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■ DISCERNING /e/ AND /æ/. A CHALLENGING TASK OR NOT?

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Nesrazmera između srpskog i engleskog samoglasničkog sistema često uzrokuje mnoštvo problema u artikulaciji engleskih samoglasnika kod odraslih učenika kojima je maternji jezik srpski. Njihova nemogućnost da prepoznaju i adekvatno izgovore brojne samoglasnike koje srpski sistem samoglasnika ne prepoznaje naročito je očigledna u slučajevima samoglasnika srednjeg i niskog vokalskog prostora. Tipičan primer je slučaj /e/ i /æ/. Naš rad bavi se istraživanjem kvalitativnih i kvantitativnih karakteristika ova dva samoglasnika u artikulaciji 10 ženskih i 5 muških ispitanika na zadatku čitanja teksta. Akustička merenja samoglasnika obuhvatala su vrednosti frekvencije formanta F1 i F2 i samoglasničku dužinu. Dobijeni rezultati potvrđuju tvrdnju da razlikovanje ova dva samoglasnika predstavlja jedan od najtežih zadataka odraslim srpskim govornicima engleskog jezika kao stranog.

Ključne reči: Engleski samoglasnici, akustička svojstva, akustička analiza, formant, dužina samoglasnika

1. INTRODUCTION

The asymmetry between the vowel inventories of the English and Serbian languages has always caused a plethora of problems to adult Serbian EFL learners. One of the most dominant central questions in relevant literature is how difficult it is for Serbian EFL learners to distinguish and acquire L2 vowels that their mother tongue does not recognize. The results obtained during the course of the research mostly supported the two most influential theories of language learning—Best's Perceptual Assimilation Model – PAM (Best 1995) and Flege's Speech Learning Model – SLM (Flege 1995).

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Best's PAM is based on the assumption that vowel categories from L2 are subject to assimilation to the most similar L1 vowels. In other words, the more similar an element in the inventory of the mother tongue is, the lower the level of L2 vowel acquisition. Similarly, Flege's SLM argues that the success in perception and production of L2 vowels is higher if the elements of the L2 vowel inventory are sufficiently phonetically different from the L1 elements. In that case, such a category is established as 'new' or 'foreign' and is more likely to be easily acquired by EFL speakers.

Both theories, therefore, are based on the influence of the mother tongue on L2, which can be either positive or negative. Positive influence is defined as *transfer*, whereas negative as *interference*. In terms of vowels, cross-linguistic studies have paid special attention to the phenomenon of interference, unequivocally pointing to the close link between L1 and L2 perception and production, hypothesizing that successful acquisition and correct, native-like *production* of L2 phonemes are conditioned by an accurate *perception* of phonemic contrasts in L2 input. An English listener, for instance, will *categorize* a vowel with a short duration, a high F1 and a high F2 as the vowel /æ/ in the word *cat*, most likely because English speakers tend to *pronounce* the vowel in *cat* with those same properties (Escudero 2009: 2). Unlike them, Serbian and speakers' production is often highly influenced by the degree of similarity between two similar L1 and L2 vowel sounds. Minimal differences often go undetected, opening a path to communication disruption or resulting in vowel discrimination failure. In such cases, a phonetic category of an L2 sound can still be established in L1 speakers, but mostly through strategies *different* from those used by native speakers. In literature, the most frequently mentioned strategy for vowel discrimination is vowel duration, or vowel quantity. Many papers have examined this phenomenon, as well as the reasons why EFL speakers primarily rely on durational cue in articulation and recognition of English vowels. In the next section, we will try to provide answers to this question and then examine whether the respondents of our research resorted to applying the same criterion in the production of vowels /e/ and /æ/.

