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The role of motivation and vocabulary learning strategies in L2 vocabulary knowledge: A structural equation modeling analysis

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Abstract

This study explores the complex relationships between language learning motivation, vocabulary learning strategies, and two components of second language vocabulary knowledge (i.e., vocabulary size and depth), within the framework of self-regulated learning. Responses to questionnaires were gathered from 185 secondary-level Korean adolescent learners of English as a foreign language, regarding their motivation and vocabulary learning strategy use; additionally, the results of their vocabulary size and depth tests were collected. We adopted structural equation modeling for analysis, with vocabulary learning strategies consisting of memory, cognitive, and metacognitive categories, and vocabulary knowledge consisting of vocabulary size and depth. The results showed that motivation directly predicted vocabulary learning strategies

and vocabulary knowledge, and indirectly predicted vocabulary knowledge via vocabulary learning strategies. When further classified, intrinsic motivation was found to have a stronger influence on the use of vocabulary learning strategies and vocabulary knowledge than extrinsic motivation. We discuss the implications of increasing learners' motivation and repertoire of strategies for improving vocabulary size and depth.

Keywords: motivation; self-regulated learning; vocabulary depth; vocabulary learning strategies; vocabulary size

1. Introduction

Vocabulary plays a significant role in second language (L2) learning and teaching (Nation, 2013; Schmitt, 2008). Based on empirical evidence in this regard, researchers have focused on identifying ways to improve learners' L2 vocabulary knowledge by either providing various types of treatment or accommodation (Lee et al., 2019; Laufer, 2009) or promoting influential learner factors such as motivation and learning strategies (e.g., Barcroft, 2009; Fontecha & Gallego, 2012; Gu & Johnson, 1996; Zhang & Lu, 2015). The present study focuses on the latter aspect and explores the complex relationships between L2 learners' motivation, their use of vocabulary learning strategies (VLS), and two components of vocabulary knowledge.

Previous studies that have examined the relationships between language learning strategies (LLS) and different dimensions of L2 skills/knowledge suggest that the former facilitate L2 learning (e.g., Bećirović et al., 2021; Cáceres-Lorenzo, 2015; Macaro, 2001; Yu, 2019). Research on L2 vocabulary has further explored this relationship by investigating the strategies or combinations of strategies that successful learners use to broaden L2 vocabulary (e.g., Kojic-Sabo & Lightbown, 1999; Zhang & Lu, 2015). The role of motivation in L2 vocabulary learning has also gained researchers' attention. With motivation being one of the most important factors in L2 learning (Csizér, 2019; Dörnyei, 2020), a few studies have examined the relationship between motivation and L2 vocabulary knowledge (e.g., Alamer, 2022; Fontecha & Gallego, 2012; Lee, 2017). These studies indicate a close relationship between the constructs.

However, despite the increasing interest, few attempts have been made to explore the relationships between these two important learner factors and vocabulary knowledge. In addition, previous studies have suffered from limitations. First, they tapped into either VLS (e.g., Kojic-Sabo & Lightbown, 1999; Zhang & Lu, 2015) or motivation (e.g., Fontecha & Gallego, 2012; Zheng, 2012) to explore vocabulary knowledge. However, it may be worthwhile to examine these variables together in view of the proposition that motivated learners are likely to employ more strategies to foster their L2 learning (Lou & Noels, 2019).

This proposition has gained empirical support in recent studies (Lee, 2020; Zhang et al., 2017) in L2 vocabulary learning contexts. Second, most studies (e.g., Gu & Johnson, 1996; Lee, 2020; Zhang & Lu, 2015) have primarily recruited undergraduate L2 learners as participants who, arguably, may have already acquired a large L2 vocabulary. Finally, most of the existing empirical investigations have only examined one aspect of vocabulary knowledge, that is, vocabulary size (breadth) (e.g., Kojic-Sabo & Lightbown, 1999; Zhang et al., 2017). However, in view of the current thinking regarding operationalizing this target knowledge in the field, it seems beneficial to consider both aspects of L2 vocabulary knowledge together (see Schmitt, 2014 for an in-depth review of this issue). Additionally, certain VLS (e.g., paying attention to diverse aspects of a target word) may be associated with the development of depth knowledge; that is, adding the depth aspect of L2 vocabulary knowledge may facilitate better measurement of the relationship between a range of VLS and L2 vocabulary knowledge.

In view of the aforementioned limitations, the present study aims to examine the structural relationships among different types of L2 motivation, VLS, and two components of L2 vocabulary knowledge (i.e., size and depth) of adolescent learners of English as a foreign language (EFL) using the structural equation modeling (SEM) analysis. This attempt draws on self-regulated learning (SRL) as the theoretical framework, assuming that "self-regulated students activate, alter, and sustain specific learning practices" (Zimmerman, 2002, p. 70), taking the initiative and responsibility for their own learning. Within this framework, we hypothesize that motivated L2 learners would likely employ more VLS, which would, in turn, contribute to the expansion of their L2 vocabulary size and depth knowledge.

2. Literature review

In this section, we first review the literature on the relationships between motivation and L2 vocabulary knowledge, followed by the studies on the relationships between VLS and L2 vocabulary knowledge. Thereafter, we review the studies on the relationships between two major predictors of this study (i.e., motivation and VLS) and outcome variables (i.e., different components of L2 vocabulary knowledge).

