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Examining the effects of two cognitive styles (field dependence vs. field independence) on learners' mobile-assisted vocabulary acquisition

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Abstract: Learners with different cognitive styles (here, *field dependence* vs. *field independence*) may learn second language vocabulary differently in different vocabulary learning settings. Although cognitive style has been widely studied in second language research, little is known about how field dependence/independence affects learners' vocabulary acquisition in a mobile-assisted learning setting. One approach to solve this problem is to investigate the possible effect(s) of field dependence/independence on learners' short-term vocabulary recall in a mobile-assisted vocabulary acquisition setting (here, *Memrise*). To investigate such effect(s), this study adopted a pretest-posttest design involving 147 intermediate-level learners of English as a second language. Using the Group Embedded Figures Test, participants were divided into two groups: field dependent and field independent learners. For 4 weeks, both groups practiced and reinforced a set of English vocabulary, selected from the Vocabulary Level Test, through Memrise flashcards. Our findings reveal a post-intervention improvement among both field-dependent and field-independent learners, but with field-independent learners slightly outperforming their counterparts in the short-term recall of the vocabulary. Implications and recommendations for future research are discussed.

Keywords: cognitive style; field dependence-independence; vocabulary recall; mobile-assisted vocabulary acquisition

1 Introduction

Vocabulary is a fundamental property of language (Nation & Newton, 2008). Despite its importance, second language vocabulary acquisition seems to be typically a

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complex issue which can be attributed to variations in learners' cognitive style. This issue has also grown in importance in light of the ubiquity of mobile technology introducing an area of enquiry, mobile-assisted vocabulary acquisition (MAVA). That is, learners with different cognitive styles may learn second language vocabulary differently in different vocabulary learning settings such as MAVA. However, to date, there is scarce research on the impact of cognitive style on short-term recall and vocabulary acquisition using MAVA.

To address the above-mentioned issue, this study took an approach that focused on the role of cognitive style and short-term recall in vocabulary acquisition. It is important to note that we consistently use the term "short-term recall" to describe the cognitive function responsible for temporarily holding and processing information before it is either forgotten or transferred to long-term memory. Additionally, we designate short-term recall as a dependent variable that will be examined in relation to vocabulary acquisition and cognitive style. Two broadly investigated cognitive styles in education research were chosen: *field dependent* (*FD*) and *field independent* (*FI*) (Chen, 2010; Frank & Keene, 1993; López-Vargas et al., 2017; Nezhad & Shokrpour, 2012). The reason for such a choice can be explained by the relationship between short-term recall and FD/FI styles (Davis & Cochran, 1990); this will be explained more in the discussion section. Further, a mobile app, Memrise, was used to provide learners with a MAVA setting. Concerning target vocabulary items, this study employed the Vocabulary Level Test (VLT), adapted by Webb, Sasao, and Ballance (2017). Overall, this study aims to investigate the impact of field-dependence/independence on short-term vocabulary recall using Memrise.

2 Literature review

2.1 Cognitive style

Cognition refers to the process of amassing and interpreting information gained from learning or experience, and then changing that information to knowledge to interpret the surrounding world (Te Molder & Potter, 2005). Individuals with different personal, behavioral, and psychological characteristics adopt different approaches, representing different *styles*, to engage their cognition. Style describes one's proclivity towards the adoption of an approach in a variety of situations, and when this approach features intellectual and perceptual activities, it is referred to as *cognitive style* (Witkin et al., 1977). As Keefe (1979) defined, cognitive style refers to the link between the characteristic means for learning concepts and the usual approaches adopted to solve problems. As such, cognitive style can be construed as the connection

between personality and cognition. Riding and Rayner (2013) characterized cognitive style as the frequent approach preferred for processing, restructuring, and representing information.

The disparities among cognitive styles concern different ways that learners engage in cognitive activities (e.g., intellectual activities). For example, when problem-solving, some learners deconstruct the task (i.e., the field) and analyze its components to find the causes and possible solutions. Conversely, other learners view the whole task to realize the causes and related answers. Another feature of cognitive styles is that they are not dichotomously valued as intelligence; one who has a higher intelligence quotient score can cognitively outperform the one with a lower score (Witkin et al., 1977). In fact, every cognitive style may be equally valuable and effective under a specific condition and in performing particular tasks.

Although there is consistency in individual learners adopting a cognitive style, there is inconsistency in this regard across learners, meaning that different learners adopt different cognitive styles when communicating with the learning environment (Witkin et al., 1977); hence, cognitive style can be used as a measure of learner differences (Messick, 1984).

