Teaching Phonetics from a Brain Dominance Theory Perspective: A Way to Optimise EFL Students' Pronunciation

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Abstract

Pronunciation is very challenging to many students. This issue may be due to the effects of brain lateralisation, in which the learners tend to use the dominant hemisphere. Thus, this paper endeavours to promote EFL students' pronunciation through the integration of a brain-based course. It attempts to explore the field of neurolinguistics and investigate the effects of brain dominance in teaching and learning phonetics. A pre-test/post-test experiment is used to examine the students' achievement. The major findings reveal that teaching phonetics regarding students' brain dominance is very effective in enhancing their performance.

Keywords: Neurolinguistics, brain dominance theory, phonetics, brain-based course, brain hemispheres.

تدريس علم الصوتيات من منظور نظرية هيمنة الدماغ: طرق لتحسين نطق طلبة اللغة الإنجليزية كلغة أجنبية

ملخص

يعتبر النطق تحديًا كبيرًا للعديد من الطلاب وقد يكون سبب ذلك آثار انقسام الدماغ وهيمنة أحد شقي الدماغ على الآخر حيث يميل الطلاب غالبا إلى استخدام شق الدماغ السائد. يسعى هذا المقال إلى تعزيز نطق طلاب اللغة الإنجليزية كلغة أجنبية من خلال دمج دورة لعلم الصوتيات تأخذ بعين الاعتبار الدماغ. وتحاول هذه الدراسة الاطلاع على مجال علم اللغة العصبية ودراسة آثار هيمنة الدماغ عند تدريس وتعلم علم الصوتيات. وتتبع هذه الدراسة منهج ما قبل وما بعد الاختبار لفحص إنجازات الطلاب قبل وبعد الدورة التدريبية. وقد كشفت النتائج الرئيسية للدراسة أن تدريس علم الصوتيات مع مراعاة هيمنة أحد شقي الدماغ على الآخر لدى الطلاب فعال للغاية في تعزيز أدائهم.

الكلمات المفاتيح: علم لغة عصبية، نظرية هيمنة دماغ، صوتيات، دورة تدريبية وفق دماغ، شقي دماغ.

Enseigner la phonétique à partir de la théorie de la dominance cérébrale: un moyen d'optimiser la prononciation des étudiants d'Anglais langue étrangère

Résumé

La prononciation est très difficile pour de nombreux étudiants. Ceci peut être dû aux effets de la latéralisation cérébrale, dans laquelle les apprenants utilisent l'hémisphère dominant. Cet article vise à explorer la neurolinguistique et d'étudier les effets de la dominance du cerveau dans l'enseignement et l'apprentissage de la phonétique pour promouvoir la prononciation des étudiants en langue Anglaise. Une expérience pré-test/ post-test est utilisée pour examiner les performances des étudiants. Les résultats révèlent que l'enseignement de la phonétique en considérant la dominance cérébrale des apprenants est très effectif.

Mots-clés: Neurolinguistique, théorie de dominance cérébrale, phonétique, cours basé sur cerveau, hémisphères.

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Introduction:

Insights from the field of neuroscience that explore the human brain and its functions in learning have attracted the attention of researchers in the field of education. However, implementing these findings into educational practices, particularly in EFL classes, seems conspicuously absent. Knowing more about the brain would help educators adapt and enrich their lessons in order to maximise their students' performance. In this regard, the present study attempts to investigate the possibility of improving the students' achievement in phonetics through a brain based course. In fact, pronunciation seems a problematic issue to many students. This can be due to the teaching methods adopted by many teachers that usually do not go in line with all the students' most dominant brain side. It is hypothesised that EFL learners' performance in English pronunciation would improve if a brain-based course was used. To reach this objective, an alternative approach, which primarily reforms the classical teaching methods of English pronunciation by more brain stimulating activities, was used in this study.

1- Literature Review:

In this section, concepts and different studies about the brain and lateralisation are discussed. Because having a clear understanding of the core element in neurolinguistics - the brain - is important, an anatomic overview to this complex organ is needed in addition to a brief definition of the field of research.

1-1- Neurolinguistics:

Neurolinguistics is the study of language and the brain. The field of neurolinguistics is connected to many other disciplines such as neuroscience, linguistics, psychology, pathology, for example. Thus, it is important to draw the boundaries of this research field with some definitions. Caplan states that neurolinguistics is a discipline which stresses out three important features concerning the brain: how it represents and uses the language, how it evolves, and how it is affected by diseases**(1)**. Ahlsén (2006) defines neurolinguistics as an area that mainly explores the relationship between language, communication, and brain functions. The main concern of neurolinguistics is to determine how the brain first understands language, and second, how it produces it. This is achieved through the combination of two important theories: (a) the neurological/neurophysiological theory, and(b) the linguistic theory. The first concerns the structure and the function of the brain; whereas the second concerns the structure and the function of language**(2)**. As far as its relation to the other disciplines is concerned, Ahlsén (2006) further adds that neurolinguistics is closely related to psycholinguistics, except for the former which is rather interested in brain research**(3)**. Neurolinguistics, unlike psycholinguistics which studies the process of language development in the mind, is the scientific study of the link between language and the brain. It mainly explores the functions of the different parts of the brain**(4)**.

