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PLOSIVES OF THE GERMAN DIALECTS IN WESTERN HUNGARY

1. INTRODUCTION

The subject of this study is the Eastern-Danubian-Bavarian / Eastern-Middle-Bavarian dialect, which is spoken in a competent way by considerable groups of the German minority in Western Hungary. This paper is a study of the most important acoustic parameters of the plosives in the Eastern-Danubian-Bavarian German dialect in Western Hungary. In the acoustic modelling the following parameters are taken into account, which all have great importance in the perceptive processing of sound structures: 1. time structure, 2. voice onset time, 3. frequency and intensity of the acoustic components. The comparative analysis concentrates on the acoustic form of the plosives only. Although principally voice onset time belongs to time structure, it was analysed as a separate parameter, as it is an important factor in the classification of plosives, above all in cases of voiced/voiceless opposition (Gósy 2000).

At the description of the peculiarity of the plosives it seems to be necessary to take into account all three components for determination: the articulation and the acoustic and auditory factors. This was suggested also in Kohler's description (1995: 59):

> "Hierbei spielt einerseits ein höherer bzw. geringerer intraoraler Druck während der Verschlußbildung eine Rolle, der sich seinerseits in eine größere oder geringere Schallintensität im Moment der Verschlußlösung und damit im Einsetzen des nachfolgenden Vokals abbildet. Über solche Parameterschwankungen wird dem Hörer eine auditive Differenzierung zwischen den phonetischen Kategorien signalisiert."

The experiments and examinations in the last decades have showed this development clearly, although there is still deficiency in the question about the real function of the process of perception (cf. Schubiger 1977: 139). On the basis of these considerations it became clear that first of all the perception of the plosives depends strongly on the context. For a better classification other acoustic parameters will have to be taken into consideration, such as the change of the first formant of the following vowel or the peculiarities of aspiration noises related to the aspirated plosives or the lengths of the succeeding vowel (cf. Gósy 2000: 196). In case of all the languages and varieties that were not examined in this way, the additional parameters which have a supplementary role in making the perception possible will have to be determined.

By the classification of the plosives in the German language in general and in Bavarian in particular it has to be taken into account that the usual distinctive features (e. g. voiceless/voiced, aspirated/not aspirated) or the distinction on different levels between fortes and lenes, extreme marks are not sufficient for the characterisation of sound types. In this paper the results recorded in previous studies are supplemented with the acoustic values of the plosives of the German dialects in Western Hungary in an empirical way.

2. Methods

The subject of this study is the pronunciation of competent speakers of the Eastern-Danubian-Bavarian dialect in Western Hungary. In the selection of test persons the following considerations had to be made. As competent speakers in the researched areas are mainly to be found among the older and oldest generation, all test persons are from these age groups. In 12 locations there was one male speaker, consequently both the number and the acceptable territorial deviation supported the scientific relevance and reliability of the results. There were isolated words spoken into the microphone, from which the researched plosives were isolated. The test persons produced the words from their memories, always two-three units at a time, one after the other. They were spoken at a normal speed of speech, but one must not ignore the fact that generally the isolated words were produced at a lower speed than in spontaneous speech (cf. *Figure 1*). In the selected words the plosives were determined as initial, medial and final sounds. As initial sounds they were in a CV-position, as medial sounds in a voiced environment (that means in a VCV-position or among a vocal and a nasal sound) and as final sounds in a VC-position. All words consisted of one or two syllables and in the most cases the first one was accented. An examination of the realisation of the sound types in a spontaneous speech was not considered, especially because there were no data available for comparison, as the research of spontaneous speech in Hungary has advanced only in the past years (cf. Gósy 1998).

