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Working Memory and Language Aptitude in Relation to the Retention of New Vocabulary Items among Iranian ELF Learners

Rezvaneh Karimzadeh ^{a, *}, Farzad Sabeki ^b

^a Department of Education, Ministry of Education, Saravan, Iran.

^b Department of English Language and Literature, University of Sistan and Baluchestan, Zahedan, Iran.

* Corresponding author Email: r.karimzadeh1374@gmail.com

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Abstract: Language aptitude studies have recently been noticed to develop into a modern interdisciplinary research topic with a great enthusiasm related to educational psychology, second language learning, and cognitive neuroscience, especially with regard to working memory. Moreover, because in the process of teaching and learning, lexical knowledge has a leading role which may be touched by the differences that are observed in the degree of the working memory and the learner's aptitude. This study was organized to explore the significance of the difference between the working memory and language aptitude among Iranian foreign language learners in relation to the retention of new vocabulary items. For this end, 47 Iranian EFL learners studying at grade nine were randomly chosen from different high schools in different districts in Saravan, Iran. In this study, a LLAMA test was applied to measure the participant's language aptitude, an N-back test to measure working memory and Vocabulary Knowledge Scale for measuring knowledge of vocabulary. Mann-Whitney U test was used to answer the research questions since the assumptions of parametric tests did not met. The results revealed that learners who had a higher working memory and higher language aptitude had similarly better performances in the retention of new vocabulary items. The present investigation offers some speculative and performative visions for not only teachers, but also researchers mainly involved in the studies of language and mind.

Keywords: Language Aptitude, Working Memory, Retention of New Vocabulary Items, Iranian EFL Learners

1. Introduction

A great number of studies have vastly approved that boundless discrete learning variables have various impacts on learning consequences. However, during second language learning, some students seem to pick up the new language items with more considerable comfort than the others (Zafar & Meenakshi, 2017). For some English language learners, leaning takes place in a more rapid rate than others; such learners are taken into account to have some exceptional resource available so that they can promote their language learning opportunities. At the present, one of the fresh ideas about it is that this capability had a leading role in the success of adults' second language acquisition (Zolyomi ,2022) and it could have a very significant predication for I2 speech act enlightenment (Derakhshan & Malmir, 2021). Currently, the scope is determined to become associated with the notion of language aptitude as an ambitious attempt to be illustrated by educational specialists. In conjunction with this, in L2 learning context, the role of working memory has been progressively noticed (Robinson, 2002). In This cognitive ability, the relevant knowledge can be kept and manipulated in a short period of time. Also, it is very important for controlling and fostering goal related information regardless the attendance of stimuli which is disturbing (Schmeichel, Volokhov & Demaree, 2008). Language learners who demonstrated higher scores on working memory scale have showed much better performance in many aspects for instance; focusing on tasks (Song, MacQuarrie, & Hennessey, 2023), going through a continuous reduction in workload of mental processing throughout strategy learning of the planning task (Raduntz, 2020) and obtaining more lexical information than the learners without an immense working memory (Sok & Shin, 2023). In addition, with regard to the effective use of foreign language, lexical items are crucial in learning process and have key function in the typical learners' discovery duration of language training (Zimmerman





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& Risemberg, 1998). According to Sedita (2005) who claimed that vocabulary surrounds all the necessary words the learners are obliged to apprehend to access their previous knowledge, verbalize their ideas to interact successfully, and learn new thoughts. One of the recent views for mastering vocabulary items is that technology-based instruction (Khoshsima & Khosravi, 2021) and employing digital games (Lee, 2023) can be worthwhile in ameliorating the retention of new vocabulary items. Therefore, giving our attention to the retention of the new vocabulary items would be undeniable in modern language learning settings. As there are decades of fast educational developments within the cognitive revolution, our understanding on our cognitive abilities has enormously developed due to contemporary advances in the interdisciplinary issues of foreign language learning especially, language aptitude and working memory (Roninson, 2002). Consequently, researchers can develop a comprehensive understanding of their topic (Azevedo & Aleven, 2013). Therefore, aptitude and working memory are two concepts that have widely been explored in the literature; however, they have rarely been explored along with retention of new vocabulary items. As a result, this study aimed at responding to this fundamental need by examining the discrepancies between language aptitude and working memory in term of new vocabulary retention among Iranian EFL learners.