2. VOWEL QUANTITY AND VOWEL QUALITY ACQUISITION PROBLEMS

Acoustic analyses of qualitative and quantitative differences of vowels in EFL speakers have generally shown that spectral characteristics of English vowels are more difficult to perceive and articulate than their temporal features (Flege *et al.* 1997; Lazendic/Best 2013; Nikolić 2016; Dančetović 2017). On the other hand, it remains insufficiently clear why, even after years of learning, EFL learners fail to adequately produce the qualitative features of vowels reflected in the values of F1 and F2 formants, particularly in the case of neighbouring vowels. Although often noticeably expressed, the values of formant structures do not always lead to successful discrimination between vowels for various potential reasons. The relationship of formant frequencies and the corresponding perceived quality of vowels is not linear. Therefore, a change in F1 from 200 to 300 Hz brings about a much larger change in perceived vowel quality (height) than a numerically equal change from 700 to 800 Hz. (Wang/Van Heuven 2006: 238). Next, due to the smaller vocal tract in women of an average of 10-15%, differences

in formants' values for the same vowels are subject to variation depending on the sex of the speaker and are therefore sometimes more difficult to perceive. For this reason, acoustic analysis should always be conducted on separate groups of participants depending on gender. Finally, it is argued that individual differences and internal/external factors play an important role in vowel acquisition. A listener can hardly 'predict' formants' values because they differ from person to person—the greater the differences in the shape and size of the vocal tract in speaker, the greater the differences in formants for the same vowels (Wang/Van Heuven 2006: 238). Additionally, in the acoustic measurements, the recorded digital audio signals for the same speaker often point to variations in the values of formants for the same vowels due to various factors such as variations in amplitude, external noise, the emotional state of the speaker, etc. (Almaadeed *et al.* 2016: 346).

On the other hand, although highly variable and dependant on many factors, temporal properties of vowels in communication are notably more expressed and therefore more *receptive* to EFL speakers. As such, they are the primary cue to which Serbian and other EFL speakers opt in distinguishing vowels within oppositions. The success in perceptual vowel discrimination is directly proportional to the expression of duration in vowels—the longer the duration in articulation, the greater the possibilities of their adequate perception and vice versa. These differences are often transferred to the production of EFL speakers, thus leading to hyperarticulation—prolonged articulation of vowels—another proof verifying the claim that duration is the primary (if not only) feature associated with vowels in EFL speakers. Certainly, this conclusion is not surprising, as vowel duration is a perceptible property easier to identify or articulate than vowel spectral properties, particularly if the temporal differences between long and short vowels are more expressed (Dančetović 2017), as in high vowels. High vowels are usually shorter than low vowels, and mid vowels intermediate in duration (Strange *et al.* 2004: 1791). In other words, the perceptual differences between high vowels are more easily acquired than those of vowels from the middle and lower part of the vowel space, such as the examined vowels from our research as one of the most typical examples of this complex interdependence. One of the reasons is "...because the degree of this distinction varies across dialects." (Collins and Mees 2013: 159). Next, regardless of the fact that /æ/ belongs to the group of short/lax vowels, it exhibits durational differences half-way between lax and tense vowels, causing various researchers to classify it as tense (Wang/Van Heuven 2006; Strange *et al.* 2004). Certainly, in comparison to /e/ and other short vowels in English in the same phonological environment, these differences are clearly more noticeable, especially if the vowel /æ/ is followed by a lenis consonant (Dančetović 2017). In Serbian EFL speakers' production, however, differences in vowel length with regard to their phonological context are not always manifested.

Yet, despite the indisputable interdependence of perception and production of vowels in EFL speakers, it cannot be said that there is a uniform pattern by which one can "infer someone's production abilities from perceptual ones and vice-versa." (Llisterri 1995: 98).

