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英語音韻處理能力對臺灣國中生英文單字量的影響

The Role of Phonological Processing Abilities in the Taiwanese Seventh Graders' English Vocabulary Size

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中文摘要

由於教育部課程綱要規定國中畢業生英文單字量（應用字彙 1200 字）與高中英文指定科目考試單字量(7390 字)差異懸殊，因此，本實驗希望藉由探討國中生英文單字量與英語音韻處理能力的關係，期能提供現職國中英文教師提升國中生英文單字量的方法，以減少國中畢業生銜接高中英文龐大單字量的壓力。

本教學研究由兩大部分組成。第一部分為測量學生的英文單字量，第二部分為測量學生的英語音韻處理能力。音韻處理能力又可分為三個能力：聲韻覺識能力、聲韻記憶能力、語音轉錄在字彙存取上的能力。因此，本實驗共包含四個測驗: 英語單字量測驗、聲韻覺識測驗、聲韻記憶測驗以及唸名速度測驗。除了單字量測驗是全班一起施測，聲韻覺識測驗、聲韻記憶測驗以及唸名速度測驗皆為一對一的個別測驗。共有五十五位來自同一國中的七年級生參與本研究。

研究結果顯示聲韻覺識能力、聲韻記憶能力、語音轉錄在字彙存取上的能力都與學生的單字量顯著相關。多元回歸分析的結果指出，聲韻覺識能力、聲韻記憶能力能準確預測學習者的單字量。此外，聲韻覺識能力、聲韻記憶能力較佳的學生明顯比聲韻覺識能力、聲韻記憶能力不佳者擁有更大的單字量。

本項研究證明了英語音韻處理能力（尤其是聲韻覺識能力、聲韻記憶能力）對提升英文單字量的重要性。最後，根據研究發現，本文亦提出教學建議。

關鍵字：英語音韻處理能力、單字量

ABSTRACT

The English vocabulary gap between junior high and senior high education stage is huge, so students in Taiwan often find it challenging to expand their vocabulary from 1,200 words to 7,390 words. Since a vast body of research has demonstrated a positive link between vocabulary learning and phonological processing abilities, the present study intends to shed some light on the role of phonological processing abilities in the Taiwanese seventh graders' vocabulary size.

Specifically, phonological processing abilities consists of three subcomponents—phonological awareness, phonological short-term memory, and phonological recoding in lexical access. The current study aims to investigate 1) the correlation between the three subcomponents of phonological processing abilities and vocabulary size, 2) the relative contribution of the three subcomponents of phonological processing abilities to vocabulary size, and 3) the difference between students with *high* phonological processing abilities and those with *low* phonological processing abilities in terms of their vocabulary size. The participants were fifty-five seventh graders from two classes in the same junior high school. All participants took a battery of assessments: 1000-Word Level Test, Phonological Awareness Skills Test, Children's Test of Nonword Repetition, and rapid letter naming and rapid object naming in Comprehensive Test of Phonological Processing.

The results of two-tailed Pearson correlation showed that all of the three subcomponents of phonological processing abilities were significantly correlated with vocabulary size at the 1000-word level. The regression analysis revealed that phonological awareness and phonological short-term memory had significant predictive power in vocabulary size, while phonological recoding in lexical access did not. In addition, the results of independent sample T-test indicated that learners with *high* phonological awareness and phonological short-term memory differed significantly from those with *low* phonological awareness and phonological short-term memory in terms of their vocabulary size. In contrast, learners with *high* phonological recoding in lexical access did not differ significantly from those with *low* phonological recoding in lexical access in terms of vocabulary size.

Based on the present findings, phonological processing abilities, phonological awareness and phonological short-term memory in particular, played a very important role for Taiwanese junior high school students in attaining their vocabulary size.

Keywords: Phonological Processing Abilities, Vocabulary Size

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CHAPTER ONE

INTRODUCTION

Background and Motivation

Vocabulary knowledge is central to language comprehension and production and hence is of critical importance to language learners (Candlin, 1990; Zimmerman, 1997). The major language domains include pronunciation, vocabulary, and grammatical construction; vocabulary is the building brick for the development of the above language domains (Nation, 2001). As Wilkins (1972: 111) noted, "Without grammar very little can be conveyed; without vocabulary nothing can be conveyed."

EFL learners, however, are reported to have difficulties in language learning because of the lack of adequate vocabulary (Arden-Close, 1999; Hasan, 2000; Lin, 2002). In this "input-poor environment," where vocabulary cannot be easily acquired, Taiwanese English learners tend to memorize seemingly endless wordlists in order to develop the vocabulary size required by the English curriculum (Kouraogo, 1993). However, according to Nation (2001: 236), words should be learned from context: "Learning [vocabulary] from context is a cumulative process where meaning and knowledge of form are gradually enriched and strengthened."[1]

[1] Guessing the meaning from context is the most important strategy that language users must employ to increase their vocabulary "although it has the disadvantage of being a form of incidental learning (and therefore being less certain) and of not always being successful (because of lack of cues)" (Nation, 2001: 262).

Memorizing decontextualized wordlists, therefore, may not be an effective way to learn vocabulary. In addition, Hsu (2009) reported that due to the lack of exposure and motivation, Taiwanese students' vocabulary size is limited. Although having studied English since their 3rd grade in elementary school, some junior high school students still have limited English vocabulary. Under this condition, if junior high school students do not have a solid background of English vocabulary learning, the extended and substantial increase of vocabulary size required by the English learning in senior high school would make pressure upon the junior high school graduates become even more severe if the teaching method is not of great help.

Indeed, many teachers and researchers indicated that the vocabulary gap between junior high and senior high education stage is huge (Huang, 2007; Huang, 1999; Lin, 2006; Yang, 2006; Yang, 2002; Wang, 2005). The Ministry of Education (MOE) in Taiwan announced the vocabulary benchmarks and prescribed a productive vocabulary size of 1,200 words and a receptive vocabulary size of 2,000 words for a junior high school graduate. The College Entrance Examination Center (CEEC) prescribed a vocabulary size of about 4,000 words for the Scholastic Aptitude Test and a vocabulary size of about 7,390 words for the Appointed Subject Test for senior high school students, which are essential for the reading and writing tests. The huge gap between prescriptions from the two organizations (i.e., MOE and

CEEC) implies that without appropriate help from English teachers, students would find it quite challenging to upgrade their receptive vocabulary from 2,000 words to 7,390 words. Because of the aforementioned vocabulary gap, the transition of English education from junior high school to senior high school is not easy. To fill the gap of required receptive vocabulary,[2] issues regarding ways to help students efficiently foster their vocabulary acquisition warrant more research.

Among the studies of vocabulary learning, a vast body of research has demonstrated that a powerful relationship exists between phonological processing abilities and vocabulary acquisition (Anthony et al., 2007; Baddeley et al., 1998; Gathercole & Baddeley, 1993; Jean & Geva, 2009). Phonological processing abilities refer to the abilities to use the phonological information in processing written and oral language (Wagner et al., 1987). Phonological processing abilities encompass three subcomponents that are crucial for vocabulary learning: (1) phonological awareness (PA), (2) phonetic recoding in working memory[3] (i.e., phonological short-term memory or phonological loop), and (3) phonological

[2] The present study will focus on receptive vocabulary, to be specific, learners' ability to recognize printed words due to the backwash effect of the Basic Competence Test for Junior High School Students, where only receptive vocabulary is tested, not productive vocabulary.

[3] Working memory has both processing and storage functions separate from long-term memory. The working memory structure has three main components: 1) the central executive (which is responsible for attentional controlling of resources and information in the working memory system), 2) the visuo-spatial sketchpad (whose function is to store and process visual images as well as spatial information), and 3) the phonological loop (which is responsible for storing and rehearsing verbal-based information (Baddeley & Hitch, 1974).

recoding in lexical access[4] (or retrieval of phonological codes from long-term memory) (Wagner & Torgesen, 1987). The three subcomponents of phonological processing abilities are interrelated. Phonological awareness is learners' knowledge of sounds; phonological short-term memory is the mechanism in which the coding information in a sound-based representation is used to facilitate temporary storage (Wagner et al., 1997); phonological recoding in lexical access refers to the efficiency of retrieving from permanent memory the phonological codes which are the outcome of both the knowledge (PA) and the mechanism (phonological short-term memory).

By definition, phonological awareness refers to the ability to attend to, detect, and manipulate the sound units of words independently of their meanings based on an understanding of sound structure. As a meta-linguistic skill, phonological awareness enables people to manipulate, segment, and blend sounds in words (Wagner, Torgesen, & Rashotte, 1994).[5] Treimen and Zukowski (1991) proposed that phonological awareness can be represented at three distinct levels. Since a word can be described in terms of its syllabic structure, onset-rhyme structure, and

[4] Phonological recoding in lexical access means "recoding written symbols into a sound-based representational system to get from the written word to its lexical referent (Wagner & Torgesen, 1987: 192)."

[5] When asked to manipulate sounds, for example, one should say the word *cup* without saying /k/, and the answer is *up* (Wagner, et al., 1997). For the segmentation task, test takers should break the word *it* into two sounds /i/ and /t/ (Dodd et al, 1996; as cited in Gillon, 2004). In the blending task, these sounds—/m/…/u/…/n/—would make the word *moon* (Wagner, et al., 1999; as cited in Gillon, 2004).

segmental or phonemic structure, so can phonological awareness be divided into syllable awareness, onset-rhyme awareness, and phonemic awareness. It should be noted that as a metalinguistic ability, phonological awareness (especially phonemic awareness) does not come naturally with the learning of reading and writing (Magnusson & Naucler, 1993). Therefore, explicit training is necessary to foster phonological awareness.

It has been found that phonological awareness and vocabulary learning can be mutually enhanced through a reciprocal relationship (Bowey & Francis, 1991; Koda, 2006; Perfetti, Beck, Bell, & Hughes, 1987). For example, Metsala (1999) observed that children may develop a deeper insight into the phonological structure of a language while their vocabulary bank is getting larger. Also, phonological sensitivity can support the learning of new words because the learners who have received phonological sensitivity training tend to learn phonologically unfamiliar words more easily than those who have not been trained (de Jong et al., 2000). By contrast, learners with poor phonological awareness are more likely to lag in foreign language vocabulary acquisition due to their difficulty in constructing phonological representations for new words (Hu & Schuele, 2005). Therefore, phonological awareness has been identified as a factor that either facilitates or hinders vocabulary acquisition.

The importance of phonological awareness in vocabulary learning is also pointed out by Hu (2003). She argued that the phonological aspect of words appears to be more significant than the semantic aspect, especially for the cognitively mature EFL learners (i.e., adolescents). Foreign language words seldom involve new concepts since the semantic concepts of lexical items are normally denoted similarly to those in their own native language. Hence, foreign language vocabulary learning "involves more of the learning of new sound patterns and the mapping of the sound patterns onto old concepts (Hu, 2003:430-431)." Although vocabulary learning is not merely a phonological issue, it seems that the establishment of solid phonological representations of words could be the key to success in fostering vocabulary learning for Taiwanese learners of English (Hu, 2003).

According to the nine-year integrated curriculum guidelines published in 2008, English teachers in elementary school should teach phonics to help learners understand the relationship between written letters (i.e., graphemes) and spoken sounds (i.e., phonemes). However, Lai (2003) argued that phonics instruction may not be sufficient for beginners in the learning of new words. "Students who have difficulty with phonological awareness can still learn phonics, but they have difficulty *using* this knowledge in reading and spelling" (Trehearne et al, 2003: 119). Therefore, it is important for students to have well-developed phonological awareness. Nevertheless, in Taiwan, phonological awareness training is not as common as phonics instruction. Without adequate knowledge about phonological awareness training, English teachers' PA instruction provided to the Taiwanese students in elementary school and junior high school might not be effective in helping learners recognize and remember (new) written words.

As noted earlier, in addition to phonological awareness, another component of phonological processing abilities—phonological short-term memory, also known as "phonological loop,"[6] involves storing and rehearsing distinct phonological features for short periods of time, contributing to ongoing phonological decoding and comprehension processes (Wagner et al, 1997). Baddeley et al. (1998) stressed the vital role the phonological short-term memory plays in learning new words, for its function is to process novel input from speech and to support the more permanent storage of phonological representation of new words. Mastery of Phonological short-term memory skills can, therefore, enhance vocabulary learning (See also Gathercole & Baddeley, 1993).

As to the third subcomponent of phonological processing abilities—phonological recoding in lexical access, rapid automatized naming (RAN) tasks (i.e., naming a series of names of objects, colors, digits, or letters as fast and

[6] The phonological loop contains two parts: a phonological store and a rehearsal process. The phonological store is to store information in the phonological form, and the rehearsal process is to maintain the representations of phonological information and to prevent them from decaying (Baddeley, 1986).

accurately as possible) are typically employed to measure the efficiency of retrieving phonological information from a long-term store (Gillon, 2004; Wagner & Torgesen, 1987). Rapid naming is normally used to explore its own relationship with reading. Hu (2008) also suggested that RAN is a significant predictor of accurate word recognition[7] both in the L1 and L2 context (Geva et al., 2000; Gholamain & Geva,1999; Nassajizavareh & Geva, 1999). The efficiency with which children are able to retrieve phonological codes should influence the degree of decoding printed words (Baddeley, 1986; Wolf, 1991). Bowers and Wolf (1993) reported that the precise timing mechanism assessed by RAN is important for developing the knowledge of common letter patterns in printed words. In the process of word recognition, language users link the form of words to meaning. The form-meaning link of word recognition is the most fundamental aspect of word knowledge (Schmitt, 2010), and thus the first step of word learning. Regarding this connection, phonological recoding in lexical access as measured by RAN, which is significantly linked to recognizing printed words, is very likely to have a close relationship with vocabulary learning as well.

On the whole, the three subcomponents of phonological processing abilities have been proved to be closely linked to vocabulary learning. In fact, care should be

[7] "Word recognition is characterized as a fast, automatic, data-driven process" in which the stimuli (i.e., pictures or words) "activate an L1 or L2 association in the learners' mental lexicon" (Fraser, 1999: 231).

taken in using these two terms: vocabulary learning and vocabulary size. "Vocabulary learning should involve a gradual increase in the learners' vocabulary size" (Laufer, 1998: 255). Vocabulary size hence is the end result of vocabulary learning. However, it should be noted that the words a learner has just learned may not always remain at the retention interval. In this regard, *vocabulary learning*, usually measured by one-shot assessment in the existing research, does not necessarily mean the end behavior—*vocabulary size*. In view of this, since a substantial amount of studies have shown the positive link between phonological processing abilities and vocabulary learning, the present study is to further explore the relationship between phonological processing abilities and vocabulary size. The research gap of the relevant studies of phonological processing abilities conducted in Taiwan will be introduced in the following section.

Rationale of the Study

A great deal of related L2 research on phonological processing abilities has been conducted to examine its effects on vocabulary learning, most of which reveal the facilitative effects (e.g., de Jong, 2000; Gathercole et al., 1994; Gathercole & Baddeley, 1989; Geva et al., 2000; Jean & Geva, 2009; Metsala, 1999). However, such results and effects may not be widely generalized in the EFL contexts due to first language background differences.

In the EFL context of Taiwan, Chinese is the first language. Chinese is a logographic language, while English is an alphabetic language. A huge body of research reports that visual skills play a more important role in Chinese reading. Therefore, Chinese learners of English tend to be limited to a “visual strategy” (or whole-word phonology) without noticing the sound-letter correspondences while learning English (Akamatsu, 2003; Holm & Dodd, 1996; Huang & Hanley, 1994; Read et al., 1986). Given the L1 differences, Taiwanese learners’ English phonological processing abilities will be further examined in the current study based on the existing Taiwanese research reviewed below.

First, much work in Taiwan has been done to investigate the relationship between L1 phonological processing abilities and L2 reading/spelling (Chien, 2002; Chien & Chen, 2002; Lai, 2005; Chen, 2010; Lee, 2006; Liao, 2010; Zhang, 2006); nonetheless, comparatively little research focuses on the relationship between L2 phonological processing abilities and L2 vocabulary learning (e.g., Chiu, 2004; Hu, 2007; Tan, 2006). Second, the participants targeted in the existing Taiwanese research of phonological processing abilities are mainly elementary school children (e.g., Chien, 2002, 6th graders; Chien & Chen, 2002; Hu, 2007, 3rd graders; Ko, 2004, 4th graders), with only a few studies aiming at more cognitively mature English learners (Chang, 2000, five-year junior college freshmen; Lee, 2006, 8th graders). Third, very little research in Taiwan (e.g., Hu, 2007, 3rd graders) examines all of the three subcomponents of English phonological processing abilities—phonological awareness, phonological short-term memory, and phonological recoding in lexical access—to capture the whole picture of their relationship with receptive vocabulary. Fourth, when selecting PA assessments, not all related studies examine phonological awareness in terms of the overall three levels—syllabic, onset-rhyme, and phonemic levels[8] (e.g., Chang, 2000 and Chiu, 2004, at the phonemic and syllabic level; Ko, 2004 and Lee, 2006, at the phonemic level).

In view of these potential research gaps, the present study will be conducted in the hope of shedding more light on the relationship between phonological processing abilities and vocabulary size.

Purpose of the Study

The participants of the existing studies in Taiwan were mostly young children. However, only a few of them included EFL adolescent learners. Given that vocabulary size is obviously different among EFL learners, it is possible that the three subcomponents of phonological processing abilities may be particularly

[8] Although a few studies in Taiwan (i.e., Chien, 2002; Chien & Chen, 2002) investigated the three distinct levels of phonological awareness—syllable, onset rhyme, and phoneme, the phonological awareness assessments are self-designed by the researchers without estimation of their reliability and validity.

significant language factors contributing to their vocabulary size. The primary purpose of this study, therefore, is to fill the gap by exploring the relationship between phonological processing abilities and vocabulary size among the 7th graders in junior high school. The current study aims to investigate:

- Whether Taiwanese junior high school students' phonological awareness (i.e., syllable awareness, onset-rhyme awareness, and phonemic awareness) correlates with their vocabulary size;
- Whether Taiwanese junior high school students' phonological short-term memory correlates with their vocabulary size;
- Whether Taiwanese junior high school students' phonological recoding in lexical access correlates with their vocabulary size;
- The relative contribution of the three subcomponents of phonological processing abilities (i.e., phonological awareness, phonological short-term memory, and phonological recoding in lexical access) to their vocabulary size;
- Whether the students with higher phonological processing abilities differ from those with lower phonological processing abilities in terms of their vocabulary size.

Significance of the Study

The present study tries to find an effective way to expand junior high school students' vocabulary size in the hope that they can be better prepared for the heavy load of vocabulary learning in senior high school. In terms of remedial perspective, phonological training might be helpful for the EFL learners who want to acquire more vocabulary. As suggested by Magnusson and Naucler (1993), phonological awareness (PA) at the phonemic level is not a natural outcome of language acquisition. Hence, phonological awareness (i.e. phonemic awareness in particular) should be explicitly taught (Tunmer & Rohl, 1991). Nevertheless, the value of PA, especially at the phonemic level, seems to be underestimated by many teachers in Taiwan, for they usually assume that students have developed adequate phonemic analysis skills when they start to learn English (Hu, 2004). The current study, therefore, aims to offer insights into PA training by examining Taiwanese junior high students' PA level and its relation with vocabulary size.

In addition, the present study aspires to shed some light on the relative contribution of the three subcomponents of phonological processing abilities (i.e., phonological awareness, phonological short-term memory, and phonological recoding in lexical access) to Taiwanese junior high students' vocabulary size. Based on the positive evidence generated from the present research, the pedagogical implication is that English teachers should include these assessments of phonological processing abilities as screening tests to identify the junior high school students who might have difficulty acquiring the required receptive vocabulary. At the same time, teachers would know which phonological processing abilities should be enhanced to increase low achievers' vocabulary size.

Organization of the Thesis

The outline of the subsequent chapters in this thesis is presented as follows: Chapter Two will review the literature concerning the relationship between vocabulary learning and each subcomponent of phonological processing abilities, and research questions will be proposed at the end of the chapter. Chapter Three will outline the method of the present study, including participants, research design and stimuli, procedure for data collection, and data analysis. Chapter Four will present the results and their detailed interpretations based on the research questions. Chapter Five will demonstrate major findings, pedagogical implications, limitations of the present study, as well as directions for future research.

CHAPTER TWO

LITERATURE REVIEW

In this chapter, there are four major sections. The first section will discuss the aspects of recognizing a word and the studies on vocabulary size conducted in L1 and L2 context. In the second section, the concept of phonological processing abilities will be introduced based on the three primary subcomponents—1) phonological awareness, 2) phonological short-term memory, and 3) phonological recoding in lexical access in terms of the definition, the assessments, and the findings on the relationship between each subcomponent of phonological processing abilities and vocabulary learning. The third section will briefly summarize the findings of the existing research reviewed in the previous sections.

Vocabulary Size

Vocabulary Knowledge

Before looking into the measures of vocabulary size, the first issue to be confronted is to define what a word is. According to Schmitt (2010), the grammatical inflections of the root form (or base form) should be counted as one *lemma*. The English inflections include plural, third person singular present tense, past tense, past participle, -ing, comparative, superlative, and possessive (Nation, 2001). All of the items included under a lemma are the same word class (or part of speech). For example, the verb *teach, teaches, taught, teaching* can be viewed as one lemma. While a lemma covers inflectional morphology, a *word family* covers even broader categories, including the headword, its inflections as well as its derived forms (Nation, 2001). The words which are semantically related but from different word classes should be counted as one word family. For example the verb *teach*, the adjective *teachable*, and the noun *teacher* belong to the same word family. In most cases, only a base word would be represented in vocabulary tests for practical purposes. Read (1988) explained that if a learner knows the root form of a word, little additional learning is required to understand its inflectional and derived forms, so vocabulary tests should contain the root form only. In addition, Schmitt (2010) contended that it is potentially confusing for nonnative learners, especially beginners, to learn a variety of inflectional forms. Although stating different reasons, Read (1988) and Schmitt (2010) led to the same conclusion—the measurement instrument is suggested to include only the root forms of a lemma or a word family for the convenience of testing.

In general, vocabulary knowledge consists of two aspects—vocabulary quality (depth) and vocabulary size (breadth). By definition, vocabulary quality means how well a learner masters a word with the following aspects: pronunciation, orthography, morphology, syntactic patterning, meaning, collocations, register, and frequency of the word in the target language (Nation, 1990; Qian, 1999), while vocabulary size refers to the number of words known by an individual learner (Qian et al., 2004). Compared with vocabulary quality, vocabulary size has attracted more research interest. The major reason is that learners' vocabulary size is proved to be directly relevant to a wide range of language skills[9] (Alderson, 2005; Meara, 1996). Laufer and Goldstein (2004) reported that vocabulary size accounted for 42.6 % of the total variance in the participants' academic "performance in reading, listening, speaking and writing, grammatical accuracy, sociolinguistic appropriateness, and language fluency" (as cited in Schmitt, 2010: 4). In short, vocabulary size has been shown to be a good predictor of general language proficiency.

Vocabulary knowledge can also be classified into other two dimensions, namely, the receptive and productive vocabulary. Mastery of receptive vocabulary knowledge means being able to recognize a word and its meaning while reading or listening, whereas mastery of productive vocabulary knowledge means being able to produce words while speaking or writing (Nation, 2001).

However, only receptive vocabulary size would be measured in the current study due to the following two reasons. First, receptive vocabulary is more

[9] Anderson's (2005: 88) study shows that "the size of one's vocabulary is relevant to one's performance on any language tests," including reading, listening, writing, and grammar.

emphasized than productive vocabulary at the stage of junior high school due to the backwash[10] effect. In Taiwan, only English reading skills are tested on the Basic Competence Test for Junior High School Students (BCT), with listening, speaking, and writing skills excluded. Reading skills mainly require the mastery of receptive vocabulary, rather than the mastery of productive vocabulary. Therefore, receptive vocabulary appears to be more important than productive vocabulary for junior high school students. Second, compared with receptive vocabulary, productive vocabulary tends to have more performance variation with beginners. Schmitt (2000) has indicated that the nature of vocabulary acquisition is cumulative, complicated, and time-consuming. At the beginning level,[11] a lexical item is usually considered as "learned" if learners know the written form and meaning for word recognition (Schmitt, 2010). However, the beginners tend to have difficulty using these words productively for the lack of knowledge about them. External factors such as orthography and articulation are very likely to influence the accuracy of beginners' productive vocabulary. In this regard, less potential confounding variable would be present when beginners' receptive vocabulary is measured. In view of the two major

[10] "Backwash is the effect that tests have on learning and teaching…. Backwash is now seen as a part of the impact a test may have on learners and teachers, on educational systems in general, and on society at large"(Hughes, 2003: 53).

