9th International Conference on Speech Prosody 2018
13-16 June 2018, Poznań, Poland

IP length and peak (and valley) trends in neutral declaratives in Connaught and Ulster Irish – a comparison

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Abstract

This paper explores the influence of IP (i.e. Intonational Phrase) length on the scaling of the IP-initial and IP-final tonal targets – peaks (and valleys) in three Irish dialects. The analysis covers a set of matched neutral (i.e. broad focus) declaratives of two IP lengths (with 2 and 3 accent groups, respectively) produced by native speakers of two Connaught dialects, C-CF and C-IM and the Ulster dialect of U-GD. The data was analysed for H and L tone scaling in the phrase-initial and final accents. Additionally, the ratio of the final to the initial peak height was calculated (and the final to initial L height in the case of the U-GD dialect).

The results show little to no influence of IP length in the Connaught dialects on any of the peak metrics. However, for the U-GD dialect there is a strong influence of IP length on the initial accent (L*+H) where both the L* and H elements are substantially raised. The final accent behaves rather differently being remarkably invariant in both IP length conditions.

Index Terms: Connaught Irish, Ulster Irish, neutral declaratives, IP length, peak height, peak scaling ratio

1. Introduction

This paper explores tonal scaling of initial prenuclear (IP-initial) and nuclear (IP-final) peaks in neutral declaratives of varying lengths (2 and 3 accent IPs) for three dialects of Irish. These are the Ulster dialect of Gaoth Dobhair (U-GD) and the Connaught dialects of Inis Mór, the largest of the Aran Islands (C-IM) and the coastal area of Cois Fharraige, Co. Galway (C-CF) – see locations in Figure 1. The scaling of the IP-initial and IP-final peaks is looked at, as well as the relationship between them – the scaling ratio of the final to the initial peak.

Past studies have suggested that the height of initial peaks tends to be greater in longer utterances than in short [1, 2, 3]. While this finding is debated and not always supported across utterances of many different lengths, a number of studies show a distinct trend towards lower initial peaks in short (2-accent phrases) than in the longer phrases [4, 5, 6]. The nuclear peaks, however, tend to be higher in the 2-accent phrases than in the longer utterances [2, 5, 6].

The dialects looked at in this study differ in their declarative tunes – in Connaught Irish, they tend to be sequences of H*+L, while in Ulster Irish they are typically sequences of L*+H accents. The peak (H) scaling values looked at here are thus the starred tones in C-IM and C-CF, but the trailing tones in U-GD – for this dialect, the scaling of the starred low tone is also considered.

It is worth noting that the dominant tunes in these dialects are generally constant across sentence modes, but the scaling of the initial and final peaks can be used as a marker of interrogativity in WH and Y/N questions [7]. Given their apparent importance in differentiating sentence mode, it was hypothesized that the scaling of these peaks might be more constrained in Irish and the effects of phrase length consequently less likely to manifest in these dialects.

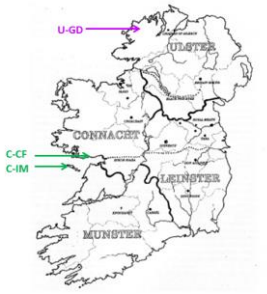

Figure 1: *Map of Ireland with the Ulster and Connaught locations indicated: Gaoth Dobhair (U-GD), Cois Fharraige (C-CF) and Inis Mór (C-IM).*

This work complements ongoing research aimed at the provision of multi-dialect synthesis of Irish, to be deployed in public and educational applications [8, 9]. Explicit modelling of the intonational characteristics of the dialects will help towards these goals while adding to our understanding of the prosodic structure of Irish.

