

Second Language Vocabulary Acquisition and Measurement Tools

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Abstract

This paper reviews the history and current status of second language vocabulary acquisition research, tracing its advancement from a marginal position to its current prominence. It explores the evolution of theoretical frameworks of vocabulary, revealing a trend towards greater diversification and depth in theory development, research methodologies, and educational investigations. Spanning receptive and productive vocabulary size, depth of vocabulary knowledge, and the mental lexicon, it discusses the progression of the debate over the nature of vocabulary as knowledge or competence, binary or continuous. Furthermore, it highlights the importance of rigorous measurement of vocabulary, critically analyzing widely-used tools such as Vocabulary Levels Test, Vocabulary Size Test, Vocabulary Knowledge Scale, and Word Association Test. By focusing on common misconceptions and misuses of these tools, the paper aims to offer insights for future research and pedagogical practices in second language vocabulary acquisition.

Keywords

Second Language Vocabulary Acquisition, Measurement Tools.

1. Introduction

The origin of second language acquisition (SLA) research is rooted in humanity's curiosity about how languages are acquired in the human brain. All human children, regardless of ethnicity or skin color, are capable of effortlessly acquiring their native languages with only limited exposure and without knowledge of grammar or linguistics. This must indicate that the acquisition of a second language also occurs at a deeper cognitive level, rather than merely through rote memorization of grammatical rules and regular language training in the classroom. Vocabulary, as the basic constituent component of a language system, builds the semantic bridge between linguistic forms and the reality of the world. It has always been a core concern in traditional language teaching practice, e.g., grammar-translation pedagogy. However, in the study of SLA, vocabulary did not initially receive significant attention, but as SLA research deepened and the needs of teaching guidance grew, its academic status steadily rose.

However, when we try to outline a roadmap for vocabulary acquisition, we find that words are not simply a pile of letters or a straightforward combination of semantic symbols: the mental lexicon has a complex network and is loaded with rich meaning to represent the conceptual system. How do we define "vocabulary"? should it be defined as a hierarchy of knowledge or a practical ability? What aspects does vocabulary knowledge entail? What dimensions does the ability cover? And how can these aspects and dimensions be rigorously measured in academic studies to offer insights to inform vocabulary learning and teaching?

2. History and Current Status of Second Language Vocabulary Acquisition Research

The research on second language acquisition (SLA) was generally recognized to emerge in the late 1960s and early 1970s, but vocabulary acquisition was not initially a primary focus in the field. For instance, in the SLA journal *Studies in Second Language Acquisition*, only one article related to vocabulary learning appeared in the 1970s. Since 1980s, interest in the topic surged, with an average of at least one article published annually, a trend that has persisted into the past decade. In China, studies on second language (L2) vocabulary teaching and learning have long been found across various journals, but it was not until 1995, with the publication of Chen Jianlin's *Using Semantics to Guide English Vocabulary Teaching* and Chen Xiaowei's *Preliminary Discussion on Word Guessing Techniques*, that related research in China began to align with international scholarship[1].

Since then, vocabulary acquisition research in China has flourished, particularly after 2000, characterized by diverse perspectives, interdisciplinary approaches, and a remarkable increase in empirical studies, which often draw on distinct theoretical frameworks, including purely linguistic paradigms, cognitive linguistics paradigms, and neuropsychological paradigms[2]. This multiplicity makes synthesis challenging, but the field can generally be summarized into three dimensions:

(1) The perspective of how to teach vocabulary

The long-standing research topic in this regard is the effectiveness of different vocabulary teaching methodologies. For example, Wang and Shu investigated the effects of thematic clustering and semantic clustering on multidimensional knowledge of target words (spelling, meaning, grammatical function, syntactic collocation, and semantic association) among 95 non-English major university students[3]. Additionally, studies incorporating corpus usage to inform teaching practices, e.g., exploring the feasibility of chunk-based instruction, are relatively common. Other research topics include metaphor theory, input frequency, and annotations of target words. Notably, within this dimension, the terms "vocabulary learning" and "vocabulary acquisition" appear with equal frequency.