[11] The General English Proficiency Test (GEPT) developed by the Language Training and Testing Center (LTTC) can be divided into five levels. The elementary (beginning) level is corresponding to the English proficiency level of junior high school graduates. The participants in the present study are Taiwanese 7th graders, most of whom, not able to pass the elementary level of GEPT, are still learning the root form of English vocabulary.

reasons above, the present study aims to measure learners' receptive vocabulary size only.

Receptive Vocabulary Size Tests

A number of receptive vocabulary size tests have been used in L1 and L2 acquisition research. The test most widely used for non-native speakers is probably the Vocabulary Levels Test[12] (VLT), which is made by Nation (1990) and modified by Schmitt et al. (2001). The VLT has centered on vocabulary at four frequency levels: 2,000, 3,000, 5,000, and 10,000 words, but this test does not include the 1,000-word level, the level most suitable to measure the Taiwanese 7th graders' ability.[13]

Another well-known standard vocabulary size test is Meara's Yes/No Vocabulary Test (Meara and Buxton 1987). As a checklist test consisting of real words and pseudowords, examinees need to indicate whether they think they know the meaning of the items after reading lists of lexical items in isolation. If a learner recognizes a word and checks it, this means they "know" it. Apparently, the Yes/No

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[12] According to Schmitt (2010: 197), "The VLT test uses a form-recognition matching format, in which the stem is the definition, and the options are the target words. Each cluster of items contains three stems and six options. In the latest Schmitt et al. (2001) versions, each level has ten clusters (i.e., 30 [target] items).

[13] Before entering junior high school, an elementary school graduate is required by the Ministry of Education in Taiwan (MOE, 2003) to have a receptive vocabulary size of 300 words and a productive vocabulary size of 180 words. For a junior graduate, MOE announces the vocabulary benchmarks of a productive vocabulary size of 1200 words and receptive vocabulary size of 2000 words. Therefore, the first 1000-word level test is critical for the 7th graders whose vocabulary size is very likely to be below 1000-word level.

test aims to measure receptive vocabulary size through word recognition. However, there is one fundamental methodological issue: The words in this test format are presented to learners in isolation, without being supported by linguistic context. The decontextualized measurement cannot provide a richer environment to enhance learners' awareness of language usage when compared with contextualized measurement (Nation, 2001). Another problem confronted is the phenomenon called "mock" hits by Anderson and Freebody (1983): The "yes" answers may result from learners' transforming the unknown words into the known ones. For example, the word "sham" could be interpreted as "shame," and thus the word "sham" is checked as one of the known words. In addition, Meara's (1996) study shows that the Yes-No format is found to be less valid for the beginners because the low-level learners tend to claim knowledge of the pseudowords overwillingly. In all, the word knowledge of test takers, especially beginners, is often measured wrongly by checking words they do not actually know, non-words included.

Nation and Gu (2007) have designed the Vocabulary Size Test (VST), employing a traditional meaning-recognition format of four-option multiple choice, with the stem of the target word and a non-defining example sentence. For example, upon reading the stem "They have a lot of *time*," the test-taker has to choose the corresponding meaning of the target word from the four options of definitions:

money, *food*, *hours*, and *friends*. The VST ranges from the first to the fourteenth level, with 1,000 words in each. Nevertheless, each 1,000 word frequency band comprises ten items (or stems) only. With the format of 10 multiple choices for each level, it is very difficult to exclude the wild guessing effect if VST is employed.

Among the widely used vocabulary size tests, it seems more suitable to use the 1000-word level test made by Nation (1993) to test the young learners' receptive vocabulary size because of the following three reasons: First, this test includes more test items (40 items) compared with VST (10 items) mentioned above. Second, the target item is tested in the context with an attempt to make sure the context words are of higher frequency than the target word. Third, to eliminate the disadvantage of guessing effect in the true/false format, Nation (1993) suggests three types of responses in the instruction (i.e., True, Not True, Do Not Understand), and that each word should be tested twice in two contexts. Only when the item is correct in both contexts will a mark be given. However, this test is not without pitfalls, either. The true/false decision is based on learners' full understanding of the whole sentence, where the judgment of general knowledge might allow other factors besides vocabulary knowledge to play a role. After removing the controversial sentences, Nation (1993) contended that the advantage of presenting test items in context, rather than by definition, would override the disadvantage of presenting them based on general knowledge. The 1000-word level test as designed by Nation (1993) with test items presented in context may provide useful results as the measurement of Taiwanese 7th graders' vocabulary size.

Studies of Vocabulary Size Conducted in L1 and L2 Contexts

Much of the research into English native speakers' vocabulary size has provided reliable estimates. Goulden, Nation, and Read (1991) found that average university students had a vocabulary size of 17,000 word families (a base from and its derived forms) (as cited in Schmitt, 2010). In Zechmeister et al.'s (1995) study, junior high school students had a vocabulary size around 11,836 lemmas, university students knew about 16,000 lemmas, and retired adults 21,252 lemmas (as cited in Schmitt, 2010). According to Nation (1997), English native speakers were expected to "add roughly 1,000 word families a year to their vocabulary size" until up to a vocabulary size of approximately 20,000 word families (as cited in Schmitt, 2010: 6). For example, a five-year-old L1 child might have a vocabulary about 4,000 to 5,000 word families. Nevertheless, Nation (1997) has warned that there is likely to be a great variation among individuals.

Although it is not necessary for second language learners to achieve native-like vocabulary size in order to use English well, Nation (2006) has indicated that if

English learners intend to read a certain range of authentic texts, 8,000-9,000 word families is a prerequisite for this goal (as cited in Schmitt, 2010). However, the vocabulary size of EFL learners reported in research studies falls quite short of this requirement. The vocabulary size of EFL university students ranges from 1,200 to 4,000 words, while that of EFL high school students ranges from 1,000 to 3,500 words. The great variation of vocabulary size appears to be common among EFL learners. See Table 1 for details.

Table 1

Summary of Foreign Learners' English Vocabulary Size

Country	**Vocabulary Size**	**Study**
China English majors	4,000	Laufer (2001)
Japan EFL university	2,300	Barrow et al. (1999)
	2,000	Shillaw (1995)
Oman EFL university	2,000	Horst et al. (1998)
Indonesia EFL university	1,220	Nurweni & Read (1999)
Israel high school graduates	3,500	Laufer (1998)
Greece high school (age 15)	1,680	Milton & Meara (1998)
Germany high school (age 15)	1,200	Milton & Meara (1998)
France high school	1,000	Arnaud et al. (1985)

Note. From *Researching vocabulary: A vocabulary research manual* (p. 9), by N. Schmitt, 2010, Basingstoke: Palgrave Macmillan.

The studies of vocabulary size conducted in the EFL context of Taiwan targeted students ranging from the level of elementary school to college (See Table 2 on p.18). It is noted that the majority of empirical studies (Chen, 1998, 1999; Cheng, 2007; Huang, 2001; Lin, 2003; Yang, 2002) focused on college students' vocabulary size probably because of those students' urgent need to meet the requirements of academic English in college. The results of existing studies showed that the English majors knew around 5,000 words (Cheng, 2007), technology university students, around 1,000 to 2,000 words (Huang, 2001; Lin, 2003; Yang, 2002), and college students in general, about 2,000 to 3,000 words (Chen, 1998, 1999).

Only a handful of research into vocabulary size aimed at senior high school (Chao, 2003; Hsu, 2008; Huang, 2000; Ting, 2005), junior high school (Huang, 2000; Huang, 2007), and elementary school students (Chua, 2007; Tsao, 2009). It is reported that Taiwanese senior high school students had a vocabulary size ranging from less than 1,000 words to 3,000 words (See Table 2). In sum, a very heterogeneous level of vocabulary size can be found among Taiwanese senior high students.

With respect to Taiwanese junior high school students' vocabulary size, the 9th graders were reported to fail to reach the 1,000-word level in Huang's (1997) study (cited in Huang, 2000). Nevertheless, the result of Huang's (2007) study revealed that the 9^{th} graders had the vocabulary size between the 1,000- and 2,000-word levels.

Before entering junior high school, an elementary school graduate is required by MOE (Ministry of Education, 2003) to have a receptive vocabulary size of 300 words and a productive vocabulary size of 180 words. The empirical studies showed that the 6^{th} graders had a receptive vocabulary size of about 220 words (Tsao, 2009), and the 4^{th} graders had a receptive vocabulary size of 130 words (Chua, 2007). Most primary school graduates' receptive vocabulary size is below 1000-word level. Therefore, in the present study, it is assumed that the 1000-word level test (Nation, 1993) may be sufficient to be administered to measure the 7^{th} graders' vocabulary size.

Table 2

Summary of Studies Investigating Taiwanese Students' Receptive Vocabulary Size

Subjects	**Receptive Vocab Size**	**Study**
English majors	5,000	Cheng (2007)
College students	2,000-3,000	Chen (1998, 1999)
Technology Uni. Ss	1,000-2,000	Huang (2001)
		Lin (2003)
		Yang (2002)
12th graders	2,000-3,000	Chao (2003)
12th graders;	1,000-2,000	Huang (2000);
10th graders	1,000-2,000	Hsu (2008)
10th graders	1,000 or less	Ting (2005)
9th graders	1,000-2,000	Huang (2007)
9th graders	Below 1,000	Huang (2000)
6th graders	220	Tsao (2009)
4th graders	130	Chua (2007)

Given the significant variance in junior high school students' vocabulary size, the present study aims to explore the relationship between junior high school students' vocabulary size and their phonological processing abilities, and whether those with higher phonological processing abilities would differ from those with lower phonological processing abilities in terms of their vocabulary size.

Phonological Processing Abilities

As noted earlier, phonological processing abilities, important in processing spoken and written language, consist of phonological awareness (PA), phonological short-term memory (PM), and phonological recoding in lexical access (PR). The three subcomponents of phonological processing abilities are distinct while interrelated (Wagner & Torgesen, 1987; Wagner et al., 1993, 1994, 1997). In this section, three bodies of research centering on each of the three subcomponents of phonological processing abilities would be elaborated as follows.

Phonological Awareness (PA)

Levels of Phonological Awareness

Phonological awareness refers to the ability to organize and store phonological representation of written and spoken words (Morais, 2003). To be specific, phonological awareness involves the ability to attend to, detect, and manipulate the sound units of words independently of their meanings based on an understanding of sound structure. Therefore, learners with high PA can manipulate sound structures more accurately, while those with low PA manipulate sound structures less accurately and tend to have difficulty in constructing phonological representations (Hu & Schuele, 2005). Phonological awareness is important because it enables children to understand the alphabetic principle and to decode words in print. As a multilevel skill, phonological awareness can be described in terms of syllable awareness, onset-rhyme awareness, and phonemic awareness (Goswami & Bryant, 1990; Treimen & Zukowski, 1991).

Phonological awareness at the syllable level refers to one’s awareness of accessing the sound structure where words can be divided into syllables. For example, people with syllabic awareness know that the word *baby* can be divided into two syllables as *ba-by*. Onset-rhyme awareness refers to one’s awareness of accessing the sound structure where syllables can be divided into an onset (the initial consonant and consonant cluster in a syllable) and a rhyme (the vowel and final consonant or consonant clusters). For example, in the word *cat*, the *c* is the onset of the syllable, and *at* is the rhyme of the syllable. Phonemic awareness refers to one’s awareness of accessing the sound structure where a word can be broken into the smallest units of individual sounds or phonemes. For example, people with phonemic awareness are aware of the three phonemes: /f/ /r/ /i/ in the word *free* and are able to blend or manipulate the individual phonemes of the target word if necessary.

The developmental sequence of English phonological awareness at the three distinct levels has been noted by a number of researchers (Chard & Dickson, 1999;

Morais, 1991; Goswami, 2000): Learners first acquire awareness at the syllable level, then at the onset-rhyme level, and finally at the phonemic level. The syllable awareness is, by default, developed first. Nevertheless, Yopp (1988) and Adams (1990) argued that instead of syllables, rhymes are the easiest of the phonological awareness and thus would be developed first. In general, among the three levels of phonological awareness, the awareness of phonemes (the minimal sound unit in languages) is the most complex level of phonological awareness and has been proved to have a significant impact on early reading abilities and word recognition (Byrne & Fielding-Barnsley, 1993; Ehri, et al., 2001; as cited in Lee, 2006). However, according to the research mentioned above, whether learners would acquire the rhyme awareness or syllabic awareness first still remains controversial and warrants more investigation.

Assessments of Phonological Awareness

The three levels of phonological awareness (syllable awareness, onset-rhyme awareness, and phonemic awareness) are related to each other because all of them require the awareness of how a word can be broken into smaller units (Gillon, 2004). Within each level of phonological awareness, the assessments of PA tasks are different in their degree of difficulty and linguistic complexity (Yopp, 1988). Despite the diversity of the PA assessments under each level, the combination of multiple measures has been proved to have greater validity than any individual test has (Yopp, 1988). Schatschneider et al. (1999) has also indicated that, although the tasks measured at each level of PA are strongly related, the optimal PA measure should be different for learners at various stages of PA development. Since there are heterogeneous levels of PA among the target students, a variety of PA tasks designed for learners at different cognitive levels would be included in the present study.

Specifically, in terms of syllable awareness, in the present study the tasks employed to evaluate learners' phonological awareness at the syllable structure include the following tasks: syllable blending, syllable segmentation (syllable counting), and syllable deletion. Among these skills, syllable segmentation is more difficult than syllable blending for Chinese students. Lai (2005) reported that many Taiwanese 12th graders tended to miscount English syllables by adding a schwa. For example, the word *look* is a one-syllable word, but some Taiwanese learners of English would miscount the word as a two-syllable word like /ˈlʊkə/. In view of this, syllable segmentation would be included along with other measures of syllable awareness to see whether this tendency exists among the junior high school students in the current study.

As to the assessments of onset-rhyme awareness, this level of awareness is usually measured only through rhyming tasks due to the following two reasons: First, "in order to understand that words rhyme, there first must be an awareness that words share a common ending (rhyme unit) that can be separated from the beginning of the word (onset)" (Gillon, 2004: 6). Second, the onsets are composed of single phonemes, and thus it is learners' initial phonemic awareness that is assessed. The result of Wimmer et al.'s (1994) research also shows that the onset detection task measures the aspects of phonological awareness somewhat different from the rhyme detection tasks. Therefore, in the present study the measures of onset-rhyme awareness represented by rhyme awareness only included rhyme recognition and rhyme supply (production). It is easier for learners to identify a rhyme than produce a rhyme, so rhyme recognition is easier than rhyme production for the participants.

The measures of phonemic awareness are deemed as the most difficult tasks because the notion of phonemes is quite abstract. Listeners do not hear isolated phonemes in words; instead, "phonemes are blended into syllables within the sound stream" (Gillon, 2004: 7). In the present study, phonemic awareness will be measured while the students perform the following tasks: phoneme isolation of initial/final sound, phoneme blending, phoneme segmentation, phoneme deletion of initial/final sound, phoneme deletion of the first sound in a consonant blend, and phoneme substitution.[14] Among these tasks, phoneme deletion is most frequently used (Gillon, 2004; Preston & Edwards, 2007), and is considered as a particularly accurate indication of phonological awareness (Schatschneider et al., 1999). In Chung's (2000) study, phoneme deletion was not an easy task even for junior college freshmen (equal to the 10th graders of high school). Therefore, it is assumed that phoneme deletion is a challenging task for the 7th graders in the current study.

Relationship between Phonological Awareness and Vocabulary Learning

A vast body of research has demonstrated that a strong relationship exists between PA and vocabulary learning in both L1 and L2 studies. Nevertheless, there is a debate over whether it is PA that supports vocabulary learning, or it is vocabulary learning that supports PA (de Jong, 2000; Hu, 2005, 2008; Metsala, 1999; Metsala & Walley, 1998; Roberts, 2005).

The scholars believing that PA can support vocabulary learning hold that phonological sensitivity can support the acquisition of new words. For example, students with better PA could learn more words (de Jong et al., 2000). In de Jong et al.'s (2000) first study, the phonological sensitivity of 40 five-year-old children was related to their learning of new words which were phonologically unfamiliar; in their second study, the experimental group of five-year-old children who had received

[14] The examples of the phonemic awareness tasks are provided in Chapter Three.

phonological sensitivity training learned the phonologically unfamiliar words more easily than the control group. In contrast, poor PA slows vocabulary acquisition (Hu, 2005, 2008). In Hu's (2008) research, 37 children at Grade 5 with lower PA acquired new color terms more slowly and less accurately than those with better PA. This is because learners with poor PA tend to learn words holistically and are thus unable to draw upon patterns observed in known words when they learn new words (Edwards et al., 2004; Walley, 1993).

On the other hand, the researchers believing vocabulary learning can support PA argue that vocabulary growth leads to more sharply defined phonetic categories (Roberts, 2005). Metsala and Walley (1998) and Metsala (1999) also agree with the potential influence of vocabulary growth on phonological development: Learners who know more words are more likely to develop a deeper insight into the phonological structure of a language. The longitudinal empirical studies have shown that receptive and productive vocabulary skills could predict phonological awareness of preschool learners (Puolakanaho et al., 2004; as cited in Chiang & Rvachew, 2007).

Other researchers (Bishop, 1997; Koda , 2006; Studdert-Kennedy, 2002) hold the belief that there are bi-directional effects between PA and vocabulary learning. As students learn more words and gain more experience with language, their phonological representations become more well-built, and this process in turn helps them to learn new words more effortlessly and become more skilled when performing PA tasks (Studdert-Kennedy, 2002). On the whole, the results of the above studies all show a positive relationship between phonological awareness and vocabulary learning.

Factors Affecting the Development of Phonological Awareness in Speakers of Other Languages

A great deal of related research on phonological awareness has been conducted to examine its effects on L2 vocabulary learning, some with facilitative but some with debilitative effects depending on learners' first language background. There are three major language systems—logographic, syllabic, and alphabetic—which differ from each other in terms of the basic units of phonological representation and in terms of the regularity in symbol-to-sound correspondence (Koda, 2006).

For example, Chinese is a logographic language in which characters (hieroglyphs) are recognized by the written forms with the sounds arbitrarily assigned, whereas English is an alphabetic language in which the phoneme-grapheme correspondence rules are important in receptive and productive vocabulary. In addition, a huge body of research reports that visual skills play a very important role in Chinese reading. As a result, Chinese learners of English are more likely to use the "visual strategy" when learning English, without noticing the phoneme-grapheme correspondences of the alphabetic language (Akamatsu, 2003; Holm & Dodd, 1996; Huang & Hanley, 1994; Read et al., 1986). A great amount of evidence indicates that the phonological awareness developed by beginning L1 Chinese readers corresponds to whole-word phonology, with no awareness of individual phonemes (Walley, 1993; Studdert-Kennedy & Goodell, 1995; Hu, 2003). In addition, Hu (2008: 40) has indicated that "holistic phonological representations (i.e., whole-word phonology) are believed to be primitive and underspecified and thus are more difficult to retain, to recall, and to articulate than fine-grained, more distinctly segmented representations, particularly in the case of phonologically complex items or new phonological contexts." In other words, at the early stages of word learning, holistic construction of new words may be possible, but it would become increasingly burdensome as learners' vocabulary grows.

As indicated by some research (Perfetti & Zhang, 1995; Perfetti & Liu, 2005), reading Chinese requires more of the syllable awareness, rather than the phonemic awareness. In this regard, non-alphabetic L1 readers who do not develop their phonological capacity at the phonemic level may experience considerable difficulty in mastering English phonological processing skills. Therefore, it is more difficult for Chinese learners of English to detect, decode, and combine the phonological representations of new English words (Huang, Lin & Su, 2004).

In addition to L1 language background, the early experiences of PA training also have a place in PA development. In exploring how PA can be raised in the EFL context, McDowell and Lorch (2008) examined the possible facilitators of phonemic awareness: Pinyin—an alphabetic representation of Chinese, and the International Phonetic Alphabet (IPA). In this study, three groups of subjects at around the age of seventeen were involved: MC (Mainland Chinese group), MCI (Mainland Chinese group with additional IPA exposure), and HK (Hong Kong participants).[15] The result showed that both MC and MCI participants who were familiar with Pinyin performed better than HK group in the task of phoneme-grapheme nonword matching.[16] Furthermore, the Mainland Chinese group with IPA training outperformed the non-IPA-trained MC group in the task of initial phoneme deletion.[17] This study reveals that phonological awareness is not only affected by L1 orthography, but the early experiences of PA training also play a part. In Taiwan, although IPA training is exclusively rare, English learners here commonly receive

[15] The Mainland Chinese students learned their L1 by means of Pinyin. To learn English, some Mainland Chinese students were trained with IPA, but some were not. Hong Kong learners, although using similar Chinese writing systems, had not been trained in either Pinyin for acquiring L1 (Cantonese), or in IPA for learning English.

[16] "Using nonwords prevents participants from relying on semantic information, forcing them instead to apply grapheme-phoneme correspondence rules. In this task, participants are required to listen to a series of monosyllabic nonwords (n = 20) and select the appropriate match from an array of four written stimuli: (1) the target nonword, (2) a distractor nonword which has a different vowel nucleus, (3) a distractor nonword which has a different postvocalic consonant coda, and (4) a completely dissimilar letter string" (McDowell and Lorch, 2008: 503).

[17] "Items included two types of stimuli: simple onsets with single initial phonemes (n = 12) and complex onsets of consonant clusters (n = 8)" (McDowell and Lorch, 2008: 502).

phonics instruction in elementary school, and still some are even trained with Kenyon and Knott Phonetic Alphabet (K.K.) in cram schools. Hence, the background survey is necessary to take the variable of PA-relevant training such as the training of phonics and Kenyon and Knott Phonetic Alphabet into consideration.

Phonological Short-Term Memory

Another important factor impacting vocabulary learning is learners' ability to hold the amount of information in their phonological short-term memory over a few seconds, during which the information will decay if not refreshed. Therefore, this process involves a subvocal rehearsal system that serves "the function of registering visual information within the store and providing the items to be named" (Baddeley, 2003: 191). To be specific, phonological short-term memory consists of 1) the phonological short-term storage, which maintains incoming auditory speech in phonological codes, and 2) a subvocal rehearsal process, which can be utilized to refresh the phonological representations in the phonological short-term storage (Gathercole et al., 1994). For example, "if a subject is shown a sequence of letters for immediate recall, then despite of their visual presentation, subjects will subvocalize them, and hence their retention will depend crucially on their acoustic or phonological characteristics" (Baddeley, 2003: 191). Hence, to store unfamiliar phonological forms of new words, learners with better phonological short-term memory are able to subvocalize sound-based information more accurately than those with lower phonological short-term memory. In this regard, phonological short-term memory is crucial to acquire the unfamiliar vocabulary of a foreign language.

Assessments of Phonological Short-Term Memory

Phonological short-term memory is usually evaluated by two cognitive tasks: digit span and nonword repetition. Digit span refers to the measurement of recalling series of digits presented by an examiner. According to French (2006: 27), nonword repetition "consists of correctly repeating back a series of words whose phonotactic structure resembles that of a real word, but whose semantic content is for the most part meaningless, as in the words *sabyask* and *jubjoppering*." The results of Baddeley, Gathercole, and Papagno's (1998; as cited in French, 2006) study indicated that both digit span and nonword repetition had a positive association with vocabulary learning, but the coefficients of digit span ranged from .25 to .45, while the coefficients of nonword repetition from .4 to .6. This result suggests that nonword repetition is the most empirically proven measure for assessing both L1 and L2 learners' phonological short-term memory.

