PITCH ACCENT VARIABILITY IN FOCUS PRODUCTION AND PERCEPTION IN BULGARIAN DECLARATIVES

Snezhina Dimitrova[1], Sun-Ah Jun[2]
[1]Department of English and American Studies, Sofia University "St. Kliment Ohridski", Sofia, Bulgaria
[2]Department of Linguistics, University of California Los Angeles, Los Angeles, USA
snezhinad@hotmail.com, jun@humnet.ucla.edu

ABSTRACT

We investigated variability of pitch accents when it marks different focus types in the speech of young Bulgarians from Sofia. In the production experiment, we found interspeaker variability in the choice of pitch accents, and (!)H* as the predominant nuclear pitch accent in Broad Focus, which is different from the H+(!)H* or H+L* attested in earlier studies. We also found variable alignment of the trailing H tone of pre-nuclear pitch accent L*+H, as well as a new rising tone (LH*) used by some speakers in narrow focus. Perception experiments suggest that LH* is not functionally distinct from L+H*, and that H* and LH* are not consistently distinguished in marking narrow focus.

Keywords: focus types, production, perception, interspeaker variation, Bulgarian intonation.

1. INTRODUCTION

In many languages, types of narrow focus (e.g., information focus, contrastive focus, or corrective focus) are often marked by different pitch accent types. In English, it has been claimed that all-new information is marked by H* while contrastive focus is marked by L+H* ([14], [15]). This is, however, far from undisputable. Some studies ([4], [6], [8], [9]) did not find systematic correspondences between focus type and pitch accent choice in English, questioned the H* vs. L+H* phonological distinction and argued that although listeners interpret H* and L+H* differently, their domains tend to overlap, with the latter creating a bias towards contrastive interpretation, and the former compatible with both new and contrastive contexts ([16]).

Focus in Bulgarian can be marked by a variety of lexico-syntactic means, but it can be cued by prosody alone. Previous work, although conducted within different methodological frameworks, suggests that the choice of pitch accent plays a major role in cueing focus ([11], [12], [13]). Early work within the Autosegmental-Metrical (AM) framework ([1]) describes broad focus (BF) declaratives as having a H* nuclear pitch accent and one or more pre-nuclear L*+H pitch accents. In later studies (e.g., [2]), the nuclear pitch accent in BF is analysed as H+(!)H* or H+L*. The nuclear pitch accent in Narrow focus was first described also as H* ([1]), and contrastive focus was further characterised by delayed peak. In [3] this was changed to (L+)H* for all narrow focus types, with later peak alignment, larger pitch excursions, longer duration, and stronger intensity, distinguishing narrow from broad focus. They also reported interspeaker variation in BF (occasional use of H* instead of H+(!)H*), as well as in narrow focus (variability between H* and L+H*).

However, these findings are based on recordings made in the 1990's of speakers aged between 25 and 60 at the time of recording. Informal observation suggests that young speakers do not show the same pattern. To confirm this observation, we conducted a production experiment to (i) examine pitch accent use for focus marking by young (20s and 30s as of 2015) Bulgarians from Sofia, (ii) categorize the tonal shapes within the AM framework if any new type of pitch accent is found, and (iii) examine speaker variability. We also carried out two perception experiments in order to investigate if variable pitch accent types are distinctive from each other or in free variation.

2. PRODUCTION OF FOCUS

The production experiment aimed at collecting contemporary data from young speakers from the region of the Bulgarian capital Sofia.

2.1. Method

A total of 540 sentences from 3 data sets were analysed: (i) 270 "out of the blue" readings; (ii) 105 sentences preceded by prompting questions; (iii) 165 readings of the sentence *Милена намери лимони* in reply to questions eliciting the focus types shown in Table 1. All sentences had a SVO structure, comprised predominantly sonorants, and the number of syllables and stress location were varied systematically ([7]). Three female and 2 male speakers aged 22 – 34 from Sofia read each subset three times. The recordings were analysed in *Praat* ([5]); word and accented syllable boundaries were marked, and tones were labelled in accordance with the principles in intonational phonology ([7], [10]).

Table 1: Three focus types examined in the study.