2.2 Cognitive style: field dependence/independence

Learners can appreciate the field (i.e., the surrounding context) in different ways, which can be attributed to different cognitive styles. In this sense, learners can be categorized as field dependent (FD) or field independent (FI). FD learners view the whole field, rather than its components, with much less probability of restructuring it. Witkin et al. (1977) explained that FD learners are *socially-orientated* individuals whose perceptions and intellects rely on the social aspects of the field. In their research, Guo and Yang (2018) demonstrated that in communicative contexts, particularly when uncertainty arises, FD learners who are *message-oriented* show a higher proclivity to consider the social cues, as opposed to constituent cues, of communication. To illustrate, in FD-based perspectives, interaction is seen mainly as the medium of communication, and what linguistic cues[1] (e.g., syntax cues, semantics cues) contribute to interaction is often overlooked. Moreover, FD learners show an inherent tendency towards being physically close to other learners, which can be indicative of their sense of dependency on external social referents (Zhang & Sternberg, 2001).

1 Pragmatics is not included as part of the linguistic cues because it also encompasses social aspects of interaction.

On the other hand, FI learners are analytical and self-perception oriented; they often deconstruct the field (e.g., learning task) and give their focal attention to particular parts of it rather than see the whole field (Rassaei, 2015). FI learners can analyze an item in a discrete fashion from its surrounding context. As such, Witkin et al. (1977) delineated that FI learners can detect a simple shape in a complex pattern in a short time. Another feature of FI learners is that they are *impersonally-oriented* individuals who often self-define learning goals; also, they prefer to learn and solve issues using internal cues and de-contextualized information (Garber et al., 2018; Pearson, 1992). For example, if ambiguity arises in communicative contexts, FI learners often consider the constituent cues (i.e., linguistic cues), as opposed to social cues, of communication to resolve that.

Zhang (2004) put forward that learners'field-dependence/independence can be determined by their susceptibility to external and internal cues while performing tasks. FI learners are not heavily influenced by the organization or the social aspects of the field when engaging in activities like problem solving, but rather they restructure the field, regardless of how dominating it might be. Conversely, FD learners are more conformist to the organization of the field and are not likely to restructure it; that is, they often accept and digest the material with its given structure (Chen, 2010; Jonassen & Grabowski, 1993).

2.3 Second language vocabulary acquisition

Vocabulary is an important element of language (Nation & Newton, 2008). There are mixed beliefs about vocabulary acquisition. While some people might think that for English as a second language (ESL) learners, vocabulary acquisition can occur via guessing the meanings of vocabulary items from context, research suggests that ESL learners need direct exposure to and explicit instruction on vocabulary to learn the target word(s) (Folse, 2004). As Chapelle and Jamieson (2008) explained, ESL learners need to devote their time to studying vocabulary, because (a) the guessing-from-context strategy, commonly used in reading comprehension activities, often leads to *inaccurate* guesses, and (b) unknown content words in a reading passage are very likely to remain unlearned if no attempt is made to consult their meanings from a dictionary, teacher, or computer/mobile application.

Even a small number of unknown content words in a reading text can make reading comprehension problematic for ESL learners. As Hu and Nation (2000) posited, the ESL learner's reading comprehension can be affected by vocabulary to the extent that two unknown content words in each line of a text – assuming that each line holds approximately ten words – would make reading comprehension problematic for the learner. Studies indicate that an ESL learner needs to understand

between 95 % (Laufer, 1992) and 98 % (Hu & Nation, 2000; Schmitt et al., 2011) of the content words in an authentic text (e.g., a novel) to comfortably read and successfully comprehend the whole text. These percentages require a vocabulary size between about 5,000 words for complex texts like novels (Hirsh & Nation, 1992) and 8,000–9,000 words for academic texts (Nation, 2006). Such vocabulary size estimates signify that importance needs to be placed on vocabulary retention and instruction to enhance the depth and size of ESL learners' vocabulary.

The term *retention* is defined as "the ability to provide the meaning of a new word after a given period of time" (Ramezanali, 2017, p. 6). To have ESL learners retain a large vocabulary (e.g., 8,000 words) can create some barriers for teachers as well as students. For example, classroom instruction is time bound; therefore, teachers cannot cover all the vocabulary items. Also, for the same reason, students cannot learn all the vocabulary items in the classroom context because of a limited lexical exposure taking place in the classroom (Chapelle & Jamieson, 2008). According to Nation (2013), any vocabulary item requires a minimum of 10–15 exposures to be retained. If such a frequency of lexical exposure does not happen, ESL learners are less likely to leverage *repetition*, which is an important technique necessary for vocabulary recall and retention (Webb, 2007).

However, advancements in MAVA have easified lexical exposure, and therefore, repetition in and out of the classroom context. MAVA provides learners with different means through which they can interact with word definitions, synonyms, sample sentences, etc., each of which can lead to vocabulary development (Tozcu & Coady, 2004). For example, in a MAVA setting, ESL learners can: Access word meanings while reading a passage simply by voicing "what does [X] mean?" to their smart device, favorite the word's meanings on a dictionary app, create a flashcard with the word immediately, add mnemonics to flashcards, and the like. Chapelle and Jamieson (2008) postulated, these interactions go beyond word guessing; they increase the kinds of support (e.g., verbal support, imagery support) that learners need when engaged in different language activities. Research suggests that more kinds of support would result in a better vocabulary recall and retention (Yoshii & Flaitz, 2002). Therefore, in line with Thornbury's (2002) criteria for claiming to have learned a word, it can be deduced that MAVA has the capacity to help ESL learners earn a good command of vocabulary because it promotes (a) vocabulary retention, and (b) the use of the vocabulary items in different communicative contexts.