The nonword repetition test is favored as a measure of phonological short-term memory for two primary reasons. First of all, as indicated by Hulme, Maughan, and Brown (1991; as cited in Gathercole & Baddeley, 1993b), when the tasks involve recalling familiar stimuli, other factors such as long-term lexical-phonological knowledge are more likely to contribute to the immediate memory performance. Hence, learners should find the familiar stimuli easier to repeat. For this reason, in comparison to digit span,[18] nonword repetition appears to provide a relatively reliable measure of phonological short-term memory (Baddeley et al., 1998).

A second advantage of using nonword repetition as a measurement of phonological short-term memory is its resemblance to the natural process of vocabulary acquisition and thus is significantly related to vocabulary learning. "Every word we now know was once unfamiliar to us, and on many occasions will have started its journey into our mental lexicon via such a repetition attempt" (Garthercole, 2006: 513). It is a natural and common occurrence for language learners to be exposed to unfamiliar phonological forms, and a frequent strategy for learners to learn new words is to imitate the sounds of new words (Gathercole et al., 1994). Likewise, the task of nonword repetition requires learners to "invoke a variety of phonological and memory-related processes—perception, encoding, storage, retrieval, and production" (Montgomery & Windsor, 2007: 779), the process similar to the learning of new

[18] Digit span is based on the ability to recall the familiar stimuli—numbers.

words. The learners poor at repeating nonwords are proved to have difficulty acquiring new receptive and productive vocabulary (Baddeley et al., 1998; Gathercole and Baddeley, 1990, 1993 a, 1993b; Gathercole et al., 1999). More research into the relationship between phonological short-term memory and vocabulary size will be elaborated in the following section.

Relationship between Phonological Short-Term Memory and Vocabulary Learning

A huge body of research has reported a positive link between phonological short-term memory and the learning of novel or unfamiliar words in both L1 (Gathercole, 1995; Gathercole & Baddeley, 1989; Gathercole et al., 1999) and L2 vocabulary acquisition (Cheung, 1996; Service, 1992). As a component of working memory, phonological short-term memory plays a crucial role in amassing a temporary store of unfamiliar phonological forms and thus can facilitate vocabulary learning (Baddeley et al., 1998; Gathercole, 1995). In contrast, limited phonological short-term memory would hamper the construction of phonological representations in long-term memory when the words to be learned have highly unfamiliar sound structures (Baddeley et al., 1998). Consequently, phonological short-term memory could either facilitate or constrain vocabulary development. The section below will review more empirical studies in the L1 and L2 context.

Phonological Short-Term Memory and L1 Vocabulary Learning

L1 studies have used nonword repetition as a measurement of phonological short-term memory to offer insights into learners' reliance on phonological short-term memory for the learning of new words (e.g., Avons, Wragg, Cupples, & Lovegrove, 1998; Gathercole & Baddeley, 1989; Gathercole, Hitch, Service, & Martin, 1997; Michas & Henry, 1994; as cited in Gathercole, 2006).

In Gathercole and Baddeley's (1990) study, 48 children at the age of five were assessed on performing the nonword repetition task and on learning the new names of toys. Some toys were given familiar names such as *Peter* and *Michael*, while the others were given unfamiliar names such as *Meton* and *Pimas*. The results showed that the higher the nonword repetition scores, the better the learning of unfamiliar names of the toys. As to the familiar names of the toys, no significant difference was reported between the groups of children with high and low phonological short-term memory.

For native English speakers, phonological short-term memory seemed to play a less important role in vocabulary learning as learners were beyond the age of five years or so (Gathercole, Willis, Emslie, and Baddeley, 1992; as cited in French, 2006).

As shown in Gathercole's (1995) longitudinal study, "the association between nonword repetition and native vocabulary scores at 8 years of age had declined markedly in strength" (as cited in Gathercole, 2006: 514). However, this finding is contrary to Gathercole, Service, Hitch, Adams, and Martin's (1999) study: phonological short-term memory (as indicated by both digit span and nonword repetition) was closely related to the vocabulary learning of both 5-year-olds and 13-year-olds. Therefore, the lasting influence of phonological short-term memory seems to remain from early childhood to early adolescence for the L1 leaners.

The association between phonological short-term memory and vocabulary learning for older L1 populations was also shown in Grupa's (2003) study. The results indicated that the developmental relationship between phonological short-term memory and vocabulary learning existed in 52 undergraduates at the age of 18 to 26. In the same study (Grupa, 2003), another sample of 58 adults (aged 18 to 26) provided further evidence that nonword repetition and the learning of new words in native language actually extended into adulthood. In conclusion, "Word learning mediated by temporary phonological storage [i.e., phonological short-term memory] is a primitive learning mechanism that is particularly important in the early stages of acquiring a language, but remains available to support word learning across the life span" (Gathercole, 2006: 513).

Phonological Short-Term Memory and L2 Vocabulary Learning

Similar to L1 studies on phonological short-term memory, L2 research also uses nonword repetition tasks to explore the relationship between phonological short-term memory and L2 vocabulary learning (Masoura & Gathercole, 1999, 2005; Service, 1992; Service & Kohonen, 1995; as cited in Gathercole, 2006).

Service's (1992) research included forty-four 9-year-old Finnish elementary school children. During the period of two and a half years, each participant was tested on the nonword repetition test and three language subskills (i.e., listening comprehension, reading comprehension, and written production). The results showed that nonword repetition was a good predictor of English proficiency for Finnish elementary school students. However, Servie (1992) speculated that the strong link between nonword repetition and L2 language skills may be mediated by vocabulary knowledge due to the fact that vocabulary is the essential element for language skills such as reading, listening, writing, and speaking.

To examine the above hypothesis, Service and Kohonen (1995; as cited in French, 2006) retested 42 of the original 44 Finnish elementary school students in Service's (1992) study. In addition to English nonword repetition, the participants were assessed on English vocabulary knowledge, language comprehension and production skills. The results revealed that nonword repetition was closely related to

L2 language skills as well as to L2 vocabulary knowledge. The most significant finding of this study is that the link between phonological short-term memory and L2 language skills is actually mediated by vocabulary knowledge. That is, vocabulary skill alone could explain the largest proportion of variance in overall L2 proficiency scores.

In light of the findings reported by Service and Kohonen (1995), Cheung (1996) examined the relationship between phonological short-term memory and L2 word learning by recruiting eighty-four bilingual 12-year-old Chinese students. The participants were assessed on the accuracy of 62 two-syllable nonwords. The learning of the three new words (i.e., *egregious*, *jocular*, and *succulent*) is operationalized by calculating the total number of trials to learn the English pronunciation and Catonese translation of the three words. The result showed that nonword repetition had a strong association with the number of vocabulary learning attempts.

However, in Masoura and Gatehrcole's (2005) study, the result showed that although English vocabulary scores were related to phonological short-term memory performance, the sample of 40 Greek children's speed of learning new English words was strongly influenced by their current English vocabulary knowledge. The finding suggests that "foreign vocabulary acquisition is mediated largely by use of existing [vocabulary] knowledge representations" (Masoura and Gatehrcole, 2005: 421). In sum, phonological short-term memory, vocabulary knowledge, and vocabulary learning share a complex and mutually facilitative relationship.

As noted above, the link between phonological short-term memory and vocabulary learning has been empirically established. However, the words acquired in the learning task may not always remain in the retention interval. Moreover, learners' vocabulary knowledge could also play a part in affecting the relationship between phonological short-term memory and vocabulary learning (Masoura and Gatehrcole, 2005). Therefore, the present study attempts to further explore the relationship between phonological short-term memory and vocabulary size among the junior high school students in the EFL context of Taiwan.

Phonological Recoding in Lexical Access

The third subcomponent of phonological processing abilities is phonological recoding in lexical access. By definition, phonological recoding in lexical access refers to "getting from a written word to its lexical referent by recoding the written symbols into a sound-based representation system" (Wagner & Torgesen, 1987: 192). Hence, in the early stages of acquiring reading skills, phonological recoding plays a significant role in word recognition in the L1 and L2 context (Geva et al., 2000;

Gholamain & Geva,1999; Nassajizavareh & Geva, 1999). The theoretical models below will illustrate the relationship between phonological recoding in lexical access and word recognition.

Theoretical Models of Phonological Recoding in Lexical Access

The role of phonological recoding in lexical access has been widely discussed in three major models of word recognition which are developed for alphabetic languages: (1) the phonology-first verification model (e.g., Van Orden, 1991), (2) the dual-route model (e.g., Coltheart, 1993), and (3) the parallel-access model (Taft & Graan, 1998).

The phonology-first verification model proposes that orthographic codes would first be transformed into phonological codes before the lexical meaning is retrieved. Van Orden's (1991) study showed that phonological codes are the first decoding process to access meaning. Figure 1 illustrates the coding process in the phonology-first verification model, where the orthographic codes first activate the phonological codes before accessing the lexical meaning (i.e., semantics), and at the last verification stage, the inappropriate homophonic lexical items are eliminated.

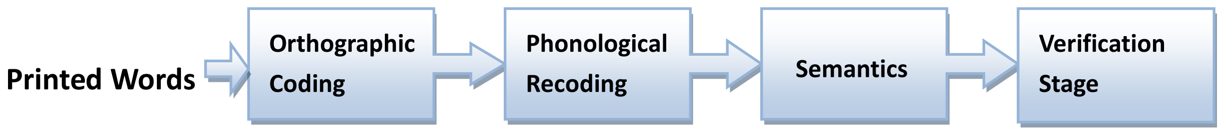

Figure 1. The phonology-first verification model.

The dual route model proposed by Coltheart et al. (1993) suggests that there are two routes to lexical meaning: (1) the lexical route in which the orthographic information is mapped to its orthographic lexicon, and (2) the sublexical route in which the letters are converted into phonemes. When encountering low-frequency or irregular words, the computation of lexical route might be slow; therefore, the sublexical route would be chosen to provide more information to access the lexical entry. Figure 2 illustrates the coding process in the dual route model.

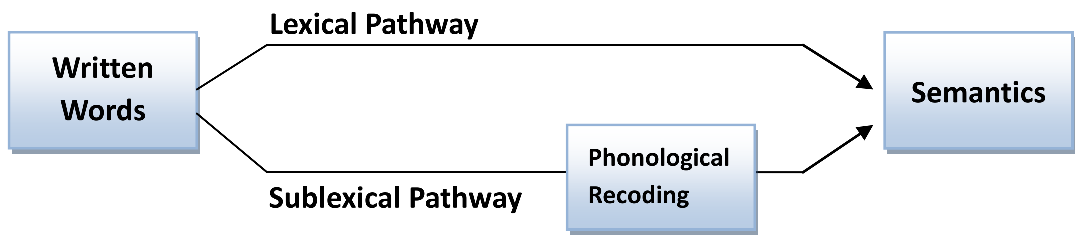

Figure 2. The dual route model.

In the parallel-access model, Seidenberg (1990) contends that the orthographic route and the phonological route are activated *simultaneously* in access to lexical meaning. Taft and Graan (1998) also point out that the competition between the two pathways of orthographic (e.g., graphemes: s, t, a, m, p) and phonological coding (e.g., phonemes: /s/, /t/, /æ/, /m/, /p/) would lead to the semantic codes. Figure 3 illustrates the coding process in the parallel-access model.

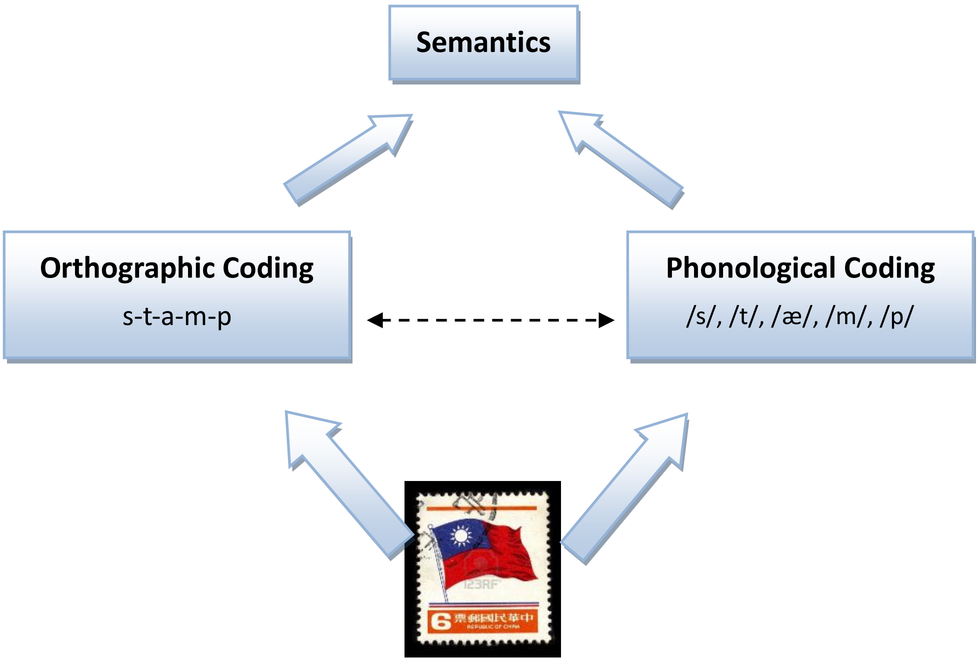

Figure 3. The parallel-access model.

Based on the three models, the importance of phonological recoding in word recognition is certain and indubitable. As shown in many empirical studies (Gottardo et al., 1999; Balota et al., 2000), phonological recoding plays a significant role in helping readers to decode low-frequency and irregular words. For example, readers tend to have difficulty associating the orthography and the meaning of low-frequency words, so they need to decode the low-frequency words phonologically (Gottardo et al., 1999). Likewise, when encountering irregular words (i.e., with lower degree of script-to-sound correspondence), readers are more likely to perform phonological recoding in the process of word identification (Balota et al., 2000). Therefore, phonological recoding is critical for learners to reduce the load of visual information in word learning (Swank, 1994).[19]

After reviewing the theoretical model of phonological recoding in lexical access, how phonological recoding in lexical access is assessed will be described in the next section.

Assessments of Phonological Recoding in Lexical Access

Studies investigating the use of phonological recoding in lexical access normally draw upon the following three assessments: (1) lexical decision, (2) semantic judgment, and (3) rapid automatized naming (RAN).

In lexical decision tasks, a participant is presented with a string of lexical items, including valid words (e.g., *rose*) and nonwords which are similar with the target words orthographically or phonologically (e.g., *roze*). The participant has to decide whether the stimuli are real words. The results of the research employing lexical decision tasks usually show that "sounds" (i.e., phonological codes) do not play a

[19] Phonological codes are more stable than visual codes, thus making them well-suited for coding information that is to be held in short-term memory.

role in accessing lexical semantics (Zhou et al., 1999; Chua, 1999). According to Shen and Forster (1999), lexical decision tasks might not be a valid measurement of phonological recoding because they may tap into a very early stage of lexical access—a stage too early for phonological recoding to take place.

However, the counter-evidence is provided in the studies which used semantic judgment as a measurement of phonological recoding in lexical access. In semantic judgment tasks, a participant is presented with two words and required to decide instantly whether the second word is semantically related to the first word (e.g., *flower* and *rose*). The results obtained from semantic judgment tasks reveal that phonological recoding is involved in accessing semantic codes (Perfetti & Zhang, 1995; Tan & Perfetti, 1999). Although semantic judgment tasks seem to be a more reliable measurement of phonological recoding than lexical decision tasks, semantic judgment tasks usually involve higher cognitive levels of semantic knowledge and thus may be too difficult for beginners.

Therefore, researchers tend to favor the use of pictures[20] as eliciting displays for beginners because compared with words, pictures provide an easier access to the semantic codes (Levelt, 1993). The visual stimuli can denote concepts directly, while the stimuli of words in lexical decision tasks and semantic judgment tasks are

[20] "Pictures become symbols of objects by physical similarity. Therefore, recognizing pictures comprises essentially the same cognitive processes as perceiving the objects themselves" (Potter, 1979; cited in Levelt, 1993: 62).

very likely to involve other factors such as alphabetic principles to exert influence.

Basically, the picture naming tasks can be categorized as isolated naming and serial naming. According to Wagner et al. (1997: 469), "*Isolated naming* involves naming as quickly and accurately as possible individual items that are presented one at a time on a computer screen. *Serial naming* involves naming a series of items as quickly and accurately as possible. The measure of serial naming performance is *how long it takes* to name the series, which is often converted into the number of items named per second." Compared with isolated naming, serial naming performance is more correlated with performance on the other two subcomponents of phonological processing abilities—phonological awareness and phonological short-term memory (Wagner, Torgesen, Laughon, Simmons, & Rashotte, 1993; Wagner et al., 1994). Thus, the present study employs serial picture naming as the assessment of phonological recoding in lexical access.

The serial picture naming task is also known as rapid automatized naming (RAN) or simply *rapid naming*, which typically includes naming items such as pictures of common objects, colors, digits, or letters. The purpose of these tasks is to examine how efficiently (i.e., as fast and accurately as possible) learners could activate phonological information from long-term memory (Wagner & Torgesen, 1987, 1993; Wagner, Torgesen, & Rashotte, 1994). In this view, learners with better phonological recoding abilities are able to retrieve phonological codes more efficiently by naming more items per second. By contrast, those with lower phonological recoding abilities retrieve phonological codes at relatively lower speed, and thus tend to have difficulty in word recognition.

Although there must be individual differences in naming speed among the participants, those with relatively lower phonological recoding in lexical access are more likely to have difficulty in word recognition. According to Lewellen, Goldinger, Pisoni, and Greene's (1993: 316) research, students with more extensive vocabulary knowledge were consistently faster than those with more limited vocabulary knowledge in naming visually presented words, which suggests that "students who differ in lexical familiarity also differ in processing efficiency." Also, in Raduege and Schwantes (1987; as cited in Plaut & Booth, 2000) study, older or good readers have fast and automatic word decoding skills, whereas younger or poor readers' word decoding is slower and less automatic. Taken together, individual differences in the speed of naming tasks would influence subsequent individual differences in word recognition.

As a widely used test of phonological processing abilities, the *Comprehensive Test of Phonological Processing* (CTOPP[21]; Wagner, Torgensen & Rashotte, 1999)

[21] The Comprehensive Test of Phonological Processing (CTOPP) has been designed as "an extension and improvement over commercially available tests of phonological coding" for all three subcomponents of phonological processing ability—phonological awareness, phonological

contains rapid color naming, rapid object naming, rapid digit naming, and rapid letter naming for measuring phonological recoding in lexical access. To provide reliable and valid assessments of phonological processing abilities, Wagner et al. (1999) have developed two versions of the test: one is for individuals aged 5 and 6 years old, and the other is for individuals aged 7 through 24 years old. For 7-year-olds and above, rapid digit/letter naming and rapid color/object naming are provided as measurements, while the young children's (5- and 6-year-olds) core subtests are rapid color naming and rapid object naming, without digit/letter naming. This is because the L1 kindergarteners' performance tends to be restricted by their limited knowledge about the digits and letters when they are asked to name them. Hence, the task of naming objects and colors should avoid this limitation for L1 young children.

According to Wagner and Torgesen (1987), the ideal task of phonological recoding in lexical access should measure the efficiency of the retrieval on the condition that the phonological codes are retrieved from long-term memory and used as a means of accessing lexical meaning. Considering the requirements for an ideal task of phonological recoding in lexical access, the rapid naming of letters might be problematic in that naming letters "involve retrieving phonological codes,

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short-term memory, and phonological decoding of lexical access (Lennon & Slesinski, 2001).

but not using them to make lexical access" (Wagner & Torgesen, 1987). Since letters and numbers are printed symbols, rapid naming of letters/numbers does not seem to involve establishing connections between meanings and sounds. In addition, Catts et al. (2002) also oppose the use of rapid naming of alphanumerical stimuli (i.e., letters and numbers) in that the alphanumeric naming may involve more automatized naming than object naming (Wolf et al, 1986; as cited in Catts et al., 2002). Therefore, caution should be taken when choosing the rapid naming tasks.

Similarly, Meyer et al. (1998) doubt that number and letter naming tasks are less reliable measures in comparison to object and color naming tasks. The alphanumeric naming tends to reflect the impact of early reading abilities and alphabet mastery by means of exposure to alphabet or printed words. On the contrary, color and object naming tasks are less related to prior mastery of alphabet and reading. Therefore, the number/letter and color/object naming tasks were further investigated in Meyer et al.'s (1998) longitudinal study. The results showed that color/object naming speed was strongly related to reading level and written vocabulary across Grades 1, 3, 5, and 8 (n=160) while number/letter naming was not related to the participants' reading level.

Nevertheless, Misra et al.'s (2004: 241-242) used functional magnetic resonance imaging "to evaluate the neural substrates that may underlie performance on these tasks." The results showed that "The letters task caused greater activation than object naming in the angular gyrus, superior parietal lobule, and medial extrastriate areas, whereas object naming only preferentially activated an area of the fusiform gyrus," suggesting that "the letter naming task specially pinpoints key components of this network." Moreover, other studies also revealed that in the L1 context, although all subtests of the RAN seemed to be good predictors of word reading in kindergarten, object naming lost its predictive abilities when the readers were in the first and second grade (Badian, 1996; Semrud-Clikeman et al., 2000; as cited in Misra et al., 2004). By contrast, letter naming continued to predict wording reading abilities until age eighteen (Wolf et al., 1994; Wolf et al., 2000; as cited in Misra et al., 2004).

It should be noted that in the EFL context of Taiwan, most learners acquire letters prior to objects, which is totally different from L1 young children. Hence, whether the finding in L1 research (Catts et al., 2002; Meyer et al., 1998; Misra et al., 2004) can be generalized in the EFL context warrants more investigation. In view of this, in the current study both the tasks of letter naming and object naming have been chosen as measurements of phonological recoding in lexical access to see which subtest (i.e., letter naming or object naming) of RAN is more related to the vocabulary size of Taiwanese junior high school students.

Relationship between Phonological Recoding in Lexical Access and Vocabulary Learning

As noted earlier, the other two subcomponents of phonological processing abilities (i.e., phonological awareness and phonological short-term memory) have been proved to be closely related to vocabulary learning. As the core of the third body of phonological processing abilities, phonological recoding in lexical access is crucial in word recognition in the L1 and L2 context (Geva et al., 2000; Gholamain & Geva,1999; Nassajizavareh & Geva, 1999). Recognizing a word by its form and meaning (i.e., the form-meaning link) is the most fundamental aspect of word knowledge (Schmitt, 2010), and thus the first step of word learning. In most cases, a word is normally considered learned if a learner is able to link the form to its meaning (Schmitt, 2010). Word recognition, therefore, is viewed as the essential aspect of word learning. Because of its significant relationship with accurate word recognition, phonological recoding might be significantly related to vocabulary learning.

Geva (2000) recruited seventy L1 first graders and two hundred forty-eight L2 first graders who had similar word recognition difficulties. Rapid letter naming was used to measure phonological recoding in lexical access. The result showed that rapid naming tasks played a more important role in L2 children than in L1 children, which suggests that rapid naming as a measurement of phonological recoding is a good indicator of potential word recognition difficulty, especially for L2 learners.

To see whether rapid naming could predict Taiwanese junior high school students' English word recognition ability, Chiu (2004) included 199 junior high students (7th graders) and administered rapid naming of letters (designed by Wagner, Torgesen, & Rashotte, 1999) and word recognition. The results showed that rapid letter naming could predict the participants' performance on word recognition. Therefore, rapid letter naming is a powerful predictor of Taiwanese learners' English word recognition—the fundamental aspect of word learning.

To investigate the relationship between L1 and L2 phonological recoding in lexical access and L2 word learning ability, Hu (2007) studied 76 elementary school children (3rd graders). Both Chinese and English phonological recoding in lexical access was assessed through rapid naming of colors. The results revealed that the correlation between L2 phonological recoding in lexical access and L2 word learning was greater than L1 phonological recoding in lexical access and L2 word learning. Hence, L2 rapid color naming is significantly linked to L2 word learning.

In all, the link between vocabulary learning (accurate word recognition in particular) and phonological recoding in lexical access has been proved in Hu's (2007) study. The present study attempts to shed light on the relationship between phonological recoding in lexical access and vocabulary size.

Summary of the Findings in the Existing Research

The major findings concerning vocabulary learning and phonological processing abilities are summarized as follows.

