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Chinese L2 Learners' Depth of Vocabulary Knowledge: In Relation to the Effect of Learner Variables

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Abstract

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This research mainly explores Chinese L2 learners' depth of vocabulary knowledge and the correlations between that depth and learner-related factors, including language aptitude, motivation, language learning strategies. Analyses were conducted to investigate whether L2 learners at a similar vocabulary size level have differences in the depth of their vocabulary knowledge, and, if so, how learner-related factors individually and collectively affected the learners' depth of vocabulary knowledge.

A total of 231 college students joined this study. They took three types of tests in succession, including three vocabulary tests, three questionnaires, and a language

aptitude test. The result showed that for Chinese L2 learners at the same size/breadth of vocabulary knowledge, there was heterogeneity in their depth of vocabulary knowledge. Among the learner-related factors, language aptitude and motivation were found to have significant effects on the depth of vocabulary knowledge, but strategy use and learning style did not significantly affect it.

These findings have important implications for both research about the depth of vocabulary knowledge and vocabulary teaching. It provides a theoretical foundation with a model for future research on the concurrent influence of the individual differences, such as language aptitude and motivation, on the depth of vocabulary knowledge. Pedagogically, it provides Chinese L2 teachers some practical suggestions on availing of individual differences to promote vocabulary teaching. This suggests that teachers can provide students with an individualized methodology of vocabulary teaching and to adjust the teaching methods to become more flexible to help students improve in their vocabulary learning.

key words: depth of vocabulary knowledge, size/breadth of vocabulary knowledge, individual difference, language aptitude, motivation, learning strategy, learning style, SEM

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I. Introduction

1. Research Needs

Vocabulary knowledge plays a fundamental and essential role in second language acquisition (Laufer, 1989; Laufer, 1998; Meara, 1996; Nation, 1990; Read, 1988). Scholars have put forward proofs for the fact that acquisition of vocabulary knowledge is the core task in the process of second language learning (Allen, 1983; Coady & Huckin, 1997; Lewis, 1997). Communicative ability of second language learners, for example, is largely affected by vocabulary knowledge (Nation, 2001; Schmitt, 2000). In short, vocabulary knowledge is the cornerstone of language learning.

Some researchers have proposed different but complementary theoretical frameworks regarding the concept and connotation of vocabulary knowledge (Richards, 1976; Nation, 1990; Wesche & Paribakht, 1996; Henriksen, 1999; Qian, 1999). They proposed that vocabulary knowledge is multi-dimensional rather than uni-dimensional. Some researchers have also claimed that the definition of vocabulary knowledge comprises at least two important dimensions—breadth and depth (Qian, 1999, 2002; Qian & Schedl, 2004; Wesche & Paribakht, 1996).

The breadth of vocabulary knowledge refers to the number of words that language learners know at a surface semantic level (Anderson & Freebody, 1981; Nation & Waring, 1997). Regardless of the number of lemmas or word families a learner may know, it is far from enough to ascertain how well a learner has mastered

the word knowledge. The tip-of-the-tongue phenomenon (Brown & McNeill, 1966), for example, proves that even when one knows a word, it may not mean that they can retrieve it successfully when needed. This indicates that part of the vocabulary knowledge may have become productive knowledge, while the other part remains at the receptive level. VK covers a spectrum rather than being an all-or-nothing situation. 'Knowing a word' means that learners must not only know the spelling, pronunciation, syntax, and meaning of a word, but also the collocations, word usage restrictions, and other pragmatic functions (Nation, 1990). Acquiring this depth of knowledge is a network building task (Haastrup & Henriksen, 2000). Read (2004) elaborated on the development of depth in vocabulary acquisition, breaking it into three levels, i.e. precision of meaning, comprehensive word knowledge, and network knowledge. The growth of the depth of vocabulary is the development of a system full of complexity, which is an open, dynamic, non-linear, adaptive, and complex system with multiple heterogeneous elements interacting with each other (Larsen-Freeman & Cameron, 2008).

As an important component of the vocabulary acquisition system, individual differences between learners cannot be neglected. The factors of individual differences are numerous and complex, among which foreign language aptitude, motivation, learning strategies, and learning styles are widely explored (Li & Sui, 2012). First, language aptitude, a factor of individual differences, was identified as a consistent factor in predicting learning success (Dörnyei & Skehan, 2003). Second, some researchers proved the positive correlation between motivation and second language learning (Bernaus & Gardner, 2008; Csizér & Dörnyei, 2005; Masgoret &

Gardner, 2003; Schmidt & Watanabe, 2001), while some others found learning strategy is also demonstrated to contribute to the success of language learning (Barcroft, 2009; Fan, 2003; Farajee & Arabmofrad, 2015; Gu & Johnson, 1996; Ranalli, 2013). Third, learning strategy is a paramount factor that cannot be neglect whenever the individual differences are studied. Nation (2001) clarified that vocabulary learning strategies are part of language learning. Oxford (1990) also said that language learning strategies internally guide learners, who can perform their tasks more effectively by monitoring and adjusting their strategies and gradually gaining the self-confidence to reach a state of proficiency. Last but not least, learning style is a relatively consistent and lasting learning tendency that individuals have. It is a complex composed of individuals' outlook on learning, learning orientation, cognitive processing strategies, and management strategies (Lu, 2005).

The research on individual differences in second language acquisition mainly involves the following three aspects: (i) the relationship between certain factors and the second language acquisition process, acquisition speed, final level and/or interlanguage skills; (ii) the predictive power of certain factors to the learning results; and (iii) the relationship between two or more factors (Li & Sui, 2012). Most research largely focuses on the relationship between a single factor and second language acquisition. However, the factors that individual differences comprise are an integrated and dynamic system. Gazing at a certain part of individual differences, such as foreign language ability or motivation, will only make the research myopic and lopsided. Scant studies have demonstrated how the various factors of individual differences simultaneously act on the vocabulary knowledge learning in a

comprehensive manner. In addition, according to Wang's (2008) research findings, the vocabulary development of Chinese college students showed a linear trend from freshmen to senior, but there was an imbalance between the development of breadth and the development of depth. The development of depth of vocabulary knowledge fluctuated gradually from freshmen to seniors, and especially stagnated in the fourth year. She pointed out that the developmental imbalance was closely related to English proficiency. However, the conclusion seems to be oversimplified since individual difference might also be an essential influence. Therefore, it is important to re-examine the relationship between individual difference and vocabulary knowledge learning from a complex perspective.

2. Research Purpose

With a view to filling the above-mentioned gap, this study attempts to ascertain how much influence the factors of individual differences have on the acquisition of the depth vocabulary knowledge, how various factors work together and form the coefficient results in achieving the depth of vocabulary acquisition, and the role of each factor in vocabulary acquisition. Among Gardner (1985) and Dörnyei and Skehan (2003), the author chose four factors of individual differences that relate to vocabulary learning, i.e., language aptitude, learning strategies, motivation and learning style. Structural equation modeling in the Analysis of Moment Structure package software (AMOS) is used to analyze the role of individual differences and depth of vocabulary knowledge of college English learners in China.

3. Research Questions

This study aimed to explore the depth of learners' L2 vocabulary knowledge, on which learner-related variables might have effects, such as language aptitude, motivation, learning strategies and learning style of Chinese college EFL students. Hence, the author proposed two questions:

1) Do Chinese L2 learners at the same level of vocabulary size have a different depth of vocabulary?
2) What are the learner-related factors that affect the learners' knowledge of vocabulary depth?

4. Outline of the Dissertation

This study has six chapters. The first chapter provides an overview of the research. It introduces the background and the purpose of the research and then raises research questions. Chapter II is a literature review which introduces detailed theoretical and empirical academic studies related to the variables of individual difference and vocabulary knowledge. The next chapter involves research methodology, which clarifies the participants, instruments, and procedures of data collection. Chapter IV shows the results of the analysis, and Chapter V explains and discusses the results collected. In the last chapter, a conclusion is made, and suggestions and limitations are proposed.

II. Literature Review

1. Vocabulary Knowledge

To begin it is necessary to understand the theoretical basis of vocabulary knowledge. As Laufer and Goldstein (2004) explained, vocabulary knowledge is "the sum of interrelated sub-knowledges" or "…construed as a continuum consisting of several levels of knowledge, starting with superficial familiarity with the word and ending with the ability to use the word correctly in free production" (p. 400). As such, vocabulary knowledge is a multidimensional concept which comprises both the form and meaning of words and a series of recognitions involving the use of the words.

Learning vocabulary is a long-term and complicated process, so different scholars hold different views as to learners' mastering vocabulary knowledge. With the continuous deepening of research, the exploration of vocabulary knowledge has gradually evolved into multiple categories and sub-fields. In all the classifications of vocabulary knowledge, the framework of breadth and depth of vocabulary knowledge is frequently discussed in various literature (Anderson & Freebody, 1981; Qian, 1999, 2002; Read, 1988, 1993, 1998; Schmitt, 2010; Wesche & Paribakht, 1996).

Many scholars have suggested the concept of vocabulary knowledge in terms of its breadth and depth. The influential distinction of the breadth and depth of vocabulary knowledge is given by Anderson and Freebody (1981):

> The first may be called ‘breadth’ of knowledge, by which we mean the number of words for which the person knows at least some of the significant aspects of meaning. … [There] is a second dimension [depth] of vocabulary knowledge, namely the quality or ‘depth’ of understanding. We shall assume that, for most purposes, a person has a sufficiently deep understanding of a word if it conveys to him or her all of the distinctions that would be understood by an ordinary adult under normal circumstances. (pp. 92–93)

Therefore, the breadth of vocabulary knowledge also referred to as the size of vocabulary knowledge. This relates to how many words that a learner knows, while the “depth of vocabulary knowledge refers to how well a learner knows a word” (Fan, 2015, p.6). Since vocabulary knowledge is a heterogeneous collection of various types of knowledge about a word, a great deal of fruitful research had been conducted in this field.

1.1 Size/Breadth of Vocabulary Knowledge

Research on the breadth of vocabulary knowledge is abundant because it is an important factor used to evaluate or predicate L2 learning (Laufer, 1992, 1997; Laufer & Nation 1995, 1999; Meara & Buxton, 1987; Meara & Jones, 1988; Meara, 1992, 1996; Nation 1990; Schmitt, 1993). One of the key issues is how many words are needed for second language (L2) learners to comprehend English, measured by the ability to read a novel or a newspaper, or listen to and understand a dialogue (e.g.,

Hazenberg & Hulstun, 1996; Meara & Buxton 1987; Nation, 2006; Nurweni & Read, 1999). The threshold of vocabulary size/breadth for independent reading is 3,000 high-frequency English words (Nation, 1990; Qian, 1999). Laufer (1992) estimated that figure should be 5,000 English words, which covers about 95% of the running words of a text. If a learner needs to read an academic text, say in economics, the minimum size/breadth of vocabulary knowledge might be 4,000–5,000 words (Sutarsyah et al., 1994). However, Nation (2006) argued that a vocabulary size/breadth close to an 8,000-word family, i.e., a 98% coverage of a text, would provide a high degree of reading comprehension.

Another issue is how to estimate the size/breadth of vocabulary. Various attempts have been made to develop vocabulary tests to measure the size/breadth of L2 learners' vocabulary knowledge (Meara & Jones, 1988; Nation & Beglar, 2007; Nation, 1983, 1990; Schmitt et al., 2001). Among them, the Vocabulary Levels Test: Version 2 (Schmitt et al., 2001), a revised test originally designed by Paul Nation (1990), was applied in this study. It is an effective tool for diagnosis and placement. As a diagnostic tool, it can discriminate the weak points in vocabulary at a specific frequency level. At the same time, it can divide learners into appropriate groups on the basis of their vocabulary knowledge (Schmitt et al., 2001). It assesses the receptive word knowledge at four levels on the basis of frequency, i.e., 2,000, 3,000, 5,000 and 10,000 words. Knowledge of the 2,000 words is the basic requirement for common daily communication (Schonell et al., 1956). Learners at the 3000-word level begin to read authentic texts. It is deemed by most researchers that a 5000-word level would enable learners to infer a new word on the basis of context (Schmitt,

2010). Considering the English proficiency of subjects, three levels were tested except 10,000 words.

1.2 Depth of Vocabulary Knowledge

Regarding the understanding of vocabulary depth, different researchers have put forward different views. They proposed a different but complementary definition of the depth of vocabulary knowledge, which provides a multi-angle framework for subsequent research.

Some researchers (Dale, 1965; Henriksen, 1999; Palmberg, 1987; Wesche & Paribakht, 1996) held a view of the depth knowledge derived from a developmental perspective. On the basis of the behavior of learners, they divided the mastery of vocabulary knowledge into several levels and considered vocabulary knowledge a continuum along different levels. The results of vocabulary knowledge tested is nothing but a temporal state at a specific stage during the vocabulary acquisition process. Faerch and Kasper (1984), for example, believed that the lexical knowledge continuum starts from a vague understanding of the existence and form of the word in the target language, and gradually develops to an ability to freely use the word correctly and appropriately.

Others defined the depth of vocabulary knowledge from a multidimensional perspective, due to its complication, as a mosaic of interrelated language sub-knowledge. Cronbach (1942) indicated five aspects that involve ‘understanding a word’. They are generalization, application, breadth of meaning, precision of

meaning, and availability. Richards (1976) pointed out that knowing a lexical item includes a framework of word frequency, register, syntactic behavior, derivations, associations, semantic features, and polysemy of a word. Haastrup and Henriksen (2000, pp.221-222) regard lexical competence in three different dimensions: (1) partial to precise knowledge (different levels of comprehension of the same lexical item), (2) depth of knowledge, and (3) receptive to productive use ability. The depth dimension of lexical competence 'involves the knowledge of a word's different sense relations to other words in the lexicon, e.g., paradigmatic (antonymy, synonymy, hyponymy, gradation) and syntagmatic (collocational restrictions).' Nation (2000, p.50) divided the vocabulary framework into three aspects from the receptive and productive perspective: (1) form, including spoken form, written form and word parts; (2) meaning, which involves form and meaning, concept and referents and association; and (3) use, including grammatical functions, collocations, and constraints on use, such as register and word frequency. Read (2004, pp.211-212) stated three aspects to distinguish the depth knowledge of L2 learners: (1) precision of meaning, which is about how elaborated and specific a learner knows a word in terms of meaning; (2) comprehensive word knowledge, which comprises not only the semantic features of a word but also its grammatical characteristics, including its phonology, orthography, morphology, syntax, collocation and pragmatic usage; and (3) network knowledge, which is the ability to associate the words with other related lexical items and to form a lexical network.

In this study, Read's (1993) definition was adopted. He defined the depth of knowledge as "a consideration of the quality of the learner's vocabulary knowledge

(how well are particular words known?)" (p.357). In order to test the relevant knowledge, Nation's (2000) vocabulary framework was adopted, to examine the participants' depth knowledge from three dimensions: meaning (polysemy and synonymy), collocation, and derivational form. Therefore, two tests were applied to the study: the Word Associates Test and the Derivative Word Form Test (Schmitt & Zimmerman, 2002).

1.3 The Relationship Between the Breadth and Depth of Vocabulary Knowledge

The correlation between the breadth and depth of vocabulary knowledge has been documented to be strong (Nurweni & Read, 1999; Qian, 1999; Schmitt & Meara, 1997). There is a strong and positive relationship between vocabulary depth and breadth for L2 learners, especially for those whose vocabulary size/breadth is over 3,000 (Qian, 1999).

However, the balance of vocabulary knowledge in breadth and depth has been questioned. Liu (2001) found that the imbalance between vocabulary breadth and vocabulary depth development is mainly caused by the speed of acquisition. That is, the speed of breadth acquisition was much faster than that of depth acquisition. The slower acquisition of depth of knowledge was also confirmed in Wang (2008).

Actually, this imbalance between the size/breadth and the depth of vocabulary knowledge may be problematic, as it was proven that language skills may be related to the depth of vocabulary knowledge. For example, Schmitt and Meara (1997) and Huang (2002) found a positive relationship with specific language skills, such as

listening and speaking. However, Ma (2009) pointed out that the coefficients of depth with specific skills are lower than that of vocabulary size. In China, the L2 learners' English writing was closely dependent upon the depth of vocabulary knowledge. Although learners had a substantial vocabulary, they had difficulty writing fluently using the words they learned (Chu, 2005). The depth of vocabulary knowledge is more efficient and prevalent in the evaluation of learner language skills compared with vocabulary size/breadth (Li, 2007; Lv, 2004). Therefore, it is necessary to delve into the depth of vocabulary knowledge on the basis of size and breadth.

Vocabulary knowledge embraces both breadth and depth of knowledge and many factors may affect the imbalanced development of L2 vocabulary knowledge. As Vanniarajan (1997) classified, the factors are both external (including environment and context) and internal (including talent, cognition, and motivation). Individual differences, including language aptitude, motivation, strategies, learning styles, and their relations with the vocabulary knowledge will be discussed in the next chapter.

2. Learner-Related Factors Affecting Depth of Vocabulary Knowledge

Vocabulary learning is a complex activity which requires a great deal of personal effort. It is the learners themselves who play the main role in learning vocabulary. Therefore, individual difference is a fundamental factor that cannot be neglected.

Dörnyei (2005) defined individual differences as “characteristics or traits in respect of which individuals may be shown to differ from each other” (p. 1). It contributes to one’s L2 achievements (Dörnyei, 2005). A great deal of research concerning individual differences has been conducted on the topic of individual difference since the late 1990s (e.g., Breen et al., 2001; Dörnyei, 2005; Dörnyei & Skehan, 2003; Ehrman et al., 2003; Robinson, 2001). Individual difference comprises many factors. Gardner and Lambert (1959) proposed two factors that could predict a learner’s L2 acquisition: linguistic aptitude and motivation. In subsequent research, Gardner and his collogues explored the relationship between second language acquisition and factors such as attitude, motivation, and anxiety (Gardner & Lambert, 1972; Gardner, Lalonde, & Pierson, 1983; Gardner, Lalonde, & Moorcroft, 1985; Gardner & Macintyre, 1993; Gardner, 1990). After that, more factors were put froward to create a detailed composite of individual differences, such as affective, cognitive, and personality-related components and so on. Personality and intelligence were regarded as psychological learner variables (e.g., Birch & Hayward, 1994; Eysenck, 1994; Snow, Corno, & Jackson, 1996). In the development of one’s second language, “language aptitude and language learning motivation” are also deemed as the foremost cognitive and affective individual difference variables (Dörnyei, 2005, p.6). Other researchers made a loose and encyclopedic taxonomy of individual differences (e.g., De Raad, 2000; Revelle, 2000). De Raad (2000), for example, claimed that individual differences comprise possible characteristics including “attitudes, values, ideologies, interests, emotions, capacities, skills, socio- economic status, gender, height, and so forth” (p. 41). If an

educational perspective is taken, personality, ability/aptitude, motivation, learning styles and language learning strategies are traditionally given as the primary learner factors (Dörnyei, 2005). In this study, the scope of individual differences focusses on language aptitude, motivation, language learning strategies, and learning styles.

2.1 Language Aptitude

For L2 learners, language aptitude may be an influential factor to predict achievement (Skehan, 1989). According to Carroll's (1990) definition, aptitude is "the amount of time a student needs to learn a given task, unit of instruction, or curriculum to an acceptable criterion of mastery under optimal conditions of instruction and student motivation" (p.26). Foreign language aptitude refers to a natural ability that allows language learners successfully adapt to language learning environments, whether it is formal instruction or immersion, and to make full use of the environment to successfully acquire a foreign language (or a second language) (Robinson, 2012).

Although foreign language aptitude seems to indicate that the ability to learn a foreign language varies between learners, several complex problems with this assumption have been studied. The early focal point of language aptitude lay in how cognitive abilities play a role in the prediction of the speed of learners' progress when they learn a foreign language (Kormos, 2013). It then gradually shifted to the issue of whether a learner has the capacity to learn a new language. Language aptitude has become an important individual factor related to the learner's cognitive

characteristics (e.g. Ehrman & Oxford, 1995; Grigornko, Sternberg, & Ehrman, 2000; Kiss & Nikolov, 2005). Early research on language aptitude focused on the factors affecting young beginners. After that, the scope was expanded to that of higher proficiency learners. The aptitude test has developed from measuring only explicit learning ability (aptitude for explicit learning) to measuring both explicit and implicit learning ability (aptitude for implicit learning) (Li & Ma, 2016). Besides, Li (2007) pointed out that both the breadth and depth of vocabulary knowledge can effectively predict comprehensive language ability.

Some research probed the relationship between language aptitude and vocabulary learning. Daneman and Green found that the ability of adults' to infer the meaning of new words from context has positive correlation with their working memory capacity (1986). For young learners, one's ability in phonemic and phonological coding and processing can predict their uptake of L2 word coding skills (Sparks et al., 2008, 2009, 2011). Granena and Long (2013) used the LLAMA tests (Meara, 2005) to study the correlation between language aptitudes and learners' L2 lexis and collocation level. It showed that language aptitude has significant correlation with phonemic, lexical and collocational scores. They claim that language aptitudes can offset shortfalls caused by age in grammar, vocabulary and collocation acquisition. However, Li's (2016) study stated that language aptitude only has moderate correlation with L2 vocabulary learning.

As to language aptitude tests and constructs, Carroll and his coresearcher Sapon initially created an aptitude test battery, the Modern Language Aptitude Test (MLAT, Carroll & Sapon, 1959) to study foreign language aptitude and set the parameters

within. He made a four-component model of aptitude, which consists of phonemic coding ability, grammatical sensitivity, inductive language learning ability, and associative memory (Dörnyei & Skehan, 2003). In 1966, Pimsleur issued the Pimsleur Modern Language Aptitude Battery (PLAB, Pimsleur 1966), which picked out several factors in language aptitude, such as vocabulary size/breadth, language analysis measures, sound discrimination measures, and sound-symbol association measures. Petersen and Al-Haik (1976) published the Defense Language Aptitude Battery (DLAB), whose purpose was to select military personnel for language-related training. Following this, Skehan developed Carroll's theory. He combined grammatical sensitivity and language inductive ability into language analysis ability and defined it as the ability to infer language rules and conduct language summaries (Skehan, 1998). In this way, he changed the subcomponents of language aptitude from four to three: speech coding ability, language analysis ability, and memory. The LLAMA tests v3 (Meara & Rogers, 2019), which was created on the loose basis of the MLAT test, is adopted as the language aptitude test in this study.

2.2 Motivation

Motivation is indispensable to the learning process. It is the drive to learn: the emotional factor that stimulates and guides learning behavior, and determines its intensity and duration. Schunk, Meece, and Pintrich (2014) defined motivation as "the process whereby goal-directed activities are instigated and sustained" (p.5). Gardner claimed that "attitude and motivation are comprised of three components:

(a) motivation to learn the foreign language; (b) desired affiliation with the target language community; and (c) attitude toward the learning situation" (as cited in Sparks & Ganschow, 2001, pp. 92-93).

In view of the important role of motivation in human learning behavior, researchers in psychology and education all attempt to explain motivation from their own perspectives, forming various motivational theories. The mainstream psychological motivational theories mainly include: behaviorist motivation theory (James, 1890; McDougall, 2015; Suárez & Gesa, 2019), hierarchical theory of needs (Maslow, 1962, 2013), Weiner's attribution theory (Weiner, 1972), expectancy-value theory (Vroom, 1964), and self-efficacy motivation theory (Bandura, 1982).

The research of motivation for L2 learning has also greatly developed, including Gardner's Motivation Theory (Gardner & Lambert, 1959), Self-determination Theory (Deci & Ryan, 1985), Dörnyei's Three-level Motivation Theory ("the Language Level, the Learner Level, and the Learning Situation Level") (Dörnyei, 1994, p.283) and the motivational self-system (Dörnyei, 2005, 2009). Among these theories, Gardner's motivation theory is one of the most influential. Gardner and Lambert (1959) brought in two famous concepts– the integrative oriented motivation and instrumental oriented motivation. The integrative motivational tendency refers to the learner's desire to integrate into the target language culture and community without ethnocentrism. Therefore, learners with this motivational tendency are more interested in the target language community and are more willing to learn the language of the community. They also pointed out that although motivational strategy suggestions in discussion may be of some value, they

are still not recommended for use in teaching without more empirical testing (Gardner & Lambert, 1959). Later Gardner (1985) developed the Attitude/Motivation Test Battery (AMTB) to test the motivation, which is adopted as the tool for motivation testing in this study.

