
THE RELATIONSHIP BETWEEN ENGLISH AND POLISH RHYTHM MEASURES IN POLISH LEARNERS OF ENGLISH

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Abstract

This paper investigates native and non-native speech rhythm in the speech of Polish learners of English at an intermediate/upper-intermediate level. More specifically, it attempts to explore the relationship between rhythm measures scores in L1 Polish and L2 English within individual speakers. Phonological vowel reduction in terms of duration is present in English and crucial for the perception and acoustic measurements of linguistic rhythm. Polish, on the other hand, has no phonological reduction of that kind. The acquisition of L2 vowel reduction is highly determined by the level of language proficiency and influences non-native rhythmic patterns. The study tests six speech rhythm measures: %V, ΔV , ΔC , VarcoV, VarcoC and nPVI-V in two tempos: normal and fast. The results show that most of these measures are positively and significantly correlated with each other between L1 Polish and L2 English across the subjects and for two tempos, although to a different degree. Highly significant correlation has been noted for %V and ΔC in fast tempo. Moderate significant correlations between the two languages are observed for ΔV , ΔC (normal tempo), VarcoV and nPVI in fast tempo.

Key words: L1 and L2 speech rhythm, rhythm measures, vowel reduction

1. Introduction

The rhythm of languages has for a long time been a phenomenon of particular interest for many linguists, phoneticians and phonologists trying to define and describe its patterns using different tools and perspectives. Rhythm measures (metrics) have been introduced to speech rhythm research in the hope of finding the objective acoustic correlates of rhythm, and their application in the domain of linguistics has started to be attractive for researchers especially with regard to the Rhythm Class Hypothesis, which until recently was grounded mostly in subjective intuitions and certain language specific phonological criteria (Dauer, 1983), and not supported by any experimental evidence (e.g. Lehiste, 1977; Roach, 1982). In 1999, a year of the first publication presenting the results of the study conducted with the use of instrumental measurements of vocalic and consonantal segments (Ramus, Nespors, & Mehler, 1999), there appeared some prospects that the existence of language classes may finally be validated with reliable instruments and pure perceptions confirmed in the physical reality. At the moment, there is already an impressive number of different measures employed in the studies on speech rhythm

and proposed as an improvement on the ones introduced by Ramus et al. (1999). The most commonly used measures and also the ones applied in the present paper include:

- %V – timing proportions of vocalic intervals in an utterance (Ramus et al., 1999),
- ΔV and ΔC - standard deviation of vocalic and consonantal intervals (Ramus et al., 1999),
- nPVI (normalised Pairwise Variability Index) - the mean of the differences between successive vocalic intervals divided by the sum of these intervals (Grabe & Low, 2002),
- VarcoV and VarcoC - standard deviation of vocalic and consonantal intervals divided by the mean vocalic interval duration (Dellwo & Wagner, 2003; White & Mattys, 2007).

2. Rhythm in English and in Polish

From the beginnings of speech rhythm studies, English has frequently been classified as a prototypical stress-timed language (Abercrombie, 1967, p. 97; Dauer, 1983, p. 56; Laver, 1994, p. 529) due to its complex syllable structures, variable stress pattern and vowel reductions. Rhythmic feet (or interstress intervals) forming a beat unit in English are said to be of approximately equal length and most commonly include two or three syllables that are articulated in sequences ranging from 4 to 6 syllables per second (Waniek-Klimczak, 2005).

The rhythm of Polish, on the other hand, is not such a clear issue, and recently most attention is devoted to the fact that it appears to be a mixed-type language. It is because its features do not match those of typically stress- or syllable-timed languages (Dauer, 1987; Nespór, 1990; Ramus et al., 1999). Namely, Polish presents a large variety of syllable types and great syllable complexity, which places it among stress-timed languages. However, it presents no phonological vowel reduction at normal speech rates, which is a characteristic of syllable-timed languages.

The questionable status of Polish is visualised in the work of Ramus, Nespór and Mehler (1999), in which they plotted 8 languages (English, Dutch, Polish, French, Spanish, Italian, Catalan and Japanese) and their corresponding scores in a three-dimensional space on the (%V, ΔC), (%V, ΔV) and (ΔV , ΔC) planes.

The projection of the first of the paired measures seemed to show a clear association with the standard rhythm classes. The statistical tests revealed that each class (stress-, syllable- and mora-timed languages) was significantly different from the others with respect to %V and ΔC (see Figure 1 for Ramus et al.'s 1999 data). The results of their measurements seem to be directly related to phonological properties of the languages in question, and especially to their syllabic structure when it comes to ΔC and %V. A higher ΔC score reflects the greater variability of the number of consonants and their duration within a syllable, since it is the consonants that contribute to a greater number of syllable types in a language and to the overall syllable weight. In other words, if a language possesses a small number of syllable types, thus fewer syllable-final consonants, the variability of consonantal interval durations is lower and consequently

the ΔC scores are lower as well. With English, Dutch and Polish allowing more than 15 syllable types and getting higher ΔC scores (5.35, 5.14, 5.33 respectively), and Japanese with only four legal syllable types and lower ΔC scores (3.56), both groups at two other ends of the ΔC and %V scale, there appears to be a perfect instrumental justification of the hypothesis that variations in syllable structures condition the perception of rhythm.