3. PREVIOUS RESEARCH

A wide array of papers in literature has dealt with this vowel contrast. The diversity of the results confirms the complexity of the problem of their delimitation, often leading to the conclusion that discrimination between vowels largely depends on additional factors. Bohn and Flege (1992) in their research, for example, argued that the length of residence/experience significantly affected the production of the vowel /æ/ in their L1 German subjects. Comparing the results between the two groups of respondents (experienced and inexperienced), they concluded that experienced learners achieved native-like production of /æ/, whereas the inexperienced did not. Similar research by Flege *et al.* (1997) examined the production of English vowel contrasts by experienced and inexperienced groups of speakers of German, Spanish, Mandarin, and Korean. Experienced German and Mandarin groups showed better results in production of vowels /ɛ-æ/ than the inexperienced ones. On the other side, however, neither the experienced nor inexperienced Korean group managed to produce adequate height distinction, whereas both groups of Spanish speakers did. The research results also indicated that the inexperienced group of German subjects managed to successfully differentiate the contrast in a labelling task, relying mostly on durational cue. The experienced group of German speakers, though, did manage to achieve better results in both labelling and production than the inexperienced group, but in a different way than native English speakers did. This led the authors to conclusions that (1) regardless of the experience, L2 speakers resort to different strategies in discrimination of English vowels than native speakers and (2) that L2 speakers' production and perception are dependent on the activity they carry out.

This vowel contrast has always caused a significant number of difficulties in Serbian EFL speakers as well. Several recent studies point out that discerning the two vowels has been equally difficult both in perception and production to Serbian EFL learners regardless of their age. Paunović (2009) in her research investigated vowel production in terms of neighbouring categories of vowels. The author pointed to a debatable quality of the vowel /æ/ and to the fact that subjects in the research assimilated this vowel into the L1 category of /a/. Investigating the two vowel contrasts /i-ɪ/ and /ɛ-æ/ in perception and production of Serbian participants, Krebs-Lazendic & Best (2013) concluded that the late learners failed to differentiate the two vowels in situations when they had to rely on spectral cue only (p.456), exhibiting thus even greater difficulties than Japanese or Spanish listeners for the same contrast, and assimilating both vowels to Serbian category of /e/. The same group also failed to differentiate the two vowels in the production experiment. In her research, Marković (2016) examined the acquisition of the contrast /e-æ/ in Serbian EFL students. The results showed that the subjects failed to adequately acquire this distinction due to differences in quality of the produced vowels. The results also indicated that the distinction between the two vowels was based on their temporal characteristics e.g. their duration. Analysing the quality of the vowels /e-æ/ produced by the Serbian participants, Nikolić (2016) deduced that these two vowels were not entirely acquired by the highly competent Serbian L2 speakers. He also highlighted the distinction in duration between /æ/ and /e/ (where *ash* was usually longer than /e/) as another supporting point to the claim that the differentiation between the two vowels is mainly made in terms of their duration, but not (always) in terms of their quality (p.98).

4. PRESENT STUDY

From previous research, it can be concluded that Serbian EFL speakers generally do not make a distinction between the examined vowels and that the primary cue of discrimination between them is their duration. At the level of production, these two vowels often occupy a similar vowel space area (or even overlap). Also, the vowel /æ/ is frequently characterized by a significantly longer duration and insensitivity to phonological context. Our research aims to examine these findings and check whether there are significant differences in the articulation between male and female group of respondents. However, unlike some previously mentioned research, our focus will be exclusively on distinguishing the mentioned vowel opposition without comparing it to the Serbian vowel system and its influence and without taking the complexity of the relationship between perception and production into consideration. In other words, we will try to focus only on 1) the ability of the respondents to produce spectral differences between the vowels, 2) the articulatory differences with regard to the duration of the vowels, and 3) differences in production between male and female group of participants.

The participants in this research were 10 female and 5 male senior students from The English Language and Literature Department at Faculty of Philosophy in Kosovska Mitrovica, all Serbian L1 speakers. Despite the fact that, in a formal educational context, all the students at this department are mainly exposed to British English, the subjective impression we had during the production of the stimuli was the strong presence of American accent in most of the students' speech.

3. METHODOLOGY AND PROCEDURES

Vowel formants F1 and F2 and vowel duration vary depending on the production tasks used in research. Normal speech, for example, affects F1 values more than reading of words in isolation. Additionally, F1 formant movement seems to be further affected by the speaking rate (Van Son *et al.* 1992). In production of isolated words, on the other side, vowels are usually lengthened and hyper-articulated. For the abovementioned reasons, we opted for a passage-reading task as a compromise, a task in which we anticipated the most stable and realistic results in both formant values and duration.