	Isolated (Phon/s)	Spontaneous (Phon/s)
Brennberg	3,53	9,97
Kroisbach	4,87	7,54
Agendorf	3,89	7,30
Ragendorf	3,65	8,89
Wieselburg	4,40	9,19
Sankt Peter	4,72	10,15
Schwabendorf	3,87	8,84
Pernau	4,60	8,62
Sankt Gotthard	5,05	8,99
Raabfidisch	4,15	10,54
Unterzemming	5,47	8,10
Ödenburg	4,82	9,50

Figure 1: Average speech speed of the test persons

The material of the research was examined with the help of the speech signal analysis program CSL (Computerised Speech Laboratory, Serial Number 4300B). The recorded and digitalised acoustic signals were examined with the help of oscillograms and spectrograms with different resolutions. The values of time structure were determined in the following way: we distinguished a closure phase and an offset phase of plosives. Since only the plosive [k] and in a few cases the plosive [t] show regularly signs of aspiration, we do not define a different phase for aspiration. Voice onset time was determined by measuring the time between the moment of the offset of closure and the first signs of voicing in oscillograms and spectrograms. We did not take into account at the average of the VOT the cases in medial position with a full voiced closure phase. The values of frequency and intensity of the acoustic components deliver data about the moment of the offset of closure. We measured the most important frequency components at this moment as well as their intensity.

The summarised calculations of the average of the parameters include accordingly at each plosive 36, respectively 24 specifications, depending on whether there were two or three phonetic positions examined, since closure phase was not determined in initial position. The number of the examined elements made it possible to make even a statistic evaluation of the data about the acoustic parameters of the German dialect in Hungary. This was done with the help of the software Microsoft Excel. The question to answer was whether the deviations in the case of the parameters of the bilabial, dental and velar plosives are statistically significant appearances, in a dimension of $p < 0,05$.

In a next step the evaluated acoustic values of the plosives of the Eastern-Danubian-Bavarian German dialect in Hungary are compared with the corresponding plosives of the Hungarian language by confrontative-contrastive methods. The comparison of the acoustic values of the plosives is supposed to give a first view about the differences and similarities concerning the parameters of the segments, which can give some orientation for the characterisation of this set of problems.

With regard to the Hungarian values from this analysis there is an initial picture to expect: how does the sound type "plosive" behave among the competent speakers of the German dialect in Western Hungary from the old and oldest generation? Are there any signs of interference or is this situation the comparative basis between the younger generations for studies to be done later on? The acoustic values of the corresponding sound types of the Hungarian language are taken from the study made by Olaszy (1989) "Elektronikus beszédelőállítás".

3. Results of the acoustic analysis

When it comes to the problems of the voiced-voiceless opposition, the following tendencies can be established. The moment of the offset of closure is according to the examined acoustic manifestations to be regarded as voiceless, with all plosive variants of the Eastern-Danubian-Bavarian German dialect in Hungary. In medial position we find a voiced realisation, though this does not appear regularly, whereas in the offset phase in the case of the [b̥, d̥, g̥] types one can sometimes detect tracks of voiced sounds; but with regard to the auditory and acoustic relevance of these appearances there are further examinations needed. The corresponding Hungarian plosives stand for the voiced [b, d, g] in general, which represents an important difference.

Plosive	Average	Spread
p	82,24	21-127
t	72,74	29-146
k	112,79	50-182
b	67,55	23-127
d	34,46	10-92
g	34,68	5-84

Figure 2: Average and spread time of the closure phase of plosives[1]

The plosive type [k] stands out from all other types for the longest closure phase. The overall average values are at 113 ms. As it is shown in *Figure 2*, this is followed by [p] with a value of ca. 82 ms and [k] with a value of ca. 73 ms. There is a relatively large spread of values at all of the plosive types, but this is partly in relation to the different phonetic positions. The plosive [b̥] with an average closure phase of ca. 68 ms stands out for a considerably longer closure phase compared with [d̥] and [g̥] which show a length of 35 ms. The spread is considerable among these plosives as well, especially in the case of [b̥], which is almost identical with the corresponding values of [p].