2. Materials and methods

Thirteen speakers were initially analysed, and two dropped due to inconsistencies in the tunes used, so the data presented here is for eleven (4 C-IM, 4 C-CF and 3 U-GD speakers). The Connaught informants are from Cois Fharraige on the coast of County Galway, and from Inis Mór, the largest of the three Aran Islands off the coast of County Galway. The Ulster informants are from Gaoth Dobhair in County Donegal. All are native speakers of the local variety with Irish as their first language, and none are professional speakers (e.g. actors, newsreaders). It is worth noting that locating native speakers of Irish, and particularly for a specific dialect, is not always easy within time constraints. The main criterion for selecting representative speakers was that they are native speakers of the dialect and use Irish daily. Thus, we recorded both females and males ranging in age from 20 to 60. The information about the speakers' gender and age is presented in Table 1.

The data presented here include a set of two structurally matched declaratives with two and three pitch accents,

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respectively. These items were interspersed with other material, and embedded in question-answer mini-dialogues designed to elicit a neutral reading. This design would likely ensure that the readings would be produced as single IPs and carry a tune typical of each dialect, hence H*+L (H*+L) H*+L% for Connaught, and L*+H (L*+H) L*+H% for Ulster. The target phrases are presented in Table 2.

Five repetitions of each target phrase were obtained for each speaker, thus giving 130 declarative tokens in total. Out of those, only two items were excluded due to errors/disfluencies.

Table 1: *Information about the speakers recorded for the study.*

Dialect	No. speakers and gender	Age group
C-CF	1 female	30-45
	3 male	20-30
C-IM	4 female	45-60
	1 male	45-60
U-GD	3 female	30-45
	2 male	30-45 and 45-60

Table 2: *The short (2-accent) and long (3-accent) declaratives with their translations into English. Stressed syllables are marked in colour.*

	Declarative
short	Bhí **Cian** ag an **ma**rgadh. *Cian was at the market.*
long	Bhí **Cian** ag **caint** leo sa **ma**rgadh. *Cian was talking to them in the market.*

The Cois Fharraige and Gaoth Dobhair data were recorded in a semi-anechoic room, while the Inis Mór data were recorded on location in the home of one of the speakers in a quiet room. The data were recorded at the 44,100 Hz sampling frequency onto a laptop using the Audacity software [10].

The selected data were analysed using Praat [11]. F0 was extracted using the autocorrelation method, with the pitch floor set at 70 Hz for the male speakers, and at 100 Hz for the female speakers. The f0 traces were inspected for possible f0 estimation errors and corrected in the few necessary instances.

The data were transcribed for accents and boundary tones using the IViE labelling system [12, 13] in order to select comparable data for measuring tonal scaling. The IViE analysis showed that in the Connaught declaratives the main tune was H*+L (H*+L) H*+L% (n=33 in Cois Fharraige, and n=31 in Inis Mór); L*+H (L*+H) L*+H% was the dominant pattern (n=25) in the Ulster declaratives. These numbers exclude any other data which did not conform to the all-falling (Connaught) or all-rising (Ulster) patterns. Consequently, two speakers were omitted – a U-GD speaker whose all declarative data featured the L*+HL% nuclear tune, and a C-IM speaker whose declaratives consistently exhibited the H* (H*) H*+L% pattern.

The f0 measurements taken are shown in Figure 2. These include the f0 points corresponding to the accentual H and L (2 per accent group), and the f0 at the initial and final phrase boundaries, thus giving 6 f0 points in the short IPs and 8 in the long IPs. The extracted f0 measurements in Hertz were converted to semitones [ST] in order to make the data of male and female speakers comparable. The ST values were calculated relative to the speaker-specific baseline [14] defined as the lowest f0 in the speaker's data in order to yield only positive values.

The measured f0 points were used to produce mean stylized contours for the short and long declarative in each dialect, shown in Figure 3. The H scaling measurements include **Hpn1** (height of the first prenuclear, i.e. IP-initial, peak), and **Hn** (height of the nuclear, i.e. IP-final, peak). A further measure derived was the **Hn/Hpn1 scaling ratio**, which was calculated with the formula Hn/Hpn1*100. For the U-GD data, the scaling of the leading L tones was also looked at, mirroring the above H peak metrics (to yield measures for **Lpn1**, **Ln** and the **Lpn1/Ln** scaling ratio).