(2) The perspective of how vocabulary is acquired

In recent years, incidental learning studies have yielded abundant findings, while there are also a growing number of scholars have raised objections, arguing that vocabulary, as the primary carrier of meaning, is inherently present in learners' consciousness from the outset. Another important topic in this area is learning strategies, with frequently discussed strategies including memory strategies, metacognitive strategies, contextual strategies, word-guessing techniques, and selective attention. Fan and Xia provided a comprehensive summary of related studies[4]. A recent trend in this dimension explores the relationship between vocabulary competence and other language skills, particularly vocabulary's predictive power for overall language proficiency or specific abilities.

Such studies are predominantly empirical and follow a similar research paradigm: measuring students' vocabulary size and depth using specific tools, then comparing their speaking, reading, listening, or writing abilities. For instance, Zhang examined the relationship between vocabulary size, productive vocabulary knowledge, and English listening and speaking skills, confirming their strong predictive power, with vocabulary size slightly outperforming productive vocabulary ability[5-6]. Other focal issues include vocabulary development trajectories, lexical transfer, lexical attrition, as well as individual differences in vocabulary acquisition. This dimension can be regarded as the mainstream of the early twenty-first century vocabulary acquisition research.

(3) The perspective of defining and measuring vocabulary knowledge/competence

Compared to the first two dimensions, this area is more ontological in nature, with a stronger indication of the evolution and inheritance of its measurement methods and theoretical development. This will be elaborated on in the next section.

3. Framework of Second Language Vocabulary Knowledge/Competence

3.1. Vocabulary Size

Before the 1990s, vocabulary research predominantly adopted a binary perspective, treating the mastery of vocabulary as an all-or-nothing matter, its items being either fully known or entirely unknown. Although this view has been often considered outdated, its simplicity retains practical appeal and utility in certain contexts. For instance, when providing data for reference with a view to curriculum designing, the measurement of students' vocabulary size is both a necessary and efficient indicator. Such large-scale data collections often rely on basic qualitative criteria, and sometimes serves as the working definition of vocabulary knowledge. Examples include Gui's survey of English majors' vocabulary size across provinces in the 1980s[7] and Zhou and Wen's longitudinal investigation of STEM college students' vocabulary size in 2000[8]. both widely-cited studies directly measured university students' vocabulary size. The current College English Curriculum Requirements of China stipulates that non-English majors should grasp a vocabulary size of 4,500 words, with higher benchmarks set at 5,500 and 6,500 words. To establishing official benchmarks like this for standardization requires extensive surveys and statistical analysis for reference, and the concept of vocabulary size serves best the purpose.

However, this perspective fails to capture the complexity of overall picture of vocabulary acquisition. connotations, semantic relationships, grammatical features, collocations, context knowledge, and knowledge of word frequency, involve multiple domains such as semantics, syntax, cognitive psychology, pragmatics, etc. Clearly, an individual's vocabulary knowledge and competence cannot be simply equated with vocabulary size alone.

To draw clear boundaries, some researchers began using the term "receptive vocabulary knowledge" in studies, contrasting it with "productive vocabulary knowledge." While productive vocabulary knowledge is far from being synonymous with depth knowledge of vocabulary, receptive vocabulary knowledge is generally treated in research as a substitution for vocabulary size.

3.2. Depth of Vocabulary Knowledge

Since the mid-1990s, new definitions and theoretical frameworks for vocabulary knowledge have systemically surfaced, presenting a dazzling array of perspectives. Among these, the framework proposed by Nation has been the most frequently cited in academic circles. Building on Richards' eight assumptions about vocabulary competence (including word frequency, register, syntax, derivation, association, semantics, and polysemy), Nation developed his vocabulary competence framework, which underwent two subsequent revisions[9]. The initial framework encompassed four aspects—form, position, function, and meaning—before later fixating them into receptive and productive dimensions. In 2001, Nation redefined it by further incorporating three categories: form (spoken/written/composition), meaning (form-meaning connection/conceptual reference/association), and use (grammar/collocation/constraints on use)[10]. These were then paired with receptive and productive perspectives, leading to a list of 18 types of knowledge. This created a highly integrative vocabulary knowledge framework, as illustrated in Figure 1. For example, receptive collocational knowledge refers to the co-occurrence of a target word with other words, while productive referential knowledge pertains to what a target word can denote.

