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## THE PERCEPTION OF ENGLISH LENIS PLOSIVE CONSONANTS WORD-FINALLY AND WORD-INITIALLY BY THE POLES

The study endeavours to probe into the perception of English lenis plosive consonants word-initially and word-finally by the Poles without any experience with English either in form of formal classroom teaching or contacts with native speakers. It proceeds from a concise contrastive articulatory and acoustic juxtaposition of Polish and English plosives, grouped into respective phenomena, to the analysis of research data. The research is expected to shed some light upon efficiency of the perception of lenis plosives by the Poles, who utilise the voiced – voiceless rather than fortis – lenis distinction as a functional contrast. Then, more detailed questions are posed concerning the potential influence of neighbouring sounds, such as vowels of front or back quality, on the perception. Finally, certain observed tendencies and regularities are indicated.

The Polish-English contrastive studies abound in works handling the comparison of Polish and English both from the phonological and phonetic point of view. Among the most prominent contributors in the field one can mention Gussman, Rubach, Reszkiewicz, Biedrzycki for a phonological analysis and Jassem, Koczyński, and more recently Sobkowiak for an articulatory and acoustic description. Although the phonological comparison of the two languages is in a constant flux, mainly owing to the introduction of new theories such as Optimality Theory, Government, Dependency, the articulatory and acoustic descriptions remain unquestioned.

Despite a number of comprehensive Polish-English articulatory and acoustic contrastive comparisons, little is known about how in fact the indicated differences can influence perception. In other words, very little data has been obtained so far in terms of verifying all the articulatory and acoustic facts from the perceptual point of view. One can only conjecture about the extent to which such phenomena accompanying English plosives as aspiration, the fortis-lenis distinction, vowel shortening and lengthening before the following fortis or lenis stops can impede or facilitate their perception by the Poles. In order to gain elucidating data it is imperative that

a linguist should conduct the research which will verify each articulatory and acoustic phenomenon in one language (English) from the point of view of its auditory value for hearers of the other language (Polish).

Nowadays the studies of perception are regaining their position in phonetics. Phoneticians are aware of shortcomings of solely articulatory and acoustic descriptions. Each act of communication must include a speaker and a hearer. A felicitous act of communication necessitates both effective phonetic encoding of a message on a speaker's part and effective decoding by a hearer. With at least little acquaintance with contemporary phonetics one can easily see that the third, auditory dimension of sound communication has been for a great part neglected for the sake of the first two; articulation and acoustics. The reason for such scarce data concerning auditory perception seems to be the fact that it is not a domain easily amenable to research. Scientists, despite highly advanced technological devices, are not able to look freely into a human mind and ascertain which processes are operative when a hearer perceives linguistic sounds. Nevertheless, linguists, using speech synthesis devices and comparing different languages, are in a position to collect enough information in order to construct hypotheses and perception models even though some of them seem rather too abstract and unfeasible.

The Polish-English comparative phonetics shows little, if any, interest in an all-out resort to perception as a weighty part of phonetics. Complacent with exact articulatory and acoustic descriptions linguists working in the field appear to disregard this aspect of contrasting. Such an attitude seems unjustified. The Polish-English comparative studies of perception can provide material for the world-wide discussion by means of verifying contrasting articulatory and acoustic phenomena present in both languages from the auditory point of view.

This paper endeavours to follow the contemporary interest in the studies on perception. It strives to assess the perception efficiency of lenis plosive consonants by the Poles who utilise the voiced – voiceless distinction in their native phonetic system.

## General characteristics of plosive consonants

In the taxonomy of consonants a stop is very often classified as a *posture*, viz.; “positioning of the articulators producing a stricture of complete closure” (Abercrombie 1967: 140). Nonetheless, considering stops only in terms of a posture is fairly inadequate since it is much too static a view. According to Abercrombie (1967) a stop involves not only a posture; it involves a movement to that posture and a movement away from it, and the manner in which this posture is taken and subsequently relinquished are supplementary factors which need to be taken into account.

Assuming a slightly different angle, plosives can be perceived as a consonant produced with a breath channel completely closed, and an inevitable period or a phase during which air will be completely enclosed somewhere between the lungs and the lips (Heffner 1964: 118). The lowest point at which a complete closure can be made is at the glottis. The next point is usually the back portion of the velum. From this

point forward the tongue can produce stops against the velum, the palate, or the teeth. Beyond the teeth these are lips to produce a complete stop.