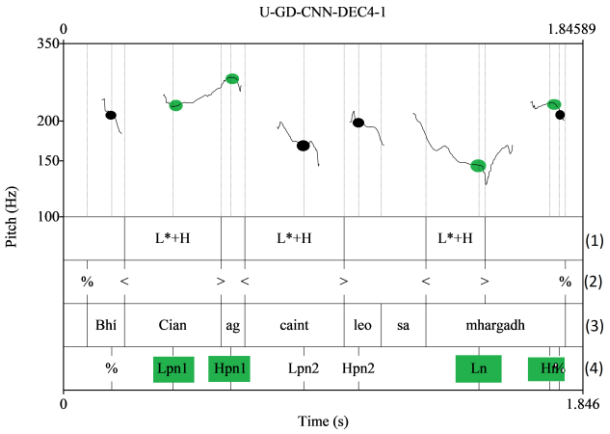

Figure 2: *Example of the declarative "Bhí Cian ag caint leo sa mhargadh" by a U-GD speaker, showing the f0 measurement points (circles, coloured green in PN1 and N accents). The annotation tiers include: (1) IViE transcription of accents; (2) stressed syllable and IP boundaries; (3) orthographic transcription, and (4) H and L f0 points in each accent group and at IP boundaries where the f0 measurements were taken.*

3. Results and discussion

This section presents the following results: stylized contours (Section 3.1), peak scaling of Hpn1, Hn and Hn/Hpn1 ratio (Section 3.2), and mirror metrics of Lpn1, Ln and Ln/Lpn1 ratio (Section 3.3). The data is discussed mainly in terms of means and standard deviations, and the first (Q1) and third (Q3) quartiles where relevant. Due to the small size of this dataset, paired samples *t*-tests are used separately for each dialect to estimate the possible effect of IP length on the f0 metrics. Speaker averages (over all his/her repetitions per Length condition) are used in the tests; exact *t* values are reported.

3.1. Stylized contours

Stylised f0 contours, based on the 8 or 6 f0 measurement points for the long and short IPs, respectively, are shown in Figure 3 for each of the three dialects.

In the two Connaught dialects there is effectively no difference in scaling for the prenuclear or nuclear peaks according to IP length (the greater dip for the L tone in the IP-initial accent in C-CF and C-IM is not important, as it is almost certainly a reflection of the greater number of unstressed syllables in the first accent group for the short IP). However, the trend noted in other languages does show up in the U-GD dialect. In the IP-initial accent, both L and H are higher in long IPs. In the nuclear accent, the H is also lower in the long IP condition.

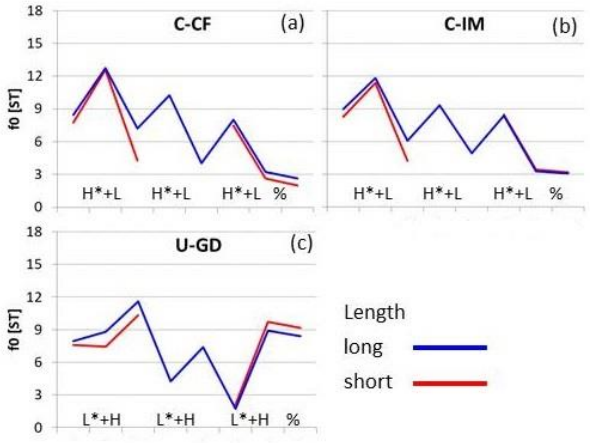

Figure 3: *Stylised f0 contours for short and long IPs of C-CF, C-IM and U-GD.*

3.2. Peak scaling and peak ratio

3.2.1. IP-initial H (Hpn1)

Scaling measurements for the IP-initial prenuclear peak (Hpn1) are shown in Figure 4(a). One can see that for C-CF and C-IM there is no significant difference in the scaling of Hpn1 between long and short IPs – the values between Q1 and Q3 largely overlap in the long and short IP conditions in both Connaught dialects. The absence of a significant difference in these data is confirmed by the *t*-test results (C-CF: $t(3) = -0.75$, $p = 0.506$; C-IM: $t(3) = -0.117$, $p = 0.914$).

