

Modeling Individual Differences in Breadth and Depth of L2 Vocabulary Knowledge Development: A SEM Approach

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This study investigates how aptitude, motivation, strategy use, and language processing experience operate in tandem to contribute to breadth and depth of L2 vocabulary knowledge development. Participants included 141 Korean EFL learners in university English courses. The learners completed the Korean version of the Modern Language Aptitude Test, the Attitude/Motivation Test Battery, the Vocabulary Learning Strategies Survey, and a background questionnaire. Vocabulary breadth and depth were measured by the Vocabulary Level Test and the Word Associates Test, respectively. Data were analyzed using structural equation modeling (SEM). The results revealed support for the following model: (a) aptitude positively influenced vocabulary breadth development; (b) motivation positively influenced vocabulary depth development through the mediation of language processing experience; and (c) motivation positively influenced strategy use, but strategy use did not significantly influence vocabulary acquisition. By considering the combined effects of cognitive and motivational factors, this study expands upon previous research conducted with a single focus on individual differences in lexical development. The results also shed light on the role of motivation, which has received inadequate attention in the literature on L2 vocabulary development. The implications of these findings also are discussed in relation to L2 vocabulary instruction.

[individual differences/L2 vocabulary breadth and depth/SEM/
개인적 차이/어휘 지식의 넓이와 깊이/구조방정식 모형]

I. INTRODUCTION

Vocabulary knowledge and its acquisition play a critical role in second language (L2) development (Nation, 2001; Schmitt, 2008). As a result, L2 researchers have sought to identify the factors influencing successful L2 vocabulary acquisition. Several studies have focused on individual difference (ID) variables based on previous findings that ID factors produce substantial differences in L2 attainment (Dörnyei, 2005). Among the various ID variables, researchers have considered aptitude and motivation to be primary cognitive and affective factors in L2 development (Dörnyei, 2005). In addition to these key determinants, strategy use plays an important role in L2 acquisition because learners' active participation in the learning process through strategy use enhances the effectiveness of their L2 learning (e.g., J. Kim, 2011, S. Lee, 2007). L2 language also develops through engaging in the language processing experience, such as reading, writing, listening, and speaking; thus, experience with the L2 is a significant factor in its acquisition (e.g., Pulido, 2009).

Speculating that these IDs would also affect L2 vocabulary learning, researchers have examined the roles of IDs in L2 lexical development: aptitude (e.g., Dahlen & Caldwell-Harris, 2013), motivation (e.g., Mori & Calder, 2015), strategy use (e.g., Zhang & Lu, 2015), and language processing experience (e.g., Pulido, 2009). These studies have added to our understanding of each ID factors involved in vocabulary learning. However, to date, there exists scant research examining how these critical factors work together simultaneously in L2 vocabulary achievement. Furthermore, although vocabulary development involves expanding both the breadth and depth of vocabulary knowledge, previous studies mostly have focused on single-factor impacts vis-à-vis vocabulary breadth. Considering this research gap, the present study seeks to provide a more comprehensive model delineating the overall pattern of interrelationships between the multiple ID factors involved in vocabulary learning, thereby advancing our understanding of the joint influence of these ID factors on breadth and depth of L2 vocabulary knowledge development.

Drawing upon Laufer and Hulstijn's (2001) theory that both cognitive and motivational components play pivotal roles in L2 vocabulary learning, this study considers aptitude and motivation to be major cognitive and motivational IDs in the mechanisms underlying L2 vocabulary acquisition. This study also hypothesizes that learners' different levels of strategy use and varying amounts of L2 processing experience constitute mediating ID variables that lead to achievement variations in L2 lexical development (e.g., Pulido & Hambrick 2008; Zhang, Lin, D. Zhang, & Y. Choi, 2016). The current multi-componential model encompassing important and varied IDs is expected to offer pedagogical insights into how ID factors directly and indirectly influence the breadth and depth of L2 vocabulary knowledge development, thereby providing language educators with valuable information on how best to assist individual learners' successful L2 lexical acquisition. Based on these introductory

remarks, the following section discusses relevant empirical findings in the existing literature regarding the influences of ID variables on L2 vocabulary learning.

II. REVIEW OF THE RESEARCH

1. Breadth and Depth of Vocabulary Knowledge

The construct of vocabulary knowledge is multidimensional and quite complex (Read, 2000). However, it has generally been conceptualized in terms of vocabulary breadth and vocabulary depth (e.g., Read, 2004). Breadth of vocabulary refers to the number of words that one knows with respect to the form-meaning connection, whereas depth of vocabulary knowledge refers to how well one knows a word (Anderson & Freebody, 1981). While defining vocabulary breadth is relatively straightforward, conceptualizing depth of vocabulary knowledge remains rather complicated. Nation's (2001) word knowledge specification is widely considered the best description of depth of vocabulary knowledge (Schmitt, 2008), reflecting three different dimensions of lexical knowledge, with both receptive and productive aspects: form (spoken form, written form, and word parts), meaning (form and meaning, concept and referents, and associations), and use (grammatical functions, collocations, and constraints on use). In terms of vocabulary development, both breadth and depth are fundamental components enabling lexical items' receptive and productive use. Learners must acquire a large vocabulary to perform effectively in English: 8,000–9,000 word families for reading and 5,000–7,000 families for oral discourse (Schmitt, 2008). Meanwhile, in order to use lexical items appropriately, learners need to acquire depth in their vocabulary knowledge, including collocations. In this sense, depth means going beyond simply “knowing” the form and meaning of a word.