Form	Spoken	R P	Study 3	What does the word sound like? How is the word pronounced?
	Written	R P	Study 1	What does the word look like? How is the word written and spelled?
Meaning	Word parts	R P		What parts are recognizable in this word? What word parts are needed to express the meaning?
	Form and meaning	R P	Studies 1, 4, 5, 6 Study 2	What meaning does this word form signal? What word form can be used to express this meaning?
	Concepts and referents	R P		What is included in the concept? What items can the concept refer to?
	Associations	R P		What other words does this make us think of? What other words could we use instead of this one?
Use	Grammatical functions	R P		In what patterns does the word occur? In what patterns must we use this word?
	Collocations	R P		What words or types of words occur with this one? What words or types of words must we use with this one?
	Constraints on use (register, frequency...)	R P		Where, when, and how often would we expect to meet this word? Where, when and how often can we use this word?

Figure 1. Nation's framework of vocabulary competence (2001)

Meara quickly pointed out that such an idealized vocabulary knowledge checklist is unattainable not only for second language learners but even for native speakers[11]. Moreover, it fails to reflect the process of vocabulary acquisition or the interrelationships among different types of knowledge, rendering it impractical for instruction or learning. Despite the critiques, the influence of Nation's framework has been profound. Today, most articles discussing vocabulary knowledge draw reference of the list, even if they do not adopt it for analytical purposes. Meara himself utilized this framework in a study examining the correlations among vocabulary size, associative knowledge, and affix knowledge among Japanese learners. In China, for instance, Wang et. al employed this framework to explore the roles of vocabulary and grammatical knowledge in listening comprehension[12]. Ma, building on Nation's framework of vocabulary knowledge, proposed a multidimensional vocabulary knowledge model, classifying it into 12 aspects: phonological knowledge, spelling knowledge, morphological knowledge, semantic knowledge, first language (L1) knowledge, word frequency knowledge, collocational knowledge, syntactic knowledge, stylistic knowledge, pragmatic knowledge, variant knowledge, and vocabulary strategy knowledge[13].

It could be noticed that both Nation's and Ma's frameworks, though introducing multiple dimensions to examine vocabulary knowledge, still adopt a binary approach to vocabulary competence. However, in the realm of a person's understanding of the meaning and usage of any word, there must exist an ambiguous, intermediate state. To address this limitation, Coady and Huckin proposed a continuum-based definition, viewing vocabulary competence as an interlocking system from receptive to productive knowledge, during which familiarity and automaticity gradually increase[14]. This perspective has inspired the designs of many subsequent tools for measuring depth of vocabulary knowledge. Nowadays, these tools typically take the form of graduated scales, though debates persist over the methods of grading. In summary, vocabulary acquisition research has evolved significantly, reflecting diverse theoretical foundations and methodological approaches. While the complexity has enriched the field, it also poses challenges for application in statistical analysis and practical teaching. Nonetheless, the three-dimensional framework—teaching methods, acquisition processes, and knowledge definition—provides a robust structure for understanding and advancing the study of vocabulary acquisition.

3.3. Mental Lexicon

The definitions and theoretical accomplishments discussed above all take individual words as their objects, treating vocabulary as a summary of isolated items, which is inadequate to guide

learning and teaching practices. To address the shortcoming, Meara proposed a lexicon-centered definition, which quickly gained widespread acceptance among researchers[15]. This approach posits that to fully understand an individual's vocabulary competence, words cannot be adequately examined in isolation. Instead, it is necessary to investigate the structure of, and the associations in, the lexicon—that is, whether the connections between words are sufficiently organized and strong—as well as the speed of access (the degree of automaticity).

