

# The Role of Chinese Vocabulary Knowledge in Composition Writing among Upper Elementary School Students

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## Abstract

The present study aims to investigate the role of vocabulary knowledge in composition writing among Chinese children. Drawing on Nation's (2001) vocabulary framework, this study operationalized Chinese vocabulary knowledge from receptive and productive perspectives and in form, meaning, and use domain, respectively. A total of five measures assessing receptive vocabulary knowledge, productive vocabulary knowledge (form, meaning, and use), and composition writing skills were administered to 249 Chinese students in grade 4 ( $N = 91$ ), grade 5 ( $N = 90$ ), and grade 6 ( $N = 68$ ). Hierarchical regression results showed that across upper elementary grades, productive vocabulary knowledge made a significant and substantial contribution to Chinese writing performance after controlling for age and receptive vocabulary knowledge. Inspections on vocabulary knowledge in each individual domain further revealed that knowledge of vocabulary form was the strongest predictor of writing performance at grade 4, while knowledge of vocabulary meaning and use make increasing contributions to composition writing at higher grades. Findings from this study underline the relative importance of productive vocabulary knowledge in form, meaning, and use at different developmental stages and extend writing models to non-alphabetical languages. Pedagogical implications were also drawn from the present study to inform better educational practices on scaffolding beginning writers with specific aspects of vocabulary knowledge.

**Keywords:** vocabulary knowledge, writing, literacy, Chinese, language production

## 1. Introduction

Vocabulary knowledge is of fundamental importance in early language and literacy development. Research on English learners has identified strong associations between vocabulary knowledge and important literacy skills, including reading (Cain & Oakhill, 2014; Proctor et al., 2005), listening (Matthews & Cheng 2015; Stæhr, 2009), speaking (Uchihara & Clenton, 2020), and writing (Olinghouse & Leaird, 2009). Given the crucial role of vocabulary knowledge in language and literacy skills, finding appropriate ways to assess and monitor vocabulary development among language learners has long been a focus of researchers and educational practitioners. Traditionally, vocabulary knowledge has been commonly measured by vocabulary breadth with the use of global tests, such as Vocabulary Levels Test (VLT, Nation, 1983) or Vocabulary Size Test (VST, Beglar, 2010). Nevertheless, there is a growing recognition that vocabulary knowledge is a multidimensional construct which should be operationalized from various aspects (Schmitt, 2014; Webb, 2009). Recent increasing effort has been paid to operationalize vocabulary knowledge from each individual aspect, including spoken form (Nation, 1990, 2001), written form (Schmitt, 2014), morphological structure (Lesaux et al., 2010), and syntactic function (Nagy & Scott, 2000). However, as is reviewed by Schmitt (2014) and Webb (2009), available measures of vocabulary knowledge to date are still limited in providing a comprehensive account of vocabulary knowledge.

The issue of measuring vocabulary knowledge is particularly significant when it comes to assessing learners of languages other than English, given that existing measures of vocabulary are mostly developed and standardized for English (native) speakers (Faitaki et al., 2020) and that characteristics of vocabulary vary considerably in typologically different languages (Dahl, 2009; Fenk-Oczlon & Fenk, 2008, 2014; Yang, 2008). As a non-alphabetical language, Chinese language is characterized by a logographic character-based writing system, in which words are often orthographically complex (Leong et al., 2000). Moreover, in contrast to more than 30 years of studies investigating writing development in alphabetic languages (Berninger, 2009), there is a paucity of research on writing development in Chinese. Despite a growing attention to the role of component skills, such as

syntactic awareness and word spelling (e.g., Leong et al., 2008; McBride-Chang et al., 2003; Shu et al., 2006), in Chinese writing composition, the lack of theoretical conceptualization and operationalization of multidimensional aspects of Chinese vocabulary knowledge constitutes a key challenge in building a more comprehensive understanding of vocabulary and writing development among Chinese young learners. Taken together, the widely recognized importance of vocabulary knowledge in early literacy development, the typological differences between Chinese and alphabetical languages, and the inadequate understanding of the role of Chinese vocabulary knowledge in (Chinese) writing development together collectively underlie the importance of investigating how vocabulary knowledge in Chinese can be operationalized from various aspects with theory-driven approaches and an awareness of typological differences. Drawing on Nation's (2001) theoretical conceptualization of vocabulary knowledge, our study aims to unpack the multiple dimensions of vocabulary knowledge in Chinese and clarify their relative importance in early writing development.

## 2. Literature Review

### 2.1 Theoretical Conceptualizations and Operationalizations of Vocabulary Knowledge

The conceptualization of vocabulary knowledge has undergone significant changes over the past decades from a global construct to a group of components. Early studies primarily viewed vocabulary knowledge as a single construct which can be measured through a global index such as vocabulary size or vocabulary breadth. These measures focus on estimating the number of words one knows, taking the common formats including picture-word matching task (e.g., Zhang et al., 2019; Yang et al., 2020), vocabulary checklist (e.g., Chen, 2022; Chen & Zhang, 2023), and oral definition task (e.g., McBride-Chang & Ho, 2000; Zhang et al., 2014). In recent years, however, there has been a paradigm shift of sorts with growing awareness of the multidimensional nature of vocabulary knowledge, driving empirical studies to operationalize vocabulary knowledge from various component skills, including phonological awareness (Chung & Lam, 2020), morphological awareness (Lesaux et al., 2010; Nagy & Scott, 2000), and orthographic skills (Yeung et al., 2013). However, as Schmitt (2014) reviewed, studies tapping into individual aspects of vocabulary largely overlap with each other due to a lack of agreement on which aspect of vocabulary to be measured. The inconsistent conceptualization of vocabulary knowledge highlights the need for adopting a more theory-driven operationalization of vocabulary knowledge.

Among the theoretical accounts of vocabulary knowledge, Nation's (2001) conceptualization has long been viewed as one of the most comprehensive (Schmitt, 2014; Webb, 2009). This framework (see Table 1) divides vocabulary knowledge into three main domains: (1) Form, which refers to one's knowledge of the spoken and written format of the word; (2) Meaning, which refers to the semantic properties of the word as well as its semantic association with other words; and (3) Use, which refers to the syntactic function and the pragmatic norms of the word. Each of these three domains of vocabulary knowledge can be further divided into receptive and productive mastery subdomains. Receptive vocabulary refers to the ability to recognize/comprehend a word when encountering it, whereas productive vocabulary refers to the ability to retrieve and use a word in various contexts. The differentiation between receptive and productive vocabulary highlights another long-lasting issue in vocabulary research. While it has been well established that receptive and productive knowledge of vocabulary do not develop in tandem, the relationship between them across early language developmental stages remains unclear. While some research suggests that receptive and productive knowledge should be highly associated as producing a word requires a basic understanding of its receptive meaning (Melka, 1997), others argue that it is possible for one to spell or use a word correctly before fully knowing its meaning (Faitaki et al., 2020; Nation, 2001). It is also noteworthy that measures of vocabulary knowledge to date largely focus on assessing the receptive knowledge of vocabulary, such as by asking participants to indicate whether they know a word (e.g., Yes/No test, Miralpeix & Meara, 2014) or by choosing a picture corresponding to a word (e.g., the Peabody Picture Vocabulary Test, Dunn & Dunn, 1997). Far less is known about the role of productive vocabulary, as independent of receptive vocabulary, in language and literacy development (Schmitt, 2014; Webb, 2009). Theory-driven measures of vocabulary knowledge, which differentiate receptive vocabulary from productive vocabulary, are thus needed in the operationalization of vocabulary knowledge.

Table 1. Theoretical framework of vocabulary knowledge (Nation, 2001)

Form	Spoken	R	What does the word sound like?
		P	How is the word pronounced?
	Written	R	What does the word look like?
		P	How is the word written and spelled?
	Word Parts	R	What parts are recognizable in this word?
		P	What word parts are needed to express the meaning?
Meaning	Form and Meaning	R	What meaning does this word form signal?
		P	What word form can be used to express this meaning?
	Concept and Referents	R	What is included in the concept?
		P	What items can the concept refer to?
	Association	R	What other words does this make us think of?
		P	What other words could we use instead of this one?
Use	Grammatical Function	R	In what patterns does this word occur?
		P	In what patterns must we use this word?
	Collocation	R	What words or types of words occur with this one?
		P	What words or types of words must we use with this one?
	Constraints on Use	R	When, where, and how often would we expect to meet this word?
		P	Where, when, and how often can we use this word?