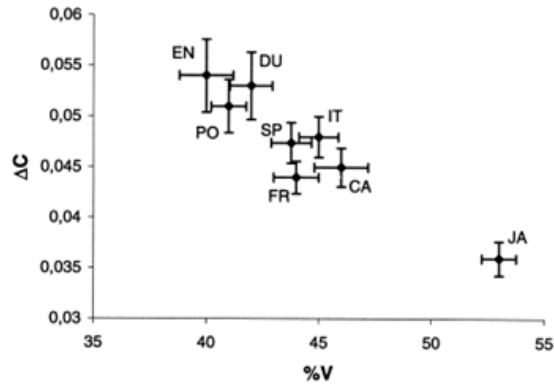


Figure 1. Distribution of languages over the (%V, ΔC) plane. Error bars represent ± 1 standard error (after Ramus et al., 1999, p. 273).

The application of ΔV leaves a lot of questions open and may seem to be a dubious issue in attempts to verify the rhythm perception. In the study discussed here, it seemingly points at the differences between Polish and the other seven languages when paired with %V on a scale, which may indicate the possibility of treating Polish as a member of neither stress-, syllable- nor mora-timed class (see Figure 2).

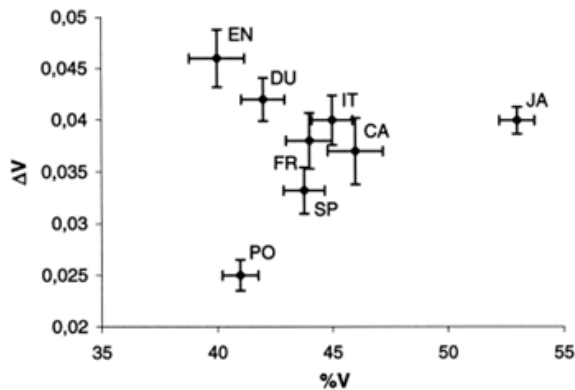


Figure 2. Distribution of languages over the (%V, ΔV) plane. Error bars represent ± 1 standard error (Ramus et al., 1999, p. 273).

3. Experiment

The aim of the following experiment is to verify the existence of a relationship between L2 English and L1 Polish rhythm measure scores in individual Polish learners of English. The experiment discussed here tests six rhythm measures: %V, ΔV , ΔC , VarcoV, VarcoC and nPVI-V and verifies their correspondence between L1 and L2 of Polish learners of English. The measure-based scores are expected to show differences which are mainly due to the phonological structure of the two languages. However, the phrases that undergo interval measurements are controlled for the number of syllables, consonantal clusters and vowel qualities. Consequently, the main discrepancies between Polish and English are predicted to be observed in the vocalic interval scores due to a high degree of vowel reduction expected in L1 English. Although the degree of vowel reduction may not be detectable in L2 English to a similar extent, the characteristics of the target variety (L1 English) are expected to affect the organisation of L2 English. Thus, the rhythmic organisation of speech in L2 English and L1 Polish is expected to reflect the inter-relationship between the two languages at the level of individual speakers.

3.1 Participants

30 Polish first-year students of English at the University of Łódź aged between 19-24 took part in the experiment. Their level of English was expected to meet the requirements of intermediate or upper-intermediate level of language proficiency. They were selected randomly without any subjective perceptions of native/non-native accent or objective fluency tests. The female participants outnumbered male ones with the proportion of 25 to 5, but the gender variable was not subjected to analysis here.

3.2 Materials

The reading passages used in the experiment were two texts, one in English, and the other one in Polish. The former text was one of Aesop's Fables, *The North Wind and the Sun*, already used in phonetic demonstrations (recommended by the IPA for indicating phonemic contrasts in English) or speech rhythm research (e.g. Grabe & Low, 2002). The latter was a text devised by the author for the purpose of this experiment. It is of equal length as *The North Wind and the Sun*, i.e. it contains the same number of syllables. It is also characterised by approximate vowel qualities in stressed syllables and overall similar rhythmic structure to the English text.

The exact material that has been selected for phonetic measurements consists of four phrases within which no pauses or breaks in the flow of speech are to be expected (see Appendix 1). Each of them has two versions: English and Polish. They also differ in length; Phrase 1 and Phrase 2 are longer (11 syllables each) and Phrase 3 and Phrase 4 are shorter (5 and 7 syllables). The phrases have a similar number of consonant segments, which may enable a more controlled comparison of languages in terms of syllable structure and length.

3.3 Procedure

The recording session took place at the beginning of the winter semester, prior to the pronunciation training and intensive exposure to English, through attending numerous courses in English, the students get as part of their first year's curriculum. The subjects entered the room individually or in pairs and were given time to read the texts in English and Polish, and asked to pronounce a number of words in the English text that might cause some difficulty for Polish speakers, both in terms of word stress and vowel qualities. After a short practice, the subjects were asked to read the English text first in a natural manner with their normal tempo and then to read the same text faster, making a noticeable difference between the two rates of speech.

