Syntactic constituency, phonological constituency and the phonology and phonetics of tone: An informal report

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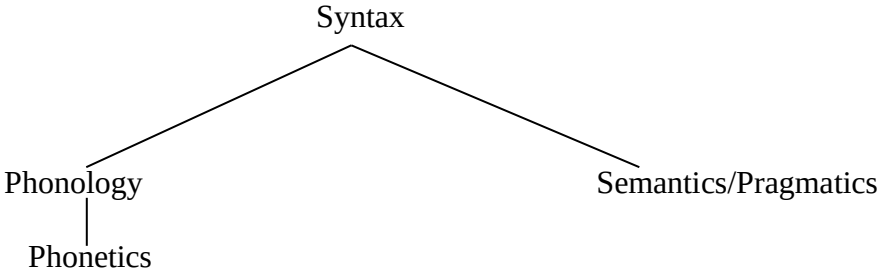
1. Introduction

Across the span of nearly a decade, the National Science Foundation grant entitled "The Effects of Constituency on the Phonology and Phonetics of Tone"[1] provided a framework for interchange and collaboration on the topic of the syntax-phonology interface between the researchers on the grant-- Lisa Selkirk, Gorka Elordieta, Seunghun Lee, Emily Elfner—as well as with a set of colleagues including co-authors Scott Myers and Angelika Kratzer, additional grant consultants[2], and graduate student research assistants. The findings of the various research projects that were carried out are consistent with a particularly restrictive version of the Chomskyan Y-model of grammatical architecture. In the general version of the Y-model, illustrated in (1), the output of the syntactic derivation provides input to the phonological and phonetic interpretation of the sentence, on the one hand, and on the other hand, to its semantic/pragmatic interpretation. An obvious prediction of this general model is that there is no possible effect of the phonology branch on the semantics branch or vice versa, and this seems to hold true.

(1) The Chomskyan Y-model of grammar



Over the years, the precise nature of the interface between syntax and phonology has continued to be a matter of debate. The assessment of Bennett and Elfner (2019) in the conclusion of their review article 'The Syntax-Phonology Interface' in the *Annual Review of Linguistics* is that "Research on phrasal phonology, and its relation to syntax, has potentially profound consequences for our understanding of the architecture of the grammar, raising issues related to the modularity and independence of different types of linguistic knowledge…" The following report reviews in what ways the publications based on the research carried out in our NSF-grant-

[1] NSF research grant BCS-1147083 to Elisabeth Selkirk, 7/1/2013-12/31/2016.
[2]Additional grant consultants were Charles Kisseberth, Jim McCloskey, Mark Baker, Larry Hyman, Scott Myers, Norvin Richards, Aritz Irurtzun, Junko Ito, Armin Mester, Kristine Yu, Seth Cable, Lee Bickmore.

related collaborations argue for a theory of the syntax-phonology interface in which the (morpho)syntactic representation has *no direct relation* to the output representation of the phonological module. Rather, it is in the phonology *per se* that the language-particular phonological patterning of sentences is defined. The evidence from our investigation of sentence phonology is moreover consistent with the radical separation between phonology and semantics that is implied by the Y-model.

In our crosslinguistic research projects addressing the question of the effects of constituency on the phonology and phonetics of tone, we have investigated a set of languages already known to be relevant to our research questions: Xitsonga, Luganda, Lekeitio Basque, Connemara Irish, and Standard American and British English. In our investigation of these languages, we examined and analyzed the ways in which the patterns of tonal phonology and phonetics observed in phonological output representations are related to the output morphosyntactic constituent structure of a representative array of sentence structures. The most recent publications resulting from the grant-related collaborations to be reported on below— Kratzer & Selkirk (2020), Elordieta & Selkirk (2022) and Lee & Selkirk (2022)-- converge in adopting the model of the syntax-phonology interface below in (2), in which the only *direct* relation between syntactic representation and phonological representation in the grammatical architecture lies at the interface between the (morpho)syntactic *output* representation (which for convenience we refer to as MSO, for morphosyntactic output) and the *input* representation for the phonology module (which we refer to as PI, for phonological input). There is no possible direct interface between MSO and the output phonological representation (which we refer to as PO). Indeed, the phonological properties of PO are arguably determined on the basis of PI alone, by the phonology *per se,* a system of rules/principles/constraints that appeal only to properties of phonological representation(s).

(2) The MSO-PI-PO model of the syntax-phonology interface

Morpho-Syntactic Output Representation (MSO)

↓ Spell-out (gives phonological expression to MSO in PI)

Phonological Input Representation (PI)

↓ Phonology *per se* (determines optimal PO on basis of PI)

Phonological Output Representation (PO)

↓ Phonetics

Phonetic Interpretation

The familiar term *Spell-out* is used in (2) to refer to the interface between MSO and PI. In the version of the MSO-PI-PO model of the syntax-phonology interface put forward here, the function of Spell-out is to *give phonological expression in PI* to the three core types of entity that

constitute the MSO of a sentence: (i) lexical meaning-bearing root morphemes, (ii) morphosyntactic features, and (iii) morphosyntactic constituent structure.

Root morphemes are each spelled out with distinctive segmental and/or tonal properties. Morphosyntactic features or feature complexes are also spelled out with distinctive segmental or tonal properties, and/or with prosodic properties imposed by prosodic morphology. Lastly, in the spirit but not the letter of the original version of Match theory (Selkirk 2009, 2011), it is proposed that the morphosyntactic constituents of MSO are spelled out in the *input* phonological representation PI as phonological/prosodic constituents: morphosyntactic word constituents are spelled out as prosodic word constituents (ω), morphosyntactic phrases as prosodic phrases (φ), and morphosyntactic clauses as the prosodic constituents labelled (ι), a symbol for 'intonational phrase'. In the original version of Match theory (Selkirk 2011) a matching relation was instead defined between the (morpho)syntactic constituents of MSO and prosodic constituents of the phonological *output* representation *PO*. Based on more recent research, we argue that syntax-phonology Match constraints should be reconceptualized as forming part of the syntax-phonology interface module referred to here as Spell-out. As a consequence, in the MSO-PI-PO model in (2) the relation between the prosodic constituency of PO and the morphosyntactic constituency of MSO is necessarily indirect, mediated by the representation of the prosodic constituency in PI which phonologically spells out the constituent structure of MSO.

Phonological and phonetic phenomena involving tone provide particularly telling evidence of the need to posit a distinction between input and output phonological representations in the phonological module of the grammar. In many languages of the world, individual root morphemes and morphosyntactic feature complexes may be associated with distinctive tonal features, just as they are associated with combinations of segments (consonants and vowels) that are specified in terms of distinctive segmental features. Phonological theory has long posited an input phonological representation (PI) in which these distinctive "lexical" tones would appear as part of the spelled out, input, phonological representation of their associated root morphemes or morphosyntactic feature(s). Crucially, the patterns of distribution of these lexical tones in the overt/attested output phonological representation (PO) of the sentence may, depending on the language, be more than a simple sequence of the linearized spelled out tones in PI. Over past decades it's been shown that properly phonological principles or constraints are responsible for characterizing the patterns of distribution of lexical tones in the output phonological representation (PO) in cases where these patterns are distinct from those in the input representation (PI).

The languages investigated with the support of this grant fall into two categories—those with lexical tone in the above sense (Lekeitio Basque and the Bantu languages Xitsonga and Luganda) and those with no lexical tone (Connemara Irish and Standard American and British English). In the two languages without lexical tone, tones which are predictable and arguably epenthetic systematically appear in the PO representations of all-new, pragmatically neutral sentences, as part of the 'default prosody' of the sentence. Importantly, as we report below, in *both* the lexical-tone languages and the non-lexical-tone languages there is a common role for the prosodic structure of the sentence in determining key aspects of the distribution of tone in PO.

It should be pointed out that in Standard American and British English, it is well-documented that there are tones that appear in the PO representation which are associated with certain 'pragmatic' meanings. These meaning-bearing 'intonational' tonal units are arguably 'morphemic' and associated with specific morphosyntactic features and constituents in MSO. As elements of MSO, they contribute to the semantic/pragmatic interpretation of the sentence. And as elements of MSO, they are given language-particular phonological expression as tones which appear with their designated constituents in the spelled out phonological representation PI. In the context of the MSO-PI-PO version of the Y-model of grammatical architecture, the existence of such meaning-bearing tones in the 'intonational' contour of PO in no way implies that there is a direct connection between the phonology module of the grammar and the semantics/pragmatics module. Like any other morpheme, tonal morphemes have a representation in MSO, where the relation to semantics/pragmatics is defined.

The results of our grant-supported research provide important additional evidence for the hypothesis that it is the prosodic constituency of PO which has a direct influence on the distribution of tone in the PO of a sentence, via phonological markedness constraints on the relation between tone and prosodic constituency. Moreover, the results of our research provide new evidence for making a distinction between PI and PO representations of prosodic constituency. This distinction appears to be key to a typologically valid and theoretically plausible understanding of the range of observed mismatches between the morphosyntactic constituent structure of MSO and the prosodic structure of PO. It is the latter which directly controls the distribution of tone in the PO of a sentence.

In our research we have adopted an optimality theoretic constraint-based approach to characterizing the phonological module of a grammar. In this model of the phonology *per se*, a set of candidates for the PO of a sentence is generated on the basis of the PI of that sentence. The actual PO that corresponds to that PI is the optimal candidate, the one that best satisfies the language-particular ranking of the set of universal phonological constraints. This set of universal constraints included *markedness* (wellformedness) constraints on the PO representation and *faithfulness* constraints on the relation between PO and PI. A core goal for our research in the context of the MSO-PI-PO model of the syntax-phonology interface has been the further development of the relevant constraint systems of the phonology *per se*: (i) the universal markedness and faithfulness constraints involving tone and its relation to prosodic constituent structure, whose language-particular ranking determines the distribution of tone in PO, and (ii) the universal markedness and faithfulness constraints on prosodic constituent structure itself, whose language-particular ranking determines the properties of prosodic constituent structure in PO.

Quite generally, as in any optimality-theoretic constraint-based approach, a language-particular high ranking in the phonology *per se* of markedness constraints on the output phonological representation (PO) is responsible for any and all varieties of phonologically-driven difference ("mismatch") between the phonological input (PI) and output (PO) representations. The mismatches with PI that are revealed in the corresponding PO may involve the phonological representation of segments, segmental features, or tones, as has been standardly assumed, or mismatches between the PI and PO of the phonological/prosodic constituent structure of a sentence (prosodic words, phonological phrases, or intonational phrases), as has been argued in

our recent grant-supported publications. So, given the assumption that the morphosyntactic constituency of MSO is spelled out as, and therefore matches up with, the prosodic constituency of PI, the phonology *per se* is one possible source in the grammar for mismatches between the prosodic constituency of PO and MSO.

There is another possible source in the grammar for constituency mismatch between MSO and the phonological output representation PO, namely the *Spell-out* module itself, which constitutes the interface between MSO and the input phonological representation PI. A second goal for our research on the syntax-phonology interface in grammar has been to arrive at a more complete understanding of the Spell-out relation between MSO and PI as it concerns the prosodic constituency of PI. Are the Match constraints universal which spell out syntactic constituents in MSO as corresponding prosodic constituents in PI? In a particular language are the Match constraints entirely cross-categorial, taking into account only the word vs. phrase vs. clause status of the constituents of MSO (but not the lexical category of their heads)? What of the difference between constituents with functional category heads as opposed to lexical category heads? In response to this last question, as we will see below, the evidence from Connemara Irish suggests that, in that language, *all* phrases in MSO-- both lex-headed and fnc-headed—may be spelled out as phonological phrases in PI. But in Xitsonga, for example, it is only the phrases of MSO which are headed by lexical roots that are spelled out as phonological phrases in PI.

An additional aspect of Spell-out relevant to constituency mismatches concerns the constraints or statements that spell out the specific *morphosyntactic features* that are associated with morphosyntactic constituents. Kratzer & Selkirk 2020 argue, for example, that in Standard American and British English there is a morphosyntactic feature [G] that represents the information structure notion of Givenness. In the morphosyntactic derivation the [G] feature may trigger syntactic movement, or certain types of feature agreement. In the semantics, the [G]-feature places a Givenness requirement on the discourse context, which amounts to establishing an anaphoric relationship with a preceding discourse referent. As for its impact on phonology, it is argued that in Standard American and British English a [G]-marked phrase in MSO is spelled out as the *absence of phonological phrase status in PI* (thereby contrasting with the expected spellout of a phrase of MSO as a phonological phrase in PI that would be produced by MatchPhrase). In other words, in the case of [G]-marking in Standard American and British English, it is the Spell-out module itself, not the phonology *per se,* that is the source of this mismatch between the presence of a phrasal constituent in MSO and the absence of phrasal status for the corresponding terminal string in PO. So, on the basis of our recent-NSF-grant-supported research, we conclude that both grammatical modules that are involved in deriving the PO of a sentence from its MSO—Spell-out and the phonology *per se*— may contribute to mismatches in constituent structure between MSO and PO. The relation between the morphosyntactic constituent structure of MSO and the constituency-sensitive phonological properties of its corresponding representation in PO is apparently far from direct.