Fruitful research results have proven that the relationship between motivation and L2 learning is positive. Motivation is one of the key factors that determines the success of language learning (e.g., Gardner et al., 1985; Gardner & MacIntyre, 1991). If students are clear about their purposes in language learning, and persevere in taking actions for their goals, they will be more likely to succeed in learning. Being one of the most essential factors of individual differences, motivation is regarded as a key element to explain the effects of individual differences to foreign or second language learning of teenagers and adults (Dörnyei & Ryan, 2015; Gardner, 2006; Kormos & Csizér, 2008; Lamb, 2012). Motivation and attitude have a positive correlation with foreign language achievement (Gardner, 1990). Some researchers also explored the connection between subfactors of motivation and L2 proficiency. Mori and Calder (2015) found that one out of six motivational factors (i.e., positive perceptions) has a positive effect on L2 proficiency. Zhang et al. (2013) also found a significant correlation between motivation scales and proficiency in English.

With in-depth and detailed study, the influence of motivation on vocabulary learning gradually surfaced. For example, Fontecha and Gallego (2012) examined the correlation between motivation and L2 vocabulary size/breadth in different grade levels. The relationship was significant between the two variables in the ninth grade, but not in another grade. The subfactors of motivation are also interrelated with

vocabulary learning. Some are relatively stable for a while, such as attitudes and goal orientation, whereas others are apt to vary or fluctuate both over short and long periods (Dörnyei, 2010). However, only intrinsic motivation has been found to be a predictor of proficiency level. Language anxiety, a subfactor of motivation, is a prevalent phenomenon in learning. Most studies recorded the relationship between anxiety and language performance or acquisition, but there is not much research on how anxiety influences vocabulary knowledge. MacIntyre and Gardner (1994), for example, conducted an experiment to purposely trigger learners' anxiety by introducing a camera into a task of vocabulary learning. They found that the anxiety arousal can lower the effectiveness of vocabulary instruction. Because anxiety is one of the critical subfactors of motivation, this study includes anxiety as a subfactor in the category of motivation.

In addition, modeling is a common methodology in motivation analysis. Tseng and Schmitt (2008) applied a structural equation model approach to create an integrated model of vocabulary knowledge and motivation. It suggests that motivation boosts vocabulary learning. More importantly, it infuses the whole learning cycle along, not only limited in the initiation of the cycle. Dörnyei designed a process model of motivation (Dörnyei, 2000, 2001; Dornyei & Ottó, 1998), which helped to expound the nature of L2 motivation. Many researchers did empirical studies with the model (e.g. Chambers, 1999; Shoaib & Dörnyei, 2005; Ushioda, 2001; Williams et al., 2002), but to my knowledge, research on its role in vocabulary learning is rare.

2.3 Learning Strategies

It should be noted that excellent language aptitude and strong motivation as discussed above are not the only reasons for high attainment. Strategy use plays an important role in L2 acquisition because learners' active participation in the learning process through strategy use enhances the effectiveness L2 learning (e.g., Kim, 2011; Lee, 2007). Successful language learning is not something that can be done simply by rote memorization, but it requires the full use of various learning skills and strategies. Successful language learners often use a variety of strategies depending on the language task, learning materials, personality characteristics, learning goals and learning stages (Cohen, 2014; O'Malley & Chamot, 1990; Oxford, 1990a).

Learning strategies, as defined by Wenden (1987), "are the various operations that learners use in order to make sense of their learning" (pp.7-8). Rubin (1987) defines strategic learning as "the process by which information is obtained, stored, retrieved, and used" (p.29). It means vocabulary learning is accomplished in a psychologically complicated and profound way through a deep cognitive process. Oxford (1990) indicates that language learning strategies are "specific actions, behaviors, steps or techniques students use often consciously to improve their progress in apprehending, internalizing, and using the L2" (p.8).

The influential theories of vocabulary learning strategies include Depth of Processing Hypothesis (Craik & Lockhart, 1972); Noticing Hypothesis (Schmidt, 2001), and Involvement Load Hypothesis (Laufer & Hulstijn, 2001). First many scholars focused on the effects of deep processing on learners' acquisition of new

knowledge and supported the concept of 'Depth of Processing' and the positive effects generated in learning activities (Craik & Lockhart, 1972; Craik & Tulving, 1975; Craik, 2002). The Theory of Depths of Processing or Depth of Processing Model is proposed by Craik and Lockhart (1972). They claimed that whether new information can be stored in long-term memory or not is determined by the final depth or level of processing that the learners engage in rather than the time of retention in short-term memory.

Second, the 'Noticing Hypothesis' (Schmidt, 2000) indicates that noticing happens when the superficial structure features of utterances are observed instead of abstract rules or principles. It is the initial stage of language input processing. It is equivalent to 'apperception' (Gass, 1988), 'detection within selective attention' (Tomlin & Villa, 1994), and 'detection plus rehearsal in short term memory' (Robinson, 1995). Without noticing, one may not pay attention to the features of input, let alone figure out the gap and realize the subsequent process. Schmidt (2001) stated that "learning in the sense of establishing new or modified knowledge, memory, skills, and routines is therefore largely, and perhaps exclusively, a side effect of attended processing" (p. 29).

Third, Involvement Load Hypothesis (Laufer & Hulstijn, 2001) is composed of three parts. The first is that incidental vocabulary acquisition is believed to be affected by three factors: *need, search,* and *evaluation*. The second is that when other factors are the same, the more the learner is involved in new word processing, the better the retention of new words. The last hypothesis holds that when other factors

are the same, the greater the amount of involvement required for the task designed by the teacher or researcher, the better the retention of new words.

There has been a controversy over the effect of strategies on language learning. Some research yielded a positive relationship with language acquisition (e.g., Oxford, Nyikos, & Crookall, 1987) and vocabulary size/breadth (e.g., Gu & Johnson, 1996; Lee, 2007) while other researchers found no positive affect (e.g., Gardner, Tremblay & Masgoret, 1997; Tseng & Schmitt, 2008). However, some studies have shown that certain learning strategies help learners improve their retention of new information when they process and integrate it deeply and meaningfully (Anderson, 2005; Baddeley, 1997). Dóczi and Kormos (2016) pointed out that vocabulary learning is more effective in an intentional situation than in an incidental one, because the former requires more input and provides more opportunities to encounter new words. In other words, intentional vocabulary learning requires more techniques and strategies to sucessfully facilate the acquisition of new words. The depth of vocabulary processing, for example, depends on the learner's attention. It means that the more learners pay attention to the characteristics of the form and meaning of a new word, the more abundant the connection they have with their existing knowledge, the greater the possibility that the new word will be retained (Laufer & Hulstijn, 2001). Furthermore, Schmitt and Schmitt (1993) revealed that many factors determine a strategy's effectiveness, such as individual personality, study features, task types, and the learning surroundings. Gu (2002) found a gender differences in strategy use in the vocabulary size/breadth test.

2.4 Learning Style

Keefe and Ferrell (1990) defined learning style as “a gestalt combining internal and external operations derived from the individual’s neurobiology, personality and development, and reflected in learner behavior” (p. 16). Reid (1995, p. viii) characterized it as “an individual’s natural, habitual, and preferred way(s) of absorbing, processing, and retaining new information and skills.” Since learning style is mainly manifested in the individual’s perception of external information stimuli, attention, and problem-solving methods, its formation is affected by a variety of factors. Learner-related factors include personality traits, learning interests, and biological rhythms; environment-related factors comprise family background, partner types, and social environment; education-related factors involve teaching methods, forms of information stimulation, and teaching venue layout.

Since Thelen (1954) first proposed the concept of ‘learning style,’ dozens of theoretical models have emerged. Believing that people learn through different senses, such as visual or auditory sense, and have their own preferred learning senses and learning methods, Reid (1987) conducted an in-depth and detailed research on perceptual learning style. She designed a set of questionnaires for perceptual learning style preference, and divided them into visual, auditory, tactile, group, individual, and kinesthetic styles. In addition, Reid made a detailed analysis and explanation of the characteristics and advantages of each style. She also pointed out that learners, especially language learners, should give full play to the style advantages related to

sensory preferences, and receive information from multiple senses and channels, so as to effectively perceive and internalize the knowledge gained.

Ehrman and Oxford (1990) pointed out that the dimensions of learning styles originate from three sources: 1) the study of perception and Gestalt psychology, 2) ego psychology, and 3) the theories of Carl Jung (p.311). The field independence/dependence variable falls under Gestalt psychology. Cognitive styles, for example, flexible vs. constricted control, originate from ego psychology. Two instruments are based on Jungian theories. One is the Myers-Briggs Type Indicator (MBTI) (Myers et al., 1985), a psychological-type learning-styles model; another is the Kolb Learning Styles Inventory (Kolb, 1984). It is an experiential learning model that was set up on the basis of the following six premises:

i) Learning is best understood as a continual process of rebuilding knowledge from experience, not as results.
ii) Everything one learns is re-learning. The new knowledge or ideas that one learns can be examined, tested, and incorporated into the learner's knowledge system.
iii) Learning needs conflict resolution between modes of adaptation to the world dialectically opposed to them.
iv) Learning is an integral adaptation process which involves a learner's whole sensory, cognitive, and behavioral functioning.
v) Learning results from synergetic human-environmental transactions through the learner's balance of the dialectic processes in which new

experiences are incorporated into current concepts and existing concepts are adapted to new experiences.

vi) Learning is regarded as the transaction between socio-historical social knowledge and personal knowledge and is the process of knowledge generation. (Passarelli & Kolb, 2012)

Based on the experiential learning theory, Kolb (1984) proposed "four learning styles that are associated with different approaches to learning—Diverging, Assimilating, Converging, and Accommodating" (Kolb & Kolb, 2005, p.4). Forming a learning cycle, the four learning modes were divided into two dialectical groups: Concrete Experience and Abstract Conceptualization, which are related to grasping experience; and Reflective Observation and Active Experimentation, which are associated with transforming experience. Because of the wide usage and high reliability (Kolb, 1985, 2015; Sims et al., 1986; Willcoxson & Prosser, 1996) of the Learning Style Inventory, this research also uses it as the tool to assess individual learning styles.

Some studies have shown the association between learning style and learning strategies. It was proved that learning styles may significantly affect the way in which learners use the learning strategies and the development of learning (Ehrman & Oxford, 1990b; Rossi-Le, 1995). As to detailed strategies, Hao and Fu (2006) found only independent learning styles, introspective intelligence, and memory strategies out of eighteen variables are related to English performance.

Being different from aptitude, learning style is not an inborn ability or talent. Instead, it is a habitual operation through which one interacts with the learning surroundings and gradually forms personal preferences, which are value-judgment neutral and bipolar (Dörnyei, 2005). Learning style is conceptually not the same as learning strategies although they share some similarities. Both are related to individual reactions that one has to the learning process or tasks. However, a learning style has a more consistent character. It is a "strategy used consistently across a class of tasks" (Snow et al.1996, p. 281). A learning style is more stable than a strategy for individual as well because the former is physiologically formed and may not be learned and isn't adjusted to the surroundings and tasks (Riding, 2000) whereas the use of strategy is inseparable from the task or context (Sternberg & Grigorenko, 2001).

English performance was also discovered to be related to the learning style. Based on Kolb's learning style theory, Su (2019) found that the most excellent students tend to have the accommodating style; the middle-level students largely have the diverging style, and the poorer ones mainly the converging style. No significant difference has been found in learning styles among learners of different grades in her study.

Research on the learning styles of L2 learners in China is also abundant. Learning style is connected with culture and its values, which have an important influence on learning style. Chinese students tend to learn English more independently, because they regard learning as a kind of work that needs to be done on their own, a process of self-study, thinking, and independent problem solving

(Hao & Fu, 2006). They prefer visual, physical, and auditory learning styles (Reid, 1987). However, the survey results of Ehrman and Oxford (1995) indicated that Chinese and Taiwanese students mostly adopted analytical learning styles, preferring specific sequential learning, and mastering details. An empirical study by Su (2019) found that out of Kolb's four learning styles the accommodating style was most common among Chinese college students who majored in Korean language, followed by the converging style. The diverging style had a small number, and the assimilating style was the least common.

As to the relations between learning style and vocabulary learning, most research focused on how learners maintained and retained English vocabulary knowledge. Tight (2010) investigated the perceptual learning style (auditory or visual) matching in L2 vocabulary learning. The results revealed that matching different learning style preferences has no obvious effect on vocabulary learning. Instead, instruction with multiple styles may be more helpful. Chen and Wang (2015) used mobile AR L2 vocabulary instruction to study the motivation and vocabulary learning effects of different learning styles. It is found that field-independent learners outperformed field-dependent ones on vocabulary learning under mobile AR instruction. But the learning styles did not affect learners' motivation. Hou (2020) explored the relationship between the learning styles of 104 young English teachers in elementary schools and vocabulary attrition. The results show that 47.12% of teachers are converging learning style. The remaining ones are assimilating, diverging, and accommodating styles, in descending order. There is a negative correlation between the degree of vocabulary attrition and converging learning style,

whereas vocabulary attrition is positively correlated with assimilating learning style. The degree of vocabulary attrition is negatively correlated with convergent learning style, and positively correlated with assimilating style.

Since previous research concerning vocabulary knowledge and individual differences has focused on the relationship between a single factor and vocabulary knowledge, multiple factors of individual differences have not been explored. Further study is needed about what factors of individual differences have an impact on the depth of vocabulary knowledge learning, and how these factors affect it.

III. Methods

1. Research Design

The study was designed to investigate whether Chinese L2 learners at the same vocabulary level have a different depth of vocabulary and whether there is any correlation between individual differences and the L2 learner's depth of vocabulary knowledge. The research was designed as follows.

First, two levels of vocabulary size/breadth were considered in this study to gain a comprehensive understanding of the possible differences between learners' vocabulary depth. Second, two tests based on previous research were applied to gauge the participants' knowledge of word meaning, collocation, and derivative word forms. Third, based on Gardner (1985) and Dörnyei and Skehan (2003), four factors of individual differences were selected: language aptitude, learning strategies, motivation, and learning style.

The tests and questionnaires which were adopted after careful selection (see Section 3.3 Instrument) are as follows. First, a pilot study was conducted to confirm the feasibility of the three sets of subtests and experiment design. In addition to the results of the pilot study, feedback from the participants gathered through interviews was taken into consideration. Based on this input, modification and adjustment were made to the test instruments and process.

The Pearson correlation coefficient, ANOVA (SPSS, v.26.0), and AMOS structural equation modeling (v.24.0) were used to generate a thorough and

descriptive analysis. The model was used to explore how individual learner variables affect the L2 learner's depth of vocabulary knowledge of English learners in China. Figure 1 and Figure 2 provide a general idea of the questions and design of this research.

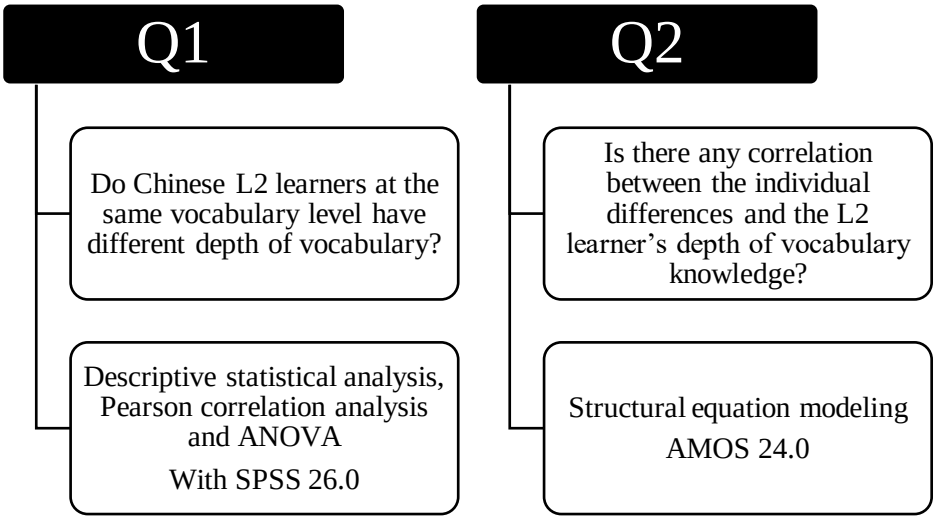

Figure 1. Research Questions and Analysis

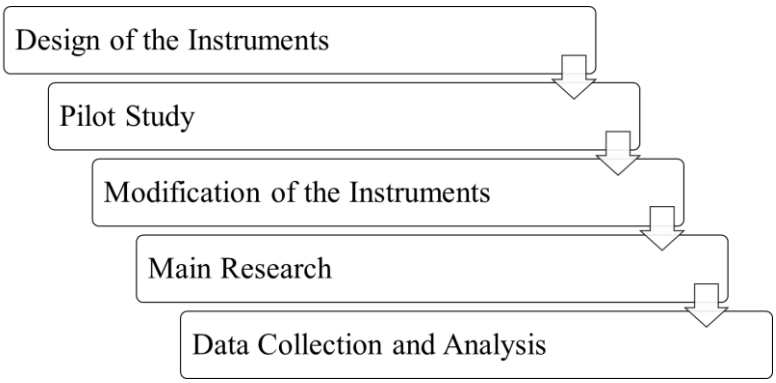

Figure 2. The Procedure of the Research

2. Participants

A total of 431 students were initially recruited from a provincial university in China, but some students dropped out of the tests due to their length and frequency. Only 231 students, 74 males and 157 females, eventually completed all of the tests and questionnaires and their tests results were checked to be valid. There was no grade or major limitation to the participants as they were to be classified based on their vocabulary size/breadth. Most participants majored in Economics and several were from other disciplines, including Computer Science, Management, Chemistry, Chinese Literature and Media, Education, and Foreign Language. 113 participants had not passed College English Test-Band 4, accounting for 48.9%; 17 had passed College English Test-Band 6, which accounted for 7.4% of the whole participants. The rest, 101 persons, were between those two levels. Among the participants, 18 started learning English before elementary school; 18 started from grade 1; 131 from grade 3; 17 between grades 4-6, and 47 from grade 7.

The participants were classified into two groups: Group-Low including participants whose Vocabulary Level Test total score was between 0 and 49, and Group-High of those whose total score was 50 or above.

Table 1. Descriptive Statistics of the Participants

		Frequency	Percent
Gender	Female	157	68.0
	Male	74	32.0
	Total	231	100.0
AoA	Before elementary school	18	7.8
	Grade 1	18	7.8
	Grade 3	131	56.7
	Grade 4-6	17	7.4
	Grade 7	47	20.3
	Total	231	100.0
English proficiency	Below CET band 4	113	48.9
	CET band 4- CET band 6	101	43.7
	Above CET band 6	17	7.4
	Total	231	100.0

Note. AoA=Age of Acquisition; CET= College English Test in China.

3. Instruments

This research included four tests and three questionnaires in total. Vocabulary size/breadth was measured using Vocabulary Level Tests (Schmitt et al., 2001). The depth of vocabulary was measured by two tests: the Word Associates Test (WAT) (Read 1993, 1998) and the Derivative Word Form Test (Schmitt & Zimmerman, 2002).

For learner variables affecting the depth of vocabulary, there was one test, the LLAMA aptitude test (Meara & Rogers, 2019), and three surveys, including the

Attitude/Motivation Test Battery (Gardner, 2004), the Vocabulary Learning Strategies Survey (VLSS) (Schmitt & Schmitt, 1993), and Kolb's Learning Style Inventory (Kolb & Kolb, 2005). Figure 3 is a brief map of all the related tests and questionnaires.

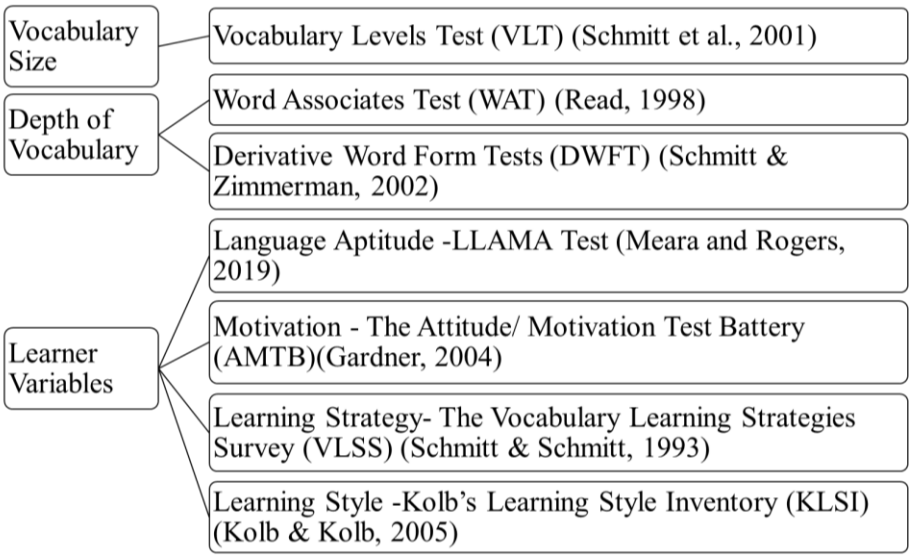

Figure 3. Sketch Map of Tests and Questionnaires

Since seven tests were involved in total, it took a great deal of time and energy for participants to complete. To simplify the process, the author combined the VLT, WAT, and DWFT tests to make one test of vocabulary. The AMTB, VLSS, and KLSI were adapted into one questionnaire of individual differences as well. The LLAMA tests were conducted separately. The participants took the tests over three sessions (see Table 2). Followed are the introduction of each instrument in detail.

Table 2. The Field Test List

No.	Name of the Test	Subtests Included
1	Test of vocabulary	i) Vocabulary Levels Test ii) Word Associates Test iii) Derivative Word Form Test
2	ID questionnaire	i) Attitude/Motivation Test Battery ii) Vocabulary Learning Strategies Survey iii) Kolb's Learning Style Inventory
3	Language aptitude test	LLAMA tests

3.1 Vocabulary Size/Breadth

The Vocabulary Levels Test (Schmitt et al., 2001) was used to measure the vocabulary size/breadth of the participants. It is improved and designed on the basis of Nation's (1990) vocabulary test, including five parts, namely 2,000, 3,000, 5,000, 10,000, and academic words. Among them, words in 2,000-word level and 3,000-word level are high frequency words in English language use, the 10,000-words level represents low frequency words, and the 5,000-word level is between the high frequency and the low frequency groups. The academic words come from the Coxhead (2000) academic word list, which contains 570 words, covering the most frequently used and widely used words in 28 disciplines. Each level contains 10 test items and each item contains six-word choices and three English phrases. The

participants are required to select three words that match the English entries from among the six target words, as shown in Figure 4:

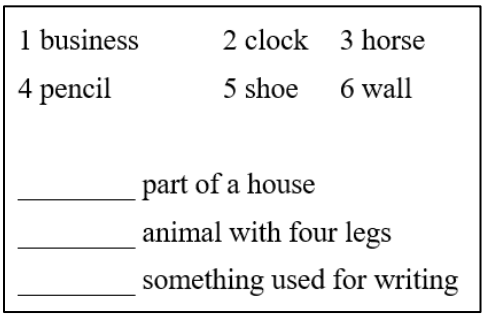

Figure 4. Example of Vocabulary Levels Test

The words used in the English entries are all high-frequency words at the 1,000- and 2,000-word levels to avoid the test-takers' inability to understand the English definitions and affect the validity of the test. In addition, the test is designed using gap-filling, which minimizes the possibility of blind answering and random guessing. According to the College English Teaching Syllabus in China (1996), the vocabulary size/breadth benchmark of university entrants is 1,800 words. It should reach 4,200 words by the time they pass the College English Test (Band 4). Considering the workload of the tests and the actual vocabulary level of the participants, the academic and 10,000-word levels are excluded from the study. There is one point for each answer, and no points are deducted for incorrect answers. The total score is 90 (3*10*3 =90).

3.2 Depth of Vocabulary Knowledge

Based on the framework of Nation (2001) and Read (2004), two kinds of tests were utilized to test the participants' depth of vocabulary knowledge, Word Associates Test (WAT) (Read, 1993, 1998) and the Derivative Word Form Test (Schmitt & Zimmerman, 2002),.

