

THE PERCEPTION AND IMITATION OF THE BRITISH ENGLISH /θ/ AND /ð/ BY POLISH SPEAKERS

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The pronunciation and auditory discrimination of the British English dental fricative, i.e. the tense /θ/ and its lax counterpart /ð/ cause significant trouble for Polish learners. Since the Polish language does not contain these sounds in its phonological system, the phenomenon of the so-called phonemic under-differentiation takes place. Namely, two phonemes of a foreign language whose equivalents are not distinguished in the native language are confused, as e.g. /θ/ and /s/ in *thin:sin*, /θ/ and /f/ in *thin:Finn*, /θ/ and /t/ in *thin:tin*, /ð/ and /z/ in *bathe:bays*, /ð/ and /v/ in *thine:vine*, or /ð/ and /d/ in *thy:die* (cf. Weinreich (1963:18); Krzeszowski (1970:41) and Kopezyński (1977:15)). Consequently, most Polish speakers when speaking English will substitute closest articulatory and acoustic equivalent of the native language for the phoneme of the foreign language which has no equivalent in the native language. Thus, E. /θ/ — a voiceless dental fricative will be rendered by Poles as either /f/ — a labio-dental fricative, or /s/ — a dental sibilant, or /t/ — a dental stop. Likewise, /ð/ will be rendered by them by the voice counterparts of the above mentioned sounds, i.e. by /v/, /z/ or /d/. There also exists a possibility of /θ/ being substituted by P. /ts/ and /ð/ by P. /dz/ since the places of articulation of the latter approximate the articulation of the E. /θ/ and /ð/ (cf. Kopezyński (1977:76)). We, however, have found very few occurrences of substitutions of the kind in the tests to follow. Nor, as a teacher of English, have we noticed a single substitution of /ts/ for /θ/, although the pronunciation of /dz/ in the place of /ð/ has been infrequently observed. Nevertheless, we assume that (a) /θ/ in *thin* /θin/ can be pronounced by Poles as /f, s, t, ts/; (b) /ð/ in *thy* /ðai/ can be pronounced by Poles as /v, z, d, dz/.

To investigate experimentally which substitutions prevail, we have carried out a number of perceptual and repetition tests with monolingual Polish

speakers. All subjects were fifteen-year-old grammar school students, native speakers of Polish, with no previous knowledge of English. The experimenter deliberately chose this age group, as in the majority of schools in Poland teaching English formally commences in the first grade of the grammar school. The informants had undergone general screening and no speech defects were noticed.

Three tests were constructed with the purpose of investigating the interpretation of English interdental fricatives by native speakers of Polish. In order to obtain information on the perception of these phonemes discrimination and identification tests were designed, the imitation test elicited information on both the perception and production of the sounds.

PERCEPTION

The Discrimination, Identification and Imitation Tests had been prepared according to a model common to them all. Namely, /θ/ Discrimination and Identification Tests utilized the same list of minimal pairs in all the trials, the order of the pairs, however, was changed for each trial. The Discrimination Test consisted of three trials each of which had been recorded by different phoneticians. The same recordings were used in the Identification Test which consisted also of three trials in which the informants transcribed the minimal pairs perceived. In this test, however, an additional procedure was applied, i.e., the second listening to the whole test (three trials) with the purpose of comparing definite segments indicated by the experimenter with respect to their sameness or dissimilarity. The segments which sounded 'foreign' to the students were encircled. The writer considered this procedure to be indispensable as many segments, although rendered by the same value in the transcription, did not 'sound the same' to the subjects. Special answer sheets were prepared and supplied to the subjects, who were the same group throughout all the trials, their number, however, slightly varying in particular trials due to the absence of some members of the group (the experiment was extended over a few days). /ð/ Discrimination and Identification Tests were carried out according to the above-mentioned pattern, the only difference being a change of one phonetician (a different voice) and a comparatively shorter list of minimal pairs in the tests (21 versus 10). The limited number of minimal pairs in the /ð/ test was merely due to the scarceness of contrasts between /ð/ and /v, z, d/, especially in the medial and final positions. We realize that due to the differences in the number of minimal pairs between the /θ/ and /ð/ Perception Tests the comparison of the results may not be satisfactory.

The recorded test lists had been presented to a few native speakers of English and also native speakers of Polish — all phoneticians. They assessed the recordings to be adequate.

DISCRIMINATION TEST

Procedure:

I. /θ/

This test consisted of three trials and was administered to a group of 25 informants. In trials 2 and 3, however, this group was smaller by 4 informants due to their absence. The examples to which the subjects listened had been tape-recorded by three trained phoneticians and teachers of English — two males and a female. The phoneticians were native speakers of Polish since no native R.P. speakers of English were available at the time of the experiment. The subjects were not informed that the examples they were going to listen to were English (they were not familiar with the language anyway).

The test comprised 21 minimal pairs in which /θ/ was contrasted with either the apical stop, the groove sibilant or the labio-dental fricative — the sounds assumed to be most likely confused with the interdental fricative. The distribution of the phonemes was mostly initial prevocalic #_V (13 pairs), 5 pairs were distributed in the #_r context and 3 in the final postvocalic position V_#. Other possible distributions such as initial preconsonantal, medial and final postconsonantal were not examined.

The subjects were instructed to concentrate on the pairs to follow and state whether they were the same or different and mark their answers on the answer sheets. The time spacing between subsequent pairs was eight seconds. The following are the pairs:

(1) bath — buff*	[ba:θ] — [b ^ f]
(2) bus — bath*	[b ^ s] — [ba:θ]
(3) but — bath*	[b ^ t] — [ba:θ]
(4) sin — thin	[sɪn] — [θɪn]
(5) thin — fin	[θɪn] — [fɪn]
(6) tin — thin	[tɪn] — [θɪn]
(7) fresh — thresh	[frɛʃ] — [θrɛʃ]
(8) thug — fug	[θ ^ g] — [f ^ g]
(9) sill — thill	[sɪl] — [θɪl]
(10) thaw — saw	[θo:] — [so:]
(11) thill — fill	[θɪl] — [fɪl]
(12) fill — thill	[fɪl] — [θɪl]
(13) thick — sick	[θɪk] — [sɪk]
(14) tar — thar	[t'a:] — [θa:]
(15) theme — feme	[θi:m] — [fi:m]
(16) through — true	[θru:] — [tru:]
(17) through — true	[θru:] — [tru:]
(18) thinner — sinner	[θɪnə] — [sɪnə]

- (19) tinker — thinker [t'ɪnkə] — [θɪnkə]
 (20) trill — thrill [tri:l] — [θri:l]
 (21) frilling — thrilling [frɪlɪŋ] — [θrɪlɪŋ]

* Note that pairs 1, 2 and 3 are not minimal pairs. However, due to the scarcity of contrasts between /f, s, t/ and /θ/ in the final position, the writer included them in the list. The subjects were instructed to compare the final sounds only in these three pairs.)

Results:

Tables 1, 2, 3, 4 and 5 contain the results of the /θ/ Discrimination Test in numbers and percentages.

	Correct answers	Incorrect answers	TOTAL
Trial 1	371	154	525
Trial 2	330	111	441
Trial 3	363	78	441
Trials 1, 2 and 3	1064	343	1407 ¹

Table 1. Number of correct and incorrect answers given by the subjects in trials 1, 2 and 3 of the /θ/ Discrimination Test.

