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Melodic prominence of verbs in Czech spoken narratives

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Abstract

In spoken narratives, full verbs were recently found on occasion deaccented despite their central syntactic role. Deaccenting appeared to be linked with the information status of the verbs. In the current study, we ask how often the accented ones are more/less prominent in their f_0 values relative to their prosodic neighbors. Narratives spoken by 16 speakers provided 473 cases of phrase-internal verbs (position typical of Czech). We used several f_0 metrics and analyzed them considering the phonological status of the accents and the verb roles in the information structure. The results suggest that Czech verbs do not typically dominate. In the case of strings of H* accents, up to 90% of the verbs had lower f_0 values than the neighbors. In sequences of L* accents, the results are consistent with the previous, but they cast doubts on certain practices. Importantly, classification of the verbs as thematic or rhematic brings about easier and more plausible interpretation of the results.

Index Terms: prominence, full verb, information structure, accent-group, fundamental frequency, theme, rheme

1. Introduction

1.1. Preliminaries

Verbs are often ascribed a special (or central) status in the syntactic structure of sentences: they are deemed the pivotal constitutive elements. However, in our previous study, we found quite a substantial number of autosemantic verbs (i.e., content verbs, not the auxiliary or modal ones) unaccented [1]. Our objective in the current study is to move further beyond the binary classification of accented vs. unaccented. The accented items in utterances can still differ in their relative prominence. Therefore, we set out to investigate relative prominence of the accented verbs in terms of their f_0 values and their phonological (or rather intonological) patterning relative to the neighboring accented words.

Together with the question of relative prominence, we were again interested in the assignment of the verbs in the information structure of utterances. Following the rich tradition of information structure research in the Czech language (e.g., [2], [3], [4], [5], [6], [7]), we acknowledged the existence in utterances of thematic and rhematic parts. We examined association of the analyzed verbs with the theme or rheme of an utterance. The assignment is guided by the contextual grounding of the verb, or its givenness ([2], [3]).

It is often presumed that higher f_0 means greater perceptual prominence. However, there is a prevalence of L*+H accents in Czech [8]. We, therefore, devised various types of f_0 metrics with the aim of comparing their effectiveness in producing interpretable results. Rather than testing hypotheses, we explore the state of affairs. To summarize, our research questions are:

- Are there any preferred associations of full verbs with L* or H* accents related to their information status?
- Are accented full verbs associated with higher f_0 values relative to their accented neighbors?
- Do various metrics of f_0 properties produce comparable (mutually consistent) results?

It should be noted that our research explores naturally occurring spoken texts rather than laboratory material. (Hence the absence of hypotheses on behalf of research questions.)

2. Method

Professional recordings of narratives were obtained from audiobooks that features renowned (and well-sold) texts. A sample of speech production by 16 speakers (8 female + 8 male) was collected with the requirement of at least 1000-word continuous text per speaker. Full (i.e., autosemantic) verbs were sought in phrase-internal positions, which is an arrangement typical of Czech [9]. Phrases with verbs in initial and final positions were omitted at this stage or research.

We devised several measures pertaining to differences between a verb-related f_0 value and a reference value from the prosodic neighbourhood of the verb. The differences (D) measured as correlates of prominence could be sorted into three sets: DV1, DV2 = differences of vowel-based measurements; DG1, DG2 = differences of accent-group-based metrics; DL1, DL2, DL3 = modified vowel-based metrics conceived specifically for L* accents. They are all described and explained below.

DV1 is a plain difference between the peak f_0 value of the accented syllable nucleus in the verb and an analogical measurement in the nearest preceding accented nucleus (Fig. 1). For DV2, the accented nucleus of the verb is related to a line connecting the nearest preceding and nearest following accented syllable (also termed *topline* in literature). The conceptual parameters of the line (gradient and intersect) and the timing moment were used to calculate what the verb value would be if it were directly on the connecting line using (1):

$$DV2 = f_v - \left\{ f_{pre} + \left[\left(\frac{f_{post} - f_{pre}}{t_{post} - t_{pre}} \right) \times \left(t_v - t_{pre} \right) \right] \right\} \quad (1)$$

where f_v is the f_0 in the peak of the accented syllable of the verb, f_{pre} and f_{post} are analogical values for accented syllables before and after the verb respectively, t_v is the timing of the verb peak, and t_{pre} and t_{post} are analogical timing values for preceding and following accented syllables. (See also DV2 in Fig. 1.)

