
PRODUCTION OF L3 VOWELS: IS IT POSSIBLE TO SEPARATE THEM FROM L1 AND L2 SOUNDS?

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Abstract

It is incontrovertible that acquisition of a sound system of a second language is always a complex phenomenon and presents a great challenge for L2 learners (e.g. Rojczyk, 2010a). There are numerous studies (e.g. Nowacka, 2010; Flege, 1991) which show that L2 learners whose first language has a scarce number of sounds, have problems to distinguish L2 sound categories and tend to apply their L1 segments to new contexts. It may be easily detectable in the case of vowels. There is abundance of studies examining L2 learners' successes and failures in production of L1 and L2 vowels (e.g. Flege, 1992; Nowacka, 2010; Rojczyk, 2010a). Usually such projects show how difficult it is for L2 learners to separate "old" and "new" vowel categories. However, the situation becomes much more complicated when we think of third language (L3) production. While in the case of L2 segmental production the number of factors affecting L2 sounds is rather limited (either interference from learners' L1 or some kind of L2 intralingual influence), in the case of L3 segmental production we may encounter L1→L3, L2→L3 or L3 intralingual interference. This makes separation of L3 sounds a much more complex process. The aim of this study is to examine whether speakers of L1 Polish, L2 English and L3 German are able to separate new, L3 vowel categories from their native and L2 categories. Being a part of a larger project, this time the focus is on German /œ/. This vowel was chosen since it is regarded as especially difficult for Polish learners of German and it is frequently substituted with some other sounds. A group of English philology (Polish-English-German translation and interpretation programme) students was chosen to participate in this project. They were advanced speakers of English who did not encounter any difficulties in communication with native speakers of this language and upper-intermediate users of German. They had been taught both English and German pronunciation/practical phonetics during their studies at the University of Silesia. The subjects were asked to produce words containing analysed vowels, namely: P /u/, P /ɔ/, P /ɛ/, E /u:/, E /ɔ:/ and G /œ/. All examined vowels were embedded in a /bVt/ context. The target /bVt/ words were then embedded in carrier sentences *I said /bVt/ this time* in English, *Ich sag' /bVt/ diesmal* in German and *Mówię /bVt/ teraz* in Polish, in a non-final position. The sentences were presented to subjects on a computer screen and the produced chunks were stored in a notebook's memory as .wav files ready for inspection. The Praat 5.3.12 speech-analysis software package (Boersma, 2001) was used to scroll through the audio files in order to locate an onset and offset of target vowels, measure the F1 and F2 frequencies and plot vowels on the plane. All analyses were also performed using Praat. The obtained results shed new light on L3 segmental production and L1 and L2 interference.

1. Introduction

For the decades, second (or: foreign) languages have been regarded as an indispensable tool for communication. However, in order to communicate successfully, one has to be understood properly and their speech must be intelligible to convey the intended message. And, as nobody is only a speaker, but also a listener, they must be able to understand others, as well. To achieve that goal, not only grammatical and lexical, but also some pronunciation rules need to be obeyed. Especially when the interlocutors are from different backgrounds (e.g. a native speaker and a non-native speaker or two non-native speakers from various countries) and may not share the same possible factors affecting their speech in a given language (e.g. Littlewood, 1994). It has been observed numerous times that L2 learners most often are interested in grammatical (syntactic) norm and errors and they ask such questions as “How should I use the Present Perfect correctly?” or “What is the plural of *crisis*?” at all stages of proficiency. They frequently forget that grammatical norm is not the only type of norm which must be taken into account if one wants to approximate the native, e.g. English, models. There are also pragmatic, morphological and orthographic norms. Finally, there are phonetic norms – certain generally accepted ways of pronouncing languages, for instance English (Sobkowiak, 2004). Unfortunately, it is a common situation when L2 learners care less for proper articulation and usually pay more attention to comprehension skills and grammatical rules, especially when they have not been trained to discriminate major phonetic differences since the early stages of learning L2 (Eddine, 2011).