2.4 Frayer Model of vocabulary development

To examine whether cognitive style acts as a function of vocabulary recall among ESL learners who engage in MAVA, this study used a popular vocabulary achievement

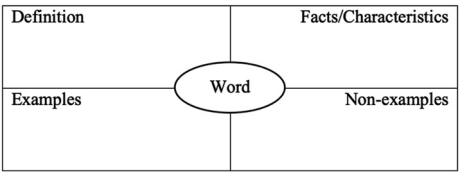

Figure 1: Frayer Model (adapted from Frayer et al., 1969).

model named the *Frayer Model* (FM) vocabulary development. Developed by Frayer et al. (1969), FM is one of the commonly employed concept mapping models in vocabulary achievement (Greenwood, 2002; Palmer et al., 2014) and concept comprehension (Bowe, 2019). FM includes five sections: *keyword holder*, *definition*, *fact* and/or *characteristics*, *examples*, and *non-examples*. *Keyword holder* is the center of the model, which is reserved for the target vocabulary item (e.g., "glance" – the word is adopted from the Vocabulary Level Test (VLT); Webb et al., 2017). *Definition* is a place where a friendly, easy-to-understand definition of the target word is given. In the *examples* section, synonyms, collocations, and in the *non-examples*, antonyms can be written, with or without example sentences. Plus, using schematic knowledge, students should write in the *facts/characteristics* section one or more cues that associate the word meaning to a mental entity established in their mind. In this study, as the flashcards were built on a mobile app – Memrise, the image upload feature of the app allowed us to add pictures to the *facts/characteristics* section of some, but not all, flashcards to help participants recall (and learn) the meaning of the target word. Figure 1 shows the components of the Frayer Model.

The FM enables learners to develop an in-depth grasp of new vocabulary items because it is not merely meant to focus students' attention on dictionary definitions; rather students using this model are encouraged to think about, analyze, and know the characteristics (or concept) of new vocabulary items, for example, by being provided with some facts about the vocabulary item.

2.5 Memrise

To operationalize vocabulary acquisition via mobile learning, the researcher employed the term MAVA. Adhering to Traxler (2010) view of mobile learning, MAVA refers to gaining vocabulary knowledge which is assisted, encouraged, or enhanced by handheld mobile devices such as smartphones. In this respect, *Memrise*, a digital flashcard app, was chosen to provide participants (ESL learners) with MAVA.

Developed in 2010, *Memrise* is a popular mobile app (also a web app) – with more than 50 million users to date – designed to assist users/learners to improve their

vocabulary recall and retention via digital flashcards. Not only does this app aim for vocabulary acquisition, but it also assists learners to memorize concepts and characters in other disciplines (e.g., science). *Memrise* offers pre-defined vocabulary courses in the form of digital flashcards across different language proficiency levels (e.g., beginner). Each level exposes learners to a certain amount of vocabulary items and their definitions. Moreover, *Memrise* has testing features including multiple choice tests, audio tests, and type-the-right-word tests. Additionally, using speech synthesis and speech recognition technology, the app offers a pronunciation feature that checks and improves the learner's pronunciation. Taken together, the tests and flashcards of *Memrise* provide learners with affordances (e.g., increased lexical exposure) that resonate well with vocabulary acquisition (Walker, 2015).

A key aspect of *Memrise* is that it is inspired by the repetition theory emanated from behaviorism. This learning theory was introduced by Watson (1958) who believed that the more regular occurrence of an associated stimulus and response, the mightier habit one will develop. As such, humans' memory is like a sieve that needs continual refills of an item to retain that item. Likewise, using the *spaced repetition* system, *Memrise* exposes learners to flashcards at regular intervals. Intervals are determined by the frequency with which the learner responds to a flashcard correctly; flashcards which are frequently marked as true will appear with longer intervals and vice versa.

Another feature of *Memrise* is its customizable flashcards, catering to learners' vocabulary acquisition style (i.e., cognitive style). Creating Memrise flashcards, learners can add word translations and mnemonic aids like an image to enhance vocabulary recall. Furthermore, Memrise has a timing feature. That is, each individual Memrise flashcard is set a timeframe that motivates the learner to respond to vocabulary prompts within a shorter time. A quicker response will result in a higher score and also a higher rank in the leaderboard of that specific lesson. The timer can be disabled at the user's discretion – to date, the timer is configurable on the web app only. Figure 2 shows an example of a multiple-choice question on Memrise. Figure 3 shows a VLT flashcard, created on Memrise, that has a meme-based prompt.