In the U-GD dialect the initial peak is found to be higher in long IPs (long: M = 12.0 ST, SD = 1.5 ST; short: M = 10.3 ST, SD = 1.8 ST). The difference in Hpn1 scaling between long and short IPs is significant ($t(2) = -9.43$, $p = 0.011$).

3.2.2. IP-final H (Hn)

The scaling of the nuclear peak is illustrated in Figure 4(b). As with the phrase-initial peak, IP length does not appear to affect the scaling of the nuclear peak in the two Connaught dialects. The Hn values in long and short IPs largely overlap in C-CF and C-IM alike. Consequently, there are no significant differences between the long and short IP conditions (C-CF: $t(3) = -1.09$, $p = 0.356$; C-IM: $t(3) = -0.08$, $p = 0.937$).

In the U-GD dialect, Hn is somewhat lower in the long IP condition (M = 9.0 ST, SD = 1.0 ST) compared to short (M = 9.5 ST, SD = 2.2 ST). This minor difference is not significant ($t(2) = -0.51$, $p = 0.661$).

3.2.3. Hn/Hpn1 ratio

The results for the peak scaling ratio of the nuclear to the initial prenuclear peak are shown in Figure 4(c). Note that the lower the percentage value on this chart, the greater the f0 drop from Hpn1 to Hn (e.g. a value of 100% would indicate that Hpn1 and Hn are of equal height, 50% – that the height of Hn is half that of Hpn1).

Not surprisingly, given the individual findings for Hn and Hpn1, there is no significant difference in the Hn/Hpn1 ratio between long and short IPs for either C-CF ($t(3) = -0.86$, $p = 0.452$) or C-IM ($t(3) = 0.16$, $p = 0.885$). Note, however, that the ratios are considerably lower in C-CF (ranging from about 50% to 75%) than in C-IM (ranging from about 65% to 85%).

There is a clear trend in the U-GD dialect for a lower Hn/Hpn1 ratio in long IPs (M = 76%, SD = 9.8%) compared to short IPs (M = 93%, SD = 10%). The mean difference thus amounts to 17%, but does not achieve statistical significance ($t(2) = 2.88$, $p = 0.102$).

It is rather striking that the Hn/Hpn1 ratio values are higher in Ulster than in the Connaught dialects, and this is particularly noticeable for the short IP condition (U-GD peak ratio values ranging from 70% (Q1) to 90% (Q3) in long IPs, and 83% (Q1) to 103% (Q3) in short IPs).

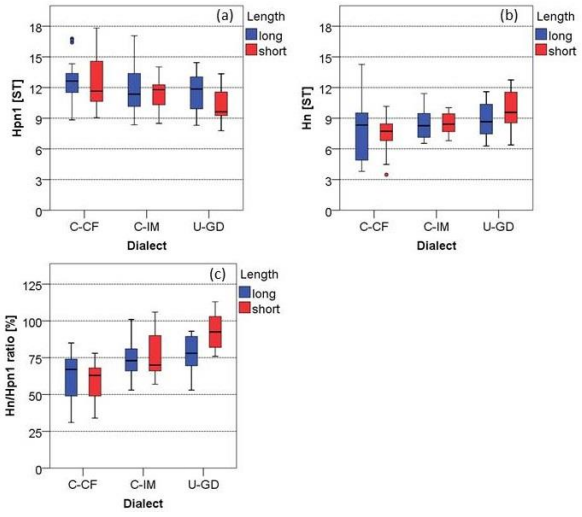

Figure 4: *Scaling of (a) the first prenuclear peak Hpn1, (b) the nuclear peak Hn, and (c) the Hn/Hpn1 scaling ratio in long and short declaratives of C-CF, C-IM and U-GD.*

3.3. The L scaling in U-GD

It is clear from the above that peak scaling differs in these three dialects, showing an influence of IP length in U-GD, but not in C-IM or C-CF. The fact that these behave differently could have to do with the different pitch accents in these dialects: the peaks in the Connaught dialects reflect leading (starred) tones, but trailing tones in U-GD. Conceivably, a trailing tone could be less constrained to maintain precise pitch targets than the leading tone?

