

The effect of prosody on availability of inverse scope in Russian

Tatiana Luchkina

University of Illinois at Urbana-Champaign

Tania Ionin

University of Illinois at Urbana-Champaign

This paper examines the interpretation of scopally ambiguous double-quantifier sentences in Russian, a free word order language. We describe the acoustic-prosodic features that successfully discriminate between the productions disambiguating double-quantifier sentences in Russian in favor of surface vs. inverse scope. We argue that the prosodic contour under which inverse scope is available in Russian is associated with a highly salient information structural configuration in which the pre-verbal QP is interpreted as focused.

1 Introduction

This paper examines the interpretation of double-quantifier sentences in Russian, a free word order language. We experimentally assess the role of information structure (IS), prosody, and word order on the availability of inverse scope in Russian. In languages like English, double-quantifier sentences like (1) give rise to more than one reading and are characterized as scopally ambiguous. Reversing the order of the quantifiers reverses what constitutes surface vs. inverse scope, as shown in (2).

- (1) One dog frightened every man.
 - a. surface scope: One specific dog frightened every man (ONE>EVERY)
 - b. inverse scope: Every man was frightened by a potentially different dog (EVERY>ONE)
- (2) Every dog frightened one man.
 - a. surface scope: Every dog frightened a potentially different man (EVERY>ONE)

- b. inverse scope: One specific man was frightened by every dog
(ONE>EVERY)

The two possible readings of (1) illustrated in (1a) and (1b) arise due to one of the two quantifiers, indefinite or universal, taking wide scope. The surface-scope reading in (1a) arises because the subject quantifier phrase (QP) ‘one dog’ takes scope over the object QP ‘every man’. The inverse-scope reading in (1b) arises when the universal object QP scopes over the indefinite subject QP. The inverse scope reading in (1b) has been shown to be more difficult to process than the surface scope reading (Tunstall 1998, Anderson 2004). One way to account for the processing difficulty (e.g., Anderson 2004) is to tie it to the processing costs incurred by covert quantifier raising (QR), which takes place at LF and raises the object QP to a position higher than the subject QP (May 1985, Fox 2000).

English is one language which exhibits covert QR as the means for deriving inverse scope. However, not all languages do QR covertly. Languages such as German, Greek, and Russian, among others, allow for variable word orders. Relative word order freedom makes overt movement of the sentence constituents, including QPs, possible, as shown in the Russian translations of (1) and (2) given in (3) and (4) below.

- (3) a. *SVO, canonical word order:*
 Odna sobaka napugala každogo človeka.
 one-NOM dog-NOM frightened every-ACC man-ACC
- b. *OVS, scrambled word order:*
 Každogo človeka napugala odna sobaka.
 every-ACC man-ACC frightened one-NOM dog-NOM
- (4) a. *SVO, canonical word order:*
 Každaja sobaka napugala odnogo človeka.
 every-NOM dog-NOM frightened one-ACC man-ACC
- b. *OVS, scrambled word order:*
 Odnogo človeka napugala každaja sobaka.
 One-ACC man-ACC frightened every-NOM dog-NOM

Word order flexibility allows Russian to alter the order of subject and object QPs overtly, reversing what constitutes surface vs. inverse scope.

Corroborating this expectation is the fact that a change in word order reverses quantifier scope in other ‘free word order’ languages (e.g., German: Beck 1996, Sæbø’ 1997, Bobaljik & Wurmbrand 2012; Greek: Baltazani 2002; Japanese: Miyagawa 1997), where overt constituent movement is motivated by grammatical features, such as object scrambling for case agreement (Japanese) or preferred information structural configuration (Greek).

In Russian, canonically an SVO language (Bailyn 1995), word order variability is discourse-constrained (Slioussar 2011) and is used to encode the categories of given vs. novel information, as well as to signal especially prominent information in discourse, i.e., words which are contrastively focused or emphasized (Neeleman & Titov 2009). To illustrate, in (3b), the direct object ‘every man’ appears pre-verbally, whereas the subject ‘one dog’ is sentence-final. It is traditionally believed that the sentence-final position in Russian is reserved for discourse-novel information (new information focus), and that it is felicitous for old or given information (Topic) to precede the novel information (Calhoun 2010). Thus, one may view scrambling in Russian as a means for a constituent to appear outside the ‘nuclear focus domain’ (Rosengren 1993) aligned with the right sentence periphery and reserved for discourse-novel information, and to form a Topic domain or a separate (contrastive) focus domain. In accordance with the preferred IS configuration, in (3b) it is plausible to associate the object phrase ‘every man’ with given, previously established information or sentence Topic (the preceding discourse must be about men). The subject phrase ‘one dog’ is then perceived as discourse-novel and presents the new information focus.

Ionin (2003) analyzed scope in Russian double-quantifier sentences which exhibit scrambling driven by topicalization under neutral (non-contrastive) prosody. Ionin proposed that in Russian, the close tie between word order and discourse function is what constrains the availability of inverse scope in sentences such as (3) and (4), for the following reasons:

1. In non-emotive matrix clauses in Russian, the leftmost position is reserved for the Topic element associated with the previously established information in discourse.

