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Prosodic cues for exhaustive interpretations: A production study on Georgian intonation[1]

The expression of focus in Georgian differs from the expression of focus in other intonational languages like English and German. The crucial prosodic device in Georgian is the division of the utterance in prosodic phrases, signaled by boundary tones. In contrast to German and English, pitch accents – if present at all in Georgian – do not constitute unambiguous cues for the focus structure, even though pitch register extension is a possible correlate of focus. However, it has been observed for other languages that a particular prosodic realization of noun phrase subconstituents may evoke an exhaustive interpretation, i.e., a reading in which the relevant alternatives in discourse are excluded. This phenomenon is well known from languages like English or German, which may signal focus through pitch accents, but is puzzling for a language like Georgian, which lacks this prosodic strategy. This article presents a small-scale production study on the prosodic reflexes of exhaustivity in Georgian. Our findings show that prosodic phrasing is the main correlate of exhaustivity, but that the element on which exhaustivity is coded may present phonetic features resembling pitch accent. These features are not associated with a single syllable, but rather affect the entire word.

1. Preliminaries

Focus is often signaled through the prosodic prominence of the focused constituent (see JACKENDOFF 1972, TRUCKENBRODT 1999, BÜRING 2010, among others). The intonational correlate of the concept of 'prosodic prominence' in languages like English is a pitch accent associated with the stressed syllable of the prosodic head of the focused constituent, as indicated by the capital letters in the answer in (1).

(1)   {Who caught the trout?}
        The young FIsherman caught the trout.

Previous research on the relation between prosody and information structure has shown that the phenomenon illustrated in (1) is by far not universal. Since it requires the possibility to manipulate the pitch realization of the stressed syllable, it is mainly found in languages with

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lexical accents that are not tonally specified, such as English, German, or Greek (see FÉRY 2010). Languages that do not use pitch accents for signaling focus may use other prosodic devices instead, e.g., prosodic phrasing as indicated by phrasal tones and other cues (see BÜRING 2010, FÉRY 2010). However, in these languages, focus is not expressed by a suprasegmental correlate that is locally associated with the focused constituent. Phrasal tones provide 'indirect' cues for identifying the focus, since they just determine the boundaries between prosodic entities; the identification of the focus is only possible with reference to additional rules.

The crucial question is to what extent a language of this type can express the complex contrasts that are known from pitch-accent languages. A problem of this kind is the interpretational effect that we obtain through the accentuation of different noun phrase subconstituents, e.g., the distinction between 'THREE boys' and 'three BOYS' in an English-type language. How is it possible to implement this contrast phonetically in a language that does not have focus-to-accent association? This is the research question of this article: the object language is Georgian and the phenomenon at issue is the exhaustive interpretation evoked through the accentuation of quantifiers.

Georgian is a language that does not necessarily display an association of focus with particular pitch accents. SKOPETEAS & FÉRY (2010) have shown that the variation in the tonal realization of preverbal constituents in Georgian cannot be accounted for in terms of the association of focus with particular pitch accents, and FÉRY (2010) shows that the word order patterns that correlate with different focus options can be accounted for through constraints referring to the alignment of the focus constituent with boundaries of prosodic phrases. However, it has been observed that speakers can perceive focus on a noun phrase subconstituent in situ (see SKOPETEAS & FANSELOW 2010), as illustrated by the examples (2a–b). The neutral realization of the utterance in (2a) evokes the literal interpretation of the quantifier (and motivates the conclusion 'so we can buy the present'). Focus on the existential quantifier in (2b) has the effect that the asserted quantity is contrasted to alternative amounts of the set of quantities that are contextually relevant (e.g., the expected amount of Lari). This contrast has the effect that the denoted quantity is interpreted as being below the expected standard and motivates a different conclusion: 'so we cannot buy the present.'

(2a) *čven*   *ramdenime*   *lar-i*   *še-v-a-grov-e-t...*
     1.PL.ERG some/a.few(NOM) Lari-NOM   PR-SBJ.1-PV-gain-AOR-PL
     'we gained some Lari...' {...so we can buy the present.}

(2b) *čven*   *RAMDENIME*   *lar-i*   *še-v-a-grov-e-t...*
     1.PL.ERG some/a.few(NOM) Lari-NOM   PR-SBJ.1-PV-gain-AOR-PL
     'We have gained a few Lari, ...' {...so we cannot buy the present.}

The question of this article is how the minimal pair in (2) is possible in a language in which focus is not necessarily associated with particular pitch accents. According to our understanding of Georgian intonation, at least focus on the preverbal constituents is not always signaled through pitch accents in this language. Hence, the minimal pair in (2a–b) implies that either our generalizations so far do not apply to this data or that Georgian uses phonetic cues in a different way from pitch accents that can assign a preverbal constituent a focus interpretation. These possibilities are the matter of empirical investigation; in order to obtain data for this issue, we carried out a small-scale production study.

First, we summarize the findings of previous research on Georgian syntax and prosody, with particular emphasis to the issues related to information structure, in Section 2. Section 3 presents some interpretational effects of narrow focus on quantifiers and Section 4 introduces the empirical study based on these effects. Section 5 discusses the empirical findings of this study and Section 6 concludes this article.

2.   Georgian syntax and prosody

Georgian is a head-final language with postpositions and basic SOV order. The order within the VP is very flexible, i.e., SOV alternates with SVO with considerable freedom and there are only a few constructions providing evidence that the former and not the latter order is the basic option in this language (see discussion in ANDERSON 1984: 186; ARONSON 1982: 47; BOEDER 2005: 64; HARRIS 1981: 22, 2000: 141; SKOPETEAS & FANSELOW 2010). Crucially, there are two alternative realizations of focus which can occur in the same contexts. Focus is preferably realized in the immediately preverbal position, and hence the SOV order can be an instance of object focus and OSV an instance of subject focus. Alternatively, focus is realized postverbally, and hence SVO can be an instance of object focus, and OVS of subject focus. In some languages, the alternative realizations of focus correspond to different focus types. For instance, preverbal focus in Hungarian is used for the expression of identificational focus (or exhaustivity), while postverbal focus introduces new information (É. KISS 1998, HORVATH 2009, among others). In Georgian, however, the preverbal and postverbal focus types are not restricted to a particular type of focus. Exhaustivity tests show that both preverbal as well as postverbal focus may motivate an exhaustive interpretation (see data and discussion in SKOPETEAS & FANSELOW 2010).

