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# Tempo and Connectedness of Czech-Accented English Speech

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## Abstract

This study explores whether speech connectedness increases with accelerated tempo in non-native pronunciation. In Czech-accented English, speech is disrupted by excessive glottalization of word-initial vowels. We hypothesized that, when speaking fast, advanced Czech learners of English as a foreign language may glottalize less because (1) they organize their speech into fewer and longer intonational phrases (IPs) and (2) reduce distinctiveness of word boundaries within IPs. Participants read a text at their normal and a self-determined faster tempo. Subsequently, they read it in synchrony with a native-speaker recording at a normal and artificially speeded-up tempo. Glottalization decreased significantly with higher tempo (both at IP boundaries and within IPs) only during self-controlled acceleration. Responsible for the drop were fewer IPs and increased resyllabification. During synchronous reading, learners copied the prosodic phrasing in the recording. They linked more than in self-paced reading, at least at normal tempo, possibly copying the model.

Second language learners even at relatively advanced levels of proficiency are often less fluent than native speakers. Features which contribute to fluency are both segmental and suprasegmental in nature. In Czech-accented English, the flow of speech is disrupted by persistent word-initial vowel preglottalization which crosses the segmental-

suprasegmental distinction. On the one hand, glottalization of vowel-initial words at the expense of linking these words to the preceding context happens on the level of segments—a consonantal sound is inserted. On the other hand, glottalization takes place in order to repair onsetless syllables and it has prosodic consequences since glottalization of weak vowels makes them perceptually more prominent, which changes the perception of rhythm.

One factor responsible to a great degree for the excessive vowel preglottalization in Czech English is transfer from learners' L1. Despite some variation (Volín, 2012), glottalization of vowels in Czech is much more frequent than it is in English (Bissiri & Volín, 2010; Volín, 2003), the reason being that its function in the two languages is different. While in English the (non)occurrence of glottalization depends on and thus marks prosodic structure (Pierrehumbert, & Talkin, 1992; Dilley, Shattuck-Hufnagel, & Ostendorf, 1996; Garrelek, 2012), in Czech glottalization regularly marks word boundaries. In English connected speech, glottalization of word-initial vowels competes with linking processes, including resyllabification of the final consonant into the onset of the following word, insertion of transient glides j and w after high vowels, and in non-rhotic accents also linking and intrusive r (Cruttenden, 2001).

Another factor contributing to the relatively high rate of glottalization in Czech English may be a slower tempo and more frequent pauses. Speech tempo is known to affect glottalization in native English; slower speakers of course glottalize more (Umeda, 1978). Recently tempo has been shown to influence glottalization in German (Pompino-Marschall, & Żygis, 2010).This is because the rate of speech is reflected in prosodic phrasing: slow speakers generally group words into shorter intonational phrases making a greater number of prosodic breaks (Caspers & Heuven, 1991; Jacewicz, Fox, & Wei 2010; Trouvain & Grice, 1999) and in English, where glottalization is highly predictable from the prosodic structure, such phrasing results in more frequent glottalization of word-initial vowels. Non-native speakers have been shown repeatedly to speak more slowly than native speakers (e.g., Kormos, & Dénes, 2004; Lennon, 1990, Munro, & Derwing, 1994), their speech rate remaining different from native speakers' rate even after years of experience in the L2 environment (Trofimovich & Baker, 2006). The slowness of non-native speech inevitably leads to a growth in the number of prosodic breaks and, by extension, to a greater likelihood of glottalization. Speech tempo is likely to affect the likelihood of glottalization in Czech English also within intonational phrases. In native English, speaking faster may lead to

reductions in distinctiveness of word boundaries in a number of ways including resyllabification (de Jong, 2001), lenitions such as flapping, which is present word-finally also in British English, place assimilations, or elisions such as t-deletion. Advanced learners of English may also run words together more in fast speech and decrease the boundary-marking glottalization in favor of the linking processes.

