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Flexible syntax–prosody mapping of Intonational Phrases in the context of varying verb height

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Abstract
This paper provides new evidence in support of the hypothesis that the syntax–prosody mapping of Intonational Phrases is flexible (Hamlaoui & Szendrői 2015). In the traditional 'rigid' approaches, Intonational Phrases are taken to map onto particular syntactic projections. In contrast, in the 'flexible' approach, the Intonational Phrase corresponds to the highest projection of the verb (HVP). Accordingly, the 'flexible' approach predicts that the HVP should also determine the size of Intonational Phrases in a language where the verb height depends on the utterance type. Our evidence comes from a language of this type, Iron Ossetic (East Iranian). First, we demonstrate that verbs in Iron Ossetic occupy different functional heads in different contexts. Then, based on novel prosodic data, we show that the HVP indeed directly determines the size of Intonational Phrases in clauses with narrow foci and negative indefinites. Additionally, in wh-questions, language-specific mapping constraints come into play.

Contents

1. Introduction

The nature of the Intonational Phrase (ι) and its mapping onto syntactic constituents has long been debated. Traditionally, ι is assumed to map onto a clause, but a 'clause' in the syntax-prosody literature has been defined (e.g.) as a TP (Zerbian 2006), CP (Truckenbrodt 2005; Henderson 2012), or the complement of Force^0 or C^0 (Selkirk 2011), to name just a few approaches. The difficulty of identifying the size of ι lies in wide cross-linguistic variation with respect to higher-level mapping of prosodic and syntactic phrases. In a novel type of approach, Hamlaoui & Szendrői (2015, 2017) propose that ι-size is flexible and corresponds to the highest projection that hosts verbal material in a given language, together with its specifier (=HVP, 'highest verbal projection'). The evidence comes mainly from the prosodic properties of Hungarian narrow focus and Bàsàá (Bantu) zero-coded passives. The advantage of this approach is that it provides a unified, syntax-based account of cross-linguistic variation in ι-size.

A prediction that the flexible ι-mapping hypothesis makes is that the HVP should also determine ι-size in a language where the height of the verb varies with utterance type. We show that, in Iron Ossetic (East Iranian), several projections are available for verb raising, depending on context, which makes it a uniquely suitable testing ground for this prediction. We demonstrate that Iron Ossetic has several discourse projections above the TP that host narrow foci, wh-phrases, and negative indefinites, respectively: [FocP [WP [NegP …]]]. If these projections are merged, the verb raises to the lowest one with a filled specifier. This analysis correctly derives the fact that, in the surface word order, each of (single) narrow foci, wh-phrases, and negative indefinites must appear immediately preverbally; if cooccurring, they must appear in the order *focus > wh-phrase(s) > negative indefinite(s).*

Based on prosodic data from an elicitation study, we develop an analysis of Iron Ossetic prosody and show that there are three layers of prosodic constituents above the level of the prosodic word: Phonological Phrase (φ), Intonational Phrase (ι), and Utterance Phrase (υ). φ is the domain of pitch accent assignment and corresponds to smaller constituents that do not include the clausal spine, DPs and PPs. Each φ is assigned a pitch accent, anchored to the stressed syllable in the leftmost prosodic word in the φ; the stressed syllable may be either the initial or the second one, based on vowel quality. The size of ι, we show, is determined by the position of the verb, in accordance

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with the flexible ι-mapping approach. Within an ι, the realization of a pitch accent on all φs other than the leftmost is suppressed, which serves as the main diagnostic of ι-size.

This paper, therefore, provides further support for the flexible ι-mapping approach, based on a new language type, while also showing that more rigid syntax-prosody mapping approaches cannot account for the same data. At the same time, we show that not all utterance types in Iron Ossetic can be accounted for with the flexible ι-mapping approach alone. While flexible ι-mapping correctly derives the prosodic realization of utterances with narrow foci and negative indefinites, in wh-questions the syntax-prosody mapping constraints are overridden by language-specific alignment constraints that target wh-phrases.[1]

This paper is structured as follows. §2 discusses the approaches to mapping of ι onto syntactic constituents, starting with the 'rigid' approaches (§2.1) and proceeding to the flexible ι-mapping hypothesis (§2.2). §3 outlines the relevant aspects of Iron Ossetic grammar: the basic clause structure (§3.1), discourse projections (§3.2), traditional descriptions of Iron Ossetic prosody (§3.3), and recent instrumental findings on stress realization and φ-formation (§3.4). §4 discusses the predictions and aims of the study (§4.1), elicitation materials and methods (§4.2), and the theoretical framework adopted (§4.3). §5 provides a preview of the results and preliminary assumptions (§5.1) and discusses the results of the production study: the contexts accounted for by the flexible ι-mapping hypothesis (§5.2) and those that require additional language-specific assumptions (§5.3). Due to the number of individual contexts investigated, the discussion of the results and an Optimality Theory (OT) analysis for each context are provided in the individual subsections in §§5.1–5.3, followed by the full list of Optimality Theory (OT) constraints used in §5.4. §6 concludes the article.

2. Approaches to ι-mapping

2.1. Rigid ι-mapping approaches

It is an accepted view in the syntax-prosody literature that prosodic constituents are organised into hierarchical units that, on the one hand, systematically reflect syntactic structure and, on the other, are subject to phonological requirements/constraints that are independent from syntax (Selkirk 1978, 1986; Nespor *et al.* 1982; Nespor & Vogel 1986, among others). Depending on the language, two or three levels of prosodic constituency above the level of a prosodic word are recognised. The smaller one(s) are typically labelled Minor or Major Phrases, or, if there is a single one, Phonological or Prosodic Phrase (φ). The larger ones are Intonational Phrases (ι); additionally, the level of Utterance Phrase (υ) may be recognised (see Shattuck-Hufnagel & Turk (1996) and Selkirk (2011) for an overview). Phonological Phrases are taken to correspond to smaller XPs (Truckenbrodt 1999; Selkirk 2011), or, alternatively, to spell-out domains (Dobashi 2003; Ishihara 2003; Kratzer & Selkirk 2007). There is more variability with respect to the mapping between Intonational Phrases and syntactic

[1] In this paper, we address only the syntax-prosody mapping of ιs in utterances that contain left-peripheral material, housed in the discourse projections. We leave the prosodic analysis of other utterance types (e.g. yes/no questions, broad-focus declaratives, etc.) for future research.

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constituents: while there is a common understanding that Intonational Phrases correspond to 'clauses', different implementations are available, with syntactic, semantic and/or information-structural factors considered primary.

In the earliest syntax–prosody literature, ι was taken to correspond to the syntactic node S, the highest one in the syntactic clause. To account for the prosodic properties of different types of embedded clauses, S was specified as not dominated by a node other than S (Downing 1970; Emonds 1970; Bing 1979; Nespor & Vogel 1986). According to a less syntax-centred view, ι was a semantic/information-structural unit larger than a prosodic word and variable in its extent, not necessarily isomorphic to any syntactic constituent. Accordingly, a single clause could contain one or more ιs (Selkirk 1984). Later, ι was proposed to correspond to the Comma Phrase in syntax, roughly equivalent to a speech act (Selkirk 2005, based on Potts 2005), or more directly to a speech act itself, without addressing its syntactic implementation (Truckenbrodt 2015). In more recent and more syntax-centred work, ι has often been taken as corresponding to CP (Truckenbrodt 2005, 2007; Cheng & Kula 2006; Pak 2008; Henderson 2012), or, less commonly, TP (Zerbian 2006, 2007, based on Northern Sotho, where matrix clauses are analysed as CP-less). In another attempt to account for the prosodic properties of both matrix and embedded clauses, it was suggested that ι corresponds to the complement of C^0 in embedded clauses and the complement of $Force^0$ ('illocutionary clause'; Rizzi 1997) in matrix clauses (Selkirk 2009, 2011). This means that in complex clauses, ι was established as recursive. In a similar vein, it has been argued that ι corresponds to syntactic phases (CP and vP), with the caveat that only non-complement embedded CPs form phases (e.g. non-restrictive relative clauses; Cheng & Downing 2007, 2009).

In addition to the difficulty in establishing the syntactic counterpart of ι, some phonological factors, known as eurhythmic constraints, have been recognised as affecting ι-formation (see Elfner 2018 for an overview). The most obvious is phonological weight: heavy syntactic constituents can form higher-level prosodic constituents even if they are not clausal (e.g. Gussenhoven 2004). Among others, ι-formation can also result from the application of the constraint StrongStart, according to which the leftmost prosodic constituent cannot be lower in the prosodic hierarchy than the following one (Selkirk 2011; Elfner 2011, 2012; Bennett *et al.* 2016).

Despite definitional discrepancies, the notion of ι has proved useful in linguistic theorizing, both with respect to phonological and morphosyntactic processes: it has been argued to be the domain of low-tone insertion in Slave (Na-Dené; Rice 1987) and morphological alternations in K'ichee' (Mayan; Henderson 2012), to name a few. This, in turn, means that a cross-linguistically valid approach to determining ι-size is called for.

2.2. The flexible ι-mapping approach

Hamlaoui & Szendrői (2015, 2017) propose that accounting for the cross-linguistic variability in mapping of ι onto syntactic constituents is possible if this mapping is not assumed to target a particular syntactic projection. Instead, they argue that ι corresponds to the highest projection that hosts overt verbal material ('the verb itself, the inflection, an auxiliary, or a question particle'), together with its specifier (HVP).

That is, the size of ι is relative and does not rigidly correspond to any syntactic projection (e.g. CP, TP and/or vP), but is determined by the syntactic height of the verb. The proposal is based on the prosodic properties of the Hungarian narrow focus construction, English wh-questions/German V2 clauses, and Bàsàá zero-coded passives. In each of these languages, ι corresponds to the HVP: FocP, CP, and TP, respectively, as schematised in (1), where the ι-edges are represented by curly braces above the syntactic square brackets. There is no restriction on the kind of material that can occupy the specifier of the HVP; for example, it does not have to have a particular information-structural status.

(1) a. $_{\iota}\{ \quad {}_{\iota}\{ \qquad \}\}$ Hungarian
$[_{\text{TopP}} \quad [_{\text{FocP}}$ Focus V $[_{\text{PredP}} \ldots]]]$

b. $_{\iota}\{ \qquad \}$ English/German
$[_{\text{CP}}$ Wh-phrase / Topic V $[_{\text{TP}} \ldots]]$

c. $_{\iota}\{ \quad {}_{\iota}\{ \qquad \}\}$ Bàsàá
$[_{\text{TopP}}$ Object $\quad [_{\text{TP}}$ Subject V $[_{\text{vP}} \ldots]]]$

These facts are derived with the help of ALIGN constraints, shown in (2).[2] The left and right edges of the HVP are aligned with the left and right edges of ι by ALIGN-R/L(HVP, ι).[3] Additionally, the edges of the full 'illocutionary' clause (the speech act) are mapped onto the edges of the larger ι by ALIGN-R/L(SA, ι).[4] The corresponding prosody–syntax mapping constraints, which ensure mapping of prosodic constituents onto syntactic ones, are low-ranked, and we omit them for the sake of simplicity.

(2) *Syntax–prosody mapping constraints referring to ι*

a. ALIGN-L(HVP, ι): Align the left edge of the highest projection whose head is overtly filled by the verb/verbal material with the left edge of an ι.

b. ALIGN-R(HVP, ι): Align the right edge of the highest projection whose head is overtly filled by the verb/verbal material with the right edge of an ι.

c. ALIGN-L(SA, ι): Align the left edge of a syntactic constituent expressing illocutionary force (speech act) with the left edge of an ι.

d. ALIGN-R(SA, ι): Align the right edge of a syntactic constituent expressing illocutionary force (speech act) with the right edge of an ι.

To illustrate, let us consider the prosodic properties of narrow-focus constructions in Hungarian, as compared to those of topics. In Hungarian, narrow (identificational,

[2]Nothing in Hamlaoui & Szendrői's (2015; 2017) account hinges on whether the constraints are formalized as ALIGN or MATCH constraints (Selkirk 2011). The same applies to the current analysis, which also uses ALIGN constraints, for the sake of consistency with the original proposal.

[3]Constraints of the form ALIGN-R/L(X, Y) are to be understood as 'align the right/left edge of every X with the right/left edge of Y'.

[4]Recursion in phonological phrasing is a debated issue. On the one hand, according to the Strict Layer Hypothesis (Selkirk 1984; Nespor & Vogel 1986), prosodic constituents of one type should not be embedded in prosodic constituents of the same type. On the other hand, recursion in prosodic phrasing has been shown to be possible in numerous languages. Therefore, the Strict Layer Hypothesis is best thought of as a violable constraint; cf. the constraint NORECURSION (Truckenbrodt 1999; Ito & Mester 2013), discussed in §5.3.1. On recursive prosodic constituents, see Peperkamp (1997); Truckenbrodt (1999); Szendrői (2001); Vigário (2003); Gussenhoven (2004); Ito & Mester (2013, 2021); Elfner (2015); Elordieta (2015); on recursive ι, see Ladd (1989), Frota (2000) and Selkirk (2009), among others.

exhaustive) foci appear immediately preverbally. Syntactically, focus-verb adjacency is derived by movement: the narrowly focused constituent moves to Spec,FocP, and the verb raises to Foc^0, as manifested by the fact that detachable preverbs in focus constructions are left behind (Horvath 1986; Bródy 1995; É. Kiss 1998). Prosodically, the narrowly focused constituent receives sentential stress, which has been analysed as targeting the leftmost constituent of an ι (Szendrői 2001, 2003). This means that, in the presence of a narrowly focused constituent, the ι in Hungarian corresponds to FocP, the projection that also houses the verb, which is in accordance with the flexible ι-mapping hypothesis. This is illustrated in (3):

(3) $_{\iota}\{$ $_{\iota}\{$ $\}\}$
[$_{\text{TopP}}$ *Péter*$_{\text{S}}$ [$_{\text{FocP}}$ MARI-T$_{\text{O}}$ *szerette*$_{\text{V}}$ [$_{\text{PredP}}$ ***meg*** t_V [$_{\text{vP}}$ t_S t_V t_O]]]].
Peter Mary-ACC love.PST PFV
'Peter fell in love with MARY.'

In contrast with foci, the movement of topics to the left-peripheral positions is not accompanied by verb movement, as shown by the lack of preverb detachment. The prediction of the flexible ι-mapping hypothesis, then, is that topics should not be part of the 'core' ι. This is borne out by the fact that in utterances with topics but not foci, sentential stress targets the preverb+verb complex (Ladd 1996; Kálmán 2001; Szendrői 2001, 2003).[5] Accordingly, topics in Hungarian are not part of the 'core' ι, as shown in (4).

(4) $_{\iota}\{$ $_{\iota}\{$ $\}\}$
[$_{\text{TopP}}$ *A postás-t*$_{\text{O}}$ [$_{\text{TopP}}$ *a kutya*$_{\text{S}}$ [$_{\text{PredP}}$ *meg-harapta*$_{\text{V}}$ [$_{\text{vP}}$ t_S t_V t_O]]]].
the postman-ACC the dog.NOM PFV-bite.PST
'The dog bit the postman.'

Hamlaoui & Szendrői (2015: 6) take multiple topics, if present, to be part of the 'maximal' ι, not separated from each other by ι-boundaries, because 'there does not seem to be any evidence for the presence of intonational phrase boundaries between the topics'. As shown in §5.1, this does not hold for Iron Ossetic, where left-peripheral topics form individual ιs.

3. Iron Ossetic

Iron Ossetic is an East Iranian language spoken in the Central Caucasus, mainly in the Republic of North Ossetia–Alania in Russia, where it has an official status, and in South Ossetia, a breakaway part of Georgia. In Russia, two closely related varieties of Ossetic are spoken, Iron and Digor. Iron speakers are considerably more numerous than Digor speakers, although no precise numbers are available. According to the 2002 census, there were 515,000 Ossetians in Russia. All Ossetic speakers in North Ossetia also speak Russian. The analysis of clausal syntax we adopt here expands the proposal sketched in Borise & Erschler (2021) and draws upon the description in Erschler (2012, 2020).

