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Palatalization of consonants in Polish before /i/ and /j/

1. Introduction

The main aim of this paper is to measure the degree of consonantal palatalization in Polish in two phonetic contexts: before the close front vowel /i/ and before the approximant /j/. Even though palatalization is assumed to take place in the relevant language in both of these positions, it has been reported that consonants preceding /j/ may undergo this process in a less regular way and to a smaller extent.

In order to complete the task the author has decided to perform acoustic measurements of the pronunciation of just one Polish segment – the lateral /l/ – in the two phonetic environments. This particular consonant is especially suited for the experiment because of its well-defined formant structure. The articulation of /l/ before /i/ and /j/ has been tested on a number of carefully selected Polish words and measured acoustically. The statistical summary of the results provides a clear-cut answer to the initial question.

2. Language change as a result of social interaction

Janet Holmes observes that "language varies in three major ways which are interestingly interrelated – over time, in physical space, and socially. Language change – variation over time – has its origins in spatial (or regional) and social variation. The source of change over time is always current variation" (2008: 205). In other words, differences between regional and social variants constitute the basis for diachronic changes in languages. The changes spread through a community simultaneously from style to style and from group to group. For instance, a particular age, religious, social or regional group may use a given element in a formal style. Later, the element may spread to a less formal style of that group and simultaneously to the most formal style of another group.

After a number cycles of this type the change may become complete and the old form is entirely replaced by the new one in the speech of all groups and in all styles. It is interesting to note that the direction of the influence is frequently from less to more prestige forms. Such a tendency is also observable in the process of borrowing or interference from a foreign language. Frequently, an

"importing culture" modifies its linguistic structure toward that what is present in a "superior culture" (cf. Foley 2004).

It is frequently assumed that linguistic changes spread through the social networks of individuals. Separate language users act as a kind of bridge for the spread of new language elements from one group to the other. Such "linguistic innovators" are usually marginal members of the groups and for a given linguistic form to be adopted by core members it "needs to be transmitted through a number of different links or bridges" (Holmes 2008: 225).

It is a logical conclusion to infer that whenever two groups are not connected through a sufficient number of individuals who act as "link-persons", linguistic influence is not potentially observable. Limited contact is the main cause of the emergence of dissimilar dialects and, eventually, separate languages.

Palatalization is an interesting example of a linguistic element which behaves in a different way in a number of Slavic languages. Irena Sawicka (1995) notes that at the last stages of the Proto-Slavic language, the presence of palatality in pairs /CV/ depended upon the value of the consonant and not the vowel. Since then the general tendency has been to depalatalize consonants, but the process has unfolded to a different degree in different Slavic languages. Sawicka mentions that, for example, in Russian the palatalization of the /t/ and /d/ preceding the high front vowel is much stronger than in Polish. In Serbo-Croatian, on the other hand, the pronunciation of such consonants in the position in question seems to be comparable to the one found in English, where palatalization does not take place. Therefore, Polish constitutes an interesting example of a language in which changes in the way that palatality functions are most probably in progress and the acoustic analysis presented in this paper should shed more light on this problem.

3. Consonantal palatalization in Polish

In present-day Polish palatalization may take place in the following three contexts:

(1) When a consonant directly precedes /i/,
(2) When a consonant directly precedes /j/,
(3) When a consonant directly precedes another palatal consonant.

The first context is the most obvious. The palatalization of a consonant preceding /i/ is obligatory in Polish. The second case, however, is more problematic. First of all, it should be stressed that such a context automatically presupposes the articulation of /j/ in, for example, *biały* ('white'), *wieś* ('village'), *fioletowy* ('purple') or *pióro* ('feather'). Although this approach has been

adopted in most of the modern literature on Polish phonetics, in older publications the interpretation of such words was different. Namely, labial palatalized consonants were treated as independent phonemes and the glide /j/ was not marked in phonemic transcription. Such an interpretation stemmed from the fact that /i/ and /ɨ/ were treated as one functional unit in Polish (cf. Rocławski 1984).