2. Since Topics are established entities, they have previous mention in discourse and must be interpreted first. This precludes scope reversal, which requires that the sentence-final QP be interpreted first.

Ionin (2003) proposed that the only IS configuration under which inverse scope is available in Russian is when the pre-verbal QP is non-topical and may therefore be interpreted in the scope of the post-verbal QP. This configuration holds under (contrastive) focus in Russian. Contra Ionin's (2003) proposal, Antonyuk (2006) argued that inverse scope for Russian sentences such as (3) and (4) is freely available, and is derived by covert QR, as in English (May 1985, Heim & Kratzer 1998).

2 Previous Experimental Work on Inverse Scope Availability

Experimental investigations of quantifier scope in Russian (Stoops & Ionin 2013; Ionin, Luchkina & Stoops 2014) have tested the availability of inverse scope in simple transitive SVO and OVS sentences presented in written form and out of context. This work documented a preference for surface-scope readings in double-quantifier sentences such as (3) and (4), more so with SVO than OVS word order. Ionin et al. (2014) also compared surface and inverse scope accessibility for written transitive sentences in Russian and English. In line with Anderson's (2004) processing-based account of scope availability, Ionin et al. (2014) found very similar patterns of results in the two languages, namely, that inverse scope readings are available but are dispreferred relative to surface scope readings. However, this prior work, by focusing on the written modality, did not consider the role of prosody in scope disambiguation.

That a link between the information structure of an utterance in relation to discourse, and its prosodic realization, may help listeners disambiguate scope has been previously established for English, a rigid word order language (Jackendoff 1972), as well as German, Japanese, and Greek, relatively free word order languages (Baltazani 2002, Hwang 2006, Hirotani 2004, Hirose & Kitagawa 2007, Büring 1997, Krifka 1998, Sæbø' 1997). Production-perception studies of scopally ambiguous sentences in these languages have found that speakers reliably signal the desired scope interpretation by means of acoustic-prosodic cues, such as segment (vowel) duration or pitch, the perceptual correlate of fundamental

frequency (e.g., Hirose & Kitagawa 2007). During comprehension, listeners have been shown to reliably utilize the prosodic encoding to determine the scopal relation intended by the speaker. More specifically, specific scope disambiguation effects have been reported. Baltazani (2002) tested the effects of word order and prosodic prominence on scope disambiguation in Greek and found that, independently of word order, placement of prosodic prominence affects the scope reading in double-quantifier sentences. In her work, Baltazani particularly emphasizes the importance of the preceding context on the interpretability of the prosodic effects in Greek: she argues that the accent pattern alone has no direct effect on scope interpretation. Baltazani also reports that select intonation contours in Greek are salient enough to enable listeners to reconstruct the context in which the utterance could be used based solely on its prosodic contour, and hence successfully disambiguate in favor of the intended scope reading.

More recently, Antonyuk-Yudina (2011) and Ionin & Luchkina (in press) have advanced the work on inverse scope availability in Russian double-quantifier sentences by examining the role of prosodic prominence. Recall that with regard to Russian, Ionin (2003) proposes that inverse scope, dispreferred in emotively-neutral sentences, is available under a contrastive focus configuration. Antonyuk-Yudina (2011) tested the scope disambiguating effect of prosodic grouping and contrastive pitch accent. Antonyuk-Yudina used simple transitive SVO and OVS sentences featuring an indefinite subject and a universal object QP. Sentences were presented in contexts biasing readers towards a surface or an inverse scope reading, and prosodic features of eight native speakers' reading performance were impressionistically analyzed. Antonyuk-Yudina did not report a word order effect on inverse scope availability (cf. Ionin & Luchkina in press), however she found that an intermediate phrase break and a perceptual strong, contrastively sounding pitch accent are associated with the surface scope interpretation. A series of downstepped pitch accents and prosodically neutral realization of the object universal QP, combined with a contrastive pitch accent on the indefinite subject QP, bring about the inverse scope reading. In the perception component of Antonyuk-Yudina's study, native speakers of Russian had to disambiguate the scope double-quantifier sentences based on the prosodic information provided in the reading performance of the model speaker. Relatively poor

performance was recorded for inverse scope disambiguation (17% success, compared to 77% success for surface scope disambiguation). A very common result in Anotnyuk-Yudina's study is incorrectly disambiguated inverse scope prosody: i.e., respondents had a tendency to match the prosodic realization characteristic of the inverse scope reading with surface scope biasing contexts. Antonyuk-Yudina concluded that the prosodic realization associated with the inverse scope reading in her study is also compatible with the surface scope reading. Ionin & Luchkina (in press) conducted a judgment study (summarized below) and found that prosodic prominence realized on the indefinite quantifier and OVS surface order are both required to derive inverse scope in Russian.

3 Research goals

In the present work, we build on the findings of the judgment study of Russian scope reported in Ionin & Luchkina (in press), focusing primarily on the prosodic characteristics of inverse-scope readings. We pursue the following research goals:

- To determine the acoustic-prosodic features of utterances in which inverse scope is accessible, relative to those which only yield the surface scope interpretation; *and*
- To examine the acoustic-prosodic properties of the prosodically prominent indefinite QP when it is produced in a context that supports a contrastive interpretation, vs. out of context, in order to investigate whether context affects the acoustic-prosodic realization of indefinite QP.

