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THE IMPACTS OF WORKING MEMORY ON READING COMPREHENSION OF IRANIAN EFL LEARNERS

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ABSTRACT

This study investigated the relationship between working memory (WMC) and second language reading performance as measured by three types of comprehension tasks: writing fluency, sentence completion, and multiple-choice comprehension tasks. The researcher also investigated the contribution of the WMC to the frequency and diversity of strategy use and differences in strategy use by various WMC readers. 12 Iranian EFL Learners read two texts individually and performed three comprehension tasks, a semi-structured interview, and an automated Operation Span Task (OST) according to the Think aloud procedure (Unsworth et al., 2005). Correlation analysis showed that the contribution of the WMC to reading comprehension varied with the type of reading comprehension scale, and that readers with high WMC used a variety of reading strategies than readers with low WMC. In addition, correlation analysis and independent sample t-tests showed that readers with high WMC tended to use top-down strategies that contributed more to global understanding of texts compared to readers with low WMC who favored decoding strategies.

Keywords: Iranian EFL Learners, Reading Comprehension, Working Memory.

I. INTRODUCTION

Working memory (WM) is in charge of the simultaneous manipulation and control and storage of data expected to complete a variety of complex activities and tasks (Baddeley, 2003; Just & Carpenter, 1992), reasoning (Kane, 2004), planning, abstraction, mental arithmetic (Linck et al., 2014), native language processing (L1), and native language processing (L2) in all learning contexts (Baddeley, 2000a; Olive, 2008).Working memory capacity (WMC) refers to an individual's potential to manipulate attention, which is confined and shared through all processes involved in work (Engle, 2002). Starting with the landmark study of WM and reading through Daneman and Carpenter (1980), Daneman and Merikle, 1996 pointed that greater than 30 years of studies on L1 reading has proven that WM is an essential predictor of reading performance and other related subjects. These findings sparked further investigation into the relationship in second language among working memory and the ability to read.

The reader's reading comprehension score is operationalized by completing reading comprehension tasks such as multiple choice, final, and final exams. Each type of evaluation item measures only some aspects of reader comprehension (Alderson, 2000). Therefore, the impact of WMC on reading comprehension at the L2 level is expected to be different when different types of problems are used for reading comprehension. To test this hypothesis, the existing study investigated the relationship among WMC and reader overall performance throughout 3 types of reading metrics.

Few research has included at least types of comprehension issues in one examine. The findings will provide crucial implications for research practice in terms of reading overall performance when examining the link among WMC and L2 reading comprehension. We also investigated the link among WMC and various variables related to reading comprehension on the L2 level, such as the distinction among explicit/implicit knowledge (Ercetin and Alptekin, 2013) and search behavior (Chun and Payne, 2004). text or the manner text is displayed (Fontanini and Tomitch, 2009), previous knowledge (Joh and Plakans, 2017), problem complexity effect (Jung, 2018), subject familiarity (Lessor, 2007), addition (Medina, 2017) and domain expertise (Payne, 2009).

II. LITERATURE REVIEW

Reading L2 is a very complex process of constructing meaning, during which readers use many strategies using different sources (e.g., L2 language knowledge, text knowledge, attitudes to the world, strategic knowledge) to achieve different levels of comprehension. (Bernhardt, 2011; Huh 2008, Zhang & Wu, 2009). The effectiveness

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of using L2 languages depends in part on strategies involving reading (Cohen, 2014). Bernhardt (2011) emphasized the important role of reading strategy in the reward reading model. The model predicted that 50% of L2 reading scores were attributed to L2 language proficiency (eg, grammar and vocabulary) and L1 literacy (eg, beliefs about word and sentence construction). Regarding the remaining 50% of the unexplained variance, Bernhardt argued that this could be partially explained by a reading strategy. Recognizing the important role of strategy use in L2 reading, researchers have taken note of this association by considering several moderating variables such as language proficiency (e.g., Carrell, 1989; Endley, 2016) and language distance (e.g., Bang & Zhao, 2007).

Much literature on the use of L2 reading strategies has focused on comparing how reading strategies are used by readers with different proficiencies in terms of the variety and frequency of strategies used as well as specific preferred strategies. Studies of the variety and frequency of strategy use have produced mixed results. For example, Zhang and Wu (2009) found that participants were similar in the types of general strategy use regardless of language ability. Reflecting the findings of some researchers, Zhang and Wu (2009), Yaili (2010), and Zhou and Zhao (2014), they concluded that participants at different levels had similar diversity but different frequencies of reading strategies used. Contrary to these findings, Gavamnia, Ketabi, and Tavakoli (2013) and Lin and Yu (2015) argued that readers at different levels of language proficiency were similar in the diversity of strategies used, but with different frequencies of execution of the strategies. used. Researchers are applying the concept of WM through WMC, which is defined as a storage and processing component (Juffs & Harrington, 2011). In research, WMC is measured for both simple and complex tasks (Wen, 2016).