2. Aptitude in L2 Vocabulary Learning

Researchers consider L2 aptitude to be one of the best predictors of L2 attainment (Skehan, 1989). Robinson (2005) defines aptitude as the “strengths individual learners have—relative to their population—in the cognitive abilities information processing draws on during L2 learning and performance in various contexts and at different stages” (p. 46). At the same time, researchers have suggested that aptitude is interrelated with other ID factors in the process of L2 development. For example, Dörnyei (2010) and Sparks and Ganschow (2001) have suggested that aptitude and motivation interact. Oxford (1990b) and Winke (2013) also note a relationship between aptitude and strategy use, reporting that the effect of aptitude on L2 learning is mediated by strategy use.

Thus far, research has yielded strong correlations between L2 aptitude and L2 achievement (e.g., Hummel, 2009; Sparks, Patton, Ganschow, & Humbach, 2012). A handful of studies indicate a significant association between L2 aptitude and L2 vocabulary learning. For example, Harley and Hart (1997) and Dahlen and Caldwell-Harris (2013) have reported that participants with high L2 aptitude scores recalled and recognized significantly more words than those with lower L2 aptitude scores, suggesting that L2 aptitude impacts L2 vocabulary breadth. Granena and Long (2012) as well as Lundell and Sandgren (2013) also found a strong correlation between L2 aptitude and L2 collocation acquisition. These studies suggest that L2 aptitude is predictive of L2 vocabulary learning, both for initial and more advanced types of L2 word knowledge. Interestingly, research remains scant regarding how aptitude, mediated by strategy use, may assist in developing breadth and depth in L2 lexical knowledge—despite research hinting at this possibility (e.g., Oxford, 1990b; Winke, 2013).

3. Motivation in L2 Vocabulary Learning

Motivation is another major ID variable that significantly affects L2 acquisition (Dörnyei, 2005). Considerable research has demonstrated that motivation is a critical determinant of successful language learning (e.g., Gardner, Lalonde, & Moorcroft, 1985; Gardner & MacIntyre, 1991). For example, Kormos and Csizér (2014) assert that motivation promotes proactive seeking of learning opportunities, which in turn, contributes to L2 achievement. MacIntyre and Noels (1996) and Schmidt and Watanabe (2001) have reported that more motivated learners use learning strategies more often, while Kormos and Csizér (2014) add that motivation exerts a considerable influence on L2 learning through the mediation of strategy use. However, Gardner, Tremblay and Masgoret (1997) have reported contrasting findings. In their study, motivation directly explained a large proportion of strategy use (23%), but the higher frequency of strategy use resulted in lower level of L2 proficiency. This finding suggests that more frequent use of language learning strategies does not necessarily lead to higher L2 achievement.

Despite a large body of research indicating a positive relationship between motivation and L2 learning, studies focusing specifically on motivation and vocabulary acquisition have yielded mixed results. For example, Fontecha and Gallego (2012) obtained a significant positive relationship between the level of motivation and receptive L2 vocabulary size for 9th grade students, but not for 8th grade pupils. Mori and Calder (2015) also reported a positive correlation between receptive L2 vocabulary scores and one of their six motivation factors (i.e., positive perceptions toward different languages and cultures); however, they found no positive correlation with the other five motivation factors (e.g., career orientation). More recently, Zhang et al. (2016) found that intrinsic

motivation—but not extrinsic motivation—had a significantly positive effect on vocabulary size. They also revealed that the effects of motivation on vocabulary size were partially mediated by strategy use. These studies suggest that the effect of motivation on vocabulary breadth has been inconsistent. Meanwhile, there is a lack of research into the role of motivation in developing depth of vocabulary knowledge. Also, there is scant research regarding how strategy use mediates the effect of motivation on depth of vocabulary knowledge. These gaps point to an area for further investigation into the role of motivation and the mediation of strategy use in the breadth and depth of L2 vocabulary knowledge development.

4. Strategy Use in L2 Vocabulary Learning

Oxford (1999) defines language learning strategies as “specific actions, behaviors, steps, or techniques that students use to improve their own progress in developing skills in a second or foreign language. These strategies can facilitate the internalization, storage, retrieval, or use of the new language” (p. 518). Research has indicated that learners reach higher L2 attainment not only through a high degree of language aptitude and motivation but also through their own active participation in the learning process (e.g., Kormos & Csizér, 2014; Oxford, 1989). However, Ehrman and Oxford (1995) obtained contrasting results with no significant correlation between strategies and L2 proficiency; similarly, Gardner et al. (1997) demonstrated that high levels of L2 achievement are not necessarily preceded by frequent strategy use.