1. In Taiwan, only English reading skills are tested on the Basic Competence Test for Junior high School Students (BCT). Since receptive mastery of vocabulary is required in reading skills, receptive vocabulary is more emphasized than productive vocabulary at the stage of junior high school. In view of this, receptive vocabulary size is the primary concern of the present study.
2. The phonological processing abilities (i.e., phonological awareness, phonological short-term memory, and phonological recoding in lexical access) are important in vocabulary learning. Moreover, the components of phonological processing abilities are distinct but interrelated.
3. The component of phonological awareness can be described in terms of syllable awareness, onset-rhyme awareness, and phonemic awareness. A vast body of research has demonstrated that a powerful relationship exists between PA and vocabulary learning in both L1 and L2 studies.

4. Another important factor which has an impact on vocabulary learning is learners' abilities to hold the amount of information in their phonological short-term memory over a few seconds. There is a positive link between phonological short-term memory and the learning of new or unfamiliar words in both L1 and L2 vocabulary acquisition.
5. The third component of phonological processing abilities—phonological recoding in lexical access—is derived from research on word recognition**,** which is the fundamental aspect of word learning. The models of word recognition suggest that phonological recoding in lexical access plays a significant role in helping learners to decode low-frequency and irregular words.

Research Questions

Based on the literature reviewed above, the present study aims to further investigate the relationship between phonological processing abilities (i.e., phonological awareness, phonological short-term memory, and phonological recoding in lexical access) and vocabulary size. The research questions are proposed as follows.

1. Does Taiwanese junior high school students' phonological awareness correlate with their vocabulary size?

2. Does Taiwanese junior high school students' phonological short-term memory correlate with their vocabulary size?
3. Does Taiwanese junior high school students' phonological recoding in lexical access correlate with their vocabulary size?
4. What is the relative contribution of the three subcomponents of phonological processing abilities (i.e., phonological awareness, phonological short-term memory, and phonological recoding in lexical access) to vocabulary size?
5. Do the students with higher phonological processing abilities differ from those with lower phonological processing abilities in terms of their vocabulary size?

CHAPTER THREE

METHODOLOGY

This chapter consists of four sections: (1) participants, (2) research design and stimuli, and (3) data analysis. The first section will present the background information of the participants in the current study. The second section will introduce the research design of the present study and the selection rationale of the stimuli, the components of the stimuli, as well as the scoring of the measurements. The last section will describe how the data is analyzed.

Participants

To participate in the present study, both students and parents were informed of the purpose of the study, the benefits of participating in the research, and the procedure for data collection through the consent form (Appendix A). The participants in the current study were fifty-eight seventh graders (29 male students and 29 female students) from the same junior high school in Taipei City. The mean age of the students was thirteen years old. Though from two different 7th-grade classes,[22] the participants were taught by the same English teacher on campus. The students' scores on English achievement tests in Fall Semester 2011 were collected

[22] The two classes were randomly grouped without taking any placement tests, which reflects the MOE requirement of normal grouping in junior high school.

to confirm there was no significant difference between the two classes, suggesting that all these students had comparable performance on English achievement tests. Moreover, the language background questionnaire completed by these students showed that all the participants were at the same English level.

The language background questionnaire (Appendix B) was filled out by the participants before the assessments of phonological processing abilities and vocabulary size. The purpose of the questionnaire was to exclude the participants 1) who had passed the elementary level of GEPT and those 2) who had stayed in an English-speaking country for more than six months.[23] In this regard, three volunteers were excluded from the current study for two had passed the elementary level of GEPT and the other one had stayed in an English-speaking country for more than six months. As a result, the present study eventually included fifty-five participants (26 male students and 29 female students).

The questionnaire also helped to obtain more information about the participants' vocabulary learning experiences which could influence the performance of the vocabulary size test as well as phonological processing abilities assessments. The design of this questionnaire was to elicit participants' English learning backgrounds and vocabulary learning experiences in terms of the

[23] The criteria (i.e., staying in an English-speaking country for more than *six* months) can also be observed in Kim's (2008) and Letelier et al.'s (2007) studies.

relationship between vocabulary learning and the three subcomponents of phonological processing abilities.

Research Design and Stimuli

The present study was conducted in the first semester of the participants' first school year (i.e., Fall Semester, 2011). The whole experimental procedure is displayed in Figure 4 below.

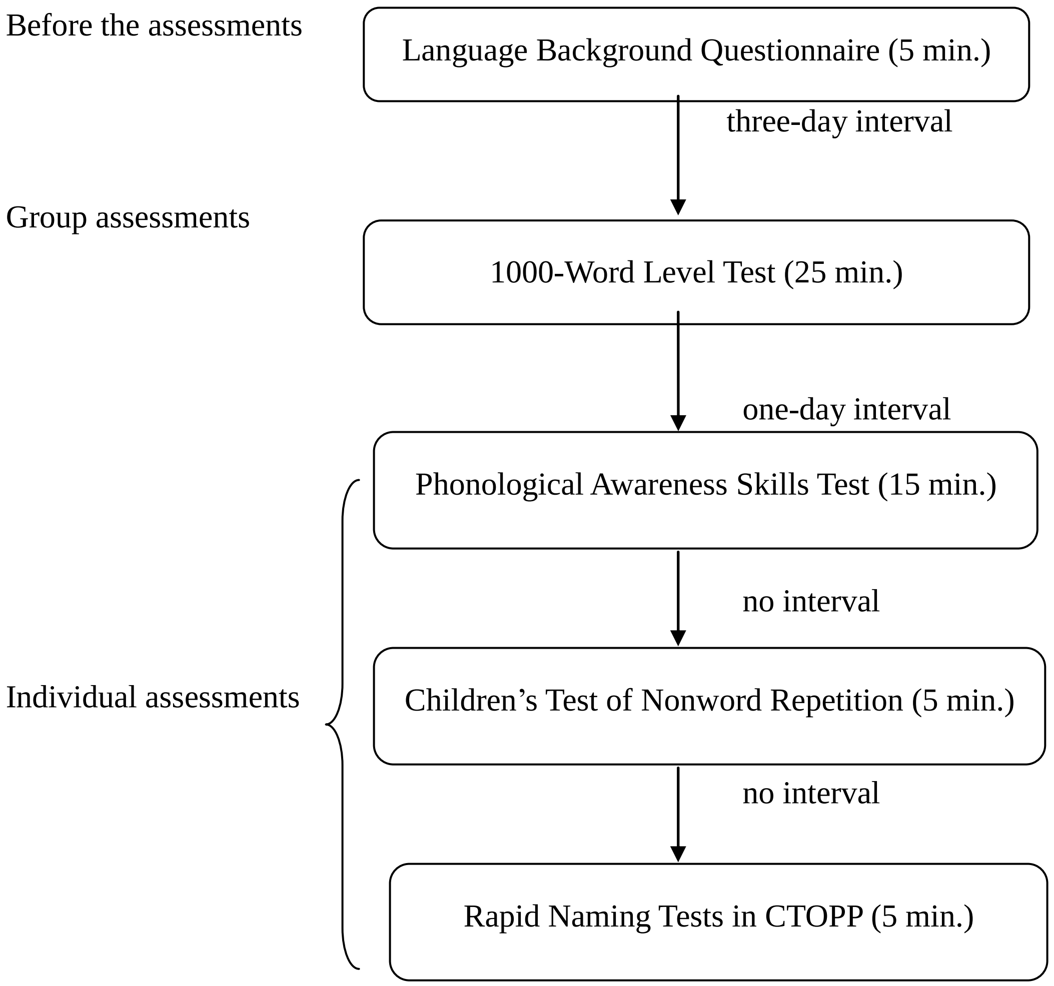

Figure 4. Procedure for data collection.

As shown in Figure 4, the whole procedure was divided into three stages: before the assessments, group assessments, and individual assessments. The participants had to fill out the language background questionnaire first before taking a battery of tests. Three days later, the 1000-word level test was administered to the participants of the two classes for 25 minutes. A day later, the participants were tested individually for the three assessments of phonological processing abilities: PAST (15 min.), CNRep (5 min.), and rapid naming tests of CTOPP (5 min.) in a single session lasting about 25 minutes. Before the battery of phonological processing abilities assessments, participants were given a test-taker booklet (Appendix C) where the Chinese instructions for the three assessments were provided to ensure their full understanding of how to perform at their highest ability. Participants' performance during the assessments of phonological processing abilities was audio-recorded for later scoring.

On the whole, the study explored the relationship between three independent variables—phonological awareness, phonological short-term memory, and phonological recoding in lexical access, and one dependent variable—vocabulary size (See Table 3).

Table 3

The Variables in This Study

Independent Variables	**Dependent Variable**
Phonological awareness (PA)	Vocabulary size
Phonological short-term memory (PM)	
Phonological recoding in lexical access (PR)	

To examine the variables of the present study, four assessments administered to the participants were: Nation's 1000-word level test, Phonological Awareness Skills Test (PAST), Children's Test of Nonword Repetition, and rapid naming tests in Comprehensive Test of Phonological Processing (CTOPP). First of all, the participants' vocabulary size was assessed by Nation's (1993) 1000-word level test. The three subcomponents of phonological processing abilities (i.e., phonological awareness, phonological short-term memory, and phonological recoding in lexical access) were measured respectively by Phonological Awareness Skills Test, Children's Test of Nonword Repetition, and rapid naming tests in Comprehensive Test of Phonological Processing. The selection rationale, components, and scoring of each assessment are introduced below.

Vocabulary Size Test

Nation's (1993) 1000-word level test was chosen to measure vocabulary size in the present study for three reasons. First, 1000-word level was assumed to be the appropriate level for the 7th graders in Taiwan.[24] Second, the advantage of presenting test items in context was pointed out by Nation (1993): the contextualized measurement could provide a richer environment to enhance learners' awareness of language in comparison to the decontextualized measurement. Third, this test could exclude the guessing effect.

This test included 40 target words (content words only)[25] in exactly the same order in two different test forms (Form A and Form B), which meant that each word was tested twice in two different contexts. The purpose was to exclude the guessing effect. Each item was designed for one target word in each form, so there were totally 80 items/sentences. Every target word was embedded in an individual sentence (e.g., "*when something* ***falls****, it goes up*"), and the test taker had to judge whether the whole statement is True (represented by the symbol of "O") or Not True (represented by the symbol of "X"). If they did not know the answer, they should state Do Not Understand (represented by the symbol of "？").[26] Only when the test

[24] The English curriculum (MOE, 2003) in Taiwan requires an elementary school graduate to have receptive vocabulary of 300 words, and a 9th grader to have a vocabulary size of 1,200 words. Therefore, the 1000-word level test should be sufficient to measure the 7th graders' vocabulary size in the study.

[25] Content words include nouns, verbs, adjectives, and adverbs.

[26] The design of the third response "Do Not Understand" was to exclude the guessing effect of

taker had the right answer for the target word in both forms, would a mark (2.5 points for each item) be given. See Appendix D for more sample items.

The test score obtained by tallying the sum of total of the following formula (the number of correct items multiplied by 2.5) (maximum = 100, minimum = 0) reflected the participants' vocabulary size in the 1000-word list as prescribed by Nation (1993). In addition, Nation proposed that the raw score be equal to the same proportion of function words known by the test taker. For example, if test takers' vocabulary score is 50 points, they are about at the 500-word stage. See Table 4 for the summary of the vocabulary size test.

Table 4

Summary of the 1000-Word Level Test (Nation, 1993)

Measurement	**Test Component**
Vocabulary size	80 test items presented in 2 contexts (Form A and Form B); 40 items in each context/form

Phonological Awareness Skill Test

Phonological Awareness Skill Test (PAST)[27] was developed by Yvette Zgonc (2000) and published in the book named *Sounds in Action: Phonological Awareness*

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choosing either True or Not True.

27 Phonological Awareness Skill Test (PAST) is available on the Internet: http://www.specialconnections.ku.edu/~specconn/page/instruction/ra/case/caseb/pdf/caseb_scene1_2.pdf
Summary of validity and reliability: http://www.literacyfirst.com/downloads/PASTValidity_Reliability.pdf

Activities and Assessment. This test, approved by the Oklahoma State Board of Education (SBE) in 2005, was used in this study because it could measure all three levels of PA—syllable awareness, onset-rhyme awareness, and phonemic awareness. Additionally, the tasks were designed with different difficulty levels.[28] The score of PAST, therefore, was able to provide a clear picture of the participants' phonological awareness.

PAST consisted of thirteen phonological awareness skills (Zgonc, 2000):

- Syllable Awareness

  (1) *Syllable blending*:

  To put the syllables of a word together (e.g., Blend two syllables *pa-per* into the word *paper*).

  (2) *Syllable segmentation*:

  To break a word into syllables and count the syllables (e.g., Segment the word *paper* into *pa-per*, thus 2 syllables).

  (3) *Syllable deletion*:

  To say a word where one syllable is left out (e.g., Say *paper* without *pa-* is *per*).

- Onset-Rhyme Awareness

[28] For example, for the onset-rime level, rhyme production is more difficult than rhyme recognition. For the phoneme level, phoneme substitution is more difficult than phoneme deletion.

(4) *Rhyme recognition*:

To tell whether two words sound alike at the end (e.g., If asked whether *sit* and *bit* rhyme, the answer is YES).

(5) *Rhyme production*:

To give another word that rhymes with a specific word, and the answer can be a real word or a nonsense word (e.g., When asked to give one word that rhymes with *sit*, possible answers are *bit, fit, mit,* and *jit*).

- Phonemic Awareness

(6) *Phoneme isolation of initial sounds*:

To tell the first sound of a word (e.g., When asked what the first sound is in the word *top*, the answer is /t/).

(7) *Phoneme isolation of final sounds*:

To tell the last sound of a word (e.g., When asked what the last sound is in the word *pot*, the answer is /t/).

(8) *Phoneme blending*:

To put the phonemes of a word together (e.g., Blend /s/ /t/ /*a*/ /p/ into the word *stop*).

(9) *Phoneme segmentation*:

To break a word into phonemes and count the phonemes (e.g., Segment the word *name* into */n/ /e/ /m/*, thus 3 phonemes).

(10) *Phoneme deletion of initial sounds*:

To say a word where the first phoneme is left out (e.g., Say *bed* without /b/ is /*ɛd/*).

(11) *Phoneme deletion of final sounds*:

To say a word where the last phoneme is left out (e.g., Say *meat* without /t/ is */mi/*).

(12) *Phoneme deletion of the first sound in a consonant blend*:

To say a word where the first phoneme is taken off a consonant blend (e.g., Say *still* without /s/ is /*til/*).

(13) *Phoneme substitution*:

To take off the first phoneme of a word and replace it with another phoneme (e.g., Replace the first sound in *pen* with /k/ is */kɛn/*).

The task instructions were translated into Mandarin Chinese and prerecorded along with one demonstration item, one practice item, and six test items for each task. During each task, the demonstration item was embedded in the instruction, and the additional practice item was provided with further guidance and corrective feedback for checking the participants' comprehension of the PA task. The prerecorded six test items for each task could only be played once; however, the MP3 player would be stopped if participants needed more time to make a response. The repetition attempts (i.e., the participants' answers) were scored 1 if judged to be accurate, and 0 if judged incorrect (maximum = 78, minimum = 0). The battery of phonological awareness tasks took about 15 minutes to administer for each participant. See Table 5 for the summary of the PA test and Appendix E for details.

Table 5

Summary of the Phonological Awareness Skills Test (Zgonc, 2000)

Measurement	**Test Component**
Phonological awareness	The total of 78 items in 13 tasks, 6 items in each task:
Syllable awareness	1. syllable blending, segmentation, and deletion;
Onset-rhyme awareness	2. rhyme recognition and production;
Phonemic awareness	3. phoneme isolation of initial and final sounds, phoneme blending, phoneme segmentation, phoneme deletion of initial and final sounds, phoneme deletion of the first sound in a consonant blend, and phoneme substitution.

Children's Test of Nonword Repetition

To measure phonological short-term memory, the current study adopted Children's Test of Nonword Repetition (CNRep) designed by Gathercole et al. (1994) because the nonword repetition test was proved to be closely linked to learners' new vocabulary learning (Baddeley et al, 1998). Moreover, CNRep was the most widely used measurement of phonological short-term memory in a variety of experimental conditions with its reliabilities .77 and validity .51 (French, 2006; Dockrell, et al., 2007).

The test items consisted of forty nonwords, each ten of them containing two, three, four, and five syllables. The participants were told at the beginning of the test that they should try to repeat upon hearing some "funny made-up words." The nonword stimuli were prerecorded and presented in a constant randomized sequence, separated by a silent interval of 3 seconds for the participant to make the repetition attempt. If the attempt was not made within 3-second interval, the MP3 player was stopped until the participant made the response. The repetition attempt was scored 1 if judged to be phonologically accurate, and 0 if judged different from the target nonword by one or more phonemes (maximum = 40, minimum = 0). See Table 6 for the summary of the phonological short-term memory test and Appendix F for more details.

Table 6

Summary of Children's Test of Nonword Repetition (Gathercole et al., 1994)

Measurement	**Test Component**
Phonological short-term memory	40 nonwords, each 10 of them containing 2, 3, 4, and 5 syllables

Rapid naming tests in Comprehensive Test of Phonological Processing

The standardized measure of rapid naming subtests in the Comprehensive Test of Phonological Processing (CTOPP) (Wagner, Torgesen, & Rashotte, 2000) was one of the most widely used assessments of phonological recoding especially for the beginners due to the advantage of picture naming. Compared with words, pictures provide a more direct access to the semantic codes in the process of lexical access.

In the present study, the picture naming tasks were composed of rapid letter naming and rapid object naming. The participants were asked to name the items of each subtest as quickly and accurately as they could. In order to measure the speed at which an individual named the target letters and objects, the rapid letter naming contained 72 items of six randomly arranged letters—*a, c, k, n, s, t,* while the rapid object naming contained 72 items of six randomly arranged objects—*boat, chair, fish, key, pencil, star*. Each subtest included the practice items to ensure participants' familiarity with the test items (i.e., letters and objects). The test was discontinued (1) when an examinee could not name the target items correctly even after error correction during the practice trial period or (2) when an examinee named more than four items incorrectly during the naming task.

As for the scoring, the time (in seconds) taken to name all the stimuli in each subtest was recalculated into the number of items named per second. See Table 7 for the summary of the phonological recoding test and Appendix G for the Chinese instruction of the rapid naming tests.

Table 7

Summary of the Rapid Naming Tests in CTOPP (Wagner et al., 2000)

Measurement	**Test Component**
Phonological recoding	72 items for each subtest (i.e., rapid letter naming and rapid object naming)

On the whole, the three assessments of phonological processing abilities were employed for the purpose of the study in order to answer the last research question: whether the students with higher phonological processing abilities differed from those with lower phonological processing abilities in terms of their vocabulary size. According to their performance on the three measurements of phonological processing abilities, participants were therefore divided into two groups. The performance of the participants above the group median for each measurement of phonological processing abilities was respectively classified as those with *high* phonological awareness (HPA), *high* phonological short-term memory (HPM), and *high* phonological recoding in lexical access (HPR). By contrast, the other part of the participants below the group median for each measurement of phonological processing abilities was respectively classified as those with *low* phonological awareness (LPA), *low* phonological short-term memory (LPM), and *low* phonological recoding in lexical access (LPR).

Data Analysis

All of the data was analyzed through 2-tailed Pearson correlation coefficient, multiple regression analysis, and t-test. First of all, correlations were run on the independent and dependent variables in order to answer the first three research questions. Moreover, hierarchical regression analyses were conducted to further examine the relative contribution of the three subcomponents of phonological processing abilities to vocabulary size (Research Question 4). Finally, independent sample t-test was carried out to see whether there were significant differences between students with higher phonological processing abilities and those with lower phonological processing abilities in terms of their performance on the vocabulary size test (Research Question 5).

CHAPTER FOUR

RESULTS

The aim of the current study is to explore the role of phonological processing abilities of the Taiwanese seventh-graders in attaining their English vocabulary size. The independent variables were the scores of phonological processing abilities assessments, including Phonological Awareness Skills Test (PAST), Children's Test of Nonword Repetition (CNRep), and rapid letter and object naming in the Comprehensive Test of Phonological Processing (CTOPP). The dependent variable was the score of 1000-Word Level Test—the measurement of vocabulary size. The assessment scores mentioned above were analyzed through the Statistical Package for Social Science (SPSS) software to answer the research questions of the present study.

This chapter contains four sections, including (1) the correlation between the three subcomponents of phonological processing abilities and vocabulary size, (2) the relative contribution of the three subcomponents of phonological processing abilities to vocabulary size, (3) the difference between the high phonological processing abilities group and the low phonological processing abilities group in terms of their respective vocabulary size, and (4) the results of questionnaire. The first section will answer Research Questions One to Three by probing into whether phonological awareness (PA), phonological short-term memory (PM), and phonological recoding in lexical access (PR) are related to vocabulary size, using 2-tailed Pearson correlation coefficient. The second section will employ hierarchical regression analysis to examine the relative contribution of PA, PM, and PR to vocabulary size. The third section will compare the performance of vocabulary size between the students with *high* PA, PM, and PR and those with *low* PA, PM, and PR through independent-samples T-test. In the last section, the results of the questionnaire will provide an insight into the participants' perception of how phonological processing abilities is related to their vocabulary learning.

Correlation between Phonological Processing Abilities and Vocabulary Size

Table 8 shows the summary of the means, standard deviations, and ranges of scores for each variable in this study.[29] The total score of phonological awareness tasks was calculated by adding the raw scores of syllable blending, syllable segmentation, syllable deletion, rhyme recognition, rhyme production, phoneme isolation of initial and final sounds, phoneme blending, phoneme segmentation, phoneme deletion of initial and final sounds, phoneme deletion of the first sound in a consonant blend, and phoneme substitution.

[29] Two of the participants were eliminated from the rapid object naming task because one participant could not name the practice items correctly even after error correction, and the other named more than four items inaccurately during the naming task.

Table 8

Descriptive Statistics of the Variables

	Valid N	Mean	S.D.	Range
Independent Variable				
Phonological Awareness				
PA-Sum	55	59.43	10.31	34-74
Phonological Memory				
Nonword Repetition	55	22.74	5.67	10-35
Phonological Recoding				
Rapid Letter Naming	55	2.5	0.47	1.67-3.6
Rapid Object Naming	53	1.42	0.25	0.93-1.96
Dependent Variable				
Vocabulary Size				
1000-Word Level Test	55	43.59	18.57	7.5-87.5

In terms of the dependent variable—vocabulary size, the results showed that the seventh graders in the current study had a vocabulary size of about 436 words on average (mean = 43.59).[30] In Taiwan, an elementary school graduate is required by MOE (Ministry of Education, 2003) to have a receptive vocabulary size of 300 words before entering junior high school.[31] Therefore, it is reasonable to see that the seventh graders' average vocabulary size was well beyond 300 words in the present

[30] Nation (1993) proposed that the raw score should be equal to the same proportion of 1000 function words known by the test taker. If test takers obtain 50 points on the 1000-word level test, they are supposed to have a vocabulary size around 500 words.

[31] The empirical study showed that the 6th graders had a receptive vocabulary size of about 220 words (Tsao, 2009).

study.

In general, the results in Table 9 can address Research Questions One to Three by indicating the correlations of the three subcomponents of phonological processing abilities and vocabulary size. The result showed a significant relationship between vocabulary size (at the 1000-word level) and all three independent variables—phonological awareness ($r = .75$, $p < .001$), phonological short-term memory ($r = .84$, $p < .001$), and phonological recoding in lexical access as accounted by rapid object naming ($r = .29$, $p < .01$). Such a positive finding suggests that phonological processing abilities play a vital role in helping Taiwanese seventh graders to expand their English vocabulary size. In terms of the measurements of phonological recoding in lexical access, although rapid letter naming was not significantly correlated with vocabulary size, rapid object naming was significantly correlated with vocabulary size ($r = .29$, $p < .01$). Such a result provides partial support for the role of phonological recoding in lexical access in vocabulary size at the 1000-word level.