In simple and complex problems, participants are presented with a list of memorized (TBR) items, including letters, numbers, words, or shapes. You are then asked to load the list in the correct order right after the last item is displayed. To name a few simple range problems, they include the number range problem, the character range problem, and the word range problem. In comparison, complex tasks require participants to perform some processing (eg, reading sentences, solving arithmetic problems) that alternates representations of individual TBR elements. Then, as with the simple range problem, the participant must memorize a list of TBR elements in the correct order.

Commonly used complicated range problems consist of arithmetic range issues (OST), read range troubles (RST), speech range troubles, and symmetric range problems. In general, sophisticated range assessments designed to measure each WM storage and computational power confirmed stronger correlations with higher-order cognition as compared to simple range tests that measure WM storage capacity (Conway, 2002; Unsworth and Engle, 2007; Dahnemann and Merikl, 1996).The elements of reading L2 interact with each other at lower-level linguistic processes (e.g. vocabulary access) and higher-level comprehension processes (e.g. text comprehension models), allowing L2 readers to interact with each other at different levels (e.g. sentence-level comprehension, contextual model of reader interpretation) (Grabe & Stoller, 2011).

Therefore, reading comprehension scores are displayed differently when different measures of reading comprehension are used. Because different tasks "almost certainly measure different components of the reading procedure or product" (Alderson, 2000, p. 270). As a result, the relationship between WMC and L2 comprehension is elusive. For example, in an early study of 34 college-level L2 students, Harrington and Sawyer (1992) compared reading skills assessed using WMC and TOEFL grammars with multiple-choice reading domains and closed-ended tests. Readers' WMC (measured by RST) was significantly correlated with multiple-choice questions, but not with close tests.

FR requires readers to record everything they can remember from the text without looking back at the passage. FR is alleged to be a “purifier comprehension scale” due to the fact there are no intervening cues among the reader and the text (Alderson, 2000). Pause units are mostly and regularly used to assess FR (e.g. Liu & Brantmeier, 2019). Pauses are units with “pauses at both ends during oral reading at normal speed” (Bernhardt, 1991, p. 208). FR is a relatively subjective assessment of the reader's comprehension. The MC asks readers to choose an answer to a question from four predefined options. The multiple-choice method is an objective method because there is no ambiguity in evaluating correct/incorrect answers (Brantmeier, 2006; Koda, 2005). SC is a semi-objective alternative to MC. The SC needs the participant to finish the sentence consistent with the clues that are in the sentences (Alderson 2000; Brantmeier, 2005, 2006).

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Grabe and Stoller (2011) detailed how low-level linguistic processes (vocabulary access, parsing, and semantic sentence formation) and higher-level comprehension processes (text comprehension model, contextual reader interpretation) of L1 and L2 readers proceed. model and enforcement control processes) are performed on the WM. The WM manages attentional resources to achieve local and global text comprehension through an iterative integration process in which the WM stores information extracted from long-term memory and decodes and updates previous texts in active mode for short periods of time, thus allowing the reader to mentally bond together. You can. (AbuRabia, 2003; Ercetin & Alptekin, 2013; Shin et al., 2019). To date, Han (2017) is one of the few studies examining how WMC is related to the use of reading strategies when reading the FL. In this study, Khan investigated whether readers could compensate for inefficient word recognition and WM limitations with metacognitive reading strategies in a time-constrained reading environment.

III. METHODOLOGY

Participants

Due to the qualitative nature of verbal reporting, studies using this indicator tend to be relatively small in size. For example, Yang (2006) reported that there were 20 EFL readers at a Chinese university with an intermediate level of knowledge. Endley (2016) had 12 participants from English-speaking universities in the Gulf region. Alkhaleefah (2017) had 4 Saudi EFL students, 2 good readers and 2 bad readers. Similar to this general practice, 12 participants (4 males and 8 females, ages 18-20) were participated in this research study.

Materials

In the questionnaire, participants were asked about background information such as gender, age, and CET scores. There is strong evidence that readers' information processing behavior changes when their knowledge of the subject changes (Akyel & Erçetin, 2009; Pritchard, 1990). Brantmeier and Yu (2014) argued for the potential benefits of using topical texts in L2 reading studies. Therefore, in this study, two texts in English were used so that learners could read the texts. The two texts, approximately 450 words long, are excerpts from two magazine articles. To gain deeper insight into the reading process, semi-structured interviews were conducted after readers had read the texts (Gass & Mackey, 2013; Zhang & Seepho, 2013). Both Think-aloud protocols (TAP) and semi-structured interviews have been tested and found to be reliable metrics (Brantmeier, 2002; Cowan, 2014; Ericsson & Simon, 1993; Gass & Mackey, 2013) and L2 reading studies (e.g., He, 2008; Lin and Yu, 2015; Wang, 2016). Automated operation span task (OSTs) developed by Unsworth and colleagues (2005) are fully computerized, mouse-operated, and automatically evaluated. All study participants were included in the analysis as they were within the cut-off values.

