PHRASE-FINAL PITCH ACCOMMODATION EFFECTS IN DUTCH

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ABSTRACT

A production experiment was carried out in order to establish the ways in which speakers of Dutch adjusted the pitch contours of three frequently used nuclear contours, the Fall, the Rise, and the Fall-Rise, in phrase-final syllables with varying amounts of sonorant segmental material in the rime. It was found that the Fall and the Rise were somewhat compressed as well as somewhat truncated. The way the Fall-Rise was affected cannot properly be described in terms of either of these concepts, as its overall pitch range was reduced as sonorant portions were shorter. F0 range compression was thus applied to all three contour types, time compression only to the Fall and the Rise.

Keywords: Intonation, Truncation, Compression, Dutch

1. INTRODUCTION

Intonational pitch contours are typically realized in phonetically variable ways. One factor contributing to this variation is the available phonetic space for the realization of an intonation contour. Speakers adjust the phonetic form of a nuclear pitch accent depending on the availability of voiced segments in phrase-final position, either by producing an incomplete version of the contour or by increasing the speed of the pitch movement in order to produce the full contour. Erikson and Alstermark [3] referred to the first adjustment strategy as "truncation" and to the second as "rate adjustment", which was renamed "compression" by Bannert and Bredvad [1]. Pitch accommodation effects such as these were also investigated for two varieties of Danish by Grønnum [8], and more recently by Grabe [5, 6] for Southern English and Northern German, and Grabe et al. [7] for four varieties of English.

Grabe [5, 6] and Grabe et al. [7] investigated the realization of falling and rising pitch accents on phrase-final words with successively less scope for voicing. The availability of voicing of three test words was manipulated by varying the phonological vowel length of the nucleus (long vs. short) and by including monosyllabic and disyllabic test words. Rate of F0 change (the amount of F0 change as a proportion of time) was adopted as the acoustic correlate of truncation and compression. The analyses in [5] and [6] suggest that cross-linguistic differences exist in the observed adjustment strategies, and that within-language variation exists depending on the contour. The analysis in [7] demonstrates that different adjustment strategies do not only occur cross-linguistically, but also across varieties of the same language. It also shows that compression in the time domain may be accompanied by compression in the frequency domain: truncation and compression are not either/or categories.

The experiment reported here investigates the effect of the availability of voiced material on the realization of three nuclear contours in Standard Dutch. It differs from Grabe's experiments in two respects. First, the availability of voiced segments is varied in monosyllabic words only. Our test words vary in phonological vowel length and in having either a sonorant or a non-sonorant coda. Second, while Grabe's experiments involved Falls and Rises, we added the Fall-Rise as a third contour. The Fall-Rise is interesting as it does not allow truncation by cutting off the final stretch of pitch as observed by [5, 6] for nuclear Falls in German, since this would confound the contour with the simple Fall. In addition, the Fall-Rise is claimed to be absent in phrase-final syllables in Standard German by [4] and [10], who say it is replaced with a simpler high rise contour.

The aim of our investigation is threefold. First, we aim to add cross-linguistic data on pitch accommodation effects in the phonetic realization of nuclear phrase-final contours. Second, we wish to examine whether the nucleus and the coda contribute to pitch realization in phrase-final position in different ways. Third, since no claims have been made that the Fall-Rise is avoided in final syllables in Dutch, the question arises what adjustments are made under time pressure.

2. METHOD

2.1. Materials

The test items for our experiment consisted of four monosyllabic proper nouns that occurred in phrase-final position and varied in the availability of voiced segmental material. This was achieved by varying the phonological length of the nucleus and the voicing of the coda consonant. We selected the four proper names presented in Table 1.

Table 1: The four test words used in the experiment.

