

The Effect of Working Memory Training on Vocabulary Recall and Retention of Iranian EFL Learners: The Case of Dual N-Back Task

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Abstract

This study examined the effect of working memory training on vocabulary recall and retention of Iranian EFL learners using dual N-back task technique. To this end, 50 EFL learners at Islamic Azad University of Shoushtar were randomly assigned to the experimental (n = 25) and control (n = 25) groups. Before the treatment, a vocabulary test was administered to the participants to assess the participants' vocabulary knowledge of the target words. The participants were taught 100 English words in 20 sessions. In each session, the experimental group also received dual n-back task to train the participants' working memory. At the end and three weeks after the last treatment session, the vocabulary test was administered. The obtained data were analyzed through two-way repeated measure ANOVA and independent samples t-tests. The results showed that the experimental group outperformed the control group in target words' recall and retention. Implications arising from the findings and suggestions for further research are also explained.

Keywords: dual n-back task, EFL learners, working memory training, vocabulary recall; vocabulary retention

1. Introduction

Memory, which is the process by which we acquire knowledge of the world and modify our subsequent behavior, is essential for learning (Dehn, 2008). It has been suggested that working memory (WM) supports language learning (Baddeley, 2003). Working memory (WM) is important for many activities both in first and second language acquisition. According to Baddeley (2003, p. 189), WM refers to the "temporary storage and manipulation of information that is assumed to be necessary for a wide range of complex cognitive activities".

Researchers have examined the role of WM in various L2 language processes, including reading (Walter 2006), writing (Adams & Guillot, 2008), sentence processing (Juffs 2004; Felser & Roberts 2007), speaking (Fortkamp 1999), vocabulary development (Papagno & Vallar 1995), learning grammar (Williams & Lovatt 2003) and the processing of input and intake (Mackey et al. 2010). WM has also been implicated as a core element in L2 aptitude (Dörnyei & Skehan 2003) and as a predictor of overall proficiency (Van Den Noort, Bosch & Hugdahl 2008).

The dominant theory of WM is the multicomponent Baddeley and Hitch model which was promulgated in 1974, and later revised by Baddeley (2000, 2007). This model defines WM as "a limited capacity temporary storage system that underpins complex human thought" (Baddeley, 2007, p. 7). According to this model, working memory is a system with several different parts that control the information being processed. This led to the development of Baddeley's Model of

Working Memory. This model assumes that each component has a limited capacity and is relatively, not entirely, independent of the others. Baddeley's original model contained three components, the phonological loop, the visuo-spatial sketchpad, and the central executive. However, the current model also contains the episodic buffer. In contrast, performance decrements when two tasks are combined indicate that they share a reliance on the same component. This empirical approach has proved invaluable in fractionating WM into its constituent parts, leading to the most recent version of the WM model, advanced by Baddeley in 2000 (Baddeley,2000) (Figure 1.1)