The comparison in *Figure 3* shows that in opposition to the closure phase there is a clear-cut tendency: [p, t, k] show always higher closure phase values than [b̥, d̥, g̥]. In the case of bilabial plosives this difference is about 14 ms, at the dental plosives ca. 39 ms and

1 Here it should be pointed out, that in the illustrations and tables for the plosives [p, t, k] in general the characters p, t, k and for the plosives [b̥, d̥, g̥] respectively in case of the Hungarian language [b, d, g] the characters b, d, g were used because of the graphic configuration options.

at the velar plosives ca. 78 ms. This means that the rows bilabial-dental-velar represent a similarly increasing difference with regard to the length of the closure phase. On the basis of the statistic evaluation related to these parameters no significant deviations in the comparison of bilabial, dental and velar plosives could be observed. In the case of [t], [k] and [g̊] there were significant differences registered between the values of the initial and the final sounds of the corresponding plosives.

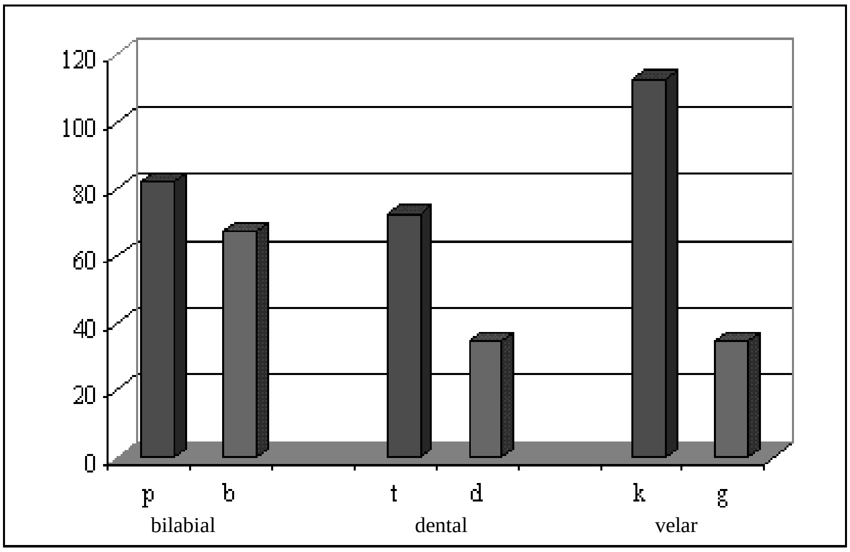

Figure 3: Time of the closure phase of the bilabial, dental and velar plosives

On average one finds the longest offset phase in the case of [k], as shown in *Figure 4*. [t] and [g̊] show almost the same average values: 62 – 63 ms. These are followed by [b̥] with ca. 59 ms, and [d̥] with ca. 53 ms and [p] with ca. 43 ms. At the evaluation of the spread pattern it is important that these move within the same frames related to [b̥, d̥, g̊], while in case of [k] and [t]very high maximal values can be mentioned.

Plosive	Average	Spread
p	42,75	11-139
t	62,44	5-235
k	80,75	7-286
b	58,61	11-179
d	53,22	6-175
g	62,64	8-176

Figure 4: Average and spread time of the offset phase of plosives

The comparisons of the overall average values in *Figure 5* show that with [t] and [d̥], respectively [k] and [g̥], the latter items represent mostly lower offset phase values.