Procedure

On the first day, 12 participants were chosen to meet individually with the researcher for two additional meetings. On the second day, researchers explained the TAP and provided participants with short excerpts from which they could practice the TAP procedure until they were ready to begin their first text. The TAP procedure was recorded on video. Researchers were seated in the back of the room and did not interfere with the reading process except to remind participants to "keep talking" when they paused for about 15 seconds. After reading the text, the participant signaled the researcher to stop recording and continued the rest of the task.

Three reading comprehension tasks after each passage. In the meantime, the researcher played back the participants' TAP recordings and took notes on reading behaviors that needed explanation. Shortly after the participants completed all of the above tasks, semi-structured interviews were conducted in Persian. Participants were asked to clarify some reading behaviors and answer some general questions about their experience of reading the text while playing the recording. For example, one of the common questions: On a scale of 1 to 10, how would you rate the complexity of the text? 1 means "very simple" and 10 means "I don't understand at all". Semi-structured interviews were also recorded on video. On day 3, the same process was repeated for text 2.

IV. RESULTS AND DISCUSSION

The Pearson correlation was performed to investigate how WMC correlated with participants' English proficiency and was expressed as a CET scale. As shown in Table 1, it showed a low correlation. This suggests

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that WMC and language skills are less likely to measure the same constructs as in terms of strategy use. Consequently, participants' patterns of WMC-based strategy use observed in the data were not related to the effect of language ability.

Table 1: Correlation Between Participants' WMC and CET Score

	CET score	
WMC	**Pearson Correlation**	**.290**
	Sig. (2-tailed)	**.601**
	N	**12**

Pearson correlation analysis was performed, and the results in Table 2 showed medium-high effect sizes for FR (r = 0.722) and SC (r = 0.834), indicating that readers with high WMC scores significantly higher for these two. indicates. than with a smaller WMC. Switching to MC did not find any significant correlations suggesting that the reader's WMC was not related to MC performance.

Table 2: Correlations Between WMC and Three Reading Comprehension Measures

		FR	SC	MC
WMC	Pearson Correlation	**.722**	**.834**	**.148**

The frequency of strategy use is the sum of strategies used by the participants, and the diversity of strategy use is the sum of unique strategies. Pearson correlation analysis was performed to determine whether the frequency and diversity of strategy use was associated with WMC. The results presented in Table 3 show a "low mean" effect size (r = 0.523) between WMC and strategy diversity, suggesting that readers with high WMC tended to use strategy diversity more.

Table 3: Correlation between WMC and the frequency and diversity of strategy use

		Frequency	Variety
WMC	Pearson Correlation	-.636	**.523**

Our study is one of the first to examine the role of WMC in reader diversity and strategy use when reading L2 texts. The discovery is not unexpected. Reading strategies refer to the actions, behaviors, and thoughts readers use to solve reading problems and achieve specific reading goals (He, 2008). Strategic use is characterized by "intent" and therefore requires cognitive resources (Akyel & Erçetin, 2009; Grabe & Stoller, 2011). Many strategies may be needed to build a situational model of the reader's interpretation as different strategies target different comprehension goals (eg, recognizing words, identifying key messages). Machines on a production line need electricity to operate. Similarly, the implementation of the read strategy is "pushed" by the WMC. Thus, readers with higher WMC's are more likely to "engage" more essential strategies in achieving the different goals of understanding and ultimate understanding than readers with lower WMCs.

V. CONCLUSION

Our records confirmed that the WMC's contribution to reading comprehension varies relying on the type of comprehension measures used. Researchers are therefore encouraged to use a combination of different types of comprehension measures in a single study when examining the relationship between WMC and L2 reading comprehension. In addition, the results of the study demonstrated the interdependent relationship between WMC and the use of the L2 reading strategy. To be precise, the little WMC is associated with slow word recognition and slow reading speed which are considered to be reading problems. It is then that the corresponding strategies are required, commanded by WM, to solve these reading problems. In contrast, a larger WMC interprets to greater "fuel" to assist the usage of extra kinds and a greater diversity of play strategies. Readers with a greater WMC not only tackle linguistic tasks (e.g., word recognition) more effectively, however further they have got the sources to strategically promote higher-level comprehension processes. Care has to be taken when interpreting effects due to limitations because of the small data set. That said, the results

highlighted the elusive relationship between reading WMC and L2 and using strategy when various reader texts, activities, and variables are involved, which requires further research on the topic.

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