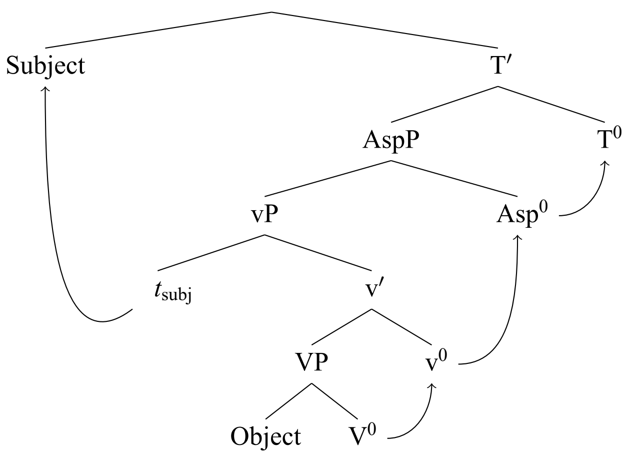
[5] For alternative views on the existence/location of sentential stress in Hungarian utterances that include topics, see Kálmán (1985); Surányi *et al.* (2012); Genzel *et al.* (2015).

3.1. Basic clause structure

The neutral word order in Iron Ossetic is SOV, but in actual discourse the word order is largely determined by information structure. Smaller phrases are mostly head-final. Iron Ossetic is morphologically complex, mostly suffixing, with a rich case system, an inventory of aspectual prefixes, and a sophisticated system of pronominal and adverbial second-position clitics (Erschler 2020).

Following Borise & Erschler (2021), we take the clausal spine to be left-branching up to the level of TP, as shown in (5). The finite verb is assembled via head movement through a series of functional heads (v^0, Asp^0) and raised to T^0. Aspectual prefixes are merged in Asp^0; their linearization on the left is achieved by means of a diacritic [+prefix].[6] The subject is generated in Spec,vP and raised to Spec,TP.

(5)



With respect to head directionality, we take the VP to be head-final, because the neutral constituent order is OV (Erschler 2020: 669). The evidence for the head-finality of vP is supplied by the behaviour of complex verbs. Complex verbs are combinations of a nominal part and a light verb that bears tense and agreement markers (e.g. *ba-fœʃtiat kod-ta* 'PFV-delay do-PST.3SG'), as exemplified in (16) and (17) below. The order of elements in such verbs is rigidly *nominal part–light verb* (Erschler 2020: 656–657). The literature on complex verbs in a number of languages, including Persian and Hindi-Urdu, agrees that the light verb must include v^0 or even be the spell-out of it (e.g. Butt & Ramchand 2005; Folli *et al.* 2005). The order *nominal part–light verb* can be derived only if vP is head-final.

We know of no direct evidence that would bear on head directionality in AspP and TP. Iron Ossetic lacks auxiliaries or any other items that can be identified as the spell-out of T^0. On the other hand, the CP is head-initial, because a complementiser, if present, always precedes the verb (Erschler 2020: 679–682). Therefore, at some point there must be a switch from the head-finality of lower projections to the head-initiality of higher ones. Given the typologically robust Final-over-Final Condition

[6] Alternatively, a derivation by a series of local dislocations in the sense of Embick & Noyer (2001) may be postulated. Nothing in the current analysis hinges on this.

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(FOFC), which prohibits head-final phrases from immediately dominating head-initial ones within the same extended projection (Sheehan *et al.* 2017: 1), we assume that this switch occurs only once. For the sake of consistency, we assume that all phrases in the inflectional domain (such as AspP and TP) are head-final, and that the phrases in the discourse domain (i.e. NegP and above) are head-initial. Nothing in our analysis hinges on where exactly in the inflectional domain the switch in head directionality occurs.

3.2. Discourse projections

Ossetic has a well-articulated left periphery, which houses several types of constituents, including topics, narrow foci, wh-phrases, and negative indefinites (Erschler 2012, 2020). The latter three constituent types share the following property: descriptively, each of them must appear in the immediately preverbal position (in the absence of another element with the same requirement). Details of the distribution and co-occurrence requirements of the left-peripheral constituents are provided below.

Negative indefinites in Iron Ossetic must appear immediately preverbally, as shown in (6a)–(6b); if there are several, all surface as a cluster, left-adjacent to the verb, as in (6c). No material can intervene between the negative indefinites and the verb, or between adjacent negative indefinites, as in (6d): *abon* 'today' cannot be inserted in any of the positions where it appears in angled brackets. The exponent of sentential negation is in complementary distribution with negative indefinites in negative sentences: that is, in the presence of a negative indefinite, no exponent of negation is used, but in the absence of a negative indefinite, the exponent of negation is obligatory.

(6) a. *ʃoflan-ə ni-ʧi (*nɐ) warʒ-ə.*
Soslan-ACC NEG-who NEG love-PRS.3SG
'No one loves Soslan.'

b. * *ni-ʧi ʃoflan-ə warʒ-ə.*
NEG-who Soslan-ACC love-PRS.3SG

c. *abon mɐdinɐ-jɐn ni-ʧi ni-sə nikɐm (*nɐ) ra-zur-ə.*
today Madina-DAT NEG-who NEG-what nowhere NEG PFV-talk-PRS.3SG
'Today, no one tells anything anywhere to Madina.'

d. * *mɐdinɐ-jɐn ni-ʧi ⟨abon⟩ ni-sə ⟨abon⟩ nikɐm ⟨abon⟩ ra-zur-ə.*
Madina-DAT NEG-who today NEG-what today nowhere today PFV-talk-PRS.3SG

In a similar fashion, a wh-phrase in a wh-question must surface immediately preverbally. If there are several wh-phrases, they form a unit that is left-adjacent to the verb, as in (7a). No material can separate the wh-phrases from each other or from the verb, as shown in (7b) and (7c).

(7) a. *abon mɐdinɐ-jɐn ʧi sə ra-zur-ə?*
today Madina-DAT who what PFV-talk-PRS.3SG
'Who is telling what to Madina today?'

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b. * *abon ʧi sə mɐdinɐ-jɐn ra-zur-ə?*
today who what Madina-DAT PFV-talk-PRS.3SG

c. * *mɐdinɐ-jɐn ʧi ⟨abon⟩ sə ⟨abon⟩ ra-zur-ə?*
Madina-DAT who today what today PFV-talk-PRS.3SG

Finally, narrowly focused constituents also appear immediately preverbally. This applies to constituents modified by 'only', as in (8), or, in responses to wh-questions, the constituent corresponding to the wh-phrase in the preceding wh-question, as in (9).[7]

(8) a. *abon alan-əl ɐrmɐʃt* ***mɐdinɐ***$_{\mathrm{F}}$ *ɐwwɐnd-ə.*
today Alan-SUP only Madina believe-PRS.3SG
'Today, only **Madina**$_{\mathrm{F}}$ believes Alan.'

b. * *abon ɐrmɐʃt* ***mɐdinɐ***$_{\mathrm{F}}$ *alan-əl ɐwwɐnd-ə.*
today only Madina Alan-SUP believe-PRS.3SG

c. * *alan-əl ɐrmɐʃt* ***mɐdinɐ***$_{\mathrm{F}}$ *abon ɐwwɐnd-ə.*
Alan-SUP only Madina today believe-PRS.3SG

(9) (In response to the question 'Who believes Alan today?')

a. *abon alan-əl* ***mɐdinɐ***$_{\mathrm{F}}$ *ɐwwɐnd-ə.*
today Alan-SUP Madina believe-PRS.3SG
'**Madina**$_{\mathrm{F}}$ believes Alan today.'

b. * *abon* ***mɐdinɐ***$_{\mathrm{F}}$ *alan-əl ɐwwɐnd-ə.*
today Madina Alan-SUP believe-PRS.3SG

c. * *alan-əl* ***mɐdinɐ***$_{\mathrm{F}}$ *abon ɐwwɐnd-ə.*
Alan-SUP Madina today believe-PRS.3SG

If elements that require immediately preverbal placement co-occur, their order is strictly *focus > wh-phrase(s) > negative indefinite(s)*. Topicalised constituents precede the resulting preverbal complex; non-topical material may also follow the verb. This is illustrated for *wh-phrase(s) > negative indefinite(s)* in (10), *focus > negative indefinite(s)* in (11), and *focus > wh-phrase(s)* in (12).[8]

(10) a. *ʃɐ=χɐzar-ə ʧi kɐmɐn nikʷə ni-sə ra-zur-ə?*
their=house-LOC who who.DAT never NEG-what PFV-talk-PRS.3SG
'In their family, who never tells anything to who?'

b. * *ʃɐ=χɐzar-ə nikʷə ni-sə ʧi kɐmɐn ra-zur-ə?*
their=house-LOC never NEG-what who who.DAT PFV-talk-PRS.3SG

c. * *ʃɐ=χɐzar-ə ʧi nikʷə kɐmɐn ni-sə ra-zur-ə?*
their=house-LOC who never who.DAT NEG-what PFV-talk-PRS.3SG

(11) a. *nɐ=χɐzar-ə ɐrmɐʃt* ***alan-əl***$_{\mathrm{F}}$ *ni-ʧi nikʷə ɐwwɐnd-ə.*
our=house-LOC only Alan-SUP NEG-who never trust-PRS.3SG
'In our family, no one ever trusts only **Alan**$_{\mathrm{F}}$.'

[7] Iron Ossetic also allows for postverbal focus, which is not discussed here. Preverbal and postverbal foci have similar semantic profiles: both may but do not have to be interpreted exhaustively or contrastively. Wh-phrases and negative indefinites in Iron Ossetic are not allowed postverbally.

[8] Examples with all three discourse projections merged, (e.g. 'In our family, **since when** does **no one** trust **only Alan**?') can be elicited but do not seem to occur in natural discourse and can be hard to parse for speakers. We leave them out of the discussion. Most importantly, the order of discourse elements in these examples cannot be altered either.

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b. * *nɐ=χɐzar-ə ni-ʧi nikʷə ɐrmɐʃt* ***alan-əl***$_{F}$ *ɐwwɐnd-ə.*
our=house-LOC NEG-who never only Alan-SUP trust-PRS.3SG

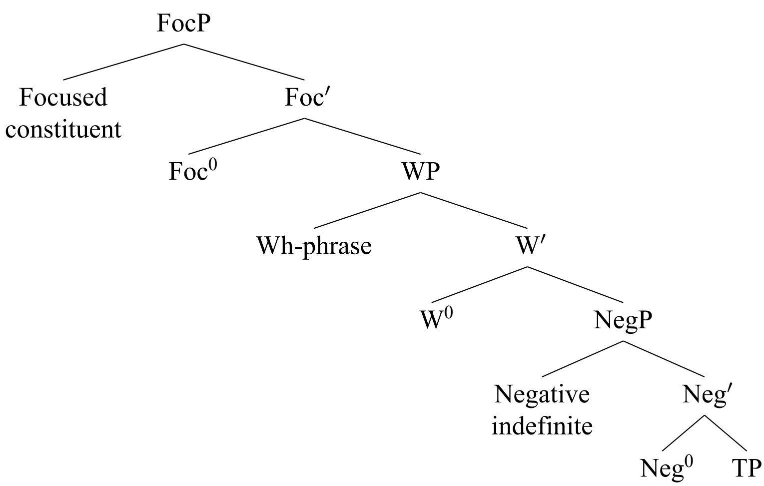
c. * *nɐ=χɐzar-ə ni-ʧi ɐrmɐʃt* ***alan-əl***$_{F}$ *nikʷə ɐwwɐnd-ə.*
our=house-LOC NEG-who only Alan-SUP never trust-PRS.3SG

(12) a. *bɐgɐnə ɐrmɐʃt* ***majrɐmbon-ə***$_{F}$ *savɐr wɐjgɐnɐg nwaʒ-ə?*
beer only Friday-LOC which seller drink-PRS.3SG
'Which seller drinks beer only on **Friday**$_{F}$?'

b. * *bɐgɐnə savɐr wɐjgɐnɐg ɐrmɐʃt* ***majrɐmbon-ə***$_{F}$ *nwaʒ-ə?*
beer which seller only Friday-LOC drink-PRS.3SG

To account for the order of the preverbal elements and their properties, we propose that the clausal architecture switches from head-final to head-initial in the discourse projections above the TP, as shown in (13). Here, foci, wh-phrases, and negative indefinites are housed in a sequence of dedicated discourse projections. For NegP in Digor Ossetic, this was proposed in Erschler & Volk (2011: 149).

(13)



If these projections are merged, we propose that the verb raises to the head of the lowest discourse projection with a filled specifier; cf. a somewhat similar treatment of Turkish by Akan & Hartmann (2019). In accordance with the Bare Phrase Structure approach (Chomsky 1994, 1995), we assume that discourse projections that house no overt material are not projected. Examples with syntactic bracketing are provided in (14).

(14) a. [$_{CP}$ *ʃɐ=χɐzar-ə* [$_{WP}$ *ʧi* [$_{W'}$ *kɐmɐn* [$_{NegP}$ *nikʷə* [$_{Neg'}$ *ni-sə*
their=house-LOC who who.DAT never NEG-what
[$_{Neg'}$ *ra-zur-ə*]]]]]]?
PFV-talk-PRS.3SG
'In their family, who never tells anything to who?'

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b. [CP *nɐ=χɐzar-ə* [FocP *ɐrmɐʃt* ***alan-əl***F [NegP *ni-ʧi* [Neg′ *nikʷə* [Neg′
our=house-LOC only Alan-SUP NEG-who never
ɐwwɐnd-ə]]]]].
trust-PRS.3SG
'In our family, no one ever trusts only **Alan**F.'

That the verb indeed undergoes movement to a discourse projection in these contexts is supported by the positioning of the constituents that the verb raises past; for example, subjects and temporal (i.e. TP-level) adverbs:

(15) [SP *sə* [W′ *kwəʃ-ta* [TP *ʒnon* *ʃoʃlan*]]]?
what work-PST.3SG yesterday Soslan
'What did Soslan do yesterday?'

We assume that NegP and WP have identical structures, with a single head and the possibility for multiple specifiers, if multiple wh-phrases or negative indefinites are present. This assumption is based on the fact that neg-phrases and wh-phrases are subject to identical ordering restrictions: no superiority constraints are attested, but animate arguments must precede inanimate ones:

(16) a. *kɐj sə ba-fɐʃtiat kod-ta?*
who.ACC what PFV-delay do-PST.3SG
'What delayed who?'

b. * *sə kɐj ba-fɐʃtiat kod-ta?*
what who.ACC PFV-delay do-PST.3SG

(17) a. *ni-kɐj ni-sə ba-fɐʃtiat kod-ta.*
NEG-who.ACC NEG-what PFV-delay do-PST.3SG
'Nothing delayed anyone.'

b. * *ni-sə ni-kɐj ba-fɐʃtiat kod-ta.*
NEG-what NEG-who.ACC PFV-delay do-PST.3SG

Furthermore, it has been shown that the exponent of sentential negation *nɐ* is a phrase rather than a head (Erschler & Volk 2011). The complementary distribution of the negative marker with negative indefinites, as illustrated in (6), is accounted for if we assume that sentential negation is spelled out in Spec,NegP as a last resort when the specifiers of NegP would otherwise remain empty. If, under the alternative assumption, negative indefinites occupied the specifiers of separate (iterated) negative projections, the complementary distribution between negative indefinites and sentential negation would be much harder to explain. Based on this and the overall parallelism between the distribution and behaviour of negative indefinites and wh-phrases, we conclude that multiple wh-phrases are also merged in multiple specifiers of a single functional head. The fact that no material can intervene between multiple wh-phrases or multiple negative indefinites follows from the multiple specifier analysis.

