

Acoustic correlates of stress and focus in Ukrainian

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Lexical stress is a structural parameter that indicates metrical strength in the lexicon (e.g., van Heuven, 2018). Vowel duration, intensity, f₀, and vowel quality have been reported as acoustic correlates of stress (e.g., Volín, & Weingartová, 2014). In Ukrainian, both traditional (Brovčenko, 1969; Toc'ka, 1969) and more recent studies (Łukaszewicz and Molczanow, 2018) argue that vowel duration is the most robust phonetic cue to stress. They also conclude that other stress correlates are less reliable (intensity) or unreliable (f₀).

The question remains how these latter correlates are affected by information structure. We selected 20 trisyllabic word pairs, one member with a SWW (strong-weak-weak), one with a WSW metrical pattern. The vowel in the second syllable was graphemic “a” (“a”), “e” (“e”), “i” (“i”), “o” (“o”) or “y” (“u”), four times each. Then, 80 question-answer pairs were created. Each target word was presented as an object in a syntactically unmarked SVO (subject-verb-object) sentence in two conditions:

1. *focused, narrow focus on the target word* (cf. (1), target word in capitals, stressed syllable underlined). The focus in the answer is a constituent matching the <wh>-phrase in the question, cf. Question-Answer Congruence rule (Büring, 2016);

- (1) Target: focal (SV[O]_F)
- | | | |
|---|----------------------------|------------------------------------|
| (Що ти написала?) | — Я написала | [" <u>ДЕ</u> РЕВО"] _F . |
| (Šo ty napysala?) | — Ja napysala | [" <u>DE</u> REVO"] _F . |
| (What you wrote _{FEM} .) | — I wrote _{FEM} . | [' <u>TREE</u> '] _F . |
| '(What did you write?) — I wrote ['TREE'] _F .' | | |

2. *unfocused, narrow focus preceding the target word* (cf. (2)). The verb in the context question was corrected in the answer, and the object is post-focal.

- (2) Target: post-focal (S[V]_FO)
- | | | | |
|--|----------|-------------------------------------|--------------------|
| (Ти написала "ДЕРЕВО"?) | — Ні, я | [прочитала] _F | " <u>ДЕ</u> РЕВО". |
| (Ty napysala "DEREVO"?) | — Ni, ja | [pročytala] _F | " <u>DE</u> REVO". |
| (You wrote _{FEM} . 'TREE'?) | — No, I | [read _{FEM}] _F | ' <u>TREE</u> '. |
| '(Did you write 'tree'?) — No, I [read] _F TREE. | | | |

Eleven native speakers of Ukrainian (8 female, 3 male) produced 40 utterances (20 in each condition) and were recorded using headset microphones. The duration and mean intensity of the second vowel (posttonic in SWW words, tonic in WSW), as well as the f₀ contours of the target words, were analyzed using Praat (version 6.4.23, Boersma and Weenink, 2024) and ProsodyPro (Xu, 2013).

For statistical analysis of duration and intensity, separate generalized linear mixed effect models were fitted in R (version 3.3.3, R Development, Core Team, 2015). The results reveal main effects of vowel quality, stress and focus, as well as an interaction between stress and focus (Fig. 1). The second vowel was produced with longer duration and higher intensity when stressed, whereby this effect was stronger in the focused condition. Visual inspection of f₀ contours (Fig. 2) suggests a higher f₀ on the pre-tonic syllable than on the tonic syllable, *irrespective* of metrical pattern (SWW or WSW). The differences in f₀ contours between SWW and WSW words are more pronounced in the focused condition than in the unfocused condition, indicating the role of f₀ as a marker of focus. Taken together, these findings may provide an explanation of why f₀ was argued to be an unreliable cue to stress in Ukrainian read speech.

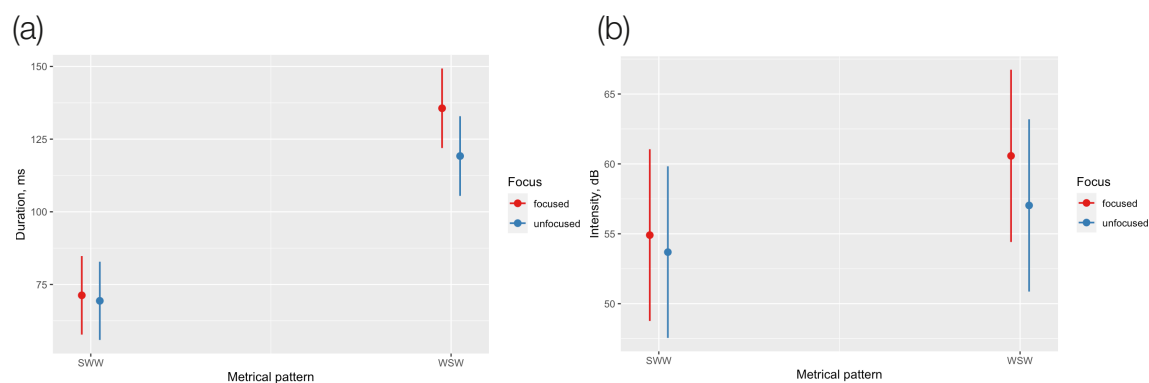


Figure 1: Predicted values of duration (a) and intensity (b) of the second vowel.