	V	VV
coda /f/	/lɔf/	/loːf/
coda /m/	/lɔm/	/loːm/

The test words were presented in short carrier sentences that were designed to elicit three different nuclear contours, a Fall, a Rise, and a Fall-Rise, which are represented as H*L L%, L*H H%, and H*L H%, respectively, following [9]. The Fall was elicited by a declarative sentence with narrow informational focus; the Rise by a *yes/no* question; and the Fall-Rise by a declarative question with corrective focus signaled by the modal adverb *toch* ('actually'). The number of syllables preceding the test word was kept constant for all sentences. All carrier sentences were preceded by a context sentence, with which they formed a mini-dialogue. (1) provides an example dialogue aimed at eliciting the Fall-Rise (FR) for the target word *loom*.

(1) a. Dit antieke horloge is nog van opa Thijssen geweest.
"This antique watch used to belong to grandfather Thijssen."
b. Het was toch van opa Loom?
"But didn't it belong to grandfather Loom?"

2.2. Procedure

Two speakers read the sentences per session; each subject read both parts of the dialogue once. To prevent order effects we added 90 sentences from other experiments as filler sentences. The sentences were presented in pseudo-randomized order to one half of the speakers and in inverted order to the other half.

Recordings were made in a sound-treated booth at Radboud University Nijmegen. The data were digitized at a sampling rate of 8 kHz and converted to mono. Analyses were carried out using the speech processing software *Praat* [2].

2.3. Subjects

Sixteen speakers of Standard Dutch were recorded for the experiment; 5 male and 11 female, aged between 18 and 30. The regional background of the speakers varied; however, no subjects with a marked regional accent were included in our recordings. On the basis of the first author's auditory judgment, all subjects were speakers of Standard Dutch.

2.4. Acoustic measurements and analysis

Based on auditory and visual information, we categorized the test sentences according to contour type and discarded sentences that fell out of this categorization. Using the *Praat* software package, we labeled the segmental boundaries of the test word; labels were inserted on a point tier at the left and right edges of the onset consonant, the nucleus, and the coda consonant. A second tier contained labels at the highest and lowest F0 targets within the accented word. Timing and frequency was measured for both segmental and F0 labels.

Our measurements follow the method used in [6]. We measured F0 duration and F0 change between the nuclear peak and the following F0 minimum in Falls, and between the nuclear valley and the subsequent F0 maximum in Rises. F0 duration in Fall-Rises was measured between the nuclear peak and the final F0 maximum. Total F0 change in this condition was calculated as the addition of F0 change between the nuclear peak and the following F0 minimum, and the F0 minimum and the subsequent peak. In view of the differences in pitch level and pitch range between male and female speakers, we calculated the F0 excursion in semitones (st). Rate of F0 change was calculated by dividing F0 change by F0 duration of the same interval (in st per sec). In addition, we measured sonorant rime duration of the test words, i.e., the duration of /oːm/, /ɔm/, /oː/, and /ɔ/.

3. RESULTS

To establish whether the segmental composition of the target words had an effect on the duration of the sonorant rime, we calculated mean durations for each test word when combined with a Fall, a Rise, and a Fall-Rise (Figure 1). Repeated measures ANOVAs were carried out separately for the three contours with sonorant rime duration as dependent variable and WORD (/loːm/, /lɔm/, /loːf/,

/lɔf/) as a fixed within-subjects factor. Mauchly's test indicated that the assumption of sphericity has been violated for the main effect in Falls, χ^2 = 14.99, $p < .05$. Therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity (ε = .70). In all three conditions, the effect of WORD was significant (Falls: F [2.10, 31.52] = 96.34, $p < .001$; Rises: F [3, 12] = 16.35, $p < .001$; Fall-Rises: F [3, 27] = 94.08, $p < .001$). Pairwise comparisons for each contour showed that the sonorant rime durations of all words differed, except for those of /lɔm/ and /loːf/ in the Fall-Rise and for /loːm/, /lɔm/, and /loːf/ in the Rise.

Figure 1: Sonorant rime duration of the four test words in Falls, Rises, and Fall-Rises.