The Word Associates Test (WAT), with confirmed reliability (α=0.93 in Read, 1998; α=0.91 in Qian, 1999; α=0.88 in Qian, 2002), has been widely used in previous research. Developed by Read (Read, 1993， 1998), the WAT measures two aspects: (1) word meaning, especially polysemy and synonym, and (2) word collocations. There are 40 items in the Word Associates Test, in which the stimulus words are all high-frequency adjectives with eight options each. Four options are polysemy and synonyms of the stimulus word and the other four words are nouns that can form a collocation with the word tested. The participants are required to choose at most four out of the eight options, which are either semantically related to or collocate with the stimulus word. Considering the large number of questions, the author reduced the test words from 40 to 20. The total score is 80 with 4 points for each question. One point is awarded for each correct selection. Zero for wrong selections. However, to prevent the participants from guessing, they are told a different scoring rule. If any answer was wrong in the four selections, they would not get any points. Therefore, they should choose the surest answer. All the items were made into an online test on the website https://www.wjx.cn/ . Figure 5 is an example:

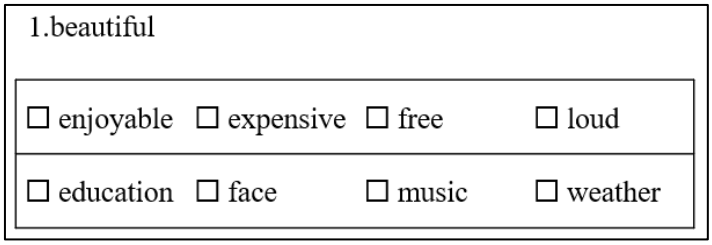

Figure 5. Example of Word Associates Test

The knowledge of connotation in vocabulary indicates far more depth than the meaning and collocation. Since it may comprise form and word parts according to Nation's frame (2001), the Derivative Word Form Test (Schmitt & Zimmerman, 2002) was added. In the test, participants had to fill in the blanks in each sentence with the correct form of the word given. There are 16 target words in total, which are chosen from the Academic Word List (Coxhead, 2000). They are high frequency words in academic contexts from a variety of disciplines, including nouns, adjectives, verbs and one adverb. Each target word has four sentences, each with blank to be filled with a derivative of the stimulus word. If there is no appropriate form of the word for a given sentence, then subjects are instructed to write 'X' instead. For each correct answer one point was given and the total score is 64 points. Figure 6 is an example of the stimulus word STIMULATE:

stimulate	
Noun	A massage is good stimulation.
Verb	Massages can stimulate tired muscles.
Adjective	A massage has a stimulating effect.
Adverb	He massaged X .

Figure 6. Example of the Derivative Word Form Test

3.3 Learner Variables

Four learner variables were adopted: Language Aptitude, Motivation, Learning Strategy, and Learning Style. The test and reference of each learner variable were shown in Table 3.

Table 3. Surveys and Tests for Learner Variables

Learner Variables	Surveys and Tests	Reference
Language Aptitude	The LLAMA Tests v3	Meara & Rogers, 2019
Motivation	The Attitude/Motivation Test Battery (AMTB)	Gardner, 1985; 2004
Learning Strategy	The Vocabulary Learning Strategies Survey (VLSS)	Schmitt & Schmitt, 1993
Learning Style	Learning Style Inventory3.1	Kolb & Kolb, 2005

3.3.1 Language Aptitude

This study adopts Meara and Rogers's (2019) LLAMA aptitude test as a tool to test participants' language aptitude. The test was developed on the basis of Carroll and Sapon (1959), and has been widely used in L2 acquisition research (Granena & Long, 2012). After revision for several times, it has been uploaded as an online test on: https://www.lognostics.co.uk/tools/LLAMA_3/index.htm. The LLAMA Tests v3 includes four sub-tests: LLAMA B3 (Vocabulary Learning Test), LLAMA D3

(Speech Perception Test), LLAMA E3 (Sound-Symbol Pairing Test) and LLAMA F3 (Grammar Rules Inference Test). The words to be tested are chosen from Central American dialects so the test is independent from the participants' native language. They need not use L1 to answer the question. Granena (2013) validated the internal consistency of LLAMA battery test is acceptable (α=.77). LLAMA B3, E3 and F3 involve controlled and reflective processes which require labored cognitive control. All three subtests provide participants with a couple of minutes to study the materials and apply strategies. Some researchers have argued that these tests actually measure explicit language aptitude (Granena, 2013; Skehan et al., 2016; Yilmaz & Granena, 2016).

The purpose of LLAMA B3 is to measure the participant' ability to learn new words in a short time. Participants first explore the names of pictures shown on the screen (see Figure 7). After two minutes, the system starts the test automatically. The participants' task is to match the words with their pictures (see Figure 8). There are 20 words in total with one point for each word. The interface of LLAMA B test is as follows:

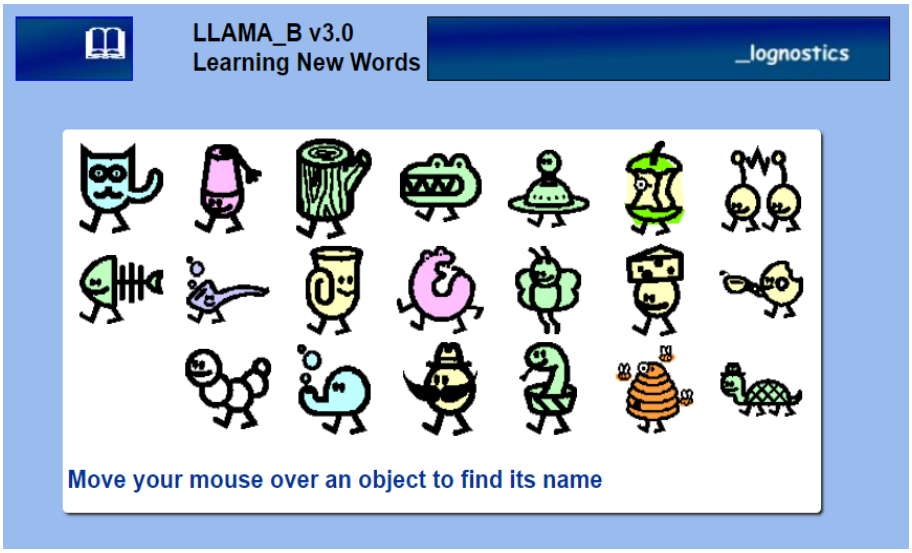

Figure 7. The LLAMA_B3 Learning Page

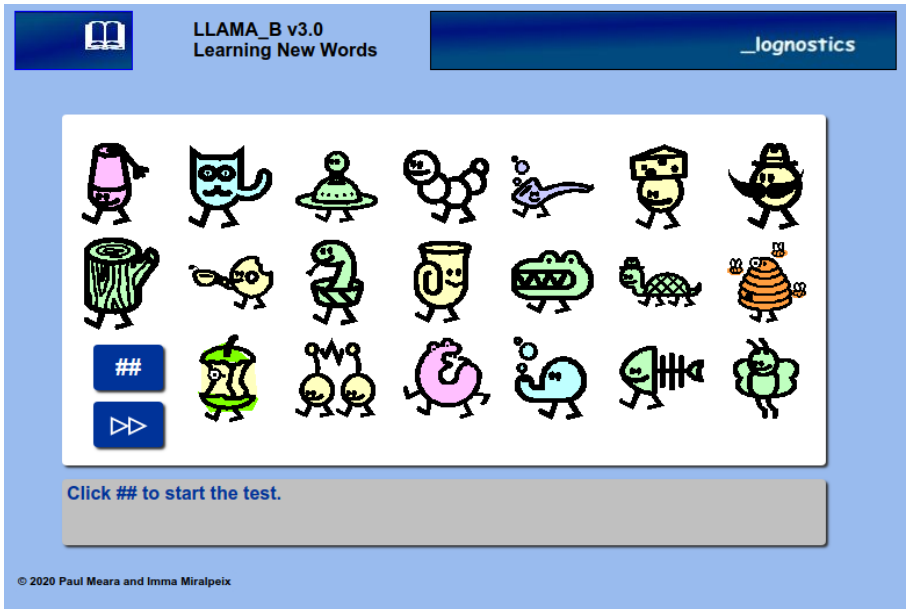

Figure 8. The LLAMA_B3 Test Page

LLAMA D3 test evaluates one's ability to recognize a new word by stating whether it is given for the first time or if it is a repeated word. As with the LLAMA

B test, there are 20 words in total with one point for each word. The following is the interface of LLAMA D test (see Figure 9):

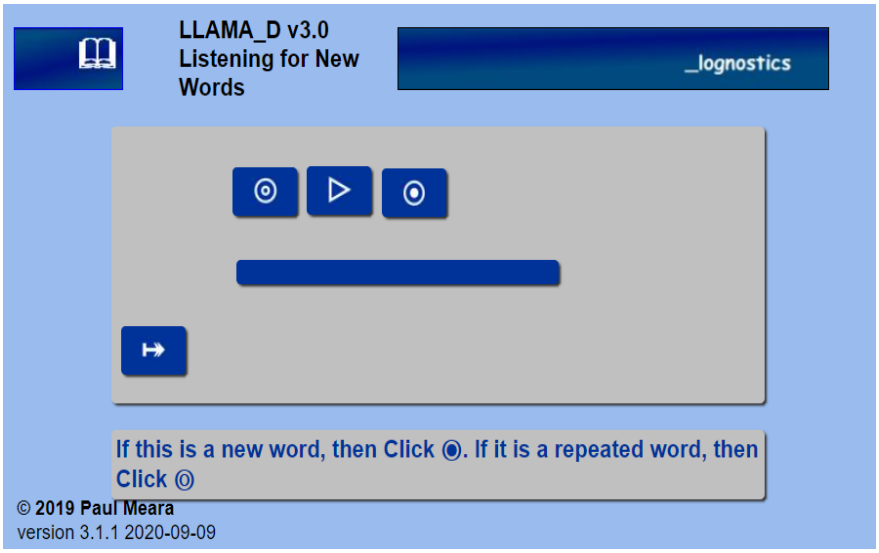

Figure 9. The LLAMA_D3 Test Page

The aim of LLAMA E3 test is to test one's aptitude in connecting sounds and symbols. As the Figure 10 shows, there are 24 blue buttons in the grey square with symbols on each one. A sound comes out when the participant clicks one of the buttons. Participants have two minutes click as many buttons as possible to explore the relationships between the sound and the symbol. When test begins, the participants see an interface as in Figure 11. When they click 'Next' button, a sound plays. They must choose a button that represents the sound from the 20 buttons with symbols. There are 20 items in this subtest with one point for each.

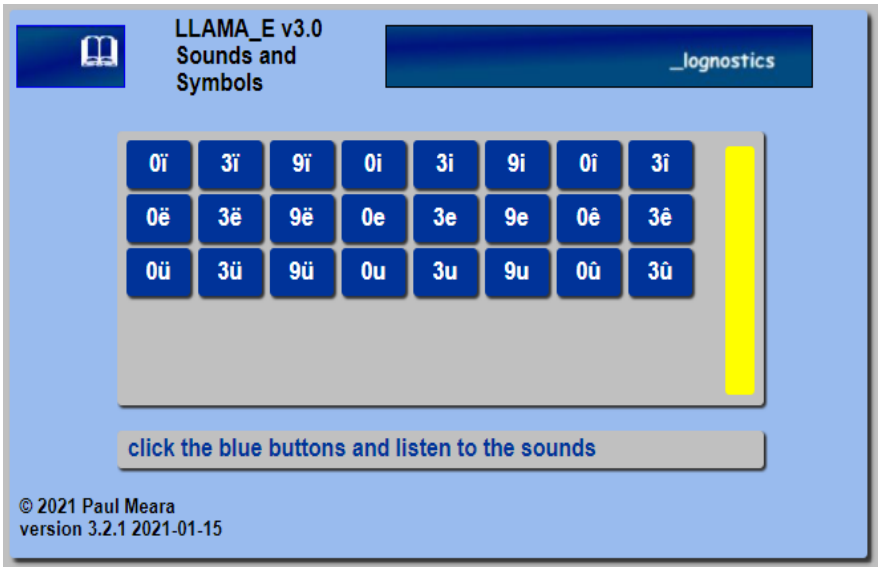

Figure 10. The LLAMA_E3 Learning Page

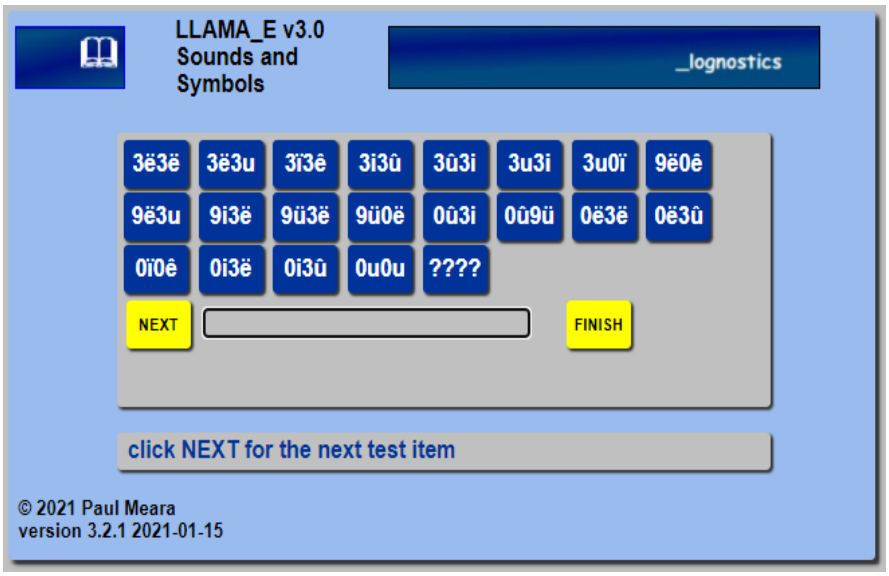

Figure 11. The LLAMA_E3 Test Page

The LLAMA F3 test measures one's grammatical sensitivity: the ability to acquire grammar rules from unfamiliar information. When participants click the red buttons on the display page (see Figure 12), a sentence shows up in the blue bar and a picture in the yellow square. Using the red buttons to scroll through the collection for five minutes, they try to find as many connections as possible between the 20 sentences and pictures. After this, the system goes into the test automatically (see Figure 13). Participants then try to describe each picture with the words given on 16 blue buttons. There are ten questions and with a maximum score of 20 points.

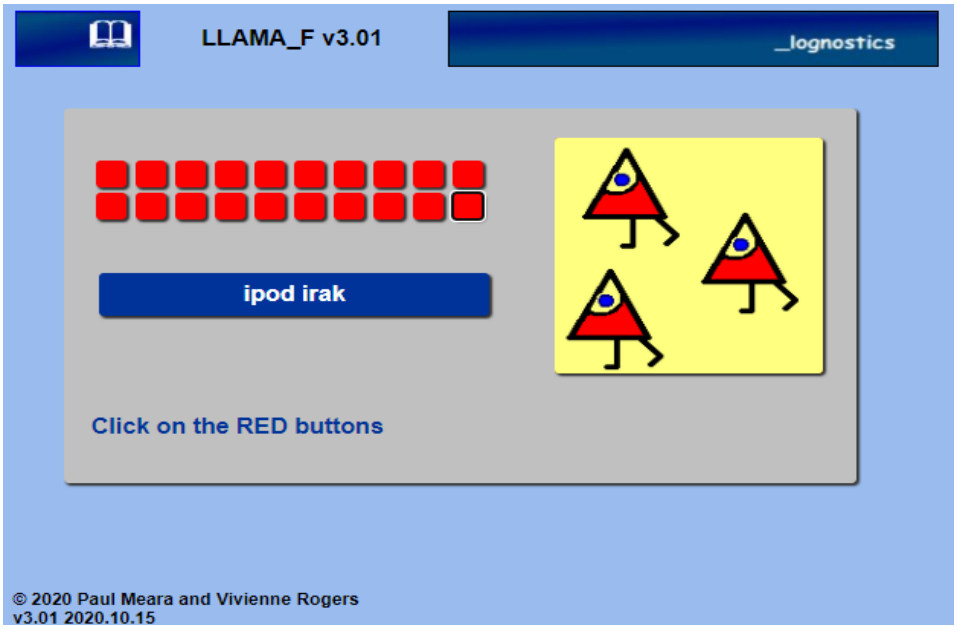

Figure 12. The LLAMA_F3 Learning Page

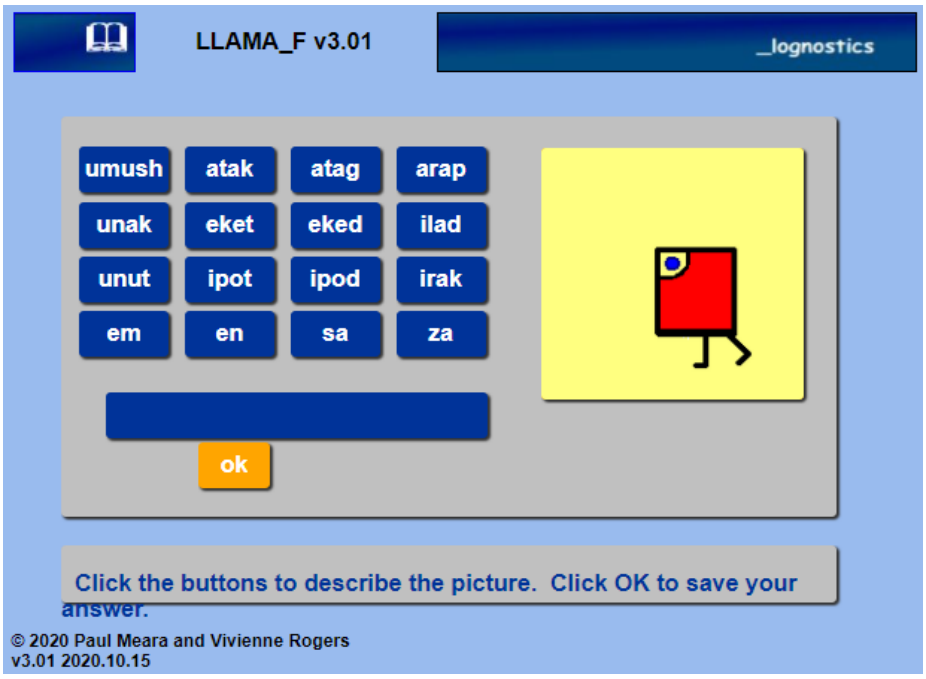

Figure 13. The LLAMA_F3 Test Page

The system provides a report of the participants' scores when they finish. Because the operating system of the computers in the lab were quite outdated, all the LLAMA subtests were conducted on the participants' mobile phones. After participants finished each subtest, they were asked to submit screenshots of their scores on the website https://www.wjx.cn/ . The Reliability of the language aptitude test is 0.678, which is acceptable (see Table 4).

Table 4. Reliability Statistics of the Language Aptitude Test

Cronbach's Alpha	*n* of Items
0.678	4

3.3.2 Motivation

The Attitude/Motivation Test Battery (Gardner et al., 1985; Gardner, 2004) is based on social psychology and has been proven to have high reliability and validity. Four indicators were adopted from the battery: attitudes toward vocabulary learning, interest in foreign languages, personal orientation, and anxiety about English class. The questionnaire consists of 19 items with a 7-point Likert scale ranging from 1 (very untrue of me) to 7 (very true of me).

Because the survey examined participants' L2 learning strategies, learning styles, and learning motivations at the same time, there was concern that the length of the content may lead them to feel fatigue and negative emotions in the process of answering, affecting the reliability of the survey. Moreover, considering participants may not be familiar with the situations in some statements, the author deleted some items so the test could be more compact and suitable for Chinese learners. One statement was added in the Instrumental orientation part as well: *Studying English can be important for me because I want to meet the requirements for English level to get my diploma or Bachelor degree.* In addition, in order to more closely follow the research purpose and theoretical framework, a few words in some items were modified from 'attitudes towards foreign language learning' to 'attitudes towards vocabulary learning.' What is more, the researcher translated the motivational scale into Chinese to ensure that the participants could correctly understand it. A pilot study of 30 students was then conducted to check the scale and minor alterations were made to some translations. SPSS 26.0 was used to test the reliability of the

questionnaire. Cronbach's alpha analysis indicated a score of .886 (see Table 5), which indicated a high reliability. Then the final revision of the scale was then created (see Appendix 6).

Table 5. Reliability Statistics of Motivation

Cronbach's Alpha	*n* of Items
.886	19

3.3.3 Learning Strategy

The Vocabulary Learning Strategies Survey (VLSS) (Schmitt & Schmitt, 1993) was used to investigate the strategies of vocabulary learning. The questionnaire has 40 questions, which are divided into two categories according to Schmitt's (1993) classification of vocabulary learning strategies. The first category is the strategies used when learners encounter new words. It is divided into four sub-categories: use reference materials, ask others for information/work with others, analyze words from available information, and avoidance. The second category is the strategies used when learners encounter the words more than once. They are divided into the following nine sub-categories: repetition, study the formal and grammatical aspects of a word, (make and) use study aids, perseverance strategy, use physical actions, manipulation of meaning, create system of associations, work with others, and imaging. However, in this study the combined strategy taxonomy of Oxford (1990) and Schmitt (1997) was applied in this category, because it is more consistent with other individual variables. According to Oxford's (1990) taxonomy, strategies are:

Social Strategies (SOC), Memory Strategies (MEM), Cognitive Strategies (COG) and Metacognitive Strategies (MET). After this, Schmitt's (1997) added a new category-Determination Strategies (DET).

The above-mentioned questionnaire was partly modified for Chinese L2 learners in the study. For example, the items that included difficult terms such as "scale of gradable adjective meanings" (Schmitt & Schmitt, 1993, p.5) and "cognates" (Schmitt & Schmitt, 1993, pp.5-6) were deleted. For clarification of meaning, some words were added, such as the word "motion" in "Use physical action when studying *motion* words," and "in English" as in "Paraphrase the meaning of the new word *in English*." In addition, in the subcategory "make and use study aids," the author added "Use APPs or software to study words" because mobile phone apps have now become the prevailing tool for Chinese college students to study English vocabulary. the strategy *Use APP or software to study words* falls into the category of COG, based on Oxford (op. cit.), which refers to the strategy of "manipulation or transformation of the target language by the learner" (p.43).

The questionnaire consists of 40 items with a 5-point Likert scale ranging from 1 (Never or almost never true of me) to 5 (Always or almost always true of me). The learning strategy scale showed high reliability (Cronbach's Alpha=0.946) (see Table 6).

Table 6. Reliability Statistics of Learning Strategy

Cronbach's Alpha	*n* of Items
.946	40

3.3.4 Learning Style

Kolb & Kolb's Learning Style Inventory (2005) was used to explore the participants' learning style. It is used by many researchers and has been proven to have high reliability (Kayes, 2005; Ruble & Stout, 1990, 1991). After repeated revision, it has been widely used to measure learning styles in terms of different ages, education levels, and disciplines. Due to its high reliability and validity, and the moderate number of questions, it is used in this study.

There are twelve ipsative questions in Kolb's learning style scale. Each question has four options A, B, C and D, and each option represents a tendency in learning style. According to their self-evaluation, the participants rank the four options in the order of "the one which best typifies your learning style," "the second to the best," "the third to the best," and "least typifies your learning style." In view of the differences in language understanding and culture between China and Western countries, the author translated this questionnaire into Chinese and put it online for the participants to answer. In the questionnaire, the online system automatically assigned "1, 2, 3, 4" points to the options in the order in which the participants ticked. However, the participants intuitively choose the option first that best characterize their learning styles in the pilot study, which is assigned "1" in the online system but "4" in the paper scale. To avoid the contradiction, the author follows the scoring method of the online system but changed the method of processing data and statistics to maintain the same scoring principle as the original paper scale.

Depending on the participants' answers, four types of learning styles can be assigned based on Kolb's model, namely Concrete Experience (CE) and Abstract Conceptualization (AC); Reflective Observation (RO) and Active Experimentation (AE). Among them, the score of Concrete Experience is the sum of the scores of option A in the twelve questions. Similarly, the score of Reflective Observation is from that of option B; Abstract Conceptualization from that of option C; the score of Active Experimentation from option D. Then the four types of scores are calculated in pairs to form the results of another two other dimensions, i.e., a 'grasping' dimension, which is obtained by subtracting the score of CE from that of the AC, and a 'transformation' dimension obtained by subtracting the score of the reflective observation (RO) from AE score. The 'grasping' dimension is a measurement of an individual's inclination towards information reception in a way which preferences abstractness over concreteness (AC-CE), whereas the 'transformation' dimension is about the way of processing information which preference action over reflection (AE-RO). The results are divided into four quadrants according to the values of the two dimensions (see Figure 14):

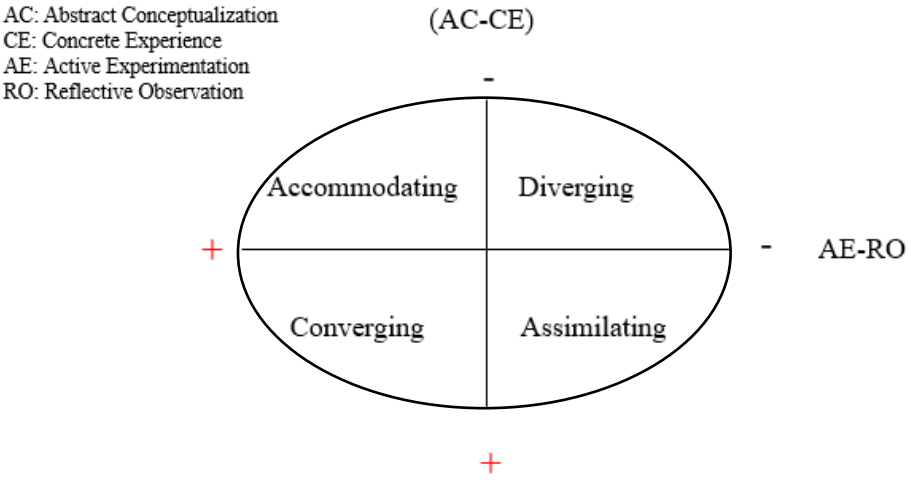

Figure 14. The Learning Style Circle

4. Procedure

4.1 Pilot Study

A pilot study was conducted to predict possible problems with the execution of online tests, such as the order of the tests, and to confirm that the contents and Chinese translations were appropriate for the research. A preliminary version of the tests was designed based on previous research (e.g., Lee, 2017) and presented to 30 participants on the website https://www.wjx.cn/.