The crucial question for our purpose is whether Georgian displays pitch accents associated with the lexical accents in the way that is known for languages like English, German, or Greek. The concept of lexical accent is weakly implemented in Georgian, which is reflected in the divergent assumptions of Georgian grammarians about the locus of word stress in

this language (see ALKHAZISHVILI 1959; KIZIRIA 1987; TEVDORADZE 1978; ZHGHENTI 1963; discussion in VICENIK & JUN 2008 and SKOPETEAS, FÉRY & ASATIANI 2009). One of the characteristic properties of Georgian intonation is that the non-final prosodic constituents in declarative sentences are typically realized with a clear tonal contour, often rising, but sometimes falling (see VICENIK & JUN 2008; SKOPETEAS, FÉRY & ASATIANI 2009). We analyze these contours as the intonational product of phrasal tones associated with the right edge of non-final prosodic constituents. Hence, the typological expectation for a language lacking a clear distribution of prominence at the lexical level and using boundary tones instead is that postlexical pitch accents will have a less prominent role in the prosodic structure (see FÉRY 2010). Alternatively, prominence can be realized with correlates different from pitch, e.g., with intensity or voice modality, or whole words can be rendered more prominent, e.g., by changing duration, voice modality and/or pitch register.

Empirical studies on Georgian intonation have established two different views on this issue. On the one hand, VICENIK & JUN (2008 and subsequent work) observe that focused constituents are realized with a H* or L+H* pitch accent.[2] Thus, in their view, Georgian is an ordinary language with pitch accents, of the same type as English, German, or Greek. On the other hand, on the basis of a quantitative study, SKOPETEAS & FÉRY (2010) show that there is considerable variation in the pitch realization of preverbal constituents in general, and that the identified patterns do not unambiguously correlate with focus. Pre-verbal constituents are fully intonated, regardless of their focused status. Focus on postverbal constituents is often realized with a characteristic low and flat pattern on the whole word, labeled 'super-low' in SKOPETEAS & FÉRY (2010). This pattern is not a pitch accent associated with the stressed syllable, but rather a word melody.

In both accounts, focus interacts with prosodic phrasing. VICENIK & JUN (2008) observe that an intermediate phrase boundary can be inserted before the focused phrase. SKOPETEAS & FÉRY (2010) argue that the variation observed in preverbal constituents can be accounted for if we assume a preference for the focused constituent to be phrased separately from the rest of the utterance. FÉRY (2010) shows that word order variation in production data can be accounted for if we assume a highly-ranked constraint for the focused constituent to be aligned with the left edge of a prosodic phrase.

In sum, the crucial issues to be solved are the following: (a) preverbal and postverbal focus do not have interpretational differences in Georgian,

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[2] In autosegmental-metrical notation, a H* is a high target of the intonational contour that is associated with the stressed syllable, while an L+H* is a rise whose high target (H) is associated with the stressed syllable.

i.e., both options can motivate an exhaustive interpretation; (b) there is evidence that phrasing and phrasal tones are crucial for the identification of the focus structure of the utterance; (c) the question remains to be elucidated whether instances of pitch variation in Georgian are correlates of pitch accents, or whether they are indicators of a global prominence on certain words. To this aim, our study compares two readings of the same sentences with constant word order. It is expected that the difference in reading correlates with the prominence of a single word, a quantifier.

3. Exhaustivity and the interpretation of quantifiers

A number of studies on Hungarian argue that the constituent structure of this language involves a left-peripheral position that always surfaces left adjacent to the finite verb and is inherently associated with an interpretable feature [+exhaustive] (see É. KISS 1998, 2010; HORVATH 2009). This means that elements occurring in this position obtain an exhaustive interpretation, i.e., they assert that the proposition holds true for only one member of a set of contextually relevant alternatives. Evidence for this generalization comes from minimal pairs contrasting the interpretation of constituents in this preverbal position and in the postverbal domain and showing that only the former option gives rise to a reading excluding relevant alternatives.

É. KISS (2010: 77–88) presents new arguments for the exhaustivity of the Hungarian focus position. An interesting piece of evidence for the exhaustivity account on Hungarian focus comes from the upward extension of indefinite quantifiers such as 'a couple of' or 'few.' The basic observation is that in non-focused configurations these elements allow for a reading in which they do not literally refer to a low quantity but to any quantity that entails a low quantity. The effect of this phenomenon can be observed in example (3). The quantifier *pár* 'couple' is upwards extended, such that the continuation presupposing that the corresponding quantity is enough for the purpose at issue is felicitous (see É. KISS 2010: 84).

(3) *Pár   forint   össze-gyűlt   ...*
     couple   forint   PRT-gathered
     'A few forints were collected...' (...so we could buy the present).
     (É. KISS 2010: 83f.)

The quantifier phrase in (3) is in a sentence-initial position that is not focused. In Hungarian, this can be seen from the fact that the verbal particle (*össze-* 'PRT') precedes the verb. When a constituent occupies the focus position, the finite verb is attracted to a position that is right adjacent to the focus. As a result, the preverb is stranded in the postverbal domain, as exemplified in (4). Crucially, the placement of the quantifier phrase into the focus position has an effect on the interpretation: the

asserted quantity is now understood as the sole member of the scale of quantities for which the proposition holds true. The upward extension of the quantifier is not possible anymore. The presupposition that the corresponding quantity is enough for the purpose at issue is now impossible (see É. Kiss 2010: 84).

(4) *Pár   forint   gyűlt   őssze...*
      couple forint   gathered   PRT
      'It was a few forints that were collected...' (...so we couldn't buy the present) (É. Kiss 2010: 83f.)