Arguably, these two simple metrics are primarily suitable for the H* accents or for situations where perceptual experiments established that higher f_0 values indeed imply greater prominence. No such experiments exist for Czech, so the use of DV1 and DV2 for L* accents must be done with caution.

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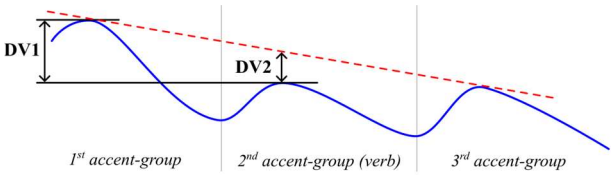

Figure 1: *Illustration of DV1 and DV2 metrics; blue line = f_0 track, red broken line = topline (see text).*

DG1 is the difference between the mean f_0 of the accent-group containing the verb and the mean f_0 of the preceding accent group. The DG2 metric related the mean f_0 of the accent-group containing the verb to the average f_0 of accent-groups flanking the verb (Fig. 2).

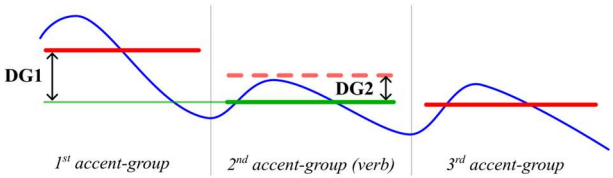

Figure 2: *Illustration of metrics DG1 and DG2; blue line represents an f_0 track, red broken line a mean f_0 value in the verb accent-group (see text).*

As stated above, a common stress-group pattern in Czech is L*+H (post-stress rise, see [8]). Therefore, three metrics were designated specifically for those. DL1 is actually the same as DV1: we only renamed it for the presentation purpose. DL2 is conceptually very much like DL1 (or DV1), which means vowel-based, only it is measuring the post-stress peaks. DL3 works with the height of the post-stress vowel above the level of the stressed vowel. In other words, it measures the f_0 difference between L and H in the L*+H accents and compares this difference in the verb with the previous one.

Apart from these f_0 measures, we annotated intonological status of the three accented syllables in our phrases roughly following [10]. (The verb was always between two other accents in a three-accent phrase.) Only H* vs. L* dichotomy was identified for the subsequent analyses. There are several reasons for this decision. First, there was a massive prevalence of H* and L*+H accents in our sample. Other types occurred in only negligible numbers. (L*+H will be referred to as L* accents further on.) Second, our difference measures need to be interpreted only in comparable sequences of accents. There were three phrases that had to be discarded since they actually contained accents that were not mutually comparable (see also the first paragraph of *Results*). Third, with this simplified annotation, there is low risk of erroneous labeling and unless serious reasons emerge in the future, there seems to be no need to make matters more complicated for Czech narratives.

As to the information status of the verbs, we established their role as part of the theme or of the rheme. We agreed with [2] that despite certain transitional features, each verb can be classified as either thematic (Th) or rhematic (Rh) given their wider narrative co-texts. Our classification was based on the givenness of the semantic content of the verb (the grammatical content like person, number or tense being ignored). If the verb was given by the co-text, or the situational or the factual context, then it was classified as thematic. Rhematic verbs brought new, contextually unbound information.

3. Results

The material provided 473 accented autosemantic verbs in the specified position (about 30 items per speaker). Of those, 276 were accented with L* and 197 with H* (*cf.* [3]). Three phrases had to be discarded as the phonological status of verb neighbors was undiscernible. That leaves 274 L* and 196 H* accents for the analyses. As the prominence measures of high accents work differently from those of low ones, the results will be presented separately for each of the types. In the following paragraphs, we will first deal with phonology, and then with f_0 values.

3.1. Phonological patterns

Our sample of three-accent phrases provided all combinations of high and low accents. Table 1 shows, however, that certain combinations were more frequent than others. In both low and high verbs (the middle letter in the triplet stands for the verb) the uniform arrangement (HHH and LLL) was always most numerous. The prevalence is especially clear in the case of L* verbs, that is for LLL configurations.

Table 1: *Counts of various combinations of H* and L* accents in the analysed phrases. (Ordered by number of occurrence in the sample.)*

H* verbs	*n*	L* verbs	*n*
HHH	61	LLL	113
LHL	59	LLH	71
LHH	47	HLH	49
HHL	29	HLL	41

Given that the ratio of thematic to rhematic verbs in the whole sample was 1:1.75 (172 verbs belonging to the theme, 301 verbs belonging to the rheme), we could calculate χ^2 test to see if there were any statistically significant differences in fit to this ratio in any of the eight combinations of accents found in the sample. Figures 3 and 4 display percentages of thematic and rhematic verbs in each type of a phrase. Clearly, the rhematic verbs outnumber the thematic ones with the exception of HHL phrases.

