

Focus and intonation in Georgian

Constituent structure and prosodic realization

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Abstract

It has been claimed – at least for some languages – that focus is phonologically implemented through prosodic prominence. This article presents an account of the prosodic realization of Georgian utterances that shows that focus does not have a 1-to-1 relationship with prosodic prominence. Georgian displays a number of prosodic events reflecting properties of the constituent structure. Information structural concepts such as focus and givenness do not add or delete pitch accents to signal prosodic prominence, but rather influence the choice of particular word orders, which themselves influence the formation of prosodic phrases and concomitant tonal contours. We propose that Georgian belongs to the group of ‘phrase languages’ that primarily use phrasing as a correlate of information structure. These languages add or delete phrase boundaries at the edges of constituents in order to signal information structure. The resulting phrases can but do not have to be associated with tonal prominence, like pitch accents.

Keywords

Georgian intonation, prosody-syntax mapping, focus prominence, focus phrasing, V-final languages

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1. Preliminaries

The insight that the focus of the utterance is associated with prosodic prominence has a long tradition in linguistics. Hermann Paul (1880, §86, §88) already wrote that in German the “strength of the accent” is the typical way to mark the psychological predicate as the most important part or as the new contribution of the utterance. In recent years, numerous studies on the world’s languages have reported effects of focus on several phonetic measures such as the pitch, duration, and intensity of the focused constituent. These studies have led to the assumption of a cross-linguistic axiom that establishes a strict one-to-one relationship between focus and prosodic prominence, as stated for instance by Jackendoff (1972), see (1a), and Truckenbrodt (1995), see (1b), and defended by Büring (2010), among others.

(1) Focus as prosodic prominence

- a. “If a phrase P is chosen as the focus of a sentence S, the highest stress in S will be on the syllable of P that is assigned highest stress by the regular stress rules.” (Jackendoff 1972: 237)
- b. “Focus: If F is a focus and DO is its domain, then the highest prominence in DO will be within F.” (Truckenbrodt 1995: 121)

The axioms in (1) require prominence as a correlate of focus, which goes implicitly or explicitly together with non-prominence of the given material. In this view, alignment of the focus constituent with the edge of a prosodic or syntactic constituent reflects prominence. There are two crucial limitations to this assumption. First, the straightforward reading of the focus-to-prominence association in (1) implies an operation licensing a local indicator of prominence (e.g., a pitch accent with the feature [+prominent]) on the element in focus that is associated with a constituent independently of its syntactic properties. However, current studies show that at least a substantial part of the phenomena relating to focus prominence may be deduced from principles of greater generality that establish the mapping of prosodic phrases on syntactic constituents and language-dependent generalizations about the prominence asymmetries within prosodic domains (Selkirk 1984, Cinque 1993, Zubizarreta 1998, Reinhart 2006, among others). The implication of these accounts is that, even if the correlation between focus and prosodic prominence empirically holds true in a given language, it does not necessarily imply that these two concepts are directly mapped in the grammar; the same phenomenon may be the product of a more complex architecture in which the correlation between discourse features and prosodic realization is mediated by syntax.

The second limitation comes from an empirical perspective: the assumption of a focus-to-prominence correspondence is not universally valid. Studies on the focus realization in different languages reveal a major division between languages such as German or Greek, which use local indicators of focus prominence, i.e., pitch accents associated with prominent lexical syllables, and languages such as Hindi (Patil *et al.* 2008, Féry 2010), Turkish (Kamali 2011, Güneş 2012), Korean (Jun 1998) or West Greenlandic (Arnhold 2014), in which focus correlates with tonal events reflecting the prosodic phrasing of the utterance. This typology interacts with a crucial property at the level of metrical phonology: languages that do not have word stress at the lexical level (without excluding the possibility of postlexical stress), like French or Korean, are more

likely to appear in the latter type, since they lack a lexically determined host for pitch accents. Languages with weakly implemented lexical stress, such as is the case in Turkish, Hindi, and as we argue below Georgian, are also good candidates for this new typological category of languages.

The present study is devoted to Georgian and it contributes to the general discussion on the prosodic typology by means of an empirical investigation of the phonetic correlates of focus. It provides an account that integrates these findings into current assumptions about prosodic constituency and its mapping to syntax. Georgian intonation has already been the subject of several empirical studies (Alkhazishvili 1959, Tevdoradze 1978, Kiziria 1987, Bush 1999, Müller 2007, Skopeteas, Féry, and Asatiani 2009, Vicens and Jun 2014, Skopeteas and Féry 2010, 2014, and Féry, Skopeteas, and Hörnig 2010). These studies make clear that Georgian intonation varies along with the context; in particular, it is sensitive to information structure. There are at least two conflicting views about the analysis of focus-related tonal events, which correspond to the typological categories just introduced. Some authors assume that focus in Georgian is reflected in pitch accents (Vicens and Jun 2014), while others propose that the primary factor is prosodic phrasing and that many tonal movements are best analyzed in terms of their relation with prosodic constituents (Skopeteas, Féry, and Asatiani 2009, Skopeteas and Féry 2010). In the latter account, focus is not always expressed by a change in tonal implementation, but only in those cases in which prosodic phrasing is changed as well. The difference between the two analyses is not just a superficial one. It reflects a difference in the role of tonal events in the intonation of languages. In a non-tonal language like Georgian, tonal excursions can result from the effect of pitch accents related to lexical stress, like in English or German, see the axioms in (1), or they can originate from differences in phrasing. We subscribe in this paper to an alternative view of the relation between focus and prosody. Focus is preferably aligned with a prosodic constituent, and prominence may or may not accompany alignment. In this view, a focus is usually phrased more clearly. This is a consequence of the more general need for constituents that carry information structural roles to be ‘packaged’ individually, as was already observed by Chafe (1976). In this case, pitch excursions do not indicate prosodic prominence but integration (or not) into particular prosodic domains. The first hypothesis is called the ‘focus-as-prominence hypothesis,’ and the second one the ‘focus-as-phrasing hypothesis.’

The article is structured as follows. Section 2 introduces the background assumptions that motivate our hypotheses about Georgian prosody. Section 3 presents the method for collecting the data examined in this article. Based on this data, Section 4 introduces the basic intonational patterns in all-new contexts and establishes a baseline for the interpretation of the effects of information structure in the subsequent sections. Section 5 examines the local effects of focus and examines correlates of focus that could enforce the ‘focus-as-prominence hypothesis.’ Section 6 presents the effects attributed to phrasing, and in doing so assesses the ‘focus-as-phrasing hypothesis.’ The final section concludes.

2. Background and hypotheses

Two major issues are particularly relevant in the study of Georgian prosodic structure. Georgian is a V-final language, which motivates expectations about the mapping of prosody onto syntactic constituents (Section 2.1). Second, Georgian is a language with weakly implemented stress at the lexical level, which motivates expectations about the role of pitch accents at the prosodic level (Section 2.2).

2.1. V-final syntax and prosodic constituency

Since prosodic constituency reflects the syntactic structure of the utterance (Selkirk 1984, Gussenhoven 1984, 1992, Truckenbrodt 1995, 2007), assumptions about the constituent structure are required for any statement about prosodic phrasing. Georgian is a language with flexible word order. All permutations of the three basic constituents, verb, subject, and object, are grammatical and can be selected in appropriate contexts. In all-new contexts, SOV alternates with SVO (Harris 1981: 22, Anderson 1984, Hewitt 1995: 528). A close inspection of the syntactic properties of SOV and SVO shows that the basic word order in this language is V-final (Harris 1981, Skopeteas and Fanselow 2009, 2010). Thus, the crucial typological question concerns what our expectations are about prosodic phrasing in V-final languages of this type.

The language type of interest is V-final languages that allow the verb to appear in a non-final position under particular contextual conditions. It has been observed for these languages that postverbal material is frequently separated by an intonational boundary. In Papago, utterances with non-final verbs display a tonal pattern indicating a boundary at the right edge of the verb (Hale and Selkirk 1987: 161). In Chikasaw, only the first argument and the verb are phrased together, both in SVO and OVS (Gordon 2005: 306); in Modern Farsi, postverbal material is prosodically separated from the verb (Mahjani 2003: 53); in Turkish, the right edge of the verb is associated with a low boundary tone in both V-final and non-V-final orders (Özge and Bozsahin 2010: 148).¹ Some facts reported for Old Georgian are historically relevant for our study: punctuation in 11th century manuscripts indicates that scribes consistently prescribed a comma-intonation at the right edge of non-final verbs (Boeder 1991). These findings lead to the generalization in (2) about the prosodic constituency of non-V-final orders in V-final languages: the verb generally forms a prosodic phrase with the immediately preceding argument.

- (2) a. (S) (OV)
 b. (SV) (O)

We assume that the prosodic constituents in (3) reflect the prosody-syntax mapping in V-final languages. The prosodic constituent that comprises the core layer of the clause is aligned with the right edge of the final verb in SOV and with the right edge of the non-final verb in SVO. We assume that the basic order of V-final languages involves an object and a verb within the verb phrase and a subject surfacing in a higher position; see (3a). The crucial issue is that postverbal objects in these languages are adjoined to a position outside the VP (the different accounts with respect to the operation involved are irrelevant for our claim, which only relates to the bracketing and not to the labeling of this construction); see (3b).

- (3) a. [S [[O] V]]
 b. [[S [V]] O]

The prosody-syntax mapping is determined by matching constraints (Selkirk 2011) predicting that syntactic categories are mapped by prosodic categories. We assume three layers of prosodic constituency (Nespor and Vogel 1986, Selkirk 1984, Gussenhoven 1984): individual words are mapped to Prosodic Words (ω), lexical projections to Prosodic Phrases (φ), and root clauses to Intonational Phrases (ι). The constraints in (4) indicate how these prosodic constituents are mapped on syntactic constituents.

¹ But see the discussion in Kan (2009: 104ff.) and Günes (2012).

(4) Match theory of syntactic-prosodic constituency correspondence (Selkirk 2011)

a. MATCH CLAUSE

A clause in syntactic constituent structure must be matched by a corresponding prosodic constituent, call it ι , in phonological representation.

b. MATCH PHRASE

A phrase in syntactic constituent structure must be matched by a corresponding prosodic constituent, call it φ , in phonological representation.

c. MATCH WORD

A word in syntactic constituent structure must be matched by a corresponding prosodic constituent, call it ω , in phonological representation.

The size of the Prosodic Phrases is determined by two additional constraints, the first one reducing the number of φ -phrases, and the second one reducing their size. The constraint NOPHRASE is a markedness constraint penalizing the creation of unnecessary prosodic constituents; see (5a) (Féry and Samek-Lodovici 2006, Féry 2011). The constraint MAXBIN restricts the size of embedded prosodic constituents to two: a prosodic constituent maximally contains two embedded subconstituents.

(5) a. NOPHRASE

Avoid the proliferation of prosodic domains.

b. MAXBIN

π_n -phrases consist of maximally two π_{n-1} -phrases.

c. Assumed ranking

MAXBIN >> NOPHRASE >> MATCH

These constraints apply uniformly at all levels of prosodic constituency. The relevant layer for our purposes is the Prosodic Phrase. In the following tableaux, we examine the role of the constraints at this level, i.e., NOPHRASE- φ , MAXBIN- φ and MATCH- φ . The formation of three phrases is dispreferred, which implies the constraint ranking NOPHRASE >> MATCH. A realization of the entire clause in a single constituent is banned by the ranking MAXBIN >> NOPHRASE (cf. Truckenbrodt 2007: 453). Applying these constraints and their rankings to constituent structures of SOV/SVO in V-final languages predicts the candidates in (2).

Tableau 1. SOV order

[S [[O] V]]	MAXBIN	NOPHRASE	MATCH
((S O V) φ) ι	*!	*	*
\curvearrowright ((S) φ (O V) φ) ι		**	
((S O) φ (V) φ) ι		**	*!
((S) φ (O) φ (V) φ) ι		***!	

Tableau 2. SVO order in V-final constituent structure

[[S[V]]O]	MAXBIN	NOPHRASE	MATCH
((SVO) _φ) _t	*!	*	*
((S) _φ (VO) _φ) _t		**	*!
☞ ((SV) _φ (O) _φ) _t		**	
((S) _φ (V) _φ (O) _φ) _t		***!	

The constituent structure of the input in Tableau 2 is not the only possibility for obtaining non-V-final orders in V-final languages. Along with the possibility of extraposing the verb to the right, a subset of V-final languages has an operation of fronting the verb (Haider and Rosengren 2003). It has been shown that Georgian has an operation of V-fronting that is optional and does not require a contextual trigger (Skopeteas and Fanselow 2010). The constraints introduced so far predict that the constituent structure of SVO in V-final languages with V-fronting will be mapped onto Prosodic Phrases in the pattern that is known for SVO languages, i.e., ((S)_φ(VO)_φ)_t; see for instance prosodic phrasing in German main clauses (Féry 2011). The difference between this tableau and the preceding one is located in the input and in the effect of MATCH.

Tableau 3. SVO order in V-final constituent structure with V-fronting

[S[V[O]]]	MAXBIN	NOPHRASE	MATCH
((SVO) _φ) _t	*!	*	*
☞ ((S) _φ (VO) _φ) _t		**	
((SV) _φ (O) _φ) _t		**	*!
((S) _φ (V) _φ (O) _φ) _t		***!	

In sum, the OT model accounts for the facts reported for V-final languages. Based on the syntactic facts for Georgian, we meet the expectations summarized in (6).

(6) Prosody-syntax mapping in Georgian

- a. Orders with a final V: The verb is expected to be integrated into the Prosodic Phrase encompassing the VP, i.e., ((S)_φ(OV)_φ)_t.
- b. Orders with a non-final V: The structural possibilities of Georgian predict two prosodic options, i.e., ((SV)_φ(O)_φ)_t or ((S)_φ(VO)_φ)_t.

2.2. Focus-as-prominence vs. focus-as-phrasing

The straightforward implication of the assumption of a pitch accent is that the head X of the accent phonetically aligns with the stressed syllable, resulting thus in a (Y+)X*(+Z) accentual pattern involving an optional leading tone Y, a starred tone X* and an optional trailing tone (Pierrehumbert 1980, Grice 1995, Arvaniti, Ladd, and Mennen 2006). Phonological association is reflected in phonetic alignment, which constitutes a starting point for establishing the existence of a pitch accent – without excluding the possibility of secondary association of pitch accents with non-starred syllables (Ladd 1983, Prieto, D’Imperio, and Gili Fivela 2005). The question is whether there are pitch events induced by focus in Georgian that reflect an association of tonal targets with particular parts of the stressed syllable. It has been claimed that Georgian focus is expressed with a high pitch accent, either H* or bitonal L+H* (Jun, Vicenik, and Lofstedt 2008: 52). We call this analysis the ‘focus-as-prominence hypothesis’; see (7a). It

makes clear predictions about the pitch realization when focus is involved. The alternative view is that focus is reflected in the prosodic phrasing. Prosodic constituents in Georgian are realized with a default rising contour, $L_{\phi}H_{\phi}$. The delimitation of prosodic constituents by means of these contours is the product of the interaction between constituent structure and the focus domain. We call this analysis the ‘focus-as-phrasing hypothesis’; see (7b).

