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The Effect of Brain Dominance on both L2 Vocabulary Production and Retention

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Abstract **–** The present study was attempt to investigate the effect of brain dominance on both immediate and delayed vocabulary retention of second language learners. To this end, initially a sample of 120 Iranian high schoolers were selected. After the administration of a subset of the Michigan Test of English Language Proficiency (MTELP), a sample of 90 pre-intermediate students were selected. Subsequently, after the administration of the brain dominance inventory, a sample of 60 students were randomly assigned to three different groups of 20 members each. After six consecutive treatment sessions, the participants were exposed to both immediate and delayed tests of vocabulary production. The data were analyzed using a One-way ANOVA procedure for each question. The results revealed that the whole-brained learners were superior to both left and right-brained dominant participants on both tests. Furthermore, the right-brained dominant learners could exceed their left-brained dominant counterparts on both immediate and delayed vocabulary production test.

Keywords**:** brain dominance, right-brained oriented, left-brained oriented, whole-brained dominant, immediate and delayed vocabulary retention.

1. INTRODUCTION

McCarthy (1990, p.8) claims that "no matter how well the students learn grammar, no matter how successfully the sounds of L2 are mastered, without words to express a wider range of meanings, communication in L2 just cannot happen in any meaningful way". According to O'Rourke (1974), vocabulary is considered to be one of the most important factors that affects students' thoughts, actions, aspirations, and success, especially in academic achievements. In the line, Harley (1996) asserts that vocabulary learning is an indispensable part of each student's life. One of the most important, challenging, and indispensable parts of proficiency in a second language is vocabulary learning. Vocabulary forms the basis of listening, speaking, reading, and writing, therefore, it is considered to be the core component of language proficiency. Thus, vocabulary as an indispensable part of the second language learning process deserves a great deal of ongoing attention.

Researchers have always benefited from cognitive theories in improving second language learning in general, and vocabulary learning in particular. The concept of brain dominance has been one of the most thought-provoking and attention-striking terms in second language learning so far. The terms brain dominance, hemispheric preference, and brain hemisphericity have been used interchangeably in this paper. The aforementioned terms characterize one's inclination to rely one hemisphere of the brain either left or right more than the other one (Alptekin & Atakan, 1990). Advocators of the hemispheric brain hypothesis

believe that depending on their cognitive style, people tend be either right-brained or left-brained. However, some scientists acknowledge the existence of third that tends to be whole-brained; which means they draws on both hemisphere to a similar degree (Mercer, 2010). As it is supposed that brain dominance affects how we process new information and therefore how we learn, many researchers' have explored the relationship between learning strategy use and brain dominance. However, there's a paucity of research on the effect of brain dominance on vocabulary retention as a truly challenging part of second language learning. The present study aims at feeling the aforementioned gap. To this aim the following research questions and research hypotheses are formed:

1) Does Brain dominance have any significant effect on L2 vocabulary production?
2) Does Brain dominance have any significant effect on the retention of productive vocabulary in L2?

In view of the questions of the study, the following null hypotheses are formulated:

1) Brain dominance has no significant effect on L2 vocabulary production.
2) Brain dominance has no significant effect on the retention of productive vocabulary in L2.

2. LITERATURE REVIEW

In the 19th century, a great deal of attention was shifted toward how the human brain process language. Pierre Paul Borca and Carl Wernicke were among the most prominent investigators of that time who made a great deal of contribution to our present body of knowledge about the dual processing nature of the human cortex. By observing patients' with speech disorders and autopsies of the deceased subjects, they discovered Broca's area and Wernicke's area which led to the emergence of brain lateralization idea. As a consequence of a century of clinical experimentation, it came to light that despite anatomical symmetry, each cortical hemisphere specializes in execution of specific functions (Jedyank, 2009).