The study of brain-language relationship began in the 19th century, after the landmark studies of Broca (1861), the neurologist who identified the responsible areas of the brain in language development and the correlation between language disturbance and the brain damages**(5)**. These studies reached their utmost evolution due to the impact of some brain injuries that resulted in many language problems. Khan, Mahmood, and Uzair (2011) point out to the fact that the brain is not responsible only for the control of different physical functions such as movements, but it is also responsible for language development**(6)**. It should be noted that neurolinguistics has provided numerous studies on language, the brain, and on how language learning takes place. As Ebrahimi (2014, p.22) rightly puts, "knowing about the human's brain, its physical and neurological structure, as well as its functions seems vital to understanding, for they provide a better picture of the processes involved in second language acquisition"**(7)**. In view of that, it is relevant, in the present research, to provide the reader with an anatomic overview of the brain and how it affects language teaching and learning.

1-2- The Brain:

The human body comprises a series of interrelated systems, each of which is responsible for specific functions such as the respiratory, circulatory, digestive, reproductive, muscular, skeletal and nervous systems. The major part of the latter, which controls the other systems, is the brain[(8)]. The brain is a body organ that lies within the skull. Hoffelder and Hoffelder (2007, p.13) describe the brain as "a convoluted, wrinkled, ropy looking, pinkish-gray mass that looks something like a large mushy walnut"[(9)]. Scannell and Burnett (2010) provide a texture description of the brain stating that brain is a firm cottage cheese consistency and a soft tofu texture. They add that the brain weights about 3 pounds in the average adults and that it consists of almost 78% water, 9% fat, and around 8% protein[(10)]. Surprisingly, the brain, which is the body information processing centre, makes only 2% of the total body weight[(11)] and consumes almost 25% of the body's total energy[(12)].

Anatomically, the brain consists of three major subdivisions namely: the brain stem, the cerebellum and the cerebrum.

The brain stem is one of the major parts of the brain. It lies in the lower portion of the brain, directly connected to the spinal cord[(13)]. It performs many functions in the body, particularly the vital function. It regulates heart rate, blood pressure, breathing, digestion, attention and consciousness[(14)].

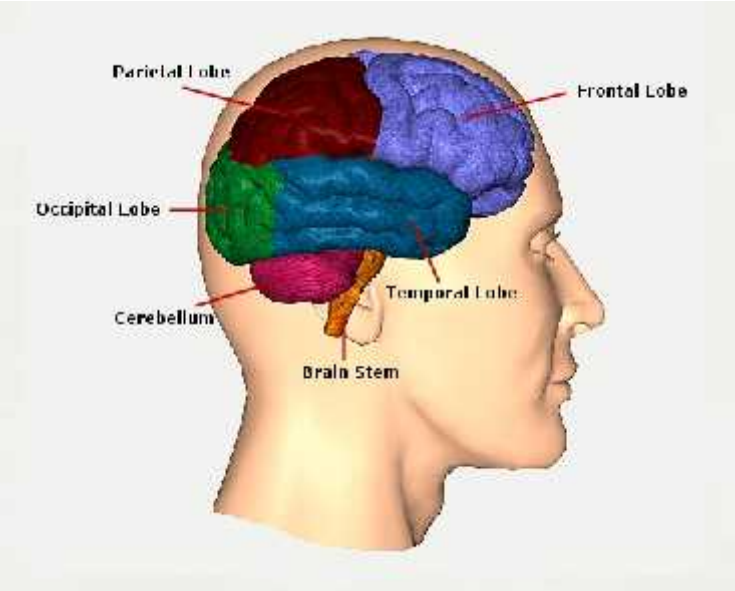
The Cerebellum or "little brain" represents only 10% of the brain and weights approximately 150 grams. It is located below the cerebrum and behind the brain stem. Its function is related to voluntary movements and some cognitive functions and emotions such as crying and laughter[(15)].

The Cerebrum consists of many portions: (a) the thalamus which controls the level of consciousness, (b) the hypothalamus which controls the body's internal environment, (c) the hypophysis, (d) the epithalamus, and (e) the two cerebral hemispheres. The cerebrum is the section of the brain that is responsible for language, speech, memory and also movements[(16)].

1-3- The Brain Hemispheres:

The brain is divided into two halves, left and right, which are called brain hemispheres. The connection between the two hemispheres is realised via a thick fibrous band called 'the corpus callosum'. Each side is subdivided into four lobes namely: the frontal, the parietal, the occipital and the temporal lobe[(17)] (See **Figure 1**)

Figure n°1: Structure of the Brain



Source: (Lehr Jr, 2018) [(18)]

The Frontal Lobe is located right behind the forehead[19]. It is responsible for various functions including planning, problem solving, voluntary movements and, most importantly, language production[20]. Erlauer (2003), notes that the frontal lobe is especially involved in conscious thinking [21].

The Parietal Lobe is located above the occipital lobe[22]. It directs touch, pain, temperature, pressure and other sensations such as the perception of the shapes and the sizes of different objects[23].

The Occipital Lobe is situated under the skull, caudal to the cerebrum. Its functions include mainly visual perception. In addition, it connects different colours or objects with memories and any previous experiences[24].

The Temporal Lobe lies under the parietal and the frontal lobe, and is situated in front of the occipital lobe. It is involved in both visual and auditory inputs, as indicated by Clark, Boutros, and Mendez (2010)[25]. Thus, the temporal lobe is the one responsible for memories' retrieval based on the information it perceives through the ear. Besides sounds interpretation, the temporal lobe is also involved in face recognition and language comprehension[26].

1-4- Brain Dominance Theory:

By definition, brain dominance, also referred to as brain lateralisation, means that each of the brain hemispheres controls different functions. This creates a distinction between the left hemisphere and the right hemisphere in directing different tasks[27]. For instance, people with a left-dominant side tend to be more analytical and logical. By contrast, people with a right-dominant side tend to be more intuitive and subjective[28].

