The relationship between active memory and the development of written word recognition strategies during reading in children aged 6 to 10 years (A developmental study)

العلاقة بين الذاكرة النشطة وتطور استراتيجيات التعرف على الكلمات المكتوبة خلال عملية القراءة عند الأطفال من سن 6 إلى 10 سنوات (دراسة تطورية)

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Abstract:

This study aims to explore the relationship between active memory and the development of written word recognition skills during reading. Descriptive design was used. The population was divided into four equal groups (60 students) of primary school students in the 1st, 2nd, 3rd and 4th years. To test the hypotheses, Active memory test was applied (including the phonological looptests and the visuospatial sketchpad) and the Recognizing written words test. The results showed a correlation between active memory components (excluding the central executive) and strategies used to recognize written words, particularly the phonological loop. Also, the development of word recognition skills, along with the student's age, enhances the connection between the phonological loop and word recognition abilities. Therefore, the study concluded that there is a relationship between active memory and the development of written word recognition strategies, with a focus mainly on the phonological loop.

Keywords: active memory, strategies, written, words recognition, reading

1. Introduction

Reading is a linguistic process that involves various mechanisms and requires perceptual, motor and cognitive abilities including thinking and understanding. It is an essential life experience, similar to walking or playing, as it allows us to connect with the experiences of others from different places and times. According to Gough & Juel (1989), reading consists of word recognition and comprehension. However, these two elements alone are not sufficient when considered separately, as word recognition serves as the foundation for understanding written texts (Gough, 1990, p.128).

In this paper, we will focus on working memory, which is crucial for acquiring cognitive processes such as language comprehension and long-term learning. By doing so, we will explore its relationship with

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the development of word recognition strategies in children. The study was conducted on 4 groups of learners aged between 6 and 10 years. We will apply Baddeley's model, which divides working memory into the visuospatial sketchpad that processes visual information, the phonological loop that stores information from both auditory and visual channels, and the central executive that manages and coordinates these two systems.

2. Problem

Scholars have given different names to the active memory. Some call it the short-term memory, others name it the primary memory, while others call it the temporary memory. In this context, Baddeley defines the active memory as a limited-capacity system that allows retaining temporary information and processing it when executing the other cognitive process, such as language learning, attention, etc (Baddeley, 1993, p.96). In addition, this memory is made consists of three components, which are:

The central system, it serves as the core of working memory, overseeing and coordinating the various activities happening within it. It regulates the flow of information between different components and manages the functioning of both phonological loop and avisuospatialsketch pad.

The phonological loop, which is a dedicated system responsible for handling and retaining auditory information. The visuospatial sketchpad, which it processes and stores the visual and/or spatial information.

The study of this memorial system (active memory) shows that it is the center of the cognitive mental activity. It has a direct efficient effect on the different cognitive processes, including reading which is a basic communicative process. In this context, reading is better learned when taken as a language skill, which allows children to recognize written words and understand what others think about (Gombert., 1992, p.233). Studies in cognitive psychology and psycholinguistics on reading learning and difficulties aimed at understanding the cognitive processes in the linguistic activity and those that allow the individual to learn reading and explaining the processes that enable the reader to derive meaning from written text.

Notable studies include Frith's developmental model of reading acquisition, which proposed that reading progresses through three stages. The logographic phase, it includes the direct procession of the visual words. The alphabetic phase, this involves decoding, where the child processes words by breaking them down into sounds. It requires knowledge of the letters in a written sequence and goes through 03

sub-stages, the linear transformation of letters, phonological grouping and written correspondences. The orthographic phase, this stage is marked by an extensive vocabulary and the ability to categorize based on an advanced information system. In this phase, knowledge is acquired directly without relying on phonological rules.The recognition of written words is a process that necessarily involves three key strategies.

The relationship between reading and active memory has attracted the attention of psychologists, resulting in numerous studies on this topic. Kanfer & Ackerman (1989) demonstrated that a significant factor contributing to learning difficulties, particularly in reading, is a limited active memory capacity. Additionally, Siegel & Ryan (1989) indicated that reading challenges arise from a general deficiency in active memory.

