

Toneme realization in two East Norwegian dialects

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This study investigates the realization of toneme 1 vs. toneme 2 words in two East Norwegian dialects. Two speakers were recorded pronouncing a number of tonal minimal pairs both in a text and as isolated words. Listeners from different dialect regions then identified the words without the help of any context. Though generally high identification rates were found, the factors context, listener dialect and speaker identity appeared to have some impact on identification. Acoustic analysis showed clearly distinct f_0 contours for toneme 1 vs. 2 words. Having similar shapes, the main difference between the two types of contours lie in syllable-internal timing, the toneme 2 contour occurring later than the toneme 1 contour.

1. Introduction

The present study is the continuation of the work on Norwegian tonemes reported in Van Dommelen & Nilsen (2002). In that paper we investigated the perception of toneme 1 and 2 words in two North Norwegian dialects and found that toneme identification rates varied considerably across different words. Analysis of the test words' acoustic characteristics suggested that toneme identification rate varied as a function of f_0 contour. Highly identifiable toneme word pairs had clearly distinctive tonal contours, in contrast to the non-distinctive contours found for words that had yielded low recognition rates. It is commonly believed that toneme realization in East Norwegian (so-called low-tone) dialects is more consistent, giving rise to easily perceivable toneme identity. This issue was investigated following the same experimental procedure as in the previous study but using speech material produced by two low-tone dialect speakers.

2. Experimental procedure

2.1. Preparation of stimuli

Speech recordings were made in our sound-treated studio using a Milab LSR 1000 microphone and a Fostex D-10 digital recorder with a sampling rate of 44.1 kHz. Manipulations and f_0 analysis were carried out using the Praat program (Boersma & Weenink, 2002).

The speech material consisted of two parts. Part one was a one-page text written by one of the authors (RAN). The text had the character of a novel fragment and used standard orthography. Contained in the text were nine different toneme 1 words and their toneme 2 counterparts, thus yielding a total of 18 stimulus words. The second part of the speech

material consisted of isolated words spoken with a focal accent that were elicited in a dialogue with RAN. The same nine pairs of toneme 1 and 2 words were recorded, i.e. a total of 18 isolated words.

Using this speech material, two low-tone dialect speakers were recorded: a 25-year-old female (J) from Tingvoll (Nordmøre) and a male (D) from Varteig (Østfold) aged 26. The dialect spoken by J belongs to the Trøndelag dialect region and can be classified as North-East Norwegian, while D's dialect is South-East Norwegian. Both speakers are students at NTNU's Department of Scandinavian Studies and Comparative Literature.

2.2. Listening test

From the recorded speech material, for each of the two speakers the 36 (2x18) stimulus words were excised for use in the listening test. In the listening test, these 72 stimuli occurred twice in a completely randomized order. Using the CSRE (Computerized Speech Research Environment) program, 144 (2x72) stimuli were presented to individual listeners seated in the department's sound-treated studio of the department. Their task was to categorize the stimuli as A or B using short descriptions given in a list. In English translation, an example of such a description for the stimulus word *bygge(t)* ([¹bygə] / [²bygə]) is: A - "definite form singular of the noun *building*"; B - "infinitive of the verb *to build*".

The group of subjects comprised ten listeners speaking a low-tone dialect and six listeners with a North Norwegian background. They were all familiar with technical linguistic terms as used in the word descriptions. Before performing the test they were given a written instruction supplemented by an oral explanation as well as a demonstration including five randomly chosen stimuli.

3. Perception test results

In the analysis of the perception test results, the following four factors were taken into account: *context* (isolated words vs. words excised from context), *speaker* (D vs. J), *toneme* (1 vs. 2), and *listener dialect* (low-tone vs. North Norwegian). The results of an analysis of variance with these factors are displayed in Table 1. As could be expected, significantly higher identification rates were found for the words in isolation than for the words excised from context. As can be seen from Table 2, for the group of low-tone dialect listeners the effect of context was relatively small (98.1-94.3= 3.8 %). For the North Norwegian listener group the effect was more substantial, amounting to 95.1-86.8= 8.3 %. This difference between the two groups is reflected by the significant Context x Listener dialect interaction.

Also the factor speaker identity had a significant effect on identification rates. Since the size of the effect was rather small (pooled across the two listener groups 95.1-93.4= 1.7 % better identification for speaker D) one should not, however, attach too much importance to the statistical significance. Speaker D's toneme 1 yielded higher identification than toneme 2 words (98.3 % vs. 91.8 %), while the reverse was true for speaker J (89.6 % vs. 97.2 %; cf. the significant interaction between the factors Speaker and Toneme).

As had been expected, also the factor listener dialect had an impact on toneme identification. Listeners from low-tone dialects, i.e. dialects akin to the variants presented in the test, achieved higher correct identification rates than the North Norwegian subjects. Average values for the two groups were 96.2 % and 91.0 %, respectively.