2.1. Relationships between motivation and L2 vocabulary knowledge

The concept of language learning motivation has received considerable attention in the field of L2 learning (e.g., Boo et al., 2015; Dörnyei, 2009, 2020; Ushioda, 2019; Wu, 2003). Research in this area has drawn on different theoretical frameworks, such as the socio-educational model (Gardner, 1985, 2010), the self-determination theory (SDT) (Ryan & Deci, 2000, 2017), and the L2 motivational self

system (Dörnyei, 2005, 2009). We adopted the SDT as our theoretical framework of L2 learning motivation because of its suitability to account for different stages of L2 learning motivation (see next paragraph for details) among secondary-level Korean EFL learners (Jang & Kim, 2014; Woo, 2007). Furthermore, in view of the suggestion that the socio-educational model may be better oriented toward intercultural and community-related phenomena (than learning), and the L2 motivational self system may be suitable for older learner groups who may have developed greater capability of visualizing an ideal self (Sugita McEown et al., 2014), the SDT appears to be a better fit for our purpose.

The SDT differentiates between "types of motivation" along a continuum, from "controlled to autonomous" (Ryan & Deci, 2017, p. 3). At the two opposite ends of this continuum there lie *amotivation* (i.e., lack of motivation) and *intrinsic motivation*. Intrinsically motivated learners study L2 "because of the inherent pleasure in doing so," whereas *amotivation* arises "when a learner has no goals … for learning a language" (Noels et al., 2001, p. 426). In the middle of the continuum there lies *extrinsic motivation*, which can be subdivided into *external regulation* (learning regulated by external rewards or punishments), *introjected regulation* (learning controlled to some degree by internal feelings or pressure), and *identified regulation* (learning resulting from a conscious valuing and acceptance of personal goals) (Ryan & Deci, 2000). Learners oriented toward *external regulation* and *introjected regulation* will "stop putting effort into L2 learning once the pressure is lifted" (Noels et al., 2001, p. 425), whereas those oriented toward *intrinsic motivation* and *identified regulation* are relatively more self-determined; hence, they are more persistent in their efforts to learn. A previous finding based on Korean EFL contexts (Jang & Kim, 2014) confirmed this assumption, revealing that *intrinsic motivation* was positively related to secondary-level students' English proficiency levels.

The importance of motivation in language learning has been highlighted in the literature (e.g., Csizér, 2019; Dörnyei, 2019, 2020; Ryan & Deci, 2017), and L2 vocabulary acquisition research is no exception in this regard (e.g., Laufer & Hulstijn, 2001; Papi, 2018; Zheng, 2012). An important contribution in this regard is Tseng and Schmitt's (2008) study, in which they proposed a model of vocabulary learning by taking a process-oriented approach, and operationalizing vocabulary learning as a cyclical process. This model proposed that motivational constructs influence the development of vocabulary knowledge, which is succinctly summarized by the authors as follows: "motivation appears to be involved in all stages of [vocabulary] learning (instigating, sustaining, and evaluating), thus permeating the whole process" (Tseng & Schmitt, 2008, p. 383).

However, extant studies on the relationships between motivation and L2 vocabulary knowledge have produced rather mixed findings (e.g., Alamer, 2022;

Canga Alonso & Fontecha, 2014; Fontecha & Gallego, 2012). For example, Fontecha and Gallego's research (2012) measured receptive vocabulary knowledge and motivation to learn English among secondary-level EFL Spanish students studying in the 8th and 9th grades. They found that the students with higher motivation scored higher on receptive vocabulary tests than those with lower motivation in the 9th grade; however, the same pattern was not found for students in the 8th grade. More recently, Alamer's (2022) study with 366 Saudi EFL students, based on the SDT framework, revealed that autonomous motivation (i.e., the construct consisting of *intrinsic motivation* and *identified regulation*) positively predicted vocabulary size, whereas controlled motivation (i.e., the construct consisting of *introjected regulation* and *external regulations*) negatively did so. The review of these studies not only underscores the need to measure the subconstructs of motivation, but also suggests that other variables could be at play, mediating the relationships between motivation and L2 vocabulary knowledge. In this regard, we turn to one of such potential mediating variables: VLS.

2.2. Relationships between vocabulary learning strategies and L2 vocabulary knowledge

Influenced by research on language learning strategies (e.g., O'Malley & Chamot, 1990; Oxford, 1990), a few L2 vocabulary studies have presented a domain-specific group of learning strategies (i.e., VLS), which refers to "a wide spectrum of strategies used as part of an on-going process of vocabulary learning" (Gu & Johnson, 1996, p. 669). Gu and Johnson (1996) distinguished between *metacognitive regulation* and *cognitive strategies*, with the former consisting of selective attention and self-initiation, and the latter including guessing, dictionary, note-taking, rehearsal, encoding, and activation. Another key work in this area is Schmitt's (1997) inventory of VLS. Adopting certain major categories from Oxford's (1990) classification, Schmitt first classified VLS into two broad groups: *discovery strategies* and *consolidation strategies*. *Discovery strategies* aim to determine the meaning of new and unfamiliar words. These strategies are subdivided into *determination strategies* (e.g., guessing the meaning of a new word from its form or contexts, or referring to resources, such as dictionaries) and *social strategies* (i.e., asking others for the meaning of a new word). By contrast, *consolidation strategies* are concerned with remembering introduced words, and are subdivided into *memory* (i.e., learning vocabulary by executing manipulative mental processing), *cognitive* (e.g., repetition and using mechanical means such as word lists and vocabulary notebooks), *metacognitive* (i.e., self-regulating one's own vocabulary learning), and *social strategies* (e.g., learning or practicing vocabulary with peers).

