

On the Relationship between Right- brain and Left- brain Dominance and Reading Comprehension Test Performance of Iranian EFL Learners

Hassan Soleimani, Ph.D.

Department of Applied Linguistics, Payame Noor University, 19395-3697, Tehran, Iran
arshia.soleimani@gmail.com

Fateme Sharifi Matin

Department of Applied Linguistic, Payame Noor University, Tehran, Iran
fateme_sharifi@yahoo.com

Abstract

A tremendous amount of works have been conducted by psycholinguistics to identify hemisphere processing during second/ foreign language learning, or in other words to investigate the role of the brain hemisphere dominance in language performance of learners. Most of these researches have focused on single words and word pairs (e.g., Anaki et al., 1998; Arzouan et. al., 2007; Faust & Mahal, 2007) or simple sentences (Rapp et al., 2007; Kacinik & Chiarello, 2007), and it has been discovered that there is an advantage of right hemisphere for metaphors and an advantage of left hemisphere for literal text. But the present research was designed to study Iranian EFL learners' performance in different reading tasks, so there could be differences between the consequences of the former research and the results of the present study due to the context. Here left-brain and right-brain dominance was investigated in 60 individuals (20 right-handed and 10 left-handed male, 20 right-handed and 10 left-handed female) via the Edinburg Handedness Questionnaire (EHQ). The research results suggested that the right-handed learners who are supposed to be left-brain outperformed the left-handed ones; and regarding participant's gender, male learners outperformed female learners on reading comprehension test tasks.

Key words: psycholinguistics, brain hemisphere, left-brain, right-brain, left-brained, right-brained, reading comprehension, interhemispheric processing.

1. Introduction

Psycholinguistics is a branch of study which examines the relationship between the human mind and language. In other words, it can be said that it is the combination of the disciplines of psychology and linguistics. In psycholinguistic research language users and producers are considered as individuals not samples and representatives of the society. And linguistic performance of each individual is determined by the strengths and limitations of the mental apparatus which all human beings share. In fact, psycholinguistics traces similar patterns of linguistic behavior among large groups of individual speakers of a particular language or of all languages. It examines the processes that occur in brain while producing and perceiving both written and spoken discourse, even though the involving processes may be so well established to be aware of them. Since psycholinguistics believes the notion that language is produced by the human mind, it has two interconnected goals; one of them is to understand the processes underlying the language and the other one is to study language as a product of human mind and therefore as an evidence of the way in which human beings organize their thoughts and impose patterns upon their experiences (Field, 2003).

2. Review of literature

In the 1960s, Sperry found out that the right and left hemispheres of the brain think and process information in very different ways. Before he starts his work on cognition and behavior, for decades it was known that the left or right-hemispheres or halves of the brain are responsible for doing different tasks. In the 1860s, Broca found out that speech is related to the front area of the left hemisphere; and in 1940s, it was discovered by Penfield and Jasper that motor function of one side of the body is related to the opposite hemisphere of the brain; i.e., the left hemisphere commands the person to lift their right hand. By the

1969s, scientists and doctors conducted research on neural functions of different areas of the brain. The research was done on the patients who suffered from brain damages in which only one or a few aspects of brain functions were affected. Evidence from those research lead to the idea that the left hemisphere is superior to the right one and it is responsible for higher order brain functions. In other words, it can be said that our left brain is the dominant half of the brain and so, more evolved than the right one. However, when Sperry started to work on human and animal brain and thought, it was found that the whole brain is much greater than its parts. In the 1950s, when he severed connections between the left and right brains of chimpanzees, i.e., the two hemispheres could not communicate with each other and could not access information stored in the opposite brain, the obtained result was that each half of the brain was still able to learn and function (Cardarelli, 2010).

Since the 1940s, specific severe epileptics were treated by surgically severing left and right brain connections (a commissurotomy). Severing this connection reduced seizure severity and frequency with otherwise little effect on behavior and the patients' ability to learn. Sperry tested 10 commissurotomy patients and then found out that the two halves of the brain are very specialized. He also discovered that these two halves are totally independent and each one is capable of thought, emotion, and memory which are not accessible to the opposite half of the brain (Cardarelli, 2010).

In split-brain experiments, they tell to a patient to look at the centre of a screen or piece of paper, and then images or words are presented to one hemisphere. When the image is placed to the right of the centre, it can only be seen by the right eye, so, only the left hemisphere can process the image. In commissurotomy patients, there is no connection between the two hemispheres, therefore, scientists are able to test each half independently (Cardarelli, 2010).

A patient is able to read a word without hesitation, when it is presented to the left hemisphere. When the same word is presented to the right hemisphere, although the meaning or context of the word will be conjured, the word cannot be read by the patient. For example, when the word walk is written on the crosswalk, although it is the left hemisphere that can read the word, the context and meaning of the word walk can be understood by the right hemisphere. In a similar way, when a picture from an object is presented to patients, the left hemisphere can recognize its name. However, the right hemisphere is able to see the object, but it cannot communicate what it is, even the patient may say that I have not seen anything. Here, the patient can also select the presented object from a group of objects, but they have no idea about why the subject has been selected (Cardarelli, 2010).