Finally, evidence for the verb raising to the head of the lowest discourse projection with a filled specifier comes from word order: no adverbs can intervene between a constituent in the specifier of the lowest discourse projection and the verb, as was shown in (6d), (7c), (8b), (8c), (9b) and (9c). If the verb had stayed in the TP after the

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merger of the discourse projections, we would expect TP-level adverbials to intervene between the verb and the constituents in the discourse projections. This does not take place.[9]

3.3. Prosody: traditional descriptions

Traditional literature on Iron Ossetic describes the prominent role of prosodic phrasing in the language, closely connected with word stress and the way stress is rendered intonationally. In a lexical word, stress targets the first or second syllable, which together comprise the 'stress window'. The exact location of stress depends on vowel quality (Bagaev 1965; Isaev 1959; Dzakhova 2010). Iron Ossetic has 'strong' (S) and 'weak' (W) vowels: /a, e, i, o, u/ and /ɐ, ə/, respectively. Stress targets the initial syllable if the first vowel is strong (ŚS: *rálizən* 'to run away', *χábar* 'news'; ŚW: *ráʒmɐ* 'forward', *sólpə* 'ladle'), and the second syllable if the first vowel is weak (WẂ: *kɐʃtɐ́r* 'young', *ʃɐnə́kk* 'lamb'; WŚ: *bɐláʃ* 'tree', *χɐdón* 'shirt').[10] Personal names, regardless of vowel quality, are stressed on the second syllable.

In connected speech, stress is described as assigned within a larger prosodic constituent: a so-called 'prosodic group', as opposed to a prosodic word. Within a prosodic group, only the stress on the leftmost word is intonationally expressed; other words are described as 'stressless' (Abaev 1924, 1939; Bagaev 1965; Isaev 1959; Testen 1997). The nature and intonational expression of what is described as stress in a prosodic group have not been discussed in the grammars, but the important insight that comes from the traditional literature is that the distribution of stresses allows for identifying prosodic groups.

Prosodic grouping and the corresponding assignment of the intonational expression of stress applies to a number of contexts, which may be divided into 'nominal' and 'verbal' ones. The nominal contexts include combinations of nouns and their modifiers, and nouns and postpositions (DPs and PPs). The verbal contexts include combinations of sentential negation/negative indefinites, wh-phrases or narrowly focused immediately preverbal constituents and verbs, as well as combinations of more than one of the above and verbs (Abaev 1939). The verbal contexts may include second-position clitics and certain particles, which surface between the preverbal constituent and the verb and are also included in the prosodic group. Any other material is described as placed outside the prosodic group.

3.4. Stress and φ-formation

As an OT analysis of stress placement in Iron Ossetic, we adopt the proposal put forward in Borise & Erschler (2022), according to which a prosodic word in Iron

[9] There is a heterogenous group of adverbs that, according to Erschler (2012) and our current data, can intervene between the wh-phrase/narrowly focused constituent and the verb, but not between negative indefinites or a negation marker and the verb. These include only adverbs in the superlative grade and the manner adverb *aftɐ* 'so, in this way'. We leave the derivation of this kind of utterances for further research. Importantly for the reasoning above, none of them are TP-level adverbs.

[10] Some exceptions to these patterns, where stress is initial, have historically had an initial /ə/, which in today's language is pronounced weakly or not at all, and is not rendered in the orthography (Bagaev 1965). Additionally, heavy second syllables in a SW context may attract stress (Isaev 1959, 1966). Some variability in stress placement in SS contexts is discussed in Abaev (1939, 1949).

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Ossetic contains a binary iambic foot, under a moraic (as opposed to syllabic) analysis: each foot corresponds to two morae. This is enforced by FT-FORM=I and FT-BIN constraints (Prince 1980; Kager 1989; Prince & Smolensky 1993). Feet are left-aligned in a prosodic word. This is derived via ALIGN-FT-L and PARSE-SYLL (Hayes 1980; Halle & Vergnaud 1987; McCarthy & Prince 1993; Prince & Smolensky 1993). The constraints are defined in (18), and the tableaux deriving word stress placement in the four stress-window types are provided in (19)–(22). We adopt the following constraint ranking: ALIGN-FT-L ≫ FT-BIN ≫ PARSE-SYLL; the ranking of FT-FORM=I with respect to the other constraints is undetermined. Justification for the ranking is provided in the context of individual tableaux. Note that syllables with strong vowels are taken to be heavy/bimoraic ($S_{\mu\mu}$), and syllables with weak vowels are taken to be light/monomoraic (W_{μ}).

(18) a. FT-BIN: Feet are binary (under a moraic analysis).
b. ALIGN-FT-L: Feet are aligned with the left edge of a prosodic word.
c. FT-FORM=I: The foot type is iambic.
d. PARSE-SYLL: All syllables should be contained in a foot.

In ŚS stress windows, the candidates with both strong vowels parsed into a foot, (19b) and (19c), fatally violate FT-BIN, because the feet in them contain four morae. Candidate (19d), with the initial vowel unfooted, fatally violates ALIGN-FT-L. The winning candidate, (19a), violates the lower-ranked PARSE-SYLL only. In terms of constraint ranking, (19) shows that FT-BIN is ranked above PARSE-SYLL; otherwise, (19b) would win over (19a).

(19) *Stress placement in ŚS stress windows*

SS	ALIGN-FT-L	FT-BIN	PARSE-SYLL	FT-FORM=I
a. ☞ $(\acute{S}_{\mu\mu})S_{\mu\mu}$			*	
b. $(S_{\mu\mu}\acute{S}_{\mu\mu})$		*!		
c. $(\acute{S}_{\mu\mu}S_{\mu\mu})$		*!		*
d. $S_{\mu\mu}(\acute{S}_{\mu\mu})$	*!		*	

Similarly, in ŚW stress windows, FT-BIN is fatally violated by (20b) and (20c), which have trimoraic feet. (20d), with the initial vowel unfooted, fatally violates ALIGN-FT-L. The winning candidate, (20a), again violates PARSE-SYLL only. Like (19), (20) illustrates the FT-BIN ≫ PARSE-SYLL ranking: under the opposite ranking, (20b) would win over (20a).

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(20) *Stress placement in ŚW stress windows*

SW	Align-Ft-L	Ft-Bin	Parse-syll	Ft-Form=I
a. ☞ $(\acute{S}_{\mu\mu})W_{\mu}$			*	
b. $(S_{\mu\mu}\acute{W}_{\mu})$		*!		
c. $(\acute{S}_{\mu\mu}W_{\mu})$		*!		*
d. $S_{\mu\mu}(\acute{W}_{\mu})$	*!	*	*	

In WẂ stress windows, Ft-Bin is responsible for excluding candidate (21b), in which the foot contains only one mora, and Align-Ft-L excludes (21d), where the foot is not left-aligned in the prosodic word. Candidate (21c), which is not iambic, fatally violates Ft-Form=I.

(21) *Stress placement in WẂ stress windows*

WW	Align-Ft-L	Ft-Bin	Parse-syll	Ft-Form=I
a. ☞ $(W_{\mu}\acute{W}_{\mu})$				
b. $(\acute{W}_{\mu})W_{\mu}$		*!	*	
c. $(\acute{W}_{\mu}W_{\mu})$				*!
d. $W_{\mu}(\acute{W}_{\mu})$	*!	*	*	

Finally, in WŚ stress windows, (22d) fatally violates Align-Ft-L, (22b) incurs a fatal violation of Parse-syll, and (22c) of Ft-Form=I. The winner, (22a), violates Ft-Bin but still fares better than its competitors. WŚ stress windows show that Align-Ft-L is ranked above Ft-Bin. If the opposite were the case, (22d) would be the winner instead of (22a).

(22) *Stress placement in WŚ stress windows*

WS	Align-Ft-L	Ft-Bin	Parse-syll	Ft-Form=I
a. ☞ $(W_{\mu}\acute{S}_{\mu\mu})$		*		
b. $(\acute{W}_{\mu})S_{\mu\mu}$		*	*!	
c. $(W_{\mu}\acute{S}_{\mu\mu})$		*		*!
d. $W_{\mu}(\acute{S}_{\mu\mu})$	*!		*	

Borise & Erschler (2022) also show, based on a production study, that DPs of all sizes in broad-focus declaratives in Iron Ossetic consistently map onto prosodic constituents, φs, as illustrated in (23). This is ensured by Align-L/R(DP/PP, φ) and Align-L/R(φ, DP/PP) constraints, listed in (24). The signature property of a φ is a single pitch accent, anchored to the stressed syllable in the leftmost prosodic word. This is ensured by Align-L(Hd-PrWd, φ) (based on Prince & Smolensky 1993), provided in (25). Therefore, the distribution of pitch accents allows for tracking the size of φs; these results provide an instrumental validation to the existing descriptions of Iron Ossetic.

(23) a. $_{\varphi}$(*wɐjgɐnɐg*)
seller
'seller'

b. $_{\varphi}$(*bɐrʒond wɐjgɐnɐg*)
tall seller
'tall seller'

c. $_{\varphi}$(*asə avd bɐrʒond ɐrəgon wɐjgɐnɐg-ə*)
this seven tall young seller-NUM
'these seven tall young sellers'

(24) *Syntax–prosody and prosody–syntax constraints referring to φ*

a. ALIGN-L(DP/PP, φ): Align the left edge of a DP/PP with the left edge of a φ.
b. ALIGN-R(DP/PP, φ): Align the right edge of a DP/PP with the right edge of a φ.
c. ALIGN-L(φ, DP/PP) Align the left edge of a φ with the left edge of a DP/PP.
d. ALIGN-R(φ, DP/PP) Align the right edge of a φ with the right edge of a DP/PP.

(25) ALIGN-L(HD-PRWD, φ): Align the head prosodic word of a φ (i.e. the word bearing the pitch accent) with the left edge of a φ.

4. Current study

4.1. Predictions and aims

The syntactic facts in §3.1 and §3.2 show that if the discourse projections are merged, the verb in Iron Ossetic may be found at different heights in the clause. The prediction of the flexible ι-mapping hypothesis, then, is that the size of ι will vary, depending on verb height. Based on the traditional descriptions of Iron Ossetic prosody, this is indeed the case, with the expression of 'stress' marking the left edges of 'prosodic groups', in the contexts that we identify as containing the discourse projections. This has not previously been verified instrumentally, which means that the current study was also largely exploratory.

Therefore, the aims of the study were the following: to (a) verify instrumentally the traditional accounts of the formation of 'verbal' prosodic groups (i.e. those including verbs and negative indefinites, wh-phrases or narrowly focused constituents), (b) recast them in terms of Autosegmental-Metrical Theory, (c) provide an Optimality Theory account of the syntax–prosody interaction, and (d) test the predictions of the flexible ι-mapping hypothesis.

4.2. Materials and methods

The study targeted the contexts described in the literature as triggering 'verbal prosodic grouping', as discussed in §3.3. The elicitation materials consisted of 68 pre-constructed utterances in Iron Ossetic, which fell into the groups in (26). The number

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of test utterances per condition was dictated by the number of possible components that can affect phrasing: one or two negative indefinites in (26a); one or two wh-phrases of different complexities, with or without negative indefinites in the same wh-question, in (26b); and varying syntactic complexity of narrow foci, either accompanied by negative indefinites or not, in (26c). The stimuli were constructed by the authors and checked with a native speaker who did not participate in the study.

(26) *Elicitation materials*

a. declarative SOV clauses with negative indefinites ($n = 2$)
b. wh-questions of varying complexity: with one or two wh-phrases, as well as wh-questions with negative indefinites ($n = 39$)
c. utterances containing narrow foci, of varying syntactic complexity, including utterances with both narrow foci and negative indefinites ($n = 27$)

The utterances were presented one at a time on a computer screen. Participants were instructed to familiarise themselves with the utterance and pronounce it using natural intonation. The examples intended to elicit focus were preceded by a wh-question (for context). Thirteen speakers of Iron Ossetic took part in the study (8 male, 5 female; age range 20–60; mean age 36.8; median age 35). All participants came from North Ossetia and had a complete or in-progress university degree. The recordings were made in Vladikavkaz, Russia, in January of 2019. The data were recorded with a head-worn Shure SM10A microphone and a Marantz PMD 620 recorder, at a sampling rate of 44.1 kHz and 16 bits per sample, in a quiet room. The recordings were manually annotated in Praat (Boersma & Weenink 2021). Where applicable, quantitative F0 data was collected with ProsodyPro (Xu 2013).

Examples that illustrate individual clause types in §5.1 and §5.2 represent typical productions, as uttered by most or all speakers in our sample. We take them to be representative intonational renditions of each utterance type. Interspeaker variation, where applicable, is mentioned in the context of individual examples.

4.3. Theoretical framework and scope of the results

For the purposes of the prosodic analysis, we adopt Autosegmental-Metrical (AM) theory (Liberman 1975; Bruce 1977; Pierrehumbert 1980). According to the AM theory, the tonal contour consists of a sequence of pitch targets aligned with specific hosts in the prosodic structure, and transitions between them (interpolation). The values of pitch targets are high (H) or low (L), and there are several types of pitch targets: pitch accents, which align with metrically strong syllables (e.g. H*, L*), and boundary tones, which align with edges of prosodic domains (e.g. %H, L%). Complex pitch targets consist of two tones. In a complex pitch accent, the main pitch target, aligned with the stressed syllable, is asterisked, with a leading or trailing tone preceding or following it (e.g. L+H*, L*+H) (for later refinements and critiques of tonal alignment within complex accents, see e.g. Grice 1995; Arvaniti *et al.* 2000; Atterer & Ladd 2004; Dilley *et al.* 2005; Barnes *et al.* 2012). Smaller prosodic units, such as prosodic words, are grouped into larger prosodic units, such as Prosodic Phrases and Intonational Phrases.

Pitch accents are assigned within smaller prosodic units, while all types of prosodic units can carry initial and/or final boundary tones.

To the best of our knowledge, no AM analysis of Iron Ossetic has so far been proposed. Borise & Erschler (2022) take the first step towards a systematic account by demonstrating that in neutral broad-focus declaratives, each φ in Iron Ossetic carries a complex pitch accent consisting of two tonal targets, L and H. The L portion is invariably associated with the stressed syllable in the leftmost word of a φ (the first or the second syllable, depending on vowel quality, as discussed above), and the H portion is realised on the post-tonic syllable. The exact alignment of the rise from L to H is shown to be determined by the quality of the stressed vowel: 'strong' stressed vowels can carry a low or rising tonal contour, while 'weak' ones carry a low tone only. Borise & Erschler (2022) propose that the tonal alignment is determined by the mora count of the stressed vowel, as introduced in the context of stress assignment above: strong stressed vowels correspond to two morae, and weak ones correspond to one. The two morae of strong stressed vowels can accommodate a low plateau or rise in F0, whereas weak stressed vowels can accommodate only a single low tone. Accordingly, Borise & Erschler (2022) label the two rising pitch accents L+H* and L*+H. The intuition behind these labels is that, in L+H*, the starred tone H* is primary, in that it appears on both the stressed and the post-tonic syllable, and in L*+H, L* is primary, because this is the only tone aligned with the stressed syllable. Strong, stressed vowels can carry either accent, but weak vowels can only carry L*+H.

Most pertinently for the current purposes, Borise & Erschler (2022) show that in neutral broad-focus contexts, each φ carries a rising pitch accent, with the F0 peak reached on the post-tonic syllable. We find that the same applies to topicalised φs in our data. In contrast, we find that the pitch accents carried by the leftmost φs in the 'core' ιs in our data – such as the ιs in the context of narrow foci, wh-phrases, and neg-words – are monotonal H*s aligned with the stressed syllables themselves. Therefore, we tentatively assume that the distinction between the bitonal rising and monotonal high pitch accents might be rooted in information structure: rising pitch accents seem to mark given/familiar/topical material, while monotonal high pitch accents mark new constituents. Put differently, the constituents outside of the core ι carry bitonal rather than monotonal accents. The one exception to this is the wh-word *savɐr* 'which', which often carries a rising rather than high pitch accent, in contrast with other wh-phrases. This, in fact, fits well with the hypothesis that bitonal pitch accents are correlated with givenness, due to the given or D(iscourse)-linked status of 'which' (Pesetsky 1987, 2000). The relevant examples are discussed in §5.2.2 and §5.3.2.