The brain dominance theory has always been subject to a great debate. It is highly believed that people use absolutely both sides of the brain. The truth is that one side seems to be more dominant than the other, resulting in different cognitive styles and preferences[29]. Nonetheless, one of the latest studies claims that the left/right brain dominance theory is a myth and the result of pop psychology[30]. Bielefeldt (2006) clearly states that the brain lateralisation, which is a more technical term for brain dominance, is the state of using one hemisphere more dominantly than the other. He further adds that even though people's brain is lateralised, they use, at least, some of each side of their brains in chorus[31]. This denotes that the brain dominance theory is way far from being a myth. In the same context, Ashraf, Samir, and Yazdi (2017, p.67), state that "Brain Dominance refers to improved cooperation between the right and left hemispheres of the brain in the process of learning"[32]. Saleh (2001) reviews numerous studies that tackle brain hemisphericity revealing the effects of teaching using approaches that match the students' brain dominance preferences (namely Boyle and Dunn 1998; Brennan, 1984; Dunn, Sklar, Beaudry, & Bruno, 1990; and Jarsonbeck, 1984), as cited in Saleh, 2001[33].

One of the world-shattering researches in the field was initiated by Roger W. Sperry, who won a Nobel Prize in 1981. Sperry conducted a study on his aphasic patients and came up with a series of theories that concern the brain hemisphericity. He found that the left hemisphere, on the one hand, is more analytical, rational and logical in processing information and that it has a tendency to control language processing. The right hemisphere, on the other hand, is more intuitive in synthesis and tends to manage spatial and visual information[34].

Table n°1: Functions of the Hemispheres

Left Hemisphere	**Right Hemisphere**
Language – Speech	Seeing - Locating (Visuospatial)
Verbal Sounds: words, consonants	Non-verbal Sounds: barking, whistling
Analytical Processing: seeing the details in a picture	Holistic Processing: seeing the bigger picture
Listening – Reading	Metaphor - Poetry –Humour
Writing – Speaking	Music, Intonation, Rhythm
Abstract Words: loyal, freedom	Concrete Words - desk, jacket

Calculation	Recognition
Thinking	Attention, Emotion
Word puzzles	Art - Colours
Logical: Cause and Effect	Drama
Good with numbers	Face recognition
Factual	Imaginative

Source: Celik, 2007, cited in Dülger, 2012 [(35)]

Table 1 displays the different functions related to each hemisphere. Accordingly, one of the hemispheres is more involved in some functions than the other, notwithstanding that they work together[(36)].

For many people, showing a particular preference towards one of the hemispheres leads to some differences in terms of personal characteristics and behaviours. Based on many studies about the brain, the major differences between the left and the right brain dominance are indicated in Table 2.

Table n°2: Characteristics of Left and Right Brain Dominance

Left Brain Dominance	**Right Brain Dominance**
Analytical, linear and sequential	Holistic, Synthesising
Intellectual, logical in problem solving	Intuitive in problem solving
Verbal functions and prefers verbal instructions	Visual and spatial processing, prefers symbol illustration
Remembers name	Remembers faces (face recognition)
Facts and logic	Imagination
Objective	Subjective
Planned and structured	Fluid and spontaneous
Reliance on language in thinking and remembering	Reliance on images in thinking and remembering
Prefers talking and writing	Prefers drawing and manipulating objects (emotional perception)
Prefers multiple choice tests	Prefers open-ended questions
Controls feelings	Emotional and more free with feelings
Not good at body language and rarely uses metaphors	Good at body language interpretation and favours the use of metaphors
Counting, number skills, and math	Sense of humour and musical activities

Sources: [(37, 38)]

It is clearly displayed in the table above that there are great disparities between the left and the right sides of the brain. Sometimes, they are not only differences, but completely the opposite characteristics. Yet, it is worth mentioning that both hemispheres work together as a "team", as stated by Brown (2000, p. 118)[(39)]. Despite all the differences, some people can rely on both hemispheres, i.e. whole brain dominance. As Dülger (2012) points out, being a whole-brained learner is advantageous in instructional learning. However, using one side more dominantly than the other without significant awareness about the characteristics of this hemisphere and what matches with it the most can affect the learning process and one's outputs[(40)]. Bielefeldt (2006; p.7), for instance, praises the importance of having a clear understanding of the brain and its functions in the teaching process. He writes:

It is important for instructors to have knowledge of brain hemisphericity in order to identify the advantages and disadvantages in their teaching techniques and understand when and how to develop and use certain techniques. In addition, knowledge of brain hemisphericity can assist them in becoming more flexible and effective in teaching in the classroom[(41)].

Therefore, being knowledgeable about the brain dominance does not only help the learners improve their achievement, but also helps the teachers enhance their teaching methods. The teachers may improve their efficiency and ensure that they appeal to their students with different brain dominance styles[(42)]. This can be also achieved, as far as teaching and learning English pronunciation is concerned, which is the core concept discussed in this research paper.

1-5- Brain-Based English Pronunciation Teaching:

At present, brain based education is noticeably getting a substantial recognition. Numerous studies are directed towards the translation of neuroscience findings into educational scenery. Thus far, many studies have overlooked brain based teaching and learning English pronunciation. Several studies on language localisation conclude that language is localised in the left hemisphere. Two brain areas are identified called: Broca's area and Wernicke's area. Dulger (2012) explains that the Broca's area is responsible for expressive language functions, whereas the Wernicke's area is responsible for understanding functions[(43)]. As Turkington (2002) states: " Broca's area is usually associated with maintenance of a list of words and parts of words used in producing speech and their associated meanings. It has been linked to articulation of speech and semantic processing (assigning meanings to words)"[(44)]. This denotes that the broca's area is the part of the brain that is related to the physical aspect of speech production through the movement of the articulators (i.e. the organs of speech). The wernicke's area is mainly associated with speech understanding and involved in memory functions related to speech recognition and auditory functions[(45)]. In other words, it is a part of the brain that is involved in memory function and understanding the meaning of the produced sppech. Therefore, the two areas, located in the left hemisphere of the brain, work together in speech production, memory and comprehension.

