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The Relationship between Non-verbal Active Memory and the Writing Skills of Iranian EFL Deaf Female Learners' Proficiency

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Abstract

This study aimed to investigate the impacts of nonverbal working memory on the writing skills of Iranian (EFL) deaf learners. To attain the purpose of the study, 15 secondary school deaf learners were selected to participate in this study. They were 8th-grade female students of Golestan Exceptional School aged 13-15. The researcher used a non-verbal memory test and a writing test to collect the required data. The participants were asked to participate in the selected tests. The results revealed that there was a statistically significant relationship between learners' non-verbal working memory and writing tests. The findings, also, demonstrated that there was not any significant difference between the writing skill performance of learners with higher capacities of non-verbal working memory and learners with lower capacities of non-verbal working memory. Therefore, the level of non-verbal working memory did not influence the writing skill. The findings have implications for pedagogy as well as further research.

Keywords: Non-verbal active memory, Writing skills, English language learners, Deaf and hard-of-hearing learners

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1. Introduction

The term working memory was first coined by Miller et al. (1956) in the 1960s to compare the performance of the mind with computer processes. Atkinson and Shafrin (1968) also used this skill to demonstrate short-term memory and called it "short-term storage". Active memory is a system consisting of separate but related components that create a kind of flexible mental storage space in a coordinated activity and is used to store and transfer information during the time required for cognitive activities (Dehan, 2008). Continuous use of working memory is necessary for the continuation of concentration, purposeful thinking, and mental efforts during learning (Burkholder & Pisani, 2003).

Working memory is a multidimensional system that, in addition to temporarily storing stimuli that have been attended to, is used to manipulate information (Melby, 2013; Neto et al., 2010). The components of active memory according to the model are the phonological loop, visual-spatial plane, and central executive mechanism. Recently, another component called temporary storage has been added to working memory (Baddeley, 2003). Baddeley defines working memory as a brain system that provides temporary storage and transformation of information necessary for complex cognitive learning activities such as learning and understanding language. Ellis (1993) stated that there is a significant relationship between working memory and language learning. The ability to work memory plays an important role in various aspects of life, including reading comprehension, writing, problem-solving, mathematical reasoning, written language, and various behavioral domains (Swanson & O'Connor, 2009; Schneider, 2015).

In recent decades, working memory has been a popular area of research, especially in relation to deaf and hard-of-hearing children. Hearing is one of the most important human senses, without which many human adaptations to the environment are disturbed and mental processes are delayed, natural hearing is the ability to understand the words of others without the need for special aids or methods (Hayward, et al, 2009). According to this definition, someone whose hearing is damaged needs special tools or methods to understand the words of others. Milanifar (2000) stated that the sense of hearing is one of the most important means of obtaining information from the environment as well as being aware of the feelings and

emotions of others, and deafness has a great impact on a person's cognition and receiving information from the surrounding environment. Hassanzadeh (2008) showed in his research that deaf children do not have any difference in intelligence as compared with hearing children and only in terms of academic progress, a significant difference is observed between them. Afrooz (2008) believes that deafness is not only a deprivation of a sense, and since spoken language is an important factor in establishing social relations, education, and learning, deaf people have a limited function in the field of language. Because deaf children are unable to use listening and speaking skills, working memory is thought to play an important role in their learning, especially language learning.

Deaf people, due to their inability to use the verbal components of language, non-verbal working memory is an important factor in their language learning, in addition, deaf students can use some language skills such as speaking and listening. Reading and writing skills are very important in their language learning and can play a major role in helping deaf students learn better. Hence, this study aimed to investigate the impacts of non-verbal working memory on the writing skills of Iranian EFL deaf learners.

2. Methodology

2.1. Design of the Study

This study was ex post facto in design quantitative correlational study in nature. Ex post facto design is a quasi-experimental study examining how an independent variable, present before the study in the participants, affects a dependent variable. In this study, there are two variables, nonverbal working memory and writing skills.

2.2. Participants

The participants of this study were 15 secondary school deaf learners. They were 8th-grade female students of Golestan Exceptional School and aged between 13-15. Using available sampling, the researcher chose these students to participate in this study. This was the second year that they were studying English. They were not able to use listening and speaking skills.

2.3. Instruments

Two instruments were used in this study:

2.3.1. Working Memory Tasks

Two working memory tasks, namely the Spatial Span Task (Wechsler & Naglieri, 2006) and the Odd One Out Span Task (Henry, 2001), were selected since they require a minimal amount of verbal instruction and only non-verbal responses and they were especially suitable for deaf learners. The researcher used these tests to measure the level of learners' working memory capacity.