The speech samples in both languages were recorded with the use of MXL Studio 1 USB microphone directly to the laptop computer in the .wav format in a relatively quiet, but not soundproof room. They were later segmented manually into vocalic and consonantal intervals with the use of Praat, version 5.0.29, for normal and fast tempo, mainly according to the criteria proposed by Grabe and Low (2002). Finally, the six rhythm measures were calculated for each participant, measure and tempo.

3.4 Results and analysis

In order to analyse the relationship between L2 English and Polish produced by Polish learners of English in terms of rhythm measures, the differences between English and Polish scores were calculated for each measure, tempo and for each participant. The obtained values are presented in Appendix 2. The results show that the greatest difference values are present within ΔV scores for both normal and fast tempo. 13 subjects for normal and 19 subjects for fast tempo obtained differences above 18.0, and the maximum difference is 30.6 and 33.2 for normal and fast tempo, respectively. Despite the highest difference scores, standard deviation values for ΔV are not the highest. The consonantal variability measure ΔC shows the highest standard deviation scores and its means for two tempos are second highest. 8 students obtained high scores for ΔC normal tempo, reaching the value of 39.7 (subject 18). Occasional high difference values appear for ΔC fast tempo (4 scores above 18.0), VarcoV and VarcoC (3 scores above 18.0 for both tempos), and nPVI (2 scores above 18.0 for fast tempo). When it comes to %V which generally exhibits the lowest variability between its scores and the lowest variability between its differences, as represented by low standard deviation values (2.0, 2.5), 8 subjects for normal and 10 subjects for fast tempo obtained scores above 8.0. The greatest difference is 9.7 (subject 9) for normal tempo and 13.1 (subject 29) for fast tempo.

The greatest number of lowest differences between L2 English and Polish scores are noted for VarcoC for which 12 (normal tempo) and 11 (fast tempo) subjects obtained scores below 5.0. The smallest number of subjects with scores below 5.0 can be observed in terms of ΔV (3 for normal and 1 for fast tempo). Other measures seem to have low scores below 5.0 scattered randomly across students and tempos, with the number of low scores ranging between 5 (%V normal, VarcoV fast) and 9 (VarcoV normal).

Looking at individual participants' differences, it seems that, in general, there is no consistency between their scores for all the measures and tempos, i.e. when they obtain low values for one or two measures, some other measures show high scores, and the remaining ones get scores close to the average. The most consistent subjects appear to be those whose difference scores tend to be either low and average or high and average, e.g. half of subject 6's scores are low and the other half are close to average for the group, and 5 of subject 30's scores are high and the remaining 7 are close to the average.

Figure 3 shows the mean and standard deviation of the differences between L2 English and Polish rhythm measure scores for two tempos. It is clearly visible that ΔV measure exhibits the greatest mean difference scores. The smallest differences are represented by %V and VarcoC, but the two show considerable differences between their standard deviation scores; nPVI is placed slightly higher, followed by VarcoV (with the greatest differences between tempos) and ΔC . Interestingly, for all measures, except for ΔC , fast tempo scores exceed the normal tempo ones. Moreover, ΔC shows the greatest standard deviation values, indicating that the scores are spread out over the largest range of values.

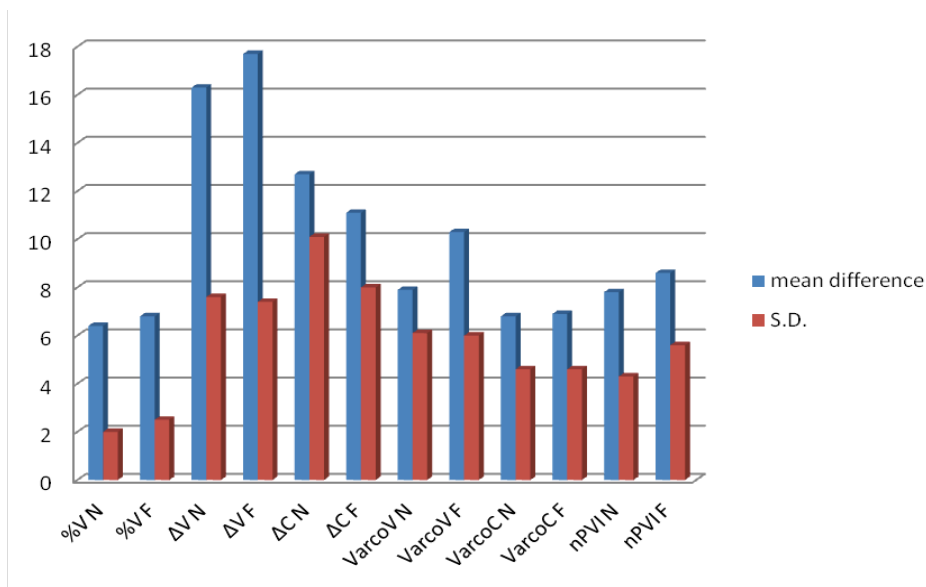


Figure 3. Mean and standard deviation of the differences between L2 English and Polish rhythm measure scores for two tempos (N-normal tempo, F-fast tempo).