While Memrise is one of the top-ranked language learning applications, it is essential to acknowledge that no tool is without its occasional shortcomings. Noteworthy among critics is Lotherington's (2018) identification of areas for improvement in content-based mobile apps like Memrise. These areas include concerns about instructional content, exercises that might be perceived as less engaging, and a course progression that may appear somewhat inflexible in its structure (Lotherington, 2018, p. 211). However, Memrise offers a multitude of benefits and features that have contributed to its popularity among language learners and researchers. Its incorporation of fun and interactive features, alongside affordances that enhance

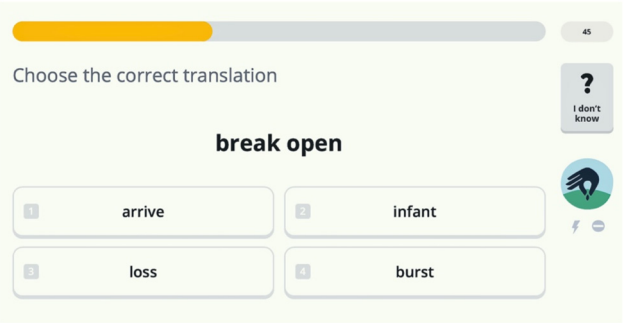

Figure 2: Multiple-choice question (Memrise).

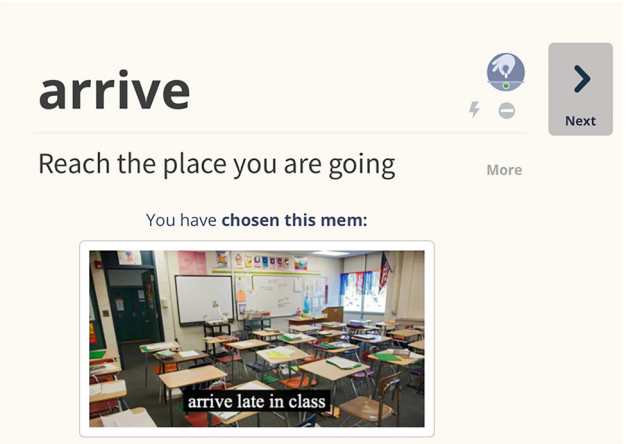

Figure 3: A sample VLT flashcard with a meme on Memrise.

learner engagement in vocabulary acquisition, has earned it a well-deserved reputation (Smith et al., 2018; Walker, 2015). The research has shown that *Memrise*, when used in conjunction with traditional learning methods, can serve as a valuable tool for enhancing students' vocabulary performance (Walker, 2015). Moreover, its adoption of a spaced repetition system reflects its dedication to effective language learning practices. Thus, our decision to focus on Memrise for this study is rooted in the recognition of its strengths and affordances (see Section 2.6 for further details on affordances) while also acknowledging areas that may benefit from further development.

2.6 Affordances

Affordances, as elaborated by Gibson (1977), refer to the inherent potential properties and functions that a technological tool offers to its users. In the context of technology-assisted learning, affordances pertain to the different ways that digital tools and mobile applications present for fostering interaction, engagement, and learning (Norman, 1999). Within this framework, Memrise provides numerous affordances to language learners. Notably, it facilitates *multimodal learning* through text, audio, video, and interactive exercises. Additionally, Memrise employs *gamification* principles, incentivizing language learning through point systems, competitive features, and engaging challenges. Another key affordance is Memrise's *adaptive learning*, where exercises and challenges adapt based on individual learner performance, ensuing optimal level of engagement. By examining the affordances offered by Memrise, we can gain useful insights into how language learners perceive and use this application. This understanding sheds light on how learners harness the application utilized herein to enhance their vocabulary acquisition and retention, providing valuable information on the effectiveness of this learning tool in vocabulary development.

3 The current study

Previous research in the context of cognitive style with a concentration on FD/FI have focused mainly on differences in students' performance, and choice of learning approaches and strategies. The primary focus of these studies includes: the cognitive aspects of learning and learning strategies for ESL listening and speaking (Ma & Oxford, 2014), the impact of cognitive style and metacognition on learning achievement (López-Vargas et al., 2017), learning styles, phonological memory, and personality (Grey et al., 2015), the examination of FD/FI against academic achievement and thinking style (Zhang, 2004), how differences in students' learning approaches and cognitive style affect their navigational behavior on Massive Open Online Courses (Guo & Reinecke, 2014), and the effect of FD/FI and cognitive strategy instruction on free-recall memory and strategy use of students (Frank & Keene, 1993).

While cognitive style has been much investigated, no previous research, to the researcher's knowledge, has examined how cognitive style affects learners' short-term vocabulary recall in a MAVA setting. Therefore, this study focusing on FD and FI learners investigated the impact of cognitive style on learners' short-term

vocabulary recall performance in the Vocabulary Level Test (VLT) using Memrise. The target vocabulary items were selected from the VLT.