2. Learning an L2 phonetic system

Native speakers of a given language are equipped with the knowledge concerning all phonological rules of this language, e.g. what sounds are possible in it and what sounds are not, what happens to words uttered very fast opposed to those articulated in more careful speech or what are the possible and impossible sound combinations in particular parts of words. This knowledge is reflected in both recognition and production of sounds. Non-native users who want to be successful learners of an L2, should also acquire this kind of knowledge (Gass & Selinker, 2008). However, as sound systems of various languages differ greatly, this task frequently turns out to be very difficult one, especially for adult learners (e.g. Rojczyk, 2009; Rojczyk, 2010a), and some learners never master the target language’s pronunciation at the satisfactory level (Littlewood, 1994).

One also cannot forget that there is no ready phonological representation of L2 automatically available to a learner and that every learner must construct their own. Moreover, the representation which they construct may differ from the one constructed by a native speaker of a given language (Ard, 1990).

What is also very important, is the fact that certain L2 sounds are much more difficult to acquire than others, and this has been proved by numerous studies on SLA. Potential difficulties in acquiring some L2 sounds are frequently attributed to the influence of L1 phonological knowledge. Although the popular assumption is that learning a given L2 sound is easier when this sound is similar to a L1 sound and that it is

more difficult when the L2 sound clearly differs from the L1 sound, research on L2 speech perception and production has clearly shown that perceiving L2 sounds is not as simple as just deciding whether given sounds in L1 and L2 are similar to each other or not. There are numerous linguistic and psychological factors contributing to the process of sound perception and then – to production (Pilus, 2005).

The Speech Learning Model (Flege, 1995) is one of the models which have been mainly focused on the ultimate attainment of L2 production. The SLM concentrates on those L2 learners who have spoken their L2 for many years. It predicts that phonetic similarities and dissimilarities of the learner's mother tongue and their target language's segments shall influence the degree of success in production and perception of non-native sounds (Flege, 1995; reported in Rojczyk, 2009) as bilinguals are not able to fully separate their L1 and L2 phonetic subsystems (Flege, 2003). The sounds in L2 are divided into two kinds – “new” and “similar”. New sounds are those which are not identified by learners with any L1 sound. Similar sounds are those regarded as being the same as certain L1 sounds (Brown, 2000). It should be added that phonetic similarity and dissimilarity are defined in terms of the acoustic and articulatory characteristics of the linguistically relevant speech sounds. The attainment of native-like production and perception of given second language sounds is then connected to the phonetic distance between L1 and L2 segments (Flege, 1995; Rojczyk, 2010a). According to the SLM, L2 learners will be less successful in learning those L2 sounds which are regarded as being similar to L1 sounds as the similarity shall block the formation of a new phonetic category by means of the equivalence classification. On the contrary, those L2 sounds which are perceived as being different or new in terms of L1 categories, will encourage L2 learners to create new L2 categories (Flege, 1995; Rojczyk, 2010a). Certainly that stands in contradiction to popular beliefs concerning L2 learning shared by laypeople.

Another vital model concerning speech perception and production is called the Perceptual Assimilation Model (PAM). The Perceptual Assimilation Model, formulated and developed by Best (e.g. Best, 1994; Best, 1995), claims that the difficulties which L2 learners encounter while learning L2 speech sounds are determined by perceptual limitations. The PAM suggests that L2 listeners tend to classify sound contrasts in L2 into various categories, depending on the degree of similarity between their native and non-native sounds (Pilus, 2005). Similarity is understood here as the spatial proximity of constriction location and active articulators (Brown, 2000). Such classifications of L2 contrasts do determine how these contrasts will be assimilated to learners' native categories (Best, 1995; Pilus, 2005). However, predictions made by SLM are more relevant to the present study as SLM, unlike PAM, focuses on the process of learning, concentrates on experienced language learners, and the present study does not concern L3 segmental contrast, but a single L3 segment.