In seven out of eight types of phrases the differences were statistically insignificant. Only the combination HHL produced a significant result at the level of $\alpha = 0.05$. Generally, it could be stated that there is no visible preference for certain combination of H* and L* accents in marking the difference between thematic and rhematic verbs.

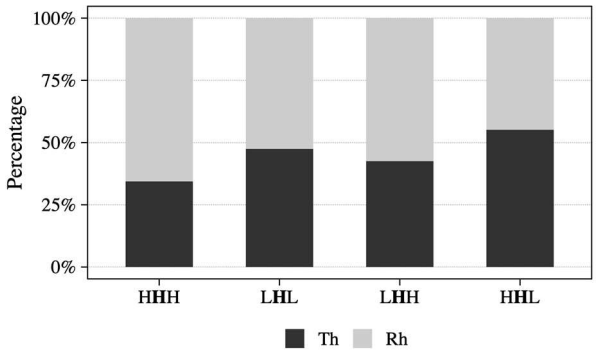

Figure 3: *Percentages of thematic and rhematic H* accented verbs in sets of phrases defined by the accent combination. (The middle letter stands for the verb.)*

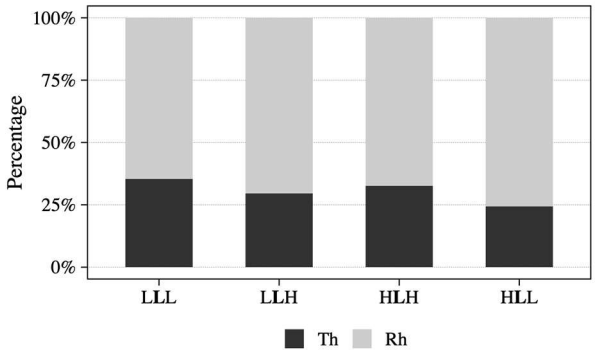

Figure 4: *Percentages of thematic and rhematic L* accented verbs in sets of phrases defined by the accent combination. (The middle letter stands for the verb.)*

3.2. Fundamental frequency measures

Our concern was the relative prominence in a phrasal neighborhood as expressed by f_0 values. That could be established primarily for parallel phonological arrangements. Given that our sample consisted of three-accent phrases, uniform sequences (LLL or HHH) were of interest. These occurred in about 37% of the phrases, i.e., in 174 cases (*cf.* Table 1). As our study is motivated by our recent findings of surprisingly weak prosodic status of verbs [1], we will present the results here with respect to verbs with **lower** relative f_0 values.

3.2.1. The HHH phrases

There were 61 phrases with a succession of H* accents. Percentages of lower f_0 values by thematic/rhematic status of the verb are displayed in Figure 5.

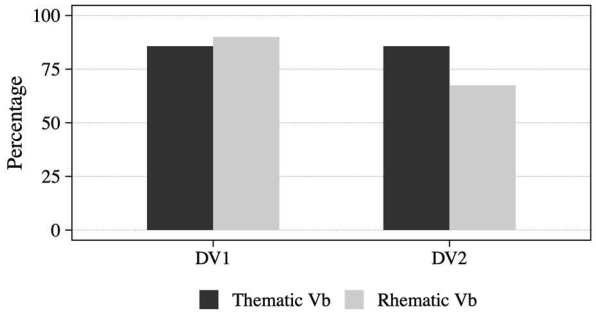

Figure 5: *Percentages of thematic and rhematic verbs with lower f_0 values given by metrics DV1 and DV2.*

In all four columns of the graph, it is always more than half of the verbs being less prominent. In the rhematic verbs measured by DV1 it is actually 90%. It has to be stressed, though, that whereas DV1 compares f_0 values directly, DV2 takes into account possible declination. That is in favor of rhematic verbs: only 67% now have a lower f_0 value relative to the neighbors.

The next pair of metrics (DG1 and DG2) is based on the arithmetic means of f_0 in the accent-groups. Past research suggested a possibility that Czech listeners are perceptually much less fixated on the one stressed syllable, and instead, they pay more attention to the accent-group as a whole, i.e., as a configuration (e.g., [11], [12], [13]). Figure 6 shows that if this is the case, then in HHH phrases about 90 % of verbs would be less prominent in plain comparison of values (DG1).