3.1 Research questions

The present study explores the relationship between the two cognitive styles studied herein, short-term vocabulary recall among English language learners, and a widely-used vocabulary learning application – Memrise. This study is grounded in two research questions (RQs):

RQ1: How does the implementation of Memrise impact the vocabulary recall of English language learners, considering their performance on the vocabulary levels test?

RQ2: How do field-dependent and field-independent cognitive styles influence the vocabulary recall of English language learners utilizing Memrise for vocabulary acquisition?

RQ1 examines the impact of implementing Memrise on the vocabulary recall of English language learners. This question holds significance within the broader context of technology-enhanced learning, aligning with our study's overarching focus on the integration of mobile-assisted language learning. RQ2 probes the influence of cognitive styles on vocabulary recall when using Memrise for vocabulary acquisition. This question extends the discourse to the realm of individual learning differences and their interaction with digital learning tools. These research questions lead to the formulation of research hypotheses (see the Result section) that connect to the core themes of our study, allowing us to explore the effectiveness of Memrise and the interplay of cognitive styles within the context of vocabulary recall.

4 Methods

4.1 Participants

To carry out the research, ESL learners (n = 201) aged between 15 and 22 years old, 53 % male and 47 % female, from three English language centers in Johor Bahru, the second biggest state of Malaysia, participated in this study. They were chosen using non-probability, convenience sampling. The selected participants (n = 138; for further details on sampling, see the Procedure section) consisted of school or college students

who desired to extend their ESL studies by attending enrichment classes whose curricula were different than those of their school or college.

4.2 Measures

4.2.1 Proficiency tests

To have homogenous participants, two standardized proficiency tests of English were incorporated: the First Certificate in English (FCE) adopted from *FCE Result* (Davies & Baker, 2011); and the Oxford Online English (OOE; Oxford Online English, n.d.). Concerning the FCE test, only the Reading and Use of English papers were selected. The FCE reading paper encompasses 4 sections, 35 questions (e.g., gapped sentences, multiple matching). The Use of English paper encompasses 5 sections, 65 questions (e.g., gap filling, spotting errors). For each of the Reading and Use of English papers, participants had 1.15 h to complete the test (2.30 h total).

Concerning the OOE test, only the vocabulary section was selected for the purpose of this study. The OOE Vocabulary consists of forty multiple-choice questions that evaluate learners' knowledge of vocabulary, phrasal verbs, adjectives, antonyms, prepositions, and synonyms. Participants were required to complete this test in 40 min. The content validity of both the FCE (Reading and Use of English) and OOE (Vocabulary) tests was checked with three experts: two trained English practitioners and one researcher in the field. After conducting the proficiency tests, 192 participants were identified as intermediate level of English.

4.2.2 Group Embedded Figures Test (GEFT)

The researcher adopted the Group Embedded Figures Test (GEFT) to have a thorough grasp of the level of participants' field-dependence/independence. GEFT, constructed by Witkin et al. (1971), is a validated psychological test that identifies one's cognitive style as to field-dependence/independence (i.e., one's dependency on the field). It has a Spearman–Brown reliability coefficient of 0.8–0.9. More information on the validity and reliability of this test can be gained in the GEFT manual (Witkin et al., 1971).

GEFT consists of three sections of 25 complex figures presented as a whole; test takers are required to recognize a hidden simple form within each complex figure. On completion of the test, the scores ascertain whether the test taker is FD, FI, or a mix of both. As mentioned before, in the current study, learners who were a mix of both FD and FI were not included (n = 45).

Out of the 25 questions/figures in the GEFT, the initial seven in Section 1 serve primarily to introduce and raise respondents' awareness about the test, and 18 questions in sections two and three determine the cognitive style of respondents. Thus, the maximum raw score of 18 indicates a high level of field-independence, while a score lower than 5 shows that the respondent is completely field-dependent. Respondents who get a score between 6 and 14 are considered a mix of both FI and FD. Respondents are not penalized for choosing a wrong answer.

4.2.3 Vocabulary levels test (VLT)

To measure the participants' vocabulary size for the pretest and posttest, the present study used the updated vocabulary levels test adapted by Webb et al. (2017). The test, originally constructed by (Nation, 1983), is comprised of five levels. Each level employs 10 clusters of three matching questions with six possible answers; each cluster targets the same part of speech. Distribution of conjugation in each 10 clusters (each level) of the VLT includes: nouns (n = 5), verbs (n = 3), and adjectives (n = 2). Participants were required to choose three matching answers out of six items, and accordingly, gain a point for each correct response, ranging from 0 to 3 for each level. The maximum score for the whole test is 150. Table 1 shows a sample cluster of the VLT.

Table 1: A sample VLT cluster.

Definitions	Arrive	Collect	Consider	Glance	Need	Pack
Look quickly at something						
Reach the place you are going						
Think about something						

4.3 Procedure

Participants were informed of the research objectives, instruments, and phases designed for the purpose of answering the research question of this study. It was explained that the whole treatment would be completed within 5 weeks, two sessions per week and each session for 1 h in their own classroom. In total, the treatment comprised ten sessions. Figure 4 demonstrates the treatment design of the present research.