It also seems worthwhile to observe how the obtained rhythm metric values behave when located in a three-dimensional space as proposed by Ramus et al. (1999) and White and Mattys (2007). Figs. 4-9 demonstrate the projections of the data for four phrases for L2 English and L1 Polish normal and fast speech on the (%V, ΔC), (%V, ΔV) and (ΔV , ΔC) planes.

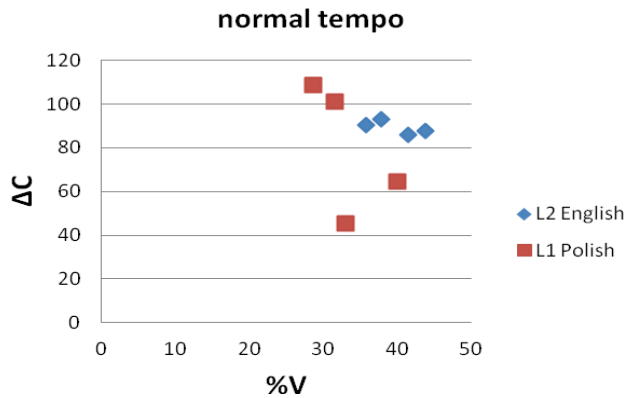


Figure 4. Distribution of L1 Polish and L2 English over the %V and ΔC plane for Phrases 1-4 for normal tempo (after Ramus et al., 1999).

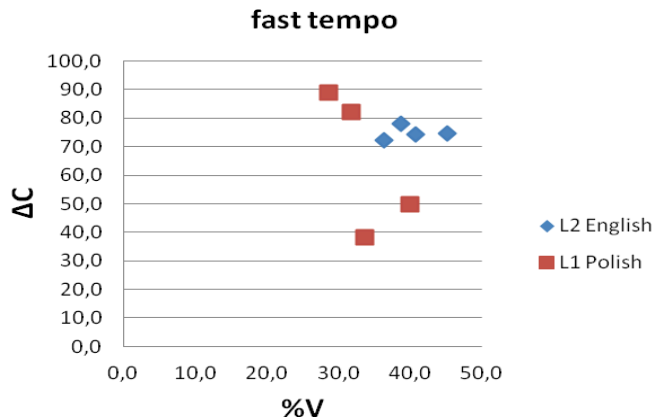


Figure 5. Distribution of L1 Polish and L2 English over the %V and ΔC plane for Phrases 1-4 for fast tempo (after Ramus et al., 1999).

Figs.4 shows the four phrase mean scores plotted on the %V, ΔC plane for normal tempo. It is clearly seen that L2 English scores cluster together, while Polish scores form two accumulations with English scores in between. These accumulations result from the fact that Polish ΔC scores obtain the most variable values across phrases (45.5, 108.6, 101.2, 64.4 for normal tempo and 38.1, 88.8, 82.2, 49.9 for fast tempo) resulting from considerable differences between the durations of consonantal intervals in each of the phrases. Consonantal intervals can encompass single segments and clusters, and their arrangement within the investigated phrases was not controlled for (e.g. Phrase1 contains 5 single-consonant intervals, 4 two-consonant clusters and 1 four-consonant cluster,

while Phrase 3 includes 4 single-consonant intervals, 3 two-consonant clusters and 3 three-consonant clusters).

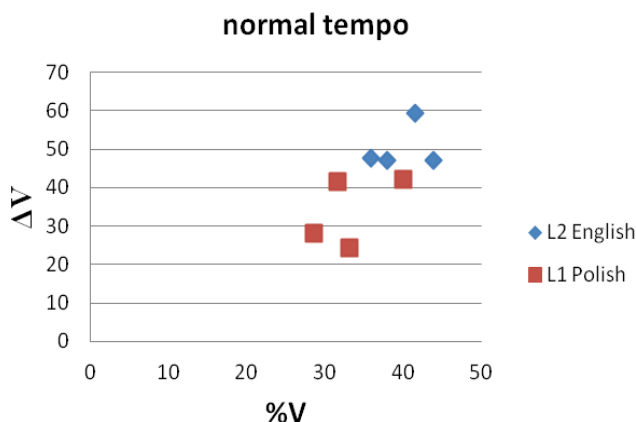


Figure 6. Distribution of L1 Polish and L2 English over the %V and ΔV plane for Phrases 1-4 for normal tempo (after Ramus et al., 1999).

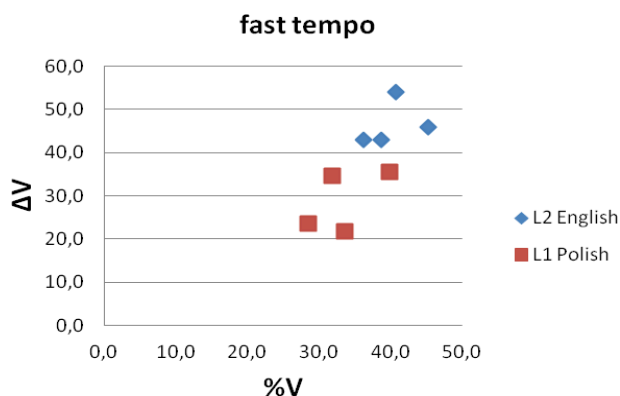


Figure 7. Distribution of L1 Polish and L2 English over the %V and ΔV plane for Phrases 1-4 for fast tempo (after Ramus et al., 1999).