2. Theoretical Framework

2.1 Language Aptitude

Language aptitude has been examined to be one of the greatest dominant identity records in relation to EFL learning success (Skehan, 1989). Foreign Language Aptitude (FLA) is a remarkable perspective on the subject. Conceptually, FLA is presumed to be a rather fixed talent for learning a foreign language differing in individuals (Dornyei & Skehan, 2003). Of course, some individuals acquire a foreign language at a flying speed while others experience some hardships with this process despite how tough their efforts and how great their motivation is (Carroll, 1981).

In the bright era of language aptitude investigations, Carroll provided the differentiation among cognitive abilities involving intelligence and language aptitude (Skehan, 2014, p. 381). In his perspective, aptitude was viewed to have integral parts in addition to be a static characteristic which was not easy to explain. Carroll (1981) introduced four primary foundations of language aptitude including: phonetic coding ability, grammatical sensitivity, rote learning ability for foreign language materials, and inductive language learning ability.

As already noted, language aptitude has been considered by a huge number of researchers. In a late venture, Kocic (2019) suggested that aptitude is an important aspect in foreign language learning by focusing on the proposition that aptitude has a significant position in the teaching methodology by suggesting some different optional programs based on the interconnection between language aptitude and SLA theory.

In another accomplishment, Smith and Stansfield (2017) discussed the construct and usage of aptitude in SLA research. Likewise, they brought beneficial comprehensions about its measurement. In a similar tendency, Burns (2018) provided a general view on language aptitude and its application in the classes.

Besides, language aptitude has been argued with sensitive periods in second language acquisition (Long & Granena, 2018). The researchers were concentrated just on two views: firstly, the robustness of maturational constraints and secondly its role for language learning.

2.2 Working Memory

The latest view of working memory (WM) as it was first proposed by Baddeley and Hitch (1974) is a revision of the image of short-term memory due to a demand to make a strong contradiction between their fundamental functions in the brain.

Baddeley (2003) in line with the seminal theory, defines working memory as a system which functions with a number of components involving the central executive, the phonological loop, the visuo-spatial sketchpad and the episodic buffer. As claimed by Henry (2012), the central executive has a general intentional control of the working memory system. Also, the phonological loop keeps short-term phonological information and permits the learner to recall smaller segments of auditory clues for a brief moment (Henry, 2012). Moreover, the visuo-spatial sketchpad (VSS) not only is related to processing and retains visual and spatial data, but also encodes verbal evidence to imaginary form (Gathercole & Baddeley, 1993, p. 17). To put it another way, the VSS smooths the way of recollection



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of "what" and "where": which bring up the visual factors of the object and its location (Henry, 2012). As stated above, the Episodic Buffer (EB) acts as the main current in addition to the WM model allowing impermanent maintenance of items in a multimodal code being qualified to join data from the subsidiary systems (Baddeley, 2000, p. 417). An analysis of past research shows a considerable practical support that variations do exist in working memory being interconnected with EFL.

An inquiry among English students by Nowbakht (2019) delved into the depth of the role of working memory, language proficiency and age in the perception of anaphoric English sentences.

Regarding the importance of working memory, Barker (2016) supplied a review of working memory and its application in educational situations. Another experiment has been administered by a team of scholars (Emmorey, Giezen, Petrich, Spurgeon, & O'Grady Farnady, 2017) to prove the conjunction between 30 linguistic and spatial working memory resources and comprehending the sign language in comparison to the verbal speech. Results made visible the existing enhancement between speakers' complex working memory task and advantages on their linguistic short-term memory.