Based on previous research on the classification of VLS, several studies have examined the relationship between VLS and vocabulary knowledge using different methodological approaches. One group of such empirical investigations employed cluster analysis as a method of analyzing data, which enables the identification of distinctive clusters with different learner profiles. For example, in the aforementioned study by Gu and Johnson (1996), 850 non-English-major undergraduate Chinese EFL learners were asked to respond to a VLS questionnaire and take a vocabulary size test (VST). The results revealed that strategies such as *semantic encoding*, *word list learning*, and *contextual encoding*, among VLS, were significantly related to vocabulary size. Furthermore, the participants could be grouped into five different clusters based on different patterns of VLS use, with two of them constituting the majority and the only difference between the two being the use of *encoding strategies* (i.e., encoders and non-encoders), another two being high achievers (i.e., active strategy users and readers), and the other being low achievers (i.e., passive strategy users). With a similar aim in mind, Kojic-Sabo and Lightbown (1999) conducted a cluster analysis to examine 43 EFL and 47 English as a second language (ESL) students' strategic approaches to vocabulary learning and their relationships with vocabulary breadth. The participants' VLS were grouped into five categories, namely "(a) time, (b) learner independence, (c) vocabulary notes, (d) review, and (e) dictionary use" (p. 179). Among the eight clusters generated by the cluster analysis, it was found that those clusters with little use of VLS had relatively low vocabulary breadth. In contrast, the two clusters which reported greater use of VLS had the largest vocabulary breadth, but these two clusters were rather different, in that one selectively used only certain types of VLS, and the other used all types of VLS to more or less the same degree. Based on this result, Kojic-Sabo and Lightbown (1999) suggest that "specific combinations of some of the strategies are as effective as the use of all five [strategies]" (p. 189).

Some of the more recent studies have employed the SEM to investigate the relationships between VLS and vocabulary knowledge. It should be noted here that they began to see vocabulary knowledge operationalized as constituting different components, including vocabulary size and depth knowledge, with the former and the latter referring to "how many words are known" in terms of the form-meaning link and "how well those words are known" in terms of diverse aspects of vocabulary (e.g., collocations, multiple senses), respectively (Schmitt, 2014, p. 914). As one of such studies, Zhang and Lu (2015) administered a battery of vocabulary tests as well as a questionnaire on VLS to 150 Chinese EFL undergraduate students. The VLS were categorized into five factors: *form* (i.e., mnemonic strategies based on studying the form of vocabulary), *association* (i.e., mnemonic strategies based on associating words with semantically or morphologically related

ones), *repetition* (i.e., cognitive strategies based on repetition), *word list* (i.e., cognitive strategies based on word lists), and *picture/image* (i.e., mnemonic strategies based on associating the vocabulary with images or situations). The results revealed that both *form* and *association* positively predicted vocabulary size and depth, whereas *word list* had a negative effect. Similarly, Fan (2020) employed both vocabulary size and depth tests, as well as the VLS questionnaire, using the SEM approach, with 419 Chinese EFL undergraduate students. The results of this study showed that *attention* (i.e., attending to vocabulary during reading English texts or watching English media) and *guessing* (i.e., guessing the meaning of words from the textual or situational contexts) positively predicted both types of vocabulary knowledge, whereas *socializing* (i.e., asking others about the meaning and use of vocabulary) had a negative effect.

Although the studies mentioned above identified a close relationship between VLS and L2 vocabulary knowledge, researchers (e.g., Gu & Johnson, 1996; Kojic-Sabo & Lightbown, 1999) suggest that future studies should further examine the role of motivation, which may play an important part in such a relationship. In the following section, we review studies that have examined the complex relationships between motivation, VLS, and L2 vocabulary knowledge.

2.3. Relationships between motivation, vocabulary learning strategies, and L2 vocabulary knowledge

In the field of L2 research, a few studies have revealed a close relationship among motivation, language learning strategy use, and achievement operationalized as general proficiency level or knowledge in specific domains (e.g., Matsumoto et al., 2013; Yamamori et al., 2003). In L2 vocabulary research, Zhang et al. (2017) were among the first to explore the relationships between motivation, strategy use, and L2 vocabulary knowledge in a single study. Within the SRL framework, their study, including 107 10th grade Chinese EFL learners and using the SEM approach, revealed that VLS mediated the association between motivation and vocabulary size. However, when motivation was specified as either *intrinsic motivation* or *extrinsic motivation*, *extrinsic motivation* did not directly predict vocabulary size (but did so indirectly via VLS). *Intrinsic motivation* directly and indirectly predicted vocabulary knowledge and had a greater influence on the use of VLS. The authors concluded that "[l]earners need to have autonomous intrinsic motivation to use various learning strategies" and highlighted that intrinsically motivated learners "actively seek out useful resources that could help with their learning" (Zhang et al., 2017, p. 69).

In another study, this time involving 492 Korean undergraduate students registered in an English academic writing class, Lee (2020) tested the structural

model of L2 aptitude, motivation, language processing experience, and two components of L2 vocabulary knowledge (i.e., size and depth). The results of the structural model revealed that motivation directly predicted strategy use, and indirectly predicted both components of vocabulary knowledge via the mediation of language processing experience; by contrast, aptitude directly predicted both components of vocabulary knowledge. Interestingly, strategy use was not a significant predictor of vocabulary knowledge. Lee attributed this latter finding to the possibility that her participants (more or less advanced ones) could have used a set of strategies selectively (hence, a lack of a significant relationship). She added that this finding "does not imply that using or promoting L2 vocabulary strategies is not relevant for language learning, rather it suggests that when considering the complexity of vocabulary knowledge development, there are individual factors that may not be as pertinent as others" (e.g., age, proficiency) (p. 12).