(Note that the results of the three trials cannot be treated jointly as has been revealed by the appropriate statistical tests applied. This procedure is to be

¹ The tests in this and all other experiments underwent statistical computation in order to establish whether the results from particular trials in an experiment could be treated jointly or not. Our hypothesis was that the means in the trials were equal, i.e. $H_0: \bar{x}_1 = \bar{x}_2 = \bar{x}_3$. This was calculated according to the formula $\delta^2 = \frac{\sum(x_1 - \bar{x}_1)^2 + \sum(x_2 - \bar{x}_2)^2 + \sum(x_3 - \bar{x}_3)^2}{N - k}$ (variations within the groups). The second hypothesis made was that the variations between the groups were equal, i.e. $\delta_1^2 = \delta_2^2 = \delta_3^2$ and so we applied the formula $\delta'^2 = \frac{\sum n_i(\bar{x}_i - \bar{x})^2}{k - 1}$ (cf. Puchalski (1971: 170-173)).

$\left. \begin{matrix} \bar{x}_1 \\ \bar{x}_2 \\ \bar{x}_3 \end{matrix} \right\}$ — mean number of correct answers given by a subject in particular trials.
 \bar{x} — mean number of correct answers given by a subject in trials 1, 2 and 3 treated jointly.

$\left. \begin{matrix} n_1 \\ n_2 \\ n_3 \end{matrix} \right\}$ — number of subjects participating in particular trials.

N — number of subjects participating in all three trials.

k — number of trials.

Since in the /θ/ Discrimination Test $F = 10.90 > F_{0.05} = 3.15$, we cannot treat the results of trials 1, 2 and 3 jointly.

used throughout the paper with reference to all tests. For detailed information on the statistics utilized here see note 1.

	Correct answers	Incorrect answers	TOTAL
Trial 1	71%	29%	100%
Trial 2	75%	25%	100%
Trial 3	82%	18%	100%
Trials 1, 2 and 3	76%	24%	100%

Table 2. The results from Table 1 in percentages.

The mean values of correct answers given by the subjects are presented in numbers and percentages below:

	Mean in numbers	Mean in percentage
Trial 1	14.84	71%
Trial 2	15.71	76%
Trial 3	17.29	81%
Trials 1, 2 and 3	15.89	76%

Table 3. Mean values of correct answers given by the subjects in trials 1, 2 and 3 of the /θ/ Discrimination Test.

In particular contexts, i.e. prevocalic initial, postvocalic final and before /r/ the results are somewhat different from the ones shown in Tables 1, 2 and 3, especially for [θ] distributed finally after a vowel, where the percentage of correct discriminations is very high.

	#_V		TOTAL	#_r		TOTAL	V_#	
	Corr.	Incorr.		Corr.	Incorr.		Corr.	Incorr.
Trial 1	233	117	350	68	32	100	70	5
Trial 2	212	82	294	60	24	84	58	5
Trial 3	238	56	294	67	17	84	58	5
Trials 1, 2, and 3	683	255	938	195	73	268	186	15

	TOTAL
Trial 1	75
Trial 2	63
Trial 3	63
Trials 1, 2 and 3	201

Table 4. Numbers of correct answers given by the subjects in particular context groups.

	#-V		TOTAL	#-r		TOTAL	V-#		TOTAL
	Cor.	Inc.		Cor.	Inc.		Cor.	Inc.	
Trial 1	67%	33%	100%	68%	32%	100%	93%	7%	100%
Trial 2	72%	28%	100%	75%	25%	100%	92%	8%	100%
Trial 3	81%	19%	100%	80%	20%	100%	92%	8%	100%
Trials 1, 2 and 3	73%	27%	100%	73%	27%	100%	93%	7%	100%

Table 5. Percentage of correct answers given by the subjects in particular context groups.

II. /ð/

The /ð/ Discrimination Test was given three times to the same group of 24, 22 and 24 students (again, some persons were absent during the second trial). The principles of administering the tests were the same as in the previous experiment. However, this time the recorded voices of the phoneticians were different — there were one male and two female voices.

The test consisted of 10 minimal pairs in which /ð/ was contrasted with /d/, /z/, and /v/. Again, the distribution of the contrasting phonemes was largely initial prevocalic (7 pairs), in 2 pairs the distribution was medial intervocalic, and in one — final postvocalic. Here is the list of the minimal pairs under investigation:

(1) bays — bathe	[beiz] — [beið]
(2) lesser — leather	[lesə] — [leðə]
(3) die — thy	[dai] — [ðai]
(4) thy — sigh	[ðai] — [sai]
(5) sign — thine	[sain] — [ðain]
(6) vow — thou	[vau] — [ðau]
(7) lather — larder	[la:ðə] — [la:də]
(8) thine — dine	[ðain] — [dain]
(9) these — vs (letters v)	[ðiz] — [vi:z]
(10) vine — thine	[vain] — [ðain]

Results:

The results of the /ð/ Discrimination Test are contained in the Tables 6, 7, 8, 9 and 10.

	Correct discriminations	Incorrect discriminations	TOTAL
Trial 1	169	71	240
Trial 2	164	56	220
Trial 3	191	49	240
Trials 1, 2 and 3	524	176	700*

Table 6. Number of correct and incorrect discriminations given by the subjects in the /ð/ Discrimination test.

* $F_{0.05} = 3.15 < F = 6.00$

	Correct discriminations	Incorrect discriminations	TOTAL
Trial 1	70%	30%	100%
Trial 2	75%	25%	100%
Trial 3	80%	20%	100%
Trials 1, 2 and 3	75%	25%	100%

Table 7. The results from Table 6 in percentages.

Table 8 presents mean values in numbers and percentages of correct answers given by the subjects in particular trials throughout the /ð/ Discrimination Test.

	Mean in numbers	Mean in percentages
Trial 1	7.04	70%
Trial 2	7.5	75%
Trial 3	8.00	80%
Trials 1, 2 and 3	7.5	75%

Table 8. Mean values of correct discriminations given by the subjects in trials 1, 2 and 3.

In context groups results are the following:

	#-V		TOTAL	V-V		TOTAL	V-#		TOTAL
	Cor.	Inc.		Cor.	Inc.		Cor.	Inc.	
Trial 1	106	62	168	39	9	48	24	—	24
Trial 2	101	53	154	41	3	44	21	1	22
Trial 3	122	46	168	45	3	48	23	1	24
Trials 1, 2 and 3	329	161	490	125	13	140	68	2	70

Table 9. Number of correct discriminations given by the subjects in particular context groups.

	#-V		TOTAL	V-V		TOTAL	V-#		TOTAL
	Cor.	Inc.		Cor.	Inc.		Cor.	Inc.	
Trial 1	63%	37%	100%	81%	19%	100%	100%	—	100%
Trial 2	65%	35%	100%	93%	7%	100%	95%	5%	100%
Trial 3	72%	28%	100%	93%	7%	100%	96%	4%	100%
Trials 1, 2 and 3	67%	33%	100%	89%	11%	100%	97%	3%	100%

Table 10. Percentages of correct and incorrect discriminations in particular context groups given by the subjects.

It should be noted that the percentages of the initial position distribution are slightly lower than those of the 'comprehensive' distribution, while the percentages in the medial and final distributions are much higher.