The left brain when isolated is able to calculate and do math functions without problem, but the right brain can only do easy addition problems (just up to the number 20), and it is not able to subtract, divide or multiply. Research done by Sperry indicated that in fact the passive right hemisphere is superior to the dominant left hemisphere in some ways. It is said that the left brain is responsible for speech, writing, and calculation, and the right brain takes part in the complex tasks such as spatial perception, word comprehension, and non-verbal communication. Right-brain tasks constitute important mechanisms; with the help of these mechanisms humans are able to perceive and interact with the world. The right-brain functionality is required for some processes such as music appreciation, intuition, and reading faces. The right brain seems passive and inferior to the left-brain because it is basically mute. It is able to think, process, and feel, but it cannot communicate those thoughts because the major language center of the brain is not located in this hemisphere. However, most evidence up to now shows that both halves of the brain are needed for most tasks and there is no time when one side of the brain is working while the other is only idling (Cardarelli, 2010).

Reading comprehension which is the focus of our research, is often seen as a single skill that depends on a unitary cognitive process, but it is viewed by many scholars as a progressive sequence that moves from visual symbol recognition, to letter-sound correspondence, to phonetic decoding, and finally to text comprehension (Chall, 1979; Perfetti, 1979, cited in Grimes, 2003). Many believe that reading process is a unitary process in which readers use the same set of cognitive processes and process and comprehend different types of the text in the same way. However, it is said that reading comprehension is not a singular cognitive process. Different cognitive skills may underlie different types of reading comprehension demands (Guthrie, 1973, cited in Grimes, 2003) and

different kinds of text structure may demand different kinds of cognitive processing abilities. Reading comprehension can be viewed as the process of getting meaning from written text. It can be considered as a subvocalized language function in normal subjects involving complicated language processing skills that originate in the left hemisphere. Many readers report "hearing" the words in their heads as they read silently. It is known that in as many as 90% of individuals, language processing involves structures in the language and speech areas of the left hemisphere (Leonard, 1997, Grimes ,2003) and studies of the brain confirm activation of these areas of the brain during reading tasks (Shaywitz, Pugh, Jenner, Fulbright, Fletcher, Gore, and Shaywitz, 2000; Horwitz, Rumsey, and Donohue, 1998; Carlson, 1998; Baynes, 1990, cited in Grimes,2003).

According to Grimes (2003), there are lots of theories that have tried to maintain the role of right and left hemisphere to the reading process. Among them Graham and Kershner (1996) who proposed that the analytic, sequential, and "auditory" aspects of reading are maintained by the left brain, and holistic, simultaneous, and visual spatial processing during reading by the right brain. Children's preferred learning styles through use of questionnaire were investigated by these two researchers and learning styles were compared to reading achievement; it was investigated that dyslexic readers do not indicate a strong learning preference in either auditory (left hemisphere) or visual (right hemisphere) modalities. Bakker (1979- 1992) hypothesized that two types of dyslexia resulted from an over-reliance of each hemisphere, with the right hemisphere contributing spatial-perceptual reading strategies and the left hemispheric adding syntactic-semantic reading strategies. A Balance Model of reading developed by this researcher stresses a developmental process in which reading begins as a predominantly right-hemisphere process with emphasis on strict visual processing when decoding before finally switching to a more fluid linguistic process involving language centers of the left hemisphere for fluent readers. Later on, in an EEG reading study which supported his model (Bakker, 1992), it was mentioned that readers relied heavily on right hemisphere functions to process words visually when decoding, while more experienced readers indicated dominant left brain activation when reading because text comprehension had become much like an internalized language function involving language centers of the left hemisphere.

Bakker (1992) recorded brain responses at the parietal and temporal locations in the left and right hemispheres of fifty kindergarten children while they were reading single words to test his theory. For four years, follow up brain recordings were also taken at one-year intervals. Consequences of the study indicated large hemisphere amplitudes during the first two years of the study, so, it was suggested that the children read the words with mainly right hemisphere activation. On the other hand, data obtained from the final two years of the study showed that a large shift to the left brain activation occurred and that the children read words with mainly left hemisphere activation. Findings of this study supported the idea that reading begins as a primarily visual, right hemisphere function but progresses to a more language dominated function mediated by the left hemisphere (Grimes, 2003).

Later on, a Bilateral Cooperative Model of Reading was suggested by Taylor and Taylor (1983). This model introduced the concepts of LEFT and RIGHT track processes and proposed that reading is not a sole language function of the left hemisphere. These authors defined that LEFT processes are those aspects of reading that involve processing sequentially ordered material, phonetic coding and syntax, while RIGHT tract processes handle pattern-matching functions, relate text to real-world context, and evoke mental associations and images. Here, the ideas were not directly related to hemisphere lateralization, but contribution of the hemispheres to these reading processes could be seen. LEFT track processes are consistent with known functions of the left hemisphere. Taylor and Taylor claimed that LEFT track processes involve processing sequential material, which is a well established function of the hemisphere (Halpern, 2000, cited in Grimes, 2003) and would account for the accurate processing of letters in sequence when decoding words. It was said that, LEFT track processes also involve phonetic coding and syntactic processing, which are other identified left hemisphere functions (Gazzaniga, Ivry, and Mangun, 1998, cited in Grime, 2003) that further contribute to accurate reading. Right track processes are also consistent with

well-known functions of the right hemisphere. According to Taylor and Taylor, RIGHT track processes handle pattern matching functions, which is a visual spatial process mediated by the right hemisphere (Halpen, 2000, cited in Grimes, 2003). Visual spatial processing identifies the correct orientation of letters, so it plays a role in word identification. It was also stated that RIGHT track processes evoke mental associations, which is another well-established role of the right hemisphere (Loring-Meire and Halpen, 1999, cited in Grime 2003). Mental association relies on the ability to generate a mental image, which is a function that can aid comprehension of text (Grimes, 2003).