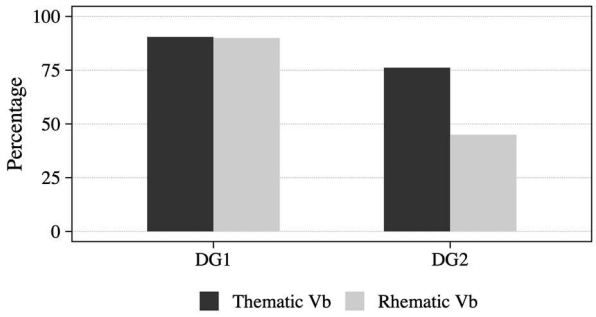

Figure 6: *Percentages of thematic and rhematic verbs with lower f_0 values given by metrics DG1 and DG2.*

DG2 produces a different picture. Since it takes into account declination and the verb is always in the second position in our phrases, only 76% thematic verbs are now less prominent than its neighbors. As to rhematic verbs, it is only 45%. That makes sense given the difference between the themes and rhemes of utterances.

3.2.2. The HHL phrases

In this type of phrases, we could not use DV2 and DG2 metrics. We only present these phrases for the sake of wider view of the situation. Figure 7 shows that both DV1 and DG1 produce similar results. DG1 slightly emphasizes the difference between thematic and rhematic verbs, again in line with general understanding of the nature of theme-rheme division.

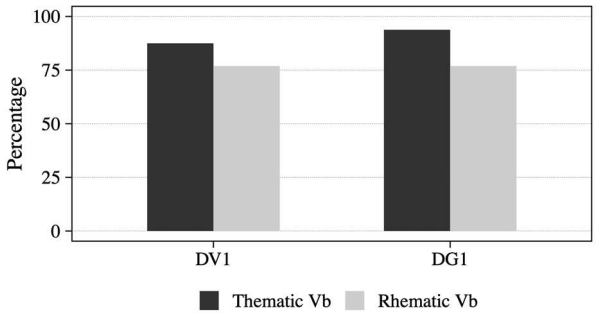

Figure 7: *Percentages of thematic and rhematic verbs with lower f_0 values given by metrics DV1 and DG1 in LLH phrases.*

It has to be remembered that establishing downward trends in these phrases would quite probably lower the number of less prominent verbs, especially the rhematic ones (*cf.* Figs. 5, 6).

3.2.3. The LLL and LLH phrases

As stated above, the L* accents pose a conceptual problem as their perception by listeners possibly differs from that of H* accents. Fig. 8 displays the results for metrics DG1 and DG2, i.e., something directly comparable to Fig. 6, but actually related to all the results presented in Section 3.2 so far. At first sight, it suggests greater number of 'weak' rhematic verbs. (The attribute 'weak' will be used to refer to lower relative prominence suggested by f_0 measures.) This conclusion is not compatible with the results presented for H* accents. We could therefore argue that the f_0 value in L* deserves the opposite interpretation. One has to remember though, that DG1 and DG2 are based on the mean of the whole accent group. The behavior of measures based on the accented vowels is therefore needed.

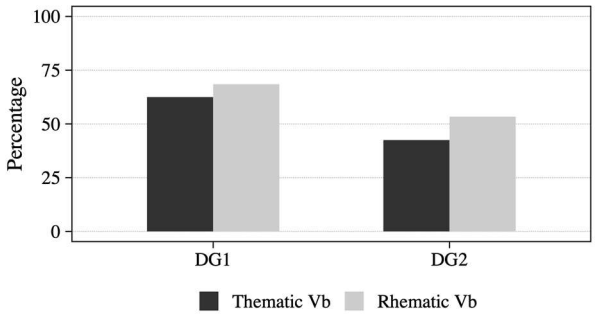

Figure 8: *Percentages of thematic and rhematic verbs with lower f_0 values given by metrics DG1 and DG2 in LLL phrases.*

Such information is provided by Figure 9. DL1 in both panels shows that if we compare the vowel-based f_0 value of the verb with the preceding accented vowel, the rhematic verb will be 'weaker' more often than the thematic ones. That would not be compatible with what we know about themes and rhemes unless lower f_0 value in L* accents actually means greater prominence.