Consequently, labial palatalized consonants had to be treated as phonemes, since they were in parallel distribution with their non-palatal counterparts (cf. Szober 1957, Benni 1959, Bartnicka-Dąbrowska 1968, Wierzchowska 1967, 1980, Jaworski 1986). The very existence of /j/ in such words was, therefore, inessential. Nowadays, however, in many Polish dialects, including standard Polish, the articulatory distinction between /i/ and /ɨ/ is clear and the distribution of the discussed consonants is predictable. They are always palatalized when followed by /i/ and always non-palatal when followed by /ɨ/.

Moreover, by accepting that in words such as the ones cited above we are dealing with an approximant following a palatalized consonant we may add an additional rule that consonants are also palatalized if they are followed by /j/. In this way one considerably reduces the size of the Polish phoneme inventory. All the labial palatalized consonants are in complementary distribution with their non-palatal counterparts and should be treated as allophones of the latter.

All in all, in words with a palatalized labial consonant followed by a vowel other than /i/ one assumes the articulation of /j/. By analogy, the same presumption is made for other similar cases. It is accepted, for instance, that the pronunciation of the words *lis* ('fox'), *lias* ('lias') and *las* ('forrest') is [ʎis], [lʲjas] and [las], respectively.

The third context in which palatalization takes place in Polish is disputable. The opinion that consonants are palatalized if they are followed by other palatal consonants was frequently expressed by Zdzisław Stieber (1966). Many other authors, such as Maria Steffen-Batogowa (1975), Bożena Wierzchowska (1967, 1971) or Irena Sawicka (1995), state that in most cases the process in this context is only optional. In order to aptly summarize this particular case more research needs to be done.

It is worth noting that palatalization in Polish may also take place in connected speech on the border between two words. Again, this is most likely to happen when the second word begins with /i/, relatively less frequently when it starts with /j/ and still less commonly when it begins with a palatal consonant.

4. Gradability of palatality

From an articulatory perspective palatality is a gradable feature. In Polish phonetic literature at least two levels at which consonants may be palatalized are suggested. Authors, such as Maria Dłuska (1983), Janusz Strutyński (1987),

Irena Sawicka (1995), and Marek Wiśniewski (1997), draw an essential distinction between the terms *palatalny* (‘palatal’) and *palatalizowany* (‘palatalized’). The former refers to consonants for which the palatal region is the only place of articulation. Such segments do not have direct non-palatal counterparts.

On the other hand, in the case of “palatalized” consonants the palatal area plays the role of an additional, secondary place of articulation and such segments have their primary place of articulation located somewhere else. They also have direct non-palatal counterparts. Such a division suggests that some consonants, or their phonetic realizations in particular contexts, may be interpreted as “more palatal” than others.

Indeed, one may encounter many more expressions suggesting such a hierarchy. Sawicka (1995) also makes use of the terms *lekkie zmiękczenie* (‘light palalalization’), *półmiękkość* (‘semi-palatality’), *lekka palatalizacja* (‘light palatalization’), *zmiękczenie częściowe* (‘partial palatalization’), all of which are contrasted with *zmiękczenie pełne* (‘full palatalization’). Similarly, Stieber (1966) and Steffen-Batogowa (1975) discuss *warianty miękkie* (‘palatal variants’) or *w pełni miękkie* (‘fully palatal’) and *warianty półmiękkie* (‘semi-palatal variants’). Bronisław Rocławski (1984), on the other hand, suggests that in purely articulatory terms we may distinguish as many as three levels of palatality.

It is worth observing that the assumption that palatality is gradable is frequently reflected in narrow transcription. A common example of this are the different representations of the allophones of /l/ – the palatal [ʎ] and the palatalized [lʲ]. Their distribution depends either on the individual habits of the speaker (Sawicka 1995) or the phonetic context (Dłuska 1983). Similarly, Steffen-Batogowa (1975) suggests the symbols [ǵ ḱ] for the palatalized allophones of the velar plosives /k g/ preceding [i], [ɨ], [e] or [j], and [g’ k’] for the “semi-palatal” allophones of /k g/ preceding [l’] or [ń].

The degree of palatality depends on the phonetic context. It is frequently assumed that consonants are palatalized to the highest degree when they precede /i/. The opinions concerning the position before /j/, however, are divided. Authors such as Strutyński (1987) or Wiśniewski (1997) state that consonantal palatalization in Polish takes place before /i/ and /j/ without discussing any potential differences as to the degree to which the process takes place in the two environments.