In what follows, we will first summarize the case for recursive prosodic phrase structure in PO made by Elfner 2015 for Connemara Irish based on the distribution of epenthetic edge tones in PO. Then we'll summarize the case for prosodic phrasal recursion made by Elordieta 2105 and Elordieta & Selkirk (2022) for Lekeitio Basque, based on patterns of the constituency-based pitch scaling of tones. After that we will summarize the case for the MSO-PI-PO model of the

syntax-phonology interface that is made in Kratzer & Selkirk (2020), Elordieta & Selkirk (2022) and Lee & Selkirk (2022) on the basis of different sorts of constituency-based tonal phenomena in these languages. This informal report includes only the grant-supported publications that directly bear on questions concerning the nature of the syntax-phonology interface. It does not report on any of the articles published in *Phonology* 32(1), 2015 'Constituent Structure in Sentence Phonology', a special issue that was edited by grant collaborators Selkirk and Lee, for example.

2. Elfner (2015) on Connemara Irish

Elfner, Emily (2015) Recursion in prosodic phrasing: evidence from Connemara Irish. *Natural Language & Linguistic Theory*, Vol. 33, No. 4 (November 2015), pp. 1169- 1208

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 and Truckenbrodt 2005; Wagner 2005, 2010; Selkirk 2009, 2011; Ito and 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.

Elfner (2015) investigates the distribution of non-lexical tones in pragmatically neutral all-new sentences of Connemara Irish. The paper establishes that the distribution of the predictable left-phrase-edge LH tone found in the output phonological representation (PO) is defined with respect to the recursive embedding of phonological phrase (φ) structure in PO. For example, in the PO of the VSO sentence type 1 in (3), the phonological phrases φ4 and φ3 are the only φ at whose left edge LH appears. φ4 and φ3 are moreover the sole φ that dominate other φ in the recursive φ structure of the sentence. φ4 corresponds to the morphosyntactic ΣP and φ3 to the TP. In the set of recursion-based prosodic subcategories identified by Ito and Mester (2007, 2012, 2013), the subtype of φ that forms the context for the appearance of this predictable LH edge tone is a *nonminimal* φ (a φ that dominates another φ).

(3)
Sentence type 1:
MSO:
ΣP[Verb$_i$ **TP[** DP[Noun Adjective]$_{DP}$ … $_{vP}$[t$_i$ $_{VP}$[t$_i$ [$_{DP}$ Noun Adjective]$_{DP}$]$_{VP}$]$_{vP}$ **]TP]ΣP**
Subject Object
PO:
φ4(*LH*$_{\omega}$(*verb*)$_{\omega}$ **φ3(***LH*$_{\varphi 1}$($_{\omega}$(*noun*)$_{\omega}$ $_{\omega}$(*ad*^{HL}*jective*)$_{\omega}$)$_{\varphi 1}$ $_{\varphi 2}$($_{\omega}$(*noun*)$_{\omega}$ $_{\omega}$(*ad*^{HL}*jective*)$_{\omega}$)$_{\varphi 2}$ **)φ3)φ4**
↑ ↑

Elfner (op.cit.) goes on to make the case that a LH tone appears at the left edge of *any nonminimal* φ in the PO of a sentence in Connemara Irish. For example, in sentence type 2 in (4) the presence of an additional adjective in the object phrase of the VSO sentence coincides with the presence of a LH tone at the left edge of the φ2 that spells out the object phrase. The presence of that additional LH in sentence type 2 is due to the φ status of the sequence of two adjectival modifiers of the noun, represented by φ5. In sentence type 2, then, φ2 is a non-minimal φ (it dominates another φ, namely φ5), and so it is assigned a left-edge LH tone in PO.

(4)
Sentence type 2:
MSO:

ΣP[Verb$_i$ **TP[** DP[Noun Adjective]$_{DP}$ … $_{v}$P[t$_i$ VP[t$_i$ [$_{DP}$ Noun [Adjective Adjective]]$_{DP}$]$_{VP}$]$_{v}$P **]TP]ΣP**
Subject Object

PO:

$_{\varphi 4}(^{LH}{}_{\omega}(verb\ )_{\omega}\ _{\varphi 3}(^{LH}{}_{\varphi 1}(_{\omega}(noun\ )_{\omega}\ _{\omega}(ad^{HL}jective\ )_{\omega})_{\varphi 1}$ $\boldsymbol{\varphi 2}(^{\mathbf{LH}}{}_{\omega}(\ noun)_{\omega}\ _{\varphi 5}(_{\omega}(ad^{HL}jective)_{\omega}\ _{\omega}(ad^{L}jective)_{\omega})_{\varphi 5}\boldsymbol{)_{\varphi 2}}\ )_{\varphi 3}\ )_{\varphi 4}$

As for the absence of LH at the right edge of the corresponding object DP in sentence type 1, it is due to the minimal φ status of φ2, which is in turn due to the non-φ, mere ω status of the N and of the A in the object phrase. (In general, in Connemara Irish single words count only as a prosodic ω, not a φ, regardless of whether or not they have phrasal status in the syntax.)

This data from Connemara Irish, which shows that the recursive embedding of phonological phrase constituents determines the distribution of predictable edge tones in the output phonological representation of a sentence, is the first such data reported in the literature concerning the distribution of edge tones-- in any language. It opens up a broad area for future research on edge tones and their relation to constituency in other languages.

The notion of recursion-based prosodic subcategories such as *nonminimal* φ was proposed by Ito and Mester (2007, 2012, 2013) who show that various aspects of the above-word phonology of Tokyo Japanese receive genuinely insightful explanations in terms of such prosodic subcategories. In this theory of prosodic subcategories, a *minimal φ* is one that dominates no other φ (but only prosodic word(s) ω); a *nonminimal φ* dominates at least one other φ. A *maximal* φ is a φ dominated by no other φ and is immediately dominated by the higher order intonational phrase (ι). In prosodic phonology, the representational notions 'maximal' and 'minimal' are defined in terms of the nesting of the phonological constituent types identified in the prosodic hierarchy, not in terms of morphosyntactic constituent structure. Evidence for the various subcategories of the prosodic category *φ* comes from phonological constraint-based restrictions on the distribution of diverse types of phonological phenomena in the PO of a sentence.

The 'maximal' and 'minimal' subcategories of prosodic constituent types like φ have no analogues in the notions *maximal phrasal projection* or *minimal phrasal projection*, which play a role in syntactic theory (Jackendoff 1977, Haider 1993). In the morphosyntax, the features of a particular head, e.g. a noun N, are 'projected' through a chain of constituents dominating that head, up through the maximal phrasal projection, in this case N^{max} (aka NP). The

morphosyntactic representations of the sentence types 1 and 2 in Irish include the nesting of multiple maximal projections: DP, VP, *v*P, TP, ΣP, AP, NP. In the phonological representations of the sentence types 1 and 2, however, there is just one maximal φ in the sentence; it corresponds to ΣP, the highest phrasal node in the MSO of the sentence. This maximal φ, which is also nonminimal, dominates a chain of nonminimal φs. In Connemara Irish, Elfner 2015 shows, it is these nonminimal φs of the prosodic constituent structure of phonological representation that provide the context for the epenthesis of the LH edge tone by the phonology. It is not just any phrasal subtype of the morphosyntax. To return to the theme of this report, the relation between the output constituent structure of the morphosyntax (namely MSO) and the distribution of epenthetic non-lexical tones in the output phonological representation (PO) is indirect, mediated by the presence of a properly phonological, recursively embedded, φ-level prosodic constituent structure in the phonological representation of the sentence.

Elfner (op/cit.) presents another, familiar, argument for the phonological/prosodic nature of the constituent structure that guides the distribution of the edge-tones of Connemara Irish. As the examples of sentence types 1 and 2 suggest, and is further revealed in the article, in Connemara Irish, a single word never counts as a phonological phrase (φ). Though an N-A sequence may be grouped into a φ constituent, neither individual word within that constituent has the status of a φ in PO. There is a purely phonological explanation for the absence of phrasal (φ) status in PO for the word or words that form a phrase within a syntactic maximal projection of MSO. This is the very general phonological requirement that prosodic constituents be minimally binary. Note that for decades, the motivation for a prosodic binarity constraint on the structure of feet (*f*) has been widely recognized. Evidence of binarity restrictions on prosodic words is also extremely compelling (see e.g. Ito and Mester 2007, 2012, 2013, among others). And evidence of a prosodic binarity constraint on phonological phrases in other languages is also compelling (see, e.g., Lee and Selkirk (2022) on phrasal binarity effects in Xitsonga). In an optimality theoretic constraint-based phonological framework, inter-language variability in whether or not prosodic phrases must be binary-branching is to be expected; it depends the language-particular ranking of phonological constraints on PO. In other words, the fact that in Connemara Irish, a single noun, adjective or verb will not on its own have the status of a phonological phrase is the normal consequence of a language-particular constraint ranking in which the phonological markedness constraint calling for binarity of φ in PO is higher ranked then any phonological faithfulness constraint calling for that φ status to be retained in PO.

In summary, the data that Elfner 2015 brings to light concerning the distribution of edge tones in Connemara Irish is naturally accounted for by referring to independently motivated types of phonological constraints on PO. It is consistent with a theory of grammatical architecture in which the morphosyntactic constituency of MSO is only indirectly responsible for the phrase-sensitive distribution of tone in PO.

3. Elordieta (2015) on Lekeito Basque

Elordieta, Gorka (2015) Recursive phonological phrasing in Basque *Phonology **32***, No. 1, pp.49-78. (Thematic issue: *Constituent structure in sentence phonology*, edited by Elisabeth Selkirk and Seunghun J. Lee)

ABSTRACT: This paper presents data that force a revised account of the distribution of downstep and pitch reset in Lekeitio Basque. In the light of these data, previous analyses of pitch reset in Lekeitio Basque make wrong predictions. On the one hand, pitch reset is predicted where downstep occurs, and on the other, an ordinary reset is predicted where a large reset occurs. The occurrence of downstep and pitch reset, as well as the amount of pitch reset observed, is best accounted for under the assumption that languages possess a hierarchical prosodic structure that roughly matches the surface syntactic structure of a sentence, including levels of embedding or nesting of syntactic constituents. The analysis proposed in this paper is that pitch reset in Lekeitio Basque applies at the left edge of a non-minimal phonological phrase, i.e. a phonological phrase that dominates at least another phonological phrase.

Elordieta (2015) reports on an experimental investigation of constituent-sensitive pitch downstep and reset (upstep) in Basque which recorded and analyzed utterances of simple sentence types that contrasted in the morphosyntactic phrase structure of the argument(s) of the verb. In subsequent NSF-grant-supported research on the sentence prosody of Basque (Elordieta & Selkirk (2022)), it is argued that the sentence-final verb in Basque moves to a higher position in MSO than was assumed in the Elordieta 2015 paper: the verb is now understood to be external to the VP and to other higher phrases in the verbal projection. This means that an additional provision concerning the prosodic structure context for upstep is now required. This revised analysis is presented in Elordieta & Selkirk (2022). It is presented here in our grant report alongside the Elfner 2015 article, since both focus on arguments for making reference to recursion-based subcategories of prosodic constituents in accounting for tonal phenomena in PO.

The four sentence types A, B, C, D examined in (Elordieta 2015) are presented in (5)-(8) with the revised MSO constituent structure we are now assuming. The accordingly revised phonological output representations show the locations of downstep (↓) and upstep (↑), along with the revised phonological phrase (φ) structure of PO that would be spelled out on the basis of the revised MSO that is assumed in Elordieta & Selkirk (op.cit.). The Elordieta 2015 analysis that pitch reset (upstep) appears at the left edge of a nonminimal phonological phrase (φ_{nonmin}) still holds with the revised assumptions about the φ structure of these sentence types; it must be supplemented by the provision that upstep appears at the left edge of a maximal φ (φ_{max}) as well.

As the revised MSO structures in the examples (5)-(8) below show, in Lekeitio Basque only syntactic phrases that are overtly headed by lexical category items are spelled out as φ in phonological representations (Elordieta & Selkirk 2022). This contrasts with Connemara Irish, where Elfner 2015 reports that *all* phrasal projections— with both lexical and functional category heads-- are spelled out as φ. In the examples of MSO in (5)-(8) below we have opted to not show any syntactic phrases which are not overtly headed by a lexical item. This is because of limitations on space in each line of the page. Also for reasons of space, the property of being a prosodic word (ω) is not indicated in the prosodic structures in (5)-(8), except on the raised verb, which is only a ω, not a φ. And, except in (5), an accented word's phonologically redundant property of being a φ_{min} (Elordieta & Selkirk 2018) is not shown. The status of a particular φ as an instance of $\varphi_{nonmin,}$ and/or $\varphi_{max,}$ which depends on the recursive φ structure of phonological representation (Ito & Mester, op. cit.), is shown, since it is crucial to the analysis of the distribution of downstep and upstep.

In the Type A sentence of (5), a left branching object noun phrase precedes the (raised) verb in MSO. The proposal that lexically accented nouns qualify as φ_{min} is indicated in the PO in (5)

(but won't appear in the remaining cases). Note that the raising of the verb to an Aux-adjacent position means that the constituent formerly headed by the V is not lex-headed in MSO, and, for reasons of space, is left out in examples (5)-(8).

