Recursion in Prosodic Phrasing: Evidence from Connemara Irish
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Abstract. One function of prosodic phrasing is its role in aiding in the recoverability of syntactic structure. In recent years, a growing body of work suggests it is possible to find concrete phonetic and phonological evidence that recursion in syntactic structure is preserved in the prosodic organization of utterances (Ladd 1986, 1988; Kubozono 1989, 1992; Féry & Truckenbrodt 2005; Wagner 2005, 2010; Selkirk 2009, 2011; Ito & Mester 2013; Myrberg 2013). This paper argues that the distribution of phrase-level phrase accents in Connemara Irish provides a new type of evidence in favour of this hypothesis: that, under ideal conditions, syntactic constituents are mapped onto prosodic constituents in a one-to-one fashion, such that information about the nested relationships between syntactic constituents is preserved through the recursion of prosodic domains. Through an empirical investigation of both clausal and nominal constructions, I argue that the distribution of phrasal phrase accents in Connemara Irish can be used as a means of identifying recursive bracketing in prosodic structure.

1   Introduction

Traditionally, the prosodic organization of utterances is thought to be related to syntactic structure in its basic constituency, but to differ from it fundamentally in several respects. For example, under the Strict Layer Hypothesis (Nespor & Vogel 1986; Selkirk 1986; Pierrehumbert & Beckman 1988), prosodic structure was assumed to be unable to create the nested structures that are the building blocks of hierarchical syntactic structure. Under this type of approach, where the relationship between syntactic and prosodic structure is indirect, much of the information contained in hierarchical syntactic structure would be lost in the translation into prosodic structure, suggesting that prosodic structure is, at best, an indirect method of conveying information about the syntactic organization of sentences.

There is, however, a growing body of work which suggests that prosodic structure can be recursive, and that this recursive structure is derived from the nesting of syntactic constituents. For example, a number of studies have argued that gradient phonetic evidence from pitch scaling and duration provide evidence for differences in the relative strength of prosodic boundaries (Ladd 1986, 1988; Kubozono 1989, 1992; van den Berg et al. 1992; Féry & Truckenbrodt 2005; Wagner 2005, 2010; Féry & Schubö 2010; Féry 2011). This work suggests that there is a close correspondence between syntactic and prosodic constituent structure that would be difficult to account for under the restrictions imposed by the Strict Layer Hypothesis and its derivatives. Another related line of inquiry involves the analysis or reanalysis of phonological domain-sensitive tonal phenomena under the assumption that prosodic structure is fundamentally recursive rather than strictly layered, where it is argued that an account assuming that prosodic structure is recursive provides a better account of language-specific data than strict layering (Ito & Mester 2007, 2010, 2012, 2013; Selkirk 2009, 2011; Myrberg 2013). If it is indeed the case that recursivity in prosodic structure is derived from the nesting of phrases found in syntactic constituent structure, this would suggest that there is far more information about the syntactic organization of utterances conveyed in their pronunciation than was previously believed. This opens up a rich area for research, in which prosodic structure may be used as a more direct means of deriving information about hierarchical relations in syntactic constituent structure.

This paper provides additional evidence for the view that prosodic structure directly preserves information about nested syntactic constituent structure by analysing new data from Connemara Irish (CI). I will argue that the distribution of phrase accents which demarcate prosodic phrases in Irish provide direct evidence to support this hypothesis in two ways. First, I propose that phrase-level prosodic structure in neutral (all-new) sentences is demarcated by two phrase accents, rises (LH) and falls (HL), which mark the left and right edges of prosodic phrases, respectively.[1] In addition, I will show that the LH phrase accent has a more limited distribution than expected: it demarcates the left edge of only those prosodic phrases that immediately dominate another prosodic phrase—in other words, this accent appears only in the presence of recursive prosodic structure. Assuming a direct one-to-one mapping between syntactic and prosodic constituent structure provides a motivation for the distribution of phrase accents and their relationship to recursive prosodic structure: recursive prosodic domains in the prosodic structure correspond to nested syntactic domains in the syntactic structure.

In addition to the theoretical implications of the analysis as described above, the goals of this paper are also empirical in nature. The paper aims to contribute to the description of the prosodic system of modern Irish, and in particular the Connemara dialect. This work builds on previous work on intonation and prosody in CI (de Bhaldraithe 1945; Blankenhorn 1981a; Bondaruk 1994, 2004; Dalton & Ní Chasaide 2005a, 2005b), but it is the first study to examine in detail the relationship between syntactic structure and prosodic structure in this language. The data discussed here come from a corpus of recordings collected by the author over a period of two years, and consist of recordings of a variety of sentences with different syntactic configurations. The core arguments proposed in this paper are based on a qualitative analysis of the recordings in this corpus, particularly their tonal representation, and representative pitch tracks are used throughout the paper in support of the proposed analysis.[2]

This paper is organized as follows. Section 2 provides an overview of the methodology used to collect the corpus data and to conduct the qualitative analysis of pitch tracks. Section 3 presents the core proposal of the paper: that the tonal properties of discourse-new sentences in CI can be described on the basis of two phrase accents, LH and HL, that serve to demarcate the edges of prosodic constituents, and particularly the role of the LH accent as an indicator for prosodic recursion. Section 4 provides a quantitative analysis of the data used to motivate the core proposals, first by providing a quantitative overview of the distribution of the observed tonal patterns in the corpus, and secondly, by briefly discussing the presence of between- and

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[1] As will be discussed below, I refer to LH and HL tones as "phrase accents" following Grice et al. (2000). Phrase accents behave like boundary tones because they play a role in demarcating the edges of prosodic constituents, but unlike boundary tones in the traditional sense of the term (Bruce 1977; Pierrehumbert 1980), they align with the stressed syllable of the word rather than with the absolute edge of the prosodic constituent. Other examples of edge-dependent phrase accents may include the post-focal accent in European Portuguese (Frota 2000) and the initiality accent in Stockholm Swedish (Bruce 1977; Myrberg 2010).

[2] The data and much of the analysis reported in the present paper build on Elfner (2011, 2012, 2013). However, the data discussed in the present paper represent only a subset of those discussed in Elfner (2012). Space constraints prevent me from discussing the full range of data in the present paper, but interested readers are referred to that work for additional examples of pitch tracks, as well as more detailed discussion of tonal phenomena for syntactic configurations not discussed in this paper.

within-speaker variation. Section 5 presents further support for the proposed analysis through an examination of the behaviour of complex DPs consisting of a noun and multiple adjectives. Section 6 provides a brief discussion of apparent mismatches between syntactic and prosodic structure, while section 7 discusses the theoretical implications of the proposed analysis. Section 8 concludes the paper.

2   Methodology

The data discussed in this paper are based on a corpus of recordings collected by the author.[3] The materials consist of single-sentence utterances, which were presented to participants one sentence at a time. Participants were asked to read the sentences as naturally as possible, as though speaking to a friend. The sentences were not placed in any particular context, in order to avoid placing focus on any particular word: I assume, following Nespor and Vogel (1986) and many others, that default sentential stress and prosodic phrasing occurs in neutral sentences in which all words in the sentence are new to the discourse. Each sentence was followed by a nonsense tag such as *Tá siad sásta* 'they were satisfied', in order to avoid list intonation on the target sentence. All of the sentences recorded in the corpus are based on read text, pre-constructed by the researcher and checked beforehand by one or more native speakers.

The recordings were collected on several separate occasions over a period of approximately two years. In each case, the researcher met individually with the participants. While all materials were constructed before meeting with the consultants, the recording sessions were conducted in a fashion more akin to fieldwork than to formal experimental work, as the goal was to collect recordings for a variety of different structures rather than collect data for a controlled experiment. However, the materials were designed in such a way as to elicit minimal pairs for the constructions of interest.

The amount of data collected from each individual speaker also varies, and in some cases, represents the results of on-going elicitation and analysis resulting from several recording sessions. In total, the speech of seven speakers was recorded and taken into account for the analysis presented in this paper. Of these seven, two speakers (MN and YF) were recorded on five separate occasions. The remaining five speakers were only recorded on one occasion. In total, the database of recordings that was consulted in this research consists of 407 sentences, each one transcribed and analysed by the researcher using Praat (Boersma & Weenink 2007).

All seven participants are native speakers of the Connemara (Conamara) dialect spoken in the Connemara *Gaeltacht* (a federally-designated Irish speaking area including Galway and much of the Connemara region to the west), located in Galway County, Ireland, and which is part of the larger Connacht dialect area (which includes speakers from Mayo County). All of the speakers recorded for this project grew up in the Cois Fharraige region west of Galway city in Ireland. The participants ranged in age from 25-59, and consisted of six females and one male. As is the norm among modern Irish speakers (due to the endangered status of the language), all participants were bilingual with English, but use Irish on an every-day basis with family, friends, and colleagues. At the time of recording, four of the speakers resided in the Connemara *Gaeltacht*, two in or around Dublin (Dublin/Maynooth), and one in a predominantly Irish community in Dorchester, a suburb of Boston, Massachusetts. All seven speakers had at least

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[3] The same corpus was used in Elfner (2012). For further details, please refer to this work.

one native-speaker parent and reported using Irish as the predominant language in the home and community during childhood.[4]

Due to space restrictions, the sample pitch tracks used as illustration in this paper were selected from among the recordings in the corpus. The choice of which pitch tracks to include was based primarily on the clarity of the F0 contour, to ensure that the exposition in the paper is as clear as possible. While not all recordings provide equally clear F0 contours, it is assumed that the patterns discussed in this paper are in some sense the "default" pattern. As will be discussed throughout the paper, there are many possible explanations for deviations from what is proposed to be the dominant pattern including, among other things, inter- and intra-speaker variation in phrasing patterns and disfluencies or unnaturalness due to laboratory context in which the recordings were produced. While it is hoped that future planned experimental research will shed light on the nature of these deviations from the "ideal" contour, it is beyond the scope of the present paper to provide a full account of the variation found in the data. In what concerns the representativity of the F0 contours presented and discussed in this paper, a quantitative analysis of a subset of the sentences present in the database is provided in section 4 in order to provide the reader with an idea of the range of variation present in the data.

The acoustic analysis was performed using Praat (Boersma & Weenink 2007). Because the paper is concerned with the analysis of the categorical presence or absence of pitch phenomena (phrase accents), a qualitative approach to data analysis was deemed appropriate for this stage in the research. Because there is no established intonational transcription system for Irish,[5] tonal transcription was performed using the autosegmental model, in which only H and L tones are assumed. I have chosen to remain neutral regarding the status of the proposed LH and HL phrase accents that are discussed in this paper, and refer to them using only what is proposed to be their underlying tonal make-up.

3   Distribution of phrase accents in CI

3.1   Basic patterns

CI (like other dialects of Irish) is a stress language where pitch and tone are used for phrasing and intonational purposes (de Bhaldraithe 1945; Blankenhorn 1981a; Bondaruk 1994, 2004; Dalton & Ní Chasaide 2005a, 2005b). Word-level stress, which falls on the initial syllable with few exceptions (e.g. Ó Siadhail 1989; The Christian Brothers 2004),[6] is thus distinguishable by pitch when it is associated with a phrase accent. In this paper, I discuss two phrase accents (LH and HL) that appear in neutral "all-new" speech, whose distribution is arguably determined by prosodic phrasing. Because I will consider only all-new contexts, the phrasing in the sentences examined in this paper is assumed to be the "default" phrasing pattern that is as free as possible from possible additional influences from information structure (Nespor & Vogel 1986).

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[4] Note, however, that one participant, AN, reports having lived in England from ages 5-9.
[5] Though see Dalton and Ní Chasaide (2005b, 2005a) for discussion of adapting the IViE system for Irish intonation (Grabe et al. 1998; Grabe et al. 2001).
[6] This stress pattern is found in all dialects of Irish except Munster (the southernmost dialect), which shows quantity-sensitivity in some contexts (e.g. O'Rahilly 1932 (1979); Blankenhorn 1981b; Green 1996; Green 1997).

The basic distribution of the LH and HL phrase accents in CI can be illustrated with the following pitch track for a transitive sentence where both the subject and object are branching (i.e. consist of two words, a noun and an adjective). Note for now that basic word order in CI, as in other dialects of Irish, is VSO; the syntax of this sentence will be discussed in the next section:[7, 8]

(1) Pitch track for a basic VSO sentence
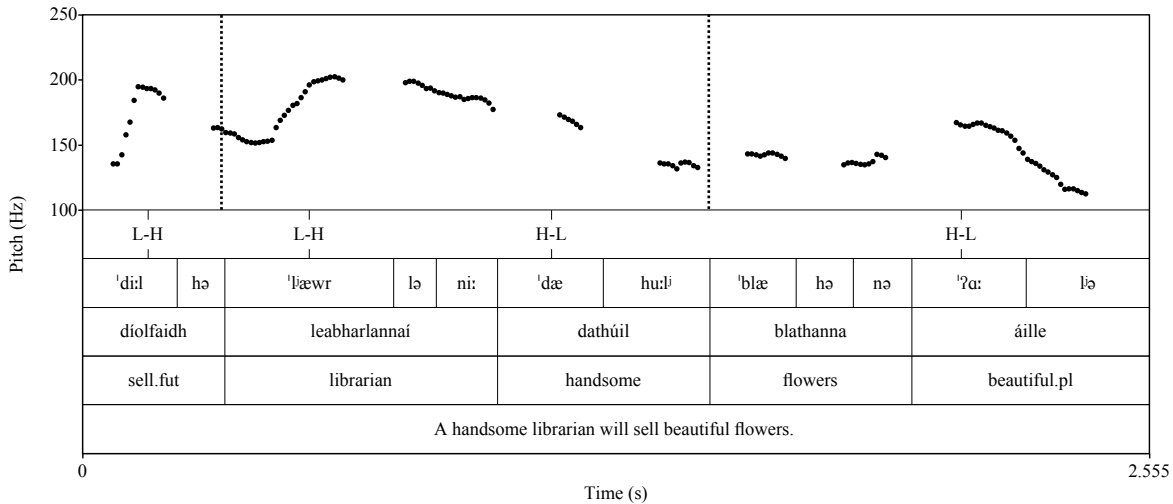
2010_05_25_035MNe_e1

As indicated, rises (LH phrase accents) appear on the stressed (initial) syllable of the verb (*díolfaidh* 'sell.fut') and the subject noun (*leabharlannaí* 'librarian'), while falls (HL phrase accents) appear on the subject's modifying adjective (*dathúil* 'handsome') as well as on the object's adjective (*áille* 'beautiful.pl'). For each of the phrase accents, the main pitch movement (rise or fall) begins within the stressed syllable. For LH phrase accents, the rise in F0 begins at the beginning of the stressed vowel, and the peak is reached by the end of the stressed syllable. If there are unstressed syllables in the word, these are interpolated through to the next phrase accent. For instance, the second (unstressed) syllable [hə] in *díolfaidh* 'sell.fut' shows a gradual decline in F0 because the next phrase accent, the LH accent associated with the subject noun *leabharlannaí* 'librarian', specifies an upcoming low target on the stressed syllable of this word. We therefore see an interpolation from the H on *díolfaidh* to the L on *leabharlannaí*. In contrast, the LH accent on *leabharlannaí* is followed by an HL accent on the adjective *dathúil* 'handsome'. As a result, the two unstressed syllables following the initial syllable in

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[7] The codes appearing below the pitch tracks are a reference to the date they were recorded on, an three-digit number indicating the trial number, the participant's initials (e.g. MN, YF), and the repetition number (e.g. *e1* meaning repetition 1).