According to the type of test format, three sets of tests were provided to the participants. The first set included Vocabulary Levels Test (VLT), Word Associates Test (WAT), and Derivative Word Form Test (DWFT), which required the participants to select or produce the vocabulary. The second set consisted of

questionnaires which contained the Attitude/Motivation Test Battery, The Vocabulary Learning Strategies Survey, and the Learning Style Inventory, which used a Likert scale ranging from one to five points. The third was the language aptitude test (The LLAMA Tests v3), a ready-made computer-based test program. In a futile attempt to avoid overwhelming the participants, the tests were conducted over three consecutive days.

4.2 Modification of the Instruments

Based on the problems discovered in the pilot study, modifications were made in the questionnaire and tests. First, several questions were rephrased to clarify the meaning and some items irrelevant to this research were excluded (see *3 Instrument* for details). For example, questions that weren't suitable for college students were deleted from the motivation test, such as *My parents try to help me to learn English.* *Using cognate words to learning English* was excluded since it is not a common learning strategy for Chinese college students. The strategy *Interacting with native speakers* was also deleted based on the responses of the participants of the pilot study. Another strategy, *Put English labels on physical objects*, was reported to be seldom used by students so it was removed. The word 'paraphrase' in *Paraphrase the word's meaning* meant to use different words to explain a concept, but it might be easily misunderstood as 'to translate' in Chinese. So, the strategy was adapted to *Paraphrase the word's meaning in English* in the translated questionnaire. In

addition, a few typos were corrected and inaccurate translations were improved in the learning style questionnaires.

Second, the obscure parts of individual translations were also modified based on the problems identified in post-pilot interviews with the participants. For example, the English-language directions on the LLAMA tests were translated into Chinese. In addition, test instructions were provided in a PowerPoint presentation so as to avoid unnecessary problems during the test which could affect the test validity. Also, the time interval between the tests was adjusted based on feedback from the participants.

4.3 Main Research

After the final version of the vocabulary tests and questionnaires were confirmed, the primary tests were conducted. Before the tests began, the participants were informed that the surveyed information would be only used for scientific research, and that their personal information and scores would be kept strictly confidential in accordance with relevant Chinese laws. The tests were conducted over three days. The first test was the vocabulary test, measuring participants' breadth and depth of vocabulary knowledge, including the Vocabulary Levels Test, the derivative form test, and the Word Associates Test. In order to ensure that the participants could correctly understand and complete each test, a 20-minute demonstration and training in batches was provided to the participants to ensure that they understood the purpose of the study, the guidelines, and the procedures of the

tests. In order to achieve authentic results from participants, it was repeatedly stated that the purpose of the test was to conduct empirical research, which was totally different from the final exams they had ever taken. Therefore, it was meaningless for them to look up terms in the dictionary or ask others for help. The vocabulary test time was 120 minutes.

The second test was for learner variables including the motivation, learning strategies and learning style. The participants were asked to take three sets of tests: The Attitude/Motivation Test Battery (AMTB) Gardner (1985), the Vocabulary Learning Strategies Survey (VLSS) (Schmitt & Schmitt, 1993) and Learning Style Inventory (Kolb, 1984). It was conducted online one day after the vocabulary test. All 431 participants were invited to chat groups on the APP *WeChat* Version 7.0.21 and then led to the test link where the online questionnaires were provided. All the participants took the tests online at the same time and there were no time constraints.

The last test was the test for language aptitude, LLAMA Test v3. It was conducted on an individual basis to avoid the technical problems identified in the pilot study. In the pilot study when 30 people logged on to the LLAMA test website at the same time, there was a problem with the connection. To avoid this technical problem, the test was scheduled on an individual basis according to each participant's convenience. Since the LLAMA website does not provide an individual's score records, a screenshot of the score record page at the end of each sub-test was individually collected. When all the tests and questionnaire surveys were finished, the data were collected and analyzed.

5. Data Collection and Analysis

As there were many types of tests involved in this study, the results were compiled into a digital version in order to simplify the statistical procedures. First, the three test scores and questionnaire results from the test website were collected and sorted. Invalid test papers were excluded; for example, if (1) the answers were completely the same or had obvious irregularities, such as selecting "Always or almost always true of me" in all items of the questionnaire, or choosing the same order in all items from "Never or almost never true of me" to "Always or almost always true of me"; if (2) the answering time was too quick; for example, less than 20 minutes on the vocabulary level test; or if (3) the participants failed to complete all three tests. Another issue to overcome with the data was to transform the scores of negative items in the motivation questionnaire and the scores of learning styles, as mentioned above.

The participants were then classified into two groups on the basis of learners' vocabulary size/breadth and depth of vocabulary knowledge based on the two vocabulary assessment tests (the Word Associates Test (WAT) and the Derivative Word Form Test), which were manually scored and organized in MS Excel. The learner variables, including language aptitude, motivation, language learning strategies, and learning styles were also scored and coded (see Table 7). Then all the data were fed into SPSS 26.0. For the measurement of differences between the types of vocabulary depth, a paired t-test was used. In addition, Pearson correlation tests were conducted to explore any connection between the depth and individual

difference variables among participants at the same size/breadth of vocabulary (Research question 1).

Table 7. Data Coding

Domains	Tests	Sections	Code
Depth of VK	Word Associates Test		DVK1
	Derivative Word Form Test		DVK2
Size/ Breadth	Vocabulary Level Test		VLT
Language Aptitude	Vocabulary Learning L-B3		A1
	Speech Perception L-D3		A2
	Sound-Symbol Pairing L-E3		A3
	Grammar Rules Inference L-F3		A4
Motivation	Attitude/Motivation Test Battery	Attitudes toward vocabulary	M1
		Interest in foreign languages	M2
		Integrative orientation	M3
		Instrumental orientation	M4
		English class anxiety	M5
Learning Strategy	Vocabulary Learning Strategies Survey	Social Strategies (SOC)	LS1
		Memory Strategies (MEM)	LS2
		Cognitive Strategies (COG)	LS3
		Metacognitive Strategies	LS4
		Determination Strategies	LS5
Learning Style	Learning Style Inventory3.1	Accommodating type	S1
		Diverging type	S2
		Converging type	S3
		Assimilating type	S4

After the analysis using SPSS, the structural equation statistical software AMOS 24.0 was applied to further explore the relationship between learner variables affecting the difference and the depth of VK (Research question 2). First, exploratory factor analysis on the questionnaire scales was performed to exclude some items that were not suitable for factor analysis from the statistics of the structural equations. Next the measurement model was established, estimated, and evaluated. If necessary, the measurement model was corrected. Then followed establishment of the structural equation model. Using the same procedure as with the measurement model, it was estimated, evaluated, and revised, if necessary. Finally, the structural equation model was used to calculate the influence of learners' individual differences on the depth of vocabulary knowledge. Figure 15 exhibits the collection and analysis process of the data.

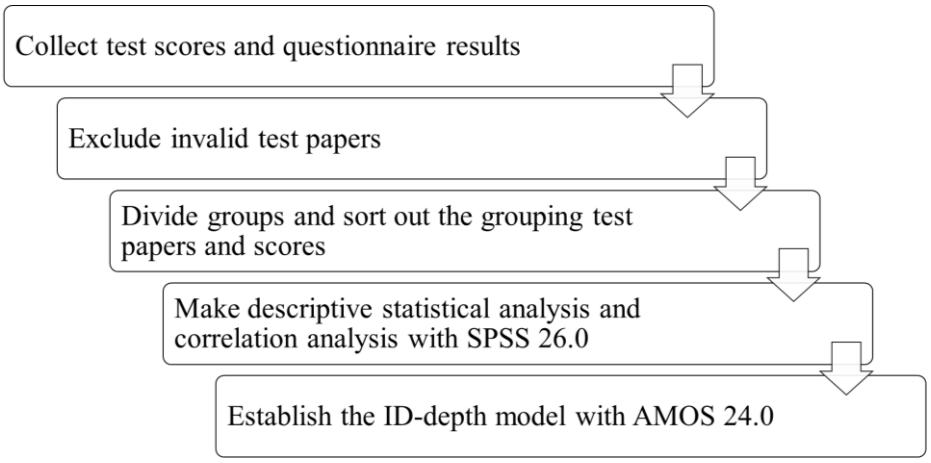

Figure 15. The Procedure of Data Collection and Analysis

IV. Results

After the data were collected the SPSS 26.0 statistical program was used to perform the analysis, and the following descriptive statistics were obtained. Since there are many tests in the survey the valid data has been checked and sorted, and there is no missing value.

In the Vocabulary Level Test, there are 30 answers in each word level with 1 point for each answer. Each level scores 30 points and the total score of the test is 90. Table 8 shows that as the difficulty increases, the average scores of each level gradually decrease. The mean of total score is 50.09 points. Participants were divided into two groups according to these averages: Group-Low with a mean between 0-49 and Group-High with mean of and above 50. There are significant differences between the two groups as compared using independent samples of the vocabulary size/breadth of the individual members (see Table 9), therefore, the group composition was deemed workable.

Table 8. Descriptive Statistics of the Vocabulary Size (Breadth)

		n	Min	Max	*M*	*SD*
Group-Low	Word 2000	113	3	28	14.97	6.918
	Word 3000	113	1	20	9.90	4.643
	Word 5000	113	0	15	6.81	2.782
	Total vocabulary size/breadth	113	10	49	31.69	12.073
Group-High	Word 2000	118	9	30	26.32	2.984
	Word 3000	118	13	30	22.65	4.150
	Word 5000	118	5	30	18.74	7.336
	Total vocabulary size/breadth	118	50	89	67.71	11.670
All groups	Word 2000	231	3	30	20.77	7.756
	Word 3000	231	1	30	16.42	7.749
	Word 5000	231	0	30	12.90	8.175
	Total vocabulary size/breadth	231	10	89	50.09	21.585

Note. Group-Low= Low level of Vocabulary Size/breadth Group; Group-High=High level of Vocabulary Size/breadth Group

Table 9. Independent Samples Test of the Vocabulary Size (Breadth) Between Group-High and Group-Low

	Paired Differences				*t*	*df*	Sig. (2-tailed)
	M	*SD*	95% CI of the Difference				
			Lower	Upper			
2000 word	-11.349	0.706	-12.744	-9.953	-16.065	150.87	0.000
3000 word	-12.750	0.579	-13.890	-11.609	-22.027	229	0.000
5000 word	-11.923	0.724	-13.354	-10.492	-16.462	151.23	0.000
VLT	-36.022	1.562	-39.100	-32.944	-23.059	229	0.000

1. Difference of Vocabulary Depth Among the Learners at the Same Level of Vocabulary Size (Breadth)

As mentioned in Chapter III, the depth of vocabulary knowledge includes two parts. The Word Associates Test includes 20 questions of 4 points each. The Derivative Word Form Test comprises 16 questions of 4 points each. The total score of depth of vocabulary knowledge is 144. As Table 10 displayed, the mean scores of Group-High both in the word associates test and the Derivative Word Form Test is higher than those of Group-Low, but the standard deviations of the two groups are close.

Table 10. Descriptive Statistics of the Depth of Vocabulary Knowledge

		n	Min	Max	*M*	*SD*
Group-Low	Word Associates Test	113	8	61	34.27	11.181
	Derivative Word Form Test	113	0	48	23.88	10.283
	Total vocabulary Depth	113	8	100	58.16	17.266
Group-High	Word Associates Test	118	14	72	44.01	11.307
	Derivative Word Form Test	118	9	58	36.89	9.875
	Total vocabulary Depth	118	32	117	80.90	17.471
All groups	Word Associates Test	231	8	72	39.25	12.235
	Derivative Word Form Test	231	0	58	30.53	11.981
	Total vocabulary Depth	231	8	117	69.77	20.741

Note. Group-Low= Low level of Vocabulary Size/breadth Group; Group-High=High level of Vocabulary Size/breadth Group

To test whether there was a difference in the depth of vocabulary knowledge of participants at the same vocabulary size/breadth, a paired *t*-test was conducted. Since the total scores of the Word Associates Test and the Derivative Word Form Test were different, the data was standardized to make the total score consistent. As shown in Table 11 and Table 12, there was a statistically significant increase in the depth of vocabulary from the Word Associates Test (M=34.27, SD=11.181) to the Derivative Word Form Test (M=29.86, SD=12.854), t (113)=3.272, p<.005 (two-tailed) in Group-Low. However, in Group-High the decrease in the depth of

vocabulary from the Word Associates Test (*M*=44.01, *SD*=11.307) to the Derivative Word Form Test (*M*=46.1123, *SD*=12.344), *t* (118) = -1.702, *p*>.005 (two-tailed) did not reach statistical significance.

Table 11. Difference of Vocabulary Depth

		n	*M*	*SD*	*SEM*
Group-Low	DVK1	113	34.27	11.181	1.052
	standardized DVK2	113	29.86	12.854	1.209
Group-High	DVK1	118	44.01	11.307	1.041
	standardized DVK2	118	46.11	12.344	1.136

Note. Group-Low = Low level of Vocabulary Size/breadth Group; Group-High = High level of Vocabulary Size/breadth Group; DVK1 = the Word Associates Test; DVK2 = Derivative Word Form Test; SEM= Standard Error of Mean.

Table 12. Paired Samples *t*-test of DVK1 and DVK2

		Paired Differences					*t*	*df*	Sig. (2-tailed)
		M	*SD*	*SEM*	95% CI of the Difference				
					Lower	Upper			
G-L	DVK1 - DVK2	4.42	14.356	1.350	1.742	7.094	3.272	112	0.001
G-H	DVK1 - DVK2	-2.10	13.430	1.236	-4.552	0.345	-1.702	117	0.091

Note. G-L = Low level of Vocabulary Size/breadth Group; G-H = High level of Vocabulary Size/breadth Group; DVK1 = the Word Associates Test; DVK2 = Derivative Word Form Test; CI = Confidence Interval; SEM= Standard Error of Mean.

2. Learner Variables Affecting the Variation in Vocabulary Depth

2.1 Language Aptitude

As shown in Table 13, the mean score of B3 (mean = 9.37) is the highest in both Group-Low and Group-High among the four sub-tests. This may result from the participants' method of learning English. The teaching materials used in English instruction were predominantly written rather than aural. Thus, participants have much more experience mapping new words to pictures than D3, E3 tests, which involved listening ability.

Table 13. Descriptive Statistics of the Language Aptitude Test

		n	Min	Max	*M*	*SD*
Group-Low	B3	113	0	20	6.81	6.420
	D3	113	0	14	3.96	4.262
	E3	113	0	17	1.81	3.037
	F3	113	0	18	5.74	4.504
	TS	113	1	57	18.32	12.333
Group-High	B3	118	0	20	11.82	6.759
	D3	118	0	19	5.76	5.073
	E3	118	0	20	4.98	6.516
	F3	118	0	18	7.88	4.963
	TS	118	2	69	30.45	16.74

Note. Group-Low = Low level of Vocabulary Size/breadth Group; Group-High = High level of Vocabulary Size/breadth Group; B3 = the Vocabulary Learning Test; D3 = Speech Perception Test; E3 = Sound-Symbol Pairing Test; F3 = Grammar Rules Inference Test; TS = Total Score.

From the data in the Table 14, the scores of the four language aptitude subtests of Group-Low is not significantly related to the depth of vocabulary knowledge. The situation of Group-High is different. All the scores of language aptitude are significant excluding B3, the Vocabulary Learning Test. If the score of overall participants is examined, the Pearson correlation coefficient is moderate positive (B3=.289; D3=.258; E3=.242; F3=.281). Since the *p*-value is under 0.01, the correlation between the language aptitude and the depth of vocabulary knowledge is statistically significant. In other words, the language aptitude of large vocabulary-size/breadth learners is moderately related to the depth of vocabulary knowledge, whereas the language ability of learners with small size/breadth is not.

Table 14. Pearson Correlations Between Language Aptitude and Depth of Vocabulary Knowledge

		B3	D3	E3	F3	TLA
G-L	*r*	0.053	0.147	-0.135	0.177	0.110
	Sig.	0.576	0.119	0.154	0.061	0.247
	n	113	113	113	113	113
G-H	*r*	0.179	.219*	.210*	.212*	.283**
	Sig.	0.053	0.017	0.022	0.021	0.002
	n	118	118	118	118	118
TG	*r*	.289**	.258**	.242**	.281**	.372**
	Sig.)	0.000	0.000	0.000	0.000	0.000
	n	231	231	231	231	231

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
Note. G-L = Low level of Vocabulary Size/breadth Group; G-H = High level of Vocabulary Size/breadth Group; TG = Total group; *r* = Pearson Correlation; Sig. = Sig. (2-tailed); B3 = the Vocabulary Learning Test; D3 = Speech Perception Test; E3 = Sound-Symbol Pairing Test; F3 = Grammar Rules Inference Test; TLA = Total language aptitude.

Table 15. Descriptive Statistics of Motivation

		n	Min	Max	*M*	*SD*
Group-Low	M1	113	21	49	35.11	6.311
	M2	113	3	21	14.01	3.985
	M3	113	3	21	14.56	4.456
	M4	113	3	21	15.88	3.467
	M5	113	7	21	14.12	3.405
	Total Score	113	40	127	93.67	16.331
Group-High	M1	118	23	49	39.33	5.399
	M2	118	5	21	15.83	3.352
	M3	118	6	21	16.20	3.451
	M4	118	9	21	16.74	2.703
	M5	118	3	21	13.34	3.557
	Total Score	118	70	127	101.44	12.495
All Groups	M1	231	21	49	37.26	6.221
	M2	231	3	21	14.94	3.779
	M3	231	3	21	15.40	4.050
	M4	231	3	21	16.32	3.123
	M5	231	3	21	13.72	3.498
	Total Score	231	40	127	97.64	14.981

Note. Group-Low = Low level of Vocabulary Size/breadth Group; Group-High = High level of Vocabulary Size/breadth Group; M1 = Attitudes toward vocabulary learning; M2 = Interest in foreign languages; M3 = Integrative orientation; M4 = Instrumental orientation; M5 = English class anxiety.

Table 16 presents the correlations between motivation and vocabulary depth. In Group-Low positive correlations were found between DVK1 and M2 (r=.190, p=0.044) and M3 (r=.207, p=0.028). And a significant positive correlation was also found between M3 and Total DVK (r=.224, p=0.017). In Group-High, positive correlations with DVK2 were found in M1 (r=.273, p=0.003<0.01 (2-tailed)), M2

(*r*=.183, *p*=0.047<0.05 (2-tailed)), M3 (*r*=.234, *p*=0.011<0.05 (2-tailed)), and Total motivation (*r*=.230, *p*=0.012<0.05 (2-tailed). Concerning all groups, DVK1 had a significant positive correlation with M1 (*r*=.180, *p*=0.006<0.01 (2-tailed)), M2 (*r*=.189, *p*=0.004<0.01 (2-tailed)), M3 (*r*=.188, *p*=0.004<0.01 (2-tailed)) and Total motivation (*r*=.173, *p*=0.008<0.01 (2-tailed)). It should be noted that all the domains of motivation except M5 had positive correlations with DVK2 and Total DVK.

Table 16. Pearson Correlations Between Motivation and Depth of Vocabulary Knowledge

			M1	M2	M3	M4	M5	TM
G-L	DVK1	*r*	0.064	.190*	.207*	0.084	-0.075	0.130
		Sig.	0.497	0.044	0.028	0.379	0.427	0.171
		n	113	113	113	113	113	113
	DVK2	*r*	0.122	0.097	0.150	0.079	-0.157	0.096
		Sig.	0.196	0.309	0.112	0.406	0.096	0.312
		n	113	113	113	113	113	113
	Total DVK	*r*	0.115	0.181	.224*	0.101	-0.143	0.141
		Sig.	0.226	0.055	0.017	0.286	0.132	0.136
		n	113	113	113	113	113	113
G-H	DVK1	*r*	0.037	0.009	0.015	0.026	-0.038	0.017
		Sig.	0.689	0.922	0.873	0.779	0.682	0.852
		n	118	118	118	118	118	118
	DVK2	*r*	.273**	.183*	.234*	0.180	-0.144	.230*
		Sig.	0.003	0.047	0.011	0.051	0.121	0.012
		n	118	118	118	118	118	118
	Total DVK	*r*	0.179	0.109	0.142	0.119	-0.106	0.141
		Sig.	0.053	0.239	0.125	0.200	0.254	0.127
		n	118	118	118	118	118	118
All	DVK1	*r*	.180**	.189**	.188**	0.107	-0.096	.173**
		Sig.	0.006	0.004	0.004	0.105	0.147	0.008
		n	231	231	231	231	231	231
	DVK2	*r*	.336**	.242**	.264**	.177**	-.186**	.265**
		Sig.	0.000	0.000	0.000	0.007	0.004	0.000
		n	231	231	231	231	231	231
	Total DVK	*r*	.300**	.251**	.263**	.165*	-.164*	.256**
		Sig.	0.000	0.000	0.000	0.012	0.012	0.000
		n	231	231	231	231	231	231

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed). *Note.*TM=Total Motivation; G-L=Low Vocabulary Size Group; G-H=High Vocabulary Size Group; All=All groups; M1=Attitudes toward vocabulary learning; M2=Interest in foreign languages; M3= Integrative orientation; M4=Instrumental orientation; M5=English class anxiety; DVK1=Word Associates Test; DVK2 =Derivative Word Form Test; Total DVK= DVK1+DVK2

2.2 Language Learning Strategies

As shown in Appendix 5, Group Frequency of Learning Strategies, the most frequent choices (total 36 out of 40 items) consisted mainly in the option *Sometimes* in Group-Low, while the most frequent choices were distributed relatively normally in Group-High, i.e., 15 items in *Sometimes*, 14 in *Always* and 11 in *Seldom.* If the most frequently used strategies of the two groups are compared, the strategies that the large vocabulary size/breadth group most often uses are: *using bilingual dictionary* (stra1); *checking part of speech* (stra9); *guessing meaning from reading context* (stra10); *repletion strategies* (stra13, 14); *studying the spelling* (stra15); *way of the word sounds* (stra16); *using study aids* (stra22, 23, 24, 25); *associations* (stra31) and *imaging* (stra39,40). However, these strategies were used only sometimes by the small size/breadth group. On the contrary, the following strategies were rarely used by the large size/breadth group while they were used more often by small size/breadth group: *using monolingual English dictionary* (stra2); *paraphrasing the meaning* (stra29); *creating system of associations* (stra32, stra33) and *work with others* (stra36, 37).

There are 40 items in the learning strategy questionnaire, which unequally distribute in the variables. LS2 has the most items, a total of 16 items of 90 points. Then it is followed by LS5 (40 points for eight items), LS1 (35 points for seven items) and LS3 (30 points for six items), respectively. The least is LS4, with a total of 15 points for three items. Therefore, the adjusted data is shown in Table 17.

Table 17. Descriptive Statistics of Learning Strategies

		n	*M*	*SD*	Adjusted *M*	Adjusted *SD*
Group-Low	LS1	113	16.92	5.075	43.509	13.049
	LS2	113	47.87	11.186	47.867	11.186
	LS3	113	19.80	3.915	59.389	11.744
	LS4	113	9.91	2.016	59.469	12.095
	LS5	113	24.58	5.005	55.294	11.261
	TS	113	119.07	22.659	265.529	47.341
Group-High	LS1	118	16.66	4.700	42.843	12.086
	LS2	118	49.42	11.393	49.415	11.393
	LS3	118	20.05	4.004	60.153	12.012
	LS4	118	10.63	1.753	63.763	10.519
	LS5	118	27.06	4.943	60.883	11.122
	TS	118	123.81	22.354	277.057	44.629
All groups	LS1	231	16.79	4.878	43.169	12.543
	LS2	231	48.66	11.294	48.658	11.294
	LS3	231	19.93	3.954	59.779	11.862
	LS4	231	10.28	1.916	61.662	11.495
	LS5	231	25.84	5.116	58.149	11.511
	TS	231	121.49	22.58	271.418	46.237

Note. Group-Low= Low level of Vocabulary Size/breadth Group; Group-High=High level of Vocabulary Size/breadth Group; LS1 = Social Strategies (SOC); LS2= Memory Strategies (MEM); LS3= Cognitive Strategies (COG); LS4= Metacognitive Strategies (MET); LS5=Determination Strategies (DET); TS= Total Score

As shown in Table 18, DVK1 had a significant positive correlation with some domains of learning strategy in Group-Low, such as LS2 (r=.235, p=0.012<0.05 (2-tailed)), LS4 (r=.226, p=0.016<0.05 (2-tailed)), LS5 (r=.186, p=0.049<0.05 (2-tailed)) and Total Learning Strategy (r=.230, p=0.014<0.05 (2-tailed)). The total score of DVK showed a significant positive correlation only with LS5 (r=.212,

p=0.024<0.05 (2-tailed)) in Group-Low. Nonetheless, no significant positive correlation was found between DVK1 and any domain of learning strategy in Group-High. In addition, the positive correlation was only significant between DVK2 and LS5 (r=.201, p=0.029<0.05 (2-tailed)), as well as Total DVK and LS4 (r=.194, p=0.035<0.05 (2-tailed)).