## 2.2 Characteristics of Chinese vocabulary and writing system

A review of traditional and updated theoretical conceptualizations of vocabulary knowledge highlights the growing significance of measuring vocabulary knowledge from different aspects. Nevertheless, as is noted earlier, available measures of vocabulary knowledge were mostly developed for English learners and may not provide a full account for learners of Chinese language. As a non-alphabetical language, Chinese vocabulary notably entails typological characteristics in terms of form, meaning, and use.

### 2.2.1 Form

Chinese vocabulary is characterized by the basic logographic unit called a character. Characters are made up of radicals, and each radical consists of strokes (Leong et al., 2000). There are at least ten types of Chinese character structures (Fu, 1993) and eight basic types of strokes (Law et al., 1998). The order of the strokes used in writing the characters follows consensual principles (Yu et al., 2011). In contrast to alphabetic languages, the written form of Chinese vocabulary does not necessitate prior access to the spoken form of the word (Rapp et al., 1997), but instead emphasizes the learning of character structures, basic stroke forms, and stroke sequences (Perfetti & Guan, 2012; Wang et al., 2014). Given the complexity of the Chinese writing system, learning the written form of vocabulary is presumed to be critical and challenging for Chinese learners. Instructions on handwriting skills and dictation practices have thus been the predominant approaches in Chinese classrooms in elementary schools (Lin et al., 2009; Yeung et al., 2013a, 2013b).

### 2.2.2 Meaning

Semantic transparency constitutes another feature of Chinese language, in which the written form often provides a clue to the meaning of words and thus differs considerably from the grapheme-phoneme correspondence in alphabetical languages. Notably, Chinese vocabulary is semantically transparent at both the character and word level (Shu et al., 2003). On the one hand, most Chinese characters contain a graphic component called semantic radical to denote the meaning of the character. For example, the character *chi* (吃) ‘eat’ and *he* (喝) ‘drink’ both have the radical *kou* (口) ‘mouth’, which is semantically related to the character. On the other hand, the majority of Chinese words are compounds comprising two or more characters, where the constituent character(s) often represent(s) the meaning of the word (Chung & Hu, 2007). For example, the meaning of the two-character word *ma-che* (马车) ‘carriage’ can be easily inferred from its constituent characters *ma* (马) ‘horse’ and *che* (车) ‘car’.

The learning of Chinese vocabulary meaning is further complicated by a large number of homonyms in Chinese (Tong et al., 2009). Homonyms are Chinese characters having the same written form but different meaning. For example, the character shou (手) in the word shou-zhang (手掌) ‘palm’ means ‘hand’ while in the word ge-shou (歌手) ‘singer’ means ‘a person working in a particular area’.

### 2.2.3 Use

Another notable characteristic of Chinese language is the unclear boundary between words and phrases. Compared to the more clearly identifiable word units in English, the word boundary in Chinese is less obvious. While many characters can themselves be words, most Chinese characters are combined to form words and phrases, represented in print as a string of characters (Hoosain, 1991; Ju & Jackson, 1995). Given the relatively free combination of characters to form words and phrases, knowledge of vocabulary use, which concerns the ability to form between-word collocations, may be closely related to within-word morphological skills among Chinese learners (Matthiessen & Halliday, 1997). It is also noteworthy that Chinese has relatively few explicit inflectional markers (Li & Thompson, 1981). Grammatical features, such as tense and plurality, are often denoted by word order and the use of function words (Chang, 1992). It is thus hypothesized that vocabulary knowledge is associated with syntactic knowledge among Chinese learners.

Overall, the typological characteristics of Chinese vocabulary in form, meaning, and use domains demand further scholarly attention when conducting or interpreting findings on Chinese vocabulary. It is also significant to examine whether and to what extent early vocabulary development among logographic language learners resemble those of alphabetical languages.

### 2.3 Theoretical Framework of Written Language Production

Composition writing constitutes a critical yet challenging literacy skill for young learners to master (Abbott et al., 2010). Several models have been proposed to conceptualize writing into a series of cognitive process. One classic model of writing was proposed by Hayes and Flower (1980), in which writing was theorized into three major processes: planning, translating, and reviewing. Another equally influential model is the Simple View of Writing (Juel et al., 1986), in which writing was conceptualized into two principal component skills, including idea generation and spelling. Idea generation refers to the process of finding concepts and ideas to prepare the writing content, whereas spelling refers to the transformation of ideas into linguistic representation. Berninger and colleagues (Berninger, 2000; Berninger et al., 1997, 2002) proposed a similar model, in which text generation involves idea generation and the transformation of ideas into language representation. It is noteworthy that theoretical conceptualizations of writing, while differing in naming writing processes, converge to emphasize linguistic transformation as a critical stage of writing, in which writers’ lower-level linguistic skills, including vocabulary knowledge, are presumed to be plausible predictors of writing performance (Laufer & Nation, 1995; Olinghouse & Wilson, 2013).

In addition, models of writing have converged to conceptualize writing as a productive activity involving a complicated interplay between various cognitive processes, highlighting the demand for writers to deal with diverse processes in writing (Berninger & Swanson, 1994; Flower & Hayes, 1981). Due to the limited capacity of working memory, advanced linguistic knowledge is believed to relieve the writer’s working memory to focus on higher-order skills, such as generating ideas, organizing discourse, and monitoring writing goals (Berninger, 2000). Taken together, models of writing collectively suggest that text production concerns not only lower-level linguistic skills, but also the allocation of cognitive resources between lower- and higher-level processes (McCutchen, 1996). In particular, young beginner writers are often characterized by very limited language proficiency as well as cognitive capacity. Previous literature suggests that children investing too much time and cognitive effort in finding the right spelling face more challenges in the whole writing process (Abbott et al., 2010) and the speed with which children access linguistic presentations also influences the quality of their writing (Berninger & Swanson, 1994).

It is also important to note that models of writing, which emphasize lower-level linguistic knowledge as a key influential factor in text production (Kent & Wanzek, 2016; McCutchen, 2006; Medwell & Wray, 2007), were initially developed to account for writing among English language learners. It thus remains unclear whether and to what extent these traditional models of writing can be extended to account for writing production processes among learners of other languages, particularly those with non-alphabetic writing systems like Chinese. The potential influence of language typological features in writing might be supported by a large group of Chinese reading research showing that the symbol-meaning correspondence (or “grapheme-meaning correspondence”) plays a particularly important role in reading success among Chinese children (McBride-Chang et al., 2003; Shu & Anderson, 1997). It is thus of theoretical significance to investigate to what extent there is an interplay between

lower-level linguistic transformation and higher-order processing in writing production among Chinese learners as young as elementary school students who are still developing linguistic skills and cognitive capacity.

#### *2.4 Empirical Findings on Critical Component Skills in Chinese Writing*

Numerous studies have shown significant positive correlations between various aspects of vocabulary knowledge and composition writing among young Chinese learners. However, different aspects of vocabulary knowledge were often found to differ in their strength of association with writing performance. Drawing on Nation's (2001) three-dimensional conceptualization of vocabulary knowledge, we now review some empirical findings on the respective role of vocabulary in form, meaning, and use domains in Chinese composition writing.

The ability to produce the written form of vocabulary has been widely reported as a crucial component skill in early writing development. A large body of research has reported that transcription skills, handwriting fluency, and word spelling skills were strong predictors of writing performance among young Chinese learners. Yan et al. (2012), for example, found that word spelling skill and handwriting fluency measured at the ages of 6 to 9 were significant predictors of overall writing performances at the age of 9 over phonological awareness and knowledge of vocabulary meaning. Three subsequent studies by Yeung and colleagues (2013a, 2013b, 2017) provide additional support to the importance of word spelling skills and handwriting skills in early Chinese writing development by tracking the development of elementary school students in Hong Kong. While empirical findings have collectively suggested the importance of vocabulary written form for beginning writers in Hong Kong, where the traditional character writing system is used, it remains unclear to what extent it accounts for young learners of simplified Chinese character with less orthographic complexity in mainland China.

Knowledge of individual word meaning has been the most common indicator of 'vocabulary knowledge'. Although little research has examined its role in Chinese composition writing, previous findings from English writing research and Chinese reading research help illuminate the relationship between vocabulary and writing skills in Chinese. On the one hand, research on English learners has yielded consistent findings on the strong association between knowledge of vocabulary meaning and overall writing performance (e.g., Berninger, 2009; McBride-Chang et al., 2003). On the other hand, studies on young Chinese learners collectively showed that knowledge of vocabulary meaning is a critical component skill for reading (e.g., Tong & McBride-Chang, 2016). Nevertheless, it is important to note that knowledge of vocabulary meaning involves not only one's understanding of individual word meaning but also its semantic relationship with other words (Nation, 2001), which has been rarely attended to. A more comprehensive operationalization of Chinese vocabulary knowledge beyond the individual word level is thus of theoretical significance and may enrich the extant understanding of early vocabulary development.