Figure 5 presents the same data for fast speech. The way the two languages are distributed on the %V, ΔC plane is very similar to their distribution for normal speech, indicating that the tempo is independent from the two measures.

Figs.6 and 7 display scores over the %V and ΔV plane for two tempos. As in the case of %V, ΔC planes above, the scores are distributed in a very similar way, despite changes in the speech tempo. L1 Polish values are also more variable than the English

ones, but to a lesser extent than in Figs.4 and 5. The only noticeable difference between Figs.6 and 7 is that the former Figure 6 shows a slight overlap between L2 English and L1 Polish for normal tempo, while Figure 7 demonstrates that there is a small distance between the two languages and a clear border between two accumulations can be drawn.

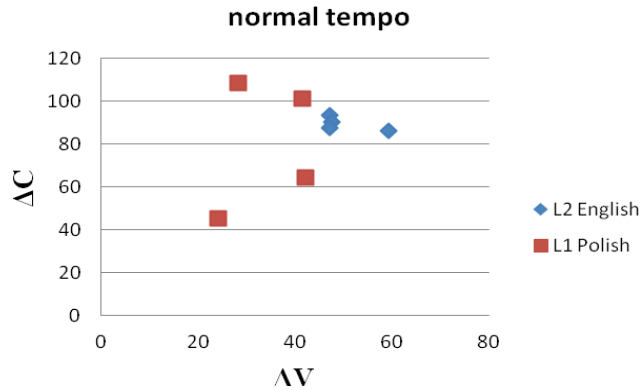


Figure 8. Distribution of L1 Polish and L2 English over the ΔV and ΔC plane for Phrases 1-4 for normal tempo (after Ramus et al., 1999).

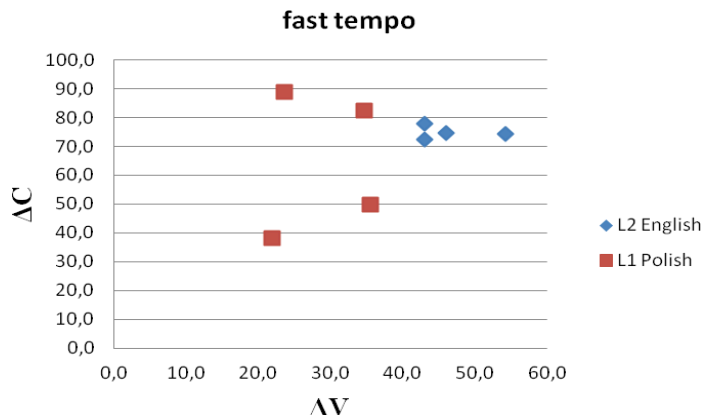


Figure 9. Distribution of L1 Polish and L2 English over the ΔV and ΔC plane for Phrases 1-4 for fast tempo (after Ramus et al., 1999).

Figs.8 and 9 again demonstrate considerable variability of Polish scores as compared to the L2 English ones which gather together, pointing to the consistency and relative stability of values across phrases. The dispersed Polish values are mainly generated by the differences in ΔC between individual phrases. The most important observation here

is the fact that the scores do not seem to overlap, although they are in close proximity. The greater distance between two languages can be observed in the case of fast tempo, but generally the distributions are very similar for both tempos.

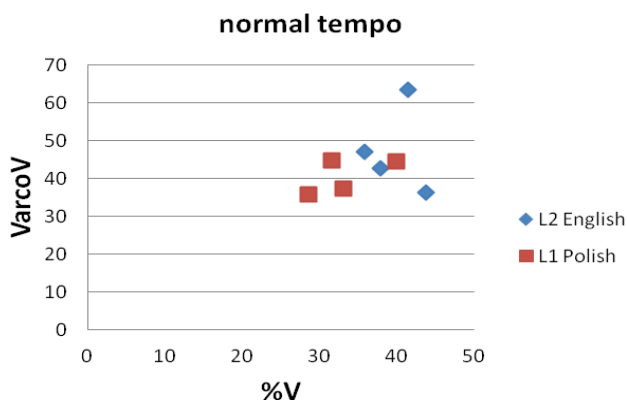


Figure 10. Distribution of L1 Polish and L2 English over the %V and VarcoV plane for Phrases 1-4 for normal tempo (after White & Mattys, 2007).

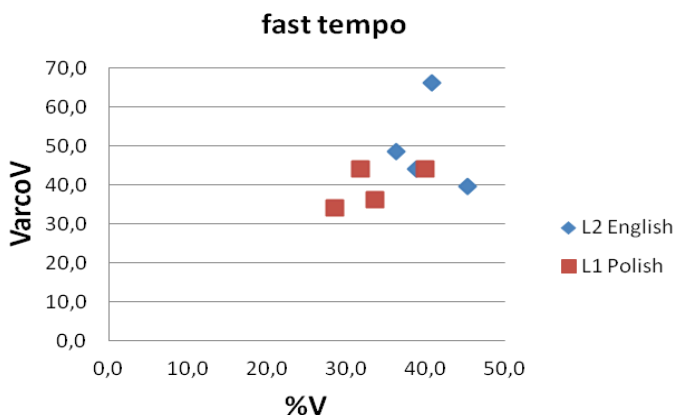


Figure 11. Distribution of L1 Polish and L2 English over the %V and VarcoV plane for Phrases 1-4 for fast tempo (after White & Mattys, 2007).