Still, Dłuska (1983) assumes that the palatalization before /i/ is stronger than before /j/ and Sawicka (1995) discusses some cases exemplifying such an assumption. For instance, /l/ and /r/ may be palatalized to a smaller degree before /j/ than /i/. The third context – before another palatal consonant – seems the most doubtful. As mentioned above, palatalization is here only optional and its degree may be in such cases relatively low. Sawicka states: “It is difficult to

assess to what degree and how regularly palatalization takes place in the above contexts" (1995: 149, my translation, Ł.S.). Similarly, palatalization in connected speech on the border between two words may also be weaker. Sawicka mentions in this case *półmiękkie warianty* ('semi-palatal variants') and stresses that the process is never obligatory in such an environment.

5. Limiting the scope of investigation

The remaining part of this paper will concentrate on the degree of palatalization of /l/ preceding /i/ and /j/. The reason for narrowing the scope of the investigation to only this case is that an in-depth examination of the palatalization of all Polish consonants in all six possible environments would be too broad for the current publication.

The phoneme /l/ seems to be a perfect candidate for an initial acoustic investigation of consonantal palatalization in Polish. It is particularly often described as having "fully palatal" realization [ʎ] (especially preceding /i/) and partially palatalized [l^{j}] (in some other contexts).

Even though the degree to which this particular consonant happens to be palatalized has never been properly investigated, some authors assume that variance within the degree of the tongue height is distinctly possible in this case. Additionally, the consonant has a well-defined formant structure, which makes it particularly appropriate for the experiment. As explained in the section below, the level of palatality may be measured on the basis of the height of the first two formants.

6. Acoustic characteristics of [l], [l^{j}] and [ʎ]

The formant values of the basic allophone of the Polish /l/ are suggested, for example, in Kosiel (1970), Jassem (1973) and Szczepankowski (1985). The proposed results for F1 and F2 are summarized below:

	F1	F2
Kosiel	300–450 Hz	1550–1750 Hz
Jassem	350–400 Hz	1750–1950 Hz
Szczepankowski	350–400 Hz	1600–1800 Hz

It is worth mentioning that the lateral articulation of /l/ involves an antiformant between F2 and F3 (cf. Kosiel 1970, Kent et al. 1992, Dukiewicz 1995, Pickett 1999, Johnson 2003). Consequently, the amplitude around this area is comparatively low. On the other hand, Wiktor Jassem (1973) proposes that the

antiformant for the Polish /l/ is situated much higher than this. His results indicate that it is actually between F4 and F5.

As far as the acoustic characteristics of the palatalized versions of /l/ are concerned, one should mention Bogdan Szczepankowski's (1985: 40) observation that in many palatalized consonants in Polish, F2 is higher than in their non-palatal counterparts. This opinion is also valid for the allophones of /l/ examined in this paper. Jassem (1973), for instance, discusses the raising of the second formant to 2200 Hz for [lʲ] and to 2400 Hz for [ʎ]. The results presented in various publications by Wierzchowska also indicate this tendency. The values of F2 for [lʲ] she proposes are 2300 Hz (1967), 2500 Hz (1980) and 2500–3000 Hz (1971).

On the whole, the second formant is the main acoustic element which may be used in measuring the degree of palatality. Additionally, one may also take into account the height of F1, since it is commonly associated with vertical tongue movements (cf. Stevens et al. 1953, Rocławski 1976, Kent et al. 1992, Dukiewicz 1995) and palatalization, by definition, involves raising the tongue towards the palate.

