Effects of focus on $f_0$ and duration in Irish (Gaelic) declaratives

Amelie Dorn, Ailbhe Ní Chasaide

Phonetics & Speech Laboratory, School of Linguistic, Speech and Communication Sciences, Trinity College Dublin, Ireland
dorna@tcd.ie, anichsid@tcd.ie

Abstract

This pilot study investigates the effects of focus (broad, narrow and contrastive) on tonal patterns, $f_0$ scaling and duration of accented syllables and rhythmic feet for a controlled dataset in Donegal Irish. Results show differences in pre-focal tonal patterns between broad focus and the other focus types. Narrow and contrastive focus renditions are implemented by largely the same phonetic means. Focused domains are overall longer in duration and have wider $f_0$ excursion than broad focus. Durational differences depend on sentence position.

Index Terms: intonation, focus, Irish Gaelic, duration

1. Introduction

In spoken communication focus is generally known to be employed for highlighting specific parts of an utterance for pragmatic and discourse functions. Languages differ in employed for highlighting specific parts of an utterance for pragmatic and discourse functions. Languages show differences in pre-focal tonal patterns between broad focus and the other focus types. Narrow and contrastive focus renditions are implemented by largely the same phonetic means. Focused domains are overall longer in duration and have wider $f_0$ excursion than broad focus. Durational differences depend on sentence position.

In intonation, changes in $f_0$ and duration are the assumed primary marking of focus [3]. A recent study on voice source correlates of focus in Irish English, however, also shows that it is not only changes in $f_0$ that are affected by focal accentuation, but the dynamics of the voice source as a whole [8]. Phonetic effects of focus are manifested in a larger $f_0$ excursion of focal accents, whereas pre-focal material remains largely unaltered and post-focal pitch accents are substantially compressed as has been shown for English [1]. It is generally known, that focally accented syllables are also characterised by higher intensity. Apart from pitch adjustments on focused constituents in an utterance, it has been observed that the duration of un-focused constituents is also affected on a wider level [2]. Further, the duration of focus syllables may also be influenced by sentence length and utterance position [7, 9-11]. In English and Dutch, for example, the effect of focus on the duration of words is stronger in sentence-initial and medial position, whereas in sentence-final position focal lengthening occurs to a much lesser degree. Contrary to these findings, in Swedish, focused words in IP-final position were found to be lengthened more than in other positions [11]. In English, the reduced effect of focus on the duration of phrase final items may be attributed to the already given lengthening of pre-boundary constituents in utterance final position [12, 13]. Some also argue, that duration may be a perceptually stronger cue for signaling focus than changes in $f_0$ alone [9].

In this study we analyse the tonal patterns, $f_0$ scaling, and duration as phonetic correlates of focus for three different focus conditions (broad, narrow and contrastive) in a Northern variety of Irish (Donegal, henceforth DI) (see Figure 1).

The study has been prompted by a number of different factors: On a more general level, it is part of an ongoing investigation of the prosody of Irish varieties and contributes to the typology of Irish dialects. To our knowledge, experimental investigation on the effects of focus on duration has to-date not been carried out for this particular variety of Irish, and consequently this pilot experiment contributes to a more comprehensive description of Irish intonation.

Figure 1: Map showing dialect area.

We are also dealing with a variety of Irish with a default rising pitch accent in neutral declaratives (L*+H L*+H L*+H %) [14]. This pattern is different from the generally observed falling (H*+L) pattern more typical of statements. In a previous study of bilingual speakers of Donegal Irish and Donegal English (studied in two separate groups) both were found to employ the same accent type (L*+H) in broad as well as in contrastive focus conditions [15]. This earlier study confirmed that the trends reported for English [1] were also found here. In this paper, we look closer at elements of the pitch patterns and particularly at duration characteristics.