[8] In all pitch tracks included in this paper, Tier 1 indicates the tonal transcription, while Tier 2 represents a syllable-by-syllable phonemic transcription in IPA, including stress assignment. Tier 3 represents word-level transcription in Irish orthography, while Tiers 4 and 5 indicate the English gloss and translation, respectively.

leabharlannaí show an extended high tone "plateau" along with what is assumed to be natural declination.[9]

On the other hand, HL phrase accents achieve the H target in the middle of the stressed vowel, resulting in what appears to be a slight rise in F0 at the beginning of the word *áille* 'beautiful'. The accent then shows a gradual decline in pitch through to the end of the word that it associates with. While this pattern raises the possibility that the L component of the HL accent is actually a right-edge boundary tone, rather than part of a complex pitch or phrase accent as argued here, there is also evidence that for some speakers, the L target from the HL accent is reached within the stressed syllable rather than at the right edge of the word (Dalton & Ní Chasaide 2005a, 2005b). For the purposes of this paper, I will assume that the L target is part of the HL phrase accent rather than a right-edge boundary tone, although this possibility should be investigated further in future work.

The phonetic alignment of the phrase accents LH and HL are supported by the data reported for CI in Dalton and Ní Chasaide (2005a, 2005b). However, the analysis presented in their paper departs from the phonological characterization of the phrase accents as reported in the present work. Specifically, Dalton and Ní Chasaide (2005a, 2005b) analyze the LH and HL phrase accents described here as 'prenuclear' and 'nuclear' accents, respectively. [10] This approach is not adopted here, because the designation of the two phrase accents as such is not rich enough to fully account for the data discussed in this paper: specifically, it does not account for the presence of the HL accent in positions other than that associated with the nuclear (final) accent of the sentence, nor does it account for the specific distribution of the LH accent, which is more complex than simply 'prenuclear'. For instance, the HL accent present on the subject's adjective in the sentence above would be characterized as prenuclear rather than nuclear, yet it is argued here to take the same form as the nuclear accent. Further examples of prenuclear HL accents are shown in several other examples in this paper.

Finally, the object noun *blathanna* 'flowers' is not specified as bearing a phrase accent. Like unstressed syllables, the F0 value of words which do not bear a phrase accent are interpolated between phrase accents. In the case of *blathanna*, this word is preceded by a low tone (the second half of an HL phrase accent). This accounts for the relatively low F0 level, which is extended up until the end of the word. In other tonal contexts, however, we may expect to see a different interpolation pattern: for instance, we would predict that a word that is unspecified for tone but which is flanked by H tones would show a high tone plateau, much as can be seen for the unstressed syllables in *leabharlannaí*. In this example, the rise at the end of *blathanna* is partially obscured by the glottal stop at the beginning of the adjective *áille* 'beautiful.pl'; however, it is still evident that in this particular example we see an extension of the first tone rather than a gradual rise from low to high. However, other examples show a more gradual interpolation much like the fall that can be observed on the unstressed syllable of the

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[9] An alternative analysis is that the second H tone is downstepped relative to the first, which would also contribute to the observed declination of the H tone plateau.

[10] Note that Dalton and Ní Chasaide assume a different system of intonational analysis, the IViE system (Grabe et al. 1998; Grabe et al. 2001). The LH accent proposed here corresponds to their H*(+L) prenuclear accent, and the HL accent to their H*+L nuclear accent. The IViE system explicitly rejects accents of the form L*+H, hence their (superficially) different interpretation of the LH accent.

verb. It is not clear at this time whether this difference represents between or within speaker variation, or whether it represents a significant intonational pattern.

3.2   Syntax-prosody correspondence

In this paper, I will argue that a transparent approach to syntax-prosody mapping, where syntactic constituents are mapped to prosodic domains in a one-to-one fashion, provides a coherent account of the distribution of phrase accents in CI. As will be discussed in the sections to come, the assumption that prosodic domains are derived directly from the syntactic structure necessitates the assumption that prosodic domains are fundamentally recursive in nature. The basis for the analysis developed in this paper follows primarily from the proposals made in Wagner (2005, 2010) and Selkirk (2011), which argue in favour of a framework in which prosodic phrasing is fundamentally recursive. Both proposals argue that prosodic domains can retain information about the nested nature of prosodic structure and that this information is preserved via the recursion of prosodic domains, contra the Strict Layer Hypothesis (Beckman & Pierrehumbert 1986; Nespor & Vogel 1986; Selkirk 1986) and subsequent work following in this tradition.

For the purposes of this paper, I will assume a basic mapping principle in which XP/X^{Max} constituents in the syntactic representation are mapped onto prosodic domains in the prosodic component (φ). This mapping principle is for all intents and purposes equivalent to the constraint MATCH-PHRASE proposed in Match Theory (Selkirk 2011; but see also Elfner 2012; Bennett et al. to appear-a). However, while the analysis proposed in this paper is compatible with Match Theory, it also departs from Match Theory in two ways. First, it is not crucial to the current analysis that there be a categorical distinction between prosodic levels beyond the basic distinction between phonological phrase (φ) and prosodic word (ω).[11] Secondly, the analysis presented in this paper does not crucially rely on an indirect reference theory of the interface, in which syntactic and prosodic domains may be non-isomorphic. While apparent cases of mismatches do exist in CI (as discussed in section 6), it is not possible at this time to distinguish between an analysis along the lines of that proposed in Selkirk (2011), where the syntax-prosody mapping principle can be overruled or outranked by prosodic markedness constraints (as on binarity), and an analysis where apparent mismatches derive from a choice between two possible underlying syntactic structures, as proposed in Wagner (2005, 2010). This topic is discussed further in section 6.[12]

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[11] That is to say, there is no evidence offered in this paper that would require a categorical distinction between φ and the intonational phrase (ι). This is not a claim that such evidence does not exist or that such an analysis would not be possible, but rather that it has yet to be systematically argued that (for Irish) that a separate ι category is necessary, i.e. that there are distinct prosodic phenomena that pattern within the prosodic domain ι. Under the recursion-based analysis offered here, it is possible that the category φ_{Max} could plausibly be reanalysed as the domain traditionally associated with ι-level phonemena. The implications of this assumption are left for future research.

[12] An anonymous reviewer observes that the account proposed in this paper also departs from much recent work which proposes that there is a relationship between cyclic or phase-based spell-out and prosodic phrasing, including Wagner (2005, 2010), as well as many others (e.g. Dobashi 2004, 2009, 2010; Ishihara 2007; Kratzer & Selkirk 2007; Kahnemuyipour 2009). As

A crucial piece of the argument developed in this paper requires an understanding of the syntax of the constructions involved. As a first step, we can take a closer look at the structure of basic transitive (VSO) sentences of the type examined in the pitch track above. The syntactic structure of Irish VSO sentences assumed in this paper is based on the arguments developed in Chung and McCloskey (1987) and McCloskey (1991, 1996, 2009, 2011), which can be represented as follows:

(2) Structure of a VSO sentence in Irish (with branching subject and object)[13]
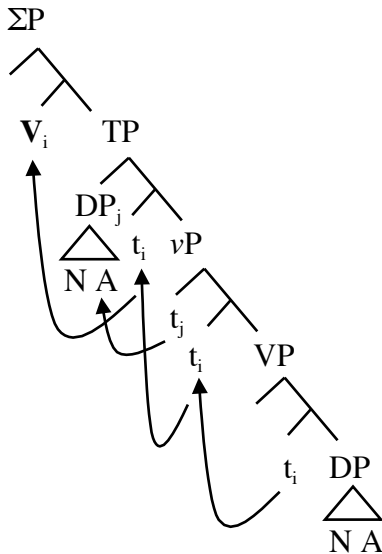
In this structure, the object DP remains low within VP. The verb begins in V and through successive head movement passes through v and T to Σ, the head of the polarity phrase ΣP.[14] The subject begins in Spec, vP and moves to Spec,TP. Under the assumption that prosodic structure ignores traces and empty projections (Nespor & Vogel 1986), the crucial observation that we can take away from this structure is that there is a syntactic constituent that dominates S and O to the exclusion of V: in the tree above, this constituent is TP. McCloskey (2011) discusses a number of examples with converging evidence in favour of this structure, using arguments from right-

will become evident in the discussion to follow, the analysis of phrase accent distribution proposed here relies on the assumption that the structure of the entire sentence is available at Spell-Out, rather than only a phase or cyclic chunk. However, the analysis proposed here is not inherently incompatible with a phase-based or cyclic approach in which, for example, information about the structure of already spelled-out material remains accessible, or where spelled-out phases are assembled in a hierarchical rather than linear manner.

[13] The internal structure of branching DPs in Irish will be discussed in more detail in section 5.

[14] McCloskey (2009, 2011) proposes that the verb raises through v, T, and ends up in the head of the polarity phrase ΣP. This proposal is based on the ability of the verb to convey information about polarity in VP ellipsis, where the bare verb is used in place of polarity particles (like *yes* and *no*) in answer to yes/no questions. It is also clear that if (some) subjects raise to Spec,TP (McCloskey 2001), the verb must then occupy a position above this projection. I will assume, following McCloskey, that this projection is ΣP; however, it is not crucial to this paper what the label of this projection is.

node raising, coordination, focus constructions, and ellipsis; for space reasons, however, I will not summarize these arguments here and interested readers are referred to the cited work on this topic.

Given the hypothesis that there is a direct one-to-one mapping between syntactic and prosodic constituent structure, what is the prediction for the prosodic representation of a sentence with the structure above? As a start, we can assume a very basic mapping principle which can be formulated as follows, as based on the definition of the constraint Match-Phrase offered in Selkirk (2011). Here, I rephrase the mapping principle formally in terms of corresponding sets of terminal nodes in the syntactic and prosodic representations (see also Elfner 2012; Bennett et al. to appear-a).

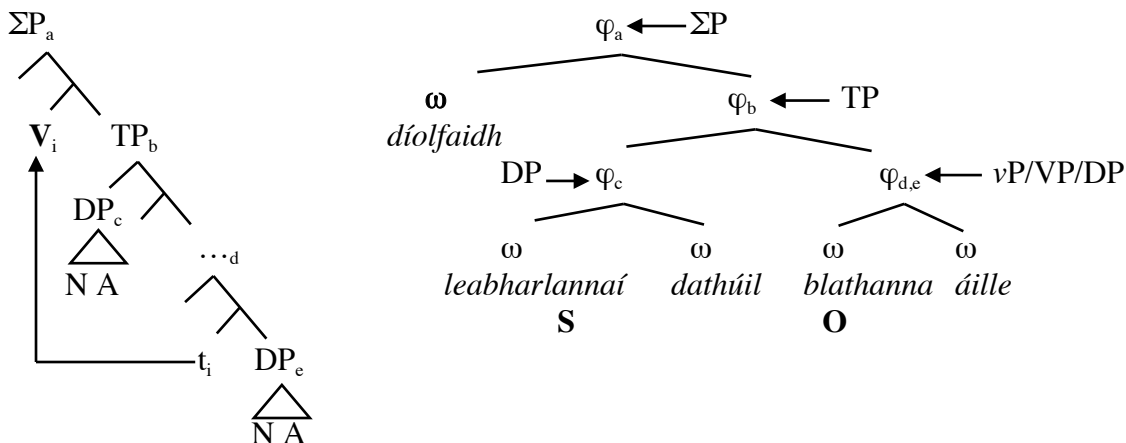(3) Syntax-prosody mapping principle ("Match-Phrase")

$X^{Max} \rightarrow \varphi$

"For every syntactic phrase (XP) in the syntactic representation that exhaustively dominates a set of one or more terminal nodes α, there must be a prosodic domain (φ) in the phonological representation that exhaustively dominates all and only the phonological exponents of the terminal nodes in α."

This mapping principle, coupled with the assumption above that prosodic structure ignores traces and phonologically empty projections (Nespor & Vogel 1986),[15] predicts a prosodic representation as in (4b) that preserves basic constituency of phonologically overt elements, as defined by the syntactic representation in (2) (repeated in (4a)):[16]

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[15] In order for analyses assuming the copy theory of movement (Chomsky 1993) to remain compatible with the assumptions made here, we would need to assume that copies are deleted before they are sent to PF, or at least before prosodic domains are assigned. Deleted copies would then be expected to behave as phonologically null elements, because they would have no phonological exponent at spell-out.