3. The present study

The review of the previous studies on this issue has identified some research gaps (e.g., mostly focusing on vocabulary size, target learner populations largely being adults). Accordingly, we include both components of vocabulary knowledge in light of the need for a more comprehensive view of vocabulary knowledge (Lee, 2017; Schmitt, 2014) and the consideration that certain VLS may be more strongly associated with the depth aspect of L2 vocabulary knowledge. Additionally, we explore this issue with adolescent EFL learners whose profiles connected with the relationships between motivation, VLS, and L2 vocabulary knowledge may differ from those of undergraduate L2 learners since this population has been the primary target of previous research (e.g., Fan, 2020; Lee, 2020; Zhang & Lu, 2015). In view of these considerations, the present study intends to address the following two research questions:

1. Do motivation and VLS predict L2 vocabulary size and depth?
2. To what extent do *intrinsic motivation* and *extrinsic motivation* function differently with VLS and L2 vocabulary knowledge?

4. Method

4.1. Participants

A total of 185 secondary-level students aged around 14 to 15 years in Seoul, Republic of Korea, participated in this study. Among them, 78.4% (N = 145) were 8th graders and 21.6% (N = 40) were 9th graders. As for gender, 71.9% were male

(*N* = 133) and 28.1% were female (*N* = 52). At the time of the study, the 8th and 9th graders had been exposed to 506 and 626 hours of instruction in English as a mandatory school subject, respectively (see Table 1 for the summary of participants' demographic information). No participant had more than one month of study abroad experience in English-speaking countries. Also, these participants could be considered EFL learners in view of their learning context (i.e., little exposure to the target language outside the classroom).

Table 1 Demographic information of the participants (*N* = 185)

Categories	Values	Numbers	Percentages	Previous hours of instruction in English
Grade	8th grade	145	78.4%	506 hours
	9th grade	40	21.6%	626 hours
Gender	Male	133	71.9%	-
	Female	52	28.1%	-

4.2. Instruments

4.2.1. Questionnaire on motivation

To measure motivation, we adapted the questionnaire used by Jang and Kim (2014), which was based on Hayamizu's (1997) Stepping Motivation Scale grounded in the framework of the SDT (Deci & Ryan, 1985). It included motivational concepts, such as intrinsic reasons and external, introjected, and identified regulation. The questionnaire included items related to *intrinsic motivation* (five items, e.g., "I study English because the process of increasing my English abilities is fun") and *extrinsic motivation* (comprising external, introjected, and identified regulation; 12 items, e.g., "My parents get angry if I don't study English" for external regulation; "I study English because I want my friends to think of me as smart" for introjected regulation; "I think it is necessary to study English as part of my life" for identified regulation). All items were in Korean and were measured on a 5-point Likert scale. We found that the questionnaire had an acceptable level of reliability (α = .83 for IM and α = .77 for EM).

4.2.2. Questionnaire on vocabulary learning strategies

In terms of VLS, we adapted Park and Kim's (2012) VLS questionnaire in Korean, which was designed based on Schmitt's (1997) inventory and Park's (2001) questionnaire based on Korean EFL learners' VLS. The finalized questionnaire comprised 23 items divided into three categories: 11 items related to *memory strategies* (e.g., "Connect the word to personal experience," "Connect the word to

its synonyms and antonyms"), six to *cognitive strategies* (e.g., "Keep a vocabulary notebook," "Use the vocabulary section in your textbook"), and six to *metacognitive strategies* (e.g., "Continue to study word over time," "Testing oneself with word tests"). All items were in Korean and were measured on a 5-point Likert scale. We found that the questionnaire had an acceptable level of reliability (α = .85 for memory, α = .76 for cognitive, and α = .70 for metacognitive).

4.2.3. Vocabulary size test

Nation and Beglar's (2007b) bilingual version of the *Vocabulary Size Test* (VST) was used in consideration of the participants' level of L2 proficiency (Nation, 2013) to measure their vocabulary size. The VST was developed for non-native speakers of English and covers 14,000-word families based on particular frequency levels (Nation & Beglar, 2007a), of which we used the first three (1,000, 2,000, and 3,000). According to the Ministry of Education of Korea (2015), middle-school students are expected to acquire around 1,250 words, which are mostly below the 2,000 level; however, to prevent any ceiling effect, we added the 3,000 level. The test was given in a multiple-choice format, with each correct answer carrying one point, amounting to a total of 30 points. The VST had a moderate level of reliability (α = .84).

4.2.4. Vocabulary depth test

We adapted Read's (1993) *Word Association Test* (WAT) to measure the participants' depth of vocabulary knowledge. The WAT contains 40 target adjectives, and for each adjective eight other words are presented in a box format. In the left and right boxes, potential synonyms and collocates of the target adjective are presented (see Figure 1 for an example). A test-taker is asked to select four words that are related to the given target adjective, with three different combinations of answers possible (one synonym and three collocates, two synonyms and two collocates, and three synonyms and one collocate). While adapting this test, we compared the testing words in the WAT with the English wordlist compiled for middle-school students by the Ministry of Education of Korea (2015) and selected 10 target adjectives from the given 40. Each correct answer was given one point, which allowed for a maximum score of 40 points (10 target adjectives x four correct answers per adjective). The WAT had an acceptable level of reliability (α = .80).

1. beautiful

☑ enjoyable ☐ expensive ☐ free ☐ loud	☐ education ☑ face ☑ music ☑ weather

Figure 1 Sample item of word association test

4.3. Procedure

A battery of questionnaires and vocabulary tests was first piloted with 28 middle-school students, who were similar in terms of their English proficiency level and previous learning experience to the participants of the main study. The questionnaires and tests were revised as per the students' feedback, mostly in terms of the difficult terms (or expressions) in the questionnaire items. For instance, the terms such as prefix and antonym in the questionnaire items were added with some examples in English.