3. The matter of an L3

3.1 The complexity of TLA

The situation when a given learner is learning more than one second/foreign language becomes even more complex. Although for many years acquisition of third or any additional language was classified as a part of second language acquisition and researchers did not make any significant differentiation between them (e.g. Cenoz, 2000; Jessner, 2006), for the last two decades TLA has been acknowledged as a separate phenomenon differing markedly from SLA (Chłopek, 2011). Among the main differences between them which ought to be mentioned, is, above all, the number of already acquired languages (or interlanguages) which are likely to create more opportunities of potential interlingual interactions. Moreover, the order of language acquisition may play a crucial role in TLA. One should remember that while during SLA the number of such configurations is rather limited (a learner may acquire either two languages simultaneously or simply one after another), in the case of learning/acquisition of three various languages there are more possibilities (e.g. L1+L2 first and then L3, L1 first and then L2 + L3 or three languages one after another). The competence and fluency in each of acquired languages are another vital factors affecting TLA. All these elements make third language acquisition a process far more complex and dynamic than second language acquisition (Chłopek, 2011).

Interference of a learner's mother tongue in the process of SLA is widely perceived as an obvious and well-known problem (e.g. Arabski, 2006). It has been proved that transfer of linguistic properties from a learner's L1 into the target language (TL) is one of pervasive features of the process of second language acquisition (Towell & Hawkins, 1994). While in the case of SLA one may encounter either L1→L2 transfer or L2 intralingual transfer (there is also a possibility of L2→L1 transfer but it is not as frequent phenomenon as the two previous options), in TLA, as languages may influence one another in any configuration, the number of transfer possibilities increases rapidly. For instance, for three languages it might be: L1→L2, L1→L3, L2→L3, L2→L1, L3→L2 or L3→L1 (Chłopek, 2011; Ionin, Montrul, & Santos, 2011). Moreover, although it is a rare phenomenon, also language combinations may affect other language (e.g. L1+L2→L3, L1+L3→L2 or even L2+L3→L1) (Chłopek, 2011). Furthermore, it has been proved that different languages influence the others in various ways and, for instance, L2 may affect L3 in ways that L1 does not (Odlin, 2005).

All these factors altogether suggest that L3 in its various aspects may be strongly affected by both one's L1 and L2. Depending on study, languages combination and language aspects assessed, it has been proved in various studies that in the case of L3 acquisition, L2 may frequently serve as a predominant source of transfer (e.g. Hammarberg, 2001; Treichler, Hamann, Schönenberger, Voeykova, & Lauts, 2009) but it may be L1 as well (e.g. Chumbow, 1981). Nevertheless, it must not be forgotten that the order of language acquisition cannot be an exclusive explanation here. Typological distance between languages is perceived as one of crucial factors affecting transfer as it may be even more influential than the order of language acquisition (Leticica & Mardešić, 2007; Chłopek, 2011). Typological distance is based on classifying languages according

to their structural characteristics (Lammiman, 2010). The easiest explanation is that the closer given languages are one to another, the more similarities they share, which in turn may pose significant difficulties to learners. What seems also intriguing, De Angelis and Selinker (2001) found in their study that typological similarity between non-native languages is likely to provoke non-native transfer in non-native production. Also Lipińska's (2014a) study on lexical transfer in L3 production proved that typologically closer L2 English affected to a greater extent L3 German than L1 Polish.