Ahmadian (2012) examined how inter-personal discrepancies communicate with task-based vigilant online planning condition affecting the complexity, accuracy and fluency of the task, in working memory capacity. He postulated that distinct differences in working memory capacity would impact on the vigilant online planning, since such an online planning is supposed to get involved in the content and quality of the talk while talking (Ellis, 2008). It looks as if the speaker is arranging the content of the speech while at the same time being involved in another cognitively demanding activity. Consequently, under the condition of careful online planning, working memory capacity has relationship with accuracy and fluency.

2.3 Retention of New Vocabulary Items

Retention is an essential technique in the educational process, imagine you picked up many words and the next day you woke up with a clear mind because you did not hold the information in your memory; therefore, your achievement will be zero (Alacapinar, 2002). Retention is the continuous keeping, using, or controlling of something in the person's memory (Richards & Schmidt, 2002). Thus, the retention of vocabulary is maintaining vocabulary in students' memory as they can retain and employ it. In general, there are two kinds of word retention; that is, short-term and long-term retention. If the test is taken immediately after instruction, it will be considered the short-term vocabulary retention. However, if there is a two-week-long interval between the instruction and test-taking, it will be considered the long-term vocabulary retention (Grace, 2000). An examination of former investigations verified that there are plenty of reports have been explored the vocabulary retention in association with EFL.

Ramezanali (2017) in an attempt studied which type of gloss presentation; namely, aural and videoanimation was more adequate for the student's short- and long-term vocabulary learning and retention. The findings indicated that glossing was significantly more sufficient than a non-glossing presentation for the learner's short-term retention.

In another research Salehi (2016) examined the effects of Instructional Video Games (IVGs) on the retention of vocabulary among Iranian EFL learners. The inferential data analysis suggested that the user of IVGs significantly performed better in vocabulary retention test in comparison with those students who did not use IVGs.

Taheri (2014) probed over the impact of applying language games on vocabulary retention among elementary students. Data analysis indicated that introducing language games in teaching activities more significantly influenced on the delayed time rather than the immediate one. In a similar vein, the credit of transferring meaning via using thesauruses, dictionaries, and contextual clues on acquisition and retention of vocabulary items were searched. The results indicated that the context method has positively weighted on the amount of retention both in the immediate test and the delayed post-test (Ansarin & BananKhojasteh, 2013).

In the continuation of the foregoing theoretical and empirical discussions and reports, this article lines up to direct the research questions (RQs) below:

RQ 1: Is there any statistically significant difference between the retention of new vocabulary items by Iranian EFL learners with high and low working memory?



RQ 2: Is there any statistically significant difference between the retention of new vocabulary items by Iranian EFL learners having higher or lower language aptitude?

3. Methodology

3.1 Participants

To proceed with this research, 47 ninth-grade students from five different high schools in Saravan, Iran were selected randomly. The participants of this study were a mixture of 22 females and 25 males, (aged 12 to 15 years old) with Persian or Baluchi as their first languages. It is worth mentioning that the learners had the lowest chance of practicing English for communicative purposes outside of the academic setting. According to the teacher's knowledge, the learners' proficiency level was elementary.

3.2 Instrumentation

3.2.1 Language Aptitude Test

The computerized Language Learning and Modern Aptitude (LLAMA) test fostered by Meara (2005) originated from the theoretical foundations of the Modern Language Aptitude Test (MLAT), consists of four subcategories, namely; the LLAMA B (a vocabulary learning test quantifying the capacity to learn a great amount of words quite rapidly; the LLAMA D (being created to examine the capacity of learners to identify small segments of oral language being familiarized with a short while before; the LLAMA E (a sound-symbol correspondence test offering a set of 24 recorded syllables, along with a transliteration of these syllables in an uncommon alphabet to occupy the connection between the sounds and the writing system reflecting the phonetic coding qualification of Carroll's model; and finally, the LLAMA F (a grammatical inference test dealing with the available time to learn the new language. Finally, after accomplishing the test, the test-taker's scores are demonstrated on a screen display panel. The LLAMA score may vary from 0 to100. The rating scale may differ from very weak to excellent. Meara (2005) validated the reliability of the LLAMA test through its internal reliability. Likewise, the Language Learning and Modern Aptitude (LLAMA) Test was used to measure the learners' language aptitude.