The empirical situation presented in (3)–(4) allows for two alternative accounts. The straightforward conclusion from the interpretation of (4) is that the structural position occupied by the noun phrase *pár forint* 'couple forint' bears the feature [+exhaustive] in (4) but not in (3). This conclusion is pursued by a paradigm of accounts of the Hungarian left periphery assuming that the exhaustivity feature is part of the syntactic position that immediately precedes the finite verb (see É. Kiss 1998, 2010; Horvath 2009). However, the phenomenon of evoking alternatives, which is attested in (4), is a general property of focus that is also observed independently of syntactic constructions, e.g., in instances of intonational focus (see Rooth 1992, 1996). The interpretational properties of (4) can also be explained if we take into account that the intonational nucleus of a Hungarian utterance is always associated with the left edge of the intonational phrase that contains the predicate (see Szendrői 2001, 2003). The syntactic position preceding the predicate is obligatorily accented in Hungarian, and this property motivates a reading evoking alternatives which blocks the upward extension of the quantifier in (4). In contrast to the immediately preverbal position, either topicalized or postverbal material cannot bear the intonational nucleus and consequently does not evoke alternatives.

Georgian differs from Hungarian in that it allows two options for expressing narrow focus, i.e., an immediately preverbal option and a postverbal one (see discussion in Section 2). It is crucial that the corresponding linear orders are ambiguous with respect to the focus structure, i.e., the O in SOV and in SVO can be either in narrow focus or part of a broad focus domain. In a neutral realization of an object quantifier phrase, as illustrated in (5a–b), native speakers accept in both orders the upward extension of the quantifier which renders the positive continuation felicitous.[3] The interesting point is that native speakers of Georgian have the intuition that the same utterances can be realized in a way that motivates an exhaustive interpretation, similar to the interpretation of the Hungarian focus position (see Skopeteas &

FANSELOW 2010). In the exhaustive reading, the negative continuation is judged as felicitous and the positive continuation is rejected. This interpretation is independent of the constituent structure in Georgian, i.e., it appears both in SOV and in SVO order.

(5a) *čven   ramdenime   lar-i   še-v-a-grov-e-t...*
     1.PL.ERG some/a.few(NOM) Lari-NOM   PR-SBJ.1-PV-gain-AOR-PL
     'we gained a few Lari...'
     (...so we could buy the present)
     (...so we couldn't buy the present)

(5b) *čven   še-v-a-grov-e-t   ramdenime   lari   ...*
     1.PL.ERG PR-SBJ.1-PV-gain-AOR-PL some/a.few(NOM)   Lari-NOM
     'we gained a few Lari...'
     (...so we could buy the present)
     (...so we couldn't buy the present)

The question at issue is what the properties of the 'realization' of the utterance that motivate these alternative interpretations are. This question is of particular relevance for a language of the prosodic type of Georgian, i.e., a language that does not display a straightforward association between focus and pitch accents.

4. Method

In order to examine this question we carried out an experimental study in language production. The experiment examines two factors: (a) WORD ORDER: SOV vs. SVO; and (b) EXHAUSTIVITY: non-exhaustive vs. exhaustive. Full permutation of the levels of these factors results in $2 \times 2 = 4$ experimental conditions. These four conditions were implemented in two items: the item presented in (6a) and the item presented in (6b).

(6a) *čven   ramdenime   lar-i   še-v-a-grov-e-t...*
     1.PL.ERG some/a.few(NOM) Lari-NOM PR-S.1-PV-gain-AOR-S.1.PL
     'we gained a few Lari...'
     -   non-exhaustive continuation:
         ... ase   rom   še-gv-i-dzl-i-a
         so   that   PR-SINV.1.PL-PV-can-PRS-OINV.3
         sačukr-is   q'id-v-a.
         present-GEN   buy-TM-INF.NOM
         '... so we could buy the present'.
     -   exhaustive continuation: '... so we could buy the present'.
         ... ase   rom   ar   še-gv-i-dzl-i-a
         so   that   NEG   PR-SINV.1.PL-PV-can-PRS-OINV.3

sačukr-is   q'id-v-a.
present-GEN   buy-TM-INF.NOM
'... so we could not buy the present'.

(6b) *čven   ramdenime   k'anpet'-i   v-i-q'id-e-t...*
1.PL.ERG some/a.few(NOM) candy-NOM S.1-PV-buy-AOR-S.1.PL
'We bought a few candies...'
- non-exhaustive continuation:
    ... ase   rom soso   k'maq'opil-i
    so   that Soso(NOM) satisfactory-NOM
    da-rč-eb-a.
    PR.FUT-stay-TM-S.3.SG
    '... so Soso will be happy'.
- exhaustive continuation:
    ... ase   rom soso   k'maq'opil-i   ar
    so   that Soso(NOM) satisfactory-NOM   NEG
    da-rč-eb-a.
    PR.FUT-stay-TM-S.3.SG
    '...so Soso will not be happy.'

The Georgian speakers were presented the sentences (involving the target utterances and one of the two continuations) in written version. Their task was to carefully read the sentences and then to perform them orally without looking at the written text. Our purpose was to study the phonetic properties of the realization that motivated the exhaustive reading of the indefinite quantifier.

The experimental material was randomized within larger experimental sessions that contained tasks from two other production experiments. The proportion of the elements of the present study in these sessions was 1:8. In the following, we discuss the data that were obtained from four speakers who read the entire set of sentences twice; one speaker read the sentences three times and we report all her performances.[4] This results in a dataset of 2 (items) × 2 (performances) × 3 (speakers) + 2 (items) × 3 (performances) × 1 (speaker) = 18 sentences per experimental condition. The recordings took place in Berlin, December 2007. All speakers were native speakers of Georgian (all female, age range: 21–27, average age: 23.2), grew up in Georgia and had been living there until recently (0.6 to 3 years before the recordings). Recordings were made in a DAT-recorder (Sony 100) and were converted into .wav files at a 22 050 Hz sampling frequency.

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[4] Three further speakers were recorded; however, they had obvious difficulties in understanding this task and their data were excluded from this report.

