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The Syntax-Prosody Interface: Current Theoretical Approaches and Outstanding Questions

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Abstract

The syntax-prosody interface concerns the relationship between syntactic and prosodic constituent structure. This paper provides an overview of theoretical advances in research on the syntax-prosody interface. Current theoretical work is situated historically, and is framed in light of the central research questions in the field, including (a) to what extent prosodic structure can be used as a diagnostic for syntactic constituent structure, (b) the significance of recursion in prosodic theory, and (c) how mismatches between syntactic and prosodic constituent structure are modeled in different approaches to the syntax-prosody interface. The paper concludes with a discussion of the current state of the field and directions for future research.

Keywords: syntax-prosody interface, prosody, prosodic theory, recursion

1 Introduction

The study of linguistic interfaces has traditionally presented a number of challenges to researchers: developing an understanding of how modules interact necessitates an understanding of how each one functions independently. As a field, interest in the study of interfaces is growing as we make progress in the development of comprehensive theories of linguistic grammar. The goal of this paper is to provide an introduction to current theoretical work on the syntax-prosody interface, the point of interaction between sentence structure (syntax) and sound (phonetics/phonology).

Research in this area is concerned with the question of how information about the structure of sentences is conveyed in their pronunciation. This paper will assume as a starting point that syntax is hierarchical in nature, as evidenced by syntactic tests for constituency and dominance relations between syntactic elements, and will discuss the different theoretical debates regarding the ways in which *prosodic* structure can be hierarchically represented, including how prosodic structure relates to syntactic structure.

In phonetic terms, *prosody* refers generally to the suprasegmental features of language (pitch, duration, and intensity). These features can be manipulated to provide structure to the linear speech stream by varying the ways in which words are grouped together and emphasized in utterances, resulting in prosodic *domains* or *constituents*. Prosody, perhaps more than any other aspect of language, involves the interaction of linguistic modules. Even work that focuses on the syntax-prosody interface, as will be the focus of this paper, requires an awareness and understanding of how prosody functions within the grammatical system at large, from fine phonetic detail up to semantics and information structure.

This paper provides an introduction to current theoretical work on the syntax-prosody interface. The intention of this paper is not to argue for any one approach to the syntax-prosody

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interface, but rather to provide readers with a starting point and the tools to conduct original research that will contribute to the current theoretical debates. This paper will therefore be of interest to anyone who is interested in learning more about how to do research in this area.

2 Prosody as a diagnostic for syntactic constituent structure

2.1 Architecture of the grammar

Much work on the syntax-prosody interface deals with questions of *constituency*: how are words in an utterance related to one another hierarchically? In syntax, constituency is defined on the basis of syntactic constituency tests, whose goal is to manipulate syntactic constituents defined by syntactic structure. These tests provide evidence that sentences are hierarchically structured: even though words are pronounced in a linear fashion, they are related to one another in terms of membership in syntactic phrases. At the syntax-prosody interface, prosodic constituency is diagnosed in terms of prosodic boundaries and prosodic domains, which are demarcated by such phenomena as the distribution of pitch accents and boundary tones, the domains of application of segmental (“sandhi”) processes, and phonetic cues such as pauses, duration, and the scaling of tonal accents (Pierrehumbert 1980; Nespor and Vogel 1986; Selkirk 1980, 1986; for a review, see Ladd 2008 [1996]). A central research question in work at the syntax-prosody interface concerns whether—and to what extent—prosodic constituents are isomorphic with syntactic constituents.

All linguistic interfaces are ultimately concerned with questions relating to the architecture of the grammar. At the syntax-prosody interface, in addition to the question of how syntactic structure and prosodic constituents correspond to one another, the direction of interaction is also important to consider. Within generative (and more specifically, minimalist) theories of syntactic structure, the “Y-model” of the grammar (Figure 1) is commonly assumed to operate uni-directionally, in which syntactic structure influences prosodic structure, and not vice-versa (Chomsky 1995).

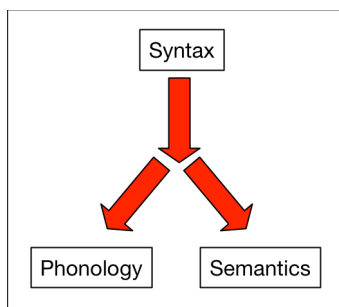


Figure 1: The Y-model of the grammar

Specifically, this approach predicts that phonological well-formedness constraints on the prosodic organization of utterances, such as eurhythmic constraints, will not (and cannot) affect how syntactic constituent structure is derived, and therefore will have no effect on the interpretation of meaning. Alternatives to this approach include models in which syntactic

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structure has access to phonological information, and thus may influence syntactic structure formation, such as whether or not a movement operation takes place (Richards 2010), as well as models in which mismatches between the prosodic and syntactic structure of sentences are attributed to variation in the underlying syntactic structure, derived from the application of optional syntactic processes such as extraposition (Wagner 2005, 2010, 2015).