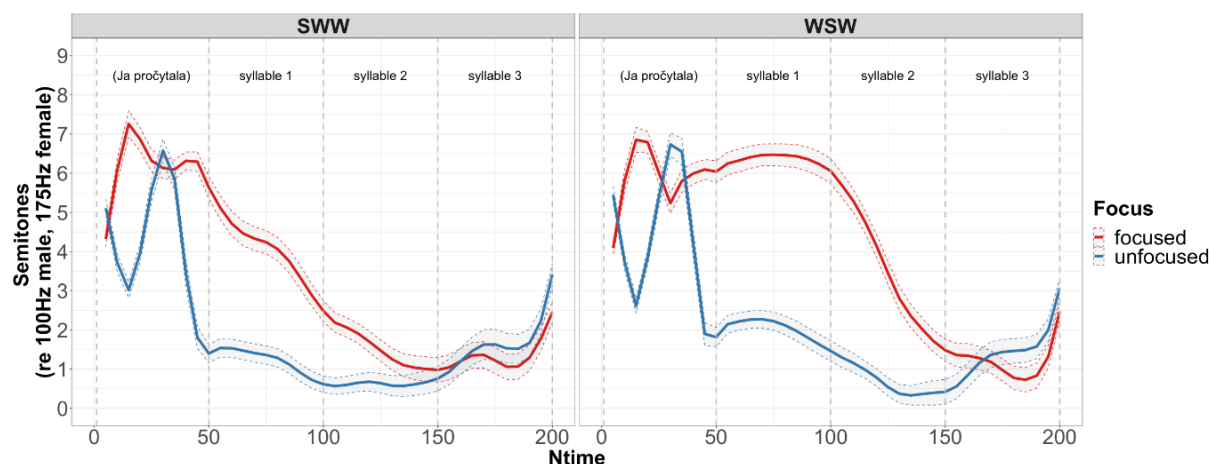


Figure 2: Averaged f0 contours per condition across normalized time. The first time interval (0-50) represents the subject and the verb; the later intervals the three syllables of the target word.

Bibliography

- Boersma, P., & Weenink, D. (2024). *Praat: Doing phonetics by computer* [computer program]. Version 6.4.23. Retrieved 6 November 2024.
- Brovčenko, T. O. (1969). *Slovesnyj naholos v sučasnij ukrajins'kij movi. Eksperymental'ne doslidžennja*. Kyiv: Naukova Dumka.
- Büring, D. (2016). *Intonation and meaning*. Oxford University Press.
- Łukaszewicz, B., & Molczanow, J. (2018). The role of vowel parameters in defining lexical and subsidiary stress in Ukrainian. *Poznan Studies in Contemporary Linguistics*, 54(3), 355-375. <https://doi.org/10.1515/psicl-2018-0014>
- R Development Core Team. (2015). *R: A language and environment for statistical computing*. Vienna: R Foundation for Statistical Computing.
- Toc'ka, N. I. (1969). Zvukova charakterystyka sučasnoji ukrajins'koji literaturnoji movy. Holosni zvuky. In I. K. Bilodid (Ed.), *Sučasna ukrajins'ka literaturna mova. Vstup. Fonetyka* (pp. 50–130). Kyiv: Naukova Dumka.
- Van Heuven, V. J. (2018). Acoustic correlates and perceptual cues of word and sentence stress: Towards a cross-linguistic perspective. In R. Goedemans, J. Heinz, & H. van der Hulst (Eds.), *The Study of Word Stress and Accent: Theories, Methods and Data* (pp. 15-59). Cambridge University Press.
- Volín, J., & Weingartová, L. (2014). Acoustic correlates of word stress as a cue to accent strength. *Research in Language*, 12(2), 153–166. <https://doi.org/10.2478/rela-2014-0008>
- Xu, Y. (2013). ProsodyPro - a tool for large-scale systematic prosody analysis, in *Proceedings of the Tools and Resources for the Analysis of Speech Prosody (TRASP 2013)* (Aix-en-Provence), 7–10.