In the main study, the aforementioned questionnaires and vocabulary tests were administered to the participants on two consecutive days. On the first day, the questionnaires on motivation and VLS were given to the participants with a time limit of 20 minutes for completion (10 minutes for each). On the second day, the two vocabulary tests were given with a time limit of 30 minutes (20 minutes for VST and 10 minutes for WAT). The time limits for the instruments were fixed based on the results of the pilot. The overall procedure was conducted by the participants' homeroom teachers in their ordinary English lessons.

4.4. Data analysis

To answer the research questions, we first collected data as following: (a) we measured learners' *intrinsic motivation* and *extrinsic motivation* using questionnaires; (b) we measured learners' *memory*, *cognitive,* and *metacognitive strategies* using questionnaires; and (c) we assessed learners' L2 vocabulary knowledge using two vocabulary tests (vocabulary size and depth tests). To ensure enough statistical power, instead of averaging item scores for a composite score, we decided to compute latent variables for these three constructs, such as L2 motivation, L2 vocabulary learning strategies, and L2 vocabulary knowledge. Furthermore, since these constructs were related to each other in both direct and indirect relationships based on complex paths among them (i.e., multiple independent variables and dependent variables in one model at the same time), we decided to simultaneously implement a number of regression analyses. As a combination of computing latent variables and implementing a series of regression analyses at the same time, the SEM using Stata 16 software (StataCorp, 2019) was the primary data analysis method used in the present study. In view of Kline's (2012) suggestion, as well as those of other previous studies (Jin & Lee, 2022; Lee et al., 2020, 2022), we used the following five indices for the SEM analysis: the chi-square test (a testing model should not significantly differ from a saturated model, $p > .05$ for acceptable fit); the root mean square error of approximation (RMSEA < .08 for acceptable fit); the comparative fit index (CFI > .90 for acceptable fit); the Tucker Lewis index (TLI > .90 for acceptable fit); and the standardized root mean square residual (SRMR < .08 for acceptable fit).

5. Results

In this section, we first present the descriptive statistics of the target variables, followed by the results of the SEM.

5.1. Descriptive statistics

Table 2 shows the mean, standard deviation, and normality test results for the observed variables, and Table 3 shows the correlation matrix. The results indicated that all variables included in the SEM models were normally distributed. Furthermore, the observed variables were not strongly correlated (i.e., < .60), with the exception of the correlation between VST and WAT (r = .63, p < .001), and that between memory and metacognitive strategies (r = .69, p < .001).

Table 2 Mean, standard deviation, and normality test results for the observed variables (N = 185)

Variable	*M(SD)*	Shapiro-Wilk normality test
Vocabulary tests		
VST	20.08 (4.14)	passed at 0.1%
WAT	24.63 (4.13)	passed at 5%
Motivation		
IM	2.85 (0.91)	passed at 5%
EM	2.74 (.059)	passed at 5%
VLS		
Memory	2.95 (0.78)	passed at 5%
Cognitive	2.96 (0.84)	passed at 5%
Metacognitive	2.75 (0.76)	passed at 5%

Note. IM = intrinsic motivation, EM = extrinsic motivation, VLS = vocabulary learning strategies, VST = vocabulary size test, WAT = word association test.

Table 3 Correlations among the observed variables

Variable	VST	WAT	IM	EM	Memory	Cognitive	Metacognitive
VST	1.00	-	-	-	-	-	-
WAT	.63***	1.00	-	-	-	-	-
IM	.44***	.43***	1.00	-	-	-	-
EM	.31***	.39***	.48***	1.00	-	-	-
Memory	.52***	.49***	.57***	.46***	1.00	-	-
Cognitive	.33***	.32***	.46***	.29***	.63***	1.00	-
Metacognitive	.40***	.39***	.49***	.36***	.69***	.58***	1.00

Note. IM = intrinsic motivation, EM = extrinsic motivation, VST = vocabulary size test, WAT = word association test; *** p < .001.

Before running the full SEM model in Figure 2, we checked whether all measurement models had been measured by their indicators (variables) to ensure

construct validity. The model comprised three latent variables and seven indicators; no structural relationships were specified between the latent variables. The results indicated that the model had acceptable model fit indices: χ^2 (11) = 7.037 (p > .05), RMSEA < .08, CFI > .90, TLI > .90, and SRMR < .08. Table 4 shows that all standardized factor loadings were statistically significant (p < .001), ranging from .60 to .90; thus, the three latent variables suggested were sufficiently represented by their indicator variables with enough statistical power (Kline, 2012). Furthermore, the computed average variance extracted (AVE; acceptable if ≥.50) and composite construct reliability (CCR; acceptable if ≥ .70) supported the convergent validity of the latent variables (Kline, 2012).