Furthermore, Sperry (1968) proposed Split-model of intelligence as result of his work on aphasic patients. He attributed different functions to each hemisphere of the brain. Torendo (2000) states metaphorically that "In a sense, the body cannot have two masters" (p.8), so one hemisphere of the brain must be dominant over the other. The body functions are also carried out by both hemispheres "evenly but in a crossed fashions" (Kok, 2010, p.145). Brown (2007) reports Torrance's study (1980) in which he elaborates different features of the left and right brain dominant learners:

- Left-brain dominant learners: Intellectual; remember names; respond to verbal instruction and explanations; experiment systematically and with control; make objective judgments; planned and structured; prefer established certain information; analytic readers; reliance on language in thinking and remembering; prefer writing and talking; prefer multiple choice tests; control feelings; not good at interpreting body language; rarely use metaphors; favor logical problem solving
- Right-brain dominant learners: Intuitive; remember faces; respond to demonstrated ,illustrated or symbolic instructions; experiment randomly and with less restraint; make subjective judgments; fluid and spontaneous; prefer elusive uncertain

information; synthesizing readers; reliance on images in thinking and remembering; prefer drawing and manipulating objects; prefer open-ended questions; more free with feelings; good at interpreting body language; frequently use metaphors; favor intuitive problem solving

After many years of investigation of the brain hemispheres' functions, researchers fictitiously described brain dominance as dichotomous in nature. However, recently it is suggested that things should not be divided into black and white and the human brain is no exception. In a similar vein, Saleh (2001) asserts brain hemisphericity should not be envisages as dichotomous, rather it should "operate on a continuum" (p.194).

Researchers attribute successful assimilation of new information to many factors, including learning style in general, and brain dominance in particular. Lightbown and Spada (1999) maintain that “learners have clear preferences for how they go about learning new material” (p.58). Due to the aforementioned fact, material developers should take into account the various cognitive styles of the learners prior to initiation of material instruction. In the same line, teachers must also discover their students' cognitive preferences, and learning styles while teaching to promote learning conditions (Sale, 1997).

Some studies have suggested that learners' a better retention of the new information follows treatments which best fits learners' cognitive preferences rather than teaching instructions without any consideration of the hemispheric preferences (Brennan, 1984; Dunn, Sklar, Beaudry, & Bruno, 1990; Jarsonbeck, 1984). There are also some evidences which indicate the selection of the field of study based on hemispheric preferences by students (Kolb, 1979; MacCarthy, 1996; Saleh, 2001).

Tendero (2000), in her study on the effect of brain dominance on four macro skills, suggested “the respondents’ hemispheric dominance was negatively and insignificantly correlated with their listening and speaking skills; but was positively, although not significantly, correlated with reading and writing skills” (vii).

In traditional schooling, much emphasis is put on analyzing and synthesizing language elements, which highlights the fact that left-brained oriented learners are favored in traditional educational system. On the other hand, “Creativity”, something that right brain dominant learners are claimed to be good at, “is seriously impaired” (Oflaz, 2011, p.1509).

As the preceding section has revealed, the effect of brain on dominance on second language learning has been considered an issue of concern. Even though, vocabulary learning is deemed to be an integral part of second language proficiency, no one has worked on the effect of brain hemisphericity on vocabulary retention. Therefore, the present study attempts to investigate brain dominance on L2 vocabulary production both immediately, and delayed.

3. METHOD

3.1. Participants

Initially a sample of 120 Iranian high schoolers were selected. The participants included female native speakers of Persian, and they ranged from 19-20 in terms of age. After the administration of a subset of the Michigan Test of English Language Proficiency (MTELP), and the exclusion of the students whose score did not fall between one standard deviation

above and below the mean, a sample of 90 students remained. Finally, based on the result of Brain Dominance Inventory, a sample of 60 students were randomly assigned to three different groups of 2 members each.

3.2. Instrumentation

A full description of the instruments utilized in the present study is provided below:

3.2.1. Michigan Test of English Language Proficiency (MTELP)

In order to homogenize the participants in terms of their language proficiency, MTELP was administered to all the participants prior to the implementation of the treatment. The version of MTELP used in this study contained 100 items, including 40 vocabulary, 40 grammar, and 20 reading comprehension items, all of which in multiple-choice format.