It is worthy to mention that without the brain the production of speech is impossible. In this respect, Gut (2009) asserts that the brain controls the movements of all organs of speech involved in the articulation of sounds[(46)]. This shows the correlation between the brain (left hemisphere) and phonetics (production, storage, and perception). In fact, pronunciation is being taught based on traditional methods and the use of some common activities of phonetics[(47)]. Nonetheless, a recent study conducted by Czajka (2012) has tackled the impact of brain dominance on learning English pronunciation. It concludes that a strong correlation exists between brain dominance hemisphericity and success in second language pronunciation[(48)]. Following the same pathway, this research paper tries to scrutinise the effects of brain dominance on the students' performance in English pronunciation. It attempts to enrich phonetics lectures from a brain dominance perspective for a better students' achievement.

2- Methodology:

As formerly stated, the foremost objective of this study is to examine the performance of EFL learners in English pronunciation from a neurolinguistic approach. That is the integration of neuroscience findings in language teaching and learning landscape, particularly Phonetics. To achieve this objective, an experimental design is opted for in this research work.

2-1- Participants:

The experiment is carried out during the academic year 2017-2018 on a total of 40 first year BA students, at the Department of English, University of Frères Mentouri Constantine 1. The sample of the participants is equally divided into two groups: control group and experimental group. Moreover, the experimental group is divided into two subgroups, one for the left brained learners and the other for the right brained learners. This subdivision is needed to adapt the course of phonetics according to the participants' brain dominance characteristics.

2-2- Research Instruments and Procedure:

In order to address whether or not a brain-based course of phonetics can enhance the students' proficiency in English pronunciation perception and production, several tests are used as data collection tools. First, three brain tests are administered to identify the brain

dominant side of the subjects. The first brain test is adopted from Frender (2004)[(49)], which consists of 50 statements that describes one's preferences in learning regarding brain dominance theory. The second one is an online brain test with instant results[(50)] and the third one is a brain questionnaire revised by Davis (1994 as cited in Ingleby, Joyce, and Powell (2010)[(51)]. The questionnaire consists of multiple choice questions, in which each provided choice works for a particular side of the brain (left brain, right brain, or whole brain). The participants' chosen options reflect their brain dominant side. Second, a pre-test and a post-test of phonetics are used to determine the effectiveness of a brain-based course on the students' performance (see appendices). In other terms, the pre-test is used to identify the level of the students in English pronunciation.

Afterwards, a brain-based course of phonetics is integrated in the classroom for the students of the experimental group. Later, a post-test is designed with regards to the elements taught in the classroom for both groups, and administered to the participants to determine to what extent the implementation of a brain-based course in phonetic classes can be efficient in improving the learners' level. It is worth mentioning that the difference between the integrated course and the traditional course is that the former gives huge importance to the students' brain hemisphere dominance. To explain further, the activities employed in this course are adapted to the brain dominant side of the students. This explains the presence of two sub-groups: one for left brained students and the other for right brained students. Although many common activities and techniques of teaching phonetics for both sub-groups, many activities are very specific. To illustrate, phonetics is taught to the left brained participants through outlines, note taking activities, auditory instruction, with detailed lessons in a clean and organised classroom. These students work on assignments and quizzes individually. On the other hand, the right brained students are taught phonetics through visual aids such as pictures, charts and videos. They prefer simplified lessons rather than detailed ones and work mostly in groups. Most of the activities that are common are the integration of games, music and the sense of humour to create a friendly atmosphere. For further details, Frender (2004) suggests a set of techniques used in a brain-based course in which she classifies these techniques into two distinguished classes: left and right[(52)]. Caine and Caine (1990) provide some teaching implications of brain-based education[(53)].

Particularly, this research is settled in order to find out whether the treatment enables the students of the experimental group to achieve better grades when compared to the grades obtained by the students of the control group. It is worthy to mention that the course adopted in this experiment lasts 15 weeks with 90 minutes per week focusing on teaching vowels and consonants. Both the pre-test and the post-test consist of exercises that cover vowels and consonants, which are the key elements of the first year syllabus of phonetics at the University of Frères Mentouri Constantine 1.

3- Results:

This section is devoted to the results obtained in the experiment. It shows the students' scores in all the tests, in both the control and the experimental groups.

3-1- Brain Dominance Test:

The results obtained from the three tests reveal a diversity in both groups where there are left brained, right brained and even whole-brained (bilateral) students. The latter means that the students have a balanced brain regarding the two hemispheres. To elucidate, three brain tests are used in this study so as to avoid any kind of confusion where there are students who simply scored as left brained in one test and right brained in another. This leads to a contradiction, where a final test is indispensable to firmly determine the truly dominant side of their brain. In the other situations where the results are similar in two brain tests, the third one is used simply in order to double check the obtained scores.