Furthermore, Saaidoune (2004) conduct a study on the relationship between active memory and understanding written words in fourth grade learners. It shows a correlation between active memory capacity and comprehension of written language. Therefore, this study seeks to explore the relationship between active memory and the development of strategies for recognizing written words, taking into account the variations in reading abilities among individuals. Based on this context, we propose the following research question.

- Is there a correlation between the written word recognition and the active memory strategies in children?

3. Hypotheses

There is a relationship between active memory and the development of written word recognition strategies during reading in children. Namely: There is a correlation between Written Word Recognition and the Sentences active memory;

3.1. There is a correlation between Written Word Recognition and Words active memory,

3.2. There is a correlation between Written Word Recognition and Digits active memory;

3.3. There is a correlation between Written Word Recognition and Numbers active memory;

3.4. There is a correlation between Written Word Recognition and Physical structural active memory**.**

4. Objectives of the study

- It aims to examine active memory in relation to how children acquire reading skills, to determine whether there is a connection between active memory and the development of written word recognition strategies, and to identify the intervening systems involved.
- Understanding the relationship between active memory and the development of written word recognition skills: the study aims to explore how active memory contributes to the development of word recognition strategies in children during the stages of learning to read.
- Identifying developmental differences in reading strategies: The study seeks to identify differences among children in the age groups of 6 to 10 years regarding their strategies for recognizing written words and the impact of active memory on their performance.

5. Importance of the study

This study seeks to contribute to the existing body of literature and explore new areas, offering valuable insights into the complex relationship between active memory and the development of word recognition strategies in children. The findings are expected to enhance scientific understanding and provide opportunities for improving educational interventions and Reading instruction methods.

6. Determinants

6. 1. Active Memory AM

Dumont examined Baddeley's (1974) proposal of using the term "active memory" to describe short-term memory. He defined it as a system designed for the temporary storage and processing of information necessary for executing complex cognitive tasks. This expression appears when there is a complex mental activity and when the information reaches it. In addition, it is a common point between cognition and knowledge (Dumont, 1998, p. 180).

In addition, Seron (1994) considers that the active memory intervenes in information retention to use it immediately. This system, suggested by Hitch & Baddeley (1974), is one of the most complicated theoretical proposals that affect the short term retention of the information. It allows the temporary retention and procession of information during cognitive activities that rely on a coordinated work of infra systems (phonological look, spatiovisual record and the central system) (Van der Linden et al., 2000, p. 85).

Research in this area indicates that active memory relies on several components. In this context, Dumont identifies three key components (Dumont ,1998, p. 211).

The Central Administrator: It is a limited attention system that connects lower-level processes and regulates the flow of information between them and long-term memory. In other words, it is the strategic selection of the most effective acts. Due to the limitation of this system, other systems, called "Esclave" by Baddeley, automatically store the information.

The Phonological Loop: It is an Esclave system. It focuses on the automatic system of the written and oral linguistic information. It is made up of the short-term phonological stock that affects the memory for two seconds, and another that controls the pronunciation and is necessary for learning language and acquiring new terms. The troubles that affect this stock are very complicated, mainly for the little learners. In this regard, Baddeley & Gathercole (1990) studied a group of children with special linguistic troubles, and found out a temporal variance in their abilities to repeat words of different lengths (Dumont, 1998, p. 230).

The Spatiovisual Sketchpad: It is the second system in the active memory model. This system temporarily stores visuospatial information and allows for the repetition and processing of mental images. It's an operation that relies on a visual storage mechanism and spatial-verbal rehearsal. It has a limited capacity for retaining spatial and visual information (Dumont, 1998, p. 230).

In the current study, WM is defined as the ability to temporarily hold and manipulate information while performing cognitive tasks, such as reading (Baddeley, 2000, p.417). It will be measured using tasks such as the backward digit span test or active memory tasks that assess both storage and processing capabilities (e.g., the ability to recall a sequence of numbers in reverse order) (Gathercole & Pickering, 2000, p.177).