3. Methodology and research design

3.1 Participants

Subject selection in this study was done on the basis of handedness, normal reading ability, age, and also level of the participants. The participants were 60 EFL Students from different branches of Kish institute in Tehran in intermediate level; it should be mentioned that in the present study intermediate level has been considered as a continuum, i.e., from pre-intermediate to upper-intermediate. All of the subjects of this study were Persian speakers for whom English was considered as a Foreign Language. The samples selected were mixed in terms of their gender, 30 men and women. The subjects were between the ages of 15 to 32 years old ($M=23$), and on average they have been studying English for 3 years. The students were randomly selected from the available classes in intermediate level, while half of them were male and the other half female students. At first there were about 95 subjects in this study, but 35 of them were removed from final data analysis, because a homogeneous group was needed. So, the number of them was decreased to 60 ($N=60$). 40 the subjects were right-handed and the other 20 were left-handed as assessed by a questionnaire; namely Edinburgh Handedness Inventory. The mentioned assessment was carried out according to what was made by Gonzaleza & Goodalea, 2009 and also Vanve, 2009. All participants of this study were naïve to the purpose and hypothesis of the study.

3.2 Instrument and procedure

To meet the requirements of the present study, a host of various instrumentations were used.

Solution Placement Test (Elementary to Intermediate) was used in this study. The test was taken to determine the subject's level and homogeneity. The test helped the researcher to make sure if all of the subjects were in intermediate level as was decided. The mentioned test has been developed by Lynda Edward (2011) after consultation with teachers and is designed to assess the subject's knowledge of the key language as well as their receptive and productive skills.

Sine no exact instruments have been found by the researcher to determine right-brain and left-brain dominance (after consulting many experts in the related fields of study), Edinburgh Handedness Questionnaire (EHQ), a handedness questionnaire, was used to measure the mentioned phenomenon in subjects of the present study. According to Grimes (2003), it has been confirmed that 90% of right-handers have left- hemisphere dominance for language. And also, it has been estimated that over 95% of right-handed people and 70–80% of left-handers show language lateralization to the left hemisphere (Annett & Alexander, 1996; Kimura, 1983; McKeever, Seitz, Krutsch, & Van Eys, 1995; Rasmussen & Milner, 1977, as cited in Gonzaleza & Goodalea, 2009).

The purpose of this study was to check the students' comprehension with regard to each type of reading, so two formats of items including multiple choice and cloze test were applied here. The reading tests were selected from the book *Intermediate Total English: Teachers Resource Book* by Moreton, Naughton, Bewsher, and Peebles (2006). The present test comprised two passages, one including nine multiple choice items and the other 40 cloze test items; totally 49 questions, each with three answer choices. The first passage including multiple choice items was presented exactly from the mentioned book with no changes, so there was no need to test its validity and reliability. Cloze test items for the second passage were developed by the researcher. Following the principles of cloze construction, there was no deletion in the first and the last sentence of the text, then words in the other sentences of the passage were count in order and about every seventh word was deleted.

For the scoring on cloze passage to be easier and more objective, the removed items were presented in the form of three answer choices. The test takers required to attempt to choose the original words from the items provided. It is to be noted that like any other teacher-made or researcher-made tests, there was an obligation to carry out a full validation and reliability before the test become operational.

The design of the study was a comparison paradigm (Mackay, 2005) with two groups: a left-brain dominant group and a right-brain dominant one. The participants were 60 EFL Students from different branches of Kish institute in Tehran in intermediate level; 30 male and 30 female; in each group 20 right-handed and 10 left-handed. Each group was asked to perform three tasks mentioned above. The time frame for the study was 65 minutes for the placement test, 10 minutes for the questionnaire, and 30 minutes for the reading test, spread over two sessions. Placement test was given to the participants separately in one session, and the questionnaire and the reading test both in another session.

3.3. Data analysis

Depending on the obtained results from the test, nonparametric-tests of association were applied to test the research hypotheses; a non-parametric test was conducted since the assumptions of parametric test were not met. It goes without saying that descriptive statistics is indispensable to arrive any statistical inference. Four assumptions were considered in order to analyze the data through parametric tests: interval data, independence, normality, and homogeneity of variances. For interval data and independence there were no statistical tests. The MC and Cloze tests were measured on an interval scale while the subjects of the study did not participate in more than one group. Normality of each group was tested through ratios of skewness and kurtosis over their respective standard errors. Ratios between the ranges of ± 1.96 show that the assumption of the normality is met. Here, the ratio of 2.03 for the Cloze test indicated that it was not distributed normally in terms of its kurtosis. Regarding MC test, the skewness of 4.33 and the kurtosis of 7.28 which are higher than ± 1.96 indicated that it also did not enjoy a normal distribution. According to these results and also because of unequal groups' sizes, the non-parametric test of Mann-Whitney U – a non-parametric equivalent for independent t-test- was used to find the answers of the research questions. The obtained results for non-normality of the data on MC and Cloze tests was also supported by the results of the Kolmogorov-Smirnov and Shapiro-Wolf tests, since all of the statistics had significance values less than .05.

4. Results and Discussion

In what follows, firstly various statistical calculations are presented followed by the discussion as a separate section.