In what follows, we summarize the experimental task used in Ionin & Luchkina (in press), and highlight the key finding of that study, that prosodic prominence is required to obtain the inverse scope reading in double-quantifier sentences in Russian. We then focus on the prosodic properties of the stimuli used in Ionin & Luchkina (in press) and look in detail at the acoustic-prosodic characteristics that lie at the heart of inverse scope availability in Russian.

4. Experimental study

Ionin & Luchkina (in press) conducted an auditory sentence-picture verification task (SPVT) in which double-quantifier sentences were presented auditorily along with a picture that illustrated each sentence (see Figures 1 and 2 below). Native speakers of Russian had to listen to each sentence and decide whether it matched the picture by selecting either YES or NO. Target sentences were equally divided between control items, where the sentence is unambiguously true in the context of the picture (e.g., (5) in the context of Figure 1), and test items, where the sentence is true on the surface OR the inverse scope reading, but not both, in the context of the picture (e.g., (5) in the context of Figure 2). For more details about the types of control and test pictures, and their distribution across the four sentence types in (3) and (4), see Ionin and Luchkina (in press).

(5) Odna sobaka napugala každogo človeka.
 one-NOM dog-NOM frightened every-ACC man-ACC

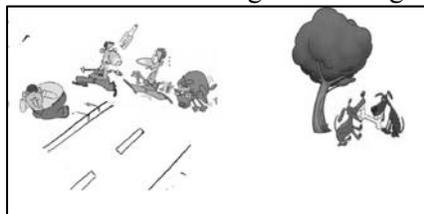


Fig. 1: Sample control picture:
 makes (5) unambiguously true

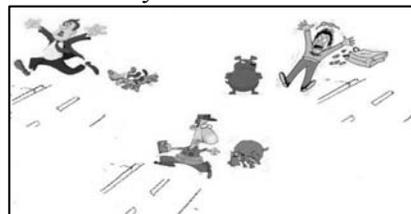


Fig. 2: Sample test picture: makes
 (5) false on the surface-scope
 reading and true on the inverse-
 scope reading

Performance on the test items was analyzed to determine which scope reading, surface or inverse, the respondents accessed for a given sentence type. Two word orders, SVO and OVS, were crossed with two quantifier configurations, indefinite subject with universal object (3) and universal subject with indefinite object (4). Four different SPVT versions were prepared. In the Baseline SPVT, the stimulus sentences were presented out of context and with neutral prosody, i.e., the entire sentence was contained within one prosodic phrase and the nuclear pitch accent was aligned with the sentence-final word. In the Emphasis SPVT, the stimulus sentences were presented out of context and with a perceptually salient pitch accent

always on the indefinite quantifier (in follow-up work, Ionin & Luchkina, under review, we have manipulated the prosodic prominence of the universal quantifier as well;). Depending on the word order, the pitch accent could appear sentence-initially, e.g., with the subject quantifier *one* in example (5), or be aligned with the penultimate word in a sentence where the indefinite quantifier appeared in the penultimate position (see (3b) and (4a)). The Topic SPVT differed from the Baseline SPVT only in that the test sentences were preceded with a short two-sentence context which set up the Topic reading of the indefinite quantifier, as shown in (6). The Focus SPVT differed from the Emphasis SPVT in that the test sentences were preceded with a short two-sentence context which set up the contrastive focus reading of the indefinite quantifier. Additionally, the focus particle *vsego* ‘only’ preceded the prosodically prominent indefinite QP, as shown in (7) below.

(6) Topic SPVT:

- Anna: V parke guljali tri mužčiny,
 In park walked three men
 potom tuda pribežali tri sobaki.
 Then there ran in three dogs
 “Three men were walking in the park. Then there ran in three dogs.”
- Vera: I čto, sobaki isportili progulku?
 And what dogs ruined walk
 “And did the dogs ruin the walk?”
- Anna: Nu, odna sobaka napugala každogo čeloveka.
 Well one dog frightened every man
 “Well, one dog frightened every man.”

(7) Focus SPVT:

- Anna: V parke guljali tri mužčiny,
 in park walked three men
 potom tuda pribežali tri sobaki.
 then there ran in three dogs
 “Three men were walking in the park. Then there ran in three dogs.”
- Vera: A dal’še? Naverno, každogo čeloveka
 and next probably every man,

napugali vse sobaki?
 frightened all dogs
 “And what happened next? Probably every man was frightened
 by all the dogs?”

Anna: Net, čto ty, vsego odna sobaka
 No what you only one dog
 napugala každogo cheloveka.
 frightened every man
 “Oh no, only one dog frightened every man.”

All Baseline and Emphasis SPVT stimuli were recorded by the first author, while the Topic and Focus stimuli were recorded as dialogues by both authors (both are native Russian speakers). Recordings were made in a sound-proof recording booth using a Marantz PDM 750 solid state recorder and a head-mounted microphone. The model speakers were trained to produce prosodic prominence stimuli such that the indefinite quantifier would be audibly prominent.

