**Prosodic effects of Information Structure in Estonian**

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**Abstract**

The paper reports the first results and future prospects of a study of the prosodic expression of Information Structure (IS) in Estonian. The study was based on data elicited with a production task and consisting in sets of identical sentences produced with different focus structures. The aim of the study was to check for correlations of four focus structures (subject focus, object focus, predicate focus and sentence focus) with accent patterns, prominence strength (as reflected in word duration changes), prosodic phrasing and pitch accent types. It was found that subject focus can be expressed either by inverted constituent order or by nuclear accent placement. This suggests that Estonian belongs to the category of languages that have both plastic intonation and plastic syntax. Sentence-initial subject focus, unlike sentence-final narrow focus, was also distinguished by pitch accent types and by a tendency to be phrased separately. Sentence-final narrow focus was found to be disambiguated from predicate focus and sentence focus by prominence strength. The latter two did not differ significantly in terms of duration, but sentence-focus sentences differed from narrow-focus and predicate-focus sentences in that they exhibited a smaller proportion of upstepped nuclear accents. The IS categories topic vs. focus and given vs. new information were not found to be signalled by pitch accent type.

**1. Introduction**

The paper presents the first results and future prospects of a study of the prosodic correlates of Information Structure (IS) in Estonian. The prosodic expression of IS in Estonian has not been systematically studied before and therefore our first aim was to establish some basic facts as a basis for more detailed studies in future. The research questions and methods of analysis are presented in Section 3, but first we will describe our data (Section 2). Section 4 discusses the findings and Section 5 presents the conclusions and prospects.

**2. Data**

The data was elicited using the design and materials of the “Who does what” production task of the “Questionnaire on Information Structure” (Skopeteas et al., 2006). The task is part of a series of tasks designed for a broad typological study of different means of expressing IS; it is intended for eliciting double foci as compared to single foci. The task consists in answering questions about pictures. Informants are thus not presented with preformed sentences but are prompted to produce the sentences themselves, which permits to study not only the prosodic reflexes of IS but also e.g. the syntactic ones. There are altogether 8
pairs of pictures; in each pair, one picture represents a single event and the other two events, chosen so as to elicit simple transitive clauses with a subject, verb, and object, each consisting of a single lexical word. Each picture is shown several times with different questions, in order to elicit identical sentences with different IS. The task and the instructions are designed so as to avoid priming effects, list intonation, elliptical answers, use of pronouns instead of lexical nouns, production of longer narratives instead of simple sentences etc.

We used the task in isolation and with some modifications: some questions were added in order to elicit more types of IS with the same task, and the questions were recorded and presented to the informants together with the pictures in the form of a PowerPoint slide show, not by an instructor. The subjects were alone in the recording studio and answered the questions on their own pace. The task was performed by 9 subjects, 4 women and 5 men. Since the task risked being too repetitive when used in isolation, we took some additional measures to avoid this by reordering the pictures and by combining the task with a different task. However, the repetitiveness may have still had an effect on the data. In future, we intend to use a perception test in order to verify how successfully the sentences convey the intended IS.

For the purposes of the present study, we analyzed a set of 8 sentences, each produced by all 9 informants with 4 basic IS patterns: subject focus, object focus, predicate focus (i.e. VP focus) and sentence focus. In future, further types of IS, e.g. contrastive topics and foci, will be included in the study. The sentences were elicited with the single-event pictures, e.g. the picture of a man drinking coke; subject focus was elicited with the question “Who is drinking coke?”, object focus with the question “What is the man drinking?”, predicate focus with the question “What is the man doing?”, and sentence focus with the question “What is happening?”

The sentences elicited with the production task were analysed with Praat (Boersma & Weenink 2012), segmented into words and labelled for accent placements, accent types and prosodic phrase breaks. Disfluent sentences were eliminated from the data. Nuclear, pre-nuclear and post-nuclear accents were identified perceptually and by observing the F0 track and the intensity curve of the sentences. Pitch accent types were identified on the basis of the Estonian tonal inventory in Asu (2004); the following accent types were labelled: H*, H*L, ^H*L, L*, HL*, (H)L*1.

