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Effects of Focus on f_0 across Four Varieties of Donegal Irish

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Abstract

This paper reports on the effects of three types of focus, broad (*bf*), narrow (*nf*) and contrastive (*cf*), on tonal patterns and pitch accent scaling in focal, pre-focal and post-focal constituents across four varieties (RF, BF, GCC, RG) of Donegal Irish (DI). The analysis was carried out on a controlled data set where the three focus conditions (*bf, nf, cf*) were elicited on each of the three potentially accentable syllables (A1, A2, A3) in separate iterations of a phrase. Results suggest that the same pitch accent types is used for realising *nf* and *cf*. Across the four varieties, the preferred focal pitch accent is the low rise (L*+H) in *bf*, *nf* and *cf*, except in the RG variety where the fall (H*+L) occurred more frequently when focus was realised on the phrase-initial syllable (fA1). The low rise (L*+H), however, was still a second choice. In terms of pitch accent scaling, focal accents show larger f_0 excursions, while post-focal constituents are typically de-accented. This is the case for all of the four DI varieties.

Index Terms: intonation, prosodic focus, Irish Gaelic, Donegal Irish

1. Introduction

Information structure concerns the different means by which information in utterances can be packaged into meaningful units [1]. In discourse, part of this involves highlighting, or focusing of new information in relation to already given, or background, information. Focus then determines which part of a sentence contributes new or contrastive information [2]. Languages vary in the use of different grammatical means (syntactic, morphological or prosodic markers) for focus marking, and typically, different focus types can be marked by one or more of these grammatical means. Often, a trade-off between these markers can be expected, as is the case in Spanish and Italian, for example [3]. Prosodic focus marking then can be realised by varying means across different languages. In the literature, some have taken the view that the realisation of focus depends on the intonational phonology of a particular language [4]. Others, have suggested that focus in very different languages appears to be marked by specific phonetic pitch adjustments, affecting different regions of the utterance and speculate that such adjustments may apply to all languages [5]. In this respect it is of interest to investigate in this paper what the prosodic correlates of focus are in the four Donegal Irish varieties Rann na Feirste (RF), Baile na Finne (BF), Glean Cholm Cille (GCC) and Ros Goill (RG). These Gaeltacht (Irish speaking) areas are shown in Figure 1. Note that they do not form a continuous dialect area but rather isolated 'language pockets' where Irish survives as a community language. The detailed study of dialect prosody contributes to our understanding of the structure of Irish, but also contributes to parallel research in the development of multidialect speech synthesis and other technologies for the dialects of Irish (the ABAIR initiative [6, 7]).

In the present study it is also of interest to ascertain how the realization of focus in these dialects compares to the trends observed for other languages. As reported for certain Romances languages, this may concern a preference for specific tones in focal accentuation, or differences in tonal alignment, which can lead to differences in tunes between broad and contrastive focus as noted, for example, in [8-11]. Previous studies on prosodic focus marking for some DI varieties have suggested that the low rise (L*+H) is the preferred tune in focal accents for both narrow and contrastive focus [12, 13].

Figure 1: *Map of Co. Donegal showing the four local dialect areas (Rann na Feirste (RF), Baile na Finne (BF), Gleann Cholm Cille (GCC) and Ros Goill (RG) (green) examined in this paper.*

If, as is widely reported, the *f0* excursion size is a major aspect of prosodic focus signaling [14, 15], it is also of interest to see how this would be realised on L* + H tones: if the focal accent involves rescaling of the accent, if the change involves a raising of H, a lowering of L* or a combination of both of these. It is also of interest to see if the four Donegal Irish varieties might show a 'tri-zone pitch range adjustment' (involving different adjustments in the pre-focal, focal and post-focal portions of the utterance) as reported by [5] for English and claimed for many languages very different from English, such as tone languages.

2. Materials and methods

2.1. Materials

The materials in this paper are largely the same as those reported for Donegal Irish in [14-16]. One target sentence with

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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 /mʲeːw/, **A2**: luí /lʲiː/, **A3**: lea /ʎa/).

Bhí	Méabh	‘na	luí	ar	a’	leabaí
/vʲi	ˈmʲew	nˠə	ˈlʲi	ərˠ	ə	ˈʎabˠi/
was	Méabh	in her	lying	on	the	bed

‘Méabh was lying on the bed.’