- **The Control Group:**

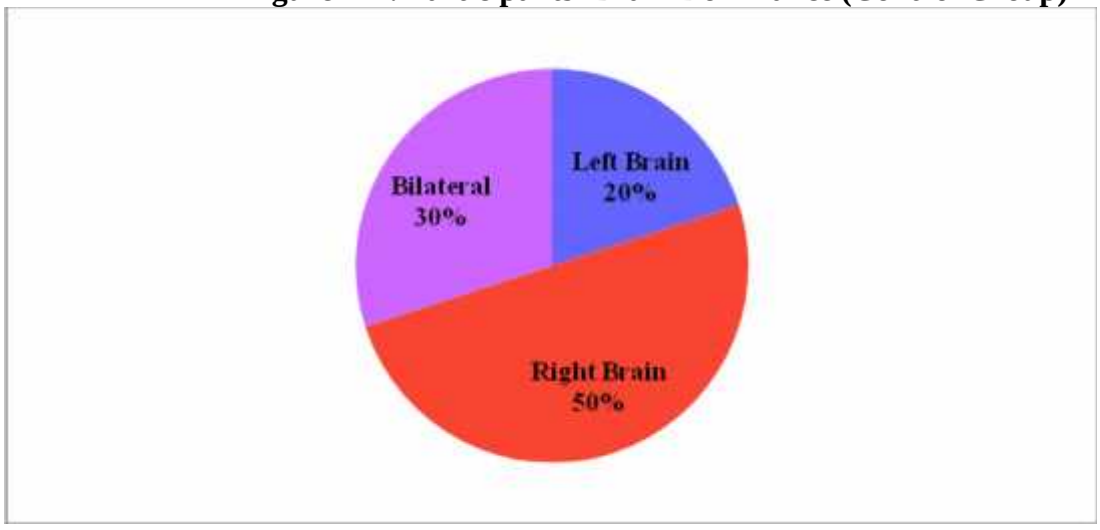
Table 3 represents the scores obtained by the subjects of the control group in the three brain dominance tests.

Table n°3: Students' Results in the Brain Dominance Tests (Control Group)

Students	Brain Test 1	Brain Test 2	Brain Test 3	Brain Dominance
1	Left brain	Right brain	Left brain	Left brain
2	Left brain	Left brain	Bilateral	Left brain
3	Right brain	Right brain	Right brain	Right brain
4	Right brain	Bilateral	Bilateral	Bilateral
5	Left brain	Right brain	Right brain	Right brain
6	Left brain	Left brain	Left brain	Left brain
7	Bilateral	Right brain	Bilateral	Bilateral
8	Left brain	Bilateral	Left brain	Left brain
9	Bilateral	Right brain	Right brain	Right brain
10	Bilateral	Bilateral	Bilateral	Bilateral
11	Right brain	Right brain	Right brain	Right brain
12	Bilateral	Bilateral	Bilateral	Bilateral
13	Right brain	Bilateral	Right brain	Right brain
14	Bilateral	Bilateral	Left brain	Bilateral
15	Bilateral	Left brain	Bilateral	Bilateral
16	Right brain	Right brain	Right brain	Right brain
17	Bilateral	Right brain	Right brain	Right brain
18	Right brain	Bilateral	Right brain	Right brain
19	Bilateral	Right brain	Right brain	Right brain
20	Right brain	Right brain	Bilateral	Right brain

As can be seen from the table above, the majority of students in the control group are right brained with a total of 10 students (50%), i.e. half of the group are right brained learners, whereas the other half is divided between left brained learners with a total of just 4 students (20%) and bilateral learners with a total of 6 students (30%), see **Figure 2.**

Figure n°2: Participants' Brain Dominance (Control Group)



- **The Experimental Group:**

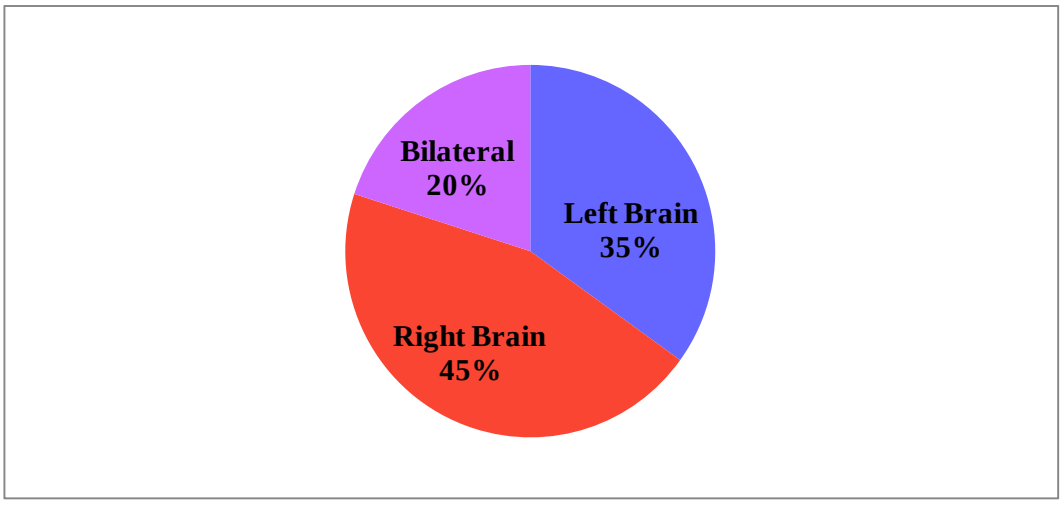
Table 4 represents the scores obtained by the subjects of the experimental group in the three brain dominance tests.