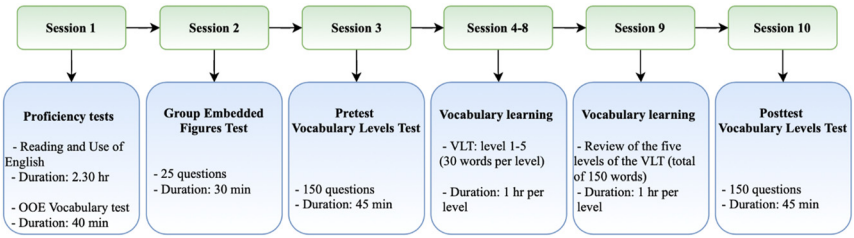

Figure 4: Treatment design.

To begin with, two proficiency tests were conducted in the first session. After conducting the tests, 192 participants were identified as intermediate-level ESL learners. To identify participants' cognitive style, the GEFT was administered (session 2). According to the format of GEFT, participants were required to find a simple shape in a complex figure in 20 min. Following the GEFT, participants were categorized as either FD (n = 69) or FI (n = 78) learners based on their final scores. However, 45 participants were excluded due to exhibiting a combination of both FD and FI cognitive styles. To ensure an equal distribution of participants for analysis, we randomly selected 69 participants from the FI group, matching the existing number in the FD group.

In the third session, the pretest instructions and timing were explained to participants; pretest included 150 matching questions adopted from the VLT. For the next six sessions, participants learned and practiced the target vocabulary items using digital flashcards of Memrise. In each of those sessions, participants were exposed to a level of the VLT clusters, including 30 vocabulary items. Participants could consult each other or their teacher about the content of flashcards

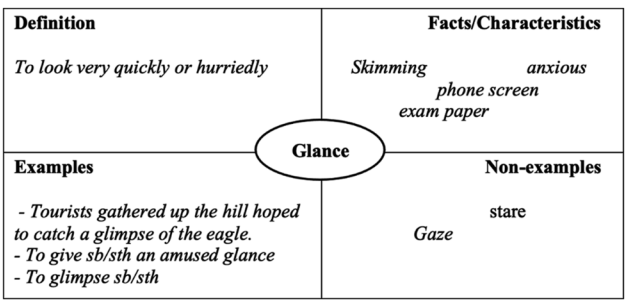

Figure 5: Sample content; target word: Glance.

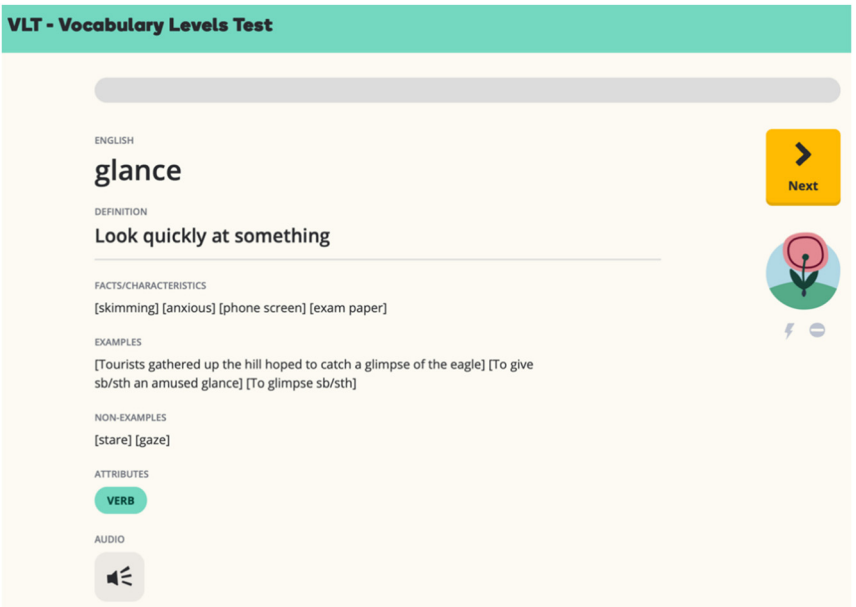

Figure 6: Sample VLT flashcard on Memrise; target word: Glance.

or ask for further VLT-based clarification if they needed any. Figures 5 and 6 show a sample content using the FM and a sample VLT flashcard on Memrise, respectively.

By session nine, participants finished practicing and reviewing 150 vocabulary items of the VLT. Finally, to measure participants' performance in short-term vocabulary recall, a posttest with identical questions and timing to the pretest was conducted in the tenth session. The results of the posttest were compared with those of the pretest to make interpretations on participants performance and on the possible relationship between participants' cognitive styles and their vocabulary recall.