3.2 Learning an L3 phonetic system

In comparison to L2 phonetic studies, L3 pronunciation research is a relatively new and undeveloped area with a limited number of studies compared even to that on L3 lexis and morphosyntax (see e.g. Tremblay, 2008; Wrembel, 2010). However, for the last decade there have been some attempts to explore this subject in greater depth. First and most obvious topics of interest for scholars was assessing L3 learners' production or perception in this case (e.g. Tremblay, 2008; Wrembel, 2011) or examining L2's influence on L3 acquisition (e.g. Tremblay, 2006; Wrembel, 2010). However, due to the complexity of cross-linguistic influence the case of acquisition of L3 pronunciation has been proved to be a much more complicated matter (Wrembel, 2011). Still, more research is needed in order to explain how L1 and/or L2 affect L3 pronunciation (Llama, Cardoso, & Collins, 2007). And as acquisition of more than one foreign language is becoming obvious and common nowadays, L3 research must be extended in theory as well as provide clear implications for classroom practice.

One of the hypotheses is that a learner's mother tongue serves as a dominant source of influence on third language pronunciation (e.g. Ringbom, 1987). Study by Llisteri and Poch (1987) can confirm this hypothesis. In that study an acoustic analysis of L3 vowels produced by native speakers of Catalan and L2-Spanish revealed that L1 affected L3 production exclusively. One of Wrembel's studies (Wrembel, 2013) revealed similar conclusions. The participants of that study were native speakers of Polish who were proficient users of L2-English and different-level speakers of L3 French. Their speech samples were recorded and evaluated online by expert raters. They rated accent, intelligibility, acceptability and confidence level. The results suggested that the prevailing source of transfer in that case was the participants' L1, however L2's influence was also noticeable.

There were also case studies which reported that at early stages of L3 acquisition, L2 exerts a strong influence on the third language pronunciation (e.g. Marx, 2002; Williams & Hammarberg, 1998). However, those studies did not include an acoustic analysis of produced sounds but were based on the speakers' impressions or on the judgements of a group of listeners who assessed speakers' overall accent as being affected either by their L1 or their L2. Wrembel (2010) proved that in L3 production L2 mechanisms tend to be reactivated and the transfer from L1 may thus be hindered. In her study participated native speakers of Polish, L2-German and L3-English. Their oral production was recorded and assessed perceptually by 27 language experts. The study participants varied according to their proficiency in English. The results showed that L2 had a stronger effect on TLA production at the initial stages of L3 acquisition and became less

influential as L3 developed. However, the researcher suggested that the typological similarity between English and German might have influenced the obtained results.

Tremblay (2008), on the other hand, performed an acoustic analysis of the VOT in the L3 Japanese of L1-English L2-French bilinguals. The results were interpreted as an evidence for L2 influence on L3. Also Wrembel (2011) analysed VOT in the L3 French of L1-Polish and L2-English bilinguals. Her research suggested a combined cross-linguistic influence of both Polish and English on L3 production. She highlighted that it provided a further evidence for an L2 presence in L3 phonological acquisition.

De Angelis (2005) claims that non-native languages are classified as “foreign language” category in learners’ minds thus creating a cognitive association between them. As one’s L1 does not sound “foreign” it is usually excluded and blocked from this association. This process was called by De Angelis as an “association of foreignness” (De Angelis, 2005, p. 11). It should favour non-native transfer giving L2 a privileged status. L2 privileged status was observed as having a strong impact on L3 in TLA lexical and pronunciation studies (Llama et al., 2007).

4. Current study

4.1 Previous research on foreign vowel production

Previous research on foreign vowel production focused more on L2. There were numerous studies describing L2 vowel production and the influence of L1 on it, however, the most important ones here are those devoted to Polish learners of L2 English. Previous research on Polish learners’ production of English vowels shows that although it is difficult, Polish learners of English are able to acquire correct production of new L2 sounds, at least to some extent.