2.2 Prosodic structure theory

Much theoretical work on prosody assumes *prosodic structure theory* (Selkirk 1981 [1978]; Nespor and Vogel 1986; Beckman and Pierrehumbert 1986; Pierrehumbert and Beckman 1988), which posits that the prosodic organization of sentences can be represented using a hierarchically ordered structure that is distinct from syntactic structure. Prosodic structure is part of the phonological grammar, and mediates between syntactic constituent structure and the phonetic output of the speech stream; phonological and phonetic phenomena thus target constituents and domains relating to prosodic structure rather than syntactic structure. The domains present in prosodic structure are formalized via the universal prosodic hierarchy, a system of hierarchically ordered domains of increasing sizes (Selkirk 1981 [1978]).

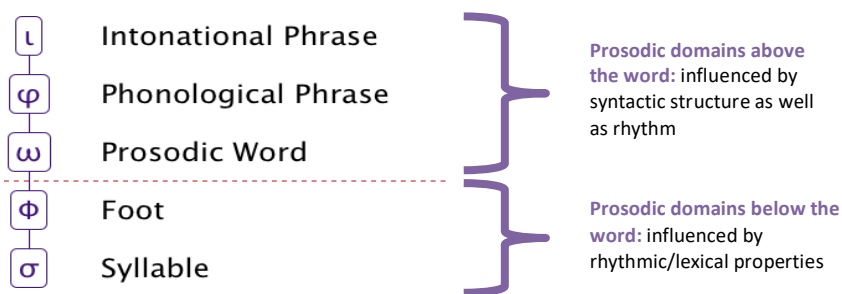


Figure 2: The prosodic hierarchy

Prosodic structure theory is part of a rich tradition used to describe the prosodic properties of languages from a typological perspective, under the assumption that all languages use the prosodic hierarchy as a universal system of prosodic organization. The prosodic hierarchy illustrated above in Figure 2 represents a minimalist version of the hypothesis, as argued for in recent work, (Selkirk 2011; Elfner 2012, 2015; Ito and Mester 2013); however, research on specific languages has included proposals that additional prosodic categories be included as part of the universal hierarchy. For example, languages with lexical pitch accent systems like Japanese and Basque arguably require the inclusion of additional intermediate categories such as the Minor/Accentual Phrase and the Major Phrase, which together take the place of the Phonological Phrase (φ) in the hierarchy in Figure 2 (McCawley 1968; Selkirk and Tateishi 1988, 1991; Pierrehumbert and Beckman 1988; Jun and Elordieta 1997).¹ Conversely, it has also been

¹ Though see, for example, Ito and Mester (2012) and Ito and Mester (2013) on Japanese and Elordieta (2015) on Basque for alternative accounts employing the recursion of φ domains as an

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proposed that the prosodic systems of some languages require reference to fewer domains than are represented in the hierarchy in Figure 2. For example, the Inuit languages have been claimed not to require reference to the phonological phrase level, showing evidence only of word-level and intonational phrase-level domains (Arnhold 2014; Arnhold et al. to appear). For further discussion of prosodic typology, see the papers collected in Jun (2005) and Jun (2014), and references cited therein.

2.3 Direct reference and phase-based approaches

Prosodic structure theory asserts that the representation of prosodic constituent structure is distinct from syntactic constituent structure; it is derived (at least in part) through reference to syntactic domains, but subject to its own set of prosodic well-formedness constraints. This type of approach is often referred to in the literature as an *indirect reference* approach to the syntax-prosody interface because domain-sensitive phonological processes refer to syntactic structure only as mediated by prosodic structure (Selkirk 1981 [1978], 1986; Nespors and Vogel 1986).

In opposition to indirect reference approaches are *direct reference* approaches. Instead of assuming that domain-sensitive phonological and phonetic processes reference prosodic structure, direct reference approaches assume that these domains can be derived directly from syntactic structure and the mechanisms of syntactic spell-out. These approaches assert that the domains created by prosodic structure are actually just syntactic domains, thus rendering prosodic structure superfluous to the grammatical derivation. Domain-sensitive phonological processes thus *directly* reference syntactic structure. Early examples of work proposing direct reference approaches to the syntax-phonology interface include Cooper and Paccia-Cooper (1980), Gee and Grosjean (1983), and Kaisse (1985)

Direct reference approaches initially received critical attention because of the seemingly many clear counter examples where prosodic domains do not match syntactic domains (Selkirk 1981 [1978], 1986; Nespors and Vogel 1986). However, relatively recently, new proposals assuming direct reference have emerged, primarily due to the emergence of theories of cyclic, phase-based, and multiple spell-out, independently proposed to be an integral component of syntactic computation (Uriagereka 1999; Chomsky 2000, 2001). If sentences are spelled-out incrementally, then perhaps these spelled-out chunks correspond to prosodic domains, and may be able to account for apparent mismatches between syntactic and prosodic domains. If we can thus derive prosodic domains without reference to prosodic structure as an intermediate step, using only independently-motivated domains from syntactic theory, perhaps prosodic structure is therefore not necessary to account for domain-sensitive phonetic and phonological patterns.