6.2. Word recognition strategies WRS

Most of the reading developmental models (Sprenger, 2016, p.156) confirm that learning reading goes through different steps, which are characterized with different strategies. Nevertheless, the most common model is that of Frith (1985), which mentions three complementary successive strategies:

Logographic Strategy: The Developmental models suggest that the first strategies children learn are logographic, where they associate words with specific symbols rather than with the letters that make up words. This approach serves as a foundation for reading and emphasizes written symbols without considering the phonological structure of the word (Morton, 1989, p.113). This strategy involves a holistic

processing of words, which are recognized by their visual patterns. In this context, the indicators for processing information from the visual phase are phonological. Furthermore, this strategy is crucial for recognizing words based on their initial letters. According to Frith, the logographic strategy represents a phase where visual storage occurs and serves as a key element in the initial stage of reading, paving the way for the development of visual terms.

Alphabetical Strategy: It is based on red coding the phonological code, as the child makes a phonological analysis until getting sounds. According to Frith, learning difficulties result from inability to use the phonological knowledge needed for reading. This strategy applies the rules of alphabetical transformation and needs reference to the lexical knowledge.

Orthographic Strategy: This strategy is characterized with a wide linguistic wealth and the ability to collect based on a more developed information system. The knowledge here is direct without use of the phonological rules. This means that recognizing words and shapes is based on a direct visual knowledge through reference to the overall shape. The letters are gathered together in words that have an oral meaning. This does not mean that the orthographic strategy resembles the alphabetical that is also based on the visual factor, as they differ in the linguistic procession and have qualitative differences. In this context, Morton (1989) considers that these strategies differ than the alphabetical because orthographic units are processed via the auditory system during the alphabetic phase, whereas the logographic strategy processes images through the visual system.

Word recognition enables the distinction between letters and words. Reading models support the idea that there are three fundamental phases involved in recognizing written words:

1st phase: It is called the cognitive composite and represents an activity phase in Morton (1969) model. In this context, the symbols (sounds) are extracted and formed to be included in the lexicon (Forster, 1976). In addition, all the components of the letters are analyzed (Rumelhart & Chelland, 1982, p. 72).

2nd phase: It is the shift towards the lexicographic side (Forster, 1976, p. 45) and the procession of information in the active memory.

3rd Phase: According to Forster, this phase involves recognizing the complete meaning of the word. All information related to the word is accessed, culminating in a thorough comparison of the information with the word's characteristics. This phase emphasizes meaning retrieval, with its primary function being the storage or recognition of the stimulus. Additionally, the lexicon utilized for word recognition consists

of a collection of perceptions that correspond to meaningful units of language (O'Dowd et al., 1989, p. 111).

In the current study, WRS are defined as methods or approaches children use to identify and decode written words. These strategies include:

- Phonological Decoding: The ability to break words into individual phonemes and decode them (sounding out words based on letter-sound correspondence) (Ehri, 1995, p.116).
- Visual Recognition: Recognizing entire words as familiar patterns without needing to decode each letter or sound.

Strategies will be measured through reading tasks that assess the accuracy speed of word recognition (Share, 1995, p.15).

6.3. Reading

It is a mechanism to translate the written language into sounds. Scholars do not agree on one definition. According to Fahim (1984) reading as a very complicated mental process, that exceeds the ability to recognize written shapes that explain a written meaning. Thus, it includes two processes, the automatic and the mental that includes thinking and deducing. Furthermore, Morie-Domestre considers that reading is a complex system where visual, audio, and motor mechanisms intervene. It does not only need voice recognition, rather, it needs understanding the meaning of words and the participation of intelligence and experience (Noeh, 1976, p. 95).