Broad focus (*bf*) was prompted by a general question, not giving any information about the focusable elements in the phrase (e.g. What was happening?). Narrow focus (*nf*) was elicited by a wh-question where the trigger word was replaced with a question word and provided new information in the response (e.g. Who is lying on the bed?). Contrastive focus (*cf*) was triggered by a yes/no question where the target word was replaced by an alternative (e.g. Was Mary lying on the bed?). Note, that no narrow focus (*nf)* on A2 (luí) was elicited as it was unnatural for Irish speakers to produced narrow focus on this element. As a consequence, this condition was excluded from the data set.

Recordings were carried out locally in the Irish speaking area (Gaeltacht) in Donegal using digital recording equipment ZOOM Handy Recorder H4, and Edirol 25 USB audio interface via Audacity sound recording software [17]. Four informants from each of the four locations in the Irish speaking area in Donegal (see Figure 1) were recorded in pairs in a quiet room of an educational institution. Sentences were read five times in randomised order from a computer screen yielding 80 tokens for each focus condition (bf, nfA1, cfA1, cfA2, nfA3, cfA3) and a total of 480 tokens. Due to the unnaturalness of triggering narrow focus on the IP-medial verb luí (A2), this condition was not included in the data set. Consequently, no comparison for this condition is available in the analysis across the four varieties. Utterances which were not produced with focus on the intended accent, or which contained disfluencies were discarded (16%), leaving a total of 305 tokens.

2.2. Methods

As a first step in the data analysis for each variety, careful auditory analysis and inspection of the *f0* contours was carried out. All utterances were labelled manually in the same manner in Praat [18] using IViE labelling [19]. Then, values were extracted automatically using adapted Praat scripts [20].
First, target utterances were transcribed orthographically (see Figure 2, tier 5), then stressed syllables were segmented (tier 4) and tone labels were annotated (tier 3). As a second step, the potentially accented syllables in each group were marked (s1, s2, s3) as was the unstressed material preceding and/or following accented syllables (sp1, sp2, sp3, sp4) (tier 2). Further, the absolute f_0 minimum (L) and maximum (H) in each of the three accent groups (A1, A2 and A3) were annotated as was the beginning (B) and end (E) of the pitch contour of each phrase (tier 1). Mean representations of the *f0* contours of target phrases were generated from the measured pitch points (B, L1, H1, L2, H2, L3, H3, E). For each speaker, *f0* values were converted to semitones (st) with the individual speaker’s minimum as the reference value. From the annotated pitch points, the *f0* scaling of each accent contour was calculated by subtracting the L from the H value (*f0*exA1, *f0*exA2, *f0*exA3 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.

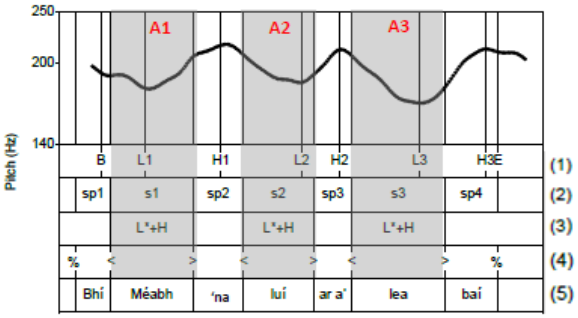

Figure 2: Example of *f0 annotation and segmentation points*.

Statistical analyses were carried out to test for significant differences in the realisation of *f0* excursion in focal *bf*, *nf* and *cf* within a particular variety, and also to test for cross-variety differences. To determine whether the three focus types were significantly different in terms of focal *f0* excursion within each variety, a series of one-way ANOVA tests were conducted for RF, BF, GCC, RG separately, followed by Tukey’s HSD post-hoc tests. The alpha level was set to 0.05. In addition, the effect size was calculated as eta squared ($\eta 2$). To also determine potential cross-variety differences the effect of the independent variables (i.e. focus and dialect) on the dependent variable (i.e. *f0* excursion) were tested with a series of linear mixed models [21]. In the first models, focus condition (3 levels: nf, cf, bf) and dialect (4 levels: BF, GCC, RF, RG) were treated as fixed factors. Speaker (4 levels) and repetitions (5 levels) were included as a random factor to take inter-speaker and repetition variability into account. Pairwise interactions between the fixed factors were also tested and models log-likelihoods compared. As the interactions between condition *focus* and *dialect* were not significant, simpler models were chosen to investigate the significance of the main effect focus condition. Here we report the outputs of the latest models where *focus condition* was treated as a fixed factor and *inter-speaker*, *repetition* and *dialect* were treated as random factors. The relevance for including these three random factors in the models was evaluated by carrying out a set of likelihood tests [22]. Accent position (A1, A2, A3) was not included as fixed factor in the models as for the narrow focus condition, accent position A2 was not available. Interactions between *focus* and *dialect* were not significant, thus simpler models were chosen. The p-values were calculated using the method of Monte Carlo sampling by Markov chain (pMCMC = Monte Carlo Markov Chain) [23]. In all models, significance was set at pMCMC $\alpha < 0.01$.