The passage included was *The Boy Who Cried Wolf* by David Deterding (2006), a passage widely used in research of similar kind to ours. The text contains several lexical items for acoustic analysis of the vowels /æ/ and /e/. We randomly picked five words for the analysis of each vowel: *plan*, *exactly*, *ran*, *actually*, and *had*; and *shepherd*, *next*, *pleasure*, *successful*, and *get* for the vowel /e/. The subjects were instructed to read the text two times—silently for the first time and aloud for the second—reading it in a common, standard manner. In order for them to be more relaxed and sound more natural, it was suggested to them that they use an accent of their choice.

THE BOY WHO CRIED WOLF

There was once a poor shepherd boy who used to watch his flocks in the fields next to a dark forest near the foot of a mountain. One hot afternoon, he thought up a good plan to get some company for himself and also have a little fun. Raising his fist in the air, he ran down to the village shouting 'Wolf, Wolf.' As soon as they heard him, the villagers all rushed from their homes, full of concern for his safety, and two of his cousins even stayed with him for a short while. This gave the boy so much pleasure that a few days later he tried exactly the same trick again, and once more he was successful. However, not long after, a wolf that had just escaped from the zoo was looking for a change from its usual diet of chicken and duck. So, overcoming its fear of being shot, it actually did come out from the forest and began to threaten the sheep. Racing down to the village, the boy of course cried out even louder than before. Unfortunately, as all the villagers were convinced that he was trying to fool them a third time, they told him, 'Go away and don't bother us again.' And so the wolf had a feast. (Deterding 2006)

For the recordings, we used a laptop and the Sony ICD-PX470 digital voice recorder. The files were further analysed for the F1 and F2 measurements and targeted vowel duration in PRAAT speech analysis computer software (Boersma/Weenik 2015). The F1 and F2 values for both male and female participants were manually extracted for all vowels and then further calculated for mean values. In order to investigate the distribution of the target vowels in production of the participants, the obtained average formant values were converted into the Bark scale values using the formula of Traunmüller (1990) and plotted onto a two-dimensional chart. The duration of the vowels was measured in milliseconds.

4. RESULTS

Table 1 presents the values of the F1 and F2 formants for the examined vowels produced by both groups of respondents. Graph 1 shows the spectral characteristics projected on the two-dimensional axis.

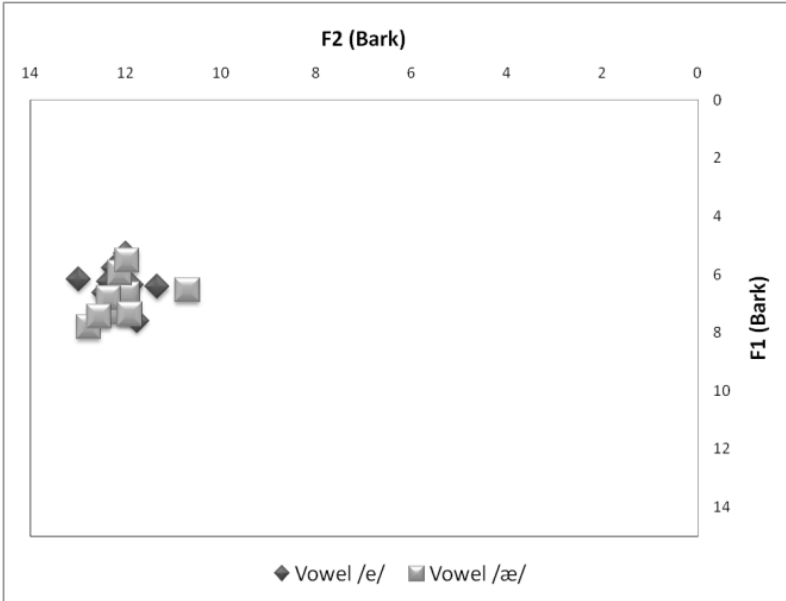
FEMALE PARTICIPANTS				
No.	Vowel /æ/		Vowel /e/	
	F1	F2	F1	F2
1	760	1790	652	1992
2	704	1413	686	1554
3	885	1932	691	1758
4	812	1769	716	1839
5	721	1707	677	1687
6	739	1812	662	1811
7	819	1697	852	1660
8	625	1752	542	1716
9	829	1870	785	1760
10	573	1711	603	1785
MEAN VALUE	747	1745	687	1756
STANDARD DEVIATION	91.15	131.47	82.28	110.83