IDENTIFICATION TEST

Procedure:

I. /θ/

This test utilized the same examples and the same recordings as in the Discrimination Test. It was administered three times to a group of 25, 25 and 20 informants respectively (it was the same group of people as in the /θ/ Discrimination Test, however, 5 of them were absent during the last trial). The subjects were instructed to write down the examples according to the norms of the Polish orthography. If, however, they encountered a sound which they considered unfamiliar and did not know how to render, they were told to use an X sign. Time spacing was longer than in the Discrimination Test, i.e., the tape was stopped after each pair and the experimenter made sure that everyone had finished before proceeding to the next pair. In the cases of doubt on the part of the informants, the example was played back again. After the transcriptions had been written the subjects were exposed to another round of listening to the same three tests. They were instructed to compare definite consonants in given pairs, e.g., the two final consonants in *bath* — *bus* or the two initial consonants in *thrilling* — *frilling*, etc., and mark with a circle the 'less Polish' sounding one. This additional procedure allowed the writer to establish more contrasts, e.g. to investigate whether the <f> transcriptions in the minimal pair *thin* — *Finn* (rendered both as <fin — fin>) sounded exactly the same to the listener or if the <s> transcriptions of the final consonants in the pair *bath* — *bus* (both rendered as <bas>) sounded 'Polish' or 'non-Polish'.

Results:

The Polish orthography Identification Test revealed that contrasts between the minimal pairs were noticed by the subjects as follows:

	Contrast	No contrast	TOTAL
Trial 1	483	42	525
Trial 2	491	34	525
Trial 3	339	81	420
Trials 1, 2 and 3	1313	157	1470 ^a

Table 11. Number of contrasts perceived by the subjects in trials 1, 2 and 3.

^a $F_{0.05} = 3.15 < F = 11.61$

	Contrast	No contrast	TOTAL
Trial 1	92%	8%	100%
Trial 2	93%	7%	100%
Trial 3	81%	19%	100%
Trials 1, 2 and 3	89%	11%	100%

Table 12. The results from Table 11 in percentages.

The mean values of contrasts noticed by the subjects are:

	Mean in numbers	TOTAL	Mean in percentages	TOTAL
Trial 1	19.32	21	92%	100%
Trial 2	19.64	21	93%	100%
Trial 3	16.95	21	81%	100%
Trials 1, 2 and 3	18.76	21	89%	100%

Table 13. Mean values in numbers and percentages of contrasts perceived by the subjects in the /θ/ Identification Test.

Presented below are the actual transcriptions of the words containing /θ/ as written by the students in all three trials in the order from most to least frequent (note that the segments perceived as 'non-Polish' have been presented here by bold type):

bath — baX, baf, baaf, baf, bof, bof, paf, paf, poaf, bajf, faf, pof, pof, bat, bat, bot, bas, bak, bek, baw, waw, bag, beg, bel, bałk, bafi, bafr.

thin — fyn, fyn, fin, fym, finy, finy, fyny, fyjn, fym, fen, fen, fXn, fem, fem, fenne, fyX, fynX, fien, fejn, fynk, pfyn, fe, fynf, fynp, sin, syn, sym, tyn, pyn, wpyn, win, wpen, byg, then.

thresh — fresz, fresz, freś, fiesz, fXeś, frysz, fryś, fryś, fryX, freśl, flesz, fleś, fyX, tleś, tleś, tXśc, trleś, wleś, X.

thug — fag, fag, feg, fyg, fXg, fog, folg, fyk, fyk, fyl, fek, faw, faby, fole, fylk, fyrk, gage, fajge, few, few, fajby, fabiy, sag, sag, sajk, salby, salbe, sadX, tab, tag, tage, pang.

thill — fyl, fyll, fil, fil, fyl, fyl, fyll, fiul, feł, feł, feyl, fXl, fyj, feXl, fylk, feul, fyjeł, feo, fyjl, floł, fen, fyn, feX, fyX, syl, sul, pył, pyly, peł, pXy, plu, wel.

thaw — fou, fou, fo, fo, fu, foul, fol, fole, fal, foł, foX, fun, fur, fuk, sou, stoł, po, pol, poł.

thick — fyk, fyk, fyg, fek, sek, sekt, pek, pyk.

thar — fa, fa, fo, fal, fol, foł, fon, sol, soł, sag, salm, tou, to, tor, tolm, too, toX, wol, wau, gał, Xo.

theme — fyjn, fyjn, fyj, fijm, fin, fyjm, fyn, fyin, fejm, fyjne, fini, fining, fiXn, fajbl, sin, sijn, sim, sejn, styjn, stin, pyjn, pym, ping, pejn, penir, tin, X.

thigh — faj, faj, fajn, fal, fale, faly, fany, faji, fajly, fajle, flajn, fancj, falt, faXe, sau, sany, salf, waj.

through — fru, fru, friu, friou, fruł, fu, flu, frył, fou, fau, fil, fiu, fX, fnu, fou, foul, tru, tfu, tlu, toul, plu, X.

thinner — fyna, fyna, fyne, fyny, fena, fyner, fynor, fynen, fyjke, syno, synen, tyne, pfyna.

thinker — finke, finka, finker, fyńke, fynen, fyke, fyjke, fynke, fynker, fynter, fiXe, feka, fyka, fike, fiker, synke, synker, synta, syka, tynke, tynke, tinker, tynker, tynkeX, pynke.

thrill — freł, fyl, fyl, feł, flył, fuł, frXl, freył, fro, frou, flu, flyX, floł, fryj, feul, fyjt, fryX, truł, trXoł, tlył, tuoł, tfruł, trył, tryle, tXoł, czer, czyt, czXl, pył, klył, X.

thrilling — fylyn, fylyng, fylin, filyn, fylyin, fynym, firly, fylyim, frylin, fryryn, fiejn, fiejn, fyjn, fyjm, fyln, fejen, fyl, fil, fryj, fej, fXlin, tlyling, Xejn, Xyn.

A distributional analysis has revealed the following substitutions made by the students:

#-V	<X>	<f>	<f>	<s>	<s>	<t>	<t>	<p>	<p>	<w>	θ
T1	1	184	141	4	5	5	4	—	—	2	1
T2	1	225	45	24	8	9	4	23	2	2	2
T3	20	120	43	71	6	10	2	—	—	—	4
Ts 1, 2, 3	22	529	229	99	19	24	11	23	2	7	7

<e>	<g>	<m>	<d>	<z>	<sz>	TOTAL
—	1	—	1	—	1	350
—	1	—	—	—	—	350
2	—	1	—	1	—	280
2	2	1	1	1	1	980

Table 14. Substitutions of /θ/ in the initial prevocalic position transcribed by the subjects in trials 1, 2 and 3 of the /θ/ Identification Test.

#-r	<X>	<f>	<f>	<t>	<t>	<s>	<s>	<e>	<oz>	<oz>	<p>	<w>	<w>	<k>	<ch>	TOTAL
T1	—	42	53	2	2	—	—	—	—	1	—	—	—	—	—	100
T2	2	46	9	24	7	—	—	3	2	—	3	1	1	1	1	100
T3	6	32	13	2	1	15	4	6	1	—	—	—	—	—	—	80
Ts 1, 2, 3	8	120	75	28	10	15	4	9	3	1	3	1	1	1	1	280

Table 15. Substitutions of /θ/ in the initial position before /r/ transcribed by the subjects in trials 1, 2 and 3 of the /θ/ Identification Test.