2.3.1.1. The Spatial Span Task

It is a measure of visuospatial short-term working memory (Wechsler & Naglieri, 2006). A set of nine identical blue blocks is affixed to a whiteboard in an unstructured array. The examiner can view a number on each of the blocks and is seated directly opposite to the child being tested. Children are instructed to tap a sequence of blocks in the same order as the examiner in the "forward" test, and in the reverse order in the "backward" test. Children are administered two trials for each sequence length, beginning with two blocks, ranging up to a span of nine. Two trials of each sequence length are administered, and the test is terminated once both trials of the same sequence length are failed. The task begins with two practice trials in both the spatial span forward and backward conditions to ensure that the child understands the task. One point is awarded for each sequence accurately repeated. Wechsler and Naglieri (2006) proved the reliability and validity of this test to be acceptable.

2.3.1.1.2. The Odd One Out Span Task

It is a measure of executive-loaded visuo-spatial working memory (Henry, 2001). It will be presented in PowerPoint and comprises 63 slides, each displaying a set of three shapes. On each of the slides, two of the shapes are identical, and one is slightly different: the "odd one out." The examiner will show the students a slide and ask them to identify which shape is the odd one out. The student will be instructed to try to remember the location of this shape. The following slide contains an empty grid with three boxes, and the student will be asked to point to the empty box in the same location as the shape that they have just seen. After four

single-item trials have been displayed, the student is shown two sets of shapes in a row. There then follows a slide with two empty grids, one on top of the other. The child is instructed to point to the empty boxes in the same location as the two "odd" shapes they have previously seen, in the same order that they were presented. If the child initially verbalizes or signs their answer (e.g., left, middle, etc.), they are reminded that they need to point to the location of the shape. Trial length increases sequentially in blocks of four with a maximum of six sets of shapes. Once the child makes two errors within a block, the test is terminated. The total number of trials correctly recalled is then calculated. Before the test begins, two practice trials are administered to illustrate the task procedure: a single-item and a two-item trial. Correct responses to the practice items are indicated to the child if they do not initially answer correctly. Henry (2001) proved the reliability and validity of this test to be acceptable.

2.3.2 Writing Test

This test was taken from students' English books as their weekly tests. Since the participants of this study are 8th-grade students, the researcher chose a topic from their school English book and asked them to write about it.

2.4. Procedures

At the beginning of the study, the researcher used two intact classes of secondary female students to participate in the study. She used an available sampling method to choose the participants. The participants were all deaf learners and they did not have any other physical or mental problems. Then she did the pilot study and asked some of the randomly selected students to participate in the tests to find out if any misunderstanding arose.

At the next stage, she instructed all of the participants to non-verbal working memory test and a writing test. To accomplish the working memory tests, the researcher used some blocks and some shapes in the form of a PowerPoint presentation. In the writing test, the students were asked to write some sentences on the given topics. The topics have been chosen from the 8th grade English book. The researcher chose topics like weather, seasons, food, etc. At the end of the study, data analysis was done to find the relationship between the variables.

4. Findings

4.1. Examining the Normality of Data

Before performing the analysis of data, the normality of collected data was assessed using One-Sample Kolmogorov-Smirnov Test. This test was used to show the normality of the distribution of data and to make decisions about using parametric or nonparametric tests to analyze data. When the sig<0.05, the distribution of data is not normal and it is not possible to use parametric tests. When sig>0.05, the distribution of data is normal and it is possible to use parametric tests. The next table, Table 4.1, shows the result of the One-Sample Kolmogorov-Smirnov test which was applied to ensure the normality of the collected data of all types.

Table 4.1

One-Sample Kolmogorov-Smirnov Test for Tests of Writing and Working Memory

		writing	Spatial span	Odd one out
N		15	15	15
Normal Parameters[a]	Mean	16.93	38.00	14.40
	Std. Deviation	.96	4.34	1.72
Most Extreme Differences	Absolute	.272	.344	.258
	Positive	.272	.344	.258
	Negative	-.261	-.256	-.208
Kolmogorov-Smirnov Z		1.055	1.33	1.00
Asymp. Sig. (2-tailed)		.216	.057	.269

a. Test distribution is Normal.

The above table shows the results of the one-sample Kolmogorov-Smirnov test. The results showed that the data of all of the tests are normal, because for all of the variables sig>0.05. Accordingly, it is possible to use parametric tests to analyze data.

4.3 Addressing the First Research Question

The first research question guiding the study was: *Is there any relationship between nonverbal working memory and the writing skill of Iranian EFL deaf learners?* To answer the first research question, the researcher used a writing test and a test of nonverbal working memory. The next table shows the descriptive statistics of the scores of the above-mentioned tests.

