VARIATION IN VOWEL QUALITY AS A FEATURE OF ESTONIAN QUANTITY

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Introduction

In Estonian, diachronic feet can be short (Q1), long (Q2), or overlong (Q3) quantity degree. The feet are left headed. Phonologically it is a combination of a stressed vowel and/or following consonant that can change the quantity (see Table 1). Interestingly, the relative values of V1 and V2 syllable compensates for the variation of the first syllable, being long in Q1, short in Q2 and extra-short in Q3. The quantity can be described as the ratio of syllable rhyme durations (e.g., [1], [7], [18], [19], [21], [22], [23], [24]) by comparing the V1 duration with the weighted sum of segment durations within a foot (e.g., [14]).

Table 1. Possible combinations of sound segments that demonstrate the quantity opposition.

<table>
<thead>
<tr>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
</tr>
</thead>
<tbody>
<tr>
<td>[v1]</td>
<td>[v2]</td>
<td>[v3]</td>
</tr>
<tr>
<td>–</td>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>X</td>
<td>–</td>
<td>Y</td>
</tr>
<tr>
<td>Y</td>
<td>X</td>
<td>–</td>
</tr>
</tbody>
</table>

The pitch is relatively flat in the first syllable and falls at the syllable boundary in Q1 and Q2, whereas in Q3 it falls at the base of the last syllable (see Figure 1, [15]). Perception studies (12) show that conflicting temporal and pitch cues can confound the discrimination of Q1 and Q3, whereas temporal cues are sufficient for successful discrimination if the pitch cue is not present. These results suggest that instead of a fixed set of features that describe the quantity degrees, there is a more complex interaction between different features that are weighted by the listener.

Table 2. Number of observations of vowels in the first and the second syllable.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Foot</th>
<th>1</th>
<th>e</th>
<th>o</th>
<th>a</th>
<th>2</th>
<th>e</th>
<th>o</th>
<th>a</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Q1</td>
<td>11</td>
<td>9</td>
<td>13</td>
<td>14</td>
<td>16</td>
<td>23</td>
<td>24</td>
<td>44</td>
</tr>
<tr>
<td>M</td>
<td>Q2</td>
<td>11</td>
<td>14</td>
<td>17</td>
<td>12</td>
<td>20</td>
<td>23</td>
<td>12</td>
<td>23</td>
</tr>
<tr>
<td>M</td>
<td>Q3</td>
<td>11</td>
<td>14</td>
<td>12</td>
<td>13</td>
<td>17</td>
<td>24</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>F</td>
<td>Q1</td>
<td>11</td>
<td>9</td>
<td>13</td>
<td>14</td>
<td>16</td>
<td>23</td>
<td>24</td>
<td>44</td>
</tr>
<tr>
<td>F</td>
<td>Q2</td>
<td>11</td>
<td>14</td>
<td>17</td>
<td>12</td>
<td>20</td>
<td>23</td>
<td>12</td>
<td>23</td>
</tr>
<tr>
<td>F</td>
<td>Q3</td>
<td>11</td>
<td>14</td>
<td>12</td>
<td>13</td>
<td>17</td>
<td>24</td>
<td>12</td>
<td>13</td>
</tr>
</tbody>
</table>

Two vowels /i, y, u, e, ø, ɤ, o, æ, ɑ/ being long in Q1, short in Q2 and extra-short in Q3. The duration of the second syllable compensates for the variation and therefore is not perceivable (5). In an unstressed syllable quantity degrees affect the vowel quality in the opposite direction and the variation crosses the perceptual boundaries (5).

Materials and methods

The data were extracted from the University of Tartu phonetic corpus of Estonian spontaneous speech, 11 hours and 44 minutes of speech from 14 speakers (6 female, 8 male, age ranging from 21 to 55 years with an average of 33.8 years) was used.

The data were analyzed with Praat [6]. Words with two open syllables in Q1, Q2 and Q3 were found and segmental segments as well as F1, F2, F3 and F4 values at the mid-point of V1 and V2 were extracted with a Praat script. Formant values found by the script were manually checked. The vowels /i, y, u/ and the unstressed vowel /æ/ were left out of the analysis because there were less than five obervations of each vowel in first syllable of Q1 and 236 words were analyzed 392 words in Q1, 200 words in Q2 and 134 words in Q3. The number of tokens for each vowel is presented in Table 1.

Results and Discussion

The model seems to handle the opposition of Q1 vs. Q2 and Q3 very well, but the opposition of Q2 and Q3 is not so clear. A lot of variability in segment duration could be reduced by taking the phrasal position and accentuation conditions into account. The model could be improved also by considering a characteristic of the pitch contour as a variable.

Conclusions

- The duration of vowels is more important for Estonian quantity opposition than the duration of syllable initials. Rather than the V1 duration by itself, the ratio is the segment duration within the foot that describes the quantity degrees contrast.
- The variation in vowel quality is related to the quantity. Vowels in stressed syllables of Q1 feet are closer to the center and stressed and Q2 feet are more peripheral.
- The difference in V1 quantity between Q1 and Q2 can be perceived as it exceeds 1 Bark difference.
- Vowels in unstressed syllables vary significantly, but the most variation is not connected with the quantity of the foot. While the space of V2 is general, the vowel /æ/ has moved to the low front corner of the space, and is realized as /a/.

Table 3. Multinomial logistic regression analysis of the quantity of the foot (Q3 as the reference level). In the comparison of Q1 vs. Q3 all segment durations are significant, but the most significant results are the effects of V1 and V2 duration. The formant values of Q1 are significant. Particularly, the F1 formant ratio of V2 shows the most significant impact (thought the difference is not different statistically). The impact of V2 F2 ratio is not significant. In the comparison of Q2 vs. Q3, the duration of C1 is not significant and therefore is not perceived. Also, the F3 ratio of V1 is significant, even though the mean difference of the ratio between Q2 and Q3 is relatively small. The F2 ratio of V1 and the formant ratios of V2 are not significant.

References