5 Results

To answer the research questions, this study adopted a quantitative approach using a two-way mixed ANOVA. We initially inspected the boxplot (see Figure 7) to identify the presence of outliers. While there were two mild outliers in our sample, the

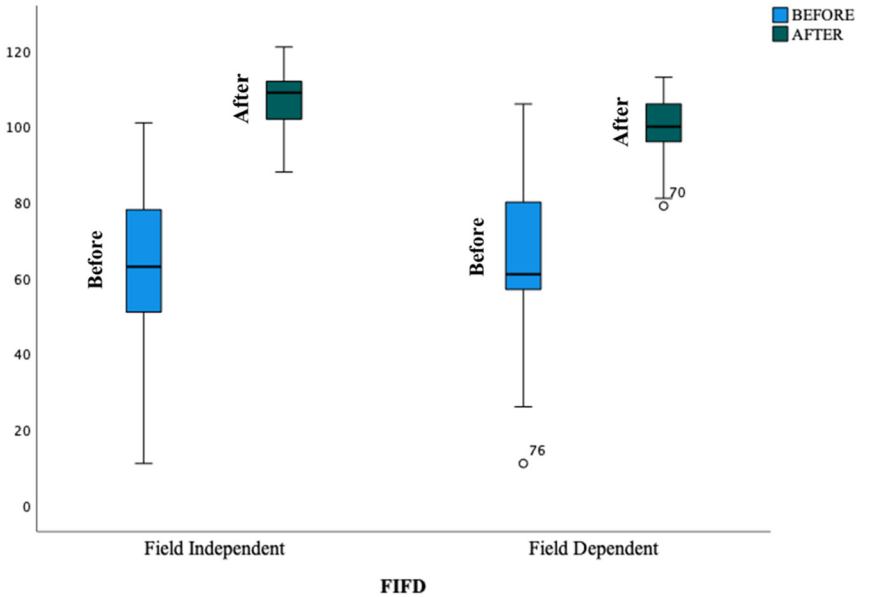

Figure 7: Boxplot of cognitive styles.

researchers decided to include both outliers in the analysis, as their presence did not substantially affect the results. To validate this assumption, a sensitivity analysis was conducted to compare the results of the two-way mixed ANOVA with and without the outliers.

Conducting the Shapiro–Wilk test, it was found that the data was normally distributed before and after the intervention ($p > 0.05$), considering both the FI and FD groups. There was homogeneity of variances and covariances, as assessed respectively by Levene's test of homogeneity of variance ($p > 0.05$) and by Box's test of equality of covariance matrices ($p = 0.673$).

According the findings obtained from the within-subjects effects analysis, there was a statistically significant interaction between the Memrise-enhanced intervention and time (pre/posttest) on the participants' vocabulary short-term recall, $F(1, 136) = 8.93$, $p = 0.003$, partial $\eta^2 = 0.062$. There was a statistically significant increase in mean recall from the pretest ($M = 64.10$, $SD = 19.31$) to the posttest ($M = 103.90$, $SD = 8.63$) when considering the main effect of time, $F(1, 136) = 546.74$, $p < 0.001$, partial $\eta^2 = 0.801$ (see Tables 2 and 3).

Table 2: Descriptive statistics.

	FD/FI	*n*	Mean	Std. deviation
Pretest	Field dependent	69	65.13	19.94
	Field independent	69	63.07	18.75
	Total	138	64.10	19.31
Posttest	Field dependent	69	99.84	8.13
	Field independent	69	107.96	7.10
	Total	138	103.90	8.63

Table 3: Results of within-subjects effects.

Source	df	*F*	Sig.	Partial eta squared
Time	1	546.74	<0.001	0.801
Time × FD/FI	1	8.93	0.003	0.062
Error (time)	136			

Table 4: Results of between-subjects effects.

Source	Df	*n*	*F*	Std. error	Sig.	Partial eta squared
Intercept	1	69	8,360.04		<0.001	0.984
FD/FI	1	69	2.718	1.837	0.102	0.020
Error	136	138				

As shown in Table 4, the results of the between-subjects analysis revealed that the main effect of group did not yield a statistically significant difference in mean recall levels between the two intervention groups, with the mean for FD (M = 82.49) not significantly differing from that of FI (M = 85.52), $F(1, 136) = 2.718$, $p > 0.05$, partial $\eta^2 = 0.020$.

In summary, the study's results indicate that the participants exhibited improvements in the vocabulary short-term recall in the posttest, with FI learners demonstrating a slightly better performance compared to FD learners. However, it is noteworthy that there was no statistically significant difference observed in mean short-term recall between the two categories of cognitive styles examined in this study.

6 Discussion

This study employed the digital language-learning platform, Memrise, as a tool to examine its impact on vocabulary short-term recall among English language learners. Notably, our aim was to understand how the MAVA setting provided in this study influences the vocabulary acquisition, with a particular emphasis on its effect on learners' performance in the vocabulary levels tests. The motive for using the mobile platform is that the affordances of mobile devices (e.g., smartphones) have fostered a stronger preference among today's students for these devices over desktop computers. User-friendly operating systems, fast computations, free applications, and "anytime, anywhere" features of smartphones have rendered them effective learning tools, and possibly a replacement for desktop computers (Anshari et al., 2017; Burston, 2011). Furthermore, our research aimed to explore the potential impact of individual learning preferences on retention in digital learning contexts. We especially sought to investigate whether the learners' cognitive style can act as a function of vocabulary short-term recall in the MAVA setting.