With regard to the relationship between strategy use and L2 vocabulary learning, several studies (e.g., Y. Gu & Johnson, 1996; S. Lee, 2007) have found a positive relationship between strategy use and vocabulary size. Including measures of vocabulary depth, Zhang and Lu (2015) also have reported that strategies to learn word forms and associations are significant predictors of both breadth and depth of vocabulary knowledge. On the other hand, Tseng and Schmitt (2008) found that frequent use of strategies failed to positively influence L2 lexical acquisition. These mixed findings warrant further investigation regarding the role of strategy use in L2 vocabulary learning.

5. Language Processing Experience in L2 Vocabulary Learning

Language acquisition requires exposure to language and takes place when learners are involved in processing language through reading, listening, speaking, and writing. Numerous studies have demonstrated L2 exposure strongly contributing to L2 vocabulary acquisition, suggesting that learners’ frequency of exposure to L2 is a significant individual factor leading to achievement differences in L2 word learning (e.g., Rott, 1999; Webb,

2007). Among the various language modalities, several studies have found reading to be the primary mode of vocabulary development (e.g., Krashen, 1989; Pigada & Schmitt, 2006). For example, Ellis (2002) and Krashen (1989) reported that the amount and frequency of reading, over time, both in and out of school (i.e., exposure to print), was a critical determinant of vocabulary knowledge development. In more recent investigations, Elgort and Warren (2014) and McQuillan (2006) obtained comparable results, suggesting that print exposure and frequency of student reading are key contributing factors in shaping L2 vocabulary knowledge.

In addition to reading, listening has been studied as another type of linguistic input for incidental vocabulary learning. For example, Vidal (2003) found that listening to academic lectures in EFL contexts can be a source of L2 vocabulary acquisition, and frequency of word occurrence in lectures accounted for 11 percent of the variance in vocabulary gain and retention. In a subsequent study, Vidal (2011) further found that vocabulary knowledge gained from listening was retained better than that from reading. Employing a dimension approach, van Zeeland and Schmitt (2013) revealed significantly higher vocabulary uptake of word form and word class from listening compared to that of word meaning. Gains in word form, word class, and word meaning were also positively affected by their frequency of occurrence in the input, suggesting that more exposure to listening is beneficial in accruing lexical knowledge from a partial to full range.

Along with listening, speaking—i.e., engaging in interaction with L2 speakers—also offers language exposure and practice opportunities that foster L2 vocabulary skills. Through growth analyses, Rydland, Grover, and Lawrence (2014) revealed that the amount and the diversity of talk exposure through interaction with teacher and peers were strong predictors of L2 learners' vocabulary knowledge. Similarly, Palermo et al. (2014) obtained a positive association between L2 talk exposure from peers and family members and learners' receptive and productive L2 vocabulary skills.

As another type of productive mode, writing also provides opportunities for extending and consolidating students' L2 vocabulary. For example, Webb (2005) reported that writing tasks were more effective than reading tasks in acquiring five aspects of vocabulary knowledge—orthography, syntax, association, grammatical functions, and meaning and form—on both receptive and productive measures. The researcher also found the productive task (i.e., writing) to be more effective in promoting productive vocabulary knowledge than the receptive task (i.e., reading). Pichette, de Serres, and Lafontaine (2012) and Zou (2017) reported similar results, explaining that writing necessitates deeper processing of new words, consequently leading to higher recall of items. In addition to gain and retention of new words, Muncie (2003) found that writing stimulated more advanced and sophisticated use of L2 vocabulary. Overall, numerous studies illustrate that greater exposure to L2 leads to higher L2 word gains. As such, it appears that L2 processing

experiences via reading, listening, writing, and speaking play a beneficial role in breadth of L2 vocabulary knowledge development; however, research remains scarce when it comes to how such exposures influence depth of L2 vocabulary knowledge.

In summary, the literature demonstrates that previous studies mostly have focused on the effects of a single ID variable on vocabulary breadth or depth. However, scant attention has been given to overarching interrelationships between various ID factors (aptitude, motivation, strategy use, and language processing experience), particularly in terms of how they directly and indirectly influence the development of breadth and depth of L2 lexical knowledge. Thus, the following research questions emerge:

- 1) How are aptitude, motivation, strategy use, and language processing experiences related to breadth and depth of L2 vocabulary knowledge development?
- 2) What pedagogical implications do the findings offer for L2 vocabulary teaching and learning?

