Teaching Chinese characters to Chinese heritage language learners: Effects of shared reading, frequency of character exposure and explicit teaching of radicals

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A thesis submitted in fulfilment of the requirements for

the degree of Doctor of Philosophy

University of Canterbury

Te Whare Wānanga o Waitaha

Christchurch, New Zealand

May 2022

Acknowledgements

One chapter in my life comes to an end. The past three years and eight months have been rewarding for me, allowing me to learn, explore, grow, and flourish. I appreciate every challenge and difficulty that I have gone through. This fantastic chapter of my life has not been possible without tremendous support from my supervisory team, family and friends, the research site, and participants.

My sincere thanks must go to my supervisors, Professor John Everatt, Associate Professor Alison Arrow and Dr Amanda Denston, for their professional guidance, constructive suggestions, inspiring talks and constant help. I also would like to offer my special thanks to Professor Hanwei Wang for his kind support and helpful advice. I am deeply grateful to the research site, participants, and friends who helped me with the data collection. My gratitude extends to my fellow doctoral students, without whom my student life would not have been as pleasant. I am particularly indebted to my family back in China for being my backbone through ups and downs and for their unwavering support and belief in me.

Words are not enough to express how grateful I am for all the support from these beautiful souls. 谢谢! Dziękuję! Gracias! مرسی! Salamat! Thank you! I am excited to see what the future holds for me.

Abstract

Learning to read Chinese has been the main focus of Chinese heritage language education. According to models of Chinese word recognition and orthographic learning (Perfetti & Tan, 1999; Perfetti & Harris, 2013; Share, 1995), orthography-phonology mapping is core to reading development, though semantic and phonetic radical awareness, along with the frequency of exposure to orthography-phonology and orthography-semantics correspondences, also play significant roles. However, the lack of explicit instruction on phonetic radicals and limited exposure to characters in Chinese textbooks have been proposed as limitations to conventional instruction methods used with Chinese heritage language learners (Ho, Yau et al., 2003; Koda, Lü, et al., 2008; Wu et al., 1999). Alternative methods that focus on teaching characters through reading activities have been found to be useful with Chinese native children (e.g. Anderson et al., 2002; Lee et al., 2011; Shum & Liu, 2014; Tse et al., 2006), and may show similar benefits for Chinese heritage language learners (e.g. Lü, 2017; Li, 2006). However, there is scant empirical research examining the effectiveness of such methods with Chinese heritage language learners.

` The current research examined Chinese character acquisition and reading comprehension among Chinese heritage language learners who were at their early stages of learning to read Mandarin Chinese. The research focused on a newly developed teaching method that involved classroom shared reading activities. Individual studies also considered the effects of frequency of exposure to Chinese characters during shared reading activities and explicit instruction on phonetic and semantic radicals. Study 1 involved frequent exposure to novel Chinese characters' orthography, phonology and semantics in the context. Study 2 also considered explicit instruction about semantic radicals, whereas Study 3 also investigated explicit instruction on phonetic radicals. The three studies implemented a quasi-experimental design in which a group of children experienced the new shared reading method and were

compared against a control group who experienced traditional teaching methods. All child participants were in Year 1 classes at a Chinese community school in New Zealand. Both groups were assessed on measures of Chinese character knowledge and Chinese reading comprehension both before and after ten teaching sessions.

Study 1 and Study 3 found that the shared reading method produced greater improvement of character knowledge (orthography-phonology correspondence and orthography-semantics correspondence) and Chinese sentence reading comprehension than the traditional textbook-based method. Study 3 also found that the shared reading method was related to better phonetic radical awareness. These findings suggest that Chinese heritage language learners can benefit from frequent exposure to the orthography, phonology, and semantics of novel characters provided in shared reading activities. However, given the null effect in Study 2, this positive effect may have been influenced by children's radical awareness. For example, poor phonetic radical awareness may suppress the facilitation of semantic radical awareness on character acquisition.

Findings from the current research imply that the combination of shared reading activities and instruction on new characters can provide an effective alternative to conventional textbook-based teaching methods used with Chinese heritage children. The current research demonstrated a way to design reading materials for Chinese heritage children that considered the format of words and the frequent appearance of new characters in the text. The research findings imply that teaching common phonetic radicals along with semantic radicals may facilitate character learning for children at the early stages of learning to read Chinese.