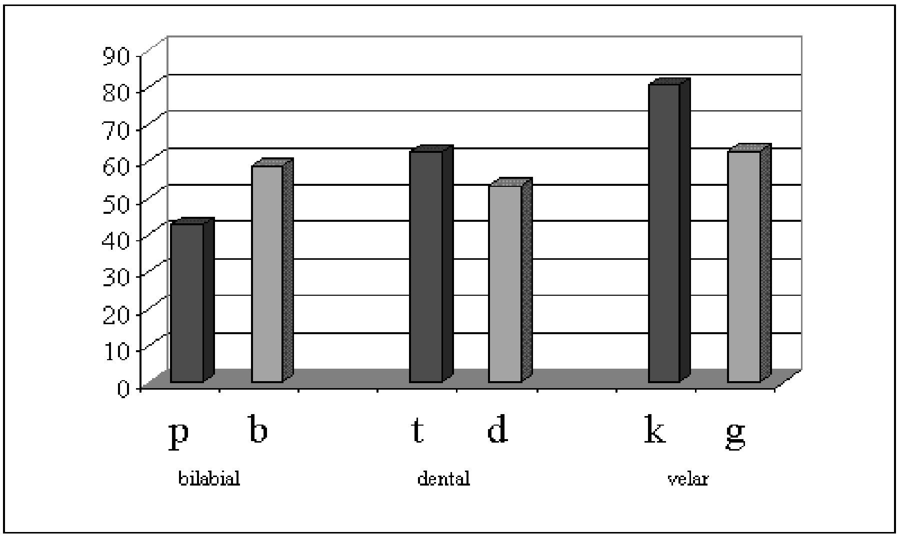

Figure 5: Time of the offset phase of the bilabial, dental and velar plosives

In the first case the difference of the values is ca. 11 ms, in the second case ca. 18 ms. Again, the clearest difference is to be found in the case of the velar plosives. In the case of [p] and [b̥] the average value of [b̥] is about 16 ms higher. In comparison to the closure phase, though, the differences of this parameter are smaller.

Plosive	Average	Spread
p	148,38	60-240
t	160,94	100-233
k	193,75	88-409
b	141,08	45-263
d	102,54	21-238
g	105,79	26-250

Figure 6: Average and spread time of the specific length of plosives

Figure 6 shows the average values of the specific lengths of formation of the examined plosives. The comparatively smallest values one finds among the [d̥] and [g̥]: 103 ms and 106 ms. The plosive [b̥] stands out for an almost identical value with the [p], between 141 ms and 148 ms, so the difference is tiny in this case.

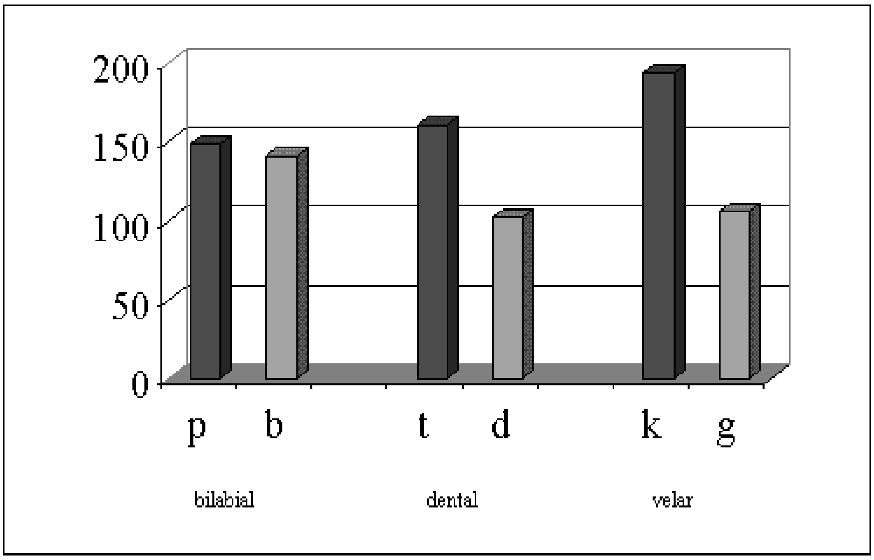

Figure 7: Time of the specific length of the bilabial, dental and velar plosives

The [t] (161 ms) and [k] (194 ms) plosives represent the highest values in this diagram. Looking at the spread of the individual values, the overall tendency is that in case of the [b̥, d̥, g̥]-types these are particularly large, but the value of [k] (409 ms) is extremely high even in this comparison. The smallest spread is represented by [t]: with values between 100 and 233 ms. *Figure 7* shows a tendency once again, which supports the previous results: among the bilabial plosives the difference is very small (ca. 7 ms), among the dentals considerably higher (ca. 60 ms), while among the velars extremely high (ca. 89 ms).