Table 9

Correlations of Phonological Awareness Skills Test, Children's Test of Nonword Repetition, Rapid Letter Naming, Rapid Object Naming, and 1000-Word Level Test

	PA-Sum	**NonWord Repetition**	**Rapid Letter Naming**	**Rapid Object Naming**
1000-Word Level Test	.75***	.84***	.22	.29**

Note. *p < .05 **p < .01 ***p < .001

Relative Contribution of Phonological Processing Abilities to Vocabulary Size

As illustrated above, all of the subcomponents of phonological processing abilities were significantly related to vocabulary size. In order to examine which subcomponent of phonological processing abilities contributed to vocabulary size the most, hierarchical regressions were conducted. Results of the analysis are shown in Table 10 below. Variance explained at each step was presented cumulatively. The order of the independent variables was selected automatically by the SPSS software with stepwise regression based on their correlations with the dependent variable. As shown in Table 10, the regression model included phonological short-term (as indicated by nonword repetition) as Step 1, phonological awareness (as indicated by the sum score of phonological awareness subtests) as Step 2, and phonological recoding in lexical access (as indicated by rapid object naming) as Step 3.

Table 10

Hierarchical Regression Analysis Examining the Concurrent Predictors of Vocabulary Size

		Vocabulary Size		
	Variables entered	**R^2**	**ΔR^2**	**p**
Order				
1	**Phonological Memory**	.686	.686***	.000
2	**Phonological Awareness**	.736	.050**	.009
3	**Phonological Recoding**	.738	.002	.631

Note. *p < .05 **p < .01 ***p < .001

The results of the regression analysis revealed that phonological short-term memory, phonological awareness, and phonological recoding in lexical access could explain up to 73.8% of the variance in the vocabulary size test at the 1000-word level. Specifically, phonological short-term memory explained 68.6% of unique variance in vocabulary size (β = .613, t = 5.936, p < .001), and phonological awareness explained 5% unique variance in vocabulary size (β = .298, t = 2.7, p < .01), whereas phonological recoding in lexical access did not significantly explain any unique variance in vocabulary size. It should be noted that, although phonological recoding in lexical access (as indicated by rapid object naming) was significantly correlated with vocabulary size (see Table 6), phonological recoding in lexical access had limited predictive power in vocabulary size.

Difference between the High Phonological Processing Abilities Groups and the Low Phonological Processing Abilities Groups in Terms of Vocabulary Size

To answer the last research questions, the 55 participants were divided into two groups according to their scores of Phonological Awareness Skills Test, Children's Test of Nonword Repetition, rapid object naming, and rapid letter naming.

Based on the group median of Phonological Awareness Skills Test scores (median = 63), the 28 participants whose performance was above the group median were assigned to the High PA group. The other 27 participants whose performance was below the group median were assigned to the Low PA group. Table 11 presents results of the T-test between the High PA group and the Low PA group. The result showed a significant difference between the High PA group and the Low PA group in terms of vocabulary size at the 1000-word level ($t = 6.33$, $p < .001$). Such a finding suggests that the High PA group performed significantly better than the Low PA group on the vocabulary size test.

Table 11

T-test Results of Variables between High PA Group and Low PA Group

		High PA		Low PA				
	N	**Mean**	**SD**	**Mean**	**SD**	**t value**	**df**	**p**
1000-Word Level Test	55	55.44	14.89	31.29	13.32	6.33***	53	.000

Note. *p < .05 **p < .01 ***p < .001

According to the median score of Children's Test of Nonword Repetition (median = 22), the 32 participants whose performance was above the group median were assigned to the High PM group. The other 23 participants whose performance was below the group median were assigned to the Low PM group. Table 12 presents results of the T-test between the High PM group and the Low PM group. The result indicated that there were significant differences between the High PM group and the Low PM group in terms of vocabulary size at the 1000-word level ($t = 8.96$, $p < .001$), which suggests that the High PM group performed significantly better than the Low PM group on the vocabulary size test.

Table 12

T-test Results of Variables between High PM Group and Low PM Group

		High PM		Low PM				
	N	**Mean**	**SD**	**Mean**	**SD**	**t value**	**df**	**p**
1000-Word Level Test	55	55.70	13.54	26.73	8.80	8.96***	53	.000

Note. *p < .05 **p < .01 ***p < .001

Based on the median score of *rapid letter naming* (median = 2.51 items named per second), the 28 participants whose performance was above the group median were assigned to the High PR group. The other 27 participants whose performance was below the group median were assigned to the Low PR group. Table 13 presents results of the T-test between the High PR group and the Low PR group. The result showed no significant difference between the High PR group and the Low PR group in terms of vocabulary size at the 1000-word level (t = 1.3, p = .167). Such a finding suggests that the High PR group (as indicated by rapid letter naming) did not perform significantly better than the Low PR group on the vocabulary size test.

Table 13

T-test Results of Variables between High PR (Rapid Letter Naming) Group and Low PR Group

		High PR		Low PR				
	N	**Mean**	**SD**	**Mean**	**SD**	**t value**	**df**	**p**
1000-Word Level Test	55	46.78	17.97	40.27	18.92	1.30	53	.167

Note. *p < .05 **p < .01 ***p < .001

According to the median score of *rapid object naming* (median = 1.44 items named per second), the 27 participants whose performance was above the group median were assigned to the High PR group. The other 26 participants whose performance was below the group median were assigned to the Low PR group.[32] Table 14 presents results of the T-test between the High PR group and the Low PR group. The result indicated that there was no significant difference between the High PR group and the Low PR group in terms of vocabulary size at the 1000-word level ($t = 1.79$, $p = .078$), which suggests that the High PR group (as indicated by rapid object naming) did not perform significantly better than the Low PR group on the vocabulary size test.

[32] Rapid object naming included 53 participants in total (two students who violated the criteria of performing rapid naming tasks were eliminated) (See pp. 73-74).

Table 14

T-test Results of Variables between High PR (Rapid Object Naming) Group and Low PR Group

		High PR		Low PR				
	N	**Mean**	**SD**	**Mean**	**SD**	**t value**	**df**	**p**
1000-Word Level Test	53	48.88	16.23	40.09	19.31	1.79	51	.078

Note. *p < .05 **p < .01 ***p < .001

Figure 5 shows the performances of the High phonological processing abilities groups (High PA, PM, and PR as indicated respectively by rapid letter naming and rapid object naming) and the Low phonological processing abilities groups (Low PA, PM, and PR as indicated respectively by rapid letter naming and rapid object naming) on the vocabulary size test at the 1000-word level. The result of the current study revealed that both the High PA and PM groups significantly differed from the Low PA and PM groups in terms of their vocabulary size, while the High PR groups (as indicated by rapid letter and object naming) showed no significant difference from the Low PR groups (as accounted by rapid letter and object naming). On the whole, the finding of the current study showed that the Taiwanese thirteen-year-old students' phonological awareness and phonological short-term memory could differentiate them from others in terms of vocabulary size, whereas their abilities of phonological recoding in lexical access could not.

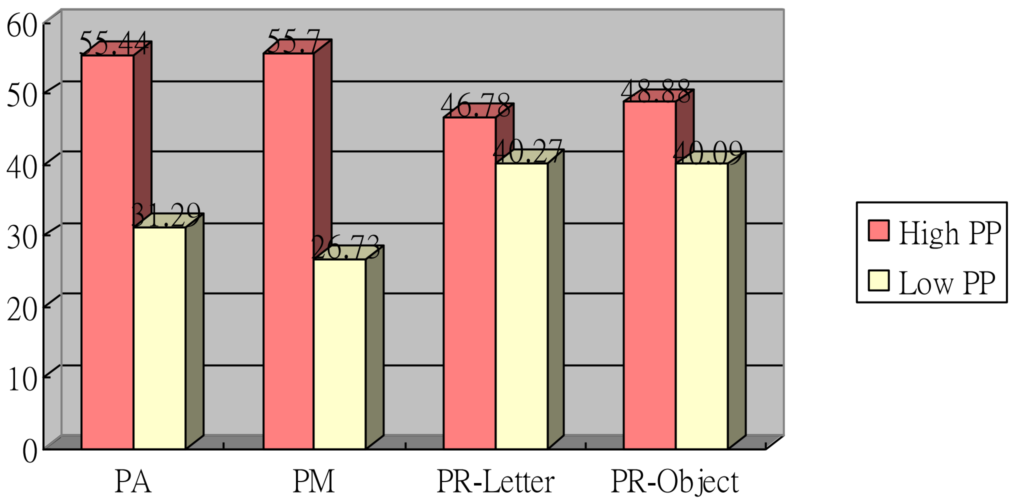


Figure 5. Performance of High phonological processing abilities group and Low phonological processing abilities group on 1000-word level test.

Results of Questionnaire

Phonological Awareness and Vocabulary Development

Based on the questionnaire data collected from the participants, 66.7% of the participants had learned Kenyon and Knott Phonetic Alphabet (K.K.) before, while the rest had not. Among the participants who had learned K.K. phonetic symbols before, 85.3% thought they performed *okay* in learning K.K. phonetic symbols, 8.8% thought they performed *well* in learning K.K. phonetic symbols, and 5.9% thought they had a *poor* performance in learning K.K. phonetic symbols. Such results indicated that the majority of the participants thought that their learning of

K.K. phonetic symbols were neither very good nor very bad, but fell in the medium.

With regard to phonics learning experience, 74.1% of the participants said they had learned phonics before, and the rest said they had not. Among the participants who had learned phonics before, 67.6% thought they performed *okay* in learning phonics, 16.2% thought they performed *well* in learning phonics, and 16.2% thought had a *poor* performance in learning phonics. Such results indicated that more than a half of the participants considered their knowledge of K.K. phonetic symbols as neither extremely good nor extremely bad, but stayed in the medium.

To see whether the knowledge of K.K. phonetic symbols and phonics could facilitate phonological awareness, the statistic method—one-way ANOVA—was employed to explore whether the participants who had learned K.K. phonetic symbols and/or phonics were significantly different from those who had not in terms of the scores on Phonological Awareness Skills Test (with the p value set at .05). Table 15 shows the results of one-way ANOVA analysis of how the knowledge of K.K. phonetic symbols and phonics influences the performance on Phonological Awareness Skills Test.

Table 15

One-way ANOVA Analysis of How the Knowledge of K.K. Phonetic Symbols and Phonics Influences the Performance on Phonological Awareness Skills Test

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Knowledge of K.K. phonetic symbols (YES/NO)	805.787 4757.861	1 52	805.787 91.497	8.807	.005**
Evaluation of their K.K. phonetic symbols knowledge on a three-point scale	1392.236 2549.793	2 31	696.118 82.251	8.463	.001***
Knowledge of phonics (YES/NO)	553.178 5188.304	1 52	553.178 99.775	5.544	.022*
Evaluation of their phonics knowledge on a three-point scale	1066.488 1944.593	2 34	533.244 57.194	9.323	.001***

Note. *p < .05 **p < .01 ***p < .001

The results indicated that the participants with the knowledge of K.K. phonetic symbols and/or phonics differed significantly from those without such knowledge in terms of their performance on Phonological Awareness Skills Test ($p < .05$). In addition, the participants' self-evaluation of knowing K.K. phonetic symbols and phonics corresponded to their performance on Phonological Awareness Skills Test. In other words, those who thought they had learned K.K. phonetic symbols and/or phonics *well* tended to have higher scores on phonological awareness subtests. On the contrary, those who thought they had learned K.K. phonetic symbols and/or phonics *poorly* tended to have lower scores on phonological awareness subtests.

Also, understanding of the sound-letter correspondence is a part of phonological awareness. When asked how often the teachers both on and off campus emphasized the sound-letter correspondence in vocabulary instruction, 38.9% of the participants said their teachers *often* emphasized the sound-letter correspondence when teaching vocabulary, 29.6% said *sometimes*, 27.8% said *always*, and 3.7% said *never*. Such results indicate that the majority of the participants thought that their teachers *often* put an emphasis on the sound-letter correspondence in vocabulary instruction. Nevertheless, there were still 12.7% of the participants said they *never* paid attention to the sound-letter correspondence when learning vocabulary and 38.2% said *sometimes*. Taken together, the findings suggest that although teachers often emphasized the sound-letter correspondence rules when teaching vocabulary, about half of the students still ignored the importance of sound-letter correspondence.

Phonological Short-term Memory and Vocabulary Development

The present study has provided empirical support to the notion that phonological short-term memory contributes significantly to vocabulary size. In this respect, the subvocal rehearsal (repetition) in helping the storage of unfamiliar phonological information can be a useful vocabulary learning strategy. Nevertheless, 32.7% of the participants said they repeated new words *sometimes*, and 3.7% of the participants *never* used this mnemonic device to facilitate the memorization of new words. Such a result suggests that about one third of the participants did not employ this mnemonic strategy often when learning new vocabulary.

Phonological Recoding in Lexical Access and Vocabulary Development

Previous studies (Gottardo et al., 1999; Balota et al., 2000) showed that learners' sensitivity toward sounds (i.e., phonological information) can facilitate the process of recognizing words, especially low-frequency or irregularly spelled words. According to the questionnaire data collected in the study, up to 40.7% of the participants said they recognized low-frequency words through sounds *sometimes*, 38.9% said *often*, and 14.8% said *always*. Likewise, 42.6% of the participants said they recognized words of irregular spelling through sounds *sometimes*, 40.7% said *often*, and 11.1% said *always*. Such results suggest that more or less, the participants would recognize low-frequency or irregularly spelled words with the aid of sounds.

In addition to word recognition, phonological recoding in lexical access has been proved to be closely associated with reading (Badian, 1996; Semrud-Clikeman et al., 2000; Wolf et al., 1994; Wolf et al., 2000; as cited in Misra et al., 2004). The last question in the questionnaire aims to investigate the participants' tendency of using the strategy of reading aloud to facilitate reading comprehension: Only 7.4% of the participants said they *never* read English articles out loud to facilitate their reading comprehension. Hence, the participants' response seemed to be consistent with the existing research on the close relationship between phonological recoding in lexical access and reading.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

This chapter includes four sections: (1) summary of the findings, (2) discussion of the research questions, (3) pedagogical implications, (4) limitations of the present study and suggestions for future research. The first section contains the major findings in relation to the five research questions of the current study. The second section interprets the results presented in Chapter Four by providing logical explanations supported by the existing research. The third section discusses the pedagogical implications of the findings. The last section points out the limitations of the present study and provides suggestions for future research.

Summary of the Findings

The purpose of the present study was to explore the role of phonological processing abilities in the Taiwanese seventh graders' vocabulary size at the 1000-word level. The findings of the study are summarized below in terms of each of the five research questions.

RQ1: Does Taiwanese junior high school students' phonological awareness correlate with their vocabulary size?

The results of the study showed that there was a strong relationship between phonological awareness and vocabulary size (at the 1000-word level). In general, the sum scores of the thirteen PA subtests and the 1000-word level test were closely related for the Taiwanese seventh graders.

RQ2: Does Taiwanese junior high school students' phonological short-term memory correlate with their vocabulary size?

The 2-tailed Pearson correlation coefficient also revealed that phonological short-term memory had the highest correlation with a vocabulary size of 1000 words among the three subcomponents of phonological processing abilities.

RQ3: Does Taiwanese junior high school students' phonological recoding in lexical access correlate with their vocabulary size?

In the current study, phonological recoding in lexical access was measured through two rapid naming tasks—rapid object naming and rapid letter naming. The results showed that the former task was significantly correlated with vocabulary size, while the latter was not. In this view, the positive link between phonological recoding in lexical access (as indicated by rapid object naming) and vocabulary size was still supported by the results of the current study.

On the whole, the three subcomponents of phonological processing abilities—phonological awareness, phonological short-term memory, and phonological recoding in lexical access—were all significantly correlated with vocabulary size at the 1000-word level.

RQ 4: What is the relative *contribution of the three subcomponents of phonological processing abilities (i.e., phonological awareness, phonological short-term memory, and phonological recoding in lexical access) to vocabulary size?*

According to the results of the regression analysis, phonological short-term memory explained the highest (68.6%, $p < .001$) unique variance in vocabulary size, and phonological awareness could also significantly predict vocabulary size (5% unique variance, $p < .01$). Contrary to the other two independent variables, phonological recoding in lexical access (indicated by either rapid object naming or rapid letter naming) did not have significant predictive power in vocabulary size. Such results suggest that phonological short-term memory played a primary role in vocabulary size, and phonological awareness also had a minor impact on vocabulary size. By contrast, phonological recoding in lexical access had limited explanatory power for the vocabulary size at the 1000 word level. It should be noted that Research Question Three and Research Question Four actually relate to two different aspects of the same issue: correlation and predictive power. The discrepancy lay in that phonological recoding in lexical access was significantly correlated with vocabulary size but did not have significant predictive power for vocabulary size.

RQ5: Do the students with higher phonological processing abilities differ from those with lower phonological processing abilities in terms of their vocabulary size?

The results of the T-test revealed that the *high* phonological awareness group differed significantly from the *low* phonological awareness group in terms of vocabulary size at the 1000-word level. Likewise, the significant difference in vocabulary size was demonstrated between the *high* phonological short-term memory group and the *low* phonological short-term memory group as well. Nonetheless, such a significant difference in vocabulary size was not displayed between the *high* phonological recoding in lexical access group and the *low* phonological recoding in lexical access group (as indicated by either rapid object naming or rapid letter naming). The overall results suggest that the participants with phonological awareness and phonological short-term memory could differentiate themselves from others in terms of vocabulary size, whereas their abilities of phonological recoding in lexical access did not differentiate them from others.

In conclusion, the present study revealed that all of the three subcomponents of phonological processing abilities were significantly correlated to vocabulary size at the 1000-word level. More importantly, two of the subcomponents—phonological awareness and phonological short-term memory—not only had significant predictive power for vocabulary size but also reliably differentiated the thirteen-year-old Taiwanese students in terms of their English vocabulary size.

Discussion of the Research Questions

Phonological Awareness and Vocabulary Size

The results of the study showed a significant correlation between phonological awareness and vocabulary size. Furthermore, phonological awareness had a significant predictive power for vocabulary size, and thus the participants who differed significantly in phonological awareness also differed markedly in their vocabulary size. In other words, the learners with higher PA tended to have considerably greater vocabulary size, and vice versa.

By definition, phonological awareness refers to the abilities to detect and manipulate the sound units of words based on an understanding of sound structure, which is independent of their meanings. Learners with better phonological awareness are more able to blend, segment, and manipulate sounds in words (Wagner, Torgesen, & Rashotte, 1994). The empirical evidence has shown that since learners with good phonological awareness are good at constructing phonological representations for new words, they are thus more likely to acquire foreign language vocabulary; in contrast, the learners with poor phonological awareness tend to have difficulty in constructing phonological representations for new words and thus will struggle when learning new words (Hu & Schuele, 2005). In this view, phonological awareness can support the learning of new words. In Hu's (2008) research, thirty-seven children at Grade 5 with lower phonological awareness acquired new color terms more slowly and less accurately than those with better phonological awareness. Moreover, the learners who have received phonological awareness training can learn phonologically unfamiliar words more easily than those who have not been trained (de Jong et al., 2000). According to the empirical studies mentioned above, phonological awareness could without a doubt contribute to vocabulary development (Bowey & Francis, 1991; Koda, 2006; Perfetti, Beck, Bell, & Hughes, 1987). In this respect, since vocabulary size involves the accumulated process of vocabulary learning, the distinct contribution of phonological awareness to vocabulary development is also very likely to manifest itself in vocabulary size, which is successfully proved by the present study.

Phonological Short-Term Memory and Vocabulary Size

In this study, phonological short-term memory not only had the highest correlation with vocabulary size, but also explained the highest unique variance in vocabulary size. As a result, the participants who differed significantly in phonological short-term memory also differed notably in their vocabulary size. That is, the learners with *higher* phonological short-term memory tended to have greater vocabulary size, while learners with *lower* phonological short-term memory tended to have smaller vocabulary size.

Furthermore, it should be noted that the present study included thirteen-year-old Taiwanese seventh graders as participants and indicated a strong association between their phonological short-term memory and vocabulary size. Such a positive finding corresponded to Gathercole et al.'s (1999) and Cheung's (1996) studies, in which the extending influence of phonological short-term memory remained until early adolescence. As Gathercole (2006: 513) stated, "Word learning mediated by temporary phonological storage [i.e., phonological short-term memory] is a primitive learning mechanism that is particularly important in the early stages of acquiring a language, but remains available to support word learning across the life span." Based on the empirical studies of vocabulary learning, the current study further revealed the powerful impact of phonological short-term memory upon vocabulary size.

Why phonological short-term memory played a more prominent role in vocabulary size than phonological awareness and phonological recoding in lexical access is explained below. In terms of the nature of the variable, phonological short-term memory has been found to contribute significantly to vocabulary development (Cheung, 1996; Papagno, Valentine, & Baddeley , 1991; Service & Craik, 1993; Service & Kohonen, 1995; Speciale, Ellis, & Bywater, 2004; Swanson, Saez, Gerber, & Leafstedt, 2004; as cited in Hu, 2007). “To be able to learn a new phonological form just heard, the child needs to encode the details of the phonological form and retain it in working memory for reproduction before it decays completely” (Hu, 2007: 12). Thus, the abilities to repeat a novel sequence of sounds is very important for vocabulary development because phonological short-term memory can facilitate vocabulary learning by providing a temporary store of unfamiliar phonological forms (Baddeley et al., 1998; Gathercole, 1995). The learners who are poor at repeating nonwords are proved to have difficulty acquiring new vocabulary (Baddeley et al., 1998; Gathercole & Baddeley, 1990, 1993a, 1993b; Gathercole et al., 1999). The ability of repeating nonwords depends on the efficacy of one’s phonological short-term memory. As a result, “it [phonological short-term memory] is associated with the development of vocabulary in children, and with the speed of acquisition of foreign language vocabulary in adults” (Baddeley, 2000: 418). Since vocabulary size involves the end result of vocabulary learning, the critical contribution of phonological short-term memory to vocabulary development is also very likely to be reflected in vocabulary size.

While phonological short-term memory played a more important role in vocabulary size, phonological awareness also had its influence upon vocabulary size. In fact, the link between phonological awareness and vocabulary size was probably mediated by phonological short-term memory because phonological short-term memory alone could explain the largest proportion of variance (68.6% of unique variance) in overall vocabulary size scores. Additionally, the close relationship between phonological awareness and phonological short-term memory was clearly shown by the study: Phonological awareness was much more related to phonological short-term memory ($r = .73$, $p < .001$) than to phonological recoding in lexical access as indicated by rapid object naming ($r = .39$, $p < .01$).[33] The underlying reasons behind the intercorrelations among the three independent variables and their correlations with the dependent variable—vocabulary size—will be provided in the following section.

Phonological Recoding in Lexical Access and Vocabulary Size

The results of the current study showed that phonological recoding in lexical access (as indicated by rapid object naming) was significantly correlated with the vocabulary size test, although not as highly correlated with vocabulary size as the

[33] Such a finding corresponded to that in Wagner et al. (1987, 1993): phonological awareness tended to be more highly correlated with phonological short-term memory than with rapid naming.

other two subcomponents of phonological processing abilities—phonological awareness and phonological short-term memory were. Nevertheless, such a significant correlation between phonological recoding in lexical access and vocabulary size was not reflected in its ability to predict vocabulary size. Moreover, there was an insignificant difference in vocabulary size between the *high* PR groups and the *low* PR groups (as indicated by rapid object naming and rapid letter naming). The reasons for such limited predictive power of phonological recoding in lexical access for vocabulary size could be explained in terms of the differences in the nature of the measurements.

With regard to the above differences, the speed/accuracy distinction may explain why phonological recoding in lexical access did not have significant predictive power for vocabulary size. According to Share (2008: 592), "Any speeded measure should correlate more strongly with timed or rate-dependent measures than simple untimed accuracy." In the current study, the assessments of phonological recoding in lexical access as measured by rapid naming tasks were scored based on *speed*, whereas the vocabulary size test was scored based on *accuracy*. As a result, phonological recoding in lexical access failed to predict vocabulary size, which was normally measured by untimed protocols.