A topic of debate within phase-based approaches to prosodic domains regards the extent to which these domains are prosodic or syntactic in nature. The strong hypothesis is that phasal domains *are* prosodic domains, and that there is no need to posit a separate prosodic representation as part of the phonological grammar. Work assuming this strong hypothesis do not (necessarily) espouse the idea that prosodic well-formedness constraints (including

alternative to multiple intermediate phrasal domains. For theoretical discussion of the use of recursion in prosodic hierarchy theory, see Ito and Mester (2013).

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eurhythmic constraints) play a role in sentential prosody; rather, such factors are considered to occur late in the grammatical derivation, after the creation of prosodic domains. For work exploring versions of this “strong” hypothesis relating to cyclic or phase-based spell-out, see, for example, Seidl (2001), Wagner (2005), Wagner (2010), Wagner (2015), Pak (2008), Newell (2008), Dobashi (2013), and Newell and Piggott (2014).

Conversely, the “weak” version of this hypothesis maintains that while phases (or other types of domains created by cyclic/multiple spell-out) play a role in defining prosodic domains, phase theory and prosodic structure theory are not incompatible with one another. Rather, prosodic domains are created on the basis of phasal domains rather than syntactic constituent structure. Work incorporating both phase theory and prosodic structure theory include Dobashi (2003), Ishihara (2007), Kratzer and Selkirk (2007), and Selkirk (2009). A critical study comparing phase-based approaches with non-cyclic (edge-based/syntactic) approaches can be found in Cheng and Downing (2012) and Cheng and Downing (2016)

2.4 Prosody and word order

In addition to its role in providing information about syntactic constituent structure, another relevant area of investigation is the relationship between word order and prosodic structure. One main area of inquiry is the degree to which prosodic structure interacts with linearization (Kayne 1994; Fox and Pesetsky 2005), resulting in a postsyntactic reordering of terminal nodes or phrases, as has been argued to occur in domains such as second-position clitic phenomena (Halpern 1992; Werle 2009; Huijsmans 2015), pronoun postposing in Irish (Bennett et al. 2015, 2016), clitic right dislocation in Romance languages (López 2009), the fronting of prosodic (but not syntactic) constituents in Latin, Classical Greek and Russian (Agbayani and Golston 2010, 2016; Agbayani et al. 2011), scrambling in Japanese (Agbayani et al. 2015), and alternations between VSO/VOS word order in Austronesian and Mayan languages (Clemens 2014; Clemens and Coon to appear).

Provided that linearization is one of a number of operations that occur during syntactic spell-out (whether the operations at spell-out occur serially or in parallel), it is perhaps not surprising that prosody may play some role in determining how terminal elements are linearized. However, if it is indeed the case that such manipulations occur only at spell-out, they should not have any effect on the semantic, pragmatic, or information structural interpretation of the manipulated structures. This has been argued to be the case for the phenomena cited above. Under a conservative approach regarding the ability of prosody to manipulate word order, any manipulation that also has an interpretational effect (such as, for example, topicalization) must be analysed in such a way as to ensure such movement occurs in the syntactic component preceding spell-out.

A more radical approach to the syntax-phonology interface asserts that prosody can also have a direct effect on syntactic structure, affecting domains as syntactic movement and thus word order. Such an approach can be found in Contiguity Theory, as in (Richards 2010, 2016, 2017), where it is proposed that syntactic agreement and selectional relations are sensitive to the prosodic characteristics of specific languages, and that syntactic movement is sometimes triggered to help resolve prosodic constraints on contiguity.

3 Recursion of prosodic structure

3.1 Evidence for recursion

A topic of increasing importance in the study of the syntax-prosody interface is the role of recursion in the creation of prosodic domains. Under the Strict Layer Hypothesis (Selkirk 1981 [1978], 1984, 1986; Nespor and Vogel 1986; Beckman and Pierrehumbert 1986; Pierrehumbert and Beckman 1988), prosodic structure was hierarchically organized but adhered to a strict constraint banning the recursion of prosodic categories. In this way, prosodic structure was thought to differ fundamentally from syntactic structure.