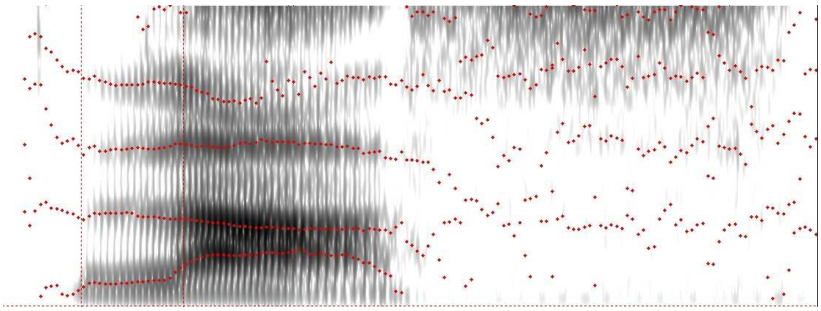

Figure 1: [l] in [las]; mean F1 = 424 Hz, mean F2 = 1497 Hz

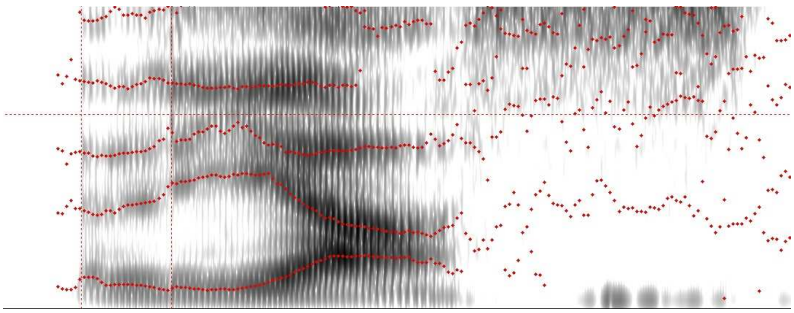

Figure 2: [lʲ] in [lʲas]; mean F1 = 386 Hz, mean F2 = 1684 Hz

In the initial experiment presented in this section the acoustic value of [l], [l^{j}] and [ʎ] was tested on the basis of the author's pronunciation of the words *las* ('forest'), *lias* ('lias') and *lis* ('fox'). In the spectrograms of the three examples the initial element is in each case separated from the rest of the utterance by dotted lines and the mean values of its first two formants are presented below in the respective Figures. It is easily observable that, as expected, F2 is the lowest for [l] (Figure 1), slightly higher for [l^{j}] (Figure 2), and the highest for [ʎ] (Figure 3). Moreover, the F1 in the three cases is also positioned as predicted. It is the highest for [l], slightly lower for [l^{j}] and the lowest for [ʎ].

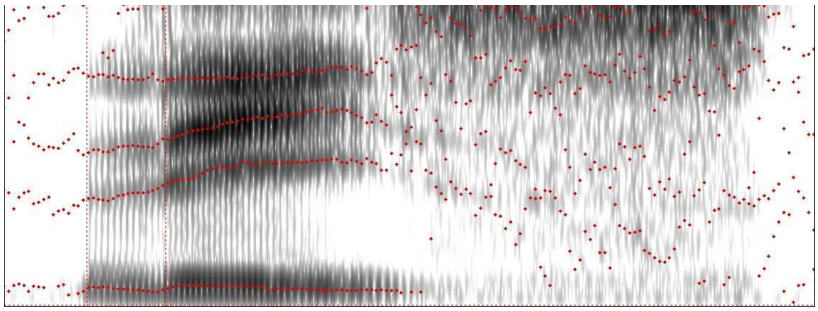

Figure 3: [ʎ] in [ʎis]; mean F1 = 271 Hz, mean F2 = 1836 Hz

Even though the above results substantiate the claim that the palatalization of /l/ in Polish is gradable, further research needs to be conducted. The fact that the speaker knows precisely which element of pronunciation is being investigated may bias the results. Furthermore, in order to draw reliable conclusions more than three examples need to be examined.

7. Designing the experiment

As stated in the introduction, the major aim of this paper is to measure the degree of palatalization of /l/ in Polish before /i/ and /j/. The parameter which is to be estimated are the mean values of F1 and F2 in the pronunciation of the lateral approximant followed by /i/, /j/ and vowels other than /i/. In order to obtain unbiased results the informants have not been informed of what is being investigated. The instruction they were given was just to read into a microphone the examples listed below (in the version presented to the respondents the words had been mixed randomly).