Presentations with Published Abstracts

Cheng, M., Everatt, J., Arrow, A., & Denston, A. (2021, July 30 - August 1). *Progressive Character Reading: Chinese Literacy Instruction for Chinese Heritage Language Learners* [Conference presentation]. 6th International Conference on Chinese as a Second Language Research (CASLAR), Washington, DC, United States.

Cheng, M., Everatt, J., Arrow, A., & Denston, A. (2021, March 5 - 6). *Progressive character reading approach for Chinese heritage language learners* [Conference presentation]. 5th Annual Conference of the Association for Reading and Writing in Asia (ARWA), Taipei, Taiwan.

Cheng, M., Everatt, J., Arrow, A., & Denston, A. (2020, September 24 - 25). *Learning Chinese characters through shared-reading* [Conference presentation]. 4th Annual Conference of the Association for Reading and Writing in Asia (ARWA), Hong Kong.

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Chapter 1 Introduction

Literacy affects the development of individuals and the transformation of societies (e.g., St Clair, 2010; Zua, 2021). In a rapidly changing society, literacy is a life skill and a primary learning tool for the development of individuals (Fordham, 1992) and a key to economic growth and social control (Baker, 2011).

Interpreting literacy from a social practices' view focuses on how literacy develops within a specific context. Two key concepts underpin the perspective of the social practices of literacy (Hamilton et al., 1994). One is literacy events where reading and writing play a role, and a written text is involved (for example, reading a newspaper and writing a message). The other is literacy practices, referring to common patterns people use in reading and writing in any situation, such as using exaggerated tones when parents read books to children. People use their literacy practices according to given literacy events. However, the social viewpoint does not address issues such as how people comprehend and produce text and how literacy is acquired (St Clair, 2010).

Literacy can also be understood from a cognitive perspective and interpreted as a set of cognitive processes (e.g., Ehri, 2005; Gough & Tunmer, 1986; Perfetti, 1985). Such cognitive processes are proposed as the way that the learner turns marks on a page into a meaningful language and involve cognitive abilities such as semantic and phonological decoding of the words (e.g., Perfetti, 1985; Share, 1995). Teaching approaches that use cognitive perspectives of literacy are supported by educational research (Belzer & Clair, 2005). For instance, National Reading Panel (US) (2000) reported the contribution of explicit instruction in phonological strategies to learning to read. However, one drawback of cognitive perspectives is that these perspectives focus on cognitive aspects that are often assumed to occur within every reader regardless of the social contexts of reading (St Clair, 2010).

The present research looks at literacy from a cognitive framework. As mentioned above, literacy from a cognitive perspective has instructional implications. The cognitive perspective suits the present research best because the focus of the present research is on the development of Chinese character knowledge and Chinese reading comprehension through teaching practices tailored for Chinese heritage children. Chinese heritage children are raised in Chinese-speaking families and can speak, or at least understand, the Chinese language (He, 2008). The current research sought to examine the effect of frequent exposure to Chinese characters, explicit instruction on phonetic and semantic radicals, and the radical-based grouping of novel characters on learning to read in Chinese for Chinese heritage language learners. This thesis also explores whether shared reading activities in the classroom promote character acquisition and Chinese reading comprehension for Chinese heritage children.

This thesis has five chapters. Chapter 2 provides a background to the present research, including the Chinese language and its written system and models of reading. Models of word recognition and orthographic learning for alphabetic languages and the Chinese language are discussed. It is followed by a review of factors related to Chinese orthographic learning and approaches to teaching Chinese characters. Research gaps are discussed, and research questions for the current research are introduced. Each of chapters 3, 4 and 5 presents a separate study in the current research. These three studies examined the effectiveness of a shared reading teaching method on developing Chinese character knowledge and Chinese reading comprehension for Chinese heritage children at the early stages of learning to read Chinese. These three studies implemented a quasi-experimental design which incorporated pre- and post-tests, ten teaching sessions, an experimental group and a control group, but each study had different focuses. Study 1 (Chapter 3) focused on frequent exposure to novel Chinese characters' orthography, phonology and semantics in the context. Study 2 (Chapter 4) focused on frequent exposure to novel Chinese characters' orthography, phonology and semantics in

the context and explicit instruction on semantic radicals. Study 3 (Chapter 5) focused on frequent exposure to novel Chinese characters' orthography, phonology and semantics in the context and explicit instruction on phonetic radicals. Methodology, results and discussion of each study were included in Chapters 3, 4 and 5. The final chapter discusses the overall findings in the current research. It concludes with a discussion of implications on Chinese literacy instruction for Chinese heritage children, the limitations to the current research, and suggestions for future research.

