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The Influence of Brain Dominance on Learning English Pronunciation[1]

Abstract: The paper provides a description of a study that was aimed at verifying the influence of brain dominance on learners' proficiency in the perception and production of English pronunciation. Eighty-eight subjects participated in the research. The procedures involved the use of the following research tools: questionnaires for both learners and teachers; the Brain-Dominance Inventory (BDI); and, finally, a pronunciation perception and production test. The mean scores obtained by the participants varied considerably among the three brain-dominance groups (right-brain, left-brain, and bilateral learners). The results of the study suggest that right-brain dominance and integrated hemisphericity correlate to success in second-language pronunciation.

1. Introduction

Scholars have long neglected the aspect of pronunciation in the process of foreign language learning. In recent years, more attention has been paid to pronunciation-teaching objectives. Nevertheless, little has been done to explicate the possible reasons for the differences among learners' abilities to acquire a second-language phonological system. The aim of this paper is to examine the potential influence of learners' brain-dominance types on the acquisition of English phonetics.

The article begins with a brief introduction of the theoretical background, and a compendious account of hemispheric preference studies. A description of the research design follows. Next, the results of the research are presented and discussed. The paper closes with a summary of the research findings and conclusions.

[1] The article is based on the author's master thesis of the same title, written under the supervision of Małgorzata Baran-Łucarz, PhD.

2. Language and the brain

In the 19th century, a vast amount of research was carried out in order to explain how language is processed in the brain. The two most prominent investigators of that time were Pierre Paul Broca and Carl Wernicke. Observation of patients suffering from speech disorders, followed by autopsies of the deceased subjects, led these renowned clinicians to discover what are now referred to as *Broca's area* and *Wernicke's area*, and provided significant contributions to our knowledge of the dual processing nature of the human cortex.

The concept of brain lateralization emerged as a consequence of almost a century of clinical and experimental investigation that followed. It came to light that despite gross anatomical symmetry, each cortical hemisphere specializes in specific functions, executing them faster and more effectively than its contralateral counterpart. The left hemisphere, often described as *logical* or *analytical*, is largely responsible for linguistic sounds, controlling articulatory muscle movements and hand gestures during communication. By contrast, the right hemisphere, commonly labelled *holistic*, manages visual-spatial functions. It processes information that is not decoded by verbalization, and manages the quality of the sounds, tones and rhythm of speech (Chojnacka-Szawłowska 1993; Jedynak 2009; Kurcz 1992).

2.1. Brain dominance

The terms *hemispheric preference*, *brain dominance* and *brain hemisphericity* are used interchangeably in this paper. They refer to one's mode of learning and thinking. This means that one's tendency to use one half of the brain more than the other determines one's cognitive style. This idea has been a common assumption for over forty years (Mercer 2010). Supporters of the hemispheric preference hypothesis divide learners into the right-brained and the left-brained. Some scientists acknowledge the existence of the third group that draws from both hemispheres to a similar degree.

Arabski (1997) described a simple test designed to define whether a person's centre of logical analysis is localized in the right or left hemisphere. People whose eyes involuntarily wander to the right when they are attempting to answer a question are supposedly left-brained. Right-brained individuals, on the other hand, look to their left. A person may be classified as belonging to the left- or right-brained group if he or she looks in the same direction 80% of the time (Diller 1978).

Krashen et al. (1974) used the method described above to analyse the relationship between L2 learners' hemispheric preferences and the teaching methods used. The researchers were looking for an analogy between the students' results and different approaches to teaching Spanish at the University of California. The outcome of the study revealed that methods emphasizing grammatical rules and employing translation for language learning were completely inadequate for right-brained learners.

In his search for evidence of right-hemispheric processing of linguistic and affective intonation, Elliott (1995) recounted two experiments that utilized the dichotic listening method. In both studies, those participants who exhibited left-ear advantage and were classified as having right-hemisphere superiority achieved higher scores in the affective intonation identifying tasks (Ley and Bryden 1982; Shipley-Brown et al. 1988 qtd. in Elliott 1995).