With regard to these parameters the statistic evaluation also showed no significant deviations in the comparison of bilabial, dental and velar plosives. The registered data in the different phonetic positions showed significant differences in the case of [p] between the values of the initial and final sounds, in the case of [k] between the initial and medial, respectively between the medial and final sounds. In the case of [d̥] as well, significant differences were measured between the values of initial and medial sounds, whereas in the case of [g̥] between the initial and medial, respectively between the initial and final sounds. On the basis of the statistic evaluation only in the comparison [k] vs. [g̥] was a significant deviation observed. Considering the different phonetic positions, in the case of [p] a significant difference was identified between the values of the medial and final sounds.

The presentation of the time structure was concluded with the analysis of the percental distribution of the formation phases in comparison with the specific length of the formation (cf. *Figure 8*). Even though in the case of the bilabial plosives the difference with regard to the specific length of formation is (ca. 7 ms), the percental relation is clear: the corresponding value in the case of [b̥] is ca. 19 % higher in comparison with [p]. The smallest difference are found at the dental plosives ([t] – 53 %; [d̥] – 66 %), while in case of velars it turns out to be higher: the [k] has a lower value by 21 % in comparison with [g̊].

Plosive	Total	Offset phase	%
p	148,38	52,50	35 %
t	160,94	84,54	53 %
k	193,75	85,13	44 %
b	141,08	76,63	54 %
d	102,54	68,08	66 %
g	105,79	69,25	65 %

Figure 8: Time structure: specific length vs. offset phase

As a summery about the time structure we can maintain that on the basis of the data with regard to the time structure the peculiarity of the individual plosives was apparent above all in the case of velars and dentals. On the basis of time structure the opposition of the bilabial [p] and [b̥] plosives was the most difficult to determine. If we take a close look at the individual data, it is important that the length of the closure phase shows the biggest deviations, whereas the offset phase shows no obvious auditory relevance at the definition of [p, t, k] and [b̥, d̥, g̊]. If the entire specific length of formation is examined, even here we get a clear picture only about the dentals and velars with regard to the peculiarity and the options for definition of the plosives. The internal time structures on the other hand show also in the case of bilabials characteristic features.

In *Figure 9* there are the average data with regard to the VOT-values of the individual plosives listed, supplemented by data about their spread. The high value in the case of is [k] (52 ms), striking, where apparently the aspiration plays a role, which appears often. At the same time the [g̊] with the ca. 34 ms shows a high value in comparison to other plosive variants as well. The lowest value is to be found in the case of [d̥] with ca. 17 ms, all other plosives show a value around 20 ms.

Plosive	Average	Spread
p	22,58	8-39
t	20,05	6-41
k	52,08	18-98
b	20,40	10-29
d	16,50	3-33
g	34,38	7-115

Figure 9: Voice onset time: average and spread

Figure 10 shows the comparison of the [p, t, k]- and [b̥, d̥, g̥]-types. Most striking is the tendency that the difference is the smallest (ca. 2 ms) in the case of the bilabial plosives. It is somewhat higher (ca. 10 ms) in the case of the dental plosives and the clearest difference (ca. 18 ms) is to be found in the case of the velar plosives. The statistic evaluations of the VOT-values show significant deviations only in the comparison [k] vs. [g̥].

The specificity of the VOT-values was that even though it was possible to determine the specific values (cf. *Figures 9* and *10*), their function in opposition could not be proved. The differences were much too small and their auditory importance is questionable. It is remarkable, however, that these tendencies contradict the findings of Henton/Ladefoged/Maddieson (1992: 79), which were regarded as universal, and according to which the more in front the place of articulation is located, the shorter the VOT-values will appear. It is similar in Hungarian (cf. Gósy 2000: 197), where there are no significant differences in the case of the bilabials and dentals, but the values of the German dialect show even in the case of bilabials higher VOT-values. It supports the hypothesis that the VOT-values show language specific features.