For his part, Guerra (2007) says that reading does not only manifest in recognizing letters and understating meanings; rather, it is complicated structure and analysis to reach a new meaning starting from the linguistic expression. This cannot be achieved unless these two processes are complementary. Based on this, this definition shows a complementarity between processes**.** The individual is able to read and quickly identify the overall shape of the text. Rapid reading enhances comprehension, whereas fragmented reading disrupts the auditory structure of the word, making reading, understanding, and assessment more difficult (Mucheilli & Bourcier, 1979, p. 65). According to the Petit Robert dictionary, the term "read" refers to recognizing the characteristics of a word, decoding its symbols, understanding the content, and verbally explaining a written text (Toraill, 1991, p. 138).

In the current study, reading is considered as the process of interpreting and understanding written language, which involves decoding text and comprehending its meaning. Reading ability will be assessed through fluency tests (speed and accuracy in reading aloud), word recognition accuracy, and comprehension tests for understanding the meaning of the text (Snowling & Hulme, 2011 , p.23).

7. Materials and Methods

7.1. Design

In order to test hypotheses, descriptive design was used to check relationships between active memory and the development of written word recognition strategies.

7.2. Participants

Table 1: Distribution by age, gender and education

Group/ criteria	G 1	G 2	G 3	G 4
Gender	Males and females (N=15)	Males and females (N=15)	Males and females (N=15)	Males and females (N=15)
Age	6-7	7-8	8-9	9-10
Education	1st year	2nd year	3rd year	4th year
Pathological record	nothing	nothing	nothing	nothing
Reading rate	Good (7/10)	Good (7/10)	Good (14/20)	Good (14/20)

7.3. Instruments

7.3.1. Wechsler intelligence Test (The revised version)

Wechsler intelligence Test (1981) is one of the most famous tests of intelligence in children of 06 to 16 years. All its items are adapted to the age of the child, as each age has a specific education. The test has 12 subtests, 06 are about the verbal scale while the rest are about the non-verbal scale. However, there are only 10 compulsory tests to reduce the time needed.

In the current study the intelligence test is applied in the first step before the main study in order to select the sample and to ensure that children do not suffer from any disorder at the level of Intelligence.

7.3.2. Reading Test "Jeannot and Georges"

This test is presented in the form of two easily understandable texts. The first is applied to children from CE to CM1 and constitutes form A. The second is applied to children from the two years of CM to college and even beyond. These texts have been composed methodically, taking into account the expected

acquisitions of children in the different classes and the main difficulties they encounter. Each of these texts is printed separately, without title, author's name, illustrations or any other indication external to the text itself, in characters chosen for their great readability and their familiarity to children. Each is accompanied by a selection of images that illustrate it, on separate cards. 6 for form A. 5 for form B. This material makes it possible to measure the main dimensions characterizing the acquisition of reading by the child. That is to say: the time taken by the child to read aloud the text presented to him the formal correction of this oral restitution, the comprehension of the text read. The whole test makes it possible to assess the level of acquisition of reading of a child. According to these three dimensions by comparing it to the real level of children of his class and his age (Chassagny, 1962; Herbessiere & Sax, 1972). It was adapted by Saaidoune to 04th grade Algerian students in 2004. It aimed to:

- Diagnosing the reading difficulties
- Setting an objective reference to avoid subjectivity
- Determining the reading level of the normal or low students.

The reading test is derived from the French reading test known as Alouette Lefavrais (1997) (as cited by Ghaleb Qazadri, 2013) developed the reading test "Vacation Text", she adapted the French test to the Arabic population. This study was carried out on a sample of 140 male and female students from Algerian schools. During scoring of reading, the examiner focuses on measuring the time, as the total number of words read, the number of correct words, and the number of errors is calculated for each of first three minutes for normal students and exceeds 3 minutes for students with reading difficulties, their reading time. This type of assessment is known as quantitative assessment. As for qualitative it relates to classifying errors made such as deletion, repetition, self-correction, stopping, cutting, and substitution. Based on this, the reading pattern and rhythm of children are determined (whether fast, slow, automatic, or natural). Ghaleb Qazadri also verified its reliability and validity. Reliability was testing by test-retest. Pearson correlation coefficients for variables are ranging from 0.41 to 0.93 which confirms the reliability of this test (p. 0.01). Also, validity was testing by correlation coefficients for variables which are ranging from 0.64 to 0.96.This test is valid for measuring reading skills.