[16] Following standard practices in prosodic theory, I use the symbol φ to represent a phrase-level prosodic domain (as defined in (3)) and ω to represent a prosodic word-level domain, which I assume roughly correspond to lexical words in the syntax. I follow Selkirk (1995) in assuming a basic distinction between lexical words (V, N, Adj, etc.), which are by default parsed as prosodic words ω, and function words (Det, P, Prn, etc.), which are not. While the issues surrounding the prosodic status of function words in Irish are more complicated than can be discussed at present (though see Bennett et al. to appear-a, to appear-b), this distinction can be upheld for the majority of cases, including all of those discussed in this paper. For the purposes of this paper, I will assume that function words like determiners and prepositions are proclitic on the prosodic word which immediately follows it (following Bennett et al. to appear-a, to appear-b).

(4) a. Syntactic Representation   b. Recursive Prosodic Representation

ΣP$_a$

   V$_i$ TP$_b$

      DP$_c$

     N A   ...$_d$

          t$_i$ DP$_e$

            N A

φ$_a$ ← ΣP

ω   φ$_b$ ← TP
díolfaidh

     DP → φ$_c$ φ$_{d,e}$ ← vP/VP/DP

  ω   ω   ω   ω
leabharlannaí *dathúil* *blathanna* *áille*
    S   **O**

As can be seen in (4b), there are four φ-level prosodic constituents: one each for the DP arguments (both branching), one for the constituent TP that dominates the subject-object constituent, and one for the constituent ΣP that dominates the verb and the TP constituent. Note that the φ constituent dominating the object is congruent with any dominating maximal projections in the syntax, such as VP and vP: because VP, vP and DP$_e$ dominate the same set of phonologically overt terminal elements (words), the mapping principle in (3) is satisfied by the single occurrence of φ$_{d,e}$; there is no need for each maximal projection to correspond to a *unique* prosodic domain φ.[17]

    In this paper, I follow the assumptions of bare phrase structure (Chomsky 1995), although nothing crucial relies on this choice and the same observations would hold of an analysis assuming X-bar theory (Chomsky 1970; Jackendoff 1977). Note, however, that, strictly speaking, the adjectives in the above syntactic representation may be analysed as phrasal (dominated by AP) or alternatively as simultaneously maximal and minimal. For instance, given the mapping principle in (3), we would predict that adjectives should map onto a φ constituent, just like other maximal projections:

(5) Incorrect mapping from simultaneously maximal/minimal A to φ

  AP/A^{Max} *φ
    | |
    A   ⟶   ω
 áille   *áille*   'beautiful'
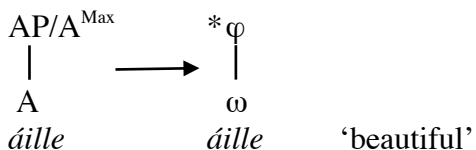
However, this does not appear to be the case: as will be discussed in this paper, there is no positive evidence suggesting that (non-branching) constituents that are simultaneously maximal and minimal are mapped onto a φ domain. Rather, there is a preference for these constituents to be treated like minimal projections: in prosodic terms, these are treated like prosodic words rather than phonological phrases, as in the following representation:

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[17] As will be discussed in section 3.3, this point will become important for the analysis of the distribution of the LH accent in CI.

(6) Attested mapping from simultaneously maximal/minimal A to ω

AP/A^{Max}
|
A $\longrightarrow$ ω
áille   *áille*   'beautiful'
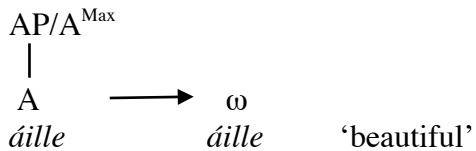
This topic will be returned to in section 5, but for the time being, I will assume that we can account for this pattern by making reference to a eurhythmic preference or constraint which requires φ constituents to be minimally binary, as follows (Ito & Mester 1992):[18]
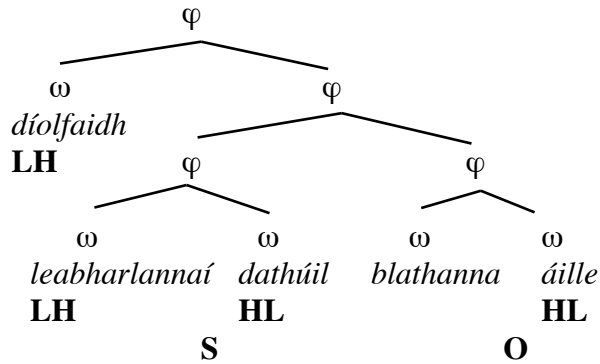
(7) BINARY-MINIMUM(φ): a φ constituent in the prosodic representation must dominate a minimum of two ω.

Under this hypothesis, the mapping principle would by default map the simultaneously maximal/minimal A to a φ constituent, but this mapping would be overruled by the eurythmic constraint, creating a "mismatch" between syntactic and prosodic constituent structure. This interaction may occur in parallel as in an OT derivation (as assumed in Selkirk's Match Theory) or as a post-spell-out effect (as in Wagner 2005). Note, however, that while adopting such an approach tacitly assumes an indirect reference approach to the interface, an alternative approach could plausibly analyse this pattern by referring to the syntactic characteristics of these projections: specifically, their status as simultaneously maximal and minimal projections. For example, one way to do this would be to assume that their minimality status takes preference over their maximality status, resulting in a mapping that parses them (prosodically) as ω rather than φ. Such an account is proposed in Bennett et al. (to appear-a) within the framework of Match Theory. For the purposes of the present paper, either approach is plausible.

Following up on the hypothesis that the distribution of LH and HL phrase accents is structurally defined, we can take the tonal transcription from the pitch track in (1) and assign the phrase accents (LH and HL) as follows onto the recursive prosodic structure derived in (4b):

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[18] An anonymous reviewer suggests that the failure for adjectives to be parsed as prosodic phrases may be part of a more general unsolved puzzle in syntax-prosody mapping, such that adjectives do not project as prosodic phrases while sentential adverbs do. If this is the case in CI, this would suggest that the reason that APs are not parsed as φ is not due to eurhythmic constraints, as the analysis sketched above would suggest. At this point, I do not have sufficient data regarding the prosodic status of sentential adverbs in CI, but it would make an interesting topic for future research.

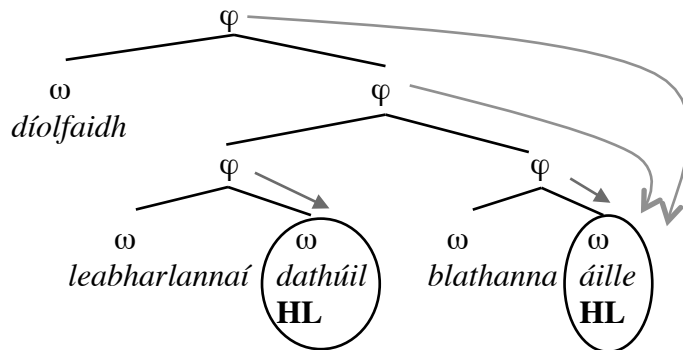(8) Distribution of tonal elements in a VSO sentence, as based on (1)

```
                         φ
              _____/ _____
             ω                     φ
          díolfaidh        _____/ _____
            LH            φ               φ
                      __/ \__          __/ \__
                     ω       ω        ω       ω
              leabharlannaí dathúil  blathanna áille
                  LH        HL                 HL
                            S                  O
```

First, consider the distribution of HL. Both the adjective modifying the subject (*dathúil* 'handsome') and that modifying the object (*áille* 'beautiful') are associated with an HL phrase accent. Given the representation in (8), the distribution of HL is relatively straightforward: the HL accent appears on the rightmost word of a prosodic domain φ:

(9) Distribution of HL phrase accents in CI
    HL phrase accents associate with the stressed syllable of the rightmost word in every φ.

(10) Distribution of HL phrase accents as rightmost in φ

```
                         φ
              _____/ _____
             ω                     φ
          díolfaidh        _____/ _____
                          φ               φ
                      __/ \__          __/ \__
                     ω       ω        ω       ω
              leabharlannaí dathúil  blathanna áille
                          HL                 HL
```

In this particular example, the subject's adjective *dathúil* receives an HL phrase accent because it is rightmost in the prosodic domain corresponding to the subject DP. Similarly, the object's adjective *áille* is rightmost in the prosodic domain corresponding to the object DP. Additionally, the right edges of the two prosodic domains dominating these constituents (those corresponding to TP and ΣP, respectively) also predict the presence of HL on the object adjective.

3.3   Distribution of LH Phrase accents: Evidence for Non-minimal φ

The distribution of LH, on the other hand, is more complex: this accent appears on the verb and the subject noun in the above example, and would appear to associate with the leftmost word of the prosodic domain φ. However, the absence of LH on the object noun, also leftmost in a prosodic domain, would suggest that this is not the whole story. Instead, I would like to draw attention to the difference between the domains corresponding to TP and ΣP, on the one hand,

and the domains corresponding to the two DPs, on the other: the prosodic domains (φ) corresponding to TP and ΣP each dominate another prosodic domain (φ), and thus meet the structural description of (prosodic) recursion: a category φ which dominates another category of the same type, φ. The prosodic domains corresponding to the DPs, on the other hand, dominate only ω (and not φ) domains. Provided we maintain a distinction between ω and φ domains, the prosodic constituents corresponding to the DPs are not recursive.

In recent work, Ito and Mester (2007, 2010, 2012, 2013) propose that the behaviour of domain-sensitive phonological processes, like phrase accent insertion, can be adequately explained under the assumption that prosodic structure can be recursive, and that phonological constraints may target natural classes of the recursive domains. In particular, Ito and Mester (2007, 2010, 2012) propose that phonological constraints may target the *maximal* or *minimal* projection of a prosodic category in recursive structures. These are defined as follows, where φ stands for a prosodic domain (Ito & Mester 2012):

(11) Maximal φ (φ_{Max}): φ not dominated by φ.
   Minimal φ (φ_{Min}): φ not dominating φ.

Above, it was suggested that the LH accent appears only on the leftmost word of *recursive* prosodic domains. Using the maximal/minimal distinction used by Ito and Mester, we can describe the natural class of recursive domains using the term *non-minimal*, defined as follows:

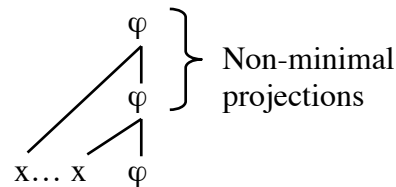(12) Non-minimal φ ($\varphi_{Non\text{-}min}$): φ that dominates φ.

The natural classes *maximal*, *minimal*, and *non-minimal* can illustrated schematically as follows:

(13) (Some) natural classes of recursion-based prosodic subcategories
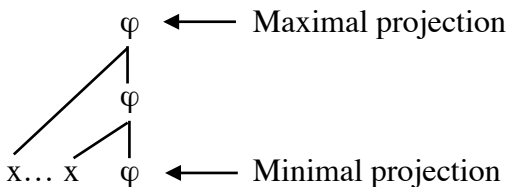
a. Maximal/minimal projections of φ   b. Non-minimal projections of φ

Note that the class of non-minimal projections includes the maximal projection, and is distinguishable from the maximal projection only when there is more than one layer of recursive prosodic structure.

In order to accommodate other possible natural classes of projections, Ito and Mester (2013) propose a schema that makes use of the binary features [±max] and [±min] following their use in Haider (1993). This assumption produces a typology of five natural classes of the recursion-based subcategories of a prosodic category κ: the maximal projections $\kappa^{[+max,-min]}$, the minimal projections $\kappa^{[-max,+min]}$, the intermediate projections $\kappa^{[-max,-min]}$, the non-minimal projections $\kappa^{[-min]}$, and the non-maximal projections $\kappa^{(-max)}$. Also included is the non-recursive $\kappa^{[+max,+min]}$, which represents the projection that is simultaneously maximal and minimal, and therefore

consists only of a single instantiation of the category. I follow Ito and Mester (2013) in this interpretation of *minimal* and *maximal* as binary features, but will continue to refer to the non-minimal projection $\varphi^{[-min]}$ as $\varphi_{Non\text{-}min}$, and the minimal projection $\varphi^{[-max,+min]}$ as φ_{Min}.[19]

Given the formulation of non-minimal φ domains, we are now in a position to describe the distribution of the LH accent:

(14) Distribution of LH phrase accents in CI
LH phrase accents associate with the stressed syllable of the leftmost word in every $\varphi_{Non\text{-}min}$.

Turning back to the VSO sentence under discussion, note that there are two $\varphi_{Non\text{-}min}$ in the prosodic representation, corresponding to TP and $\sum$P, each with an LH accent associated with the leftmost word of their domain:

(15) Distribution of LH accents on the leftmost word in every $\varphi_{Non\text{-}min}$
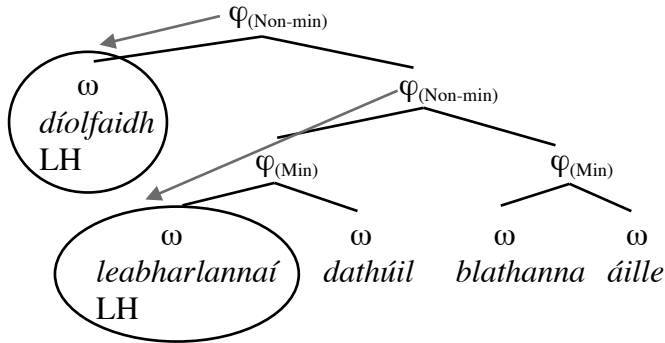
This analysis correctly accounts for the absence of the LH accent on the leftmost word of the object DP, *blathanna* 'flowers', which is at the left edge of φ_{Min} but not $\varphi_{Non\text{-}min}$. In addition, the adjectives *dathúil* 'handsome' and *áille* 'beautiful', are similarly not associated with an LH accent because they are at the right, rather than left, edge of φ_{Min} and $\varphi_{Non\text{-}min}$, respectively.

Further evidence for this analysis of the distribution of LH phrase accents in CI comes from the investigation of sentences with increasingly complex syntactic structures.[20] The presence of recursive prosodic structure, under the one-to-one mapping hypothesis, is directly dependent on the complexity of the syntactic structure from which it is derived. As a result, we predict that the distribution of LH phrase accents will be correlated with depth of embedding in the syntactic structure. For example, we can consider sentences which extend the basic VSO structure discussed above by adding arguments (indirect objects), adjuncts or adverbs. In the predicted prosodic representation, this results in an increase in the number of $\varphi_{Non\text{-}min}$ and a corresponding increase in the number of LH phrase accents.