Further, we analyse contrastive focus as a separate type of narrow focus [4]. It is of interest to us, if both these semantically different focus types are realised by the same phonological and/or phonetic means in the Donegal variety, since in some languages speakers distinguish between these focus types [5].

The aim of this paper is to determine if one or a combination of these acoustic measures contribute to distinguishing between the different focus types, or if differentiation is made by other variables not investigated here.

2. Methods and materials

2.1. Materials

The materials in this paper are largely the same as those reported for Donegal Irish and Donegal English in [15]. One target sentence with three potentially accented syllables (underlined) was embedded in mini-dialogues to provide a context and elicit narrow and contrastive focus on each of the three potentially accented syllables respectively (A1: Méabh /mæv/; A2: lu /lʊ/; A3: lea /le/).
Consequently, no comparison for this condition constituted new information in the response (e.g. Who is lying on the bed?). Narrow focus (nf) was triggered by a wh-question word was replaced with an alternative (e.g. Was Mary lying on the bed?). Broad focus (bf) was prompted by a general question, where the trigger word was replaced by an alternative (e.g. Any news?). Contrastive focus (cf) was elicited by a y/n question, where the trigger word was replaced with a question word and constituted new information in the response (e.g. Who is lying on the bed?).

Records were carried out locally in the Irish speaking area (Gaeltacht) in Donegal on a digital recorder ZOOM Handy Recorder H4. Six informants from three locations in the Irish speaking area in Donegal were recorded in pairs in a quiet room of an educational institution. Sentences were read four times in randomised order from a computer screen. This gives a total of 216 tokens (3 focus conditions x 3 potentially accentuated syllables) x 4 repetitions x 6 speakers. Due to the unnaturalness of triggering narrow focus on the IP-medial verb luí (A2) in Irish, this condition was not included in the data set (-24 tokens). Consequently, no comparison for this condition is available in the analysis. This leaves a total of 192 tokens. Utterances on which the desired focus type failed to be elicited, or which showed disfluencies in the pitch contour, were excluded from the analysis (around 20%).

2.2. Methods and measurements

Figure 2 illustrates the measurement points annotated for analysis.

![Figure 2: Schematic representation of the f0 measurement points and derived metrics.](image)

All data was orthographically transcribed and segmented using the PRAAT software [16]. The auditory analysis was carried out within the autosegmental-metrical framework using IVI labeling [17]. First, the main tune types were determined by careful auditory analysis. Then, the absolute low (L) and high (H) in each stress group (L1, H1, L2, H2, L3 and H3 respectively) were annotated. From these, the f0 scaling of each accent contour was calculated by subtracting the H from the L value (scalA1, scalA2 and scalA3 respectively). Note, however, that these calculations were only carried out for the most common contour type (L*+H), in order to provide reliable comparisons of results. Instances of high (H*) or downstepped accents (H*) were excluded from the comparative analysis. The duration of accented syllables (dursA1, dursA2 and dursA3 respectively) and the duration of rhythmic feet (durftA1, durftA2 and durftA3 respectively) were calculated. Durations of syllables and durations of feet were each pooled across all speakers regardless of accent type, as differences in duration were minimal.

3. Results

Results are presented as a comparison between broad focus (bf) and narrow (nf) and contrastive (cf) focus. Section 3.1 shows results of tonal patterns in pre-focal and focal accents in broad focus and when focus was produced on the IP-final stress group (A3). Section 3.2 outlines the results for scaling of focused accents. Section 3.3 presents results of durations of syllables and durations of rhythmic feet of focused constituents.

3.1. Tonal patterns

Results from the auditory analysis show that the rise (L*+H) is the default accent type employed on all focally accented constituents. This equally applies to broad, narrow and contrastive focus renditions.

Similar to findings reported for English [1], pitch accents in pre-focal material in DI were retained when focus was produced on the IP-medial (A2) and the IP-final (A3) stress groups. Similarly, post-focal material was deaccented. When contrastive focus was produced on A2, around half of the IP-initial pre-focal pitch accents were realised as L*+H, whereas the other half were H*.