5. Results

In this section, the prosodic properties of the 72 recorded utterances (18 utterances pro experimental condition) are reported. First, we report the global effects that appear at the boundary between the two clauses (see Section 5.1). Second, the local effects in the realization of the quantifier that correlate with the examined discourse conditions are examined (see Section 5.2).

5.1. Global effects

The first result amounts to global prosodic differences that depend on the examined conditions. The most important one is to be found in the correlates of phrasing. In the exhaustive version, the first clause generally ends in a low tonal target that is aligned with the right boundary or with the first syllable of the last word; see illustration in Figure 1. This realization is dominant in the exhaustive condition: it occurs in 35 out of 36 cases, i.e., 97% (see distributions in Table 1).

Figure 1. Low boundary (exhaustive, SVO, speaker TAM, item 1/token 2)
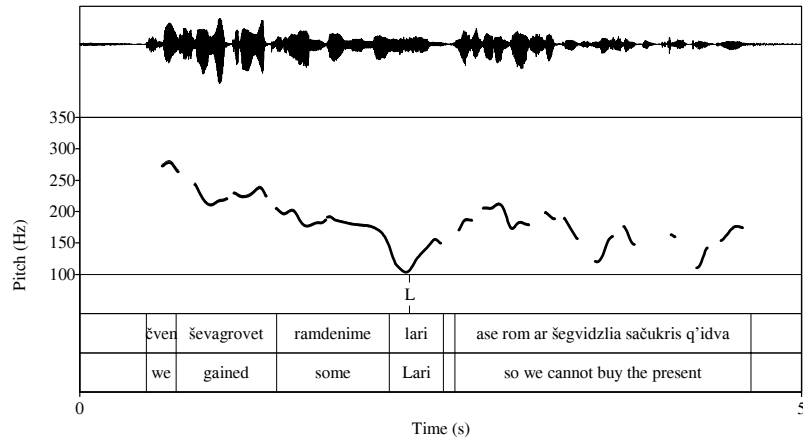
By contrast, in the non-exhaustive versions, a low boundary tone ends the first clause in only 24 cases (67%). In the further 12 cases, we observe a high tonal target, as indicated by 'H' in Figure 2.

Figure 2. High boundary (non-exhaustive, SVO, speaker TAM, item 1/1)

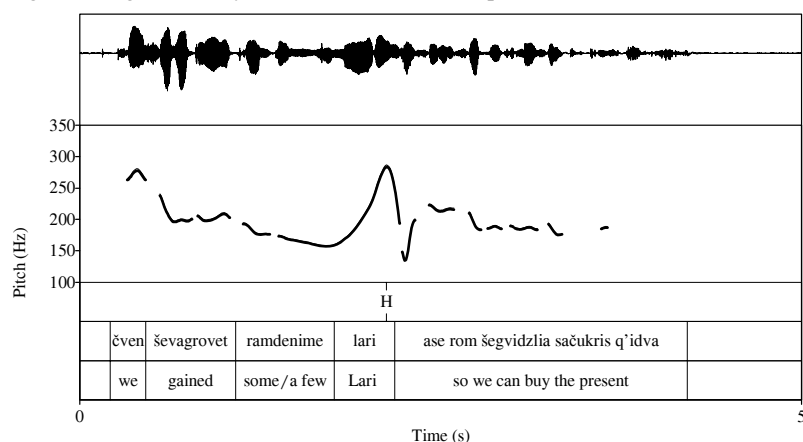|	čven	ševagrovet	ramdenime	lari	ase rom šegvidzlia sačukris q'idva	
	we	gained	some / a few	Lari	so we can buy the present	

Table 1 summarizes the frequency of these two realizations in the four examined conditions. The crucial generalization from this table is that the occurrence of high or low tonal targets at the right edge of the first clause correlates with the contrast between exhaustive and non-exhaustive utterances and is not influenced by the word order manipulation in the first clause (SOV vs. SVO). A repeated-measures analysis of variance on the speaker-aggregated data reveals a marginally significant main effect of exhaustivity ($F_{1,4} = 8.6$, $p < .06$), but not a significant main effect of order nor a significant interaction effect.

Table 1. Boundary tones aligned with the end of the first clause

	non-exhaustive				exhaustive			
	L		H		L		H	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
SOV	*12*	67	*6*	33	*17*	94	*1*	6
SVO	*12*	67	*6*	33	*18*	100	*0*	0
total	*24*	67	*12*	33	*35*	97	*1*	3

The distribution of pauses goes into the same direction. In the exhaustive version, there were more pauses between the two clauses than when it was used non-exhaustively. For instance, a small pause of .09 seconds can be observed in Figure 1. Altogether there were 29 pauses ($\geq .05$ sec) after the first clause in the exhaustive readings (means: .23 sec; SE of the means: .03), and 20 pauses ($\geq .05$ sec) in the non-exhaustive readings (means: .27 sec; SE of the means: .04). Similar to our observations on clause boundaries, the crucial factor for the distribution of pauses is the difference between exhaustive and non-exhaustive interpretations (see results in Table 2). The effects that may be observed in Table 2 do not reach statistical significance.

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Table 2. Pauses (≥ .05 sec) at the end of the first clause

	non-exhaustive				exhaustive			
	pause		no pause		pause		no pause	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
SOV	*10*	56	*8*	44	*13*	72	*5*	28
SVO	*10*	56	*8*	44	*16*	89	*2*	11
total	*20*	56	*16*	44	*29*	81	*7*	19

A final question is whether the occurrence of low boundaries depends on the presence of pauses. Our data shows that the presence of a pause is not a *conditio sine qua non* for the occurrence of a low boundary. However, we observe that a low boundary at the end of the first clause is more frequent when the speaker realizes a pause at the end of this clause (43 out of 49 tokens, i.e., 88%) than in the utterances without pause (16 out of 23 tokens, i.e., 70%).