7.3.4. Active Memory Tests

The active memory tests include the phonological loop and visuospatial sketchpad, based on Yuill tests (1989), which were designed and adapted to the Algerian environment by Gasmi (2001), and the test of Siegel & Ryan (1989) which was adopted by Saaidoune (2004). These tests are:

The phonological loop tests:

- **Sentences Active Memory Test:** It was designed by Siegel & Ryan (1989) and applied by Seigneuric & Megherbi (2008).The child is given a series of sentences with increasing lengths, he is asked to produce the last word of each sentence, pronounce it out loud, and retain it. At the end of each series, he must remember the words he produced, respecting the order of their appearance according to a presentation.
- **Words Active Memory Test:** The child must recognize the intruding word in the series that include 04 words. He must pronounce and memorize the word to recall the words orderly. The intruder is put in a different position in each series.
- **Digits Active Memory Test:** It was used by Paul et al (1984) and applied by Seigneuric & Megherbi (2008) without any adaptation. In this test, the student reads sets of 03 separate digits and has to remember the last number of each set. The sets are presented in the form of series.
- **Numbers Active Memory Test:** The child is required to identify the largest number from a set of three numbers ranging from 10 to 99. Additionally, the child must articulate and remember the last letter presented. The numbers are shown in a series format, and for each series, the child must remember the larger numbers in the correct sequence.
- **Spatial Structure (lines) Active Memory Test:** It assesses the visuospatial sketchpad system. Beginning with two points on a grid, the child is tasked with creating a line of three points by using their finger to indicate where to place the third point to complete the line. They must remember the positions and colors of the grids presented in a series format. At the end of each series, the child needs to recall the order of the line positions and recreate them on an empty grid.

The reliability of active memory test was confirmed during the exploratory study, conducted on 140 primary school students (Bouzyat Ben Yahia, Bachir Ibrahimi, Mohamed Ben Slim, and Khadidja Um Al-Mu'mineen) in Bouirine district of Djelfa. Correlation coefficients between test-retest after 15 days indicates trong Pearson correlation coefficients (0.71 for the phonological loop - sentences, 0.80 for phonological loop - words, 0.65 for the phonological loop - numbers memory) and 0.81 for Spatial-visual notebook, and 0.80 for Central system. That confirms the reliability of this test (p. 0.01).

Also, validity was testing by correlation coefficients for variables which are (0.65 for Sentence memory, 0.70 for Word memory and 0.62 for Number memory, which indicates validity of phonological loop at p.

0.01). Also, we found 0.61 for Spatial-visual notebook, 0.92 for Central system. All coefficients are significant at (p.0.01).)The test is valid for measuring active memory.

7.3.5. Written Word Recognition Test

This involves reading a set of words and is based on the MIM test (MIM Test from the Belec Battery for assessing written language and its disorders, developed by Mousty, Leybaert, Alegria, and Morais, 1994). The test is made up of meaningless words, frequent words, and rare words. In each type of words, we find short and long words .It facilitates the diagnosis of the troubles in children of 07 to 12 years. Belec (2013) allows recognizing the written words and the reading and writing difficulties, in addition to their relations with the skills that may be the source of troubles. This battery is made up of reading tests and writing tests that aim to analyzing the role of the alphabetical strategy, the logographic strategy, and the orthographic strategy in the process of reading. This test was adapted by Boufellah in 2014. It focused on the cognitive aspect of reading and its disorders, there for reading is a complicated skill that requires the procession of information (recognizing and distinguishing letters and words, and understanding their meanings). It aims at evaluating the children who have reading difficulties, mainly in recognizing the written words. Moreover, it evaluates the metalinguistic skills.