3.2.2 N-Back Test

The N-back test is a computerized cognitive test (Gray, Chabris, & Braver, 2003; Jaeggi, Buschkuehl, Jonides, & Shah, 2011; Jaeggi, Studer-Luethi, 2010) that introduces a limited group of stimuli in a non-stop process that the test-taker is recommended to reply to each test item as previously arranged. The test items are characterized in audio-visual forms. The visual test items can appear in the form of figures, pictures, letters, lexical items, and digits arranged either individually or spatially. In this test, the stimuli are presented sequentially. At particular spots, one is requested to go over the item that appeared N presentation earlier. For instance, if one is required to restate the figure which existed one back earlier, the participant has to push a button on the occasion when the form is similar to same 1 trial back. The N- back testing software demonstrates the test score spontaneously when the test ends. The outcomes cover the matches, right answers, failed answers and the score. The rating extends from weak to top. A pilot study was carried out with 25 test-takers at Hazrat Fatemeh High School to calculate the internal reliability of the test. The KR-21 formula was applied and the index of reliability amounted to 0.62. The face validity of the n-back test was equal to that of WM test. It appears to be involved in maintaining, interminable revising, and refining data. Since at least two tasks including maintaining and manipulating information were required to be processed at the same time, it seemingly parallels with the criterion of domain-general administrative attention (Kane & Engle, 2002). The N-back test was operated to assess the participants' working memory.

3.2.3 Vocabulary Knowledge Scale

The Vocabulary Knowledge Scale (VKS) is one of the most well-known measures of vocabulary acquisition introduced by Paribakht and Wesche (1993). The specific goal of the VKS is creating an applicable tool to be used in studying retention and the use of new words. For this purpose, a 5-point scale has been applied. Also, this instrument brings together self-report and performance items to stimulate self-perception and knowledge of specific written words. The rating measure goes from being absolutely unknown for the learner to the recognition of the word and



its application so that the participant is able to use it in a grammatically and semantically accurate sentence. Bachman and Palmer (2000) investigated the validity of self-ratings using confirmatory factor analyses. They found that selfreporting can be considered as a reliable and valid measure of vocabulary acquisition questionnaire. The vocabulary knowledge scale was used to quantify the participants' lexical knowledge.

3.5 Procedure

Language aptitude test, N-Back test and vocabulary knowledge scale were given to 47 EFL students at nine high schools, in three periods, in the city of Saravan. In the first test administration, language aptitude, and in the second one, the N-Back test was given to the participants at all schools. For the retention of the new vocabulary items, ninety words out of 200 from Vision 1 (the English course book of the schools' official curriculum) were selected. The learners were given a test in which 90 vocabulary items in three categories were presented as verbs, nouns and adjectives. For each of these categories, thirty vocabulary items were selected. Two benchmarks were taken into consideration while selecting the words. Firstly, all the word items were taken from *Vision 1*, the textbook the learners were planned to study in the next year. In this way, according to Oxford & Scarcella (1994), the students' needs and motivational requirements were met. Secondly, the included word items were adopted from the Oxford 3,000 keyword list. The previously administered pre-test was used as a proof that the participants already had some knowledge of these vocabulary items. Two weeks after the end of training sessions, the students were requested to rate the vocabulary items by the vocabulary knowledge scale. The students were precisely enlightened that their responses would remain incognito, and informed consent letters were given to all participants to read and sign. In a small talk, the researchers declared that the data would be used only for research purposes. Prior to the test administration, the students were briefed on the research objectives along with the necessary instruction regarding the correct way of filling out the test items and other details. Likewise, an example was given regarding how to choose the most relevant response in Persian. The required time to complete the tests and questionnaire was 15-20 minutes.

