The Effects of Pragmatic Focus on Norwegian Tonal Accent

Niamh Kelly¹, Rajka Smiljanić²

¹,²Department of Linguistics, The University of Texas at Austin, USA
niamh.kelly@utexas.edu, rajka@austin.utexas.edu

Abstract

The present paper examines the effects of pragmatic focus on the realisation of the lexical pitch accent contrast in the Trøndersk variety of Norwegian. Target disyllabic words with accent 1 and accent 2 were read with broad and narrow focus by 10 native speakers of Trøndersk. Broad-to-narrow focus changes were implemented through an expanded pitch range and vowel lengthening for both accents. A different effect of focus on the two accents was also found. Accent 1 words had no change in the timing of tonal events in narrow focus compared to broad focus, while accent 2 words had a later alignment of the pitch contour in narrow focus. An unexpected H tone, a ‘word-focus tone’ was also found at the end of a number of target words. The results thus revealed that narrow focus affected pitch cues even though these are primarily used to distinguish the lexical pitch contrasts. Furthermore, the asymmetrical impact of focus on accent 1 and accent 2 words increases the distinction between the two accents.

Index Terms: lexical pitch accent, Norwegian, focus, Scandinavian, prosody

1. Introduction

Most varieties of Norwegian and Swedish have a lexical tonal accent (or pitch accent) contrast, called accent 1 and accent 2. This tonal accent contrast has been described impressionistically and experimentally [1, 5, 8, 16–18, 25, 29, 35, 38, 41, 43, 44] in a number of dialects. Some dialects realise the contrast with two different tonal contours while others use a different alignment of the same tonal contour to distinguish between two accents. The current study investigates the realisation of the accents in narrow focus in the Trøndersk dialect of Eastern Norwegian, spoken in central Norway. The goal is to examine how the lexical accents are impacted by pragmatic information conveyed through pitch and durational cues.

Focus is known to affect the realisation of the f0 contour [3, 19, 27, 28, 34, 39, 47], and languages with lexical pitch contrasts tend to use an expanded pitch range to mark focus [9, 32, 37, 46]. Serbo-Croatian, for example, uses an expanded pitch range, a change in peak alignment, and vowel lengthening to indicate narrow focus; importantly though, there are restrictions as to how much f0 alignment changes in dialects with the lexical tonal contrast compared to the dialects without it [40]. The realisation of focus varies by dialect in Swedish, where dialects with single-peaked accents simply use a wider pitch range on the target word to signal focus, while those with double-peaked accents add another pitch gesture after the primary stressed syllable (hence the term ‘double-peaked’) [7]. These results show that languages with a lexical tonal contrast use a variety of ways to convey pragmatic focus.

Norwegian has a lexical tonal accent and focus is realised prosodically. Our earlier examination of disyllabic words (with initial stress) in a neutral context (broad focus) [23] indicated that in the Trøndersk dialect, both accents have a HL contour, but accent 2 words have a higher f0 minimum, later alignment of both H and L, steeper boundary slope (slope to the AP H% tone), and a longer final vowel than accent 1 words. The Trondheim Model [10, 11] describes East Norwegian intonation as being composed of intonational phrases that are in turn composed of accent phrases or units (APs), specified for accent 1 or 2 depending on the head of the AP [14, 15, 21]. An AP thus runs from a stressed syllable, followed by any number of unaccented syllables, to a H% boundary tone [13, 25, 31] at its right edge.

Narrow focus in East Norwegian is described as being marked by means of a H tone, associated with the right edge of the AP [13, 25, 31]. Since this is in the same position as the H% boundary tone of the AP, it appears that the two H tones combine to reach an even higher f0 level in focus. The AP boundary H% has been found to occur earlier in narrow focus than in broad focus [24, 30]. In addition to the focus H tone, accent 1 words in Norwegian were found to signal focus with increased duration of the vowel, syllable and word [30].

The goal of the present study was to examine how the properties of each accent are modified when target words are produced with a narrow focus reading. In other words, we wanted to know to what extent the cues that differentiate the lexical tonal accents can also be used to express narrow focus. Based on previous work on Norwegian [13, 25, 30, 31] and other tonal accent languages [37, 40], it was expected that the f0 maximum and the AP H% tone would be higher in focus, and that the alignment of all tones would be earlier, and vowel duration (of both vowels) longer.

2. Methods

2.1. Speakers

Ten native speakers of Trøndersk (four males, six females) aged 18-45 were recorded reading sentences containing the target words.