III. METHOD

1. Participants

One hundred and forty-one adult EFL learners participated in the study. Participants included 99 males and 42 females. They were freshmen students recruited from compulsory academic English writing classes within the natural sciences and engineering schools of a Korean university. The participants represented a wide range of L2 proficiency, as measured by the reading section of the Michigan Test of English Language Proficiency (University of Michigan, 2010), a standardized test designed to assess international students' English proficiency (Cronbach's $\alpha = .92$). Total scores ranged from 25 to 100 ($M = 63.72$, $SD = 18.66$). None of the participants in this study had experience studying and living abroad.

2. Materials

1) Modern Language Aptitude Test

The Modern Language Aptitude Test (MLAT) (Carroll & Sapon, 1959) is the most widely used and researched L2 aptitude test. In this study, a Korean version of MLAT, previously validated with 1,080 Korean EFL learners (P. Chung, 1987), was used to assess L2 aptitude (Cronbach's $\alpha = .93$). Consisting of 119 items, this test measures the following

skills: (1) phonetic/phonemic coding ability, which refers to the ability to form and retain associations between sounds and symbols; (2) grammatical sensitivity, or the ability to recognize the grammatical functions of words in the context of sentences; and (3) rote memory, defined as the ability to make rapid and efficient associations between lexical forms and meanings and retain them (Carroll, 1981). For information regarding the test and their specific tasks, see the Language Learning and Testing Foundation's Website.

2) Attitude/Motivation Test Battery

Learners' L2 motivation was measured via items selected from the Attitude/Motivation Test Battery (AMTB) (Gardner, 1985). This test has been validated as a reliable and valid instrument for assessing motivation (e.g., Gardner & MacIntyre, 1993). Three subtests assessed learners' attitudes toward learning the language, their desire to learn it, and motivational intensity. Attitude, desire, and intensity were measured by 8, 8, and 6 items using a 6-point rating scale (1 – not at all true of me, 6 – very true of me). The reliability of the subtests for attitude, desire, and intensity was .88, .87, and .70, respectively (Cronbach's α).

3) Vocabulary Learning Strategies Survey

The Vocabulary Learning Strategies Survey (VLSS) gauged learners' use of vocabulary learning strategies (Schmitt, 1997). Following Oxford's (1990a) taxonomies of language learning strategies, the survey included cognitive, metacognitive, memory, and social strategies. Cognitive strategies were measured by 12 items, metacognitive strategies by 5 items, memory strategies by 17 items, and social strategies by 4 items. Participants were instructed to indicate the extent to which they used each strategy item on a scale of 1 (not at all true of me) to 6 (very true of me). The reliability of the subtest for cognitive, metacognitive, memory, and social was .71, .69, .88, and .70, respectively.

4) Language Processing Experience

Language processing experience was measured by four questions in a background questionnaire. Participants were asked to estimate the amount of time (hours per week) that they spent reading, listening, speaking, and writing in English. Similar questionnaires have been used in previous L2 research (e.g., Dewey, 2004; Freed, Dewey, Segalowitz, & Halter, 2004).

5) Vocabulary Level Test as a Measure of Vocabulary Breadth

The Vocabulary Level Test (VLT) (Schmitt, Schmitt, & Clapham, 2001) was used to measure learners' breadth of vocabulary knowledge. This test is the most widely used of its kind in terms of assessing L2 vocabulary size (Schmitt, 2010). The VLT consists of five sections, each testing the learner's receptive knowledge of 30 target words from five different frequency levels: the 2,000 level, the 3,000 level, the 5,000 level, the 10,000 level, and the academic level. This test (Figure 1) required the participants to match target words with the corresponding definition. Each correct answer was scored as one point, with maximum score of 150 points (Cronbach's $\alpha = .93$).

You must choose the right word to go with each meaning. Write the number of that word next to its meaning.	
1 decent	
2 frail	_____ weak
3 harsh	_____ concerning a city
4 incredible	_____ difficult to believe
5 municipal	
6 specific	

FIGURE 1 The Vocabulary Level Test

6) Word Associates Test (WAT) as a Measure of Vocabulary Depth

The Word Associates Test (WAT) (Read, 1998) was used to measure learners' depth of vocabulary knowledge. This test was devised to assess learners' depth of receptive vocabulary knowledge in terms of synonymy, polysemy, and collocation. The WAT (Figure 2) contains 40 items, each one comprised of a single stimulus word and two columns, containing four words apiece. Among these eight words, four are associates (i.e., related words) to the stimulus word and the other four are distractors. The left column contains either synonyms of the stimulus word (i.e., testing synonymy) or words that represent one aspect of its various meanings (i.e., testing polysemy). The right column contains four nouns, among which one can collocate with the stimulus word (i.e., testing collocation). This test required the participants to circle the words that are relevant to the stimulus word. The response for each option (i.e., circled or not) was scored separately, and each correct response was given one point. Even though an option was not circled, it was possible to obtain one point if the response of not circling was correct. However,

participants who gave no response for a complete test item did not earn a point. The maximum score was eight points for each test item and 320 points for the entire test (Cronbach's $\alpha = .91$).