In the final postvocalic distribution /θ/ was rendered by the letters:

V-#	<X>	<f>	<f>	<t>	<t>	<w>	<w>	<d>	<d>	<k>	<k>
T1	—	37	27	4	3	2	—	—	—	—	1
T2	5	43	14	4	—	—	—	—	—	2	1
T3	16	10	13	—	—	3	2	6	1	1	—
Ts 1, 2, 3	21	90	54	8	3	5	2	6	1	3	2

<e>	<s>	<s>	<g>	<g>	(l)	<fi/fr>	<n>	TOTAL
—	—	1	—	—	—	—	—	75
—	—	1	1	1	1	2	—	75
5	1	—	—	—	1	—	1	60
5	1	2	1	1	2	2	1	210

Table 16. Substitutions of /θ/ in the final postvocalic positions transcribed by the subjects in trials 1, 2 and 3 of the /θ/ Identification Test.

θ →	<X>	<f>	<f>	<s>	<s>	<t>	<t>	<p>	<p>	<e>	<w>
T1	1	263	221	4	6	11	9	—	—	1	4
T2	8	314	68	24	9	37	12	26	2	5	6
T3	42	162	69	87	10	12	3	—	—	15	3
Ts 1, 2, 3	51	739	358	115	25	60	24	26	2	21	13

<w>	<d>	<d>	<k>	<k>	<g>	<g>	<oz>	<oz>	<e>	<l>
—	1	—	—	1	1	—	—	1	—	—
1	—	—	3	1	2	1	2	—	—	1
2	6	1	1	—	—	—	1	—	2	1
3	7	1	4	2	3	1	3	1	2	1

<fi/fr>	<z>	<sz>	<m>	<n>	<ch>	TOTAL
—	—	1	—	—	—	525
2	—	—	—	—	1	525
—	1	—	1	1	—	420
2	1	1	1	1	1	1470

Table 17. Substitutions of /θ/ in the initial prevocalic, initial before /r/ and final postvocalic positions transcribed by the subjects in trials 1, 2 and 3 of the /θ/ Identification Test.

In percentages the structure of the substitutions is the following:

#-V	<X>	<f>	<f>	<s>	<s>	<t>	<t>	<p>	<p>	<w>	<ø>	<c>
T1	.3%	53%	40%	1%	1.5%	1.5%	1%	-	-	.5%	.3%	-
T2	.3%	64%	13%	7%	2%	2.5%	1.5%	6.5%	.7%	1.5%	.7%	-
T3	7.0%	43%	15%	25%	2%	3.5%	1%	-	-	-	1.5%	1%
Ts 1, 2, 3	2%	54%	23%	10%	2%	2.5%	1%	2.5%	.2%	1%	1%	.2%

<g>	<m>	<d>	<z>	<sz>	TOTAL
.3%	-	.3%	-	.3%	100%
.3%	-	-	-	-	100%
-	.5%	-	.5%	-	100%
.2%	.1%	.1%	.1%	.1%	100%

Table 18. The structure of substitutions in the initial prevocalic position transcribed by the subjects in trials 1, 2 and 3 in percentages.

#-r	<X>	<f>	<f>	<t>	<t>	<s>	<s>	<ø>	<cz>	<cz>	<p>	<w>	<w>	<k>	<ch>
T1	-	42%	53%	2%	2%	-	-	-	-	1%	-	-	-	-	-
T2	2%	46%	9%	24%	7%	-	-	3%	2%	-	3%	1%	1%	1%	1%
T3	8%	40%	16%	2%	1%	19%	5%	8%	1%	-	-	-	-	-	-
Ts 1, 2, 3	3%	43%	27%	10%	4%	5%	1.5%	3%	1%	.3%	1%	.3%	.3%	.3%	.3%

#-r	TOTAL
T1	100%
T2	100%
T3	100%
Ts 1, 2, 3	100%

Table 19. The structure of substitutions in the initial position before /r/ transcribed by the subjects in trials 1, 2, and 3 in percentages.

V-#	<X>	<f>	<f>	<t>	<t>	<d>	<d>	<w>	<w>	<ø>	<s>	<s>	<k>
T1	-	49%	36%	5%	4%	-	-	3%	-	-	-	1.5%	-
T2	6.5%	57%	19%	5%	-	-	-	-	-	-	-	1.5%	2.5%
T3	27%	17%	22%	-	-	10%	1.5%	5%	3%	8.5%	1.5%	-	1.5%
Ts 1, 2, 3	10%	43%	25.5%	4%	1.5%	3%	.5%	2%	1%	2%	.5%	1%	1.5%

cont. ↑

<k>	<fi/fr>	<l>	<n>	<g>	<g>	TOTAL
1.5%	-	-	-	-	-	100%
1.5%	2.5%	1.5%	-	1.5%	1.5%	100%
-	-	1.5%	1.5%	-	-	100%
1%	1%	1%	.5%	.5%	.5%	100%

Table 20. The structure of substitutions in the final postvocalic position transcribed by the students in trials 1, 2 and 3 in percentages.

θ→	<X>	<f>	<f>	<s>	<s>	<t>	<t>	<p>	<p>	<ø>	<w>	<w>
T1	.1%	50%	42%	1%	1.3%	2%	2%	-	-	.1%	1%	-
T2	1.5%	60%	13%	4.5%	2%	7%	2.3%	5%	.3%	1%	1.5%	.1%
T3	10%	38.5%	16.1%	21%	2%	3%	1%	-	-	3.5%	1%	.5%
Ts 1, 2, 3	3%	50%	24%	8%	2%	4%	2%	2%	.1%	1.4	.9%	.2%

<d>	<d>	<sz>	<g>	<g>	<k>	<k>	<cz>	<cz>	<c>	<z>	<m>	<n>	<l>	<ch>
.1%	-	.1%	.1%	-	-	.1%	-	.1%	-	-	-	-	-	-
-	-	-	.3%	.1%	.5%	.1%	.3%	-	-	-	-	-	.1%	.1%
1.5%	.2%	-	-	-	.2%	-	.2%	-	.5%	.2%	.2%	.2%	.2%	-
.5%	.1%	.1%	.2%	.1%	.2%	.1%	.2%	.1%	.1%	.1%	.1%	.1%	.1%	.1%

<fi/fr>	TOTAL
-	100%
.3%	100%
-	100%
.1%	100%

Table 21. Percentage of substitutions transcribed by the subjects in all contexts in trials 1, 2 and 3.

II. /ð/

In three trials in this experiment participated 24, 21 and 24 subjects respectively (it was the same group of students). The test given was that of the /ð/ Discrimination one, the principles of administering the test and the instructions were exactly the same as in the previously discussed /θ/ Discrimination Polish orthography experiment.

Results:

The tables below illustrate to what degree the informants perceived contrasts between consonants in the minimal pairs and how they rendered the

contrasting qualities. Statistics will be provided in numbers and percentages. The substitutions in the transcriptions will be also analysed according to the distribution of analysed sounds in the words.

	Contrast	No contrast	TOTAL
Trial 1	201	39	240
Trial 2	179	31	210
Trial 3	216	24	240
Trials 1 2 and 3	596	94	690 ^a

Table 22. Number of contrasts transcribed by the subjects in trials 1, 2 and 3 of the /ð/ Identification Test.

	Contrast	No contrast	TOTAL
Trial 1	84%	16%	100%
Trial 2	85%	15%	100%
Trial 3	90%	10%	100%
Trials 1 2 and 3	86%	14%	100%

Table 23. Percentage of contrasts in the minimal pairs transcribed by the subjects in trials 1, 2 and 3 of the /ð/ Identification Test.

