performance indicators were measured: the recall and precision of the phonological phrase boundary recovery, the average time deviation between detected and reference phonological phrase boundaries and the accuracy of the classification regarding the type of phonological phrases.

The recall is measured with the following formula:

$$\text{Recall} = \frac{tp}{tp + fn}, \tag{1}$$

where tp stands for true positives, that is, the number of phonological phrase boundaries correctly found within 150 ms of the original one in the reference; fn stands for false negatives, that is, the number of missed phonological phrase boundaries (present in reference but not detected).

Precision is measured as:

$$\text{Precision} = \frac{tp}{tp + fp}, \tag{2}$$

where fp stands for false positives: phonological phrase boundaries detected where they should not be according to the reference, or more than 150 ms apart from reference phonological phrase boundary.

The recall of phonological phrase alignment-based prosodic segmentation was 82.1%, the precision was 77.7%.

The average time deviation (σ_t) of segmentation for phonological phrases was measured for true positives as:

$$\sigma_t = \frac{1}{tp}\sum_{i=1}^{tp}\left|t_i - t_i^{ref}\right|, \tag{3}$$

where tp stands again for the number of phonological phrase boundaries correctly found within 150 ms vicinity of the reference boundary. t_i is the detection time of the i^{th} phonological phrase boundary, t_i^{ref} is the location of the corresponding reference boundary. For the above tests, average time deviation was found to be: $\sigma_t = 50.4$ ms.

Finally, classification accuracy is measured as the ratio of correctly classified phonological phrase boundaries (tp_{cc}) versus all true positive phonological phrase boundaries (tp):

$$\text{Acc} = \frac{tp_{cc}}{tp}. \tag{4}$$

Classification accuracy was found to equal overall 73.1%.

3.6 *Prosodic segmentation vs. word boundaries*

Vicsi and Szaszák used a similar prosodic segmentation for phonological phrases to partially recover word boundaries in Hungarian and Finnish languages (Vicsi-Szaszák, 2010), (Vicsi-Szaszák, 2005). Of course not all phonological phrase boundaries coincide with word boundaries, the authors also underline that for Hungarian, a word boundary detector in the strict sense cannot be implemented in contrast to the mentioned Japanese (Hirose et al., 2001). However, they trained the prosodic-acoustic models of phonological phrases on samples in which phonological phrase boundaries coincided with word boundaries. Highly relying on the first syllable fixed stress of Hungarian, word boundaries were predicted in the vicinity of phonological phrase boundaries. Analysis of word boundary detection rates based on phonological phrase alignment showed 77.3% precision and 57.2% recall rate for Hungarian (on BABEL speech database), 69.2% precision and 76.8% recall rate for Finnish allowing a maximum of $\pm$ 100–150 ms deviation between phonological phrase and word boundary markers (Vicsi-Szaszák, 2005). The goal of the experiments described in present paper can be related to this issue, namely, to prove or to disclaim the conjecture that the detected word boundaries correlate well with syntactic phrase boundaries, while missed word boundaries are more likely to be embedded within a syntactic phrase, and therefore tend to form a union both prosodically and syntactically.

4 ANALYSING THE PROSODY-TO-SYNTAX MAPPING

The main goal of the paper is to present a detailed analysis regarding the prosody-to-syntax automatic mapping possibilities in spoken language. This implies the comparison between the prosodic and syntactic structures, obtained based on analyses presented so far both for prosody and syntax. The syntactic phrasing will be used as reference, and hence – although it was primarily obtained in automatic way – it has to be checked and disambiguated by human experts. The automatically obtained prosodic phrasing on the other hand is left intact as it is produced by the prosodic segmenter tool. The reason for this is that this approach will permit to evaluate the usability of the pro-

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Hamburgefon

The quick brown fox jumps over

Kjøre nášíře Fer Hęrdig. Nyn exec 6 Telädjúple: našíří são żych â ynä hæves à un heme Czy gewer en dłegra že je rým ques nocuk s sing altò

I am Buffalo Bill's horse. I have spent my life under his saddle—with him in it, too, and he is good for two hundred pounds, without his clothes; and there is no telling how much he does weigh when he is out on the war-path and has his batteries belted on. He is over six feet, is young, hasn't an ounce of waste flesh, is straight, graceful, springy in his motions, quick as a cat, and has a handsome face,