3.2.2. The Hemispheric Dominance Test (HDT)

The Hemispheric Dominance Test (HDT) was a test on the respondents' hemispheric presences in terms of information processing. It was used to determine whether the participants were left- brained, right- brained or whole brained. It was included 40 items most of which were selected from the standardized 39- item Brain Dominance Inventory (by an unknown author) revised by Evelyn C. Davis of UP Open University. In addition, a few items were also adapted from another standardized 20- item *Left- Right Brain Dominance Test* by Brown (1994).

3.2.3. Vocabulary pre-test

A vocabulary pre-test was administered to make sure that the participants had no prior knowledge of words. The test included 120 sentences in each of which one of the target words was bolded and italicized. The participants were supposed to write the Persian equivalent of each word in front of it. The time allocated to this test was 60 minutes.

3.2.4. Immediate and delayed vocabulary production post tests

Two vocabulary post-tests, each including 30 items were administered to gauge the participants' immediate and delayed vocabulary production. The vocabularies were selected from the students textbook. Both tests were in the fill-in-the-blank items to check their production of vocabulary. The first letter of the target word and its Persian equivalent were provided for the participants as clues. The participants were given 30 minutes to complete each of the two vocabulary production tests. In the delayed test the same items were utilized, but this time to prevent memory effects the items were reorganized randomly. To estimate the reliability of the test, the KR-21 method was employed. The reliability index turned out to be 0.79, thus the test could be considered as reliable. Furthermore, to check the validity of the post-test, a correlational procedure was employed through which the participants' scores on the vocabulary production test were correlated with the learners' performance on the vocabulary subtest of the MTELP. The validity index of the production test turned out to be 0.87.

3.3. Procedures

Firstly, to homogenize the participants the MTELP was administered to a sample of 120 Iranian high schoolers. After considering the result of the aforementioned test, 90

homogenous students were select. Next, the participants underwent the HDT, through which 60 students were chosen and they were randomly assigned to three different groups of 20 members each namely group: a. the left-brained, b. the right brained, c. the whole brained. In the next stage, a vocabulary pre-test was administered to make sure that the participants had no prior knowledge of the vocabulary included in the treatment sessions. Following the pre-test, they were underwent six treatment sessions in each of which the participants were supposed to learn 10 new words. Subsequently, they underwent two vocabulary posttests. The first test was administered immediately after the treatment sessions and the second occurred tree weeks later.

3.4. Data Analysis

To answer the research questions, the collected data were analyzed using two separate one-way ANOVA procedures. ANOVA procedures were used to investigate the effects brain dominance on both immediate and delayed vocabulary production.

4. RESULTS

4.1. Investigation of the first question

The first question aimed at investigating the effect of different brain dominance (right, left, whole) on L2 vocabulary production. Descriptive statistics are presented in Table 4.1:

Table 1: *Descriptive statistics for the effect of brain dominance on L2 vocabulary production*

	N	Mean	Std. Deviation
LB	20	5.20	4.663
RB	20	6.11	5.669
WB	20	11.30	6.530
Total	60	7.55	6.196

As it can be seen in Table 1, the whole-brained group had the highest mean, followed by the right-brained group, and the left-brained group.

In order to see whether or not the differences among the means are statistically significant, a one-way ANOVA procedure was run. The results of the ANOVA procedure are given in Table 2.

Table 2: *ANOVA results for the effect of brain dominance on L2 vocabulary production*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	430.900	2	215.450	6.696	.002
Within Groups	1833.950	57	32.175		
Total	2264.850	59			$\omega^2 = 0.31$

Based on Table 2, since the F-value is statistically significant ($F_{(2,57)} = 6.696$, $p < .01$), we can safely claim that there are significant differences among the groups. So, the first null

hypothesis mentioned earlier is rejected. Furthermore, the index of the strength of association (ω^2 = .31) shows that 31% of the variance in the vocabulary production scores can be accounted for by brain dominance. To locate the differences among the means, a Scheffe post-hoc test was run, which yielded the results presented in Table 3.