The nature of plosives is best presented by the stages of their production. The stages and their description are largely dependent upon a particular phonetician. Nevertheless, all these models share certain key elements as shall be seen below.

Roach (1991: 30) puts forward the following characteristics:

– One articulator is moved against another, or two articulators are moved against each other, so as to form a stricture that allows no air to escape from the vocal tract. The stricture is, then, total.

– After this stricture has been formed and air has been compressed behind it, it is **released**, that is, air is allowed to escape.

– If the air behind the stricture is still under pressure when the plosive is released, it is probable that the escape of air will produce noise loud enough to be heard. The noise is called **plosion**.

– There may be voicing during part or all of the plosive articulation.

According to Roach (1991), for a complete description of a plosive consonant, the following four phases of its production must be included.

1. The first phase is when the articulator or articulators move to form the stricture for the plosive. It is called the **closure phase**.

2. The second phase is when the compressed air is stopped from escaping. It is called the **hold phase**.

3. The third phase is when the articulators used to form the stricture are moved so as to allow air to escape. This is the **release phase**.

4. The fourth phase is what happens immediately after the phase 3, this is referred to as the **post-release phase**.

In the aforementioned model four stages are discerned. However, not all phoneticians consider them as indispensable. Gimson (1994: 139) propounds only three stages of the plosive production.

1. The **closing stage**, during which the articulating organs move together in order to form the obstruction; in this stage there is often an on-glide or transition audible in a preceding sound segment and visible in an acoustic analysis as a characteristic curve of the formants of the preceding sound.

2. The **compression stage** during which lung action compresses the air behind the closure; this stage may or may not be accompanied by voice, i.e. vibration of the vocal folds.

3. The **release stage**, during which the organs forming obstruction part rapidly, allowing the compressed air to escape rapidly (i.e. with an explosion)

Analysing the two models one can easily notice that a major disparity between them consists in the post-release phase. Roach treats it as a constituent of a plosive production process, whereas Gimson does not seem to consider it as a final element of stops but rather as a part of an oncoming sound.

For a comparison to be comprehensive, it requires that two more models by prominent phoneticians should be introduced. According to Abercrombie (1967: 140) there are also three stages of the stop articulation, namely:



1. the shutting phase, leading to
2. the closure phase, followed by
3. the opening phase

Heffner (1964) conceives of them as follows;

1. the contact
2. the hold
3. the release

Having juxtaposed all the four models, it comes to the fore that only three stages of the production are preferable among phoneticians. Some writers, e.g. Arnold (1996) argue that the last stage should be separated into a 'release' as an articulatory feature which is converse of the 'closure', and a 'plosion', which is an auditory feature.

Each phase is, of course, very brief in duration – a fraction of a second only: the speed at which articulator movements are carried out is very great. The second phase of each model is auditorily the least conspicuous; during it there is either a low murmur, if the stop is voiced, or complete silence if it is not (Abercrombie 1967).

## The comparison of English and Polish plosive consonants

In the Polish-English contrastive phonetics literature plosive consonants are well described and contrasted. In the following section only those aspects will be discussed which might be relevant for the purpose of the study. Consequently, such problems as the phonological status of palatalised plosives and the manner of articulation (i.e. delayed plosion<sup>1</sup>, lateral release, nasal release, no release) will be disregarded, although they are a source of very interesting disparities.

### Place of articulation

a) /p, b/ – both Polish and English /p, b/ are bilabial

b) /t, d/ – in English they are alveolar whereas in Polish /t, d/ are dental, i.e. the blade of the tongue touches the upper teeth.

In English /t, d/, in their allophonic variation, can become dental when preceding dental fricatives (θ, ð) (Gimson 1994, Ladefoged 1975, Roach 1991). Polish allophones of dental /t, d/ can be, conversely, alveolar in words like *trzy*, *potrzeba*, *młodszy*, *podszewka* (Jassem 1973).

c) /k, g/ – If not palatalised, they are velar both in English and Polish.

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<sup>1</sup> I deal with this problem in a great detail in *The perception of delayed plosion in English plosive consonant clusters by the Poles*. The B.A paper submitted to the University of Silesia. – A.R.

## Aspiration

It is a general fact, confirmed by all phoneticians, that the voiceless series /p, t, k/, when initial in an accented syllable, are usually accompanied by aspiration, e.g. *pin, tin, kin*.