In his own study, Elliott (1995) used the Human Information Processing Survey (HIPS) (Taggart and Torrance 1984 qtd. in Elliott 1995) to ascertain the subjects' hemispheric preference: left-brain, right-brain, or integrated. After administering the test to 66 learners of Spanish, the author formulated the following conclusion:

> … right-specialized individuals will have better pronunciation; however, this appears to be true only when the subjects are spontaneously producing the target language as opposed to performing simple repetition exercises or reading words in isolation. (Elliott 1995: 366)

A study by Baran-Łucarz (2007) presented similar findings. The participants, who were Polish students of English phonetics, were assessed on the following aspects: accuracy in segment production, L1 transfer, consistency in using Received Pronunciation (RP) or General American (GA) pronunciation of words commonly mispronounced by Poles, and the use of suprasegmentals. The Brain-Dominance Inventory (Davis et al. 1994) was utilized to determine the students' hemispheric preference. The results of the study showed that none of the 'talented' subjects was left-brain dominant; they were either right-brained or bilateral. In her concluding remarks, the researcher stated that right-brain dominance is one of the most crucial cognitive traits of 'excellent' pronunciation learners.

Woodworth and Winter observed: "The concept of brain hemisphericity in individuals has implications in education and learning theory that extend into gifted learning as well" (Woodworth and Winter 2009: 106). Nevertheless, in the history of linguistic research, the concept of brain dominance has not been given much attention. It is rather other aspects of individual learner differences that have been areas of focus. Therefore, it seems fully justifiable to examine the influence of learners' hemispheric preference on the acquisition of English pronunciation.

3. Empirical study

This section provides a description of the research design and the data gathered.

3.1. The aim of the research

The study aimed at verifying the influence of brain dominance on learners' proficiency in the perception and production of English pronunciation. The following hypotheses were formulated:

H1: There is a statistically significant difference between the pronunciation proficiency of left-brain learners and whole-brain learners.
H2: There is a statistically significant difference between the pronunciation proficiency of left-brain learners and right-brain learners.
H3: There is a statistically significant difference between the pronunciation proficiency of right-brain learners and whole-brain learners.

3.2. Variables

The independent variable was the given learner's hemispheric preference measured by the Brain-Dominance Inventory (Davis et al. 1994).

The dependent variable was the participant's score on a pronunciation test designed by the researcher for the purpose of this study.

Several moderator variables were taken into consideration. The first was the subject's general level of English proficiency. This category includes the school attended (i.e. its rank among secondary schools in Wrocław), the learner's learning background and previous contact with English. The second moderator variable was the attitude displayed by the participant's regular instructors towards teaching English pronunciation (i.e. time devoted to pronunciation instruction, providing explicit explanations of pronunciation components, correcting pronunciation errors, etc.).

The control variables for this study included participants' visits to English-speaking countries lasting more than three months, and inability to participate in pronunciation production tasks, which might be due to a low level of general English proficiency, dyslexia, or speech impediments.

3.3. The subjects of the study

The research was conducted at two different secondary schools in Wrocław: secondary school XV and secondary school XIV. Eighty-eight Polish learners of English participated in the study. Fifty subjects were females and the remaining thirty-eight were males. They were mostly seventeen- and, in rare cases, eighteen-year-old second-year students.

The control variables of the study were taken into account before any statistical calculations were carried out. Three subjects had to be excluded from the statistics because they had spent more than three months in an English-speaking country. A further ten participants were rejected due to their inability to complete the pronunciation production part of the test. Nine of them were unable to read the text because of their general low level of proficiency, and one individual due to a speech impediment. Thus, the overall number of participants who were included in the statistics was seventy-five (N= 75).

3.3.1. Arranging the research groups

Data gathered by means of introductory questionnaires revealed that the participants differed in many aspects to such a degree that they could not be treated cumulatively in statistical calculations. The amassed information was analyzed with reference to the moderator variables of the study, which allowed the researcher to classify the participants into distinct research groups.

Firstly, the fact that the subjects attended different schools seemed of crucial importance. Secondary school XIV has for many years been among the top-ranking public schools in Wrocław, while school XV ranks far lower. Therefore, the researcher expected the general level of English to be higher among learners attending school XIV. The information obtained through the introductory questionnaires seemed to confirm this speculation. Due to limited space, only a sample of the amassed data is presented below.