(7) Focus effects on prosody in Georgian

a. Focus-as-prominence hypothesis

Focus is expressed with a high pitch accent in Georgian (H^* or $L+H^*$).

b. Focus-as-phrasing hypothesis

Focus is expressed by delimiting the focus phrase from the rest of the clause by means of phrasal accents in Georgian (L_{ϕ} and H_{ϕ}).

As already introduced in Section 1, the prosodic typology at the word level allows for predictions about the prosodic typology at the sentence level. Lexical stress is weakly implemented in Georgian phonology. It is neither distinctive nor culminative (polysyllabic words are reported to have more than one stressed syllable). Although there is no general consensus in the literature as to the position of the stress in a word, the following rules of thumb are proposed by textbooks: (a) in bi- and trisyllabic words stress is initial, (b) in polysyllabic words, primary stress falls on the antepenultimate and secondary stress on the initial syllable (Robins and Waterson 1952, Aronson 1990: 18). Phonological descriptions of Georgian point out that these generalizations are only tentative. First, the phonetic cues for prominence asymmetries are weak and do not always lead to unambiguous intuitions regarding prominence contrasts at the word level. There are no substantial effects on weight (Zhgenti 1963) or on vowel quality (Aronson 1990: 18); the main correlates of the alleged stress in Georgian relate to typical melodic patterns (Zhgenti 1963; see correlates with pitch in Robins and Waterson 1952). Moreover, the realization in discourse is also influenced by the phonological environment, which includes enclitics, proclitics, and function words (see Butskhrikidze 2002: 40 about the role of morphology). These facts strongly indicate that the phonetic realization of stress is postlexical in Georgian (cf. the conclusion by Zhgenti 1963 that stress placement refers to the “rhythmical group”).

The weak implementation of stress at the word level motivates the prediction that sentential intonation will follow the pattern of languages in which focus is reflected in phrasing rather than in pitch accents. The empirical data reported in this article largely confirms this prediction. We show that there is no empirical evidence substantiating the concept of prominent pitch excursion in focused constituents. Rather the effects of focus are found in correlates of phrasing on adjacent constituents. Thus, Georgian is not a conventional intonation language like English or German. It has elements of a ‘phrase language,’ a category of intonation used to characterise languages which rely on phrasal and boundary tones rather than on pitch accents associated with lexical stress for their tonal contours.

3. Method

The aim of the study reported on in this section is to create a dataset for the examination of hypotheses relating to the impact of focus on the prosodic realization of the utterance. The empirical basis consists of minimal pairs of word orders and information structural interpretations (same order in different contexts). In particular, we examined word order permutations of a transitive verb and two noun phrases (subject, object) in the context of several questions; see Section 3.1. Section 3.2 outlines the elicitation procedure and illustrates the experimental material.

3.1. Conditions

The empirical study was designed to explore the possible permutations of word order options of sentences with a verb (V), a subject (S), and an object (O) with different information structural configurations. The factor ORDER involves four of six possible permutations of three basic constituents, verb (V), subject (S), and object (O).² The factor CONTEXT contains the possible options of narrow focus (on the V, the S, and the O), as well as the possible broad focus domains corresponding to XPs (i.e., VP-focus and all-focus).

- (8) a. Factor ORDER (4 levels): {SOV, SVO, OSV, OVS}
 b. Factor CONTEXT (5 levels): {all_F, VP_F, V_F, S_F, O_F}

Full permutation of the factors in (8) results in $4 \times 5 = 20$ cells. Not all permutations are felicitous though, as indicated in Table 1. A robust generalization in the study of Georgian syntax is that preverbal focus must be adjacent to the verb (Alkhazishvili 1959, Harris 1981: 14, 1993: 1385, Kvačadze 1996: 250, McGinnis 1997: 8, Bush and Tevdoradze 1999, Asatiani 2007, Skopeteas, Féry, and Asatiani 2009, Skopeteas and Fanselow 2010). This excludes S_FOV and O_FSV. OS orders are possible but contextually restricted, since the object constituent requires a trigger to scramble over the subject. The OSV order can only occur in contexts involving a narrowly focused subject and an object topic (McGinnis 1997: 8, Skopeteas and Fanselow 2010). The OVS order may be an option for expressing focus either on the O or on the entire VP, with a postverbal backgrounded subject in both cases. A further possibility for this order is a given VP and a focus on the final subject. The experimental conditions are restricted to the thirteen ORDER/CONTEXT permutations that are felicitous in this language; see Table 1.

Table 1. Felicitous CONTEXT×ORDER permutations in Georgian

	order	SOV	SVO	OSV	OVS
context					
all _F		[SOV] _F	[SVO] _F	–	–
VP _F		S[OV] _F	S[VO] _F	–	[OV] _F S
S _F		–	S _F VO	OS _F V	OVS _F
V _F		SOV _F	SV _F O	–	–
O _F		SO _F V	SVO _F	–	O _F VS

3.2. Material

A set of question/answer pairs was created for each cell in Table 1 and recorded with native speakers. The questions manipulated the focus domain of the answers, hence creating the contextual environments for the levels of CONTEXT; see (9). The answers instantiated the levels of ORDER; see (10).

(9) Questions

a. All-focus

ra *xd-eb-a?*
 what(NOM) happen-THM-PRS.S.3.SG

‘What is happening?’

b. VP-focus

² V-initial orders (VSO or VOS) are possible but rare in discourse and are restricted to discourse-initial sentences (Vogt 1971, Apridonidze 1986: 86, Boeder 2005: 64, Tuite 1998: 41–42).

ra ismis nino-s-gan?
 what(NOM) hear:3.SG Nino-GEN-from

‘What do we hear about Nino?’

c. Subject focus

mama-s vin e-loliav-eb-a?
 father-DAT who(NOM) PR-care-THM-AOR.3.SG

‘Who cares about the father?’

d. Object focus

Nino vi-s e-loliav-eb-a?
 Nino(NOM) who-DAT PR-care-THM-AOR.3.SG

‘About whom does Nino care?’

e. Verb focus

ra-s u-k'et-eb-s nino mama-s?
 what-DAT SV-do-THM-S.3.SG Nino(NOM) father-DAT

‘What did Nino do to the father?’

(10) Answers

a. SOV: *nino mama-s e-loliav-eb-a.*
 Nino(NOM) father-DAT PR-(IO.3.SG)care-THM-AOR.S.3.SG

‘Nino cares about the father.’

b. SVO: *nino e-loliav-eb-a mama-s.*
 Nino(NOM) PR-(IO.3.SG)care-THM-AOR.S.3.SG father-DAT

The nine question-answer permutations in Table 1 were implemented in four item sentences. Each item contained a simple configuration of a verb and two nouns – in nominative (for the subject) and in dative (for the direct object). The lexical material of the items was chosen in order to allow convenient pitch track analyses. To this end, we selected words with voiced consonants. The number of syllables of the nouns was controlled (2 syllables), but the number of syllables of the verbs varied due to lexical limitations of verbs that fulfill the syntactic requirement of subcategorizing for two animate arguments while at the same time satisfying the phonological requirement of having voiced consonants. The verbs were *e.ma.le.ba* and *em.du.re.ba* with four syllables, *e.mu.da.re.ba* with five syllables, and *e.lo.li.a.ve.ba* with six syllables.

(11) Items

a. item 1

nino mama-s e-loliav-eb-a.
 Nino(NOM) father-DAT PR-(IO.3.SG)care-THM-AOR.S.3.SG

‘Nino cared about the father.’

b. item 2

lela deda-s e-mdur-eb-a.
 Lela(NOM) mother-DAT PR-(IO.3.SG)be.annoyed-THM-AOR.S.3.SG

‘Lela was annoyed with the mother.’

c. item 3

nana gogo-s e-mal-eb-a.
 Nana(NOM) girl-DAT PR-(IO.3.SG)hide.from-THM-AOR.S.3.SG

‘Nana hid herself from the girl.’

d. item 4

nona bebo-s e-mudar-eb-a.
 Nona(NOM) grandmother-DAT PR-(IO.3.SG)beg-THM-AOR.S.3.SG

‘Nona begged the grandmother.’

In order to check hypotheses relating to pitch accents, we adopt largely accepted assumptions about word stress (Section 2.2) according to which the canonical stress position for the bisyllabic nouns is the first syllable (i.e., *nino*, *mamas*, *léla*, *dédas*, *nána*, *gógos*, *nóna*, and *bébos*). Furthermore, the verbs bear secondary stress on the first syllable and primary stress on the antepenultima (i.e., *èloliáveba*, *èmdúreba*, *emáleba*, and *èmudáreba*).

3.3. Recording

The target answers were presented one by one to the consultants in Georgian orthography on a computer screen. The consultants were instructed to memorise the sentences in order to use them as answers to questions (we used this procedure in order to eliminate effects of reading on intonation). An experimental instructor and native speaker provided the appropriate questions and the consultant uttered the answers as naturally as possible. Consultants were free to repeat the target sentences whenever they were not satisfied with their performance. Distractors were used in a proportion of 1:1 and involved a task that required substantial concentration in order to prevent a monotonous reading of the prompts.

Eight native speakers (all female, age range: 21–27, average: 23.5) participated in the experiment, which took place in Berlin. All speakers had grown up in Georgia and had left the country within the last 0.5 to 3 years before the recordings. They were presented with the 13 conditions in all 4 items twice (in pseudo-randomized order), i.e., each participant uttered $13 \text{ (conditions)} \times 4 \text{ (items)} \times 2 \text{ (tokens)} = 104$ utterances. The result is a corpus of $104 \text{ (utterances)} \times 8 \text{ (speakers)} = 832$ utterances in total, containing 64 tokens for each experimental condition.

The utterances were recorded on a digital audio tape recorder and converted into 16-bit mono WAV files at a sampling frequency of 22 050 Hz. Duration, F_0 -maximum, alignment of the F_0 -maximum within the time window of the syllable, and F_0 -means for five equal intervals were extracted for each syllable by means of a Praat script (Boersma & Weenink 1992–2013) written by the first author. Acoustic and visual inspection of the F_0 -contours was done by both authors.

4. Baseline: All-new contexts

This section examines the prosodic realizations in the all-new condition that served as a baseline. We outline the prosodic properties of our data in Section 4.1 and discuss the implications of these findings for prosodic constituency in Section 4.2.

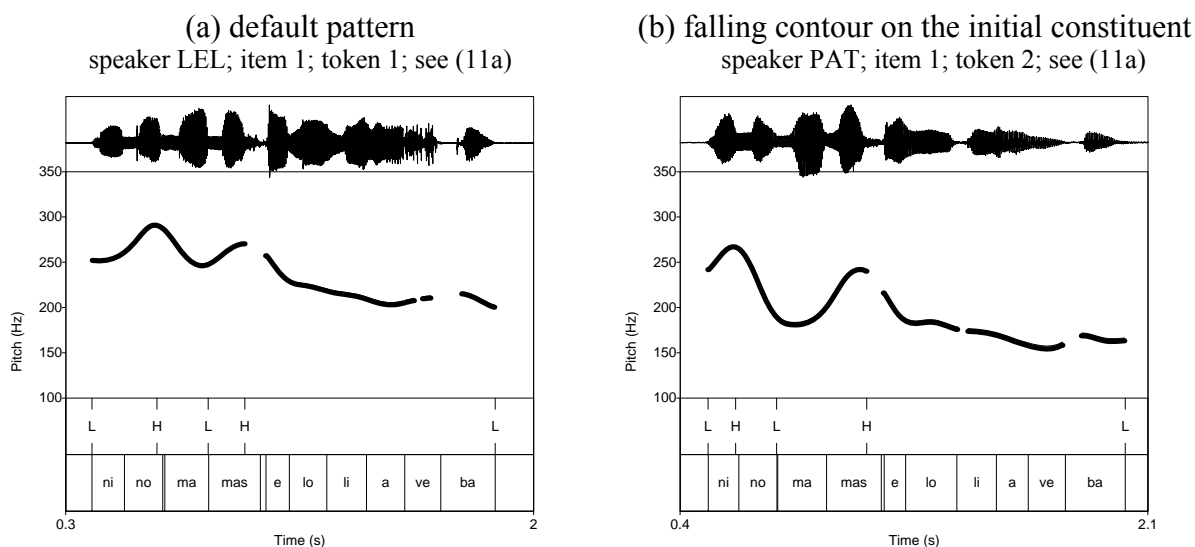
4.1. Prosodic realization

All SOV utterances in all-new contexts have an overall falling contour that we take to be the normal/default pattern for declarative sentences; see Figure 1a (Pierrehumbert 1980, Gussenhoven 2004, and Ladd 1996/2008 for English and other languages; see also Alkhazishvili 1959, Tevdoradze 1978, Zhgenti 1963, and Kiziria 1987: 134, who report that the melodic structure of declaratives in Georgian is falling). The contour on the object is almost always downstepped relative to the contour on the subject, i.e., the F_0 -maximum of the object

contour has a lower pitch level (Lieberman and Pierrehumbert 1984, Beckman and Pierrehumbert 1986, Ladd 1986 and many others). Hence, the default pattern of Georgian declaratives is a sequence of word-level rising contours targeting gradually downstepped H-targets that are associated with the right edge of prosodic constituents (Jun, Vicens, and Lofstedt 2008: 44, Skopeteas, Féry, and Asatiani 2009: 112). The final constituent (verb) always has an overall falling contour; see Figures 1a and 1b. The tonal targets in the tonal layer indicate the salient maxima (H-targets) and minima (L-targets) of the pitch contour – ignoring microvariations that presumably depend on phenomena outside the scope of this article. Our assumptions about the phonologically determined targets that underlie these pitch realizations are discussed in the proposed analysis; see Section 4.2.

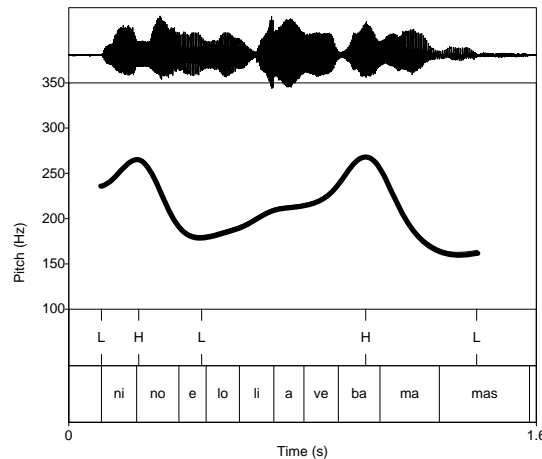
Variation occurs in the realization of the initial constituent, in which we encountered two alternative prosodic patterns; compare Figure 1a and Figure 1b. In the most frequent pattern (see frequencies in Appendix I), the initial constituent is realized with a ‘rising’ contour that reaches the F_0 -maximum (coded as an H-target in the tonal layer) within the second half of the second syllable; Figure 1a. In the second pattern, the pitch contour starts with a rise that reaches the F_0 -maximum (first H-target in the tonal layer) early, near the boundary between the two syllables, as illustrated in Figure 1b, and continues with a falling contour that reaches the F_0 -minimum (coded as an L-target) in the second syllable of the initial constituent or in the first syllable of the object. In the following, we refer to this tonal pattern as a ‘falling’ contour on the initial constituent.