The study participants were 117 adult native Russian speakers born in Russia or another country where Russian is spoken widely. They ranged in age from 18 to 54 (mean = 23). Results of the SPVT (see Ionin & Luchkina in press for more details) indicate an overall strong preference for the surface scope reading, regardless of prosody or word order. The availability of the inverse scope reading is most evident in the responses to the Emphasis and Focus SPVTs. Statistical analysis showed that prosodic prominence interacts significantly with (1) quantifier configuration (indefinite or universal in the subject position) and (2) word order. Ionin and Luchkina (in press) report that the SVO stimuli do not demonstrate considerable availability of the inverse scope reading, regardless of prosody. The availability of the inverse scope reading increases significantly whenever the indefinite QP is in the preverbal object position in the OVS order and is prosodically prominent. Despite the fact that the context preceding the test sentences in the Focus (or Topic) SPVT clearly sets up the IS category of the indefinite QP as focus (or topic), it plays no significant role in the availability of surface or inverse scope readings. For the remainder of this paper, we focus on the prosodic characteristics related to surface vs. inverse scope availability.

4. Prosodic analysis

To address our first research goal, namely, what acoustic-prosodic features characterize the oral productions in which inverse scope is accessible, relative to those which only yield the surface scope interpretation, prosodic features of the test sentences from each SPVT version were automatically extracted and analyzed. In the following analyses, we exclude the data extracted from the Topic SPVT. Because in both Baseline and Topic SPVTs, the target sentences are produced with normal tempo and emotively-neutral prosody, we do not anticipate systematic differences in the prosodic properties of the target sentences extracted from these SPVTs. Instead, we focus our attention on the systematic differences in the acoustic-prosodic features of the Baseline SPVT, which offered no prosodic cues, and the Focus and Emphasis SPVTs, which featured a prosodically prominent indefinite QP.

Figures 3 & 4¹ show the averaged time-normalized pitch contours of the SVO and OVS test sentences produced with non-emotive vs. contrastive prosody.

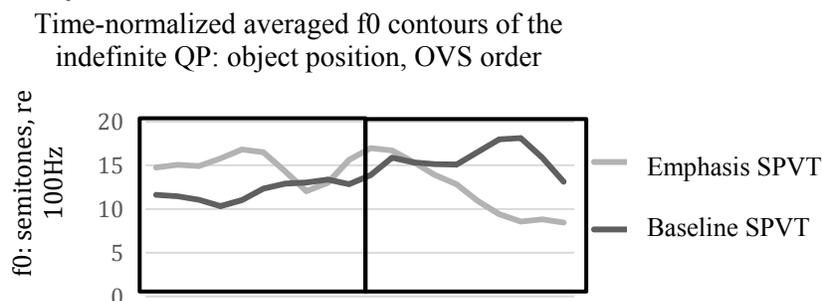


Figure 3. OVS test sentences: indefinite QP in sentence-initial object position. Each rectangle sector encloses one word as in *odnu sobaku*, ‘one dog-ACC’.

¹ Figures 3, 4, and 5 illustrate experimental stimuli in which the indefinite quantifier is in the object position. Ionin and Luchkina (in press) found that prosody affected scope interpretation only when the indefinite was in object position, not when it was in subject position. However, the prosodic contours look very similar regardless of the syntactic position of the indefinite. To save space, we only report the contours for the sentences where the indefinite is in object position.

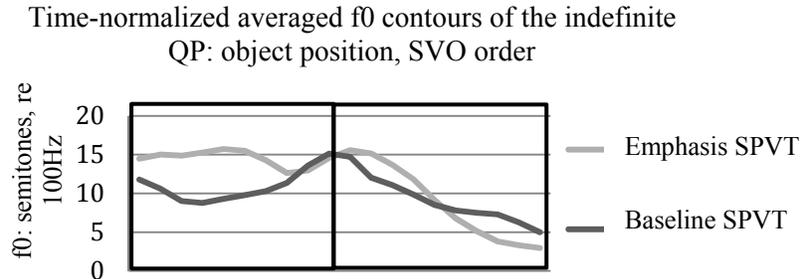


Figure 4. SVO test sentences: indefinite QP in sentence-final object position. Each rectangle sector encloses one word, as in *odnu sobaku*, ‘only one dog-ACC’.

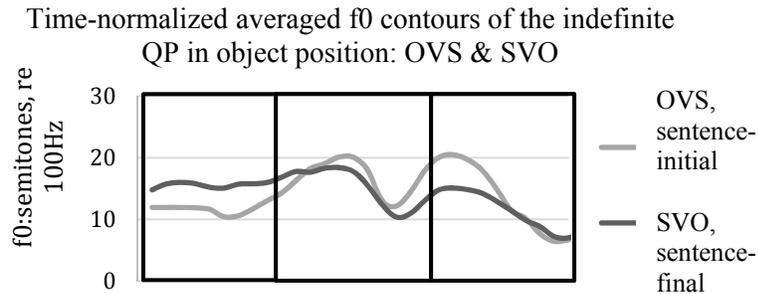


Figure 5. Focus SPVT: time-normalized averaged f0 contours of SVO & OVS test sentences with indefinite QP in object position. Each rectangle sector encloses one word, as in *vsego odnu sobaku*, ‘only one dog-ACC’.