The effect of differing speech tempo on the rate of vowel glottalization in the speech of Czech learners of English is the subject of the current study. We predicted that Czech advanced learners of English as a foreign language (EFL) would behave like native speakers of English in two respects: first, that fast speech would result in fewer and longer IPs, hence fewer glottal stops at an IP boundary, and second that within intonational phrases, learners would reduce distinctiveness of word boundaries and use vowel glottalizations less frequently.

## METHOD

The study examines Czech EFL learners' productions of continuous speech elicited by means of reading a coherent text. The aim is to determine whether there is a difference between fast and slow speech with respect to the incidence of glottalization as opposed to linking word-initial vowels to the preceding context via resyllabification and linking sounds (linking and intrusive r, transient j and w). Two methods of manipulating speech tempo were used. During self-paced reading participants themselves controlled the increase in their reading tempo, whereas in the synchronous reading mode they had to adjust their reading tempo to a recording which had been speeded up artificially.

### Materials

Participants read an original English text of 399 words, taken from the first chapter of Harry Potter and the Philosopher's Stone (Rowling, 2000). The text contained 83 target words beginning in a vowel, i.e., possible contexts for linking or glottalization. In 59 cases the target word followed a word-final consonant, creating a context for resyllabification, in the remaining 24 cases a linking sound (a transient glide or a linking r) could be inserted to connect the target with the preceding word (see the third column in Table 1).

A recording of the same English text read by a male native speaker of Standard Southern British English was used as a model for the normal

tempo in the synchronous reading task. For the fast tempo, the same recording was artificially accelerated by 10% using the Pitch-Synchronous Overlap-and-Add method in Praat (Boersma & Weenink, 2011).The model recording was transcribed orthographically and boundaries of intonational phrases were indicated. Altogether 101 intonational phrases were counted. Thirty-one of the vowel-initial words in the recording occurred at the beginning of an IP; twenty-seven (i.e., 87%) of them were preglottalized. The remaining 52 vowel-initial words were within IPs; 8 were preglottalized while 44 were linked to the preceding word (i.e., there was 15 % glottalization and 85 % linking within IPs). Out of all the 59 possible resyllabification contexts in the text, the speaker used resyllabification in 62.7% of the cases (37 instances, 3 at the IP boundary, 34 within an IP). Out of the 24 possible linking sound contexts, he used linking r, and transient glides in 77.8% and 26.7% of the cases respectively (together 11 instances, 1 at the IP boundary, 10 within an IP). An overview of the glottalization and linking in the model recording is given in Table 1. In line with descriptions of glottalization in English (e.g., Cruttenden, 2001), the speaker produced more glottalization to resolve hiatus, i.e., in glide-insertion contexts, than in resyllabification and linking *r* contexts.

**Table 1**. Glottalization and Linking in the Model Recording

| | | **Possible Linking Contexts** | | **Realizations** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Glottalization | | | Linking | | |
| | | All | IP b.–w. IP | no. | b.–w. | % | no. | b.–w. | % |
| Linking Sounds | *r* | 9 | 2–7 | 2 | 2–0 | 22.2 | 7 | 0–7 | 77.8 |
| | *j*, *w* | 15 | 9–6 | 11 | 8–3 | 73.3 | 4 | 1–3 | 26.7 |
| Re-syllabification | | 59 | 20–39 | 22 | 17–5 | 37.3 | 37 | 3–34 | 62.7 |
| **TOTAL** | | **83** | **31–52** | **35** | **27–8** | **42.2** | **48** | **4–44** | **57.8** |

## Procedure

Data were collected individually in a number of steps with a fixed order. Before recording, each participant was asked to practice reading the text aloud and encouraged to check for unknown words and their pronunciation. The data collection itself started with self-paced reading: participants read the text first at their normal tempo and then they were instructed to accelerate to the maximum tempo that was still comfortable for them. In the subsequent synchronous reading mode, the participants wore headphones, in which they heard the model recording, and were asked to read the same text along with the model speaker. First they had to adapt their speech tempo to the recording played at the original speed and then to the accelerated recording. The plan to counterbalance the order of self-paced and synchronous reading modes was abandoned after the first few trials not included in the study since synchronous reading proved to be considerably more challenging than self-acceleration.