Figure 1. *Canonical order in all-new contexts*



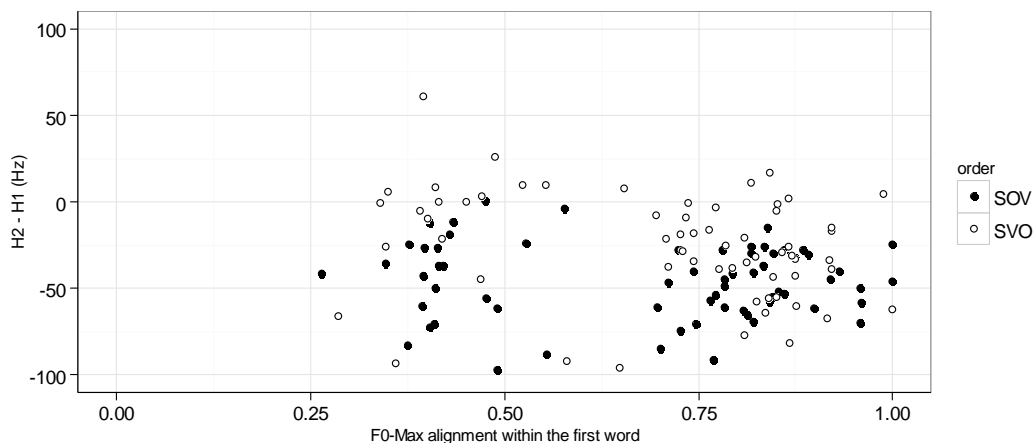
The main properties of the default pattern also appear in SVO utterances. The subject constituent varies between a rising and a falling realization, the medial verb consistently has a rising contour, and the final constituent (object) is generally falling towards a low target at the end of the utterance. However, a subset of the SVO utterances shows a different intonational property. The H-target aligned with the right edge of the verb lacks the downstep pattern described above: it is reset, which means that it reaches a comparably high pitch level to that of the initial constituent, as illustrated in Figure 2. That is to say, the default pattern of Georgian declaratives as ‘a sequence of rising contours targeting gradually downstepped H-targets’ is not necessarily the case if the verb appears in a medial position.

Figure 2. *Reset H-target of the verb contour in [SVO]_F*
 speaker PAT; item 1; token 2; see (11a)



These examples introduce two crucial prosodic properties: (a) the H-target of the initial constituent may display early or late alignment within the last syllable (compare Figure 1a with Figures 1b and 2); (b) the H-target that appears at the right edge of the medial constituent can either be downstepped (Figure 1) or reset (Figure 2). The influence of word order on these properties can be observed in Figure 3. The *y*-axis displays the difference in Hz between the second H-target and the first one (H2-H1): a negative value indicates downstep, a value around zero or higher indicates that the pitch level of the first H-target is sustained. The distribution of the data reveals that this pattern appears more frequently in the SVO order. The *x*-axis plots the *F*₀-maximum (*F*₀-max) alignment within the final syllable of the initial constituent (*t* of *F*₀-max from the left edge of the syllable/duration of the syllable). Early alignment implies a falling contour within the last syllable while late alignment implies a rising contour. The measurements in the all-new contexts reveal a bimodal distribution. An inspection of the entire dataset confirms that the alignment measurements of the H-target are clustered around two centers (around the time points .38 and .82; see Appendix I). For this reason, we will deal with this measure as a discrete variable with two values (the ‘falling contour’ corresponding to early *F*₀-max alignment vs. the ‘rising contour’ corresponding to late *F*₀-max alignment). Figure 3 indicates that both types of contour appear with both orders, but also that a falling contour is rare with an SVO order with downstep on the second H-target. Our hypotheses about the phonological entities underlying these phenomena are presented in Section 4.2. Since this data is part of a larger dataset, statistic modeling will be possible after the further conditions have been introduced (Section 6.2).

Figure 3. *Order, alignment of the initial H-target, and downstep (n = 128)*



4.2. Implications for prosodic constituency

The prosodic realizations in Section 4.1 confirm the generalization that the default prosodic pattern for non-final prosodic constituents in Georgian is a rising contour. This contour starts from a low point/value associated with the left edge of the prosodic constituent and targets a high peak associated with the right edge. In instances with polysyllabic words of any category in our corpus, the rising contour consistently starts at the initial syllable and not at the primarily stressed syllable. Previous literature has assumed that the first tonal target is a low pitch accent L* (Jun, Vicenik, and Lofstedt 2008, Skopeteas, Féry, and Asatiani 2009), however there is no evidence that the left-edge low target is associated with anything else than the beginning of the prosodic constituent. The assumption of an L* would be empirically supported if the rising contour started at a lexically stressed syllable, i.e., the antepenultima in polysyllabic words (with more than three syllables). The available examples with polysyllabic words in the literature do not display any instance of a rising contour starting from the primarily stressed syllable (see data reported in Jun, Vicenik and Lofstedt 2008 and Skopeteas and Féry 2010). In the present experiment, the critical examples are the polysyllabic verbs: when these verbs are realized with a rising contour (in non-final position), the rise starts at the first syllable and not at the antepenultima; see Figure 2. Thus, we analyze the rising contour as consisting of two tonal targets, L and H, associated with the left and right phrase boundary, respectively. The resulting rising contour is the default realization of any non-final prosodic constituent in Georgian, as accounted for by the constraints in (12). It will be shown in the following that the rising contour is the default realization of Prosodic Words and Prosodic Phrases alike. Non-final Intonational Phrases are also realized with rising contours; see the prosody of complex sentences with two conjuncts reported in Skopeteas and Féry (2007: 341). Hence, we postulate two constraints aligning the edges of any prosodic constituent π with phrase tones (whereby π is a prosodic constituent of any layer, i.e., ω , φ or ι).

- (12) a. ALIGN (π , L; L $_{\pi}$, L)
Align the left boundary of a π -phrase with the left edge of a low tone.
- b. ALIGN (π , R; H $_{\pi}$, R)
Align the right boundary of a π -phrase with the right edge of a high tone.

The end of utterance-final ι -phrases of declarative CPs is realized with a final lowering. A number of studies provide evidence for a contrast between declaratives and interrogatives based on a final rising contour in the latter sentence type; see Bush (1999), Müller (2007), and Jun, Vicenik and Lofstedt (2008). Declaratives frequently end up with a rising contour in narratives if they are non-final in the utterance. Hence, the right boundary of a final declarative ι -phrase is associated with an L-target, as expressed in (13a), and this constraint outranks the default constraints of tonal alignment; see (13b).

- (13) a. ALIGN (ι , R; L $_{\iota}$, R) (whereby ι = declarative and utterance-final ι -phrase)
Align the right boundary of a declarative utterance-final ι -phrase with a low tone.
- b. ALIGN (ι , R; L $_{\iota}$, R) >> ALIGN (π , Edge $_i$; T, Edge $_i$)

The assumptions introduced so far account for the default realization of sentences in the canonical SOV order. The root clause is matched by an Intonational Phrase, the lexical projection of the V is matched by a Prosodic Phrase containing the object constituent, and individual words are matched by Prosodic Words, in line with the MATCH constraints in (4) (Selkirk 2011). Non-final Prosodic Phrases and Prosodic Words are aligned with an LH contour and the right edge of an ι -phrase mapping a declarative sentence is aligned with an L-target. If

several tones are assigned at the same place (syllable), only the one of the highest level prosodic domain survives in the phonetics: $T_i T'_{i+1} \rightarrow T'$, whereby i is a member of the ordered set $\{\omega < \varphi < \iota\}$. Hence, whenever the tonal structures of ω -phrases and φ -phrases are identical, we only indicate the tonal structure at the level of the φ -phrase. The tonal targets that result from our assumptions are shown in the tonal tier in (14), which predicts the prosodic realization in Figure 1a.

(14) Preferred prosodic structure of SOV utterances (see Figure 1a)

[S	[[O]	V]]	
(((α) ω) φ	((β) ω	(γ) ω) φ) ι
L		H	L	H	L		L	

Word order has a significant impact on the second H-target, such that this target is frequently reset in the SVO order (see the illustration in Figure 2 and quantitative facts in Figure 3). This phenomenon is relevant for prosodic phrasing. Prosodic sisterhood among adjacent constituents is interpreted as register lowering (see Ladd 1986: 326, Selkirk 2011, etc. for a phonological analysis of downstep in different languages). Downstep affects sister constituents at all levels of prosodic phrasing: two Prosodic Words inside a Prosodic Phrase are also in a downstep relation to each other. The downstep between S and O in Figure 1 reflects the fact that the ω -phrase of the object is embedded within the sister φ -phrase of the φ -phrase encompassing the subject; see (14). The fact that the right edge of the V in the SVO order is frequently not downstepped indicates that the ω -phrase of the subject is not a sister of the φ -phrase encompassing the subject and the verb. Our assumptions are presented in (15): the second H-target in the SVO order – the one at the right edge of the verb – is reset since it is associated with a higher layer of prosodic constituency than the preceding H-target – the one on the subject, associated with the ω -phrase. The occurrence of this pattern in the SVO order confirms the predictions made by Tableau 2 and is reminiscent of the facts reported for several V-final languages (see Section 2.1).

(15) Realization of SVO with reset on the right edge of the V (see Figure 2)

[[S	[V]]	O]	
(((α) ω	(β) ω) φ	((γ) ω) φ) ι
L	H*	L	H	L		L		

The second phenomenon observed in Section 4.1 is the alternation between a rising and a falling contour in the prosodic realization of the initial constituent (see the illustration in Figure 1 and quantitative facts in Figure 3). The fact that the contour alternates in the all-new context indicates that this variation is pragmatically vacuous (i.e., falling and rising contours are not associated with different information structural roles). We assume that a falling contour marks the prosodic integration of the initial subject with the following material in a prosodic constituent. The fact that this contour is preferred with the SVO order if the second H-target is reset (Figure 3) is a confirmation of the optimal prosodic structure in Tableau 2 – in particular the avoidance of creating a phrase on each constituent, which is achieved by NOPHRASE. As a result, the prosodic integration between S and V is motivated phonologically rather than by the information structural content.

The earlier alignment of the H-target in falling contours is analyzed as a tonal event associated with the stressed syllable, i.e., an H* pitch accent, which places the high target earlier in the

Prosodic Word, and replaces the high phrase tone illustrated in (9). The H-target is not aligned with the left edge of the constituent but with the stressed syllable. With bisyllabic words, lexical stress falls on the initial syllable (see 2.2), which means that a bitonal LH left-edge phrase tone would be an alternative analysis.

5. Focus as prominence

The aim of this section is to assess the predictions of the focus-as-prominence hypothesis for Georgian, as stated in Section 1. The major question for our analysis is whether the pitch variation within the focused constituent is evidence for pitch accents – given the fact that prominence asymmetries at the word level are weak in Georgian (Section 2.2). Duration facts are also examined, since they can bear on the issue of local prominence. We report the local effects of focus on syllable duration in Section 5.1; we then proceed to the examination of the pitch excursions in Section 5.2. The implications of the empirical findings are discussed in Section 5.3.

5.1. Syllable duration

Effects of focus on the duration of the stressed syllable have been reported for several languages (Cambier-Langeveld and Turk 1999 on English and Dutch, Heldner and Strangert 2001 on Swedish, Jong and Zawaydeh 2002 on Arabic, etc.). In order to study such effects in Georgian, we examined all instances of our dataset in which a target constituent appears: (a) as co-extensive with the focus (which applies in the conditions involving narrow focus), (b) as part of a broader focus domain (i.e., as part of a VP-focus or in an all-new context), and (c) as given. The measurements for the available minimal pairs are presented in Table 2 (the underscored constituent is the target constituent in each comparison). The averages present the aggregate values of each focus configuration (see Appendix II for a full listing of the durations of stressed syllables).

Table 2 reveals two effects on syllable duration. First, duration is influenced by position in linear order: initial < medial < final. Second, the duration of the stressed syllable is influenced by focus: narrow focus > part of a broad focus > non-focused. Similar effects are reported for several languages (see the summary in Kügler and Genzel 2009).

Table 2. Stressed syllable duration
(measured in the first syllable of bisyllabic words and the antepenultima of longer words;
mean in msec and standard error of the mean)

		narrow focus		part of a broad focus		not focused		average			
		mean	SE	mean	SE	mean	SE	mean	SE		
initial	<u>S</u> _F VO	175	5	[<u>S</u> VO] _F	130	4	<u>S</u> V _F O	139	6	144	3
							<u>S</u> VO _F	140	5		
	<u>O</u> _F VS	151	3	[<u>O</u> V] _F S	139	3	<u>O</u> V _S F	142	5	144	3
							<u>O</u> VS _F	135	3		
medial	<u>S</u> <u>O</u> _F V	178	3	S[<u>O</u> V] _F	154	3	<u>S</u> O _V F	153	3	152	2
				[<u>S</u> O] _F V	156	3					
	<u>S</u> <u>V</u> _F O	156	4	S[<u>V</u> O] _F	149	4	S _F <u>V</u> O	148	4	152	2
				[<u>S</u> <u>V</u> O] _F	144	4	<u>S</u> <u>V</u> O _F	133	4		
final	S <u>V</u> O _F	202	3	S[<u>V</u> O] _F	181	3	S <u>V</u> _F <u>O</u>	170	2	174	2
				[<u>S</u> <u>V</u> O] _F	185	3	S _F <u>V</u> <u>O</u>	168	2		
	S <u>O</u> <u>V</u> _F	173	4	S[<u>O</u> V] _F	160	4	S <u>O</u> _F <u>V</u>	165	3	174	2
				[<u>S</u> O] _F V	164	3					
average		173	3		156	2		149	3		

In order to estimate the statistical significance of these findings, we fitted a linear mixed model with the fixed factors POSITION (initial; medial; final) and FOCUS (narrow focus; part of a broad focus; not focused) and the random factors SPEAKER and ITEM (only intercepts).³ This model reveals that POSITION and FOCUS interact significantly: a log-likelihood test between the full model and a model without the interaction effect results in a $\chi^2(4) = 39, p < .001$. The significant interaction effect already implies that both factors are indispensable (POSITION $\chi^2(6) = 2152, p < .001$; FOCUS $\chi^2(6) = 42, p < .001$). Furthermore, the distinction of three levels cannot be reduced for either factor: a model reducing the factor FOCUS to two levels (narrow focus; not narrow focus) leads to a significant loss of information ($\chi^2(3) = 36, p < .001$) and the same holds for a two-level model of POSITION (final; non-final; $\chi^2(3) = 1403, p < .001$).

The duration effects indicate that the speakers place prosodic prominence on the focused constituents – as expected by the focus-as-prominence hypothesis. The next question is whether this general notion of prominence is also reflected in the pitch excursions.

5.2. Pitch excursion

In this section, we examine whether the effect of focus found in the duration data is reflected in pitch excursions (Section 5.1). Section 6.2 again takes a look at the issue of pitch excursions from the perspective of phrasing.