Sudden							
beautiful	thirsty	surprising	quick	doctor	change	noise	school

FIGURE 2 The Word Associates Test

3. Procedures

This study was conducted in three sessions over a period of three weeks. During Session 1, participants completed the Vocabulary Level Test and Word Associates Test. A week later during Session 2, they completed a background questionnaire, the Attitude/Motivation Test Battery, and the Vocabulary Learning Strategies Survey. One week later during Session 3, participants completed the Korean version of the Modern Language Aptitude Test. Each task was completed within 30 minutes, and participants were provided an honorarium for their time.

4. Analysis

1) The Hypothesized Model

To investigate the interrelationships between ID factors involved in vocabulary learning, this study proposed a structural model that was grounded in prior research (Figure 3). Drawing on Laufer and Hulstijn's (2001) theory that both cognitive and motivational components play pivotal roles in L2 vocabulary learning, this model included aptitude and motivation as major cognitive and motivational IDs that could affect L2 vocabulary knowledge development (i.e., breadth and depth) both directly and indirectly. Based on the research of Dahlen and Caldwell-Harris (2013) and Granena and Long (2012), aptitude was hypothesized to have a direct effect on vocabulary breadth and depth development. Also predicted were direct links between motivation and vocabulary acquisition (breadth and depth) in light of findings by Fontecha and Gallego (2012) and Mori and Calder (2015). This model also hypothesized that indirect effects emerge from the mediation of learners' different levels of strategy use and varying amounts of L2 processing experience. Drawing on Oxford (1990b) and Winke (2013), it was hypothesized that strategy use would mediate the effect of aptitude on vocabulary breadth and depth development. Based on Zhang et al. (2016), it was expected that strategy use would mediate the effect of

motivation on vocabulary breadth and depth. Guided by research from Kormos and Csizér (2014), it was posited that language processing experience would mediate the effect of motivation on vocabulary breadth and depth. Finally, following Dörnyei (2010) and Sparks and Ganschow (2001), a correlation between aptitude and motivation was hypothesized.

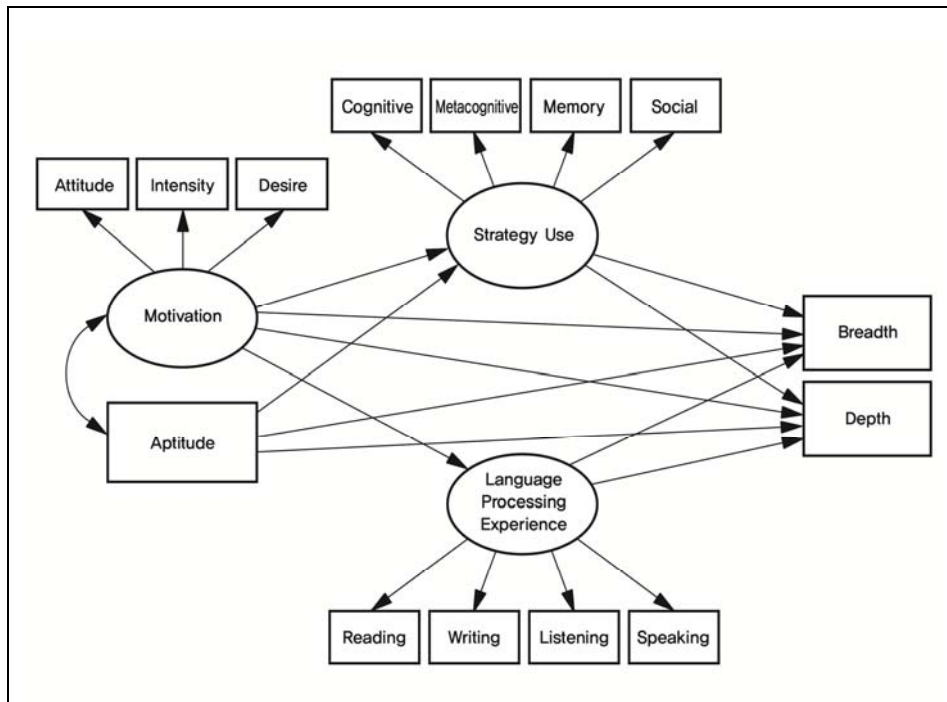


FIGURE 3 Hypothesized Model

2) Structural Equation Modeling (SEM) Approach

To answer the research questions, this study utilized SEM, a multivariate statistical analysis that reveals the complex relationships among observed and/or latent variables. Latent variable SEM is the best choice for the current analysis because it allows researchers to simultaneously perform a confirmatory factor analysis of the measured variables to arrive at the latent variables of true interest, along with a path analysis of the direct and indirect effects of the latent variables on each other. In so doing, the latent variable SEM removes the effects of measurement error when estimating the effect of one variable on another, thereby providing more accurate explanations regarding how variables are causally related in the model. In this SEM analysis, the data and descriptive statistics were managed using SPSS 21, and SEM was performed using AMOS 21.