	Mean in numbers	TOTAL	Mean in percentages	TOTAL
Trial 1	8.4	10	84%	100%
Trial 2	8.5	10	85%	100%
Trial 3	9.0	10	90%	100%
Trials 1 2 and 3	8.6	10	86%	100%

Table 24. Mean values of contrasts transcribed by the subjects in trials 1, 2 and 3 of the /ð/ Identification Test.

Presented are below the transcriptions given by the subjects in the order from most frequent to least frequent:

bathe — bejw, bejw, beiw, bej, bei, beji, bejf, bejn, bejn, bejb, bejd, bejm, bajf, fej, fef, fleyf, wejdz, bejr, wyjż, pej, bajf, vaj, flejs, wijcz, tej.

thy — waj, waj, wal, faj, taj, vaj, faj, faik, vaj, paj, fal, daj.

thine — wal, waj, wain, wain, faj, val, dajn, dajn, way, way, faj, baj, bay, taj, tan, baj, paj, tajm, fan.

^a $F_{0.05} = 19.48 > 8.66$

lather — lawe, lawe, lave, lave, lawer, laver, lazer, pawa, lawa, lacha, lavXa flawa, flada, flana.

thine — waj, waj, wal, wal, val, val, wain, wain, waj, taj, fain, fain, faj, faj, tan, faj, dajn, sajn.

these — wyjż, wyjż, wyjs, wyjś, wyjX, wyjdz, wyjdz, wyjz, wejż, wejż, wejdz, wyjś, wyjś, wyjś, wijs, wiz, wiz, viz, viz, wyj, wej, dijs, dijs, dijs, bejsz, bejż, bejX, wyjsz, liz, liz, pejm, thiz.

thou — wał, wał, wal, wal, wa, wā, vau, wałn, waun, waX, fał, foł, fal, fall, task, traj, sał, sol, pal, tal.

thine — wal, waj, waj, waj, dajn, dajn, faj, taj, tajm, tain, Xajn, dain, wain, paj, fan, bfajn, taym.

thy — waj, waj, way, way, wal, taj, saj, sajn, daj, daj, tai, laj, tawa, san, van, vaj, wa, wał.

leather — lewe, leve, lewa, lewa, lewer, lever, lewar, lywa, levey, lewar, lowe, lywer, plevaj, plewa, flywa.

In the three contexts under examination in the present paper, the informants used the following substitutions in their transcriptions:

# - V	<X>	<w/v>	<w/v>	<f>	<f>	<t>	<t>	<d>
T 1	—	128	34	—	—	—	—	1
T 2	1	64	54	—	—	—	—	13
T 3	—	33	10	50	2	39	2	7
Ts 1, 2, 3	1	225	98	50	2	39	2	21

<d>			<s>	<p>	<z>	<l>	<l>	<th>	TOTAL
—	—	—	—	—	5	—	—	—	168
10	—	1	—	—	—	1	2	1	147
—	10	1	7	6	—	1	—	—	168
10	10	2	7	6	5	2	2	1	483

Table 25. Transcriptions of /ð/ in the initial prevocalic position written by the subjects in trials 1, 2 and 3 of the /ð/ Identification Test.

V - V	<X>	<w/v>	<w/v>	<z>	<d>	<d>	<ch>	<n>	TOTAL
Trial 1	1	38	4	4	1	—	—	—	48
Trial 2	1	27	13	—	—	1	—	—	42
Trial 3	—	38	6	—	1	—	2	1	48
Trials 1 2 and 3	2	103	23	4	2	1	2	1	138

Table 26. Transcriptions of /ð/ in the medial intervocalic position written by the subjects in trials 1, 2 and 3 of the /ð/ Identification Test.

V-#	<X>	<ə>	<w>	<w>	<n>	<n>	<f>	<d>	<t>	<m>
T1	1	18	—	—	1	—	2	1	—	—
T2	—	2	11	2	2	2	—	—	—	1
T3	—	14	2	—	—	—	2	—	1	—
Ts1, 2, 3	1	34	13	2	3	2	4	1	1	1

<m>		<dʒ>	<dz>	<ʒ>	<ʃ>	<ɔz>	TOTAL
—	1	—	—	—	—	—	24
1	—	—	—	—	—	—	21
—	—	1	1	1	1	1	24
1	1	1	1	1	1	1	69

Table 27. Transcriptions of /ð/ in the final postvocalic position written by the subjects in trials 1, 2 and 3 of the /ð/ Identification Test.

/ð/→	<X>	<w>	<w>	<f>	<f>	<t>	<t>	<d>	<d>	<ə>
T1	2	166	38	2	—	—	—	3	—	18
T2	2	102	69	—	—	—	—	13	2	2
T3	—	73	16	52	2	40	2	8	—	14
Ts 1, 2, 3	4	341	123	54	2	40	2	24	11	34

		<z>	<s>	<p>	<n>	<n>	<l>	<l>	<m>	<m>	<ch>	<z>
1	—	9	—	—	1	—	—	—	—	—	—	—
—	1	—	—	—	2	2	1	2	1	1	—	—
10	1	—	7	6	—	1	1	—	—	—	2	11
11	2	9	7	6	3	3	2	2	1	1	2	1

<ʃ>	<ɔz>	<dʒ>	<dz>	<th>	TOTAL
—	—	—	—	—	240
—	—	—	—	1	210
1	1	1	1	—	240
1	1	1	1	1	690

Table 28. Transcriptions of /ð/ in initial prevocalic, medial intervocalic and final postvocalic positions written by the subjects in trials 1, 2 and 3 of the /ð/ Identification Test.

These numbers have the following values in percentages:

#-V	<X>	<w>	<w>	<f>	<f>	<t>	<t>	<d>	<d>			<s>	<s>	<p>	<z>	<l>
T1	—	76%	20%	—	—	—	—	1%	—	—	—	—	—	3%	3%	—
T2	.5%	44%	37%	—	—	—	—	9%	7%	—	.5%	—	—	—	—	.5%
T3	—	20%	6%	30%	1%	23%	1%	4%	—	6%	.5%	4%	4%	4%	—	.5%
Ts1, 2, 3	.5%	47%	20%	10%	.5%	8%	.5%	4%	2%	2%	.5%	1.5%	1%	1%	1%	.5%

<l>	th	TOTAL
—	.5%	100%
1%	—	100%
—	—	100%
.5%	.5%	100%

Table 29. Transcriptions of /ð/ in the initial prevocalic position in percentages.

V-V	<X>	<w>	<w>	<z>	<d>	<d>	<ch>	<n>	TOTAL
Trial 1	2.5%	79%	8%	8%	2.5%	—	—	—	100%
Trial 2	2.5%	64%	31%	—	—	2.5%	—	—	100%
Trial 3	—	79%	13%	—	2%	—	4%	2%	100%
Trials 1, 2 and 3	2%	75%	17%	3%	1%	.5%	1%	.5%	100%

Table 30. Transcriptions of /ð/ in the medial intervocalic position in percentages

V-#	<X>	<ə>	<w>	<w>	<n>	<n>	<f>	<d>	<t>	<m>	<m>
T1	4%	75%	—	—	4%	—	9%	4%	—	—	—
T2	—	9.5%	52%	9.5%	9.5%	9.5%	—	—	—	5%	5%
T3	—	59%	8.5%	—	—	—	8.5%	—	4%	—	—
Ts 1, 2, 3	1.5%	50%	19%	3%	4%	3%	6%	1.5%	1.5%	1.5%	1.5%

	<dʒ>	<dz>	<ʒ>	<ʃ>	<ɔz>	TOTAL
4%	—	—	—	—	—	100%
—	—	—	—	—	—	100%
—	4%	4%	4%	4%	4%	100%
1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	100%

Table 31. Transcriptions of /ð/ in the final postvocalic position in percentages.