Figure 3.1 presents the tonal patterns for pre-focal and focal accents in A3 across the three focus types. Pitch accent types in pre-focal material, however, vary across broad, narrow and contrastive focus conditions. The most common tonal pattern across the three focus types is the rise (L*+H). In broad focus there was a relatively uniform pattern (L*+H). However, in narrow and contrastive focus the pre-focal accents seem to be more variable. In particular, H* was realised in IP-initial accents, and H* occurred in IP-medial accents across the three focus types. Some phrase medial accents were de-accented, however, only to a small degree (around 10%) in each of the three conditions.

![Figure 3.1: Inventory of pre-focal and focal tonal patterns in broad (bf), narrow (nf) and contrastive focus (cf) in the IP-final stress group A3.](image)

With regard to focal types in A3, the rise (L*+H 0%) is again the most common tune across the three conditions (bf 73%, nfA3 74%, cfA3 80%). Instances of rise-falls (L*+H L%) were also found across the different focus types, however to a much lesser degree (bf: 28%, nfA3: 27%, cfA3: 20%).
For the qualitative analysis, it was decided to carry out measurements for the main tune type (L*+H) only in the present study, in order to provide reliable comparisons. Measurements of the other tune types and of the post-focal material for this tune will be tackled at a later stage. Note, however, with regard to duration, that all results regardless of accent type were averaged, as the durational differences of syllables and feet with different tunes, was minimal.

3.2. Scaling

Figure 3.2 presents the results of the effects of focus on the scaling of pitch accents in each stress group. The averaged results across all speakers are presented on a semitone scale (ST) (0=100Hz). Broad focus (black squares) is compared to narrow focus (grey squares) and contrastive focus (white triangles).

Looking first at broad focus alone, we note a difference in accent scaling across each of the three stress groups (A1, A2 and A3 respectively). The IP-medial accent (scalA2) exhibits the smallest $f_0$ range (1.5 ST), while the IP-final accent (scalA3) exhibits the largest range (4.9 ST) and is also larger than the IP-initial accent scalA1 (3.6 ST).

When comparing the scaling of broad focus accents to those under narrow focus, we note an increase in range for both scalA1 and scalA3. ScalA1 is increased by 1.4 ST, scalA3 by 1.7 ST compared to broad focus.

Under contrastive focus, we again see an increase in values for each of the accents in the respective stress groups. When contrastive focus is realised on A1, scalA1 increases by around 2 ST compared to broad focus. Similarly for contrastive focus on A3, scalA3 is 1.4 ST higher than in broad focus. The biggest difference, however, is visible in scalA2. Here we observe the highest increase (4.4 ST) in scaling when compared to the broad focus rendition.

Comparing the duration of the accented syllable of the second stress group (dursA2) in broad focus, with the contrastive focus condition, we note that A2 is significantly longer under contrastive (217 ms) than under broad focus (184 ms) ($F_{(2,36)}=21.94, p<0.0001$), which is also reflected by the effect size ($\eta^2=0.39$). The duration of the foot under contrastive focus ($ftA2$) is also significantly longer than in the broad focus condition ($F_{(2,36)}=4.28, p=0.046$, ($\eta^2=0.11$). Note that narrow focus on A2 was not included in the data set due to semantic constraints as previously pointed out in section 2.1.