Lexicon is the mental repository of words and their associated meanings, pronunciations, and syntactic characteristics that a learner stores and accesses when using a language. In a more popular phrasing, vocabulary size and depth knowledge, word associations, and automaticity capacity, among other things, together with processing mechanisms for storage, activation, retrieval, and organization, constitute an individual's lexicon. Assessing vocabulary competence, therefore, means assessing the lexicon. Researchers who adopt this view tend to prefer the term "vocabulary competence" over "vocabulary knowledge." Significant theoretical contributions to this perspective have also come from scholars such as Chapelle, Qian, Bialystok, and Sharwood Smith, as well as Zhang Wenzhong and Wu Xudong.

Notably, Meara initially argued that among the dimensions of the lexicon, vocabulary size developed most rapidly in the early stages, but in later stages, the organizational structure and network of the lexicon became more important than sheer size, while automaticity strengthened consistently throughout the whole time. This view has been substantiated by numerous studies in China[16-18]. Over time, the following aspects of vocabulary knowledge/competence have gained broad consensus among researchers: vocabulary breadth, depth of vocabulary knowledge, lexical organization, automaticity, and semantic autonomy[19-21].

In fact, as early as the 1990s, researchers such as Murphy and Schmitt, inspired by psychological studies, have already proposed the concept of the mental lexicon. When people speak, they can effortlessly retrieve a word from the tens of thousands of vocabulary items stored in the brain, indicating that vocabulary must be stored as being intricately connected in the brain based on a certain structure. One of the significant contributions to bilingual mental lexicon theory comes from Zhang[19] as earlier mentioned, who proposed three possible ways in which L1 and L2 vocabulary, along with concepts, are stored and linked in learners' minds: first, L1 and L2 share a single storage system, or operate independently, or partially overlap in meaning; second, L1 and L2 semantics are separately connected to a conceptual system, with L2 also potentially linked to concepts via L1; third, concepts are not organized as a unified system but consist of multiple nodes, each individually connected to L1 and L2 vocabulary.

Academic understanding of vocabulary knowledge and competence continues to deepen. However, it should be noted that excessive theorization may introduce more challenges to empirical research. On the other hand, treating vocabulary as a form of knowledge and dividing it into the dimensions of breadth and depth offers an approach that is both robustly testable in empirical studies and capable of providing teaching guidance to instructors.

4. Tools for Vocabulary Measurement

Synthesizing the above discussion, theoretical descriptions of vocabulary knowledge and competence can be mainly divided into three aspects: vocabulary size or receptive vocabulary knowledge, depth of vocabulary knowledge, and the lexicon or mental lexicon. The following sections will examine vocabulary measurement tools for these three perspectives, focusing on the original versions of those widely used in research instead of the adaptations.

4.1. Vocabulary Size Measurement

The most well-known vocabulary measurement tool is the Vocabulary Levels Test (VLT) designed by Nation in 1983. The initial VLT was set to include only four levels of English vocabulary: the most common 2000 words as Level 1, 3000 words as Level 2, 5000 words as Level 3, but initially without Level 4, skipping directly to 10,000 words as Level 5. Later, a Level 4 was added, which consists of common academic vocabulary beyond the 5000 words, used in universities for non-major studies. This brought it to five levels in total. The selection and determination of words within these levels are based on Thorndike & Lorge's word frequency statistics and the General Service List, while the university academic vocabulary mainly references Coxhead's University Word List.

The test procedure is as follows: Students each complete the questions in each level on their own without assistance. Each level contains 6 test items, and each item includes 6 words and 3 definition choices. Students are required to match the words with their definitions, which means there are a total of 18 sub-questions. This design aims to understand students' vocabulary size as quick as possible in a short period of time. The test eliminates contextual influences, ensuring that the 6 words are of the same part of speech, mostly in basic forms, and have significantly different meanings, to reduce the possibility of students guessing of the answers. Students do not need to have a very deep understanding of the word to choose the correct answer. When the more frequently used word in a word family is not the basic form, the more frequently used form is then substituted. The questions with the test words in the test can be randomly replaced according to categories in the word frequency list. The following Figure 2 is an illustration from the most frequently mentioned Level 3:

1. alcohol	_____ cloth worn in front to protect your clothes
2. apron	_____
3. lure	_____ stage of development
4. mess	_____
5. phase	_____ state of untidiness or dirtiness
6. plank	_____

Figure 2. Illustration of Vocabulary Levels Test, Level 3

Through the designer's validity test, an implicational relationship has been found existing among vocabulary levels. For example, if a student performs excellently on the Level 3 vocabulary, their performance on Level 2 should also be above excellent. Some researchers have pointed out that Level 4, primarily consisting of university academic vocabulary, might lead to relatively higher scores for university students. Nation has also addressed this point on several occasions. Generally speaking, VLT has high reliability and validity over years of applications across various empirical studies.