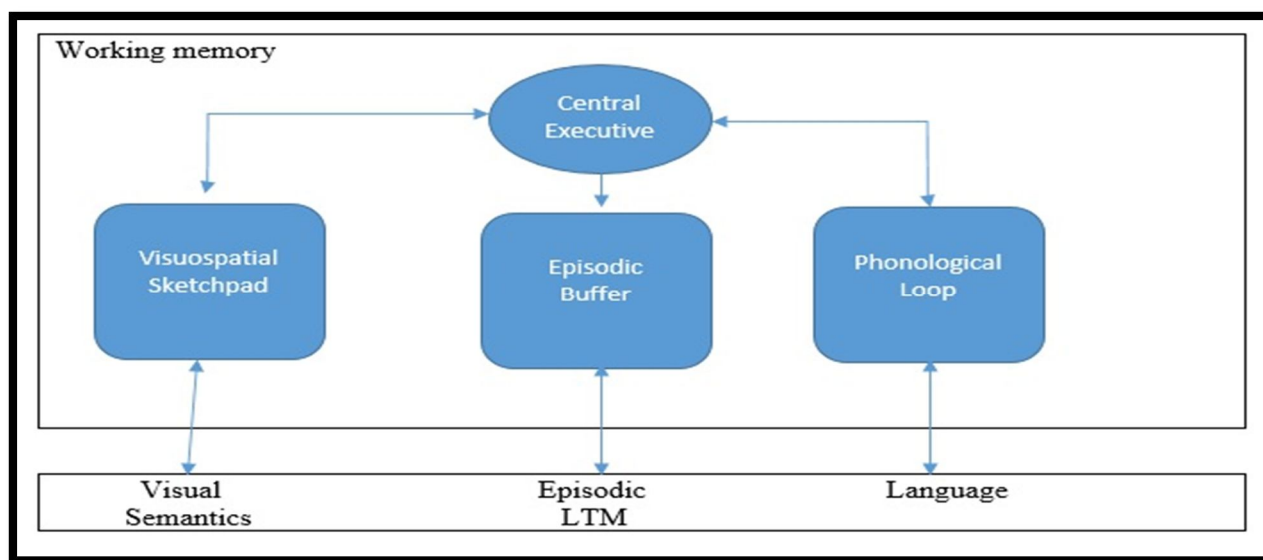


Figure 1.1 the Baddeley working memory model (2000)

The concept of a phonological loop has not gone unchallenged, however. To date, the theoretical underpinnings of the phonological loop continue to be researched and have produced interesting developments in our understanding of language acquisition and processing (Baddeley, 2007). A widely used means of measuring WM is the n-back task. The dual n-back task is a variation of memory assessment that was proposed by Jaeggi, Buschkuhl, Jonides, and Perrig, (2008). In the dual-task paradigm, two independent sequences are presented simultaneously, typically using different modalities of stimuli, such as one auditory and one visual. In the n-back task, the participant is shown a series of items (e.g., letters, words or location markers) and is asked to decide, upon presentation of each item, whether a given property of the current item matches the same property of the item N presentations back. Variations in n can be used to assess individuals' levels of processing capacity or to set a level of dual-task competition. Since its inception, the n-back task has been brought to bear on a host of issues related to WM.

One of the most known problem among second language learners is memorizing the meaning of vocabularies while still want to recall it while needed. Some researchers shown that WM might predict the overall understanding of EFL learners. For EFL learners' reading comprehension, background knowledge, language skill, processing and analysis of the information (i.e. vocabulary) are related to each other processes related to WM (Gathercole, 2007). A sufficient measure of examination has been directed on L2 vocabulary obtaining and additionally on WM

limit. Notwithstanding, more studies are required to research the conceivable relationship between WM limit and L2 vocabulary recall/retention. All things considered, it needs more investigation and examination to discover a linkage between the purported variables over the course of the current research. Since Second language researcher and L2 instructional method look to address the topic of why a few learners struggle to procure a L2 (as a rule in educated settings), specialists have been keen on seeing if WM constraints clarify contrasts in achievement in an assortment of spaces. In this study, we examined the effect of WM training through using dual n-back task on vocabulary recall and retention of Iranian EFL learners.

2. Method

2.1 Participants and setting

The participants were selected from 100 employees holding at least Bachelor of Arts degree in different majors, and working at Islamic Azad University, Shoushtar Branch. The participants were male and female, aging between 25 to 40 years old. For the purpose of study, the Vocabulary Size Test (Schmitt's vocabulary size test 2001) including 2000, 3000, 5000 and 10000 level tests were applied as pre-test. Each level included 30 items and the amount of 20 minutes for each level of proficiency considered for participants. After gathering test scores, and according to existing facilities, among remaining population 50 participants selected. The participants, then, they divided randomly into two groups, experimental and control group. Each group consisted of 25 participants.

2.2 Materials

In order to obtain measureable data with which the results of the current study could be statically analyzed, the following instruments were utilized

2.2.1 Schmitt's Vocabulary Size Test (2000)

It is designed to measure both first language and second language learners' written receptive vocabulary size in English. The test measures largely decontextualized knowledge of the word although the tested word appears in a single non-defining context in the test.

2.2.2 Dual N-back Task

The n-back task has been found to involve a number of the executive functions that have been linked to the relationship between working memory and fluid intelligence, including the processes of attentional control, updating, and the inhibition of interference. It enables subjects to improve their WM capacity and fluid intelligence. The dual n-back task involves remembering a sequence of spoken letters and a sequence of positions of a square at the same time, and identifying.