These data show that there is a difference in the global properties of the utterances which is sensitive to the examined conditions, in particular the contrast between exhaustive and non-exhaustive readings. The observed difference relates to the prosodic integration of the two clauses under a higher intonational unit. In the non-exhaustive versions, we observe a frequent high prosodic boundary at the end of the first clause. Based on the knowledge from intonational languages, this high boundary may correspond to a 'continuation rise,' i.e., to a signal that the utterance contains a further intonational unit. In contrast, the occurrence of a low boundary signals that the second clause is not part of the large prosodic constituent started in the first sentence. A (partial) pitch reset at the left edge of the second clause signals the beginning of a separate intonational unit; see Figure 1. Furthermore, the assumption that these boundaries correlate with prosodic integration is strengthened by the observation that they are accompanied by pauses.

The question is where these global effects come from. We speculate that this prosodic difference reflects the semantic relationship between the two clauses. In the non-exhaustive version, the first clause expresses the achievement of the intended outcome which allows for the realization of the purpose expressed in the second clause ('so we could buy the present' in (6a) or 'so Soso will be happy' in (6b)). In this case, the two clauses are frequently realized as parts of a higher intonational unit, and this is indicated by the high boundary at the end of the first clause. In the exhaustive version, the first clause expresses a failure to achieve the intended target, which leads to the non-intended consequence expressed in the second clause ('so we could not buy the present' in (6a) or 'so Soso will not be happy' in (6b)). The two clauses are almost never integrated into a higher intonational unit, which is reflected in the fact that they are

almost always separated by a low prosodic boundary (with a single counterexample), often accompanied by a pause.

5.2. *Realization of the quantifier*

The crucial issue for our purposes relates to the phonetic effects that are found in the quantifier *ramdenime* 'some/a few.' This word was realized in many different ways, but there were clear tendencies which can be interpreted as typical for the one or the other reading. All in all, the word was perceived as more prominent in its exhaustive than in its non-exhaustive version. There were a number of phonetic correlates for prominence that are discussed in this section, notably in duration and the occurrence of modal voice. Crucially, the correlates of exhaustivity in the word melody are less clear, as will be discussed in detail.

Comparing the realizations of the target word *ramdenime* 'some/a few' in Figure 1 and Figure 2 reveals a slight difference: in the non-exhaustive version (Figure 2) the duration of this word is 685 msec, while in the exhaustive version (Figure 1) the same word is longer, i.e., 782 msec. This difference is not accidental, but is indicative of a general pattern. The quantifier generally has a longer duration in the exhaustive than in the non-exhaustive interpretation, a difference in agreement with the prosodic prominence of the quantifier in the exhaustive version. The mean durations (and the standard errors of the means) are reported in Table 3. The measurements in this table show that the quantifier is generally longer in the SVO order, in which it is part of the final constituent (the object). This final lengthening effect has been observed in previous studies in Georgian (see the same effect on final objects in SKOPETEAS & FÉRY 2010) as well as in several languages (see summary in KÜGLER & GENZEL 2009). Table 3 shows that the quantifier *ramdenime* 'some/a few' is longer in the exhaustive condition independent of the word order effect. This effect on duration replicates previous findings showing that narrow focus correlates with a lengthening of the focused constituent in Georgian (see SKOPETEAS & FÉRY 2010). A repeated-measures analysis of variance on the speaker-aggregated data reveals a significant main effect of order ($F_{1,4} = 28.7$, $p < .05$), a marginally significant main effect of exhaustivity ($F_{1,4} = 7.4$, $p < .07$), and no significant interaction effect.

Table 3. Duration of the quantifier *ramdenime* 'some/a few' in msec

	non-exhaustive		exhaustive	
	mean	std. error	*mean*	std. error
SOV	*560*	8.7	*647*	16.3
SVO	*633*	16.4	*713*	19.3
mean	*596*		*680*	

Another property of the word *ramdenime* 'some/a few' which was found in many instances of its exhaustive reading is a breathy modal voice. Breathy voice is realized on the first syllable (*ram*) of the quantifier and is very frequently accompanied by a particular lengthening of this syllable, as illustrated in Figure 3, in which the first syllable is realized with breathy phonation and is longer than the rest of the word (*ram*: 483 msec, *de.ni.me*: 426 msec). The breathy modality was found in 16 occurrences in the exhaustive version (44%) and only 6 times in the non-exhaustive version (17%) of this word. Hence, next to duration, the breathy voice is an optional correlate of prosodic prominence in our data.

Figure 3. Prominence of the first syllable (exhaustive, SVO, speaker TAM, item 1/1)[5]
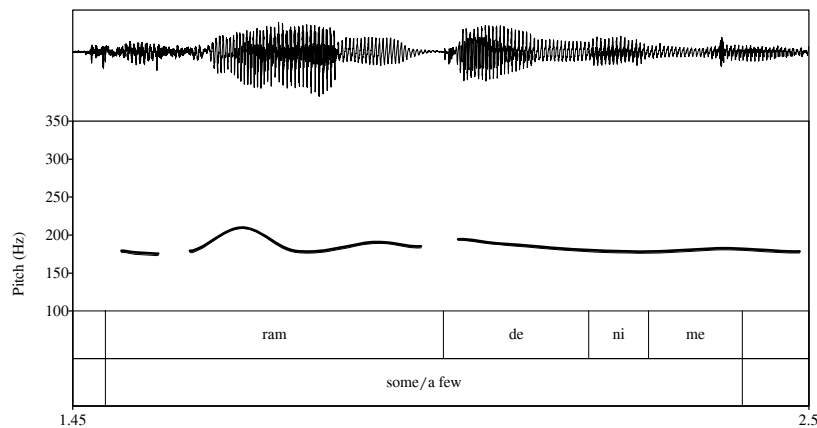
Let us turn to the melody of this word. In the SOV order, the subject *čven* 'we' always preceded *ramdenime*. The word *čven* was generally realized with a rising intonation, and it either ended on a very high pitch or it already contained the following fall, or part of it (see Figures 1–2 and 4–7). The following word *ramdenime* often started at the high level reached by the subject, but fell rapidly to a much lower level, causing a falling intonation that was not truly part of the realization of this word (see Figure 5), but is rather to be interpreted as an interpolation between the high target of *čven* and the low target of the following word; in other cases, as in Figure 4, the fall is already nearly completed when *ramdenime* started. In the following, we ignore this melodic fall in the discussion of the tonal structure and we take the value in the middle of the first syllable (on the [a] of *ram*) as the true tonal start of the word. Moreover, in especially long and prominent realizations of the first syllable of this word, there could be a (small) fall-rise on the syllable (see Figure 5), another particularity that we ignore here.