The spectrogram in Fig. 1 presents three words *pin, Tim, king*. The release of aspirated stops in each word is marked by a sharp onset of burst of noise that appears as a comparatively random pattern in the upper frequencies. For the /p/ in *pin* this period of aspiration starts at the beginning of the time scale and lasts for about 40 msec. For /t/ it is from about time 800 to time 840; and for /k/ it is from about time 1550 to time 1600

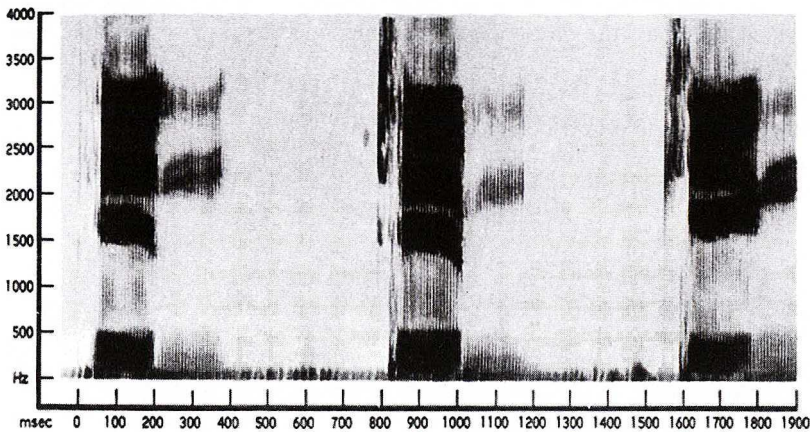


Fig. 1. The spectrogram of *pin, Tim, king* (after Ladefoged 1975: 178)

If a voiceless stop precedes a vowel in an unaccented syllable or is word-finally, such aspiration as may occur is relatively weak (Gimson 1994, O'Connor 1973, Jones 1962, Ladefoged 1975, Jassem 1973).

When approximants /l, r, w, j/ follow /p, t, k/ in an initial accented syllable, the aspiration is manifested in the devoicing of /l, r, w, j/, e.g. *please, pray, try* (Gimson 1994, Jones 1962, Ladefoged 1975, Roach 1991, Jassem 1973).

If voiceless plosives /p, t, k/ follow /s/ within the same syllable, they are unaspirated. They are thus similar to /b, d, g/ although they have no voicing in the compression stage (Gimson 1994, Jones 1962, Ladefoged 1975, Roach 1991, Jassem 1972).

The Polish voiceless stops, contrary to English, are considered to be unaspirated. This phonological fact does not seem to be so obvious phonetically. A detailed spectrographic analysis of Polish plosives reveals elements of aspiration.

[T]he Polish voiceless stops are currently described as 'unaspirated'. However, a distinct aperiodic sequent has been found after the pulse in about 80% of the voiceless stops

(...). The duration of the aperiodic segment ranges from 20 to 100 msec, but as a rule values above 60 msec occur only in /c/ (...). It is probable that if the aperiodic segment following a pulse has a duration of less than 50 msec, the stop consonant is not perceived as 'aspirated.' Jassem (1964: 364)

Wierzchowska (1980) claims that the spectrographic analysis of voiceless plosives in Polish discloses aspiration. Nonetheless, it does not perform contrastive functions in Polish, and is very often not perceived by the Poles.

Dukiewicz and Sawicka (1995) admit the existence of aspirated plosives but only as a very rare allophonic variation and consider such articulation as a feature of strongly emotional speech.

Generally, there is nothing in natural Polish speech that could resemble aspiration. Polish plosives are followed by a vowel without an intervening period of glotal friction. If traces of aspiration can be discerned, it usually means that a strong emphasis is put on a word or the word is accompanied by intense emotions (Sobkowiak 2001).

Fig. 2 shows the spectrograms of unemotional, casual pronunciation of an English syllable /ka:/ and a Polish syllable /ka/. In the left spectrogram one can discern plosion and aspiration within 0,05–0,14 sec. In the right spectrogram there is plosion at 0,06 and no aspiration.