2.2.3 Vocabulary test

A vocabulary test consisting of twenty matching vocabulary items based on the follow up activities of each session was given (newly taught vocabulary). It was to demonstrate the lexical improvement of participants in pre-test and post-test phases and to determine to what extent using Dual n-back task in teaching was effective.

2.3 Procedure

Before treatment sessions, the Vocabulary Levels Tests were conducted among 100 participants. Among 120 items, 70 items with the maximum wrong answers that most of the participants did not respond them, were selected. After excluding the highest and lowest scores, 64 subjects remained. Of these, 50 participants were selected randomly base on drawing numbers out of a hat. Then they assigned into two groups, control and experimental group. While the control group received conventional teaching, the experimental group worked with Dual-N Back software at the end of each treatment session. In order for testing the validity of the selected items for using in the treatment sessions, 60 words from the tests and 10 words from external materials were selected and used in a pilot study. The study carried out during vocabulary retention/recall measuring course consisting 12 sessions spread over about one month, three days a week, each session 75 minutes. Finally, after three weeks' interval between the posttest final vocabulary test, both experimental and control groups took a test namely a delayed test. Again it was a vocabulary level test with slight modifications in arrangement. To tackle the question of how using dual n-back task training affect vocabulary recall and retention in WM we measured obtained scores through descriptive statistics and anova and Independent Samples t-tests and Bonferroni pairwise comparisons by using IBM SPSS version 22. The results will be represented in the next session.

3. Results

The results of the research revealed the effectiveness of using dual n-back task training and WM capacity development and it is significant and learners benefit from using the task during their study period. Also the findings showed that dual n-back task plays a crucial role in expanding WM of Iranian EFL learners' vocabulary recall and retention. The above mentioned results of this study are in line with various findings in different language learning domains. As follow in accordance with Alloway, et al. (2013), development of WM capacity in the recall and retention phases was significant. Also the results of this study are in line with L2 reading comprehension studies e.g., Adams and Shahnazari-Dorcheh, (2013). The difference between results of pretest, posttest and delayed posttest (mean score) revealed that using dual n-back task training affected significantly on the learners' vocabulary retention in a long span of time. Finally, the findings support the results of study done by Jaeggi et al (2013) that indicates significant correlation between using dual n-back task and memory expansion.

Table 3.1 presents the descriptive statistics for control and experimental group over time.

Table 3.1 Descriptive Statistics for the Control Group and the Experimental Group over Time

Group	N	Time 1		Time 2		Time 3	
		(Pretest)		(Im. Posttest)		(Del. Posttest)	
		M	SD	M	SD	M	SD
Experimental	25	29.88	7.52	50.88	8.64	47.48	8.02
Control	25	29.84	7.03	35.56	6.36	30.68	5.41

As can be seen in Table 3.1, the mean of pretest in experimental group is 29.88 and in the posttest increased to 50.88 and in delayed posttest it was 47.48, while in the control group, the mean score in pretest is 29.84, and it changes to 35.56 in posttest and finally it decreased to 30.68 in delayed posttest. The standard deviation in the experimental group was 7.52, 8.64 and 8.02 in the pretest, posttest and delayed posttest respectively. Also the standard deviation has changes in pretest, posttest and delayed posttests by 7.03, 6.36 and 5.41 respectively.

In order to find out the effect of treatment between control and experimental group over times, we have run two-way repeated measures ANOVA. The results are shown in Table 3.2 below:

Table 3.2 Two-Way Repeated Measures ANOVA

Source	df	F	p
Between Subjects			
Group	1	1222.76	<.01
Within Subjects			
Time	2	296.16	<.01
Time × Group	2	134.30	<.01

As Table 3.2 showed variance between subjects group mean (F value) is equal to 1222.76 and p value is 0.01. In the other hand, the variance within subject during test administration times is equal to 296.16 and time by group is 134.30.

Table 3.3 shows the result of independent samples t-tests for posttests:

Table 3.3 Independent Samples T-Tests for Posttests

Posttest	T	df	p
Time 2- after 1 week	7.14	48	<.01
Time 3- after 3 weeks	8.68	48	<.01

As can be seen in table 3.3, t score after one week of treatment is 7.14 and after 3 weeks is 8.68. The P-value observed and degree of freedom are 0.01 and 48 for both respectively.