---

[19] Of the six possible natural classes of recursion-based projections, Ito and Mester (2013) provide typological evidence for the maximal, minimal and maximal/minimal projections, in addition to the evidence provided here for the non-minimal projections. To the best of my knowledge, there is currently no proposal that would require reference to either the intermediate projections ($\kappa^{[-max,-min]}$) or to the non-maximal projections ($\kappa^{(-max)}$), although such distinctions are predicted typologically.

[20] As mentioned above, the discussion in the present paper is limited, and as such, only a subset of examples is discussed. See Elfner (2012) for a wider range of examples and structures.

In Irish, indirect objects, adjuncts and adverbs follow the object:

(16) Díolfaidh   rúnaí   dathúil   blathanna áille   <u>le daoine anamúla</u>
     sell.FUT   secretary handsome flowers   beautiful.PL to people animated.PL
     'A handsome secretary will sell beautiful flowers <u>to animated people</u>.'

If we assume that an indirect object/adjunct will also be contained within VP (below the direct object), we predict that there will be an additional $\varphi_{Non-min}$ in the corresponding prosodic representation, because the VP constituent now dominates two distinct syntactic maximal projections (the DP object and the PP indirect object). This can be seen by comparing the syntactic representation with the predicted corresponding recursive prosodic representation as follows. I assume that both the object and indirect object are contained within VP (Larson (1988), see also Bennett et al. (2013) for Irish):[21, 22]

(17) a. Syntactic Representation   b. Recursive Prosodic Representation

---
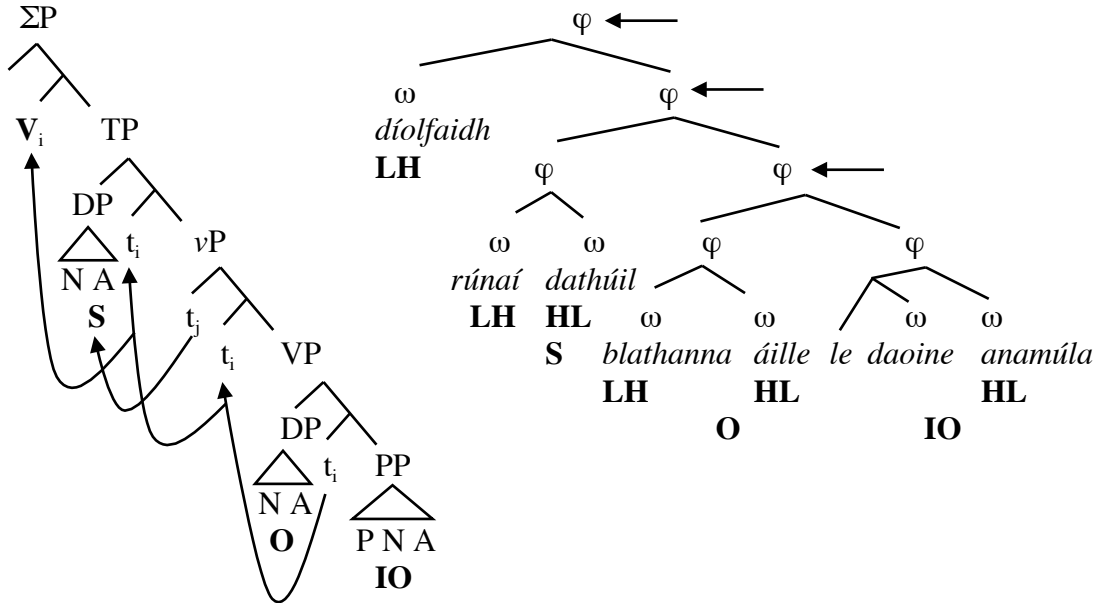
[21] In the following representation, I have represented the preposition in the indirect object as being prosodically dependent on the following noun (see footnote 16).

[22] As in other languages, certain classes of adverbs in Irish may right-adjoin to *v*P (McCloskey 1996; Ernst 2002). These are not predicted by the proposed system to behave prosodically differently than the VP-internal PP in the representation in (17a): they will form a (recursive) constituent with the object, with the possibility that they will be parse as φ themselves if they meet the binarity requirement. However, other classes of adverbs that attach at different locations in the tree (e.g. adjoined to TP or higher; left adjoined to *v*P) may make different predictions in terms of prosodic phrasing. Unfortunately, I do not at present have access to data that would test for these differences and these questions are left for future research. Note that adverbs are almost always found in sentence-final position in Irish; only a limited class may intervene between subject and object (McCloskey 1996; Adger 1997).

As indicated, the prosodic representation in (17b) shows three recursive layers of φ (and thus three φ$_{Non-min}$), as opposed to the two that were posited for the VSO sentence. The analysis developed above predicts that LH phrase accents will fall on the leftmost word of each of the φ$_{Non-min}$, namely, the verb (*díolfaidh* 'sell.fut'), the subject noun (*rúnaí* 'secretary'), and, in this case, the object noun (*blathanna* 'flowers'), which was not associated with a phrase accent in the basic VSO sentence discussed above. Instead, the leftmost (prosodic) word of the indirect object (*daoine* 'people') will not be associated with an LH accent, because it is leftmost in φ$_{Min}$ but not φ$_{Non-min}$. This pattern can be seen in the pitch track for the sentence in (18):

(18) VSO sentence with indirect object
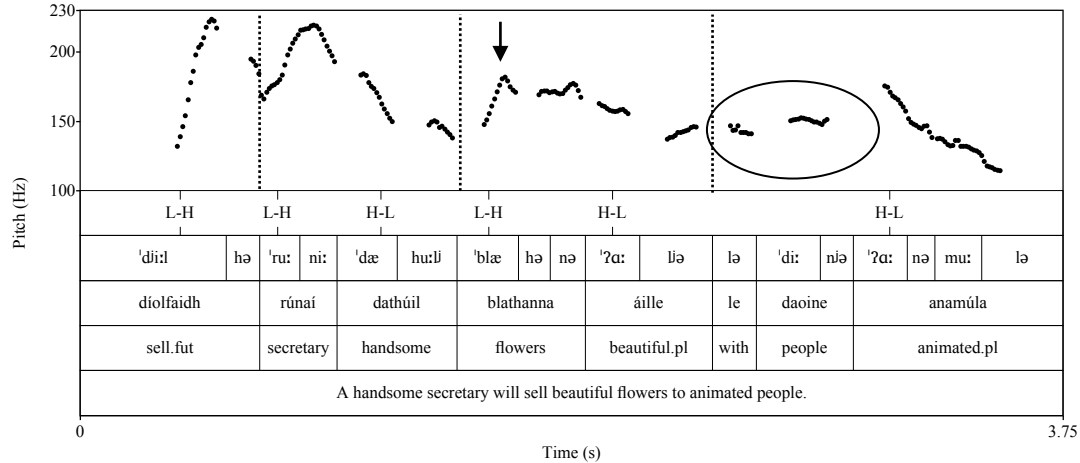
2010_05_25_019MNe_e1

As predicted, this example shows a clear LH accent on the first syllable of the verb, subject noun, and the object noun, but no pitch rise on the leftmost prosodic word of the indirect object *daoine* 'people'.[23]

  The analysis proposed here departs from other analyses

3.4 An alternative analysis of the distribution of HL?

Above, it was argued that HL phrase accents demarcate the right edge of φ. An alternative would be to analyse the distribution of the HL accent as rightmost in φ$_{Min}$ rather than simply φ. The evidence against this analysis comes from sentences like the following, in which the object in the transitive sentence is non-branching:

(19) Díolfaidh leabharlannaí dathúil blathanna.
   sell.FUT librarian   handsome flowers
   'A handsome librarian will sell flowers.'

---

[23] Note that sequences of two H tones (as in the noun-adjective sequence in the subject of the above sentence) are often downstepped, resulting in a second H tone that is lower than the one preceding it and obscuring the expected H tone plateau. As discussed above, declination also plays a role in producing this pattern, especially in words with several unstressed syllables.

As for sentences where both subject and object are branching, sentences as in (19) show an HL phrase accent on the final word in the sentence, *blathanna* 'flowers':[24]

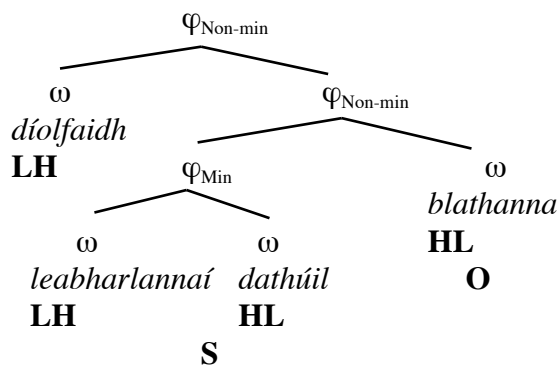(20) Pitch track for a VSO sentence with branching subject and non-branching object
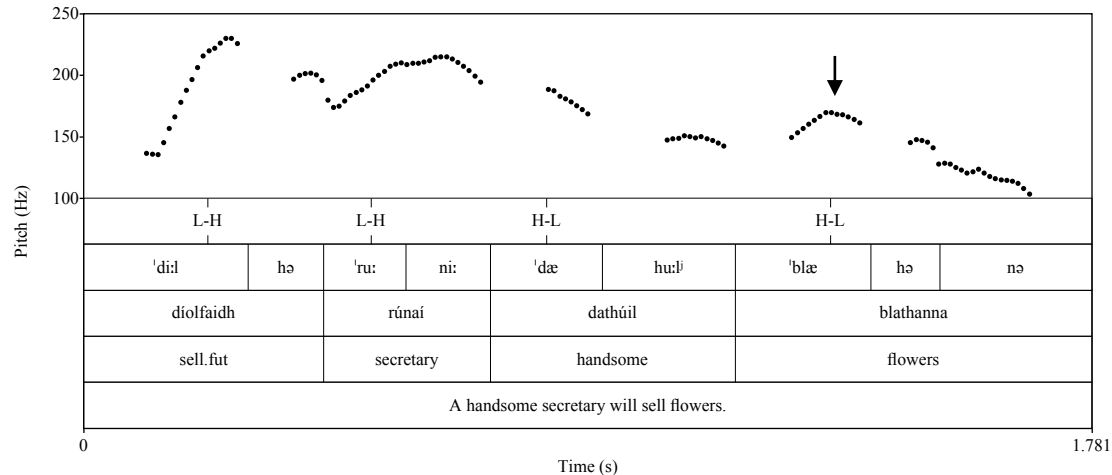
2010_05_25_017MNe1

In sentences with this structure, the single-noun object is a non-branching DP. It therefore meets the structural description discussed above for a syntactic element that is simultaneously maximal and minimal: it is a maximal syntactic constituent (D^{Max} or alternatively simply N^{Max}) which dominates a single minimal element, N^0. In this way, this structure is comparable to the AP/A^{Max} structures discussed in (5) and (6) above. Given the assumptions made for non-branching APs, this would suggest that the object noun is also parsed as ω rather than φ. If this is the case, we would here have an example of a HL accent which is rightmost in $\varphi_{Non\text{-}min}$, not φ_{Min}, as in the following representation, suggesting that characterizing the distribution of HL as φ_{Min} would be inaccurate:

---

[24] Note that even though there is a slight rise in F0 on *blathanna* 'flowers', this does not indicate the presence of an LH phrase accent. As discussed in section 3.1, the HL accent reaches its peak in the stressed vowel, then shows a gradual decline through to the end of the word. The rise in this pitch track occurs only in the onset of the initial syllable.

(21) Distribution of tonal elements in a VSO sentence with a non-branching object

```
                        φ_Non-min
              ┌──────────────┴──────────────┐
              ω                           φ_Non-min
           díolfaidh              ┌───────────┴───────────┐
             LH                 φ_Min                      ω
                        ┌─────────┴─────────┐           blathanna
                        ω                   ω              HL
                  leabharlannaí         dathúil             O
                       LH                 HL
                                   S
```

For this reason, I will continue to assume that the distribution of HL is φ rather than φ_{Min} for the purposes of this paper.

4 Representativity of the data within the corpus

The sample F0 contours used in this paper as illustration are included as representative of the general pattern which is observed across the participants in this study. In this section, I draw primarily on data from six native speakers,[25] each of which produced sentences consistent with the general pattern of LH and HL phrase accents discussed in this paper. While it is not possible to include several sample pitch tracks of each sentence for each speaker, the informal quantitative study presented in this section is intended to shed some light on the behaviour of individual speakers in the corpus of data on which the generalizations in this paper are based.

As discussed above, the LH phrase accent appears on the leftmost prosodic word in non-minimal φ constituents. As seen in the VSO sentences discussed in section 3, the LH accent is predicted to appear on the leftmost words of branching subjects whenever the subject is non-final in the sentence (i.e. followed by some other element, like an object).[26] Using the diagnostic criteria in (22), the tonal character of the first noun in branching subjects was identified as (a) bearing an LH accent, (b) bearing an HL accent, or (c) not bearing a phrase accent.

---

[25] While the corpus includes data from a total of seven native speakers, only six speakers are discussed in this section. The data from one of these speakers (MF) were considered in the rest of the paper but excluded from this section because the results were not directly comparable in quantitative terms (i.e. a different set of sentences and sentence types were recorded).

[26] I use the term *non-final subject* rather than simply *subject* because the subjects considered include only branching subjects that are followed either by a direct object or an adjunct. This count excludes branching subjects which are final in the sentence, as in intransitive sentences without any adjuncts. The reason for this distinction is that these sentence-final branching subjects are predicted to behave differently from non-final branching subjects by not bearing LH phrase accents: unlike non-final branching subjects, final branching subjects are not leftmost in $\varphi_{Non-min}$. This does appear to be the case; see Elfner (2012) for some preliminary results.