Table 4.2

Descriptive Statistics of tests of Writing and Working Memory

	N	Minimum	Maximum	Mean	Std. Deviation
Writing	15	15.00	19.00	16.93	.96
Working memory	15	42.00	66.00	52.40	5.51
Valid N (listwise)	15				

The above table shows the mean score, std. deviation, minimum, and maximum scores of students in writing and working memory tests. As it is clear from the above table, the mean scores of the writing test and working memory test are 16.93 and 52.40, respectively. The std. deviation of the writing test and working memory test are 0.96 and 5.51, respectively. Moreover, the above table shows that the minimum and maximum scores on writing test are 15.00 and 19.00 and the minimum and maximum scores for working memory are 42 and 66.

To answer the first research question, the Pearson Correlation test was used. This test was administered to find the relationship between learners' nonverbal working memory and writing skills. Because of the normality of the data, it was possible to use this test. The result of this test is reported in the following table.

Table 4.3

Pearson Correlation Test of learners' nonverbal working memory and writing skill

		writing	Working memory
Writing	Pearson Correlation	1	.679**
	Sig. (2-tailed)		.008
	N	15	14
Working memory	Pearson Correlation	.679**	1
	Sig. (2-tailed)	.008	
	N	14	14

**. Correlation is significant at the 0.01 level (2-tailed).

As it is obvious from this table, the correlation between learners' nonverbal working memory and writing tests is significant (sig < 0.05). In other words, there is a significant relationship between learners' nonverbal working memory and writing tests.

4.4. Addressing the Second Research Question

The second research question guiding the study was: Do Iranian EFL deaf learners with higher capacities of nonverbal working memory have better performance in writing skills than learners with lower capacities of nonverbal working memory? To answer the second research question, first, the researcher computed descriptive statistics of participants' writing and working memory test scores which are presented in Table 4.2 To classify the participants into two groups, to find the participants with higher levels of working memory capacity, the researcher used the participants' mean score of working memory capacity (mean=52) as a cut point and classified the learners into two groups: a group with higher working memory

capacity (>52) and a group with lower working memory capacity (<52). Table 4.4 shows the ranks of the higher and lower groups about their writing score.

Table 4.4

Ranks of Working Memory Capacity in Two Groups

	working>52	N	Mean Rank	Sum of Ranks
Writing	high	7	10.07	70.50
	low	8	6.19	49.50
	Total	15		

As it is obvious from this table, out of 15 participants, 8 learners' level of working memory is lower than the mean score (<52), and 7 learners have a higher level of working memory (>52). The mean rank of the writing score in the lower group is 10.07 and the mean rank of the writing score in the lower group is 6.19. The results of the Mann-Whitney test are represented in Table 4.5.

Table 4.5

Results of Mann-Whitney U Test

	writing
Mann-Whitney U	13.50
Wilcoxon W	49.50
Z	-1.83
Asymp. Sig. (2-tailed)	.067
Exact Sig. [2*(1-tailed Sig.)]	.094[a]

Grouping Variable: working memory>52

Based on Table 4.5, Z= -1.83 and Sig=0.094. It shows that the mean scores of learners' writing tests in higher and lower groups are different. The mean rank of higher and lower groups shows that the mean rank in the higher group is higher than the mean rank of the lower group. Since sig>0.05, the results revealed that there is not any significant difference between the writing skill performance of learners with higher capacities of nonverbal working memory and learners with lower capacities of nonverbal working memory. Therefore, the level of non-verbal working memory did not influence the writing skill.

5. Discussion

The aim of the present study was to investigate the effectiveness of non-verbal working memory on the English writing skills of students with hearing impairment. The results of the present study are in agreement with the results of Gederkol et al.'s (2004) research, who believe that working memory is a mental workspace with flexible activity, whose task is to perform daily cognitive activities that require processing and storage. Active memory is the basis of thinking and learning and plays an important role in language learning.

In deaf students, considering their hearing and speaking limitations, working memory can play an important role in learning English. Since these students are not able to fully use their sense of hearing and speaking, their reading and writing skills are involved in language learning. results of this research showed that non-verbal working memory has an effect on writing skills in deaf students.

The findings of Elavi's research (2011) also determined that students with low working memory capacity have poor performance in areas such as language learning, and working memory is a key part of learning English. As a result, finding ways to improve working memory capacity can help improve English language learning, especially in deaf students. Pisani and Cleary (2003) emphasized the importance of increasing working memory.

