a different phonological origin: quantity.

## 2. METHOD

The data were recorded in several sessions by a middle class, male speaker in his mid-sixties. The scripted speech, which formed part of a larger corpus, was based on four tonal minimal pairs and two minimal pairs with high vowels. The tonal minimal pairs had the stressed syllable in word-final position: /bɑl$^1$/ 'dancing party' - /bɑl$^2$/ '(playing) ball' and /bɛi$^1$/ 'bee' - /bɛi$^2$/ 'near, at', while two minimal pairs had penultimate stress, /ˈspøː$^1$lə/ 'rinse' - /ˈspøː$^2$lə/ 'play' and /ˈɛi$^1$kə/ 'egg+DIM' - /ˈɛi$^2$kə/ 'oaken'. The minimal pairs contrasting long and short high vowels were /zi/ 'sea' - /ziː/ 'she' and /ˈbutə/ 'penalty' -/ˈbuːtə/ 'outside'. These 12 experimental words were embedded in sentences in which they appeared in different sentential positions (final accented, final unaccented and medial accented). Sentences were spoken with different intonation contours. We controlled for intonation by only including recordings of members of minimal pairs that were both available in all three sentential positions spoken with the same intonation. The intonation contours were the declarative, the polar interrogative and the continuative intonation (cf Fig 1). The first two were elicited with syntactic statement and question sentences, the third with the help of sentences like *Heer wɛ̀t neet speule (meh heer wɛ̀t wandele)* 'He doesn't want to PLAY (but he wants to go for a WALK)', where *speule* is the target word. The investigation was based on 96 utterances with tonal minimal pairs and 60 with high-vowel minimal pairs. Segment durations in the target words were determined with the help of Praat [4]. Boundaries between the vowel and sonorant coda [l] in the case of the words for 'ball' and 'dance party' were often hard to determine. Since the lengthening for Accent 2 words is spread over the entire sonorant rhyme [5], we decided to report rhyme durations rather than vowel durations (meaning that [l] in those two words was included in the values we report). Because the number of sets in each of the three discourse conditions were unequal and we had no interest in any duration differences between intonation contours, we merged the data across intonation conditions.

## 3. RESULTS

The durations of the tonally different rimes were analyzed by means of a repeated measures analysis of variance, with WORDTYPE (monosyllabic, disyllabic), TONE (Acc 1, Acc 2) and POSITION (non-final, final accented, final unaccented) as factors. Main effects were found for WORDTYPE [$F(1)=192.2$; $p<.001$; $\eta^2=.965$], TONE [$F(1)=85.4$, $p<.001$; $\eta^2=.924$] and POSITION [$F(2)=535.5$, $p<.001$; $\eta^2=.994$], while all two-way interactions were significant: WORDTYPE and TONE [$F(1,7)=47.9$, $p<.001$; $\eta^2=.873$], WORDTYPE and POSITION [$F(2,14)=30.1$, $p<.001$; $\eta^2=.909$] and ACCENT and POSITION [$F(2,14)=19.4$, $p<.01$; $\eta^2=.866$]. Pairwise comparisons showed that the IP-internal condition is significantly different from both IP-final conditions ($p<.001$), but that the latter two did not differ significantly. Panel (a) of Fig. 2 gives rhyme durations for Accent 1, pooled over /bɑl$^1$/ 'ball, party' and /bɛi$^1$/ 'bee', and Accent 2, pooled over the final-stressed (monosyllabic) words /bɑl$^2$/ 'ball, toy' and /bɛi$^2$/ 'near, by', in non-final accented position as well as final accented and unaccented positions, averaged over eight repetitions. Panel (b) gives the equivalent data for the rimes (vowels in cases) of the penultimate syllables in /ˈspøː$^1$lə/ 'rinse' and / ɛi$^1$kə/ 'egg-DIM' (Accent 1) and those of /ˈspøː$^2$lə/ 'play' and /ɛi$^2$kə/ 'oaken'. The interaction between WORDTYPE and TONE is due to the greater differentiation of Accent 1 and Accent 2 in the case of the word-ultimate stressed syllables, where Accent 2 is 34% longer than Accent 1 in IP-final position and 22% longer than Accent 1 in IP-internal position, but much smaller in word-penultimate syllables, where the lengthening is only 10%, both finally and non-finally in the IP. The interaction between WORDTYPE and POSITION is due to the greater difference between the final and non-final positions for vowels in word-final than for the vowels in word-penultimate stressed syllables.