4. Result

To identify the differences between the learners' working memory and their language aptitude among the Iranian EFL learners in relation to the retention of new vocabulary items, the Statistical Package for Social Sciences (SPSS) version 23 was employed. The first research hypothesis stipulates that there is no significant difference between the retention of new vocabulary items by Iranian EFL learners with high and low working memory. To test this assumption, the participants' scores on the retention of new vocabulary items were scanned for analysis using the Kolmogorov-Smirnov test to inspect the concept of normality distribution.

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Retention of New Vocabulary Items	.129	47	.050	.929	47	.007

Table 1. Tests of Normality for Retention of New Vocabulary Items Scores

According to the outcome of the Kolmogorov-Smirnov test, the notion of normality of the distribution was not observed (Table 1). Because the Sig. value amounted to be 0.05, a Mann-Whitney U Test was inevitably applied.

Working Memory	Ν	Median	Mean	Std. Deviation	% of Total N
High	37	92.50	87.15	14.730	73.3%
Low	13	42.00	39.15	7.116	27.7%
Total	47	83.00	73.87	25.294	100.0%

Table 2. Descriptive Statistics for Scores in High and Low Working Memory

Table 2 displays the median and mean for high and low working memory groups. The median and mean for high group were 92.50 and 87.15 and for the low group 42.00 and 39.15 respectively.



Table 3. Independent-Samples Mann-Whitney U test summery over retention of new vocabulary items

Total N	47
Mann-Whitney U	63.500
Wilcoxon W	154.500
Test Statistic	63.500
Standard Error	42.039
Standardized Test Statistic	-3.747
Asymptotic Sig. (2-sided test)	0.000

A Mann-Whitney U Test indicated a significant difference in retention of new vocabulary items (U=63.500, Z=-3.747, p=0.000, r=0.54) (Table 3). As stated by Cohen (1988), this would be regarded as a large effect size. The medians brought to light that the learners with high working memory shined on their peers having low working memory with respect to the retention of the new vocabulary items.

With the intention of testing the hypothesis number two, which claims the absence of any significant difference between the retention of new vocabulary items by Iranian EFL learners with high and low language aptitude, primarily, the scores of the language aptitude were checked for normality distribution.

Based on the results of Table 1, this normality of the distribution for the retention of new vocabulary items was not confirmed. Consequently, Mann-Whitney U test was applied.

Language Aptitude	Ν	Median	Mean	Std. Deviation	% of Total N
High	18	58.00	57.17	5.305	38.3%
Low	29	35.00	34.97	9.433	61.7%
Total	47	46.00	43.47	13.553	100.0%

Table 4. Descriptive Statistics in High and Low Language Aptitude Groups

According to table 4, the median and mean for the high group were 58.00 and 57.17 and for the low group were 35.00 and 34.49, correspondingly.

Total N	47
Mann-Whitney U	168.000
Wilcoxon W	603.500
Test Statistic	168.000
Standard Error	45.685
Standardized Test Statistic	-2.036
Asymptotic Sig. (2-sided test)	0.042

A Mann-Whitney U Test showed significant difference in retention of new vocabulary items (U=168.00, Z=-2.036, p=0.042, r=0.29) in high (Mdn=58.00) and low (Mdn=35.00) language aptitude (Table 5). As stated by Cohen (1988), this effect size would be regarded as an insignificant one. The medians exposed that the learners with high language aptitude are more advantageous than low language aptitude learners with the respect the retention of new vocabulary items.