Chapter 2 Background

Introduction

This chapter will first focus on an introduction to the Chinese language, including its written system. Different types of Chinese language learners will be explained to develop an understanding of the present research context. Although the context is necessary, the models of reading, word recognition, and orthographic learning reviewed in this chapter primarily focus on the cognitive processes involved in reading acquisition. These models provide the theoretical framework for the present research. This chapter will also discuss factors related to Chinese orthographic learning and current approaches to teaching Chinese written words to identify the research gaps that led to the current research. When these research gaps are discussed, literacy instruction for Chinese heritage language learners in New Zealand will also be considered.

Chinese Language and its Writing System

The Chinese language is an umbrella term encompassing various dialects, including Wu, Xiang, Gan, Min, Hakka, Cantonese and Mandarin (referring to Northern Dialects). Meanwhile, Mandarin also refers to the lingua franca of the People's Republic of China, which differs from Northern Dialects. Mandarin generally used across China is based on the Beijing dialect and additional sounds from other Northern Dialects, and follows grammatical norms used in the exemplary works of literature. The present research focuses on Mandarin as the lingua franca of the People's Republic of China because it is the most commonly taught in Chinese language classrooms (He, 2008). This section will introduce the phonology (pronunciation), semantics (meaning) and orthography (form) of Chinese characters, explain simple and compound characters, and distinguish semantic and phonetic radicals.

Pronunciation, Meaning and Form of Characters

A Chinese character corresponds to a morpheme (i.e. the smallest unit of meaning in a language) and a syllable, rather than phonemes (i.e. the smallest unit of sound in a language) as in alphabetic scripts (Tong, McBride-Chang et al., 2017). The pronunciation of Chinese characters can be denoted via Pinyin. Pinyin (a Romanization system for Mandarin) was developed and published in mainland China in the 1950s to support character learning. Pinyin is often taught within the early years of primary school in mainland China and in Mandarin classes that introduce simplified characters in Hong Kong. Taiwan adopted the Pinyin system as the official Romanization system for Mandarin in 2009, but Zhuyin (or called Mandarin Phonetic Symbols) is still a primary transliteration system in Taiwan. Pinyin will be used to denote the pronunciation of characters in the current research.

A Pinyin word consists of three components: an initial (onset), a final (rime), and a tone. For example, the pronunciation of the character 中 is written as /zhōng/ in Pinyin. /zh/ is the initial, /ong/ is the final, and the diacritical mark on top of o is the tone. There are five lexical tones, including a flat, a rising, a falling-rising, a falling and a neutral tone. There is a large number of homophones in the Chinese language. Wang et al. (2006) reported that one syllable is the pronunciation of 15 homophonic characters on average. For example, the syllable /hé/ can represent more than seven characters with different meanings, such as 和 /hé/ (with) [1], 禾 /hé/ in the word 禾苗/hé miáo/ (seedlings), 合 /hé/ in the word 合适 /hé shì/ (suitable), 盒 /hé/ in the word 盒子 /hé zi/ (a box), 何 /hé/ (a family name), 河 /hé/ (the river), and 荷 /hé/ in the word 荷花 /hé huā/ (lotus). If the sound /hé/ is given, without a character, it is hard for the learner to identify the form and the meaning of /hé/ among homophones.

[1] Pronunciations of characters are enclosed in back slashes and meanings of characters are enclosed in parentheses.