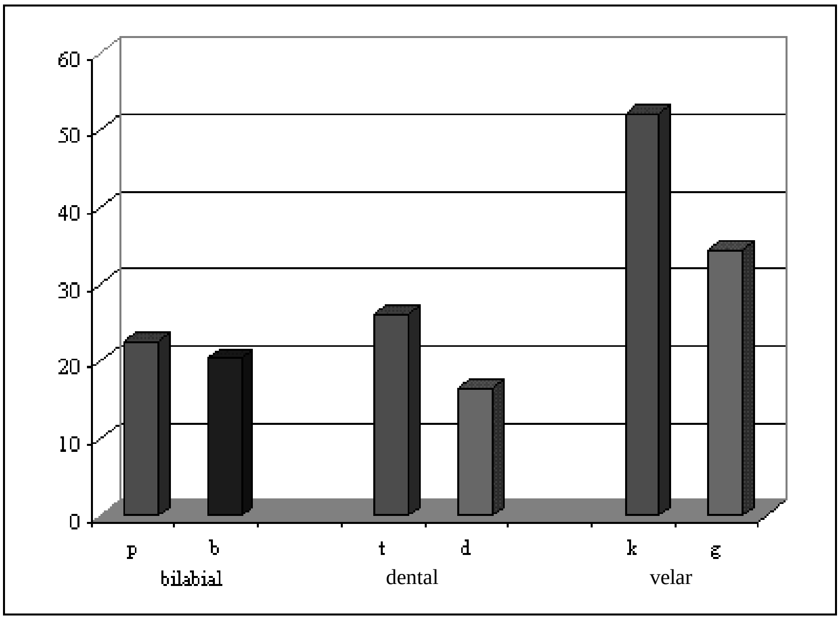

Figure 10: Voice onset time: bilabial, dental and velar plosives

The data with regard to frequency and intensity suggest (cf. *Figure 11*) that even though the plosives show a specific spectral distribution of the components, but especially in the case of bilabials the opposition is possible between [p] and [b̥] on the basis of this parameter. This is also supported by the results of the statistic evaluation of the significance of the specific differences.

p	init.	med.	fin.	Average
comp.	617	2456	2000	**1691**
int.	5	-8	-9	**-4**
comp..	3808	4280	5143	**4410**
int.	-6	-1	1	**-2**
comp.	6275	6755	6780	**6603**
int.	-12	-10	-12	**-11**

b	init.	med.	fin.	Average
comp.	3482	3100	2850	**3144**
int.	-8	-11	-7	**-9**
comp.	5510	5314	5000	**5275**
int.	-11	-13	-7	**-10**
comp.	7745	7643	7040	**7476**
int.	-13	-12	-2	**-9**

t	init.	med.	fin.	Average
comp.	3508	2758	3633	**3300**
int.	1	-16	8	**-3**
comp..	6267	5138	5942	**5782**
int.	-5	-15	13	**-2**
comp.	8550	6708	7625	**7628**
int.	-10	-15	12	**-4**

d	init.	med.	fin.	Average
comp.	3655	2542	2850	**3015**
int.	0	-5	-7	**-4**
comp.	5558	5617	5775	**5650**
int.	2	-5	2	**-1**
comp.	7156	7813	7529	**7499**
int.	-4	-10	3	**-4**

k	init.	med.	fin.	Average
comp.	1692	1945	1310	**1649**
int.	10	12	5	**9**
comp.	4525	4767	4400	**4564**
int.	12	10	4	**9**
comp.	7264	7427	7109	**7267**
int.	9	11	1	**7**

g	init.	med.	fin.	Average
comp.	1989	2973	1700	**2221**
int.	6	-8	5	**1**
comp.	4608	5692	4320	**4873**
int.	6	-12	2	**-1**
comp.	7355	7713	6844	**7304**
int.	2	-16	0	**-5**

Figure 11: Frequency (Hz) and intensity (dB) of acoustic components

5. German dialect vs. Hungarian

The comparison of the plosives of the Eastern-Danubian-Bavarian dialects in Western Hungary with the Hungarian language is done according to the same pattern. As a first parameter in *Figure 12* the closure phase of the examined language forms is shown. In the case of the [p]-types is a small difference between the measured values, the difference is 8 ms, the values of the Hungarian Standard language are higher. So in the cases of the [b/b̥]-, [d/d̥]- and [g/g̥]-types (27 ms, 36 ms resp. 45 ms), here is the difference relativly higher. Only in the case of the [k]- and [t]-types it was possible to measure a 13 ms resp. 8 ms higher value of the German dialect.