Table 1. Normality Test results for MC and Cloze Test

HANDDOM				
	Left-Handed		Right-Handed	
	Cloze Test	MC	Cloze Test	MC
N	Valid	Missing	Valid	Missing
	20	0	40	0
	20	0	40	0
Mean	28.8000	7.4000	30.9500	7.0500
Std. Deviation	3.90142	1.27321	3.08802	.98580
Variance	15.221	1.621	9.536	.972
Skewness	-.926	-2.217	-.281	.065
Std. Error of Skewness	.512	.512	.374	.374
Normality Test of Skewness	-1.80	-1.80	-.75	.17
Kurtosis	2.016	7.267	-.437	-.934
Std. Error of Kurtosis	.992	.992	.733	.733

Normality Test of Kurtos	2.03	7.28	.59	-1.27
Minimum	18.0	3.0	25.00	5.00
Maximum	34.00	9.00	37.00	9.00

The results of the Kolmogorov-Smirnov and Shapiro-Wolf tests support the above findings as non-normality of the data on MC and cloze tests. All of the statistics have significance values less than .05.

Table 2. Test of normality for MC and Cloze Tests

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df.	Sig.	Statistic	Df.	Sig.
Cloze Test	.140	60	.005	.951	60	.018
MC	.211	60	.000	.873	60	.000

What is the relationship between the brain dominance and reading comprehension ability of Iranian EFL learners?

Results obtained from the normality test indicated that the non-parametric tests are needed here; so, two- independent samples Mann-Whitney test was run to investigate any significance between the brain dominance and reading comprehension ability of Iranian EFL learners. The Mann-Whitney statistic was 313.50, which was not a significant one ($P = .173 > .05$). According to the mentioned results, it might be concluded that there is not any significant relationship between the brain dominance and reading comprehension ability of Iranian EFL learners. Therefore, the answer to the question is that there is not any significant relationship between the brain dominance and reading comprehension ability of Iranian EFL learners. Meanwhile, the medians for the left-handed students is 37 and for the right-handed ones is 38 which verify the support of first question answered.

Table 3. Mann-Whitney Test Statistics for brain dominance with Reading Comprehension

Mann-Whitney U	313.500
Wilcoxon W	523.500
Z	-1.363
Asymp. Sig. (2-tailed)	.173
a. Grouping Variable: HANDDOM	

Table 4. Median Statistics Left-Handed and Right-Handed Students on Reading Comprehension

	Median
Left-Handed	37
Right-Handed	38

Does the brain dominance affect the learner's performance in different reading test tasks?

There is not any non-parametric equivalent for Multivariate analysis, so two separate Mann-Whitney tests were run in order to compare the right-handed and left-handed learners' performance on cloze test and MC. So, the second question is divided into two minor ones. As follows:

Does the brain dominance affect the learners' performance on cloze test?

Does the brain dominance affect the learners' performance on MC test?

Regarding the first minor question, Mann-Whitney statistic of 260.50 is significant ($P = .027 < .05$). So, according to this result, it can be concluded that there is a significant difference between the right-handed and left-handed learners' performance. Thus, the answer to the first minor hypothesis is positive. The median for the left-handed learners on cloze test is 29 and for the right-

handed learners is 31. So, the right-handed learners outperformed the left-handed ones on the cloze test.

Regarding the second minor question, the Mann-Whitney statistic of 294.50 is not significant ($P = .083 > .05$). So, according to these results, the answer to this question is negative and it can be concluded that there is not any significant difference between the right handed and left-handed learners' performance on MC test. The medians for the left-handed and right-handed students on MC test are 8 and 7 respectively.

Table 5. Mann-Whitney Test Statistics Brain Dominance on Cloze Test

Mann-Whitney U	260.500
Wilcoxon W	470.500
Z	-2.209
Asymp. Sig. (2-tailed)	.027
a. Grouping Variable: HANDDOM	

Table 6. Median Statistics Left-Handed and Right-Handed Students on Cloze Test

	Median
Left-Handed	29
Right-Handed	31

Table 7. Mann-Whitney Test Statistics Brain Dominance on MC Test

Mann-Whitney U	294.500
Wilcoxon W	1114.500
Z	-1.733
Asymp. Sig. (2-tailed)	.083
a. Grouping Variable: HANDDOM	

Table 8. Median Statistics Left-Handed and Right-Handed Students on MC Test

	Median
Left-Handed	8
Right-Handed	7

Do left-brain dominant learners outperform the right-brain dominant learners in reading comprehension test tasks?

Results obtained from the normality test indicated that the non-parametric tests are needed here; so, two- independent samples Mann-Whitney was run to investigate any significance between the brain dominance and reading comprehension ability of Iranian EFL learners. The Mann-Whitney statistic was 313.50, which was not a significant one, i.e., ($P = .173 > .05$). According to the mentioned results it can be concluded that there is not any significant relationship between the brain dominance and reading comprehension ability of Iranian EFL learners. Therefore, the answer to the question is not positive and it can be said that left-brain dominant learners do not outperform the right-brain dominant learners in reading comprehension test tasks. Moreover, the medians for the left-handed students is 37 and for the right-handed ones is 38 which verify the support of first question answered.

Does participants' gender affect their performance in reading comprehension test tasks?