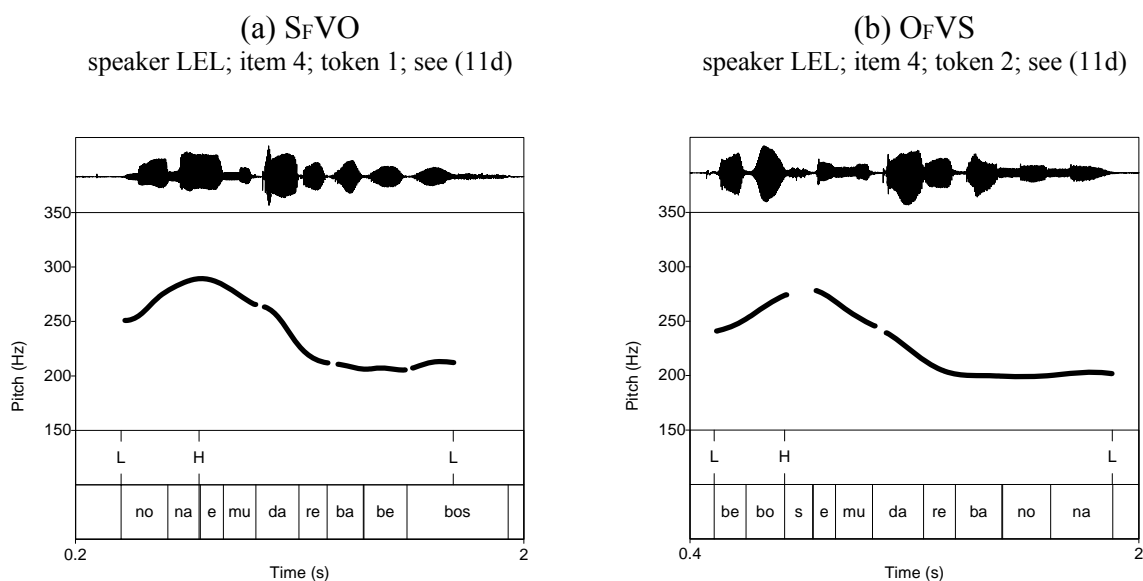
³ In order to obtain comparable parameters between the linear mixed models reported in this study (on duration, breaks, phonation, downstep, and initial contour) we used the maximal random effect structure that converges in all models. This is a model with random intercepts for SPEAKERS and ITEMS. The calculations of the effects were made with a model comparison based on the *Akaike Information Criterion*. The reported χ^2 values reflect the difference between the log-likelihood of a model containing the effect at issue and a model in which the effect at issue is removed. All calculations were made with the R-package *lme4* (Bates et al. 2013).

5.2.1. *Initial foci*

We observed that the prosodic realization of the initial constituent in the wide focus context varies between a rising and a falling contour (see Figure 1a and Figure 1b), and concluded that this alternation is pragmatically vacuous. The empirical question of this section is to re-examine the question of the variation in the contour from another perspective, and ask whether the choice of pitch contour is affected by focus. Let us assume for the sake of the argument that focus is preferably encoded by a high pitch accent associated with the stressed syllable, either H* or L+H* (Jun, Vicens, and Lofstedt 2008: 52). In this case, a falling contour is predicted to be more frequent when the initial constituent is focused.

Our dataset contains initial narrow focus in S_FVO and O_FVS. Figure 4 illustrates the most frequent pattern in these utterances. In Figure 4a, for instance, the focused subject is realized with a rising contour; the verb and object are smoothly falling from the high region of the final syllable of the subject to the bottom line, reached around the stressed syllable of the verb. The final object is low, but it is prosodically integrated with the preceding verb. The final rise on the verb that we observed in all-new contexts, see Figure 2 (see also final focus below, Figure 8), does not appear in this case: verb and object are prosodically integrated when the subject is focused. A similar pattern is found in Figure 4b for O_FVS.

Figure 4. *Rising contour on the initial focus*



The pattern in Figure 4 is not an isolated instance of a rising contour on a focused constituent, but illustrates the predominant pattern in initial focus; see Appendix I: 54 tokens (84%) of S_FVO are realized with a rising contour, while the same contour is attested in 45 (70%) of the tokens in the baseline [SVO]_F. These frequencies are thus not compatible with the assumption that focus is realized with high pitch accents.⁴

An alternative explanation for the frequency of rising contours in sentences with initial narrow focus that is compatible with the focus-as-prominence hypothesis could be a low pitch accent L* for initial foci and a phrasal tone H_φ, resulting in a rising contour (see a similar view on focus and pitch accent association in Bengali in Hayes and Lahiri 1991: 60). This possibility prompts the question: Is there phonetic evidence for a contrast between L_φH_φ (see Section 4.2) and L*H_φ in Georgian? Since initial syllables bear stress in Georgian, both analyses (a phrase

⁴ In the context of the English or German intonational system, the rising contour on the subject is reminiscent of a topic realization of the fronted constituent with a focus on the verb (Büring 1997: 58).

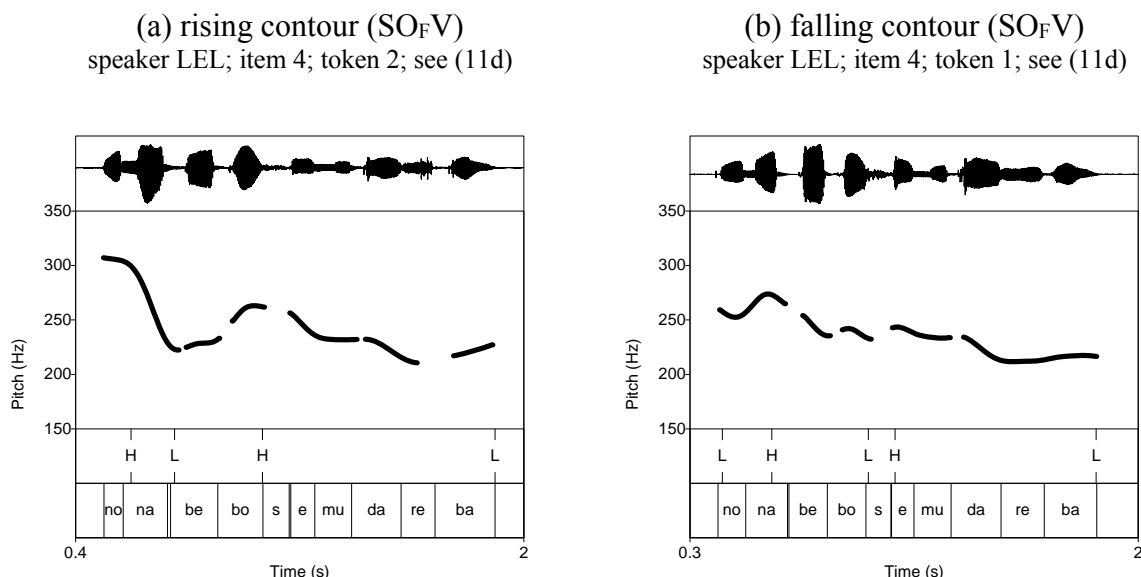
tone L_ϕ or a pitch accent L^*) predict that the L-target will be aligned with the initial syllable. In our data, the F_0 -minimum (F_0 -min) of the first syllable, which reflects the L-target, is almost always aligned with the left edge of the word independently of focus (with the exception of a few utterances with an initial dip that occur in both conditions). Moreover, the pitch range of the rising contour is not expanded under narrow focus, as shown in the average values. The average difference between the F_0 -min of the first syllable and the F_0 -max of the second syllable in utterances with rising contours is 43 Hz (95% confidence interval: ± 12) for S_FVO and 47 Hz (95% confidence interval: ± 10) for $[SVO]_F$. Contrary to the prediction of the focus-as-prominence hypothesis, the obtained averages are slightly smaller in the narrow focus condition than in the baseline.

In conclusion, there is no evidence from the alignment or the scaling of the tonal target that initial foci correlate with a tonal event associated with the stressed syllable. We will see in Section 6.2 that the observed phenomena can be understood within the framework of the focus-as-phrasing hypothesis.

5.2.2. Medial foci

The prosodic realization of the medial foci differs in several respects from that of the initial constituents. Medial focus appears in SO_FV , OS_FV and SV_FO in our dataset. Figure 5a illustrates an SO_FV sentence with a rising contour on the medial object. The rise on the focused O ends much lower than the H tone on the initial S. The contour reaches the bottom line on the penultima of the verb (*re*). The alignment of the tonal targets in this example resembles the baseline contour SOV with a falling subject; cf. Figure 1. In addition to the prosodic pattern in Figure 5a, some tokens have an overall falling contour encompassing the medial focus and the postfocal material; see Figure 5b. The initial constituent is realized with a rising contour, while the focus (object) and the postfocal material (verb) are integrated in a prosodic unit that is realized with a falling contour, which has a small amount of reset at the beginning of the verb.

Figure 5. Sentence-medial focus

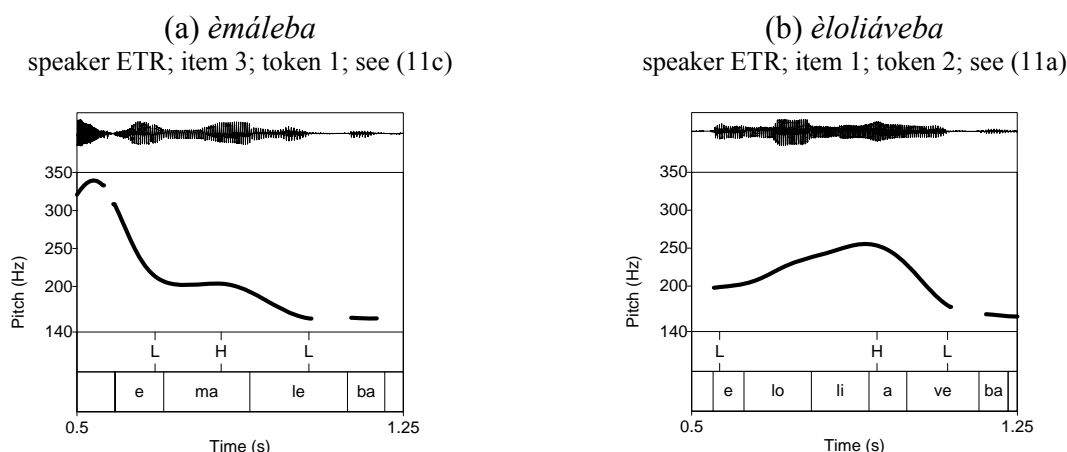


The question is whether the falling contour in Figure 5b generally correlates with focus, which would confirm the presence of an H^* pitch accent associated with focus, as suggested by Jun, Vicenik, and Lofstedt (2008: 52). In order to evaluate this possibility, we compared the average rise in the medial word, measured as the difference between the F_0 -min of the stressed syllable and the F_0 -max of the final syllable. A comparison is possible in the SOV order, which occurs in all-new and object focus contexts. The average rise within the object constituent is 31 Hz in

all-new contexts (95% confidence interval: ± 6.1) and 28 Hz (95% confidence interval: ± 4.9) in object-focus contexts. Hence, there is no substantial influence of focus on the average rise within the focused medial word (see also the plots of average pitch excursions in Figure 11 below).

Bisyllabic words do not allow for clear conclusions about tonal events realized in the first syllable. They may be analyzed either as pitch accents aligned with the stress on the first syllable or as phrase tones aligned with the left edge of the word. In order to disentangle these options, we must examine the tonal realization of polysyllabic words, i.e., the verbs in our dataset. Figure 6 shows the realization of a verb with four and a verb with six syllables in the condition SV_{FO} . The first syllable and the antepenultima bear stress, whereby primary stress falls on the antepenultima (Section 2.2). The pitch contour reaches an H-target within the stressed antepenultima; a falling contour to the bottom line starts within this syllable and ends with the word. Figure 6 confirms previous intuitions that word stress in Georgian is based on melodic patterns rather than syllable weight (Section 2.2). The stressed syllables are not longer than the unstressed ones; rather they are the anchors of the tonal targets.

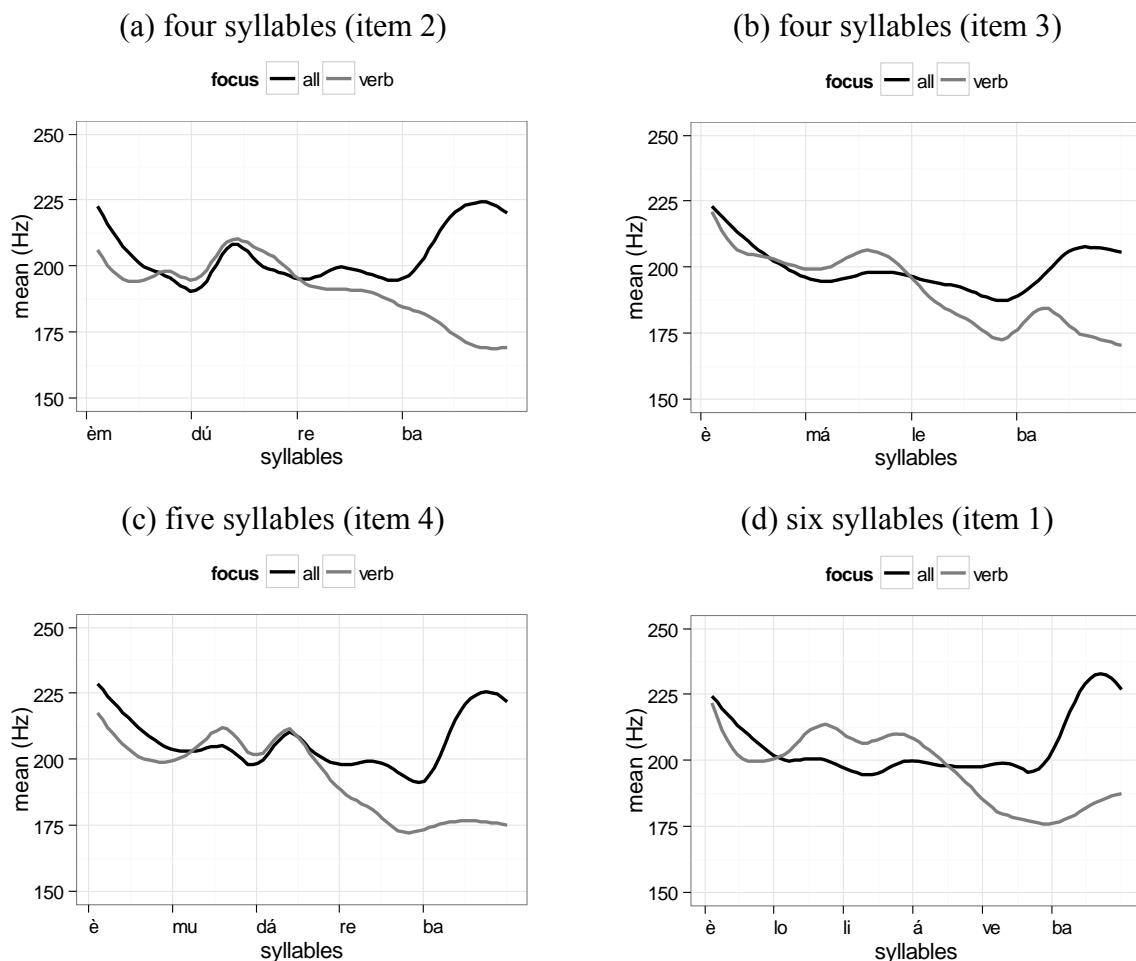
Figure 6. *Medial focus and stressed syllable of the verb in SV_{FO}*



The critical issue is whether the tonal patterns in Figure 6 are associated with focus or are just melodic correlates of word stress. Figure 7 plots the average measurements of the verbs in our dataset in the verb-focus condition (SV_{FO} , black lines) and the baseline ($[SVO]_F$, grey lines). The average measurements show that the stressed syllable is realized with a rising-falling contour that reaches the F_0 -maximum around the middle of the stressed syllable; Figure 7a–c. The peak is reached earlier in the verb *è loliáveba*, whose stressed syllable follows an open syllable and has a null onset (Figure 7d). A falling contour starts within the antepenultima in all verbs, i.e., within the second syllable of *è máleba* and *è mdúreba*, the third syllable of *è mudáreba* and the fourth syllable of *è loliáveba*. These facts show that the assumption of a pitch accent is reasonable for Georgian.