Figs.10 and 11 show almost identical projections of the same data on the (%V, VarcoV) plane as suggested by White and Mattys (2007). In this case, both languages exhibit similar degree of variability between scores. Although they overlap, two separate accumulations can be observed with respect to Polish and L2 English. The tempo does not seem to be an influential factor for the relations between the two languages.

The most striking observation is concerned with the fact that all the eight figures above present L2 English scores as being much more clustered than the Polish scores, suggesting an interesting pattern in Polish. This is particularly visible in Figs.4, 5, 8 and 9. Additionally, all the figures demonstrate that despite some degree of overlap and similarity between Polish and L2 English scores, it is possible to differentiate between the two languages used by the speakers.

The above observations have been made on the basis of the mean values for the group. In the final part of this stage of the experiment the regularity in the data at the level of individual speakers has been further explored. In order to verify the assumption that L1 Polish and L2 English exhibit similar rhythmic organisation reflected in the rhythm metric scores at the individual speaker level, statistical correlations have been conducted on the data (Pearson's r and p results are shown in Table 1).

Measure	%V		ΔV		ΔC		VarcoV		VarcoC		nPVI	
	N	F	N	F	N	F	N	F	N	F	N	F
r	0.734	0.561	0.421	0.418	0.337	0.615	0.325	0.403	0.031	0.236	0.213	0.454
p	0.000	0.001	0.010	0.010	0.033	0.000	0.042	0.014	0.437	0.101	0.133	0.006

Table 1. Pearson's r correlation and p value results between L1 Polish and L2 English for each measure and tempo, N=30.

Most generally, the majority of the rhythm metrics for L1 Polish and L2 English are positively and significantly correlated with each other across the subjects and for two tempos, although to a different degree. L1 Polish proves to be highly significantly correlated with L2 English with regard to %V normal ($p=0.000$) and fast tempo ($p=0.001$), as well as for ΔC fast tempo ($p=0.000$). Moderate significant correlations between the two languages are noted for ΔV ($p=0.010$ for both tempos), ΔC ($p=0.033$ normal tempo), VarcoV ($p=0.042$ normal tempo, $p=0.014$ fast tempo) and nPVI fast tempo ($p=0.006$). The degree of correlation as measured by Pearson coefficient is not significant for VarcoC both tempos ($p=0.437$ normal, $p=0.101$ fast) and nPVI normal tempo ($p=0.133$). In order to test whether the subjects are systematically different in the realisation of the rhythm metrics in L1 Polish and L2 English, one-tailed paired t test calculations have been conducted for all the metrics and two tempos. The results revealed significant differences between the subjects' scores for two languages in the case of two measures, ΔC normal tempo and nPVI normal tempo ($p=0.0003$ and $p=0.006$).

4. Discussion

Ramus et al. (1999) claim that the (%V, ΔC) projection seems to reflect best the traditional rhythm classes with significant effect of rhythm class. They believe that the two measures can represent certain specific phonological properties of languages and that they are directly related to syllable structure. In the majority of languages, syllables are heavy mainly due to the fact that they gain consonants, and the more syllable types a

language's phonotactics allows for, the greater the variability in the number of consonants and also in their overall duration in the syllable, which results in a higher ΔC . Moreover, this entails a greater consonant/vowel ratio on average and lower %V scores, which is demonstrated by negative correlation between %V and ΔC . Although the identity of the rhythm class that Polish belongs to is still an unresolved issue, it seems that it should not distance from English much with respect to ΔC as both languages present similar syllable types. Some degree of distance between the scores in L2 English and L1 Polish is expected in terms of %V, as English demonstrates considerable vowel reduction and Polish has no phonological reduction at all. It is therefore not surprising to discover English and Polish, that have numerous syllable types, placed closely on the %V and ΔC scale in the present findings, as in Ramus et al. (1999). With regard to %V, ΔV and ΔC , ΔV projections, present results show much greater proximity of Polish and L2 English scores than Ramus et al. (1999) who observed that Polish seems to be related to the stress-timed languages in terms of %V, ΔC plane, but on the ΔV dimension, it becomes evidently different from English. This is not true in the case of the present results, which, as expected, suggest that there is a considerably greater relationship between L2 English and L1 Polish than between L1 English and L1 Polish. Additionally, the results indicate that faster rates of speech help to differentiate between L2 English and L1 Polish slightly better than in the case of normal tempo, implying that at faster rate the subjects either tend to perform reductions in their L1 Polish, or they do not produce reductions in their L2 English.