(5) MSO $[_{clause}$ [[Mirénen lagúnen]$_{NP}$ [liburúak]]$_{NP}$ gustaten=dxáraz]$_{clause}$

Miren-gen.sg friend-gen.pl book-abs.pl like=aux 'I like Miren's friends' books.'

PO $(_{\iota}$ (((Mirénen)$_{\varphi min}$ ↓ (lagúnen)$_{\varphi min}$)$_{\varphi nonmin}$ ↓ (liburúak)$_{\varphi min}$)$_{\varphi max,nonmin}$ ↓(gustaten=dxáraz)$_{\omega}$)$_{\iota}$

The first two φ_{min} of the sentence form a φ_{nonmin}. As for the prosodic constituent corresponding to the entire object NP, it is both a φ_{max} (dominated by no other φ) and a φ_{nonmin} (dominating at least one other φ.) The orthographic acute accent in PO indicates the presence and location of the HL accent tone. The presence of tonal accent in a word causes pitch downstep of what follows; the down arrows (↓) indicate that the pitch range of the following word is downstepped with respect to the pitch range of the preceding accented word. A chain of downstepping is caused by the successive accents of the words of a Type A sentence, all of which are φ_{min}. In the sentence types B, C, D, the up arrows (↑) indicate that the pitch range is reset, in other words upstepped. Upstep is found at the left edge of either a φ_{nonmin} or a φ_{max}, as shown in what follows.

(6) Type B: [[N N] [N A]]$_{NP}$ V=aux

MSO $[_{clause}$ [[Mirénen lagúnen] [liburúak lodídxak]]$_{NP}$ gustaten=dxáraz]$_{clause}$

Miren-gen.sg friend-gen.pl book thick-abs.pl like=aux 'I like Miren's friends' thick books.'

PO $(_{\iota}$ (((Mirénen)↓ (lagúnen))$_{\varphi nonmin}$ ↑ ((liburúak)↓ (lodídxak))$_{\varphi nonmin}$)$_{\varphi max,\ nonmin}$ ↓(gustaten=dxáraz)$_{\omega}$)$_{\iota}$

In the Type B sentence, there is upstep at the left edge of the NP-internal phrase *liburúak lodídxak* 'thick books'. This phrase is a φ_{nonmin}, one that is embedded in the $\varphi_{max,nonmin}$, which corresponds to the entire complex NP. Note that this entire object NP has φ_{max} status in phonological representation since the phrases that dominate it in MSO are not spelled out as φ. This is because they are either headed by functional items or the trace of a raised lexical item. As mentioned above, these latter types of phrases are not spelled out as φ in phonological representation in Lekeitio Basque.

In sentences of types C and D, there are two object phrases. Both have the status of φ_{max}, given the lack of φ status in PO for the phrases of MSO that dominate these objects. (The verb has been raised out of the "VP", which therefore is not lex-headed and so isn't spelled out as a φ.)

(7) Type C: [N N]$_{NP}$ [N]$_{NP}$ V=aux

MSO $[_{clause}$ [[Mirénen amúmari]$_{NP}$ [liburúak]$_{NP}]_{"VP"}$ emon=dótzez]$_{clause}$

Miren-gen.sg grandmother-dat.sg book-abs.pl give = aux 'They have given the books to Miren's grandmother.'

PO $(_{\iota}$ ((Mirénen)↓ (amúmari))$_{\varphi max,nonmin}$ ↑(liburúak)$_{\varphi max,min}$ ↓(emon=dótzez)$_{\omega}$)$_{\iota}$

In type C the single word direct object shows pitch upstep. This upstep must be ascribed to its φ_{max} status (as a φ daughter of intonational phrase ι, a φ that is not dominated by any other φ). Since this object phrase consists only of a single accented word, it qualifies only as a φ_{min}. Its upstep therefore cannot be attributed to status as a φ_{nonmin}, as was the case in the type B sentence. So far, then, there are two prosodic structure contexts for the upstep of a phrase in Lekeitio Basque: phrases that count as φ_{max}, as with ↑(liburúak)$_{\varphi max,min}$ in (7), and phrases that count as φ_{nonmin}.

In the case of Type D sentences, the greater degree of pitch upstep/reset (↑↑) observed on the second object suggests that there is a combined effect of the upstep produced in response to its φ_{max} status and the upstep produced in response to its φ_{nonmin} status.

(8) Type D: [[N N]$_{NP}$ [N A]]$_{NP}$]$_{"VP"}$ V=aux

MSO: [$_{clause}$ [Mirénen amúmari]$_{NP}$ [[libúru lodídxak]$_{NP}$ emon=dótzez]$_{clause}$

Miren-gen.sg grandmother-dat.sg book thick-abs.pl give 'They have given the thick books to Miren's grandmother.'

PO ($_{ι}$ ((Mirénen)↓ (amúmari))$_{\varphi max,nonmin}$ ↑ ↑((liburúak) ↓ (lodídxak))$_{\varphi max,nonmin}$ ↓(emon=dótzez)$_{ω}$)$_{ι}$

The object phrase [[libúru lodídxak]$_{NP}$ counts both as a φ_{max} and as a φ_{nonmin}.

To summarize, illuminating explanations for the distribution of the phonetic patterns of pitch downstep and upstep for the PO of all-accented sentences of Lekeitio Basque (Elordieta 2015, Elordieta & Selkirk 2022) and of the distribution of LH left-edge tones in PO in sentences of Connemara Irish (Elfner 2015) are available if the constituent structure representations in relation to which these phenomena are defined consist of a properly phonological recursive nesting of subcategories of phonological phrases (φ). Recursion-based subcategories of φ like those exploited in the preceding accounts are identified in terms of their domination relations to other prosodic constituents (ι, φ, ω) in the phonological representation of the sentence (Ito & Mester op.cit). They are constructs of the phonological theory of prosodic constituent structure that have no independent role in morphosyntactic theory, and they are crucial to determining the finer details of sentence phonology and phonetics. Clearly, the role for the morphosyntactic phrase structure of MSO in determining these phonological and phonetic properties of PO is indirect, mediated by the recursive φ structure of PO and the subcategories of φ that are defined in terms of this recursion.

4. Kratzer & Selkirk (2020) on Standard American and British English

Kratzer A. & Selkirk E., (2020) "Deconstructing information structure", *Glossa* 5(1), p.113.

ABSTRACT: The paper argues that a core part of what is traditionally referred to as 'information structure' can be deconstructed into genuine morphosyntactic features that are visible to syntactic operations, contribute to discourse-related expressive meanings, and just happen to be spelled out prosodically in Standard American and British English. We motivate two features, [FoC] and [G], and we track the fate of those features at and beyond the

syntax-semantics and the syntax-phonology interfaces. [FoC] and [G] are responsible for two distinct obligatory strategies for establishing discourse coherence. A [G]-marked constituent signals a match with a discourse referent, whereas a [FoC]-marked constituent invokes alternatives and thereby signals a contrast. In Standard American and British English [FoC] aims for highest prosodic prominence in the intonational phrase, whereas [G] lacks phrase-level prosodic properties. There is no grammatical marking of newness: The apparent prosodic effects of newness are the result of default prosody.

Kratzer & Selkirk (2020) argue that the status of a morphosyntactic constituent as FoCus or Given is marked in MSO by an accompanying morphosyntactic feature, respectively [FoC] or [G]. These features of MSO contribute on the one hand to the semantic/pragmatic interpretation of the sentence and on the other to its phonological interpretation. (This proposal is consistent with the Chomskyan Y-model.) As for sentences which are simply all-new in the discourse, they are expected to display the sort of default phrasal phonology that is predicted by the MSO-PI-PO model described above.

Section 6 of Kratzer & Selkirk (2020) demonstrates the advantages of a new account of the output phonological representations of all-new, pragmatically neutral, declarative sentences in Standard American and British English in which prosodic constituent structure representations play a crucial role. In the case of all-new pragmatically neutral sentences, where any influence of the [G] and [FoC] features is absent, only interface Match constraints are at work in spelling out the prosodic constituency of a sentence in MSO. A word of MSO is spelled out as a prosodic word (ω) in PI; a lex-headed phrase of MSO is spelled out as a phonological phrase (φ) in PI; and a clause is spelled out as an intonational phrase (ι), as illustrated in (9b).

(9) a. Morphosyntactic output representation (MSO):

$$[\ [\ [\textit{Sarah}]_{N}]_{NP}\ [[\textit{mail-ed}]_{V}\ [\textit{the}\ [[\textit{caramel-s}]_{N}\ ]_{NP}\ ]_{DP}\ ]_{VP}\ ]_{Clause}$$

b. Phonological input representation (PI):

$$(((\text{Sarah})_{\omega})_{\varphi}\ ((\text{mailed})_{\omega}\ (\text{the}\ (\text{caramels})_{\omega})_{\varphi}\ )_{\varphi}\ )_{\iota}$$

c. Phonological output representation (PO):

$$(\ ((\text{Sár.ah})_{\omega})_{\varphi}\ (((\text{máiled})_{\omega}\ \text{the})_{\omega}\ ((\text{cár.a.mèls})_{\omega'})_{\varphi'})_{\varphi}\ )_{\iota}$$

H L ~H H L

Note that Standard American and British English, like Lekeitio Basque, allows for a single-word phonological phrase (φ) of PI to retain its φ status in PO. This is because, in the phonology of these language varieties, the φ-level member of the set of universal phonological constraint(s) calling for the binarity of prosodic constituents at foot-level or above is subordinated to the universal PI-PO constituency faithfulness constraint that calls for a φ of PI to be present in PO.

In Standard American and British English, at every level of prosodic constituency in PO above the syllable (foot, ω, φ, ι) there is a prominent prosodic *head* constituent whose presence and

position is determined by constraints of the universal phonological constraint repertoire. In the PO (9c) the words *Sarah* and *caramels* are the sole prosodic word (ω) within their respective dominating φ; so they are necessarily the (stress-prominent) head ω′ of their φ. (An orthographic acute accent in (9c) denotes the prosodic head status of a constituent.) By comparison, the verb *mailed,* which is not a phrase in MSO, does not have the status of a φ in PI and PO, and so cannot carry φ-level head prominence and its associated H accent tone in PO. The ~H tone it bears is an optional left-edge tone of the φ of the VP.

As for the question why the object phrase, not the verb, must be stress-prominent within a phrase like *mailed the caramels,* the original proposal by Truckenbrodt (2006) is that a general constraint dubbed Stress XP is responsible for this pattern. Note that Stress XP is a constraint which refers to both the phonological and syntactic properties of a sentence. Within the MSO-PI-PO model, such a constraint type would have to belong to the Spell-out module, where a direct relation between the syntactic and phonological properties of a sentence is defined. But there is no need to posit an interface constraint like Stress XP. Its effects are arguably due to a general phonological constraint with independent motivation. Kratzer & Selkirk posit a phonological markedness constraint dubbed HeavySisterProminence, which holds of the output phonological representation PO alone. HeavySisterProminence specifies that when sisters within a prosodic constituent are of unequal prosodic category, the heavy sister is the head. (The 'heavy' sister is the constituent whose category is higher in the prosodic hierarchy.) This independently motivated constraint of the phonology is operative at all levels of the prosodic structure representation of PO: in a prosodic word consisting of a foot and a syllable, the foot is the head; in a recursive ω structure where a ω dominates another ω and a clitic syllable, the sister ω is the head, and so on, regardless of the linear order of the sisters. In the nested φ structure that corresponds to the VP in the PO (9c), then, the initial daughter, a mere ω, will not carry the φ-level head prominence of the VP since its sister is a φ. This richness of phonological representation in terms of prosodic constituent structure types allows for simple, cross-linguistically valid accounts of the distribution of predictable phonological properties like headedness/prominence.

Similarly, phonological representation in terms of prosodic constituent structure provides the basis for simple accounts of the distribution of the predictable epenthetic (nonlexical) tones of PO, as we saw already in Connemara Irish. In Standard American and British English, a phonological constraint on PO which calls for a H(igh) tone to appear on the head syllable of the head ω of a φ outranks the PI-PO faithfulness constraint that would rule out the presence of tones in PO that are not present in PI. So an epenthetic H tonal accent appears on all instances of a head syllable of a φ in PO, as in (9c). In similar fashion, the presence of the predictable L tone that is found at the right edge of any φ in the PO (9c) can be understood as the effect of one of the class of phonological markedness constraints on the relation of φ-edges to tone in PO. (The optional ~H on *mailed* is not an accent tone associated with a head; it is a variety of edge tone.)

In sum, no property of 'information structure' has any role in accounting for the phonological or phonetic properties of discourse-new constituents. The prosodic properties of the PO of all-new sentences of Standard American and British English derive from (i) the spellout of morphosyntactic constituent structure as corresponding prosodic constituent structure in PI, and (ii) the assignment of prosodic-structure-sensitive 'default prosody' in PO through a language-

particular optimality-theoretic ranking of universal phonological markedness and faithfulness constraints that respectively hold of PO and of the relation between PI and PO.