The reliability of Written Word Recognition Test was confirmed during the exploratory study, conducted on 50 primary school students. Coefficients correlation between test-retest after 4 weeks indicate high reliability coefficients for all test items, exceeding 0.88. That confirms the reliability of this test (p. 0.01).

7.4. Data analysis

Several statistical tools were used to test hypotheses:

Arithmetic mean and standard deviation.

Pearson correlation coefficient to examine the correlation between active memory and the written word recognition.

8. Results

8.1. Results of Wechsler Intelligence Test

Table 2 Results of the Intelligence Test of group 01

Items/ cases	Image completion	Image order	Cubes	Things gathering	Labyrinth	Aggregate points	Mental average
Case 1	17	13	11	07	08	56	107
Case 2	15	13	12	08	11	59	112
Case 3	13	13	13	09	09	57	109
Case 4	15	13	12	09	10	59	112
Case 5	13	15	12	10	11	61	114
Case 6	15	15	10	07	11	58	110
Case 7	13	11	10	10	09	53	103
Case 8	10	10	14	11	08	53	103
Case 9	15	10	11	07	08	51	101
Case 10	11	12	11	10	09	53	103
Case 11	13	12	09	11	09	54	105
Case 12	11	10	10	11	08	50	99
Case 13	10	09	09	11	10	49	98
Case 14	14	12	11	12	08	57	109
Case 15	14	11	12	12	09	58	110

Table 3 **Results of the intelligence test of group 02**

Items/ cases	Image completion	Image order	Cubes	Things gathering	Labyrinth	Aggregate points	Mental average
Case 1	12	10	09	09	10	50	99
Case 2	13	11	09	11	12	56	107
Case 3	15	13	10	14	08	60	113
Case 4	11	12	11	11	12	57	109
Case 5	14	11	10	11	10	56	107
Case 6	13	13	10	13	09	58	110
Case 7	12	10	09	10	12	53	103
Case 8	10	09	09	08	13	49	98
Case 9	14	11	11	10	10	56	107
Case 10	11	12	08	11	08	50	99
Case 11	11	10	09	09	11	50	99

Case 12	12	10	10	10	10	52	102
Case 13	12	11	10	10	09	52	102
Case 14	13	13	11	11	10	58	110
Case 15	10	09	10	11	10	50	99

Table 4 Results of the intelligence test of group 03

Items/ cases	Image completion	Image order	Cubes	Things gathering	Labyrinth	Aggregate points	Mental average
Case 1	13	10	09	14	08	54	105
Case 2	15	10	10	09	12	56	107
Case 3	12	11	09	11	09	52	102
Case 4	14	12	10	11	12	59	112
Case 5	12	13	11	13	13	62	116
Case 6	13	11	11	10	10	55	106
Case 7	13	11	10	13	09	56	107
Case 8	14	13	10	11	09	57	109
Case 9	11	10	10	11	08	50	99
Case 10	11	11	10	11	10	53	103
Case 11	14	09	09	10	10	52	102
Case 12	13	12	09	11	11	56	107
Case 13	10	10	09	11	10	50	99
Case 14	14	12	11	12	11	60	113
Case 15	11	10	09	10	10	50	99

Table 5 Results of the intelligence test of group 04

Items/ cases	Image completion	Image order	Cubes	Things gathering	Labyrinth	Aggregate points	Mental average
Case 1	14	11	11	13	11	60	113
Case 2	10	12	10	11	09	52	102
Case 3	13	10	11	11	10	55	106
Case 4	20	11	10	10	11	56	107
Case 5	12	09	09	10	10	50	99
Case 6	15	12	12	11	12	62	116
Case 7	14	11	11	12	11	59	113
Case 8	12	12	10	11	09	54	105
Case 9	13	11	10	12	10	56	107

Case 10	12	11	11	11	10	59	106
Case 11	11	10	11	10	11	53	103
Case 12	14	12	12	11	11	60	113
Case 13	12	10	10	11	11	54	105
Case 14	11	10	11	12	11	55	106
Case 15	14	12	11	12	11	60	113

According to the intelligence test results tables, Study participants passed all five different tests applied. The mental average is between 98 and 117. This shows that students do not suffer from any problems in terms of intelligence, hence the main study continues under the recommended conditions.