Table n°4: Students' Results in the Brain Dominance Tests (Experimental Group)

Students	Brain Test 1	Brain Test 2	Brain Test 3	Brain Dominance
1	Right brain	Right brain	Right brain	Right brain
2	Bilateral	Right brain	Right brain	Right brain
3	Right brain	Right brain	Right brain	Right brain
4	Right brain	Bilateral	Right brain	Right brain
5	Left brain	Left brain	Left brain	Left brain
6	Left brain	Bilateral	Left brain	Left brain
7	Left brain	Left brain	Bilateral	Left brain
8	Right brain	Right brain	Bilateral	Right brain
9	Bilateral	Right brain	Right brain	Right brain
10	Right brain	Right brain	Right brain	Right brain
11	Right brain	Right brain	Right brain	Right brain
12	Left brain	Bilateral	Left brain	Left brain
13	Right brain	Bilateral	Bilateral	Bilateral
14	Left brain	Left brain	Bilateral	Left brain
15	Right brain	Right brain	Bilateral	Right brain
16	Bilateral	Left brain	Left brain	Left brain
17	Bilateral	Bilateral	Bilateral	Bilateral
18	Left brain	Left brain	Bilateral	Left brain
19	Bilateral	Bilateral	Bilateral	Bilateral
20	Bilateral	Bilateral	Bilateral	Bilateral

Considering the table above, it is obvious that the group is diverse with 9 right brained students (45%), 7 left brained students (35%) and only 4 bilateral students (20%), (see **Figure**

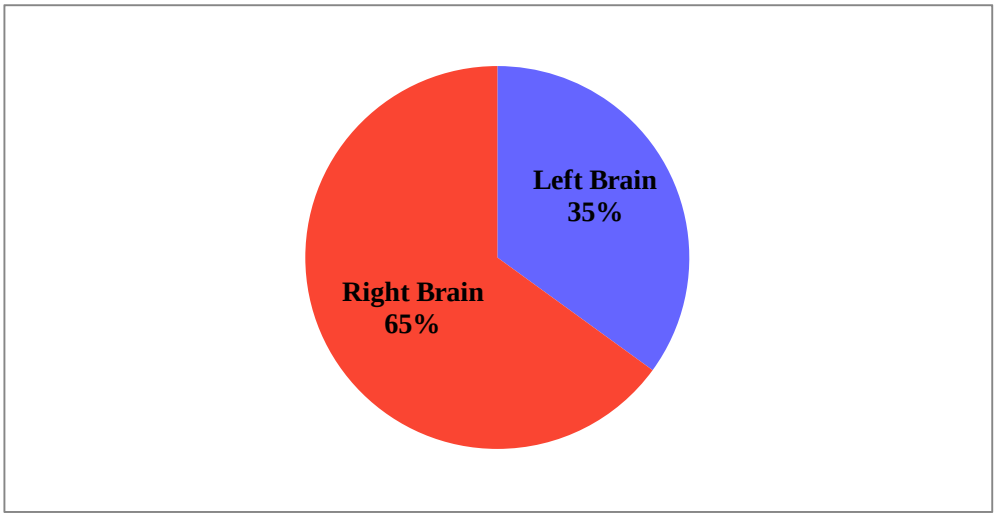
Figure n°3: Participants' Brain Dominance (Experimental Group)



Since the main concern of this paper is to investigate the effects of brain-based phonetics teaching, the students of the experimental group, need to be divided into two sub-groups in which the teacher uses the most appropriate teaching methods and techniques in each sub-group corresponding to their brain dominance. In more explicit terms, the first sub-group is created for right brained learners in addition to those who have a bilateral brain. As a matter of fact, these students can adapt in both sub-groups and any teaching method seems to be fine for them. Thus, being in any sub-group does not affect their output. Nonetheless, the reason behind including these participants within the right brained learners' sub-group in particular is

that these participants show preferences towards the right side, precisely in the second brain-test. Therefore, the number of participants in the first sub-group becomes 13 students, 65%. The remaining 7 participants, 35%, compose the second sub-group (see **Figure 4**).

Figure n°4: Left/Right Sub-groups (Experimental Group)



3-2- Pre-/Post-test Results:

In this section, the students' scores obtained in the pre-test and the post-test are provided for the sake of comparing the achievement of the participants in the control group with those in the experimental group. In order to check the validity of the hypothesis set in this research paper, both a paired sample t-test and an independent sample t-test are calculated in order to analyse the collected data and have more reliable interpretation as the regards the statistical significance. The first t-test compares means in the pre-/post-tests from the students of the same groups (i.e. the control group and the experimental group). The second, on the other hand, compares the means for both the control group and the experimental one in order to examine the effectiveness of the treatment. All the data obtained are analysed using SPSS (Statistical Package for Social Sciences). Descriptive statistics such as the mean and the standard variation are reported using the same statistical programme.

- **The Control Group:**

Table 5 presents the obtained scores by the students of the control group in the pre-test, the post-test with the differences between each test results.

Table n°5: Students' Results in the Pre/Post tests (Control Group)

Student (Control Group)	**Pre-test Scores**	**Post-test Scores**	**Differences**
1	6	9.5	3.5
2	5.75	7	1.25
3	8.5	5.75	-2.75
4	14.75	12	-2.75
5	10	10	0
6	5	3	-2
7	6	5	-1
8	9	9.25	0.25
9	7.5	3	-4.5
10	6.75	5.25	-1.5
11	3	4.25	1.25

12	12	8.25	-3.75
13	2.5	3.75	1.25
14	8	11	3
15	14.25	15.75	1.5
16	3	1.5	-1.5
17	6.25	6.5	0.25
18	12.5	12	-0.5
19	7	9	2
20	11.5	8.75	-2.75

A glance at Table 5 reveals that there is no highly significant improvement in the subjects' performance comparing their scores in the pre-test with those in the post-test.