3. Results

Section 3.1 shows the results for tonal patterns across the four DI varieties. The figures in section 3.1 show superimposed, but not time-normalised*f0* contours for the different focal conditions (bf= black line; nf=blue line; cf=red line). The extracted values for the measured *f0* points were averaged across the speakers of a given variety for the primary (preferred) tune. The three accentable syllables A1, A2 and A3

are shaded in grey and the focally accented syllables (fA1, fA2, fA3) are outlined in pink. Section 3.2 discusses the findings for pitch accent scaling.

3.1. Tunes

Figure 3 shows the superimposed *f0* contours for *bf* and *nf*A1 and *cf*A1 in RF, BF, GCC and RG respectively. The auditory analysis showed that focal accents (narrow and contrastive), regardless of which position in the phrase (A1, A2 or A3), were almost always produced with a rising pitch pattern L*+H across the varieties, with the exception of focal A1 in the RG variety where the fall H*+L was the preferred tonal pattern.

Looking first at the realisation of broad focus (*bf*) (see Figure 3), the differences in pre-nuclear tonal patterns are noted across the four varieties. The IP-initial accent is most typically a rise (L*+H) in the RF, BF and GCC varieties, but a high accent (H*) in RG. The middle accent is highly variable and is realised as a rise, a high (H*) or downstepped high (!H*) or in some cases becomes deaccented. In terms of the nuclear accents a more uniform pattern emerged across the dialects. The overall preferred nuclear pattern is the rise (L*+H %) and only few instances of rise plateau slumps (L*+H L%) were noted. When focus is realised on the IP-initial accent (fA1) again the low rise L*+H is the most typical tune in the RF, BF and GCC varieties, but a fall (H*+L) in RG. Post-focal material becomes largely de-accented.

Looking next at the realisation of contrastive focus on the second accent group (cfA2), see Figure 4, the low rise L*+H is the preferred pattern across the four DI varieties. Note, that no *nf* was elicited on A2 as mentioned in section 2 above. Pre-focal accents are typically also realised with L*+H in RF, BF and GCC, but H* is employed more frequently in RG, even though the low rise was still a frequent alternative. Post-focal material is again deaccented and realised with a falling pitch trajectory.

Looking finally at the realisation of *nf* and *cf* on the IP-final accent group (fA3), see Figure 5, L*+H is the preferred focal accent type across the three focus types in RF, BF and GCC and this accent was also found in pre-focal A1. Higher variation in tunes occurred in phrase-medial pre-focal accents where L*+H but also downstepped high accents (!H*) occurred to varying degrees across *bf, nf* and *cf*. Due to the high variation in tunes in RG, no clear trend was visible as to the preferred tonal patterns and was thus excluded from the analysis.

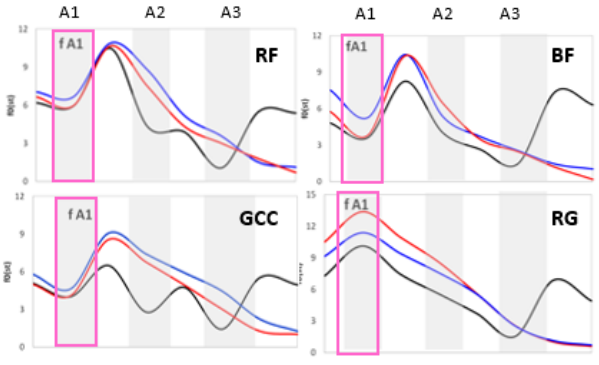

Figure 3: *Mean f0 contours in semitones (st) of sentences in bf (black line) nf*A1 *(blue line) and cf*A1*(red line) for speakers of RF, BF, GCC and RG.*

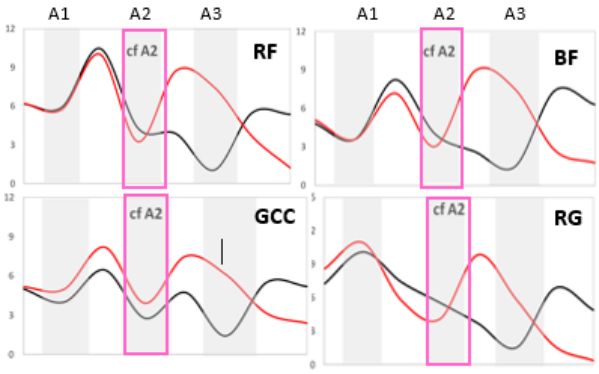

Figure 4: *Mean f0 contours in semitones (st) of sentences in, bf (black line) and cfA2 (red line) for speakers of RF, BF, GCC and RG.*