What's new about the MSO-PI-PO model of the syntax-phonology interface that is argued for in Kratzer & Selkirk 2020 in the context of prosodic structure theory is the idea that the constituency of the morphosyntactic output representation MSO is *spelled out as* the corresponding prosodic constituent structure of the *input* phonological representation PI. As mentioned above in the introduction to this report, one benefit of this proposal that there is φ structure in PI which spells out the phrase structure of MSO is that it makes it possible to characterize in purely phonological terms a significant class of mismatches between the morphosyntactic constituency of MSO and the phonological/prosodic constituency of PO. This is the class of phonological-constraint-driven constituency mismatches that is due to the Binarity constraint on prosodic φ constituent, documented for Connemara Irish (Elfner 2015), Lekeitio Basque (Elordieta & Selkirk (2022)) and Xitsonga (Lee & Selkirk (2022)). A standard phonological optimality-theoretic language-particular ranking of universal phonological markedness and faithfulness constraints involving prosodic constituency captures the precise nature of such PO-PI mismatches. (Such PO-PI mismatches would count as *indirect* mismatches between PO and MSO.)

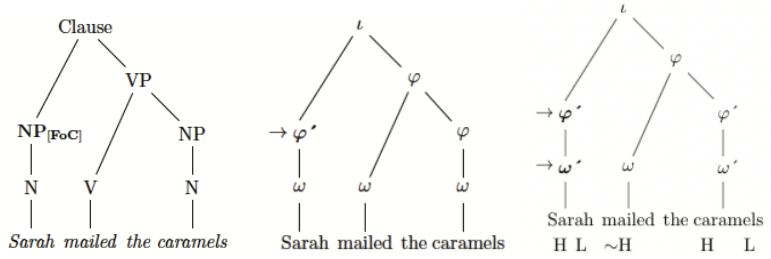
A further welcome consequence of assuming that morphosyntactic constituency is in general spelled out as prosodic constituency in PI, is that this allows in principle for the *morphosyntactic features* associated with constituents of MSO to be spelled out in PI in terms of prosodic constituency and/or prosodic constituent headedness. Kratzer & Selkirk (2020, section 7) make proposals for spelling out the [G] feature of discourse-givenness and the [FoC] feature of alternatives-based contrastive focus in terms of prosodic properties of PI. The proposed PI representations for [FoC] and [G], together with the independently motivated prosody-related phonological constraint system in the phonological module of Standard American and British English, result in the selection of the attested prosodic constituency and head prominence patterns in PO for the [G]-marked and [FoC]-marked constituents of MSO. The following paragraphs concerning the spellout of constituents of MSO that are [FoC]-marked or [G]-marked draw directly on Kratzer & Selkirk (2020).

Within the framework of assumptions in that paper—including the MSO-PI-PO model in (2)--the prosodic impact of [FoC] in Standard American and British English would have to be embodied in a spellout constraint affecting the mapping from MSO to PI and it would be expected to be a constraint on prosodic structure in PI. It's argued that a *[FoC]*-marked constituent at MSO is spelled out as an *ι-level head* in the phonological input representation PI. This spellout as an *ι-level head* presupposes, of course, that a sentence (Clause) constituent in MSO is spelled out as ι by MatchClause, which is one of the Match family of constituency spellout constraints that relates MSO and PI. In this variety of English, the spellout constraint for the [FoC] feature, stated as [FoC]= *ι*-Level-Head, ensures that in PI a [FoC]-marked constituent will be more prominent than any other constituent in the same ι. This *ι-level* headedness would be inherited by default in PO.

The case of subject FoCus is displayed in (10). The non-FoCus constituents of the VP in (10) are new in the discourse, not Given. (See Katz & Selkirk 2011 on the stress-prominence and

accentedness of discourse-new, non-[G]-marked, constituents that follow FoCus constituents in sentences of Standard American and British English.)

(10) a. MSO b. PI c. PO



In (10) ι-level heads are indicated by an arrow. The PI in (10-b) includes the prosodic head prominence that spells out the [FoC] feature that is present in (10-a), the MSO. This head prominence is faithfully maintained in the PO (10-c). The other prominences in the PO (10-c) are there by phonological default, as described above, hence are not present in the PI (10-b).

As (10) shows, the prosodic properties of the PO representation of a sentence containing a [FoC]- marked constituent are only partly determined by the greater prominence of the [FoC]-marked constituent. In sentences where a [FoC]-marked phrase cohabits with phrases that are merely new, the default phonology supplies φ-level prominence for those merely new constituents and for the [FoC]-marked constituent as well. The result is that in the PO representation, both [FoC]-marked and merely new constituents carry the tonal pitch accents supplied by the phonology to the prominent ω´ head of a φ. What distinguishes [FoC]-marked from merely new, unmarked, constituents is the status of their corresponding φ as an ι-level head prominence in PI. That prominence in PO is inherited from PI. It is phonetically realized as greater pitch prominence (see Katz & Selkirk 2011).

As for the phonology of [G]-marking, Kratzer & Selkirk (2020) propose that in Standard American and British English the spellout constraint that gives phonological expression to the [G]-marking of a phrase of MSO requires the *absence* of a corresponding φ for that phrase in the spelled-out constituent structure representation in PI, as shown in (11b). (This [G]-marking constraint must take precedence over the spellout constraint MatchPhrase, which calls for a phrase of MSO to correspond to a φ in PI.) Due to the spellout constraint for [G]-marking in standard American and British English—which is dubbed Dephrase Given—there is no φ in PI that corresponds to the DP/NP of the object phrase. In the PI (11b) the words *mailed* and *caramels* are simply sisters within the φ that corresponds to the VP:

(11) a. Morphosyntactic output representation (MSO):

$$[\ [\ [Sarah]_{N}]_{NP}\ [[mail\text{-}ed]_{V}\ [the\ [[caramel\text{-}s]_{N}\ ]_{NP,[G]}\ ]_{DP}\ ]_{VP}\ ]_{Clause}$$

b. Phonological input representation (PI):

(((Sarah)$_{\omega}$)$_{\varphi}$ ($_{\varphi}$ (mailed)$_{\omega}$ the (caramels)$_{\omega}$)$_{\varphi}$)$_{\iota}$

c. Phonological output representation (PO):

(($_{\varphi}$ ($_{\omega'}$ Sár.ah)$_{\omega'}$)$_{\varphi}$ (($_{\omega'}$ máiled)$_{\omega'}$ the (cár.a.mèls)$_{\omega}$)$_{\varphi}$)$_{\iota}$

H L H L

Importantly, in the output representation PO of (11) it is the verb that bears the H accent tone that indicates the location of the prosodic word bearing the head prominence/stress of the φ that corresponds to the VP. This a phonologically understandable departure from the default pattern of phrasal prominence on the object that is found in all-new versions of such sentences. The loss of φ status for the object in PI that is produced by the spellout constraint Dephrase Given creates a configuration in PO in which the verb and the following 'dephrased' object noun are both simply prosodic word (ω) sisters within the φ that corresponds to the verb phrase. This prosodic sisterhood in PI (11bc) of the ω that correspond to the verb and to the [G]-marked nominal object is straightforwardly responsible for the availability of phrasal head prominence on the verb in PO in Standard American and British English.

Quite generally, in phonological systems showing patterns of prosodic head/stress prominence, when daughters of a prosodic constituent node are sisters of a same highest prosodic category level, a phonological 'head-assigning' constraint comes into play. Depending on the language and the level of prosodic constituency at issue, head prominence may be 'assigned' leftmost or rightmost (Prince 1983; Hayes 1995; Kager 2001; McCarthy 2003). In Standard American and British English, the head prominence of a foot is the lefthand syllable, the head prominence of a ω is the rightmost foot, the head prominence of a simple compound ω falls on the leftmost daughter ω. Kratzer & Selkirk propose, then, that the apparent 'stress shift' to the verb in VPs with a Given direct object, is simply the result of a 'head-assigning' phonological markedness constraint like that in (12) (see McCarthy 2003: 111). It will assign head status to the leftmost ω in the φ that corresponds to the VP.

(12) The head ω of a φ consisting of a sequence of ω's is not preceded by any other ω.

Given this new analysis of the prosody of phrases with [G]-marked complements there is no direct relation between the [G]-marked status of the direct object in MSO and the appearance in PO of φ-level prominence on the verb. The latter is a matter of the phonology alone. Note that the availability of an independently motivated type of phonological explanation for the stress prominence on the verb as in (11) crucially weakens the case for the metrical-structure-theory-based claim that the discourse-givenness [read '[G]-marking'] of a righthand constituent in English is *directly* associated with a 'stress-shifting' reversal of phrasal prominence to the lefthand constituent node of that tree.

5. Interim summary, and what's to come

The MSO-PI-PO model of the syntax-phonology interface predicts that two distinct types of mismatch between the morphosyntactic constituency of MSO and the prosodic/phonological constituency of PO are in principle possible: morphosyntactic-prosodic constituency matches between MSO and PI that are introduced by Spell-out, and prosodic constituency mismatches between PI and PO that are introduced by the phonology *per se*. Both count as instances of mismatch between MSO and PO. The mismatches between MSO and PI that we've seen above include (i) the failure to spell out phrases with functional heads in MSO as φ in PI in both Lekeitio Basque and Standard American and British English (but not in Connemara Irish), and (ii) the failure to spell out [G]-marked phrases as φ in PI in Standard American and British English. As for PI-PO mismatches, we have seen the lack of φ status for single word phrases in Irish, due to a high-ranked prosodic Binarity constraint on PO, and will also see this in the case of the Bantu tone language Xitsonga. The most dramatic examples of phonology-driven PI-PO phrasal mismatch come from Lekeitio Basque (Elordieta & Selkirk in press/2022) to be reviewed in section 6.

In Lekeitio Basque, φ-level constituents of PI, which spell out lex-headed phrases of MSO, are retained in PO *only if* they contain at least one lexical H tone. Moreover, new φ's may appear in PO which do not correspond to either a φ of PI or a phrase of MSO; these involve a minimal φ that combines an unaccented word and an accented word. It's argued that the phonological module of Lekeitio Basque is the source of these MSO-PO mismatches: they boil down to mismatches between the phonological phrasal constituency of the two phonological representations PI and PO.

Results from Xitsonga will be the last to be considered, in section 7. We will see important additional examples of mismatch between the phrase structure of MSO and the φ structure of PO. In Xitsonga two of the distinct types of mismatch between the phrasal constituency of MSO and the φ constituency of PO should arguably be attributed to the language-particular choice of $\text{MatchPhrase}_{\text{LEX}}$ as the Spell-out constraint that expresses the phrasal constituency of MSO as the φ-level constituency of PI**.** Spell-out based on $\text{MatchPhrase}_{\text{LEX}}$ is shown to correctly predict the absence in PI of φ constituents corresponding to phrases of MSO that are headed by functional categories, whether these are overt in PI, as with noun classifier-headed phrases, or not overt, as with phrases whose Applicative head has been raised up to the verb in MSO. So while Lekeitio Basque provides a memorable case for the role of phonological markedness constraints in producing mismatches between PI and PO (and hence between MSO and PO), Xitsonga makes the case that the Spell-out module is itself responsible for mismatches between MSO and PI (and hence between MSO and PO).

6. Elordieta & Selkirk (2022) on Lekeitio Basque

Elordieta, Gorka and Selkirk, Elisabeth (2022) Unaccentedness and the formation of prosodic structure in Lekeitio Basque. In Kubozono, H., Ito, J. & Mester, A., eds. *Prosody and Prosodic Interfaces.* Oxford University Press, to appear. (April 2022)

Abstract

In Lekeitio Basque, radical mismatches between the morphosyntactic phrase structure of a sentence and the phonological/prosodic phrase structure of the phonological output representation appear when one or more of the words of a sentence display(s) unaccentedness, i.e., lack(s) lexical accent. Evidence of these constituency mismatches is provided by the distribution of predictable phrasal edge tones and prosodic-structure-sensitive patterns of pitch downstep and upstep. A purely phonological, optimality theoretic analysis of these mismatches is proposed. This phonological analysis relies on assuming that morphosyntactic constituent structure is spelled out as prosodic constituent structure in the input representation of the phonology module and that a language-particular ranking of purely phonological constituency faithfulness and markedness constraints relates the constituency of the phonological input to the constituency of the phonological output representation.

It's a simple fact that in every sentence of Lekeitio Basque, there is some variety of mismatch between the constituency of the morphosyntactic output representation (MSO) and the constituency of the phonological output representation (PO). This is because both the presence and the absence of a lexical tonal accent in the words of a sentence have an impact on the phonological phrase structure of PO. A word that contains a lexical H tone in PI acquires the status of a phonological phrase (φ) in PO even if doesn't correspond to a φ in PI (and therefore not to a morphosyntactic phrase of MSO). As for a lexically "unaccented" word, one that lacks H tone in PI, if the word is a phrase in MSO and consequently spelled out as φ in PI, it will lose that φ status in PO.