The speed/accuracy distinction could also explain why phonological recoding in lexical access (especially indicated by rapid letter naming) had a relatively loose relationship with the other two subcomponents of phonological processing abilities. As explained by Share (2008: 592), “A speeded measure, such as RAN [rapid automatized naming like rapid letter naming and rapid object naming], compared with a nonspeeded measure, is likely to tap speed/accuracy dissociations.” Since phonological recoding in lexical access was measured through rapid naming tasks based on speed, it is reasonable to see its weaker association with the untimed measures—Phonological Awareness Skills Test (the assessment of phonological awareness) and Children’s Test of Nonword Repetition (the assessment of phonological short-term memory).

Difference between Rapid Letter Naming and Rapid Object Naming

It should be noted that although in the current study both rapid letter naming and rapid object naming were employed to measure phonological recoding in lexical access, rapid object naming was significantly correlated with vocabulary size, while rapid letter naming was not. Such results were consistent with Meyer et al.’s (1998) longitudinal study, where the speed of object naming was strongly correlated with written vocabulary development for the eighth graders, whereas letter naming was not. Furthermore, in the current study, rapid letter naming was not even strongly linked to the other two subcomponents of phonological processing abilities: phonological awareness and phonological short-term memory.

The problem of letter naming for the Taiwanese junior high school students was indicated in Lee's (2006) empirical study: The eighth graders obviously had the ceiling effect of letter naming knowledge. Similarly, in the present study, rapid letter naming was too easy for the Taiwanese seventh graders and thus resulted in an insignificant correlation between rapid letter naming and vocabulary size. In addition, rapid letter naming might be problematic because naming letters "involve(s) retrieving phonological codes, but not using them to make lexical access" (Wagner & Torgesen, 1987). Another problem of rapid letter naming lies in that letter naming tends to reflect the impact of alphabet mastery by means of early exposure to the alphabet (Meyer et al., 1998). Taking all the defects of rapid letter naming together, rapid object naming should be a more valid assessment of phonological recoding in lexical access for the 13-year old junior high school students in Taiwan.

Difficulty of PA Tasks

The positive link between phonological awareness and vocabulary size was firmly established in the current study, where phonological awareness was measured through the thirteen subtasks of Phonological Awareness Skills Test. Among the three levels of phonological awareness (i.e., syllable awareness, onset-rhyme awareness, and phonemic awareness), phonemic awareness was the most difficult of all (Chard et al., 2000; Ehri, et al., 2001). In term of the difficulty of phonemic awareness, phoneme segmentation is a precursor of phoneme deletion, and is thus easier than phoneme deletion (Adam, 1990; Dechant, 1993; as cited from Chang, 2000).

In Chang's (2000) study, phoneme deletion was not an easy task even for junior college freshmen (equal to the 10^{th} graders in senior high school). The results of the present study revealed that among the three phoneme deletion tasks, phoneme deletion of the first sound in a consonant blend was more difficult (mean = 3.67) than phoneme deletion of initial sounds (mean = 4.4) and phoneme deletion of final sounds (mean = 5). Based on Chang's (2000) study, the task difficulties could be explained by two factors—1) first language background and 2) working memory span. First of all, in regard to the participants' first language background, consonant clusters do not exist in Mandarin Chinese. Lacking the structure of consonant clusters in their mother tongue, the participants tend to treat consonant clusters as a single unit rather than a sequence of phonemes (Chang, 2000). Hence, phoneme deletion of the first sound in a consonant blend should a considerably more difficult PA task for Taiwanese learners of English. With respect to the second factor—working memory span—the demand of segmenting an initial sound is higher than that of segmenting a final sound (Chang, 2000). This is because “the salience of a final phoneme may catch more attention from the subjects and that helps their manipulation on it” (Chang, 2000: 126). Given these two factors—first language background and working memory span, it is not difficult to understand why phoneme deletion of the first sound in a consonant blend was a very challenging task for the seventh graders in the present study. On the whole, despite the diverse difficulties of the PA assessments at each level, the combination of multiple measures has been proved to have greater validity than any individual test has (Schatschneider et al., 1999 ; Yopp, 1988).

Phonological Awareness Training: Phonics and K.K. Phonetic Symbols

In analysis of the questionnaire data through one-way ANOVA, the study also revealed that in terms of their performance on Phonological Awareness Skills Test ($p < .05$), the participants who had learned K.K. phonetic symbols and/or phonics differed significantly from those who had not. In addition, the participants' self-evaluation of their own knowledge of K.K. phonetic symbols and phonics on the three-point scale was consistent with their actual performance on Phonological Awareness Skills Test. Specifically, those who believed they learned K.K. phonetic symbols and/or phonics *well* had higher scores in phonological awareness subtasks, while those who believed they did *not* learn K.K. phonetic symbols and/or phonics well had relatively lower scores in phonological awareness subtasks. Such findings suggest that in order to raise learners' phonological awareness, it is important for them to be trained in K.K. phonetic symbols or phonics.

Nevertheless, it should be noted that although phonics instruction seemed to play a role in raising phonological awareness, phonics instruction alone may not be sufficient for beginners in learning new words (Lai, 2003). "Students who have difficulty with phonological awareness can still learn phonics (knowledge of the relationship between letters and sounds), but they have difficulty *using* this knowledge" (Trehearne et al, 2003: 119). Hence, despite the fact that the early experiences of PA-relevant skills such as phonics and K.K. phonetic symbols seem to contribute to PA development, a more comprehensive PA training is required to facilitate learners' vocabulary learning and expand their vocabulary size.

Pedagogical Implications

The findings of this study could shed light on the importance of phonological processing abilities, especially phonological awareness and phonological short-term memory, for Taiwanese learners' vocabulary size at the first 1000 word level.

Since the findings showed that learners with higher phonological awareness and/or higher phonological short-term memory differed significantly from those with lower phonological awareness and/or higher phonological short-term memory, phonological awareness and phonological short-term memory could be very useful tools to help the learners with a considerably small vocabulary size. Furthermore, English teachers in Taiwan could use the measurements of phonological processing abilities (i.e., Phonological Awareness Skills Test and Children's Test of Nonword Repetition) as screening tests to identify the students with a relatively small vocabulary size. Most important of all, in order to help the students with special needs of expanding vocabulary size, teachers should provide them extensive and explicit training in phonological awareness and phonological short-term memory.

First, as to phonological awareness training, Chinese learners of English are more likely to use the "visual strategy" while learning English, ignoring the phoneme-grapheme correspondences of the alphabetic language (Akamatsu, 2003; Holm & Dodd, 1996; Huang & Hanley, 1994; Read et al., 1986). A great amount of evidence indicates that the phonological awareness developed by beginning L1 Chinese readers corresponds to whole-word phonology, with no awareness of individual phonemes (Walley, 1993; Studdert-Kennedy & Goodell, 1995; Hu, 2003). Moreover, as indicated by some research (Perfetti & Zhang, 1995; Perfetti & Liu, 2005), reading Chinese requires more of the syllable awareness, rather than the phonemic awareness. In summary, Chinese learners of English need special PA instruction, especially at the phoneme level.

As suggested by Magnusson and Naucler (1993), phonological awareness (PA) at the phonemic level is not a natural outcome of language acquisition. Hence, phonological awareness (i.e. phonemic awareness in particular) should be explicitly taught (Tunmer & Rohl, 1991). Nevertheless, the value of PA, especially at the phonemic level, seems to be underestimated by many teachers in Taiwan, for they usually assume that students have developed adequate phonemic analysis skills when they started to learn English (Hu, 2004). According to the results of the study, all of the three levels of PA are highly associated with vocabulary size, and thus all should be covered in PA training. Moreover, based on the results of the current study, the most difficult PA tasks for the participants were exclusively those at the phonemic level. Therefore, the training of phonemic awareness should be a top concern in PA instruction.

Different approaches to implementing phonological awareness instruction can be taken. For example, in the activity of *rhyme generation*, teachers may write the keyword on the blackboard, bringing students' attention to its rhyme unit, and ask them to generate more rhyming words in group competition. Game activities are an excellent way to help students make the connection between speech and print. Also, simple class routines can promote phonological awareness. Gillon (2004: 149) provided another example: “In dismissing a group of students from class, the teacher might say, ‘all the students whose name begins with an /s/ sound may leave the class first today.’” The key of success is to integrate phonological awareness instruction into learning context and make the activity meaningful in relation to vocabulary development (Gillon, 2004).

As for phonological short-term memory, its skills can be developed as follows. Since phonological short-term memory functions as a mnemonic device in vocabulary learning, empirical studies have shown that explicit rehearsal training has a facilitative effect on recall (Bower, 1991; as cited in Broadley and MacDonald, 1993). In Broadley and MacDonald’s (1993) study, the rehearsal training contained materials of seventy color pictures representing five semantic categories (i.e., animals, fruits, vegetables, furniture, and toys). The training procedure consisted of eight progressive steps, which included presenting pictures from the same semantic category first, followed by pictures from a different semantic category. Also, as an alternative approach shown in Hulme and Mackenzie’s (1992; as cited in Broadley and MacDonald, 1993: 57) research, “the rehearsal training consisted of one daily session of 10 minutes for 10 days. Materials for the rehearsal training were randomly constructed lists of similar and dissimilar words of increasing lengths. The subject repeated successively longer sequences as each individual word was spoken by the experimenter (E-hand, S-hand; E-fish, S-hand, fish; E-clock, S-hand, fish, clock). After training, the data did show improvement [of phonological short-term memory] for the rehearsal trained group." In the present study, since phonological short-term memory skills were shown to strongly contribute to vocabulary size, it is very important to improve these skills for the students with special needs of expanding vocabulary size.

In regard to the overall training of phonological processing abilities, three suggestions are provided by Lee (2007): First, early identification is suggested. The junior high school students' English vocabulary size varies greatly, so teachers may identify the students with vocabulary learning difficulties by using phonological awareness subtests and nonword repetition as screening tests at the beginning of junior high school education. Second, early intervention in order to improve phonological processing abilities is recommended. English teachers can incorporate explicit instruction of phonological processing abilities into regular curriculum. It is crucial to equip the students whose vocabulary size is relatively small with better phonological processing skills to help them become more cognitively prepared in acquiring new words. Third, reassessment is a must. In addition to the instruction of phonological processing abilities, English teachers should regularly reassess learners' phonological processing abilities in order to monitor their progress in phonological processing abilities as well as in vocabulary development.

Limitations of the Present Study and Suggestions for Future Research

Even though the present study has indicated the positive relationship between phonological processing abilities and vocabulary size, there are still some limitations in terms of the present methodological design. The results of the current study require more future research, which is suggested below.

First of all, the number of subjects in the current study (fifty-five students) is not sufficient to adequately account for the role of phonological processing abilities in the Taiwanese seventh graders' vocabulary size. The inadequate subject pool may lower the generalizability of the results. Therefore, the results of the present study should be dealt with cautiously when applying to other populations in Taiwan. In order to have a more complete picture of Taiwanese junior high school students' phonological processing abilities, it is suggested to recruit a larger number of diverse participants in future studies.

Second, in the present study, the third subcomponent of phonological processing abilities—phonological recoding in lexical access—was measured through rapid automatized naming (RAN): namely, rapid letter naming and rapid object naming. The reason for choosing the tasks of RAN as measurements owes to the advantages of picture naming for beginners: pictures have easier access to the semantic codes (Levelt, 1993). Although semantic judgment tasks seem to be a more reliable measurement of phonological recoding, semantic judgment tasks usually involve higher cognitive levels of semantic knowledge and thus may be too difficult for beginners. The results of the present study, however, showed that phonological recoding as measured by rapid naming tasks did not account for any unique variance in vocabulary size at the 1000-word level. In view of this, future research may take other measurements (e.g., semantic judgment) into consideration when assessing the abilities of phonological recoding in lexical access.

Third, the current study lacked longitudinal studies in exploration of the relationship between phonological processing abilities and vocabulary size. Therefore, longitudinal research may be carried out in order to observe the chronological change among the same group in terms of differences in age as well as language proficiency. Specifically, Hu (2003) argued that the phonological aspect of words appears to be more significant than the semantic aspect, especially for the cognitively mature EFL learners (i.e., adolescents).[34] Thus, longitudinal studies should be conducted to investigate the role of phonological processing abilities in vocabulary size for students

[34] Foreign language words seldom involve new concepts since the semantic concepts of lexical items are normally denoted similarly to those in their own native language. Hence, foreign language vocabulary learning "involves more of the learning of new sound patterns and the mapping of the sound patterns onto old concepts" (Hu, 2003:430-431).

at different age and cognitive levels.

Fourth, a vast body of research has demonstrated that a significant relationship exists between PA and vocabulary learning in both L1 and L2 studies; nonetheless, there is a debate over whether it is PA that supports vocabulary learning, or it is vocabulary learning that supports PA (de Jong, 2000; Hu, 2005, 2008; Metsala, 1999; Metsala & Walley, 1998; Roberts, 2005). It should be noted that although the high correlations between phonological processing abilities and vocabulary size has been pointed out in the present study, but the cause and effect relation has yet to be explored. Further investigation of the causal relationship between phonological processing abilities and vocabulary size should be conducted to provide a better understanding of the relationship between the two variables.

Lastly, the assessments of phonological processing abilities were scored based on accuracy and fluency (i.e., speed in rapid naming tasks), but the errors made by the participants were not analyzed in this study. In this regard, error analysis of learners' phonological processing abilities assessments may be another interesting topic for a future research direction.

REFERENCES

Adams M. J. (1990). Beginning to read: Thinking and learning about print. London: M.I.T. Press.

Adams, M. J. (1991). A talk with Marilyn Adams. Language Arts, 68(March), 206-212.

Alderson, J. C. (2005). Diagnosing foreign language proficiency: The interface between learning and assessment. London: Continuum.

Alloway, T. P., Gathercole, S. E., Adams, A-M., Willis, C. Eaglen, R., & Lamont, E. (2005). Working memory and phonological awareness as predictors of progress towards early learning goals at school entry. *British Journal of Developmental Psychology*, 23, 417-426.

Anderson, R. C. & Freebody, P. (1983). Reading comprehension and the assessment and acquisition of word knowledge. *Advances in Reading Language Research*, 2, 231-56.

Anderson, R.C., & Freebody, P. (1981). Vocabulary knowledge. In J.T. Guthrie (Ed.),Comprehension and teaching: Research reviews. Newark: International ReadingAssociation.

Anthony, J. L., J. M. Williams, et al. (2007). Phonological processing and emergent literacy in younger and older preschool children. *Annals of Dyslexia* 57(2): 113-137.

Archibald, L. M. D., & Gathercole, S. E. (2006). Nonword repetition: A comparison of tests. *Journal of Speech, Language, and Hearing Research, 49*(5), 970-983. Retrieved from www.csa.com

Arden-Close, C. (1999). Taiwanese university freshmen's difficulties with reading in English. *Reading in a foreign language*, 12 (2), 325-354.

Astika, G. (1993). Analytical assessment of foreign students writing, RELC Journal,24, 61-72.

Baddeley, A. D. (1986). Working memory. Oxford, England; Oxford Univeristy Press.

Baddeley, A.D. (2000). The episodic buffer: A new component of working memory? *Trends in Cognitive Science*, 4, 417-423

Baddeley, A. D, Gathercole, S., & Papagno, C. (1998). The phonological loop as a language learning device. *Psychological Review, 105*(1), 158-173. Retrieved from www.csa.com

Baddeley, A.D., & Hitch, G. (1974). Working memory. In G.H. Bower (Ed.), The psychology of learning and motivation: Advances in research and theory (Vol. 8, pp. 47–89). New York: Academic Press.

Ball, E. W., & Blachman, B. A. (1991). Does phoneme awareness training in kindergarten make a difference in early word recognition and developmental spelling? Reading Research Quarterly, 26(1), 49-66.

Balota, D. A., Law, M. B., & Zevin, J. D. (2000). The attentional control of lexical processing pathways: Reversing the word frequency effect. *Memory and Cognition*, *28*, 1081-1089.

Barnard, H. 1961. A test of P.U.C. students' vocabulary in Chotanagpur. Bulletin of the Central Institute of English 1:90-100. 1971-75. Advanced English vocabulary. Workbooks 1-3. Rowley, Massachusetts: Newbury House.

Bauer, L., & Nation, P. (1993). Word families. Internal journal of lexicography, 6 (3): 1-27.

Bishop, D. V. M. (1997). Understanding word meaning. In Bishop, D. V. M. (Ed.), Uncommon Understanding: Development and Disorders of Language Comprehension in Children (pp. 83-114). Cambridge, UK: Psychology Press.

Bourassa, D., Treiman, R., & Kessler, B. (2006). Use of morphology in spelling by children with dyslexia and typically developing children. Memory & Cognition, 34, 703-714.

Bowey, J. A., & Francis, J. (1991). Phonological analysis as a function of age and exposure to reading instruction. Applied Psycholinguistics, 12 , 91-121.

Bowey, J.A. (2005). Predicting individual differences in learning to read. In M.J. Snowling & C. Hulme (Eds.), The science of reading: A handbook (pp. 155–172). Hong Kong: Blackwell.

Brady, S.A. (1991). The role of working memory in reading disabilities. In S.A. Brady & D.P.Shankweiler (Eds.), *Phonological Processes in Literacy: A Tribute to Isabelle Liberman* (pp. 129-151). Hillsdale, NJ: Lawrence Erlbaum Associates.

Broadley I. and MacDonald J. (1993). Teaching short term memory skills to children with.Down syndrome. *Down Syndrome Research and Practice*, 1(2), 56-62.

Byrne, B., & Fielding-Barnsley, R. (1993). Evaluation of a program to teach phonemic awareness to young children: A 1-year follow-up. Journal of Educational Psychology, 85, 104-111.

Candlin, C. N. (1990). General editor's preface. In L. Taylor, Teaching and learning vocabulary (p.9). London: Prentice Hall.

Catts, H. W., Gillispie, M., Leonard, L. B., Kail, R. V., & Miller, C. A. (2002). The Role of Speed of Processing, Rapid Naming, and Phonological Awareness in Reading Achievement. *Journal of Learning Disabilities*, 35(6), 509.

Chang, F. Ch. (2000). A study of Taiwanese junior college freshman's phonological processing in English. Unpublished doctoral dissertation, National Taiwan Normal University, Taipei.

Chao, Y. C. (2003). Vocabulary abilities needed for a TOEFL-type test of writing. Selected Papers from the Twelfth International Symposium on English Teaching, 173-187.Taipei: Crane Publishing Company.

Chard, D. J., & Dickson, S. V. (1999). Phonological awareness: Instructional and assessment guidelines. *Intervention in School and Clinic*, 34, 261-270.

Chen, H. J. (1998). A preliminary investigation on Taiwanese EFL Learners' vocabulary size. Proceedings of the Fifteenth Conference on English Teaching and Learning in the Republic of China, 193-211. Taipei: Crane Publishing Co.

Chen, H. J. (1999). How many words do they know? Assessing Taiwanese college EFL students' receptive and productive vocabularies. Proceedings of the

Sixteenth Conference on English Teaching and Learning in the Republic of China, 83-97. Taipei: Crane Publishing Co.

Chen, Y. L. (2010). General Lexical Knowledge, Word Parsing, Chinese Reading, and Writing in Grade 4. Unpublished Master Degree Thesis. National Taichung University of Education, Taichung City.

Cheng, C. K. (2007). College English majors’ receptive and productive vocabulary knowledge. Selected Papers from the Sixteenth International Symposium on English Teaching, 347-356. Taipei: Crane Publishing Co.

Cheng, C. K. (2007). College English majors’ receptive and productive vocabulary knowledge. Selected Papers from the Sixteenth International Symposium on English Teaching, 347-356. Taipei: Crane Publishing Co.

Cheung, H., Chen, H., Lai, C. Y., Wong, O. C., & Hills, M. (2001). The development of phonological awareness: Effects of spoken language experience and orthography. *Cognition, 81*(3), 227-241. Retrieved from www.csa.com

Chiang, P. & Rvachew, S. (2007). English-French bilingual children's phonological awareness and vocabulary skills. Canadian Journal of Applied Linguistics, 10(3), 293-308.

Chiu, C. J. (2004). An Explorative Study on Basic Reading Skillls and the Related Factors of First -Year Junior High School Students in Two Languages. Unpublished Master Degree Thesis. National Kaohsiung Normal University, Kaohsiung City.

Chua, F. K. (1999). Phonological recoding in Chinese ideograph recognition. *Journal of Experhymental Psychology: Learning Memory, and Cognition, 25*, 876-891.

Chua, K. (2007). Measuring novice English Learners’ vocabulary strength of concrete/abstract words. Unpublished Master Degree Thesis. Tunghai University, Taichung City.

Coltheart, M., Curtis, B., Atkins, P., & Haller, M. (1993). Models of reading aloud: Dual-route and parallel-distributed-processing approaches. *Psychological Review, 100,* 589-608.

Cunningham, J. W., Cunningham, P. M., Hoffman, J. V., & Yopp, H. K. (1998). Phonemic awareness and the teaching of reading: A position statement from the

Board of Directors of the International Reading Association. Newark: International Reading Association.

de Jong, P. F., Seveke, M., & van Veen, M. (2000). Phonological sensitivity and the acquisition of new words in children. *Journal of Experhymental Child Psychology, 76*(4), 275-301.

Denton, C.A., Hasbrouck, J.E., Weaver, L.R., & Riccio, C.A. (2000). What do we know about phonological awareness in Spanish? *Reading Psychology*, 21 (4), 335-352.

Dillon, C. M. (2005). Phonological processing skills and the development of reading in deaf children who use cochlear implants. Unpublished doctoral dissertation. Indiana University, Bloomington.

Dockrell, J. E., Lindsay, G., Connelly, V., & Mackie, C. (2007). Constraints in the production of written text in children with specific language impairments. Exceptional Children, 73(2), 147-164.

Elbro, C., Bostrom, I. and Peterson, D. (1998), Predicting Dyslexia from kindergarten: The importance of distinctiveness of phonological representation of lexical items. *Reading Research Quarterly*, 33 (1), 36- 60.

Engen, L. & Høien, T. (2002). Phonological skills and reading comprehension. *Reading and Writing: An Interdisciplinary Journal*, 15, 613–631.

Fan, M. (2000). How big is the gap and how to narrow it? An investigation into the active and passive vocabulary of L2 learners. RELC Journal, 31(2), 105-119.

Fowler, A. E. (1991). How early phonological development might set the stage for phoneme awareness. *Haskins Laboratories Status Report on Speech Research, 105-106*(Jan-June), 53-64.

Fraser, C. A. (1999). Lexical processing strategy use and vocabulary learning through reading. Studies in Second Language Acquisition, 21(2), 225-241.

French, L.M. (2006). Phonological working memory and L2 acquisition: A developmental study of Québec francophone children learning English. New York: Edwin Mellen Press.

Gathercole, S. E. & Adams, A. M. (1993) Phonological working memory in very young children. *Developmental Psychology*, 29 (4). pp. 770-778.

Gathercole, S. E. (1995). Is nonword repetition a test of phonological memory or long-term knowledge? It all depends on the nonwords. *Memory & Cognition, 23*(1), 83-94. Retrieved from www.csa.com

Gathercole, S. E., & Baddeley, A. D. (1989). Evaluation of the role of phonological STM in the development of vocabulary in children: a longitudinal study. *Journal of Memory and Language*, 28, 200-213.

Gathercole, S. E., & Baddeley, A. D. (1993a). Phonological working memory: A critical building block for reading development and vocabulary acquisition? *European Journal of Psychology of Education, 8*(3), 259-272.

Gathercole, S. E., & Baddeley, A. D. (1993b). *Working Memory and Language*, Hove, New Jersey: Laurence Erlbaum.

Gathercole, S. E., Service, E., Hitch, G. J., Adams, A., & Martin, A. J. (1999). Phonological short-term memory and vocabulary development: Further evidence on the nature of the relationship. *Applied Cognitive Psychology*, *13*(1), 65-77.

Gathercole, S. E., Willis, C.S. , Baddeley, A.D., & Emslie, H. (1994). The children's test of nonword repetition: A test of phonological working memory. *Memory*, 2 (2), 103-127.

Gathercole, S.E., & Baddeley, A.D. (1990). The role of phonological memory in vocabulary acquisition: A study of young children learning new names of toys. *British Journal of Psychology*, 81, 439-454.

Gathercole, S. E. (2006). Nonword repetition and word learning: The nature of the relationship. Applied Psycholinguistics, 27, 513-543.