However, the presence of the pitch accent does not depend on focus. Figure 7 shows that the tonal pattern of the stressed syllable is not substantially different in verb-focus and in all-new contexts. Moreover, these figures suggest that the pitch excursion of the stressed syllable is the wrong place to look for focus effects in Georgian prosody. The substantial difference lies in the tonal realization of the domain between the primary stress and the right edge of the target words. These facts suggest that Georgian has a bitonal pitch accent (presumably, H^*+L) whose starred tone is aligned with the syllable carrying the primary stress and whose trailing tone is aligned with the right edge of the prosodic word in the case of narrow focus and with the left edge of the last syllable in all-new contexts (see the discussion in 5.3).

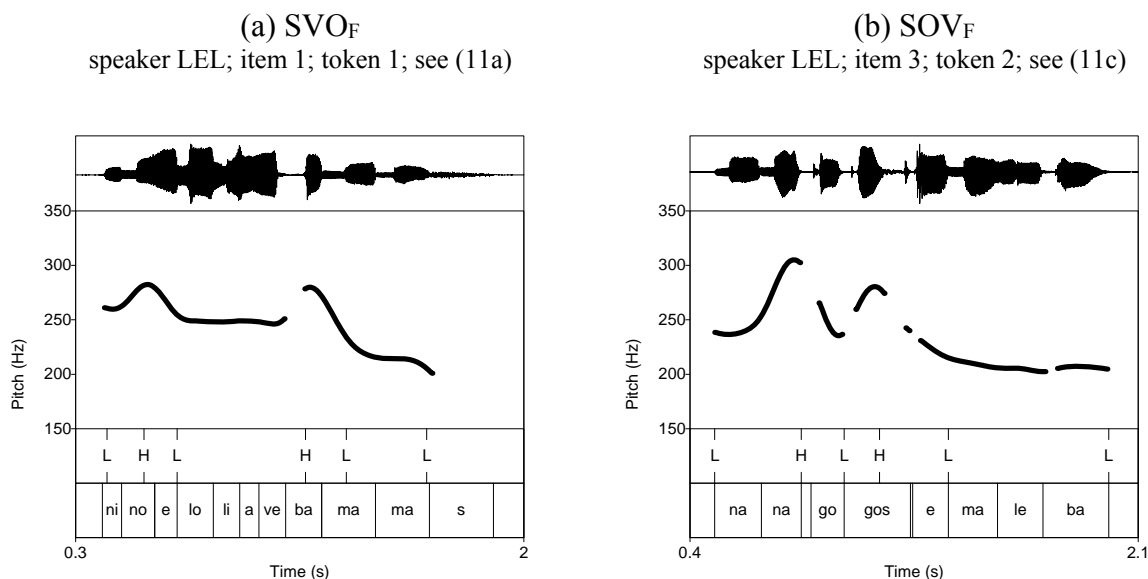
Figure 7. Average pitch excursion of medial verbs
(average measurements of 10 equal intervals per syllable; $n = 16$ per verb)



To sum up, the facts presented in this section show that there are pitch accents in Georgian, but they are lexically driven and not associated with narrow focus. The pitch accent in such a language applies to the word carrying the nuclear stress and is not influenced by the difference between broad and narrow focus domains. The examination of the medial focused verbs revealed that the prosodic realization involves a high pitch accent associated with the stressed syllable of a verb, but not of a medial noun. This difference has to do with the length of the lexical items. Only words with more than three syllables have distinct hosts for the phrase tone on the left edge of the prosodic word and the pitch accent (which falls on the stressed antepenultimate syllable). In words with three or fewer syllables, the carrier of the phrase tone coincides with lexical stress.

5.2.3. Final foci

Final narrow focus appears in SOV_F , SVO_F , and OVS_F . In a number of utterances with final focus, this constituent has a particularly flat and low realization; see for instance the examples in Figure 8. The prefocal phrases are realized with rising contours and they end high. The contour falls very steeply from the final high of the prefocal material and reaches the bottom line at the end of the first syllable of the focused constituent. The contour on the focus is flat, the usual declination in Georgian declaratives is sustained. The perceived general impression is that of a salient melodic pattern rendered by the flat contour on the final focus (see also Skopeteas, Féry, and Asatiani 2009).

Figure 8. *Low-flat final focus*


The melodic pattern of these utterances contrasts with the default declination and final lowering at the end of declarative utterances of the baseline. It can be speculated that the perceptual saliency of this pattern lies in the fact that it deviates from the general tendency toward downstepping tonal targets in Georgian, as shown for H-targets in Section 4.2, and illustrated in Figure 1. In a comparison between Figure 1 and Figure 8, it is conspicuous that the lowest tone of the focused verb is reached earlier when the verb is focused than when it is not. The crucial question is whether the extra-low tune, preceded by a very clear prosodic boundary, is a prosodic means of encoding focus. A manual decoding of the data based on the acoustic impression of the utterances resulted in the counts in Table 3, showing that the extra-low pattern is more frequent with final focus than in the baseline. A generalized mixed-effects logit model on the frequency of low-flat contours, using ORDER (SVO; SOV) and FOCUS (final narrow focus; all-focus) as fixed factors and SPEAKER and ITEM as random factors reveals a significant main effect of FOCUS ($\chi^2(1) = 19, p < .001$) but neither a significant effect of ORDER nor of the interaction between factors.

Table 3. Frequency of the low-flat contour in final narrow focus and in all-focus

	final narrow focus			baseline	
	<i>n</i>	%		<i>n</i>	%
SOV _F	31	48	[SOV] _F	15	23
SVO _F	28	34	[SVO] _F	17	27

Although there is a significant main effect of FOCUS, we observe in the counts in Table 3 that this tonal pattern also occurs frequently in the baseline condition. Thus, the extra-low pattern is not a correlate of focus. We are rather dealing with a melodic pattern (probably with stylistic effects) that is possible with different information structures and occurs more frequently in final narrow focus.

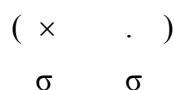
5.3. Implications for phonological structure

In Section 5.1, we were able to establish a correlation between focus and duration of the stressed syllable, which was interpreted as prominence. We also revised the local effects of focus in our dataset in light of previous hypotheses that assumed that focus is associated with an H* pitch accent (Jun, Vicenik, and Lofstedt 2008). Close examination of the pitch excursions revealed that the local effects of focus depend on its position in the linear order. Initial foci are most

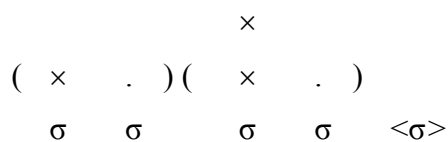
frequently realized with a rising contour, which might allow an analysis in terms of an L*+H pitch accent, but there is no compelling evidence supporting the idea that the rising contour on initial foci contrasts with the default L_φH_φ pattern.

The falling pattern of a medial focus may be considered to be in line with accounts assuming H* for the realization of focus. In order to check this possibility, let us first take a look at an account of word stress in our data. Bisyllabic words have a trochaic pattern, and we have no reason to assume that this trochaic pattern is changed in verbs. Since the stress pattern of the verbs show a regular primary stress on the antepenultimate syllable, we also assume extrametricality of the last syllable. The other feature of the longer verbs used in the experiment is a secondary stress on the initial syllable.

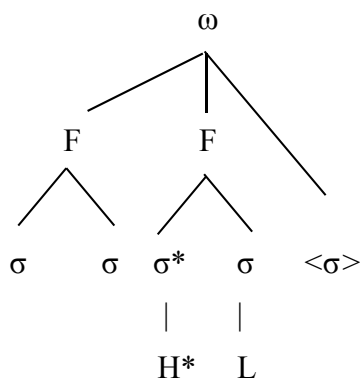
(16) a. Bisyllabic word: foot structure



b. Five-syllable word: foot structure

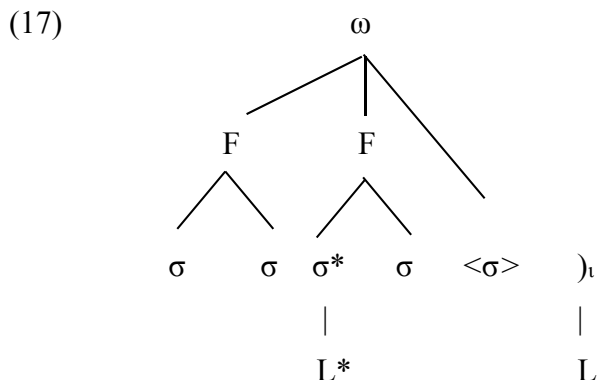


c. Tonal pattern of a five-syllable word



The H* of this pitch accent is associated with the primarily stressed syllable (antepenultima), while the following trailing L-tone is associated with the penultima (and not with the right edge of the focused phrase), speaking for a bitonal pitch accent H*+L, as represented in (16c). It is not primarily a correlate of focus, but rather appears when the word is long enough to carry its own lexical stress. This lexical stress is especially prominent when the word is in focus, although it may be perceived in other contexts as well.

Final foci often appear with a particularly flat and low prosodic contour. This characteristic tune has a salient perceptual effect: it is lower than expected, and the lowering starts earlier than expected. This pattern also occurs in broad focus (see Table 3), i.e., it is a prosodic realization of final nuclear stress (and not exclusively of final narrow focus). The melody of a final focus can be described as a low phrase tone that reaches the bottom line at the beginning of the phrase, as indicated in (17), resulting in an L* L_i tune. There is thus no high tone in the phrase mapped to the final focus. All tones are low tones. This can have the effect of lowering the register of the focused constituent altogether.



The variation in the realization of the local properties of focus (pitch accent) depends on its position in the utterance, and as a result, it cannot be unified in terms of a general principle associating a ‘focus feature’ with a particular tonal realization. This does not mean that focus is not prosodically realized, but only that it does not systematically correlate with a pitch accent. A substantial part of the tonal variation discovered in this section will be explained after the next section on prosodic phrasing and its relation to focus and to constituent structure.

6. Focus as phrasing

The preceding section has shown that the phonetic correlates of focus in Georgian cannot be explained in terms of pitch accents associated with focus. In other words, the focus-as-prominence hypothesis was rejected. Instead evidence was provided that tonal correlates of focus appear at the edges of the prosodic constituents (Section 5.2.2). The present section investigates the focus-as-phrasing hypothesis in detail. Recent studies on prosodic constituency have shown that alignment with the edge of prosodic constituents, as formulated in an abstract way in (18), is a crucial property of focus (Truckenbrodt 1999, Selkirk 2011, Büring 2010, Féry 2013). The focus-to-phrase alignment in (18) involves two variables that give rise to a family of constraints: the factor α refers either to the left or to the right edge of a prosodic constituent, and the factor π relates to a layer of prosodic constituency, Prosodic Phrase (p-phrase, φ) or Intonation Phrase (i-phrase, ι).

(18) ALIGN-FOCUS- α , π -PHRASE- α (ALIGNFOC- π - α)

Align a focus with the α boundary of a π -phrase.

(whereby α ranges between ‘left’ and ‘right’ and π refers to a φ -phrase or ι -phrase.)

Languages differ with respect to the ranking of the constraints resulting from (18). The empirical questions are: Does the focus primarily align with the left or the right boundary of prosodic constituents? Which layers of prosodic constituency are referred to by the focus rules? It will be shown in Section 6.2. that a focus in Georgian is preferably separated from the rest of the sentence by a boundary of a φ -phrase, aligned to the left. When the focus is initial, it is separated by a φ -phrase boundary to its right. In an optimality-theoretic approach, this preference for left alignment is a consequence of the ranking of the explicit constraints: ALIGNFOC-L is ranked higher than ALIGNFOC-R. The latter constraint is only active when the former one applies vacuously.

In the following, three crucial phenomena are examined. First, the distribution of prosodic breaks in Section 6.1; second, the shape of phrase tones in Section 6.2; and third, the impact of focus and phrasing on phonation, in particular the creaky realization of the postfocal domain, in Section 6.3. Section 6.4 integrates the empirical findings and develops an account of focus and prosodic phrasing in Georgian.

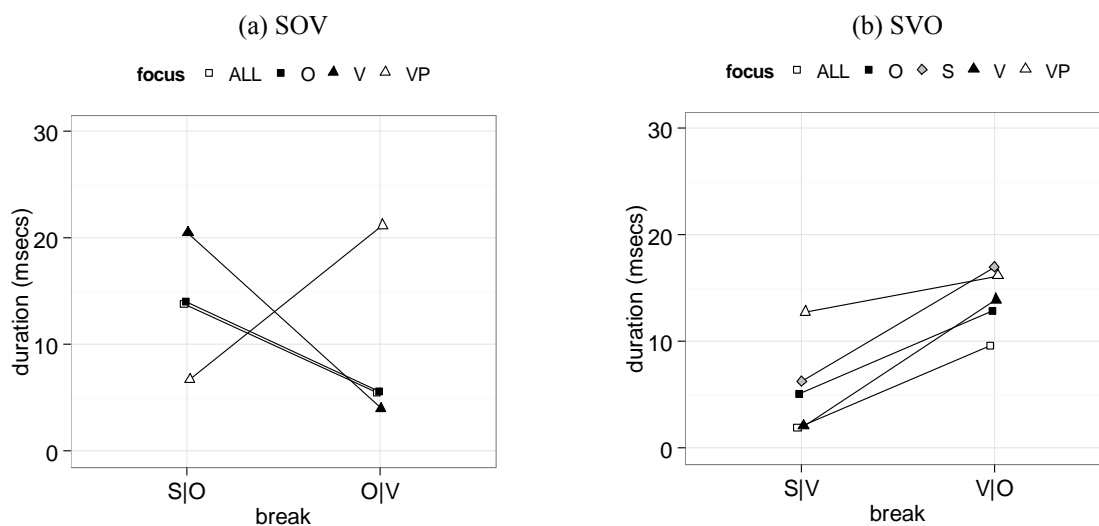
6.1. Prosodic breaks

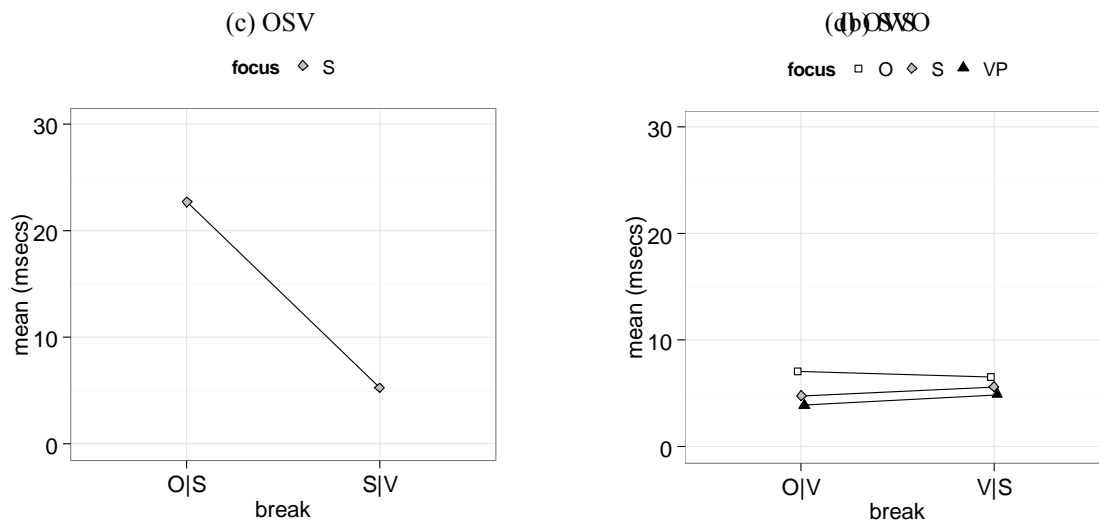
Prosodic breaks generally correlate with intonational boundaries – though their role as phonetic cues of prosodic phrasing is not straightforward (Lieberman 1975: 9, Ladd 1986: 315, Cruttenden 1997: 29). Figure 9 presents the average durations of prosodic breaks in the examined discourse conditions (see the corresponding values in msec in Appendix III). The average break durations reveal an asymmetry: V-final orders (left panel) display a preference for an early prosodic break (after the first word), while SVO (but not OVS) (right panel) prefers late prosodic breaks (before the last word). The SOV/SVO contrast is reminiscent of the contrast between $(S)_\phi(OV)_\phi$ and $(SV)_\phi(O)_\phi$ in Section 2.1 (see also Section 4.2).