For instance, Nowacka’s (2010) longitudinal study on Teacher Training College students showed gradual improvement in vowel quality produced by those students. Although most English vowels were frequently pronounced as Polish sounds, e.g. the word *accent* was pronounced /^haksent/ or /^hksent/ with Polish /^hε/ or /^ha/ instead of English /^hæ/, this tendency faded out with time. Her students were taught English phonetics and phonology during their first and second year of studies. It is noteworthy that the realization of most problematic vowels progressed only slightly during the first year, but it improved markedly after the second year of the study. Thus, it might be suggested that students need more than a year to internalize new, and especially “strangesounding”, “exaggerated” sounds such as English /^hæ/ (as Nowacka reported students called it), in their speech. On the other hand, there were vowels which did not improve at all in students’ pronunciation, for example English /ɪ/ in comparison to Polish /i/ or English /e/ compared to Polish /ε/. The results of that study revealed that there was no improvement in vowel quality for /ɪ/. Both in reading and speaking the students used the Polish vowel /i/ as a replacement for /ɪ/, e.g. in *listening* /^hlɪs^hɪn^hɪŋk/. The study results also did not show any improvement in vowel quality for /e/. In her study, the most common version of the intended English /e/ vowel, was the more open Polish

counterpart (/ɛ/), which was observed during the evaluation process in words such as *when*, *several*, *second* and *many*. What needs to be highlighted is the fact that the assessment of students' production was based on auditory impressions and not on acoustic measurements in that study.

Rojczyk (2010a, 2010b), on the other hand, made a study focusing on examining production of English vowels by advanced Polish learners of English. The subjects consisted of 43 third-year students recruited at the Institute of English, University of Silesia (31 females and 12 males). The students were advanced speakers of English having no difficulties in communicating with native speakers of English, moreover they had been given 120 hours of phonetic training in English pronunciation during the first and second year of studies. The stimuli used in the study consisted of examined vowels embedded in a /bVt/ words which were in turn embedded in carrier sentences *I said /bVt/ this time* in English and *Mówię /bVt/ tym razem* in Polish. The acoustic analysis was performed using Praat 5.1.17 speech-analysis software package. Frequencies of F1, F2 and F3 were measured at vowel mid-point and the raw measurements were later normalised using the Lobanov transform. The research focused on the production of the English /æ/, /ɪ/ and /e/ vowels. As for English /ɪ/ vowel, the results proved that the subjects managed to create a new category for English /ɪ/, between Polish /i/ and /i/. This English vowel occupied a separate area in the acoustic space of Polish learners and was not subsumed by any of neighbouring Polish vowels. The computed Euclidean distance showed that English /ɪ/ was located 338 Hz from Polish /i/ and 264 Hz from Polish /i/. Such distances suggested that this new vowel category had been established optimally, merging acoustic properties of the two neighbouring Polish vowels. On the other hand, there was high variability along F2 axis across individual speakers. It may suggest that, although the study participants had separated the English /ɪ/ category from the Polish /i/ and /i/ categories, this new category was still not stable and was constantly influenced by a magnet effect from L1 categories (Rojczyk, 2010a). Comparing to production of English /ɪ/, the case of English /e/ gave completely different results. The study results indicated almost complete assimilation of the English /e/ category by the Polish /e/ category. It was easy to notice a significant overlap between these two categories, and the computed Euclidean distance separating the two vowels had the value of only 60 Hz. What was also striking, was the fact that the locus of English /e/ was even lower than the one of Polish /e/. It showed that the subjects in this study not only failed to establish a separate category for a new vowel, but also moved it in the wrong direction (Rojczyk, 2010a). Concerning production of English /æ/ by Polish learners of English relative to English vowels /e/ and /ʌ/ and Polish vowels /ɛ/ and /a/, the study results showed that both English /æ/s and /ʌ/s produced by the subjects were partially assimilated to the Polish /a/ category. The computed Euclidean distances indicated equal proximity of /æ/ to both /ʌ/ and /a/ and a 2,5 times larger distance to /e/. What was also noteworthy was the fact that /æ/ was characterised by a lack of stability along F2 dimensions. This was evidenced by its relatively great standard deviations of F2 frequencies (155Hz). This study also showed that English /ʌ/ was almost completely subsumed by Polish /a/ and shared a significant amount of acoustic space with English /æ/ (Rojczyk, 2010b).