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[5] Notice that most pitch tracks display an interruption of the F_0 contour at the beginning of the second syllable that is caused by the obstruent [d].

The crucial issue for our purposes is the tonal pattern of the quantifier. Figure 4 illustrates an SOV utterance with non-exhaustive interpretation. In this instance, the first syllable is lower than the second one, but from the second syllable to the end of the word, the melody is slightly falling, and is still slightly falling on the next word *lari*. Only the last part of the verb is rising again to realize a high boundary.

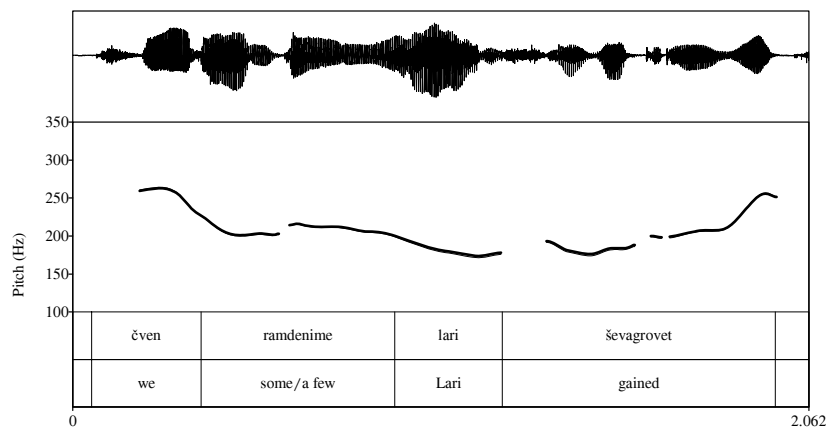Figure 4. Non-exhaustive, SOV, speaker TAM, item 1/1

Figure 5 illustrates an SOV utterance with exhaustive interpretation, which can be immediately compared to Figure 4. As in most exhaustive instances, the final melody of the first clause is falling. The last word, the verb in the SOV version, is entirely falling, and even creaky. This is why the F_0 contour of this word is not visible in the pitch track. The quantifier *ramdenime* displays a rising pattern between the first and the second syllables, and the first syllable is even longer than in the non-exhaustive version.

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Figure 5. Exhaustive, SOV, speaker ETR, item 2/3
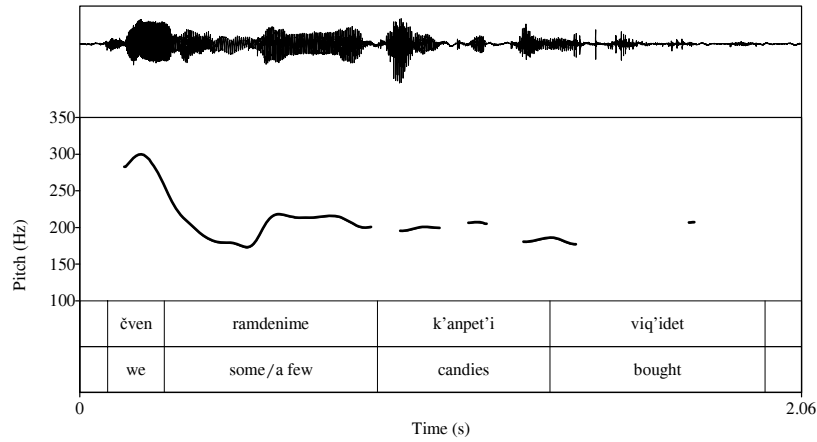
The SVO non-exhaustive utterance is illustrated by Figure 6. This pitch track is very similar to the non-exhaustive SOV utterance in Figure 4. Since now the noun *lari* is final, it carries the high boundary tone. The word *ramdenime* is slightly falling from the first syllable to the last one, and the fall continues even into the first sonorant of *lari*.

Figure 6. Non-exhaustive, SVO, speaker TAM, item 1/1
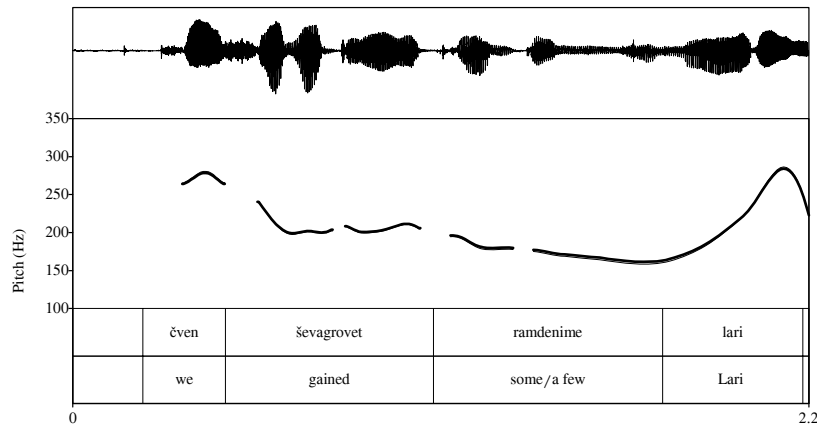
Finally, the SVO order in exhaustive interpretation is illustrated by Figure 7. In this last example the first clause ends on a low tone again, and the noun *lari* is very low, even creaky, as was the verb in Figure 5. The falling step between the first and the second syllable of *ramdenime* is present again, although not as large as before.