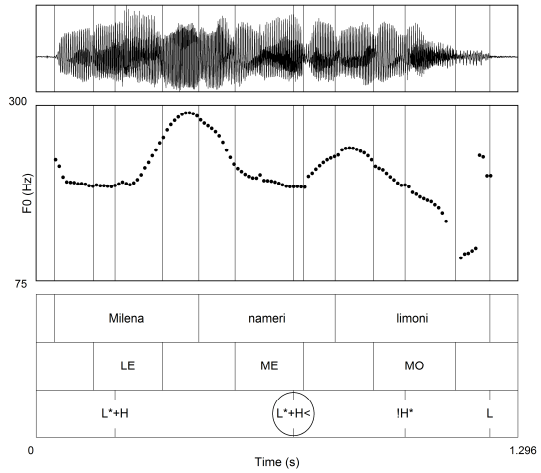
Broad focus (BF)	Какво стана днес? What happened today?	[*Милена намери лимони.*]$_F$ [Milena found lemons.]$_F$
Narrow information focus (IF)	Какво намери Милена? What did Milena find?	*Милена намери [лимони]*$_F$. Milena found [lemons.]$_F$
Narrow contrastive focus (CF)	Ивана ли намери лимони? Did Ivana find lemons?	(Не.) *[Милена]*$_F$ *намери лимони.* (No.) [Milena]$_F$ found lemons.

2.2. Results and discussion

2.2.1. Broad focus (BF)

The predominant nuclear pitch accent in BF was (!)H* and other tones were rare, contradicting the postulation of a default BF H+(!)H* tone in [2], [3]. In pre-nuclear position L*+H predominated, but the timing of H varied (often two syllables to the right of L* for some speakers, see the second pitch accent in Fig. 1 and the first pitch accent in Fig. 2). This type of delayed peak has not been found before, and its phonological status is still under investigation. Figure 1 shows a rare occurrence in our data of a nuclear pitch accent that may have been analysed as H+!H* in [2]. We analyse it as !H* nuclear pitch accent, and the preceding H as the trailing tone of the preceding pitch accent (labelled as L*+H<) realised two syllables to the right of the stressed syllable, which was a typical realisation of the prenuclear pitch accent for this speaker. This analysis captures the generalisation that, regardless of their location in a phrase, most prenuclear pitch accents are "rising" with a Low tone aligned with the stressed syllable.

Figure 1: Nuclear !H* and pre-nuclear L*+H< in Broad Focus, speaker ID.

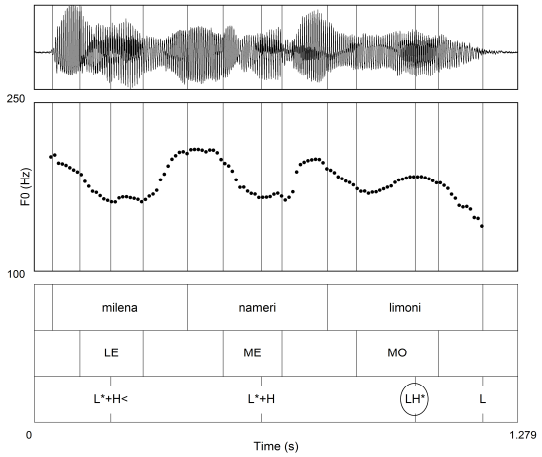


It is not clear what the analysis of prenuclear pitch accent is in [2], [3]. It is possible that the difference between the previous and the current AM accounts of BF intonation in Sofia Bulgarian is due to different analyses of the same contour, but it is also possible that it is due to the difference in the time of data collection and the age of speakers.

2.2.2. Narrow focus

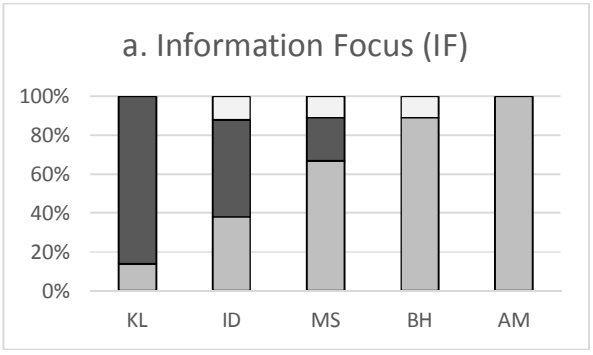
When a sentence-final Object is narrowly focused, three types of nuclear pitch accent were used by the same speaker and across speakers: (!)H*, L+H* and LH*. In general, (!)H* was more common in Information Focus (IF), and LH* and L+H* were more common in Contrastive Focus (CF). LH* is a new type of nuclear pitch accent (see Fig. 2) which has (i) a L target on the onset of the stressed syllable not attributable to declination, and (ii) f0 rise within the stressed/accented syllable (at least 10 Hz) and completed within the syllable. Such a tonal timing has not been reported before, although it is similar to the L+H* tone in [3].