## Participants

Fourteen advanced Czech learners of English (level C1 according to the Common European Framework of Reference for Languages) participated in the study, 9 females and 5 males, between 19 and 30 years of age. All participants were undergraduate students majoring in English who had passed an introductory course in phonetics. They volunteered to participate in the study but none of them was aware of the purpose of the data collection. In addition, two male native speakers of American English aged 40 and 50 were recorded.

## Data Analysis

Data from 4 female and 1 male Czech learners and from 1 native speaker were excluded from the analysis because these participants were unable to cope with the synchronous reading task. The remaining 40 recordings (10 speakers, 4 recordings each) were orthographically transcribed and annotated, marking intonational phrase boundaries. In each recording, the number of potential targets for glottalization or different types of linking at IP boundaries and within IPs was counted. Then the actual realizations of the targets were coded as glottalization (either a full glottal stop or voicing irregularities, such as creaky voice or sudden drops in F0, see e.g.,

Redi & Shattuck-Hufnagel, 2001), resyllabification, linking and intrusive r's, or transient j and w.

## RESULTS

### The Native Speaker

Unsurprisingly, when speaking fast, the native speaker grouped his words into fewer intonational phrases. As a result of increased tempo, the number of IPs dropped from 107 to 88 in the self-paced mode and from 103 to 97 in the synchronous reading mode. The smaller difference in the latter is due to the fact that our speaker more or less copied the prosodic phrasing in the model recording, which was the same in both tempos (recall that the fast recording was an artificially speeded up version of the normal recording). The rate of glottalization produced before word-initial vowels by the native speaker conformed to the expected pattern (see Figure 1). It was much higher at IP boundaries than within IPs. As expected, the increase in speech tempo resulted in a significant drop in glottalization but only at IP boundaries. The difference between normal and fast tempo was significant both for the self-paced reading and for the synchronous reading tasks ($\chi 2$ [1, 59] = 6.67; $p < 0.01$ and $\chi 2$ [1, 57] = 3.88; $p = 0.05$ respectively). The already low rate of glottalization within IPs decreased only insignificantly with tempo.

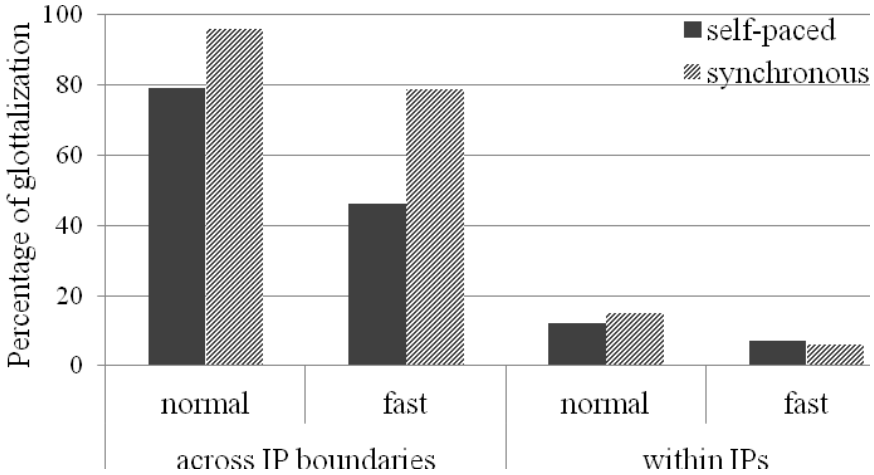


**Figure 1**. The control native speaker: The percentage of glottalization during self-paced and synchronous, normal and fast reading within IPs and across IP boundaries.