A prosodic phrase break was coded when there was a pause, or when the F0 fell to the bottom level of the utterance or there was a F0 reset. However, the

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1 (H)L* is a sentence-initial HL* with missing H because the sentence begins with a word-initial stressed syllable, cf. Asu (2004).
identification of phrase breaks was not entirely reliable because boundary cues and the prosodic hierarchy above the prosodic word have not been systematically studied in Estonian. The model of Estonian intonation proposed by Asu (2004), for instance, posits no intermediate phrase level and marks only major intonational phrase boundaries.

3. Research questions and methods

The aim of the study was to answer four general questions. The first question was whether Estonian uses different accent patterns to express IS. Estonian is known to use constituent order to express IS (Lindström, 2005; Tael, 1988), i.e. it has ‘plastic’ or ‘flexible’ syntax (in the sense of Vallduví & Engdahl, 1996; Van Valin, 1999; cf. Ladd, 2008: 252–253), and such languages may have either plastic or non-plastic intonation. The question was therefore to know whether Estonian can also use intonation to express IS when a syntactic strategy is available. This could be tested with the subject focus sentences. The informants had the choice of focusing the subject by using the inverted constituent order OVS instead of the neutral SVO order, and this permitted us to examine whether they use the syntactic strategy or perhaps a prosodic one.

The second question was whether IS can be expressed through different realisations of the same accent pattern, since it has been proposed that ambiguous accent patterns can be disambiguated by the degree of emphasis with which the accents are produced (Ladd, 2008: 254–257). For the purposes of the present study, prominence strength was estimated on the basis of word duration changes. To measure the duration changes, we first equalised the durations of the four IS versions of each sentence for each informant and then calculated the mean duration of each word across the IS versions. We then calculated the relative difference of the normalised duration of each word from the mean duration and compared the mean differences of subjects and objects in the four IS categories (for this purpose, subject-focus sentences with the inverted OVS order were grouped together with object-focus sentences). The significance of the differences between the mean values was determined by ANOVA.

The third question was whether IS correlates with prosodic phrasing, which is known to be one of the means of expressing IS (cf. Gussenhoven, 2004: 159ff.; Ladd, 2008: 273–280). To verify this, we compared the percentages of phrase breaks in the four IS conditions.

Finally, we wanted to know whether IS categories correlate with pitch accent types. To verify this we compared the proportions in which topics vs. foci and given vs. new information co-occur with different accent types.
4. Findings and discussion

4.1. Accent patterns

Our findings suggest that Estonian can be considered to have plastic intonation: only one of the 9 informants used the inverted constituent order to focus the subject (although she did so consistently, in 7 sentences out of 8). The remaining subject-focus sentences were produced with the SVO order and a distinctive accent pattern. However, it is likely that this result does not reflect the actual proportion in which the two strategies are used, first, because the SVO order may have been primed by previous answers, since most of the questions elicited the direct word order, and secondly, because a complete sentence is not the most natural answer to a subject question. We plan to conduct separate studies to establish more accurately the proportions and conditions of use of the two strategies and to test whether the prosodic strategy is also used in the VP, where narrow focus can likewise be expressed syntactically by producing the focused constituent in the sentence-final position. That the prosodic strategy may indeed be used in the VP as well is suggested by a perception study of Salveste (2013) who found that the pitch-accented constituent in the VP tended to be perceived as focal independently of its position in the phrase.

The subject-focus sentences with SVO order have the most prominent accent on the subject (cf. the duration patterns in the next section), which we analysed as the nuclear accent. More than 90% of these sentences also exhibit a slight rise in pitch or intensity on the object (as compared to the verb), and were therefore analysed as having a post-nuclear accent on the object. The pattern is exemplified in Figure 1.

The remaining sentences (i.e. sentences with subject focus and OVS order, object focus, predicate focus and sentence focus) were analysed as having a pre-nuclear accent on the first word (subject or inverted object) and the nuclear accent on the last word (object or inverted subject). 15% of these sentences also exhibited a second pre-nuclear accent on the verb. We calculated the Jaccard Binary Similarity Coefficients to verify whether the accentuation of the verb correlated with the IS conditions. The correlation was overall weak but slightly stronger with the conditions where the verb is new information, i.e. with the sentence-focus condition and especially the predicate-focus condition. However, there was an even stronger correlation with two of the informants.
Figure 1: F0 curve of the sentence Mees vaatab haamrit (‘The man is looking at the hammer’) produced with subject focus, analysed as having the nuclear accent on the subject, a post-nuclear accent on the object and a prosodic phrase break after the subject.