5. Discussion

Nowadays, as far as the studies on the present day literature suggest, there is a huge research area about the difference between the retention of new vocabulary items and working memory on one side and language



aptitude of Iranian EFL learners on the other side. The first research question of the study was raised to discover the likely difference between the retention of new vocabulary items by Iranian EFL learners with high and low working memories. The results suggested the existence of such a significant difference between the retention of new vocabulary items by the participants with high and low working memories. One reason for this result might be that participates with high WM might have training working memory strategies to minimize the WM's limitations. Thus, it led to increasing the retention process in longer intervals. Another possible reason for this might be that the participants with high vocabulary retention have been using the revision planning in the two-week interval of the data collection procedure. Here, the conclusion of the current study is well-matched with the result of Santacruz and Martinez (2018), who tried to find out the ways working memory training could assist English words retention by the use of a set of strategies. They found that majority of participants in the experimental group had benefits of the intervention and displayed a slow advancement in the retention and retrieval of words studied in the lesson; however, they improved their holistic ability in their foreign language competency. In a similar line, Efstathiadi (2016) reported that the central executive part of WM was a significant indicator of early foreign language lexical performance. Likewise, in another research, Daneman and Green (1986) maintained that higher working memory efficiency, as messured through speaking span test, correlated with second language vocabulary retention as measured by productive and receptive tasks. The findings revealed that participants with higher WM seemed to be superior in both comprehension and production of new vocabulary items in a second language than participants with lower WM. The results also marked that both groups with high and low WM display more acceptable performances during the perception of new words rather than during their production. To the best of the investigators' information, there is probably no study with contradictory outcomes. The second research question aimed at discovering the possible differences amongst the retention of new vocabulary items by EFL learners having high and low language aptitude. The outcome exposed that there was a statistically significant difference between the learners with high and low language aptitude. One explanation might be the existence of a strong relationship between the variables under the study; namely, language aptitude and the retention of the vocabulary items.

Also, another probable reason for these findings might be that the participants with high aptitude are more eager to retain the new vocabulary items than the participants with low language aptitude. In addition, this result might be due to the situations in which the high language aptitude participants have studied the new vocabulary items in the time interval. Moreover, further motivation for this outcome might be associated with the point that participants with higher signs of language aptitude are more enthusiastic about leaning, utilizing and maintaining the new vocabulary items than the low language aptitude participants.

However, in one contrastive study, Poschner (2018) made it crystal clear that low aptitude learners improved their retention significantly with application of some specific vocabulary acquisition strategies, while learners with higher aptitude levels did not demonstrate any sign of advantage from such strategies. It could be speculated that some vocabulary acquisition strategies for retention could enhance language aptitude. So far, there have apparently not been any studies with divergent result; however, the most pertinent results concerning language aptitude are given in literature review of present paper. Therefore, the generalizability of the result of this paper should be treated with caution, because the number of participants, their age, the context and instruments used to obtain the data were restricted.

6. Conclusion

Given attention to the cross-disciplinary research, have involved the researchers in diverse area of knowledge. It is compulsory to ascertain hidden instigation and look into the path that smooths the way of individuals who are engaged with learning. The goal of the current paper was to explore the differences between retention of new vocabulary items among Iranian EFL learner with high and low working memory and language aptitude of Iranian EFL learners. Therefore, with reference to the findings of the research questions of the study, the leaners with high working memory and language aptitude are superior in retention of new vocabulary items. Accordingly, teachers in classrooms' contexts can use some strategies for training working memory in order to improve its capacity into unplumbed zone. Along with this, teachers are required to practice increasing the learners' motivation and make them more sensitive to go into their foreign language aptitude as a concealed gift with a lot of unrealized dimensions.



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Does this article screened for similarity?

Yes

Ethics Approval

Ethics approval was sought from the Institutional Review Board (IRB).

Informed Consent

Written consent was obtained from the participants.

Author Contributions

Rezvaneh Karimzadeh: Designed the analysis, Collected the data, Data analysis, Statistical analysis, Manuscript preparation, Manuscript editing and review; **Farzad Sabeki:** Conceived and designed the analysis, Manuscript preparation, Manuscript editing and review. Both the authors read and approved the final version of the manuscript. **Conflict of interest**



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