Similarly, White and Mattys (2007) reported that %V and VarcoV seemed to be particularly helpful for differentiating between first languages, both between and within rhythm classes, in a way that is consistent with the phonology of the investigated languages. In view of the present findings, although English and Polish represent considerable differences regarding their vocalic systems, mainly due to vowel reductions present in English, it appears that the L2 English and Polish are not far from each other, and in fact they overlap on the %V and VarcoV scale. This may result from inadequate reductions performed by the subjects that need to be mastered in order to obtain more discriminative scores, and existing relationship between Polish and L2 English produced by Polish learners.

Generally, various degrees of significant statistical correlations within the majority of individual rhythm measures were identified, proving the presence of the relationship between Polish and L2 English. Moreover, the subjects were systematically different in their realisation of two rhythm metrics, ΔC and nPVI for normal tempo, between their L2 English and L1 Polish, which was verified by significant differences between the two languages and which points to the fact that the learners exhibit different rhythmic organisation in the investigated languages. Although statistical differences between the two languages were found only for two measures, the discrepancies between them are also evident from the results indicating that L2 English scores of the four investigated phrases cluster together to a much greater extent than Polish scores do (see Figs. 4-11), suggesting that L1 (Polish) exhibits greater variability than L2 (English). This is a rather unexpected finding, as the system of a native language can be supposed to be more stable, consistent and not undergoing crucial developmental phases (except in childhood) compared to L2 English at an intermediate or upper-intermediate level of proficiency of the subjects in this study. On the other hand, this could be explained by a greater degree

of reductions in L1 Polish than in L2 English performed by the participants and faster rate of speech in Polish. As presented by Figs.6-9, the seemingly most discriminative measure between languages is ΔV , although the discrimination is not a strict one, as all the scores are in close proximity. This may signal that L2 English conceals the more intricate timing phenomena than L1 English, regardless of the degree of syllable-timing in L1. White and Mattys (2007) obtained similar scores for Spanish speakers of English and English speakers of Spanish, which did not correspond with the subjective perception of these speakers' abilities in L2. However, in general, their L1 speakers tended to speak faster than L2 speakers and the sensitivity of ΔV confirmed in significant negative correlations with speech rate point to the unreliability of this measure in any between and within language comparisons. The reason why graphically ΔV generated the greatest differences in the present study seems to be dictated by its ability to reflect the level of variability between intervals and consequently the phonological properties of languages. Although it does not cover the durational differences between consecutive intervals (as nPVI), it can indicate the differences between Polish and English vocalic inventories and such phenomena as vowel reduction, the presence of long vowels and diphthongs, Polish, as opposed to English, generally exhibits none of these phenomena, which undoubtedly contributes to the increased variability of vocalic intervals and the differences between the languages.

The assumption behind the analysis of individual subjects' differences between their L2 English and Polish scores was that the smaller the difference, the closer the relationship between the languages' rhythmical production in each subject. The participants who turned out to be consistent in their low difference scores can be thought to demonstrate stronger relationship between their L2 English and native Polish in terms of rhythm measures, while the participants whose difference scores tended to be high, can be thought to show weaker relationship between the two languages, which may contribute to the production of more adequate rhythmic and timing relations in the target language.

5. Conclusion

The assumption that there is a relationship between rhythm metric scores calculated for the performance of individual speakers in English and in Polish can be said to be verified only in part, i.e. it is true for some subjects and for some rhythm measures only. Because of considerable variability between scores and some traits of consistent behaviour present in only a few subjects, it can be concluded that the relationship seems to be existing for particular subjects and particular measures.

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Appendix 1

1. should be considered stronger than the other / szuka pomysłów mądrych jak pomagać

f	ə	d	b	i	k	ə	n	s	ɪ	d		ə	d	s	t	r	ɒ		ŋ	g	ə	
C	V	C	C	V	C	V	C	C	V	C		V	C	C	C	C	V		C	C	V	
f	u	k		a	p	ɔ	m		i	s	w	u	f	m			ɔ̃	n	d	r	i	x
C	V	C		V	C	V	C		V	C	C	V	C	C			V	C	C	C	V	C

ð	ə	n	ð	i		ʌ	ð	ə	
C	V	C	C	V		V	C	V	
j	a	k	p	ɔ	m	a	g	a	tɛ
C	V	C	C	V	C	V	C	V	C

2. and at last the North Wind gave up the attempt / to jest fakt że kot mysz jak schab może zjeść

	ə	n	d	ə	t	l		a	s	t	ð	ə	n	ɔ:	θ	w	ɪ	n	d	g	er	v			ʌ	p
	V	C	C	V	C	C		V	C	C	C	V	C	V	C	C	V	C	C	C	V	C			V	C
t	ɔ		j	ɛ	s	t	f	a	k	t	ʒ	ɛ	k	ɔ	t	m	i	ʃ		j	a	k	s	x	a	p
C	V		C	V	C	C	C	V	C	C	C	V	C	V	C	C	V	C		C	V	C	C	C	V	C