The focus structure has an influence on the break durations, which is manifested in the differences between focus conditions. Assuming first that the left side of the focus is aligned with the boundary of a prosodic constituent (ALIGNFOC-L), an early boundary is predicted in the case of XY_FV (SOV/OSV), i.e., $X_\phi(YV)$, and a late boundary in the case of SOV_F , i.e., $SO_\phi(V)$, which is descriptively confirmed in Figure 9a. In the V-medial orders, ALIGNFOC-L predicts an early boundary in $X_\phi(V_FY)$, and a late boundary in the case of $XV_\phi(Y_F)$. The former prediction is descriptively confirmed for SV_FO ; the S|V boundary is significantly larger for V-focus than in any other condition. An advantage for $XV_\phi(Y_F)$ is not visible in the data, however, ALIGNFOC-L is confounded with the general preference for breaks after the V in SVO.

Assuming a boundary following the right edge of the focus (ALIGNFOC-R) motivates the following predictions: (a) a late boundary after the focused medial constituents, $XY_F)_\phi V$, which is not the case; observe that the default phrasing $(X)_\phi(YV)_\phi$ is maintained with medial foci; (b) an early boundary after initial focus, $X_F)_\phi VY$, which is descriptively confirmed in SVO/OVS (by only a small difference in the latter case).

Figure 9. Average prosodic breaks
(labels on the X-axis indicate the break; data point labels refer to the focus domain)





In order to examine the statistical validity of these observations we fitted a linear mixed-effects model on the data. The linear models reported in the following examine the effects of the assumed constraints. For the ALIGNFOC constraints the prediction is straightforward: ALIGNFOC-L predicts a boundary at the left edge and ALIGNFOC-R at the right edge of the focus domain. MATCH relates to the constituent structure, which is not constant across focus conditions (since preverbal focus is analyzed as fronting to an accented position that attracts the verb). In order to avoid the introduction of additional assumptions at this stage of data analysis, we calculated the descriptive factor V-POSITION, which captures the contrast between V-final orders (baseline) and orders involving a medial verb. Based on the findings in Section 2.1, V-POSITION predicts an early boundary with the SOV order and a late boundary with the SVO order. Furthermore, the model included SPEAKERS and ITEMS as random factors. The significance of the involved factors was estimated with a log-likelihood test between models that yields the χ^2 -scores reported in Table 4 and Table 5. The estimates of the model parameters for early breaks are given in Table 4, which provides evidence for a significant effect of V-POSITION and ALIGNFOC-L. The negative estimate of ALIGNFOC-L means that early breaks are shorter at the left side of a medial focus. The negative estimate of V-POSITION means that early breaks are shorter in V-medial orders. There is no evidence for ALIGNFOC-R (implying that initial foci are not followed by significantly longer breaks) nor is there evidence for an interaction effect between the constraints at issue.

Table 4. Linear mixed-effects model on early breaks

	fixed factor	estimate	χ^2 (df)	<i>p</i>
early break duration =	intercept +	13.9		
	V-POSITION +	-3.3	27.4 (1)	< .001
	ALIGNFOC-L	-3.1	24.7 (1)	< .001

The permutations between factors in late breaks are given in Table 5, which provides evidence for a significant effect of V-POSITION and ALIGNFOC-L. Similarly to the findings in early breaks, there is no evidence for ALIGNFOC-R. The negative estimate of ALIGNFOC-L means that the break duration before final foci (i.e., SOV_F, SVO_F, OVS_F) is shorter than otherwise. Late breaks also display a negative interaction effect for V-POSITION and ALIGNFOC-L implying that the effect of V-POSITION is reduced when ALIGNFOC-L applies (i.e., in SVO_F and OVS_F).

Table 5. Linear mixed-effects model on late breaks

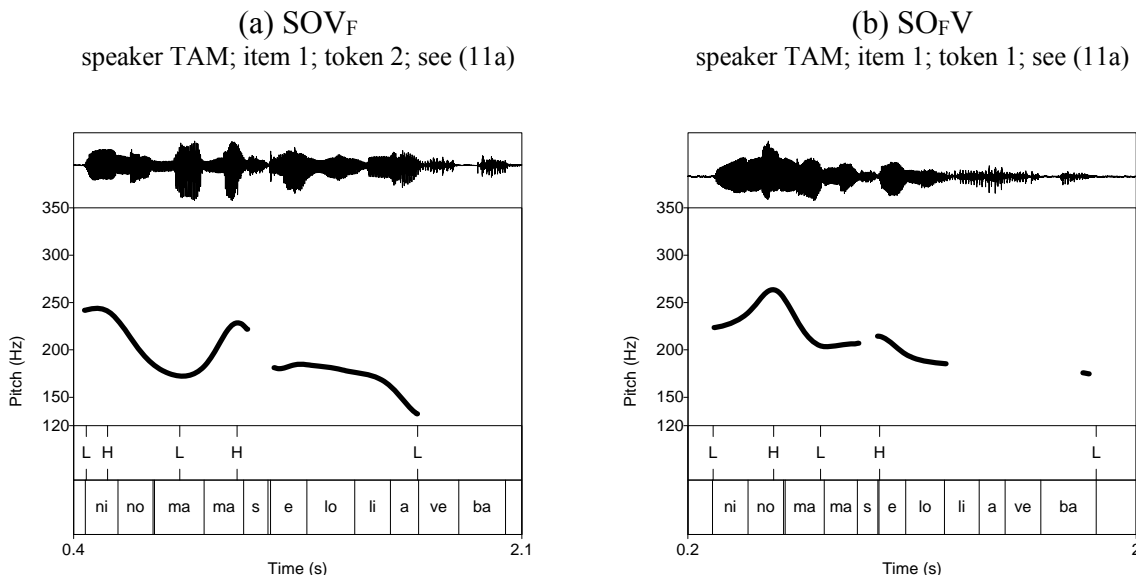
	fixed factor	estimate	χ^2 (df)	<i>p</i>
late break duration =	intercept +	11.8		
	V-POSITION +	1.3	3.7 (1)	= 0 .054
	ALIGNFOC-L +	-3.7	11.6 (1)	< .001
	V-POSITION^ALIGNFOC-L	-4.4	37.7 (1)	< .001

In sum, the differences in Figure 9 provide evidence for the impact of constituent structure on prosodic constituency, as predicted by V-POSITION in Section 2.1. Left-alignment of the focus is statistically justified both for early and late breaks. There is no evidence for right-alignment of the focus in break durations.

6.2. Phrase tones

The pitch excursions reveal two phenomena that may be influenced by focus. The first phenomenon is a high boundary preceding a final focus. This is illustrated by the contrast between SO_FV and SO_FV in Figure 10. The focus is preceded by a clear H-target that is aligned with the right edge of the prefocal object in SO_FV or with the right edge of the prefocal subject in SO_FV. This contrast confirms the conclusion that the left side of the focus aligns with a tonal boundary (Section 6.1). A further phenomenon is the different phrasing of postfocal material in cases of non-final focus, as illustrated by Figure 10b (see also initial focus in Figure 4): postfocal material is integrated into a single prosodic constituent, which means that tonal events determining the boundaries of prosodic subconstituents within the postfocal area are either compressed in pitch range (Figure 10b) or absent (Figure 4).

Figure 10. *High prefocal boundary*



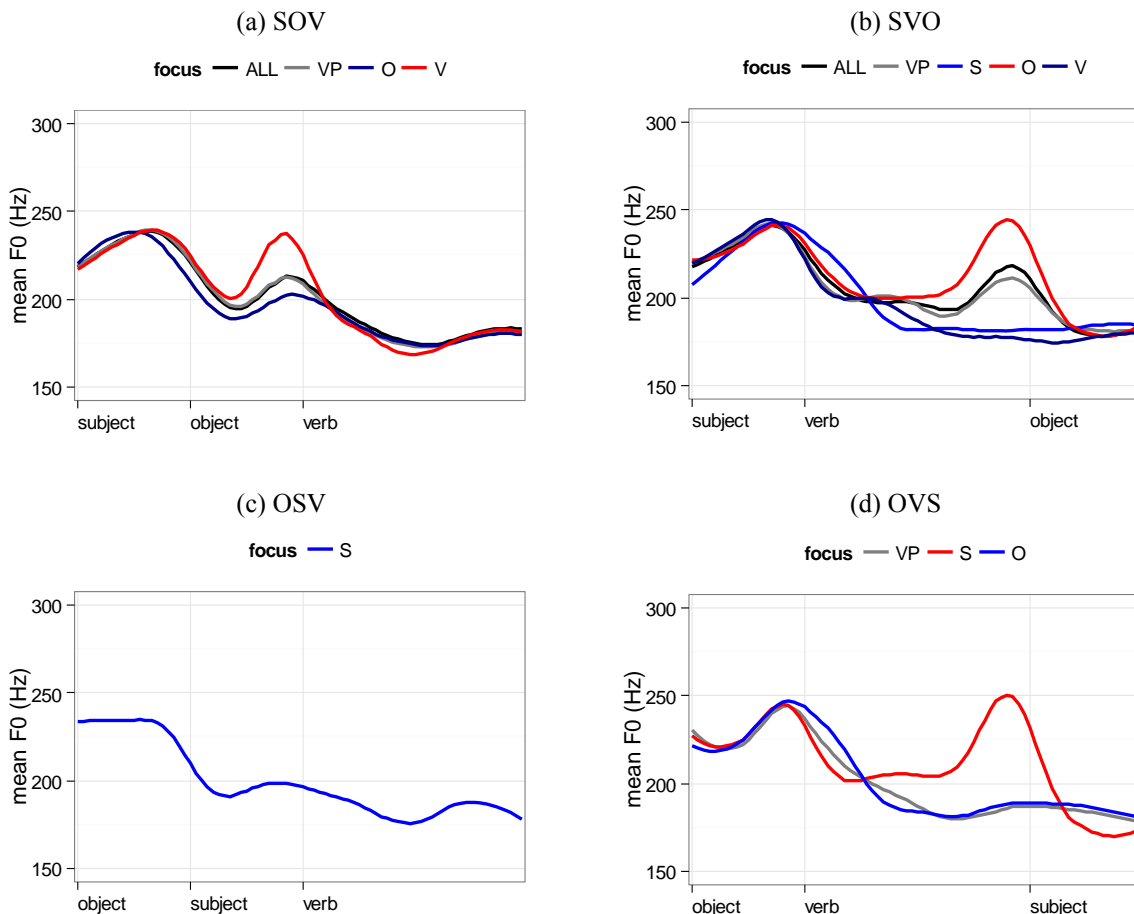
We now turn to the average pitch measurements of the entire dataset, presented in Figure 11. The focus-order permutations contain two instances of final focus: V-focus in SO_FV in (a) and O-focus in SVO_FV in (b): in both cases the average contour shows reset of pitch just before the focus. The *F*₀-value reaches a maximum that does not substantially differ from the maximum of the initial word. This result is compatible with ALIGNFOC-L as the most active constraint for aligning the focus with a prosodic domain in Georgian (Section 6.1). The same effect does not appear before a medial focus in (c) and (d): the effect of focus is not a raising of the absolute pitch level of the prefocal boundary, but a reset to the pitch level established by a preceding high target. Recall that OS_FV is phrased as (O)_φ(S_FV)_φ, and OV_FS is phrased as (O)_φ(S_F)_φ(V)_φ.

Since the prefocal boundary is the first high target in the case of medial focus, no reset effect applies.

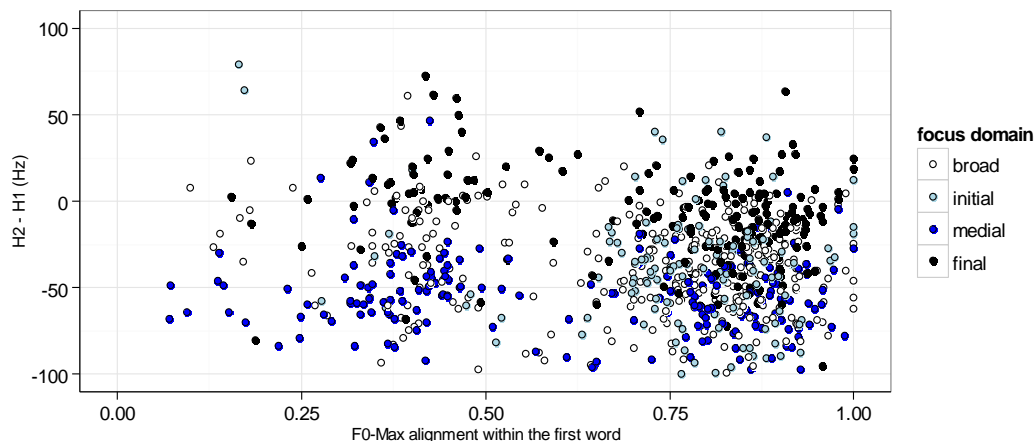
The second phenomenon introduced above relates to the phrasing of postfocal material in non-final foci. The pitch contour on initial or medial focus, i.e., S_FVO and SV_FO , does not display a rise at the right edge of the medial constituent, which reflects the lack or compression of postfocal H-targets. This prediction is not borne out for SO_FV .

Figure 11. *Time-normalized average pitch contours*

(F_0 -mean measurements of ten equal intervals per syllable; smoothed at .3; verb-scores contain the first syllable and the three last syllables of the verb)



We are now in a position to estimate the influence of prosodic constituency on the two phenomena introduced in Section 4.1: (a) downstep, and (b) alignment of F_0 -max within the initial prosodic constituent. The dependencies of these phenomena on focus are displayed in Figure 12. The y-axis stands for the difference between the first two H-targets, whereby a negative value implies downstep. The distribution of the data points indicates that downstep is almost always absent with final focus. The x-axis presents the alignment of F_0 -max with the syllable, which is bimodal in the entire dataset (see Appendix I). The data points around the first distribution indicate that falling contours mostly appear with final and medial focus and only rarely with initial focus.