In sum, the data contains two accent patterns, one of which correlates with sentence-initial narrow focus and the other is ambiguous between sentence-final narrow focus, predicate focus and sentence focus.

4.2. Prominence strength

The next question was whether the ambiguous accent pattern is disambiguated through prominence strength, as reflected in word duration changes. An additional question that rose was whether evidence from duration changes supports the categorical difference between the two accent patterns identified in the data. We compared thus the duration patterns in four categories: sentences with (i) sentence-final subject or object focus, (ii) sentence-initial subject focus, (iii) predicate focus, and (iv) sentence focus. Figure 2 shows the lengthening/shortening of the first word (on the left) and the last word (on the right) in the four categories. Sentences with initial narrow focus differ most significantly from the rest, confirming the categorical difference between this type and the others. The narrowly focused sentence-initial subject exhibits a lengthening of 10.81% (significant difference from all the other categories,
The lengthening may be partly due to the following phrase boundary, as will be discussed in the next section. The sentences with initial narrow focus are also set apart by the shortening of the object, which was of -5.05% (significant difference from all the other categories, p<.0001).

From the remaining categories, which exhibit an identical accent pattern, the sentences with sentence-final narrow focus differ significantly from the others both in terms of the shortening of the first word, which is of -6.54% (p<.01), and the lengthening of the last word, which is of 4.09% (p<.0005), whereas predicate-focus and sentence-focus sentences do not differ significantly from each other. Consequently, the evidence from duration changes suggests that narrow focus is disambiguated from predicate focus and sentence focus through prominence strength, but the latter two are not disambiguated from each other. This finding will be verified in future by measuring other correlates of prominence strength.

4.3. Prosodic phrasing
To verify whether IS correlates with phrasing we examined the percentage of separately phrased subjects and objects in the four IS conditions, again grouping...
the inverted subject-focus sentences together with the object-focus sentences, cf. Table 1.

**Table 1:** Percentages of separately phrased subjects and objects in sentences with sentence-initial narrow focus, sentence-final narrow focus, predicate focus and sentence focus.

<table>
<thead>
<tr>
<th></th>
<th>Sentence-initial narrow focus</th>
<th>Sentence-final narrow focus</th>
<th>Predicate focus</th>
<th>Sentence focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Break after first word</td>
<td>49%</td>
<td>11%</td>
<td>20%</td>
<td>9%</td>
</tr>
<tr>
<td>Break before last word</td>
<td>0%</td>
<td>14%</td>
<td>17%</td>
<td>3%</td>
</tr>
</tbody>
</table>

The results show that only the sentence-initial narrowly focused subject shows a significant tendency to be phrased separately, which is also supported by its lengthening (cf. Section 4.2). This suggests that IS does have an effect on phrasing since subjects in the other conditions are not phrased separately to the same extent. However, the fact that 49% of sentence-initial narrow foci but only 14% of sentence-final narrow foci are phrased separately suggests that phrasing does not correlate with narrow focus in general but specifically with sentence-initial narrow focus. Sentence-final narrow foci, which were disambiguated from predicate focus and sentence focus by accent strength, are thus not similarly disambiguated by phrasing.

Since the annotation of phrase breaks was not entirely reliable, we did not attempt to interpret the smaller differences in the table.

### 4.4. Pitch accent types

Next, we examined whether particular types of pitch accent are used to signal the IS categories of topic vs. focus or given vs. new information. Table 2 presents the percentages of different accents in each of these categories. The category ‘topic’ includes the subjects in object focus and predicate focus sentences and the objects in inverted subject-focus sentences (objects in the subject-focus sentences with SVO order were excluded as not typical topics); ‘focus’ includes the subjects of subject focus sentences and the objects of object focus, predicate focus and sentence focus sentences; ‘given’ includes the same elements as the category ‘topic’ plus the objects in the subject focus sentences with SVO order; ‘new’ includes the same elements as the category ‘focus’ plus the subjects of sentence focus sentences.
In all categories the falling accent (H*L) is the most frequent type, i.e. it does not distinguish between the categories. Topics and given information occur more frequently with the simple high accent (H*) than foci and new information, but only because this accent was never identified in sentence-final position, where foci and new information mostly occur. Foci and new information in turn occur more frequently with low accents because a low nucleus can be preceded either by a low, high or falling pre-nuclear accent. We checked whether the distribution of these three patterns could to be related to IS but did not find any clear correlation. In conclusion, the examined IS categories do not seem to be directly signalled by particular accent types (although they correlate with accent types because these occur with different probability in nuclear and pre-nuclear positions).