As noted earlier, given the variety of possible character combinations and the unclear boundary between words and phrases in Chinese, knowledge of Chinese vocabulary use involves both within-word morphological skills and between-word collocating skills. Despite a paucity of research on word collocating skills, numerous studies on Chinese reading and writing development have suggested the important role of morphological construction skills in early literacy development. Morphological awareness (Ku & Anderson, 2003) and morphological compounding skills (e.g., Hao et al., 2013), for example, were found to strongly correlate with reading skills among young Chinese learners. Writing research in Chinese similarly showed that morphological processing skills are associated with picture description writing skills (Leong & Ho, 2008; Leong et al., 2013) and that morphological awareness training is beneficial to narrative writing skills among Chinese learners at grade 3 to 5 (Guan et al., 2019). This empirical evidence taken together indicates the potential significance of character compounding skills for early Chinese writing development. Nevertheless, given the multidimensionality of vocabulary knowledge, additional research is still needed to clarify the relative importance of different aspects of vocabulary knowledge in Chinese composition writing.

### **3. The Present Study**

The selective review above highlights three significant yet under-explored areas in the previous literature. First, while an active line of research has set out to investigate the written knowledge of Chinese vocabulary form, limited attention has been paid to vocabulary knowledge in meaning and use domains and far less is known about the relationships between different aspects of vocabulary knowledge and writing. The second observation is that extant studies on Chinese vocabulary and writing development have been chiefly conducted in Hong Kong. It remains unclear whether traditional characters used in Hong Kong will pose greater demands on children compared to those learning simplified characters in mainland China. It is also important to note that models of writing have converged to highlight the complicated interplay between lower-level linguistic knowledge and higher-level processing in writing production (Berninger et al., 1994, 1996; Reznitskaya et al., 2007). Therefore, it

is of both theoretical and practical significance for further research to make a finer differentiation between different aspects of vocabulary knowledge and take the typological features of Chinese into account, and to investigate the role of vocabulary knowledge in writing among young Chinese learners who are still developing lower-level linguistic skills. Potential findings from these studies may help unpack the multiple dimensions of vocabulary knowledge, illuminate the implicated interplay between lower- and high-level processing in writing production, and extend the models of writing from alphabetical languages to logographic languages. The present study aims to contribute this issue by addressing the following research questions:

- (1) What (if any) observed differences are there in various aspects of Chinese vocabulary knowledge among Chinese students at grade 4, 5, and 6?
- (2) What is the unique contribution of productive vocabulary knowledge in form, meaning, and use to Chinese composition writing among students at grade 4, 5, and 6?

#### 4. Method

##### 4.1 Participants

A total of 249 typically developing Chinese students at grade 4 ( $N = 91$ ), grade 5 ( $N = 90$ ), and grade 6 ( $N = 68$ ) from two primary schools in Southern China participated in this study. All participants reported having Mandarin Chinese as their first language and were instructed predominantly in Mandarin Chinese at school. Although there were no formally collected data on classroom environments and instructions at school in this study, informal observations suggested similarities in students' learning environments and education backgrounds. The two participating schools were also similar in student demographics and were in relatively close geographic proximity.

##### 4.2 Measures

The vocabulary checklist has been commonly adopted by previous studies to assess children's receptive vocabulary in both English (e.g., Anderson & Freebody, 1983; Meara, 1992) and Chinese (e.g., Chen, 2019; Ku & Anderson, 2003; Zhang, 2020). Following the common design in previous studies (Ku & Anderson, 2003; Zhang & Koda, 2011), the vocabulary checklist in this study consists of 120 items, including 100 real words varying in frequency and 20 pseudo-words made by replacing one character in the real word with another real character phonologically or orthographically similar to the initial one. The checklist was in a yes/no-choice format, in which participants were asked to indicate whether they know the word or not (see Appendix A for testing samples). Participants gained one score if they indicated "yes" to a real word, while a two-mark reduction was given if a pseudo-word was selected. Participants' final scores were calculated by the sum of marks gained and marks penalty.

The ability to produce the written form of vocabulary is primarily measured by the transcription task (also known as *word spelling task*). This task has been widely adopted by previous studies to assess learners' knowledge of Chinese written form (e.g., Ho et al., 2007; Yeung et al., 2013a). In the present study, a total of 20 two-character words were selected as the target words based on frequency varying from high to low. For each word, its corresponding pinyin, an alphabetic unit annotating the pronunciation of Chinese words, was provided and participants were asked to produce its written form based on its spoken form. Participants' responses in the transcription task were scored dichotomously, with one mark given for each correctly written character. No penalty was given to a wrongly written character.

The depth of vocabulary knowledge in meaning and use domains has been commonly measured by eliciting lexical associations from participants with some cues, among which the Word Association Task (WAT, Read, 1993) and Lex30 (Meara & Fitzpatrick, 2000) are among the most popular (for reviews, see Fitzpatrick, 2012; Fitzpatrick & Thwaites, 2020). It has also been widely noted that the elicited responses in word association tasks can be further differentiated into paradigmatic and syntagmatic associations, which drove researchers to develop two subsets of WAT pertaining to meaning-based and collocation-based associations (Fitzpatrick, 2006; Fitzpatrick & Izura, 2011). Given the well-noted differences between paradigmatic and syntagmatic word associations and the lack of available measures of Chinese vocabulary, except the Chinese version of WAT adopted by Zhang and Yang (2016) to assess learners with Chinese as a foreign language, this study adapted the WAT into paradigmatic word association and syntagmatic word association to measure vocabulary knowledge in meaning and use domain, respectively.

On the one hand, productive knowledge of vocabulary meaning concerns the ability to produce words with the similar semantic property (Nation, 2001). This has been measured by synonym production tasks (Barcroft, 2009; Proctor et al., 2012) and paradigmatic word association tasks in Read (1993), in which participants are asked to produce as many synonyms of the given stimuli as possible within a certain time period. On the other hand,

productive knowledge of vocabulary use concerns the ability to produce vocabulary with appropriate collocation in context (Nation, 2001). This has been measured by syntagmatic word association task as in Read (1993), in which participants were asked to write down as many words that can collate with the target word as possible. In this study, six Chinese words were selected from textbooks as the cue words for paradigmatic and syntagmatic word association tasks, respectively. In each trial, one word was presented and participants were asked to generate as many target words as possible. Scores were calculated by assigning one mark to each synonym generated.

The open-ended writing task, which allows participants to come up with ideas freely, has also been widely used to assess composition writing skills among young learners. Following the design of previous research (e.g., Suzuki & Kormos, 2020; Yeung, 2020), participants in this study were asked to write a passage based on a broad writing topic. Each participant was given 35 minutes to complete the task. Participants' writing samples were scored based on marking criteria developed by Yeung and colleagues (2017a, 2017b, 2020a, 2022). This criteria-based scoring approach has been widely used by writing research and has been shown to have high reliability among both beginning and advanced learners (Mujtaba et al., 2020; Tang & Liu, 2018). A thorough review of available scoring rubrics of Chinese writing (see Appendix A) suggests that this rubric is one of the most well-established and widely-used. The rubrics consists of four dimensions, namely, content, vocabulary, sentence structure, and organization. Participants' performance in each dimension was rated based on a 0 to 5 scale (0 = Low, 5 = High) (see Appendix B for the rubrics). To minimize the effect of word dictation on written composition, character writing errors were not penalized, and any words the participants did not know how to write were dictated to the students. To ensure the reliability of scoring, a random 10% of the writing samples were scored by a second researcher and by the first author at another time. Both inter- and intra-rater reliability was found to be high (above 90%).

#### 4.3 Procedure

The data were collected in the second half of the academic year for the participants. The two participating schools were first contacted to obtain the consent from headmasters and teachers. Then, opt-out forms were sent to participants' parents/guardians. Assent forms were also given to each participant before administering the tasks. A total of five tasks were administered to each participant, including one task on receptive vocabulary knowledge, three tasks on productive vocabulary knowledge (form, meaning, and use), and one task on writing composition skills. All tasks were conducted in a group format in participants' classrooms, in which students in the same class participated as one group. Overall, a total of six groups, with two from grade 4, two from grade 5, and two from grade 6, participated in this study. To minimize the practice and fatigue effects, the sequence of tasks was randomized for each participating group and short breaks were given between the tasks. Each task began with instructions and warm-up trials to familiarize participants with the task format, followed by the official session. Each participant was assessed in approximately 50 minutes. Participants' responses were collected in paper-and-pencil format.