In terms of the individual participants, most domains of learning strategy had a significant positive correlation with the depth of vocabulary knowledge, such as DVK1 with LS2 (r=.195, p=0.003<0.01 (2-tailed)), LS4 (r=.252, p=0.000<0.01 (2-tailed)), LS5 (r=.195, p=0.003<0.01 (2-tailed)) and Total Learning Strategy (r=.203, p=0.002<0.01 (2-tailed)), DVK2 with LS4 (r=.172, p=0.009<0.01 (2-tailed)), LS5 (r=.277, p=0.000<0.01 (2-tailed)) and Total Learning Strategy (r=.132, p=0.045<0.05 (2-tailed)) as well as Total DVK with LS2 (r=.176, p=0.007<0.01 (2-tailed)), LS4 (r=.248, p=0.000<0.01 (2-tailed)), LS5 (r=.275, p=0.000<0.01 (2-tailed)) and Total Learning Strategy (r=.196, p=0.003<0.01 (2-tailed)), respectively. Overall, the results indicated that the higher vocabulary depth a learner had the more vocabulary learning strategies he or she used.

Table 18. Pearson Correlation Between Learning Strategy and the Depth of Vocabulary Knowledge

			LS1	LS2	LS3	LS4	LS5	TS
GL	DVK1	*r*	0.111	.235*	0.161	.226*	.186*	.230*
		Sig.	0.240	0.012	0.088	0.016	0.049	0.014
		n	113	113	113	113	113	113
	DVK2	*r*	0.008	0.047	-0.055	0.028	0.154	0.052
		Sig.	0.936	0.621	0.560	0.772	0.103	0.585
		n	113	113	113	113	113	113
	TDVK	*r*	0.077	0.180	0.071	0.163	.212*	0.180
		Sig.	0.419	0.057	0.453	0.085	0.024	0.057
		n	113	113	113	113	113	113
GH	DVK1	*r*	0.122	0.135	0.054	0.168	0.037	0.125
		Sig.	0.189	0.146	0.559	0.069	0.691	0.176
		n	118	118	118	118	118	118
	DVK2	*r*	-0.046	0.116	0.127	0.151	.201*	0.128
		Sig.	0.619	0.212	0.171	0.102	0.029	0.166
		n	118	118	118	118	118	118
	TDVK	*r*	0.053	0.153	0.107	.194*	0.138	0.154
		Sig.	0.572	0.099	0.249	0.035	0.137	0.097
		n	118	118	118	118	118	118
All Group	DVK1	*r*	0.096	.195**	0.110	.252**	.195**	.203**
		Sig.	0.145	0.003	0.096	0.000	0.003	0.002
		n	231	231	231	231	231	231
	DVK2	*r*	-0.030	0.106	0.048	.172**	.277**	.132*
		Sig.	0.652	0.109	0.464	0.009	0.000	0.045
		n	231	231	231	231	231	231
	TDVK	*r*	0.039	.176**	0.093	.248**	.275**	.196**
		Sig.	0.551	0.007	0.160	0.000	0.000	0.003
		n	231	231	231	231	231	231

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed). *Note.* GL = Low Vocabulary Size Group; GH= High Vocabulary Size Group; All= All groups; LS1 = Social Strategies (SOC); LS2= Memory Strategies (MEM); LS3= Cognitive Strategies (COG); LS4= Metacognitive Strategies (MET); LS5= Determination Strategies (DET); DVK1= the Word Associates Test; DVK2 = Derivative Word Form Test; TDVK= DVK1+DVK2; TS= Total Strategy.

2.3 Learning Styles

CE, RO, AC, AE are the four primary scores which assess the participants' according to the four learning orientations. Because the questionnaire is in a forced-choice format, the minimum score of each variable is 12 and the maximum 48. The remaining two are combination scores —AC-CE and AE-RO. The scores of AC minus CE makes the result of AC-CE and that of AE-RO is made by subtracting RO scores from AE. Therefore, the means of the combination scores are negative and they are not ipsative. Table 19 displays that the mean scores of Group-High in RO, AC and AE are all higher than that of Group-Low, except for that of CE. It indicates that participants in Group-Low prefer learning by concrete experience as compared with those in Group-High.

Table 19. Descriptive Statistics of Learning Style

		n	Min	Max	*M*	*SD*
Group-Low	CE	113	24	48	33.81	6.049
	RO	113	22	42	31.43	4.223
	AC	113	20	36	28.44	3.373
	AE	113	13	40	26.32	6.531
	AC-CE	113	-24	10	-5.36	8.289
	AE-RO	113	-24	13	-5.12	9.683
Group-High	CE	118	18	48	31.00	5.581
	RO	118	19	43	30.28	4.044
	AC	118	21	39	29.75	3.326
	AE	118	12	38	28.97	5.595
	AC-CE	118	-23	15	-1.25	7.809
	AE-RO	118	-23	16	-1.31	8.479
All groups	CE	231	18	48	32.37	5.969
	RO	231	19	43	30.84	4.164
	AC	231	20	39	29.11	3.405
	AE	231	12	40	27.68	6.202
	AC-CE	231	-24	15	-3.26	8.290
	AE-RO	231	-24	16	-3.17	9.267

Note. Group-Low = Low level of Vocabulary Size/breadth Group; Group-High = High level of Vocabulary Size/breadth Group; CE = Concrete Experience; RO = Reflective Observation; AC = Abstract Conceptualization; AE = Active Experimentation. AC-CE = abstractness over concreteness; AE-RO = action over reflection.

As introduced above, CE, AC, RO, and AE were achieved by adding up the options of A, B, C, and D of all twelve items, respectively. The two sets of values (AC-CE and AE-RO) were obtained by subtracting these four sets of data form jointly the points on the coordinate axis. Then learning style was divided into four

types according to the four quadrants on the coordinate axis. The following are the cut-off points for each style (Kolb & Kolb, 2005).

(1) Accommodating type: AC-CE ≦7 and AE-RO≧7

(2) When AC-CE≦7 and AE-RO≦6, it belongs to Diverging type;

(3) When AC-CE≧8 and AE-RO≧7, it falls into the Converging type;

(4) When AC-CE≧8 and AE-RO≦6, it belongs to the Assimilating type.

Through the score calculation of the learning styles, participants can be divided into four learning style types: Diverging, Accommodating, Converging, and Assimilating.

Table 20 showed that people in the Diverging type are the most common in both groups. The proportion in Group-Low is 85.8%, about 10% higher than that in Group-High. The Converging type accounts for the least among the four in both groups. There is no one of the Converging type in Group-Low and only one participant in Group-High. As a result, the number of people is too small to do any analysis of this type and the subsequent discussion does not take this type into consideration. In the SPSS operation, the mode value method was used to make up for the missing values caused by this situation, so the Converging type member in Group-High was classified as Diverging type.

Table 20. The Classification and Frequency of Learning Styles

		Frequency	Percent
Group-Low	Accommodating	11	9.7
	Assimilating	5	4.4
	Diverging	97	85.8
	Total	113	100.0
Group-High	Accommodating	17	14.4
	Assimilating	11	9.3
	Converging	1	0.8
	Diverging	89	75.4
	Total	118	100.0
All groups	Accommodating	28	12.1
	Assimilating	186	80.5
	Converging	1	0.4
	Diverging	16	6.9
	Total	231	100.0

Note. Group-Low = Low level of Vocabulary Size/breadth Group; Group-High = High level of Vocabulary Size/breadth Group.

From the perspective of learning style (see Table 21), in Group-Low, the Accommodating type (mean=37) had the highest mean value in DVK1, whereas the Assimilation type (mean=33.36) had the lowest. However, the result of the mean was the opposite in DVK2. The Assimilation type (mean=27.64) had the highest average score, which exceeded the Accommodating type — the lowest one — by 5.04 points. If the total score of depth knowledge was considered, the mean score of Assimilation type (mean=61) was the highest and the Diverging type the lowest.

Table 21. Descriptive Statistics of the Depth of Vocabulary Knowledge in Terms of Learning Style

		Learning style	*n*	*M*	*SD*
Group-Low	DVK1	Accommodating	11	33.36	8.755
		Diverging	186	38.76	12.446
		Assimilating	5	37.00	5.339
	DVK2	Accommodating	11	27.64	8.880
		Diverging	186	29.73	12.107
		Assimilating	5	22.60	5.941
Group-High	DVK1	Accommodating	17	45.53	10.590
		Diverging	186	38.76	12.446
		Assimilating	11	45.00	12.633
	DVK2	Accommodating	17	38.35	10.747
		Diverging	186	29.73	12.107
		Assimilating	11	39.55	7.244

Note. Group-Low = Low level of Vocabulary Size/breadth Group; Group-High = High level of Vocabulary Size/breadth Group; DVK1 = the Word Associates Test; DVK2 = Derivative Word Form Test.

For the Group-High, the mean score of Assimilation type (mean=45.53) was observed to be the highest in DVK1 whereas Diverging type (mean= 43.6) the lowest. The maximum mean score of DVK2 went to the Accommodating type (mean=39.55), and the minimum Diverging type (mean= 36.29). In DVK, the result was the same with that of DVK2, i.e., the maximum was Accommodating type (mean=84.55), and the minimum Diverging type (mean= 79.89).

Interestingly, regardless of DVK1, DVK2 or DVK, the maximum mean scores of depth knowledge all belonged to Assimilation type, whereas the minimum went to Diverging type in all the depth tests.

In order to understand whether there were any differences in depth knowledge of the vocabulary size/breadth within the different learning styles, a Multivariate Analysis of Variance (MANOVA) was conducted. Table 21 demonstrated the demographic characteristics of participants and statistics for all variables related. Table 24. showed the result of MANOVA and Table 23 was the between-subjects effects of the variables. Table 24. indicated that all the *p*-value was not significant ($p < .005$). In other words, no correlation was found between the learning styles and the depth of vocabulary knowledge.

Table 22. Results of Multivariate Tests of Depth of Vocabulary Knowledge in Vocabulary Size/Breadth and Different Learning Styles

Effect	Value	*F*	Hypothesis *df*	Error *df*	Sig.
Group	0.853	19.309[b]	2	224	0.000
Type	0.988	0.665[b]	4	448	0.617
Group * type	0.992	0.453[b]	4	448	0.770

b. Exact statistic

Table 23. Between-Subjects Effects of Depth of Vocabulary Knowledge in Vocabulary Size/Breadth and Different Learning Styles

Source	Dependent Variable	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Group	DVK1	1887.066	1	1887.066	14.718	0.000
	DVK2	3536.738	1	3536.738	34.703	0.000
	DVK	10590.645	1	10590.650	34.738	0.000
Type	DVK1	58.983	2	29.492	0.230	0.795
	DVK2	230.600	2	115.300	1.131	0.324
	DVK	406.334	2	203.167	0.666	0.515
Group * type	DVK1	55.385	2	27.693	0.216	0.806
	DVK2	88.092	2	44.046	0.432	0.650
	DVK	27.320	2	13.660	0.045	0.956
Error	DVK1	28847.927	225	128.213		
	DVK2	22931.030	225	101.916		
	DVK	68596.127	225	304.872		
Total	DVK1	390240	231			
	DVK2	248300	231			
	DVK	1223578	231			
Corrected Total	DVK1	34428.935	230			
	DVK2	33015.567	230			
	DVK	98946.294	230			

a. R Squared = .162 (Adjusted R Squared = .143)

b. R Squared = .305 (Adjusted R Squared = .290)

c. R Squared = .307 (Adjusted R Squared = .291)

Table 24. Difference of Depth of Vocabulary Knowledge Among Different Learning Styles

Groups	Vocabulary Knowledge	Learning Style	*M*	*SD*	*df*	*F*	*p*
Group-Low	DVK1	Accommodating	37.00	5.339	2	0.183	0.833
		Diverging	34.24	11.671			
		Assimilating	33.36	8.755			
	DVK2	Accommodating	22.60	5.941	2	0.828	0.440
		Diverging	23.53	10.576			
		Assimilating	27.64	8.880			
Group-High	DVK1	Accommodating	45.00	12.633	2	0.252	0.778
		Diverging	43.60	11.368			
		Assimilating	45.53	10.590			
	DVK2	Accommodating	39.55	7.244	2	0.748	0.476
		Diverging	36.29	9.995			
		Assimilating	38.35	10.747			

Note. Group-Low = Low level of Vocabulary Size/breadth Group; Group-High = High level of Vocabulary Size/breadth Group; DVK1 = the Word Associates Test; DVK2 = Derivative Word Form Test.

3. A Model of Relations Between Individual Differences and the Depth of Vocabulary Knowledge

In order to explore the correlations between variables of individual differences and the depth of vocabulary knowledge, an exploratory factor analysis (EFA) was conducted to verify that the scales related were suitable for factor analysis. Then a hypothesized model was set up. Next, an assessment of the model fit was conducted

by a confirmatory factor analysis (CFA). Then structural equation modeling (SEM) was applied to examine the relationship between the individual differences and the depth of vocabulary knowledge. Finally, a multiple-group analysis was conducted in SEM to check the ID-depth relationship in terms of vocabulary size/breadth and learning styles, because both are categorical variables.Exploratory Factor Analysis

Factor analysis is a data processing method that reduces the dimensionality of a large amount of data on the basis of complicated correlations, so as to structure it in a certain way. In this section, a series of exploratory factor analyses were conducted to extract latent factors and delete items that were not suitable in the categories. EFA has only been applied to strategy scales, although it is a mature scale that has been used by numerous researchers, but the taxonomies of vocabulary learning strategies vary and scholars have not yet reached a consensus. In addition, some strategies might ride the fence between two categories (Schmitt, 1997). So, EFA is a good tool to probe the ambiguous and subjective problem.

As Table 25 shows, the Kaiser-Meyer-Olkin (KMO) index was .903 and within accepted thresholds (> 0.5), which indicated the related matrix was a fit for factor analysis (Dodge, 2008). Bartlett's test of Sphericity was used to check whether there is a homogeneity of variances. The *p* value of Bartlett's test is .000, which was significant (< 0.001). It also indicates that the correlation matrix was appropriate for factor analysis (Snedecor & Cochran, 1980).

Table 25. KMO and Bartlett's Test of the Vocabulary Learning Strategy Scale

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.903
Bartlett's Test of Sphericity	Approx. Chi-Square	5612.775
	df	780
	Sig.	0.000

Then the factor analysis was applied to the scale. Principal components analysis was used (with VARIMAX rotation method) on the subscales to determine whether the factors should be removed. According to the data of Table 26 there were nine dimensions that could be taken as factors. Notwithstanding, dimension nine were deleted because it comprised only one item and was not a fit for SEM analysis. In addition, the items with a value under 0.4 were not displayed in the table, so they were also deleted due to the efficacy of measurement.

Table 26. Rotated Component Matrix of the Learning Strategy Scale

	Component								
	1	2	3	4	5	6	7	8	9
st29	0.812								
st33	0.805								
st32	0.761								
st37	0.701								
st34	0.701								
st30	0.691								
st35	0.676								
st36	0.666								
st28	0.59								
st26	0.534								
st18		0.755							
st17		0.734							
st16		0.716							
st15		0.585							
st39			0.731						
st38			0.684						
st40			0.657						
st31	0.408		0.621						
st5				0.897					
st6				0.87					
st4				0.66					
st10					0.776				
st11		0.437			0.671				
st9					0.659				
st22						0.733			
st23						0.601			
st21	0.509					0.587			
st25			0.436			0.543			
st13							0.754		
st14							0.653		
st24							0.505		
st1								0.709	
st3								0.602	
st12									0.838

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 9 iterations.

3.2 The Hypothesized Model

Based on previous studies and literature, the primary hypothesized model of individual differences and the depth of vocabulary knowledge was constructed.

Dahlen and Caldwell-Harris (2013) found that learners with high foreign language aptitude performed better on vocabulary tests than those with low aptitude. Granena and Long (2012) found significant correlations between language aptitude and vocabulary breadth and depth development. Drawing on their study results, aptitude was hypothesized to have a direct connection to the depth of vocabulary development. As one of the main variables, motivation is presumed to have a direct influence on the depth of vocabulary knowledge in the model based on the findings of Fontecha and Gallego (2012), Lee (2017) and Mori and Calder (2015). Oxford (1990) and Winke (2013) hypothesized that learning strategy might also have an effect on language proficiency and according to the research of Zhang et al. (2016), vocabulary-learning strategies could be taken as a mediator of motivation and vocabulary knowledge. Based on the research of Tight (2010) and Chen and Wang (2015) — learning styles had effects on the outcome of L2 vocabulary learning, the learning style was used as a categorical variable of individual differences in the model. As a moderator, it was not directly presented in the hypothesized model, but the relevant data was put into the model for Multiple-Group Analysis according to the learning styles of participants. The data of Vocabulary Level Test was dealt with in the same way.

Figure 16 presented the initial structural model drawn by AMOS Version 24.0. The model is one possible way to explain the data. Actually “infinitely many models can fit any data set” (Thompson, 2000, p.277) depending on the theoretical statistical perspective which is taken. However, there is only one that most suitably describe sufficiently the data and the correlations of variables. It involved four latent variables (language aptitude, vocabulary learning motivation, vocabulary learning strategy and depth of vocabulary knowledge) and two categorical variables (the breath of vocabulary knowledge and learning style).

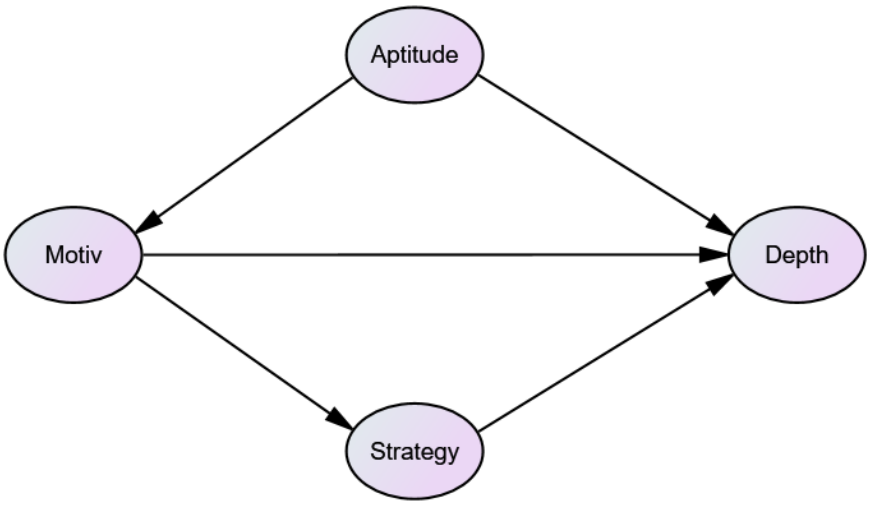

Figure 16. The Hypothesized Model

3.3 Model Modification and Assessment

There are generally two parts in a structural equation model: a measurement model and a structural model. The former illustrates the relationships between the

observed variables and the latent variables. The latter estimates loading weights between the latent variables. In this section, a measurement model was inspected by confirmatory factor analysis. Firstly, a series of confirmatory factor analyses were conducted on the motivation and strategy scales to identify the validity of the constructs in the model. To account for this, a maximum likelihood estimation was used for estimation with a robust standard error method. The thresholds of the fit indices are shown in Table 27.

Table 27. Thresholds of Fit Indices of CFA

Model	χ^2/df	GFI	AGFI	CFI	TLI	RMSEA
Acceptable Level	<3	>0.9	>0.9	>0.9	>0.9	<0.08
Source	Kline 2004	Bentler, 1990	Bentler, 1991	Hu & Bentler, 1999	Hu & Bentler, 2000	Brown, 1993

Note. df =degree of freedom; GFI=goodness-of-fit index; AGFI=adjusted goodness-of-fit index; CFI=comparative error of approximation; TLI=Tucker–Lewis index; RMSEA=root mean square error of approximation; CFA=confirmatory factor analysis.

Figure 17 shows the result of the primitive construct model of motivation. GFI and AGFI, the goodness- of-fit indexes, were .753 and .681 respectively, which were less than the acceptable .90. Moreover, the fit values of the other three model indexes of CMIN/DF (4.110), CFI (.818) and RMSEA (.116) were not quite acceptable either. Therefore, the model needed adjustment.

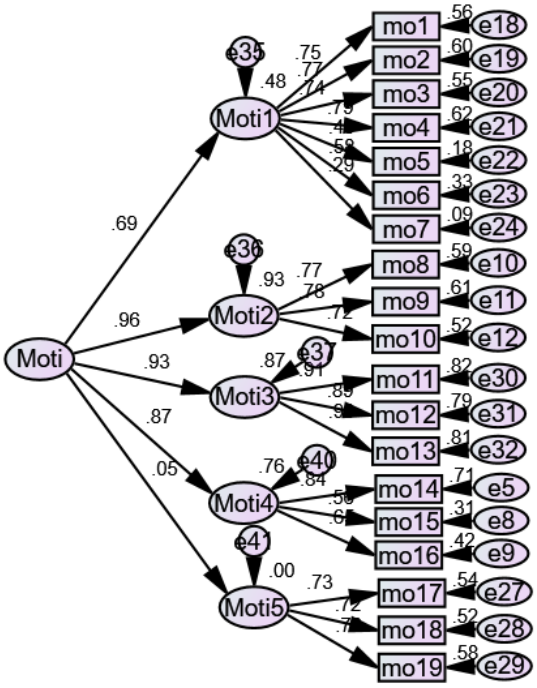

Figure 17. The Result of the Primitive Construct Model of Motivation

The path from *Moti* to *Moti5* was deleted because of the low path coefficient (.05). Then items which were of low loading value were deleted, such as items *mo7*(.09), *mo5*(.18), *mo6*(.33), and *mo15*(.31). In Appendix 9, the Modification Index for covariance was represented by M.I., which refers to the degree that an item would be reduced if fixed parameters were changed into free parameters. Then according to the Modification Index and Par Change, the items *mo3, mo4, mo14* and mo*16* were deleted. Figure 18 displays the adjusted construct of motivation and Table 28 shows the change in the fit indices from the primitive construct to the modified construct of the motivation model.

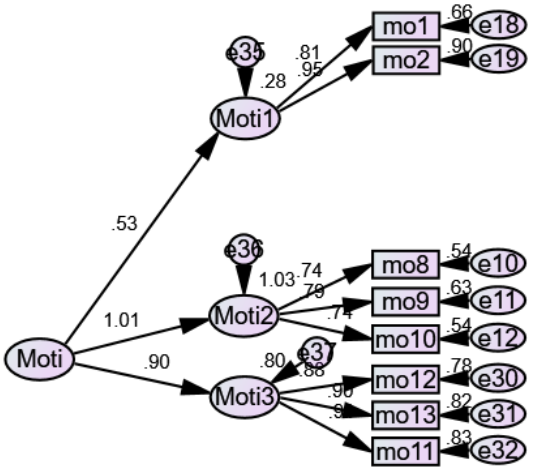

Figure 18. The Result of Adjusted Construct of Motivation

Table 28. Comparison of Fit Indices Change of the Motivation Construct Model

Model	χ^2	*df*	χ^2/df	GFI	AGFI	CFI	TLI	RMSEA
Primitive Model	604.102	147	4.11	0.753	0.681	0.818	0.788	0.116
Revised Model	32.811	17	1.93	0.965	0.925	0.987	0.979	0.064

Note. GFI=goodness-of-fit index; AGFI=adjusted goodness-of-fit index; CFI=comparative error of approximation; TLI=Tucker–Lewis index; RMSEA=root mean square error of approximation.

Based on the EFA results of learning strategy, the primitive construct model was established. From the values shown in Figure 19, the model was not ideal and subject to modification.