### Czech Learners of English

As shown in Figure 2, in our learners' speech faster tempo did result in fewer prosodic breaks, but only in the self-paced reading mode. A repeated-measures (RM) ANOVA with Tempo (Normal, Fast) and Reading mode (Self-paced, Synchronous) as the within-subject factors found a significant main effect of Tempo ($F[1, 8] = 132.64$, $p < .001$) but not of Reading Mode on the number of realized IPs. This is because there was a significant interaction between Tempo and Reading Mode ($F[1,8] = 76.24$, $p < .001$). A post-hoc Tukey HSD test showed that when speaking fast on their own, the leaners grouped words into a significantly ($p < .001$) smaller number of larger units than when speaking at the normal tempo. Consequently they produced fewer glottal stops at IP boundaries. During synchronous reading on the other hand, the non-native speakers tended to copy the prosodic phrasing of the model recording (which was identical at both speeds) and thus the small decrease in the fast reading as compared with the normal reading was not significant ($p > .1$)

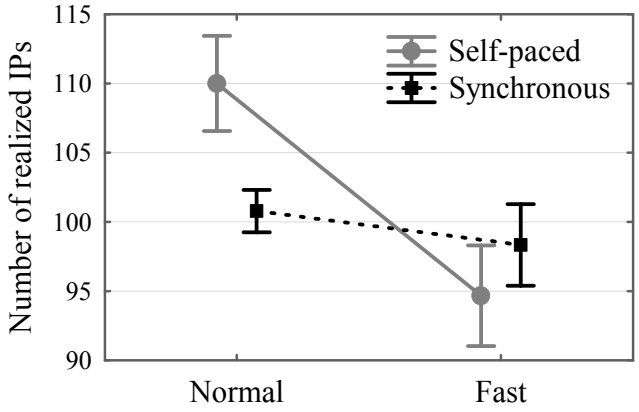


**Figure 2**. Czech learners of English: The number of realized IPs by reading mode and tempo. Error bars denote 95% confidence intervals.

Unlike the native speaker, who decreased not only the number of IPs but also the rate of glottalization at IP boundaries when speaking fast, the learners glottalized almost 100% of word-initial vowels at IP boundaries in both tempos and in both the synchronous and the self-paced reading mode. However, this was not true of glottalization within IPs, shown in Figure 3. A RM ANOVA on the percentage of glottalization within IPs found a significant main effect of Tempo ($F[1, 8] = 9.34$, $p = .016$) as well as Reading Mode ($F[1, 8] = 8.25$, $p = .021$). There was also a significant

interaction between Tempo and Reading Mode (F[1,8] = 6.58, p = .033). A post-hoc Tukey HSD test found that the difference between the two tempos was only significant (p < .05) in the self-paced mode, not in the synchronous reading mode.

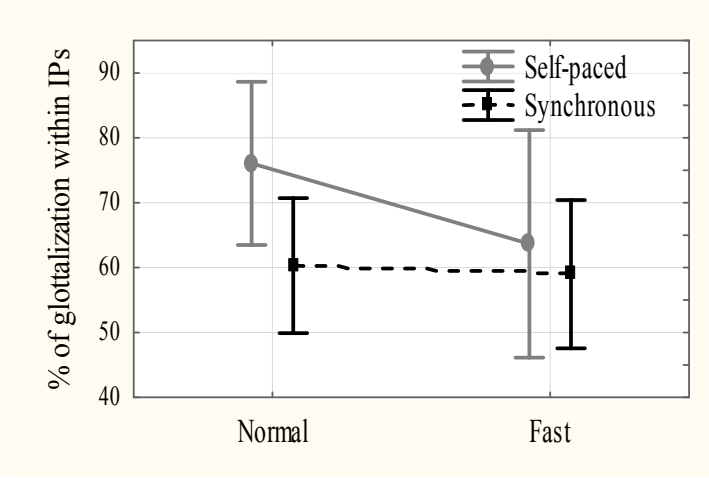


**Figure 3**. Czech learners of English: The percentage of glottalized targets within IPs by reading mode and tempo. Error bars denote 95% confidence intervals.