ð	i		ə	t		e	m	p	t
C	V		V	C		V	C	C	C
m	ɔ	ʒ	ɛ	z	j	ɛ	ɛ	tɛ	
C	V	C	V	C	C	V	C	C	

3. wrapped in a warm cloak / tak aby gnom kłął

r	æ	p	t	ɪ	n	ə	w		ɔ:	m	k	l	əʊ	k
C	V	C	C	V	C	V	C		V	C	C	C	V	C
t	a	k		a	b	i	g	n	ɔ	m	k	l	ɔ̃	w
C	V	C		V	C	V	C	C	V	C	C	C	V	C

4. then the Sun shone out warmly / ten to pan co stał z boku

ð	e	n	ð	ə	s	ʌ	n	ʃ	ɒ	n		aʊ	t		w	ɔ:	m	l	i
C	V	C	C	V	C	V	C	C	V	C		V	C		C	V	C	C	V
t	ɛ	n	t	ɔ	p	a	n	ts	ɔ	s	t	a	w	z	b	ɔ	k		u
C	V	C	C	V	C	V	C	C	V	C	C	V	C	C	V	C	C		V

Appendix 2

Sp.	%V		ΔV		ΔC		VarcoV		VarcoC		nPVI	
	N	F	N	F	N	F	N	F	N	F	N	F
1	8.0	10.4	13.6	19.0	1.3	6.8	10.7	11.9	3.1	10.3	4.8	11.4
2	3.9	6.1	4.6	18.0	1.9	1.0	5.0	16.1	7.0	3.8	6.2	5.7
3	8.1	2.5	1.4	0.6	1.5	15.3	1.8	5.3	3.9	3.0	6.9	8.9
4	5.7	5.5	24.5	19.5	25.1	34.4	7.0	7.5	6.0	18.4	5.6	10.6
5	5.0	9.7	9.1	19.3	5.0	1.6	6.7	8.2	1.2	5.9	3.2	5.4
6	5.1	7.0	3.8	7.6	9.3	1.4	0.5	1.6	3.4	2.6	8.2	11.0
7	4.3	5.5	4.7	12.0	21.3	2.2	1.7	10.4	10.3	1.9	12.4	7.4
8	8.1	7.5	18.9	22.3	15.3	26.6	1.4	12.1	5.4	12.4	9.9	4.3
9	9.7	9.3	16.1	21.4	16.6	7.5	5.1	9.2	16.1	10.7	1.3	8.6
10	6.9	5.5	18.7	20.0	1.0	11.2	16.4	16.6	7.3	7.6	15.6	4.5
11	5.2	3.9	19.8	4.6	22.2	16.6	8.6	4.0	9.0	3.0	8.7	5.5
12	3.4	3.3	22.6	13.6	7.7	21.9	17.3	6.0	3.3	11.1	14.5	14.0
13	7.5	7.2	29.6	23.8	5.0	8.3	18.5	14.3	5.0	5.6	9.3	7.6
14	9.3	9.4	13.1	27.3	1.7	6.8	0.1	15.7	4.0	4.4	0.5	11.5
15	5.3	3.7	11.2	9.5	6.5	11.5	4.7	3.2	3.3	3.9	7.9	9.5
16	7.7	7.9	23.1	18.8	35.3	17.0	8.8	6.7	20.9	8.9	1.8	3.6
17	7.7	8.2	21.7	33.2	-0.3	6.2	1.1	17.8	3.9	1.0	9.0	8.2
18	6.1	5.4	27.6	17.1	39.7	16.4	8.8	8.8	12.2	5.9	1.6	3.1
19	7.1	8.7	16.5	9.5	12.3	6.8	12.4	1.2	12.7	7.9	14.6	2.3
20	2.3	4.3	18.0	18.1	21.9	17.6	10.0	11.0	7.5	5.3	3.4	14.5
21	5.4	6.6	9.7	17.7	26.8	3.9	0.1	7.0	10.6	0.1	9.1	-8.6
22	4.5	3.5	13.9	8.3	12.0	9.6	9.0	3.6	8.9	6.7	7.4	1.2
23	9.2	7.5	24.4	28.3	6.4	1.5	10.7	20.8	5.3	1.6	7.1	8.5
24	8.7	5.4	15.7	13.6	13.1	2.9	14.6	17.0	2.6	10.2	9.5	26.6
25	3.5	4.0	9.0	19.0	11.7	15.4	1.7	13.8	1.8	6.4	11.8	16.3
26	7.1	6.9	13.4	15.6	9.4	10.5	0.9	5.0	7.5	6.8	3.9	2.4
27	6.4	8.2	18.9	20.7	18.8	19.3	6.1	14.6	10.2	19.4	6.3	4.4
28	7.2	9.9	15.2	20.9	8.3	6.4	11.0	10.7	3.3	7.9	5.7	6.1
29	9.4	13.1	20.7	19.4	12.0	13.0	11.5	4.7	0.8	3.0	15.1	7.1
30	5.6	7.0	30.6	31.0	11.9	13.8	23.4	25.5	7.6	10.8	12.0	20.6
mean	6.4	6.8	16.3	17.7	12.7	11.1	7.9	10.3	6.8	6.9	7.8	8.6
S.D.	2.0	2.5	7.6	7.4	10.1	8.0	6.1	6.0	4.6	4.6	4.3	5.6

Table 16. Differences between L2 English and Polish scores calculated for each measure, tempo and for each participant.