Table n°6: Paired Samples Statistics (Control Group)

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test Scores	7.9625	20	3.60215	.80547
	Post-test Scores	7.5250	20	3.66518	.81956

As Table 6 displays, the mean for the students' scores in the pre-test is 7.96. The mean for the students' scores in the post-test is 7.53. This indicates that there are no statistically significant differences in the subjects' scores. The standard deviation (Std. Deviation) for the pre-test scores is 3.60, and for the post-test is 3.67. This denotes that both values are almost the same for a total size of 20 participants (N=20).

Table n° 7: Paired Samples Test (Control Group)

		Paired Differences					Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		
					Lower	Upper	
Pair 1	Pre Test Scores - Post Test Scores	.43750	2.23882	.50062	-.61030	1.48530	**.393**

Table 7 shows the actual results obtained via the test. One essential value figures in this table, precisely in the last column labelled Sig. (2-tailed). In other references, the Sig-2tailed value stands for the p-value. Statistically speaking, if this value is less than or equal to 0.05, this means that there is a significant difference between the two obtained results due to particular conditions. It is noted in this test's results that the Sig. 2-tailed value equals 0.393. That is to say, there is no statistically considerable change in the students' grades. At a first glance, it is noticed that there are some differences of the students' scores in the tests. However, these differences are due to other factors rather than any specific treatment. The mean difference between the overall performances of the subjects in the control group is 0.4375, which is very little to be considered. Therefore, one may simply state that the difference between both tests is very small, and, hence, the students' progress in phonetics is also very small.

- **The Experimental Group**

In this section, the results obtained by the participants of the experimental group are given.

Table n° 8: Students' Results in the Pre/Post tests (Experimental Group)

Students (Experimental Group)	Pre-test	Post-test	Differences
1	6	13	7
2	8.5	13	4.5
3	14.25	16.25	2
4	10	14.5	4.5
5	5	9	4
6	6	7.25	1.25
7	5.5	8.5	3
8	7.5	12	4.5
9	6.75	13.25	6.5
10	15	17	2
11	9	11	2
12	7.5	6	-1.5
13	12.5	12	-0.5
14	11	10	-1
15	4.5	8.25	3.75
16	3	8.75	5.75
17	8	14	6
18	14	16.5	2.5
19	10	10	0
20	10.75	13.25	2.5

Considering Table 8, it is revealed that the greatest majority of the students have considerably improved their scores. One may note that the differences between the means from the pre-test and post-test are positive, except for very few ones. Table 9 confirms this claim where the statistical results are shown in more details.

Table n° 9: Paired Samples Statistics (Experimental Group)

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre Test (EG)	8.7375	20	3.41675	.76401
	Post Test (EG)	11.6750	20	3.16238	.70713

A closer look at Table 9 indicates that the mean for the pre-test is 8.7375 whilst it has increased to 11.6750 for the post-test results. Statistically speaking, this represents a highly significant improvement. In other words, the participants have achieved higher scores in the post-test.

Table n° 10: Paired Sample Test (Experimental Group)

		Paired Differences					Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		
					Lower	Upper	
Pair 1	Pre Test Scores - Post Test Scores	-2.93750	2.48267	.55514	-4.09943	-1.77557	**.000**

As previously interpreted in the control group results, the Sig (2-tailed) or the p-value is the most important element to consider in Table 10. It indicates **.000**, which is a very low

value. The exact p-value reported by SPSS programme is .000042. It is then worth noting that there is a huge difference in the participants' scores. This leads to one important conclusion that the participants have improved their scores and have shown a great difference from a statistical point of view. Knowing that the treatment is highly effective and positively influential leads to the confirmation of the hypothesis. In other words, teaching phonetics from a brain dominance theory perspective is highly effective in developing the performance of the students of the experimental group.

- **The Control Group Vs the Experimental Group:**

As previously stated, the most important concern of this research paper is to identify whether the students of the experimental group have improved their scores in phonetics compared to the students of the control group. In the following table, descriptive statistics comparing the two groups are displayed.

Table n° 11: Control Vs Experimental Groups' Statistics

Group		N	Mean	Std. Deviation	Std. Error Mean
Difference	Control Group	20	-.4375	2.23882	.50062
	Experimental Group	20	2.9375	2.48267	.55514

This table indicates that the mean for the control group is -.4375 while it is 2.9375 for the experimental group. This means that the scores of the participants of the experimental group are much higher than the control group. A detailed description of the statistical results, obtained by means of the independent sample t-test, is given in the following table.

Table n° 12: Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig	T	df	**Sig. (2-tailed)**	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variance Assumed	.138	.712	-4.515	38	**.000**	-3.3750	.74753	-4.88829	-1.86171
Equal variance not assumed			-4.515	37.6	**.000**	-3.3750	.74753	-4.88882	-1.86118

In order to decide which row is going to be considered in Table 12, one should look at the second column which is labelled "Levene's Test for Equality of Variance". This value determines whether the tested elements have the same or different variability between scores. The value called Sig. helps to precise when row should be considered for the interpretation. Simply put, if the Sig. value is less than or equal to 0.05, the results should be analysed from the bottom row. By contrast, if the Sig. value is greater than 0.05, the top row should be considered. As seen in Table 12, the Sig. value is 0.712. This means that we need to read the results from the top row. In the latter, the first element to look at is the Sig 2-tailed value. It enables us to check whether the means for the control group and the experimental group are different from a statistical standpoint. In this case, for instance, the Sig 2-tailed value is **.00**; its exact value that is reported in the SPSS programme is 0.000060. Since this value is less than or equal to 0.05, it is concluded that there is a statistically significant difference between the scores obtained in the control group and those of the experimental one. In other words, the

different means mentioned in Table 12 are not the result of chance or coincidence, but the effect of the treatment.