8.2. Results of reading Jeannot and Georges Test

Table 6 Results of Reading Test of Groups

Cases	Total mistakes				Duration (seconds)			
	G1	G2	G3	G4	G1	G2	G3	G4
Case 1	11	18	/	/	470	400	270	210
Case 2	27	14	/	/	520	410	220	290
Case 3	17	14	/	/	430	380	388	239
Case 4	19	15	/	/	465	400	290	242
Case 5	10	18	/	/	280	350	230	250
Case 6	22	20	/	/	500	360	270	270
Case 7	15	18	/	/	230	420	285	220
Case 8	25	16	/	/	590	370	235	280
Case 9	30	14	/	/	670	375	250	285
Case 10	52	15	/	/	510	362	242	210
Case 11	45	15	/	/	390	390	220	270
Case 12	65	17	/	/	520	385	230	250
Case 13	79	18	/	/	650	405	210	230
Case 14	32	17	/	/	610	366	239	220
Case 15	80	19	/	/	790	378	230	290

8.3. Results of Active Memory Test

Table 7 Results of Active Memory Test of groups

Tests/ characteristics	Sentences active memory				Words active memory				Digits active memory				Numbers active memory				Physical structural active memory			
	G1	G2	G3	G4	G1	G2	G3	G4	G1	G2	G3	G4	G1	G2	G3	G4	G1	G2	G3	G4
Arithmetic mean	31,3	32,66	33,6	34,75	28	32,66	31,55	31,55	34	35	37,1	38,6	28,1	28,1	37	30,7	30,6	31,4	34,15	35,6
Standard deviation	5,7	5,9	6,15	6,3	10,7	11,5	12,15	12,15	6,5	6,6	7,04	7,3	10,2	10,4	7	11,3	9,07	9,31	10,13	10,5
Maximum value	35	35	37	40	34	35	37	36	40	40	42	42	34	36	36	36	38	35	36	39
Minimum value	25	28	29	30	22	23	28	27	28	30	32	36	20	25	24	26	25	25	24	33

8.4. Results of the Written Words recognition Test

Table 8 Results of the Written Words Recognition Test of groups

Tests/ characteristics	Logographic				Alphabetical				Orthographic			
	G1	G2	G3	G4	G1	G2	G3	G4	G1	G2	G3	G4
Arithmetic mean	39,9	46,5	48	47,9	4,4	5,4	24	24	19	22	48	48
Standard deviation	1,88	2,19	2,3	2,25	1,3	1,58	1,13	7,03	2,3	2,6	2,3	2,3
Maximum value	45	48	48	48	7	9	24	24	23	23	48	48
Minimum value	38	45	47	47	2	3	23	23	16	20	46	47

Table 9 Results of correlation between Written Word Recognition and the Active Memory Strategies

Active Memory Strategies	The Written Word Recognition			
	G1	G2	G3	G4
Sentences active memory	0,411**	0,414**	0,634**	0,655**
Words active memory	0,432**	0,417**	0,604**	0,622**
Digits active memory	0,414**	0,451**	0,61**	0,615**
Numbers active memory	0,395**	0,433**	0,602**	0,633**
Physical structural active memory	0,102**	0,197**	0,337**	0,458**

****Statistically significant at (p. 0.01)**

Results show:

In the G1, the correlation coefficients between the active memory and the written word recognition are recorded as follows: (Sentences R=0.411. Words R=0.432. Digits R=0.414. Numbers R=0.395. Physical structure R=0.102). All correlations are statistically significant at (p. 0.01).

In the G2, the correlation coefficients between the active memory and the written word recognition are recorded as follows (Sentences R=0.414. Words R=0.417. Digits R=0.451. Numbers R=0.433. Physical structure R=0.197). All correlations are statistically significant at (p. 0.01).