The findings of the present study are generally in line with the results of previous studies and are a confirmation of the relationship between working memory and English

language learning. Also, the research results of Schneider (2015) and Swanson and O'Connor (2009) stated that active memory ability is effective in reading and writing, and these results are in line with the results of the current research. Arfe et al. (2015) also concluded that working memory is effective in the oral and written performance of deaf people. Considering that deaf students have limitations in reading and writing, it can be concluded that non-verbal active memory is considered an important and effective factor in increasing writing skills.

6. Pedagogical Implications

The findings of this study may provide practical implications and suggestions for EFL learners, teachers, educators, and administrators to improve qualities of material, and syllabus design. Given the importance of the capacity of working memory in successful language learning, teachers should be aware of learners' need to improve the capacity of their working memory, especially in deaf learners since working memory has a special and significant role in language learning. Hence, in addition to language learning activities, English courses should also provide materials, which are useful for learners to improve their working memory.

Moreover, in teacher training courses, teacher development programs, and workshops alternative ways to incorporate practices and activities that can improve language skills by not only focusing on foreign language teaching and learning but also incorporating what can improve learners' capacity of working memory. In other words, teacher trainers, and administrators of teacher training programs who can prepare the content of the programs should pay attention to the need to improve learners' capacity of working memory.

Conflict of interest

The author(s) certify/certifies that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in the present research paper.

References

Afrooz, G. H. (2008). Analytical and comparative study of the psychological foundations of cognitive and psychosocial characteristics of blind and deaf Youth. *Journal of Psychology and Education*. *39*(2), 1-12**.**

Atkinson, R. C., & Shiffrin, R. M. (1968). Chapter: Human memory: A proposed system and its control processes. In Spence, K. W., & Spence, J. T. *The psychology of learning and motivation* (Vol. 2). New York: Academic Press. pp. 89–195.

Baddeley, A. (2003). Working Memory: Looking Back and Looking Forward. *Nature Reviews Neuroscience, 4*(10), 829–839. https://doi.org/10.1038/nrn1201

Chan, L. K. H., Hayward, W. G., & Theeuwes, J. (2009). Spatial working memory maintenance: Does attention play a role? A visual search study. *Acta Psychologica, 132*(2), 115–123. https://doi.org/10.1016/j.actpsy.2009.03.001

Ellis N. C. & Beaton A. (1993). Factors affecting the learning of foreign language vocabulary: Imagery keyword mediators and phonological short-term memory. *Quarterly Journal of Experimental Psychology*, *46*, 533–558.

Hassanzadeh, S., Farhadi, M., Daneshi, A., & Emamdjomeh, H. (2008). The effects of age on auditory speech perception development in cochlear-implanted prelingually deaf children. *Otolaryngology-Head and Neck Surgery*. *126(5),* 524-527.

Henry, L. A. (2001). How does the severity of a learning disability affect working memory performance?. *Memory*, *9*(4-6), 233-247.

Maria Netto T., Greca DV, Zimmermann, N, Oliveira C., Fonseca, R. P., Landeira-Fernandez J. (2010). Working memory intervention programs for adults: A systematic review. Dement. *Neuropsychology*. *4*(3):222-231. doi: 10.1590/S1980-57642010DN40300011. PMID: 29213690; PMCID: PMC5619293.

Milanifar, B. (2014). *The psychology of special children and adults*. Ghoomes, Tehran [In Persian]

Miller, G. (1956). The Magical Number Seven, plus minus Two. Some Limits on Our Capacity for Processing Information. *Psychological Review*, *63*, 81-96. https://doi.org/10.1037/h0043158

Pisoni, D. B., & Burkholder, R. A. (2003). Speech timing and working memory in profoundly deaf children after cochlear implantation. *Journal of Experimental Child Psychology*, *85*(1), 63-88.

Schneider, K. J. (2015). Rediscovering awe: A new front in humanistic psychology, psychotherapy, and society. In K. J. Schneider, J. F. Pierson, & J. F. T. Bugental (Eds.), *The handbook of humanistic psychology: Theory, research, and practice* (2nd ed., pp. 73–81). Sage Publications, Inc.

Swanson, H. L. & O'Connor, R. (2009). The Role of Working Memory and Fluency Practice on the Reading Comprehension of Students Who Are Dysfluent Readers. *Journal of Learning Disabilities*, *42*, 548-575. http://dx.doi.org/10.1177/0022219409338742

Wechsler, D., & Naglieri, J. A. (2006). *Wechsler nonverbal scale of ability*. https://psycnet.apa.org/doi/10.1037/t15176-000