The drop in realized glottalization in the fast self-paced reading was accompanied by an increase in the percentage of resyllabified consonants in that reading, as shown in Figure 4. A new RM ANOVA on the percentage of resyllabification revealed a significant main effect of Reading Mode (F[1, 8] = 11.33, p = .010), an effect of Tempo approaching significance (F[1, 8] = 5.13, p = .053) and a significant interaction between the two factors (F[1,8] = 10.77, p = .011). A post-hoc Tukey HSD test showed that the increase in resyllabification with increased tempo in the self-paced mode was significant (p < .05). Another RM ANOVA showed that the percentage of linking sounds (transient glides and linking/intrusive r) did not change significantly with tempo or reading mode.

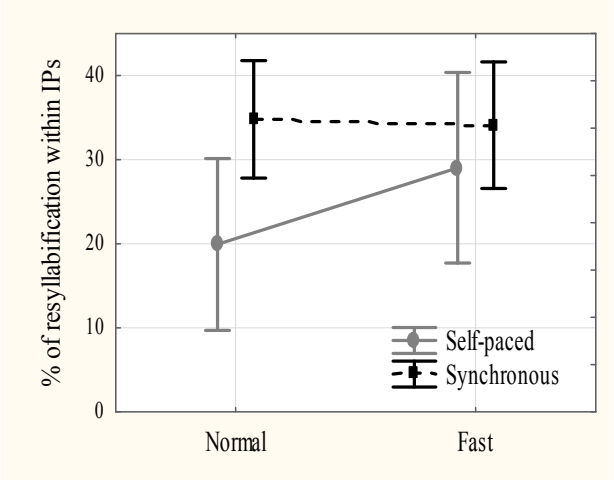


**Figure 4**. Czech learners of English: The percentage of resyllabified targets within IPs by reading mode and tempo. Error bars denote 95% confidence intervals.

## DISCUSSION AND CONCLUSION

We predicted that manipulating tempo would result in differential rates of glottalization of word-initial vowels in non-native English speech. Our participants, advanced Czech EFL learners, overuse vowel glottalization especially due to transfer from L1. In addition, as speakers of a foreign language, they have learned much of their L2 vocabulary as isolated individual words and consequently may respect word boundaries in the L2 too much to weaken them by linking. However, increasing speech tempo, which in native speech leads to organizing speech into a smaller number of larger units and to smoothing out word boundaries, might have the same effect also for these advanced learners.

The prediction about Czech learners of English that increased speech tempo would result in a fewer number of intonation breaks was confirmed albeit only for the self-paced reading. When reading in synchrony with the model, our EFL learners tended to copy the prosodic structure of the model. Since the model recording was speeded up artificially, the prosodic phrasing in the normal and fast versions did not differ. The prediction that increased speech tempo would result in a higher rate of linking at the expense of glottalization was also confirmed only in the self-paced reading task and only within intonational phrases, where glottalization dropped and resyllabification of coda consonants into

the onset of the following vowel-initial target word rose, the rate of other kinds of linking remaining about the same.

The rate of glottalization was significantly lower, and the rate of resyllabification significantly higher, in the synchronous reading mode than in self-paced reading. One reason for this could be speakers' ability to copy what they have just heard. Our learners never spoke completely simultaneously with the model but were a number of syllables behind, depending on one's ability to do the task. This lag might have been enough for a majority of them to copy some of the linking in the model recording although given the pace of the task it is likely that they did it unconsciously. An alternative reason could be a difference between the actual tempos at which the learners spoke during the self-paced and synchronous reading tasks. Although the actual rate of articulation of the forty elicited recordings were not computed, the learners were definitely slowest when they read at their own normal tempo. Keeping up with a model played at the original speed already involved an increase in speaking tempo and in linking.

While the results indicate that tempo is implicated in connectedness of nonnative speech, the connection between them is not straightforward. The learners in the study were incapable of a further increase in linking when they switched to reading along with the speeded-up model. They may have reached the maximum of their ability to link words. Also, the demands of following the speeded-up model might have led to an overall deterioration of pronunciation.