Because it is not the aim of this paper to provide a description of the intonational phonology and the full tonal inventory of Iron Ossetic, we leave other issues pertaining to the pitch accent types for future research. The contrasts between L+H*, L*+H and H* are largely irrelevant for our current purposes and have been introduced to facilitate visual recognition of the pitch accents in the figures. What is important is the presence or absence of an accent on a particular constituent, not the type of accent. Visually, the main difference between L+H* and L*+H is the presence or absence of rise in F0 on the stressed syllable. The difference between L+H* and L*+H, on the one hand, and H* on the other is the location of the F0 peak: it is on the post-tonic syllable in the case of the bitonal accents and on the stressed syllable in the monotonal accent. However, the type of pitch accent and the exact alignment of its subparts are not important for the argument at hand.

5. Results

5.1. Preliminary assumptions and preview of the results

The prosodic phrasing of the constituents occupying the discourse projections in Iron Ossetic is correctly predicted by the flexible ι-mapping hypothesis: the size of ι corresponds to the projection that hosts the verb in a given context. In addition to the 'core' ι, Hamlaoui & Szendrői (2015) discuss 'maximal' ιs, which encompass full syntactic sentences (see also Selkirk 2011; Ito & Mester 2012, 2013). In the absence of evidence for recursion of prosodic categories in this context in Iron Ossetic, we refrain from adopting the notion of maximal ι and take full sentences to map onto Utterance Phrases (υ), which carry final boundary tones, L%. υs are not discussed further; we take them to be derived by undominated constraints Align-L/R(SA, υ), parallel to (2c) and (2d), and Align-L/R(υ, SA) constraints. Recursive ιs are found only in the contexts of multiple wh-questions and are discussed separately in §5.3.2. A 'core' ι corresponds to the HVP, which is derived by Align-L/R(HVP, ι) (defined in (2a) and (2b)) and Align-L/R(ι, HVP) constraints. Of these, Align-L(HVP, ι) plays the most important role.

While φ-formation and marking, described in §3.4, are not the primary focus of this paper, φs play an important role in the current analysis as the domains of pitch-accent assignment. An ι in Iron Ossetic may consist of one or more φs. If there is more than one φ, a pitch accent is realised only within the leftmost φ and suppressed on all others. Therefore, the main diagnostic for ι formation is the lack of pitch accents on non-initial φs. This is derived with the constraint Align-L(Hd-φ, ι), shown in (27), which assigns a violation whenever a φ other than the leftmost one in the ι carries a pitch accent. It also penalises ιs that carry more than one pitch accent, because that amounts to having more than one head φ.

(27) Align-L(Hd-φ, ι): Align the left edge of the head φ of an ι with the left edge of an ι.

One of the main differences between the Iron Ossetic and Hungarian facts, as described in Hamlaoui & Szendrői (2015), is that multiple topics in Iron Ossetic behave as separate prosodic constituents, in that each topic carries its own pitch accent. Accordingly, we propose that each topic in Iron Ossetic forms its own ι, each of which is a sister to the ι formed by the HVP, as schematised in (28).[11] The pitch accents in (28) are represented as X*, as their actual values may vary.

[11] The prosodic status of multiple topics and the strength of prosodic boundaries that separate them are likely to be a point of typological variation between languages; for instance, Romance languages pattern with Iron Ossetic in this respect (Frascarelli 2000). This topic merits dedicated further research.

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(28)
X* X* X* L%
| | | |
$_{\iota}${ }$_{\iota}${ }$_{\iota}${ }
[$_{\mathrm{TopP}}$ Topic [$_{\mathrm{TopP}}$ Topic [$_{\mathrm{XP}}$ XP (XP) V]]]

The reasoning for this analysis of the prosody of topics in Iron Ossetic is twofold. First, phonetically, the final syllable of a topic receives a degree of final lengthening that is (less than but) comparable to that found on the ι-final constituent at the right edge of the utterance, and greater than the lengthening received by the focused constituent (ι-medial). This can be demonstrated by comparing the durations of final syllables in the same words when (i) topicalised (i.e. at the right edge of the topic ι), (ii) focused (i.e. forming a φ that is not adjacent to an ι-edge), and (iii) utterance-final (i.e. at the right edge of the core ι). In our sample, the words that occur in all three positions include *majrɐmbonə* 'Friday-LOC', *bɐgɐnə* 'beer', and *Alan* (personal name). The results are provided in Table 1.

Table 1. *Average duration of final syllables in different positions; standard deviations are provided in brackets.*

Word	Average duration of final syllable (ms)								
	Topicalised			Focused			Utterance-final		
majrɐmbonə	125.2	(35.2);	$n = 39$	104.7	(19.3);	$n = 26$	145.6	(33.1);	$n = 13$
bɐgɐnə	124.3	(29.2);	$n = 78$	106.6	(21.7);	$n = 26$	169.8	(38.0);	$n = 13$
Alan	256.6	(53.0);	$n = 117$	233.1	(35.9);	$n = 52$	287.0	(45.9);	$n = 26$

Second, from the theoretical standpoint, treating topics as ιs complies with the Strict Layer Hypothesis. Accordingly, we adopt an existing constraint that applies specifically to topics and maps them onto ιs (Frascarelli 2000; Feldhausen 2010), as in (29).[12] Additional constraints, needed for accounting for more complex contexts, are introduced later in this section, together with the relevant examples. The full list of OT constraints used is provided in §5.4.

(29) ALIGNTOPIC: Align the right edge of a dislocated topic constituent to the right edge of an Intonational Phrase.

5.2. ι-formation determined by the HVP

In this section, we show that the size of ι in the contexts that involve one or multiple negative indefinites, a single wh-phrase, or a focused constituent, corresponds to the

[12] Less specific constraints such as STRONGSTART ('the leftmost prosodic constituent should not be lower in the prosodic hierarchy than the following one'; Selkirk 2011; Elfner 2011, 2012; Bennett *et al.* 2016) or EQUALSISTERS ('sister nodes in the prosodic structure should be of the same category'; Myrberg 2013) could also be used for the same purpose. Each of these constraints would penalise structures such as $_{\varphi}$(Topic) $_{\iota}${HVP}, in which the topic is not followed by the right edge of an intonational phrase.

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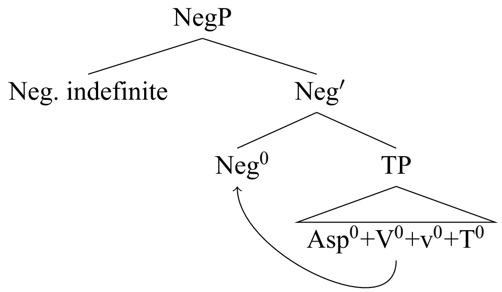
HVP – i.e. NegP, WP or FocP, respectively – to the exclusion of the topicalised material further to the left.

5.2.1. Negative indefinites

As described in §3.2, negative indefinites in Iron Ossetic are obligatorily left-adjacent to the verb. If there are multiple negative indefinites, they cannot be separated from the verb or from each other by other material. We propose that, syntactically, the presence of negation warrants the merger of NegP above TP, and negative indefinites occupy the specifiers of NegP. Obligatory adjacency of the negative indefinite(s) and the verb follows from the fact that the verb complex – that is, the complex head consisting of V^0, v^0, Asp^0, and T^0 – head-moves to Neg^0, as shown in (30):

(30)



Based on this syntactic configuration, the prediction of the flexible ι-mapping hypothesis is that the left edge of NegP, which contains the verb and negative indefinites, regardless of their number, corresponds to the left edge of ι. This prediction is borne out, as shown in Figure 1 for a single negative indefinite, and in Figure 2 for multiple ones, with the glosses, translations, and prosodic structure provided in (31a) and (31b), respectively. The OT account of the proposed phrasing is provided in (32) below.

(31) a. ι{φ( )} ι{φ( )} ι{φ( ) φ( )}
abon *alan* [$_{\text{NegP}}$ *ni-kɐm-ɐj* [$_{\text{Neg}'}$ *a-ləʁd-i*]].
today Alan NEG-who-ABL PFV-run-PST.3SG
'Today Alan didn't run away from anyone.'

b. ι{φ( )} ι{φ( ) φ( ) φ( )}
abon [$_{\text{NegP}}$ *ni-ʧi* [$_{\text{Neg}'}$ *ni-kɐm-ɐj* [$_{\text{Neg}'}$ *a-ləʁd-i*]]].
today NEG-who.NOM NEG-who-ABL PFV-run-PST.3SG
'Today no one ran away from anyone.'

In Figure 1, the negative indefinite *nikɐmɐj* 'from no one' carries a pitch accent. Given that the F0 peak is aligned with the stressed syllable, *ni,* in a ŚW stress window, we label it H*; this is a typical pitch accent that negative indefinites carry in our data. There are no other pitch accents further to the right, the only other pitch target being the final boundary tone L%. Lack of further pitch accents is a hallmark of ι-formation. The left-peripheral topics *abon* 'today' and *Alan* carry their own (rising) pitch accents, typical of topics. All participants produced the same intonational realization of this example.

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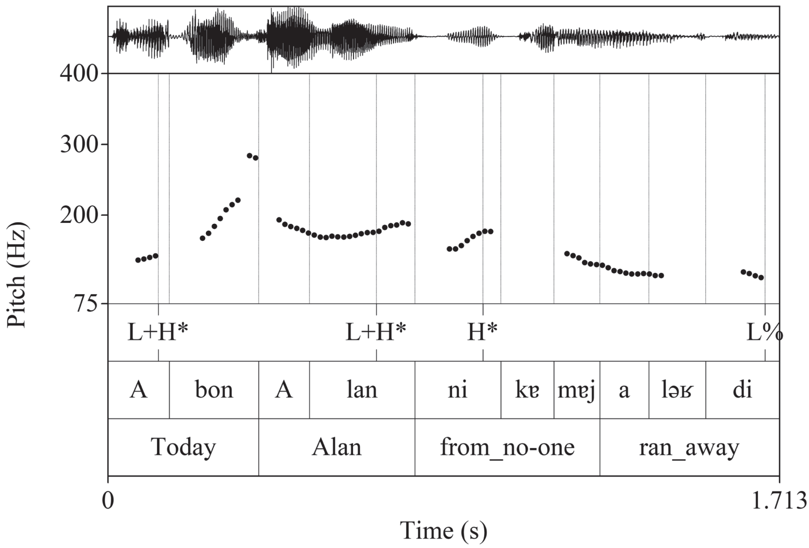

Figure 1. *Realization of the utterance in (31a) (speaker M1, stimulus pt1_1).*

Figure 2 shows that, in a sequence of negative indefinites, only the leftmost one carries a pitch accent. Here, there is an H* on the stressed syllable *ni* in *niʧi* 'no one', the leftmost negative indefinite, but not on *nikɐmɐj* 'from no one' or the verb. This was the case for all our participants: they consistently contrasted the tonal realization of examples (31a) and (31b).

These prosodic phrasing facts are predicted by the flexible ι-mapping hypothesis, given the syntax of negative indefinites: the negative indefinites, no matter their number, occupy the specifiers of the NegP projection, with the verb raising to Neg^0 and thus becoming the HVP, as shown in (30). Only the leftmost negative indefinite carries a pitch accent, which is aligned with the left ι-edge. The constraints that derive the ι-formation are provided in (32), based on the example in (31b). The syntactic constituent corresponding to HVP is contained in square brackets in the input of the tableau. The constraints in (32) are unranked with respect to each other.

Starting from the bottom of the tableau in (32), failure to phrase the topic separately results in a fatal violation of AlignTopic for candidate (32e). Excluding the leftmost negative indefinite from the core ι leads to a fatal violation of Align-L(HVP, ι) for (32d). Candidates (32c) and (32b), in which a head φ (i.e. one that bears the pitch accent) is not aligned with the left ι-edge, are excluded by Align-L(Hd-φ, ι).

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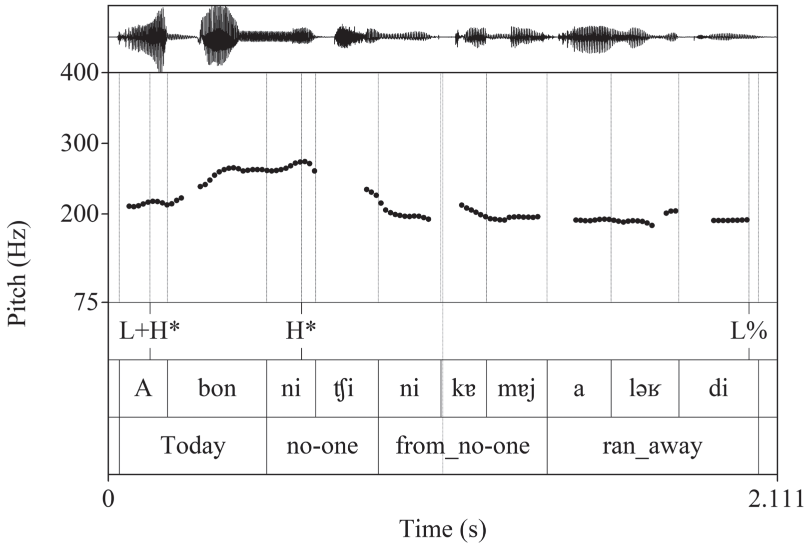

Figure 2. *Realization of the utterance in (31b) (speaker F2, stimulus pt1_2).*

(32) *ι-formation in utterances with negative indefinites*

XP [Neg$_1$ Neg$_2$ V]	ALIGN TOPIC	ALIGN-L(HVP, ι)	ALIGN-R(HVP, ι)	ALIGN-L(HD-φ, ι)
H* a. ☞ $_ι${XP} $_ι${Neg$_1$ Neg$_2$ V}				
H* b. $_ι${XP} $_ι${Neg$_1$ Neg$_2$ V}				*!
H* H* c. $_ι${XP} $_ι${Neg$_1$ Neg$_2$ V}				*!
H* d. $_ι${XP} Neg$_1$ $_ι${Neg$_2$ V}		*!		
H* e. $_ι${XP Neg$_1$ Neg$_2$ V}	*!	*		

The OT analysis of an utterance with a single negative indefinite would work in a similar fashion, except that the configurations in candidates (32b)–(32d) would not be relevant (due to there being only one negative indefinite). Constraints ALIGNTOPIC and ALIGN-R(HVP, ι) are omitted from subsequent tableaux for the sake of simplicity.

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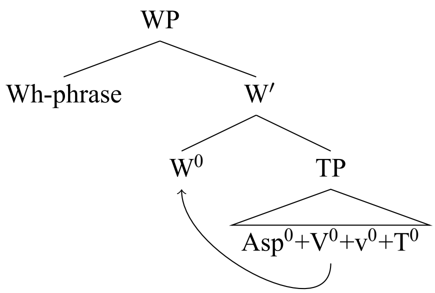
5.2.2. Wh-phrases

Like negative indefinites, wh-phrases in Iron Ossetic appear in the immediately preverbal position, as discussed in §3.2.[13] We propose that wh-phrases move to the specifiers of a dedicated projection, WP, which is merged above the TP in wh-questions, and that the verb complex head-moves into W^0, in a parallel manner to the syntax of negative indefinites, as shown in (33). The evidence for that comes from the impossibility of any intervening material (other than negative indefinites) between the wh-phrase and the verb in W^0.[14]

(33)



The prediction for wh-phrases, then, is the same as for negative indefinites: the left edge of WP, which contains the wh-phrase and the verb, should be aligned with the left edge of ι. This prediction, too, is borne out, as shown in (34) and Figure 3.