### 5. Results

#### 5.1 Descriptive Statistics and Across-Grade Comparison on Measures

Table 2 presents the means and standard deviation of participants' performance on the battery of language and literacy measures in each grade. To examine the group differences between participants at different grades across all measures, a multivariate analysis of variance (MANOVA) was conducted, with scores in all of the five measures as the dependent variables and grade (4 vs 5 vs 6) as the independent (between subjects) variable. The results showed that there is a significant main effect of grade on one or more measures, Wilks  $\lambda = 0.18$ ,  $F(8, 486) = 82.52$ ,  $p < .001$ . To further locate the differences in the measures across different grades, a series of follow-up analysis of variance (ANOVAs) were conducted, with grade (4 vs 5 vs 6) as the independent variable and performance in each measure as the dependent variable (see results in Table 2). Post hoc comparisons showed that participants at grade 6 performed better in all measures than those at grade 5, who in turn performed better than those at grade 4 ( $ps < .001$ ). Furthermore, different aspects of vocabulary knowledge varied in the degree of differences between grades. In particular, for receptive vocabulary, participants at grade 6 ( $M = 65.78$ ,  $SD = 3.64$ ) scored significantly higher than those at grade 5 ( $M = 49.88$ ,  $SD = 5.76$ ) which in turns significantly higher than those at grade 4,  $F(2, 246) = 305.53$ ,  $p < .001$ . For productive knowledge of vocabulary meaning, sixth graders ( $M = 6.34$ ,  $SD = 2.31$ ) again scored significantly higher than fifth graders ( $M = 4.52$ ,  $SD = 2.42$ ) which further higher than fourth graders ( $M = 4.52$ ,  $SD = 2.42$ ),  $F(2, 246) = 45.62$ ,  $p < .001$ . These findings demonstrate vocabulary growth across these measures as a function of grade level in our participants.

Table 2. Means, standard deviations, and analysis of variance results for variables

	All participants (N = 249)			Grade 4 (N = 91)		Grade 5 (N = 90)		Grade 6 (N = 68)		F
	Mean	SD	Max	Mean	SD	Mean	SD	Mean	SD	
Age (months)	135.72	11.72	166	124.76	6.87	136.81	6.89	148.96	6.29	253.78**
Receptive knowledge of vocabulary	52.18	10.29	74	44.29	6.41	49.88	5.76	65.78	3.64	305.53**
Productive knowledge of vocabulary form	24.66	5.90	38	19.45	4.58	25.48	3.39	30.54	3.53	159.81**
Productive knowledge of vocabulary meaning	4.63	2.37	12	3.32	1.73	4.61	2.27	6.43	2.07	45.62**
Productive knowledge of vocabulary use	9.18	4.79	25	5.22	2.64	9.61	3.73	13.93	3.58	134.59**
Overall writing scores	13.77	2.91	19	11.26	2.39	14.20	1.76	16.56	1.71	139.24**

Note. \* $p < .01$ , \*\* $p < .001$

### 5.2 Relationships between Vocabulary Knowledge and Writing Performance

The correlations between vocabulary knowledge and writing skills in grades 4, 5, and 6 are displayed in Tables 3.1, 3.2, and 3.3, respectively. As is shown in Table 3.1, writing performance at grade 4 was significantly correlated with all four aspects of vocabulary knowledge. Particularly strong correlations were found between writing performance and receptive vocabulary ( $r = .54, p < .001$ ) and productive knowledge of vocabulary form ( $r = .52, p < .001$ ). Noticeably, writing performance among participants at grades 5 and 6 was only significantly correlated with productive vocabulary knowledge in meaning and use but not form (see Tables 3.2 and 3.3). For fifth and sixth graders, writing performance had similarly strong correlations with productive knowledge of vocabulary and use, while writing performances at grade 6 had a stronger correlation with receptive vocabulary knowledge than those at grade 5. Across grades 4, 5, and 6, the correlation between receptive vocabulary and writing was found to be strong or moderate-to-strong, while productive knowledge in different domains demonstrated different relationships with writing performance. Productive knowledge of vocabulary form, while strongly correlated with writing at grade 4, was not correlated with writing at grade 5 and 6. On the contrary, the association between writing and productive knowledge in vocabulary meaning and use was strengthened from grade 4 to 6. Additionally, receptive vocabulary had the strongest correlation with writing ( $r = .54, p < .001$ ) at grade 4, while at grade 5, receptive vocabulary and productive vocabulary meaning had the strongest correlations with writing ( $r = .49, p < .001$ ).

Table 3.1. Correlations between vocabulary and overall writing scores in grade 4 (N = 91)

	1	2	3	4	5
1. Receptive knowledge of vocabulary	-				
2. Productive knowledge of vocabulary form	.06	-			
3. Productive knowledge of vocabulary meaning	.13	.20	-		
4. Productive knowledge of vocabulary use	.27**	.12	.00	-	
5. Overall writing scores	.54**	.52**	.23*	.21*	-

Note. \* $p < .01$ , \*\* $p < .001$



Table 3.2. Correlations between vocabulary and overall writing scores in grade 5 ( $N = 90$ )

	1	2	3	4	5
1. Receptive knowledge of vocabulary	-				
2. Productive knowledge of vocabulary form	.02	-			
3. Productive knowledge of vocabulary meaning	.23*	.35**	-		
4. Productive knowledge of vocabulary use	.41**	.40**	.52**	-	
5. Overall writing scores	.49**	.16	.49**	.53**	-

Note. \* $p < .01$ , \*\* $p < .001$ .

Table 3.3. Correlations between vocabulary and overall writing scores in grade 6 ( $N = 68$ )

	1	2	3	4	5
1. Receptive knowledge of vocabulary	-				
2. Productive knowledge of vocabulary form	-.19	-			
3. Productive knowledge of vocabulary meaning	.20	-.11	-		
4. Productive knowledge of vocabulary use	.29*	-.22	.40**	-	
5. Overall writing scores	.54**	-.19	.56**	.55**	-

Note. \* $p < .01$ , \*\* $p < .001$ .

### 5.3 The role of vocabulary knowledge in overall writing scores

To examine the unique contribution of vocabulary knowledge in writing performance, three sets of hierarchical regression analyses were conducted separately for grades 4, 5, and 6. Composition writing scores were entered as the dependent variable in all analyses. In each set, a baseline control model was first created to control for the effects of age (month). In the second step, receptive vocabulary knowledge was entered, followed by the three domains (form, meaning, and use) of productive vocabulary knowledge entered in the last step. The results from the three sets of hierarchical regression analysis for grades 4, 5 and 6 are displayed in Tables 4.1, 4.2 and 4.3, respectively.

At grade 4, receptive vocabulary knowledge entered in the second step was found to explain a large and significant amount of variance in writing performance ( $\Delta R^2 = .29$ ,  $\beta = .54$ ,  $p < .001$ ). Once the substantial effect of receptive vocabulary was taken into account, variables of productive vocabulary knowledge entered at the third step together accounted for a unique 21% of the variance in writing performance. Notably, productive vocabulary knowledge in form was the only variable among the three domains of productive vocabulary which achieved statistical significance with a large effect ( $\beta = .47$ ,  $p < .001$ ). The results from fifth graders were different from those at grade 4. Receptive vocabulary knowledge entered in the second step similarly explains a large and significant amount of variance in writing performance ( $\Delta R^2 = .23$ ,  $\beta = .48$ ,  $p < .001$ ), while variables of productive vocabulary knowledge entered at the third step together accounted for a unique 21% of the variance in writing performance. However, closer examinations on the contribution made by productive vocabulary knowledge in each individual domain showed that productive knowledge of vocabulary form was not a statistically significant predictor ( $\beta = -.06$ ,  $p = .38$ ), while productive knowledge of vocabulary meaning ( $\beta = .30$ ,  $p < .01$ ) and use ( $\beta = .29$ ,  $p < .01$ ) had a more substantial and statistically significant effect on writing performance. Results from sixth graders demonstrate similar patterns as those at grade 5, which again differ from those at grade 4. Receptive vocabulary knowledge entered in the second step was found to explain a large and significant amount of variance in writing performance ( $\Delta R^2 = .28$ ,  $\beta = .53$ ,  $p < .001$ ). Productive vocabulary knowledge entered at the third step together accounted for a unique 28% of the variance in writing performance. Inspection of the standardized beta weights shows that only the meaning ( $\beta = .36$ ,  $p < .001$ ) and use ( $\beta = .30$ ,  $p < .01$ ) domain of productive vocabulary knowledge made unique contributions to writing performance.