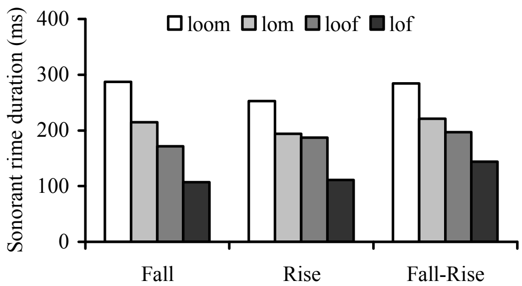


Figure 2: Mean rate of F0 change in Falls, Rises, and Fall-Rises in semitones per second.

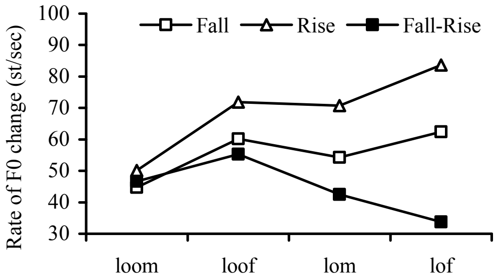
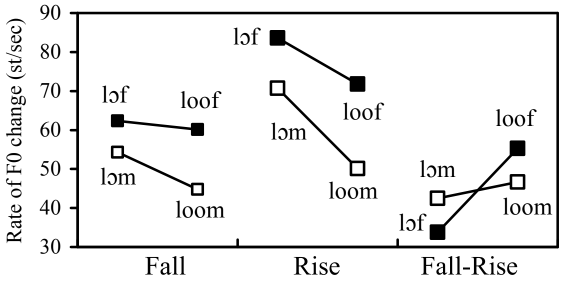


Figure 2 shows the rate of F0 change (as defined in 2.4). The data suggest that the choice of contour has different effects on the test words. First, rate of F0 change is higher in Falls and Rises than in Fall-Rises, except for /loːm/. Second, in Falls and Rises, the rate of F0 change tends to increase when the sonorant portion of the accented word is shortened. In Fall-Rises, /loːf/ shows a slightly increased rate of F0 change, whereas the rate of F0 change in /lɔm/ and /lɔf/ is smaller than in /loːm/. To get more detailed information on the influence of the nucleus and the coda, we classified the four test words according to nucleus (long vs. short) and coda type (sonorant vs. non-sonorant).

Figure 3 rearranges the data of Figure 2 according to the factors nucleus and coda type. In all conditions, except for /lɔf/ when combined with a Fall-Rise, words with a non-sonorant coda have an increased rate of F0 change (/loːm/ vs. /loːf/ and /lɔm/ vs. /lɔf/). The effect of nucleus is less clear-cut. In Rises, words with a short vowel tend to have a higher rate of F0 change. In Falls, this tendency is weaker. In Fall-Rises, there is the opposite tendency, which can most clearly be seen in /lɔf/ vs. /loːf/.

Figure 3: Rate of F0 change in Falls (left panel), Rises (mid panel), and Fall-Rises (right panel).