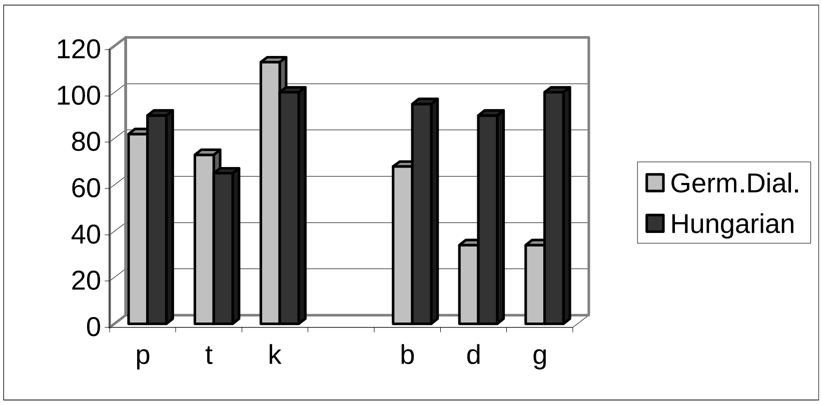

Figure 12: Time of the closure phase of plosives in Hungarian and in the German dialect

The length of the offset phase is always considerably higher in the case of the plosives in the German dialect in comparison with the Hungarian variants (cf. *Figure 13*). In Hungarian the values of the velar plosives with regard to the offset phase reach about 50 % of the corresponding values of the plosives in the German dialect, although the individual data in the case of the [k]-types are higher. The [t]-types show a similar relation: the Hungarian value in this case is about 60 % and the absolute values are close to the ones of the [g/g̥]-types. The [p]-, [b/b̥]- and [d/d̥]-types stand out for the biggest differences (33 ms, 44 resp. 44 ms also), where the specific values of the [p]-types (Hungarian: 10 ms – dialect: 43 ms) are the lowest.

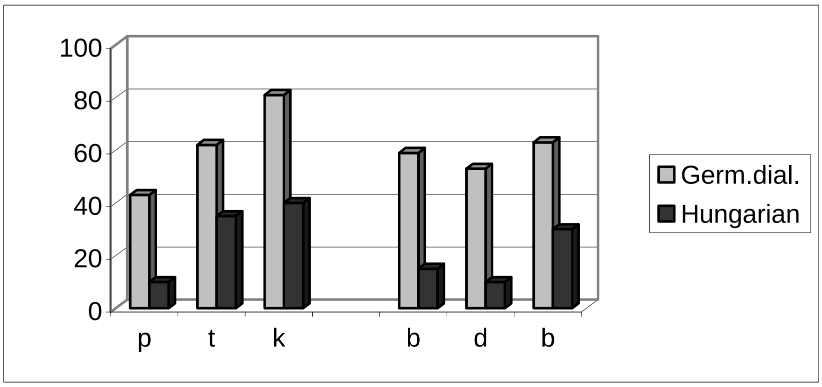

Figure 13: Time of the offset phase of plosives in Hungarian and in the German dialect

The comparison of the time structure is concluded with the data about the specific overall length of the formation. On the basis of the information given in *Figure 14* it can be stated that the plosives of the German dialect have a higher specific length of formation in comparison with the Hungarian variants (about 50-60 ms), with the exception of the [g/g̥]-

types, where no relevant deviations could be measured. The smallest difference is at the [d/d̥]-types (2-3 ms), but here is the time structure not the same. In the case of the plosives [b] and [b̥] shows the plosive of the German dialect a higher value (31 ms).