Comparisons between the three sets of regression showed that various aspects of vocabulary knowledge differed in their predictive power of writing performance among fourth, fifth, and sixth graders. In terms of receptive vocabulary knowledge, its predictive power of writing performance had a constantly significant and substantial effect at grade 4 ( $\Delta R^2 = .29$ ,  $\beta = .54$ ,  $p < .001$ ), grade 5 ( $\Delta R^2 = .23$ ,  $\beta = .48$ ,  $p < .001$ ), and grade 6 ( $\Delta R^2 = .28$ ,  $\beta = .53$ ,

$p < .001$ ) even after controlling for the effect of age. After controlling for the substantial effect of receptive vocabulary, results showed that productive vocabulary knowledge constantly makes a significant contribution to writing performance across grade 4, 5, and 6. However, in grade 4, the strongest predictive strength between productive vocabulary knowledge and writing is found in the form domain, which is a large effect, while in grade 5 and 6, the strongest predictive strength is found in the meaning domain, with a larger effect at grade 6 ( $\beta = .36, p < .001$ ) than grade 5 ( $\beta = .30, p < .01$ ).

Table 4.1. Summary of HLR analysis predicting writing scores from vocabulary measures in grade 4 ( $N = 91$ )

Variables	Model 1			Model 2			Model 3		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Age (months)	0.01	0.04	0.02	-0.02	0.03	-0.05	0.00	0.03	0.01
Receptive knowledge of vocabulary				0.20	0.03	0.54**	0.18	0.03	0.49**
Productive knowledge of vocabulary form							0.25	0.04	0.47**
Productive knowledge of vocabulary meaning							0.10	0.11	0.07
Productive knowledge of vocabulary use							0.02	0.07	0.03
$\Delta R^2$	.00			.29			.24		
<i>F</i> for $\Delta R^2$	.04			36.21**			14.39**		

Note. \* $p < .01$ , \*\* $p < .001$ .

Table 4.2. Summary of HLR analysis predicting writing scores from vocabulary measures in grade 5 ( $N = 90$ )

Variables	Model 1			Model 2			Model 3		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Age (months)	-0.03	0.03	-0.12	-0.02	0.02	-0.09	-0.4	0.02	-0.15
Receptive knowledge of vocabulary				0.15	0.03	0.48**	0.09	0.03	0.29*
Productive knowledge of vocabulary form							-0.03	0.05	-0.06
Productive knowledge of vocabulary meaning							0.23	0.08	0.30*
Productive knowledge of vocabulary use							0.14	0.05	0.29*
$\Delta R^2$	.01			.23			.21		
<i>F</i> for $\Delta R^2$	1.29			26.98**			10.54**		

Note. \* $p < .01$ , \*\* $p < .001$ .

Table 4.3. Summary of HLR analysis predicting writing scores from vocabulary measures in grade 6 ( $N = 68$ )

Variables	Model 1			Model 2			Model 3		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Age (months)	-0.04	0.03	-0.13	-0.02	0.03	-0.07	-0.02	0.02	-0.06
Receptive knowledge of vocabulary				0.25	0.05	0.53**	0.18	0.04	0.38**
Productive knowledge of vocabulary form							0.00	0.04	0.00
Productive knowledge of vocabulary meaning							0.30	0.08	0.36**
Productive knowledge of vocabulary use							0.14	0.05	0.30*
$\Delta R^2$	.02			.28			.28		
<i>F</i> for $\Delta R^2$	1.15			25.92**			13.79**		

Note. \* $p < .01$ , \*\* $p < .001$

## 6. Discussion and Conclusion

### 6.1 *The Receptive-Productive Distinction in Early Development of Chinese Vocabulary*

This study was guided by two research questions. The first research question concerned across-grade differences in various aspects of vocabulary knowledge. The results showed that although both receptive and productive vocabulary demonstrated similar substantial increases from grade 4 to 6, their respective increments were different. While there was a significantly large increase in receptive vocabulary knowledge from grade 5 to 6 which was approximately three times that of the increase from grade 4 to 5, the increments in productive knowledge from grade 5 to 6 were about the same as those from grade 4 to 5. In terms of the relative role of receptive and productive vocabulary in composition writing, productive vocabulary knowledge made a unique contribution accounting for more than 20% of variance in overall writing performance across students at grade 4, 5, and 6. The unique contribution of productive vocabulary beyond receptive vocabulary points to the receptive-productive gap in Chinese vocabulary development.

These findings partially overlap with previous research on English language learners. On the one hand, a large body of literature has suggested the distinction between receptive and productive mastery of vocabulary knowledge, where the former involves being able to recognize a word during reading or listening while the latter entails the ability to use a word in productive activities such as speaking and writing (e.g., Laufer & Goldstein, 2004; Nation, 2001). The current study adds to previous literature by showing the inconsistent developments between receptive and productive knowledge among young Chinese learners. Although this finding might be considered less surprising, it lends direct empirical support to instructional recommendations on a finer differentiation between receptive and productive vocabulary instructions and a particular attention to productive skills in Chinese classrooms. In particular, writing has long been recognized as a productive activity demanding writers' ability to produce morphologically and grammatically appropriate words (Berninger et al., 2002; Hayes, 1996). Studies have shown that abilities related to information retrieval, such as working memory, were positively associated with writing performance (Chik et al., 2012; Leong et al., 2008). Findings from the present study on the strong association between productive vocabulary knowledge and writing resonate with previous research in underlying the importance of children's ability to retrieve and produce, rather than simply recognize, vocabulary in writing.

On the other hand, however, the present findings on the nonlinear growth of Chinese vocabulary across upper elementary grades show some degree of discrepancy with previous studies. Laufer and Nation (1995), for example, found that receptive vocabulary grew at a much faster rate than productive vocabulary among English learners, while Zhong and Hirsh (2009) reported that productive vocabulary grew faster than receptive size among intermediate English learners. This study identified a nonlinear growth of vocabulary among young Chinese learners with the differentiated speed in receptive and productive domains. Fluctuation was also observed in terms of the strength of association between aspects of vocabulary knowledge among learners from grades 4 to 6, which stands in contrast to previous findings on the gradually decreasing gap between receptive and productive vocabulary knowledge among English learners (Laufer, 1998; Laufer & Paribakht, 1998).

Taken together, findings on the differentiated and nonlinear patterns of vocabulary growth in various domains among young Chinese learners highlight the complexity in contouring the multidimensional vocabulary knowledge, extend the receptive-productive distinction of vocabulary from alphabetical to logographic languages, and showed how young learners of non-alphabetical languages might demonstrate different patterns of vocabulary growth from English learners. These findings underscore the importance of adopting a more detailed and language-specific paradigm in portraying a comprehensive picture of early development of Chinese vocabulary, rather than holding a simplistic view that receptive vocabulary develops earlier or faster than productive one.

### 6.2 *The Fundamental Importance of Vocabulary Written form for Young Chinese Writers*

While the first research question concerns primarily vocabulary growth in Chinese, the second question of this study delves into the role of vocabulary knowledge in composition writing. Drawing on Nation's (2001) three-dimensional framework of vocabulary knowledge, this study made a finer differentiation between form, meaning, and use domains of vocabulary knowledge and examined their relative contributions to writing performances. The theory-driven operationalization has yielded rich findings on the role of various linguistic skills in writing production. One noteworthy finding is the decreasing importance of productive vocabulary written form in writing as learners proceed to higher elementary grades. Results from separate regression analyses among fourth, fifth, and sixth graders reveal that productive vocabulary knowledge in form was a unique predictor of writing performance at grade 4 but not at grade 5 or 6. In contrast to the decreasing contribution made by vocabulary written form, productive vocabulary knowledge in meaning and use were found increasingly predictive of Chinese

writing performance from grade 4 to 6. These findings indicate a shift in the relative importance of the dimensionality of productive vocabulary knowledge from form to meaning and use as Chinese learners proceed to higher elementary grades.