2.2. Stimuli

The target words were produced in a sentence and were preceded by two or three unstressed syllables, which are AP-external [26]. In this way, the target words were not affected by either the accent or the final H% of a preceding AP [12]. There were also two unstressed syllables following the target word in the same AP, to avoid the target word carrying the H% tone of the right edge of the AP. The target word was contrasted with a word later in the sentence, thus eliciting narrow focus on the target word. The target words were all disyllabic with initial stress and carried either accent 1 or accent 2.

Example sentences (AP = accent phrase, IP = intonational phrase, IU = intonational utterance) follow:
Calculations:

Pitch contour measurements:

Duration measurements:

Figure 1:

The following measurements were made in Praat [4] (shown in 2.4. Measurements and Analysis of towns south and west of Trondheim. Speakers controlled when they moved on to the next slide, and they were asked to speak as they would at home. The speakers were from a variety of towns south and west of Trondheim.

2.3. Procedure

Recordings took place in the phonetics studio at the National University of Science and Technology (NTNU) in Trondheim, Norway. The sentences appeared one at a time on powerpoint slides. They were written in the standard Bokmål orthography and also in a transcription of Trøndersk. Speakers controlled when they moved on to the next slide, and they were asked to speak as they would at home. The speakers were from a variety of towns south and west of Trondheim.

2.4. Measurements and Analysis

The following measurements were made in Praat [4] (shown in Figure 1):

Duration measurements:

- Stressed vowel duration (C3-V1) (msec)
- Unstressed (final) vowel duration (msec)

Pitch contour measurements:

- F0 maximum (H) (semitones)
- F0 minimum (L) (semitones)
- F0 height at vowel onset (V1) (semitones)
- F0 max. turning point (HTP) [HTP is where H turns towards L]
- AP H% tone height (APH) (semitones)

Calculations:

- F0 maximum timing (Timing of H from vowel onset divided by VC duration)
- F0 minimum timing (Timing of L from vowel onset divided by VC duration)
- Stressed syllable slope (Difference in pitch (semitones) between H and L divided by time (msec) between them)
- Boundary slope (Difference in pitch (semitones) between the turning point from L (LTP) and the AP H% divided by time (msec) between them)
- AP H% tone timing (msec from AP boundary)

Accent 1:

"Det var glimtet i en film, men ikke brannen.

((Det var ((GLIMTET-i-en)AP)IP) ((film)AP), men itj ((BRANNEN)AP)IP)IU

“There was the flash in a film, but not the fire."

Accent 2:

"Det var et minne i en film, men ikke en drøm.

((Det var et (2MINNE-i-en)AP)IP) ((film)AP), men itj en (1DRØM)AP)IP)IU

“There was a memory in a film, but not a dream."

Target words contained only voiced sonorant consonants next to the stressed vowel, such as "limet “the glue” (accent 1) and "minne “memory” (accent 2). The words had initial stress and contained the vowel /i/ in stressed position. There were five target words for each accent, each produced three times, giving 15 tokens per accent speaker, a total of 300 tokens for the current experiment (15 tokens x 2 accents x 10 speakers). These were then compared with 300 tokens from the neutral (broad focus) condition [23], that is, similar sentences where the target word did not receive narrow focus.

All measurements were made on the target word, except for APH, which was on the final syllable in the AP. Timing measures (f0 maximum and minimum and HTP) were relative to vowel onset and divided by the duration of the vowel and following consonant, to control for speaking rate differences. The duration of V and C were combined because the target words had either V:C or VC:., so combining these allowed for pooling of timing measures regardless of phonological vowel length. [Note: H is the first point at which the f0 maximum is reached. HTP is where the H turns towards L, so it follows a high plateau.] A mixed model multiple linear regression analysis was conducted using the lme4 package in R [33]. The independent variable was sentence type (neutral or focus) and the dependent variables were the measures previously described. The accents were examined separately. Speaker was included as a random effect. The significance of focus as a predictor of each measure was calculated by a likelihood ratio test comparing a model that included sentence type (focused or non-focused) as a predictor and one that did not [45]. This was conducted using the ANOVA function in R, a likelihood ratio test for nested models.

3. Results

Figure 2 shows a pitch track for the entire accent phrase (not just the target word) for one female speaker (S11F) based on one representative token for each accent in neutral and focus conditions.