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Figure 7. Exhaustive, SVO, speaker TAM, item 1/2
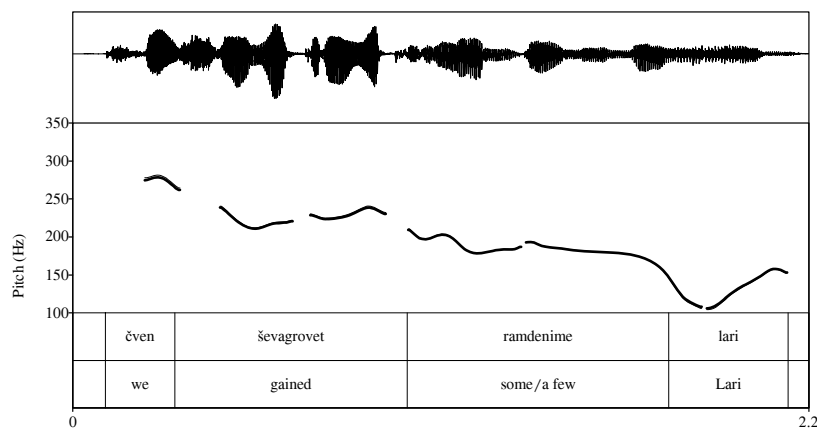
The question is whether the slight differences in the realization of the quantifier are consistent in the data. In order to get an estimation of systematic effects that depend on the examined conditions, we plotted the F_0-averages in Figure 8. This figure only contains the utterances with a low boundary at the end of the first clause (in order to avoid the variation due to the boundary tone). The averages presented in this figure consist of mean F_0 measurements of five equal intervals of the quantifier constituent and five equal intervals of the head noun (see values in Appendix I). Figure 8 shows that there was an influence of word order on the average values: the F_0 values from the SVO order were generally found in a lower pitch level. An object following a subject was realized with a higher pitch than a verb following a subject. We do not know exactly how to interpret this effect. One possibility is that this is an indicator of a different phrasing between SOV and SVO. In the first case, O and V were phrased together, and the observed boost on the object was the consequence of the new phrase. In the other case, S and V were phrased together, which explains the lowering on the verb, and the postverbal object was in an independent phrase subject to super-lowering.

However, the crucial observation is that the difference between exhaustive and non-exhaustive interpretations did not have a crucial impact on the average realizations.

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Figure 8. Average contours of the NP constituent (clauses with final low boundary)
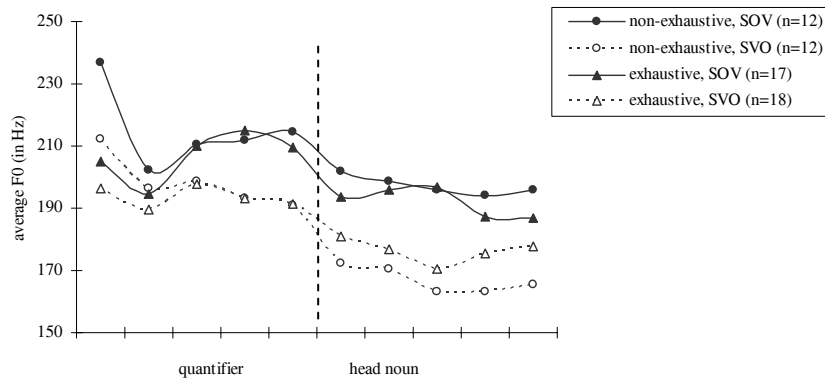
Since the averages in Figure 8 may present summaries of classes of utterances, it is necessary to discuss the data in more detail. The noteworthy observation in Figures 4–7 is the pitch difference between the first (*ram*) and the second syllable (*de*). In the exhaustive reading, the difference between the value of the first and the second syllable of *ramdenime* was positive (rising) in 31 and negative (falling) in 5 cases. In other words, there usually was a rising step between the first syllable and the second syllable of this word. The effect of this rising step in the average values of Figure 8 is the rising tendency that we may observe between the second and the third interval of the quantifier (across conditions).

This step can be interpreted as a pitch accent on the second syllable, which is often realized higher than the other syllables of the word, and which thus resembles an accented syllable in German or English. Recall however that breathy voice and exaggerated length were a particularity of the first syllable of this word. In some realizations, the first syllable is as long or nearly as long as the remaining syllables altogether (see Figure 3). It is thus not possible to assign a stress status to the one or the other syllable (a fact speaking against pitch accent).

In the non-exhaustive reading, the step between the first and the second syllable was positive in 23 (rising, 64%) and negative in 13 cases (falling, 36%); see Table 4. In the exhaustive reading, the rising pattern occurs more frequently, namely in 31 cases (i.e, 86%). This results in a significant main effect of exhaustivity ($F_{1,4} = 17.3$, $p < .05$), while the main effect of order and the interaction are not significant.

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Table 4. Tonal pattern between the first and the second syllable of *ramdenime*

| | non-exhaustive | | | | exhaustive | | | |
| | rise | | fall | | rise | | fall | |
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
SOV	*14*	78	*4*	22	*17*	94	*1*	6
SVO	*9*	50	*9*	50	*14*	78	*4*	22
total	*23*	64	*13*	36	*31*	86	*5*	14

In terms of Hz, the step was larger in the exhaustive reading than in the non-exhaustive reading. Table 5 shows the absolute pitch difference between the first and the second syllable of the word *ramdenime*, both in the falling and in the rising contours. The differences in Table 5 suggest that exhaustivity is the crucial factor, and this observation is justified by the analysis of variance that only involves a significant effect, namely the main effect of exhaustivity ($F_{1,4} = 11.6$, $p < .05$).

Table 5. F_0 differences (in *Hz*) between the first and the second syllable of *ramdenime*

| | non-exhaustive | | exhaustive | |
	mean	std. error	*mean*	std. error
SOV	*9.7*	1.6	*24.4*	3.3
SVO	*7.1*	.9	*19.9*	3.1
mean	*8.4*		*22.2*	

As one can see, the difference between the first and the second syllable of this word is much larger in the exhaustive than in the non-exhaustive reading. However, we refrain to analyze this as a difference in pitch accent in the classical sense, because other factors are also playing a role. In other words, it was just one of several properties used to render this word more prominent.