Table 1. Sample results of the introductory questionnaire for the participants

Questionnaire inquiries	**School**	**Number of subjects who answered in the affirmative**	**[%]**	**School**	**Number of subjects who answered in the affirmative**	**[%]**
Have you ever attended any additional English classes?	XV	*N* = 19	**37.25**	XIV	*N* = 20	**54.05**
Have you ever been to an English-speaking country?		*N* = 0	—		*N* = 9	**24.32**
Have you ever been taught by a native speaker?		*N* = 6	**11.76**		*N* = 25	**67.56**
Are you familiar with and able to use IPA?		*N* = 3	**5.88**		*N* = 23	**62.16**

Secondly, in school XV, two classes participated in the study. Both were divided into two groups: pre-intermediate and intermediate. The researcher considered the division into less proficient and more proficient groups (research groups 1 and 2, respectively) to be necessary to the validity and reliability of the statistical analyses.

Thirdly, the answers provided by the subjects of the study and their instructors revealed that the teachers differed considerably in their attitude towards teaching English pronunciation. One teacher from secondary school XIV seemed to attach great importance to pronunciation instruction, providing explicit descriptions of segmental as well as suprasegmental aspects, which the students practised for at least ten minutes during every lesson. This teacher's focus on pronunciation

seemed exceptional in comparison to the other teachers involved in this study. The experimenter anticipated that this teacher's students (research group 4) would obtain higher scores in the pronunciation test than the rest of the participants from school XIV (research group 3).

On the basis of the data gathered, the author decided to analyze and conduct statistical calculations for four separate groups. Table 2, below, presents the classification of the subjects into the four research groups and the number of subjects in each group after adjustments.

Table 2. Research groups

Research group	1	2	3	4
School	XV	XV	XIV	XIV
Number of subjects	$n_1 = 14$	$n_2 = 27$	$n_3 = 23$	$n_4 = 11$

3.4. Research instruments

3.4.1. Introductory questionnaires

The introductory questionnaires for the participants and their teachers were designed by the researcher for the purpose of the study. In order to avoid misinterpretations, questionnaire for the learners was composed in Polish. It was used to gather background information concerning the subjects, e.g. personal details and their learning experience.

The questionnaire for the subjects' teachers was composed in English. It allowed the researcher to assemble data concerning the learners' language awareness and their experience learning pronunciation.

3.4.2. The Brain-Dominance Inventory

The Brain-Dominance Inventory (BDI) (Davis et al. 1994) determines whether a student is a right-brain, left-brain or bilateral learner. It comprises 39 questions, which inquire into various aspects of the subjects' lives. In order to avoid language-based misunderstandings, the English-language version of the BDI was translated into Polish. The students' answers were subsequently evaluated according to the scoring key provided. Since the researcher anticipated a high rate of possible errors if the learners computed the scores, she was the person responsible for calculating the test results.

3.4.3. The pronunciation test

This test was utilized to determine the participants' level of pronunciation. It was designed by the researcher for the purpose of this study. Several segmental as

well as suprasegmental aspects of pronunciation were tested, including the English sounds /θ, ð, ɪ, i: ŋ, ʃ, ʧ/ and word-level stress. This selection was made on the basis of selected studies (Gonet and Pietroń 2004; Sobkowiak 2004).

The pronunciation test had two sections. The first section was a written perception test. Twenty-one minimal pairs comprised the first task in this section. The second task tested the subjects' ability to identify the main stress of polysyllabic words. The maximum possible score in the perception section was 27.

The second section was a production test. It was recorded on a SONY IC-P620 voice recorder. The average recording time per person was two minutes and thirty seconds; therefore, the overall material comprised over three and a half hours of recording.

In the first task of the production test, the students were asked to read a list of words. Every segment from the group of sounds tested (/θ, ð, ɪ, i: ŋ, ʃ, ʧ/) appeared three times and, if possible, in different positions in the words. Word-level stress was tested six times.

The second task was reading the "Diagnostic Passage" from Celce-Murcia et al. (1996: 398).The experimenter encouraged the subjects to focus on the content of the text. The number of times each particular sound was tested was established on the basis of "Sound frequency in English" (Sobkowiak 2004: 345–346). Thus, the phoneme / ð / was tested four times, / θ / twice, /ɪ/ five times, /i:/ three times, /ŋ/ twice, /ʃ/ three times and /ʧ/ once. In addition, word stress was tested five times. The maximum possible score in the production section was 104 points.