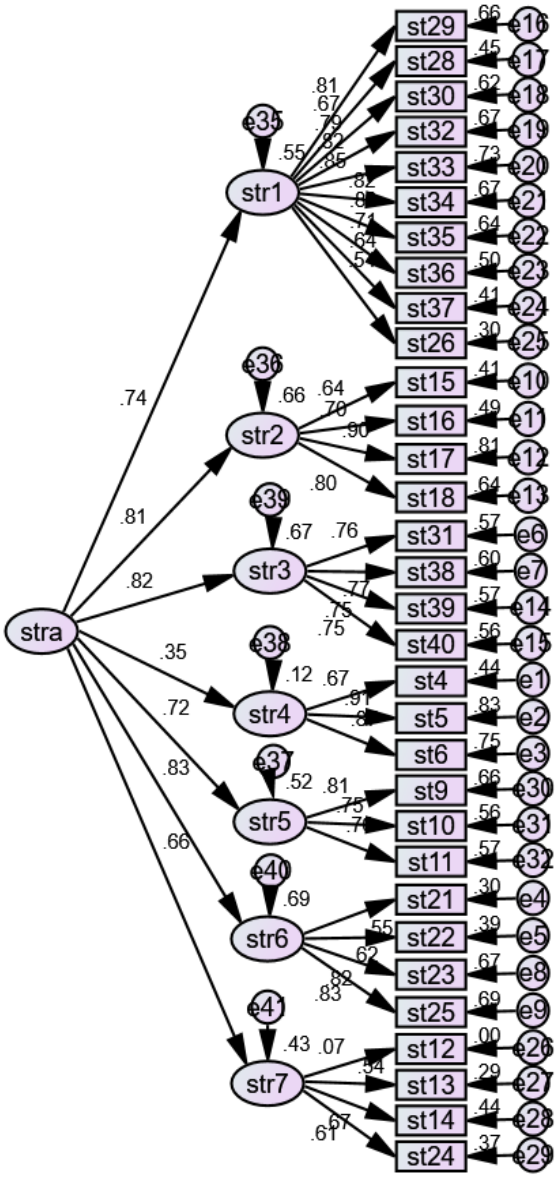

Figure 19. The Result of the Primitive Construct Model of Vocabulary Learning Strategy

Firstly, the sub-factor *str4* was deleted because the path loading (.35) was low. Then the sub-factor *str7* was also deleted due to the low error variance value. After

the comparison of Modification Index and Par Change (see Appendix 10), some items were deleted to simplify the model. Moreover, the sub-factors in *str6* were not in conformity with Schmitt's taxonomy. After the model was adjusted, the revised model was again submitted to AMOS 24.0 and the final construct model was shown in Figure 20. According to Schmitt & Schmitt (1993) and Oxford (1990a), items in *str1* are memory strategy. Items in *str2* are strategies of studying the formal and grammatical aspects of a word and belong to determination strategy. Those in *str3* are all strategies of imaging and belong to memory strategy. Table 29 showed the comparison of fit indices between the primitive model and the revised model.

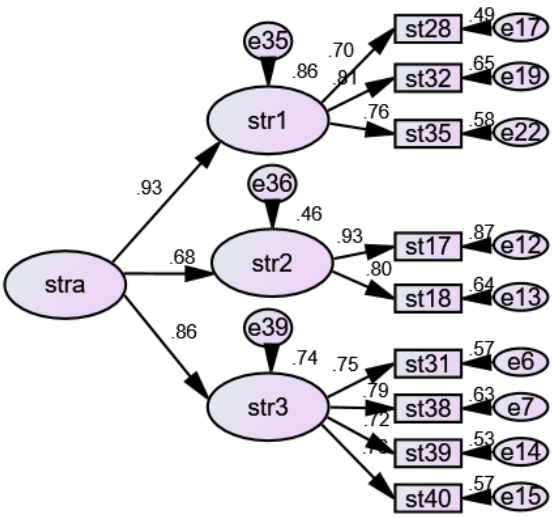

Figure 20. The Result of Adjusted Construct Model of Vocabulary Learning Strategy

Table 29. Comparison of Fit Indices Change of the Strategy Construct Model

Model	χ^2	*df*	χ^2/df	GFI	AGFI	CFI	TLI	RMSEA
Primitive Model	1139.125	457	2.493	0.762	0.726	0.840	0.827	0.081
Revised Model	47.453	24	1.977	0.958	0.922	0.976	0.965	0.065

Note. df =degree of freedom; GFI=goodness-of-fit index; AGFI=adjusted goodness-of-fit index; CFI=comparative error of approximation; TLI=Tucker–Lewis index; RMSEA=root mean square error of approximation.

After the constructs were assessed, the measurement model was established (see Figure 21) through AMOS 24.0. The purpose of building the measurement model was to differentiate the measurable variables from latent variables and to examine the relationship between the measurable variables and the latent variables. At the same time, it could also assess the effectiveness of the measurable variables as a latent variable measurement tool. There were four latent variables in the measurement model: *language aptitude, learning motivation, vocabulary learning strategy,* and *the depth of vocabulary knowledge*. The four latent variables had their own measurable variables, which were determined based on related theories and exploratory factor analysis. There are four measurable variables of *language aptitude*: Vocabulary Learning Test (A1 in Figure 21), Speech Perception Test (A2), Sound-Symbol Pairing Test (A3), and Grammar Rules Inference Test (A4). The latent variable *learning motivation* comprised three measurable variables: attitudes toward vocabulary learning (Moti1), interest in foreign languages (Moti2), and

integrative orientation (Moti3). These measurable variables were included in the latent variable *vocabulary learning strategy*. They were Associations (stra1), Grammatical Aspects (stra2) and Imagine (stra3). The last latent variable *the depth of vocabulary knowledge* involved two measurable variables: Word Associates (DVK1) and Derivative Word Form (DVK2).

As shown in Figure 21, the ellipse in the model represented each latent variable. The rectangle pointed to by the ellipse was the measurable variable of each latent variable, and the small circle was the measurement error of each measurable variable (from e1 to e12). One-way Arrows indicated path and influence, and double arrows indicated correlations between latent variables. From the measurement model diagram, it can be seen that there is a single arrow pointing from the latent variable to the measurable variable. The single arrow indicates the extent to which the latent variable can explain the measurable variable. The number above the arrow is the factor loading of each measurable variable. If the factor loading is below 0.50, it is considered meaningless (Zhang & Zhong, 2013). In another words, the value of all factor loads should be 0.50 or above. In the diagram, all factor loadings met the requirement. There are many statistical indicators of a structural equation model. It generally includes, but is not limited to: the ratio of chi-square to its degrees of freedom (CMIN/DF), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), comparative fit index (CFI), and Root Mean Square Error of Approximation (RMSEA) etc. After the measurement model was established, the statistical results of AMOS24.0 was shown in the Table 30. All the values in the data were in line with the indicators, which meant that the model fit the data well and was properly

identified. Therefore, no further modification was needed, and the model could be used for the establishment of the structural equation model in the next step.

Table 30. Fit Indices Change of the Measurement Model of ID-Depth VK

Model	χ^2	*df*	χ^2/df	GFI	AGFI	CFI	TLI	RMSEA
Measurement model	52.7	48	1.097	0.964	0.941	0.993	0.991	0.021
Acceptable Level			<3	>0.9	>0.9	>0.9	>0.9	<0.08
Source			Kline, 2004	Bentler, 1990	Bentler, 1991	Hu & Bentler, 1999	Hu & Bentler, 2000	Brown, 1993

Note. Df = degree of freedom; GF = goodness-of-fit index; AGFI = adjusted goodness-of-fit index; CFI = comparative error of approximation； TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation.

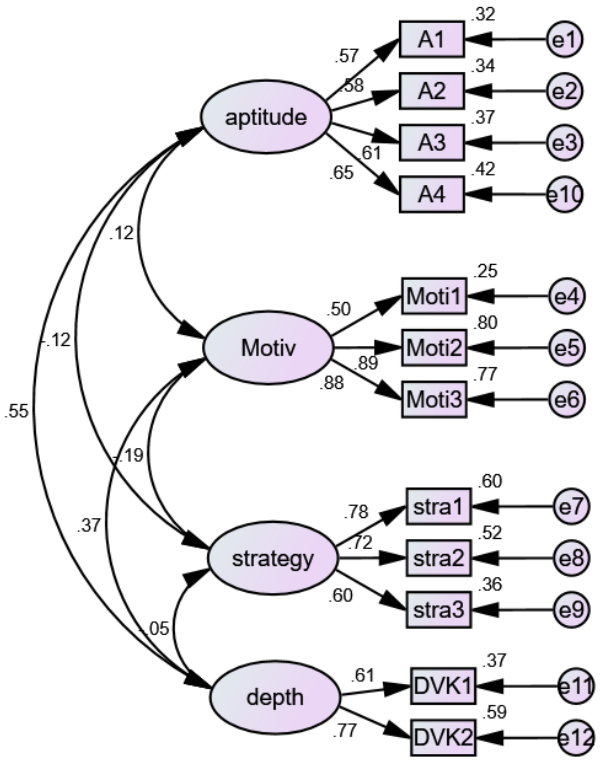

Figure 21. Inspection of the Measurement Model

Note. Aptitude = language aptitude; Motiv = learning motivation; strategy = vocabulary learning strategy; depth = the depth of vocabulary knowledge; A1= Vocabulary Learning Test; A2 = Speech Perception Test; A3 = Sound-Symbol Pairing Test; A4 = Grammar Rules Inference Test; Moti1 = Attitudes toward vocabulary learning; Moti2 = Interest in foreign languages; Moti3 = Integrative orientation; stra1 = Associations; stra2 = Grammatical Aspects; stra3 = Imagine; DVK1 = Word Associates; DVK2 = Derivative Word Form.

3.4 The Final Structural Equation Model of ID and Depth

The structural equation model is also called the latent variable model. It examines the causal relationships between the observed variables and latent

constructs and the internal causality of multiple latent constructs. Although there were no missing values in the data of this study, for the sake of smooth operation, it was set to replace the corresponding missing value with the mean of each item. The chi-square value, one of the essential statistical indicators for structural equation model fit testing, is very sensitive for large sample responses, so it is possible that some reasonable hypothesis models could be rejected. Boomsma (1987) suggested that the optimal sample size was over 200. A sample size which was less than 100 would cause the results to be unreliable. The number of samples in this study is 231, which met the requirements. Seven methods of model estimation were provided in the AMOS analysis. The most widely used estimation method is the maximum likelihood method (ML). With reference to the results of the confirmatory factor analysis, the revised hypothesized structural equation model of individual differences and the depth of vocabulary knowledge was constructed (see Figure 22).

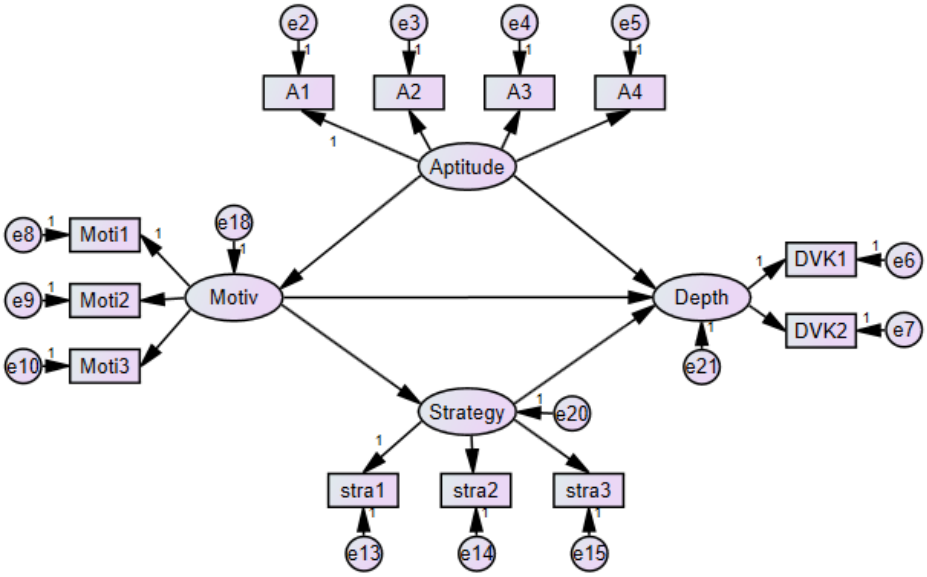

Figure 22. Revised Hypothesized Model of Individual Differences and the Depth of Vocabulary Knowledge

Figure 23 illustrated the final model of the relationships between individual differences and the depth of vocabulary knowledge. The model comprised three independent variables, language aptitude, motivation, and vocabulary learning strategy. The depth of vocabulary knowledge was the dependent variable. All the variables in the model were laten variables, which were repented in the shape of an ellipse. The relations among variables were shown by single directional arrows. The path coefficients were shown in Table 31. All the path coefficients were statistically significant except the path from *Aptitude* to *Motiv* ($p = 0.171$) and from *strategy* to *Depth* ($p = 0.534$), which were not below 0.05. Table 32 displayed the fit indices of

the final SEM and its acceptable level. It was seen that the ratio of chi-square degrees of freedom is 1.097 <3, GFI=0.963 >0. 900, AGFI=0. 941> 0. 900, CFI=0. 993> 0. 900, RMSEA=0. 020<0.080. Since all indicators met the standard, it was concluded that the model fits the data well and can be taken as the ideal model for this research.

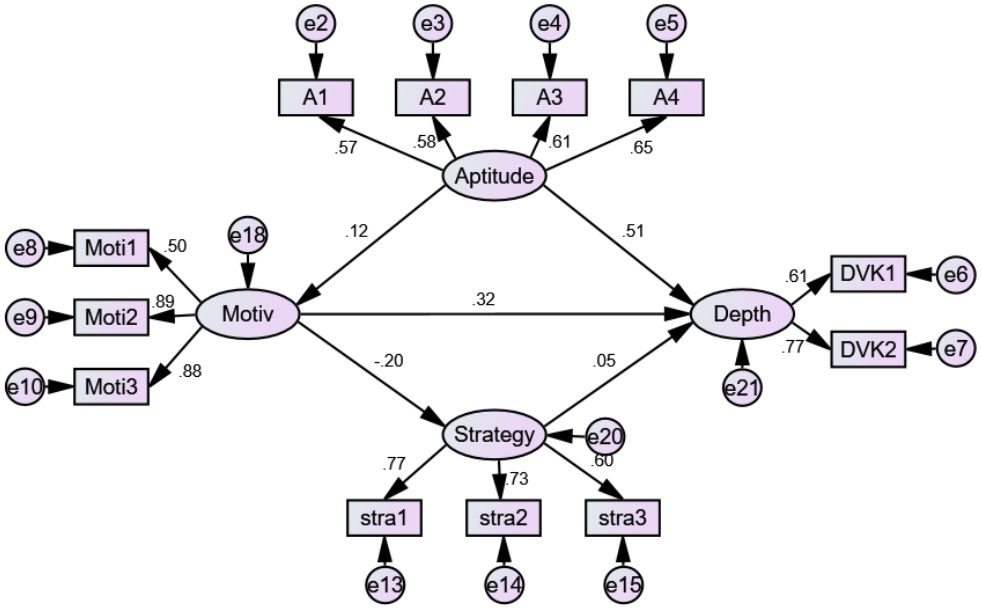

Figure 23. The Structural Equation Model of Individual Differences and the Depth of Vocabulary Knowledge

Table 31. Path Coefficients of the Structural Invariance Model

Path			Estimate(*B*)	S.E.	C.R.	P	Standardized
Aptitude	→	Motiv	0.053	0.039	1.369	0.171	0.118
Motiv	→	Strategy	-0.290	0.124	-2.336	0.019	-0.196
Aptitude	→	Depth	0.236	0.057	4.098	***	0.513
Motiv	→	Depth	0.330	0.101	3.266	0.001	0.322
Strategy	→	Depth	0.037	0.059	0.622	0.534	0.053
Aptitude	→	A2	0.685	0.116	5.908	***	0.580
Aptitude	→	A3	0.803	0.133	6.048	***	0.607
Motiv	→	Motv3	1.862	0.246	7.565	***	0.875
Motiv	→	Motv2	1.774	0.236	7.513	***	0.894
Motiv	→	Motv1	1				0.500
Strategy	→	stra3	0.820	0.116	7.078	***	0.597
Depth	→	DVK1	1				0.607
Depth	→	DVK2	1.557	0.287	5.426	***	0.771
Strategy	→	stra1	1				0.770
Aptitude	→	A4	0.778	0.125	6.220	***	0.647
Strategy	→	stra2	1.140	0.154	7.385	***	0.729
Aptitude	→	A1	1				0.573

Note. S.E.=Standard Deviation; C.R.=Critical Ratio; Motv1,2,3= Motivation1,2,3; stra1,2,3= Strategy 1,2,2; A1,2,3,4=Aptitude1,2,3,4; DVK1=Word Associates Test; DVK2= Derivative Word Form Test.

Table 32. Fit Indices of Final Model of Individual Differences and the Depth of Vocabulary Knowledge

Model	χ^2/df	GFI	AGFI	CFI	TLI	RMSEA
Final model	1.097	0.963	0.941	0.993	0.991	0.020
Acceptable Level	<3	>0.900	>0.900	>0.900	>0.900	<0.080
Source	Kline, 2004	Bentler, 1990	Bentler, 1991	Hu & Bentler, 1999	Hu & Bentler, 2000	Brown, 1993

Note. df =degree of freedom; GFI=goodness-of-fit index; AGFI=adjusted goodness-of-fit index; CFI=comparative error of approximation; TLI=Tucker–Lewis index; RMSEA=root mean square error of approximation.

Mediation refers to "the generative mechanism through which the focal independent variable is able to influence the dependent variable of interest" (Baron & Kenny, 1986, p.1173). In the model, two indirect paths were exhibited in Figure 23. One was the path from *Aptitude* to *Depth* transmitted through *Motiv*, and another was the one from *Motiv* to *Depth* transmitted through *Strategy*. But both z-scores of indirect effects (see Table 33) were below 1.96, which was regarded as the threshold of significant effect (Lockwood & Mackinnon, 1981). Besides, the estimate value of the 95% confidence intervals were also negative since all of the intervals included zero as a possible value for the correlation between aptitude or motivation and depth. It means that there were no indirect effects in both relationships.

Table 33. Result of Bootstrapping 2000

			Point estimate	Product of coefficients		Bootstrapping			
						Percentile 95%		Bias-corrected	
				SE	*Z*	Lower	Upper	Lower	Upper
Standardized direct effects									
Aptitude	→	Motiv	0.118	0.087	1.35632	-0.061	0.295	-0.054	0.299
Motiv	→	Strategy	-0.196	0.092	-2.1304	-0.373	-0.003	-0.386	-0.017
Aptitude	→	Depth	0.513	0.090	5.7	0.327	0.679	0.327	0.679
Motiv	→	Depth	0.322	0.094	3.42553	0.132	0.502	0.148	0.516
Strategy	→	Depth	0.053	0.086	0.61628	-0.121	0.219	-0.108	0.228
Standardized indirect effects									
Aptitude	→	Depth	0.037	0.028	1.32143	-0.017	0.095	-0.007	0.108
Motiv	→	Depth	-0.010	0.019	-0.5263	-0.054	0.025	-0.070	0.016
Standardized total effects									
Aptitude	→	Motiv	0.118	0.087	1.35632	-0.061	0.295	-0.054	0.299
Motiv	→	Strategy	-0.196	0.092	-2.1304	-0.373	-0.003	-0.386	-0.017
Aptitude	→	Depth	0.549	0.089	6.16854	0.367	0.703	0.370	0.705
Motiv	→	Depth	0.312	0.088	3.54545	0.131	0.479	0.148	0.491
Strategy	→	Depth	0.053	0.086	0.61628	-0.121	0.219	-0.108	0.228

V. Discussion

1. Variation of Chinese L2 Learners' Knowledge in Vocabulary Depth

From the results of the paired samples *t*-test analysis between the two kinds of depth knowledge tests among participants at the same vocabulary size/breadth (see Table 12), it was discovered that there is a significant difference between the learners with small vocabulary size/breadth (t (113) = 3.272, p<.005 (two-tailed)), whereas no difference was found in the large size/breadth group. The results can be understood as follows.

First, the Word Associates Test (WAT) used as a measurement of vocabulary knowledge depth looked at the learners' receptive knowledge while the Derivative Word Form Test (DWFT) required productive knowledge of vocabulary. Qian (1998) suggested that high proficiency learners drew more on the meaning of words while low level learners depended more on graphemic knowledge. However, the findings of the present study suggest that the receptive vs. productive knowledge rather than the meaning-based vs. form-based issue overrode the variation in the depth of vocabulary knowledge. Both groups with low and high level of vocabulary size/breadth performed better in the Word Associates Test (WAT) which utilized receptive knowledge than in Derivative Word Form Tests (DWFT) which utilized productive knowledge.

Second, it was more difficult for both groups of learners to master the morphological or orthographic knowledge tested in the Derivative Word Form Tests

(DWFT) than the knowledge of word associations tested in the Word Associates Test (WAT), although the statically significant difference between the tests was found only in the group with a low level of vocabulary size/breadth. This can be understood in that the acquisition of the morphological or orthographic knowledge is expected in the later order in the acquisition hierarchy (Laufer & Goldstein, 2004). For the low level of size/breadth group, who tend to be preoccupied with basic meaning of the target word in the test, it may have been overwhelming to produce the morphological or orthographic information in the test. This may have led to the lower scores on the Derivative Word Form Tests (DWFT) and statically significant difference in the depth of vocabulary knowledge.

2. Factors Affecting the Variation in Vocabulary Depth

2.1 Language Aptitude

The study confirmed that language aptitude has a significant positive effect on the depth of vocabulary knowledge ($\beta = 0.513>0$, z=4.098, $p=<0.05$). This is in line with Harley and Hart (1997) and Granena and Long (2012) yielding that language aptitude had a significant relationship with vocabulary knowledge. All subfactors of language aptitude have a positive correlation with the depth of vocabulary knowledge, including rote vocabulary learning (LLAMA B3), sound recognition (LLAMA D3), sound-symbol associations (LLAMA E3) and grammar inferencing (LLAMA F3). L2 learners with higher LLAMA scores tended to have a better

command of the depth of vocabulary knowledge on the test. Concerning group difference, statistically significant relations with language aptitude were found only in the group with a large vocabulary-size/breadth, which suggests that the effect of language aptitude was particularly evident with them.

The reason why learners' language aptitude was associated with their depth of vocabulary knowledge is that an excellent language aptitude can allow learners to acquire words more easily and sensitively whereas the absence of it would make learning more difficult in vocabulary learning.

Among the sub-categories of language aptitude, regarding the findings from LLAMA B3, rote learning ability ― the ability to make rapid and efficient associations between lexical forms and meanings and retain them ― may facilitate form-meaning connections of new words, in turn contributing to L2 vocabulary breadth. Learners with a better ability of rote vocabulary learning (LLAMA B3) could make more connections between the signified and the signifier in a shorter time, so their performance in the depth of vocabulary knowledge was superior to those with lower scores in the LLAMA B3 test.

Regarding sound recognition (LLAMA D3) and sound-symbol associations (LLAMA E3), phonetic/phonemic coding ability ― the ability to form and retain associations between sounds and symbols ― is assumed to assist in the acquisition of the phonological and orthographic systems of the L2 vocabulary (Dahlen & Caldwell-Harris, 2013). Also, sound recognition (LLAMA D3) involves phonetic/phonemic coding ability. Excellent sound recognition and coding ability can smooth the way to distinguishing and making associations between words with

different phonetic units quickly and thus analyze the pronunciation, morphology and meaning of words. Sound-symbol association (LLAMA E3), for example, involved inductive learning ability -- “the ability to infer or induce the rules governing a set of language materials, given sample language materials that permit such inferences” (Carroll, 1981, p. 105). It means that learners who achieve higher scores of sound-symbol associations acquire a better ability to recognize the sound and connect the phonemes to the visual signs. This might assist L2 learners, as they integrate new lexical knowledge more easily and efficiently.

In relation to the grammar inferencing (LLAMA F3), Kormos and Trebits (2012) explained that LLAMA E, being related to metalinguistic awareness, contributes to the ability to monitor and ameliorate grammatical or spelling errors. Learners with high grammar inferencing (LLAMA F3) scores also outperform low score group in depth of vocabulary knowledge (see Table 14). Grammatical sensitivity helps learners to identify the grammatical characteristics of words and to acquire knowledge of collocations more easily. For instance, when seeing that most adverbs are created by combining the suffix *-ly* with the adjectival form, learners with better grammar inferencing ability may be able to deduce a rule of adverbs from those instances.

2.2 Motivation

The effect of motivation on the depth of vocabulary knowledge was confirmed in the structural equation model (SEM). Motivation was found to have a direct

positive and moderate effect on the depth of vocabulary knowledge (β= 0.322, z=3.266, p=<0.05) among all related variables. It offers strong support for the hypothesis that motivation is related to achievement in the depth of vocabulary knowledge. In addition, the motivation of learners with a high level of vocabulary size/breadth was stronger than the low-level learners. It provides further evidence of the accuracy of previous research (e.g. Fontecha & Gallego, 2012; Masgoret & Gardner, 2003).