Note that independently of the word order or sentence position of the indefinite quantifier, the resulting prosodic contour looks very consistent in the Emphasis SPVT. The pitch accent peak and valley in the left sector in Figures 3 and 4 visually illustrate the perceptually salient (contrastive) reading of the indefinite quantifier *odin* followed with a gradual downstep in f0 in the right sector, corresponding to the noun that is adjacent to the quantifier. In the Focus SPVT (see Fig. 5), the indefinite QP is contrastively focused and prosodically prominent. Additionally, the focus marker *vsego*, shown in the leftmost sector in Fig. 5, precedes the indefinite QP and expands its focus domain. Time-normalized averaged pitch contours of the indefinite QPs in the Focus SPVT are comparable to

the contours obtained for the Emphasis SPVT: the contrastive pitch accent aligns with the quantifier shown in the middle sector in Fig. 5 and is followed with a downstep in f_0 in the following noun, shown in the rightmost sector in Fig. 5. Next, we compared select prosodic qualities of experimental sentences across prosodic conditions.

We chose to work with the cross-linguistically attested acoustic-prosodic correlates of prosodic prominence (Ladd 2008): f_0 maxima and minima, intensity and duration of the stressed vowel. We also measured the distance from the midpoint of the vowel to its tonal center of gravity (henceforth, TCoG distance)². All acoustic-prosodic measurements were taken from the stressed syllable of each content word in the target sentences of the Baseline, Emphasis, and Focus SPVT versions. Measurements were extracted automatically in Praat (Boersma & Weenink, 2013). The values of max f_0 and max intensity were taken from the center region of the stressed vowel in order to minimize the influence of the adjacent segments at the voice onsets and inter-segmental transitions. All f_0 outputs were transformed to semitone values relative to a fixed value of 100 Hz. Intensity and duration values were normalized using the natural logarithm scale. For the analyses reported below, we only use prosodic data extracted from the indefinite QP. Differences in the means and distributions of the acoustic-prosodic measurements for the indefinite quantifier *odin* across the SPVT versions and the focus marker *vsego* used in the Focus SPVT are shown in Figures 6-8.

The distributions plotted in Figures 6-8 illustrate that compared to the Baseline SPVT, the Emphasis and the Focus SPVTs feature rather distinctive prosodic realizations of the indefinite quantifier, with greater mean values of f_0 range, duration, and intensity. The acoustic-prosodic qualities of the focus marker *vsego* confirm that it is prosodically prominent and belongs to the contrastive focus domain in the Focus SPVT.

²Luchkina & Cole (2014) report that the distance between the vowel midpoint to its tonal center of gravity is an effective correlate of prosodic prominence in Russian.

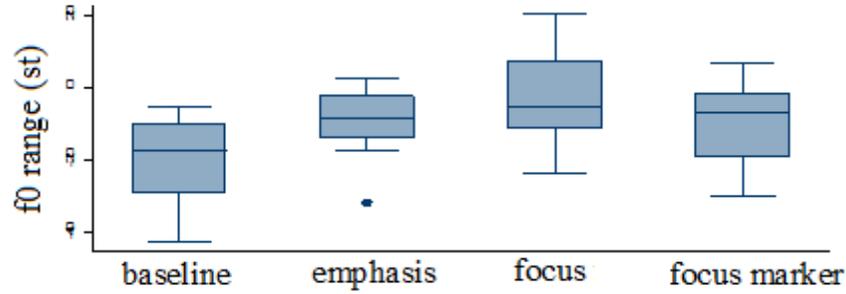


Fig. 6. Means and distributions of the f0 range (f0 max-f0 min) across the SPVT versions. Measurements shown from the indefinite quantifier and the focus marker (focus marker present in the Focus SPVT only).

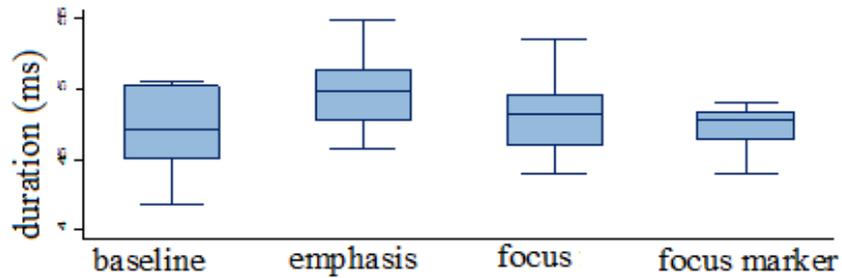


Fig. 7. Means and distributions of the stressed vowel duration across the SPVT versions. Measurements shown from the indefinite quantifier and the focus marker (focus marker present in the Focus SPVT only).