IV. RESULTS

1. Descriptive Statistics

Table 1 displays the descriptive statistics for independent (aptitude, motivation, strategy use, and language processing experience) and dependent (breadth and depth of L2 vocabulary knowledge) variables. The sample correlation matrix is presented in Appendix. The various measures showed mostly high reliabilities, ranging from .69 to .93 (Cronbach's α). All of the variables approached normal distribution, except the estimates of language processing experience, which tended to be positively skewed (> 2) and kurtosed (> 7) (Curran, West, & Finch, 1996). To address this issue, the researcher employed bias-corrected bootstrapping procedures using 1,000 bootstrapped samples, testing the relationships between the six factors.

TABLE 1
Descriptive Statistics

		Items	Pts	<i>M</i>	<i>SD</i>	α	
IV	Aptitude	119	119	83.72	10.43	.93	
	Motivation	Attitude	8	48	36.18	6.01	.88
		Intensity	6	36	22.40	4.14	.70
		Desire	8	48	38.18	6.30	.87
	Strategy use	Cognitive	12	72	44.18	6.65	.71
		Metacognitive	5	30	18.09	4.23	.69
		Memory	18	108	64.97	12.60	.88
		Social	4	24	12.45	3.82	.70
	Language processing experience	Reading (hours/week)	1	-	.82	.73	-
		Writing (hours/week)	1	-	.60	.38	-
		Listening (hours/week)	1	-	1.17	1.58	-
		Speaking (hours/week)	1	-	.59	.43	-
DV	Breadth	150	150	105.48	18.09	.93	
	Depth	320	320	234.14	16.67	.91	

Note. IV = independent variables; DV = dependent variables; Items = number of items on measure; Pts = number of points possible; α = reliability coefficient Cronbach's alpha.

2. The Structural Equation Model

Figure 4 illustrates the structural equation model, with the resulting standardized regression coefficients. The model shows the relationships between IDs and the breadth and depth of L2 vocabulary knowledge development. In the model, independent variables include three latent variables (motivation, strategy use, language processing experience, represented with ovals) and one measured variable (aptitude, represented with a rectangle). Dependent variables include two measured variables, breadth and depth of L2 vocabulary knowledge. The model's direct effects are shown as single directional arrows and correlations are shown as bidirectional ones. Table 2 provides model fit indices and model evaluation. The results suggest a good fit of the proposed model to the observed data, allowing for safe interpretation of the regression coefficients in the model.

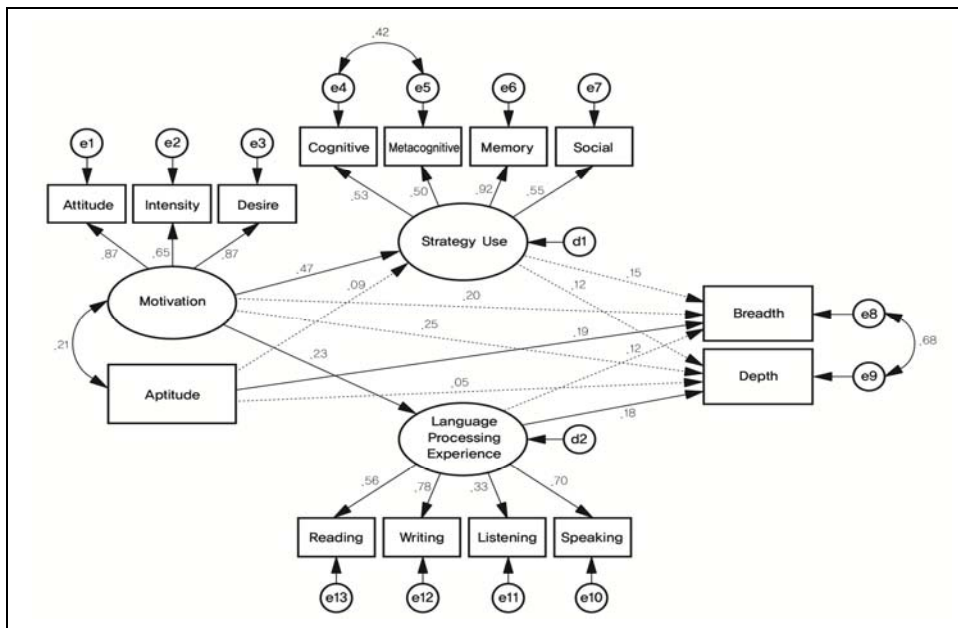


FIGURE 4 The Structural Equation Model

TABLE 2
Fit Indices of the Structural Equation Model

	χ^2 / df	GFI	CFI	TLI	SRMR	RMSEA
Accepted Level	≤ 3.00	$\geq .90$	$\geq .90$	$\geq .90$	$\leq .08$	$\leq .08$
The Model	1.71	.91	.93	.90	.07	.07