To look more closely at this, the scaling of the leading L tone in the U-GD dialect is examined here, mirroring the

metrics presented in Figure 4. The L scaling results are shown in Figure 5.

3.3.1. IP-initial L (Lpn1)

The scaling of Lpn1 in the U-GD dialect is shown in Figure 5(a). The first prenuclear L is higher in long IPs (M = 9.4 ST, SD = 2.3 ST) than in short IPs (M = 7.1 ST, SD = 2.5 ST), and this difference is significant ($t(2) = -7.97$, $p = 0.015$).

3.3.2. IP-final L (Ln)

As is clear from Figure 5(b), there is no difference in Ln scaling as a function of IP length, which is confirmed by the non-significant *t*-test result ($t(2) = 0.99$, p = 0.424). The Ln values are very low, near the speakers' pitch floor, and remarkably consistent (96% of the data are between 0 and 3 ST). This corroborates the auditory impression of a rather invariant nuclear low rise in the U-GD dialect.

3.3.3. Ln/Lpn1 ratio

The boxplots for the Ln/Lpn1 ratio in Figure 5(c) suggest a rather substantial difference (13%) between long (M = 18%, SD = 11%) and short IPs (M = 31%, SD = 6%). This difference, however, does not quite reach statistical significance ($t(2) = 3.12$, $p = 0.089$). The effect is clearly attributable to the difference in Lpn1, as Ln appears largely uninfluenced by IP length in these data.

It is striking that the Ln/Lpn1 ratios are much lower in the Ulster dialect (mostly below 40%) than the corresponding Hn/Hpn1 ratios in the Connaught dialects (ranging mostly between 50% and 90%).

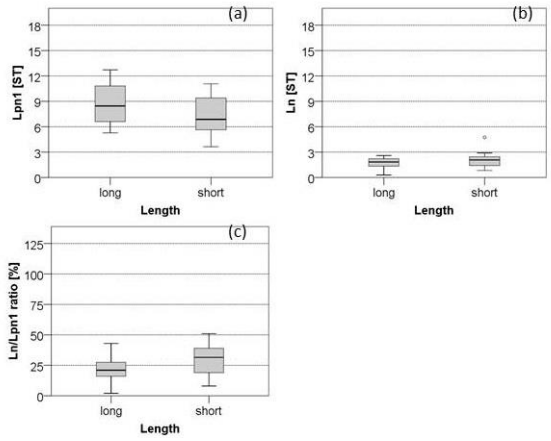

Figure 5: *Scaling of (a) Lpn1, (b) Ln and (c) the Ln/Lpn1 scaling ratio in long and short declaratives of U-GD.*

4. Conclusions

The three dialects emerge as different in these data. The two Connaught dialects do not show any clear effect of IP length on the scaling of the initial prenuclear and nuclear peaks. However, the northern dialect of U-GD does show such an effect, but only in the IP-initial position. This difference is manifested both in the scaling of the leading L* and of the trailing H tone of the phrase-initial accent.

An initial hypothesis was that Irish might show a lesser tendency to an IP length influence on the scaling of initial and final accents, as tonal scaling appears to have an important role in differentiating declaratives from WH and Y/N questions. However, this possible suggestion does not serve as an explanation for the present findings, as it should be equally true of the U-GD as of the Connaught dialects.

We conclude therefore that only the northern dialect of U-GD conforms to the raised peak trend reported in the literature. Additionally, we conjecture that the magnitude of the IP length effect on the scaling of the phrase-initial accent in U-GD is substantial (in the order of approximately 2 ST for both Lpn1 and Hpn1), particularly in the light of the results reported in the studies mentioned earlier, e.g. [3, 6] where Hertz values are used.

5. Acknowledgements

This work has been partially supported by the ABAIR initiative, sponsored by the Department of Culture, Heritage and the Gaeltacht, part of the Irish Government's 20-year strategy for Irish 2010-2030.

6. References

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