This reflects the fact that final lengthening is most effective in IP-final syllables, affecting penultimate syllables much less or not at all. The interaction between ACCENT and POSITION reflects the fact that Accent 1 and Accent 2 are differentiated most in IP-final position. This would appear to be especially true for the word-ultimate vowels (cf. Fig. 2), but there was no three-way interaction in the data.

**Figure 2:** Durations (ms) of the word-ultimate rimes in /bɛi$^1$/, /bɑl$^1$/ compared with those in /bɑl$^2$/, /bɛi$^2$/ in accented IP-internal position (NonFinal Acc), IP-final accented position (Final Acc), and IP-final unaccented position (Final Unacc) (above) as well as of the word-penultimate rimes in /spø:$^1$lə/, /ɛi$^1$kə/ compared with those in /spø:$^2$lə/, /ɛi$^2$kə/ in the same positions (below).

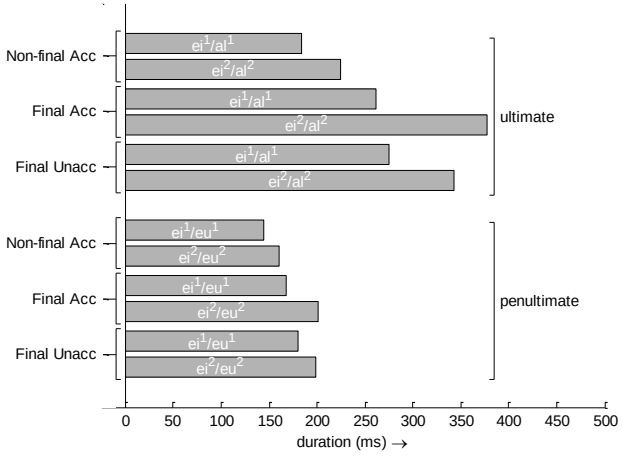
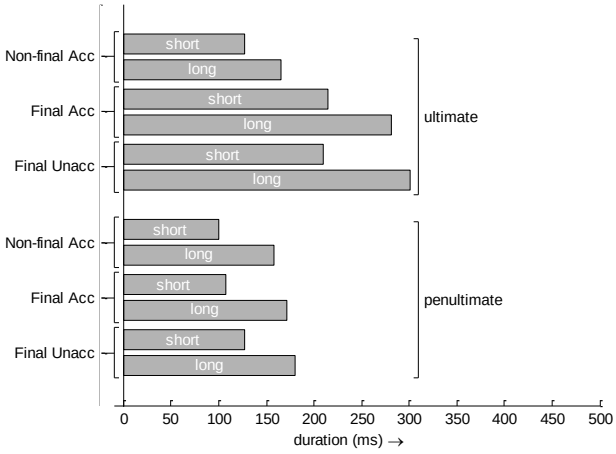



Fig. 3 presents corresponding data for the high vowels. The data in panel (a) are based on vowel durations in /zi/ 'sea' and /zi:/ 'she', while those in panel (b) are based on /ˈbutə/ 'penalty' and /ˈbu:tə/ 'outside', averaged over five repetitions. An analysis of variance was performed on the duration of the vowel, with WORDTYPE (monosyllabic, disyllabic), QUANTITY (short, long) and POSITION (non-final, final accented, final unaccented) as factors. Main effects were found for WORDTYPE [$F(1)=376$, $p<.001$; $\eta^2=.989$], QUANTITY [$F(1)=941.2$, $p<.001$; $\eta^2=.996$] and POSITION [$F(2)=135.1$, $p<.01$; $\eta^2=.971$], while there was a significant interaction between WORDTYPE and POSITION [$F(2,10)=243.8$, $p<.001$]. Pairwise comparisons showed that the non-final condition is significantly different from both IP-final conditions ($p<.001$), but that the latter two did not differ significantly. The interaction is due to the greater differentiation between IP-final and IP-internal positions for the monosyllabic words than for the disyllabic words, as is evident in Fig. 3. Final lengthening is most effective in IP-final syllables: the longer duration in monosyllables than in (trochaic) disyllables reflects the fact that word-final as well as foot-final stressed syllables are longer than otherwise identical non-final syllables.