Geva, E., Yaghoub-Zadeh, Z., & Schuster, B. (2000). Understanding individual differences in word recognition skills of ESL children. *Annals of Dyslexia, 50*, 123–154.

Gholamain, M. and Geva, E. (1999), Orthographic and Cognitive Factors in the Concurrent Development of Basic Reading Skills in English and Persian. *Language Learning*, 49: 183–217.

Gillon, G. (2004). *Phonological awareness: From research to practice*. New York: The Guilford Press.

Goswami, U. (2000). Phonological and lexical processes. In M. L. Kamil, P. B. Mosenthal, P. D. Pearson, & R. Barr (Eds.), Handbook of reading research (Vol. 3, pp. 251-267). Mahwah, NJ: Lawrence Erlbaum Associates.

Gottardo, A., Chiappe, P., Siegel, L. S., & Stanovich, K. E. (1999). Patterns of word and nonwords processing in skilled and less-skilled readers. *Reading and Writing, 11*, 465-487.

Gupta, P. (2003). Examining the relationship between word learning, nonword repetition, and immediate serial recall in adults. *Quarterly Journal of Experhymental Psychology, 56A*, 1213–1236.

Hasan, A. S. (2000). Learner's perceptions of listening comprehension problems. Language culture and curriculum, Retrieved February 12, 2011, from http://www.multilingual-matters.net/lcc/013/0137/lcc0130137.pdf

Holm, A., & Dodd, B. (1996). The effect of first written language on the acquisition of english literacy. *Cognition, 59*(2), 119-147. Retrieved from www.csa.com

Hsu, P. T. (2008). The correlation between EFL learners' vocabulary size and reading performance in a communication-oriented language proficiency test. Unpublished Master Degree Thesis. National Taiwan Normal University, Taipei City.

Hu, C. (2003). Phonological memory, phonological awareness, and foreign language word learning. *Language Learning, 53*(3), 429-462.

Hu, C. (2004). Learning to spell with poor phonological awareness. *English Teaching and Learning, 28(3)*, 31-52.

Hu, C. (2008). Rate of acquiring and processing L2 color words in relation to L1 phonological awareness. *Modern Language Journal, 92*(1), 39-52.

Hu, C. F. (2007). Phonological processing as early indicator of L2 word learning difficulties. In proceedings of 2007 International Conference on English Learning and Teaching: Linking Theory with Practice, 8-25. Taipei, Taiwan: Crane.

Hu, C., & Schuele, C. M. (2005). Learning nonnative names: The effect of poor native phonological awareness. *Applied Psycholinguistics, 26*(3), 343-362.

Huang, C. C. (1999). The effects of vocabulary knowledge and prior knowledge on reading comprehension of EFL students in Taiwan. Unpublished doctoral dissertation, Ohio University, Athens, OH.

Huang, C. C. (2000). A threshold for vocabulary knowledge on reading comprehension. Selected Papers from the Seventeenth Conference on English Teaching and Learning in the Republic of China, 132-144. Taipei: Crane Publishing Co.

Huang, C. C. (2001). An investigation of ESP students' vocabulary knowledge and reading comprehension. Selected Papers from the Tenth International Symposium on English Teaching, 436-444. Taipei: Crane Publishing Co.

Huang, C.-c., Lin, S.-j., & Su, S.-c. (2004). The effects of phonological awareness training on technological university students' phonics and vocabulary knowledge. 國立臺北師範學院學報(人文藝術類), 17, 1, 59-90.

Huang, H.S., & Hanley, J. R. (1994). Phonological awareness and visual skills in learning to read Chinese and English. Cognition, 54, 73-98.

Huang, M. Y. (2007). Acquisition of English Derivational Patterns: Integrating Word Sorting with Phonological Awareness Training. Unpublished Master Degree Thesis. National Changhua University of Education, Changhua County.

Huang, S. L. (2002). An Experhymental Study of the Effects of Phonics Instruction on the Acquisition of Phonological Awareness of Junior High School Students in Taiwan. Unpublished Master Degree Thesis. National Taiwan Normal University, Taipei City.

Huang, W. T. (1999). Integrated vocabulary teaching in a senior high school: an empirical study. The Proceedings of the 8th International Symposium on English Teaching (pp. 385-393). Taipei: Crane Publishing Co.

Huang, Z. L. (1999) 黃自來。Phonics Instruction and Word Recognition. 英語詞彙形音義三合一教學法。台北：文鶴。

Hughes, A. (2003). Testing for language teachers (2nd ed.). Cambridge ; New York : Cambridge University Press.

Iversen, S., & Tunmer, W. E. (1993). Phonological processing skills and the reading recovery program. *Journal of Educational Psychology*, *85*, 112–126.

Jean, M., & Geva, E. (2009). The development of vocabulary in English as a second language children and its role in predicting word recognition abilities. *Applied Psycholinguistics*, 30, 153-185.

Johnston, R. S., Anderson, M., and Holligan C. (1996), Knowledge of the alphabet and explicit awareness of phoneme in pre-reader: The nature of the relationship. *Reading and Writing*, Interdisciplinary Journal, 8(3), 217-234.

Kim, T. (2008). Korean L2 Writers' Previous Wring Experience: L1 Literacy Development in School. Second Language Studies, 27(1), 103-154.

Koda, K. (2006). Orthographic knowledge in L2 lexical processing–A crosslinguistic perspective. Second Language Vocabulary Acquisition, Cambridge, 35-54.

Kouraogo, P. (1993). Language learning strategies in input poor environment, System, 21(2), 165-173.

Lai, W. T. (2003). A Study of Phonics as a Method to Enhance Spelling Skills of Remedial EFL Learners in Taiwan. Unpublished Master Degree Thesis. National Tsinghua University, Hsinchu City.

Lai, Y. H. (2005). Interaction among English PA, Spelling and Reading. English teaching & learning, 30(2), 23-44.

Laufer, B. (1997). The lexical plight in second language reading: words you don't know, words you think you know and words you can't guess. In J. Coady & T. Huckin (Eds.), Second language vocabulary acquisition: A rationale for pedagogy (pp.20-34). Cambridge, England: Cambridge University Press.

Laufer, B. (1998). The development of passive and active vocabulary in a second language: same or different? Applied Linguistics, 19(2), 255–271.

Laufer, B. (2005). Focus on form in second language vocabulary Learning. EUROSLA Yearbook5.

Laufer, B. and Nation, P. (1999). A vocabulary-size test of controlled productive abilities. Language Testing, 16(1), 33-51.

Lee, C. H. (2006). The Role of Phonological Awareness in Taiwanese Students' English Reading and Pronunciation Acquisition. Unpublished Master Degree Thesis. National Tsinghua University, Hsinchu City.

Lee, K. Y. (2007). The Effects of Phonological Awareness and Chinese Naming Speed on Chinese Reading Abilities. Unpublished Master Degree Thesis. National Taitung University, Taitung City.

Lee, U. F. (1987). 國中英語一詞多義的現象：問題與方法. The Proceedings of the 4th Conference on English Teaching and Learning in ROC (pp.169-181). Taipei: Crane Publishing Co.

Lennon, J. E., & Slesinski, C. (2001). Comprehensive Test of Phonological Processing (CTOPP): Cognitive-linguistic assessment of severe reading problems. Retrieved 03-May-2011, from http://alpha.fdu.edu/psychology/comprehensive_test_of_phonologic.htm

Lervåg, A. and C. Hulme (2009). "Rapid Automatized Naming (RAN) Taps a Mechanism That Places Constraints on the Development of Early Reading Fluency." *Psychological Science (Wiley-Blackwell)*, 20(8): 1040-1048.

Letelier, L. M., Zamarin, N., Andrade, M., Gabrielli, L., Caiozzi, G., Viviani, P., & Riquelme, A. (2007). Exploring language barriers to Evidence-based Health Care (EBHC) in post-graduate medical students: a randomised trial. *Education for health (Abingdon, England),*(3), 82.

Levelt, W. J. M. (Ed.). (1993). *Lexical access in speech production*. Cambridge: Blackwell.

Levelt, W. J. M., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences*, 22, 1-75.

Levelt, W.J.M., & Meyer, A.S. (2000). Word for word: Multiple lexical access in speech production. *European Journal of Cognitive Psychology,* 12 (4), 433-452.

Lewellen, M. J., Goldinger, S., Pisoni, D. B., & Greene, B. (1993). Lexical familiarity and processing efficiency: Individual differences in naming, lexical decision, and semantic categorization. *Journal of Experhymental Psychology: General*, 122, 316-330.

Lewis, M. (1993). *The lexical approach: The state of ELT and the way forward.* Hove, England: Language Teaching Publications.

Liao, K. W. (2010). A web-based reading cognitive skills assessment system for phonological awareness, rapid naming and orthographic processing. Unpublished

Master Degree Thesis. National Taichung University of Education, Taichung City.

Lin, C. H. (2006). A quantitative analysis of the vocabulary in the first volume of Taiwanese senior high school English textbooks. Unpublished Master Degree Thesis. National Sun Yat-sen University, Kaohsiung City.

Lin, W. T. (2003). A study of TVES college students' vocabulary size and the vocabulary of their English field-specified textbooks. Unpublished Master Degree Thesis. National Yunlin University of Science & Technology, Yunlin County.

Lin, Z. (2002). Discovering EFL learners' perception of prior knowledge and its roles in reading comprehension. Journal of Research in Reading, 25(2), 172-190.

Lonigan, C. J., J. L. Anthony, et al. (2009). The nature of preschool phonological processing abilities and their relations to vocabulary, general cognitive abilities, and print knowledge. *Journal of Educational Psychology* 101(2): 345-358.

Macaro, E. (2003) Teaching and Learning a Second Language: a guide to current research and its applications. London: Continuum.

MacDonald, G. W., & Cornwall, A. (1995). Relationship between phonological awareness and reading and spelling achievement eleven years later. *Journal of Learning Disabilities*, 28 (8), 523-527.

Magnusson, E., & Naucler, K. (1993). The development of linguistic awareness in language-disordered children. *First Language*, 13, 93-111.

Meara, P. (1996). The dimensions of lexical competence. In Brown, G., Malmkjaer, K., and Williams, J. (eds), *Performance and Competence in Second Language Acquisition.* Cambridge: Cambridge University Press. pp. 35-53.

Meara, P. and Jones, G. (1990). Eurocentres Vocabulary Size Test 10KA, Zurich: Eurocentres.Metsala, J. L. (1999).

Metsala, J. L (1999). Young children's phonological awareness and nonword repetition as a function of vocabulary development. *Journal of Educational Psychology*, *91*(1), 3-19. Retrieved from www.csa.com

Metsala, J.L. & Walley, A.C. (1998). Spoken vocabulary growth and the segmental restructuring of lexical representations: Precursors to phonemic awareness and early reading abilities. In J.L. Metsala & L.C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 89–120). Mahwah, New Jersey: Erlbaum.

Meyer, M. S., Wood, F. B., Hart, L. A., & Felton, R. H. (1998). Longitudinal course of rapid naming in disabled and nondisabled readers. *Annals of Dyslexia, 48*, 91.

Misra, M., Katzir, T., Wolf, M. & Poldrack, P. (2004). Neural systems underlying Rapid Automatized Naming (RAN) in skilled readers: Unraveling the puzzle of RAN-reading relationships. *Scientific Studies of Reading. Special Issue on Neuroanatomy of Reading*, 8, 241-256.

Montgomery, J. W. and J. Windsor (2007). Examining the Language Performances of Children With and Without Specific Language Impairment: Contributions of Phonological Short-Term Memory and Speed of Processing. *Journal of Speech, Language & Hearing Research* 50(3): 778-797.

Morais, J. (1991). Constraints in the development of phonemic awareness. In S. A. Brady, & D. P. Shankweiler (Eds.), Phonological awareness in literacy: A tribute to Isabelle Y. Liberman (pp. 5-28). Hillsdale, NJ: Lawrence Erlbaum Associates.

Morais, J. (2003). Levels of phonological representations in skilled reading and in learning to read. Reading and Writing: An Interdisciplinary Journal, 16, 123-151.

Nassajizavareh, H., & Geva, E. (1999). Cognitive and linguistic processes in adult L2 readers. *Applied Psycholinguistics, 20*, 241–267.

Nation, I. S. P. (1990). Teaching and learning vocabulary. New York: Newbury House.

Nation, I. S. P. (1993). Measuring readiness for simplified reading: A test of the first 1000 words of English. *Simplification: Theory and Application.* RELC Anthology Series, 31, 193-203.

Nation, I. S. P. (2001). *Learning vocabulary in another language*. Cambridge: Cambridge University Press.

Perfetti, C. A., & Zhang, S. (1995). Very early phonological activation in Chinese reading. *Journal of Experhymental Psychology: Learning, Memory, and Cognition*, 21, 24-33.

Perfetti, C. A., & Zhang, S. (1995). Very early phonological activation in Chinese reading. *Journal of Experhymental Psychology: Learning, Memory, and Cognition*, *21*, 24-33.

Perfetti, C. A., Beck, I., & Hughes, C. (1987). Phonemic knowledge and learning to read are reciprocal: A longitudinal study of first grade children. Merrill-Palmer Quarter, 33, 283-319.

Perfetti, C., Beck, I., Bell, L., & Hughes, C. (1987). Phonemic knowledge and learning to read are reciprocal: A longitudinal study of first grade children. Merrill-Palmer Quarterly, 33, 283-319.

Plaut, D. C. and Booth, J. R. (2000). Individual and developmental differences in semantic priming: Empirical and computational support for a single-mechanism account of lexical processing. *Psychological Review*, 107, 786-823.

Powell, D., Stainthorp, R., Stuart, M., Garwood, H., and Quinlan, P. (2007). An experhymental comparison between rival theories of rapid automatized naming performance and its relationship to reading. *Journal of Experhymental Child Psychology*, 98(1), 46-68.

Preston, J. L. and M. L. Edwards (2007). "Phonological Processing Skills of Adolescents With Residual Speech Sound Errors." *Language, Speech & Hearing Services in Schools* 38(4): 297-308.

Qian, D. (1999). Assessing the roles of depth and breadth of vocabulary knowledge in reading comprehension. Canadian modern language review, 56, 282-307.

Qian, D. and Schedl, M. (2004). Evaluation of an In-depth Vocabulary Knowledge Measure for Assessing Reading Performance. Language Testing, 21(1), 28-52.

Quinn, G. 1968. The English vocabulary of some Indonesian university entrants. Salatiga, Indonesia: IKIP Kristen Satya Watjana.

Read, C., Zhang, Y. F., Nie, H. Y., & Ding, B. Q. (1986). The abilities to manipulate speech sounds depends on knowing alphabetic writing. Cognition, 24, 31-44.

Read, J. (1988), Measuring the vocabulary knowledge of second language learners, RELC Journal, 19(), 12-25.

Read, J. (2000). Assessing vocabulary. Cambridge: Cambridge University Press.

Read, J. (2007). Second language vocabulary assessment: current practices and new directions. International Journal of English Studies. 7(2), 105-125.

Schatschneider, C., Francis, D. J., Foorman, B. R., Fletcher, C. M., & Mehta, P. (1999). The dimensionality of phonological awareness: An application of item response theory. *Journal of Educational Psychology*, 91(3), 439-449.

Schatschneider, C., Francis, D. J., Foorman, B. R., Fletcher, J. M., & Mehta, P. (1999). The dimensionality of phonological awareness: An application of item response theory. *Journal of Educational Psychology*, 91(3), 439-449.

Schmitt, N. (2010). *Researching vocabulary: A vocabulary research manual*. Basingstoke: Palgrave Macmillan.

Schmitt, N., Schmitt, D. & Clapham, C. (2001). Developing and exploring the behaviour of two new versions of the vocabulary level test. *Language Testing*, 18(1), 55-88.

Seidenberg, M. S. (1990). Lexical access: Another theoretical soupstone? In D. Balota, G. Flores d'Arcais, & K. Rayner (Eds.), *Comprehension processes in reading* (pp. 31-71). Hillsdale, NJ: L. Erlbaum

Service, E. (1992). Phonology, working memory, and foreign language learning. *The Quarterly Journal of Experhymental Psychology*. 45A, 21-50.

Service, E. and Kohonen, V. (1995). Is the relation between phonological memory and foreign- language learning accounted for by vocabulary acquisition? *Applied Psycholinguistics*, 16, 155-172.

Share D. L. (2008). On the Anglocentricities of Current Reading Research and Practice: The Perils of Overreliance on an "Outlier" Orthography. *Psychological Bulletin*, 134 (4), 584–615.

Shen, D., & Forster, K. I. (1999). Masked phonological priming in reading Chinese words depends on the task. Language and Cognitive Processes, 14, 429–459.

Snowling, M. J. (1995). Phonological processing and developmental dyslexia. Journal of Research in Reading, 18(2), 132-138.

Stahl, S. A. (1992). Saying the "p" word: Nine guidelines for exemplary phonics instruction. The Reading Teacher, 45(8), 618-625.

Studdert-Kennedy, M. & Goodell, E.W. (1995). Gestures, features and segments in early child speech. In: deGelder, B. & Morais, J. (eds.). *Speech and Reading: A Comparative Approach*. Hove, England: Erlbaum (UK), Taylor & Francis.

Studdert-Kennedy, M. (2002). Deficits in phoneme awareness do not arise from failures in rapid auditory processing. *Reading and Writing: An Interdisciplinary Journal*, *15*, 5-14.

Swank, L. K. (1994). Phonological coding abilities: Identification of impairments related to phonologically based reading problems. *Topics in Language Disorders*, *14*, 56-71.

Swank, L. K., & Catts, H. W. (1994). Phonological awareness and written word decoding. *Language, Speech, and Hearing.* Services in Schools, 25, 9–14.

Taft, M., & van Graan, F. (1998). Lack of Phonological Mediation in a semantic categorization task. *Journal of Memory and Language*, *38*, 203-224.

Tan, J. H. (2006). A study on Chinese phonological awareness, English phonological awareness and English word recognition in Taiwan fourth graders. Unpublished master's thesis, National Taipei Teachers College, Taipei, Taiwan.

Tan, L.H., & Perfetti, C.A. (1999). Phonological activation in visual identification of Chinese 2-character words. Journal of Experhymental Psychology: Learning, Memory, and Cognition, 25, 382-393.

Thorn, A., & Page, M. (2009). *Interactions between short-term and long-term memory in the verbal domain.* Hove, UK: Psychological Press.

Ting, H. J. (2005). The Study of Senior High School First Graders' Vocabulary Competence, Textbooks Vocabulary Distribution and Teachers' Viewpoints. Unpublished Master Degree Thesis. Southern Taiwan University, Tainan County.

Torgesen, J. K., R. K. Wagner, et al. (1999). Preventing reading failure in young children with phonological processing disabilities: Group and individual responses to instruction. *Journal of Educational Psychology*, 91(4): 579-593.

Trehearne, M., L. Healy, M. Cantalini-Williams, and J. Moore. (2003). Comprehensive literacy resource for kindergarten teachers. Vernon Hills, IL: ETA Cuisenaire.

Treiman, R., & Zukowski, A. (1991). Levels of phonological awareness. In S.A.Brady & D. P. Shankweiler (Eds.), Phonological Processing in Literacy A tribute to Isabelle Y. Liberman (pp. 67-83). Hillsdale, NJ: Lawrence Erlbaum Associates.

Tsao, M. C. (2009). A Study of Vocabulary Size of Taiwanese Sixth Graders. Unpublished Master Degree Thesis. Tunghai University, Taichung City.

Tunmer, W. E., & Rohl, M. (1991). Phonological awareness and reading acquisition. In D. Sawyer & B. J. Fox (Eds.), Phonological awareness in reading: The evolution of current perspectives (pp. 1-30). New York: Springer-Verlag.

Van Orden, G. C. (1991). Phonologic mediation is fundamental to reading. In D. Besner & G. W. Humphreys (Eds.), *Basic processes in reading* (pp. 77-103). Hillsdale, NJ: Erlbaum.

Vermeer, A. (2001). Breadth and depth of vocabulary in relation to acquisition and frequency of input. Applied Psycholinguistics 22, 2, 217-234.

Wagner, R. K., & Torgesen, J. K. (1987). The nature of phonological processing and its casual role in the acquisition of reading skills. Psychological Bulletin , 101, 192–212.

Wagner, R. K., J. K. Torgesen, et al. (1993). Development of young readers' phonological processing abilities. *Journal of Educational Psychology,* 85(1): 83-103.

Wagner, R. K., Torgesen, J. K., & Rashotte, C. A. (1994). The development of reading-related phonological processing abilities: New evidenceof bi-directional causality from a latent variable longitudinalstudy. *Developmental Psychology,* 30, 73-87.causality from a latent variable longitudinal study. *Developmental Psychology, 30,* 73-87.

Wagner, R. K., Torgesen, J. K., & Rashotte, C. A. (1999). *Comprehensive test of phonological processing.* Austin, TX: PRO-ED.

Wagner, R. K., Torgesen, J. K., Laughon, P., Simmons, K., & Rashotte, C. A. (1993). The development of young readers' phonological processing abilities. *Journal of Educational Psychology, 85,* 1-20.

Wagner, R. K., Torgesen, J. K., Rashotte, C. A., Hecht, S. A., Barker, T. A., Burgess, S. R., Donahue, J., & Garon, T. (1997). Changing relations between phonological processing abilities and word-level reading as children develop from beginning to skilled readers: A 5-year longitudinal study. *Developmental Psychology*, 33, 468-479.

Walley, A. C. (1993). The role of vocabulary development in children's spoken word recognition and segmentation abilities. *Developmental Review*, *13*, 286-350.

Waring, R. (2000). The "state rating task"-an alternative method of assessing receptive and productive vocabulary. Studies in Foreign Languages and Literature (Notre Dame Seishin University, Okayama), 24(1), 125-154.

Webb, S. (2008). Receptive and productive vocabulary sizes of l2 learners. Studies in Second Language Acquisition, 30(1), 79-95.

Wilkins, D.A. (1972). *Linguistics in Language Teaching*. London: Edward Arnold.

Wolf, M., Miller, L., & Donnelly, K. (2000). The retrieval, auto- maticity, vocabulary elaboration, orthography (RAVE-O): A comprehensive fluency-based reading intervention program. *Journal of Learning Disabilities*, 33, 375–386.

Yang, I. L. (2006). On the issue of vocabulary size in English teaching in Taiwan. *Journal of the National Institute for Compilation and Translation*, *34*(3), 35-44.

Yang, S. W. (2002). The Role of Phonological Capacity in Children"s Vocabulary Learning Process. Unpublished Master Degree Thesis. National Taiwan University, Taipei City.

Yang, Y. F. (2002). Developing vocabulary size and analysis test for identifying TVES college students' reading levels. The Proceedings of the 19th Conference on English Teaching and Learning in the ROC (pp.489-499). Taipei: Crane Publishing Co.

Yopp, H. K. (1988). The validity and reliabilities of phonemic awareness tests. Reading Research Quarterly, 23(2), 159-177.

Yopp, H. K., & Yopp, R. H. (2000). Supporting phonemic awareness development in the classroom. The Reading Teacher, 54(2), 130-143.

Zgonc, Y. (2000). *Sounds in Action*. Peterborough, NH: Crystal Springs Books.

Zhang, Y. Z. (2006). A Tracking Study of the Relationship between Naming Speed and Reading Abilities. Unpublished Master Degree Thesis. National Taitung University, Taitung City.

Zhou, X., Shu, H., Bi, Y., & Sh-i, D. (1999). Is there phonologically mediated access tolexical semantics in reading Chinese? In J. Wang, A. Inhoff, & H.-C. Chen (Eds.) Reading Chinese script: A cognitive analysis (pp. 135-172). NJ: Lawrence Erlbaum Associates.

Zimmerman, C. B. (1997). Historical trends in second language vocabulary instruction. In N. Schmitt & M. McCarthy. (Eds.), Second language vocabulary acquisition (pp.5-19). New York: Cambridge University Press.

APPENDIXES

Appendix A.　Consent Form.