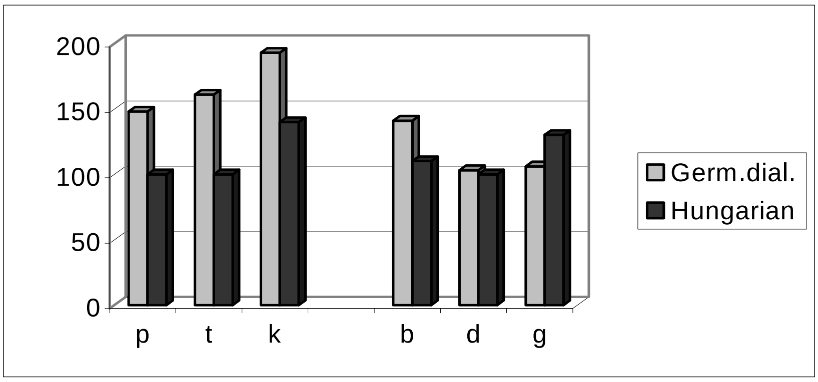

Figure 14: Time of the specific length of plosives in Hungarian and in the German dialect

Figure 15 shows the data about the frequency components in comparison. In case of the [p]-types the first component represents a relatively small difference (Hungarian: 1500 Hz – dialect: 1700 Hz), but the other components stand out for a specific spectral distribution. This applies for all plosives with the exception of the [k]-types. In the case of the [k]-types the difference with regard to the first components is similar to the one at the [p]-types (Hungarian: 1400 Hz – dialect: 1600 Hz), although here even the second component lies in the range of 4500 Hz. In the case of the [b/b̥, d/d̥, g/g̥]-types it is striking that the Hungarian plosives have a first intensive component in a quite low frequency range ([b] ca. 350, [d] 250 and [g] 300 Hz).

	Germ.dial.	Hungarian
p	1691	1500
	4410	2600
	6603	3500
t	3300	1800
	5782	3500
	7628	-
k	1649	1400
	4564	4500
	7267	-

	Germ.dial.	Hungarian
b	3144	350
	5275	1200
	7476	2300
d	3015	250
	5650	1600
	7499	2600
g	2221	300
	4873	1300
	7304	2600

Figure 15: Frequency of acoustic components of plosives in Hungarian and in the German dialect

6. SUMMARY

The above considerations represent the studied and established acoustic peculiarity of the plosives of the Eastern-Danubian-Bavarian dialect in Hungary. The results and their analysis showed that the specific parameters of the time structure in the case of the bilabial plosives allow no clear definition of [p] and [b̥], which is why their perception is probably the most problematic. With the dental and velar plosives on the other hand it was possible to measure specific values, which can make an auditory opposition possible with the limitations mentioned above. The speciality with the VOT-values was that even though it was possible to determine the specific values, their function in opposition could not be proved, because the differences were too small to have auditory relevance. As a conclusion we can formulate one more hypothesis: an acoustic and auditory definition of [p, t, k] and [b̥, d̥, g̥] is possible for the listener, as the specific acoustic parameters enable the perception in a complementary way.

This conclusion can be regarded as the basis for extended research and it supports the thesis that the determined acoustic constituents represent the peculiarity of the plosives of the studied German dialect in Hungary. As mentioned before, the auditory determination of these plosives will still have to be determined by perception tests, while several acoustic manifestations need further analysis as well. Among the competent speakers of the Eastern-Danubian-Bavarian dialect in Hungary in the older generation there were no particular signs of interferences observed in comparison with the Hungarian. Similar acoustic studies with regard to the pronunciation of German speakers in Hungary in other age groups could further determine the phonetic tendencies in the development of the situation of the bilingual speakers of the German minority in Western Hungary. Finally it should be pointed out that similar instrumental phonetic studies on the basis of newly recorded material, but also on the basis of archives of records, can deliver new information about the peculiarity and the development of the German dialects in Hungary.

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