(For "/l/ + vowel other than /i/, excluding /ɨ/")
(1) *latawiec* 'kite',
(2) *lodowiec* 'glacier',
(3) *lemur* 'lemur',

(4) *lubić* (to like',

(For "/l/ + /j/")
(5) *liany* 'lianas',
(6) *liofilizacja* 'lyophilization',
(7) *lielynazaura* 'Leaellynasaura',
(8) *Liuwa* (the name of a king of the Visigoths living in 6th century,)

(For "/l/ + /i/")
(9) *lina* 'rope,)
(10) *liść* 'leaf',
(11) *lis* 'fox',
(12) *lizak* 'lollipop'.

The context "/l/ + vowel other than /i/" was tested on four examples because there were four possible vowels to choose from.[1] Even though palatalization should not take place in any of these words, and the experiment could have been carried out on just one of them, it seemed necessary to choose a larger number of examples. Moreover, the different levels of the tongue height and advancement in the articulation of the four vowels should have an influence on the pronunciation of /l/ and its formant structure, which is an additional interesting element to measure.

The second context "/l/ + /j/", involving the alleged "weak" palatalization, could also have been tested on just one example. Indeed, one may argue that it would even be preferable, since words beginning with /l/ followed by /j/ are extremely uncommon in Polish. Still, in order to obtain reliable results more than one example was chosen.

A possible solution to this problem could have been to select words with the intended phoneme combinations internally rather than at the beginning. This would lead, however, to an even greater obstacle. Any vowels preceding /l/ would influence its pronunciation and the measurements would not be accurate. For this reason, the author found words beginning with /l/ + /j/ + one of the four vowels in the words considered in the first set, but most of them are very rare.

The last four examples were easy to find. The combination "/l/ + /i/" is common in Polish.

The sample involved 10 men and 10 women aged 20 to 24 who are native speakers of Polish. They all come from the region around Kielce in Poland.

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[1] In phonemic terms, there are six vowels in Polish: /i/, /ɨ/, /a/, /o/, /e/ and /u/. The first two had to be excluded – /i/ was separately tested in the last group of words involving "strong" palatalization and /ɨ/ does not usually appear after /l/.

8. The problem of segmentation

During analysis of the gathered data the major problem which immediately arose was the segmentation of speech. In some cases the decision on where exactly /l/ ends and the next phoneme begins was easy. In a number of examples one could observe a very short but distinct burst of air at the end of /l/ (cf. Figure 4).

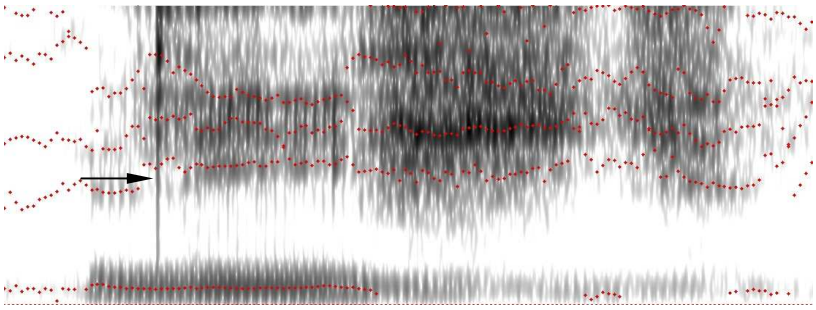


Figure 4: An example of the "weak plosion" in the final stage of /l/ in [ʌiɕt͡ɕ]

Such a weak plosion is the result of the tongue releasing its contact with the alveolar ridge (cf. Wierzchowska 1980, Szczepankowski 1985, Pickett 1999). In other cases the border was established on the basis of the reduction of the acoustic energy between /l/ and the next segment, which was clearly visible in many oscillograms (cf. Figure 5).