(a)

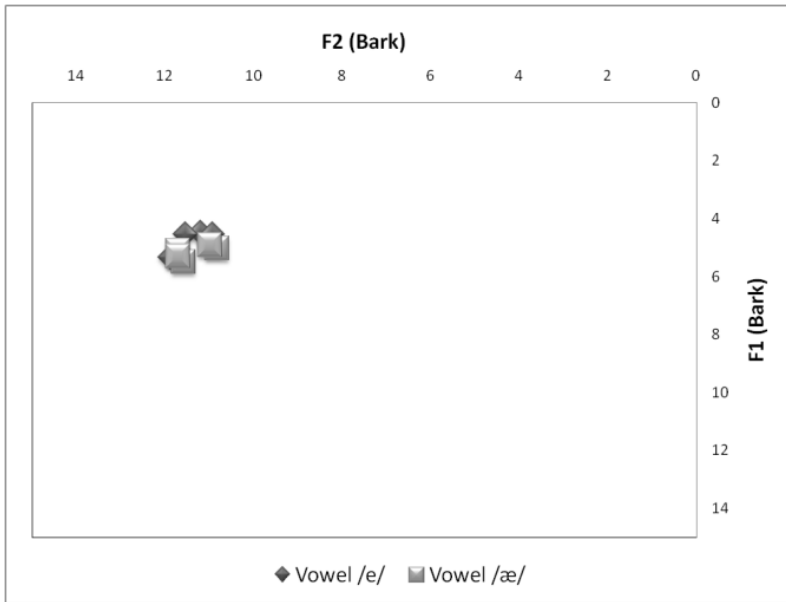
MALE PARTICIPANTS				
No.	Vowel /æ/		Vowel /e/	
	F1	F2	F1	F2
1	512	1442	451	1524
2	500	1476	457	1461
3	569	1615	457	1606
4	521	1645	525	1634
5	546	1645	548	1690
MEAN VALUE	529.6	1564.6	487.6	1583
STANDARD DEVIATION	24.82	87.57	40.64	81.17

(b)

Table 1. Formant values for the analysed vowels in production of female (a) and male (b) participants



(a)