However, it is important to note the initial purpose of Nation to design the VLT was to help his students and colleagues to identify the stage of students' vocabulary proficiency. In other others, VLT is a diagnostic tool developed for teaching practice, aimed at international students in English intensive courses preparing to enter universities in New Zealand at that time, rather than for experimental researches. For instance, if a student's accuracy rate at a certain level does not reach 80%, it indicates that they need to put more effort into that level. Although Nation revised VLT multiple times and verified its reliability and validity during his further studies in the UK, VLT should not be employed to measure students' accurate vocabulary size.

In personal correspondences with the present author via emails, Nation stated that many researchers' use of the VLT for vocabulary size measurement is a misuse and that the test results obtained are not accurate. Instead, he recommended using the Vocabulary Size Test (VST), which he developed with Laufer and published in 1999, for vocabulary size measurement[22].

VST uses the spoken corpus of the British National Corpus (BNC), the world's largest corpus, to identify 14,000 word families as test words, and arranges these 14,000 word families into 14 levels according to word frequency, with 1,000 words per level. The standard battery consists of 14 groups, with 10 words per level, each word corresponding to a word family at that level. All questions are matched with multiple choices, and the definitions in the options must be described with words from the 2,000-word range of the General Frequency List or the testees' native language.

One point is awarded for a correct answer, and zero points for an incorrect answer, for a total of 140 questions. The estimation of vocabulary size is obtained by multiplying the total score by 100. For instance, if the total score is 88, the total vocabulary size is expected to be approximately $88 \times 100 = 8,800$. Taking the word "weep" from Level 5 as an example, the Chinese and English versions of the VST are shown in Figure 3:

Weep: He wept.	Weep: He wept.
a. 毕业	a. finished his course
b. 哭	b. cried
c. 死	c. died
d. 担心	d. worried

Figure 3. Questions from Level 5 Chinese and English versions of VST

The questions first present the base form of the vocabulary word, 'weep', followed by a context sentence of appropriate length. The test word may involve inflectional changes, and students are required to choose the correct meaning of 'weep' in the context sentence from the four options. Compared with VLT, This question design is a more suitable tool for academic testing of students' vocabulary size. Nation found that although VST is slightly more difficult than VLT, it could more accurately reflect students' total vocabulary size. Nation suggested several times to the present author that the use of Chinese version of the VST for Chinese students further improve accuracy. Researchers have tested the reliability and validity of the VST and expressed considerable confidence in it[23].

4.2. Measurement of Depth of Vocabulary knowledge

The Vocabulary Knowledge Scale (VKS) designed by Wesche and Paribakht is the most frequently used and adapted tool for measuring depth of vocabulary knowledge[24], though its original purpose was not to measure students' depth of vocabulary knowledge, but to conduct research on incidental vocabulary acquisition. During the research process, Wesche & Paribakht increasingly realized that vocabulary knowledge is a continuum, covering a spectrum of different levels of developmental stages, and that the deepening process is linear. Therefore, they modified VKS to not only examine students' vocabulary knowledge status but also tracks the development of students' vocabulary knowledge. In addition, it can be used in conjunction with other language activities such as reading comprehension.

Unlike VLT or VST, VKS itself is merely a form of measurement, which provides 5 grades but does not have a word list. Researchers or teachers need to set the vocabulary to be measured themselves. An example adaption by Xu and Liu is provided in Figure 4.

- I. I have never seen the word. A
- II. I have seen the word but do not recognize it. B
- III. I know the meaning of the word. I will make a choice from C to F.
C...D...E...F...
- IV. I disagree with C to F. I think the word means: G_____.