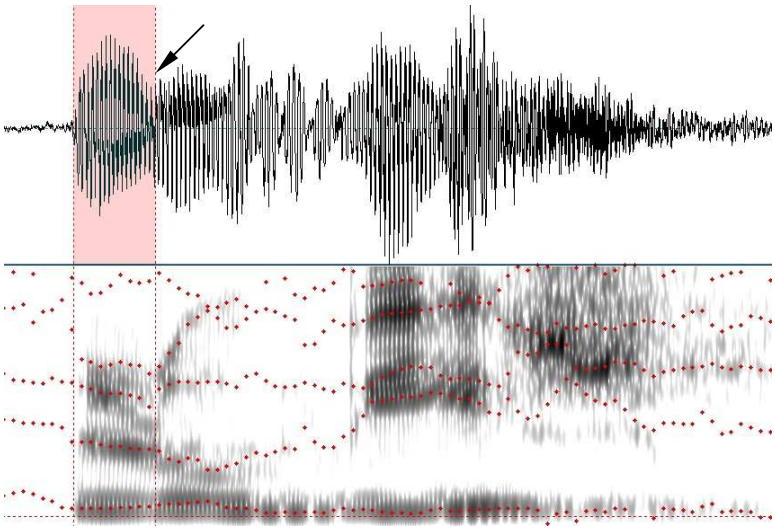


Figure 5: An example of the reduction of the acoustic energy between /l/ and a following vowel in [lubʲiʃ]

Additionally, in some recordings one could observe a visible enhancement of the acoustic energy for vowels following the lateral approximant (cf. Figure 6). Still, in some cases the decision where to place the boundary was made on the basis of auditory sensations. In such problematic cases it was the middle of the format transition which was most frequently chosen.

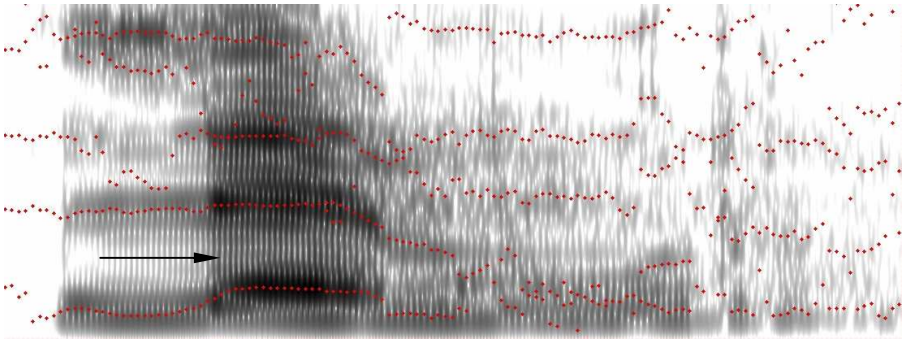


Figure 6: An example of the enhancement of the acoustic energy for vowels following /l/ in [lɛmur]

9. Results

As mentioned before, each example selected for the experiment was tested on 20 native speakers of Polish. Each articulation of /l/ in the examples was analyzed in terms of the mean value of the first and second formant and the results were recorded.

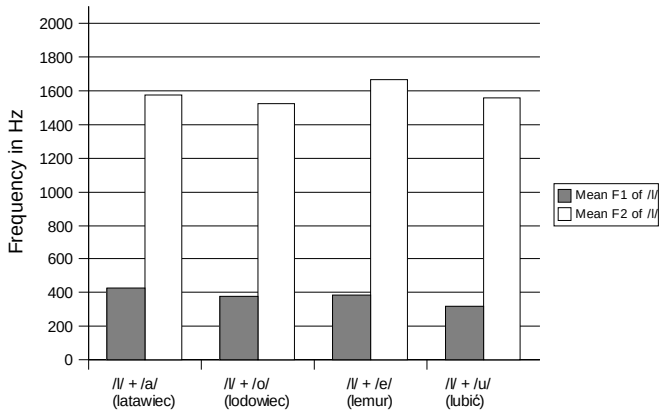
On the basis of the obtained data the mean values of F1 and F2 of /l/ for each example were calculated. These averages are presented in Diagram 1 (for individual words with "/l/ + vowels other than /i/ and /ɨ/"), Diagram 2 (for individual words with "/l/ + /j/") and Diagram 3 (for individual words with "/l/ + /i/").

Additionally, the average values of F1 and F2 for all of the examples representing a given phonetic context are provided beside each diagram. They are also directly compared in Diagram 4.

It should be noted that ten of the participants are male and the other ten are female; consequently, the variability in the individual scores obtained for each example is much smaller within these two groups than the variability of the results for each example in general. This is due to the fact that the relative height of F1 and F2 depends directly on the height of F0, which is usually significantly higher for women than for men.