The effect of overall motivational disposition on the depth of vocabulary knowledge suggests that motivation plays a significant role in acquiring deep vocabulary knowledge rather than in learning basic meaning of words. This means, learning basic meaning requires less time and energy, and therefore, requires less motivation, while the depth of vocabulary knowledge is achieved from more efforts to encode and retain the detailed information for future use, and therefore requires more motivation. In a similar vein, as Gardner and his associates claimed, the more integrative orientation a learner had, the greater chance that he/she would be a better language learner (Garner, 2001; Gardner & MacIntyre, 1991; Gardner et al., 1997; Masgoret & Gardner, 2003).

Although there is also a weak positive correlation between motivation and the depth of vocabulary knowledge as a whole, it should be noted that this does not mean that all correlations of motivation factors would be positive and significant due to sampling fluctuations, but most of them will. If factors of motivation were separately considered, attitudes toward vocabulary learning (M1, r=.300), interest in foreign languages (M2, r=.251) and integrative orientation (M3, r=.263) had positive

moderate correlation with the depth of knowledge (see Table 16). All *p*-values ($p < 0.01$) indicated that the three correlation coefficients were significant. This can be appropriately construed. In a sense, these three factors of motivation belong to intrinsic motivation. When learners are motivated intrinsically, they have a positive attitude towards vocabulary learning, and they have fun and enjoy learning, which makes vocabulary learning a positive circle, thus prompting learners to be more willing to learn vocabulary actively.

Concerning the group differences, the motivation of low vocabulary size/breadth learners shows a positive correlation with synonym and collocation recognition in both interest in foreign languages (M2, r=0.190) and integrative orientation (M3, r=0.207), but the correlations between all the factors of motivation and the Derivative Word Form Test (DVK2) were not statistically significant at all. However, the motivation of learners with large vocabulary size/breadth has significantly positive correlation with derivational word form knowledge, including attitudes toward vocabulary learning (M1, r=0.273), interest in foreign languages (M2, r=0.183), and integrative orientation (M3, r=0.234). The reason for the difference between the two groups might lie partly in the difficulty gap that receptive and productive vocabulary knowledge brought into their learning procedure. As is known, acquiring productive vocabulary knowledge is much more laborious than acquiring receptive ones. Learners with stronger motivation generate strength from the ‘Ought-to’ and ‘Ideal L2 Self’ to apply their limited resources toward the most rewarding learning activities, whereas learners with weak motivation maintain the same state of learning and they “did not incorporate lexical richness as a salient or

effective component in their self-guides" (Zheng, 2012, p.113). Without awareness and intention, learners will always put their emphasis on the repetitive use of simple words in free production (Zheng, 2012) .

In addition, English class anxiety (M5, r=-.164, p<0.01) had a weak negative correlation with the depth of vocabulary knowledge. It indicates that if a learner shows more anxiety in learning vocabulary, it might lead to a worse result in deep vocabulary learning. High proficiency learners are prone to be a risk-takers and are more tolerant of ambiguity than low proficient ones (Rubin, 1987). They show more positive attitudes in vocabulary learning, being sociable and outgoing, which can enable them to get more support from teachers or peers, and therefore, facilitate their learning. This finally leads to a better performance in vocabulary learning. Compared with low proficiency learners, high level learners enjoy learning more. They have more realistic expectations for learning success and benefit from it (Schmidt & Watanabe, 2001). In contrast, low level learners exhibit less enjoyment and more anxiety in vocabulary learning.

Unfortunately, English class anxiety was deleted when the motivation construct was built due to its low coefficient, which indicates its low correlation with the latent variable. This shows that if only the relationship between anxiety and vocabulary depth is considered, they are negatively correlated with each other. But if all motivational factors are considered to act on vocabulary depth at the same time, the effect of anxiety is marginal.

2.3 Learning Strategy

According to structural equation model (SEM), the correlation between strategy and the depth of vocabulary knowledge did not measure statistical significance (see Table 31, β=0.053, p> 0.05). That is to say, the effect of vocabulary learning strategy might be too weak to contribute to the performance of depth of vocabulary knowledge among all latent variables. Besides, the mediation effect by the strategy shown in the path from Motivation to Depth is not significant, either (see Table 33).

The findings seem contradictory to the research of Zhang et al. (2017) but in line with the findings of Gardner et al. (1997) and Lee (2020). In Zhang's research, no other latent variables were considered other than the vocabulary learning strategies and the vocabulary knowledge. Gardner and his associates' full model indicated a negative correlation between strategy use and second language learning achievement. This could be construed from an English-learning experience perspective. All participants are L2 learners who have at least seven years of English learning experience. During the long-term learning process, learners might have already formed a set of learning strategies of their own. If the strategy is workable and helpful, they will be reinforced from the strategy and continuously use them. Marrie and Netten (1991) found that successful learners tend to choose a relatively effective strategy. Compared with other latent variables, once the learning strategy is adopted by the learners, it will gradually internalize into habitual behavior, and become a relatively constant variable during long-term learning. However, learners with a low level of vocabulary depth might still struggle with the exploration of the

strategy use whereas high level learners might have developed a relatively stable and effective system of strategy use and feel unmotivated to change. Therefore, the impact that strategy use has on the depth of vocabulary knowledge is not very evident.

However, statistically significant correlations were found in some domains of learning strategy using the Pearson correlation between the domains and the depth of vocabulary knowledge (see Table 18). In the small vocabulary-size/breadth group, Memory Strategies (r=.235) and Metacognitive Strategies (r=.226) were moderately correlated with synonym and collocation knowledge. Determination Strategies (r=.186) were weakly interrelated with them, whereas moderately correlated with the overall depth of vocabulary knowledge. In the large size/breadth group, only a correlation between Determination Strategies (r=.201) and the derivative knowledge as well as that between Metacognitive Strategies (r=.194) and overall deep vocabulary knowledge were found. This is in line with the research findings of Gardner and his assotiates (1997), who suggested that lower level learners would try to use various strategies, while well-progressed learners would not feel the strong need for innovating new learning strategies.

The frequency of strategy use could also explain this (see Appendix 5). The statistics indicate that most small-size/breadth learners equally used various vocabulary learning strategies while most large-size/breadth learners have their own preferences. High level learners use strategies more frequently and diversely than the low-level learners. From the differences of specific strategy choices, it can be inferred that high level learners depended much more on metacognitive and cognitive strategies than low level learners did. Although most participants of neither

group used social strategies, such as asking for teacher's help or group discussion, low level learners use social strategies comparatively more often than high level leaners.

This might partly result from the prevailing college English teaching model in China. Since English instruction is traditionally instructor- or examination-oriented, the interaction between teachers and students in the classroom is generally insufficient. So are the exchanges after class. On the other side, there is also less interaction between students in learning. Most students follow the traditional learning methods and study on their own, with few discussions in the form of study groups. It might be more convenient and more in line with personal habits to look something up the dictionary or search for answers on the Internet. As Fan (2003) suggested, those leaners may have found the strategy more useful than others and thus they would use it more.

2.4 Learning Style

Although the proportion of each learning style varied (Diverging type 80.5%; Accommodating type 12.1%; Assimilating type 6.9%; Converging type 0.4%), the result of MANOVA indicated that none of the three[1] learning styles had a statistical effect on the depth of vocabulary acquisition. This result can partially support the findings of Hoshino (2010) and Tight (2010). What this finding indicates is that there

[1] It was supposed to be four learning styles. However, only one person fell into Converging style, which was unable to be analyzed by SPSS. So, only three styles were presented.

was no difference in the depth of vocabulary knowledge among the learning styles and no correlation was found between them in both vocabulary size/breadth groups, either. Learners with different learning styles may equally achieve a similar learning result even though the ways they take in the learning are various. A specific learning style is neither an accelerator nor a hindrance in vocabulary learning.

As is known, a learning style is a natural and habitual behavior that an individual prefers when he or she perceives, processes, or retains new information and skills. As Dunn (2000) stated, most people are competent to learn, even though everyone adopts their own approach to do it. No matter which style one prefers, it must be the style that feels the most comfortable and acceptable to themselves. Through the learning style that is most suitable for oneself, the learner can achieve their learning goal. In this regard, it cannot be denied that Chinese L2 learners in the study may have not yet found the learning style that best suits the development of vocabulary knowledge depth.

In sum, other learner variables seem to override the effect of learning style on the depth of vocabulary knowledge in this study. It is a subject to further study in the future.

VI. Conclusion

1. Main Findings

The primary goal of this study was to explore the nature of depth of L2 vocabulary knowledge of Chinese L2 learners and the contributions that various individual differences make to the depth of L2 vocabulary knowledge. Using the WAT and DWFT, this research substantiated the magnitude of learners' vocabulary knowledge in depth, covering polysemy, synonymy, collocations and derivations, and its interaction with individual differences.

Two steps were taken to achieve the aim. Through a series of *t*-tests and correlation tests, the differences and correlations were studied between language aptitude, motivation, learning strategy use, and learning style and the depth knowledge at the same vocabulary level. Then a structural equation model was established to investigate the nature of the relationship with which latent variables and factors of individual differences simultaneously acted on the vocabulary depth. Among the variables, language aptitude was found to have the greatest influence on the depth of vocabulary knowledge learning. However, the effect of motivation was found to have less influence on the depth of vocabulary knowledge learning than that of aptitude. The effect of learning strategies was the least significant.

As a result, the study confirmed that there was variation in Chinese L2 learners' depth of vocabulary knowledge at the same size/breadth of vocabulary knowledge.

Learners at the small vocabulary size/breadth had different depth of vocabulary knowledge while those at the large size/breadth group did not.

Among the learner variables, both language aptitude and motivation had significant effects on the depth of vocabulary knowledge, whereas no significant effect of strategy use and learning style on the depth of vocabulary knowledge had been found. Language aptitude, including rote vocabulary learning, sound recognition, sound-symbol associations and grammar inferencing ability, had a strong effect on the learners' depth of vocabulary knowledge, especially for learners with large vocabulary-size/breadth. Motivation was also a key variable that affected Chinese L2 learners' depth of vocabulary knowledge. It plays a more important role in learning deep vocabulary knowledge than in learning basic word meanings. Learning strategy overall, however, was comparatively not as evident as the above-mentioned variables. Nevertheless, if the relationship is considered only between certain sub-factors of strategies, such as determination strategies, and the depth of vocabulary knowledge, a weak correlation was found. Finally, no matter what the learner's learning style is, it has no influence on the depth of vocabulary learning.

2. Implications

Theoretically, on the effect of individual differences on the depth of vocabulary knowledge, the current study discovered a significant relationship with learners' variables, such as language aptitude and learning motivation. Consequently, the

effect of those learner variables on the depth of vocabulary knowledge found in the study may result in some inspiration for future research.

Regarding research methodology, this study was not limited to statistical analysis using SPSS but additionally used SEM to model the relationship between the variables of individual differences and the depth of vocabulary knowledge. This may provide methodological foundations for future research concerning this issue.

Pedagogically, the results of this research may provide some implications for Chinese L2 learners and teachers. In understanding that individual differences have significant effect on the acquisition of the deep vocabulary knowledge, teachers may value and respect students' individual differences and provide them with options for a more individualized methodology of vocabulary teaching. It is important for teachers to understand students' individual differences, such as language aptitude and motivation. Then according to these learner variables, teachers can flexibly adopt the teaching methods to promote their vocabulary learning. Some detailed suggestions are as follows.

First of all, students could be classified according to their language ability. There are a large number of students (more than 30 persons) in each class in local college English courses in China. Students are commonly classified into classes based on their performance on an English test when they enroll in the course. Although educators take into account the overall language proficiency of students' English, the individual differences of students in language aptitude are not carefully considered. This may greatly influence the effects of English learning and vocabulary retainment. Thus, the organization of class should be fine-tuned based

on the students' language aptitude in addition to their overall English proficiency. This may enable teachers to use tailored teaching approaches and resources to instruct students.

Secondly, more motivational teaching approaches could be applied to lowly motivated learners, especially those who possess an inadequate depth of vocabulary knowledge. The motivation gap shown between groups with different vocabulary levels calls for careful treatment in the classroom. Compared with highly motivated learners, teachers may spend more effort on the motivation of low-level learners, who are less confident or interested in vocabulary learning. Since intrinsic motivation was found to be directly related to deep vocabulary learning, college English teachers can help students to build self-confidence and positive attitude towards English learning. It is because of the fact that problems are subjectively difficult for learners with little experience to judge, while they are usually easier for veterans (Petty & Cacioppo, 1986). If one's motivation increases, it will lead to an increase in the likelihood of positive results. The dominant responses tend to be right when tasks are easy or well learned. If the tasks are challenging or inadequately designed, however, dominant response are more inclined to be mistakes (Hull, 1943).

Teachers' help would encourage learners with low-level of motivation to avoid the mistakes and overcome the difficulties in language learning through communication with them. Teachers could also make an attempt to design a course that may interest students and encourage their participation. In particular, teachers should pay attention to the integrative orientation of students, which directly affects the depth of vocabulary knowledge learning. Lowering students' affective filter may

also be helpful in class, for example, by using humorous language or providing an anxiety-free atmosphere.

Thirdly, learning strategies are also an aspect that teachers should selectively pay attention to. Although strategies didn't seem as significant as language aptitude as a whole, it can be seen from the difference between the high-level vocabulary group and the low-level vocabulary group that the latter needs more attention and the timely guidance of the teachers in terms of learning strategies. As Oxford and Scarcella (1994) suggested, rather than forcing students to learn vocabulary in whatever way they direct, teachers can guide them to develop effective vocabulary learning strategies as individuals. This can be useful for college English teachers in China considering the findings of the present study that the frequency of strategy use by low-level students was "sometimes". Therefore, English teachers in China can share some successful learning strategies to set an example for the learners and encourage them to use the effective strategies found in the study, such as Memory Strategies, Metacognitive Strategies, and Determination Strategies. Furthermore, the consideration of the strategy use combined with language aptitude may be useful. For example, if a student is more proficient at a certain language aptitude, such as sound recognition, the teacher can encourage him/her to use the pronunciation of words to guess the orthographic rules, or use auditory repetition to retain words or reinforce memory.

Finally, college English teachers in China can actively change the traditional English teaching approach. Moving from the teacher-oriented grammar translation method toward communicative language teaching method may also be useful for

development of vocabulary knowledge depth of vocabulary knowledge. Through the communication-rich activities in and out of the classroom students may broaden the channels of communication with other students and strengthen their awareness of solving vocabulary learning difficulties through multiple channels.

3. Limitations

The findings of the study seem convincing; however, there are some limitations. In China, the average English proficiency and individual differences of students vary from university to university. It also differs from region to region. Due to time and financial constraints, this study only drew samples from one university. Sampling surveys across different universities could be meaningful in future research in order to acquire a more balanced sample group and produce a more comprehensive model.

Besides, because learning motivation and strategies are dynamically developed, their impact on vocabulary depth is also constantly changing. Therefore, it would be worth conducting long-term research to obtain more comprehensive results. Researchers may track changes in the variables on a regular basis to have a deeper understanding of the mechanisms of individual differences in changes the to the depth of vocabulary knowledge.

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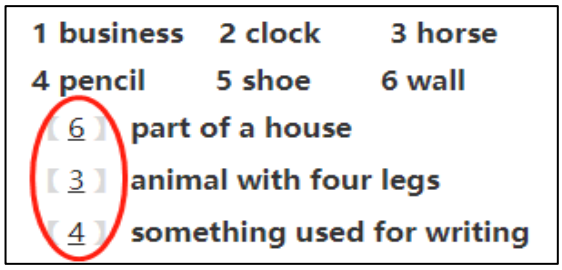
Appendices

Appendix 1. The Vocabulary Levels Test (Schmitt et al. 2001)

This is a vocabulary test. You must choose the right word to go with each meaning. Please write the number of the word into the blank next to its meaning. Here is an example.



Some words are in the test to make it more difficult. You do not have to find a meaning for these words. In the example above, these words are business, clock and shoe. If you have no idea about the meaning of a word, do not guess. But if you think you might know the meaning, then you should try to find the answer.

1.

1. copy 2. event 3. motor 4. pity 5. profit 6. tip

_____ this moves a car

_____ end or highest point

_____ thing made to be like another

2.

1. accident 2. debt 3. fortune 4. pride 5. roar 6. thread

_____loud deep sound
_____ something you must pay
_____having a high opinion of yourself

3.

1. coffee 2. disease 3. justice 4. skirt 5. stage 6. wage

_____money for work

_____a piece of clothing

_____using the law in the right way

4.

1. clerk 2. frame 3. noise 4. respect 5. theatre 6. wine

_____a drink

_____office worker

_____unwanted sound

5.

1. dozen 2. empire 3. gift 4. opportunity 5. relief 6. tax

_____chance

_____twelve

_____money paid to the government

6.

1. admire 2. complain 3. fix 4. hire 5. introduce 6. stretch

_____make wider or longer

_____bring in for the first time

_____have a high opinion of someone

7.

1. arrange 2. develop 3. lean 4. owe 5. prefer 6. seize

_____grow

_____put in order

_____like more than something else

8.

1. blame 2. elect 3. jump 4. manufacture 5. melt 6. threaten

_____make

_____choose by voting

_____become like water

9.

1. ancient 2. curious 3. difficult 4. entire 5. holy 6. social

_____not easy

_____very old

_____related to God

10.

1. bitter 2. independent 3. lovely 4. merry 5. popular 6. slight

_____beautiful

_____small

_____liked by many people

11.

1. bull 2. champion 3. dignity 4. hell 5. museum 6. solution

_____formal and serious manner

_____winner of a sporting event

_____building where valuable objects are shown

12.

1. blanket 2. contest 3. generation 4. merit 5. plot 6. vacation

_____holiday

_____good quality

_____wool covering used on beds

13.

1. comment 2. gown 3. import 4. nerve 5. pasture 6. tradition

_____long formal dress

_____goods from a foreign country

_____part of the body which carries feeling

14.

1. administration 2. angel 3. frost 4. herd 5. fort 6. pond

_____group of animals

_____spirit who serves God

_____managing business and affairs

15.

1. atmosphere 2. counsel 3. factor 4. hen 5. lawn 6. muscle

_____advice

_____a place covered with grass

_____female chicken

16.

1. abandon 2. dwell 3. oblige 4. pursue 5. quote 6. resolve

_____live in a place

_____follow in order to catch

_____leave something permanently

17.

1. assemble 2. attach 3. peer 4. quit 5. scream 6. toss

____look closely

____stop doing something

____cry out loudly in fear

18.

1. drift 2. endure 3. grasp 4. knit 5. register 6. tumble

____suffer patiently

____join wool threads together

____hold firmly with your hands

19.

1. brilliant 2. distinct 3. magic 4. naked 5. slender 6. stable

____thin

____steady

____without clothes

20.

1. aware 2. blank 3. desperate 4. normal 5. striking 6. supreme

____usual

____best or most important

____knowing what is happening

21.

1. analysis 2. curb 3. gravel 4. mortgage 5. scar 6. zeal

____eagerness

____loan to buy a house

____small stones mixed with sand

22.

1. cavalry 2. eve 3. ham 4. mound 5. steak 6. switch

____small hill

____day or night before a holiday

____soldiers who fight from horses

23.

1. circus 2. jungle 3. nomination 4. sermon 5. stool 6. trumpet

____musical instrument

____seat without a back or arms

____speech given by a priest in a church

24.

1. artillery 2. creed 3. hydrogen 4. maple 5. pork 6. streak

____a kind of tree

____system of belief

____large gun on wheels

25.

1. chart 2. forge 3. mansion 4. outfit 5. sample 6. volunteer

____map

____large beautiful house

____place where metals are made and shaped

26.

1. contemplate 2. extract 3. gamble 4. launch 5. provoke 6. revive

_____think about deeply

_____bring back to health

_____make someone angry

27.

1. demonstrate 2. embarrass 3. heave 4. obscure 5. relax 6. shatter

____have a rest

____break suddenly into small pieces

____make someone feel shy or nervous

28.

1. correspond 2. embroider 3. lurk 4. penetrate 5. prescribe 6. resent

____exchange letters

____hide and wait for someone

____feel angry about something

29.

1. decent 2. frail 3. harsh 4. incredible 5. municipal 6. specific

____weak

____concerning a city

____difficult to believe

30.

1. adequate 2. internal 3. mature 4. profound 5. solitary 6. tragic

____enough

____fully grown

____alone away from other things

Appendix 2. Word Associates Test (WAT) (Read, 1998)

There are eight words in the two boxes (upper & lower boxes). From the two boxes, select four words that you think are synonyms or words collocating with the stimulus word (i.e., 'sudden' in this example), according to the criteria mentioned above. Use your computer's mouse to check the answers like this:

Please note that the answers are not evenly distributed in the upper and lower boxes. There may be one correct answer in the upper box and three answers in the lower box, or vice versa, or two answers in both boxes.

1.beautiful

enjoyable	expensive	free	loud
education	face	music	weather

2. bright

clever	famous	happy	shining
colour	hand	poem	taste

3. calm

open	quiet	smooth	tired
cloth	day	light	person

4. natural

expected	helpful	real	short
foods	neighbours	parents	songs

5. fresh

another	cool	easy	raw
cotton	heat	language	water

6. general

closed	different	usual	whole
country	idea	reader	street

7. bare

empty	heavy	uncovered	useful
cupboard	feet	school	tool

8. acute

hidden	often	rich	sharp
angle	hearing	illness	stones

9. common

complete	light	ordinary	shared
boundary	circle	name	party

10. complex

angry	difficult	necessary	sudden
argument	passengers	patterns	problem

11. broad

full	moving	quiet	wide
night	river	shoulders	smile

12. convenient

easy	fresh	near	suitable
experience	sound	time	vegetable

13. curious

helpful	interested	missing	strange
accident	child	computer	steel

14. distinct

clear	famous	separate	true
advantage	meanings	news	parents

15. dull

cloudy	loud	nice	secret
color	knife	place	rock

16. direct

honest	main	straight	wide
fence	flight	heat	river

17. favorable

helpful	legal	possible	positive
habit	response	teacher	weather

18. tight

close	rough	uncomfortable	wet
bend	pants	surface	wood

19. violent

expected	smelly	strong	unlucky
anger	death	rubbish	storm

20. formal

fast	loud	organized	serious
bomb	education	growth	statement

Appendix 3. The Derivative Word Form Test (Schmitt & Zimmerman, 2002).

Please fill in the blanks with the correct form of the word given. If there is no suitable form, please fill "X" or "x" in the blank. Here is an example:

stimulate	
Noun	A massage is good stimulation.
Verb	Massages can stimulate tired muscles.
Adjective	A massage has a stimulating effect.
Adverb	He massaged X .

1. assume

Noun	He made an _____ that she likes meat.
Verb	He can _____ that she likes meat.
Adjective	He had an _____ idea that she likes meat.
Adverb	He decided _____ that she likes meat.

2. authority

Noun	The judge had the _____ to let us view the tax records.
Verb	He decided to _____ the viewing of the tax records.
Adjective	The _____viewing of the tax records was unpopular.
Adverb	All judges speak _____.

3. traditional

Noun The celebration of Thanksgiving is an American _____.

Verb Americans _____ Thanksgiving.

Adjective Thanksgiving is a _____ American holiday.

Adverb Thanksgiving is _____ celebrated in American families.

4. select

Noun There was a large _____ of cars to buy.

Verb We decided to _____ one car.

Adjective The best cars were bought by ___ car customers who chose carefully.

Adverb We looked at the cars _____.

5. access

Noun The university student was given _____ to the library.

Verb The student wanted to _____ the library.

Adjective The helpful librarians make it an _____ library.

Adverb The library was _____ located.

6. ethnic

Noun The people in his neighborhood shared the same _____.

Verb The neighborhood _____.

Adjective The people lived in _____ neighborhoods.

Adverb The neighborhoods were divided _____.

7. philosophy

Noun She explained her _____ of life to me.

Verb She was known to _____ about her life.

Adjective She was known as a _____ person.

Adverb She discussed her life _____.

8. inevitably

Noun A disagreement between the two politicians was an _____.

Verb A disagreement _____.

Adjective The _____ disagreement between the politicians was loud.

Adverb A disagreement _____ occurred.

9. liberal

Noun The _____ of the law was opposed by some politicians.

Verb They did not want to _____ the law.

Adjective His _____ opinions were not accepted by the politicians.

Adverb He voted _____.

10. release

Noun The _____ of the prisoner was delayed.

Verb The police had to _____ the prisoner yesterday.

Adjective The _____ prisoner left town.

Adverb The prisoner left town _____.

11. survive

Noun A young child fought for _____ after the accident.

Verb The child _____ the accident.

Adjective The child was the only _____ member of the family after the accident.

Adverb The child lived _____.

12. ideology

Noun The first politician had a different _____ from the second politician.