We tested usefulness of synchronous reading as a possible implicit training method in a subsequent study reported in this volume (Šimáčková, Podlipský, & Kolářová, 2013) and found no advantage of this method over just listening to the model recording.

## REFERENCES

Bissiri, M. P., & Volín, J. (2010). Prosodic structure as a predictor of glottal stops before word initial vowels in Czech English. In R. Vích (Ed.), *Proceedings of the 20th Czech-German Workshop on Speech Processing* (pp. 23-28). Prague: Academy of Science.

Boersma, P. & Weenink, D. (2011). Praat: Doing phonetics by computer [Computer program]. Version 5.0.40, retrieved 11 November 2011 from http://www.praat.org/

Caspers, J., & van Heuven, V. J. (1993). Effects of time pressure on the phonetic realization of the Dutch accent-lending pitch rise and fall. *Phonetica, 50*(3), 161-171.

Cruttenden, A. (2001). *Gimson's pronunciation of English*. London: Arnold.

De Jong, K. J. (2001). Rate-induced resyllabification revisited. *Language and Speech, 44*(2), 197-216.

Dilley, L., Shattuck-Hufnagel, S., & Ostendorf, M. (1996). Glottalization of word-initial vowels as a function of prosodic structure. *Journal of Phonetics*, *24*(4), 423-444.

Garellek, M. (2012). Glottal stops before word-initial vowels in American English: distribution and acoustic characteristics. *UCLA Working Papers in Phonetics*, *110*, 1-23.

Jacewicz, E., Fox, R. A., & Wei, L. (2010). Between-speaker and within-speaker variation in speech tempo of American English. *The Journal of the Acoustical Society of America, 128*(2), 839–850.

Kormos, J., & Dénes, M. (2004). Exploring measures and perceptions of fluency in the speech of second language learners. *System, 32*(2), 145-164.

Lennon, P. (1990). Investigating fluency in EFL: A quantitative approach. *Language learning*, *40*(3), 387-417.

Munro, M. J., & Derwing, T. M. (1994). Evaluations of foreign accent in extemporaneous and read material. *Language Testing, 11*(3), 253-266.

Palková, Z. 1997. *Fonetika a fonologie češtiny*. Prague: Karolinum.

Pierrehumbert, J., & Talkin, D. (1992). Lenition of /h/ and glottal stop. In G. J. Docherty & D. R. Ladd (Eds.), *Papers in laboratory phonology II: Gesture, segment, prosody* (pp. 90-117). Cambridge: Cambridge University Press.

Pompino-Marschall, B., & Żygis, M. (2010). Glottal marking of vowel-initial words in German. *Papers from the Linguistics Laboratory, ZASPiL, 52*, 1-17.

Redi, L., & Shattuck-Hufnagel, S. (2001). Variation in the realization of glottalization in normal speakers. *Journal of Phonetics, 29*(4), 407-429.

Rowling, J. K. (2000). Harry Potter and the Philosopher's Stone. London: Bloomsbury.

Šimáčková, Š., Podlipský V.J., & K. Kolářová. (2014). Linking versus Glottalization: (Dis)connectedness of Czech-accented English. *Concordia Working Papers in Lingustics*, 5, 679-693.

Trofimovich, P., & Baker, W. (2006). Learning second language suprasegmentals: Effect of L2 experience on prosody and fluency characteristics of L2 speech. *Studies in Second Language Acquisition, 28*(1), 1-30.

Trouvain, J., & Grice, M. (1999). The effect of tempo on prosodic structure. In *Proceedings of 14th International Conference of Phonetic Sciences* (pp. 1067-1070).

Umeda, N. (1978). Occurrence of glottal stops in fluent speech. *The Journal of the Acoustical Society of America, 64*, 88-94.

Volín, J. (2003). The preposition "of" and glottal stops in Czech English. In A. Grmelová & M. Farrell (Eds.), *Prague Conference on Linguistics and Literary Studies Proceedings* (pp.10-19). Praha: UK PedF.

Volín, J. (2012). Jak se v Čechách "rázuje". *Naše řeč, 95*(1), 51-54.