In Figure 4, solid lines indicate significant paths, while dotted lines indicate insignificant paths. As shown in Figure 4 and Table 3, the direct effect of aptitude on L2 vocabulary breadth was significant ($\beta = .19$), with bias-corrected 95% confidence intervals ranging from .09 to .67. Motivation had a significant effect on strategy use ($\beta = .47$), with bias-corrected 95% confidence intervals ranging from .11 to .64. Motivation also had a significant effect on language processing experience ($\beta = .23$), with bias-corrected 95% confidence intervals ranging from .01 to .04. Language processing experience had a significant effect on vocabulary depth ($\beta = .18$), with bias-corrected 95% confidence intervals ranging from .28 to 18.47. The indirect effect of motivation on vocabulary depth through the mediation of language processing experience was tested by bootstrapping procedures (Chan, 2007). The effect was found to be significant ($\beta = .04$), with bias-corrected 95% confidence intervals ranging from .02 to .38. In other words, motivation indirectly affected depth of vocabulary knowledge development through language experience. None of the other paths were found to be statistically significant.

TABLE 3
Path Coefficients of Individual Difference Variables on L2 Vocabulary Knowledge

	Unstandardized		Standardized	
	<i>B</i>	Bias-corrected		β
		Bootstrap 95% CI		
		Lower	Upper	
Aptitude → Strategy use	.03	-.03	.10	.09
Aptitude → Breadth	.33*	.09	.67	.19
Aptitude → Depth	.08	-.13	.37	.05
Motivation → Strategy use	.31*	.11	.64	.47
Motivation → Breadth	.69	-.48	1.50	.20
Motivation → Depth	.79	-.06	1.58	.25
Motivation → Language experience	.02*	.01	.04	.23
Strategy Use → Breadth	.79	-.55	3.16	.15
Strategy Use → Depth	.57	-.52	2.25	.12
Language Experience → Breadth	5.39	-4.99	13.72	.12
Language Experience → Depth	7.43*	.28	18.47	.18

V. DISCUSSION

This study has aimed to investigate how various ID factors operate in tandem to contribute to L2 vocabulary development. It therefore tested how aptitude, motivation, strategy use, and language processing experience are related to the development of breadth and depth of L2 vocabulary knowledge. The present study yielded three major findings: (1) aptitude positively influenced vocabulary breadth development, (2) motivation positively influenced vocabulary depth development through the mediation of the language processing experience, and (3) motivation positively influenced strategy use, but strategy use did not significantly influence vocabulary acquisition.

The results revealed that aptitude had a significant direct effect on L2 vocabulary breadth. This finding confirms previous research indicating a close link between aptitude and L2 vocabulary learning (e.g., Harley & Hart, 1997). As Dahlen and Caldwell-Harris (2013) suggest, phonetic/phonemic coding ability—the ability to form and retain associations between sounds and symbols—is assumed to have assisted the acquisition of the phonological and orthographic systems of the L2 vocabulary. Also, rote learning ability—the ability to make rapid and efficient associations between lexical forms and meanings and retain them—may have facilitated form-meaning connections of new words, in turn contributing to L2 vocabulary breadth.

More importantly, the SEM results revealed that motivation had a significant indirect effect on L2 vocabulary depth through language processing experience, providing insight into the relationship between motivation and L2 vocabulary learning. This finding corroborates Kormos and Csizér's (2014) report that motivation promotes learners' active seeking of learning opportunities, which in turn, facilitates L2 achievement. Indeed, the results of this study illustrate that motivation is strongly associated with students' engagement in reading, listening, speaking, and writing activities, thereby promoting depth of L2 vocabulary knowledge, such as collocations and associations. Depth of vocabulary knowledge can be acquired and enhanced through extensive exposure to the L2, which entails a long-term language learning process. Motivation constitutes the driving force of learners' continuously enthusiastic involvement in L2 learning in various modalities, leading to subsequent improvements in depth of lexical knowledge. While previous studies reported positive correlations between the level of motivation and vocabulary breadth (Fontecha & Gallego, 2012; Mori & Calder, 2015; Zhang et al., 2016), this study provides the first empirical evidence that motivation indirectly affects depth of L2 vocabulary knowledge development through the mediation of the L2 processing experience.

The current study also shows that motivation strongly exerts its effect on learners'

frequent use of strategies, yet strategy use does not significantly predict either breadth or depth of L2 lexical knowledge acquisition. This finding contrasts with previous studies reporting that strategy use positively correlates with vocabulary size (Y. Gu & Johnson, 1996; S. Lee, 2007) and depth (Zhang & Lu, 2015). The present results instead align with Gardner et al. (1997), whose study showed that motivation directly explains a large proportion of strategy use, but that this more strategy use fails to bring about higher levels of L2 attainment. The current study concurs that frequent use of a wide range of strategies may not always strongly relate to high-level L2 vocabulary achievement. As Ellis (1997) suggests, advanced learners may utilize their effective strategies selectively; thus, they may not employ a wide range of strategies frequently. In the present study, this tendency may have led to a nonsignificant relationship between high reported strategy use and achievement in vocabulary acquisition, an explanation consistent with Yamamori, Isoda, Hiromori and Oxford's (2003) proposition that "‘the more, the better’ is not always the case in strategy use" (p. 384).