Recursion in the prosodic domain does not necessarily equate to recursion in the syntactic domain, which has a narrower definition. Rather, because prosodic structure deals with the basic units of syntax, the recursion of prosodic categories may simply reflect compound structures of two prosodic words (Ito and Mester 2007), hierarchically ordered phrasal (XP) structure (Elfner 2012, 2015; Ito and Mester 2012, 2013), or the coordination of two or more sentences (Selkirk 2009; Myrberg 2013), without reference to syntactic details such as category labels. Evidence of recursivity in the creation of prosodic domains, as in Match Theory, has been argued to provide support for a more transparent version of the syntax-phonology interface than was assumed under the Strict Layer Hypothesis (Selkirk 2011; Elfner 2012, 2015; Ito and Mester 2013).

Phonetic evidence has been used to identify differences in the relative boundary strength of structures that show recursivity in the syntactic structure. The relative strength of prosodic boundaries can be measured by comparing the acoustic measures of prosodic cues such as F₀, duration, and intensity, and relative cues such as F₀ scaling and downstep. Work arguing in favour of recursion in prosodic structure on the basis of prosodic boundary strength include Lehiste (1973), Ladd (1986), Ladd (1988), Kubozono (1989), Kubozono (1992), Wagner (2005), Wagner (2010), Féry and Truckenbrodt (2005), Myrberg (2013), and Elordieta (2015). Phonological arguments in favour of recursion can be found in Selkirk (2011) on Xitsonga, and Elfner (2012, 2015).

3.2 Match Theory

The presence of recursion in prosodic structure plays a crucial role in Match Theory (Selkirk 2009, 2011), a recently-proposed indirect reference approach to the syntax-prosody interface, and in work assuming this framework (e.g. Elfner 2012, 2015; Ito and Mester 2013; Myrberg 2013; Clemens 2014; Bennett et al. 2015, 2016). In Match Theory, prosodic structure is derived directly from a family of syntax-prosody MATCH constraints, which call for correspondence between syntactic constituents (word, phrase, clause) and prosodic domains (ω , φ , ι). Schematically, the three mapping constraints can be represented as follows:

(1) MATCH constraints

MATCH-CLAUSE: syntactic clause \rightarrow intonational phrase (ι)

MATCH-PHRASE: syntactic phrase \rightarrow phonological phrase (φ)

MATCH-WORD: syntactic word \rightarrow prosodic word (ω)

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Take, for example, the phrasal level, governed by the constraint MATCH-PHRASE. This constraint can be conceptualized in terms of correspondence between sets of terminal nodes, as proposed in Elfner (2012, 2015):

(2) MATCH-PHRASE (Elfner 2015: 1178):

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 constraint requires that a correspondence relation (in the sense of McCarthy and Prince 1995) hold between every phrasal constituent in the syntactic component and every φ -level domain in the phonological component, defined such that for every set of terminal nodes dominated by a given syntactic constituent, the phonological exponents of this same set is dominated by a φ constituent. Because syntactic structure is hierarchical, therefore, prosodic structure, under this theory, will also be hierarchical. However, because MATCH-PHRASE does not preserve category distinctions (such as VP, DP, or NP), the resulting prosodic structure will consist of a recursive hierarchy of phonological phrase (φ)-level domains.

One area which requires further investigation is the proposal that the grounding of prosodic structure depends on the three proposed building blocks of syntactic structure—words, phrases, and clauses. The syntactic definitions of these terms can be defined in a number of ways, and may not even have a universal interpretation.

At the word level, we may gain some insight from examining how prosodic words are formed in morphologically-complex polysynthetic languages. For example, Windsor (2017) proposes that MATCH-WORD in Blackfoot references syntactic heads (X^0), while Guekguezian (2017) proposes that MATCH-WORD in Chukchansi references complex X^0 as derived via head movement. An additional complication, however, may arise from the MATCH constraints themselves, which may not be universally interpreted. For example, in polysynthetic languages such as Inuit, phonological “words” may in fact be syntactically phrasal, but correspond prosodically to prosodic words (Compton and Pittman 2010; Arnhold et al. to appear).²

At the phrase level, the particulars of how syntactic trees are built will have some effect on how MATCH-PHRASE is evaluated. For instance, if bare phrase structure (Chomsky 1995) is assumed rather than X-bar structure, syntactic phrases and words may be more aptly characterized as *maximal* and *minimal* projections, with fewer intermediate (X') projections present in the syntactic representation. As discussed in in Bennett et al. (2016), one complication that arises when assuming bare phrase structure is that certain elements must then be analyzed as being

² Arnhold et al. (to appear) propose that the notion of “orthographic word” corresponds systematically to a minimally defined prosodic domain, labeled the prosodic word, and which are contained within a larger prosodic domain, labeled the intonational phrase. However, as discussed in that work, it is unclear whether or not there is any evidence for an intermediate prosodic domain (φ); thus, the minimal prosodic domain may itself correspond to either ω or φ , or perhaps to both ω and φ .