The effect of lack of lexical H tone on phonological phrasing in Lekeitio Basque is arguably the result of a language-particular ranking of a phonological constraint set that includes markedness constraints on the relations between tone, prosodic head prominence, and phonological phrase constituency. (For details, see Elordieta & Selkirk 2018.) The gist of this analysis is that a φ of PO requires a prosodic head, and that the head must be associated with a H tone at the syllable level. So, given that the Lekeitio Basque constraint system also prohibits any insertion of H tone, the lack of (lexical) H in a word implies lack of prosodic head status for that word. Given the proposed constraint ranking, when a φ of PI consists only of unaccented words, there can be no corresponding φ constituent in PO. By contrast, as we saw above in the report of the Kratzer & Selkirk 2021 paper, in Standard American and British English no word of the lexicon carries lexical accent tone, but an epenthetic (nonlexical) H tone is indeed inserted on the syllables that are prosodic heads of φ in PO. That lexically toneless words should be treated differently in the two languages-- and that PI-PO mismatches ensue in one language and not in the other-- points to a difference in the phonologies of the two languages. Phonology-driven mismatches between PO on the one hand and PI (and the MSO it spells out) on the other make a compelling case for a theory of the syntax-phonology relation in which the morphosyntactic constituency itself has no *direct* impact on the constituency of the phonological *output* representation.

Compare the facts just mentioned concerning sentences containing unaccented (U) words with the facts of "all-A" sentences in Lekeitio Basque (Elordieta 2015), which were discussed in section 3 of this report. In all-accented sentence types, patterns of pitch upstep and downstep reveal a complex recursive φ structure that largely matches the morphosyntactic phrase structure

of the MSO representation of these sentences and the accordingly spelled out φ structure of PI. In these "all-A" sentences, the sole mismatches between PO constituency, on the one hand, and PI (and MSO) constituency, on the other, are the cases where a lexically accented word which is only a ω in PI acquires the status of a φ in the phonological output representation (PO). In a nutshell, the phonological constraint-ranking of Lekeitio Basque requires any (lexical) tone of PI to be associated with the head of a φ in PO, with the result that there are at least as many φs in a sentence as there are lexically accented words.

The following paragraphs review the Elordieta & Selkirk (2022) analysis of the constituency mismatches in Lekeitio Basque that are caused by unaccentedness-- the absence of lexical H tone in a word. First examined is the case of sentences where, in MSO, the verb is preceded by argument phrases that consist solely of lexically unaccented (U) words. Then a review is made of a study of prosodic constituent structure properties of a quadruplet of sentence types in which the verb is preceded by an AAUA sequence of four words and the preverbal morphosyntactic constituent structure in which the unaccented U word appears is systematically varied. In the distinct φ structures that are produced by the phonology in these AAUA cases, the U word is never a φ on its own but is sister to an A word within a larger φ structure in PO whose φ structure properties may differ significantly from the input φ structure of the corresponding PI (as well as the syntactic phrase structure of MSO).

Sentences containing only U words preceding the verb were experimentally investigated by Elordieta and Unamuno (2015). In such cases, it was found that, regardless of the constituent structure of MSO or its spellout in PI, *all* the preverbal U words are grouped into a single φ_{min}— one that dominates no other φ. An example of such a $UU_a\,UU_b$ type sentence is *Mariñeruen umiak abadien legia ikasi-dau* 'The sailor's child has learnt the priest's law'. Its subject and object arguments consist of two unaccented (U) words each:

(13) In all-U sentences, the preverbal unaccented words are all organized into one φ in PO.

MSO [[[[U][U]]**a** [[U][U]]**b**]$_{PredP}$ [[verb-aux]]$_{'TP'}$]$_{clause}$

PI (ι((U)φ (U)φ)φ**a** ((U)φ (U)φ)φ**b** (verb-aux)φ)ι

PO (ι (^{LH} U U U U ^{HL})$_{φ\text{-}x}$ (verb-aux)ω)ι

By hypothesis, in (13) the morphosyntactic structure in MSO and the φ structure in PI is the same as that of the two-argument $AA_a\,AA_b$ sentences analyzed in Elordieta (2015) and reviewed above. But the φ structure in the PO output representation is radically different in the all-U case: the verbal arguments have lost their φ structure. (This is shown by the lack of LH φ-edge tone at the left of the non-initial U's in the string.) The loss of φ structure here is arguably the consequence of the language-particular ranking of independently motivated types of prosodic markedness constraint that collectively embody the "No U-only φ" effect. More specifically, in the grammar of Lekeitio Basque the markedness constraints embodying the "No-U-only φ" effect, are ranked higher than the anti-deletion PI-PO faithfulness constraint Max(φ) and the anti-insertion PO-PI faithfulness constraint Dep (φ). (See McCarthy & Prince (1995, 1999) on the

general input-output and output-input faithfulness constraint types Max (α) (roughly, the input property α should be '***max***imally' represented in the output) and Dep (β) (roughly, the output property β should be '***dep***endent' on the input) in optimality theory.

As for the fact that the entire preverbal sequence of prosodic words (ω) belonging to the verbal arguments of PI in (13) does constitute a single φ in PO (as indicated by the flanking LH and HL edge tones), it requires further explanation. Note that PredP, like all functional category-headed phrases of MSO in Lekeitio Basque, is *not* spelled out as a φ in PI (Elordieta & Selkirk (2022); this is evident in the PI of (13). Yet there is an independent source for that sole φ in the sentence: Elordieta & Selkirk point out that the presence of the preverbal φ structure $(UUUU)_{\varphi\text{-}x}$ in PO can be ascribed to an independently motivated constraint on prosodic structure that requires that an intonational phrase (ι) dominate at least one φ. This constraint is one of the phonological markedness constraint family that ensures that a foot dominates at least one syllable, a prosodic word (ω) dominates at least one foot and a φ dominates at least one ω (see, e.g., Selkirk 1996). This universally undominated constraint on prosodic constituent structure, dubbed here Minimality(ι,φ), abbreviated Min(ι,φ), takes precedence over the "No U-only φ" set of phonological constraints, which are abbreviated $*(U^n)_\varphi$. Summarizing so far, the radical constituency mismatches of all-U sentences is captured by the phonological constraint ranking in (14), in which the phonological faithfulness constraints on prosodic constituent structure Max(φ) and Dep(φ) are subordinated to the phonological markedness constraints Minimality(ι) and $*(U^n)_\varphi$.

(14) Min(ι, φ) >> $*(U^n)_\varphi$ >> Max(φ), Dep(φ)

Subordination of prosodic constituency faithfulness constraints like Max(φ), Dep(φ) to prosodic constituency markedness constraints such as those in (14) is the condition under which constituency mismatches are produced between MSO (and its spell-out as the phonological input PI), on the one hand, and the output PO of the phonology, on the other. Finally, the fact that the verb is excluded from the single φ of (14) that is called for Minimality(ι) is ascribed by Elordieta & Selkirk to a constraint on prosodic structure from the "extrametricality" family, a NonFinality(ι) constraint that requires that a φ not be final in ι.

There is, then, a purely phonological account for the mismatches in constituent structure just mentioned between MSO and PI on the one hand, and PO on the other. The existence of mismatches like these, whose existence can be explained by the interaction of familiar sorts of phonological constraints, is consistent with a theory of the syntax-phonology interface in which the relation between the constituency of morphosyntactic representation and the constituency of the output phonological representation is not direct, but is instead mediated by the phonology module of the grammar.

In pursuit of further evidence for a phonological constraint-based analysis of MSO-PO constituency mismatches, Elordieta & Selkirk (2022) investigate the minimal quadruplet of sentence types in (15) which each contain a preverbal four-word AAUA sequence but are crucially different in morphosyntactic phrase structure in MSO. The object of this investigation is to see in what ways the phonological constraint-driven "No U-only φ" effect might lead to φ

structures in PO which fail to match up with phrase structures of MSO from which they ultimately derive (via the PI representation which mediates between MSO and PO).

(15) The AAUA minimal quadruplet in MSO

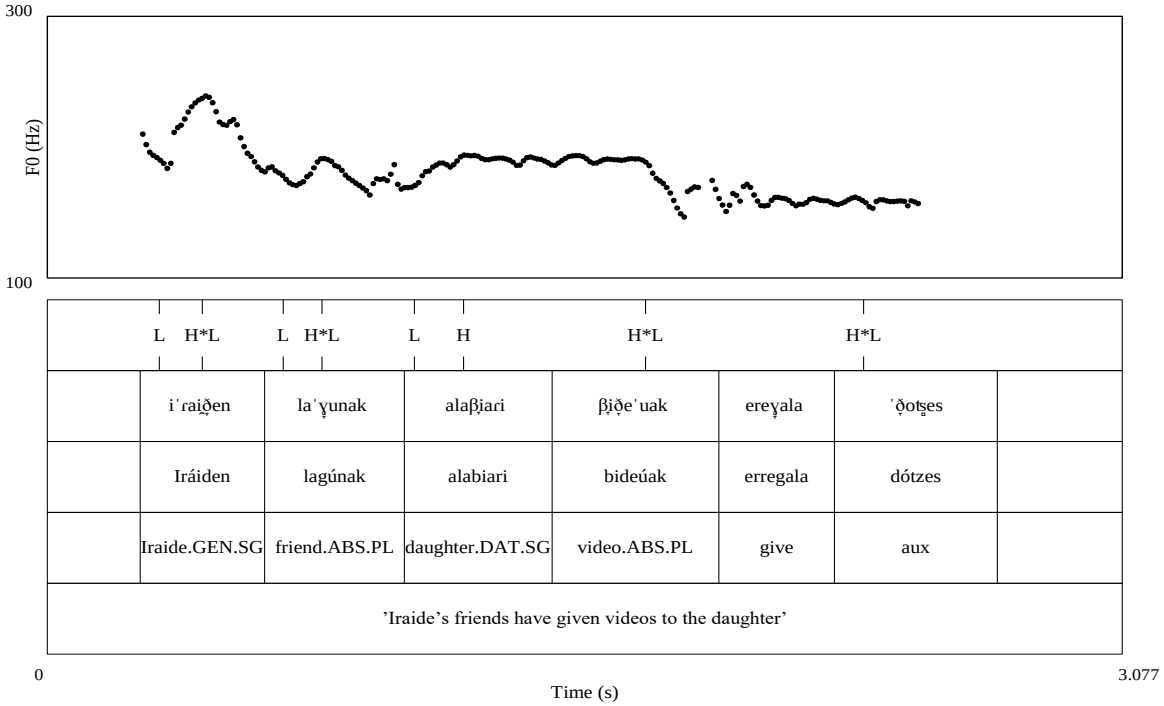
Type I: [[A][A]]$_a$ [[U][A]]$_b$ verb	(= two branching phrases)
Type II: [[A][A]]$_a$ [U]$_b$ [A]$_c$ verb	(= one branching phrase plus two non-branching phrases)
Type III: [[[A][A]] [[U][A]]]$_a$ verb	(= one branching phrase containing two branching phrases)
Type IV: [[[A][A]] [U]]$_a$ [A]$_b$ verb	(= one branching phrase containing a branching and a non-branching phrase, plus one non-branching phrase

Sentence types containing a preverbal AAUA word sequence were chosen for this minimal quadruplet comparison because of the likelihood that the phrasal affiliation of U in PO would differ from what it is in PI. On both the right and left of the U word in these AAUA sentence types, there is an A word with which the U word could potentially join to constitute a well-formed φ in PO. And, along with any merger of U and A into a single φ, there might be alteration of the surrounding φ structure of the sentence in PO. This alteration would depend on the full array of phonological faithfulness and markedness constraints and their ranking in the language. (Note that the use of an initial [AA] phrase in all these sentence types controls for the effects of a known phonological markedness constraint in Lekeitio Basque, which requires the presence of a branching nonminimal φ at the left edge of an intonational phrase (ι) (see Elordieta 2007).)

Importantly, evidence was found in the speakers' productions of the various AAUA sentence types in (15) for additional phonological-constraint-based effects on φ structure beyond those observed in the all-U sentences discussed above. These further effects produce additional types of phrasal mismatch between MSO/PI and PO which are reviewed in what follows. The φ constituency of each sentence type in PO was determined on the basis of two now-familiar properties of PO in Lekeitio Basque: (i) the presence of a predictable LH tone at the left edge of a φ and (ii) patterns of inter-word φ-initial pitch scaling (downstep and upstep) which depend on the place of the φ in the recursive embedding of φ in PO (as discussed above in connection with Elordieta (2015)).

Consider first the example of the Type II sentence in (16), where a U word-- *alabiari* 'daughter'-- stands alone as an indirect object phrase of MSO. The pitch track of this example in (16) shows the placement of the LH left-φ-edge tones of the sentence in PO, as well as the patterns of downstep and upstep in pitch scaling that reflect whether or not the following φ is a φ_{max} (a φ daughter of the intonational phrase (ι)), or a φ_{nonmin} (a φ dominating another φ), as discussed above in connection with the Elordieta 2015 paper. (17) shows the differences in the Type II case between the φ structure of PI, which spells out the phrases of MSO as φ, and the mismatching φ structure of PO.