Verb The two politicians _____ differently.

Adjective The two _____ politicians differed.

Adverb The two politicians differed _____.

13. precise

Noun A doctor must work with _____.

Verb A doctor _____.

Adjective	Medical care requires _____ work.
Adverb	Doctors must work _____.

14. minimum

Noun	Advanced warning of the storm resulted in a _____ of damage.
Verb	The advanced warning of the storm helped to _____ its damage.
Adjective	The storm caused _____ damage.
Adverb	The area was damaged _____.

15. coherent

Noun	The judge was impressed by the _____ of the lawyer's argument.
Verb	The lawyer makes sure her points _____with one another.
Adjective	The lawyer made _____ arguments.
Adverb	The lawyer argued _____.

16. persist

Noun	The judge changed his mind because of the lawyer's _____.
Verb	The lawyer would _____ until the judge changed his mind.
Adjective	The _____ lawyer persuaded the judge to change his mind.
Adverb	The lawyer argued _____.

Appendix 4. The LLAMA Tests v3 – (Meara & Rogers, 2019)

Please fill in the results of your test on the LLAMA website in the table below. Thank you for your support and participation!

1. Basic information:

Name	_____
Department	_____
Registration No.	_____

2. B3: learning vocabulary：_____

D3: listening for new words：_____

E3: sounds and symbols：_____

F3: grammar rules：_____

3. Please upload the screenshots of the following tests: B3: learning vocabulary，D3: listening for new words，E3: sounds and symbols，F3: grammar rules

Appendix 5. Group Frequency of Learning Strategies

Strategies	Group	Frequency					Total
		1	2	3	4	5	
str1	Group-Low	5	21	39	30	18	113
	Group-High	4	17	29	50	18	118
	All Group	9	38	68	80	36	231
str2	Group-Low	18	33	37	16	9	113
	Group-High	18	36	28	26	10	118
	All Group	36	69	65	42	19	231
str3	Group-Low	9	21	52	27	4	113
	Group-High	6	26	57	25	4	118
	All Group	15	47	109	52	8	231
str4	Group-Low	27	46	31	8	1	113
	Group-High	17	53	32	14	2	118
	All Group	44	99	63	22	3	231
str5	Group-Low	31	45	30	6	1	113
	Group-High	20	65	23	8	2	118
	All Group	51	110	53	14	3	231
str6	Group-Low	38	46	24	3	2	113
	Group-High	32	57	23	5	1	118
	All Group	70	103	47	8	3	231
str7	Group-Low	21	44	34	11	3	113
	Group-High	19	49	37	11	2	118
	All Group	40	93	71	22	5	231
str8	Group-Low	11	31	46	21	4	113
	Group-High	9	26	48	31	4	118
	All Group	40	93	71	22	5	231
str9	Group-Low	6	17	55	31	4	113
	Group-High	3	8	37	48	22	118
	All Group	9	25	92	79	26	231

str10	Group-Low	3	10	50	43	7	113
	Group-High	1	4	40	54	19	118
	All Group	4	14	90	97	26	231
str11	Group-Low	6	16	55	30	6	113
	Group-High	2	13	46	43	14	118
	All Group	8	29	101	73	20	231
str12	Group-Low	5	18	58	24	8	113
	Group-High	3	15	59	36	5	118
	All Group	8	33	117	60	13	231
str13	Group-Low	2	15	53	25	18	113
	Group-High	6	11	45	46	10	118
	All Group	8	26	98	71	28	231
str14	Group-Low	1	9	54	31	18	113
	Group-High	0	11	40	46	21	118
	All Group	1	20	94	77	39	231
str15	Group-Low	7	12	53	23	18	113
	Group-High	1	15	37	43	22	118
	All Group	8	27	90	66	40	231
str16	Group-Low	6	20	40	26	21	113
	Group-High	3	8	33	46	28	118
	All Group	9	28	73	72	49	231
str17	Group-Low	3	22	57	22	9	113
	Group-High	3	9	47	42	17	118
	All Group	6	31	104	64	26	231
str18	Group-Low	5	23	53	19	13	113
	Group-High	4	13	45	39	17	118
	All Group	9	36	98	58	30	231
str19	Group-Low	2	18	46	37	10	113
	Group-High	1	18	49	35	15	118
	All Group	3	36	95	72	25	231
str20	Group-Low	1	20	50	27	15	113
	Group-High	5	15	41	38	19	118

	All Group	6	35	91	65	34	231
	Group-Low	12	23	47	21	10	113
str21	Group-High	14	29	41	26	8	118
	All Group	26	52	88	47	18	231
	Group-Low	3	14	52	27	17	113
str22	Group-High	4	14	45	47	8	118
	All Group	7	28	97	74	25	231
	Group-Low	2	16	57	24	14	113
str23	Group-High	3	12	39	51	13	118
	All Group	5	28	96	75	27	231
	Group-Low	3	14	42	27	27	113
str24	Group-High	2	6	26	43	41	118
	All Group	5	20	68	70	68	231
	Group-Low	4	17	54	21	17	113
str25	Group-High	2	14	43	48	11	118
	All Group	6	31	97	69	28	231
	Group-Low	13	25	47	17	11	113
str26	Group-High	14	35	35	21	13	118
	All Group	27	60	82	38	24	231
	Group-Low	9	23	44	23	14	113
str27	Group-High	5	27	41	29	16	118
	All Group	14	50	85	52	30	231
	Group-Low	9	27	52	16	9	113
str28	Group-High	6	30	50	25	7	118
	All Group	15	57	102	41	16	231
	Group-Low	14	36	43	14	6	113
str29	Group-High	9	52	29	23	5	118
	All Group	23	88	72	37	11	231
	Group-Low	8	37	47	12	9	113
str30	Group-High	10	31	46	23	8	118
	All Group	18	68	93	35	17	231
str31	Group-Low	4	21	50	24	14	113

	Group-High	1	23	40	40	14	118
	All Group	5	44	90	64	28	231
	Group-Low	13	31	49	12	8	113
str32	Group-High	18	36	34	21	9	118
	All Group	31	67	83	33	17	231
	Group-Low	24	25	42	15	7	113
str33	Group-High	29	38	30	16	5	118
	All Group	53	63	72	31	12	231
	Group-Low	14	25	50	18	6	113
str34	Group-High	14	33	37	29	5	118
	All Group	28	58	87	47	11	231
	Group-Low	12	25	51	19	6	113
str35	Group-High	12	33	43	24	6	118
	All Group	24	58	94	43	12	231
	Group-Low	12	28	49	16	8	113
str36	Group-High	24	41	28	18	7	118
	All Group	36	69	77	34	15	231
	Group-Low	28	33	33	13	6	113
str37	Group-High	36	46	22	12	2	118
	All Group	64	79	55	25	8	231
	Group-Low	4	26	49	28	6	113
str38	Group-High	6	21	46	37	8	118
	All Group	10	47	95	65	14	231
	Group-Low	5	13	46	37	12	113
str39	Group-High	3	10	43	46	16	118
	All Group	8	23	89	83	28	231
	Group-Low	5	25	50	26	7	113
str40	Group-High	11	25	33	36	13	118
	All Group	16	50	83	62	20	231

Note. Group-Low= Low level of Vocabulary Size/breadth Group; Group-High=High level of Vocabulary Size/breadth Group; 1=Never； 2= Rarely； 3=Sometimes； 4=Very Often； 5=Always. Refer to Appendix 7 for detailed information of Str1-40.

Appendix 6. Motivation--- The Attitude/Motivation Test Battery (AMTB)

(Gardner, 1985, 2004)

Choose the alternative below the statement which best indicates your feeling.

The number in the table stands for:

1 – Very untrue of me

2 – Untrue of me

3 – Somewhat untrue of me

4 – Neutral

5 – Somewhat true of me

6 – True of me

7 – Very true of me

Here is an example:

	1	2	3	4	5	6	7
Chinese tennis players are better than Russian tennis players.	○	○	■	○	○	○	○

1. Attitudes toward vocabulary learning (M1)

	1	2	3	4	5	6	7
I would like to have a wider vocabulary							
I would like to have a deeper vocabulary							
Vocabulary adds a distinctive help to the language learning.							
Studying vocabulary can be important to me because it will allow me to be more at ease with using English.							

I really enjoy learning vocabulary.							
I plan to learn as much vocabulary as possible.							
I would rather spend more time on other learning activities other than learning vocabulary.							

2. Interest in foreign languages (M2)

	1	2	3	4	5	6	7
I wish I could speak another language perfectly.							
I want to read the literature of a foreign language in the original language rather than a translation.							
Studying a foreign language is an enjoyable experience.							

3. Integrative orientation (M3)

	1	2	3	4	5	6	7
Studying English can be important for me because it will allow me to meet and converse with more and varied people.							
Studying English can be important for me because it will enable me to better understand and appreciate English art and literature.							
Studying English can be important to me because I will be able to participate more freely in the activities of other cultural groups.							

4. Instrumental orientation (M4)

	1	2	3	4	5	6	7
Studying English can be important to me because I think it will someday be useful in getting a good job.							
Studying English can be important for me because other people will respect me more if I have a knowledge of a foreign language.							
Studying English can be important for me because I want to meet the requirements for English level to get my diploma or Bachelor degree							

5. English class anxiety (M5)

	1	2	3	4	5	6	7
It embarrasses me to volunteer answers in our English class.							
I always feel that the other students speak English better than I do.							
I get nervous and conf used when I am speaking in my English class.							

Appendix 7. The Vocabulary Learning Strategies Survey (VLSS) (Schmitt & Schmitt, 1993)

The following is a survey on learning strategies. Please select the most suitable frequency according to your own situation. Please note that there are no right or wrong answers. Number 1 to 5 stands for the following meaning respectively:

1 =Never； 2 = Rarely； 3 =Sometimes； 4 = Sometimes; 5=Always

1. When I initially learn a new word's meaning, the frequency of using the following strategy is:

	1	2	3	4	5
Stra 1. Written repetition					
Stra 2. Verbal repetition					
Stra 3. Study the spelling of the word					
Stra 4. Study the way the word sounds					
Stra 5. Study the word's part of speech					
Stra 6. Study the word's root, prefixes, and suffixes					
Stra 7. Take notes in class about new words					
Stra 8. Use Word Lists to study new words					
Stra 9. Use Flash Cards to study new words					
Stra 10.Use the vocabulary section in your textbook					

Stra 11.Use the configuration technique to remember word form					
Stra 12.Continue to study the word often over a period of time					

2. When studying and remembering the word's meaning once it is known, the frequency with which I use the following strategy is:

	1	2	3	4	5
Stra 13.Written repetition					
Stra 14.Verbal repetition					
Stra 15.Study the spelling of the word					
Stra 16.Study the way the word sounds					
Stra 17.Study the word's part of speech					
Stra 18.Study the word's root, prefixes, and suffixes					
Stra 19.Take notes in class about new words					
Stra 20.Use Word Lists to study new words					
Stra 21.Use Flash Cards to study new words					
Stra 22.Use the vocabulary section in your textbook					
Stra 23.Use the configuration technique to remember word form					
Stra 24.Continue to study the word often over a period of time					
Stra 25.Use APPs or software to study words					
Stra 26.Use physical action when studying motion words (do throwing action when studying the word 'throw')					
Stra 27.Say the new word aloud when studying it					
Stra 28.Use the new word in sentences					
Stra 29.Paraphrase the meaning of the new word in English					

Stra 30.Study the word's synonyms and antonyms					
Stra 31.Connect the new word to some situation in your mind					
Stra 32.Learn the new words in an idiom together at the same time					
Stra 33.Use 'scales' to study gradable adjective sets					
Stra 34.Associate the word with others in the same topic (furniture: table, chair, bed)					
Stra 35.Associate the word to others which are related to it (water: swim, drink, wet, blue)					
Stra 36.Study words with a group of students					
Stra 37.Have your teacher check your word lists and flash cards for correctness					
Stra 38.Make an image of the word's meaning					
Stra 39.Imagine the word form and its spelling in your mind					
Stra 40.Use the Keyword Approach (Think of a El word that sounds similar to the new L2 word. Then make a single mental the new L2 word, this linking image can be remembered, image combining the meanings of both words. When you hear bringing with it a prompt for the L2 word's meaning)					

Appendix 8. Learning Style Inventory3.1 (Kolb & Kolb, 2005)

The questionnaire is not shown in full because of the copyright protection. Only demographic information is exhibited.

Demographic Information

Gender: _____ Age: _____ Class: _____

When did you start learning English? I started from:

☐ Before elementary school ☐ Grade 1 ☐Grade 3

☐ Grade 7 ☐ Other time

English proficiency： I have

☐ **NOT** passed CET band 4

☐ passed CET band 4

☐ passed CET band 6

The following is a survey on learning styles. Please rank each set of four statements in the 12 items listed below according to your actual learning style. Assign a number from 1-4 to the square bracket next to the option. Please note that there is no right or wrong between the statements. Respond to each statement as honestly as you can.

Appendix 9. Modification Indices of Motivation

Covariances: (Group number 1 - Default model)

			M.I.	Par Change
e40	<-->	e41	7.345	.129
e40	<-->	e35	4.510	.074
e29	<-->	e37	9.520	-.167
e29	<-->	e40	4.257	.096
e27	<-->	e32	10.177	.164
e24	<-->	e37	4.512	.151
e24	<-->	e41	20.836	-.484
e24	<-->	e29	8.995	-.309
e23	<-->	Moti	4.411	.104
e23	<-->	e37	16.966	.217
e23	<-->	e35	5.067	-.129
e23	<-->	e40	11.162	-.151
e23	<-->	e29	8.217	-.219
e23	<-->	e24	6.309	.252
e22	<-->	e37	12.870	.214
e22	<-->	e41	6.173	-.221
e22	<-->	e35	4.208	-.134
e22	<-->	e36	5.361	.137
e22	<-->	e40	22.633	-.243
e22	<-->	e30	4.113	.120
e22	<-->	e29	4.889	-.191
e22	<-->	e27	4.267	-.178
e22	<-->	e23	59.342	.648
e21	<-->	e40	4.706	.078
e20	<-->	e36	7.134	-.109
e20	<-->	e40	12.863	.126
e20	<-->	e32	6.376	-.099
e20	<-->	e22	6.374	-.166
e20	<-->	e21	35.401	.269
e19	<-->	e29	4.005	.140
e19	<-->	e28	9.118	-.212
e19	<-->	e23	7.014	-.179

			M.I.	Par Change
e19	<-->	e22	5.391	-.178
e19	<-->	e21	9.248	-.160
e18	<-->	e37	12.606	-.166
e18	<-->	e31	7.565	-.125
e18	<-->	e23	4.187	-.135
e18	<-->	e21	7.412	-.140
e18	<-->	e19	67.434	.487
e12	<-->	e37	6.728	.132
e12	<-->	e41	11.619	-.265
e12	<-->	e40	4.848	-.097
e12	<-->	e31	4.677	.109
e12	<-->	e23	4.081	.149
e12	<-->	e22	40.264	.528
e12	<-->	e20	10.178	-.183
e11	<-->	e40	9.562	-.142
e10	<-->	e37	5.523	-.116
e10	<-->	e40	13.342	.157
e10	<-->	e31	5.192	-.112
e10	<-->	e29	5.583	.174
e10	<-->	e22	14.754	-.311
e10	<-->	e18	6.730	.165
e10	<-->	e12	7.526	-.191
e9	<-->	e35	5.180	.100
e9	<-->	e31	5.728	-.093
e9	<-->	e28	4.397	-.123
e9	<-->	e23	7.212	-.152
e9	<-->	e22	12.961	-.231
e9	<-->	e12	7.412	-.152
e9	<-->	e10	16.362	.220
e8	<-->	e37	7.763	-.137
e8	<-->	e41	16.885	.302
e8	<-->	e40	12.534	.142
e8	<-->	e29	6.819	.187
e8	<-->	e22	20.234	-.354
e8	<-->	e20	6.362	.137
e8	<-->	e12	6.112	-.170

			M.I.	Par Change
e8	<-->	e11	4.629	-.154
e8	<-->	e10	5.660	.159
e8	<-->	e9	10.482	.166
e5	<-->	e37	26.982	.329
e5	<-->	e40	14.947	-.204
e5	<-->	e31	35.331	.366
e5	<-->	e28	7.443	.252
e5	<-->	e27	4.115	-.186
e5	<-->	e22	8.994	.304
e5	<-->	e19	9.379	-.251
e5	<-->	e18	7.507	-.218
e5	<-->	e12	15.123	.344
e5	<-->	e10	11.679	-.294
e5	<-->	e9	21.407	-.309

Appendix 10. Modification Indices of Vocabulary Learning Strategy

Covariances: (Group number 1 - Default model)

Path			M.I.	Par Change
e35	<-->	e37	9.010	-.086
e35	<-->	e41	10.353	-.009
e36	<-->	e37	18.231	.095
e39	<-->	e41	4.181	-.005
e39	<-->	e35	13.062	.088
e40	<-->	e41	4.706	.004
e38	<-->	e41	4.098	-.005
e38	<-->	e35	21.670	.122
e32	<-->	e36	15.669	.088
e31	<-->	e41	4.050	.005
e31	<-->	e35	5.369	-.061
e31	<-->	e36	4.039	-.041
e30	<-->	e36	5.958	.054
e29	<-->	e40	11.891	.096
e29	<-->	e31	9.016	.111
e28	<-->	e35	6.064	-.078
e28	<-->	e36	8.552	.072
e28	<-->	e30	4.594	.071
e26	<-->	e37	6.902	.102
e25	<-->	e39	9.362	.114
e24	<-->	stra	6.249	-.092
e24	<-->	e37	19.611	-.170
e24	<-->	e41	8.910	-.011
e24	<-->	e35	8.688	.106
e24	<-->	e36	4.465	-.059
e24	<-->	e38	12.520	.123
e24	<-->	e31	7.972	-.098
e24	<-->	e30	4.626	-.081
e24	<-->	e25	10.161	.173
e23	<-->	e37	4.136	-.074
e23	<-->	e36	5.912	-.064
e23	<-->	e40	4.287	.051
e23	<-->	e32	7.215	-.096

Path			M.I.	Par Change
e23	<-->	e29	5.011	-.107
e23	<-->	e24	12.907	.162
e22	<-->	e32	5.984	.070
e22	<-->	e24	6.279	-.090
e21	<-->	e37	4.047	.058
e21	<-->	e25	6.941	-.107
e21	<-->	e22	19.821	.119
e20	<-->	e35	4.998	.060
e20	<-->	e32	4.077	.058
e20	<-->	e25	9.564	-.127
e20	<-->	e22	10.510	.088
e20	<-->	e21	32.746	.153
e19	<-->	e21	5.539	-.065
e18	<-->	e36	5.573	.051
e18	<-->	e22	4.788	-.060
e17	<-->	e24	5.414	.097
e17	<-->	e21	5.129	-.070
e17	<-->	e20	10.926	-.104
e16	<-->	e37	4.278	-.058
e16	<-->	e40	8.668	-.057
e16	<-->	e38	5.065	.058
e16	<-->	e24	5.838	.085
e16	<-->	e22	6.716	-.068
e16	<-->	e21	4.363	-.054
e16	<-->	e20	5.844	-.064
e16	<-->	e19	6.128	.067
e16	<-->	e18	14.900	.104
e15	<-->	e35	5.282	.074
e15	<-->	e32	5.485	.079
e15	<-->	e26	6.990	-.114
e15	<-->	e24	7.854	.120
e15	<-->	e18	4.992	-.074
e15	<-->	e16	9.748	-.098
e14	<-->	e35	11.401	-.097
e14	<-->	e27	5.043	.087
e14	<-->	e20	4.158	-.059

Path			M.I.	Par Change
e14	<-->	e17	6.793	.088
e13	<-->	e41	7.288	-.008
e13	<-->	e35	4.599	.060
e13	<-->	e32	25.167	.148
e13	<-->	e28	6.851	-.087
e13	<-->	e18	8.779	.085
e12	<-->	e37	7.480	.067
e12	<-->	e30	12.031	.082
e12	<-->	e29	4.049	.065
e12	<-->	e27	4.271	-.063
e12	<-->	e13	4.881	.049
e11	<-->	e41	9.272	.011
e11	<-->	e35	6.926	-.090
e11	<-->	e38	4.455	-.070
e11	<-->	e28	26.179	.205
e11	<-->	e14	4.337	.076
e10	<-->	e41	8.090	.010
e10	<-->	e35	4.274	-.071
e10	<-->	e40	5.863	.060
e10	<-->	e29	4.393	-.101
e10	<-->	e28	5.551	.095
e10	<-->	e27	13.609	.169
e10	<-->	e20	7.126	-.092
e10	<-->	e19	4.233	-.073
e10	<-->	e14	6.899	.096
e10	<-->	e12	5.780	-.067
e10	<-->	e11	9.950	.135
e9	<-->	e41	4.892	.006
e9	<-->	e32	14.051	-.104
e9	<-->	e30	12.764	.098
e9	<-->	e13	6.755	-.071
e8	<-->	e35	4.057	-.052
e8	<-->	e38	6.818	-.065
e8	<-->	e19	4.245	-.055
e8	<-->	e18	10.117	.084
e8	<-->	e16	4.381	-.053

Path			M.I.	Par Change
e7	<-->	e41	6.589	-.007
e7	<-->	e35	6.848	.073
e7	<-->	e31	4.240	.056
e7	<-->	e27	7.490	-.103
e7	<-->	e24	4.432	.079
e7	<-->	e16	4.214	.056
e7	<-->	e13	5.219	-.067
e7	<-->	e12	8.742	.070
e6	<-->	e35	7.685	.082
e6	<-->	e25	4.031	.090
e6	<-->	e12	8.355	-.072
e5	<-->	e32	7.435	.092
e5	<-->	e30	10.006	-.106
e5	<-->	e25	5.185	-.110
e5	<-->	e22	8.594	.094
e5	<-->	e15	7.396	-.104
e4	<-->	e35	40.304	.250
e4	<-->	e36	14.039	-.115
e4	<-->	e30	13.829	-.153
e4	<-->	e28	4.050	-.093
e4	<-->	e24	4.306	.109
e4	<-->	e23	6.973	.130
e4	<-->	e20	5.396	.092
e4	<-->	e11	4.478	-.105
e4	<-->	e5	10.130	.149
e3	<-->	e37	4.300	-.049
e3	<-->	e35	10.744	.072
e3	<-->	e14	6.382	-.059
e2	<-->	e35	6.428	-.055
e2	<-->	e32	4.480	-.048
e2	<-->	e30	4.342	.047
e2	<-->	e14	6.657	.059
e1	<-->	stra	4.739	.068
e1	<-->	e41	7.671	-.009
e1	<-->	e35	20.590	.138
e1	<-->	e36	4.545	-.051

Path			M.I.	Par Change
e1	<-->	e32	5.169	.073
e1	<-->	e28	6.609	-.092
e1	<-->	e24	6.753	.105
e1	<-->	e15	4.815	.080
e1	<-->	e13	6.123	.078
e1	<-->	e11	4.472	-.081
e1	<-->	e10	4.953	-.086
e1	<-->	e4	4.816	.098

국문초록

중국 L2 학습자의 어휘 지식의 깊이: 학습자 변수의 효과와 관련하여

영어영문학과 순 팅

지 도 교 수 남 현 정

본 논문에서 중국 영어학습자의 어휘 지식의 깊이와 학습자 변수에 관한 요인을 연구하였다. 어휘 지식의 깊이와 관련된 학습자 변수 요인으로 언어적성, 학습동기, 학습전략, 학습스타일이 연구되었다. 먼저, 동일한 어휘 크기를 가지는 영어학습자들의 어휘 지식의 깊이가 상이한가에 관하여 실험하였다. 또한 SEM 모델을 적용하여 어휘 지식의 깊이에 영향을 미치는 학습자 변수 요인이 추출되었다.

본 실험에 총 231 명의 대학생이 참가하여, 어휘테스트, 설문지, 언어적성테스트의 세차례의 테스트를 수행하였다. 그 결과 같은 어휘 크기를 가지는 영어학습자들의 어휘 지식의 깊이의 차이가 발견되었다. 어휘 지식의 깊이에 영향을 미치는 학습자 변수 요인으로는 언어적성, 학습동기가 유의미한 변수로 나타났으며, 학습전략, 학습스타일은 통계적으로 유의미한 영향을 미치지 않는 것으로 나타났다.

본 연구에서 밝혀진 결과는 추후 연구에 이론적 모델을 제공하는데 의의가 있을 것이다. 또한 어휘학습에 영향을 주는 학습자관련 요인을

제시함으로써, 교육현장에 있는 교수자들이 학습자요인을 반영한 교육을 할 수 있도록 하는데 의미 있는 제언이 될 것이다.

주요어: 어휘 지식의 깊이, 어휘지식의 크기, 학습자요인, 언어적성, 학습동기, 학습전략, 학습스타일, SEM