Writing has been commonly theorized as a productive task involving several different stages of processing. Models of writing (e.g., Berninger & Winn, 2006; Hayes & Flowers, 1980; Juel et al., 1986) have similarly identified linguistic transformation as a crucial step in writing, which generally involves a series of lower-level linguistic processing such as recalling the form of the target words and using the words with syntactic, semantic, and pragmatic appropriateness. For young writers, their writing performance is often constrained by linguistic transformation, which is in turn constrained by their linguistic skills such as vocabulary knowledge (Berninger et al., 1991; Yeung, 2013a, 2013b). This provides a strong account for the present findings on the unique contribution made by productive vocabulary knowledge to writing performance among upper elementary school students. In particular, productive knowledge of vocabulary written form was found to be the only predictor of writing at grade 4. A probable explanation for this finding is that Chinese language is characterized by a logographic writing system with orthographically complex words. Given the orthographic complexity and the observed importance of transcription and handwriting skills among young Chinese writers reported by previous research (Yeung et al., 2017), it is likely that Chinese learners as young as fourth graders have not yet mastered the orthographically complex words, and thus their writing skills may be constrained by their developing knowledge of vocabulary written form. The lower-level linguistic processing may also take up the cognitive resources used for applying knowledge of vocabulary meaning and use in composition writing (Gentry, 1982).

An alternative explanation for the findings on the substantial contribution made by productive vocabulary written form to writing concerns another typological feature of Chinese, namely, the symbol-meaning correspondence as opposed to the symbol-sound correspondence (also termed as “grapheme-phoneme correspondence”) in alphabetical languages. As is noted earlier, the written form of Chinese vocabulary typically contains one or more radical(s) or character(s) providing hints to the meaning of words (Shu et al., 2003). Chinese learners’ knowledge of vocabulary written form, therefore, is likely to associate with their understanding of word meaning. It is thus possible that the contribution of vocabulary form may surpass the contribution made by other aspects of vocabulary such as synonym and collocation skills to composition writing. Taken together, findings from our study indicate that productive vocabulary form is a critical component skill for young writers learning an orthographically complex language, which resonates with previous findings on learners in Hong Kong who are still developing their transcription skills up to grade 4 (Ho, 2010; Yan et al., 2012; Yeung et al., 2013a, 2013b, 2017).

### *6.3 The Growing Importance of Vocabulary Meaning and Use for Older Chinese Writers*

Findings from fifth and sixth graders also showed increasing contributions made by vocabulary meaning and use to composition writing, which notably surpass those made by vocabulary form. One possible explanation for this shift of vocabulary domains might be the gradual mastery of vocabulary form when young learners proceed to higher grades. Although previous research reported that Chinese learners at upper elementary school are still developing transcription skills (Yeung et al., 2013a, 2013b, 2017), it is important to note that these studies were mainly conducted in Hong Kong where traditional Chinese characters were used (Ho, 2010). Given that traditional Chinese characters often consist of more strokes and are orthographically more complex, one possible account is that it may take longer time for learners to master the written forms of Chinese traditional characters, as compared to participants learning simplified Chinese in this study. Another possibility for the discrepancy in the observed role of vocabulary knowledge in form between the present and previous research concerns the measurement. Productive knowledge of vocabulary written form, traditionally measured by dictation tasks in which participants were asked to write down the word orally presented to them, was measured by the pinyin-to-word task in this study, in which participants were given ample time to complete each word. Considering that the removal of a time constraint may have influenced the performance of older Chinese learners, it is less surprising that the contribution of productive knowledge of vocabulary form to composition writing among students at grade 5 and 6 was not as strong as what previous studies suggest.

In extending models of writing to account for Chinese beginning writers, it is also important to consider typological characteristics of Chinese language. As is discussed earlier, one notable feature that distinguishes Chinese from alphabetical languages is its character-based writing system, in which words and phrases are similarly constituted by a string of characters. Given the lack of inflections in Chinese (Li & Thompson, 1981), Chinese vocabulary does not manifest a high degree of morphological complexity and grammatical information is often expressed through function words and word order. Additionally, meanings of multiple-character words in

Chinese are largely constructed from their constituent morphemes (Ho et al., 2017). It is thus reasonable to infer that Chinese learners with advanced knowledge of vocabulary use might have better syntactic performances in writing. This provides a plausible account for the observed contribution of vocabulary knowledge in use to writing among learners at grade five and above. This finding is also consistent with previous empirical evidence on the importance of syntactic skills in upper elementary grades (e.g., Yeung et al., 2017).

Apart from vocabulary knowledge, however, there may be a wide range of factors contributing to children's writing performance and thus possibly accounting for the large percent of variance in writing performance that has not been accounted for vocabulary knowledge in this study. Ample empirical evidence has suggested that composition writing not only requires lower-level linguistic skills such as vocabulary knowledge, but also hinges on skills at higher level, such as discourse organization skills (Hillocks, 1986; Saddler & Graham, 2005), the ability to use coherence devices (Witte & Cherry, 1986), and genre knowledge (McCutchen, 1988). To sum up, drawing on Nation's (2001) theoretical framework of vocabulary knowledge, this study operationalized Chinese vocabulary knowledge from various aspects and yielded three noteworthy findings corresponding to the two research questions. First, this study found a nonlinear and differentiated growth of vocabulary knowledge and a unique contribution made by productive vocabulary to composition writing over receptive vocabulary across upper elementary level Chinese learners. These findings extend the receptive-productive distinction of vocabulary from alphabetical to logographic language which emphasizes the mastery of a different set of productive skills, such as orthographic skills, word order skills, and character collocation skill. Second, this study identified a shift of contribution made by vocabulary knowledge from form to meaning and use domains to Chinese composition writing as learners proceed to higher elementary grades. By clarifying the relationships between various aspects of vocabulary knowledge pertaining to the linguistic transformation stage and writing outcome, this study extends the extant theoretical frameworks of writing, particularly the conceptualization of linguistic constraints (Abbott & Berninger, 1993; Berninger et al., 1992), to account for writing activities among an under-explored group of learners, namely, young children learning to write in the logographic Chinese language.

In terms of pedagogical implications, findings from the present study facilitates a more detailed understanding of vocabulary development among young Chinese learners, which may in turn inform better educational practices. To illustrate, findings on the unique contribution of productive vocabulary knowledge underscores the importance to differentiate receptive and productive mastery of vocabulary, calling for educators' particular attention to assist young learners in developing not only vocabulary breath, but also the ability to produce vocabulary in writing activities. Additionally, separate analyses of the form, meaning, and use domains of productive vocabulary knowledge highlight the significance of shifting instructional focus at different grades. On the one hand, based on the findings on the substantial contribution made by productive knowledge of vocabulary written form, it is suggested that additional pedagogical attention may be given at lower elementary grades to develop learners' automaticity in producing the orthographically complex Chinese vocabulary. On the other hand, findings on the increasing contribution made by productive vocabulary meaning and use underlie the importance for educational practitioners to assist learners in developing an in-depth understanding of vocabulary, if not a shift of instructional focus from orthographic skills at lower grades to depth of vocabulary meaning and collocation at higher grades.

#### *6.4 Limitations and Future Research*

Despite the theoretical and pedagogical implications, this study nevertheless bears a series of limitations. First, it is important to note that the five measures of vocabulary knowledge adopted in this study were administered in print format. Although it has been well noted in previous literature (Kieffer & Lesaux, 2012) that practical concern, such as time constraints and feasibility, can be justified reasons to assess young children's literacy skills in written format and this study allowed participants to write pinyin for their unknown Chinese characters, with which participants' inadequate sound-to-print knowledge were supposed to be compensated, it is fully acknowledged that assessing children's vocabulary only in the written format constitutes a key limitation of the present research design. In particular, findings on the significant role of productive knowledge of Chinese vocabulary written form among fourth graders indicate that young Chinese learners at upper elementary schools have not yet fully mastered transcription skills. Therefore, the present findings on the differences in vocabulary knowledge between grades might be exaggerated or mediated by participants' hand-writing skills and thus should be interpreted with caution. In addition, while there are several benefits underlying the use of group-administered print-based vocabulary tasks for maintaining ecological validity and informing practitioners' and researchers' assessment decisions in situations when resources cannot support individual assessment, future research is needed to investigate the impact of task formats with varying levels of cognitive demands (e.g., stimulus rally presented by experimenters) on the dimensionality of vocabulary knowledge.

Another limitation of this study concerns the selection of control variables. It is important to note that some commonly measured variables, such as nonverbal intelligence and working memory, were not taken into account in this study owing to practical reasons (e.g., the will of participants and limitations of time to collect data one-to-one). Although the age of participants was measured in detailed by month and used as an indirect indicator of general cognitive development, the current study is doubtlessly limited in providing a more accurate account of early vocabulary and writing development among Chinese children. In particular, nonverbal intelligence and working memory have been shown to be strongly correlated with receptive vocabulary knowledge (Chik et al., 2012; Shu et al., 2006) and their strength of associations with productive vocabulary remains unclear. Therefore, without carefully controlling for these factors, present findings on the relative importance of receptive and productive vocabulary remains inconclusive.