Lipińska's research (Lipińska, 2013; Lipińska, 2014b), on the other hand, proved that Polish learners of English having undergone formal training in L2 pronunciation are able to separate Polish and English vowel categories, at least in laboratory conditions. In the first case (Lipińska, 2013) there were three groups of study participants - they were recruited from first-, second- and third-year students at the Institute of English, University of Silesia. There were 51 study participants, 14 male ($\approx 27\%$) and 37 female ($\approx 73\%$). They had attended no-, a half- and a full academic course in English phonetics and phonology, respectively. These three groups were chosen in order to determine to what extent the amount of formal instruction in English phonetics and phonology and the number of years participants had been learning English in general would affect correct production of English vowels. This part of research aimed at assessing whether Polish learners of English are able to separate English /æ/ from Polish /a/ and Polish /ɛ/. The study design was the same as in Rojczyk's research (Rojczyk, 2010a; Rojczyk, 2010b – see above) – the analysed vowels were embedded in the /bVt/ context, and the /bVt/ words were subsequently embedded in carrier sentences *I said /bVt/ this time* in English and *Mówię /bVt/ teraz* in Polish. The acoustic analysis was performed using Praat 5.1.17 speech-analysis software package. The results proved that although English /æ/ may be difficult for Polish learners of English to produce, they are able to separate it from Polish vowels. Formal instruction in English phonetics and phonology was helpful in this process. Students who had completed the academic course in English pronunciation achieved much better scores than those who had not been trained in English phonetics and phonology prior to the study. The other project by the same author (Lipińska, in press, b) compared Polish learners' production of English /ɪ/ and /i:/ compared to Polish /i/. The subjects consisted of 26 female participants recruited from third-year students at the Institute of English, University of Silesia. They had already completed the whole university course in English phonetics and phonology. The analysed vowels were embedded in the /bVt/ and /hVd/ (/xVd/) contexts, and the /bVt/ and /hVd/ words were subsequently embedded in carrier sentences *I said /bVt/ (hVd) this time* in English and *Mówię /bVt/ (xVd) teraz* in Polish. The acoustic analysis was performed using Praat 5.1.17 speech-analysis software package. The frequencies of F1 and F2 were measured and the analysed sounds were plotted on a vowel plane. Also the vowel length was measured. The obtained results showed that advanced Polish learners of English are able to separate Polish /i/, English /i:/ and English /ɪ/ vowel categories successfully. They can differentiate them relying both on quality and quantity.

The research on L3 vowel production is rather limited and does not concern native speakers of Polish yet. The most extensive research on L3 phonology for native speakers of Polish has been provided by Wrembel (2010, 2011, 2013), however those projects concerned general L1/L2 accentuatedness or VOT patterns, but no particular segments have been analysed yet. However, some studies on other languages showed the influence of both L1 and L2 on L3 segmental production. Listeri and Poch (1987) performed an acoustic analysis of L3 vowels produced by speakers of L1-Catalan and L2-Spanish. The results proved without any doubt an exclusive influence of L1 on L3 vowels.

4.2 Rationale and study design

The aim of this study was to examine the influence of L1 and L2 on L3 segmental production. The main question was whether speakers of L1 Polish, L2 English and L3 German are able to separate new, L3 vowel categories from their native and L2 categories and whether formal training in L2 and L3 pronunciation may facilitate this process. Being a part of a larger project, in this part of the study, the focus was on German /œ/. This vowel was chosen since it is regarded as especially difficult for Polish learners of German and it is frequently substituted with some other similar Polish sounds.