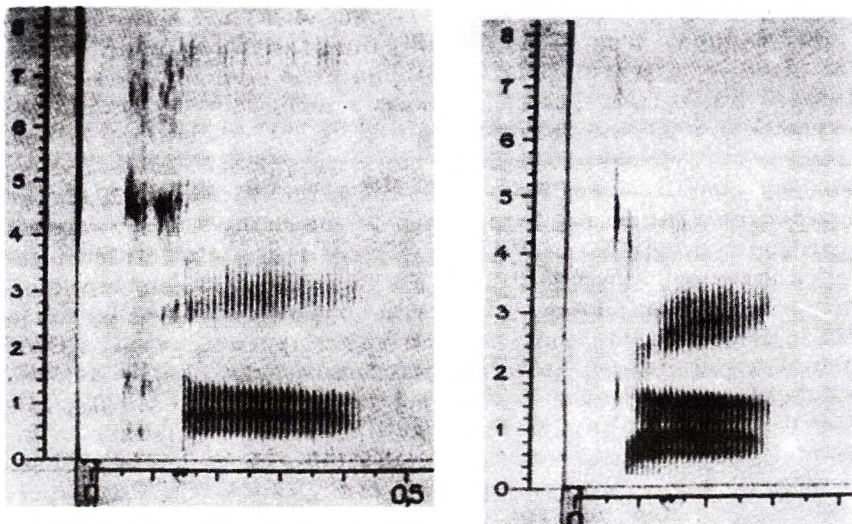


Fig. 2. The spectrograms of an English syllable /ka:/ on the left and a Polish syllable /ka/ on the right (after Jassem 1973: 185)

### Articulatory force

In English, plosives /p, t, k/ are pronounced with more muscular energy and a stronger breath effort than /b, d, g/; that is why the former are known as relatively



strong or fortis whereas the latter as relatively weak or lenis (Gimson 1994). It is very often the case that the difference between /p, t, k/ and /b, d, g/ disappears since voice may be lacking in both. Therefore, it leaves the energy difference, fortis – lenis as a constant. Auditorily this corresponds to strong versus weak sounds, with the addition that the lenis sounds are regularly shorter than the fortis ones. Acoustically the intensity of the burst of the fortis plosives is greater than that of lenis plosives (O'Connor 1973). As a result, it can be stated that in English the relevant difference between /p, t, k/ and /b, d, g/ is not in vocal cord vibration but in the strength of articulation.

In Polish, on the other hand, the essence of this opposition lies in the presence or absence of voicing, that is, vocal cord vibration. It is, however, a universal feature of the articulation of voiced and voiceless sounds that they should differ in relative strength. When articulating voiceless plosives, the whole energy is concentrated upon the articulators engaged in a compression stage. On the contrary, when a voiced plosive is produced, an ample part of energy is absorbed to make the vocal cords vibrate (Dłuska 1986). Therefore, this phenomenon is also present in Polish; however, a brief review of the phonetic literature reveals that in Polish its distinctive value is rather negligible.

Dłuska (1986) writes that the voiced – voiceless distinction is the main one in Polish and the relative difference in strength is minute and hardly observable by the Poles.

Dukiewicz and Sawicka (1995) admit the variation in force of articulation of Polish stop consonants, however, they do not perceive it as a relevant opposition. Interestingly enough, they indicate that the difference in force is the greatest in Polish and Czech compared to all Slavic languages.

Wierzchowska (1980) mentions that voicing is not the only feature differentiating /p, t, k/ from /b, d, g/ but also relative force of articulation. Nonetheless, she does not comment upon its significance in distinguishing /p, t, k/ from /b, d, g/ in Polish.

Jassem (1972) considers force of articulation as relevant in English and redundant in Polish.

Generally speaking, the difference in articulatory strength, which is functional in English in differentiating sequences /p, t, k/ from /b, d, g/, is a subsidiary feature in Polish as compared to the voiced – voiceless opposition. If there are any traces of variation in the strength in Polish, they solely derive from universal physiological nature of articulating plosive consonants and are devoid of any functional role.

### **Length of a preceding sound**

In English when a plosive occurs finally in a syllable, its value is largely determined by the length of the syllable which it closes. It is due to the fact that the voicing factor is not strongly operative. Thus, syllables closed by voiceless consonants are considerably shorter than those which are closed by a voiced consonant. Therefore, words ending with a stop are not distinguished primarily by a difference of the final consonant but rather by quantitative contrasts of preceding sounds (Gimson 1994).

Differences in length of a preceding sound are an especially effective clue in rapid speech. With the high articulatory tempo word-final plosives tend to become similar not only as to voicing but also the strength. In such cases quantitative differences in the preceding vowel can retain the contrast.