**Figure 3:** Durations of the word-ultimate rhyme in /zi/ compared to those of /zi:/ in accented IP-internal position (Nonfinal Acc), IP-final accented position (Final Acc), and IP-final unaccented position (Final Unacc) (above) as well as of the word-penultimate rhyme in /ˈbutə/ compared to those in /ˈbu:tə/ in the same positions (below).




## 4. DISCUSSION

The duration difference between /i, u/ and /i:, u:/ is treated differently from the duration difference due to the tone contrast. Word-finally, the duration difference for the high vowels is 34% (IP-internal 31%, IP-final 36%), but in penultimate position in the word it is 54% (58% IP-internal, 50% IP-final). This is the opposite pattern to that found for the tone contrast, where the difference between Accent-1 rimes and Accent 2-rimes is considerably reduced in the word-penultimate position, relative to the word-ultimate position. In line with this difference, we see that the effect size ($\eta^2$) for QUANTITY is the largest of the three factors, while that for TONE is the smallest. These data are consistent with an interpretation of the duration difference as due to a quantity contrast for the high vowels, but as due to durational enhancement of the tonal contrast for the non-high vowels. Since pitch cues for the tone contrast are available in syllables in IP-internal position, but much less so in IP-final position, it is to be expected that the durational enhancement of the tone contrast targets IP-final syllables, with a word-based effect on

word-final syllables in IP-internal positions. The enhancement appears as an exaggeration of word-final and IP-final lengthening of syllable rimes with Accent 2 (cf. [1]). The duration pattern for the quantity contrast is quite different, and is more constant across sentential and word positions.

The considerable durational enhancement of the tone contrast suggests that the pitch distinction between Accent 1 and Accent 2 is not particularly salient in general, including the contrasts in positions in which there is a difference in pitch. There are segmental facts that support this conclusion [4]. The contrast is excluded in combination with a number of segmental conditions in the rime. To begin with, short vowels require a second sonorant mora in the stressed syllable, meaning that syllable rimes with $V_iV_i$, $V_iV_j$ and VN (where N is a nasal or liquid) can have the contrast, but rimes with VT (where T is an obstruent) cannot. Further, no contrast is possible on any rhyme with /β/ or /j/ in the coda, regardless of whether a long or a short vowel precedes, e.g. /høːj/ 'hats' and /iβ/ 'century'. Next, a rime with a lax long vowel, like /tɛːt/ 'tête de veau', /vœːl/ 'much', /plɔːts/ 'place', can't have the contrast.

The explanation for these gaps in the distribution of the lexical tone can be found in conflicts with enhancement strategies in other segmental contexts. In particular, in addition to being shorter, the three diphthongs /ɛi, œy, ɔu/ end in close second elements when combining with Accent 1, while partly monophthongizing when combining with Accent 2. The tense mid vowels /eː, øː, oː/ are pure monophthongs when co-occurring with Accent 2, but are narrow rising diphthongs [ei, øy, ou] when co-occurring with Accent 1. The strategy of enhancing the longer Accent 2 syllables through monophthongization and the shorter Accent 1 syllables through diphthongization may conflict with the perceptual distinctiveness of other phonemes. For one thing, the monophthongization of diphthongs with Accent 2 causes them to be acoustically close to the mid-open monophthongs. That is, the vocoid in [bɛːʲ] (/bɛi$^2$/ 'near, at') is similar to that in [tɛːt] /tɛːt/ ('tête de veau'). If the mid long vowels were to have realizations with Accent 2, causing them to be lengthened, they would be hard to keep distinct from the phonetically monophthongized diphthongs with Accent 2. Similarly, exaggerating the diphthongal quality of vowels with Accent 1 makes it hard to have syllable rimes ending in [j,w] with Accent 2, since rimes with semivowels in the coda are inherently strongly diphthongal in phonetic terms. These segmental adjustments serve to enhance the durational difference between Accent 1 and Accent 2, while the duration itself serves as an enhancement of the tone contrast [3].

## 5. ACKNOWLEDGEMENTS

This work could not have been done without the congenial and efficient way in which Flor Aarts acted as a consultant. Figures 2 and 3 were created by Bert Cranen.

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