Table 1 shows the statistical results for disyllabic words in focus. The reference level for the linear regression tests was the neutral (broad focus) condition. This means that the sign of the coefficient represents the direction of the focus results in comparison with the neutral results. For example, the negative coefficient for accent 1 f0 minimum means that the accent 1 focus tokens had a lower average value for f0 minimum than the accent 1 non-focused tokens. The p-value indicates that the
also possible that this heightening of the AP H% is simply the lar AP boundary tone with the high focus tone. However, it is height is presumably due to the combined effect of the regu-
and earlier in narrow focus for both accents. The increase in
gardless of the accent of the target word. This tone was higher
the AP boundary). Focus affected the AP H% tone similarly re-
work [24, 30], with the AP H% occurring earlier (further from
fact becomes less steep.
That is, even though the f0 range expanded, the segments also
lower slop likely arose from the segment lengthening effect. The results thus revealed that there are some common ef-
effects of narrow focus on both accents, such as lengthened vow-
els, higher f0 maximum, higher and earlier AP boundary tone and steeper boundary slope. The results also showed that the ef-
focus differs for the two accents with regard to the align-
ment of the f0 maximum on the stressed syllable. Namely, in
accent 1, there is no change in tonal alignment in focus, while in
accent 2, the f0 maximum of the H tone is aligned later in focus. This change in narrow focus cannot be attributed to changes in speaking rate since the alignment was examined relative to syll-
able rhyme duration.

4. Discussion
The results demonstrated an asymmetrical effect of focus on the accents on both f0 range and alignment. While the whole rise over the accented syllable is expanded in accent 1 (H is raised and L is lowered), only H is raised in accent 2 in narrow focus compared to broad focus. In narrow focus, accent 2 has a later timing of the f0 maximum while the timing in accent 1 is un-
affected. These results suggests that focus actually exaggerates the difference between the two accents.
Even though the f0 range was exaggerated for accent 1 words in narrow focus, the f0 slope was shallower. The shall-
lower slop likely arose from the segment lengthening effect. That is, even though the f0 range expanded, the segments also expanded, so the slope between the maximum and minimum in fact becomes less steep.
The findings for AP H% timing were in line with previous work [24, 30], with the AP H% occurring earlier (further from the AP boundary). Focus affected the AP H% tone similarly regard-
less of the accent of the target word. This tone was higher and earlier in narrow focus for both accents. The increase in
height is presumably due to the combined effect of the regu-
lar AP boundary tone with the high focus tone. However, it is also possible that this heightening of the AP H% is simply the result of general pitch range expansion. The raising of the AP
H% tone, along with its earlier timing, contributes to the steeper boundary slope.
The examination of the pitch contour in narrow focus further revealed a high focus tone at the end of the target word in a subset of sentences. This was unexpected since focus was de-
scribed as being marked at the end of the AP, which was two syllables after the end of the target word. This ‘word focus tone’ occurred 48% of the time in accent 1 words and in 36%
of accent 2 words. This tone was found most often when the speaker paused immediately after the target word. This may indicate that the AP ended after the target word, rather than in the intended position after the following unstressed syllables. The occurrence of this tone could indicate that focus induces a prosodic restructuring by breaking up the AP; however, since this did not occur in all instances, this explanation appears un-
likely. It is more plausible that in order to make the target word sound more emphasised, the speakers paused after it, and this is what broke up the AP. This interpretation is supported by findings from Swedish [42] where pauses were inserted for in-
creased emphasis of target words. When a word focus tone was present, it was followed by a high plateau across the un-
stressed syllables, before falling at the beginning of the next AP (as shown in Figure 3). For all of the tokens with a word focus tone, the AP height was also measured, to see if the presence of a word focus tone affected the height of the AP H% tone. A likelihood ratio test confirmed that the presence of a word focus tone had no significant effect (Accent 1: p = 0.5; Accent
2: p = 0.06) on the height of the AP H% tone for either accent, probably because of this high plateau. However, the presence of a word focus tone did affect the boundary slope (both accents:
p < 0.001). For this reason, the statistical results for boundary slope are based only on tokens that do not have a word focus tone.

Finally, examination of lengthening patterns revealed that the final, unstressed vowels were longer in narrow focus com-
pared to broad focus for both accents. The results also showed that only phonologically long vowels in stressed position were lengthened in focus. Phonologically short vowels remained un-
changed. Work on Swedish has noted that focus can enhance phono-
logical length contrasts, by making long segments longer and short segments shorter [2,5,6,22]. The effect of focus on the
duration of the consonant following the stressed vowel was also

Figure 2: F0 contour for one speaker showing neutral and fo-
cused APs for one token of accent 1 (linet), left, and accent 2 (Line), right.