(22) Table summarizing the diagnostics for phrase accents

Phrase accent	Diagnostic
LH phrase accent	A rise in F0, with the peak reached by the right edge of the initial (stressed) syllable; subsequent unstressed syllables are interpolated from the stressed syllable peak to the next tonal specification (which can be H or L depending on context)
HL phrase accent	A fall in F0, which is observed beginning in the vowel of the initial (stressed) syllable and decreases between the initial stressed syllable and subsequent unstressed syllables
No phrase accent	No discernable F0 movement

The results of the counts for the realization of phrase accents on the leftmost noun in branching non-final subjects for the six speakers is shown in the barplot in (23).

(23) Barplot illustrating number of tokens by speaker for the realization of phrase accents on the leftmost noun in a branching non-final subject

**Realization of phrase accents on leftmost noun in branching non-final subjects**
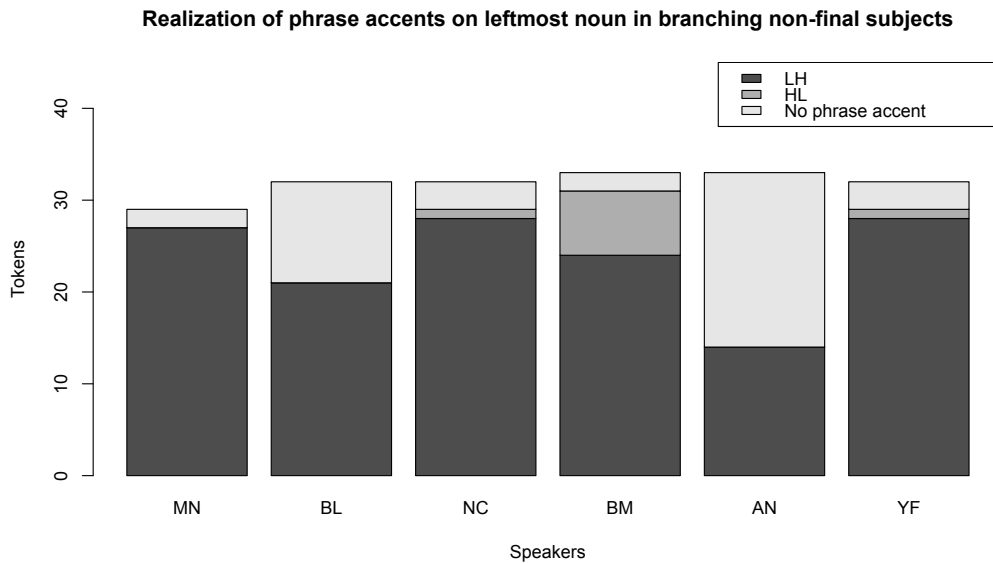
As can be seen in (23), all speakers except AN show an LH phrase accent in the majority of tokens. This is the pattern that I assume to be the default for the neutral, all-new context examined in this paper. The alternative accent, HL, is observed in a small number of cases for three speakers. The presence of this pattern may suggest that phrasing patterns are not categorically defined but rather subject to some degree of variation. Two speakers, AN and BL, showed a large proportion of nouns with no discernable phrase accent (a majority for AN). Because this pattern is (for most speakers) found in only a minority of cases, I will speculate here that this pattern is either an artefact of the reading task (flat pitch tracks were found especially in sentences that were produced early in the session) or illustrative of a different pragmatic context (such as where material is considered by the speaker to be given rather than new information).

Further analysis of these data awaits a more systematic study investigating the role of information structure in CI prosodic patterns.

Similar generalizations can be made for the presence or absence of phrase accents in other predictable contexts. First, consider the characterization of phrase accents on the adjective in branching non-final subjects, which are predicted to bear an HL phrase accent. The same criteria for identification as in (22) were used to produce the barplot in (24).

(24) Barplot illustrating number of tokens by speaker for the realization of phrase accents on the rightmost adjective in a branching non-final subject
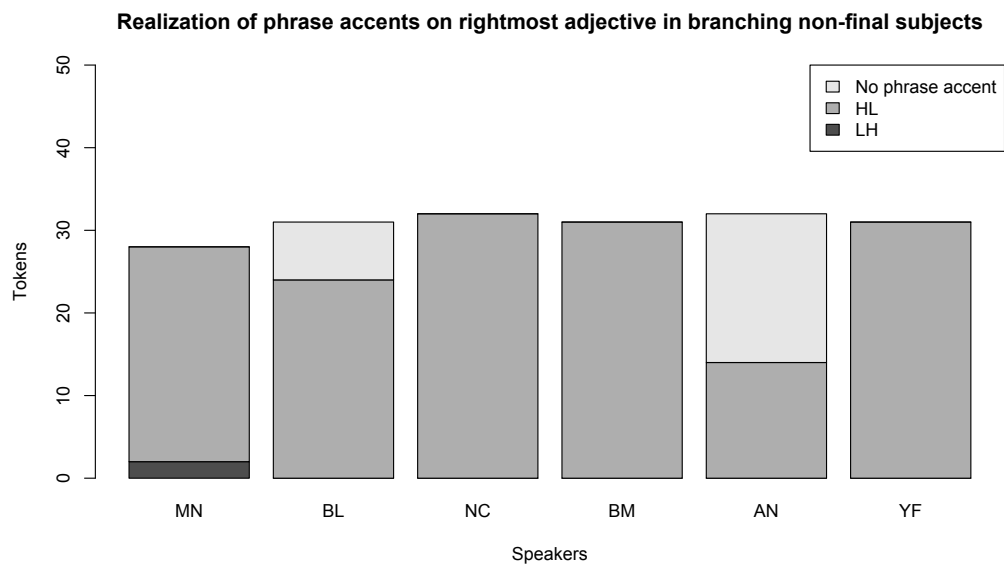

As seen in (24), all speakers except AN show an HL phrase accent on the adjective in a non-final branching subject in a majority of tokens. As in the previous barplot, the speakers AN and BL show a large proportion of adjectives with no discernable phrase accent, indicative of the relatively flat F0 contours frequently produced by these speakers. This appears to be a consistent property of their data, though it is not at present clear whether or not this pattern represents a significant deviation from the pattern observed for other speakers or whether it is an artefact of the artificial nature of the elicitation setting.

Finally, consider the barplot in (26), which illustrates the characterization of the noun in a final branching object, which is predicted to be unspecified for tone. In place of the diagnostic for "no phrase accent" I include the following distinction between "flat" and "interpolated rise":

(25) Table summarizing the diagnostics for phrase accents

Phrase accent	Diagnostic
LH phrase accent	A rise in F0, with the peak reached by the right edge of the initial (stressed) syllable; subsequent unstressed syllables are interpolated from the stressed syllable peak to the next tonal specification (which can be H or L depending on context)
HL phrase accent	A fall in F0, which is observed beginning in the vowel of the initial (stressed) syllable and decreases between the initial stressed syllable and subsequent unstressed syllables
Flat	No discernable F0 movement
Interpolated rise	Gradual rise in F0 between adjacent L and H targets

(26) Barplot illustrating number of tokens by speaker for the realization of phrase accents on the leftmost noun in branching final DPs
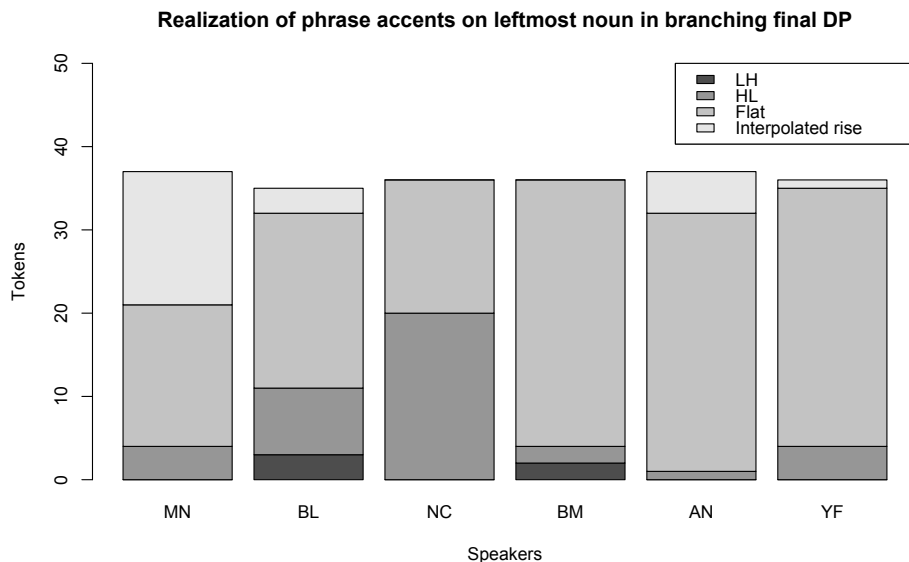
For most speakers, with the exception of MN and NC, the majority of tokens were produced with no phrase accent and a flat F0 contour. For MN, a large proportion of tokens were produced with an interpolated rise, which is also consistent with the analysis of this word as tonally unspecified.[27] NC, and to a lesser extent BL, showed a relatively high proportion of HL accents in this environment. However, it is possible that this is not representative of the same HL accent observed elsewhere because of the fall in F0 tended to be relatively small, although no

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[27] For MN but not for other speakers, many of the tokens with an interpolated rise on the final DP noun were followed by a vowel-initial adjective which was produced with an initial glottal stop (for example, the pitch track produced by MN in (1)). Because glottal stops may raise F0, it is possible that these interpolated rises are due to this segmental effect in many of these cases. Under this scenario, the realization of an accentless noun as having a flat F0 contour or an interpolated rise (or fall) may in part depend on segmental content.

quantitative measurements are available at this time.[28] LH accents (F0 rises), on the other hand, are observed only in a handful of cases. While more research is needed to determine whether or not these are true counterexamples to the generalizations presented here, the speakers behave as expected in a majority of cases, and the patterns analysed in this paper are assumed to be representative of the speakers recorded in this study.

5   Additional Structural Evidence: Complex DPs with Multiple Adjectives

In this paper, I have argued that LH and HL phrase accents are used in CI to demarcate the left and right edges of φ domains, with the distribution of LH limited to non-minimal φ domains. A prediction of this theory is that the distribution of the phrase accents is dependent only on the structural configuration of the syntactic constituent structure and its corresponding prosodic structure. For example, given the analysis of [V [SO]] sentences in the previous section, we would expect that any structure with a configuration [A [BC]] would result in a prosodic representation (A (BC)), with phrase accents distributed as follows:

(27) Schematic representation of [A[BC]] structures
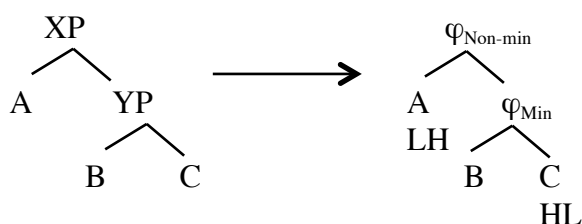
In this section, I consider evidence from one type of complex DP structure, DPs with two adjectives. I show that the distribution of tonal elements in these structures support the above analysis of the distribution of these tonal units in CI as a direct reflection of the syntactic structure.

      Adjectives in Irish follow the noun, as can be seen in the following examples:

(28) a.   blathanna bána
        flowers   white.PL
    b.   blathanna bána   áille
        flowers   white.PL beautiful.PL
        '(beautiful) white flowers'

For the purposes of this paper, I will assume a noun-raising approach to adjective ordering in Irish, where the noun raises out of NP to the head of a functional projection to the left of the adjective or adjectives (following Cinque 1994; Longobardi 2001; for Irish, Guilfoyle 1988;

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[28] In some sentences, it is clear that the HL is indeed an HL accent, and that the pattern is indicative of an alternate phrasing that is often employed by NC but not by other speakers.

Sproat & Shih 1991).[29, 30] I assume adjectives are either specifiers or adjuncts of NP, although this is not made explicit in the syntactic representations.[31, 32]

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[29] See also Rouveret (1994) and Roberts (2005) on Welsh (cf. Willis (2006)) and Stephens (1993) on Breton. I follow these authors in naming the functional projection FP and remain agnostic as to its syntactic label, which is not crucial for the current analysis.

[30] Note that the arguments that have been proposed in the cited work in favour of an N-raising account for Irish and other Celtic languages are based on the assumption that adjectives in these languages, while post-nominal, occur in the same order as in languages like English (i.e. not in the 'mirror-image' order found in Hebrew, for example). However, Willis (2006: 1816), citing Thomas (1996), observes that this is not universally true of adjective order in Welsh: for example, adjectives of QUALITY tend to precede adjectives of AGE and COLOUR in English (QUALITY > AGE > COLOUR), but follow them in Welsh (AGE > COLOUR > QUALITY). An example of this type in Irish can be seen in (28b), and to the best of my knowledge (based on my own informal fieldwork on adjective order Irish) these observations hold in Irish as well, and could ultimately provide evidence against a strict N-raising analysis for Irish, along the lines Willis (2006) for Welsh.

[31] The data reported in this paper for complex DP structures is relatively limited, with further investigation of DP structures left to future research (though see Elfner 2011, 2012, 2013 for some discussion of possessive constructions and relative clauses). For instance, I do not have access to prosodic data relating to the behaviour of DPs with numerals, intensifiers, and complements to N, and only limited data for DPs with overt determiners and prepositions. In the case of determiners and prepositions, these appear to behave consistently as proclitics to the immediately following ω (see footnote 16): their overt presence in a DP structure (as in (29)) does not affect the status of φ as minimal or non-minimal, as argued in Elfner (2012). As for other structures, it is not possible to move beyond speculation with respect to their prosodic character, and these questions must be left for future research.