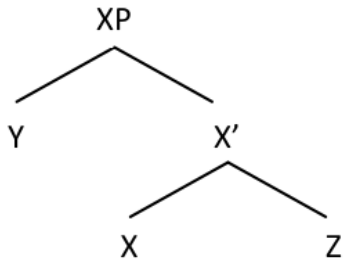
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simultaneously dominated by maximal and minimal projections, predicting that such elements will be simultaneously mapped to two prosodic categories through the application of MATCH constraints. Bennett et al. (2016: 189) suggest as a solution to this problem, that certain MATCH constraints be prioritized (or perhaps ranked) over others. For example, they argue that pronouns in Irish, being simultaneously maximal (as DP) and minimal (as D), are preferentially mapped as ω rather than φ ; similarly, CPs are mapped to ι (as clauses) rather than φ (as maximal projections). It remains a matter of debate whether such prioritization is universal or is the result of language-specific constraints/rankings, or whether some languages allow constituents to be mapped simultaneously to multiple prosodic categories.

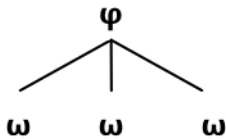
A different type of complication arises from the presence of intermediate (X' level) structure in syntactic phrases containing an overt specifier, head and complement, as in the following hypothetical structure (where Y, X, and Z are assumed to be phonologically overt):

(3) X-bar structure



In such structures, strict application of the MATCH-PHRASE constraint as defined in (2) would result in a non-binary φ -phrase (Y X Z) rather than binary (Y(XZ)),³ as illustrated in (4) and (5), respectively.

(4) Ternary structure, derived from (3)

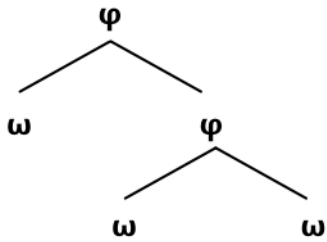


³ Note that Y and Z in this example may themselves be phrases rather than words.

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(5) Binary (recursive) structure, preserving binary branchingness



Bennett et al. (2016) derive the preference for the structure in (5) in Irish to a high-ranking prosodic BINARITY constraint requiring φ to dominate no more than two ω , rather than requiring sensitivity to bar-level categories and syntactic branchingness on the part of MATCH-PHRASE. It remains an empirical question whether ternary prosodic structures occur in languages, or whether binary (or binary-branching) structures are universally preferred.⁴ For further discussion of the relationship between syntactic branchingness and prosodic eurhythmic preferences for binary structures, see, for example, Ghini (1993).

At the clausal level, there are a number of ways in which MATCH-CLAUSE may be interpreted in the prosodic representation. As discussed in Selkirk (2011), clauses can be defined syntactically (e.g. as CP) or pragmatically (e.g. as the ‘illocutionary’ clause). As noted in Selkirk (2011), there is empirical support behind both possibilities as being the basis for intonational phrases in Match Theory (as well as its predecessors in prosodic structure theory), and it is proposed in that work that both MATCH(illocutionary clause, ι) and MATCH(clause, ι) may exist in linguistic grammars. On a different note, Hamlaoui and Szendrői (2015, 2017) propose that the mapping of intonational phrases is syntactically defined, and may vary from language to language depending on language-specific surface syntactic patterns: specifically, they argue that intonational phrase edges are defined by the highest extended projection of the verb. For further discussion of these issues, as well as empirical discussion, see Selkirk (2011) and Hamlaoui and Szendrői (2015, 2017) and the references cited within.

Finally, it is worth discussing how the Lexical Category Condition (Selkirk and Shen 1990; Selkirk 1995; Truckenbrodt 1995, 1999) relates to both MATCH-WORD and MATCH-PHRASE. This condition embodies the observation that syntactic functional elements and their projections behave differently in terms of syntax-prosody mapping as compared to syntactic lexical elements. More specifically, function words and their projections are thought not to be visible to syntax-prosody mapping constraints. It remains a matter of debate whether this condition, originally proposed as part of an end-based approach to syntax-prosody mapping, should be incorporated into Match Theory, which makes different base assumptions regarding how syntactic constituents are mapped onto prosodic constituents. This topic, specifically as relates to Match Theory, is further discussed in Selkirk (2011), Elfner (2012, 2015), and Selkirk and Lee (2015).

Match Theory thus provides a theory of syntax-prosody mapping in which prosodic structure maps directly from syntactic structure. As conceived in Selkirk (2011), this mapping is governed

⁴ Note that Richards (2017) does assume that these ternary structures arise as a result of MATCH constraints in Contiguity Theory, though the motivation for these structures is abstract.