(16) Type II: MSO = [$_{clause}$ [[A_1][A_2]]$_{\mathbf{a}}$ [U_3]$_{\mathbf{b}}$ [A_4]$_{\mathbf{c}}$ verb-aux]$_{clause}$



(17) PI: (((Iráiden)$_{\varphi min}$ (lagúnak)$_{\varphi min}$)$_{\boldsymbol{\varphi max}}$ (alabiari)$_{\boldsymbol{\varphi max}}$ (bideúak)$_{\boldsymbol{\varphi max}}$ verb-aux)$_{\iota}$

PO: (((LHIraiHLden)$_{\varphi min}$ ↓(LHlaguHLnak)$_{\varphi min}$)$_{\boldsymbol{\varphi max}}$ ↑(LHalabiari bideuHLak)$_{\boldsymbol{\varphi max}}$ verb-aux)$_{\iota}$

In Lekeitio Basque only MSO phrases which have lexical category heads are spelled out with φ constituency in PI. The lex-headed phrases of the MSO of the sentence in (16) are spelled out as the φ structure of the phonological input (PI) representation of (17), while the clause is spelled out as an intonational phrase (ι). Note that the unaccented dative-marked object phrase *alabiari* is spelled out in PI as a φ, and that this φ is a daughter of the ι that spells out the clause. A radically different φ structure appears in the output representation (PO) in (17), however, where the indirect object U and the following direct object A are sister prosodic words (ω) within a single φ that is a daughter of ι. Evidence for the phrasal constituency in the PO of this Type II sentence is (i) the presence of the LH left-φ-edge tone on the U and (ii) the H tone plateau which stretches from that LH to the HL accent on the penultimate syllable of the A word. (There is no LH edge tone at the left edge of A itself.) Moreover, the presence of pitch upstep at the left edge of the new $(UA)_{\varphi}$ of PO indicates its status as a φ_{max}, immediately dominated by ι in PO.

What accounts for the "merger" of the U and A into a 'new' φ (LHalabiari bideuHLak)$_{\boldsymbol{\varphi}}$ that is both maximal (immediately dominated by ι) and minimal (immediately dominating only ω)? Recall that in the phonological constraint ranking in (14), the higher rank of the markedness constraint set abbreviated $*(U^n)_{\varphi}$ drives the observed violations of the lower-ranked anti-φ-deletion and anti-φ-insertion faithfulness constraints Max(φ) and Dep(φ) found in all U

sentences: *$(U^n)_\varphi$ >> Max(φ), Dep(φ). This same ranking of constraints on φ structure in PO forms the basis of an account of the mismatch between PI and PO in the UA sequence in (17).

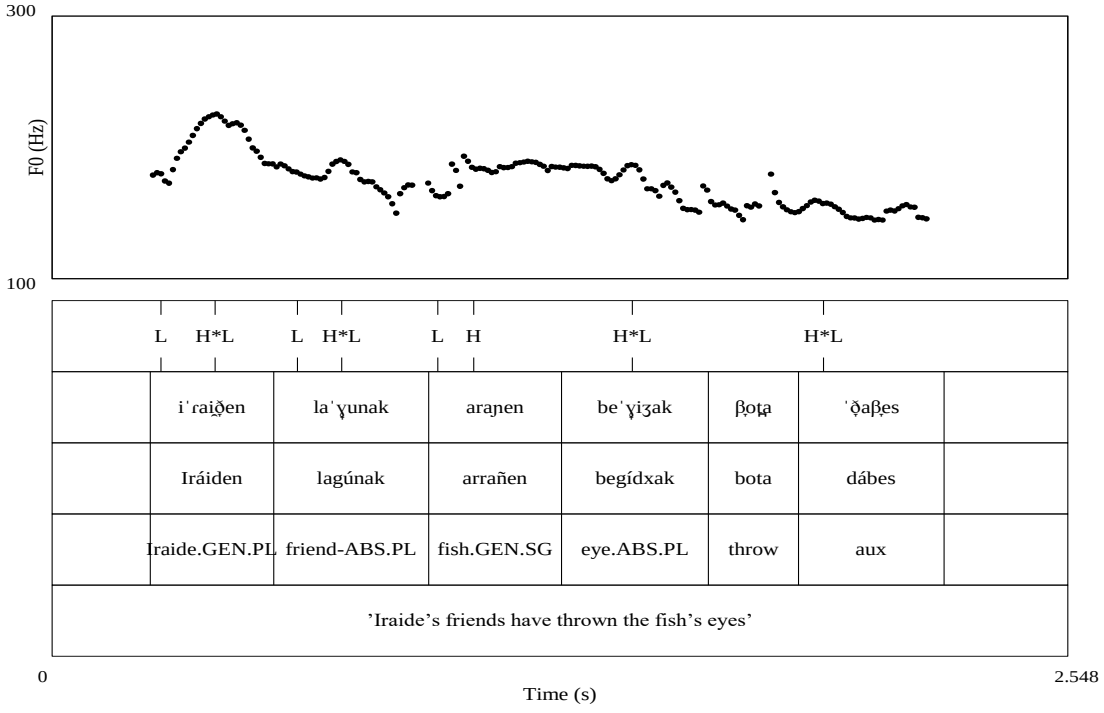
But they do not yet account for why it is the merged $(UA)_{\varphi}$ structure that is optimal.
Why not simply "dephrase" the unaccented *alabiari* of the Type II AAUA sentence in (17a)*?* The answer is that this would produce a φ-ω-φ sequence of daughters of ι in PO. Such a sequence violates the independently motivated universal prosodic markedness constraint EqualSisters (Myrberg (2013)), which calls for all sisters within a prosodic constituent to be prosodic constituents of equal level in the prosodic constituent hierarchy. Adding EqualSisters to the constraint ranking (14) that was motivated for the all-U sentence type, as in (18), provides an account for the optimality of the candidate with the more seriously mismatching merger of U and A in the observed PO in (17).

(18) *$(U^n)_\varphi$, EqualSisters >> Max(φ), Dep(φ) [replaces (14)]

EqualSisters also serves an independent role in determining the optimality of the PO in (17): it rules out a nested φ structure for the UA sequence in PO, one where U is a simple ω sister to the φ formed by A: *(^{LH} alabiari (^{LH} bideu^{HL}ak)$_\varphi$)$_\varphi$.

Consider next the Type I AAUA sentence in (19), in which the U-A sequence in MSO is the direct object argument *arrañen begidxak* 'fish's eyes', and so is spelled out as a φ in PI. As predicted by the constraint ranking (18), the U and A are sister ω within a φ in PO, as shown by the edge-tone and pitch scaling properties of the output U-A sequence, which are identical to the PO of a Type II sentence like that in (17). Indeed the pitch contours of the PO's of Type I and Type II are statistically indistinguishable.

(19) AAUA Type I : [[A_1][A_2]]$_a$ [[U_3][A_4]]$_b$ verb-aux



In (20) we see the "derivation" of the PO from the PI of the Type I sentence.

(20) PI: (((Iráiden)$_{\varphi min}$ (lagúnak)$_{\varphi min}$)$_{\boldsymbol{\varphi max}}$ ((arrañen)$_{\varphi min}$ (begídxak)$_{\varphi min}$)$_{\boldsymbol{\varphi max}}$ verb-aux)$_{\iota}$

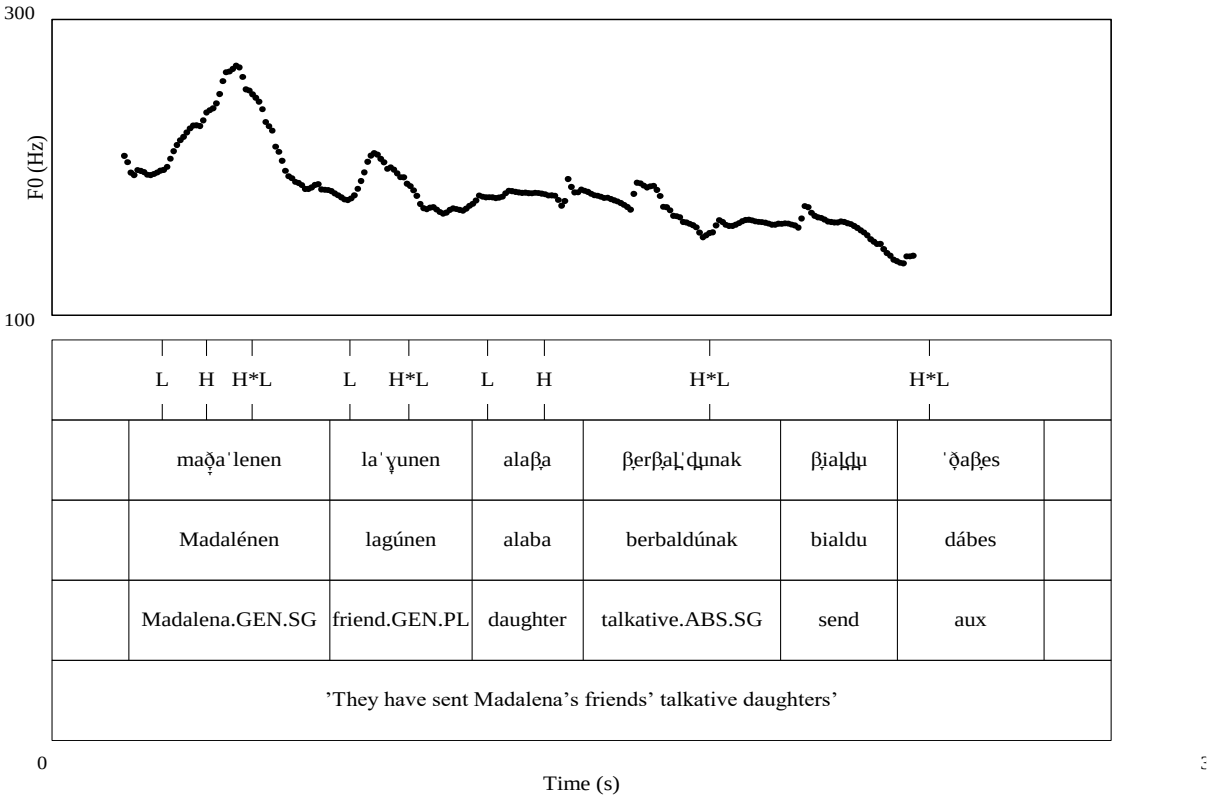
PO: (((^{LH}Irai^{HL}den)$_{\varphi min}$ ↓(^{LH}lagu^{HL}nak)$_{\varphi min}$)$_{\boldsymbol{\varphi max}}$ ↑(^{LH}arrañen begi^{HL}dxak)$_{\boldsymbol{\varphi max}}$ verb-aux)$_{\iota}$

In contrast to sentences of Type II like that in (19), what has been modified in the Type I sentence in (20) is the internal φ structure of the second argument phrase of the sentence in PI (and MSO). In the PO of (20) there is no φ for the U or for its A sister within the φ_{max} that dominates them in PO. These deletions are due to the phonological constraint ranking in (18).

And, to reiterate the obvious, the presence of pitch upstep at the left edge of the internally revamped $(UA)_{\varphi}$ of PO in (20) indicates its status as a φ_{max}, immediately dominated by ι in PO.

A Type III sentence like that in (21) contains a single preverbal phrase in MSO as in (21), in contrast to Types I and II. Note that there is a descending staircase in pitch within that the preverbal sequence, indicating that all four words of that phrase are contained within a single φ.