[32] Note that the maximal projection DP is not mapped onto a φ domain in addition to that which is projected by FP. As discussed in section 3.2, we can make the assumption following Nespor and Vogel (1986) and others, that phonologically null elements and traces do not participate in the formation of prosodic domains; it is a logical step to assume, in a framework like the one put forth in this paper, that maximal projections dominating the same set of phonologically overt elements (like DP and FP, when D is null) project only a single prosodic domain, φ. If D is instead overt, the determiner, as a function word, will behave as a proclitic onto the following N, negating the need for the DP to project its own φ domain. If other elements project between D and FP (i.e. elements which preceded the noun, like numerals), it is predicted that these elements will project additional φ domains if the element is parsed as a prosodic word. This may be the case with numerals, whose prosodic character in Irish is at this stage unclear, but unfortunately, I do not have access to data at present that would confirm this prediction.

(29) The structure of Irish DPs with one adjective

```
        DP
       /  \
      D    FP
          /  \
        Nᵢ    NP
         ↑   /  \
         | A    tᵢ
         |_____/
```
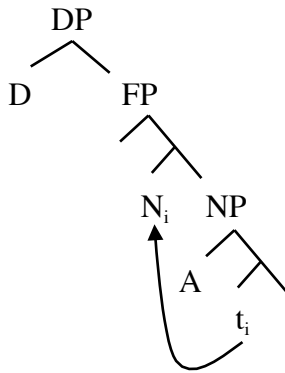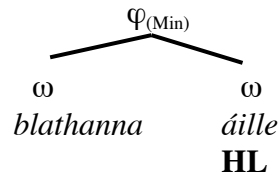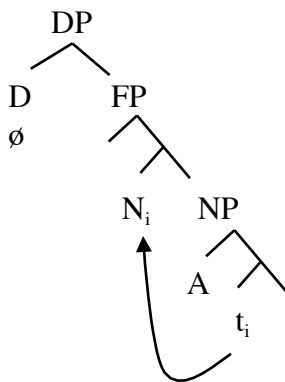
As discussed in section 3, φ constituents appear to always dominate a minimum of two ω in Irish. For adjectives, which are simultaneously maximal and minimal, these words are parsed as minimal prosodic constituents only: as ω but not φ. As discussed above in section 3.2, this pattern may have a eurhythmic explanation (e.g. a constraint enforcing minimal binarity of φ), with the result that prosodic constituents that are simultaneously maximal and minimal are parsed as minimal in prosodic terms. Given these assumptions, a DP that consists of a noun and one adjective will be parsed as a single φ, as in the representation in (30):

(30) The structure of DPs with a single adjective
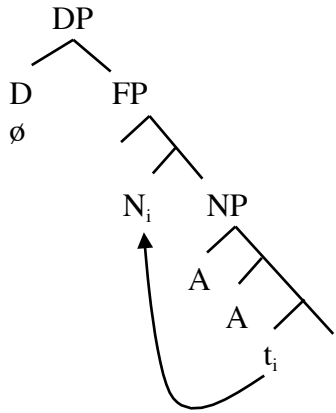   a. Syntactic structure   b. Predicted prosodic structure

```
        DP                              φ₍Min₎
       /  \                            /     \
      D    FP                         ω        ω
      ø   /  \                     blathanna  áille
        Nᵢ    NP                               HL
         ↑   /  \
         | A    tᵢ
         |_____/
```

Crucially, because the structure in is φ$_{Min}$, DPs with this structure will have an LH phrase accent at their left edge *only* when they are dominated by another φ, as was seen in the examples discussed in section 3, the subject DP in the VSO sentence and the subject and object DPs in the VSOX sentence.

      For DPs with two adjectives, on the other hand, the structure is inherently more complex. Because both adjectives are adjuncts/specifiers to NP, the two adjectives are parsed together as a φ because they are dominated by a single maximal projection (NP/N^{Max}). This constituent excludes N, because N has moved to a higher functional constituent. However, the functional
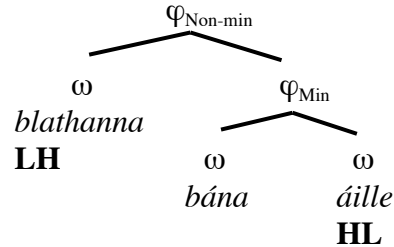
constituent FP would result in another φ constituent, dominating N and the two adjectives, as follows:[33]

(31) The structure of DPs with two adjectives
     a. Syntactic structure   b. Predicted prosodic structure

A crucial difference between the predicted prosodic structure of DPs with two adjectives as compared to DPs with one adjective is that its leftmost word (the noun) will *always* be associated with an LH accent, regardless of whether or not it is leftmost in another prosodic domain which dominates it. The reason for this is that the FP constituent that dominates N creates a $\varphi_{\text{Non-min}}$ without requiring any additional structure (as e.g. from TP in a VSO sentence). This predicts that we should see the LH accent appear on the noun wherever the DP appears, whether it is in subject or object position in a VSO sentence. Note also that the unaccented word, the first adjective, is both preceded and followed by an H tone: it is preceded by an LH accent on the noun and followed by an HL accent on the second adjective. This predicts that we should see an

---

[33] Note that although the analysis proposed here relies to a certain extent on a particular interpretation of the syntactic structure of DPs, it is in principle consistent with any syntactic derivation that results in the surface constituent structure [N[AA]], and not obviously consistent with any derivation resulting in [[NA]A]. For example, if we were to reject (or partially reject) the N-raising analysis on the basis of the observations in footnote 30 that mirror-image adjective ordering is (sometimes) possible in Irish as in Welsh, a plausible alternative would be to adopt an NP-raising approach (Cinque 1996) as proposed for languages like Hebrew (Sichel 2000; Shlonsky 2004) (although cf. Willis 2006, who rejects this approach for Welsh on both empirical and theoretical grounds). While it is not possible to sketch out a full analysis here, it is important to note that an NP-raising approach appears to make different empirical predictions with respect to prosodic phrasing as compared to the N-raising account assumed here: provided that adjectives are adjoined to NP, a pied-piping analysis involving NP-raising would result in a surface structure [[NA]A], which would be pronounced as [[$_{\text{LH}}$N A$_{\text{HL}}$] A$_{\text{HL}}$]. The data reported in this paper would appear to speak against this type of analysis, although a more comprehensive and systematic study of the prosody of adjective ordering in Irish would help to shed light on this matter.

H tone plateau stretching from the end of the noun, through the unaccented first adjective, and ending on the second adjective.[34]

These predictions can be confirmed by examining pitch contours for VSO sentences with DPs containing two adjectives placed in subject and object position. First, consider the VSO sentence where a DP of this type is placed in object position:

(32) Díolfaidh   rúnaí   dathúil   <u>blathanna bána   áille</u>
    sell.FUT   secretary handsome   flowers   white.PL beautiful.PL
    'A handsome secretary will sell beautiful white flowers.'

The predicted prosodic representation of this sentence is as follows:

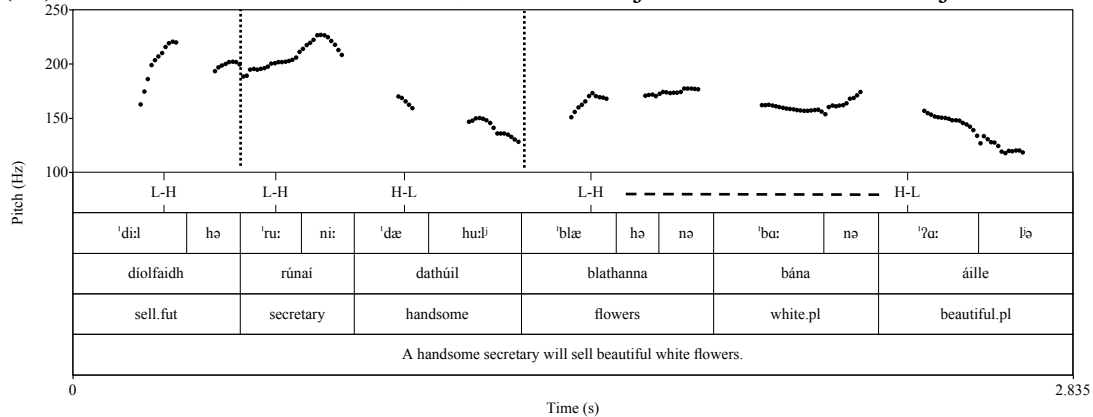(33) Prosodic representation of complex DP object (N-Adj-Adj) in a VSO sentence
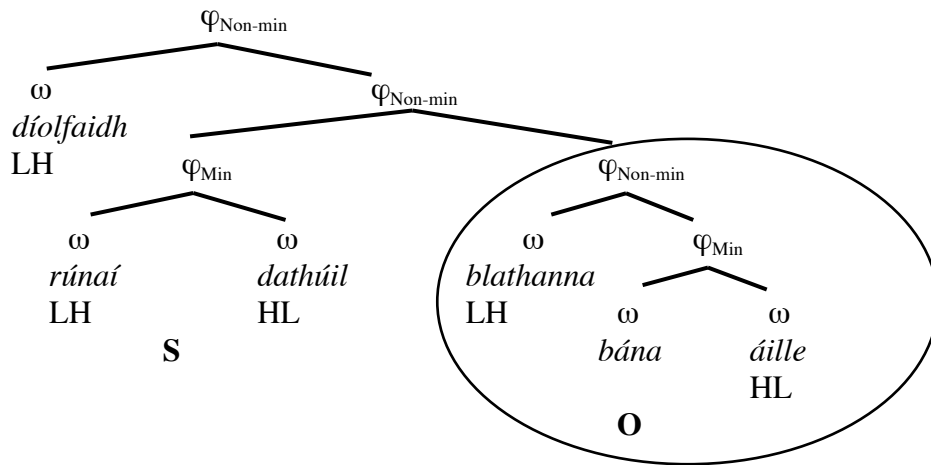
This pattern can be seen in the following pitch track, where the DP with two adjectives is placed in object position. As predicted, there is an LH accent associated with the object noun *blathanna* 'flowers' and an HL accent associated with the sentence-final adjective *áille* 'beautiful.pl'. The first adjective *bána* 'white.pl', in contrast, is not associated with a phrase accent and we see the predicted H tone plateau stretching across this word:[35]

---

[34] Note that a possible alternative prosodic analysis, in which N and two adjectives is parsed as a tertiary (non-recursive) prosodic domain (NAA) makes a slightly different prediction. Because the tertiary structure is not recursive, it is not inherently non-minimal, meaning that it can only receive an LH accent when it is itself dominated by a φ in which it is leftmost (e.g. in subject position of a transitive sentence). If it is not (e.g. in object position of a transitive sentence), it is predicted to behave like the NA objects in not bearing an LH accent. As can be seen in (34), this is not the case: there is a clear LH phrase accent on the noun, even when the construction occurs in object position. This pitch track therefore supports the recursive analysis assumed here.

[35] On *dathúil* 'handsome', the H target on HL, while obscured by the obstruent [d], is again downstepped with respect to the preceding H, on the LH accent of *rúnaí* 'secretary'. On *bána* 'white.pl', the final small increase in F0 is likely the result of the glottal stop at the beginning of *áille* 'beautiful.pl'.

(34) Pitch track for a VSO sentence, where the object is a DP with two adjectives

| | L-H | | L-H | | H-L | | | L-H | – – – – – – – – – – – – | | H-L | |
ˈdiːl	hə	ˈruː	niː	ˈdæ	huːlʲ		ˈblæ	hə	nə	ˈbɑː	nə	ˈʔɑː	lʲə
díolfaidh		rúnaí		dathúil			blathanna			bána		áille	
sell.fut		secretary		handsome			flowers			white.pl		beautiful.pl	
A handsome secretary will sell beautiful white flowers.													

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Similarly, we can place a construction of this type in subject position:

(35) Cheannaigh   múinteoirí   banúla   dathúla   málaí bána
     bought   teachers   lady-like.PL handsome.PL bags white.PL
     'Handsome, lady-like teachers bought white bags.'

As shown in the prosodic representation, the first adjective is leftmost in φ_{Min}, even in sentence-medial position:
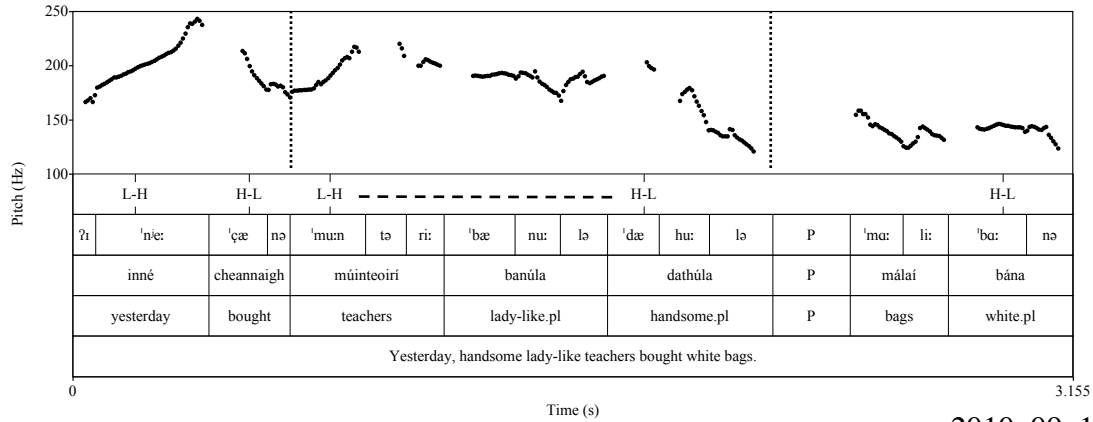
(36) Prosodic representation of complex DP subject (N-Adj-Adj) in a VSO sentence
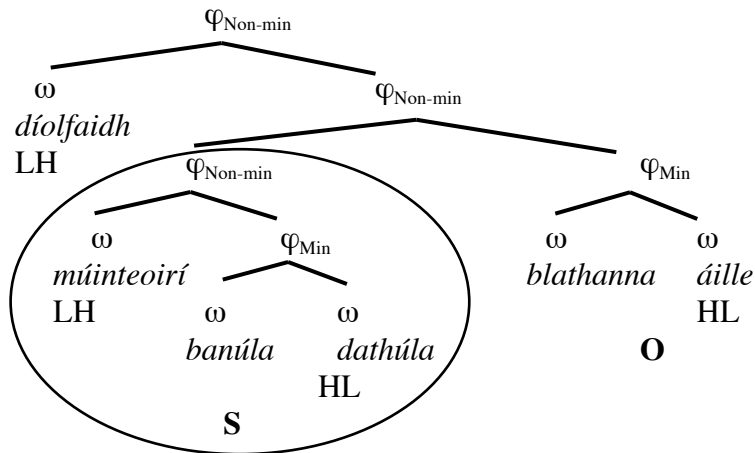
This distribution of phrase accents can be seen in the following pitch track, where there is an LH accent associated with the first word of the subject (*múinteoirí* 'teachers') and an HL accent associated with the second adjective (*dathúla* 'handsome.PL'). Again, as predicted, the H tone

27

from the LH accent carries through the first adjective to the HL accent on the second adjective as an H tone plateau.[36, 37, 38]

(37) Pitch track for a VSO sentence, where the subject is a DP with two adjectives

L-H		H-L		L-H	– – – – – – – – – – –		H-L									H-L	
ʔɪ	ˈnʲeː	ˈçæ	nə	ˈmuːn	tə	riː	ˈbæ	nuː	lə	ˈdæ	huː	lə	P	ˈmaː	liː	ˈbaː	nə
inné		cheannaigh		múinteoirí			banúla			dathúla			P	málaí		bána	
yesterday		bought		teachers			lady-like.pl			handsome.pl			P	bags		white.pl	
Yesterday, handsome lady-like teachers bought white bags.																	