4- Discussion:

The key concept of the present research paper is the brain lateralisation. It mainly tries to highlight the positive effects of considering the brain in education. Thus, the obtained results revealed that the overwhelming majority of the participants are right brained learners. This creates a great challenge for both the teachers and the learners.

In fact, as most of the teachers use more likely left brained dominant methods of teaching and, thus, it is hard to address the right brained students in the classroom. This is one of the explanations of the students' performance. The challenge is even greater for the learners to understand the syllabus and the teacher. They are mostly confused and unable to enhance their levels to their expectations. These students, unlike left brained learners, are more intuitive, spontaneous, and emotional. This makes many concepts difficult for them to grasp, especially if they are taught based on logic, objectivity, problem-solving activities and structured lessons. The obtained results go in hand with the previous conclusion. They indicate that the participants of the experimental group have got better grades than those of the control group. The most likely explanation is that the learners from the experimental group have received the appropriate teaching methods. They have followed techniques that are not opposing their brain functioning system as it is for the control group learners. This has helped the learners boost their competences in English pronunciation. After the treatment, an important improvement has been seen in the results of the experimental group. At this point, it is worth mentioning that the previously stated hypothesis is confirmed. Accordingly, taking the major findings of this research into account would be beneficial for the sake of optimising the learners' performance in pronunciation mainly.

Conclusion and Recommendations:

Findings from different disciplines such as neurolinguistics seem to be greatly effective at maximising the students' performance. The process of teaching and learning, nowadays, is not a matter of pouring knowledge and testing students. It is more based on building knowledge and developing the skills of active learners rather than passive learners. The motive behind choosing neurolinguistics is the investigation of the correlation between the students' brain dominance and their performance in English pronunciation. Evidently, the learners show a considerable improvement in phonetics when they are instructed with regard to their brain dominance. They show more motivation towards the course and acquired better marks. Hence, one may assert that teaching and learning from the brain dominance theory perspective has an excellent potential in learning. Therefore, in the light of the obtained results, it is highly recommended to consider the learners' brain dominance differences in the classroom and try to address all the learners with adapted syllabus and lessons. Hopefully, this research will pave the way forward to further research in the field from various angles in order to enrich the syllabi of phonetics and other courses. Being knowledgeable about the brain functionalities and the students' characters regarding the most dominant side of their brain enables teachers, and curriculum designers to implement the most adequate teaching methods. Such methods emphasise two important endeavours, which are improving the teaching and learning process and optimising the learners' competencies and skills.

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Appendices:

Appendix A: Pre-test

1. Define the following terms briefly:
A. Acoustic Phonetics: .
B.
C. Larynx:
D. Fill in the blanks with one word only:
E. The is the most flexible organ of speech.
F. When the glottis is the air stream escapes freely.
G. The soft palate, also called the, is a.organ of speech which consists of muscle fibers.
H. Circle the word which has a different vowels sound in the following groups of words**.**
I. Give, fit, drill, time, big.
J. Met, red, threat, many, bead.
K. Bird, hurt, learn, board, church.
L. Underline the words with /u:/ sound.
M. Sport, look, chew, cord, rude, stock, pool, move.
N. Underline the words with /ə/ sound.
O. Mother, serve, close, hear, famous, heard, about, oblige.

P. Classify the following words according to their vowel sounds
Q. Marry, rough, half, hand, lung, stuck, badge, heart, pack, luck, cut, part.

/ɑ:/	**/æ/**	**/ʌ/**

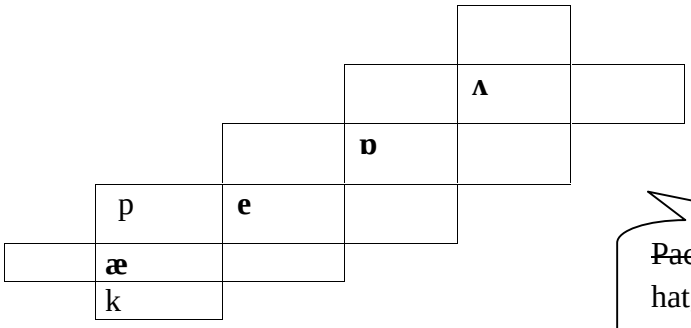
2. Write the following words in Roman alphabet (normal spelling)
/wɪnd/ ……/truː/ ……. /frɒm/…… /tʊk/ ……
3. What is the vowel sound that refers to the following description
a) It is a short vowel, front, close and unrounded:
b) It is a long vowel, mid-open, back, and pronounced with a strong lip rounding:

Appendix B: Post-test

1. Define the following terms briefly.
A. Plosives:
B. Voicing:
C. IPA:
D. Apex:
2. Write the number of sounds in these words.

Word	**Sounds**	**Word**	**Sounds**
Through		Possible	
Example		Measure	
Next		Feast	
Dark		Trick	

3. Give a detailed description of the vowels in the following words.
Hard:
Shot:
Rush:
Underline the words in which their initial is voiceless fricative in the following list.
Night, shape, cars, pieces, gate, force, thief, size.
4. Underline the words in which their final is voiced palato-alveolar.
Math, part, sea, breathe, eyes, half, door, dog.
5. What are the sounds that refer to the following description?
a) Voiceless, velar, plosive:
b) Voiceless bilabial stop:
6. Labio-dental, fricative, continuant, voiced:
7. Write the following words in Roman Alphabet.
a. /nɔːθ/
b. /dɪspjuːt/
c. / fiːldz/
/ pleʒə/
8. Give two words, each includes the following symbols:
a. / ʃ /
b. / ð /
c. / ʤ /
d. / j /
9. Complete the following using the given words. The first word is done for you.



~~Pack~~, cup, pet, gone, get, hat, fun, cot.