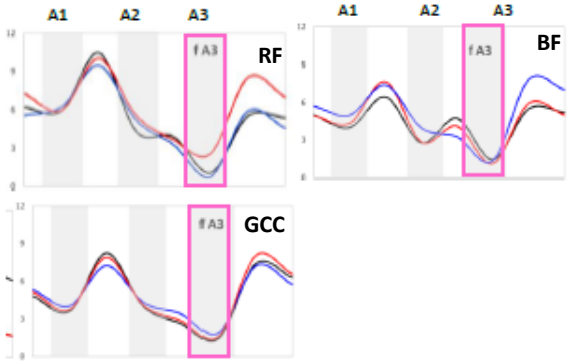

Figure 5: *Mean f0 contours in semitones (st) of sentences produced in bf (black line) nf*A3 *(blue line) and cf*A3 *(red line) for speakers of RF, BF and GCC.*

3.2. Pitch accent scaling

Table 1 shows the values in semitones (st) for pitch accent excursions averaged across all speakers for the preferred tune only, within each variety for A1, A2 and A3 in *bf* and the corresponding narrow and contrastive focus renditions. Note, that no values were obtained for nfA2. Contrastive and narrow focus on the phrase-final accent group (cfA3 and nf A3) in the RG variety had to be excluded from the analysis due to the high variability in tunes which didn't yield conclusive results.

Table 1: *Average focal pitch accent scaling in semitones (st) in the DI varieties.*

	bf_{A1}	nf_{A1}	bf_{A2}	nf_{A2}	bf_{A3}	nf_{A3}
RF	4.5	4.2	-0.43	--	4.5	4.4
BF	4.6	5.2	-1.4	--	5.9	5.3
GCC	2.5	4.4	1.9	--	4.1	6.3
RG	-2.7	-2.0	-2.2	--	--	--
	bf_{A1}	cf_{A1}	bf_{A2}	cf_{A2}	bf_{A3}	cf_{A3}
RF	4.5	5.0	-0.43	5.2	4.5	5.7
BF	4.6	6.5	-1.4	5.6	5.9	6.4
GCC	2.5	4.4	1.9	3.8	4.1	3.9
RG	-2.7	-2.4	-2.2	5.8	--	--

Looking first at the effects of focus on *f0* in RF, BF, GCC and RG respectively, the measurements in Table 1 show that

focal accents in A1 and A2 are most typically higher compared to their equivalent in broad focus. Accent excursion appears to depend on the position in the phrase: the most dramatic effect of excursion differences compared to broad focus is observed in phrase-medial focus (A2) with the most substantial boosting of the accent and this effect is also statistically significant in each of the four varieties (RF: $F_{(2,18)}$=105,97; p<0.0001, η2=0.9; BF: $F_{(2,23)}$=207.76; p<0.0001, η2=0.9; GCC: $F_{(2,18)}$=27.26; p<0.0001, η2=0.6; RG: $F_{(2,12)}$=75.56; p<0.0001, η2=0.9). In the phrase initial (A1) accent groups in both *nf* and *cf*, accent excursion is overall higher than in *bf*, except for *nfA1* in the RF variety, but the differences are much less clearly pronounced than in the phrase-medial accent and are only significant for GCC (RF: $F_{(2,33)}$=0.38; p<0.69, η2=0.03; BF: $F_{(2,41)}$=2.67; p<0.081, η2=0.11; GCC: $F_{(2,31)}$=3.74; p<0.035, η2=0.2). In the case of focal A3, the situation was not clear-cut. In one variety, RF, contrastive focus has a considerably but not significantly greater *f0* excursion than *bf* (*cf:* $F_{(2,26)}$=0.87; p<0.43, η2=0.06), in another variety, GCC, narrow focus (but not contrastive focus) has a considerably greater *f0* excursion (*nf:* $F_{(2,15)}$=8.58; p<0.01, η2=0.4; *cf:* $F_{(2,14)}$=0.05; p<0.832, η2=0.003), in a further variety, BF, there are minimal differences in the three focal conditions ($F_{(2,34)}$=0.45; p<0.644, η2=0.03).

