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Intonational phonology of Estonian statements with low level nuclei

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Abstract
This paper investigates low level nuclei in Estonian statements. The intonational phonology of such nuclei is discussed on the basis of tightly controlled data where it appears that similar low level accents occur also in prenuclear position. This leads to the conclusion that the most appropriate analysis is to treat such nuclei as low targets (L*) preceded by a high unstressed syllable (H).

Introduction
A reading passage designed for investigating the interaction of Estonian intonation with quantity (Asu and Nolan, 2001) exhibited frequent occurrences of low level nuclei which have previously not been discussed in work on Estonian intonation. An example is shown in Fig. 1 where it can be seen that the pattern involves a step down from a high unstressed syllable (on) to a low stressed syllable (Tuu-).

Figure 1. F0 trace of an utterance ‘And my name is Tuuli’.

Such nuclei were preliminarily described as instances of ‘total downstep’, following the usage of Grabe (1998) who adapts the term from Pierrehumbert (1980). Consequently, such low level nuclei were initially labelled within the Autosegmental-Metrical (AM) framework as downstepped falls !H*+L, following the phonological inventory used by the IViE project (see Grabe, 2001 for the labelling guide).

Similar low level nuclei are reported for German. In German ToBI (Grice and Benzmüller, 1995) such nuclei are treated as low intonational targets rather than downstepped high accents, resulting in a categorical distinction between H+L* and !H*+L. Grabe (1998), however, finds no evidence for bimodal distribution between ‘partial downstep’ and ‘total downstep’ in German, and therefore calls into question the usage of a separate phonological category H+L* for totally downstepped nuclei. Her work also shows that unlike Northern Standard German, Southern Standard British English does not have ‘total downstep’ but only ‘partial downstep’.

Low nuclei are also common in many Romance languages such as Spanish, Catalan, Italian and Portuguese, where the last accent may be realised as a fall (Portuguese, Italian) or a progressively falling slope (Catalan). An H+L* analysis of the accent is proposed by several studies (e.g. Grice, 1995 for Palermo Italian; Frota, 1998 for European Portuguese) while Estebas-Vilaplana (2000) argues in favour of treating the last accent in neutral declaratives in Central Catalan as a strongly downstepped H*.

The aim of the present paper is to explore the intonational phonology of the low level nuclei in Estonian statements, with respect in particular to establishing whether the category !H*+L used preliminarily is best suited for analysing the accent. The discussion will be based on experimental data and will evaluate four possible phonological analyses. In the first section of the paper some general observations about the functional distribution of the low level nuclei will be presented.

Functional distribution
In order to get some idea of the functional distribution of the nuclei under discussion, the data from the above mentioned reading passage was studied (for the design of the passage see Asu and Nolan, 2001). The passage was about 10 min long and was recorded by 5 female speakers of Standard Estonian. All occurrences of low level nuclei were noted and classified, allowing the following broad conclusions to be
Low level nuclei occurred only in statements and never in questions. They occurred frequently on the final item in lists of different length after the connective ja (‘and’). These two observations suggest that the pattern carries the meaning of finality or completedness, which according to Ladd (1996:76) is characteristic of downstepping. Additionally, such low level patterns occurred in the reading passage on the verb in a two-item sequence introducing direct speech (a proper noun followed by a verb), e.g. Kaarel **ütles** (‘Kaarel said’), and on a verb complement following different forms of the verb **olema** (‘to be’), e.g. **Minu vanaisa oli kuulus** (‘My grandfather was famous’) or **Paat on valmis** (‘The boat is ready’).

There were only a few cases where all five speakers produced the low level nucleus on the same utterance, which points to the optional nature of the pattern. The frequency of the pattern seems also to be slightly speaker specific, as the data of one speaker contained considerably more of such nuclei than the data of the others, while another speaker used them only rarely. It might also be the case that such nuclei are characteristic of a certain style, e.g. reading vs. spoken, but this needs to be investigated in further research.

### Phonological analysis

In order to explore the phonological analysis of the pattern, data collected as part of a larger experiment on downtrends in Estonian questions and statements was used (Asu, 2002).

### Materials and method

The materials were a set of statements controlled for the number of accented and unaccented syllables. Each utterance contained four accents and either one or three unaccented syllables between the accents, thus consisting of either disyllabic or tetrasyllabic feet. The material comprised 6 different meaningful statements (3 for each type of foot structure), all starting with a proper noun followed by a verb in unaccented position. The rest of the syntactic structure in the utterances varied slightly consisting of adverbials of place or time, or direct or indirect objects, and in one case an object complement.

The data was recorded by 5 female speakers of Estonian between the ages of 20 and 29. The data was presented to the subjects as a list where each utterance was repeated 5 times in a semi-randomised ordering. The recordings were made in a quiet environment in Tartu, Estonia, using a Sony TCD D8 portable DAT recorder.

The data was digitised at 16 kHz on a Silicon Graphics Unix workstation where an F0 contour was computed for each utterance using Xwaves+. The present study includes the analysis of 141 statements (9 statements had to be discarded for a variety of reasons). For quantification, the frequency and time of the following points of the F0 contour was recorded: the first reliable value in the F0 trace, the accent peaks (H), the beginning and end of the troughs (L), and the turning point at the end of the rise and at the beginning of the fall if there was a high plateau instead of a peak. In cases where the nucleus did not have a peak, the point in approximately mid-vowel position of the accented syllable was measured.