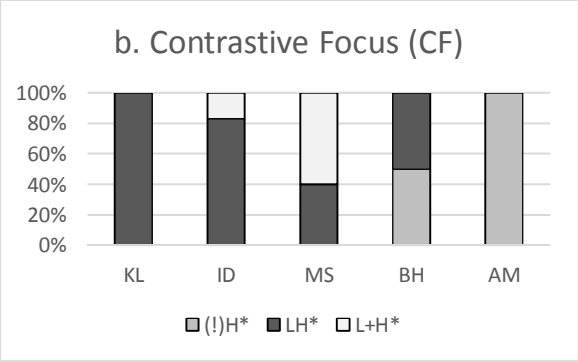
Figure 2: Nuclear LH* and pre-nuclear L*+H< in IF, speaker KL.



To illustrate interspeaker variation in the types of nuclear pitch accent on a narrowly focused Object, the percentage of occurrence of each pitch accent type is given in Fig. 3 when the focus is (a) IF and (b) CF.

Figure 3: Percentage of each pitch accent type used in (a) IF and (b) CF on sentence-final Object by the 5 speakers.





When a sentence-initial Subject is narrowly focused, the most frequent pitch accent was L+H* in both IF and CF, with two speakers also using L*+H in CF. When the Verb is narrowly focused, the predominant tone was LH*, but one speaker only used H*, and two others occasionally used L*+H. This new use of L*+H as a focus cue could be due to its frequent "default" use as the prenuclear pitch accent in declaratives. In the case of narrow focus on both Subject and Verb, obligatory deaccenting to the right of a narrowly focused word was observed.

2.3. Summary and conclusions

We found both intra- and interspeaker variability in the choice of pitch accent to signal focus types. (!)H* predominated in BF. In narrow focus, we found a new tonal shape not previously reported, represented here as LH*. The smaller amount of rise sometimes found in LH* occasionally made labelling decisions difficult. This may suggest that LH* in Bulgarian is a variant of H* (cf. [9]). However, the production data seem to point to a pragmatic/semantic similarity between LH* and L+H*. Below, we provide preliminary results on the perceptual distinctiveness of these two pitch accents. The H+!H* or H+L* nuclear pitch accent in BF reported previously ([2], [3]) occurred very rarely in our data. Alignment of the H target in the pre-nuclear L*+H in BF was much more variable than that in narrow focus. This variability needs further investigation. In order to address the perceptual salience of (some of) the observed variability in the pitch accent types, we conducted two perception experiments.

3. PERCEPTION EXPERIMENT 1

Our production results seem to suggest a functional similarity between LH* and L+H* in narrow focus. We therefore hypothesize that L+H* and LH* will be judged equally acceptable for marking narrow focus in Sofia Bulgarian.

3.1. Method

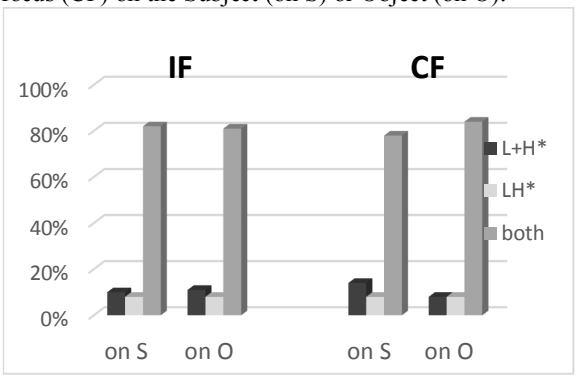
We used 4 renditions of the utterance *Milena nameri limoni* produced by 2 female speakers with narrow focus on either the S or O marked by LH* or L+H* (8 utterances in all). The pitch contour was manipulated using PSOLA in *Praat* ([5]): an original LH* was resynthesized to obtain L+H*, or vice versa, thus giving 8 trial pairs, each containing an original and a manipulated answer from the same speaker. Each pair was preceded by a question, and occurred twice in the test, with the answer order reversed. The 16 dialogues were mixed with 12 distractors.

In a forced choice context matching experiment, listeners heard the question followed by the two replies, and judged whether reply A, reply B, or both best answered the question. Fifteen listeners aged 31-52 (3 male, 12 female) took part in the test. Listener consistency was high (84%), with the exception of 2 listeners (below 50%) whose answers were excluded from the analysis.