11 English philology (Polish-English-German translation and interpretation programme) students recruited at the University of Silesia were chosen to participate in this project. There could not be more of them as it is the only university programme in the area which includes formal instruction in L2 English and L3 German pronunciation and the number of students in the group is strictly limited. They were all fifth year students, females and their age ranged between 22 and 25 years old (mean 23, median 23). All study participants were advanced speakers of English and upper-intermediate users of German. Thanks to a regular administration of tests in practical use of English and German a group of informants characterised by a uniform level of proficiency in both languages could be selected. None of the informants encountered any difficulties in communication with native speakers of English or German. Prior to the study, they had completed the whole university course in English pronunciation (2 years; 4 semesters) and the whole university course in German pronunciation (1 year, 2 terms). That was the main difference between this project and the previous studies in which study participants had not been formally trained in phonetics and phonology of their both L2s and L3s. All subjects volunteered and were not paid for their participation. None of the informants reported any speech or hearing disorders.

In this study production of German /œ/ was compared to production of “similar”, neighbouring Polish and English vowels. The subjects were asked to produce words containing analysed sounds, namely: P /u/, P /ɔ/, P /ɛ/, E /u:/, E /ɔ:/ and G /œ/. The material used in this study was the same for all subjects. All examined vowels were embedded in a /bVt/ context. This context was preferred since /b/ in the analysed languages is of the same quality, while in the case of more popular, “standard” /hVd/ context, English uses a glottal fricative /h/, and Polish has a velar /x/ (Jassem, 2003). This fact can cause some difficulties in vowels comparison because of the possibility that consonantal effects might persist throughout the whole vowel portion, its target included (Fox & Jacewicz, 2009). The target /bVt/ words were then embedded in carrier sentences *I said /bVt/ this time* in English, *Ich sag' /bVt/ diesmal* in German and *Mówię /bVt/ teraz* in Polish, in a non-final position. This position was preferred because previous research has shown that there exists a significant influence of utterance final positions on spectral properties of different sounds (e.g. Cho, 2004, reported in Rojczyk, 2010a). The sentences were presented not only in an orthographic form, but also in phonemic transcription in order to avoid confusion how to pronounce given words. It was possible as the informants had been taught IPA phonemic transcription during their English and German practical phonetics and phonology/pronunciation courses. The

sentences were presented to the study participants on the computer screen. Although only six vowels were analysed in this study, also other vowels were recorded from each speaker for future research purposes. Also sentences containing other contexts were recorded. First of all, they acted as distracters in this study. Moreover, they were recorded for further research purposes. The use of distracting sentences guaranteed that informants did not realise which vowels were actually examined by the researcher. The sentences were presented to subjects on a computer screen as a Power Point presentation and the produced chunks were stored in a notebook's memory as .wav files ready for inspection. The Praat 5.3.12 speech-analysis software package (Boersma, 2001) was used to record and scroll through the audio files in order to locate an onset and offset of target vowels, measure the F1 and F2 frequencies and plot vowels on the plane. Frequencies of F1 and F2 were measured at vowel mid-point, where the moment of formant movement is minimal, so as to avoid transition movement from and to the neighbouring consonants.

It was supposed that L3 vowels could be affected by L2 sounds as a result of “foreign language effect”.

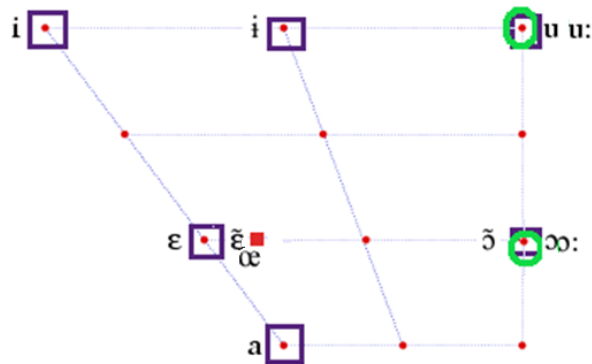


Figure 1. Polish vowels (marked as purple squares) with overlaid English /u:/ and /ɔ:/ (green circles), and German /œ/ (red square).