(34)

$_\iota\{_\varphi($	$)\}$ $_\iota\{_\varphi($	$)\}$ $_\iota\{_\varphi($	$)$ $_\varphi($		$)\}$
	abon	*mɐdinɐ*	[$_{\text{WP}}$ *kɐmɐ*	[$_{\text{W}'}$ *ɐrba-zur-zɐn*	]]?
	today	Madina	who.ALL	PFV-talk-FUT.3SG	

'Who will Madina call today?'

In Figure 3, the stressed syllable *mɐ* in the WẂ stress window in the wh-word *kɐmɐ* 'who.ALL' is aligned with a peak in F0, which we analyse as the pitch accent H*. There are no further pitch targets to the right, until the final boundary tone L%, which shows that the wh-phrase and the verb are combined into an ι. The topicalized constituents, *abon* 'today' and *Madina,* carry their own (bitonal) pitch accents and are outside of the core ι. Figure 3 also demonstrates that wh-phrases, in contrast to negative indefinites, are the locus of two high pitch targets: in addition to the stress-aligned pitch accent, they also carry an initial high boundary tone %H. In Figure 3, it is realized as an F0

[13] For the prosodic behaviour and analysis of multiple wh-questions, see §5.3.2.

[14] We remain agnostic as to the location of the interrogative operator in the structure. The word order in Ossetic yes/no questions (i) and alternative questions (ii) is the same as that in declaratives (iii). Accordingly, we assume that the WP projection is present only in wh-questions.

(i) *Yes/no question*
mɐdinɐ piʃmo nə-ffəʃ-ta?
Madina letter PFV-write-PST.3SG
'Did Madina write a letter?'

(ii) *Alternative question*
mɐdinɐ ɐvi ʃoʃlan piʃmo nə-ffəʃ-ta?
Madina Q.or Soslan letter PFV-write-PST.3SG
'Did Madina or Soslan write a letter?'

(iii) *Declarative*
mɐdinɐ piʃmo nə-ffəʃ-ta.
Madina letter PFV-write-PST.3SG
'Madina wrote a letter.'

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peak on the unstressed initial syllable *kɐ* in *kɐmɐ* ‘who.ALL’. %H appears only on ιs that include wh-phrases. Anticipating the discussion in §5.3.2, the presence of %H contributes to the special prosodic behaviour of more complex wh-questions – multiple wh-questions and those that also include negative indefinites – which is unexpected from the point of view of the flexible ι-mapping hypothesis.

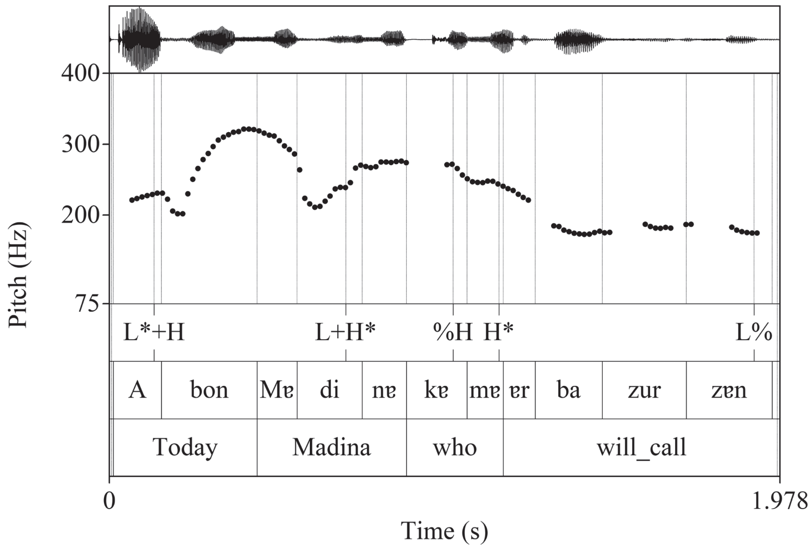

Figure 3. *Realization of the wh-question in (34) (speaker F5, stimulus pt2_25).*

In (35) and Figure 4, a wh-question with a heavier wh-phrase, *savɐr wɐjgɐnɐdʒə binojnag* ‘which seller’s spouse’, is shown. Despite the weight, it carries only a single pitch accent, anchored to the wh-word *savɐr* ‘which’. As mentioned in §4.3, *savɐr* is unlike other wh-phrases in that it can be realized not only with a monotonal but also with a bitonal pitch accent: in our data, eight speakers realised it with the former, and four (M1, M2, M3, F3) with the latter.[15] Monotonal H* is realized as an F0 peak on *sa,* the stressed syllable in the ŚW window in *savɐr,* while in the bitonal realization, the peak in F0 is reached on the post-tonic syllable, *vɐr.* In Figure 4, the bitonal realization is provided: *vɐr* carries the H* part of the pitch accent. The initial syllable, *sa,* is aligned with %H, which overrides the L part of the pitch accent.

(35) $_ι${$_φ$( )} $_ι${$_φ$( )} $_ι${$_φ$( ) $_φ$(
abon *indʒən* [$_{WP}$ *savɐr* *wɐjgɐnɐdʒ-ə* *binojnag* [$_{W'}$
today cottage_cheese which seller-GEN spouse
)}
ɐlχɐn-ə]]?
buy-PRS.3SG
‘Which seller’s spouse buys cottage cheese today?’

[15] Speaker M5’s realization of this example was disfluent and excluded from the analysis.

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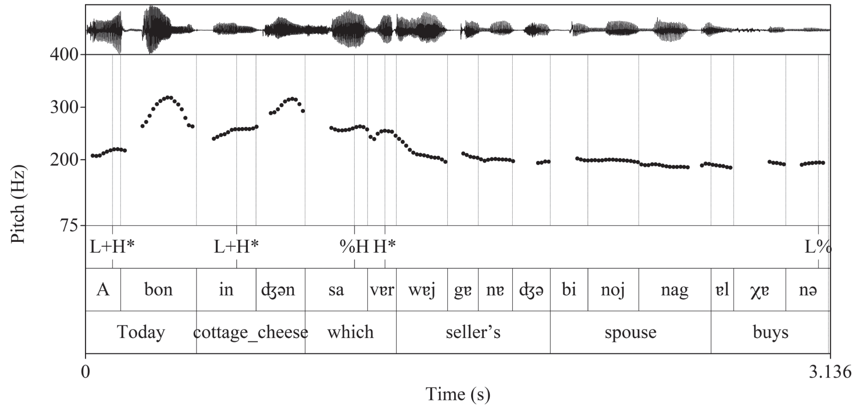

Figure 4. *Realization of the wh-question in (35) (speaker F3, stimulus pt2_20).*

To sum up, the left edge of WP, which hosts the wh-phrase and the verb, corresponds to the left edge of ι, as predicted by the flexible ι-mapping hypothesis. This is shown in the tableau in (36). Here, similarly to the examples with negative indefinites, misalignment of the left ι-boundary and the left edge of the WP, as in (36c), is penalised by Align-L(HVP, ι), and anchoring the pitch accent to any constituent other than the leftmost one in the core ι, as in (36b), is excluded by Align-L(Hd-φ, ι).

(36) *ι-formation in simple wh-questions (with one wh-phrase and no other discourse elements)*

XP [Wh V]	Align-L(HVP, ι)	Align-L(Hd-φ, ι)
H* | a. ☞ $_{\iota}${XP} $_{\iota}${ Wh V}		
H* | b. $_{\iota}${XP} $_{\iota}${Wh V }		*!
H* | c. $_{\iota}${ XP Wh V}	*!	

5.2.3. Preverbal focus

The last constituent type that requires immediately preverbal placement in Iron Ossetic is narrow focus. We propose that, syntactically, the adjacency between the focused constituent and the verb results from movement of the focused phrase into the specifier of FocP, accompanied by movement of the verb to Foc^0, in a similar manner to the derivation of the discourse projections provided in the previous sections. This is shown in (37).

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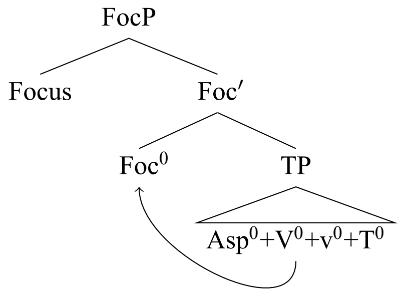
(37)



The flexible ι-mapping hypothesis makes the same predictions about the prosodic behaviour of preverbal foci as it did for negative indefinites and wh-phrases: the left edge of the discourse projection that attracts the verb (in this case, FocP) should align with the left edge of ι. This prediction is also borne out, as shown in (38) and in Figures 5–7.

(38) a. (In response to the question 'What does Madina like?')
ι{φ( )} ι{φ( ) φ( )}
mɐdinɐ [$_{\text{FocP}}$ ***lɐgʷən gɐdə-tɐ***$_{\text{F}}$ [$_{\text{Foc}'}$ *warʒ-ə*]].
Madina bald cat-PL.NOM love-PRS.3SG
'Madina likes **bald cats**$_{\text{F}}$.'

b. (In response to the question 'When does Alan drink beer?')
ι{φ( )} ι{φ( )} ι{φ( ) φ( )}
alan *bɐgɐnə* [$_{\text{FocP}}$ ***majrɐmbon-ə***$_{\text{F}}$ [$_{\text{Foc}'}$ *nwaʒ-ə*]].
Alan beer Friday-LOC drink-PRS.3SG
'Alan drinks beer **on Fridays**$_{\text{F}}$.'

In Figures 5 and 6, the narrowly focused constituents, *lɐgʷən gɐdətɐ* 'bald cats' and *majrɐmbonə* 'on Friday', respectively, carry a pitch accent, with no pitch accents further to the right. This fits with the definition of ι in Iron Ossetic. The F0 peaks in pitch accents on focused constituents are reached within the stressed syllable: *gʷən* in the WẂ stress window in *lɐgʷən* 'bald', and *maj* in the ŚW stress window in *majrɐmbonə* 'Friday.LOC'. Therefore, we label them H*. The narrowly focused constituent in each of the examples is preceded by topical constituent(s), external to the core ι, each of which carries its own pitch accent.

There is also an alternative realization of narrow focus, shown in Figure 7. Here, the pitch accent on the focused constituent is shaped like a high plateau instead of a peak. This realization is often accompanied by increased duration of the stressed syllable in the focused constituent (*maj* in Figure 7). We did not find a consistent contextual difference between the two focus realizations and, provisionally, also label the plateau realization H*.[16] Among our participants, the peak realization was somewhat preferred by the female speakers, and the plateau type by the male speakers.

[16] The distinction between the peak and plateau realizations of H* on the focused constituent, when viewed in the context of the preceding high target, is reminiscent of the distinction between 'unlinked' or two-peak accents and 'linked' or 'hat pattern' accents (Gussenhoven 1984; 't Hart *et al.* 1990; Gussenhoven & Rietveld 1992, among others). In Iron Ossetic, then, the two patterns may be closely related phonologically.

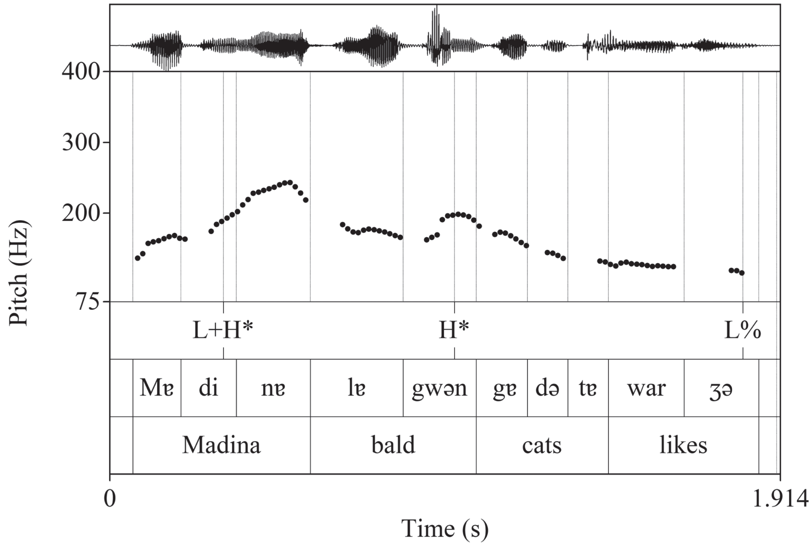


Figure 5. *Realization of (38a) (speaker F5, stimulus pt3_21).*

The focused constituent in (38a) received seven peak realisations (from 3 male and 4 female speakers) and six plateau realisations (from 5 male and 1 female speaker); in (38b), the focused constituent received six peak realisations (from 3 male and 3 female speakers) and seven plateau realisations (from 5 male and 2 female speakers). Most (10/13) speakers (the exceptions being M4, F4 and M7) produced (38a) and (38b) with the same realization of H*.

The prosodic phrasing in clauses with narrow foci also adheres to the predictions of the flexible ι-mapping hypothesis, as shown in the tableau in (39). As before, Align-L(HVP, ι) is responsible for the alignment between the left ι-edge and the left edge of FocP, and Align-L(Hd-φ, ι) ensures the realization of the pitch accent on the leftmost constituent in the ι.

(39) *ι-formation in utterances with narrow foci*

XP [Foc V]	Align-L(HVP, ι)	Align-L(Hd-φ, ι)
a. ☞ $_{ι}${XP} $_{ι}${Foc V} (H* on Foc)		
b. $_{ι}${XP} $_{ι}${Foc V } (H* on V)		*!
c. $_{ι}${ XP Foc V} (H* on XP)	*!	

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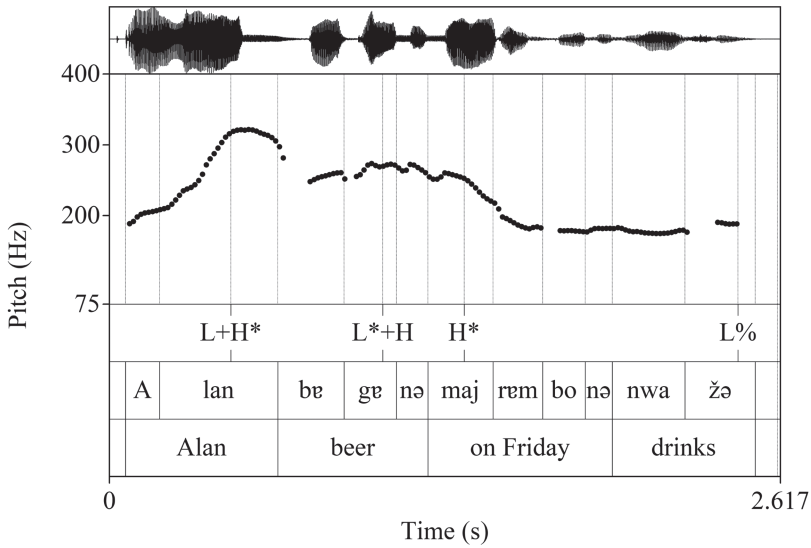
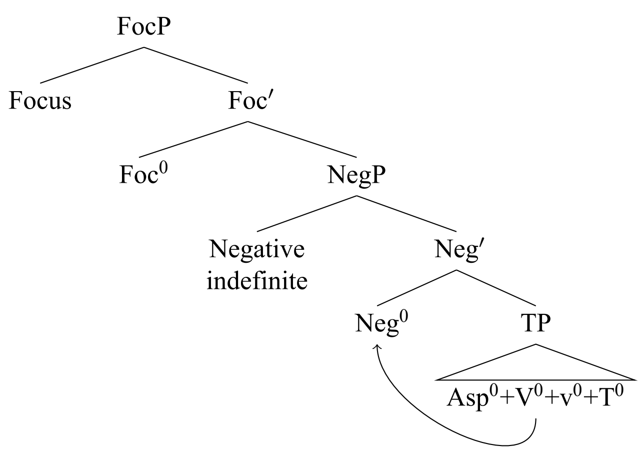


Figure 6. *Realization of (38b) (speaker F3, stimulus pt3_27).*

Next, let us consider those cases where more than one discourse projection is merged. One such combination is FocP and NegP, in those examples where the verb is immediately preceded by a negative indefinite, itself preceded by a narrowly focused constituent: *focus > negative indefinite(s) > verb*; other word order permutations are not allowed. According to the syntactic analysis in §3.2, these contexts are derived by movement of the verb to the head of the lowest discourse projection with a filled specifier (here, Neg^0), as shown in (40). Accordingly, the prediction of the flexible ι-mapping hypothesis is that the left edge of ι should be aligned with the left edge of NegP, as the HVP, and the focused constituent should be phrased separately, as it is not part of the HVP.