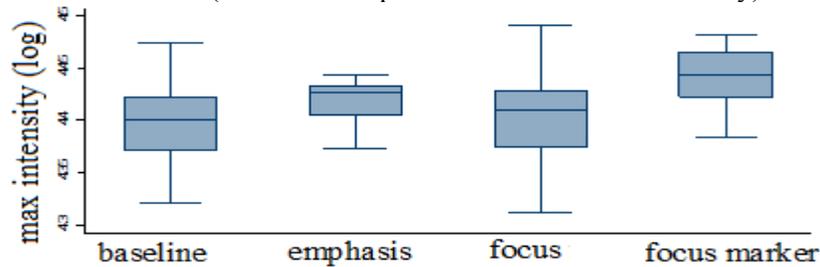


Fig. 8. Means and distributions of the stressed vowel max intensity across the SPVT versions. Measurements shown from the indefinite quantifier and the focus marker (focus marker present in the Focus SPVT only).

So far we have argued for systematic acoustic-prosodic differences between the emotively-neutral vs. contrastively-prominent productions of the indefinite QP and presented some preliminary evidence that robust prosodic cues play a critical role in making the inverse scope readings available in the Emphasis and Focus SPVTs. However, when used in natural speech, such cues are interpretable relative to discourse in which they occur. With regards to scope relations, Baltazani (2002) argues that in Greek, prosody by itself does not influence scope relations, rather it is the IS configuration, contextually set up and supported by distinctive prosodic cues, that renders the inverse scope reading available. Similarly, Ionin (2003) proposes that in Russian, scope is interpreted based on the IS category of the indefinite QP: inverse scope is unavailable when the indefinite QP occupies the pre-verbal sentence Topic position, however a contrastively focused indefinite QP makes the inverse scope reading available. Ionin & Luchkina (in press) tested this prediction using Topic and Focus SPVTs. They found no differences in the preference for surface scope in Topic SPVT relative to Baseline SPVT, as well as in Focus SPVT relative to the Emphasis SPVT. Recall that in addition to a context which set up the contrastive reading of the indefinite QP, Focus SPVT also featured the focus marker *vsego* 'only', which reinforced the focus reading of the indefinite QP and expanded its focus domain. Ionin & Luchkina's results indicate that neither of these cues has a significant effect on inverse scope availability. Given highly similar acceptability rates for the inverse scope readings obtained in these SPVT versions, we predict highly similar prosodic expression of prominence in the Emphasis SPVT and the Focus SPVT. To test this prediction, we subjected our prosodic data to a rigorous statistical test of each acoustic-prosodic parameter's ability to predict a major prosodic condition of the SPVT study. By assessing the differences in the magnitude of the predictive power for each of our measurements, we are able to gauge the overall similarity between the oral productions of the indefinite QP extracted from Baseline, Focus, and Emphasis SPVTs. To this end, the model speakers' production data were submitted to a multinomial logistic regression analysis which determined how well each prosodic condition could be predicted based off the acoustic-prosodic parameters of f_0 (maxima and minima), vowel intensity and duration, and TCoG distance. The dependent variable in the analysis was prosodic condition (3 levels: Baseline, Emphasis, Focus). The Baseline and Focus prosodic condition were each used as the reference level of the dependent

variable. The model was fit in STATA. To save space, we only report the output with Focus prosody as the reference level of the dependent variable. Results of the multinomial logistic analysis are summarized in Table 1.

Condition	Parameter	Regression coefficient
Baseline (relative to Focus)	intensity	-21.7***
	duration	3.37***
	f0 max	-1.56**
	f0 min	1.06***
	TCoG distance	608.9*
Emphasis (relative to Focus)	intensity	-9.38*
	duration	ns
	f0 max	-.59*
	f0 min	.49**
	TCoG distance	ns

Table 1. Multinomial regression ($\chi^2(18)=103.99$, $p<0.001$) estimates and significance levels for the acoustic parameters of f0, intensity, duration, and TCoG distance. Measurements from Focus SPVT are used as the reference level of the dependent variable.

The results indicate that all acoustic-prosodic parameters chosen for the analysis robustly differentiate between Focus and Baseline SPVTs, which represent two extremes of the experimental design: whereas the Baseline version offers no prosodic or context cues, the Focus version offers both. The magnitude of the regression coefficients, suggestive of each factor's effect size, shows that the distance between the central point of the stressed vowel and its tonal center of gravity, i.e., the region with the maximum area in the f0 curve over that vowel, is the strongest discriminant between Baseline and Focus prosody. Additionally, vowel intensity, duration, and f0 minima and maxima all robustly discriminate between Baseline and Focus prosodic conditions. Table 1 also indicates that the prosodic differences between the Emphasis and the Focus SPVTs are more subtle: neither duration nor TCoG distance discriminate between these two SPVT versions, and intensity and f0 maxima and minima, while all significant, have considerably smaller effect sizes (see the regression coefficients associated with these variables in Table 1), confirming our expectation that

the prosodic realizations of the indefinite QP presented in the Emphasis and Focus SPVTs are highly similar.