Since it is a general articulatory feature that sounds are shorter before voiceless obstruents, this phenomenon is also observed by some phoneticians in Polish, e.g. by Dukiewicz and Sawicka (1995). Still, it does not have any functional role in Polish. The lack of contrastive function largely results from the fact that Polish has only voiceless obstruents word-finally. As a consequence, the length of a vowel in Polish is exempted from the role it has in English, i.e. distinguishing fortis from lenis obstruents (Biedrzycki 1978).

### Length of a plosive consonant

Because a vowel in English is shorter before fortis stops and it is longer before lenis stops, there must be a certain phonetic compensation for this situation. The resulting phenomenon is the variation in length of a final plosive. Word-finally, fortis plosives are longer than the corresponding lenis plosives (Jassem 1972: 80). The shortening effect of /p, t, k/ is the most noticeable when the vowel is one of the long vowels or diphthongs (Roach 1991). Therefore, after Ladefoged (1975) one can generalise about this phenomenon, stating that it is a rule of English that, after a given vowel, syllable final fortis consonants are longer than the corresponding lenis consonants.

The spectrogram in Fig. 3 displays the two words *lend* /lend/ (on the left) and *lent* /lent/ (on the right). One can discern the compression stage of /d/ – 40 msec and /t/ – 110 msec.

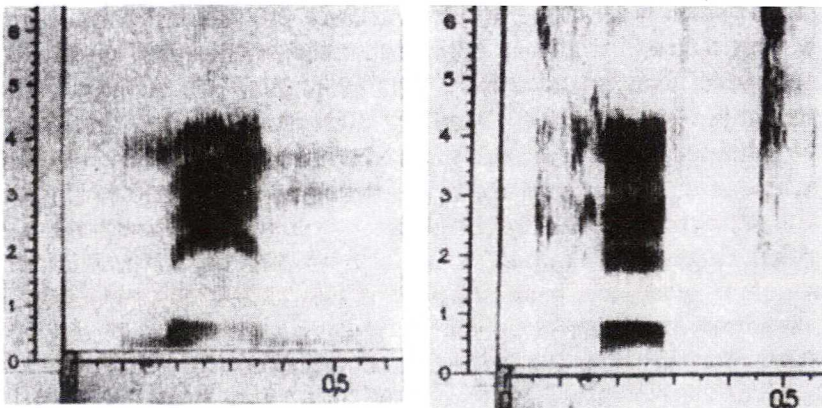


Fig. 3. The spectrogram of the words *lend* and *lent* (after Jassem 1973: 275)



In Polish, since the variation in length of a preceding sound is hardly observable and because syllables are characterised by more stability than the English ones (Jassem 1972), the length of a stop seems to be inconsequential in terms of its perception. It is extremely difficult to find any relevant data concerning the length of a plosive word-finally in Polish, although Wierzchowska (1971, 1980), and Dukiewicz and Sawicka (1995) claim that Polish word-final voiceless plosives tend to be longer than their voiced counterparts. Nonetheless, the phenomenon does not perform any contrastive functions and is claimed to be disregarded by a hearer in Polish.

### The perception of English lenis plosives by the Poles – the research

The objective of the research was to evaluate the perception of English lenis plosives by the Poles without any experience with English either in form of formal classroom teaching or contacts with native speakers.

For the purpose of the study the list of 12 words was drafted, representing the sequences /p, t, k/ and /b, d, g/ both word-finally and word-initially preceded and followed by a front and back vowel. Not all the words were existing morphemes in English, however, they all belonged to the category of potential words in English, i.e. they did not violate the English syllable structure.

#### Word-initially

/b, d, g/ + a front vowel /æ/

ban

dan

gan

/b, d, g/ + a back vowel /ɒ/

bon

don

gone

#### Word-finally

a front vowel /æ/ + /b, d, g/

nab

nad

nag

a back vowel /ɒ/ + /b, d, g/

nob

nod

nog

The above words were subsequently randomly dispersed with words containing fortis /p, t, k/ in the same positions (e.g. *tan, con, knack, not*) and printed as a list for recording.

The list was read and recorded by an educated speaker of British English.

Next, the group of 30 subjects without any experience with English was chosen. They were played the recorded words and asked to fill in the initial or final sound they heard in each word on a prepared research sheet.