(40)



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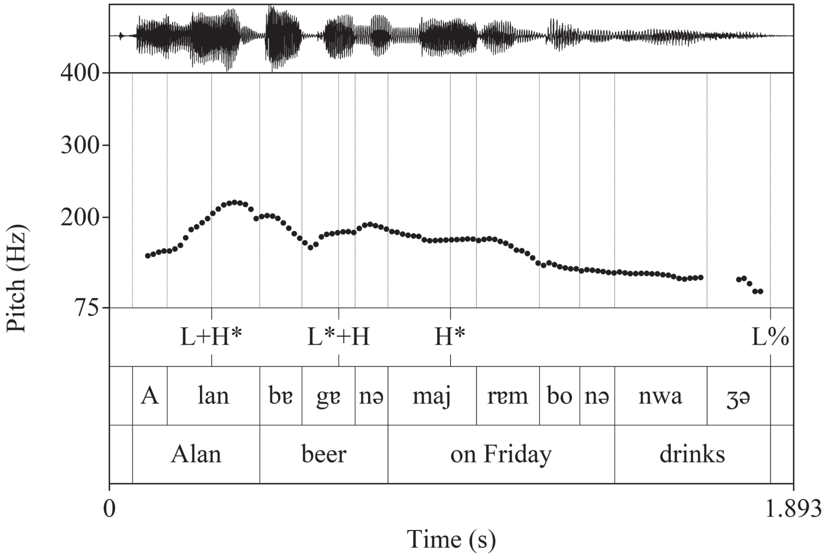

Figure 7. *Realization of (38b) (speaker M1, stimulus pt3_27).*

The prediction is borne out, as shown in (41) and Figure 8 for an utterance that contains a narrowly focused constituent and two negative indefinites:[17]

(41) ι{φ(*nɐ=χɐzar-ə*)} ι{φ([FocP ***alan-əl***F)} ι{φ([NegP *ni-ʧi*) φ([Neg′ *nikʷə*) φ([Neg′ *ɐwwɐnd-ə*)}]]]].
our=house-LOC Alan-SUP NEG-who never trust-PRS.3SG
'In our family, no one ever trusts **Alan**F.'

In Figure 8, the first negative indefinite, *niʧi* 'no one', carries an H* pitch accent (F0 peak aligned with the stressed syllable *ni* in an ŚS stress window), and there are no pitch accents further to its right, neither on the second negative indefinite nor on the verb. This means that the negative indefinites and the verb form an ι, to the exclusion of the narrowly focused constituent. The focused constituent, *alanəl* 'Alan-SUP', is phrased separately, which is manifested by a stress-aligned L+H*, with a rise throughout the stressed and post-tonic syllables (*la* and *nəl,* respectively). Note that the bitonal pitch accent on *alanəl* is typical of material external to the core ι and different from the realisation of focus within the core ι in more simple contexts discussed above. The left-peripheral topic carries its own pitch accent. This is the realization that most (10/13) participants produced; the remaining three (speakers F1, F4 and F5) included the focused constituent into the core ι; we leave the factors that might condition this variation for future research.

[17]The same predicted phrasing is attested when focus is combined with a wh-phrase in the same utterance: ι{Focus} ι{Wh-phrase Verb}. For reasons of space, we provide no dedicated discussion of this construction.

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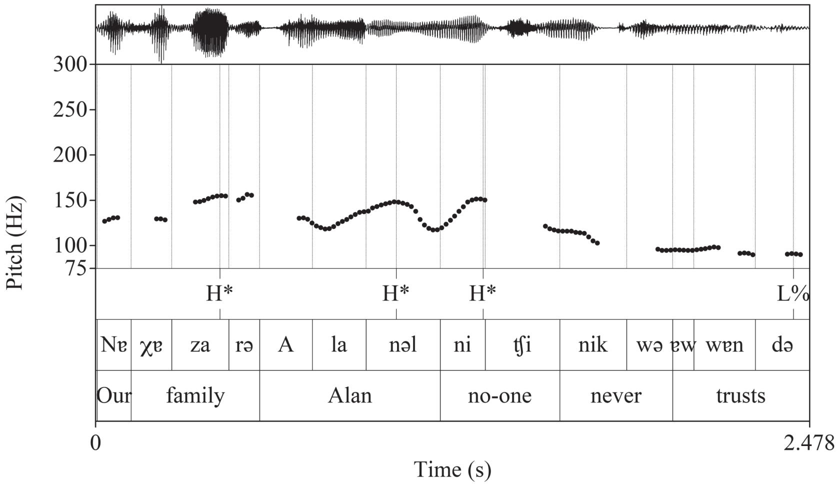

Figure 8. *Realization of (41) (speaker M6, stimulus pt3_18).*

To recap, the prosodic properties of these more complex contexts also straightforwardly follow from the flexible ι-mapping hypothesis. The OT analysis is provided in (42). Like in the preceding, less complex contexts, Align-L(HVP, ι) penalises the candidates in which the left boundary of the core ι does not correspond to the left edge of the HVP, (42b)–(42d). Similarly, Align-L(Hd-φ, ι) penalises the candidate with the pitch accent realised not on the leftmost constituent of the ι, (42c).

(42)

XP Foc [Neg V]	Align-L(HVP, ι)	Align-L(Hd-φ, ι)
H* a. ☞ $_ι${XP} $_ι${Foc} $_ι${Neg V}		
H* b. $_ι${XP} $_ι${Foc Neg V}	*!	
H* c. $_ι${XP} $_ι${Foc Neg V}	*!	*
H* d. $_ι${ XP Foc Neg V}	*!	

5.3. ι-formation determined by language-specific factors

The flexible ι-mapping hypothesis successfully accounts for the behaviour of simple wh-questions (i.e. those with a single wh-phrase and no other discourse projections

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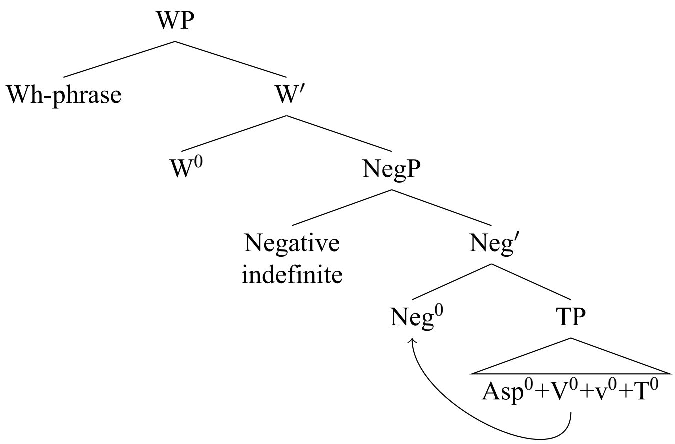
merged). In contrast, the behaviour of more complex wh-questions – multiple wh-questions and wh-questions that include negative indefinites – cannot be explained by the constraints we have so far introduced. Instead, we propose that the prosodic phrasing in these constructions is rooted in the mapping requirements of wh-phrases of Iron Ossetic that are independent from and override the mapping constraints of the flexible ι-mapping hypothesis.

5.3.1. Wh-questions with negative indefinites

As discussed in §3.2, wh-questions in Iron Ossetic may also include one or more negative indefinites: in such constructions, the word order is strictly *wh-phrase* > *negative indefinite(s)* > *verb*. Syntactically, wh-questions of this shape are parallel to the *focus* > *negative indefinite(s)* > *verb* constructions in (40): the verb raises to Neg^0, the negative indefinite(s) occupy the specifier(s) of NegP and the wh-phrase is in Spec,WP, as illustrated in (43).

(43)



Accordingly, the flexible ι-mapping hypothesis predicts that such constructions should be prosodified in a similar way to constructions in (40), as schematised in (44):

(44) a. *Attested, focus:* ${}_{\iota}\{{}_{\varphi}(\text{Foc})\}\ {}_{\iota}\{[{}_{\varphi}(\text{Neg})\ {}_{\varphi}(\text{V})]\}$

b. *Predicted, wh-phrases:* ${}_{\iota}\{{}_{\varphi}(\text{Wh})\}\ {}_{\iota}\{[{}_{\varphi}(\text{Neg})\ {}_{\varphi}(\text{V})]\}$

However, the phrasing in (44b) is only marginally attested. Instead, based on the distribution of H*, the ι in these constructions, in the overwhelming majority of our examples, includes not only the negative indefinite but also the wh-phrase, as shown in (45).

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(45) a. *Attested, wh-phrases:* $_{\iota}\{_{\varphi}$(Wh) $[_{\varphi}$(Neg) $_{\varphi}$(V)]}

b. $_{\iota}\{_{\varphi}($)} $_{\iota}\{_{\varphi}($) $_{\varphi}($) $_{\varphi}($) $_{\varphi}($

mɐdinɐ [$_{\text{WP}}$ *kɐmɐn* [$_{\text{NegP}}$ *nikʷə* [$_{\text{Neg}'}$ *ni-sə* [$_{\text{Neg}'}$

Madina who.DAT never NEG-what

)}

ra-zur-ə]]]]?

PFV-talk-PRS.3SG

'Who does Madina never tell anything to?'

Figure 9 illustrates the prevailing realization of (45b): here, neither of the negative indefinites carries H*s, which means that they are not at the left edge of ι. Instead, the wh-word *kɐmɐn* 'who.DAT' carries the H* pitch accent on the second syllable (as well as %H on the initial syllable), which means that the core ι includes the wh-phrase, both negative indefinites and the verb. Most speakers (10/13) produced this pattern; only speakers M1, F2, and F3 placed *kɐmɐn* outside of the core ι, as in (44b). Notably, the prevailing pattern is not predicted by the flexible ι-mapping hypothesis.

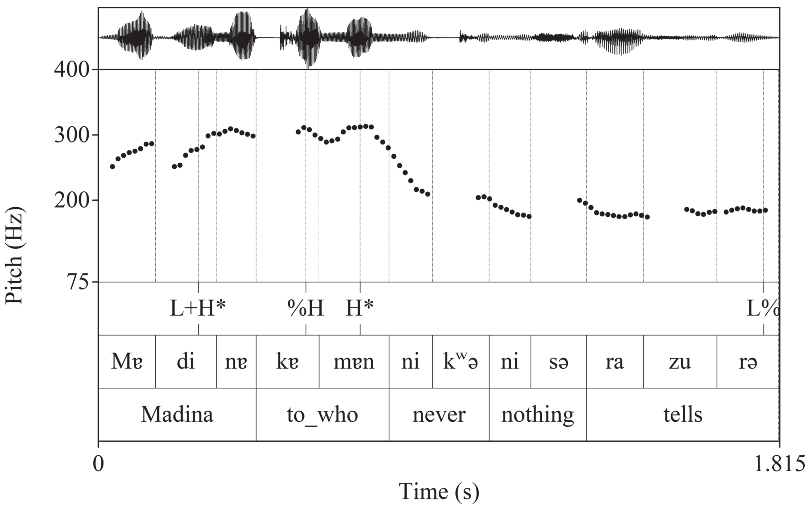

Figure 9. *Realization of (45b) (speaker F5, stimulus pt2_38).*

We propose that the prosodic behaviour of wh-phrases, as revealed by the wh-questions with negative indefinites, is due to a mapping constraint that targets wh-phrases and overrides the requirements of the flexible ι-mapping hypothesis. According to this constraint, introduced in (46), the left edge of the specifier of WP must be aligned with the left edge of the core ι (the precise formulation of this constraint, referring to the specifier of WP as opposed to the maximal projection of WP, will be relevant in the discussion of multiple wh-questions in §5.3.2).[18]

[18] A reviewer points out that syntax-prosody mapping constraints are not usually assumed to refer to notions such as specifier, but only to heads and phrases. We acknowledge this; given the peculiar behaviour of wh-phrases in Iron Ossetic (in contrast with negative indefinites and foci) we are leaving this issue for further research.

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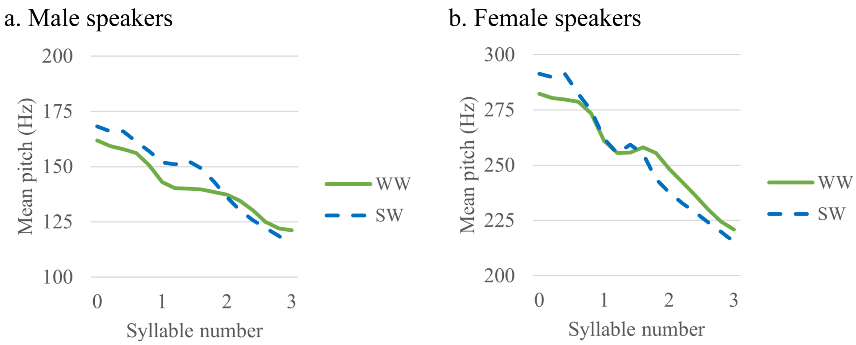

Figure 10. *Averaged F0 contours on disyllabic wh-phrases preceded by left-peripheral constituents, according to stress window type. On the x-axis, ticks correspond to syllable boundaries: first (0-1), second (1-2), and third (2-3) syllables.*

(46) Align-L(Spec,WP, ι): Align the left edge of the specifier of WP with the left edge of the ι.

While the constraint in (46) is language-specific, there is, in fact, robust phonetic evidence for a prosodic boundary aligned with the left edge of the occupant of Spec,WP – i.e. the wh-phrase: the %H boundary tone, introduced in the context of simple wh-questions in §5.2.2.[19] The realization of polysyllabic wh-phrases demonstrates that this target is distinct from H*, which is aligned with the second or third syllable of a wh-phrase, depending on the location of stress. This is shown in Figure 10, which provides averaged results for the F0 contours that span disyllabic wh-phrases in our data, of WẂ and ŚW stress window types (ŚS and WŚ types were not attested). The WẂ dataset includes wh-words *kɐmɐ* 'who', *kɐmɐn* 'to whom', and *sɐmɐn* 'why' ($n = 91$, from all speakers), and the ŚW dataset is based on the realization of the wh-word *savɐr* 'which' ($n = 65$, from all speakers).[20] Figure 10 also includes the F0 values of the third syllable (the initial syllable of the following verb), to illustrate the subsequent drop in F0. To account for the pitch range difference, the results are shown separately for male and female speakers.

Wh-words of both stress window types present evidence for a high F0 target on the initial syllable. In the ŚW condition, the H*-part of the stress-aligned L+H* is realised on the second, post-tonic syllable, and the high target on the initial syllable is %H, which overrides the L-part of the pitch accent. In the WẂ context, H* is realised on the stressed (second) syllable itself, due to the second syllable being the rightmost one in a φ. The ŚW and WẂ stress windows, therefore, are similar in that in both, the stress-related F0 peak is realized on the second syllable. In both, we also see another, even higher F0 peak on the initial syllable, which is independent of stress. We take

[19] %H boundary tones that mark interrogative ιs are attested beyond Iron Ossetic: they are well-described for Hungarian, where they are also realized on the wh-phrase, aligned with the left ι-edge (Mycock 2010; Mády *et al.* 2013), as well as Maltese (Grice *et al.* 2019). %H in Hungarian, though, is not a property of all interrogatives: it is limited to genuine wh-contexts and does not appear in wh-containing exclamatives (Gyuris & Mády 2013) or yes/no-questions (Mády & Szalontai 2014). We do not know what the facts in Iron Ossetic exclamatives and non-wh interrogatives are.