(21) Type III: $[[A_1][A_2]]\ [[U_3][A_4]]_{\mathbf{a}}$ verb-aux



As with the Type I sentence in (20), there is only a minor mismatch between PI and PO. The UA constituent *alaba berbaldúbak,* the second branching constituent internal to the preverbal phrase, loses its own internal φ structure in PO, becoming just a φ_{min}, and so undergoes downstep in PO:

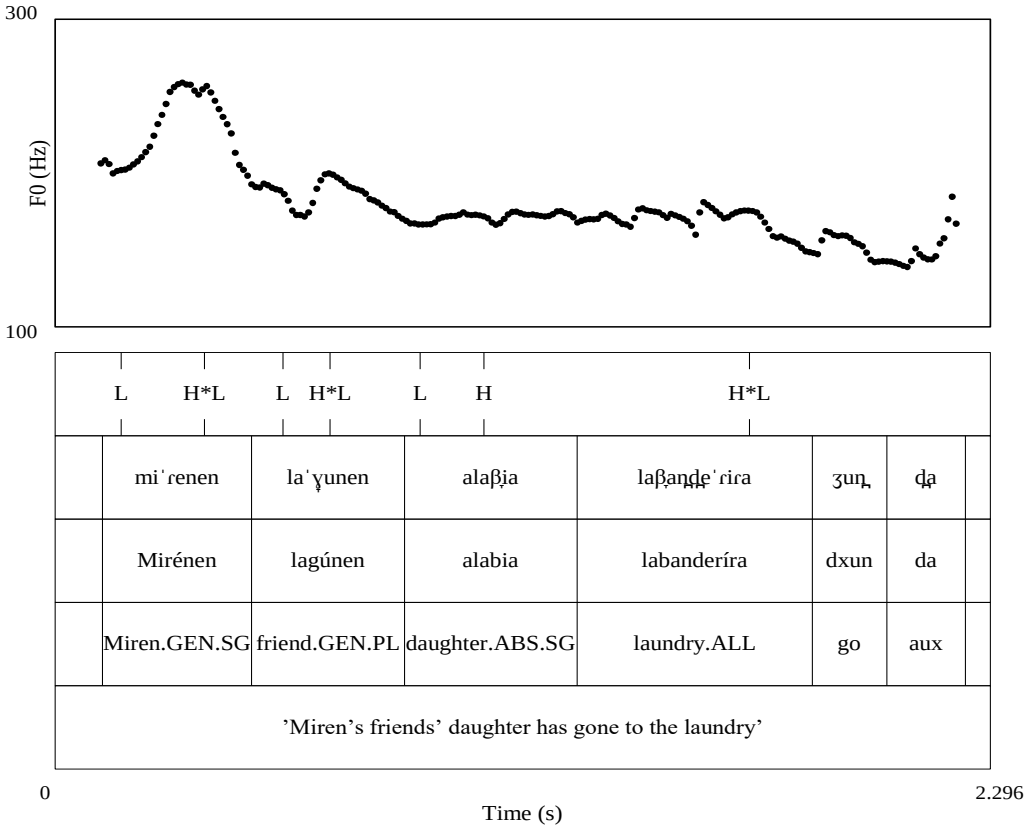
(22) PI: ((((Madalénen)$_{\varphi min}$ (lagúnen)$_{\varphi min}$)$_{\varphi nonmin}$ (((alaba)$_{\varphi min}$ (berbalkdúnak)$_{\varphi min}$)$_{\varphi nonmin}$)$_{\varphi max}$ verb-aux)$_{\iota}$

PO: (((^{LH}Madale^{HL}nen)$_{\varphi min}$ ↓(^{LH}lagu^{HL}nen)$_{\varphi min}$)$_{\varphi nonmin}$ ↓(^{LH}alaba begi^{HL}dxak)$_{\varphi min}$)$_{\varphi max}$ verb-aux)$_{\iota}$

Summing up, the phonological constraint ranking (18) is successful in accounting for the constituency mismatches between MSO/PI and PO reviewed so far. The mismatches come about in Lekeitio Basque because of the lower rank of the phonological faithfulness constraints Max(φ) and Dep(φ) with respect to the phonological markedness constraints *(U^{n})$_{\varphi}$ and EqualSisters in the language-particular ranking of these constraints.

The more significant PI-PO mismatch observed in Type IV sentences in Lekeitio Basque, however, shows that the set of prosodic constituency faithfulness constraints at play in the language cannot be limited to Max(φ)and Dep(φ) In (24) we see that the preverbal accented phrase *labanderíra* must have been incorporated into the preceding AAU phrase in PO, where it forms a new φ_{min} in which it is sister to the preceding unaccented *alabia*, as shown in (24). The distribution of L(H) φ-edge tones and the presence of downstep at the left edge of the (UA) in PO points to this analysis.

(23 Type IV: [[[A$_1$][A$_2$]] [U$_3$]]$_{\mathbf{a}}$ [A$_4$]$_{\mathbf{b}}$ verb



(24) PI: ((((Mirénen)$_{\varphi min}$ (lagúnen)$_{\varphi min}$)$_{\varphi nonmin}$ (alabia)$_{\varphi min}$)$_{\varphi max}$ (labanderíra)$_{\varphi min}$)$_{\varphi max}$ verb-aux)$_{\iota}$

PO: ((((LHMireHL nen)$_{\varphi min}$ ↓(LH laguHLnen)$_{\varphi min}$)$_{\varphi nonmin}$ ↓(LHalabia labanderiHLra)$_{\varphi min}$)$_{\varphi max}$ verb-aux)$_{\iota}$

Indeed the pitch contour of the PO of the Type IV sentences is statistically indistinguishable from the pitch contour of the Type III sentences. So there is a quite radical mismatch between the PO and the PI and MSO of these Type IV sentences.

This 'incorporation' of the preverbal A as sister to the preceding U within a 'new'φ that is embedded in the complex internal φ structure of the sentence-initial φ is unexpected. What the current phonological constraint ranking (18) predicts (wrongly) is that the new (UA) phrase and the preceding (AA) phrase would both be φ_{max} daughters of intonational phrase of the sentence. Some modification of this phonological constraint system is called for. Elordieta & Selkirk (op.cit.) propose adding a new faithfulness constraint to the current repertoire of input-output faithfulness constraints, one that would disfavor the splitting up in PO of a φ that is both maximal in ι (a daughter of ι) and initial in ι (intonational phrase) in the PI representation of the sentence. They call this constraint Ident(Sq-of-ι-initial-φ_{max}). ('Sq' stands for the *sequence of* and refers here to the sequence of prosodic words (ω) in a φ.) The Ident(Sq-of-ι-initial-φ_{max}) constraint belongs to the independently motivated Ident family of phonological faithfulness constraints (McCarthy and Prince 1995). It disallows the 'dismembering' in PO of the initial φ constituent of the intonational phrase. Of course, more research is needed to help decide whether this proposed phonological markedness constraint Ident(Sq-of-ι-initial-φ_{max}) plays a further role in other languages where the phonological constraint system predicts the existence of major mismatches between PI and PO. See Elordieta & Selkirk for more discussion.

7. Lee & Selkirk (2022) on Xitsonga

Lee, Seunghun & Selkirk, Elisabeth (2022) Xitsonga Tone: The Syntax-Phonology Interface In Kubozono, H., Ito, J. & Mester, A., eds. *Prosody and Prosodic Interfaces.* Oxford University Press, to appear. (April 2022)

Abstract:
Patterns of prosodic-structure-sensitive high-tone spread in the Bantu language Xitsonga reveal mismatches between syntactic and phonological/prosodic constituency. A modular account of these mismatches is proposed: Match constraints (Selkirk 2011) are re-construed as spell-out constraints relating the output representation of the morphosyntax to the input representation for the phonology. It's argued that in Xitsonga the spell-out constraint MatchPhrase$_{LEX}$ relates only phrases with lexical category heads to phonological phrases in the phonological input representation. Moreover, in the phonology per se, a novel class of prosodic-structure faithfulness constraints interacts with prosodic-structure markedness constraints to produce further constituency mismatches in the output phonological representation.

The Selkirk (2011) analysis of H (high) tone spread in Xitsonga relied entirely on the rich set of data and insights in Kisseberth (1994). Additional data on Xitsonga H tone spread in a broader

range of syntactic contexts was collected in subsequent field work done in the context of the current NSF grant and has informed the proposals in Lee & Selkirk (2022) that are reviewed here.

The intent of Lee & Selkirk (2022) is to demonstrate that insightful analysis of a broad range of data concerning H tone spread and its relation to φ structure in Xitsonga benefits from the modularity in prosodic constituent structure formation that is made possible by the MSO-PI-PO model. The present account differs from the direct MSO-PO interface account by Selkirk (2011), in which a phonological input representation (PI) plays no role in the formation of prosodic constituent structure in PO, and the syntax-phonology interface constraint MatchPhrase defines a direct relation between MSO and the output phonological representation (PO). Instead, in the context of the currently proposed MSO-PI-PO theory of the syntax-phonology interface, the interface Match constraint forms part of the Spell-out module that relates the morphosyntactic constituency of MSO to the phonological/prosodic constituency of the *input* phonological representation (PI).

A first simple pair of representative sentences from Xitsonga illustrates the existence of H tone spread (HTS) and the restrictions to which HTS is submitted. In (25), where a direct object follows the verb, the lexical H tone of the verbal root *lav*- spreads rightward into the sole word of the object phrase, but stops its spread at the pre-final syllable of that word. In (26), by contrast, where the object phrase consists of two words, H tone spreads just to the final syllable of the verb, not into the object phrase at all.

(25) PI: ni-láv-a nguluve
PO: ni-láv-á ngúlú:ve ‘I want a pig’ (gloss: 1sg-want-FV pig)

(26) PI: hi-láv-a hlambeto yi-ntsó:ngó
PO: hi-láv-á hlambeto yi-↓ntsó:ngó ‘We want a small cooking pot’

(gloss: 1pl-want-FV cooking pot cl-small)

The phonological analysis that Selkirk (2011) and Lee & Selkirk (2022) propose for these facts of H tone spread relies on two distinct independently motivated types of phonological markedness constraint— constraints on the nature of prosodic constituent structure in PO and constraints on the tone-prosodic constituency relation in PO. Markedness constraints on the tone-prosodic constituency relation include NonFinality(H,φ)-- the requirement that a tone not appear on (or spread to) the final syllable of a φ-- a well-known phenomenon in the tonal literature. Phonological markedness constraints on prosodic constituency itself include the commonly attested constraint Binarity(φ), discussed above in connection with Irish and Basque.

The effect of NonFinality(H,φ) in Xitsonga, first posited by Kisseberth, is seen above in the PO of (25). As for the fact that there is H spreading from the verb into a word of the object phrase in (25) while there is none in (26), where the object phrase branches in PO, this difference can be in part understood as effect of the independently motivated prosodic constituency markedness

constraint Binarity(φ). Binarity(φ) rules out single-word nonbinary φ in PO and is the force behind the change in φ structure from PI to PO illustrated in (27).

(27) PI: (($_{φ}$ (ni-láv-a)$_{ω}$ ($_{φ}$ (nguluve)$_{ω}$)$_{φ}$)$_{φ}$)$_{ι}$
PO: (($_{φ}$ (ni-láv-á)$_{ω}$ (ngúlú:ve)$_{ω}$)$_{φ}$)$_{ι}$ 'I want a pig'

In (27), the H tone of the verb spreads within a single two-word phrase φ up the next to last syllable, as permitted by NonFinality(H,φ). By contrast, in (28), which shows the φ status of the two-word object phrase in PO in sentence (26), there is no H tone spread from the verb into the object phrase. H tone only spreads from the position of its lexical source on the verb root to the final syllable of the verb. (NonFinality(H,φ) is not at issue in this merely ω-final position.)

(28) PI: (((hi-láv-a)$_{ω}$ ((hlambeto)$_{ω}$ ($_{φ}$ (yi-ntsó:ngó)$_{ω}$)$_{φ}$)$_{φ}$)$_{ι}$
PO: ((hi-láv-á)$_{ω}$ ((hlambeto)$_{ω}$ (yi-↓ntsó:ngó)$_{ω}$)$_{φ}$)$_{ι}$ 'We want a small cooking pot'

The status of the two-word object as a φ itself has responsibility for the failure of the H tone to spread beyond the verb into the object phrase, due to the high rank of another constraint on the relation between tone and prosodic constituency. Selkirk (2011) proposes that this additional constraint is a markedness constraint of the CrispEdge family (Ito & Mester (1999)), one which restricts the spread of a phonological feature through the left edge of a prosodic constituent of PO: CrispEdgeLeft (φ,H). As for why there is rightward spread of H tone in the first place , Lee & Selkirk (2022) adopt the Kisseberth & Cassimjee (1998) proposal for a constraint requiring simply that a H tone (literally a 'H tone span') spread rightwards, dubbing it HTS-R. The constraint-ranking CrispEdgeLeft (φ,H) >> HTS-R in the phonological module of Xitsonga thereby accounts for the fact that H tone does not spread into a φ, which in Xitsonga is required to have two words (or more).

While the tone-constituency markedness constraint CrispEdgeLeft (φ,H) embodies the effect of the *left* edge of a φ on tone spread seen in (28), the constraint NonFinality(H,φ) embodies the effect of the *right* edge of a φ on HTS-R seen in (27). The idea here is that H tone spread simply goes rightward as far as it can in PO, as long as no violations of phonological constraints on the tone-constituency relation are incurred, an insight due to Cassimjee and Kisseberth (op cit.). The constraint rankings in (29) make explicit the direct effect of the φ constituency of PO on the spreading of H tone in PO in Xitsonga.

(29) Direct effect of φ-constituency of PO on rightward H tone spread in PO in Xitsonga:

a. NonFinality(H,φ) >> HTS-R

b. CrispEdgeLeft (φ,H) >> HTS-R

The general claim, then, is that effects of φ structure on the spread of tone in PO are embodied in phonological markedness constraints on the tone-φ relation in PO, as in (29).

As for phonological restrictions on the output phonological representation of φ-structure itself, Lee and Selkirk (2022) propose that these are embodied in the ranking of phonological markedness constraints on the prosodic constituency of φ in PO relative to a (novel) class of prosodic constituency faithfulness constraints governing the correspondence between the φ constituency of PI and PO. The McCarthy and Prince 1999 theory of constraints on input-output faithfulness does not include faithfulness constraints on the correspondence between input and output prosodic constituency. (At the time of the development of that theory, prosodic constituency was not taken to be present in the phonological input representation.) Extending the coverage of McCarthy & Prince 1999, the anti-deletion faithfulness constraint Max(φ) and the anti-epenthesis faithfulness constraint Dep(φ) are assumed in Lee and Selkirk (2022) (as well as in the more recent papers from this NSF grant project that have been reported on here (Kratzer & Selkirk 2020, Elordieta & Selkirk (2022)). Max(φ) calls for a φ of the input PI to correspond to a φ of PO, while Dep(φ) calls for a φ of the output PO to correspond to a φ of PI.