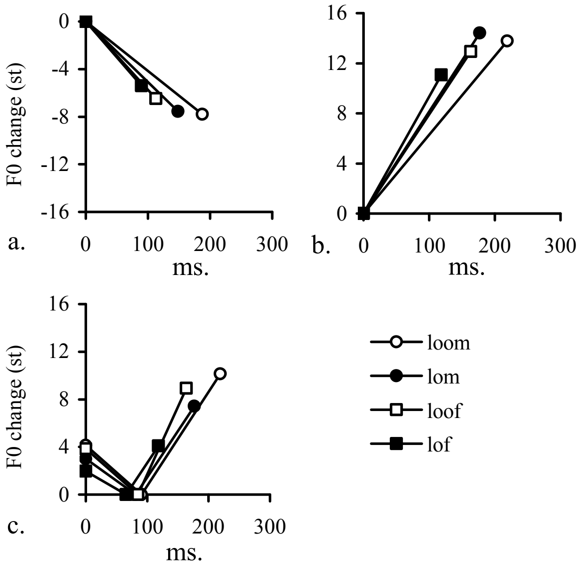


A repeated measures ANOVA was carried out with rate of F0 change as dependent variable and NUCLEUS (long vs. short), CODA (sonorant vs. non-sonorant), and CONTOUR (Fall, Rise, Fall-Rise) as fixed within-subjects factors. We found significant main effects of NUCLEUS (F [1, 15] = 14.914, $p < .01$) and CONTOUR (F [2, 30] = 16.775, $p < .001$) as well as interactions between NUCLEUS and CONTOUR (F [2, 30] = 8.111, $p < .01$), NUCLEUS and CODA (F [1, 15] = 6.258, $p < .05$), and CODA and CONTOUR (F [2, 30] = 16.137, $p < .001$). Pairwise comparisons revealed significant differences of the mean rate of F0 change between Falls and Rises and between Fall-Rises and Rises but not between Falls and Fall-Rises.

The interaction between NUCLEUS and CONTOUR confirms the impression from Figure 2 that a shorter vowel tends to increase the rate of F0 change but not in Fall-Rises. Whereas an increase of the rate of F0 change suggests a tendency to compress the F0 contour, the opposite is usually interpreted as evidence for a tendency to truncate the F0 contour. In the case of the Fall-Rise, however, truncation of the final rising movement would confound the Fall-Rise with the Fall. We therefore looked in more detail at the source of the decreased rate of F0 change in the Fall-Rise by plotting the high and low pitch targets of the four test words, as shown in Figure 4. Panel (a) shows that the increased rate of F0 change of /lɔf/ results from a fall which is steeper than the fall of /loːm/.

Panel (b) shows a similar situation for the rising movement. Panel (c) shows that the decreased rate of F0 change of /lɔf/ is not a result of truncating the final rising movement. Although the F0 change is bigger for the rise, both the falling and the rising movement are shortened. This amounts to a compression of the pitch range. Rate of F0 change decreases as the low target after the nuclear peak is raised and the final high target lowered.

Figure 4: F0 change in Falls (a), Rises (b), and Fall-Rises (c) in semitones. The starting points of the final falls and rises, respectively, are normalized.



4. DISCUSSION

In Dutch, the speaker's choice of adjustment strategy in an environment with limited voiced segmental material is contour-dependent. In Falls and Rises, the rate of F0 change increases as sonorant material becomes shorter, an indication of compression. However, a reduction in absolute F0 change can also be observed, which suggests truncation. Apparently, compression and truncation can apply simultaneously. A different picture emerges in Fall-Rises. Here, F0 change becomes progressively smaller when sonorant material becomes limited, but this goes hand in hand with a decrease in rate of F0 change.

The question arises what process lies beneath this realizational adjustment. The term truncation properly applies to the premature ending of individual pitch movements, not to an overall vertical reduction in the size of a complex pitch movement. We might consider characterizing the higher pitch of the low target in the shorter word condition as undershoot. A drawback to this approach is that the realizational variation of the low and the final high target in Fall-Rises would need to be described by two different terms: undershoot and truncation. A final option is to speak of pitch range compression, which covers the realizational adjustment of both targets, or of pitch range reduction, a term that could apply to the phonetic realization differences of all three nuclear contours.

The problem with using rate of F0 change as a measure of truncation or compression in the fall-rise is not confined to complex contours. As a reviewer points out, alternative methods that differentiate between different zones of an F0 movement may be called whenever rate of F0 change varies across the F0 duration, as in the case of falls that bottom out towards the end of the F0 duration in longer syllable rimes. In such cases, the rate of F0 change in shorter rimes may be faster than in longer rimes if measured over the entire duration of the rime, whereas the rate of F0 change may be the same if only the first half of the long rime is compared with the entire duration of the short rime.

5. REFERENCES

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