[20] There are no other wh-phrases of the ŚW type in our sample. The existing wh-phrases in Iron Ossetic happen to be almost exclusively of the WẂ type.

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it to be %H. %H is present both in topicless wh-questions, in which the wh-phrase is utterance-initial, and in wh-questions that include topical constituents to the left of the wh-phrase.[21] %H is unique to wh-question contexts in Iron Ossetic: ŚW and WẂ stress windows in non-wh-contexts do not carry %H.

Another constraint that plays an active role in the prosody of wh-questions, as demonstrated by more complex wh-questions, is Wrap-WP, (47), modelled after a general Wrap-XP constraint (Truckenbrodt 1995, 1999) and a more specific Wrap-CP (Truckenbrodt 2005). The insight behind this is that the whole WP constituent should be contained within the same ι.

(47) Wrap-WP: A WP is contained within an ι.

The last active constraint in the formation of more complex wh-questions is NoRecursion (Truckenbrodt 1999; Ito & Mester 2013), defined in (48):

(48) NoRecursion: No recursive prosodic structures.

We propose that the left ι-boundary that precedes the wh-phrase, as evidenced by the presence of %H, overrides the formation of the left ι-boundary that results from alignment with HVP. This is achieved by ranking Wrap-WP higher than the syntax–prosody mapping constraint Align-L(HVP, ι). In the tableau in (49), we also show Align-L(Spec,WP, ι) as a high-ranking constraint, together with Wrap-WP; the evidence for this is provided in §5.3.2. Finally, NoRecursion, which penalises recursive ιs, is ranked below Wrap-WP but above Align-L(HVP, ι); the evidence for this is also provided in §5.3.2. The constraints in (46)–(48) do not affect prosodic phrasing in simple wh-questions (i.e. those that involve a single wh-phrase and no other discourse projections) but determine the formation of more complex wh-questions, such as those involving negative indefinites.

The OT derivation of the phrasing in (45b) is provided in (49). Here, the high-ranked Wrap-WP penalises candidate (49d), in which the WP – the wh-phrase and the rest of the clause to the right – do not form an ι. NoRecursion bans candidate (49c), which includes recursive ιs. As before, Align-L(Hd-φ, ι) bans the realisation of the pitch accent on a constituent other than the leftmost one in the core ι in (49b). Although the winning candidate, (49a), incurs a violation of Align-L(HVP, ι), it is not fatal.

[21] The latter type is illustrated in Figure 10 because non-utterance-initial wh-phrases are less susceptible to F0 perturbations like initial glottalization.

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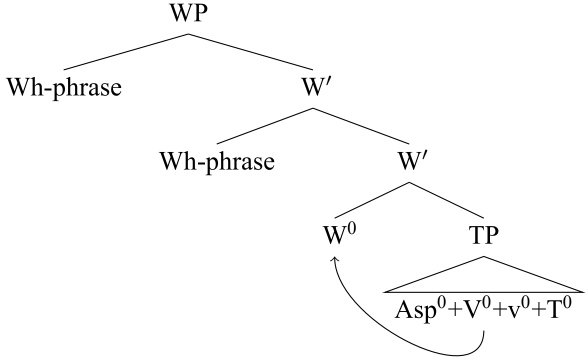
(49) *ι-formation in wh-questions with negative indefinites*

XP Wh [Neg V]	ALIGN-L (Spec,WP, ι)	WRAP-WP	NO RECURSION	ALIGN-L(HVP, ι)	ALIGN-L(HD-φ, ι)
H* a. ☞ $_{\iota}\{\text{XP}\}\,_{\iota}\{\text{Wh Neg V}\}$				*	
H* b. $_{\iota}\{\text{XP}\}\,_{\iota}\{\text{Wh Neg V}\}$				*	*!
H* c. $_{\iota}\{\text{XP}\}\,_{\iota}\{\text{Wh}\,_{\iota}\{\text{Neg V}\}\}$			*!		*
H* d. $_{\iota}\{\text{XP}\}\,_{\iota}\{\text{Wh}\}\,_{\iota}\{\text{Neg V}\}$		*!			

5.3.2. Multiple wh-questions

The constraints in (46)–(48) also play an important role in the prosodic shape of multiple wh-questions. According to the syntactic analysis proposed here, multiple wh-phrases occupy multiple specifiers of WP, as shown in (50). If prosodic phrasing in wh-questions were governed by the standard syntax-prosody mapping constraints alone, multiple wh-phrases and the verb would form an ι, as was the case for multiple negative indefinites in §5.3.1.

(50)



Instead, in multiple wh-questions, the left edge of each wh-phrase is aligned with an ι-edge, marked by %H. This is shown in (51) and Figure 11. Figure 11 also demonstrates that each of the wh-words carries its own %H and H* (the visible portion of L+H*; recall that *savɐr* ‘which’, in contrast with other wh-phrases, often carries a bitonal pitch accent).[22] Furthermore, the wh-phrases that are not immediately preverbal in multiple wh-questions, unlike topics, do not receive final lengthening. Accordingly, we take multiple wh-questions to be prosodified as nested ιs as opposed to sister ιs. This is ensured by ranking ALIGN-L(Spec,WP, ι) and WRAP-WP above other constraints

[22]Multiple wh-questions in our sample included either (i) one mono- and one disyllabic wh-phrase, or (ii) two complex wh-phrases constructed with *savɐr* ‘which’. For the sake of illustrating both the boundary tones and the pitch accents on both wh-phrases, we are using a multiple wh-question of type (ii).

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(most importantly, NoRecursion), which means that recursive ιs are found only in the context of multiple wh-questions in Iron Ossetic. The example in (51) also includes a negative indefinite to demonstrate that our proposal successfully accounts for these even more complex cases.

(51) ι{φ( ) ι{φ( ) φ( ) φ( )}}
[WP *savɐr gɐdə* [W′ *savɐr wəng-mɐ* [NegP *nikʷə* [Neg′ *ra-liz-ə*]]]]?
which cat which street-ALL never PFV-run-PRS.3SG
'Which cat never runs along which street?'

The pattern shown in Figure 11 was produced by most (10/13) participants. However, speakers F2 and M7 excluded both wh-phrases from the core ι and placed H* on *nikʷə* 'never'; speaker M6 included both wh-phrases and the negative indefinite in the core ι. We do not provide an account of these minority patterns.

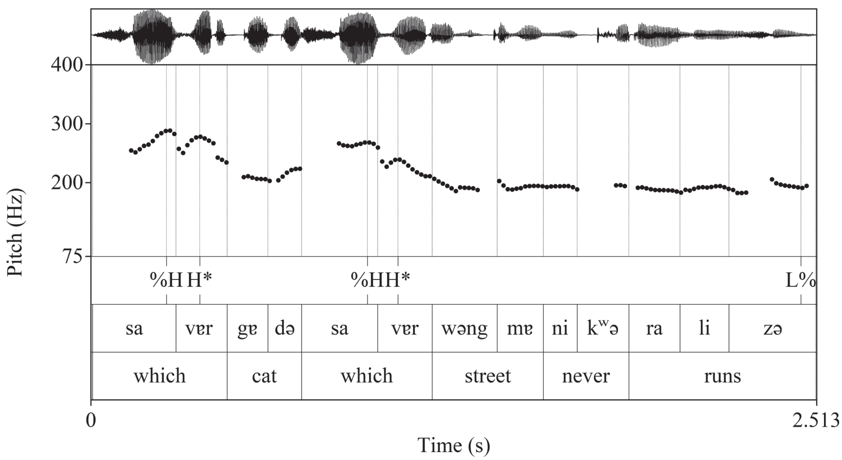

Figure 11. *Realization of the wh-question in (51) (speaker F3, stimulus pt2_39).*

The OT analysis of multiple wh-questions is provided in (52). In candidate (52d), failure to align each Spec,WP with a left ι-edge is fatal. In candidate (52c), the right ι-boundary after the first wh-phrase leads to a fatal violation of Wrap-WP. Candidate (52b), which contains three recursive ιs, including one aligned with the left edge of the HVP (NegP), incurs two violations of NoRecursion, the second one being fatal. The winning candidate, (52a), incurs a single violation of NoRecursion, thus winning over (52b). Even though (52a) also violates Align-L(HVP, ι), it fares better than its competitors.

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(52) *ι-formation in multiple wh-questions with negative indefinites*

Wh Wh [Neg V]	ALIGN-L (Spec,WP, ι)	WRAP-WP	NO RECURSION	ALIGN-L(HVP, ι)	ALIGN-L(HD-φ, ι)
H* H* | | a. ☞ ${}_{\iota}\{$Wh ${}_{\iota}\{$Wh Neg V$\}\}$			*	*	
H* H* | | b. ${}_{\iota}\{$Wh ${}_{\iota}\{$Wh ${}_{\iota}\{$Neg V$\}\}\}$			**!		
H* H* | | c. ${}_{\iota}\{$Wh$\}$ ${}_{\iota}\{$Wh Neg V$\}$		*!		*	
H* H* | | d. ${}_{\iota}\{$Wh Wh Neg V$\}$	*!			*	*

To recap, the phrasing facts in complex wh-questions demonstrate that the formation of ι in Iron Ossetic has two sources. In the default scenario, the size of ι is determined by the standard syntax–prosody mapping constraints. In wh-questions, ι-formation is governed by dedicated higher-ranked constraints, which is demonstrated by more complex wh-contexts: those that involve multiple wh-phrases and/or negative indefinites.

5.4. Full list of OT constraints used

For the convenience of the reader, (53) lists all the constraints introduced in this paper and (54) provides the ranking relationships among them that can be established on the basis of our data.

(53) a. Syntax–prosody mapping constraints referring to ι, defined in (2): ALIGN-L(HVP, ι); ALIGN-R(HVP, ι); ALIGN-L(SA, ι) ; ALIGN-R(SA, ι)

b. Constraints on foot structure, defined in (18): FT-BIN; ALIGN-FT-L; PARSE-SYLL; FT-FORM=I

c. Syntax–prosody and prosody–syntax constraints referring to φ, defined in (24): ALIGN-L(DP/PP, φ); ALIGN-R(DP/PP, φ); ALIGN-L(φ, DP/PP); ALIGN-R(φ, DP/PP)

d. ALIGN-L(HD-PRWD, φ), defined in (25)

e. ALIGN-L(HD-φ, ι), defined in (27)

f. ALIGNTOPIC, defined in (29)

g. ALIGN-L(Spec,WP, ι), defined in (46)

h. WRAP-WP, defined in (47)

i. NORECURSION, defined in (48)

(54) a. FT-BIN ≫ ALIGN-FT-L ≫ PARSE-SYLL

b. ALIGN-L(Spec,WP, ι), WRAP-WP ≫ NORECURSION ≫ ALIGN-L(HVP, ι), ALIGN-L(HD-φ, ι)

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6. Conclusions

The mapping of ι onto syntactic constituents has long been a matter of debate, with most existing approaches assuming that there is a particular syntactic projection that the ι maps onto. This leads to wide variation in analyses, both between languages and between studies. The flexible ι-mapping hypothesis (Hamlaoui & Szendrői 2015, 2017) is an attempt to provide a unified, cross-linguistically valid analysis of ι-mapping by dispensing with the notion that ι corresponds to a specific syntactic projection and, instead, taking it to map onto the highest projection that hosts the verb/verbal material (HVP). This approach was originally developed for a set of languages that vary with respect to the structural height of the HVP: Hungarian and Bàsàá. To the best of our knowledge, the flexible ι-mapping hypothesis had not been tested on a range of constructions within a single language that vary with respect to verb height.

Iron Ossetic provides a unique testing ground of this sort, because, as we demonstrate, the HVP in this language varies between TP, NegP, WP, and FocP, depending on utterance type. Then, based on instrumental prosodic data, we show that the prediction of the flexible ι-mapping approach that the size of ι co-varies with the height of HVP is borne out in Iron Ossetic. This applies to the prosody of utterances that contain negative indefinites, narrow foci, and single wh-phrases. Given that these elements are housed in specifiers of different syntactic projections and attract the verb to the head of the projection they occupy, more rigid approaches to ι-formation, which equate ι-size to a particular XP, would not be able to account for the Iron Ossetic data. In turn, the Iron Ossetic facts provide support for the flexible ι-mapping approach.

This paper also demonstrated that the constraints governing flexible ι-mapping may be overridden by high-ranking language- and construction-specific constraints. In Iron Ossetic, these are Align-L(Spec,WP, ι) and Wrap-WP, which, together with NoRecursion, ensure the placement of the left ι-boundary at the left edge of each Spec,WP and penalise the insertion of the left ι-boundary at the left edge of the HVP. These constraints apply to the prosody of wh-questions, and their contribution becomes apparent in the more complex ones (multiple wh-questions and wh-questions that also include negative indefinites). The non-HVP-aligned ι-boundary in wh-questions carries a high initial boundary tone %H.

In sum, the current analysis of Iron Ossetic strengthens the case for the flexible ι-mapping approach. Further research will show whether it can be used to provide a unified account of some of the phenomena described in the literature, in which ι is taken to map onto a variety of different syntactic projections (i.e. CP or TP).

Competing interests. The authors declare none.

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Supplementary material. A complete list of sentences used as stimuli is provided in the online supplement to this article can be found at https://doi.org/10.1017/S0952675723000015.

References

Abaev, Vasilij I. (1924). Ob udarenii v osetinskom jazyke [On stress in the Ossetic language]. *Doklady Akademii Nauk, Serija B [Reports of the Academy of Sciences, Series B]*. 152–155.

Abaev, Vasilij I. (1939). *Iz osetinskogo èposa: 10 nartovskix skazanij [From Ossetian epos: 10 Nart legends]*. Leningrad: USSR Academy of Sciences.

Abaev, Vasilij I. (1949). *Osetinskij jazyk i fol'klor [Ossetic language and folklore]*, volume 1. Moscow: USSR Academy of Sciences.

Akan, Tamer & Katharina Hartmann (2019). SOV-X: syntactic and pragmatic constraints of the postverbal domain in Turkish. In Josef Bayer & Yvonne Viesel (eds.) *Proceedings of the workshop "Clause Typing and the Syntax-to-Discourse Relation in Head-Final Languages"*. Konstanz: Fachbereich Linguistik, Universität Konstanz, 123–144.

Arvaniti, Amalia, D. Robert Ladd & Ineke Mennen (2000). What is a starred tone? evidence from Greek. In Michael B. Broe & Janet B. Pierrehumbert (eds.) *Papers in laboratory phonology V: acquisition and the lexicon*. Cambridge: Cambridge University Press, 119–131.

Atterer, Michaela & D. Robert Ladd (2004). On the phonetics and phonology of "segmental anchoring" of F0: evidence from German. *JPh* **32**. 177–197.

Bagaev, Nikolaj K. (1965). *Sovremennyj osetinskij jazyk (fonetika i morfologija) [The contemporary Ossetic language (phonetics and morphology)]*, volume 1. Orjonikidze: North-Ossetian Publishing.

Barnes, Jonathan, Nanette Veilleux, Alejna Brugos & Stefanie Shattuck-Hufnagel (2012). Tonal center of gravity: a global approach to tonal implementation in a level-based intonational phonology. *Laboratory Phonology* **3**. 337–383.

Bennett, Ryan, Emily Elfner & James McCloskey (2016). Incorporation, focus and the phonology of ellipsis in Irish. Paper presented at the workshop 'Ellipsis Licensing beyond Syntax', Leiden University.