The remaining syllables (*ni.me*) were not realized with any particular prominence. They were accompanied neither by modality, nor by duration. Nevertheless they participated to the general impression of prominence of the entire word in the following way: the tonal direction from the first to the second syllable could be different from the further tonal direction at the end of the word, between the second syllable and the end of the word. This happened 27 times in the exhaustive cases and only 12 times in the non-exhaustive cases. We interpret this change of tonal direction in the word as another indicator of prominence.

The amount of pitch difference in the last syllables of *ramdenime* was not so important as the one found at the beginning of the word. Table 6 gives an overview of the averages of the absolute pitch difference between the second and the last syllable.[6] It turns out that the difference

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[6] The third syllable of this word is tonally uninteresting as it only carried an interpolation between the second syllable and the word's end.

between the exhaustive and the non-exhaustive versions is negligible. In the SOV order, the difference is larger in the non-exhaustive than in the exhaustive versions, which is reflected by a significant interaction effect in the analysis of variance ($F_{1,4} = 8.6$, $p < .06$). Moreover, the differences are not consistent in the results per speaker (in the data of two speakers the difference was larger in the non-exhaustive than in the exhaustive versions).

Table 6. F_0 differences (in *Hz*) between the second syllable and the last part of *ramdenime*

	non-exhaustive		exhaustive	
	mean	std. error	*mean*	std. error
SOV	*18*	3.6	*14.8*	2.3
SVO	*15.6*	2.7	*24.8*	3.8
mean	*16.8*		*19.8*	

To close the discussion of the realization of *ramdenime*, we do not find any contrast in the way it forms a prosodic unit with the following word *lari* or *k'anpet'i*. In all cases, both words are pronounced tightly together, and there does not seem to be any noteworthy difference in the prosodic realization or in the duration of the noun (see also average values in Figure 8).

6. Conclusions

The aim of this article was to clarify two conflicting observations on the expression of information structure in Georgian. The first observation is that pitch accents are not correlates of narrow focus in Georgian in the same way as in some European languages such as German, English, and Greek. This is in conflict with the observation that Georgian speakers attribute interpretational differences of sentences on the basis of prosodic prominence of their subconstituents. This point is exemplified in the interpretational properties of indefinite quantifiers that normally give rise to an upward extension, which is blocked when the quantifier is in narrow focus. It has been speculated that, in Hungarian, this interpretational difference is located in the position of the quantified NP, which is in the preverbal focus position when its interpretation is exhaustive and in a non-focus preverbal position when its interpretation is non-exhaustive and upward extending. This difference correlates with a larger pitch accent in the former case, and a smaller one in the latter case.

The question that has been pursued here is which prosodic strategies are used in Georgian to express these interpretational effects. To this aim, we carried out a language production study with minimal pairs of sentences, manipulating the exhaustive viz. non-exhaustive interpretation of quantifiers. In contrast to Hungarian, Georgian shows no difference in

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word order in the two interpretations. But it has two sentential word orders (SOV and SVO) that are compatible with both interpretations.

The findings of the empirical study showed clear correlates of prosodic prominence in the realization of the quantifiers. In particular, in the contexts that motivated the exhaustive interpretation there was a lengthening effect on the duration of the quantifier (see Table 3), especially on the first syllable. We also found some effects on the phonation of the first syllable, namely frequent occurrence of breathy voice. We interpret lengthening and breathy voice as phonetic correlates of prosodic prominence.

In line with the view that pitch accents are not used to indicate prosodic prominence in Georgian, only few correlates of exhaustivity could be identified in the tonal pattern of the collected utterances. The differences summed up in Figure 8 relate to the position of the target constituent in the linearization and not to its interpretational properties. Although the general tonal contour was not changed, there were some variations between the tonal targets, such as pitch expansion correlating with exhaustivity, a further indicator of prosodic prominence in Georgian. We were reluctant to assimilate pitch expansion to pitch accent, because the effect of prominence on the quantifier was scattered on the first two syllables, and also on the contour of the whole word. By contrast, pitch accent in German or English is mainly located on a single lexically stressed syllable.

Our answer to the conflicting observations summed up above is that the correlates of prosodic prominence in Georgian are duration (lengthening effect), phonation type (breathy voice), and pitch range (expansion effect) of the target constituent, thus forming a cluster of correlates anchored to the prominent constituent. This result strengthens the view expressed in our previous work that Georgian does not realize prosodic prominence by the bias of pitch accents in the way that is known from familiar languages. This has interesting consequences for the typology of intonation, a domain where much remains to be explored.

A last remark touches the phrasing of the entire sentence, thus of the main clause and the following subordinate clause. In the exhaustive reading, the main clause nearly always ended with a low boundary tone and a following break, emphasizing the finality of the utterance. The following sentence (*so that we cannot buy the present*) had properties of a separate utterance. In the other case, the non-exhaustive reading, the two sentences were more often forming a single proposition, which was expressed by a more frequent high boundary tone and fewer breaks. This difference in the higher prosodic structure expresses a distinction in the syntax of these sentences, a suggestion that has not been deepened here, but that certainly deserves greater scrutiny in the future.

7. Appendix

Appendix I. Average contours of the NP constituent (clauses with final low boundary)

constituent	interval	non-exhaustive				exhaustive			
		SOV (*n*=12)		SVO (*n*=12)		SOV (*n*=17)		SVO (*n*=18)	
		mean	SE	mean	SE	mean	SE	mean	SE
quantifier	1	237	7.8	212	2.5	205	3.4	196	2.5
	2	202	1.9	196	2.2	194	3.1	190	2.4
	3	210	3.0	198	2.3	210	3.3	198	2.8
	4	212	4.3	193	3.1	215	3.9	193	3.5
	5	215	8.4	191	5.0	209	4.3	192	5.7
head noun	1	202	4.8	172	2.4	194	5.3	181	9.4
	2	199	4.4	171	4.2	196	4.8	177	9.5
	3	196	4.0	163	6.1	197	5.3	171	3.8
	4	194	4.2	163	4.9	187	5.7	176	5.0
	5	196	10.4	165	6.7	187	5.8	178	3.9

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