3.2. Preliminary results and discussion

The hypothesis was confirmed. As shown in Figure 4, listeners judged L+H* and LH* as equally appropriate about 80% of the time. Specifically, listeners found both tones acceptable 81% of the time for IF on O, and 82% of the time for IF on S. For CF on O, listeners judged both tones equally acceptable 84% of the time, and for CF on S, 78%. The preliminary results thus point to a functional similarity of LH* and L+H* in both IF and CF, in S as well as in O position in SVO declaratives in Sofia Bulgarian.

Figure 4: Appropriateness judgements (%) for L+H* vs. LH* in information focus (IF) and contrastive focus (CF) on the Subject (on S) or Object (on O).



4. PERCEPTION EXPERIMENT 2

The second experiment tested the distinctiveness of LH*/L+H* vs. (!)H*. (Below, "H*" also represents !H*, and "LH*" also represents L+H*.) Earlier findings and our own production results suggest the following hypothesis: (1) LH* and H* are distinct

pitch accents in Bulgarian, with the first one preferred in narrow focus contexts and the second one - in broad focus environments. However, since the choice between LH* and H* is a matter of free variation in narrow focus contexts for some young speakers, we hypothesize that (2) these two tones are not distinctive in the narrow focus contexts.

4.1. Method

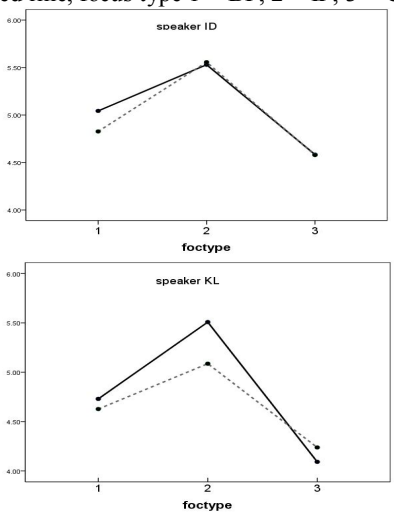
The stimuli were five SVO declarative sentences produced with H* or LH* nuclear tone on the Object by two young female speakers from Sofia. Their pitch contour was manipulated using the same method as in Perception Experiment 1. Each sentence was paired with three different questions designed to elicit BF, IF, or CF. The overall number of experimental trials was 60 (2 speakers x 5 utterances x 2 pitch accents x 3 questions). The questions were presented to listeners on paper. Listeners judged a sentence's appropriateness as an answer to the respective question on a 7-point Likert scale, where 1 = totally inappropriate and 7 = fully appropriate. Each trial began with an alerting tone, followed by a 2 sec pause, the recorded sentence, and a 3 sec pause during which listeners made their decision. Thirty-seven Bulgarians (9 male, 28 female, aged 19-21) from Sofia took part in the test.

4.2. Results and discussion

Repeated-measures ANOVAs with Pitch Accent (H* and LH*) and Focus Type (BF, IF and CF) as independent variables were performed separately for the two speakers (ID, KL). Results for speaker ID showed a significant main effect of Focus Type ($F(2, 8)=10.193$, $p < .05$) but no significant effect of Pitch Accent and no significant interaction between the two. The ANOVA analysis for speaker KL also showed a significant main effect of Focus Type ($F(2, 8)=15.369$, $p < .01$) but no significant main effect of Pitch Accent. However, there was a significant interaction between the two ($F(2,8)=8.915$, $p < .01$). Bonferroni post hoc tests showed significant differences (all $p < .05$) between H* in IF vs. CF and LH* in IF vs. CF for both speakers. H* vs. LH* only approached significance ($p = .056$) in IF for speaker KL but was non-significant elsewhere.

Both speakers' use of H* in BF was judged more appropriate than LH*, but the actual amount of the difference was not significant, not supporting the first hypothesis. In narrow focus, both tones were assessed as equally appropriate in speaker ID's utterances, supporting the second hypothesis. For speaker KL, for whom we found significant interaction between Pitch Accent and Focus Type, LH* was evaluated as more appropriate in CF, though again the difference was not significant.

Figure 5: Mean appropriateness scores for each speaker: (a) ID and (b) KL. H* solid line, LH* dotted line, focus type 1 = BF, 2 = IF, 3 = CF



The small difference between listeners' ratings of H* vs. LH*, and the overall higher ratings given for IF than for other Focus types may reflect the lack of differences in the stimuli other than f0 shapes: listeners may have expected longer durations, extended pitch range, and greater intensity differences in CF, and shorter durations, smaller pitch range and weaker intensity in BF, as found by [3]. In the absence of those cues, the different f0 shapes in pitch accent types seem to be a weak cue to a focus type for our speakers. However, the different perception judgments given for our two speakers are in conformity with the interspeaker variability reported in the current paper and in [2, 3].