The duration of the IP-final accented syllable (dursA3), is of almost the same duration in broad (200 ms), narrow (206 ms) and contrastive (208 ms) focus. Although the durations under narrow and contrastive focus are somewhat longer, these differences are not significant ($F_{(2,56)}=0.36, p=0.702$, ($\eta^2=0.013$). A similar observation can be made for the duration of the IP-final foot ($ftA3$). Here again, feet under narrow and contrastive focus are only minimally longer (409 ms in both conditions) when compared to broad focus (403 ms), respectively) compared to broad focus (257 ms). Differences between focus types are overall significant ($F_{(2,56)}=7.26, p=0.002$). A Tukey pairwise comparison test, however, showed that the differences between bf and cf are significant, but those between bf and nf are not. 21% of this variance is explained by the type of factor focus ($\eta^2=0.21$). Similarly, the duration of the IP-initial feet (durftA1) under both narrow (397 ms) and contrastive focus (418 ms) are longer than in broad focus (389 ms). These differences are also overall significant ($F_{(2,56)}=3.54, p=0.036$), but the effect of focus on these differences is comparatively smaller ($\eta^2=0.11$).
These differences were also not significant ($F_{2.55}=0.09$, $p=0.911$), ($\eta^2=0.003$).

4. Discussion

In this paper we examine the effects of three different focus types (broad, contrastive and narrow) on tonal patterns, $f_0$ scaling and duration in Donegal Irish.

The default accent type under focus is again the rise (L*+H), which confirms findings reported in [15]. It is also the overall most common pitch accent choice in pre-nuclear and nuclear positions. With regard to tone types our data showed variation in pre-focal pitch patterns. DI has a relatively monolithic pre-nuclear tonal pattern in broad focus (L*+H), but in narrow and contrastive focus conditions pre-focal material showed deviations from this pattern: H* and $\eta$H* occurred more frequently in nf and cf than in bf. The deviations from the main pattern in pre-focal material, however, don’t seem to be obligatory, since L*+H is also an option. Since this is a pilot experiment, analyses of more data is needed to determine, if nf and cf are indeed distinguished from bf by their pre-focal tonal patterns. In terms of nuclear tonal patterns, DI speakers largely employ the same type as in the neutral rendering when focus occurs on the IP-final stress group, however, with an expansion of the pitch range, similar to findings in [11].

With regard to scaling of focally accentuated constituents, our results are largely in agreement with those reported for English [10, 11]. $F_0$ shows a larger excursion under focus than in the neutral rendering in all sentences positions. The most striking difference in scaling compared to the non-focus conditions occurs on the IP-medial stress group. Under contrastive focus, pitch accents showed a somewhat larger $f_0$ excursion in IP-initial position than under broad and narrow focus. In IP-final stress groups, on the other hand, a slightly higher scaling was observed for narrow than for contrastive focus. Further analysis will be needed to determine, if we are really dealing with a possible distinction between narrow and contrastive focus with respect to these parameters or if these differences are in fact brought about by inter-speaker variation.

Regarding syllable and foot duration in DI, both narrow and contrastive focus have largely the same effect: focused syllables are overall longer than in broad focus as are durations of rhythmic feet. This trend, however, was hardly evident when focus was produced on the IP-final constituent (durA3, durftA3). Our findings show that the Irish data exhibit trends which are more akin to the case of English and Dutch, where focused IP-initial and IP-medial syllables and feet are considerably longer in duration than IP-final ones [9]. A certain limit in lengthening of IP-final pre-boundary constituents is a well-known phenomenon in English [10, 12, 13] and seems to apply also to this Northern variety of Irish.

5. Conclusions

This paper has provided insights into the effects of focus on the tonal patterns, $f_0$ scaling and duration in a Northern variety of Irish. At the outset of this study we questioned whether the proposed acoustic measures contribute to distinguishing between the different focus types in Donegal Irish.

Our results showed a distinction between broad focus on the one hand and narrow and contrastive focus on the other hand in terms of variability of pre-focal pitch patterns, focal accent scaling and durational differences of focused constituents in IP-initial and IP-medial position. No apparent distinction between narrow and contrastive focus, however, emerged. Since this is a pilot experiment, we do not propose that results are definite. In general our results for this variety of Irish confirm findings reported in previous studies for other languages, where focus is generally assumed to be accompanied by longer duration and larger $f_0$ excursion.

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7. References