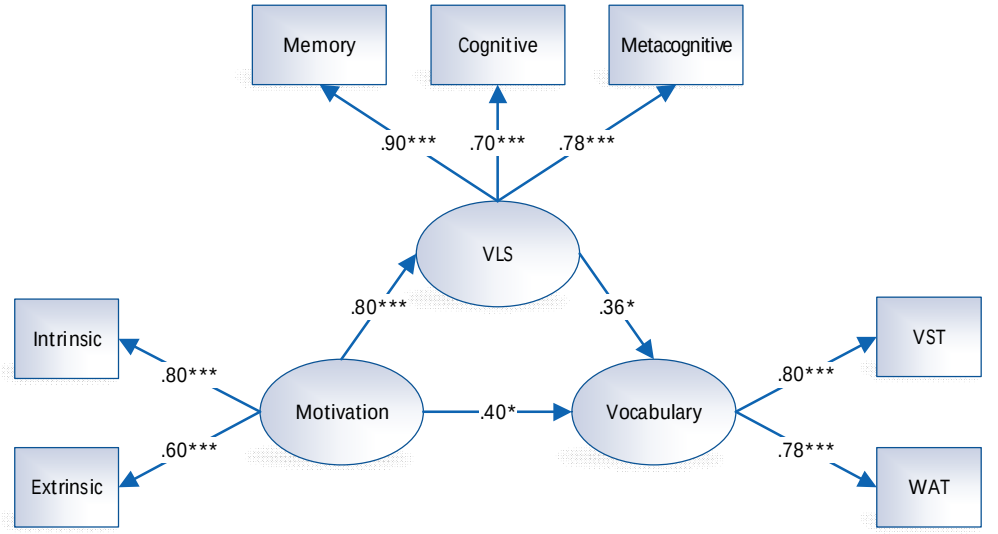

Figure 2 Structural model of the relationship between motivation, vocabulary learning strategies, and vocabulary knowledge (VLS = vocabulary learning strategies, VST = vocabulary size test, WAT = word association test; *p < .05; ***p < .001)

Table 4 Assessment of measurement models

Construct	Indicator	Standardized factor loading	Average variance extracted (AVE)	Composite construct reliability (CCR)
Motivation	IM	.80***	.50	.70
	EM	.60***		
VLS	Memory	.90***	.64	.84
	Cognitive	.70***		
	Metacognitive	.78***		
Vocabulary	VST	.80***	.63	.77
	WAT	.78***		

Note. IM = intrinsic motivation, EM = extrinsic motivation, VLS = vocabulary learning strategies, VST = vocabulary size test, WAT = word association test; *** p < .001.

5.2. Contribution of motivation and learning strategies to vocabulary knowledge

To examine the role of motivation and VLS in L2 vocabulary knowledge, we employed the SEM approach with three models as per Zhang et al. (2017). Figure 2 shows our first model for the role of IM, EM, and VLS. The results indicated that our data had acceptable model fit indices, χ^2 (11) = 7.04 (p > .05), RMSEA < .08, CFI > .90, TLI > .90, SRMR < .08, supporting the first SEM model. IM (β = .80, p < .001) and EM (β = .60, p < .001) significantly loaded on the latent variables of motivation; memory (β = .90, p < .001), cognitive (β = .70, p < .001), and metacognitive strategies (β = .78, p < .001) loaded on the latent variables of VLS; and vocabulary size (β = .80, p < .001) and vocabulary depth (β = .78, p < .001) loaded on the latent variables of vocabulary knowledge. Regarding the relationships between the latent variables, motivation directly influenced VLS (β = .80, p < .001) and vocabulary knowledge (β = .40, p < .05), and VLS directly influenced vocabulary knowledge (β = .36, p < .05).

Table 5 Effects of motivation and VLS on two types of vocabulary knowledge (N = 185)

Path between independent and dependent variables			Beta coefficient (SE)
TOTAL EFFECTS			
Motivation	→	VLS	.80*** (.06)
VLS	→	Vocabulary knowledge	.36* (.18)
Motivation	→	Vocabulary knowledge	.68*** (.07)
DIRECT EFFECTS			
Motivation	→	VLS	.80*** (.06)
VLS	→	Vocabulary knowledge	.36* (.18)
Motivation	→	Vocabulary knowledge	.40* (.18)
INDIRECT EFFECTS			
Motivation	→	Vocabulary knowledge	.29* (.13)

Note. Some total effect values do not add up because of rounding off. VLS = vocabulary learning strategies; *p < .05; ***p < .001.

Table 5 shows the path coefficients of motivation and VLS on vocabulary knowledge to assess whether VLS mediated the association between motivation and vocabulary knowledge. Since we used two vocabulary tests (i.e., VST and WAT), the information in Table 5 helped determine whether motivation and VLS predicted the size and depth of vocabulary knowledge. Motivation had a total effect of .68 (p < .001) on vocabulary knowledge, including a direct effect of .40 (p < .05) and an indirect effect of .29 (p < .05), mediated by VLS. For different dimensions of vocabulary knowledge, no significant difference was found (p > .05).

5.3. Contribution of different types of motivation to vocabulary knowledge

To distinguish the different roles that IM and EM play in the process of vocabulary learning, we employed two additional SEM models, as suggested by Zhang et al.

(2017). Figure 3 presents the second model for the role of IM and VLS in L2 vocabulary knowledge. The results indicated that our data had acceptable model fit indices, χ^2 (7) = 4.85 (p > .05), RMSEA < .08, CFI > .90, TLI > .90, SRMR < .08, supporting the proposed SEM model. Memory (β = .90, p < .001), cognitive (β = .71, p < .001), and metacognitive strategies (β = .78, p < .001) loaded significantly on the latent variable of VLS, and vocabulary size (β = .80, p < .001) and vocabulary depth (β = .78, p < .001) loaded significantly on the latent variable of vocabulary knowledge. IM directly influenced VLS (β = .64, p < .001) and vocabulary knowledge (β = .20, p < .05), and VLS directly influenced vocabulary knowledge (β = .55, p < .001).