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by violable correspondence constraints that may be outranked by conflicting constraints, such as those governing prosodic well-formedness, as in an Optimality Theoretic framework. As will be discussed in the next section, any mismatches between syntactic and prosodic structure are modeled using constraint interaction.

4 Mismatches

A final aspect of the syntax-prosody interface that deserves some discussion is the question of *mismatches*: instances of non-isomorphic mappings between syntactic and prosodic structure. While certain types of mismatches may occur systematically under direct reference approaches (especially those assuming a phase-based or multiple spell-out approach to prosodic domain building), this section will focus on mismatches as derived under indirect reference approaches, and more particularly, Match Theory.

Because indirect reference approaches to syntax-prosody mapping require a mediating level of phonological computation between the syntactic output and the phonetic pronunciation, indirect reference approaches also typically allow for interaction or influence from different types of prosodic well-formedness constraints. In constraint-based models of the syntax-prosody interface, such as those assuming ALIGN⁵ or MATCH constraints, these interactions are represented using ranked and violable OT constraints, which interact directly with syntax-prosody correspondence constraints and which are also assumed to be violable (for discussion, see Selkirk 1995, 2011; Truckenbrodt 1995, 1999). Some examples of prosodic markedness constraints dealing with eurhythmic preferences which have played a role in prosodic analyses include BINARITY (Ito and Mester 1992; Ghini 1993), EQUALSISTERS (Myrberg 2013), and STRONG-START (Selkirk 2011; Elfner 2012; Clemens 2014; Bennett et al. 2016). Such constraints may conflict with the isomorphic mapping of syntactic structure; in languages where these constraints outrank the relevant syntax-prosody correspondence constraints, we expect to see the emergence of prosodic structure which better satisfies these prosodic markedness constraints, rather than the more faithful isomorphic structure.

In Match Theory, the interaction between prosodic markedness constraints and MATCH constraints makes specific predictions regarding the presence of recursion in prosodic representations. Under this approach, unlike edge-alignment approaches to syntax-prosody mapping (Chen 1987; Selkirk and Shen 1990; Truckenbrodt 1995, 1999), recursion is an integral component of prosodic structure; because syntactic representations are hierarchical, prosodic representations are, by default, also hierarchical. However, one result of the influence of prosodic markedness constraints, such as those mentioned above, is that the amount of recursion present in prosodic structures is reduced. In previous approaches couched within prosodic structure theory, recursion was either avoided due to the presence of an inviolable constraint on prosodic structure (as in the Strict Layer Hypothesis) or as a violable constraint NONRECURSION. For further discussion, see Selkirk (2011), Elfner (2012), Ito and Mester (2013), and Selkirk and Lee (2015).

⁵ For OT-based theories using alignment constraints, see, among others, Selkirk (1995); Truckenbrodt (1995, 1999).

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5 Case study: pronoun postposing in Irish

As an illustration of the above theories, this section will discuss the phenomenon of pronoun postposing in Irish (among others, Chung and McCloskey 1987; Adger 1997, 2007; Elfner 2011, 2012; Bennett et al. 2015, 2016), with a particular focus on the account proposed in Bennett et al. (2016). This account is an apt illustration of the different factors which interact at the syntax-prosody interface, including syntax-prosody mapping (MATCH) constraints, prosodic markedness constraints governing eurhythmic preferences (STRONG-START), and constraints governing the linearization of syntactic structure. The principal patterns are as follows.⁶

Irish is a verb initial language, with a basic word order of VSOX in finite clauses, where X represents a second verbal complement or adjunct element. When the object is a pronoun and is followed by an X element, however, the word order may (optionally) be realised as VSXO. This pattern is illustrated with the following examples taken from Bennett et al. (2016); (6) shows a non-pronominal object and VSOX word order, while (7) shows a postposed object pronoun.

(6) Fuair sé nuachtán Meiriceánach óna dheartháir an lá cheana.
get.PST he newspaper American from.his brother the-other-day
'He got an American newspaper from his brother the other day.'
(Bennett et al. 2016: 170)

(7) Fuair sé ___ óna dheartháir an lá cheana é.
get.PST he from.his brother the-other-day it
'He got it from his brother the other day.'
(Bennett et al. 2016: 171)

In sentences with multiple adjuncts, the pronoun may postpose to an intermediate (non-clause final) position, as in the following example:

(8) D'fhuadaigh sé ___ leis chun an bhaile í i ngan fhios.
abduct.PST he with.him to the home her in secret
'In secret, he took her home with him by force.'
(Bennett et al. 2016: 171)

Finally, they observe pronoun postposing is ultimately an optional process; the object pronoun may remain in canonical object position:

(9) D'fhág Wilhelm iad ansin.
leave.PST Wilhelm them then
'Wilhelm left them then.'