To summarize, we have visually inspected the f_0 contours of the target sentences presented in emotively-neutral Baseline SPVT, as well as in the Emphasis and Focus SPVTs, in which the indefinite QP is prosodically prominent. We then examined the discriminability of the oral productions of the indefinite QP extracted from Baseline, Emphasis, and Focus SPVTs. Results of our analyses indicate that (1) more eventful f_0 contours and (2) qualitatively distinct values of intensity, duration, and f_0 characterize the indefinite QP produced in Emphasis and Focus SPVTs, but not in Baseline SPVT. Finally, we have highlighted the similarities between the indefinite QP qualities in the Focus and Emphasis SPVTs. These similarities are particularly important since regardless of other design differences, such as context availability, these SPVT versions yielded comparable rates of inverse scope availability in Ionin & Luchkina's study.

6. Discussion

In this work, we continue to analyze the interpretability of double-quantifier sentences in Russian, a free word order language. In languages like English, transitive sentences with two quantifiers, one existential and the other universal, are scopally ambiguous. However, inverse scope in English has been found to be dispreferred to surface scope, possibly because it incurs a greater processing cost (Anderson, 2004). Inverse scope availability in Russian has been characterized as even more limited: Ionin & Luchkina (in press) recently reported that while the surface scope reading is consistently preferred over the inverse scope reading, inverse scope readings are more accessible in OVS sentences in which the indefinite quantifier is preverbal and is prosodically prominent. Building on the findings of Ionin & Luchkina (in press), in this study, we analyze the acoustic-prosodic features of the indefinite QPs used in different prosodic conditions in Ionin & Luchkina (in press). We find that a number of systematic acoustic-prosodic correlates of pitch accent, such as f_0 range, vowel segment intensity and duration, and distance between the vowel midpoint and its tonal center of gravity reliably differentiate the prosodic realization of the indefinite QP in the Focus and Emphasis SPVTs from those in the Baseline SPVT. Our results are in line with Ionin's

(2003) proposal that a contrastive reading of the indefinite QP is needed for the inverse scope to become available.

One unexpected finding of Ionin & Luchkina (in press) is that the inverse scope accessibility in the Emphasis SPVT, which features only prosodic prominence, matches that obtained in the Focus SPVT, where context helps set up a contrastive focus reading of the indefinite QP. Recall Baltazani's (2002) argument that in Greek, prosodic prominence should be seen as secondary to context, which is necessary to motivate the presence of the contrastive pitch accent and set up the IS configuration matching the focus reading of the indefinite QP. According to Baltazani, listeners 'proceed from prosodic structure to information structure to scope calculation' (2002:73). In the present study, we have experimentally shown that regardless of the context manipulation and availability of a focus marker, the prosodic features of the indefinite QP produced in the Emphasis and Focus SPVTs are highly similar. Following Ionin & Luchkina (in press), we propose that Russian speakers access inverse scope readings from contrastive prosody alone, and reconstruct the IS from prosody. This proposal agrees with the view expressed by Baltazani (2002) that it is possible for listeners to interpret (particularly salient) prosodic contours out of context, and thus successfully access both readings of the scopally ambiguous sentence. We conclude that two IS configurations are available in Russian double-quantifier sentences, one in which the preverbal QP is interpreted as the sentence Topic (under neutral prosody) and one in which the pre-verbal QP is interpreted as contrastively focused. Our results suggest that the preference for surface scope in Russian may be overridden by IS considerations: surface scope is strongly preferred when the preverbal NP is the topic, but inverse scope becomes available when the preverbal NP is in contrastive focus. This is consistent with the proposal of Neeleman and Titov (2009) that contrastively focused NPs reconstruct to their base position in the scope of the subject, making the inverse scope readings available.

7. Conclusion

Building on the findings reported in Ionin & Luchkina (in press) that inverse scope availability is significantly higher in scrambled OVS

sentences which feature a contrastive pitch accent aligned with the indefinite QP, we have described the acoustic-prosodic features which successfully discriminate between the productions disambiguating surface and inverse scope in Russian. We also determined that the role of discourse-level information in inverse scope availability in Russian is secondary to the role played by the prosodic cues. We concluded our investigation with a tentative argument that the prosodic contour under which the inverse scope is available is associated with a highly salient information structural configuration in which the pre-verbal QP is interpreted as focused. Such an IS configuration is unavailable under neutral prosody, where the pre-verbal QP is in Topic position.

A still-unresolved question, at present, is how our findings on the relationship between scope and prosody compare to those on other languages. Specifically, Bobaljik and Wurmbrand (2012) argue that languages such as Japanese and German, inverse scope becomes available whenever the IS and the LF are in conflict (i.e., whenever the IS topic-focus configuration does not match the surface-scope configuration). Our data do not align with those discussed by Bobaljik and Wurmbrand for German and Japanese, and our prosodic configuration (prosodic prominence on the indefinite quantifier) is different from that discussed by Bobaljik and Wurmbrand (a rise-fall contour, cf. Krifka 1998). In follow-up work (Ionin & Luchkina, under review), we examine the effects of a rise-fall prosodic contour on Russian scope, in order to allow for a cross-linguistic comparison of the effects of prosody on scope.

References

- Anderson, Catherine. (2004). The structure and real-time comprehension of quantifier scope ambiguity. PhD dissertation, Northwestern University.
- Antonyuk, Svitlana. (2006). The scope of quantifier phrases in Russian: A QR analysis. Linguistics in the Big Apple.
- Antonyuk-Yudina, Svitlana. (2011). Why Prosody Matters. An extended 4-page abstract of the presentation, Linguistic Society of America, Annual Meeting, Pittsburg.
- Bailyn, John. (1995). A configurational approach to Russian 'free' word order. PhD dissertation, Cornell University.