In their account of the loss of input φ structure in the output PO in the case of the single-word direct object in (27), then, Lee & Selkirk propose that the phonological markedness constraint Binarity(φ) outranks Max(φ) in the constraint ranking of the phonology of Xitsonga, as in (30):

(30) Binarity(φ) >> Max(φ)

In the phonology module of Xitsonga, it is a ranking like (30) of phonological constraints on prosodic constituent structure itself, that determines the φ constituency of PO that restricts the rightward spread of H tone. (30) provides an example of a language-particular resolution of the conflicting demands on PO that are made by phonological markedness constraints on the phonological output PO itself and phonological faithfulness constraints on the relation between PI and PO.

Note that because the φ-structure of the phonological *input* PI is directly determined by the phrase structure of MSO-- through Spell-out of a morphosyntactic phrase as a phonological phrase (φ)— constituency mismatches between PO and PI that result from violations of Max(φ) in PO count also as (indirect) mismatches between the φ structure of PO and morphosyntactic phrase structure of MSO. In other words, the phonology *per se*—as exemplified in the phonological constraint ranking (30)-- is an important source in the grammar for constituency mismatches between MSO and PO.

In the MSO-PO-PI model of the syntax-phonology interface, where there is no direct influence of morphosyntactic structure or principles of morphosyntax on the prosodic constituent structure of PO, there are actually two possible sorts of mismatch between the constituency of MSO and the constituency of PO. The first involves mismatches between PI and PO, created by the phonology *per se*, as discussed above. The second possible source for constituency mismatches between MSO and PO in the MSO-PO-PI model is the interface Spell-out module itself, which relates the morphosyntactic output representation MSO to the input phonological representation PI. A first example, provided in Kratzer & Selkirk (2020) and reviewed above, is the spelling out of [G]-marked constituents in MSO as a mere string of prosodic words in PI. In Standard American and British English, a [G]-marked phrasal constituent in MSO may *not* be spelled out

as a φ. (This [G]-marking-based requirement on PI may be viewed as a variety of prosodic morphology.) Additional examples of constituency mismatches between the phrases of MSO and PI, analyzed in Lee & Selkirk (2022), are produced in languages where only the phrases of MSO which are headed by a lexical category item (N,A,V) are spelled out as φ in PI. It's proposed that in the Spell-out module of such languages only the phrasal spellout constraint MatchPhrase$_{LEX}$ comes into play, not the more general constraint MatchPhrase. MatchPhrase$_{LEX}$ has the potential for directly generating a significant set of mismatches between the phrase structure of MSO and the φ structure of PI. This mismatching φ structure in PI together with the relative ranking in the phonology *per se* of faithfulness and markedness constraints on φ structure in PO could moreover lead to even greater mismatches between PO and PI, and hence between PO and MSO. Illustrations of these sorts of cases is provided by the Lee & Selkirk article and reviewed in what follows.

Lee & Selkirk present evidence of two very different predicted consequences for patterns of H tone spread in Xitsonga of the assumption that it is MatchPhrase$_{LEX}$ that spells out the phrases of MSO in Xitsonga. In both cases Fnc-headed phrases of MSO are *not* spelled out as φ in PI and so have no corresponding φ in PO that would restrict the rightward spread of H tone. A first set of data from Xitsonga sheds light on the status of phrases headed by noun-classifier morphemes when it comes to H tone spread. Every noun in Bantu belongs to one of a large number of noun classes that in most cases are indicated by overt classifier morphemes which immediately precede the noun stem. Noun classifiers have typically been assumed to be prefixes forming part of the larger noun. They play a central role in agreement phenomena in Bantu. But as pointed out by Herbert (1992) noun classifier morphemes in Xitsonga behave is if they are outside the morphosyntactic N-headed phrase, and must lack the morphosyntactic status of prefix to the noun. The fact is that in Xitsonga, a H tone from a preceding verb will always spread rightward into the classifier morpheme for the noun that follows the verb, as seen in (31ab). Importantly, the H tone will continue its spread into the noun to the right of the class marker only if the post-verbal noun phrase consists of just a single noun, as seen in the example in (31a). In the case of (31b), where the noun phrase consists of two words, the H tone spreads into the classifier morpheme but *not* into the noun stem itself.

(31) a. H tone spread into noun class marker and noun of a one-noun phrase

PI ni lánguta mu lungu 'I look at a European'

1sg-look.at cl1-European

PO nilángútá mú lú:ngu

b. H tone spread into noun class marker but not into noun of a multi-word phrase

PI ni lánguta mu lungu ló nkúlú 'I look at a big European.'

1sg-look.at cl1-European cl1- big

PO nilángútá mú lungu lónkúlú

This lack of H tone spreading into the initial noun stem of a multi-word noun phrase is predicted by the phonological analysis of H tone spread reviewed above, but only if the class marker does *not* form part of the morphosyntactic structure of the noun phrase (as pointed out by Herbert (1992)). Lee & Selkirk's analysis is that the Fnc-headed classifier phrase of MSO is *not* spelled out as a φ in PI; rather, only the Lex-headed NP constituent has status as a φ, as shown in (32ab). With this contrast of φ structure in PO, the patterns of H tone spread in (32) then follow from the phonological analysis of constituency-sensitive H tone spread patterns proposed above:

(32) a. MSO $_{VP}$[*ni* [*languta*]$_{V}$ $_{clP}$[*mu* $_{NP}$[[*lungu*]]$_{NP}$]$_{clP}$]$_{VP}$

PI (φ ni lánguta mu (φ lungu)φ)φ

PO (φ nilángútá mú lú:ngu)φ

b. MSO [$_{VP}$ [$_{V}$ *ni languta*]$_{V}$ [$_{clP}$ *mu* [$_{NP}$ [$_{N}$ *lungu*]$_{N}$ [*lo-* [*nkulu*]$_{A}$]]$_{NP}$]$_{clP}$]$_{VP}$

PI (ni lánguta mu (φ lungu ló (φ nkúlú)φ)φ

PO (φ nilángútá mú (φ lungu lónkúlú)φ)φ

Given the Lee & Selkirk analysis of the phonology of H tone spread, the mismatching absence of a φ in PI (and PO) for the Classifier Phrase (clP) of MSO has the correct consequences for H tone spread. The H tone of the verb will spread in PO from the verb into the classifier itself in both (32a) and (32b). But that H tone will further spread into the following noun stem only if, as in (32a), the noun stem is *not* at the left edge of a φ. In (32b) the presence of a binary-branching φ with the noun stem at its left edge in PO has the consequence that the tone-constituency markedness constraint CrispEdge-L(φ,H) blocks the further rightward spread of the H tone.

Another rather different sort of case supporting the contention that it is MatchPhrase$_{LEX}$, not simple MatchPhrase, that spells out phrasal constituents of MSO in Xitsonga is based on sentences with a double object construction like those in (33), for which the full MSO representation is supplied in (34). In the PO of the sentences of both (33a) and (33b) lexical tone spreads from the complex verbal word into the immediately following one-word noun phrase, up to the pre-final syllable of that first noun. This now-familiar pattern of H tone spread indicates that the verb and the noun of the first object phrase together form a φ in PO, to the exclusion of the second object phrase.

(33) a. verb [*noun1*]$_{NP1}$ [*noun2*]$_{NP2}$

PI: vá (xavela (munhu)φ ti (nguvu)φ)φ

3p-buy-appl someone cl10-cloth

PO: (φ (φ váxávélá múnhu)φ tingu:vu)φ

'They are buying clothes for someone'

b. verb [*noun1*]$_{NP1}$ [*noun2*]$_{NP2}$

PI: ndzi (nyíka xi (koxa)φ (nyama)φ)φ

1s-give cl7-old.woman meat

PO: (φ (φ ndzinyíká xíkóxa)φ nya:ma)φ

'I am giving an old woman meat.'

The task is to explain why double object sentences have the prosodic constituency in PO that is observed in the two examples (33a) and (33b), given that, in MSO, both noun phrases would be grouped together to the exclusion of the verb in an applicative phrase ApplP.

As shown schenatically in (34), in such a sentence, in the morphosyntactic derivation, the verb first raises to the head of the ApplP and these together raise to the initial position of the sentence:

(34)

MSO $[_{VP}\ [_{V}\ \textit{sm-verb}_i\textit{-appl}_j]\ ...[_{\textbf{\textit{applP}}}\ [_{NP}[_{N}\ \textit{noun}]_{N}]_{NP}\ [\ \varnothing\varphi i,j\ [_{\textbf{\textit{VP}}}\ \varnothing i\ [_{NP}[_{N}\ \textit{noun}_{N}]_{NP}]_{\textbf{\textit{VP}}}\ ]\ ]_{\textbf{\textit{applP}}}]_{VP}$

SPELL-OUT (by MatchPhrase_{LEX})

PI $(_{\varphi 1}\ (_{\omega}\ \text{sm verb appl}\ )_{\omega}\ \ (_{\varphi 2}\ (_{\omega}\ \text{noun}\ )_{\omega}\ )_{\varphi 2}\ (_{\varphi 3}\ (_{\omega}\ \text{noun})_{\omega})_{\varphi 3}\ )_{\varphi 1}$

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PO $(_{\varphi 1}\ \mathbf{(_{\varphi 4}}\ (_{\omega}\ \text{sm verb appl}\ )_{\omega}\ (_{\omega}\ \text{noun}\ )_{\omega}\ \mathbf{)_{\varphi 4}}\ (_{\omega}\ \text{noun})_{\omega}\ )_{\varphi 1}$

It was proposed above that in Xitsonga it is the interface constraint MatchPhrase_{LEX} which spells out phrases of MSO as φ in PI. This has the consequence that the applicative phrase ApplP, headed by the non-overt applicative marker in MSO in (34), would *not* be spelled out as a φ in the PI. Instead the two object phrases and the verb are spelled out as sister constituents within the PI of (34). Spell-out by MatchPhrase_{LEX} thereby creates constituency mismatches between MSO and the phonological input representation PI. It gives the ApplP of MSO no matching φ in the input phonological representation PI. And the phonological module goes on to create even further mismatches between the constituency of PI and PO, as illustrated in (33).

Consider more closely the mismatch-producing "insertion" in PO of a new φ_4 that groups the verb together with the noun of the first object phrase in (33) and (34). The constraint ranking motivated above-- Binarity(φ) >> Max(φ)—necessarily rules against φ status in PO for the one-word φ's in the PI in (34). High-ranked Binarity(φ) also rules against a PO in which the ω's of the object phrases and the ω of the verb would all be sisters within a three-way-branching φ of PO. The patterns of H tone spread in PO show that Binarity(φ) is indeed satisfied in PO. The verb and the post-verbal object are grouped together in a φ that is initial in the sentence, as shown by the spreading of the H tone from the verb to the pre-final syllable of the following noun. As for the alternative, right-edge grouping of the two object nouns into a φ in PO, it is ruled out by another independently motivated markedness constraint StrongStart (Selkirk 2011, Bennett et al 2016). Strong Start favors prosodic constituent structures in which the leftmost daughter of a constituent is "stronger" (= higher in the prosodic hierarchy) than the daughter to the right. The φ status of the verb plus following noun in (33)/(34) is called for by the language-particular constraint ranking (35), in which StrongStart(φ) outranks the "anti-insertion" faithfulness constraint Dep(φ).

(35) Phonology determines the (in)direct effect of φ-constituency of PI on PO (see also (29))

StrongStart(φ) >> Dep(φ)

Summing up, in cases such as these, the language-particular exploitation of $\text{MatchPhrase}_{\text{LEX}}$ in Spell-out and the language-particular high ranking of independently motivated phonological markedness constraints on the prosodic constituency of PO in the phonological module—namely StrongStart(φ) and Binarity(φ)-- together contribute to constituency mismatches between MSO and PO in Xitsonga.

8. Conclusion

The conclusion from our more recent NSF-supported grant research, reviewed in sections 4, 6 and 7, is that the MSO-PI-PO model of the syntax-phonology interface allows for an insightful general theory of the relation between morphosyntactic constituency and the constituency-sensitive distribution of tone in the output phonological representation PO, as seen in the diverse tonal phenomena of all the languages studied. Assuming the existence of a phonological input representation PI which mediates between MSO and PI allows for a highly restrictive version of an optimality-theoretic constraint system of the phonology *per se* to play a central role both in the characterization of the relation between tone and prosodic constituent structure in PO. It also allows for a simple modular characterization of the relation between the (sometimes-mismatching) prosodic constituent structure of PO and that of MSO, one which posits phonologically-driven constituency mismatches between PO and PI as well as Spell-out-driven mismatches between PI and MSO).

Overall, assuming that any effect of morphosyntax on phonology is possible only in Spell-out allows for a significant simplification of the theory of possible direct impacts of syntax on phonology. The Spell-out model of the syntax-phonology interface argued for in Kratzer & Selkirk 2020, Elordieta & Selkirk 2022 and Lee & Selkirk 2022 simply gives phonological expression to basic lexical or structural properties of the MSO representation as corresponding phonological properties of the phonological input representation PI.