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The distribution of tonal elements in these sentences supports the analysis developed above, where it was proposed that the distribution of LH and HL phrase accents provides information about prosodic bracketing: the phrase accents are sensitive to prosodic constituent structure, both with respect to demarcating the edges of prosodic domains, as well as, in the case of the LH accent, contributing information about the presence of recursion in the prosodic structure. Analysis of other structural examples are beyond the scope of this paper, though see Elfner (2011, 2012, 2013) for further discussion.

6   Apparent Mismatches

Throughout this paper, I have argued that the distribution of LH and HL phrase accents in CI provide evidence for a representation of prosodic domain structure in which prosodic structure directly reflects the syntactic structure. So far, no evidence has been presented which would

[36] In this particular example, the sentence is preceded by a sentential adverb *inné* 'yesterday'. For this speaker, the adverb phrases together with the verb, which accounts for the presence of the HL accent on the verb (as well as the LH on *inné*). This example is included here because the phrasing of the verb does not appear to affect the tonal patterns observed on the subject, which is the purpose of the example.

[37] Note that there is a slight dip in F0 on the adjective *banúla* 'lady-like.pl'. This appears to coincide with the segment [l], though it remains unclear why this occurs (this was also observed in other recordings in the corpus). There is also a fall in F0 on *málaí* 'bags'. It is unclear whether this fall indicates the presence of an HL phrase accent (which would indicate an atypical phrasing of the final object) or whether this is a property of this particular utterance or perhaps this particular speaker (note that a similar pattern is also observed in (40), which was uttered by the same speaker).

[38] Note the presence of a pause between the subject and object. It has been observed (Bennett 2008) that such pauses occur in natural speech, and do not (necessarily) indicate a disfluency. This pause may also be seen in the pitch track (40).

require us to differentiate between an account of phrase accent distribution in which the relevant domains are defined directly from syntactic structure, and one in which phrase accents refer to a separate representation of prosodic domains which are derived from syntactic structure from the "syntax-prosody mapping principle" in (3).[39] In this section, I provide a brief overview of a subset of sentential configurations where there appears to be a mismatch between syntactic and prosodic phrasing. While it is beyond the scope of this paper to provide a complete analysis of these cases at this time, my intention in presenting these cases here is to show that while the correspondence between syntactic and prosodic phrasing is transparent in certain ("default") configurations, as in the examples discussed above, it is also the case that what appear to be eurythmic effects can affect prosodic phrasing in CI.

Specifically, the mismatches discussed in this section are those which appear to be related to the binarity of prosodic constituents: they occur when arguments are non-branching. Up to this point, all of the examples discussed have included branching DP constituents: for example, in the transitive VSO sentences, both the subject and object were minimally branching, consisting of a noun-adjective sequence. However, when the subject is non-branching, for instance, a bare noun, we find that the verb and the subject noun tend to phrase together, contrary to what we would predict from the syntactic structure.

For example, consider the sentence in (38): instead of a subject DP containing both a noun and an adjective (*múinteoirí banúla* 'lady-like teachers'), the subject consists of only a noun (*múinteoirí* 'teachers'):
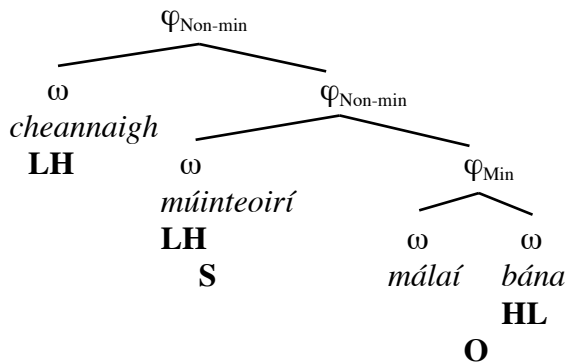
(38) $_{\Sigma P}$[Cheannaigh $_{TP}$[$_{DP}$[múinteoirí] $_{VP}$[$_{DP}$[málaí bána]]]]
bought teachers bags white.PL
'Teachers bought white bags.'

Assuming the syntax-prosody mapping principle in (3), the prosodic representation will, by default, parse the noun itself as a φ (assuming a syntactic structure much as in (4), where basic constituency is [V[SO]]).[40] Note that this prosodic representation predicts that both the verb (*cheannaigh* 'bought') and the subject (*múinteoirí* 'teachers') will be associated with an LH accent because they are each leftmost in a non-minimal φ. As will be seen below, this representation is predicted by the system, but not what is found empirically.

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[39] In section 3.2, it was proposed that the failure for APs to be parsed prosodically as φ could be accounted for with reference to a BINARY-MINIMUM constraint, which would seem to support an indirect reference approach. However, it was also noted that this apparent "mismatch" could plausibly also be accounted for in syntactic terms, which would be compatible with a direct reference approach.

[40] Note that we are, as in the case of the APs discussed in section 3, required to assume that the non-branching subject noun is parsed prosodically as a minimal projection (ω) rather than as a φ, despite being dominated by the DP/NP maximal projection. As before, this may be explained in either prosodic terms (resulting from BINARY-MINIMUM) or in syntactic terms.
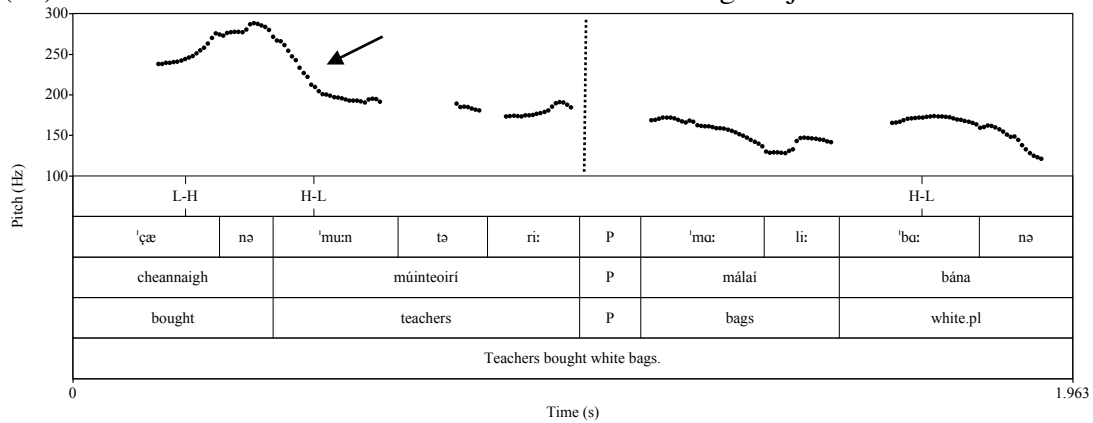
(39) Incorrect but predicted distribution of tonal elements in a VSO sentence (non-branching subject)

```
                        φ_Non-min
              ┌──────────────┴──────────┐
              ω                      φ_Non-min
         cheannaigh          ┌──────────┴────────┐
            LH               ω                  φ_Min
                         múinteoirí         ┌──────┴──────┐
                            LH              ω            ω
                             S            málaí        bána
                                                       HL
                                            O
```

While this structure is predicted based on our syntactic assumptions, the predicted distribution of phrase accents is not consistent with the distribution of phrase accents seen in pitch tracks such as the following, where the subject noun is marked with an HL accent, rather than an LH accent:[41]

---

[41] Note that the F0 peak for the HL accent on *múinteoirí* 'teachers' is earlier than expected, with most of the fall in pitch occurring before the end of the first syllable. This might be the result of the phonological deletion of the second of the adjacent H peaks or fusion of the two H tones (from the concatenation of LH and HL): unlike previous cases discussed in this paper, there does not appear to be any downstep between these two peaks, as appears to be common with adjacent H tones in CI. It is plausible that instead of employing downstep to distinguish the adjacent H tones, the second H tone target is deleted instead, which might lead to an early fall toward the L target. It is unclear at present what conditions the differential phonological treatment of adjacent H tones (deletion vs. downstep); however, given that both deletion and fusion are plausible phonological repairs for a tonal OCP violation (Meyers 1997), it seems unlikely that this example is problematic for the proposed prosodic analysis. Note also that there is a break between the subject and object: as described in footnote 38, these pauses are also found in natural speech and do not appear to indicate a disfluency.
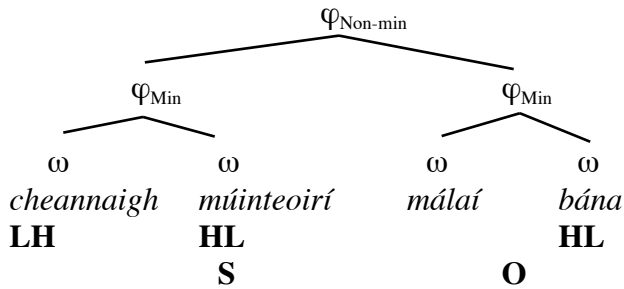
(40) Pitch track for a VSO sentence with a non-branching subject

	çæ	nə	ˈmuːn	tə	riː	P	ˈmɑː	liː	ˈbɑː	nə
	L-H		H-L						H-L	
cheannaigh			múinteoirí			P	málaí		bána	
bought			teachers			P	bags		white.pl	
Teachers bought white bags.										

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If the analysis developed in this paper is correct, the presence of the HL accent on the subject is indicative that it is rightmost in φ rather than leftmost in φ$_{Non-min}$, as the prosodic representation in (39) would suggest. The tonal pattern seen in this pitch track is consistent instead with a prosodic representation like the following, where the verb and the subject are phrased together as a φ:

(41) Proposed prosodic representation for a VSO sentence (non-branching subject) as in (38)

```
                        φ_Non-min
              ┌─────────────┴─────────────┐
           φ_Min                        φ_Min
         ┌───┴───┐                    ┌───┴───┐
         ω       ω                    ω       ω
    cheannaigh múinteoirí          málaí    bána
       LH      HL                    LH      HL
                S                             O
```

The structure in (41) departs from the syntax-prosody mapping principle in (3) by eliminating the constituent denoted by TP in the syntax, which would group together the subject and object.

　　How can we account for this mismatch? There are (at least) two plausible explanations that would be consistent with the analysis proposed in this paper, each of which I will discuss briefly here. One option, which would maintain the direct mapping hypothesis, would be to assume that there may be more than one possible syntactic parse available to speakers for this and other sentences: the apparent mismatch would then reflect the choice of a different underlying syntactic parse, rather than an actual mismatch between the underlying syntactic representation and prosodic phrasing. For example, we could assume that, alongside the more usual [V[SO]] structure, [[VS]O] structure is derived syntactically for non-branching subjects by extraposition of the object, as proposed by Wagner (2005, 2010) to account for apparent syntactic-prosodic structure mismatches in English. Indeed, as Wagner points out, there is often little positive evidence available that would actually rule out the extraposed structure in many cases, so it may be that the [[VS]O] parse is a plausible syntactic structure that may be available alongside the basic [V[SO]] parse that we have seen already. In sentence production, speakers would then have access to both the non-extraposed structure [V[SO]] and the extraposed structure [[VS]O] when

31

planning their utterance. Provided that both parses are available to speakers, it is possible that speakers may have access to prosodic information alongside discourse and other factors when deciding which parse to choose.[42] As such, speakers may choose the parse which best satisfies eurhythmic constraints as on binarity for any given sentence. As a result, when the subject is branching, the [V[SO]] structure would be chosen because the alternative does no better with respect to binarity; presumably, the parse with the extraposed object would also add unnecessary syntactic complexity. However, when the subject is non-branching, as in (38), the [[VS]O] parse would be preferred because it better satisfies binarity. Given that the importance of eurhythmic constraints in the formation of prosodic domains is already well-established (e.g. Nespor & Vogel 1986; Ghini 1993), it seems plausible that in the comparison of these two possible syntactic configurations, speakers weigh eurhythmy alongside syntactic-prosodic structure correspondence and choose the representation that best satisfies these competing factors. The challenge for this analysis would be to provide syntactic evidence for these extrapositions. Further investigation of this possibility is left to future research.

An alternative would be to assume that the available syntactic structure is limited to one option, the [V[SO]] configuration as established by syntactic diagnostics (e.g. McCloskey 2011), and that the prosodic representation in (41) represents a true "mismatch" between syntactic and prosodic structure. In this case, as above, the mismatch could once again be motivated by prosodic factors relating to eurhythmy. This type of analysis would be consistent with a framework like Match Theory (Selkirk 2009, 2011) as well as its predecessors in edge-based alignment frameworks (e.g. Selkirk 1986; Selkirk & Shen 1990; Selkirk 1995; Truckenbrodt 1995, 1999). Match Theory assumes that there is a direct correspondence between syntactic and prosodic constituents but which can be "overruled" under influence from competing prosodic markedness constraints, as on binarity. Under this system, eurhythmic factors would be directly responsible for choosing between different prosodic parses while the underlying syntactic structure would remain constant.