- Baltazani, Maria. (2002). The prosodic structure of quantificational sentences in Greek. In Proceedings from the 38th Meeting of the Chicago Linguistic Society, ed. by M. Andronis, E. Debenport, A. Pycha, and K. Yoshimura, 63-78). Chicago, IL: Chicago Linguistic Society.
- Beck, Sigrid. (1996). Quantified structures as barriers for LF movement. *Natural Language Semantics* 4, pp. 1-56.
- Bobaljik, Jonathan. & Susi Wurmbrand. (2012). Word order and scope: Transparent interfaces and the $\frac{3}{4}$ signature. *Linguistic Inquiry* 43, 371-421.
- Boersma, Paul. & David Weenink. (2013). Praat: doing phonetics by computer [Computer program]. Version 5.3.60.
- Büring, Daniel. (1997). The great scope inversion conspiracy. *Linguistics and Philosophy* 20, 175-194.
- Calhoun, Sasha. (2010). The Centrality of Metrical Structure in Signaling Information Structure: A Probabilistic Perspective, *Language*, 86(1), 1-42.
- Fox, Danny. (2000). Economy and Semantic Interpretation. Cambridge, MA: MIT Press and MITWPL.
- Heim, Irene. & Angelika Kratzer. (1998). *Semantics in Generative Grammar*. Malden, MA: Blackwell.
- Hirota, Masako. (2004). Prosody and LF: Processing of Japanese Wh-questions, Ph. D. dissertation, University of Massachusetts at Amherst.
- Hirose, Yuki. & Kitagawa, Yoshihisa. (2007). Prosody-scope correlatino in Wh-interrogatives: Production and Perception, Paper presented at Poster presented at International Conference on Processing Head-final Structures, Rochester Institute of Technology, Rochester, NY.
- Hwang, Hyun Kyun. (2006). Intonation patterns of wh-interrogatives in South Kyungsang Korean and Fukuoka Japanese. *Eoneohak, Journal of the Linguistic Society of Korea*, 45: 39-59.
- Ionin, Tania. (2003). The one girl who was kissed by every boy: Scope, scrambling and discourse function in Russian. In Proceedings of ConSole X.
- Ionin, Tania. Tatiana Luchkina. & Anastasia Stoops. (2014). Quantifier scope and scrambling in the second language acquisition of Russian. In Proceedings of GALANA-4.
- Ionin, Tania. & Tatiana Luchkina. (in press). One Reading for Every Word Order: Revisiting Russian Scope. Proceedings of WCCFL 2014.

- Ionin, Tania. & Tatiana Luchkina. (under review). Focus on Russian Scope: An Experimental Investigation of the Relationship between Quantifier Scope, Prosody, and Information Structure.
- Jackendoff, Ray. (1972). *Semantic Interpretation in Generative Grammar*. Cambridge, MA: MIT Press.
- Krifka, Manfred. (1998). Scope inversion under the rise-fall contour in German. *Linguistic Inquiry* 28, 662-688.
- Ladd, D. Robert. (2008). *Intonational Phonology*. Cambridge, Cambridge University Press.
- Luchkina, Tatiana. & Jennifer S. Cole. (2014). Structural and Prosodic Correlates of Prominence in Free Word Order Language Discourse Proceedings of the 2014 meeting of the Speech Prosody Conference (SP 7), Dublin, Ireland.
- May, Robert. (1985). *Logical form: Its structure and derivation*. Cambridge, MA: MIT Press.
- Miyagawa, Shigeru. (1997). Against optional scrambling. *Linguistic Inquiry* 28, 1-26.
- Neeleman, Ad. & Titov, Elena. (2009). Focus, contrast and stress in Russian. *Linguistic Inquiry* 40, 514-524.
- Stoops, Anastasia. & Ionin, Tania. (2013). Quantifier scope and scrambling in Russian: an experimental study. In Proceedings of the Annual Workshop on Formal Approaches to Slavic Linguistics: The Bloomington Meeting.
- Slioussar, Natalia. (2011). Processing of a free word order language: The Role of Syntax and Context. *Journal of Psycholinguistic Research*, 40:291-306.
- Rosengren, Inger. (1993). "Wahlfreiheit mit Konsequenzen – Scrambling, Topikalisierung und FHG im Dienste der Informationsstrukturierung", in Reis (ed.) *Wortstellung und Informationsstruktur*, Tübingen: Niemeyer, 251–312.
- Sæbø, Kjell Johan. (1997). Topic, Focus and Quantifier Raising. In P. Dekker, M. Stokhof, & Y. Venema (Ed.), *Proceedings of the 11th Amsterdam Colloquium* (pp. 67-72). Amsterdam: Institute for Logic, Language and Computation.
- Tunstall, Susanne Lynn. (1998). *The interpretation of quantifiers: Semantics and processing*. Ph.D. thesis, UMass.

luchkin1@illinois.edu