5. CONCLUSIONS

A comparison of our production results with those of earlier work shows (i) different nuclear pitch accent in BF: (!)H* in the current study vs. H+!H*/L* in [2, 3]; (ii) variable alignment of the trailing tone in L*+H, and (iii) a new LH* tone in IF and CF. Our first perception results suggest a functional similarity between LH* and L+H* in narrow focus. The second perception experiment showed no significant perceptual distinctness of H* and LH* in BF as well as in narrow focus. However, this may be due to the lack of non-f0 cues to focus types. Further research is needed to clarify the perceptual distinctiveness of the pitch accent types. Finally, the observed differences between the current findings in the production data and previous studies may be attributable to the differences in generation of the speakers.

Acknowledgements
This research was partly supported by a Fulbright Senior Scholar Grant to the first author.

6. REFERENCES

[1] Andreeva, B., Avgustinova, T., Barry, W. J. 2001. Link-associated and focus-associated accent patterns in Bulgarian. In: Zybatow, G., Junghanns, U., Mehlhorn, G., Szucsich, L. (eds.), *Current Issues in Formal Slavic Linguistics,* pp. 353-364, Peter Lang: Frankfurt am Main.
[2] Andreeva, B. 2009. Towards the intonational phonology of the Sophia Variety of Bulgarian. In: Zybatow, G., Junghanns, U., Lenertová, D., Biskup, P. (eds.), *Studies in Formal Slavic Phonology, Morphology, Syntax, Semantics and Information Structure. Proceedings of FDSL 7*, Leipzig 2007. Frankfurt: Peter Lang, 357-371.
[3] Andreeva, B., Koreman, J., Barry, W. J. 2014. Local and global acoustic correlates of information structure in Bulgarian, *Speech Prosody 2014*, Workshop on the Prosody of Slavic Languages.
[4] Bartels, C., Kingston, J. 1994 Salient pitch cues in the perception of contrastive focus. In: Bosch, P., van der Sandt, R. (Eds.), *Focus and natural language processing, Vol. 1: Intonation and syntax*, 1-10. IBM Deutschland Informationssysteme GmbH Scientific Center, Institute for Logic and Linguistics.
[5] Boersma, P., Weenink, D. *Praat: doing phonetics by computer* (last accessed 30 January 2015) http://www.fon.hum.uva.nl/praat/
[6] Calhoun, S. 2004. Phonetic dimensions of intonational categories: the case of L+H* and H*. *Proc. Speech Prosody* 2004, Nara.
[7] Jun, S.-A., Fletcher, J. 2014. Methodology of Studying Intonation: From Data Collection to Data Analysis, in Sun-Ah Jun (ed.) *Prosodic Typology II: The Phonology of Intonation and Phrasing.* Oxford: Oxford University Press.
[8] Katz, J., Selkirk, E. 2011. Contrastive Focus vs. Discourse-New: Evidence from Phonetic Prominence in English. *Language*, 87(4), 771-816.
[9] Ladd, D. R., Schepman, A. 2003. "Sagging transitions" between high pitch accents in English: Experimental evidence. *Journal of Phonetics*, 31, 81-112.
[10] Ladd, D. R. 2008. *Intonational Phonology*. 2nd edn., Cambridge: Cambridge University Press.
[11] Misheva, A. 1991. *Intonatsionna sistema na bulgarskiya ezik.* Sofia: BAN. (*Intonation System of Bulgarian*)
[12] Misheva, A., Nikov, M. 1998. Intonation in Bulgarian, in: Hirst, D., Di Cristo, A. (Eds*.) Intonation Systems. A Survey of Twenty Languages,* Cambridge: CUP, 275-287.
[13] Penchev, Y. 1980. *Osnovni intonatsionni konturi v bulgarskoto izrechenie*. Sofia. (*Main intonation contours in the Bulgarian sentence*)
[14] Pierrehumbert, J., Hirschberg, J. 1990. The meaning of intonational contours in the interpretation of discourse, In Cohen, P., Morgan, J., Pollacks, M. (eds.) *Intentions in Communication,* Cambridge, MA: MIT Pres, 271-311.
[15] Speer, S., Ito, K. 2011. Prosodic properties of contrastive utterances in spontaneous speech. *Proceedings of ICPhS XVII, Hong Kong, 17-21 August 2011*: 1890-1893.
[16] Watson, D., Tanenhaus, M. K., Gunlogson, C. A. 2008. Interpreting pitch accents in online comprehension: H* vs. L+H*, *Cognitive Science* 32, 1232-1244.