Finally, the Bonferroni pairwise comparisons have been implied. It can be used to correct any set of P values for multiple comparisons, and is not restricted to use as a follow-up test to ANOVA.

Table 3.4 Bonferroni Pairwise Comparisons for the Experimental Group

Time (I)	Time (J)	Gain (Mean Difference)	Sig.
Time 1	Time 2	- 21	.00
Time 2	Time 3	3.40	.00
Time 1	Time 3	17.60-	.00

As Table 3.4 shows the comparison between the results of time 1 and time 2 shows -21 in mean difference and it is 3.40 in comparison of time2 and time 3 results and finally in comparison of time 1 and time 3 mean changes to -17.60. The level of significance was 0.00 for all tests results.

4. Discussion

In this study dual N- back task was used as treatment to see whether this kind of training has any effect. Vocabulary acquisition was assessed by an immediate posttest, where individuals attempted to recall words and attempted to answer the questions from Schmitts' vocabulary size test, that were same as the pretest with some modifications. In this test, the participants had to find correct definition among three available definitions. The mean score of experimental group in pretest was 29.88 compared to 50.88 in posttest and in the control group it was 29.84 in pretest and 35.56 in posttest. It indicates improvements in result of the experimental group over control group. The results suggested that the application of WM training in the experimental group had an impact on their actual performance (post-test), resulting in a smaller gap between the recall of the vocabularies and WM capacity expansion. Regarding the short term effect, the experiment group showed higher mean score of immediate posttest than the control group while there was not any significant difference in the two groups' pre-test. This results indicates that although both experimental and control group developed their scores, but experimental group that received Dual n-back task training out performed. The findings of the current experimental study provided empirical support of the effectiveness of applying dual n-back task on vocabulary retention of Iranian EFL learners. The difference between results of pretest, posttest and delayed posttest (mean score) revealed that using dual n-back task training affected significantly on the learners' vocabulary retention in a long span of time. Taking research outcomes into account based on the statistical analysis of results of various calculations such as Bonferroni pairwise comparisons, two way repeated measure ANOVA and independent sample t-test of three phases of this study including pre-test, post-test and delayed posttest demonstrated that there were significant differences between the results of pre-test and post-test and delayed posttest of vocabulary retention in the experimental group. WM and long-term memory have reciprocal influences on each other that are difficult to separate. The relationship is clearly bidirectional: Long-term

knowledge is used to recall and enhance short-term and WM representations; and WM facilitates the building and retrieval of long-term structures.

Finally, as a finding of this study, the experimental group which used dual n-back task training improve their retention and ability to recall information more exactly and even after long period of time. Participants given dual n-back task training performed better than those who were given no treatment. The findings contribute to the idea that L2 vocabulary memorization and using in long periods of time can be achieved by using software like dual n-back task training and other software as medium to improve WM capacity. This results indicates that although both experimental and control group developed their scores, but experimental group that received Dual n-back task training out performed. Also, it can be said that the WM training had a positive effect on short term memory for vocabulary recall in the experimental group when compared to the control group who did not receive the training.

5. Conclusion

The findings of the current experimental study provided empirical support for the effectiveness of using dual n-back task training on vocabulary recall and retention among Iranian EFL learners. The obvious effect of usefulness of using dual n-back task training might be attributed to the fact that all participants in the experimental group who exposed to using dual n-back task after each session, performed better than the other group. They exposed to use dual n-back task training after each session for fifteen minutes. The data collected showed that exposure to using dual n-back task training has a significant effect on participants in experimental group recall and retention. Therefore, according to the findings, the participants could also expand their memory through using dual n-back task training. Individuals' WM capacity, presents a significant correlation with vocabulary acquisition in an L2 situation. (Wardlow & Heyman). This statement justifies why the great majority of the participants claimed they had learned most of the words taught during the period of data collection. It is noteworthy that some words are more difficult to learn due to their feature of being abstract, thus being less prone to being visualized and to being transferred to long-term memory.

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