Table 3: *The results of the Scheffe test for the effect of brain dominance on L2 vocabulary production*

(I) grouping	(J) grouping	Mean Difference (I-J)	Std. Deviation	Sig.
LB	RB	-.950	1.794	.869
LB	WB	-6.100*	1.794	.005
RB	WB	-5.150*	1.794	.021

A look at Table 3 shows that the mean difference between the left brained and the right-brained groups is not statistically significant. However, the mean differences between the left-brained and the whole-brained groups as well as the right-brained and the whole-brained groups are statistically significant. Therefore, it can be claimed that the whole-brained excelled both right-brained and left-brained participants in vocabulary production test. In other words, drawing on both hemispheres simultaneously culminates in a better vocabulary production capability when compared to a one-sided brain orientation.

4.2. Investigation of the second question

The second question was aimed at investigating the effect of brain dominance on the retention of productive vocabulary. The descriptive statistics are given in Table 4.

Table 4: *Descriptive statistics for the effect of brain dominance on the retention of productive vocabulary*

	N	Mean	Std. Deviation
LB	20	3.20	4.262
RB	20	4.50	4.883
WB	20	8.90	6.357
Total	60	7.55	6.196

As it can be observed in Table 4, the whole-brained group had the highest mean, followed by the right-brained, and the left-brained groups.

As it is clear from table 4, the means are different. In order to see if these differences are statistically significant, one-way ANOVA was used, with the results given in Table 5.

Table 5: *ANOVA results for the effect of brain dominance on the retention of productive vocabulary*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	356.933	2	178.467	6.496	.003
Within Groups	1566.000	57	27.474		
Total	1922.933	59			ω^2 = .17

Based on Table 5, the F-value is statistically significant ($F_{(2,57)} = 6.496$, $p < .01$). Thus, we can safely claim that there are significant differences among the means of the groups. So, the second null hypothesis developed earlier is also rejected. Moreover, the index of strength of association ($\omega^2 = 0.17$) shows that 17% of the variance in the retention of productive vocabulary scores can be attributed to brain dominance. In order to locate the differences, a Scheffe post-hoc test was used. The results are summarized in Table 6.

Table 6: *The results of the Scheffe test for the effect of brain dominance on productive retention of vocabulary*

(I) grouping	(J) grouping	Mean Difference (I-J)	Sig.
LB	RB	-1.300	.736
LB	WB	-5.700*	.005
RB	WB	-4.400*	.036

Table 6 makes it clear that the mean difference between the left-brained and the right-brained groups is not statistically significant. However, the mean differences among the left-brained and whole-brained groups as well as right-brained and whole-brained are statistically significant. Hence, we might regard simultaneous utilization of both hemispheres of the brain as a factor contributing to the effect of brain dominance on retention of productive vocabulary. Comparing the results obtained for the first research question with this question, it might also be reasonable to conclude that time lapse resulted in some vocabulary attrition as a natural phenomenon.

5. DISCUSSION AND CONCLUSION

As the results of this study suggests the whole-brained learners had an edge over both their right-brained and the left-brained oriented counterparts. In other words, the utilization of both hemispheres of the brain simultaneously and equally can be considered as a contributing factor in improving both vocabulary production and retention of productive words. The underlying reason for this phenomenon might be that the whole-brained learners tap into both hemispheres of the brain to the same degree and at the time rather than one side of it. Subsequently, a larger area of cortex will be involved in processing ne information. Therefore, the more neural the neural connections are made, the better the recall of information will be.

The aforementioned conclusion implies that material developers and teachers must design activities which activates both hemispheres. In other words, educators must not only make use of verbal, linear models, but also active, image-rich, visual-spatial models so that learners would benefit from both hemispheres. It is also suggested to increase students' awareness of their brain orientation, and instruct them explicitly on how to employ learning strategies which tap into the both hemispheres of the brain for a better information retention.

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