Figure 12. *Focus, alignment of the initial H-target, and downstep (n = 832)*

The critical issue for downstep is the predictions of the assumed factors for the boundary between the second and the third words. V-POSITION predicts a boundary after the verb $(XV)_\varphi(Y)_\varphi$; ALIGNFOC-L predicts a boundary preceding final foci, $(SV)_\varphi(O_F)_\varphi$, $(OV)_\varphi(S_F)_\varphi$, and $(SO)_\varphi(V_F)_\varphi$; ALIGNFOC-R predicts a boundary following medial foci, $(SO_F)_\varphi(V)_\varphi$ and $(SV_F)_\varphi(O)_\varphi$. A linear mixed-effects model was fitted on downstep with these fixed factors as well as the interaction effects of both alignment constraints with V-POSITION (Table 6). The measure of downstep is the difference between H_1 (F_0 -max of the first constituent) and H_2 (F_0 at the right edge of the medial constituent). The results reveal that downstep is absent when ALIGNFOC-L applies, i.e., in cases of final focus (see SOV_F , SVO_F and OVS_F in Figure 11). Moreover, there is a cumulative effect of V-POSITION indicating that sustained pitch level is more frequent with V-medial orders. ALIGNFOC-R comes with a negative estimate, indicating that the second H-target decreases with medial focus, i.e., downstep applies on the right edge of the focus, it rather increases as a result of postfocal deaccenting. No significant interaction effects were found between factors.

Table 6. Linear mixed-effects model on downstep

	fixed factor	estimate	χ^2 (df)	p
$H_2 - H_1 =$	intercept +	-45.5		
	V-POSITION +	10.3	25 (1)	< .001
	ALIGNFOC-L +	29.9	133 (1)	< .001
	ALIGNFOC-R	-13.3	33 (1)	< .001

The contour on the initial constituent is expected to interact with the constraints that apply to the boundary between the first and the second word. For this purpose, we fitted a generalized mixed-effects logit model on the likelihood of a ‘rising’ contour on the initial constituent. The fixed factors of the model are (a) V-POSITION, predicting an early boundary in V-final orders (see Section 2.1); (b) ALIGNFOC-L, predicting an early boundary for SO_FV , OS_FV , SV_FO , $S[VO]_F$ and $S[OV]_F$; and (c) ALIGNFOC-R, predicting an early boundary for S_FVO and O_FVS . (SPEAKERS and ITEMS were used as random factors.) The available permutations allow testing of the interaction between V-POSITION and ALIGNFOC-L, but not between V-POSITION and ALIGNFOC-R. The parameters of the final model (after reducing the non-significant interactions) are given in Table 7. The results involve a significant effect of ALIGNFOC-R, reflecting the fact that rising contours are more frequent with focused subjects in S_FVO/O_FVS (see the counts in Appendix III). V-POSITION and ALIGNFOC-L have negative estimates, i.e., a rising contour in the initial constituent is less likely in V-final orders and preceding a (medial) focus.

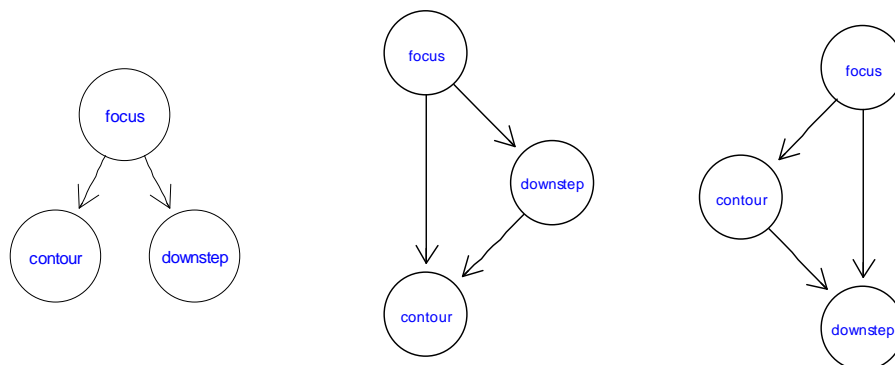
Table 7. Generalized linear mixed-effects model on the likelihood of initial rising contours

	fixed factor	estimate	χ^2 (df)	<i>p</i>
$\log(p(\text{rise})) =$	intercept +	2.2		
	V-POSITION +	-0.9	19.3 (1)	< .001
	ALIGNFOC-L +	-0.6	8.5 (1)	< .01
	ALIGNFOC-R	1.6	18.8 (1)	< .001

The linear models have shown that the contour on the initial constituent and the presence of downstep are influenced by focus. The last question is whether the two dependent variables influence each other. This question cannot be answered by the linear models: inserting downstep as a predictor in the model in Table 7 would violate the basic assumption of linear models that the fixed factors do not correlate with each other (non-multicollinearity). Hence, we need a multivariate statistic procedure in order to obtain an answer to this question. For this purpose, we fitted three alternative Bayesian networks on each type of narrow focus compared to the baseline (all-focus). We assume an influence of the focus on contour and on downstep (which is the result of the linear models in Table 6 and Table 7) and we address the question of which model better fits the data: (a) a model in which the two dependent variables do not influence each other, (b) a model in which downstep influences the choice of contour on the initial constituent, or (c) a model in which the contour on the initial constituent influences downstep (see Figure 13). The goodness of fit of each model for each type of focus is captured by the log marginal likelihood, which gives information about the amount of variation that is explained by the respective model (a higher value implies an increase in the goodness of fit). For initial foci, the maximal fit is achieved by the model that does not assume any probabilistic dependency between contour on the initial constituent and downstep. For medial and final foci, the maximal fit is reached by the model in which the choice of contour depends on the size of downstep. This finding indicates that downstep influences the choice of initial contour, such that a falling contour is predicted to occur when the second tonal target is not downstepped. This correlation suggests that speakers prefer to integrate the first two constituents into a single prosodic unit if the second H-target is not downstepped, i.e., a rule reducing the proliferation of the prosodic structure is at issue.

Figure 13. *Focus, contour on the initial constituent and downstep:*

Probabilistic dependencies as Bayesian networks (log marginal likelihood of model fit; calculated with R-package *abn*, see Lewis 2013)



initial	-693	-696	-697
medial	-898	-897.1	-897.4
final	-864	-860	-861

In sum, ALIGNFOC-L is a crucial constraint in Georgian, inducing a prosodic boundary at the left edge of the focus. The effects of ALIGNFOC-L are manifested in the break durations (Section 6.1) as well as in the downstep data (Table 6). We could also show that constituents on the left side of medial focus are more frequently realized with falling contours, i.e., they are frequently prosodically integrated in the focus (see negative estimate of ALIGNFOC-L in Table 7). ALIGNFOC-R is much less active, since there is no prosodic boundary at the right edge of medial foci, although the rising contours at the initial constituent indicate that ALIGNFOC-R does apply with initial foci in Georgian (Table 7). These findings are challenging, since they do not fit the assumption of a categorical distinction between two types of phrase languages, aligning the focus with a boundary on the left or on the right. Our account of these conflicting observations is given in Section 6.4.

6.3. Phonation

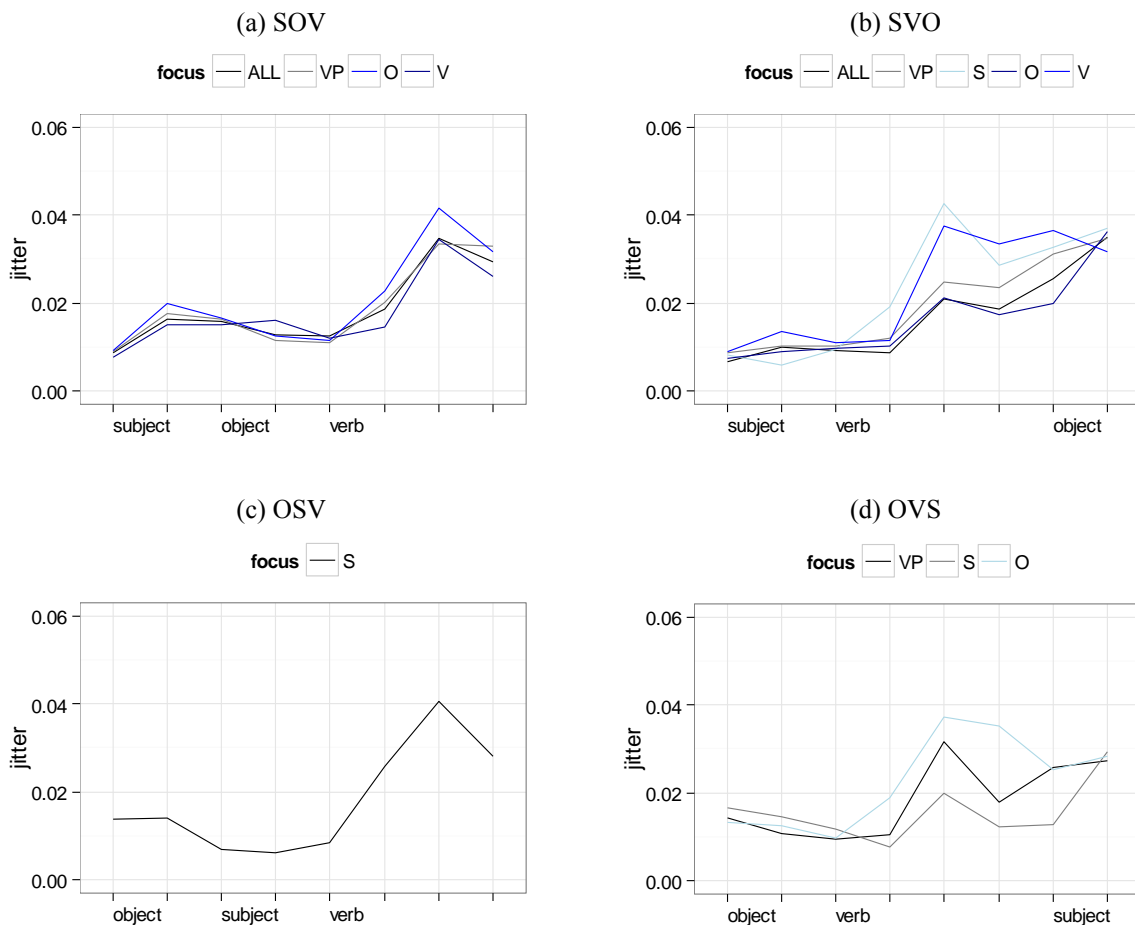
A characteristic property of Georgian speech is the occurrence of creaky voice on final constituents, accompanied by a decrease in intensity and reflected in irregular pitch periods in the waveform (Gordon and Ladefoged 2001: 389) (see for instance the decrease in intensity in the waveform of the last part of the utterances in Figure 10). In our data, creaky voice typically occurs at the end of the utterance, as schematically represented in (19a) (whereby *g* stands for a creaky *a*). It appears more frequently in the postfocal domain, as in (19b–c). In V-medial orders, the verb (or the part of the verb after the stressed syllable) is frequently perceived as creaky, see (19c–d); postverbal material is in many cases creaky as well, see (19c), but is not necessarily so, see (19d).

- (19) a. [nona bebos emudareḡḡa]_F (speaker KET; item 4; token 2)
 S O V
- b. lela [dedas]_F emdureḡḡa. (speaker KET; item 2; token 2)
 S O V
- c. [mamas]_F eloliaveḡḡa niḡḡo. (speaker ETR; item 1; token 2)
 O V S
- d. [bebos]_F emudareḡḡa nona (speaker MAI; item 4; token 2)
 O V S

These observations are confirmed by the average jitter measures in Figure 14. Jitter measures the variation in the duration of fundamental frequency cycles and reflects the degree of aperiodicity in the glottal source, which is a phonetic correlate of creaky phonation (Gordon and Ladefoged 2001: 397). A high value in jitter corresponds to a higher degree of aperiodicity, i.e., it is an indicator of creaky phonation. Figure 14 reveals that the verb position plays a role. While high jitter values in SOV appear at the end of the utterance, a peak in jitter values appears at the end of the verb in SVO, which supports the view that the right edge of the verb is aligned with a prosodic domain. A further influence comes from the focus domain. Higher jitter values appear in conditions with non-final focus (on the final V in SO_FV or on the medial verb in S_FVO, O_FV_S and SV_FO). This finding suggests that creaky phonation has the same distribution as postfocal deaccenting in languages such as English and German and is probably a phonetic correlate of the decrease in intensity in the postnuclear region of the utterance.

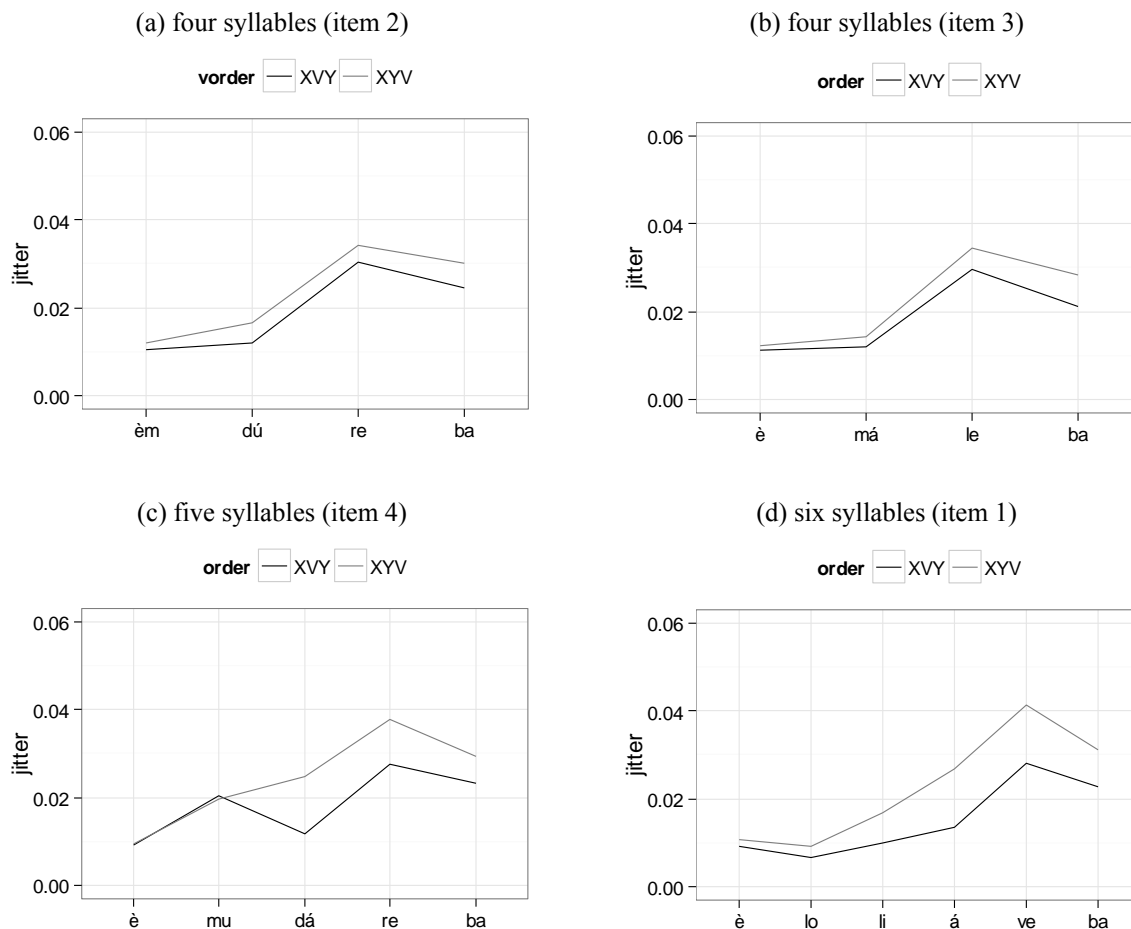
Figure 14. *Average jitter*

average local jitter values obtained for vowels (measured in Praat); verb syllables: first, antepenultimate, penultimate, ultimate



A closer inspection of the verbs in our dataset reveals that creaky phonation emerges after the stressed syllable (the antepenultimate). Figure 15 plots the measurements for each verb separately. The crucial result is that across items, the maximal increase in aperiodicity is – independently of the verb’s length – observed after the stressed antepenultima. The domain of the word following the stress is accompanied by a radical decrease in intensity and periodicity. This finding fits with the observation in Section 5.2.2 that the stressed syllable is the locus of a pitch accent and gives further support for the availability of phonetic correlates of lexical stress in Georgian.