The choice between these two possible alternatives will not be made in this paper, as a full discussion would require access to additional data, both prosodic and syntactic, that is not available at this time. As such, this topic is also left to future research.

7 Theoretical Implications
7.1 Deriving recursive prosodic domains

Recent years have seen increasing support for a view of prosodic structure that retains information about recursion and the nesting of phrases present in syntactic structure. Most evidence has come primarily from gradient phonetic phenomena which demonstrate the presence of prosodic boundaries of different relative strengths. These include investigations of pitch scaling (Ladd 1986, 1988; Kubozono 1989, 1992; Féry & Truckenbrodt 2005; Féry & Schubö 2010) as well as pre-boundary lengthening (Wagner 2005, 2010).

The analysis proposed in this paper presents a different kind of argument in favour of a recursive account of recursion in prosodic structure. Unlike previous approaches, the argument is

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[42] This assumption raises the issues of when in the course of syntactic spell-out speakers have access to phonological and prosodic information. This is an interesting (and large) topic, but unfortunately beyond the scope of this paper.

based not on gradient phenomena or relative boundary strength,[43] but rather on the categorical distribution of phrase accents: their presence or absence rather than their relative strength. Further, the sentences analysed in this paper are not recursive in the syntactic sense of phrases embedded within phrases of the same type, as was the case of the coordinate structures discussed in Ladd (1988), Féry and Truckenbrodt (2005), and Wagner (2005, 2010). Rather, the sentences considered here are for the most part basic transitive sentences with modification of the complexity of the arguments, *syntactically* recursive only in the sense that syntactic phrases (XPs) are embedded inside other syntactic phrases. True recursion is apparent only in the resulting prosodic domains, where φ is embedded inside φ.

The analysis proposed in this paper attempts to remain neutral with respect to whether the domains relevant for phrase accent insertion (a type of domain-sensitive phonological process) are derived directly from syntactic structure, or whether these domains are prosodically defined, as under prosodic hierarchy theory (Selkirk 1978: et seq.). The division between these two approaches, usually referred to as *direct* and *indirect reference* approaches to prosodic domain formation, have been at odds with one another in the literature on the syntax-prosody interface for many years, and have recently come under scrutiny once again in recent research (for example, see Wagner 2005, 2010; Pak 2008; Selkirk 2011). While additional data may serve to shed light on this distinction, the analysis proposed in this paper can be made to be consistent with either an approach in which recursive prosodic domains are derived directly from syntactic constituent structure or one in which recursive prosodic domains are derived from syntactic structure, but also subject to constraints on prosodic well-formedness.

Rather, what is crucial for the proposed analysis is that prosodic structure be capable of encoding recursion. This proposal clearly contradicts work under the Strict Layer Hypothesis (Beckman & Pierrehumbert 1986; Nespor & Vogel 1986; Selkirk 1986; Pierrehumbert & Beckman 1988), which disallows the recursion of prosodic domains. In later work assuming Optimality Theory (Prince & Smolensky 1993/2004), the ban on recursion on prosodic structure is relaxed, but the preference for non-recursive structure was retained in the form of a violable OT constraint NONRECURSIVITY (Selkirk 1995; Truckenbrodt 1995, 1999). Under this framework, the presence of recursion in prosodic structure remains marked, employed only when needed to satisfy higher-ranked constraints. An example of this type of analysis can be found in Truckenbrodt (1999: 241), where the violable constraint NONRECURSIVITY is violated in order to satisfy ALIGNR-XP and WRAP-XP.

More recently, the recursion of prosodic domains has come to play a larger role in the theoretical literature. Notably, Wagner (2005, 2010) develops a theory of prosodic domain formation that is based on a cyclic spell-out model of syntactic structure: in this way, the recursion of prosodic domains emerges organically from underlying syntactic structure. On a similar vein, Selkirk (2011) proposes Match Theory, a containment theory of prosodic domain formation in which the left *and* right edges of syntactic constituents are simultaneously mapped onto prosodic constituents. Unlike the edge-based theory from which it derives (Selkirk 1986, 1995; Selkirk & Shen 1990) but like the theory developed in Wagner (2005, 2010), the recursion of prosodic domains derives directly from syntactic structure: because both the left and right edges of syntactic domains (e.g. XP) must be "matched" to a prosodic constituent (e.g. φ), the resulting effect is the recursion of prosodic domains.

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[43] This is not to preclude the possibility that such arguments also exist for Irish.

The analysis developed in this paper is in line with the proposals in Wagner (2005, 2010) and Selkirk (2011): here, recursion in prosodic phrasing derives naturally from the assumption that there is a close correspondence between syntactic and prosodic structure, formalized in the mapping principle in (3). While the OT-based alignment model developed in Truckenbrodt (1995, 1999) does allow for some amount of recursion, such an account would not be powerful enough to provide the level of recursion needed to derive the φ constituents proposed for the CI data, at least not with the set of constraints assumed in that work (ALIGNR-XP, ALIGNL-XP, and WRAP-XP, as defined below). For example, this becomes clear if we consider the basic case of Irish transitive VSO sentences with branching subject and object, as discussed in this paper. Even if all of ALIGNR-XP, ALIGNL-XP, and WRAP-XP outrank NONRECURSIVITY, there is still no motivation for the extra layer of recursion that groups together the subject and object, even though this constituent is derived from the syntactic structure itself. This can be seen by comparing candidates (c) and (d) in the OT tableau in (45) (note: the ☞ indicates the optimal candidate based on the ranking in the tableau, while ☹ indicates the intended winner based on the analysis proposed in this paper):

(42) ALIGNL/R(XP,φ): assign one violation mark for every left/right edge of a syntactic constituent XP that does not coincide with the left/right edge of a prosodic constituent φ.

(43) WRAPXP: assign one violation mark for every syntactic constituent XP that is not contained within a phonological phrase (φ). (Truckenbrodt 1995, 1999)

(44) NONRECURSIVITY: assign one violation mark for every prosodic constituent of type *n* that contains another prosodic constituent of the same level. (Selkirk 1995)

(45) OT tableau showing how the isomorphic candidate is harmonically bounded by (c)

$_{\Sigma P}[V _{TP}[[DP_1] [DP_2]]]$	ALIGNR(XP,φ)	ALIGNL(XP,φ)	WRAPXP	NONREC
a. (V DP₁ DP₂)	*!	*!**		
b. (V) (DP₁) (DP₂)			*!*	
c. ☞ (V (DP₁) (DP₂))				**
d. ☹ (V ((DP₁) (DP₂)))				***

As shown in tableau (45), the constraint NONREC favours candidate (c) over candidate (d) because it shows less recursion. Given this constraint set, candidate (d) is harmonically bounded (i.e. it will never be chosen as the winner under any ranking of the constraints).[44] However, under an approach to syntax-prosody mapping like the one assumed here, candidate (d) emerges as the winner because it does the best at preserving the constituency present in the underlying syntactic representation.

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[44] One way to ensure that candidate (d) be chosen as optimal is to employ a prosodic markedness constraint like MAXIMALBINARITY-φ, which would prefer candidates which φ constituents are maximally binary. If this constraint also outranks NONREC, candidate (d) would then win over candidate (c). However, adding this constraint introduces new problems to the analysis. For example, MAXBIN-φ would not be able to choose between candidate (d) and a similar candidate showing the phrasing ((V (DP₁)) (DP₂)). Additional constraints would still be needed to distinguish between these candidates.

7.2 Advantages of a Recursion-based Theory of Prosodic Structure

The analysis of prosodic phrasing in CI proposed here accounts for the distribution of phrase accents by making specific reference to the presence of recursion in prosodic structure. This type of analysis is relatively new in prosodic theory, and may initially appear to be unnecessarily divergent from previous work on prosodic theory. Especially given that LH and HL have non-identical distributions, one might question whether the two phrase accents are really marking the edges of two different intermediate prosodic categories, akin, for example, to the Major and Minor Phrase distinction that is often assumed in Japanese (e.g. McCawley 1968). In this section, I will discuss the advantages of assuming a recursive theory of prosodic phrasing over some of the possible alternatives.[45]

One advantage of the recursion-based theory of prosodic phrasing concerns the potential for typological description. In Ito and Mester's recent work on prosodic phrasing in Japanese (Ito & Mester 2007, 2012, 2013), one of their arguments in favour of adopting a recursion-based account (where they discuss both phrase- and word-level phenomena) is that it simplifies the task of prosodic description and cross-linguistic comparison. For example, it is well-established that Japanese shows evidence for two intermediate prosodic categories, the Major/Intermediate Phrase and the Minor/Accentual Phrase, as proposed by McCawley (1968) and others. Ito and Mester argue that if it were possible to describe the prosodic system of Japanese using a single intermediate category (φ) and to derive the former Major/Minor phrase distinctions using recursion, these problems of typological description would be reduced: while not all languages may distinguish between Major and Minor Phrases, it is relatively uncontroversial to assume that all languages distinguish one intermediate category (φ).

Under this theory there are two possible loci for cross-linguistic variation. First, languages may vary with respect to the degree to which φ is recursive: this depends in part on the status of constraints like NONRECURSIVITY and also on language-specific differences in surface syntactic structure (Selkirk 2011; Ito & Mester 2013). Secondly, language-specific phonology may vary with respect to which parts of the recursive structure are targeted by phonological processes. Under this theory, languages differ not in their inventory of prosodic categories, but rather in how they use phonological processes to demarcate the boundaries of a restricted set of prosodic categories that are available universally and may be recursive. The recursion-based theory therefore potentially provides a clearer picture of the universal nature of prosodic phrasing, and does not require that all languages show distinctions between the universally available categories in exactly the same way. While the present paper only discusses one language in detail, it is hoped that the material presented here will contribute to future typological work.[46]

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[45] However, I will not attempt to sketch out alternative analyses of the CI data assuming edge-alignment, strict layering, or other alternative accounts here. The purpose of this paper is not to argue that the recursion-based analysis of phrase accent distribution in CI is the only possible analysis of the CI data; rather, I wish to show that the account proposed here provides an elegant account of a new set of data, and that there are several advantages to adopting a theory of prosodic phrasing that uses recursion.

[46] What is not discussed here is just how restricted this set of prosodic categories needs to be. Selkirk (2011), as well as Ito and Mester (2013), assumes that there are three basic prosodic categories: ι, φ, and ω. In this paper, I have assumed a distinction between just two levels, φ and

A second advantage of the recursion-based analysis as proposed in this paper for CI is that it allows for a more transparent view of the syntax-prosody interface than is possible under edge-based or edge-alignment alternatives. Under the edge-based or edge-alignment theories where each edge of a syntactic constituent is assumed to be derived independently, the relationship between syntactic and prosodic structure is obscured by the nature of the mapping principles themselves. Following the proposals in Wagner (2005, 2010) and Selkirk (2011), the theory of syntax-prosody mapping assumed in this paper is maximally simple: syntactic phrases (XP/X$^{\text{Max}}$) map onto prosodic domains φ. All qualifications of this mapping principle (e.g. that only phonologically-overt words are prosodically visible) are well-established in the literature, and do not require adding any additional machinery to the theory. The edge-based alternative, on the other hand, necessarily departs from a strict correspondence to underlying syntactic structure, as discussed above in section 7.1, making it more difficult to know the extent to which prosodic phrasing can be used to better understand the structure and constituency of sentences.

8   Conclusion

The main goal of this paper has been to present an analysis of phrase accent distribution in Connemara Irish. I have argued that the distribution of the two phrase-level phrase accents, LH and HL, depends on a view of the syntax-prosody interface in which prosodic structure is recursive in a way that directly reflects the nesting of phrases in the syntax. More specifically, I have proposed that LH accents target the leftmost word of non-minimal projections of the prosodic domain φ, while HL accents target the rightmost word of φ, where φ domains are derived directly from maximal projections in the syntactic structure. In addition to basic transitive sentences (VSO) with binary subject and object, I have argued that the pattern can be extended to parallel structures, in particular extended transitive and ditransitive sentences (VSOX) and complex DP structures (DPs with multiple adjectives).

While the analysis proposed in this paper deviates from more traditional theories of syntax-prosody mapping, the recursion-based analysis was argued to possess advantages over a comparable analysis using a more traditional strict layering or edge-based approach. Firstly, the proposed analysis elegantly accounts for the distribution of the two phrase accents in CI, without any machinery beyond a straightforward mapping principle coupled with assumptions about the relationship between syntactic and prosodic structure that have been well-established in the literature. Building on the proposals in Wagner (2005, 2010) and Selkirk (2011), the framework assumed in this paper allows for a much more transparent view of the syntax-prosody interface than would be possible under the edge-based approach. However, this paper leaves open the question of how best to account for apparent mismatches: are these best accounted for syntactically or using eurhythmic/prosodic means? Even though these issues are not resolved in this paper, it is hoped that the proposals made here will lead to further research on this topic, and a deeper understanding of the relationship between syntactic and prosodic constituent structure.

ω, with no evidence presented that would bear on the presence of a third category ɩ. An even more radical proposal would see no categorical distinction between prosodic categories at all, with different levels of prosodic boundary strength responsible for demarcating what would appear to be different "types" of prosodic categories, along the lines of that proposed in Wagner (2005, 2010). It is hoped that this question will be addressed in future research.

A second advantage of the proposed analysis of phrase accent distribution in CI is that by understanding prosodic phrasing in terms of recursion of an intermediate category φ rather than two separate prosodic categories (e.g. Major/Minor Phrase as in Japanese), we move closer to a truly universal theory of prosodic structure. As discussed by Ito and Mester, a theory which both limits the number of distinct prosodic categories and allows for recursion in prosodic structure provides us with a way to better understand the typology of prosodic phonomena. This minimalist view of prosodic structure, coupled with the assumption that prosodic domains may be transparently mapped from syntactic structure, allows for a theory that may ultimately prove to be more powerful in its descriptive and analytical ability.

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