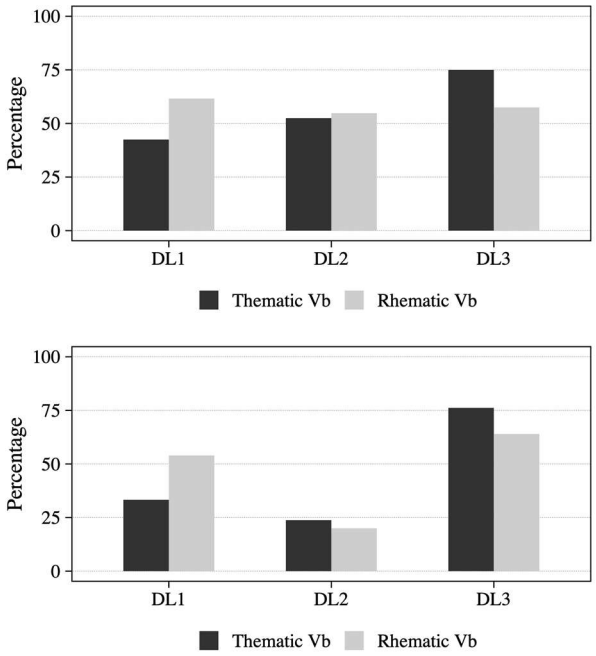

Figure 9: *Percentages of thematic and rhematic verbs with lower f_0 values produced by metrics DL1, DL2, and DV3 in LLL phrases (top panel) and LLH phrases (bottom panel).*

DL2 metric (middle pair of columns in Fig. 9) reflects the f_0 values for the post-stress vowels. This was of interest because all the L* accents in our sample were actually L*+H accents. (This simplification of referring was signaled in the *Method*.) DL2 metric, however, does not suggest any difference between thematic and rhematic verbs, which is possible but in the light of DL3 results not probable. DL3 metric compares the distances between L and H in the L*+H accents. It is actually the height of the rise in the accent. This metric brings back the compatibility with the results in HHH phrases. The rhematic verbs are again less often 'weak' than the thematic ones. It holds for both LLL and LLH phrases (top and bottom of Fig. 9)

4. Discussion

In this study, we tried to follow up on our previous finding that Czech full verbs, despite their central syntactic role, can be deaccented in spoken narratives [1]. We looked at the full verbs that retained the accent, and we tried to compare their relative prominence in their immediate prosodic neighborhood.

Most of the measurements led to the conclusion that verbs less prominent than their immediate neighbors are quite common. This is in line with suggestions by [14] even if German verbs are guided by different syntactic rules than the Czech ones.

One of the serious limitations of our study is the lack of knowledge concerning the perceptual impact of the acoustic measures. How our findings relate to human perception needs to be established in the follow-up research. For example, unlike [15: p. 9] we cannot claim that one or the other accent is more prominent in Czech. (There is actually indirect evidence that L*+H might be more prominent than H*, but that seems to be limited to nuclear positions [16: p. 311]). Also, although DV2 and DG2 took into account downtrends in prosodic phrases computationally, a perceptual model for Czech should be developed before any serious generalizations are made.

It is nevertheless clear that verbs do not dominate in their immediate prosodic context. There are substantial numbers of verbs that are 'weaker' than their neighbors and it is usually the case that rhematic verbs are not as often 'weak' as the thematic ones if we accept that for L* accents higher f_0 is not greater prominence. It could be argued that classifying the verb as thematic or rhematic is too elementary: verbs might differ substantially in their predictability above their theme/rheme allocation. That would require more detailed analyses of information structure.

Statistical modeling of our results is postponed at this stage. We first need to carry out perceptual experiments to establish how to amend our metrics (or which ones to exclude). Only then can we start cross-genre and cross-language comparisons and other investigations into speech communication issues.

5. Conclusions

Various measures of f_0 values indicate regular occurrence of weaker prosodic prominence or verbs in Czech narratives. Also:

- The full verbs in narratives are more often rhematic rather than thematic with the ratio of about 3 : 2.
- Verbs in prosodic phrases do not seem to prefer any of the H/L combinations over others.
- Despite their syntactic importance, verbs do not necessarily dominate in their prosodic contexts.
- Many columns in the presented graphs show that lower prominence is more frequent in thematic rather than rhematic verbs.

It seems that (a) downtrends have to be taken into account, and (b) L* accents are not more prominent (at least in Czech) if they have higher f_0 values. Their prominence might be given by the height of the post-stress rise. Both of these aspects deserve more attention in the future in the form of dedicated perception experiments.

6. Acknowledgements

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7. References

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