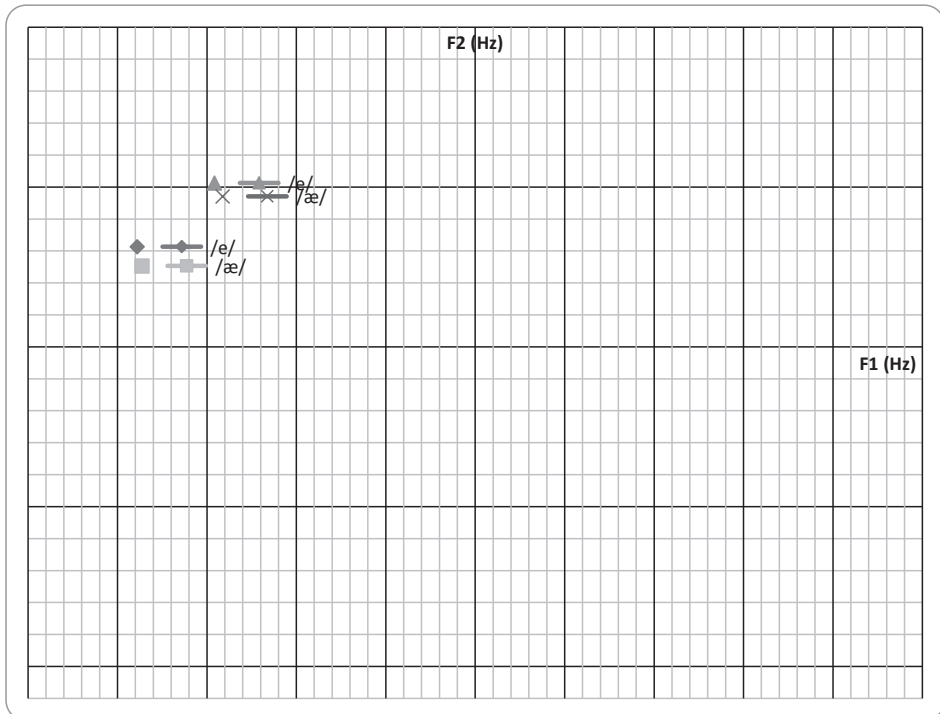


(b)

Graph 1. Spectral properties of examined vowels in the production of female (a) and male respondents (b)

The plotted formant values from Chart 1 show that the two vowels are minimally dispersed in the vowel space of male respondents. On the other hand, although the mean values of the two formants at inter-vowel level clearly indicate that the group of female respondents failed to adequately acquire spectral characteristics of vowels (apparently assimilating the vowel /æ/ into the native category of /e/), fairly high F1 and F2 standard deviation (STD) values point to a slight variability in articulation among female participants. With regard to openness, notably high F1 standard deviation values indicate that vowel /æ/ varies in position it occupies in vowel space at inter-speaker level, ranging from 573-885 Hz. In addition, similarly high STD F2 value from Table 1 point to a similar dispersion on horizontal axis, suggesting a slightly wider area in which vowels are scattered, the F2 value ranging from 1413-1932 Hz. Similarly, high STD values for the vowel /e/ at inter-speaker level also point to a great production range from 542 to 852 Hz for F1 and 1554 to 1992 Hz for F2. Still, despite these fluctuations, mean values exhibit remarkable similarities, proving that female speakers in general failed to successfully delimit the two vowels with respect to their quality (Graph 2).

In male participants, even more stable F1 and F2 values at inter-speaker level within the group indicate that investigated vowels occupy a compact vowel space area and are densely clustered together. In comparison to the group of female subjects, lower STD F2 value in male subjects shows that females exhibit greater front/back differences in articulation of both vowels than males.



Graph 2. Mean values of tested vowels in production of female (■ and ◆) and male participants (▲ and X)

Regarding the duration of the examined vowels², the conclusion that can be drawn by the insight into Table 2 of the mean values is that both groups of respondents showed a similar tendency to articulate the vowel /æ/ as a long vowel, i.e. longer than its counterpart /e/. The value of the standard deviation indicates that the range of duration is wider in female than in male participants, whereas the duration at interspeaker level in male group of respondents is more uniform in terms of both vowels, supported by similar STD values.

FEMALE PARTICIPANTS NO.	Vowel /æ/ duration in ms	Vowel /e/ duration in ms
1	130	70
2	120	100
3	120	80
4	120	90
5	110	90
6	90	90
7	120	90
8	80	70
9	110	70
10	80	70
MEAN VALUE	105	82
STANDARD DEVIATION	33.74	10.77

(a)

- 2 Despite the fact that durational findings in the context of the target vowels are irrelevant on average in connected speech unless the tempo were normalized, we presented the production results to illustrate that the differences between male and female participants' articulation of the two vowels are almost negligible, and that both groups clearly pronounce the /æ/ vowel longer than its counterpart /e/. This fact is not surprising, however, since there are three monosyllables with /æ/, all ending in a lenis consonant and two with /e/, ending in a fortis consonant, which clearly contributed to the difference in duration.