⁶ Similar patterns are also found in (closely-related) Scottish Gaelic; the discussion in this section will focus on Irish.

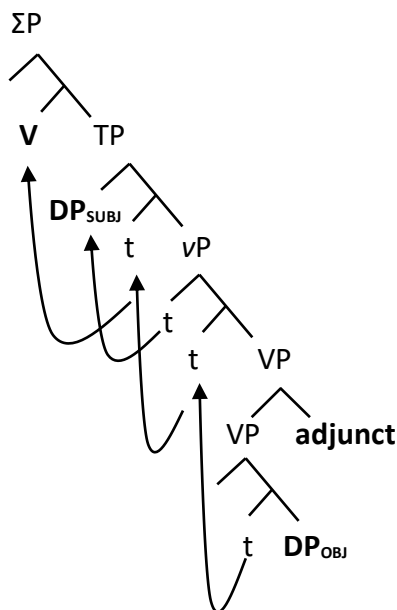
(Bennett et al. 2016: 172)

As discussed in Bennett et al. (2016), the displacement of the object pronoun is not accompanied by any change in semantic or informational structural interpretation, but rather appears to be driven by purely prosodic factors. The role of prosody has previously been observed to play a role, for example, in McCloskey (1999), Adger (1997), and Adger (2007).⁷

The analysis developed in Bennett et al. (2016) relies on two observations regarding the prosodic and phonological realization of postposed and non-postposed pronouns, which may be pronounced as prosodically strong (capable of bearing a pitch accent, with an unreduced, long vowel as the syllable nucleus) or as prosodically weak (incapable of bearing a pitch accent, with a reduced, short vowel as nucleus). First, they observe that postposed pronouns in Irish are realised in their weak form, and are phonologically enclitic onto the immediately preceding prosodic word. Second, they observe that in examples like (9) where the object pronoun is not postposed and therefore surfaces in canonical object position, the pronoun may be realised either in its prosodically weak form, an enclitic dependent again on the immediately preceding lexical word (the subject in the above examples), or alternatively, in its prosodically strong (unreduced) form (i.e. as an independent prosodic word). Crucially, unpostposed pronouns are never realised as prosodically weak *proclitics*, prosodically dependent on the *following* prosodic word.

The prosodic account proposed in Bennett et al. (2016) assumes Match Theory (Selkirk 2011) and can be summarized as follows. The syntactic structure of VSOX sentence in Irish is as in (10), based on Bennett et al. (2016):

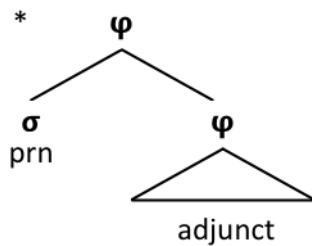
(10) Syntactic representation of VSOX sentences in Irish



⁷ Earlier versions of the analysis ultimately proposed in Bennett et al. (2016) can be found in Elfner (2011), Elfner (2012), and Bennett et al. (2015).

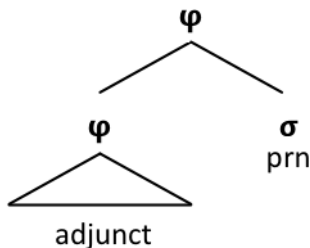
In this structure, [OX] form a syntactic constituent in the vacated VP; because VP is a syntactic phrase, this constituent is “matched” to a φ by the constraint MATCH-PHRASE (as defined in Section 3.2 above). A prosodic markedness constraint, STRONG-START, penalizes prosodically weak elements at the left edge of a φ (Selkirk 2011; Elfner 2012), and outranks MATCH-PHRASE in Irish. When O is a lexical word (or phrase), the left edge of the φ (OX) constituent is aligned with a non-dependent prosodic element (ω or φ , as the case may be), thus satisfying STRONG-START. When O is a weak pronoun, however, the left edge of the φ constituent would be aligned with a prosodically weak element (a clitic, prosodically a σ rather than a ω), thus violating STRONG-START, as in (11).

(11) Proclitic weak pronoun *in situ*: STRONG-START violation

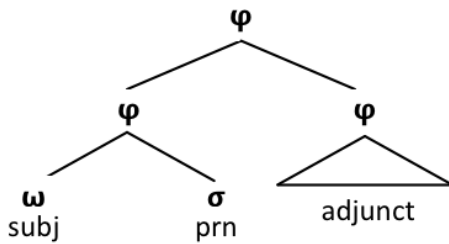


The three available options for the pronunciation of the object pronoun each satisfy this potential violation of STRONG-START: pronoun postposing and encliticization *in situ* remove the weak pronoun from the left edge of φ , as shown in (12) and (13), respectively, while the realization of the pronoun in its strong form allows for the left edge of φ to be aligned with a prosodically strong element (ω), as in (14).