In addition, although measures used in this study are theory-driven based on Nation's (2001) framework, the operationalization of vocabulary knowledge in each domain was not exhaustive. For example, vocabulary knowledge in use domain should involve not only collocation-making skills but also the ability to use the word appropriately according to social pragmatic contexts, which were not measured in this study. Thus, findings from the present study on the vocabulary growth in use domain and its relative importance to composition writing might not be a conclusive account for young Chinese learners. Moreover, it is important to note that this study adopts a cross-sectional rather than longitudinal design, in which individuals at different grades participating in this study at the same time. Given the well-noted concerns on the cross-sectional design, particularly the potential influences from teachers and instruction, findings from the present study on between-grade differences in vocabulary knowledge can be wholly attributed to developmental factors and one should be cautious in interpreting the present findings as vocabulary 'growth'. At the same time, with the cross-sectional design, it remains unclear whether the observed relationship between vocabulary knowledge and writing suggests that vocabulary knowledge is helpful for long-term writing success, particularly when there is a divergence between findings from this study and previous studies conducted with younger students (e.g., Yeung et al, 2013a, 2013b). Given these limitations, future research with longitudinal data is needed to determine whether findings from this study are indeed developmental or are better accounted by other factors.

This study is also limited in that only narrative writing tasks were adopted to assess participants' composition skills. As is well-noted in previous research, learners' performances often differ substantially across narrative, descriptive or argumentative writing tasks. For example, the genre has been found to play a role in L2 writer's performance in terms of calling upon their command of language, particularly aspects of vocabulary knowledge (e.g., Olinghouse & Wilson, 2013; Qin & Uccelli, 2016). Given that different genres demand different skills and knowledge, findings from the present study are limited in terms of their generalizability to other genres. Another related limitation of this study concerns the use of holistic writing rubrics rather than a detailed examination on the lexical performances in text, given the ample empirical evidence suggesting that some types of vocabulary are important in particular types of genres. For example, Olsen et al. (2018) found that narrative writings mostly demand a rich vocabulary knowledge relating to the emotions and desires of story character, while Qin and Uccelli (2016) reported that narrative and argumentative writing performances were largely predicted by the use of stance markers and organizational markers, respectively. Therefore, findings from the present study might be more informative if participants' writing samples were analyzed in detail with a closer differentiation between different types of vocabulary. Future research taking into account the aforementioned limitations and neglected factors in this study is expected to enrich the extant understanding of early vocabulary and writing development and inform better educational practices in and beyond upper elementary classrooms.

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## Appendix A

### Testing samples



huàn zhě

患 者

zī shēn

资 深

fàn chóu

mí bǔ

补

nóng dù

浓 度

hǎi tún

海 豚

zhuàn xiě

写

cè liáng

测 量

miáo huì

描 绘

guān liáo

官 辽

fā shāo

发 烧

gǔ dòng

古 董

chǔ xù

wān yán

xìn lài

信 赖

zhǔ zǎi

主 宰

dào suì

稻 穗

xù yì

xùn fú

驯 服

zhǒng zhàng

肿 胀

(1) 开心

快乐 高兴 喜悦 愉快

(2) 难过

伤心

(3) 漂亮

美丽

(4) 安静

平静 肃静

(5) 很大的

(6) 很小的

太小 渺小 细小



(1) \_\_\_\_\_ 知识

学习、背诵、朗读、有趣的、丰富的、奇怪的、充实的

(2) \_\_\_\_\_ 的花

鲜艳、芬芳、美丽、烂漫、绽放、希望、迷人、芳香

(3) \_\_\_\_\_ 的天气

恶劣、美好、糟糕、炎热、晴朗、寒冷、凉爽、温暖

(4) \_\_\_\_\_ 礼物

选择、签收、拆开、赠送

(5) 漫长的 \_\_\_\_\_

极夜、夜晚、时光、旅程、人生、岁月

(6) 明亮的 \_\_\_\_\_

眼睛、窗户、灯光、天空、星星、镜子、月光、灯泡、阳光、银河

## Appendix B

### Summary of studies measuring Chinese writing performance

	Participants	Writing Task	Scoring Rubrics
Chai et al. (2012)	419 Secondary 3 (15-year-old) students from three public secondary schools in Singapore	Write two essays of different topics, with one using paper and pen and one using computers	(1) Content - 25 points; (2) Structure - 25 points.
Li et al. (2012)	59 Grade 4 students from a primary school in Shenzhen, China	Write a composition collaboratively within one week	A total of 30 points for: (1) Topic - 1.5 point; (2) Idea - 7.5 points (3) Content - 9 points; (4) Organization - 3 points; (5) Sentence Fluency - 6 points; (6) Punctuation and Spelling - 3 points.
Yan et al. (2012)	154 native Cantonese-speaking children in Hong Kong aged 6-9	10 min to write a composition entitled "My Favourite Toy"	1-4 scale on each: [Content]: (1) Relevance; (2) Breath; (3) Depth. [Organization]: (4) Sentence Level Organization; (5) Paragraph Level Organization; (6) Prominence of Organizational Elements; (7) Intelligibility.
Guan et al. (2013a)	314 students at Grade 4, 5, and 6 from two elementary schools in northern China	20 min each for: (1) narrative writing based on 4 black-and-white line drawing cartoons; (2) expository writing on the topic of "My Favourite Pet"; (3) argumentative writing on the advantages and disadvantages of watching television.	(1) Expressive Aspects - 40 points ; (2) Content including title - 40 points; (3) Commentary - 20 points.
Guan et al. (2013b)	160 Grade-4 students from one typical primary school and 180 Grade 7 students from one middle school in Beijing	10 min to write on one of the two writing prompts	Systematic Analysis of Language Transcript conventions (SALT, Miller & Chapman, 2001): [Macro-organization]: (1) Topic - 1 points; (2) Logical Ordering of Ideas - 4 points; (3) Number of Key Elements - 3 points; [Complexity]: (4) Mean Length of T-unit; (5) Clause Density; [Productivity]: (6) Total Number of Characters; (7) Total Number of Different Characters; [Spelling and Punctuation]: (8) Number of Alternative Characters with Similar Pronunciation; (9) Number of Alternative Characters with Similar Orthography; (10) Number of Punctuation Errors.
Yeung et al. (2013a)	340 Cantonese-speaking children in Hong Kong assessed at Grade 1, 2, and 4	Write a composition based on the topic of "A Happy Birthday"	(1) Content - 3 points; (2) Sentence Structure - 5 points; (3) Organization - 3 points; (4) Usage of Words - 4 points. Spelling errors were not penalized.
Yeung et al. (2013b)	259 Grade 4 students from two elementary schools in Hong Kong	Write a composition based on the topic of "A Happy Birthday"	(1) Content - 3 points; (2) Sentence Structure - 5 points; (3) Organization - 3 points; (4) Usage of Words - 4 points. Spelling errors were not penalized.
Guan et al. (2014)	749 students at Grades 4, 5, and 6 in one primary school in Zhejiang, China	20-min narrative writing based on 4 black-and-white line drawing cartoons	(1) Expressive Aspects - 40 points ; (2) Content including title - 40 points; (3) Commentary - 20 points.