MALE PARTICIPANTS	Vowel /æ/ duration in	Vowel /e/ duration in
NO.	ms	ms
1	110	70
2	90	70
3	80	50
4	110	80
5	110	90
MEAN VALUE	100	72
STANDARD	11.54	12.11
DEVIATION		

(b)

Table 2. Duration of the analysed vowels in production of female (a) and male (b) participants

5. DISCUSSION

The analysis of the results obtained for the tested vowels in production of both male and female participants showed that neither group succeeded in producing relevant quality differences between the vowels. A simple analysis of the inter-speaker raw values of F1 and F2 indicates a diverse acoustic shape of the two vowels in production of female participants, which is confirmed by fairly high standard deviation values. However, Graphs 1 and 2 show that the two vowels occupy a small vowel space area, clearly indicating a poor level of delimitation between the analysed vowels. Comparing the results obtained at the intra-speaker level, we concluded that, although highly competent EFL speakers, whose interlanguage production can be characterized as American-like, the respondents of both groups failed to recognize certain phonological differences typical for it. Namely, in accordance with Ladefoged's claim (2011) that vowels before all nasals in many forms of American English may be considerably raised, we anticipated subjects' F1 values for vowel /æ/ in words *plan* and *ran* in comparison to *had* to be significantly lower. However, neither male nor female subjects manifested this, producing the vowel /æ/ with mean F1=810 Hz for *plan* and *ran* and F1=714 Hz for the word *had* in female subjects and F1=560/539 Hz in male participants. This suggests that both male and female participants' production of the quality of the vowels is insensitive to phonological environment.

On the other hand, the expected differences in terms of vowel duration are in contradiction with the obtained results. In comparison to some previous studies conducted on a similar sample of respondents (Dančetović 2017) in which the results indicated a high degree of hyperarticulation, we initially expected the durational differences among the tested vowels to be more pronounced. The results we obtained

in this research show that the differences are significantly less noticeable, and that vowel duration still remains the primary cue in distinguishing the examined vowels.

Yet, in contrast to the mentioned research in which carrier sentence was used in the procedure as a task for vowel examining, it can be concluded that the level of variation in the duration of English vowels is highly dependent on the applied task. Some previous research (Paunović 2009; Nikolić 2016) support this argument. Their production tests confirmed that the final results were affected by the choice of tasks in the research and that hyperarticulation was least present in the text-reading test.

6. CONCLUSION

Based on all the above and taking into account previous research, it can be concluded that adequate acquisition of the vowel contrast /e-æ/ represents one of the most difficult tasks for Serbian EFL learners. Without reference to the exact number of years of EFL exposure, the age at which L2 acquisition began, personal emotional/motivational state of speakers, mother tongue influence, or comparison with values for the same vowels produced by the native speaker, our experiment showed that vowel space for the examined vowels is still insufficiently defined and demarcated. Variations in vowel height/backness among the speakers, although noticeable, were insufficient in the overall mean results we obtained, clearly indicating overlapping in the vowel space area. Temporal differences, on the other hand, although not too prominent, prove that the tested vowels, as all the other pairs of pure vowels in English, are acquired and discerned exclusively on the principle of vowel quantity.

NOTE: The research was conducted within the project “Kosovo and Metohija between national identity and European integrations.”

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SUMMARY

DISCERNING /e/ AND /æ/. A CHALLENGING TASK OR NOT?

Disproportion between Serbian and English vowel systems often causes problems in the articulation of English vowels in adult EFL learners. Their inability to adequately recognize and pronounce numerous vowels that the Serbian vowel system does not contain is particularly obvious in cases of vowels of the mid and low vowel space area. A typical example of this phenomenon is the case of /e/ and /æ/. This paper presents the findings of a research of the acoustic properties of the two vowels in Serbian EFL senior students. The study comprised both qualitative and quantitative characteristics of vowels in the articulation of ten female and five male participants in a reading task. The acoustic measurements of the vowels included frequency values of the formants F1 and F2 and their length. The results obtained verify the claim that the distinction between the two vowels represents one of the most difficult tasks for Serbian EFL learners.

KEYWORDS: English vowels, acoustic properties, acoustic analysis, vowel formants, vowel length, Serbian EFL learners.

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