The Mann-Whitney statistic of 305.50 is significant ($P = .032 < .05$). Based on these results, the answer to the fourth question is negative and it can be concluded that there is a significant difference between the male and female learners' performance on reading comprehension test tasks. The median for the male learners on reading comprehension test is 38.5 and for female learners is

37. Therefore, it can be said that male students outperformed female learners on reading comprehension test tasks.

Table 9. Mann-Whitney Test Statistics Gender on Reading Comprehension Test

Mann-Whitney U	305.500
Wilcoxon W	770.500
Z	-2.147
Asymp. Sig. (2-tailed)	.032
a. Grouping Variable: HANDDOM	

Table 10. Median Statistics Male and Female Students on Reading Comprehension Test

	Median
Male	38.5
Female	37

5. Conclusion

Regarding the brain dominance, it can be said that although the two hemispheres of the brain seem to be similar, each one has its specific functions. The right hemisphere of the brain is dominant for emotions, creativity, music and rhythm, intuition, sensitivity, daydreaming, spontaneity, humor, emotions, exploration, experimentation, inventiveness, musical expression, hands- on learning and creativity; and the left hemisphere for mathematical and language abilities, analytical thought, logical thinking, sequencing, categorizing, planning, speech, spelling, as well as word and number recognition. It is worth noticing that both sides of the brain are able to analyze process and store information from thoughts and ideas and also make decisions, but one side of it is usually more dominant than the other side (Day, 2009).

Support for the present study was based on several studies by Atchley et al., 1999; Coney & Evans, 2000; Faust et al., 1995; Faust & Chiarello, 1998, cited in Vance, 2009, Anaki et al., 1998; Arzouan et. al., 2007; Faust & Mahal, 2007, Rapp et al., 2007; Kacinik & Chiarello, 2007), that had shown activation of right hemisphere for metaphors and an advantage of left hemisphere for literal text based on single words and word pairs. So, it seemed plausible to conduct a study to determine if context could be considered as an influential factor in comprehension of EFL learners.

Results of the study were as follows:

1. There is not any significant relationship between the brain dominance and reading comprehension ability of Iranian EFL learners.
2. The second question of the present study can be broken down into two minor ones and the results for this question are as follows:
 - a. Brain dominance affects the learner's performance on cloze test. The right-handed learners who are supposed to be left-brain dominant outperform the left-handed ones who are right-brain dominant.
 - b. Brain dominance does not affect the learner's performance on MC test. In other words there is not any significant difference between the right-handed and left-handed learners' performance on MC test.
3. According to what was mentioned in result number 1, it was rejected that left-brain dominant learners outperform the right-brain dominant learners in reading comprehension.
4. Participant's gender affects their performance in reading comprehension task. And, male learners outperform female learners on reading comprehension test tasks.

6. Pedagogical implications

The research questions investigated in this study have relevance to educational psychology and suggest implications for the improvement of educational practices.

Research on the contribution of the brain hemispheres to the reading process will increase understanding individual differences in the reading process. Understanding how reading develops and where it breaks down may lead to more specific and efficient interventions to aid the development of reading skill among EFL learners. Recognizing reading as a complex cognitive process will allow researchers and educators to identify at which stage and for what reason reading becomes insufficient for learners.

It was highly likely that the left hemisphere is involved in complex process of reading. However, it was necessary to continue research to promote our understanding of hemispheres contribution to the reading process.

Understanding about the brain and its specific areas has encouraged language teachers to teach in a way that reflect these special functions of the brain. For instance, right and left hemisphere teaching is a way that is selected by some teachers who are interested in particular functions of the left and right hemisphere. On the other words, knowing about the brain and the way it learns naturally will be helpful for language teachers and educators to be more effective in their classrooms. Providing different materials, time frames and grouping arrangements can be helpful for educators to provide different learning styles for different individuals. Because individual differences are not a simple matter, it is an issue that is closely related to personal differences (Genessee, 2000).

References

- [1] Ahlse'n, E. (2006). *Introduction to neurolinguistics*. Philadelphia: John Benjamins Publishing Company.
- [2] Caplan, D. (1995). Language and the brain. *Published in The Harvard Mahoney neuroscience institute letter; On the brain*, Vol. 4. No. 4, Fall 1995.
- [3] Cherry, K. (2005). Left brain vs. right brain: understanding the myth and reality of left brain and right brain dominance. *Presented in About.com.Psychology*.
- [4] Christison, M. A. (1999). Applications of brain-based research for second language teaching and learning: Part 2. *TESOL Matters*, Vol. 9. No. 3. June/July 1999.
- [5] Day, L. (2009). Left or Right Brain Dominant? From: baby sensory. Retrieved from <http://baby.sensory.com>.
- [6] Field, A. (2009). *Discovering Statistics Using SPSS (3rd ed.)*. London: Sage Publication.
- [7] Field, J. (2003). *Psycholinguistics*. London: Routledge, Taylor & Francis Group.
- [8] Genessee, F. (2000). Brain research: implications for second language learning. Retrieved December 1st, 2000 from <http://escholarship.org/uc/item/58n560k4>
- [9] Grimes, J. A. (2003). *The role of the brain's right hemisphere in comprehending spatially oriented text* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Database. (UMI No. 3097972)
- [10] Harley, T. (2001). *The Psychology of Language From Data to Theory (2nd ed.)*. Edition.
- [11] Hove & New York. Psychology Press Ltd: Taylor & Francis Group.
- [12] Konečná, E. (2008). *Developing Reading Skills in English in Primary School Learners with Dyslexia* (Unpublished master's thesis). University of Pardubice; Faculty of Arts and Philosophy
- [13] Mackey, A., & Gass, S.M. (2005). *Second Language Research, Methodology and Design*.
- [14] Mahwah, New Jersey: Lawrence Erlbaum Associates, Publishers.
- [15] Moreton, W., Naughton, D., Bewsher, A., Peebles, J. (2006). *Intermediate Total English: Teachers Resource Book*. Harlow and England: Pearson Education Limited.
- [16] Randall, M. (2007). *Memory, Psychology and Second Language Learning*. Amsterdam/ Philadelphia: John Benjamins Publishing Company.
- [17] Regard, M., Cook, N. D. Wieser, H. G., & Landis, T. (1994). The dynamics of cerebral dominance during unilateral limbic seizure. *Online Oxford Journals, Brain*, Vol. 117, No. 1, Pp 91- 104, 1994.