教學實驗說明

研究者：柯雅珍

國立臺灣師範大學‧英語學系碩士班(英語教學組)

研究題目：英語音韻處理能力對臺灣國中生英文單字量的影響

I.　實驗目的:

由於教育部課程綱要規定國中畢業生英文單字量（應用字彙 1200 字）與高中英文指定科目考試單字量(7390 字)差異懸殊，因此，本實驗希望藉由探討國中生英文單字量與英語音韻處理能力的關係,期能提供現職國中英文教師提升國中生英文單字量的方法，以減少國中畢業生銜接高中英文龐大單字量的壓力。

II.　實驗流程：

本教學實驗研究由兩大部分組成。第一部分為測量學生的英文單字量，第二部分為測量學生的英語音韻處理能力。音韻處理能力又可分為三個能力：聲韻覺識能力、聲韻記憶能力、語音轉錄在字彙存取上的能力。因此，本實驗共包含四個測驗: 英語單字量測驗、聲韻覺識測驗、聲韻記憶測驗以及唸名速度測驗。除了單字量測驗是全班一起施測(約 25 分鐘)，聲韻覺識測驗、聲韻記憶測驗以及唸名速度測驗皆為一對一的個別口說測驗(總長約 25 分鐘)，用以得知個別學生英語音韻處理的能力，學生的發音將以錄音筆記錄下來作為評分依據。一對一的個別測驗將在學校的午休時間進行，因此，不會佔用學生在校的正課學習時間。本實驗結果僅供學術研究分析之用，對於學生個人的測驗結果絕對保密。

III.　參與益處：

學生參與本研究的益處為：實驗結束後，會個別發放學生個人測驗結果告知(1)**目前的英文單字量**以及(2)**對英語音韻的處理能力**。全程參與的學生在實驗結束後將獲得小獎勵，以感謝學生的合作與協助。

※注意事項：

家長及學生若對前述的內容有任何疑問，均可向研究者提出討論。

研究者的聯絡方式如下：

手機:　　　　　　　　　email:

教學實驗參與同意書

班級:____________ 座號:_________ 學生姓名:_______________

若您同意孩子參與本教學實驗，請在「同意」欄打勾；若不同意，請在「不同意」欄打勾，謝謝。

☐ 同意

☐ 不同意

家長簽名：________________

日期：____________________

獲得家長**同意**的學生請在下方簽名，謝謝。

學生簽名：_________________

研究者：柯雅珍

日期：__________

Appendix B. Language Background Questionnaire.

英語字彙學習與音韻處理能力問卷調查

(Questionnaire of Vocabulary Learning and Phonological Processing Abilities)

各位同學好：

這是一份學術性的研究問卷，目的在了解國中學生英語字彙與音韻處理能力的學習情況。本問卷所有資料僅供學術研究之用，個人基本資料絕對保密，請放心填答。非常感謝你們的熱心協助。

研究生：柯雅珍　敬上

聯絡方式：

國立台灣師範大學‧英語學系碩士班(英語教學組)

I. 背景資料 (Background Information)

姓名:　　　　　　　　　座號:　　　　　　　　　班級:

性別:　□男　□女　　　　年齡:

1. 你是否**通過**全民英檢測驗(GEPT)呢?　□是　　□否

   如果勾選「**是**」的話，是下列哪一等級呢?（可複選）

   □初級初試　□初級複試　□中級初試　□中級複試　□其他________

2. 你是否曾在**英語系國家居住過半年以上**?　□是　　□否

   如果勾選「**是**」的話，是下列哪個英語系國家?

   □美國　□加拿大　□英國　□澳洲　□紐西蘭　□其他________

   承上題，居住多久呢? ____________年____________月

   承上題，目的為何呢? ______________________________

II. 字彙學習和音韻處理能力 (Vocabulary Learning & Phonological Processing Abilities)

i. 聲韻覺識能力 (Phonological Awareness)

3. 你是否學過**KK 音標**？ □是 □否

如果勾選「**是**」的話，你覺得自己學得如何呢？ □差 □尚可 □好

4. 你是否學過**自然發音**（phonics）？ □是 □否

如果勾選「**是**」的話，你覺得自己學得如何呢？ □差 □尚可 □好

5. 學校或補習班**老師**在教你英文單字時，會特別強調**聲音(發音)和字母(拼字)的對應關係**嗎？

□不曾 □偶爾 □很常 □總是

6. 你**自己**背單字時，會特別注意**聲音(發音)和字母(拼字)的對應關係**嗎？

□不曾 □偶爾 □很常 □總是

ii. 聲韻記憶能力 (Phonological Short-Term Memory)

7. 學習新的英文單字時，你會**複誦（反覆唸出）**新單字來幫助自己**記住生字**嗎?

□不曾 □偶爾 □很常 □總是

iii. 語音轉錄在字彙存取上的能力 (Phonological Recoding in Lexical Access)

8. 遇到**不常使用**(使用頻率低)的英文字時，會**先試著唸出字的發音**，再藉著聲音辨認出字義(字的意思)嗎?

□不曾 □偶爾 □很常 □總是

9. 遇到**拼字不規則**(聲音和字母的**對應關係**不規則)的英文字時，會**先試著唸出字的發音**，再藉著聲音辨認出字義(字的意思)嗎?

□不曾 □偶爾 □很常 □總是

10. 讀英文文章時，你會**唸出聲音**來幫助自己**理解文章內容**嗎?

□不曾 □偶爾 □很常 □總是

Appendix C. Test-Taker Booklet.

學生題本

1. 待會的教學實驗共有三個測驗：聲韻覺識測驗、聲韻記憶測驗、唸名速度測驗，總長約 25 分鐘。
2. 你的回答會用錄音筆記錄下來作為評分依據，為了收音清楚，請盡量靠近錄音筆。
3. 測驗中若有任何疑問，請立刻反應。

注意：按下錄音筆後，請你先大聲說出自己的*班級*、*座號*、*姓名*。

(施測者開始錄音)

一、 聲韻覺識能力測驗

聲韻覺識能力測驗共有 13 個小測驗，每個小測驗都會有一題示範題、一題練習題（練習題階段，請試著說說看，若有任何疑問或錯誤，施測者會暫停並指正講解）、六題測驗題（測驗題進行中，錄音檔只會播放一次，施測者不會重覆播放或糾正講解，但如果你需要時間思考答案時，施測者會先暫停錄音檔，直到你說出答案，才會繼續播放錄音檔）。

測驗開始

(1) 音節組合測驗

請仔細聽錄音檔的幾個音節，依照指示將這些音節組合成一個完整的單字。

例如: 聽到 out-side，你可以說: outside。

此題為練習題: ro-bot。請回答。(五秒間隔) 你可以說: robot。

接下來有六組聲音要處理，請依指示作答。試題開始。

(2) 音節切割測驗

請仔細聽錄音檔的英文單字，依照指示將這個單字切割成不同的音節。

注意: 請先切割音節，再數數看這個單字共有幾個音節。例如: 聽到 rainbow，你可以說: 「rain-bow，兩個音節。」

此題為練習題: party。請回答。(五秒間隔) 你可以說:「par-ty，兩個音節。」

接下來有六個英文單字要處理，請依指示作答。試題開始。

(3) 音節刪除測驗

請仔細聽錄音檔的英文單字，依照指示拿掉這個單字的某個部分，並把剩下的部分說出來。例如: sunshine，拿掉 shine，答案是 sun。

此題為練習題: airline，拿掉 air。請回答。(五秒間隔)答案是 line。

接下來有六個英文單字要處理，請依指示作答。試題開始。

（4）同韻字辨識測驗

請仔細聽錄音檔兩個為一組的單字，如果韻腳一樣的，像是 h-at 和 s-at，這兩個字就是押韻的字。<u>請判斷聽到的每組單字是否押韻</u>。

例如: sit-bit 是否押韻，你可以說: 有押韻。

此題為練習題: chair-boy 是否押韻，請回答。(五秒間隔)你可以說:沒有押韻。

接下來有六組單字要處理，請依指示作答。試題開始。

(5) 同韻字製造測驗

請仔細聽錄音檔的單字，並<u>說出一個和這個單字押韻的字</u>。注意:說出來的單字可以是實際存在的字，也可以是自己創造的字，只要和錄音檔聽到的單字押韻就可以了。

例如: 聽到 sit，你可以說: bit, fit, mit, dit 或 jit。

此題為練習題: big，請說出一個和 big 押韻的字。(五秒間隔)你可以說: dig。

接下來有六個單字要處理，請依指示作答。試題開始。

(6) 音素首音分析測驗

請仔細聽錄音檔的英文單字，依照指示說出這個單字的<u>**第一個音**</u>是什麼。

例如: 聽到 bus，你可以說: /b/。

此題為練習題: top。請回答。(五秒間隔) 你可以說: /t/。

接下來有六個英文單字要處理，請依指示作答。試題開始。

(7) 音素尾音分析測驗

請仔細聽錄音檔的英文單字，依照指示說出這個單字的<u>**最後一個音**</u>是什麼。

例如: 聽到 bus，你可以說: /s/。

此題為練習題: pot。請回答。(五秒間隔) 你可以說: /t/。

接下來有六個英文單字要處理，請依指示作答。試題開始。

(8) 音素組合測驗

請仔細聽錄音檔的幾個單音，依照指示將這些單音組合成一個完整的單字。

例如: 聽到 s-i-t，你可以說: sit。

此題為練習題: s-t-o-p。請回答。(五秒間隔) 你可以說: stop。

接下來有六組聲音要處理，請依指示作答。試題開始。

(9) 音素切割測驗

請仔細聽錄音檔的英文單字，依照指示將這個單字切割成不同的單音。

注意: 請先切割單音，再數數看這個單字共有幾個單音。例如: 聽到 dime，你可以說: 「d-i-me，三個單音。」

此題為練習題: hat。請回答。(五秒間隔) 你可以說:「h-a-t，三個單音。」

接下來有六個英文單字要處理，請依指示作答。試題開始。

(10) 音素首音刪除測驗

請仔細聽錄音檔的英文單字，依照指示拿掉這個單字的**第一個音**之後，把剩下的部分說出來。例如: bed，拿掉/b/，答案是 ed。

此題為練習題: can，拿掉/k/。請回答。(五秒間隔)答案是 an。

接下來有六個英文單字要處理，請依指示作答。試題開始。

(11) 音素尾音刪除測驗

請仔細聽錄音檔的英文單字，依照指示拿掉這個單字的**最後一個音**之後，把剩下的部分說出來。例如: goat，拿掉/t/，答案是 go。

此題為練習題: meat，拿掉/t/。請回答。(五秒間隔)答案是 me。

接下來有六個英文單字要處理，請依指示作答。試題開始。

(12) 子音群音素首音刪除測驗

請仔細聽錄音檔的英文單字，依照指示拿掉這個單字**子音群的第一個音**之後，把剩下的部分說出來。例如: crow，拿掉/k/，答案是 row。

此題為練習題: still，拿掉/s/。請回答。(五秒間隔)答案是 till。

接下來有六個英文單字要處理，請依指示作答。試題開始。

(13) 音素替代測驗

請仔細聽錄音檔的英文單字，將這個單字的**第一個音**依照指示**替換為另外一個單音**，並把新的單字說出來。

例如: 將 pail 的第一個音，用/m/取代，答案是 mail。

此題為練習題: 將 top 的第一個音，用/h/取代。請回答。(五秒間隔)答案是 hop。

接下來有六個英文單字要處理，請依指示作答。試題開始。

二、　聲韻記憶測驗—假字複誦

請仔細聽錄音檔的英文單字，並複誦你所聽到的英文單字。注意：你可能會覺得這些單字聽起來很奇怪，這是因為這些英文單字並不是實際存在的英文字，而是一些聽起來很像英文字的「假字」。接下來，請試著把你聽到的單字說出來。(測驗題進行中，錄音檔只會播放一次，施測者不會重覆播放或糾正，但如果你需要時間思考答案時，施測者會先暫停錄音檔，直到你說出答案，才會繼續播放錄音檔)。

測驗開始。

三、　快速唸名測驗

快速字母唸名測驗

練習題：請試著用英文說說看下列圖片中的字母。

測驗題: 待會請從第一行第一個項目開始，依序逐項唸出看到的英文字母。你所唸的內容會被**計時**並錄音。注意：要唸得又快又正確，而且越快越好。

請翻閱試卷。計時開始。
測驗結束。

快速物件唸名測驗

練習題：請試著用英文說說看下列圖片中的物件。

測驗題: 待會請從第一行第一個圖片開始，依序逐項用英文說出看到的圖片。你所說的內容會被**計時**並錄音。注意：要說得又快又正確，而且越快越好。

請翻閱試卷。計時開始。
測驗結束。

Appendix D. 1000-Word Level Test.

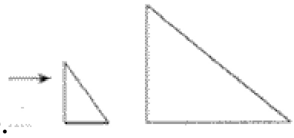
單字測驗：1000 字程度 (測驗 A)

指示：本測驗共有 40 題，第一題為示範題。

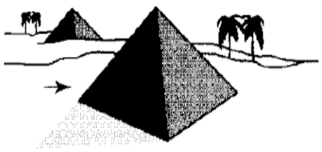
如果你認為敘述內容為**真**，請打圈(O)。如果你認為敘述內容為**假**，請打叉(X)。

如果你**看不懂**敘述內容為何，請寫上問號（？）。

__O__ 1. We cut time into minutes, hours, and days.



_____ 2. This one is little.



_____ 3. You can find these everywhere.

_____ 4. Some children call their mother Mama.

_____ 5. *Show me the way to do it* means 'show me how to do it.'

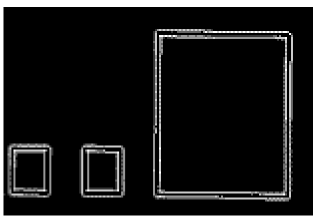
單字測驗：1000 字程度 (測驗 B)

指示：本測驗共有 40 題，第一題為示範題。

如果你認為敘述內容為**真**，請打圈(O)。如果你認為敘述內容為**假**，請打叉(X)。

如果你**看不懂**敘述內容為何，請寫上問號（？）。

__X__ 1. We can stop time.



_____ 2. Two of these are little.

_____ 3. You must look when you want to find the way.

_____ 4. When someone says, 'What are you called?', you should say your name.

_____ 5. There are many ways to get money.

Check I. S. P. Nation's Website to see the complete tests.
http://www.er.uqam.ca/nobel/r21270/levels/

Appendix E. Phonological Awareness Skills Test (PAST).

聲韻覺識能力測驗

(1) 音節組合測驗 (Syllable Blending)

請仔細聽錄音檔的幾個音節，依照指示將這些音節組合成一個完整的單字。

例如: 聽到 out-side，你可以說: outside。

此題為練習題: ro-bot。請回答。(五秒間隔) 你可以說: robot。

接下來有六組聲音要處理，請依指示作答。

試題開始。1. pen-cil

2. rain-bow
3. pop-corn
4. black-board
5. side-walk
6. pa-per

(2) 音節切割測驗 (Syllable Segmentation)

請仔細聽錄音檔的英文單字，依照指示將這個單字切割成不同的音節。

注意: 請先切割音節，再數數看這個單字共有幾個音節。例如: 聽到 rainbow，你可以說: 「rain-bow，兩個音節。」

此題為練習題: party。請回答。(五秒間隔) 你可以說:「par-ty，兩個音節。」

接下來有六個英文單字要處理，請依指示作答。

試題開始。1. sometime

2. basket
3. bedroom
4. fantastic
5. maybe
6. helicopter

(3) 音節刪除測驗 (Syllable Deletion)

請仔細聽錄音檔的英文單字，依照指示拿掉這個單字的某個部分，並把剩下的部分說出來。例如: sunshine，拿掉 shine，答案是 sun。

此題為練習題: airline，拿掉 air。請回答。(五秒間隔)答案是 line。

接下來有六個英文單字要處理，請依指示作答。

試題開始。1. downtown，拿掉 down。

2. inside，拿掉 in。
3. forget，拿掉 get。
4. basket，拿掉 ket。

5. after，拿掉 ter。

6. skateboard，拿掉 skate。

(4) 同韻字辨識測驗 (Rhyme Recognition)

請仔細聽錄音檔兩個為一組的單字，如果韻腳一樣的，像是 h-at 和 s-at，這兩個字就是押韻的字。請判斷聽到的每組單字是否押韻。

例如: sit-bit 是否押韻，你可以說: 有押韻。

此題為練習題: chair-boy 是否押韻，請回答。(五秒間隔)你可以說:沒有押韻。

接下來有六組單字要處理，請依指示作答。

試題開始。1. bed - fed 是否押韻。

2. top - hop 是否押韻。

3. run - soap 是否押韻。

4. hand - sand 是否押韻。

5. funny - bunny 是否押韻。

6. girl - giant 是否押韻。

(5) 同韻字製造測驗 (Rhyme Production)

請仔細聽錄音檔的單字，並說出一個和這個單字押韻的字。注意:說出來的單字可以是實際存在的字，也可以是自己創造的字，只要和錄音檔聽到的單字押韻就可以了。

例如: 聽到 sit，你可以說: bit, fit, mit, dit 或 jit。

此題為練習題: big，請說出一個和 big 押韻的字。(五秒間隔)你可以說: dig。

接下來有六個單字要處理，請依指示作答。

試題開始。1. pain

2. cake

3. hop

4. see

5. dark

6. candy

(6) 音素首音分析測驗 (Phoneme Isolation of Initial Sound)

請仔細聽錄音檔的英文單字，依照指示說出這個單字的**第一個音**是什麼。

例如: 聽到 bus，你可以說: /b/。

此題為練習題: top。請回答。(五秒間隔) 你可以說: /t/。

接下來有六個英文單字要處理，請依指示作答。

試題開始。1. big

2. land

3. farm

4. apple
5. desk
6. ship

(7) 音素尾音分析測驗 (Phoneme Isolation of Final Sound)

請仔細聽錄音檔的英文單字，依照指示說出這個單字的**最後一個音**是什麼。

例如: 聽到 bus，你可以說: /s/。

此題為練習題: pot。請回答。(五秒間隔) 你可以說: /t/。

接下來有六個英文單字要處理，請依指示作答。

試題開始。1. pick
2. ran
3. fill
4. bug
5. same
6. tooth

(8) 音素組合測驗 (Phoneme Blending)

請仔細聽錄音檔的幾個單音，依照指示將這些單音組合成一個完整的單字。

例如: 聽到 s-i-t，你可以說: sit。

此題為練習題: s-t-o-p。請回答。(五秒間隔) 你可以說: stop。

接下來有六組聲音要處理，請依指示作答。

試題開始。1. m-e
2. b-e-d
3. h-a-t
4. m-u-s-t
5. sh-o-p
6. p-l-a-n-t

(9) 音素切割測驗 (Phoneme Segmentation)

請仔細聽錄音檔的英文單字，依照指示將這個單字切割成不同的單音。

注意: 請先切割單音，再數數看這個單字共有幾個單音。例如: 聽到 dime，你可以說: 「d-i-me，三個單音。」

此題為練習題: hat。請回答。(五秒間隔) 你可以說:「h-a-t，三個單音。」

接下來有六個英文單字要處理，請依指示作答。

試題開始。1. in
2. at
3. name
4. ship

5. sock
6. chin

(10) 音素首音刪除測驗 (Phoneme Deletion of Initial Sound)

請仔細聽錄音檔的英文單字，依照指示拿掉這個單字的**第一個音**之後，把剩下的部分說出來。例如: bed，拿掉/b/，答案是 ed。

此題為練習題: can，拿掉/k/。請回答。(五秒間隔)答案是 an。

接下來有六個英文單字要處理，請依指示作答。

試題開始。1. sun，拿掉 /s/。
2. pig，拿掉 /p/。
3. mop，拿掉 /m/。
4. neck，拿掉 /n/。
5. bat，拿掉 /b/。
6. tape，拿掉 /t/。

(11) 音素尾音刪除測驗 (Phoneme Deletion of Final Sound)

請仔細聽錄音檔的英文單字，依照指示拿掉這個單字的**最後一個音**之後，把剩下的部分說出來。例如: goat，拿掉/t/，答案是 go。

此題為練習題: meat，拿掉/t/。請回答。(五秒間隔)答案是 me。

接下來有六個英文單字要處理，請依指示作答。

試題開始。1. rose，拿掉 /z/。
2. train，拿掉 /n/。
3. group，拿掉 /p/。
4. seat，拿掉 /t/。
5. bake，拿掉 /k/。
6. inch，拿掉 /ch/。

(12) 子音群音素首音刪除測驗 (Phoneme Deletion of First Sound in a Consonant Blend)

請仔細聽錄音檔的英文單字，依照指示拿掉這個單字**子音群的第一個音**之後，把剩下的部分說出來。例如: crow，拿掉/k/，答案是 row。

此題為練習題: still，拿掉/s/。請回答。(五秒間隔)答案是 till。

接下來有六個英文單字要處理，請依指示作答。

試題開始。1. clap，拿掉 /k/。
2. stop，拿掉 /s/。
3. trust，拿掉 /t/。
4. black，拿掉 /b/。
5. drip，拿掉 /d/。
6. smile，拿掉 /s/。

(13) 音素替代測驗 (Phoneme Substitution)

請仔細聽錄音檔的英文單字，將這個單字的**第一個音**依照指示**替換為另外一個單音**，並把新的單字說出來。

例如: 將 pail 的第一個音，用/m/取代，答案是 mail。

此題為練習題: 將 top 的第一個音,用/h/取代。請回答。(五秒間隔)答案是 hop。

接下來有六個英文單字要處理，請依指示作答。

試題開始。1. 將 man 的第一個音，用 /k/ 取代。

2. 將 pig 的第一個音，用 /d/ 取代。

3. 將 sack 的第一個音，用 /t/ 取代。

4. 將 well 的第一個音，用 /f/ 取代。

5. 將 bed 的第一個音，用 /r/ 取代。

6. 將 shop 的第一個音，用 /ch/ 取代。

Appendix F. Children's Test of Nonword Repetition (CNRep).

聲韻記憶測驗—假字複誦

請仔細聽錄音檔的英文單字，並複誦你所聽到的英文單字。注意：你可能會覺得這些單字聽起來很奇怪，這是因為這些英文單字並不是實際存在的英文字，而是一些聽起來很像英文字的「假字」。接下來，請試著把你聽到的單字說出來。

試題開始。

1. ballop	2. bannifer	3. blonterstaping	4. altupatory
5. bannow	6. barrazon	7. commeecitate	8. confrantually
9. diller	10. brasterer	11. contramponist	12. defermication
13. glistow	14. commerine	15. empliforvent	16. detratapillic
17. hampent	18. doppelate	19. fenneriser	20. pristoractional
21. pennel	22. frescovent	23. loddenapish	24. reutterpation
25. prindle	26. glistering	27. pennerriful	28. sepretennial
29. rubid	30. skiticult	31. perplisteronk	32. underbrantuand
33. sladding	34. thickery	35. stopograttic	36. versatrationist
37. tafflest	38. trumpetine	39. woogalamic	40. voltularity

Appendix G. Rapid Naming Tests in CTOPP.

快速字母唸名測驗

練習題：請試著唸唸看下列英文字母: a, c, k, n, s, t

*(**請測驗執行者注意**：如果受試者無法正確唸出上列字母，經糾正後無效，本快速字母唸名測驗即停止測試。)*

測驗題：待會請從第一行第一個項目開始，依序逐項唸出看到的英文字母。你所唸的內容會被計時並錄音。注意：要唸得又快又正確，而且越快越好。

*(**請測驗執行者注意**：如果受試者在測驗進行時，錯誤達五次以上(包含五次)，本快速字母唸名測驗即停止測試。)*

請翻閱試卷。計時開始。
測驗結束。

快速物件唸名測驗

練習題：請試著用英文說說看下列圖片中的物件: boat, chair, fish, key, pencil, star

*(**請測驗執行者注意**：如果受試者無法正確唸出上列物件，經糾正後無效，本快速物件唸名測驗即停止測試。)*

測驗題：待會請從第一行第一個圖片開始，依序逐項用英文說出看到的圖片。你所說的內容會被計時並錄音。注意：要說得又快又正確，而且越快越好。

*(**請測驗執行者注意**：如果受試者在測驗進行時，錯誤達五次以上(包含五次)，本快速物件唸名測驗即停止測試。)*

請翻閱試卷。計時開始。
測驗結束。