All the subjects were presented with the recorded words played from a cassette. Listening conditions were comparable for all the listeners.

The achieved material was analysed only in terms of the voiced – voiceless (lenis – fortis) distinction. That is, if the element was perceived correctly as e.g. voiceless but differed as to the place of articulation (e.g. /p/ for /k/, or /t/ for /p/), still it was classified as a correct response.

## Results and analysis

Fig. 4 presents the juxtaposed results for word-initial /b,d,g/ followed by a front vowel and /b, d, g/ followed by a back vowel.

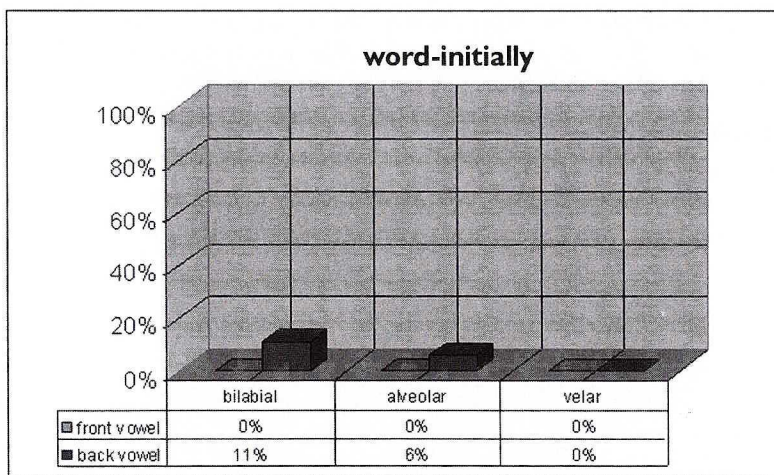


Fig. 4. The results for /b, d, g/ + a front and back vowel

The English lenis plosives before a front vowel are not perceived at all by the Polish. The percentage of recognition for /b, d, g/ followed by a back vowel is 11% for bilabial /b/, 6% for alveolar /d/ and 0% for velar /g/.

Fig. 5 shows the juxtaposed results for /b, d, g/ preceded by a front vowel and /b, d, g/ preceded by a back vowel.

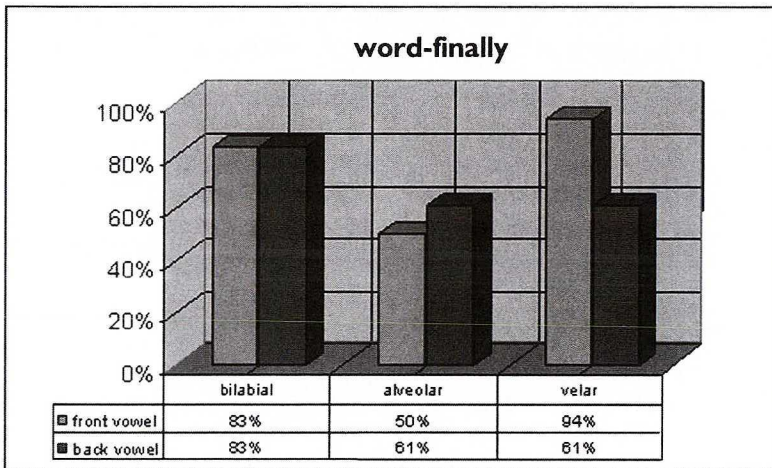


Fig. 5. The results for a front and back vowel + /b, d, g/

The percentage of correct responses for /b, d, g/ preceded by a front vowel amounted to 83% for /b/, 50% for /d/ and 94% for /g/. The correct recognition for a back vowel preceding /b, d, g/ was 83%, 61%, 61% for /b/, /d/, /g/ respectively.

Fig. 5 displays the comparison of overall perception of lenis plosives word-initially and word-finally.