- [18] Sperry, R. W., Hubel, D. H., & Wiesel, T. N. (1981). Some effects of disconnecting the cerebral hemispheres. Nobel Lecture. Retrieved December 8, 1981 from the World Wide Web: [http:// www.Nobelprize.org](http://www.Nobelprize.org)
- [19] Sprenger, M. (1999). *Learning & Memory: The Brain in Action*. Alexandria, Virginia USA: Association for Supervision and Curriculum Development.
- [20] Springer, J. A. (1999). Language dominance in neurologically normal and epilepsy subjects: A Functional MRI Study. *Online Oxford Journals, Brain* [Vol. 122. No. 11, Pp 2033-2046, November 1999]. Retrieved from <http://Int. UnionPhysiol. Sci./Am. Physiol. Soc>.
- [21] Taylor, K. I. and Regard, M. (2003). Language in the right cerebral hemisphere: contributions from reading studies. *Published in News in Psychological Science*, Vol. 18. No. 6, 257-261, December 2003.
- [22] Vance, K. M. (2009). *Hemispheric difference during metaphoric advertisement comprehension: The influence of brand familiarity* (Doctoral thesis). Available from ProQuest LLC Dissertations and Theses database. (UMI No. 3376876)
- [23] Vikingstad, E. M. et. al., (2000). Language hemispheric dominance in patients with congenital lesions of eloquent brain, Vol. 47. Issue 3- Pp 562-577. Retrieved September 2000, from [http:// www. OvidSp.com](http://www.OvidSp.com)
- [24] Uhrich, T. (2005). *Effects of Bimanual Activity on Reading Achievement*. (Doctoral dissertation). Available from ProQuest LLC Dissertations and Theses database. (UMI No. 3178835)

Appendix 1.

Placement Test

Part 1. Grammar and Vocabulary

Complete the sentences with the correct answers.

1. My sister _____ very tired today. A be B am C is D are
2. His _____ is a famous actress. A aunt B uncle C grandfather D son
3. I'd like to be a _____ and work in a hospital. A lawyer B nurse C writer D pilot
4. We _____ like rap music. A doesn't B isn't C aren't D don't
5. There _____ a lot of water on the floor. What happened? A are B is C be D am
6. He _____ TV at the moment. A watches B is watching C watched D has watching
7. Helen is very _____. She doesn't go out a lot. A bored B confident C angry D shy
8. Did you _____ to the beach yesterday? A went B were C go D goed
9. Have you got _____ orange juice? I'm thirsty. A some B a C any D the
10. Let's go into _____ garden. It's sunny outside. A a B any C – D the
11. He's _____ for the next train. A looking B waiting C listening D paying
12. Mark _____ his car last week. A cleaned B did clean C has cleaned D is cleaning
13. I bought some lovely red _____ today. A cabbages B cucumbers C bananas D apples
14. Which bus _____ for when I saw you this morning? A did you wait B had you waited C were you waiting D have you waited
15. Where _____ you like to go tonight? A do B would C are D can
16. That's the _____ film I've ever seen!

- A worse B worst C baddest D most bad
17. My dad _____ his car yet.
A hasn't sold B didn't sell C doesn't sell D wasn't sold
18. I've been a doctor _____ fifteen years. A since B for C until D by
19. Look at the sky. It _____ rain. A will B can C is going to D does
20. If I _____ this homework, the teacher will be angry!
A am not finishing B won't finish C don't finish D didn't finished
21. This book is even _____ than the last one!
A most boring B boringer C more boring D far boring
22. I'll meet you _____ I finish work. A if B when C as D so
23. We're getting married _____ March. A in B on C at D by
24. If you _____ steak for a long time, it goes hard.
A cook B are cooking C have cooked D cooked
25. I _____ you outside the cinema, OK?
A 'll see B am going to see C am seeing D see
26. I _____ not be home this evening. Phone me on my mobile.
A can B could C may D should
27. The criminal _____ outside the hotel last night.
A was caught B has been caught C is caught D caught
28. He asked me if I _____ a lift home.
A wanted B want C was wanting D had wanted
29. If I _____ older, I'd be able to vote in elections.
A had B am C were D have
30. You _____ go to the supermarket this afternoon. I've already been.
A mustn't B can't C needn't D won't
31. Kathy drives _____ than her sister.
A more carefully B more careful C carefully D most carefully
32. The _____ near our village is beautiful.
A country B woods C view D countryside
33. I'm _____ I can't help you with that.
A apologise B afraid C regret D sad
34. It was really _____ this morning. I couldn't see anything on the roads.
A cloudy B sunny C icy D foggy
35. Can you look _____ my dog while I'm away?
A for B at C to D after
36. If I'd started the work earlier I _____ it by now.
A would finish B had finished C will finish D would have finished
37. This time next year I _____ in Madrid.
A am working B will work C will be working D work
38. I wish he _____ in front of our gate. It's very annoying.
A won't park B wouldn't park C doesn't park D can't park
39. He said he'd seen her the _____ night.
A last B before C previous D earlier
40. I _____ agreed to go out. I haven't got any money!
A mustn't have B shouldn't have C couldn't have D wouldn't have
41. It was good _____ about her recovery, wasn't it?
A information B words C news D reports
42. I _____ the report by 5.00 p.m. You can have it then.
A have finished B will have finished C finish D am finishing
43. Because of the snow the teachers _____ all the students to go home early.
A said B made C told D demanded