The pronunciation perception section was appraised by the experimenter alone, but the oral part of the test was evaluated by an experienced teacher of phonetics for five randomly chosen participants. This procedure was applied in order to increase the reliability of the research and to validate the scoring of the oral test, since the researcher had little experience in judging pronunciation production performance. Analyzing evaluation sheets filled out by a more experienced person enabled the author of this paper to draw some valuable conclusions, which were applied when scoring the remaining subjects. The Pearson correlation between the scores assigned by the two evaluators was 0.94 for the list of words, and 0.99 for the text.

3.5. The research procedure

The procedure was conducted in April 2010 in school XIV, and in October 2010 in school XV. In both cases it lasted for approximately one month. First, the participants of the study and their instructors of English were requested to fill out the introductory questionnaires. The Brain-Dominance Inventory was then administered to ascertain the subjects' hemispheric preference; left-brain, right-brain, or bilateral. Finally, the pronunciation test was administered.

3.6. The results

3.6.1. Results of the Brain-Dominance Inventory

The results of the BDI are presented in Table 3, below.

Table 3. Results of the BDI

	Subgroups					
	Left		**Whole**		**Right**	
	N	%	*N*	%	*N*	%
Group 1	9	64.28	1	7.14	4	28.57
Group 2	10	37.04	7	25.93	10	37.04
Group 3	9	39.13	3	13.04	11	47.83
Group 4	11	100	0	0	0	0
TOTAL	39	52	11	14.67	25	33.33

Most of the students (52%) were left-brain dominant; 33.33% were right-brain dominant; the least frequent was the whole-brain type (14.67%). Since all the subjects from Group 4 turned out to be left-brain dominant, further statistical analysis for this group could not be conducted.

3.6.2. Results of the pronunciation test

The raw scores for the pronunciation test confirmed the researcher's earlier speculation. Group 4, where pronunciation had been taught systematically, attained the highest score. Moreover, Groups 3 and 4 (the higher-ranked school XIV) achieved better results than Groups 1 and 2 (school XV). Table 4 delineates the pronunciation test mean scores.

Table 4. The pronunciation test mean scores

Group	1	2	3	4
Mean	53.00	62.89	82.74	97.18
SD	9.98	10.81	14.25	16.09

3.6.3. Results of the statistical analysis

The results of the statistical calculations conducted for the separate research groups are presented in Tables 5–10, below. Table 5 presents contrasting results for the three brain-dominance types found in Group 1. The mean scores varied considerably between the whole-brain learners, whose results where the best, and the two remaining subgroups. However, due to the fact that there was only one whole-brain learner, it was impossible to conduct statistical analysis for this brain-dominance type. An independent t-test was conducted for the left-brain and right-brain participants (Table 6). Since the observed t-value was 0.165, and the critical value is 2.201 at the $p<0.05$ level of significance, these results were not statistically significant.

Table 5. Results of the pronunciation test for Group 1

	Group 1		
	Subgroups		
	Left-brain (*N* = 9)	**Whole-brain** (*N* = 1)	**Right-brain** (*N* = 4)
Mean	52.22	59	53.25
Mode	45	59	47, 50, 52, 64
Median	49	59	51
Low-high	34–69	—	47–64
Range	36	—	18
SD	11.65	—	7.46

Table 6. Results of the independent t-test for the left-brain and right-brain learners in Group 1

	Left-brain	**Right-brain**
Mean	52.22	53.25
N	9	4
Df	11	
Tobs	0.165	
Tcrit	2.201	
p (two-tailed)	.05	

Table 7 presents the statistical data from the pronunciation test for Group 2. Once again, the whole-brain subjects managed to achieve the highest mean score, while the left-brain learners' mean was the lowest. The outcome of the independent t-tests, shown in Table 8, confirmed that the results of the left-brain and whole-brain learners were statistically significant at $p<.05$; therefore, H1 of the study was validated. The differences between the left-brain and right-brain learners, and between the right-brain and the whole-brain learners, were not significant at $p<.05$.