/ð/ →	<X>	<w>	<w>	<f>	<f>	<t>	<t>	<θ>	<d>	<d>			<z>
T1	1%	60%	16%	1%	—	—	—	7%	1%	—	.5%	—	4%
T2	1%	48.5%	33%	—	—	—	—	1%	6%	5%	—	.5%	—
T3	—	30%	7%	21%	1%	16%	1%	6%	3%	—	4%	.5%	—
Ts 1, 2, 3.	.5%	49%	18%	8%	.5%	6%	.5%	5%	3%	1.5%	1.5%	1.5%	1.2%
	<s>	<p>	<n>	<l>	<l>	<m>	<m>						
	—	—	.5%	—	—	—	—						
	—	—	1%	.5%	.5%	1%	.5%						
	3%	—	—	.5%	.5%	—	—						
	1%	.5%	.5%	.5%	.5%	.1%	1%						
	<ch>	<ʒ>	<ʒ>	<ez>	<dʒ>	<dz>	<th>	TOTAL					
	—	—	—	—	—	—	—	100%					
	—	—	—	—	—	—	.5%	100%					
	1%	.5%	.5%	.5%	.5%	.5%	.5%	100%					
	.5%	.1%	.1%	.1%	.1%	.1%	.1%	100%					

Table 32. Transcriptions of /ð/ in initial prevocalic, medial intervocalic and final postvocalic positions in percentages.

PERCEPTION AND PRODUCTION

Imitation Test

Procedure:

This test investigated both the tense and lax qualities of the English interdental fricative. The test was administered to one group of informants and consisted of two trials. The informants were a new group of students (not the one participating in the Discrimination and Identification Tests). Nineteen subjects participated in trial 1 and 21 in trial 2. They listened twice to the same list of English words which was first read by a female (trial 1) and then by a male (trial 2). The order of the items was the same in both trials. The speakers as in the previous tests were Polish natives — both trained phoneticians, as well as teachers of English. The test (two trials) was carried out in one recording session — one informant at a time (it was difficult to hold two separate recording sessions with each informant due to the fact that they were not available on other days). The recordings took place in a sound-proof studio equipped with instruments of reasonable quality. Each informant had 8 seconds to repeat the word he had heard. A list of ten English short words — 9 monosyllables and one disyllable — had been tape-recorded for the experiment. The distribution of the /θ/ and /ð/ sounds in these words was mostly prevocalic initial, e.g. *thumb* (3 words), *then* (4), intervocalic for /ð/, e.g. *either* (1), and

postvocalic final for /θ/, e.g. *faith* (2). /ð/ was not included in the postvocalic final distribution in the test because of the additional interference of devoicing that takes place in the Polish language and which surely influences perception and hence production as well. The following is the list designed for the Repetition test.

(1) moth	[mɔθ]
(2) then	[ðen]
(3) faith	[feiθ]
(4) those	[ðəuz]
(5) thumb	[θʌm]
(6) either	[aiðə]
(7) this	[ðis]
(8) thane	[θein]
(9) though	[ðəu]
(10) theme	[θi:m]

The analysis of the recordings was mainly auditory, although in some doubtful cases supported by spectrogrammes. The reasonable hypothesis was, however, that none of the informants would be able to articulate either /θ/ or /ð/ correctly, as none of the informants had undergone any formal or informal training of English, none of the informants had been informed that the language they were imitating was English, the repetition took place from tape recordings and thus none of the informants had a possibility to watch the articulatory movements of the phoneticians and later imitate them. Hence, the writer's primary interest was the approximations that the subjects made, i.e. which of the approximations prevailed in the subjects' renditions of /θ/ and /ð/.

Results:

Tables 33, 34, 35, 36 and 37 render the number of correct and incorrect imitations of the sounds /θ/ and /ð/ made by the subjects in trials 1 and 2. The results, presented in numbers and percentages, will consider overall values as well as those in the appropriate context groups.

(a)	[θ]	[f]	[s]	[t]	Other*	TOTAL
Trial 1	—	91	2	—	2	95
Trial 2	—	99	5	—	1	105
Trials 1, 2	—	190	7	—	3	200 ⁵

(* Other imitations are [fs] and [fʃ]).

⁵ When examining the structure of the answers of trials 1 and 2, a comparison of the percentages obtained is sufficient (Table 33a). As the results do not reveal any significant disparity, we can treat trials 1 and 2 jointly.

(b)	[θ]	[v]	[d]	[ə]	[f]	[z]	[dz]	Other*	TOTAL
Trial 1	—	70	5	7	5	1	2	5	95
Trial 2	—	94	9	—	1	1	—	—	105
Trials 1, 2	—	164	14	7	6	2	2	5	200*

(* Other single imitations are [fs], [t], [l], [b], and [s])

Tables 33 (a) (b). The imitations given by the subjects in trials 1 and 2 of the Imitation test.

(a)	[θ]	[f]	[s]	[t]	Other	TOTAL
Trial 1	—	96%	2%	—	2%	100%
Trial 2	—	94%	5%	—	1%	100%
Trials 1, 2	—	95%	4%	—	1%	100%

(b)	[θ]	[v]	[d]	[ə]	[f]	[z]	[dz]	Other	TOTAL
Trial 1	—	74%	5%	8%	5%	1%	2%	5%	100%
Trial 2	—	89%	9%	—	1%	1%	—	—	100%
Trials 1, 2	—	82%	7%	4%	3%	1%	1%	2%	100%

Tables 34 (a) (b). The percentage of particular imitations given by the subjects in trials 1 and 2 of the Imitation test.

(a)	Means /θ/			
	[f]	[s]	Other	TOTAL
Trial 1	4.8	96%	.1	2%
Trial 2	4.7	94%	.2	4%
Trials 1, 2	4.8	96%	.1	2%

(b)	Means /θ/											
	[v]	[d]	[ə]	[f]	[z]	[dz]	TOTAL					
Trial 1	3.7	74%	.2	5%	.4	8%	.2	5%	.1	1%	.1	2%
Trial 2	4.4	89%	.4	9%	—	—	.1	1%	.1	1%	—	—
Trials 1, 2	4.1	82%	.3	7%	.2	4%	.1	3%	.1	1%	.1	1%

Means /θ/	
Other	
.3	5%
—	—
.1	2%

Tables 35 (a) (b). Mean values of particular imitations of both /θ/ and /ð/ produced by the subjects, presented first in numbers (total = 5) and percentages (total = 100%).

* The percentages of trials 1 and 2 in Table 33(b) differ considerably and we cannot treat the results of these two trials jointly.

A context analysis of the oral renditions of /θ/ and /ð/ is given below in Tables 36 and 37 in numbers and percentages respectively.

(a)	/θ/	# - V				TOTAL	V - #				TOTAL
		[f]	[s]	[t]	Other		[f]	[s]	[t]	Other	
Trial 1		55	1	—	1	57	36	1	—	1	38
Trial 2		60	3	—	—	63	39	2	—	1	42
Trials 1, 2		115	4	—	1	120	75	3	—	2	80

(b)	/ð/	# - V							TOTAL	V - V					TOTAL		
		[v]	[d]	[ə]	[f]	[dz]	[z]	Other		[v]	[d]	[f]	[z]	[dz]		[ə]	Other
Trial 1		61	2	7	3	2	—	1	76	9	3	2	1	—	—	4	19
Trial 2		73	9	—	1	—	1	—	84	21	—	—	—	—	—	—	21
Trials 1, 2		134	11	7	4	2	1	1	160	30	3	2	1	—	—	4	40

Tables 36 (a) (b). The number of sound substitutions for /θ/ and /ð/ in particular contexts produced by the subjects in trials 1 and 2 of the Imitation test.