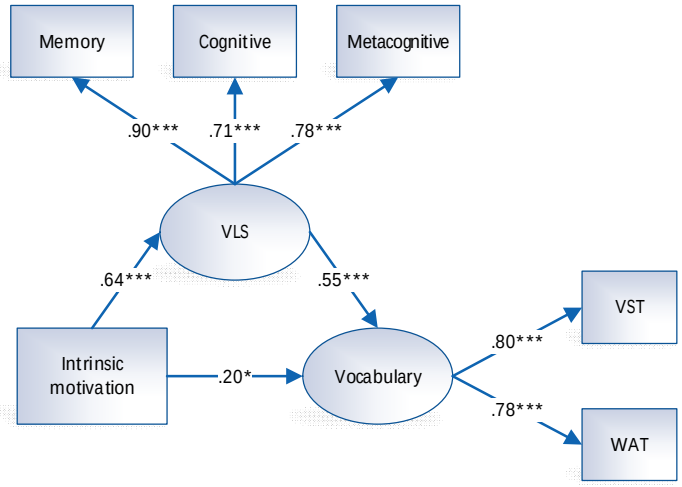

Figure 3 Structural model of the relationship between intrinsic motivation, vocabulary learning strategies, and vocabulary knowledge (VLS = vocabulary learning strategies, VST = vocabulary size test, WAT = word association test; *p < .05; ***p < .001).

Table 6 Effects of intrinsic motivation and VLS on two types of vocabulary knowledge (N = 185)

Path between independent and dependent variables			Beta coefficient (SE)
TOTAL EFFECTS			
IM	→	VLS	.64*** (.05)
VLS	→	Vocabulary knowledge	.55*** (.09)
IM	→	Vocabulary knowledge	.55*** (.06)
DIRECT EFFECTS			
IM	→	VLS	.64*** (.05)
VLS	→	Vocabulary knowledge	.55*** (.06)
IM	→	Vocabulary knowledge	.20* (.09)
INDIRECT EFFECTS			
IM	→	Vocabulary knowledge	.35*** (.07)

Note. Some total effect values do not add up because of rounding off. IM = intrinsic motivation, VLS = vocabulary learning strategies; *p < .05; ***p < .001.

Table 6 shows the path coefficients of IM and VLS on vocabulary knowledge to assess whether VLS mediate the association between the other two. The results indicated that IM had a total effect of .55 (p < .001) on vocabulary knowledge, including a direct effect of .20 (p < .05) and an indirect effect of .35 (p < .001), mediated by VLS.

Figure 4 presents the third model for the role of EM and VLS in L2 vocabulary knowledge. The results indicated that our data had acceptable model fit indices, χ^2 (7) = 5.87 (p > .05), RMSEA < .08, CFI > .90, TLI > .90, SRMR < .08, supporting the proposed SEM model. Memory (β = .91, p < .001), cognitive (β = .70, p < .001), and metacognitive strategies (β = .77, p < .001) loaded significantly on the latent variable of VLS, and vocabulary size (β = .80, p < .001) and vocabulary depth (β = .78, p < .001) loaded significantly on the latent variable of vocabulary knowledge. EM directly influenced VLS (β = .48, p < .001) which in turn directly influenced vocabulary knowledge (β = .62, p < .001). However, no significant direct effect of EM on vocabulary knowledge was found (β = .11, p > .05).

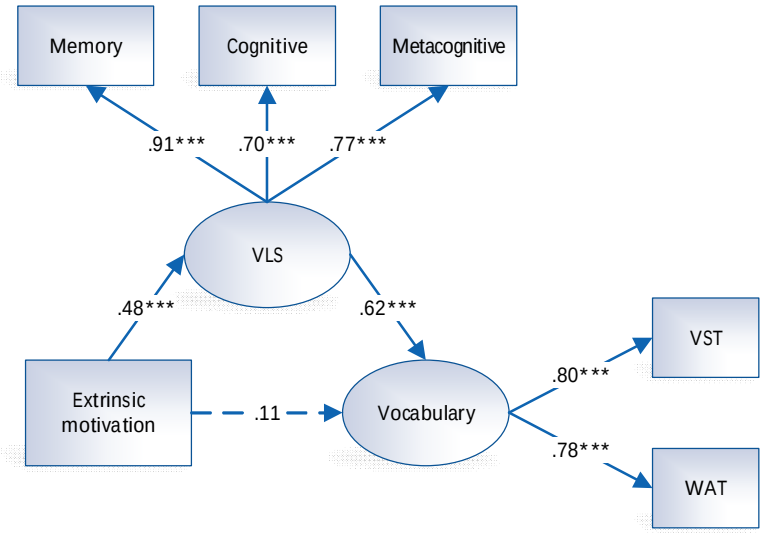

Figure 4 Structural model of the relationship between extrinsic motivation, vocabulary learning strategies, and vocabulary knowledge (VLS = vocabulary learning strategies, VST = vocabulary size test, WAT = word association test; ***p < .001).

Table 7 shows the path coefficients of EM and VLS on vocabulary knowledge to assess whether VLS mediate the association between EM and vocabulary knowledge. The results indicated that EM had a total effect of .41 (p < .001) on

vocabulary knowledge, including an insignificant direct effect of .11 ($p > .05$) and a significant indirect effect of .30 ($p < .001$), mediated by VLS.

Table 7 Effects of extrinsic motivation and VLS on two types of vocabulary knowledge ($N = 185$)

Path between independent and dependent variables			Beta coefficient (SE)
TOTAL EFFECTS			
EM	→	VLS	.48*** (.06)
VLS	→	Vocabulary knowledge	.62*** (.07)
EM	→	Vocabulary knowledge	.41*** (.07)
DIRECT EFFECTS			
EM	→	VLS	.48*** (.06)
VLS	→	Vocabulary knowledge	.62*** (.07)
EM	→	Vocabulary knowledge	.11 (.08)
INDIRECT EFFECTS			
EM	→	Vocabulary knowledge	.30*** (.05)

Note. Some total effect values do not add up because of rounding off. EM = extrinsic motivation, VLS = vocabulary learning strategies; ***$p < .001$.