Figure 3: Pitch track showing a word focus tone (WF) and the following plateau over the words “i en”.
Table 1: Statistical results for disyllabic words in focus. The left 3 columns show the results for accent 1 comparing broad and narrow focus and the right 3 columns show the results for accent 2 comparing broad and narrow focus.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Accent 1</th>
<th></th>
<th>Accent 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coef.</td>
<td>t-value</td>
<td>p-value</td>
<td>Coef.</td>
</tr>
<tr>
<td>F0 Maximum (st)</td>
<td>0.26</td>
<td>2.43</td>
<td>&lt;0.05*</td>
<td>0.4</td>
</tr>
<tr>
<td>F0 Minimum (st)</td>
<td>-0.3</td>
<td>-2.5</td>
<td>&lt;0.05*</td>
<td>-0.15</td>
</tr>
<tr>
<td>F0 vowel onset (st)</td>
<td>0.13</td>
<td>1.3</td>
<td>0.193</td>
<td>0.04</td>
</tr>
<tr>
<td>Beginning of f0 rise</td>
<td>18.3</td>
<td>1.4</td>
<td>0.169</td>
<td>73.6</td>
</tr>
<tr>
<td>F0 max alignment</td>
<td>0.006</td>
<td>0.44</td>
<td>0.653</td>
<td>0.11</td>
</tr>
<tr>
<td>F0 min alignment</td>
<td>0.18</td>
<td>1.24</td>
<td>0.218</td>
<td>0.02</td>
</tr>
<tr>
<td>F0 turning point</td>
<td>-0.023</td>
<td>-1.67</td>
<td>0.095</td>
<td>0.004</td>
</tr>
<tr>
<td>Stressed syllable slope</td>
<td>-0.004</td>
<td>-3.45</td>
<td>&lt;0.001*</td>
<td>0</td>
</tr>
<tr>
<td>AP H% height</td>
<td>1.8</td>
<td>10.6</td>
<td>&lt;0.001*</td>
<td>1.6</td>
</tr>
<tr>
<td>AP H% timing</td>
<td>12.7</td>
<td>4.3</td>
<td>&lt;0.001*</td>
<td>10</td>
</tr>
<tr>
<td>Boundary slope</td>
<td>0.01</td>
<td>5.7</td>
<td>&lt;0.001*</td>
<td>0.002</td>
</tr>
<tr>
<td>Stressed vowel dur.: Long (msec)</td>
<td>16</td>
<td>4.3</td>
<td>&lt;0.001*</td>
<td>21.9</td>
</tr>
<tr>
<td>Stressed vowel dur.: Short (msec)</td>
<td>-3.4</td>
<td>-0.9</td>
<td>0.39</td>
<td>1.4</td>
</tr>
<tr>
<td>Final vowel duration (msec)</td>
<td>16.6</td>
<td>5.2</td>
<td>&lt;0.001*</td>
<td>17.4</td>
</tr>
</tbody>
</table>

5. Conclusion

In the Trondelag dialect of East Norwegian, focus is implemented through an expanded pitch range and a change in tonal alignment. The lexical tonal accents are affected differently, in that accent 1 words have no change in alignment in narrow focus while accent 2 words have a later alignment. Focus thus enhances the lexical tonal contrast, as it also does with phonologically segmental differences: lengthening occurred for phonologically long vowels and phonologically long consonants. The asymmetrical effect of focus on both f0 contrasts and segmental contrasts is evidence that focus does not simply expand everything. Rather, its effect is mediated by phonological contrasts. There was lengthening of all vowels in unstressed syllables, where the phonological contrast between short and long vowels is neutralised. The AP H% tone was earlier and higher for both accents in narrow focus.

The results of this investigation add to the literature on the prosodic marking of focus and how it interacts with lexical pitch contrasts. Future research will include perception experiments to determine what acoustic factors listeners tune into to distinguish words with contrasting accents and furthermore how these perceptions are affected by prosodic focus.

6. Acknowledgements

Thanks to Wim van Dommelen for the use of the recording studio at NTNU, Trondheim. Special thanks also to Gjert Kristoffersen and his collaborators for help in choosing target words and to Gjert for transcribing the sentences into the dialect. Thanks to Randi Nilsen for insight into Norwegian intonation. We also thank the TAL reviewers and attendees for their very useful comments. Special thanks also to the IMS Stuttgart. The research used for this investigation was conducted with the support of the National Science Foundation Doctoral Dissertation Research Improvement Grant No. 1322700.
7. References