Figure 15. *Medial and final verbs*
 average jitter values obtained for vowels; $n = 80$ per verb in XYV and $n = 128$ per verb in XVY



In order to examine the validity of these observations, we fitted a linear mixed-effects model on the difference in the jitter values between the stressed syllable and the penultima of the verb. The fixed factors of the model refer to the two phenomena that influence phonation: V-POSITION (final; medial) and FOCUS (inside the focus; outside the focus) (SPEAKER/ITEM are introduced to the model as random factors). The results of this model show a significant interaction effect as well as a significant effect of FOCUS (Table 8). V-POSITION does not have a significant effect, which reflects the fact that the average increase in jitter values after the stressed syllable of the verb is similar in XYV/XVY (Figure 15). The role of ORDER is only significant in interaction with FOCUS (see the effects in Figure 14).

Table 8. Linear mixed-effects model on jitter increase after the stressed syllable of the V

	fixed factor	estimate	χ^2 (df)	p
jitter increase =	intercept +	.016		
	FOCUS (outside) +	.002	14.3 (1)	< .001
	V-POSITION (medial) +	-.004	.1 (1)	= .7
	FOCUS^V-POSITION	.009	4.3 (1)	< .05

6.4. Implications for phonological structure

The previous sections reported the effects of focus on prosodic breaks, on the F_0 -contour, and on phonation. Prosodic breaks do not reveal clear evidence for the insertion of a break at the left or right side of a focus (see the discussion of the empirical findings in Table 4 and Table

5). The major effect in the phonation measurements is that modal phonation increases after focus. F_0 -measurements indicate a major role of left alignment of the focus with a prosodic boundary: ALIGNFOC-L has a significant effect on downstep (Section 6.2). However, we also found evidence for ALIGNFOC-R, in particular in the frequencies of rising contours on initial foci (Table 7). This finding shows an effect of Emergence of the Unmarked in the alignment of focus with syntactic phrases. Georgian shows both ALIGNFOC-L and ALIGNFOC-R effects (but not in all contexts): (a) ALIGNFOC-L is visible if ALIGNFOC-R applies vacuously, and (b) the alignment constraints are outranked by MAXBIN, which prevents them from both applying simultaneously.

(20) Constraint ranking

MAXBIN >> NOPHRASE >> ALIGNFOC-R >> ALIGNFOC-L >> MATCH

First, final focus is illustrated in Tableaux 4 and 5. SOV is the basic order in Georgian. ALIGNFOC-R applies vacuously for final foci, to the effect that the winning candidate is the one that satisfies ALIGNFOC-L, phrasing the final focus separately from the prefocal material. These assumptions about prosodic phrasing account for the fact that the downstep does not apply before final foci (see SOV_F , SVO_F and OVS_F in Figure 11b). The initial constituent appears more frequently with a falling contour in this case, which was taken as an indication that the prefocal material is prosodically integrated in a single prosodic constituent (see also the dependencies in Figure 13). The constraint MATCH has no effect in the following tableaux. It is ranked below the Align constraints, which renders it inactive in the sentences with narrow focus illustrated here. Its effect was illustrated in Tableaux 1 to 3 with wide focus. It was shown there to play an active role in the choice of candidates.

Tableau 4. XYZ_F ($SVO_F/OVS_F/SOV_F$)

[X [Y [Z _F]]]	MAXBIN	NOPHRASE	ALIGN FOC-R	ALIGN FOC-L	MATCH
$((X Y Z)_{\varphi})_t$	*!	*		*	*
$((X)_{\varphi} (Y Z)_{\varphi})_t$		**		*!	
$\curvearrowright ((X Y)_{\varphi} (Z)_{\varphi})_t$		**			*
$((X)_{\varphi} (Y)_{\varphi} (Z)_{\varphi})_t$		***!			

In the case of initial foci, ALIGNFOC-L applies vacuously: the only active constraint is ALIGNFOC-R in this case (Tableau 5). There is evidence that the initial constituent constitutes a separate Prosodic Phrase: rising contours are more frequent in S_FVO and O_FVS (see the effect of ALIGNFOC-R in Table 7 and the counts in Appendix I). The postfocal domain in S_FVO/O_FVS is realized with low pitch (Figure 11) and creaky phonation (Figure 14). The realizations of both the first prosodic phrase and the second one are accounted for by ALIGNFOC-R, which has the effect of inserting a boundary after the initial focus.

Tableau 5. X_FVZ (S_FVO/O_FVS)

[X _F [V [Y]]]	MAXBIN	NOPHRASE	ALIGN FOC-R	ALIGN FOC-L	MATCH
((X V Y) _φ) _l	*!	*	*		*
☞ ((X) _φ (V Y) _φ) _l		**			
((X V) _φ (Y) _φ) _l		**	*!		*
((X) _φ (V) _φ (Y) _φ) _l		***!			

The ranking between ALIGNFOC-L and ALIGNFOC-R only plays a significant role in medial focus. In SO_FV/OS_FV, the constraint ranking in (20) predicts that the medial focus is phrased together with the prefocal material. This prediction accounts for the fact that initial constituents are realized with a falling contour (see the negative effect of ALIGNFOC-L on initial contours in Table 7 and the counts in Appendix I): falling contours are more frequently attested in SO_FV/OS_FV. Postfocal material is deaccented and frequently realized with creaky phonation (Figure 14). The pitch averages in Figure 11 reveal a difference between medial focus in SO_FV/OS_FV and medial focus in SV_FO: the former orders display a rising contour on the medial constituent, while there is no visible effect of a rising contour on the verb in the latter case. This difference is not accounted for by the present assumptions, and is probably related to the difference between arguments and predicates in prominence: arguments are regularly prominent, but verbs only exceptionally so. As a correlate of this difference, it seems that postfocal deaccenting has a larger effect on verbs than on arguments.

Tableau 6. XY_FZ (SO_FV, OS_FV, SV_FO)

[X [Y _F [Z]]]	MAXBIN	NOPHRASE	ALIGN FOC-R	ALIGN FOC-L	MATCH
((X Y Z) _φ) _l	*!	*	*	*	*
((X) _φ (Y Z) _φ) _l		**	*!		
☞ ((X Y) _φ (Z) _φ) _l		**		*	*
((X) _φ (Y) _φ (Z) _φ) _l		***!			

Finally, our data contains three cases of VP-focus: S[OV]_F, S[VO]_F, and [OV]_FS. The constraint ranking predicts the phrasing (S)_φ(OV)_φ and (S)_φ(VO)_φ for VP-focus (Tableau 7). In the average pitch contours, there is no difference between the prosodic realization of VP-focus and all-focus in the SOV/SVO orders (Figure 11). Initial VP-focus is expected to be phrased as (OV)_φ(S)_φ (Tableau 8). Figure 11 indicates that the major contrast in the OVS order is between OVS_F and [OV]_FS/O_FVS. The difference between the latter orders is that rising contours are more frequent

in O_FVS (Appendix I), which confirms the view that the O is phrased separately in O_FVS but not in $[OV]_{FS}$.

Tableau 7. $S[XY]_F$ ($S[OV]_F$, $S[VO]_F$)

$[S[X Y]_F]$	MAXBIN	NOPHRASE	ALIGN FOC-R	ALIGN FOC-L	MATCH
$((SXY)_\varphi)_t$	*!	*		*	*
$\curvearrowright ((S)_\varphi(XY)_\varphi)_t$		**			
$((SX)_\varphi(Y)_\varphi)_t$		**		*!	*
$((S)_\varphi(X)_\varphi(Y)_\varphi)_t$		***!			

Tableau 8. $[OV]_{FS}$

$[[OV]_{FS}]$	MAXBIN	NOPHRASE	ALIGN FOC-R	ALIGN FOC-L	MATCH
$((OVS)_\varphi)_t$	*!	*	*		*
$((O)_\varphi(VS)_\varphi)_t$		**	*!		*
$\curvearrowright ((OV)_\varphi(S)_\varphi)_t$		**			
$((O)_\varphi(V)_\varphi(S)_\varphi)_t$		***!			

7. Conclusion

This article presented a study on the influence of syntax and information structure on Georgian prosody. The analysis of the prosodic facts resulted in two major insights.

Georgian is an SOV language that allows several word order permutations depending on the context. The examination of the intonational contours revealed a contrast in the prosodic structure of SOV and SVO utterances. While SOV utterances have downstep throughout, a subset of SVO sentences have no downstep at the right edge of verb. This finding shows that the part of the utterance up to the verb is prosodically mapped to a syntactic constituent, a result in line with previous observations on the prosody of V-final languages (Section 2.1). These phenomena provide strong evidence that syntactic configurations are reflected in the prosodic structure, as assumed by the family of MATCH-constraints for the syntax-prosody interface.

The second conclusion of this study relates to the effects of focus on phonological structure. Previous studies on Georgian have suggested that focus is expressed by pitch accents similarly to intonational languages like English or German, in which the phonological head of the focused domain bears a pitch accent. The data analyzed in this paper shows that there is evidence for pitch accents realized at the syllable carrying the primary stress. Phonetic correlates of this pitch accent are found in an H-target within the stressed syllable (Figure 7); further evidence is found in creaky phonation, which increases immediately after the accent (Figure 15). These findings confirm the existence of pitch accents in Georgian: their effect is only visible in words with more than three syllables, since in these words the stressed syllable does not coincide with the carrier of the phrase tone at the left edge of the prosodic word domain. However, no evidence could be found that the occurrence or the contour of these accents is influenced by focus (Figure 7).

As a third result, it could be shown that focus is mainly expressed by prosodic phrasing. It is often aligned with prosodic boundaries that are visible in the break durations, in the frequencies of contours on initial constituents, and in the downstep of phrase tones. These phenomena cannot be easily accommodated in terms of a categorical distinction between left and right alignment of the focus with prosodic boundaries. We found evidence for alignment on both sides of the focus, although these phenomena do not appear simultaneously. Final foci are aligned with a high phrase tone at the left edge, initial foci are aligned with a high phrase tone at the right edge, and medial foci are prosodically integrated in a constituent preceding the focus and separated from the postfocal material. These findings lead to the conclusion that Georgian prosody presents a not yet established language type in the prosodic typology of focus: both alignment constraints apply but are outranked by a higher-order constraint restricting the proliferation of the prosodic contour (MAXBIN).

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Appendix I. Contour on the initial word

F_0 -max alignment in Figure 3 and Figure 12 is the quotient of the part of the word up to F_0 -max through the word's total duration (calculated using the following formula, whereby t_α is the time point of the left edge and t_β the time point of the right edge of the first constituent):

$$alignment = \frac{t_{max} - t_\alpha}{t_\beta - t_\alpha}$$

The distribution of the data from F_0 -max alignment is bimodal. A cluster analysis carried out in SPSS revealed two clusters with centers at .38 and .82 of the word's duration ($F_{1,830} = 3831; p < .001$); the clustering procedure classified the data into two groups around the threshold of .6, which we adopt for the distinction between 'falling contour' (early F_0 -max alignment) and 'rising contour' (late F_0 -max alignment). Table 9 reports the n of tokens that were assigned to each cluster in each condition.

Table 9. Frequencies of rising and falling contours on the initial constituent (threshold = .6)

order	focus	rising contour		falling contour		total	
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
SOV	all	41	64	23	36	64	100
	VP	44	69	20	31	64	100
	O	34	53	30	47	64	100
	V	43	67	21	33	64	100
SVO	all	45	70	19	30	64	100
	VP	44	69	20	31	64	100
	S	54	84	10	16	64	100
	O	45	70	19	30	64	100
	V	45	70	19	30	64	100
OSV	S	29	45	35	55	64	100
OVS	VP	57	89	7	11	64	100
	S	50	78	14	22	64	100
	O	63	98	1	2	64	100

Appendix II. Syllable durations

Table 10. Average durations of stressed syllables

order	focus	initial word		medial word		final word		verb	
		(first syllable)		(first syllable)		(first syllable)		(antepenultima)	
		<i>mean</i>	SE	<i>mean</i>	SE	<i>mean</i>	SE	<i>mean</i>	SE
SOV	all	142	7.0	156	5.6	108	6.6	164	3.6
	VP	141	10.2	154	5.4	116	8.1	160	5.8
	O	144	11.2	178	3.3	113	6.1	165	4.0
	V	142	8.6	153	5.7	130	7.6	173	3.8
SVO	all	130	9.1	114	7.6	185	4.2	144	3.4
	VP	142	10.5	121	7.0	181	5.2	149	4.8
	S	175	9.3	109	7.8	168	3.2	148	3.4

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	O	140	11.1	113	6.9	202	5.8	133	5.0
	V	139	13.0	142	5.6	172	3.9	156	4.5
OSV	S	134	8.0	184	6.0	126	4.5	172	5.8
OVS	VP	139	4.9	116	7.8	181	6.8	151	3.2
	S	135	4.6	104	7.5	217	6.5	138	3.5
	O	151	3.6	104	4.6	171	5.8	146	2.4

Appendix III. Prosodic breaks

Table 11. Average durations of prosodic breaks (in msec)
(outliers larger than 2.5 standard deviations from the mean were eliminated)

order	focus	$\omega_1 \mid \omega_2 \omega_3$		$\omega_1 \omega_2 \mid \omega_3$	
		<i>mean</i>	SE	<i>mean</i>	SE
SOV	all	14	4.9	6	1.1
	VP	16	5.2	6	2.9
	O	20	5.7	4	0.8
	V	16	5.2	21	8.2
SVO	all	6	4.0	10	4.7
	VP	11	3.9	13	4.9
	S	12	4.0	17	5.5
	O	9	4.3	14	5.7
	V	19	5.6	16	5.4
OSV	S	23	5.1	5	1.1
OVS	VP	7	2.5	7	1.2
	S	5	0.9	6	1.0
	O	4	0.9	5	0.9