On the whole, this study expands upon previous single-focus research regarding the roles of ID factors in L2 vocabulary learning by examining the joint influence of various ID factors on the breadth and depth of L2 vocabulary knowledge development. The study confirms that both cognitive (e.g., aptitude) and affective (e.g., motivation) variables play important roles in L2 lexical acquisition. While aptitude directly affects the establishment of initial form-meaning connections, motivation indirectly influences the development of more advanced types of lexical knowledge through learners' involvement in the language experience.

These findings offer implications for language educators seeking to facilitate L2 vocabulary learning. First, the significant indirect effect of motivation on depth of L2 vocabulary knowledge through the mediation of the language experience offers a pedagogical insight that managing motivation is an important part of vocabulary instruction. Depth of lexical knowledge is necessary for learners to use language appropriately, but it is difficult to teach explicitly; depth of vocabulary knowledge can be improved through long-term involvement in the language experience. Therefore, emphasizing the importance of in-depth vocabulary knowledge and encouraging learners to invest their efforts in contextualized language learning experiences (e.g., extensive reading) may help them cultivate various aspects of lexical knowledge. In addition, to promote growth in vocabulary breadth, instructors could provide lower aptitude learners with phonological awareness training to assist them in efficiently establishing associations between forms, sounds, and meanings. Finally, when it comes to learner training, instructors may need to pay more attention to the quality of learners' strategy use than to the quantity, guiding students to employ strategies effectively and appropriately by adapting to different learning purposes and contexts.

Some limitations of the present study need to be noted. First, the sample in this study was

small for SEM analysis; studies using larger sample sizes would be desirable to confirm the current findings. In addition, the instrument for the language processing experience might not have been a sufficiently sophisticated measure of language processing experience. This methodological constraints might be improved in future studies. Finally, in order to address the unexpected result indicating that strategy use does not significantly affect vocabulary breadth and depth development, future research might improve the vocabulary learning strategies survey and the current model while conducting a more detailed analysis to provide a clearer picture regarding the effect of strategy use and its pedagogical implications.

VI. CONCLUSION

Using a structural equation modeling framework, this study investigated how ID factors, such as aptitude, motivation, strategy use, and language processing experience, relate to L2 vocabulary knowledge development. This research contributes to the literature in several ways. First, going beyond previous studies focusing on single-factor impacts on vocabulary breadth, this study, by using the latent variable SEM, provided more comprehensive and accurate explanations of the interrelationships between various ID factors involved in both breadth and depth of L2 vocabulary knowledge development. In addition, to the best of the researcher's knowledge, this study provides the first model including primary cognitive (aptitude) and affective (motivation) variables simultaneously, involving the two important aspects of vocabulary knowledge—breadth and depth—as dependent measures. This model revealed a direct effect of aptitude on vocabulary breadth and an indirect effect of motivation on vocabulary depth, supporting Laufer and Hulstijn's (2001) theory that both cognitive and motivational components play pivotal roles in vocabulary learning. Finally, this study is the first to offer empirical evidence that motivation significantly influences depth of vocabulary knowledge development through the mediation of language experience, providing a new perspective on the role of motivation, which has been overlooked in L2 vocabulary research. Given the importance of depth of vocabulary knowledge for appropriate lexical use, motivating learners and increasing their exposure to the L2 should be emphasized in vocabulary instruction alongside explicit teaching approaches.

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APPENDIX
Correlations Between All Observed Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Aptitude													
2. Attitude	.14												
3. Intensity	.16	.55**											
4. Desire	.21*	.77**	.54**										
5. Cognitive	.10	.26**	.50**	.28**									
6. Metacognitive	.06	.22*	.46**	.28**	.58**								
7. Memory	.18*	.34**	.55**	.31**	.50**	.47**							
8. Social	.04	.34**	.39**	.29**	.18*	.19*	.51**						
9. Reading	.14	.09	.22**	.09	.08	.07	-.02	-.07 ^a					
10. Writing	.15	.15	.20*	.12	.10	.06	.16	.17*	.47**				
11. Listening	.03	.18*	.18*	.14	.03	-.05	.10	.08	.14	.20*			
12. Speaking	.04	.15	.15 ^a	.07	.02	-.07	.03	.18*	.36**	.55**	.33**		
13. Breadth	.28**	.28**	.25**	.30**	.07	.14	.29**	.20*	.13	.15	.13	.17*	
14. Depth	.15	.28**	.25**	.34**	.12	.09	.26**	.19*	.16	.20*	.18*	.17	.73**

Note. * $p < .05$. ** $p < .01$.

Examples in: English

Applicable Languages: English

Applicable Levels: Tertiary

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