### Results and discussion

It was expected that the majority of statements would be produced with a succession of H*+L accents as can be seen Fig. 2 (such a pattern will be referred to as the default). For simplicity’s sake all the examples presented in this paper will be of the same utterance, a statement consisting of tetrasyllabic feet: **Leena lamab Jaanusega maalisel laevakesel** (‘Leena is lying with Jaanus on a picturesque little boat’).

![Figure 2. F0 trace of a statement showing the succession of four H*+L accents.](image)

In fact such utterances only formed 40% of the whole, the rest exhibiting a low level nucleus. A closer look at the statements without a peak in the nucleus position showed interestingly that such instances could further be divided into at least three different subcategories depending on the point in the utterance at which accented syllables started being low rather than high. The distribution of the patterns is plotted in Fig. 3 where the different patterns are marked according to the first low accent in the utterance.

The discussion of the intonational phonology of the low accents will have as its starting point the following two assumptions: firstly, there is a tendency for pitch accents to reduplicate within an intonational phrase, and secondly, the types
of pitch accents should not be multiplied, i.e. the analysis should be guided by the principle of economy.

Figure 3. A pie chart showing the distribution of accent patterns in statements. Apart from the default H*+L pattern, low accents can begin on the fourth, third, or second/first accent.

In Fig. 2, the ‘default’ pattern, we can see that all the peaks (H*) are aligned with the accented syllables, and that there are low troughs (L) between the peaks. Fig. 4 shows a typical ‘low a4’ pattern with a low level nucleus. The prenuclear accents are similar to those in Fig. 2 (H*), but there is no peak in the nucleus.

Figure 4. F0 trace of a statement with a low level nucleus (‘low a4’).

It is hard to decide on the basis of just this pattern upon the most suitable phonological analysis. The discussion will consider the four most likely options: (1) a totally downstepped fall which, as we recall, was the preliminary analysis of the pattern (!H*+L), (2) a fall with an H* aligned early (<H*+L), (3) a low target preceded by a high tone (H+L*), and a downstepped high target preceded by a high tone (H+!H*).

Figure 5. F0 trace of a statement with a low on accent 3 and accent 4 (‘low a3’).

In Fig. 5 we can see another F0 trace where the nucleus is low, but where also accent 3 is low (‘low a3’). The two first prenuclear accents are similar to those in Fig. 2 and Fig. 4 (H*). It is important to note that there is high pitch before each of the low accented syllables, suggesting that there is a high tone after accent 3. Given that accent 3 initiates a clear rise, it is harder to sustain an analysis in terms of a downstepped falling accent than in the case of the nucleus. Even if it is accepted that a low level nucleus is the end point of a continuum of degrees of downstepping, in the case of accent 3 the !H*+L analysis is contradicted by the rising pitch. All the other options (<H*+L, H+L*, H+!H*), however, remain plausible analyses at this point, since each allows a realisation with lower pitch on the current accented syllable and higher pitch just preceding the subsequent accent.

Figure 6. F0 trace of a statement with four low accents (‘low a2/a1’).

In Fig. 6 we can see a pattern where all four accented syllables are low. There is now even less justification for !H*+L. The early fall (i.e. a fall aligned before the accented syllable) is a possible analysis for accents 2, 3, and 4, but there is no high tone before the first accent at the beginning of the statement. More importantly, accounting for this pattern with a sequence of ‘early falls’ (<H*+L) would mean that the observed pitch behaviour is consistently at odds with the phonological association of the tones. Such a high degree of abstractness in the phonology-phonetics relation is undesirable if it can be avoided. On these grounds the <H*+L analysis will therefore be ruled out.

The remaining two analyses (H+L* and H+!H*) both have a high leading tone, which poses a problem for the beginning of the utterance as it starts with a low accent. However, the prediction could be made that any unstressed syllables preceding the initial low accented syllable would be high. In the data presented here, lacking anacrusis, this initial H has in effect been ‘truncated’. This prediction remains to be tested.

The choice between H+L* and H+!H* is relatively straightforward. As the pattern in the whole utterance alternates between high and low, it seems counterintuitive to label the low
tones as downstepped highs (!H*) which are preceded by high tones. Doing this would simply imply a bi-tonal analysis in which !H* had completely usurped L*. Therefore the best suited analysis on the basis of the present data is H+L*. This accent is observationally adequate for the original phenomenon which triggered this investigation, the low level nucleus preceded by high pitch. Furthermore, generalising it to preceding non-H* accents, where these occur, seems to allow the maximally economical account of the complete intonational phrase.

**Quantitative summary**

Fig. 7 compares the average time alignment of the pitch events measured for one speaker’s default and ‘low a4’ utterances. Note that the rise associated with accents 2 and 3 coincides, and the patterns diverge only after the third accented syllable.

![Figure 7](image-url)

**Figure 7.** A pattern with a low level nucleus (‘a4’) plotted against the default pattern.

Fig. 8 compares the average time alignment for one speaker’s default pattern and another speaker’s ‘low a2/a1’ pattern. Whilst the duration of their utterances is almost identical, there is a clearly complementary relationship of pitch. Where one speaker has accent peaks, the other has low pitch associated with the accented syllables.

![Figure 8](image-url)

**Figure 8.** A pattern with four low accents (‘low a2/a1’) plotted against the default pattern.

**Conclusions and further research**

It seems that it is a speaker’s choice whether, and how early, to deviate from the default H*+L pattern in Estonian statements. It was demonstrated in the discussion that the overall patterns can be accounted for economically only with two pitch accents: H*+L and H+L*.

In the future it is planned to investigate more closely some phonetic characteristics of this analysis, and to study some more spontaneous data, e.g. the reading passage data, or some conversational data, for occurrences of such nuclei.

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**References**