Table 1. Analysis of variance. Effect of the factors context, speaker, toneme and listener dialect on toneme perception. Main effects and two-way interactions.

| <i>Factor</i> | <i>F</i> | <i>df</i> | <i>p</i> |
|----------------------------|----------|-----------|----------|
| Context | 30.054 | 1, 1136 | <.0001 |
| Speaker | 5.242 | 1, 1136 | 0.022 |
| Toneme | 1.642 | 1, 1136 | 0.200 |
| Listener dialect | 22.335 | 1, 1136 | <.0001 |
| Context x Speaker | 0.000 | 1, 1136 | 0.983 |
| Context x Toneme | 0.011 | 1, 1136 | 0.916 |
| Speaker x Toneme | 53.122 | 1, 1136 | <.0001 |
| Context x Listener dialect | 4.324 | 1, 1136 | 0.038 |
| Speaker x Listener dialect | 10.059 | 1, 1136 | 0.002 |
| Toneme x Listener dialect | 8.524 | 1, 1136 | 0.004 |

Finally, the factor toneme did not have any significant effect on identification rates. Mean values here were 93.9 % for toneme 1 as against 94.5 % for toneme 2. The significant Toneme x Listener dialect interaction is due to higher toneme 1 vs. 2 scores for the low-tone dialect subjects (97.1 % vs. 95.3 %) as opposed to lower toneme 1 vs. 2 rates for the North Norwegian listeners (88.7 % vs. 93.3 %).

Table 2. Identification of minimal toneme 1 - toneme 2 word pairs (percent correct). (a) Low-tone dialect listeners. For each cell n= 90; overall: n=360.

| Speaker | <i>Isolated</i> | | <i>Context</i> | |
|----------|-----------------|------|----------------|------|
| | D | J | D | J |
| Toneme 1 | 98.9 | 98.3 | 98.3 | 92.8 |
| Toneme 2 | 97.2 | 97.8 | 88.3 | 97.8 |
| Overall | 98.1 | | 94.3 | |

(b) North Norwegian listeners. For each cell n= 54; overall: n=216.

| Speaker | <i>Isolated</i> | | <i>Context</i> | |
|----------|-----------------|------|----------------|------|
| | D | J | D | J |
| Toneme 1 | 100.0 | 86.1 | 95.4 | 73.1 |
| Toneme 2 | 95.4 | 99.1 | 85.2 | 93.5 |
| Overall | 95.1 | | 86.8 | |

4. Acoustic analysis results

As has been shown in the preceding section, toneme identification rates in the perception test were generally high without any marked differences between the results for the various stimulus words. From this we can conclude that the speakers' toneme 1 vs. 2 word realizations must have been clearly distinct. To investigate this question further, some of the test words were acoustically analyzed. This was done for four word pairs, spoken in isolation as well as in context (see Figure 1). In addition, the end of the first syllable's vowel was determined (in *bønder/bønner* the midpoint of the ambisyllabic nasal). Mean f_0 contours are depicted in Figure 1. To allow better comparison of the contours' shapes, the toneme 2

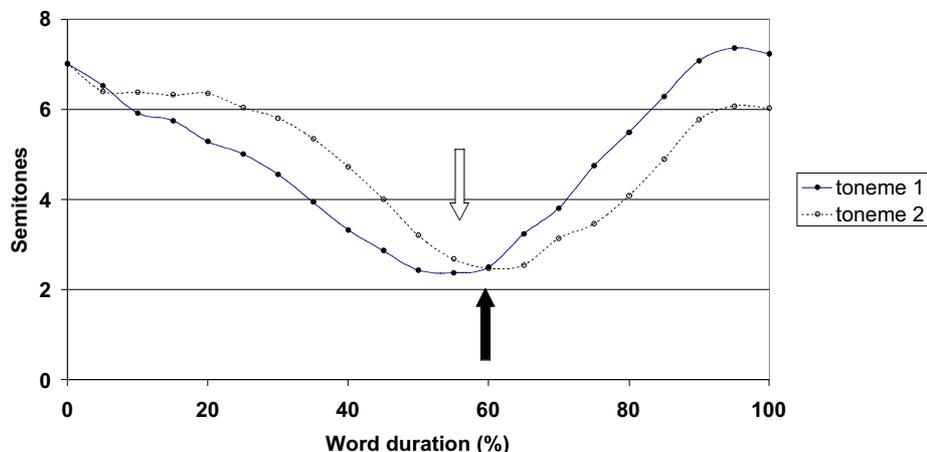


Figure 1. Mean f_0 contours for the word pairs *bønder/bønner*, *loven/låven*, *svaret/svare* and *fjæra/fjæra* (averaged across two speakers and two text conditions; $n = 16$). For comparison, the contours were frequency adjusted. Arrows indicate the end of the first syllable's vowel (in *bønder/bønner* the midpoint of the nasal).

was down-shifted by ca. 1 semitone (achieving identical mean semitone values for the two curves).

As can be seen from the figure the two toneme contours are on the one hand similar in shape, but on the other hand clearly distinct due to word-internal timing differences. Both the f_0 fall during the first syllable and the rise during the second syllable occur later in toneme 2 words. This shift seems to parallel patterns found for Swedish accent 1 vs. 2 within dialects as well as for prosodic differences between dialects (Bruce, 2001).

5. Conclusion

The present study shows that Norwegian listeners generally are very successful in identifying minimal tonal pairs spoken by East Norwegian speakers. The results suggest that the phonological toneme opposition is realized by a fall-rise gesture which is shifted in time.

6. References

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