The differences between the mean results for F1 and F2 in Diagram 1 correspond to what was expected. In *latawiec*, where /l/ is followed by /a/, F1 is rela-

tively high in comparison to the average values of F1 obtained for the other three words. This reflects the open articulation of the vowel. The value of F2, on the other hand, is average, because on the horizontal articulatory scale /a/ is a central vowel. In *lodowiec* the mean height of F1 for /l/ is average and F2 is relatively low, reflecting the mid-open, back articulation of /o/.



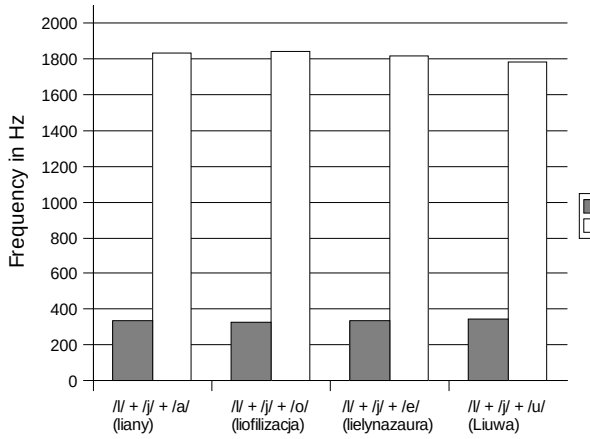
Mean for "/l/ + vowels other than /i/ (and /ɨ/)"

F1	F2
377 Hz	1584 Hz

Diagram 1. Mean F1 and F2 for individual words with "/l/ + vowels other than /i/ (and /ɨ/)"

Similarly, the average value of F1 and high F2 in *lemur* mirrors the mid-open, front pronunciation of /e/, and the low values of both F1 and F2 in *lubisz* reflect the close, back articulation of /u/. The mean results for all of the examples representing the first context analyzed, provided beside Diagram 1, confirm that the articulation of /l/ involves here a lower and less advanced position of the tongue than in the case of the examples given for the other two contexts. In comparison to the mean results cited next to Diagram 2 and 3, here F1 is clearly the highest and F2 the lowest.

There is not much variability in the mean values of F1 and F2 of the four examples in Diagram 2. The immediate conclusion one might draw from this observation is that the articulatory influence of vowels following /j/ does not reach /l/. The only noticeable dissimilarity concerns the slightly higher F1 and lower F2 of /l/ in *Liuwa*. The fact that the lateral approximant happens to be less palatalized in this example than in the other three may be due to the problems some of the participants had in reading this word. *Liuwa* is a very rare proper name, and most of the participants encountered it for the first time. This is probably why some of them had to try two or even three times before they pronounced the word correctly. The problems with articulation of this example are also visible in the prolonged articulation of /l/ – on average it lasted more than one second, which is much longer than in the case of the other three words.

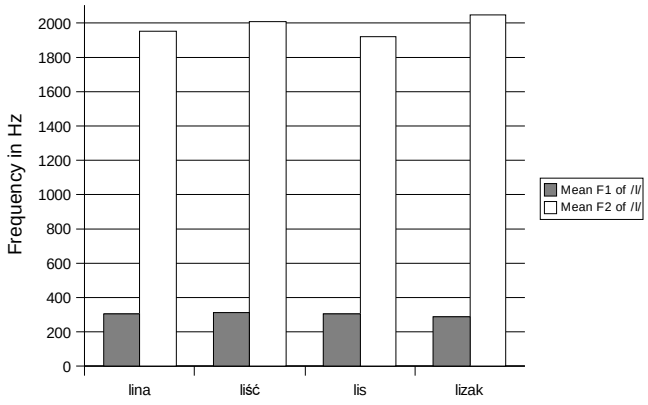


Mean for "/l/ + /j/"

F1	F2
337 Hz	1820 Hz

Diagram 2. Mean F1 and F2 for individual words with "/l/ + /j/"

The mean results for the examples representing the second context, provided beside Diagram 2, clearly indicate that the position of the tongue is here higher and more advanced than in the previous case. F1, which on average amounts to 337 Hz, is 40 Hz lower than the corresponding results for the first context. Moreover, the value of F2 is 236 Hz higher than the average result obtained in the previous case.