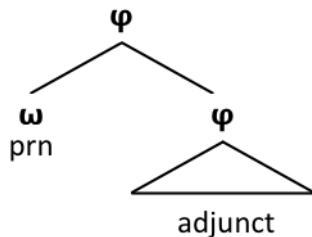
(12) Postposed weak pronoun: STRONG-START satisfied (LINEARIZATION violated)



(13) Enclitic weak pronoun *in situ*: STRONG-START satisfied (MATCH-PHRASE violated)



(14) Strong pronoun *in situ*: STRONG-START satisfied



In order to account for the availability of pronoun postposing at spell-out, Bennett et al. (2016) propose that linearization is computed in parallel with prosodic structure building, governed by a violable constraint that interacts with MATCH-PHRASE and STRONG-START at spell-out.

The analysis of pronoun postposing summarized above provides an illustration of how Match Theory, coupled with assumptions about the possibility of recursion in prosodic structure and the interaction of operations which occur simultaneously at spell-out, provide an account of a phenomenon that is puzzling from a purely syntactic point of view.^{8,9} Furthermore, this account reconciles the word order phenomenon of pronoun postposing with other independent observations regarding the prosodic system of Irish, such as the correlation between the strong and weak forms of pronouns with prosodic phrasing at the sentential level.

6 Conclusion and discussion: future directions for research

⁸ For arguments against a purely syntactic account of pronoun postposing, see Bennett et al. (2016).

⁹ It is also worth considering how (and whether) the account of pronoun postposing in Bennett et al. (2016) might be captured using a phase-based account. Elfner (2011) and Elfner (2012) in earlier versions of the Bennett et al. (2016) analysis, assumes both Match Theory and phase-based spell-out, and proposes that the domain relevant for pronoun postposing is the left edge of the spell-out domain triggered by v , rather than simply the left edge of φ . This account captures an asymmetry that is ultimately explained through morphological means in Bennett et al. (2016) and further developed in Bennett et al. (2017), that subject pronouns, while also syntactically found at the left edge of an XP, never postpose; under the phase-based account, subject pronouns do not postpose because they do not occur at the left edge of a phase.

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In many ways, research on the syntax-prosody interface is at once converging and diverging. On the one hand, the re-evaluation of the notion that prosodic structure may be recursive, as well as the development of theories of phasal and multiple spell-out, has led to fresh insights in our understanding of prosodic structure theory, as well as by providing additional evidence in favour of a theory where prosody more directly references syntactic structure. Whether syntactic structure is spelled out incrementally or all at once, the possibility that prosodic structure may play a role in determining the surface structure of traditionally syntactic domains such as word order and even syntactic movement, suggests that an understanding of prosody and the syntax-prosody interface is vital to our understanding of syntax. In the same vein, insights from traditionally phonological theories of constraint interaction like Optimality Theory (Prince and Smolensky 2004 [1993]) have motivated the investigation of the mechanics of syntactic spell-out: to what extent do prosodic structure building and mapping operations occur simultaneously with other aspects of syntactic spell-out, such as linearization?

Conversely, the advancements mentioned in the previous paragraph have also resulted in creating division between theories advocating a direct approach to the syntax-prosody interface, in which prosodic domains *are* syntactic domains, and theories where prosodic structure continues to play a mediating role as part of the phonological grammar. Theories falling under the former category predict that prosodic domains are derived using syntactic chunking mechanisms like phase theory, while theories falling under the latter category derive prosodic domains via the establishment of mapping relations between syntactic and prosodic constituents. In many respects, such theories establish the same results through different means, with relatively subtle predictions depending on, for example, which syntactic nodes may trigger phasal spell-out. One question relevant to future research regards the ways in which the two types of theories are empirically different, including a better understanding of the basis for syntax-prosody mismatches, which are handled very differently in the two approaches.

Finally, the increasing consensus that prosodic structure shows evidence of recursion may allow for a more nuanced approach to defining the relationship between syntactic and prosodic constituent structure. As discussed in this paper, there are a number of factors that conspire to make the syntax-prosody interface a complicated area for research, including varying assumptions with respect to the theory of syntactic representation, as well as the characterization of the syntax-prosody mapping principles, the influence of prosodic markedness constraints, and the role of phasal or cyclic spell-out. In much work on the syntax-prosody interface, syntactic structure is simply assumed as a starting point; however, if our understanding of the syntax-prosody interface becomes refined enough, it may become possible to more confidently use prosodic structure as a diagnostic for syntactic constituent structure.

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