The percentages of the above-given number are manifested in the tables below:

(a)	/θ/	# - V				TOTAL	V - #				TOTAL
		[f]	[s]	[t]	Other		[f]	[s]	[t]	Other	
Trial 1		96%	2%	—	2%	100%	95%	2.5%	—	2.5%	100%
Trial 2		95%	5%	—	—	100%	93%	5%	—	2%	100%
Trials 1, 2		96%	3%	—	1%	100%	94%	4%	—	2%	100%

(b)	/ð/	# - V							TOTAL
		[v]	[d]	[ə]	[f]	[dz]	[z]	Other	
Trial 1		80%	3%	9%	4%	3%	—	1%	100%
Trial 2		87%	11%	—	1%	—	1%	—	100%
Trials 1, 2		84%	7%	4%	3%	1%	.5%	.5%	100%

		V - V						TOTAL	
		[v]	[d]	[f]	[z]	[dz]	[z]		Other
Trial 1		47%	16%	11%	5%	—	—	21%	100%
Trial 2		100%	—	—	—	—	—	—	100%
Trials 1, 2		75%	7.5%	5%	2.5	—	—	10%	100%

Tables 37 (a) (b). The percentage of substitutions for /θ/ and /ð/ in particular contexts in trials 1 and 2 of the Imitation test.

DISCUSSION AND CONCLUSIONS

(1) The Polish subjects were quite successful in discriminations between minimal pairs in the Discrimination Test. 71–82 per cent of them correctly differentiated /θ/ from /f, s, t/. In context groups the highest percentage of correct discriminations can be noticed in the final position (93 per cent) against 67–81 and 68–80 per cent in the initial position and before /r/ respectively. The results, however, seem to be slightly misleading, as a close analysis of the minimal pairs in which /θ/ is distributed finally gives the following information: (a) the examples were not numerous, (b) the pairs with the contrasts /s/ — /θ/ — *bus* — *bath* and /t/ — /θ/ — *but* — *bath* had been differentiated easily and correctly in 100 per cent of the cases, (c) it was the contrast /f/ — /θ/ that caused trouble to the listeners and the average of correct answers for this pair was 86 per cent. Therefore, we can conclude that to the subjects participating in the experiment the /f/ — /θ/ contrast was confusing, whereas the other two contrasts, easy to detect. The same pattern has been discovered during the analysis of all the remaining contrasts in this test. We can even attempt a conclusion that having been given more examples with the /f/ — /θ/ contrast the subjects would have probably given approximately 78 per cent of correct identifications. Thus, under the conditions of the experiment, it seems that context does not affect the perception of the English fricative /θ/.

(2) The subjects were able to discriminate 70–80 per cent of the contrasts in the /ð/ Discrimination Test correctly, in the initial position — 63–72 per cent, in the intervocalic position — 81–93 per cent, and in the final position 97 per cent. Similarly to (1) the result of the initial position discriminations seems to be most reliable, as again, due to the difficulty of finding /ð/ — /v/ minimal pairs contrasts in the intervocalic and final positions in the English language, such contrasts were not presented to the listeners. The analysis of the answers confirmed once again that /ð/ is most often confused with /v/, less likely with /z/ or /d/.

(3) The /θ/ Identification Test — another test on perception — rendered a mean of 81–93 per cent contrasts perceived. Only 3 per cent of the students identified /θ/ as a sound completely alien to them (marked by X) which they could not match with any of the sounds of Polish. The majority, i.e. 50 per cent identified /θ/ as the Polish /f/, 24 per cent — as a non-Polish /f/, 8 per cent — as the Polish /s/, 4 per cent — as the Polish /t/, 2 per cent as a non-Polish /s/, 2 per cent as a non-Polish /t/, and also 2 per cent as the Polish /p/. The remaining numerous other identifications due to the extremely low percentage should be regarded as accidental.

The distribution of the identified phonemes in the analysed contexts does not considerably differ from the general results presented above, i.e. in the initial position 2 per cent of the subjects said the sounds were not Polish, 54

per cent considered them to be the Polish /f/, 23 per cent identified /θ/ as the Polish /s/, 2.5 per cent — as the Polish /t/, 2.5 per cent — as the Polish /p/, and 2 per cent — as a non-Polish /s/. The identifications made in the context before /r/ are the following: 3 per cent — unidentified foreign sound, 43 per cent — the Polish /f/; 27 per cent — a non-Polish /f/; 10 per cent — the Polish /t/; 5 per cent — the Polish /s/; and 4 per cent — a non-Polish /t/. 3 per cent of the informers did not identify any consonant to be present before /r/. In the final position 10 per cent of the respondents considered the sound to be unknown to them, 43 per cent heard it as the Polish /f/; 25.5 per cent — as a non-Polish /f/; 4 per cent — as the Polish /t/; 3 per cent — as the Polish /d/; and 2 per cent did not hear a consonant in this position at all. It seems that whenever /θ/ is distributed before /r/ or in the final position, /t/ ranks second after /f/ as far as the perception of /θ/ is concerned, whereas in the initial position it is /s/ that follows the prevalent /f/.

#-V	F	S	T	P
#-r	F	T	S	
V-#	F	T	(D)	

An overwhelming number of identifications in the three contexts under consideration is the labial fricative /f/; the percentage differences between other identifications are insignificant and may have been caused by non-linguistic factors, such as, e.g. fatigue, distraction, boredom, slightly worse hearing, etc. Therefore, we may conclude that the contexts used in the present experiment do not affect the process of /θ/ perception by Polish speakers.

(4) The mean percentage of the contrasts perceived in the /ð/ Identification Test is 86. Extremely few informants (only 0.5 per cent) perceived /ð/ as a sound alien to the Polish language. Most of them heard the English lax dental fricative as the Polish /v/ — 49 per cent, or a non-Polish /v/ — 18 per cent, 8 per cent of the subjects identified it as the Polish /f/, 6 per cent as the Polish /t/, and 3 per cent — as the Polish /d/. The remaining renditions are insignificant due to the low percentage with the exception of /θ/ (zero) identification (5 per cent) which will be later accounted for in the discussion of the contexts.

In the three contexts examined the identifications were the following: in the initial position the Polish /v/ — 47 per cent (the discrepancies in the percentages obtained in particular trials may be due to the duration of voice in the final lax labial fricative in the examples recorded by the phoneticians); a non-Polish variety of /v/ — 20 per cent; the Polish /d/ — 4 per cent; a non-Polish /d/ — 2 per cent; and the Polish /b/ — 2 per cent. The /f/ and /t/ identifications, although significant because of the percentage, occur only in trial 3 (cf. Table 28) and therefore can be considered to have been influenced

by the idiosyncratic pronunciation of the phonetician, i.e. a longer voice onset time. Since initial voiced consonants in Polish are always fully voiced, a relatively shorter voicing of the initial English consonants in trial 3 had been perceived by the Poles as no voicing — hence /f/ and /t/. In the intervocalic position /ð/ was overwhelmingly identified as the Polish /v/ — 75 per cent or a non-Polish /v/ — 17 per cent. Another possible identification was the Polish /z/ — 3 per cent (occurring, however, only in trial 1). In the final position a very large number of the subjects did not hear any consonant there — 50 per cent; 19 per cent of them perceived it as the Polish /v/; 6 per cent — as /f/, 4 per cent as /n/, 3 per cent as a non-Polish /v/ and also 3 per cent as a non-Polish /n/. The fact that the English lax consonants are identified by the native speakers of English by the length of the preceding vowel even if not perceptually audible, which cannot be the case with the present subjects, may be an explanation of such a high percentage of zero phonemes in this position. The substitution of /n/ and others may also be the results of the difficulties the subjects were having hearing the final sound. Finally, the identification of the Polish /f/ is the influence of the devoicing rule operating in the Polish language whenever a voiced consonant is distributed finally.