Bing, Janet (1979). *Aspects of English prosody*. PhD dissertation, University of Massachusetts, Amherst.

Boersma, Paul & David Weenink (2021). Praat: doing phonetics by computer. Computer program; published online at https://www.praat.org/.

Borise, Lena & David Erschler (2021). Verb height indeed determines prosodic phrasing: evidence from Iron Ossetic. *NELS* **51**. 65–74.

Borise, Lena & David Erschler (2022). Mora count and the alignment of rising pitch accents in Iron Ossetic. In Sónia Frota, Marisa Cruz & Marina Vigário (eds.) *Speech Prosody 2022*. Baixas: International Speech Communication Association, 871–875.

Bródy, Michael (1995). Focus and checking theory. In István Kenesei (ed.) *Approaches to Hungarian*, volume 5. Szeged: Jate, 29–44.

Bruce, Gösta (1977). *Swedish word accents in sentence perspective*. PhD dissertation, Lund University.

Butt, Miriam & Gillian Ramchand (2005). Complex aspectual structure in Hindi/Urdu. In Nomi Erteschik-Shir & Tova Rappaport (eds.) *The syntax of aspect*. Oxford: Oxford University Press, 117–153.

Cheng, Lisa & Laura J. Downing (2007). The prosody and syntax of Zulu relative clauses. *SOAS Papers in Linguistics* **15**. 51–63.

Cheng, Lisa & Laura J. Downing (2009). Where's the topic in Zulu? *The Linguistic Review* **26**. 207–238.

Cheng, Lisa & Nancy C. Kula (2006). Syntactic and phonological phrasing in Bemba relatives. *ZAS Papers in Linguistics* **43**. 31–54.

Chomsky, Noam (1994). Bare phrase structure. *MIT Occasional Papers in Linguistics* **5**.

Chomsky, Noam (1995). *The minimalist program*. Cambridge, MA: MIT Press.

Dilley, Laura C., D. Robert Ladd & Astrid Schepman (2005). Alignment of L and H in bitonal pitch accents: testing two hypotheses. *JPh* **33**. 115–119.

Dobashi, Yoshihito (2003). *Phonological phrasing and syntactic derivation*. PhD dissertation, Cornell University.

Downing, Bruce T. (1970). *Syntactic structure and phonological phrasing in English*. PhD dissertation, University of Texas at Austin.

Dzakhova, Veronika T. (2010). Ob osetinskom udarenii [On Ossetic stress]. *Vestnik Rossijskogo Gosudarstvennogo Gumanitarnogo Universiteta* **9**. 9–26.

É. Kiss, Katalin (1998). Identificational focus versus information focus. *Lg* **74**. 245–273.

Elfner, Emily (2011). The interaction of linearization and prosody: evidence from pronoun postposing in Irish. In Andrew Carnie (ed.) *Formal approaches to Celtic linguistics*. Newcastle upon Tyne: Cambridge Scholars Publishing, 17–40.

Elfner, Emily (2012). *Syntax–prosody interactions in Irish*. PhD dissertation, University of Massachusetts, Amherst.

Elfner, Emily (2015). Recursion in prosodic phrasing: evidence from Connemara Irish. *NLLT* **33**. 1169–1208.

Elfner, Emily (2018). The syntax–prosody interface: current theoretical approaches and outstanding questions. *Linguistics Vanguard* **4**. 1–14.

Elordieta, Gorka (2015). Recursive phonological phrasing in Basque. *Phonology* **32**. 49–78.

Embick, David & Rolf Noyer (2001). Movement operations after syntax. *LI* **32**. 555–595.

Emonds, Joseph E. (1970). *Root and structure-preserving transformations*. PhD dissertation, Massachusetts Institute of Technology.

Erschler, David (2012). From preverbal focus to preverbal "left periphery": the Ossetic clause architecture in areal and diachronic perspective. *Lingua* **122**. 673–699.

Erschler, David (2020). Iron Ossetic. In Maria Polinsky (ed.) *The Oxford handbook of languages of the Caucasus*. Oxford: Oxford University Press, 641–685.

Erschler, David & Vitaly Volk (2011). On negation, negative concord, and negative imperatives in Digor Ossetic. In Agnes Korn, Geoffrey Haig, Simin Karimi & Pollet Samvelian (eds.) *Topics in Iranian linguistics*, number 34 in Beiträge zur Iranistik. Wiesbaden: Reichert, 135–150.

Feldhausen, Ingo (2010). *Sentential form and prosodic structure of Catalan*. Amsterdam: Benjamins.

Folli, Raffaella, Heidi Harley & Simin Karimi (2005). Determinants of event type in Persian complex predicates. *Lingua* **115**. 1365–1401.

Frascarelli, Mara (2000). *The syntax–phonology interface in focus and topic constructions in Italian*. Number 50 in Studies in Natural Language and Linguistic Theory. Dordrecht: Springer.

Frota, Sónia (2000). *Prosody and focus in European Portuguese: phonological phrasing and intonation*. New York: Garland.

Genzel, Susanne, Shinichiro Ishihara & Balázs Surányi (2015). The prosodic expression of focus, contrast and givenness: a production study of Hungarian. *Lingua* **165**. 183–204.

Grice, Martine (1995). *The intonation of interrogation in Palermo Italian: implications for intonation theory*. Number 334 in Linguistische Arbeiten. Tübingen: Niemeyer.

Grice, Martine, Alexandra Vella & Anna Bruggeman (2019). Stress, pitch accent, and beyond: intonation in Maltese questions. *JPh* **76**. article 100913.

Gussenhoven, Carlos (1984). *On the grammar and semantics of sentence accents*. Dordrecht: Foris.

Gussenhoven, Carlos (2004). *The phonology of tone and intonation*. Cambridge: Cambridge University Press.

Gussenhoven, Carlos & A. C. M. Rietveld (1992). Intonation contours, prosodic structure and preboundary lengthening. *JPh* **20**. 283–303.

Gyuris, Beáta & Katalin Mády (2013). Approaching the prosody of Hungarian wh-exclamatives. In Peter Szigetvári (ed.) *VL1xx: papers in linguistics presented to László Varga on his 70th birthday*. Budapest: Tinta, 339–355.

Halle, Morris & Jean-Roger Vergnaud (1987). *An essay on stress*. Cambridge, MA: MIT Press.

Hamlaoui, Fatima & Kriszta Szendrői (2015). A flexible approach to the syntax–phonology mapping of intonational phrases. *Phonology* **32**. 79–110.

Hamlaoui, Fatima & Kriszta Szendrői (2017). The syntax–phonology mapping of intonational phrases in complex sentences: a flexible approach. *Glossa* **2**. article 55.

't Hart, Johan, René Collier & Antonie Cohen (1990). *A perceptual study of intonation: an experimental-phonetic approach to speech melody*. Cambridge: Cambridge University Press.

Hayes, Bruce (1980). *A metrical theory of stress rules*. PhD dissertation, Massachusetts Institute of Technology.

Henderson, Robert (2012). Morphological alternations at the intonational phrase edge. *NLLT* **30**. 741–787.

Horvath, Julia (1986). *FOCUS in the theory of grammar and the syntax of Hungarian*. Dordrecht: Foris.

Isaev, Magomet I. (1959). *Očerk fonetiki osetinskogo literaturnogo jazyka [Studies in the phonetics of the literary Ossetic language]*. Orjonikidze: North-Ossetian Publishing.

Isaev, Magomet I. (1966). *Digorskij dialekt osetinskogo jazyka [The Digor dialect of the Ossetic language]*. Moscow: Nauka.

Ishihara, Shinichiro (2003). *Intonation and interface conditions*. PhD dissertation, Massachusetts Institute of Technology.

Ito, Junko & Armin Mester (2012). Recursive prosodic phrasing in Japanese. In Toni Borowsky, Shigeto Kawahara, Mariko Sugahara & Takahito Shinya (eds.) *Prosody matters: essays in honor of Elisabeth Selkirk*. London: Equinox, 280–303.

Ito, Junko & Armin Mester (2013). Prosodic subcategories in japanese. *Lingua* **124**. 20–40.

Ito, Junko & Armin Mester (2021). Recursive prosody and the prosodic form of compounds. *Languages* **6**. article 65.

Kager, René (1989). *A metrical theory of stress and destressing in English*. Dordrecht: Foris.

Kálmán, László (1985). Word order in neutral sentences. In István Kenesei (ed.) *Approaches to Hungarian*, volume 1. Szeged: Jate, 13–23.

Kálmán, László (ed.) (2001). *Magyar leíro nyelvtan: mondattan I [Hungarian descriptive grammar: syntax I]*. Budapest: Tinta.

Kratzer, Angelika & Elisabeth Selkirk (2007). Phase theory and prosodic spellout: the case of verbs. *The Linguistic Review* **24**. 93–135.

Ladd, D. Robert (1989). Intonational phrasing: the case for recursive prosodic structure. *Phonology* **3**. 311–340.

Ladd, D. Robert (1996). *Intonational phonology*. Cambridge: Cambridge University Press.

Liberman, Mark Y. (1975). *The intonational system of English*. PhD dissertation, Massachusetts Institute of Technology.

Mády, Katalin, Beáta Gyuris & Ádám Szalontai (2013). Phrase-initial boundary tones in Hungarian interrogatives and exclamatives. In Piet Mertens & Anne Catherine Simon (eds.) *Proceedings of the Prosody–Discourse Interface Conference 2013 (IDP-2013)*. Leuven: KU Leuven, 69–73.

Mády, Katalin & Ádám Szalontai (2014). Where do questions begin? phrase-initial boundary tones in Hungarian polar questions. In *Speech prosody 2014*. Baixas: International Speech Communication Association, 568–572.

McCarthy, John J. & Alan Prince (1993). Generalized alignment. In Geert Booij & Jaap van Marle (eds.) *Yearbook of morphology 1993*. Dordrecht: Kluwer, 79–153.

Mycock, Louise (2010). Prominence in hungarian: the prosody–syntax connection. *Transactions of the Philological Society* **108**. 265–297.

Myrberg, Sara (2013). Sisterhood in prosodic branching. *Phonology* **30**. 73–124.

Nespor, Marina & Irene Vogel (1986). *Prosodic phonology*. Berlin: De Gruyter Mouton.

Nespor, Marina, Irene Vogel, Harry van der Hulst & Norval Smith (1982). Prosodic domains of external sandhi rules. In Harry van der Hulst & Norval Smith (eds.) *The structure of phonological representations (part I)*. Dordrecht: Foris, 225–256.

Pak, Marjorie (2008). *The postsyntactic derivation and its phonological effects*. PhD dissertation, University of Pennsylvania.

Peperkamp, Sharon Andrea (1997). *Prosodic words*. The Hague: Holland Academic Graphics.

Pesetsky, David (1987). Wh-in-situ: movement and unselective binding. In Eric Reuland & Alice ter Meulen (eds.) *The representation of (in)definiteness*. Cambridge, MA: MIT Press, 98–129.

Pesetsky, David (2000). *Phrasal movement and its kin*. Number 37 in LI Monographs. Cambridge, MA: MIT Press.

Pierrehumbert, Janet B. (1980). *The phonetics and phonology of English intonation*. PhD dissertation, Massachusetts Institute of Technology.

Potts, Christopher (2005). *The logic of conventional implicatures*. Oxford: Oxford University Press.

Prince, Alan (1980). A metrical theory for Estonian quantity. *LI* **11**. 511–562.

Prince, Alan & Paul Smolensky (1993). Optimality Theory: constraint interaction in generative grammar. Technical Report 2, Rutgers University Center for Cognitive Science.

Rice, Keren D. (1987). On defining the intonational phrase: evidence from Slave. *Phonology* **4**. 37–59.

Rizzi, Luigi (1997). The fine structure of the left periphery. In Liliane Haegeman (ed.) *Elements of grammar: handbook in generative syntax*. Dordrecht: Kluwer, 281–337.

Selkirk, Elisabeth (1978). On prosodic structure and its relation to syntactic structure. In Thorstein Fretheim (ed.) *Nordic prosody*, volume 2. Trondheim: TAPIR, 111–140.

Selkirk, Elisabeth (1984). *Phonology and syntax: the relation between sound and structure*. Cambridge, MA: MIT Press.

Selkirk, Elisabeth (1986). On derived domains in sentence phonology. *Phonology* **3**. 371–405.

Selkirk, Elisabeth (2005). Comments on intonational phrasing in English. In Sonia Frota, Marina Cláudia Vigário & Maria João Freitas (eds.) *Prosodies: with special reference to Iberian*. Berlin: Mouton de Gruyter, 11–58.

Selkirk, Elisabeth (2009). On clause and intonational phrase in Japanese: the syntactic grounding of prosodic constituent structure. *Gengo Kenkyu* **136**. 35–73.

Selkirk, Elisabeth (2011). The syntax–phonology interface. In John Goldsmith, Jason Riggle & Alan C. L. Yu (eds.) *The handbook of phonological theory*, 2nd edition. Chichester: Wiley-Blackwell, 435–483.

Shattuck-Hufnagel, Stefanie & Alice E. Turk (1996). A prosody tutorial for investigators of auditory sentence processing. *Journal of Psycholinguistic Research* **25**. 193–247.

Sheehan, Michelle, Theresa Biberauer, Ian Roberts & Anders Holmberg (2017). *The final-over-final condition: a syntactic universal*. Number 76 in LI Monographs. Cambridge, MA: MIT Press.

Surányi, Balázs, Shinichiro Ishihara & Fabian Schuboe (2012). Syntax–prosody mapping, topic–comment structure and stress–focus correspondence in Hungarian. In Gorka Elordieta & Pilar Prieto (eds.) *Prosody and meaning*. Berlin: Mouton de Gruyter, 35–72.

Szendrői, Kriszta (2001). *Focus and the syntax–phonology interface*. PhD dissertation, University College London.

Szendrői, Kriszta (2003). A stress-based approach to the syntax of Hungarian focus. *The Linguistic Review* **20**. 37–78.

Testen, David (1997). Ossetic phonology. In Alan S. Kaye & Peter T. Daniels (eds.) *Phonologies of Asia and Africa (including the Caucasus)*, volume 2. Winona Lake, IN: Eisenbrauns, 707–731.

Truckenbrodt, Hubert (1995). *Phonological phrases: their relation to syntax, focus, and prominence*. PhD dissertation, Massachusetts Institute of Technology.

Truckenbrodt, Hubert (1999). On the relation between syntactic phrases and phonological phrases. *LI* **30**. 219–255.

Truckenbrodt, Hubert (2005). A short report on intonation phrase boundaries in German. *Linguistische Berichte* **203**. 273–296.

Truckenbrodt, Hubert (2007). The syntax–phonology interface. In Paul de Lacy (ed.) *The Cambridge handbook of phonology*. Cambridge: Cambridge University Press, 435–456.

Truckenbrodt, Hubert (2015). Intonation phrases and speech acts. In Malies Kluck, Dennis Ott & Mark de Vries (eds.) *Parenthesis and ellipsis: cross-linguistic and theoretical perspectives*. Berlin: De Gruyter Mouton, 301–349.

Vigário, Marina (2003). Prosody and sentence disambiguation in European Portuguese. *Catalan Journal of Linguistics* **2**. 249–278.

Xu, Yi (2013). ProsodyPro: a tool for large-scale systematic prosody analysis. In Brigitte Bigi & Daniel Hirst (eds.) *Proceedings of Tools and Resources for the Analysis of Speech Prosody (TRASP 2013)*. Aix-en-Provence: Laboratoire Parole et Langage, 7–10.

Zerbian, Sabine (2006). *Expression of information structure in the Bantu language Northern Sotho*. PhD dissertation, Humboldt Universität zu Berlin.

Zerbian, Sabine (2007). Phonological phrasing in Northern Sotho (Bantu). *The Linguistic Review* **24**. 233–262.