Mean for "/l/ + /i/"

F1	F2
302 Hz	1980 Hz

Diagram 3. Mean F1 and F2 for individual words with "/l/ + /i/"

The variability in the mean results presented in Diagram 3 is also low. Only in the case of *lizak* is a slightly lower F1 and higher F2 noticeable, suggesting that /l/ is more palatalized in this word than in the other examples from this group. On the whole, the mean values of F1 and F2 for all the examples representing the context "/l/ + /i/", summarized beside Diagram 3, prove that pala-

talization tends to be stronger here than in the previous case. F1 is, on average, 35 Hz lower than in the result obtained for "/l/ + /j/", and F2 is 160 Hz higher.

In Diagram 4, the average results for the three analyzed contexts are compared directly. It is clearly visible that the value of F1 is the highest in the first phonetic context, lower in the second and the lowest in the third. Conversely, F2 is the lowest in the first, higher in the second and the highest in the third.

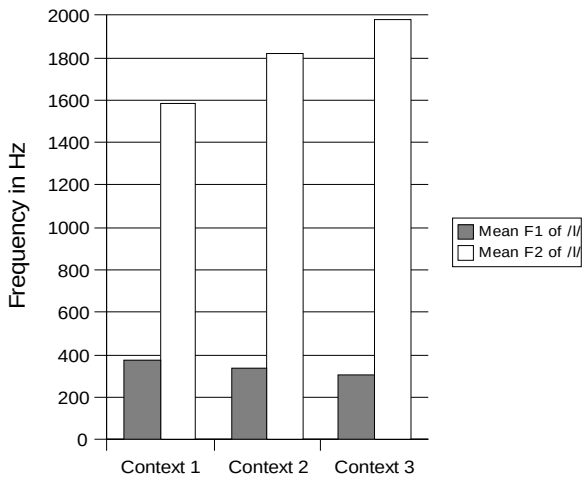


Diagram 4. Mean F1 and F2 of /l/ in the three analyzed contexts

It should be emphasized, however, that what has been shown in this paper is only a tendency for palatalization to be stronger when a consonant is followed by /i/ than by /j/, and not an absolute rule. In fact, one may find numerous examples in which the value of (one of) the analyzed formants contradicts the established tendency. For instance, the articulation of /l/ by participant number 1 in the word *liofilizacja* involves a lower F1 than in *lis*. The results are 314 Hz and 324 Hz, respectively. Moreover, in his articulation of *liść* both of the two formants have values which, when compared to the results for *liofilizacja*, contradict the general rule. In the former example F1 amounts to 337 Hz and F2 to 1621 Hz, while in the latter the mean value of F1 is 314 Hz and F2 is 1684 Hz. Similar inconsistencies may also be found in the case of the data on the bases of which Diagrams 2 and 3 were prepared. For example, the value of F1 in the pronunciation of /l/ by participant number 3 in *Liuwa* (351 Hz) is higher than in *lubisz* (313 Hz). Additionally, in the same participant's articulation of *lemur* and *lielynazaura* the values of both formants are opposite to that which would be expected. The F1 for /l/ in *lemur* amounts to 289 Hz and F2 to 1679 Hz, while the values of the formants in *lielynazaura* are 324 Hz and 1525 Hz, respec-

tively. Such cases substantiate the aforementioned claim that consonantal palatalization before /j/ tends to be not only weaker, but also less regular than before /i/.

10. Conclusion

The results obtained in the experiment described in this paper confirm the null hypothesis. From an articulatory point of view palatalization of the Polish /l/ is gradable – it tends to be stronger before /i/ than before /j/.

Nevertheless, there are issues connected with the current project which need to be further investigated. For instance, it seems necessary to measure the "amount" of palatality in consonants other than /l/ in the two phonetic contexts dealt with above. The lateral approximant has been chosen as the perfect candidate for this initial examination, but, in order to get a broader perspective on the way that palatalization functions in Polish, other possible cases should also be analyzed. Additionally, other phonetic contexts in which palatalization occurs in Polish also deserve further examination. It would be useful to find out to what degree the process takes place across word boundaries in connected speech. Finally, there are many other issues connected with the palatality in Polish which could be examined from the acoustic point of view, e.g., the average length and formant structure of /j/ following palatalized consonants in comparison to /j/ in other contexts.

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