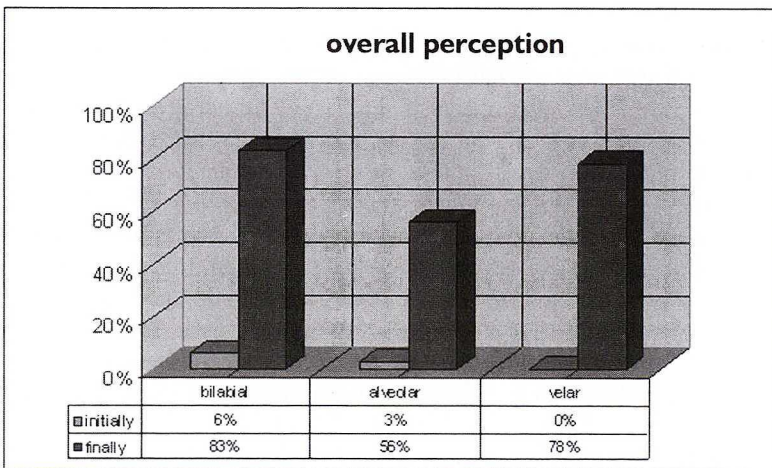


Fig. 6. The overall perception of /b, d, g/ word-initially and word-finally



Initial plosives have very poor recognition; 6%, 3%, and 0% for /b/, /d/, /g/ respectively as compared to final plosives with 83% for /b/, 56% for /d/ and 78% for /g/.

From the above results one can observe the following regularities;

Word-initially

1. The Poles incorrectly perceive virtually all English word-initial lenis plosives as voiceless

2. The following back vowel can very slightly improve the correct perception of initial bilabial /b/ and alveolar /d/

Word-finally

1. The Poles can fairly effectively perceive English lenis plosives word-finally as compared to an initial position

2. Vowel quality does not seem to have any consistent influence on the perception

3. The alveolar /d/ has the poorest recognition in comparison to the bilabial /b/ and velar /g/.

Considering those regularities one can come to the following conclusions;

1. The Poles are not able to utilise the fortis – lenis distinction as a clue to differentiating between the sequences /p, t, k/ and /b, d, g/. Due to their native phonetic system, which employs the voiced – voiceless opposition, they seem to anticipate voicing in /b, d, g/. If they detect little or no vocal cord vibration, which is often the case with word-initial English /b, d, g/, they tend to ascribe voicelessness to English /b, d, g/ despite their weak articulatory force. It is difficult to say if the Poles do not perceive variations in articulatory force altogether. Perhaps, they sense some difference but do not find it to be a relevant, contrasting feature. This problem requires, however, a separate research.

2. The Poles can read, to a certain extent, a preceding vowel length as a clue to distinguishing between word-final fortis /p, t, k/ and lenis /b, d, g/. If the Poles do not employ the fortis-lenis opposition in differentiating between /b, d, g/ and /p, t, k/, which was shown in point 1, so they must utilise quantitative differences in vowels preceding the plosives. This is quite a surprising conclusion since the length of a vowel preceding a plosive consonant is considered to be a subsidiary feature in Polish, devoid of any distinctive function. If it is the case, it is interesting why the Poles can use it fairly effectively in telling lenis /b, d, g/ from fortis /p, t, k/. The rationale might be some kind of a division between primary and secondary features employed in perception. If the Poles are faced with the lack of a primary feature, i.e. the voiced – voiceless opposition, they resort to a secondary feature, that is, the quantity of a preceding sound. This phenomenon, however, necessitates further research.

3. The Poles might be in a position to read the length of a compression stage of the lenis /b, d, g/ in distinguishing them from /p, t, k/. This feature seems to support the vowel length as a clue to differentiating final /b, d, g/ from /p, t, k/ or it might be employed as a tertiary feature when voicing is absent and the vowel length indiscernible. However, it is impossible to evaluate the actual importance of the length

of a plosive in distinguishing English lenis /b, d, g/ by the Poles unless more data are gathered.

4. The vowel quality does not seem to have any consistent influence on the perception neither by impeding or facilitating the recognition.

### The summary comment

The phonetic Polish-English contrastive studies indicate a number of differences between Polish and English plosive consonants. They look into the articulatory dissimilarities as well as investigate their acoustic properties. They denote accompanying phenomena, which are present in one system and lacking in the other. All the comparisons concentrate, however, on the aspect of production. Perception remains for a great part neglected.

This paper shows that contrastive studies from the point of view of auditory perception can enrich knowledge about phonetics of the languages. It proves that articulatory features such as the strength of articulation can impede, to a large extent, the perception of lenis plosives by speakers who employ the voiced – voiceless distinction. It also proves, however, that the same speakers can utilise features such as the length of a sound preceding a plosive or the length of the plosive to differentiate between /p, t, k/ and /b, d, g/ if the voicing distinction is lacking, even though it is absent in their phonetic system from the articulatory and acoustic point of view.

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