44. Thanks for the meal! It was _____.
A delighted B delicious C disgusting D distasteful
45. Look! Our head teacher _____ on TV right now!
A is being interviewed B is been interviewed C is interviewing D is interviewed
46. It's _____ to drive a car over 115 km/h in the UK.
A illegal B illegel C dislegal D legless
47. There's a lot of rubbish in the garden I need to get _____ of.
A lost B rid C cleared D taken
48. I'm afraid it's time we _____.
A leave B must leave C are leaving D left
49. He wondered what _____.
A is the time? B the time was C was the time D is the time?
50. They _____ our salaries by 5%.
A rose B made up C raised D lifted

Part 2. Reading

Read the text.

Saucy dragons

Levi Roots, a reggae singer from Jamaica, has a big smile on his face these days. In case you missed it, Levi recently appeared on the famous reality show for people with business ideas, Dragon's Den. The participants have to persuade the team of business experts that their ideas are excellent and hope that two or more of the team will decide to invest money in their business idea.

Levi did just that!

The singer, who has been a successful music artist for several years, also sells something he calls 'Reggae, reggae sauce'. It is made using special secret ingredients from his grandmother and is a hot Jamaican sauce that is eaten with meat. Until now it has only been possible to buy the sauce from Levi's website or once a year at the famous Notting Hill carnival. But now, thanks to the TV programme, that is all going to change!

Levi presented his business idea to the team and started with a catchy reggae song about the sauce to make them sit up and listen. He certainly got their attention! He then described his plans for the sauce. This part of his presentation didn't go so well. He made mistakes with his figures, saying that he already had an order for the sauce of 2 and a half million when in fact he meant 2 and a half thousand! But, the team were still interested and amazingly, two of the team offered to give £50,000 to the plan in exchange for 40% of the company. Mr Roots was ecstatic!

Levi is even happier today. It seems that two of the biggest supermarket chains in the UK are interested in having the sauce on their shelves. In addition to this, Levi is recording the 'Reggae, reggae sauce' song and we will soon be able to buy or download this. 'It's all about putting music into food,' says Levi with a big, big smile on his face! And music and food will probably make him a very rich man indeed!

1. Are the sentences true or false?

1. At the moment Levi isn't very happy. ____
2. Levi sells something we can eat. ____
3. His song is a big success. ____
4. He sang his song on TV. ____
5. Some supermarkets want to sell his product. ____

2. Choose the best answers.

1. Dragon's Den is a show about
A. cooking.

- B. new business ideas.
- C.famous people.

2. To make the sauce

- A. you have to go to Notting Hill.
- B. you have to ask a member of Levi's family.
- C. you need a good recipe book.

3. When Levi presented his idea

- A. he finished with a song.
- B.two and a half million people were watching.
- C.he talked about the wrong figures.

4. Some people on the team

- A. own supermarkets.
- B.didn't like the taste.
- C.bought part of Levi's company.

5. Today Levi

- A. is a millionaire.
- B.has two things he can profit from.
- C.prefers music to food.

Part 3. Writing

Imagine you have just returned from a two-week holiday. Write an e-mail to your friend telling him/her about the holiday. Include information about the journey, where you stayed, what you did and the people you met.

Appendix 2 Edinburgh Handedness Questionnaire (EHQ)

Please indicate your preference in the use of hands for each of the following activities or objects by placing a check in the appropriate column.

	always left	often left	both hands	often right	always right
writing	-----	-----	-----	-----	-----
Drawing	-----	-----	-----	-----	-----
throwing	-----	-----	-----	-----	-----
using scissors	-----	-----	-----	-----	-----
using a toothbrush	-----	-----	-----	-----	-----
using a knife	-----	-----	-----	-----	-----

using a spoon

using a broom (the upper hand)

striking a match

opening a box(the lid)

Appendix 3 Reading Test

Part 1.

Read the text about Malta and answer the following questions.

Malta is a truly wonderful country whose towns are populated with baroque palaces and its countryside abounds with the oldest known human constructions in the world. The best time to visit is spring or autumn as it is still hot enough to get a suntan and hotel prices come down significantly. The weather, sea and sandy beaches are a bonus, however. The main attractions are definitely the island's antiquities and the Baroque architecture.

There are an amazing number of things to discover as you explore 7,000 years of history. In fact, the Maltese Islands have been described as one big open-air museum. Wherever you go, the scenery on the island and the architecture are truly spectacular.

Malta is the ideal place to get away from it all with its rocky coastlines, narrow and tranquil village streets, marinas and fishing villages, etc. But the best thing about a stay there is that you can experience several holidays in one and there are endless things to do. For people who are physically fit, it is a great place for rock climbing, trekking and several types of water sports.