Figure 4. Sample adaption of VKS by Xu and Liu[25]

VKS only sets different levels for a particular word, and students choose one of the five descriptions that match their current vocabulary knowledge. Therefore, it can also be viewed as a self-report research method. In addition to VKS, other commonly used tools include Laufer & Nation's Controlled Productive VLT (1999), which actually measures productive vocabulary but is also related to depth of knowledge[26], and Nation & Webb's Vocabulary Knowledge Scale[27], and software like Range which describes lexical frequency profiles.

4.3. Measurement of Word Association

Strictly speaking, mental lexicon is more of a construct than a concrete entity, in order to describe lexical competence and word organization in the brain, where the organization of vocabulary is profiled as a network or an encyclopedia. The fact that speakers can quickly retrieve the words they need from a lexicon of up to over ten or even twenty thousand words indicates that vocabulary storage is orderly rather than random. Current scientific technology is still insufficient to visually display how individual words are specifically stored and connected in the head. Therefore, it is no surprise that there is currently no measurement tool recognized as capable of rigorously delineate the mental lexicon. However, word association tests can help us better understand the patterns.

The Word Associates Test (WAT) proposed by Read is widely used in vocabulary association tests[28]. In this test, each test word is followed by 8 option words, which are divided into two groups. The first four words have the same part of speech as the test word, and at least one is a synonym or hyponym of the test word, with a maximum of three. The latter four words have a different part of speech from the test word, but at least one has a common collocation with the test word, with a maximum of three. Students need to choose four words from the eight options as the "correct" answers. The answers are "correct" in the sense that they are more closely associated with the test word as in the mind of native speakers, but the "correct" answers are not necessarily required to be picked as two from either group, and therefore, the distribution of "correct" answers can appear in three forms: 1:3, 2:2, or 3:1. Students earn one point for selecting a correct option. For example, the test word "critical" in WAT is exhibited in Figure 5:

Critical:

clear	dangerous	important	rough	festival	illness	time	water
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Figure 5. Test word "critical" in WAT

The first group consists of adjectives, among which “important” and “dangerous” are synonyms of “critical”. The second group consists of nouns, among which “illness” and “time” are commonly collocations of “critical”. These four words are the “correct” answers, with one point awarded for each correct selection. The first group examines the paradigmatic relations of the test word, while the second group examines its syntagmatic relations.

The shortcomings of WAT are evident: First, the paradigmatic and syntagmatic vocabulary relations it involves are not comprehensive, and merely providing 8 options could provide only a partial perspective. Second, WAT does not address productive vocabulary ability, focusing solely on receptive vocabulary knowledge. Third, there is a significant guessing factor with four answers out of eight options.

Nonetheless, WAT remains the primary tool in empirical lexicon research due to its clear advantages: Above all, it is convenient and efficient, preventing students from feeling too bored during testing. Next, it is open-ended and the 40 adjectives provided by Read serve merely as reference prompts, enabling researchers to substitute their own test words and options based on their research goals. Lastly, researchers can innovate, expand, or develop adaptations of WAT based on their own needs. For example, in the study by Cui and Liu, the Kent-Rosanoff word list was used to design test words, proportionally distributing adjectives, nouns, and noun/verbs. They then used the existing results from the Edinburgh Associative Thesaurus as a control group to study the semantic association patterns of Chinese students and the crosslinguistic influence from their mother tongue[29].

Besides, there are neuropsychological and psychological methods, such as magnetic resonance imaging (MRI), used for studying mental lexicon. Though many of these studies are still in their early stages, the insights achieved are very inspirational.

5. Conclusion

In summary, based on the three aspects of theoretical development and research evolution of vocabulary knowledge/competence, existing studies have developed a relatively mature set of testing tools. However, it must be noted that these tools have limitations in their scope of application due to their underpinning logic. Blind use these tools without understanding the design purposes may cause significant deviations in research analyses.

As Schmidt wisely quoted, without grammar very little can be conveyed, without vocabulary nothing can be conveyed[30]. Acquiring vocabulary is such a complex process that the study of it in SLA is bound to be an important but difficult enterprise that will continue to attract attention, research, and new insights. The continuous refinement of measurement tools is crucial to the progress of the field.

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