A within-subjects analysis was conducted to address the first research question that how the implementation of Memrise impacts the vocabulary recall of English language learners in relation to their performance on the vocabulary levels test. According to the results, the Memrise-enhanced intervention across 4 weeks improved participants' vocabulary short-term recall. It can be suggested that when vocabulary items are presented (a) through the five components of the Frayer Model (e.g., examples/non-examples), and (b) using the affordances of Memrise (e.g., spaced repetition), English language learners' short-term recall increases. Learners' improvement in the vocabulary recall can be explained by *dual coding theory* positing that encoding information through both verbal and visual channels can substantially foster memory retention (Clark & Paivio, 1991). Memrise effectively uses multiple modalities, including text, images, and audio, to deliver vocabulary content. This multimodal approach aligns with the principles of dual coding theory and spotlights the efficacy of Memrise in improving vocabulary recall.

Moreover, a between-subjects analysis was performed to answer the second research question on how field-dependent and field-independent cognitive styles influence the vocabulary recall of English language learners utilizing Memrise for vocabulary acquisition. The results showed that FD and FI learners recalled the vocabulary items to almost an equal extent although FI learners' performance was slightly better; that is, they recalled more vocabulary items. This slight difference can be explained by research on the relationship between FD/FI and *working memory* (i.e., the short-term information storage in human mind; Miller et al., 1960). Baddeley and Hitch (1974) explained that working memory is a multifunctional information-

processing system with a limited capacity. Research suggests that to capitalize on working memory, effective *processing* or *analytic strategies* need to be developed (Moray, 1967). Bearing that in mind, FD learners whose information processing style is global and holistic and is influenced by the prevailing structure of the surrounding field (Frank & Keene, 1993) are less likely to generate processing strategies when interacting with the field. In consequence, FD learners may not optimally benefit from working memory in performing cognitive tasks, and thus are less likely to outperform FI learners in vocabulary recall tasks, particularly when the task at hand creates a high cognitive load or requires organizational skills (Davis & Cochran, 1990). On the other hand, perhaps FI learners can benefit more from working memory because they develop analytic and organizational strategies to restructure information. As such, they actively partition information into segments and peruse the relationships among those segments (Goodenough, 1976). Therefore, they are more likely to outperform FD learners in vocabulary recall tasks (Bennink & Spoelstra, 1979; Davis & Cochran, 1990). However, in the present study, field-dependence/independence was not a strong variable to differentiate the vocabulary recall of ESL learners engaged in Memrise.

This study was not free from limitations. One concern about participants' vocabulary gains was a lack of precise information about students' engagement with the app and their overall vocabulary learning out of the research context. Therefore, the results were inconclusive as to whether the participants' progress in the VLT (vocabulary gains) could be attributed exclusively to Memrise. Further, due to the use of a mobile app – probably a new learning setting for some participants – in our intervention, the two groups' vocabulary gains could be explained by novelty effect (Clark, 1983), meaning that it is possible that the technology itself had no influence on participants' vocabulary acquisition; rather, it was possibly the novelty effect of the mobile app that had a stronger power over learning.

7 Conclusions

Our findings demonstrate that exposure to MAVA has potential to improve ESL learners' short-term recall of English vocabulary and that field-dependence/independence does not seem to be a strong factor in explaining ESL learners' short-term recall of English vocabulary presented in a MAVA setting such as Memrise.

The broad implication of the present study is related to the question of whether there is a relationship between (a) MAVA and short-term recall of students with different cognitive styles, and (b) MAVA and non-MAVA-based methods in terms of vocabulary acquisition and instruction. The findings of this study suggest that

Memrise, as a MAVA tool, can be considered ideal for vocabulary acquisition. This can be attributed to the customizability of Memrise flashcards that allows the organizational structure of learning content to enjoy such explicitness that can enhance learners', particularly FD learners', vocabulary recall. As mentioned in Frank and Keene (1993), explicitness in the organizational structure of learning content can contribute to FD learners' performance in cognitive tasks without impeding that of FI learners. Therefore, teachers should be encouraged to implement the affordances of MAVA to assist their students in vocabulary acquisition. Further, the evidence from this study suggests that students should be encouraged to employ the components of the FM (e.g., facts/characteristics) to create their own flashcards in a MAVA setting.

This study only targeted the short-term vocabulary recall using a pretest-posttest design. Future research should consider using a pretest-posttest-delayed posttest design to investigate participants' long-term vocabulary gains and/or to see if participants can use their vocabulary gains across contexts. Lastly, it is a question of future research to investigate whether learning strategies (e.g., metacognitive strategies) would help us explain FD and FI as a cognitive dichotomy in MAVA.

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