Looking next at cross-variety differences, overall the *f0* excursion on A1 was significantly different between *cf* and *bf* (t=0, pMCMC=0.0001), and also between *bf* and *nf* (t=0.0004, pMCMC=0.0010). In A2, the differences between *bf* and *cf* were also significant (t=0, pMCMC=0.0001). This, for the L*+H accent involves a raising of the peak (H) or a raising of the entire accent in register, (raising of both L* and H targets), which was determined by visual inspection of the plotted *f0* measures (see Figures 3-5). There was rarely any additional lowering of the L* target as a means of focally extending the *f0* excursion. Post-focal accents are most commonly de-accented and show a steeply falling pitch slope. This trend is observed across all varieties. The pre-focal patterns are either slightly reduced (RF and BF varieties), but can also be boosted and/or raised in register (GCC and RG varieties). In phrase-final focus (A3) this trend is less consistently present and the focal accents often resemble those in the neutral rendering, e.g., significantly greater boosting of the accent was observed in RF for *cf*, but not for *nf*. It is difficult to make a definitive statement on these data. Overall, however, no significant effects of focus on the phrase-final *f0* excursion were found between *bf* and *nf* (t=0.0557, pMCMC=0.0520) or *bf* and *cf* (t=0.0426, pMCMC=0.0622). It is possible on the one hand that focal accentuation, along similar lines to A1 and A2 occurs, but that it has not been consistently elicited in this study.

4. Discussion

This paper has investigated the effects of three focus types (*bf*, *nf*, *cf*) on tonal patterns and *f0* scaling across four Donegal Irish varieties. Our findings indicate that different tonal accents are not exploited as a mechanism for signalling focal accentuation. Unlike Romance languages, such as European Portuguese [9], Florentine Italian [11] or Spanish [24], Irish does not mark contrastive focus by a categorically different pitch accent. Results also confirm the findings of the pilot experiments [12,13]. The rise (L*+H) is used in all focal conditions, except in the RG variety in phrase-initial focus (A1) (H*+L). In contrast, considerably more variability was found both in the pre-nuclear tonal accents associated with broad focus utterances and in the realisation of pre-focal accents when a later constituent carries focal (nf or cf) accentuation. In phrase-final focus (A3), the focal accents often resemble those in the neutral rendering. All in all, we tentatively conclude that focal accentuation is less dramatically and less consistently signalled when it falls on the final constituent of the phrase.

As to the pre-focal tunes in these varieties, results showed a high degree of variability within and among speakers of the same variety and also across varieties. Although L*+H is the preferred tonal pattern in RF, BF and GCC it is never the only possible choice. The RG variety differed from the other three, in that the fall H*+L occurred more frequently in focal accents on the phrase-initial accent group (A1), though the rise L*+H was the preferred tune phrase-medially. Since this tune variability in RG had also been observed in related studies [16, 25], we can conclude that this is not an effect of focus.

As to focal pitch accent scaling, the DI varieties show many of the effects of focus on f_0 which have also been reported for English and claimed as universal [5] in terms of the '3-zone pitch range adjustments' whereby the pitch accent excursion is substantially increased on the focal element, and the pitch range in the post-focal material is suppressed. The boosting of the focal accent was found, at least for A1 and A2, but not consistently for A3. The boosting of *f0* on the focally accented syllable can be achieved either by raising the height of the H peak of the bitonal L*+H accent, or by raising the register of both the L* and the H targets. There was virtually never a lowering of L* to achieve the additional *f0* excursion. One difference concerns the pre-focal material. This does not remain unaltered in the DI varieties as was found by [5], but shows rather a tendency for a reduction in the pitch range of pre-focal accents, i.e. a reduction in the scaling of the accent, or at times even an increase in register. For postfocal material, deaccentuation was found to be a major correlate of focus, in that the postfocal material showed a steep decline in *f0*.

5. Conclusions

Concluding, we can summarise that focus across the four DI varieties is largely realised in the same way. In terms of the pitch contour, it involves a raising of the *f0* peak of the focal accent, along with de-accentuation of post-focal material. De-accentuation was most commonly manifest with a sharp drop in *f0* from the (typically) preceding trailing H of the focal L*+H accent. Narrow and contrastive focus are realised by the same means: there are no significant differences in tonal patterns between these different focus types and they also show similar trends in terms of accent scaling. The scaling measurements confirmed that focal accents have wider excursion than in the unmarked rendering of the phrase. Dialect differences only emerged in tonal patterns, in that the RG variety differed from the other three in terms of its preferred pre-nuclear nuclear tune, H*+L, whereas the rise L*+H is also the default tonal pattern in broad, narrow and contrastive focal accents in the RF, BF and GCC varieties.

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