6. Discussion

This section aims to discuss the findings of the present study in light of the research questions stated above, as well as relevant previous studies. The first research question concerned whether motivation and VLS predict L2 vocabulary size and depth. The result of our structural model revealed that motivation was a significant moderator for both components of vocabulary knowledge, which is in line with Tseng and Schmitt's (2008) proposition that motivational constructs are essential elements for the development of L2 vocabulary knowledge. The employment of the SEM further revealed that motivation predicted the L2 vocabulary knowledge both directly and indirectly, in the latter case through the mediation of VLS. That is, motivation may have played an important role in L2 vocabulary knowledge by encouraging learners to harness a range of VLS (Lee, 2020). One possible explanation for this finding is that motivated learners may engage in their learning processes more actively and voluntarily, by searching for and employing available resources at their disposal (Lou & Noels, 2019; Zimmerman, 2002), that is, VLS in this context. At the same time, it may also be possible to attribute the mixed findings related to the relationship between motivation and L2 vocabulary knowledge found in previous studies (e.g., Canga Alonso & Fontecha, 2014; Fontecha & Gallego, 2012) to the fact that the indirect effect of motivation on L2 vocabulary knowledge via VLS was not considered in them.

Along with motivation, VLS was also found to predict both components of L2 vocabulary knowledge. This finding is consistent with previous studies on the relationships between VLS and L2 vocabulary knowledge (e.g., Fan, 2020; Gu &

Johnson, 1996; Zhang & Lu, 2015). However, unlike these studies, we did not observe a pattern of any particular group of strategies (e.g., metacognitive, cognitive) being associated with L2 vocabulary knowledge to a much greater extent than another. Indeed, the examination of the descriptive statistics related to VLS further revealed that the participants in the present study were not strongly oriented toward using a particular category of VLS (as found in Table 2). Although the lack of qualitative instruments makes it difficult to offer any definite explanation for this finding, it can be suggested that the participants of the present study had relatively limited experience of L2 learning compared to undergraduate L2 learners (e.g., Fan, 2020; Lee, 2020; Zhang & Lu, 2015), and may not have yet determined which type of strategy works best for their vocabulary learning.

The second research question addressed whether different types of motivation would function differently with VLS and L2 vocabulary knowledge. It was found that EM only indirectly predicted L2 vocabulary knowledge via VLS, corresponding to the results of Zhang et al. (2017). This indicated that EM could still push EFL learners in both Zhang et al.'s (2017) study and the present study to employ VLS to expand their English vocabulary knowledge; however, it was not powerful enough to predict their vocabulary knowledge directly. By contrast, IM predicted both VLS and L2 vocabulary knowledge directly, in accordance with the idea that IM is a powerful mechanism that drives participants' L2 learning (Noels et al., 2001; Tseng & Schmitt, 2008). It also appears consistent with the proposition of the SRL framework (Zimmerman, 2002), meaning that intrinsically motivated learners (who would also be self-regulated ones) would take greater responsibility for their learning and use a range of resources (e.g., learning strategies) to further their knowledge during their learning process.

The results related to the second research question can serve as a basis for pedagogical implications, specifically for L2 teachers, who should consider the findings regarding the positive role of IM in L2 learning. It has been previously suggested that L2 teachers' efforts such as offering "a predictable learning environment, moderately challenging tasks, necessary instructional support, and evaluation that emphasizes self-improvement" may lead to increased IM (Wu, 2003, p. 513). The importance of VLS in L2 vocabulary learning is undisputable in view of the results of the present study and previous research. L2 teachers should thus provide VLS training to learners by introducing the list of available VLS, explaining their value, and demonstrating how to employ each strategy in specific learning situations. Such efforts could enhance L2 learners' vocabulary learning at different stages. For example, learners will be able to use a wider spectrum of strategies when a new L2 word crops up, by guessing its meaning from its structure or sentential context. Additionally, they may draw on multiple strategies to store them

in their long-term memory by, for example, studying L2 words with peers, associating them with familiar pictures or morphologically similar words, and recycling previously learned words with materials such as vocabulary notebooks.

A few limitations of the present study are worth mentioning. First, we did not administer qualitative instruments, such as participant interviews or classroom observations, which would have provided a richer account of the results related to our SEM model. Second, the test of vocabulary depth (i.e., WAT) was not administered in its full scale; rather, it was tailored to the participants' English proficiency levels for a logistical reason. Although we believe that our decision would not have biased the results as the excluded test items were too difficult for the participants (i.e., no discriminatory power), a full scale test should be conducted in future studies, if possible, for greater accuracy.

7. Conclusions

The present study explored the relationships between language learning motivation, VLS, and two components of L2 vocabulary knowledge (i.e., vocabulary size and depth) within the framework of SRL, by employing the SEM as the primary data analysis method. Our results revealed that motivation directly predicted VLS and L2 vocabulary knowledge and indirectly predicted L2 vocabulary knowledge via VLS. However, of the two types of motivation, IM was a better predictor than EM for the use of VLS and L2 vocabulary knowledge.

We suggest the following considerations for future research. First, L2 vocabulary knowledge must be more comprehensively operationalized, and more L2 vocabulary tests should be used to measure different aspects of L2 vocabulary knowledge. Nation's (2013) framework of L2 vocabulary knowledge, which is based on form, meaning, and use, could be utilized. Second, future studies should consider other cognition-related variables (e.g., aptitude, working memory) and their relation to VLS and motivation in influencing the level of L2 vocabulary knowledge. Lastly, future research on this issue could test the proposed structural model with a more diverse learner population, including students in ESL environments in which participant characteristics may differ from those sampled in the present study.

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