Table 7. Results of the pronunciation test for Group 2

	Group 2		
	Subgroups		
	Left-brain (*N* = 10)	**Whole-brain** (*N* = 7)	**Right-brain** (*N* = 10)
Mean	57.00	69.43	64.20
Mode	58, 60	57, 61, 62, 70, 74, 79, 83	55
Median	58.5	70	62.5
Low-high	44–68	57–83	49–93
Range	25	27	45
SD	6.83	9.81	12.38

Table 8. Results of independent t-tests for the left-, right- and whole-brain learners in Group 2

	Left-brain	**Whole-brain**	**Left-brain**	**Right-brain**	**Right-brain**	**Whole-brain**
Mean	57.00	69.43	57.00	64.20	64.20	69.43
N	10	7	10	10	10	7
Df	15		18		15	
Tobs	**3.314**		1.645		0.931	
Tcrit	**2.131**		2.101		2.131	
p (two-tailed)	**.05**		.05		.05	

Table 9 compares the results for the three brain-dominance types found in Group 3. This time, the right-brain learners scored the highest. The whole-brain subgroup achieved the lowest mean score, with the left-brain students' results in the middle.

Table 9. Results of the pronunciation test for Group 3

	Group 3		
	Subgroups		
	Left-brain (*N* = 9)	**Whole-brain** (*N* = 3)	**Right-brain** (*N* = 11)
Mean	77.00	70.33	90.82
Mode	80	59, 62, 90	70, 77, 78, 79, 82, 86, 98, 100, 105, 110, 114
Median	77	62	86
Low-high	70–82	59–90	70–110
Range	13	32	41
SD	4.15	17.1	15.07

Table 10. Results of the independent t-test for the left, right and the whole-brain learners in Group 3

	Left-brain	**Whole-brain**	**Left-brain**	**Right-brain**	**Right-brain**	**Whole-brain**
Mean	77.00	70.33	77.00	90.82	64.20	69.43
N	9	3	9	11	10	7
Df	10		18		12	
Tobs	1.250		**2.516**		2.000	
Tcrit	2.228		**2.101**		2.179	
p (two-tailed)	.05		**.05**		.05	

Table 10 presents the statistical analysis for the left-, right- and whole-brain subjects in Group 3. The differences between the left-brain and the whole-brain learners, and between the right-brain and the whole-brain participants were not statistically significant at $p<.05$. However, significant differences were found be-

tween the left-brain and the right-brain dominant subjects at $p<.05$, substantiating H2 of the research.

4. Conclusion

The research aimed at verifying the influence of brain dominance on learners' proficiency in the perception and production of English pronunciation. The data obtained clearly indicate that whole-brain and right-brain students are better at pronunciation than left-brain dominant learners.

First, it has to be noted that the mean pronunciation test scores varied considerably among the three brain-dominance types. The left-brained participants did not achieve the highest results in any of the research groups whose pronunciation test results could be statistically analysed. Two research hypotheses were validated: The results revealed that there are statistically significant differences between the pronunciation proficiency of left-brained and whole-brained learners (H1), and between the pronunciation proficiency of left-brained and right-brained participants (H2). In both cases, the left-brained score was lower.

The outcome of the study corroborates the findings of research conducted by Elliott (1995) and Baran-Łucarz (2007), which are outlined in the theoretical part of the present article (section 2.1, above). Both those authors viewed the right hemispheric preference as facilitating the acquisition of second-language pronunciation. However, Elliott considered this relation to be true only when the learners are engaged in communicative tasks producing the target language spontaneously. The findings of the present study contradict this assumption, since the pronunciation test did not entail any communicative tasks.

The findings of the present study suggest that although the left hemisphere is thought to be the centre of language functions, its cortical counterpart is also of crucial importance in the acquisition of second-language pronunciation. Perhaps the reason for that lies in the right hemisphere reception and processing of sounds — an explanation that would correspond with the notion of right-brain people being good at music.

Furthermore, the level of significance of the results of this study seems to vary depending on the subjects' level of general English proficiency. The members of research Group 4, who achieved the highest score in the pronunciation test, were all left-brain dominant. This corroborates Fabbro's (1999) explanation of the right hemisphere being used more frequently at the beginning of the foreign language learning process.

The results of the research did not allow clear differentiation between the pronunciation abilities of right-brain and left-brain learners. Therefore, it would be worthwhile to repeat the study in order to clarify and validate the findings presented in this article.

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