You can enjoy a busy calendar of cultural events all year round, as Malta is also a bilingual country which has strong historical and cultural links to Britain. It is also an enjoyable place to learn and practice English, so English courses are available in several language schools and English language newspapers, books and magazines are sold everywhere. People even drive on the left here! The capital of the country is Valletta, which is less than two kilometers in length so it is possible to explore this beautiful city in a relatively short time. It has many interesting squares that are surrounded by palaces and other historical buildings. Another important tourist attraction is Gozo, which is separated from the mainland by three kilometers of sea. This island has a spectacular rocky coastline and also has a relaxing, rural atmosphere. The cuisine has Italian, French and Maltese influences. Standards are generally high and fresh fish is a favourite in local restaurants and bars. Many species of seafood are consumed all year around and this is what Maltese restaurants do best. Several dishes with rice, meat and vegetables are also popular, however.

Malta's hot, dry summers can be uncomfortable but they are normally very pleasant and the mild winters are also nice. The rain is heaviest in winter but is still only moderate. In the high season, the most economical option is a package tour that includes the flight and seven nights in a two or three star hotel as this will cost under \$ 500. Whether you end up choosing a package tour or travelling independently in Malta, you are guaranteed to have an unforgettable experience.

Choose the correct definition for these words and expressions. They are underlined in the text so look at them carefully in their context before answering.

1. abounds with means:
 - a) to be full of
 - b) to have a few of
 - c) to be decorated with

2. **bonus** means:
 - a) the best thing
 - b) an extra or added benefit
 - c) a nice surprise
3. **amazing** means:
 - a) incredible
 - b) useful
 - c) interesting
4. **to get away from it** all means:
 - a) to have fun
 - b) to escape from the pressures and routines of daily life
 - c) to have an adventure
5. **endless** means:
 - a) fantastic
 - b) with limitations
 - c) without limit
6. **standards are generally high** means:
 - a) the food has a lot of variety
 - b) the food is normally expensive
 - c) the quality of the food tends to be good
7. **mild** means:
 - a) variable
 - b) very cold
 - c) gentle or soft, i.e. not too cold
8. **the high season** means:
 - a) the most popular time of the year for tourists
 - b) the time of the year with the highest temperature
 - c) the festival period
9. **travelling independently** means:
 - a) travelling on your own
 - b) arranging your travel
 - c) arranging travelling without dependents

Reading Test

Part 2.

Read the text and look at the following multiple choice items. Decide which word is missing in items 1 – 40. Then tick (□) the correct answer.

Nearly 30 million African could soon be facing famine. The immediate cause is drought, which has destroyed crops and left people and livestock without food and water. But this is not the only **1)** ----- why Africa suffers regularly from famine. **2)** ----- African countries do not produce enough **3)** ----- and depend very much on imports **4)** ----- on having the income to pay **5)** ----- them.

Famine is caused by not **6)** ----- food being produced or people not **7)** ----- able to obtain it. This may **8)** ----- because there is not enough water **9)** ----- because people can't afford to buy **10)** ----- . Even in famine-free years, it **11)** ----- common across Africa for people to **12)** ----- have sufficient food, especially in rural **13)** ----- . The United Nations estimates that the **14)** ----- in sub-Saharan Africa is worse **15)** ----- than it was thirty years ago. **16)** ----- poverty in Africa has left the **17)** ----- with a population that has the **18)** ----- food problem in the world.

Interestingly, **East 19)**----- South Asia, where there have been **20)**----- increases in agricultural production and significant **21)** ----- growth have reduced the number of **22)** ----- who are not properly fed **23)** ----- forty-three percent to thirteen percent **24)** ----- sub-Saharan Africa has not managed to get **25)** ----- rate below the 1969 figure of thirty four **26)** ----- of the population.

The Nobel Prize-winning economist Amartya Sen **27)** ----- argued that hunger **28)** ----- famine are caused mostly by poverty and **29)** ----- just a country's ability to grow **30)** ----- food. People in poverty often go hungry **31)** ----- they do not have enough money **32)** ----- buy food when they have not **33)** ----- able to produce enough themselves. So **34)** ----- there is a drought or something similar **35)** ----- become the first victims of famine. Professor Sen argue **36)** ----- if countries in Africa could make **37)** ----- income, they would be able to avoid **38)** -----, as they could afford to import **39)** ----- to make up for any food they **40)** ----- produce themselves.

Natural disasters frequently happen, but it is when they hit countries that are already suffering from the effects of other problems that famine become inevitable.

- | | | | |
|-----|------------|------------|------------|
| 1) | reason | way | factor |
| 2) | more | most | much |
| 3) | products | exports | food |
| 4) | rather | as much | and |
| 5) | or | yet | for |
| 6) | too | rare | enough |
| 7) | to | being | having |
| 8) | be | have | being |
| 9) | and | or | that |
| 10) | food | lunch | anything |
| 11) | become | is | got |
| 12) | not | no | none |
| 13) | areas | places | contexts |
| 14) | situation | process | state |
| 15) | before | today | in future |
| 16) | growing | to grow | grow |
| 17) | country | city | continent |
| 18) | big | bigger | biggest |
| 19) | or | and | as well |
| 20) | enormous | very | an |
| 21) | economic | economical | economist |
| 22) | person | people | crowd |
| 23) | to | in | from |
| 24) | but | nor | as well as |
| 25) | the | a | some |
| 26) | percent | number | amount |
| 27) | has | have | had |
| 28) | and | yet | since |
| 29) | not | or | with |
| 30) | very | many | enough |
| 31) | because | cause | why |
| 32) | being | been | to |
| 33) | been | being | to |
| 34) | when | that | if |
| 35) | it | that | they |
| 36) | that | whether | no matter |
| 37) | sufficient | too | no |
| 38) | hungry | famine | hunger |
| 39) | food | water | nutrition |
| 40) | don't | doesn't | didn't |