5. Results

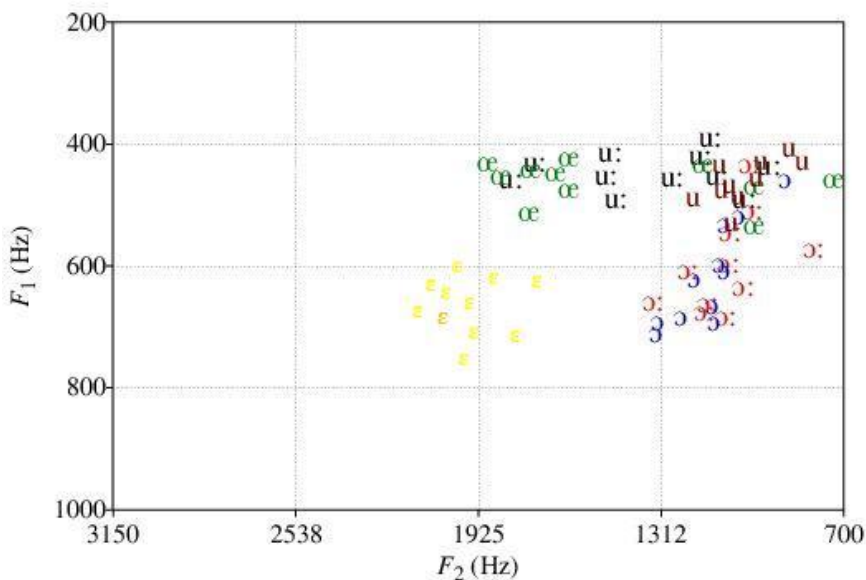


Figure 2. The obtained results: P /u/s (brown), P /ɔ/s (blue), P /ɛ/s (yellow), E /u/s (black), E /ɔ/s (red) and G /œ/s (green).

The scatter plot above presents the results obtained by the study participants. As can be easily noticed, they showed that the analysed vowel categories merged completely. While subjects' German /œ/ should be close to Polish /ɛ/, its F1 values were much too low causing the vowel to be too close and sharing the vowel space with Polish /u/ and English /u:/, as well as, in some cases, with Polish /ɔ/ and English /ɔ:/. It suggests that the influence of the study participants' both L1 (Polish) and L2 (English) persists in their L3 (German) production. German /œ/ is frequently reported as "similar" to Polish /u/ and English /u:/ which, as expected by Flege's Speech Learning Model (Flege, 1995), hinders forming a new, L3 vowel category. In some cases G /œ/ shared the vowel space with Polish /ɔ/ and English /ɔ:/ which might have been caused by the influence of the orthographic form (words containing German /œ/ are usually spelled with "ö"). What was significant was the fact that none of the subjects was able to separate this vowel from L1 and L2 categories and that in all cases the F1 values were too low. Nobody placed German /œ/ in the area closer to Polish /ɛ/ which would be the "correct" space on the vowel plane.

6. Conclusions

This study gives a new insight into the developing area of third language phonology by assessing production of L3 vowels in comparison to L1 and L2 segments. The multilingual subjects encountered difficulties in separating L1, L2 and L3 categories and, as expected by SLM (Flege, 1995), German /œ/ being perceived as “similar” to Polish /u/ and English /u:/ was almost completely subsumed into those L1 and L2 categories. In some cases it merged with English /ɔ:/ and Polish /ɔ/. The obtained results may be regarded as an effect of impaired perception suggesting a kind of “similarity” between “new” and “old” categories, spelling form (in the case of merging of G /œ/, E /ɔ:/ and Polish /ɔ/ categories) and insufficient phonetic training. Although the subjects had completed university courses in English and German pronunciation, they all agreed that it was the first formal pronunciation training in their lives, and they had been learning English for mean 11 years and German for mean 6 years. And as numerous studies proved, phonetic training is actually absent in foreign language classes (e.g. Szpyra-Kozłowska, Frankiewicz, & Gonet, 2002; Szpyra-Kozłowska, 2008; Wrembel, 2002) and the situation of L3 phonetic training is in an even worse condition (Czajka & Lipińska, 2013).

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