#_V	V	D	B	(F T)
V_V	V	Z		
V_#	Ø	V	F	(N)

(5) The analysis of the recordings of the Imitation Test confirmed the writer's hypothesis that none of the informants was able to produce /θ/ or /ð/. Apparently, we realize that this kind of test causes difficulty on two levels — perception and articulation — an interfering factor of the former cannot be excluded.

/θ/ in the initial prevocalic and final postvocalic positions was most readily replaced by /f/ (96 per cent and 94 per cent respectively). /s/ was produced in very few instances. It is worth emphasizing that no substitution of /t/ for /θ/ occurred.

As concerns /ð/ which was tested in two distributions, i.e. initial prevocalic and intervocalic, the results are somewhat different. Although, again, a labial fricative /v/ is predominant, (74 per cent and 75 per cent); the closest second substitution is /d/ (8 per cent and 5 per cent) — an alveolar stop. /z/ substitutions are marginal (1 per cent and 3.5 per cent).

/θ/	#_V	F	S	
	V_#	F	S	
/ð/	#_V	V	D	
	V_V	V	D	(F)

In summary, we can assume that Poles in their perception and production of the tense and lax British English interdental fricatives make approximations according to the locus of articulation, not its mode. Only in the case of the English lax fricative slight preference for /d/ — a different mode of articulation — rather than /z/ can be noticed in the Imitation Test, or /t/ rather than /s/ in the /θ/ Identification Test.

The overwhelming number of the labial fricative selection as a substitute for the interdental one seems to be justified by the similarity of the noise produced during the articulation of both sounds. Its 'dull' quality very much differs from the hissing of the grooved sibilant or aspiration of the apical stop.

So far, there have been carried out very few experimental studies on the perception and production of English sounds by Polish native speakers. Many teachers, however, have reported some observations from their teaching experience (e.g. Komorowska (1974); Krzeszowski (1970); Smólska (1978)). A. Koczyński's (1977) contrastive study of Polish and American English consonant phonemes presents more detailed experimental data. In his production tests the subjects read previously learned dialogues and sentences into a tape recorder. The informants varied as to age and knowledge of English (one beginning and one advanced group) — the number of years of formal and informal training also varying. The distributional contexts of /θ/ and /ð/ were primarily initial prevocalic with a few instances of final postvocalic and one occurrence of /θ/ in the intervocalic position. In his study, stops predominated in the substitutions made by the informants; grooved sibilants were the second preferred choice; not a single substitution of labial fricatives was noted. This fact is rather surprising, because as he himself mentions, many teachers have reported the substitution of /f, v/. Furthermore, studies other than Polish reveal that /f, v/ substitutions are rather common (e.g. Jones (1947), Nemser (1971)). W. J. Nemser carried out a very meticulous experimental study of the phonological interference in the English of Hungarians. He designed a number of lengthy tests administered to 4 Hungarians whose knowledge of English ranged from poor to advanced. The tests checked both receptive and productive abilities of the informants. In the tests /θ/ and /ð/ were distributed in all possible contexts. Nemser found /f, v/ in conspicuous prevalence over other possible approximations although in some tests labial fricatives were on a par with alveolar stops. He also revealed a very important fact that in the contexts V_s, V_z and #_r there is a shift to the preference of the apical stop. The phenomenon of context influence (also briefly mentioned by Koczyński (1977)) seems very crucial for such analysis. Another factor which may influence the quality of substitutions is stress. Therefore, it seems indispensable to carry out further investigation on the subject taking into consideration other contexts and also stress variations left out of the analysis in the present work.

REFERENCES

- Chomsky, N. and Halle, M. 1968. *The sound pattern of English*. New York: Harper and Row Publishers.
- Gimson, A. C. 1966. *An introduction to the pronunciation of English*. London: Edward Arnold.
- Gruza, F. (ed.). 1978. *Z problematyki błędów obcojęzycznych*. Warszawa: Wydawnictwa Szkolne i Pedagogiczne.
- Jassem, W. 1954. *Fonetyka języka angielskiego*. Warszawa: PWN.
- Jones, D. 1947. *An outline of English phonetics*. Cambridge: W. Heffer and Sons Ltd.
- Jones, D. 1964. *English pronouncing dictionary*. London: J. M. Denpi and Sons.
- Komorowska, H. 1974. *Testy w nauczaniu języków obcych*. Warszawa: Wydawnictwa Szkolne i Pedagogiczne.
- Kopczyński, A. 1973. "The Polish and English fricatives: A problem of phonological equivalence". *PSiCL* 1. 93-98.
- Kopczyński, A. 1975. "The Polish students' difficulties in the pronunciation of the English /θ/". *Glottodidactica* 7. 75-79.
- Kopczyński, A. 1977. *Polish and American English consonant phonemes*. Warszawa: PWN.
- Krzeszowski, T. P. 1970. *Teaching English to Polish learners*. Warszawa: PWN.
- Ladefoged, P. (ed.). 1972. *Three areas in experimental phonetics*. London: Oxford University Press.
- Ladefoged, P. 1972. "Units in the perception and production of speech". In Ladefoged, P. (ed.). 1972. 143-72.
- Miękisz, M. 1978. *English and Polish phonemes and their variants*. Wrocław: Uniwersytet Wrocławski.
- Nemser, W. J. 1971. *An experimental study of phonological interference in the English of Hungarians*. The Hague: Mouton.
- Puchalski, T. 1962. *Statystyka*. Poznań: Wyższa Szkoła Ekonomiczna.
- Puchalski, T. 1971. *Wnioskowanie statystyczne*. Poznań: Wyższa Szkoła Ekonomiczna.
- Puppel, S., Nawrocka-Fisiak, J. and Krassowska, H. 1977. *A handbook of Polish pronunciation*. Warszawa: PIW.
- Smólska, J. 1978. "Typowe błędy popełniane przez studentów polskich w języku angielskim". In Gruza, F. (ed.). 1978. 60-114.
- Stanisławski, J. 1964. *Wielki słownik angielsko-polski*. Warszawa: Wiedza Powszechna.
- Stanisławski, J. 1970. *Wielki słownik polsko-angielski*. Warszawa: Wiedza Powszechna.
- Weinreich, U. 1963. *Languages in contact*. The Hague: Mouton.
- Wierzchowska, B. 1965. *Wymowa polska*. Warszawa: PZWS.
- Wise, C. M. 1957. *Introduction to phonetics*. Englewood Cliffs, N. J.: Prentice Hall.
- Woźnicki, T. 1974. "Mechanizmy funkcjonujące przy odbiorze wypowiedzi językowej". *Języki Obce w Szkole* 2. 68-70.