In the G3, the correlation coefficients between the active memory and the written word recognition are recorded as follows (Sentences R=0.634.Words R=0,604. Digits R=0,610. Numbers R=0,602. Physical Structure R=0,337). All correlations are statistically significant at (p. 0.01).

In the G4, the correlation coefficients between the active memory and the written word recognition are recorded as follows (Sentences R=0,65. Words R=0,622. Digits R=0,615 Numbers R=0,633. Physical structure R=0,458). All correlations are statistically significant at (p. 0.01).

All hypotheses were verified. Therefore, there is a correlation between Written Word Recognition and Written **Word Recognition Strategies.**

9. Discussion

The analysis of results from all four groups revealed that the phonological loop facilitates phonological processing, which aids in recognizing written words in two distinct ways.

The first method involves a direct transition based on visual information, utilized by children when identifying frequently encountered words, exemplifying the application of the logographic strategy.

The second method is indirect and relies on phonological assembly, representing the alphabetical strategy. Phonological assembly functions on two patterns: the first pertains to consonants, which operates automatically and enables word reading, while the second relates to vowels, where the alphabetical strategy plays a crucial role in learning to read.

A comparison of the correlation coefficients across the four groups shows that the correlation between the phonological loop and the strategies for recognizing written words increases with the educational level and age of the children. This finding aligns with Frith's model, which indicates that the development of children's abilities is dependent on the knowledge they acquire. Furthermore, the progression of reading ability can be described through the reference to these strategies:

- Logographic strategy relies on the association between words and specific symbols rather than letters. These symbols are initially visual and subsequently auditory.
- Alphabetical strategy: it gives the letters their sounds and focuses on the alphabetical linear transformation.
- Orthographic strategy: emphasizes the direct visual recognition of common words while depending on phonological assembly for less frequently encountered words.

Drawing from previous research, including the study by Saadoune (2004), which identified a direct relationship between active memory and the comprehension of written language, as well as Frith's model (1986), which demonstrates that a child's early acquisition of written language is linked to the recognition of written words, we also conclude that there is indeed a connection between active memory and the strategies for recognizing written words. Therefore, hypothesis are supported.

The results we obtained, which were statistically confirmed, align with findings of several researchers such as Frith (1982), Perfetti (1995), and Ammar (1997). They conducted similar studies on

French-speaking children and reached the same conclusions. Their research demonstrated that children with reading difficulties struggle to effectively control the phonological strategy.

Regardless of the spoken language-whether French, English, or Arabic-the phonological strategy (phonological assembly) plays a crucial role in learning to read. This process enables children to recognize both real words and pseudo words. Any disruption in this strategy leads to difficulties with the spelling strategy, which in return contributes to reading difficulties. According to the model by Tunmer & Gough (1986), a child's ability to comprehend written language in the early stages of learning is largely dependent on how efficiently they can recognize written words.

10. Conclusion

This study highlights the crucial role that active memory plays in cognitive processes overall, with a specific focus on reading. Its objective was to explore the relationship between active memory and the development of strategies for recognizing written words. To achieve this, we examined four groups of primary school students from the 1st, 2nd, 3rd, and 4th grades. We used tests for active memory, as well as a test for recognizing written words.

All hypotheses were verified. Therefore, there is a correlation between Written Word Recognition and the Sentences active memory and there is a correlation between Written Word Recognition and Words active memory also, there is a correlation between Written Word Recognition and Digits active memory and there is a correlation between Written Word Recognition and Numbers active memory and there is a correlation between Written Word Recognition and Physical structural active memory.

As for the horizons of our study:

We aim at digging deeper in the field of reading acquisition and finding the factors that help the child acquire them.

We hope to study the strategies of the written words recognition within the other cognitive processes.

Based on the findings, it is recommended that educational interventions aimed at enhancing active memory may improve word recognition skills among children.

Activities that specifically target phonological and visuospatial processing may be particularly beneficial.

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