However, as in case of phrasing, it was again the sentence-initial focus that stood out in terms of accent type: it never bore a low accent (with one exception). This effect can be attributed to IS since subjects in general do occur with low accents. But again, it is not a general property of narrow focus since sentence-final narrow foci occurred equally often with low and falling accents. And again similarly to phrasing, accent types do not distinguish between sentence-final narrow focus, predicate focus and sentence focus, although sentence-focus sentences occur slightly more frequently with a low nucleus. The types of nuclear accents in the four IS conditions are summarised in Table 3.

We also compared the percentages of upstepped falling nuclear accents in the sentence-final narrow focus, predicate focus and sentence focus conditions,

\footnote{Low accents were grouped together because there were very few low accents without a preceding high tone in the data.}
cf. Table 4. In terms of upstepped accents, narrow focus and predicate focus do not differ considerably, but both differ from sentence-focus sentences, which have a smaller proportion of upstepped accents. This suggests that future studies may still reveal that predicate-focus and sentence-focus sentences are disambiguated from each other, although they did not differ significantly in terms of duration changes.

<table>
<thead>
<tr>
<th></th>
<th>Sentence-final narrow focus</th>
<th>Predicate focus</th>
<th>Sentence focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>^H*L</td>
<td>38%</td>
<td>32%</td>
<td>10%</td>
</tr>
<tr>
<td>H*L</td>
<td>14%</td>
<td>24%</td>
<td>31%</td>
</tr>
<tr>
<td>L*, HL*</td>
<td>48%</td>
<td>44%</td>
<td>59%</td>
</tr>
</tbody>
</table>

5. Conclusions and perspectives

The study suggests that Estonian belongs to the category of languages that have both plastic syntax and plastic intonation. More specifically, it was found that subject focus, which can be expressed by inverted constituent order, was more often expressed by direct constituent order and a distinctive prosodic pattern. However, the proportions and conditions of use of the syntactic and prosodic strategies need to be further investigated, both on the clause level and in the VP.

The distinctive properties of the sentence-initial subject focus include (i) a distinctive accent pattern, consisting in sentence-initial nuclear accent placement and the presence of a post-nuclear accent, (ii) a tendency to be separately phrased, and (iii) absence of low accents. The exact properties of sentences with early nuclear accent are another topic that needs further investigation.

Sentences with inverted subject focus, object focus, predicate focus and sentence focus exhibited an identical accent pattern which consisted of a pre-nuclear accent on the first word of the sentence (and more rarely a second pre-nuclear accent on the verb), and the nuclear accent on the last word of the sentence. Evidence from duration changes suggests that the pattern is partly disambiguated by prominence strength: narrow-focus sentences differ significantly from predicate-focus and sentence-focus sentences both in terms of the shortening of the first word and the lengthening of the last word, but predicate-focus and sentence-focus sentences are not significantly different from each other. This result will be verified in future by examining other correlates of prominence strength: intensity, accent range, and accent height.
Sentences with sentence-final narrow focus, predicate focus and sentence focus did not differ considerably in terms of prosodic phrasing and pitch accent types, although sentence-focus sentences occurred slightly more often with a low nuclear accent and less often with an upstepped falling nuclear accent.

Topics vs. foci and new vs. given information were not found to be signalled by accent type.

Topics for future research include, in addition to the ones mentioned above, the study of further types of IS contained in our data (sentences with contrastive topics, corrective and selective foci, double foci etc.) and perception studies aimed at verifying, among other things, how successfully the sentences in the data convey the intended IS, which prosodic features correlate with a better identifiability of IS, and whether the disambiguating prominence realisation patterns identified in the production study are also identifiable perceptually.

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References