Li et al. (2014)	109 Grade 4 students in Shenzhen, China	Each group write the composition on the group webpage.	(1) Ideas - 1.5 points; (2) Content - 3 points; (3) Organization - 1 point; (4) Sentence Fluency - 2 points; (5) Punctuation and Spelling - 1 point; (6) Length - 1.5 points.
Tong & McBride (2016)	129 students in Hong Kong, assessed from age 4 to 12.	10-min writing based on the topic of "My Hero"	1-4 scale on: (1) Relevance; (2) Number of Main Ideas; (3) Ideas Development; (4) Presentation of Unit Ideas; (5) Logical Ordering of Sentences; (6) Prominence or Organizational Elements; (7) Overall Intelligibility.
Yeung et al. (2017a)	91 Grade 1, 86 Grade 3, and 72 Grade 5 students in Hong Kong	35-min narrative writing based on the topic of "Today is my birthday."	0-5 scale on: (1) Content; (2) Vocabulary; (3) Sentence Structure; (4) Organization. Spelling errors were not penalized.
Yeung et al. (2017b)	47 Grade 4 and 50 Grade 6 students in Hong Kong	35-min narrative writing based on the topic of "One day at school a funny or surprising thing happened . . ."	0-5 scale on: (1) Content; (2) Vocabulary; (3) Sentence Structure; (4) Organization. Spelling errors were not penalized.
Sun et al. (2018)	390 Grade 3 English-Chinese bilinguals in Singapore and 190 Grade 3 monolingual Chinese in Mainland China	Write a composition based on a four-picture story	4-point scale on: (1) Ideas and Development; (2) Organization, Unity, and Coherence; (3) Word Choice; (4) Sentences and Paragraphs; (5) Grammar and Usage; (6) Writing Mechanics.
Guan et al. (2019)	246 Mandarin-speaking children from three schools in Zhejiang, China	20 min each for: (1) narrative writing based on 4-element cartoons; (2) expository writing on the topic of "My Favourite Pet/Toy"; (3) argumentative writing on the topic "The Advantages and Disadvantages of Watching Television for Elementary School Children"	(1) Expressive Aspects - 40 points; (2) Content including title - 40 points; (3) Commentary - 20 points.
Lan et al. (2019)	60 Grade 8 students from two classes at a junior high school in Singapore	45 min to write a composition based on the topic of "describing a room in a house"	(1) Content; (2) Organization; (3) Vocabulary; (4) Grammar; (5) Punctuation and Handwriting.
Leong et al. (2019)	129 15-year-old Chinese L2 students came from 23 classrooms mainly from three schools in Hong Kong	35-40 min to write from 50 to 150 characters on each of the topics of "A School Picnic", "My Favorite Sport" and "Should Students watch TV?"	[Discourse and Grammar] 0-3 scale on: (1) Appraisal; (2) Conjunction; (3) Reference; (4) Inter-language from spoken to written Chinese. [Application of Language] 10-point on range of vocabulary, suitability of purpose, phases and internal structure of the composition; [Accuracy] 5-point on punctuations, legibility of hand writing and errors
Huang et al. (2020)	65 Grade 11 students from two classes taught by the same teacher in a senior high school in northwestern Taiwan.	Write a composition based on the presented photos and videos to show the contexts	30-point scale on: (1) Organization; (2) Content; (3) Appearance; (4) Vocabulary Use.
Yeung et al. (2020a)	388 Grade 3 to 5 students from four schools in Hong Kong	25 min narrative writing on the topic of "going to school on a day of heavy rain"	0-5 scale on: (1) Content; (2) Vocabulary; (3) Sentence Structure; (4) Organization. Spelling errors were not penalized.

Yeung et al. (2020b)	129 students in Grades 3 and 5 in Hong Kong.	40 min to write: (1) a narrative writing on 'Today is my birthday' and 'Today is an important day'; (2) a expository writing on 'How can we use technology to facilitate learning?'	0-4 scale on: [Content] (1) Topic; (2) Main Idea; (3) Logical Order; (4) Plot; (5) Organisation; [Expressive] (6) Choice of Vocabulary; (7) Grammar; (8) Punctuation; (9) Use of Complex sentences; (10) Style.
Zhang et al. (2020)	3869 Grade 4 to 6 students learning Chinese in China's minority areas as subjects in Xinjiang, China	Write a short essay corresponding to the situation shown in a picture and hinted through keywords	0-6 scale on overall writing quality
Huang et al. (2021)	79 Grade 4 students from two intact classes of an elementary school in Zhejiang, China	Write a descriptive article	4-point scale on: (1) Organization; (2) Sensory Details; (3) Figurative Expression; (4) Creativity.
Liao et al. (2021)	103 first-year undergraduate students in Hong Kong who showed relatively low proficiency in Chinese language	60 min to write an invitation letter using a maximum of 600 Chinese characters	(1) Content - 50 points; (2) Language and Expression - 30 points; (3) Organization and Format - 20 points.
Yang et al. (2021)	40 Grade 4 students of about 10 years old in China	Write descriptive papers based on observed pictures and videos	(1) Thematic Coherence - 35 points; (2) Structural Integrity - 35 points; (3) Linguistic Expressiveness - 20 points; (4) Creative Thinking - 10 points.
Zhu et al. (2021)	145 Grade 10 students from two secondary schools in Hong Kong	A Chinese integrated writing test based on six reading passages	0-7 scale on: (1) Content; (2) Language; (3) Organization.
Chen et al. (2022)	59 Grade 4 Chinese students from two primary school classes	90-min writing based the topic of "The Grade Wall" and "The Forbidden City" with or without SVVR-supported learning method	(1) Thematic Coherence - 35 points; (2) Structural Integrity - 35 points; (3) Linguistic Expressiveness - 20 points; (4) Creative Thinking - 10 points.
Hong et al. (2022)	90 students with mean age 14.47 from ne urban junior high school in Taipei	Write a composition describing people swimming in a pool	6-point scale on: (1) Content; (2) Organization; (3) Vocabulary and Sentence Structure; (4) Chinese Character, Format, and Punctuation.
Lan et al. (2022)	36 Vietnamese students in their first year at a university in Taiwan	Two writing tasks: (1) Introducing the Taiwan scenery; (2) Comparing the city traffic in Taipei City and cities in Vietnam	0-5 scale on: (1) Content; (2) Organization; (3) Vocabulary; (4) Grammar; (5) Punctuation and Handwriting.
Lu (2022)	32 adult Chinese L2 learners in London	Two argumentative and two narrative essays from a pool of 10 argumentative and 10 narrative prompts	5-point scale on: (1) Task Response; (2) Cohesion and Coherence; (3) Lexical Resources; (4) Grammatical Range and Accuracy.
Su et al. (2022)	146 Grade 3 and 104 Grade 5 students in Beijing, China	10 min to write a narrative entitled "An unforgettable memory".	1-6 scale on: (1) Content; (2) Task Requirements; (3) Comprehensibility; (4) Coherence; (5) Cohesion.
Vettori et al. (2022)	141 primary school children from grades 2 to 5 in Central Italy	Write an invented story	5-point holistic scale based on 8 elements of narrative genre: (1) Title; (2) Opening; (3) Setting; (4) Description of Character; (5) Problem; (6) Central Event; (7) Resolution of the Problem; (8) Story Ending.

Yeung (2022)	41 Grade 3 to 5 children with developmental dyslexia and 41 typically developing counterparts in Hong Kong	25-min narrative writing based on the topic of “going to school on a day with heavy rain”	0-5 scale on: (1) Content; (2) Vocabulary; (3) Sentence Structure; (4) Organization. Spelling errors were not penalized.
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## Appendix C

### Writing rubrics (Yeung et al., 2020)

	Content	Vocabulary	Sentence Structure	Organization
0	Very poor: the responses include mostly irrelevant information.	Very poor: the responses are made up of inappropriate choice of vocabulary.	Very poor: the responses are made up of incorrect sentence structures.	Very poor: the discourse is not organized and lacks logic.
1	The responses include information that is not relevant, slight off topic, and the expression is vague.	The responses are made up of limited vocabulary and some misuse of words in written Chinese.	The responses are made up of incomplete sentence structures with many syntactic errors.	The structure of the discourse is not clear. Incorrect paragraphing.
2	The responses are relevant to the topic, but the content is simple (such as repeating the same themes).	The choice of vocabulary in written Chinese are generally appropriate, with some minor errors.	The responses demonstrate some appropriate uses of simple sentence structures, but some incomplete sentence structures are evident.	The structure of the discourse is simple. The organization is somewhat loose and not coherent.
3	The responses are relevant to the topic. There is a description of the incidents or activities involved.	The responses demonstrate rich choice of vocabulary. There is an appropriate usage of simple vocabulary, and the responses demonstrate some appropriate uses of sophisticated vocabulary in written Chinese.	The responses are good and demonstrate some appropriate uses of complex sentence structures (e.g., the use of connectives). Sentence flow is generally smooth.	The structure of the discourse is slightly loose. There is some inconsistency, but the overall organization is coherent.
4	The responses are relevant and have a clear focus. There is a detailed description of the incidents or activities involved.	The responses demonstrate appropriate use of rich and sophisticated choices of vocabulary. Able to write in written Chinese throughout the responses.	The responses are good and demonstrate appropriate use of complete sentences. Complex sentence structures (e.g., the use of connectives, metaphor) can also be found in the responses. Sentence flow is generally good.	The discourse is well organized and coherent, with a clear progression of ideas.
5	Very good: the responses are relevant, with a clear focus, detailed, creative and thoughtful.	Very good: the responses demonstrate rich, completely appropriate and sophisticated choice of vocabulary in written Chinese.	Very good: the responses demonstrate a wide range of sentence structure and appropriate use of subordinate clauses and complex sentences. Sentence flow is excellent.	Very good: discourse is well organized, coherent, and thoughtful with a logical and analytical progression of ideas.

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