A Chinese character differs from a Chinese written word. Although a single Chinese character represents a morpheme, in most cases a Chinese character cannot stand alone as a word and must be paired with another character or more to form a Chinese word (Wood & Connelly, 2009). Sun et al. (1996) reported that more than 65% of Chinese words are two-character compound words, and around 10% are three-character compound words. For example, the character 手 /shǒu/ can be a word which means the hand without pairing with another character, whereas the character 机 /jī/ is always paired with other characters to form a word. The character 手 /shǒu/ and the character 机 /jī/ also can create the compound word 手机 /shǒu jī/ (a mobile phone).

The form of a Chinese character comprises graphic units and, therefore, is quite different from a typically written word in most alphabetic writing systems that contain a linear assembly of letters and corresponding sounds. The smallest graphical unit within a character is a stroke, a basic writing pattern that can be finished without a pen leaving the paper (Chinese Language Committee, 1997). Each stroke does not represent any meaning or sound within a Chinese character. For example, the character 十 /shí/ (the number ten) is formed of basic strokes 一 and 丨. Stroke patterns called radicals may provide hints of the meaning or sound of a Chinese character. Semantic radicals imply the character's meaning, and phonetic radicals imply the character's pronunciation. For instance, 女 is a semantic radical in the character 妈 /mā/ (mother) and denotes female, and 包 /bāo/ is a phonetic radical in the character 抱 /bào/ (to hug) which shows the sound (see page 20 for more information).

Chinese characters have two forms, including traditional characters and simplified characters. Simplified characters are standardised characters used in mainland China, but Hong Kong and Taiwan still use the traditional script. Simplified characters have approximately 22.5% fewer strokes than traditional characters (Gao & Kao, 2002), although the types of characters

(including simple and compound characters) and the function of radicals have been maintained. The current research focuses on simplified characters, although because of the structural similarity between these two scripts, the literature review in the following sections also covers research on traditional characters.

Simple and Compound Characters

According to graphic units that formed a Chinese character, there are two types of characters, namely, simple and compound characters. Simple characters are only composed of strokes and do not have radicals, such as 土 /tǔ/ (soil) and 头 /tóu/ (the head). The mapping from the form (orthography) to the meaning (semantics) of a simple character and from the form (orthography) to the pronunciation (phonology) are not systematic. Orthographically similar characters usually do not share semantic properties, such as 人 /rén/ (a person), 大 /dà/ (big), and 天 /tiān/ (sky). Orthographically different characters may have similar meanings, such as 干 /gān/ (dry) and 水 /shuǐ/ (water). In contrast, orthographically similar characters are often pronounced in different ways, for example, 口 /kǒu/ (the mouth), 日 /rì/ (the sun) and 田 /tián/ (the filed).

Compound characters have two or more orthographic units (e.g. having two radicals or having one radical and some strokes). The majority of compound characters are phono-semantic compound characters formed of one semantic radical and one phonetic radical. For example, a phono-semantic compound character 草 /cǎo/ (grass) has a semantic radical 艹 that denotes plants and a phonetic radical 早 /zǎo/ that provides the clue of the pronunciation /cǎo/. It is reported that over 80% of the total number of Chinese characters are phono-semantic compound characters (Tong, McBride-Chang, et al., 2017; Tzeng, 2002), and approximately 72% of characters in Chinese language textbooks for primary school students are phono-

semantic compound characters (Shu et al., 2003). Apart from phono-semantic compound characters, compound characters also include compound pictograms and semantic compounds. Compound pictograms are derived from the shape of the object that these characters represent. For example, a compound pictogram 朵 /duǒ/ (a measure word for flowers) was created according to the shape of flowers. Semantic compounds are composed of semantic radicals. For instance, a semantic compound 看 /kàn/ (to look at) has a radical that means the hand on the top and a radical that means eyes on the bottom. Putting a hand above eyes indicates the meaning of the character 看 /kàn/ (to look at). Some regularity can be found in the orthography-semantics mapping and orthography-phonology mapping of a phono-semantic Chinese character, although not all mappings are regular.

Semantic and Phonetic Radicals

There are approximately 200 semantic radicals in Chinese (Hoosain, 1991). Most semantic radicals are non-pronounceable: for example, the semantic radical of the character 你 /nǐ/ (you) is 亻 which cannot be pronounced. Some semantic radicals are simple characters with independent pronunciations and meanings. For instance, the simple character 土 /tǔ/ (soil) is the semantic radical of the compound character 地 /dì/ (the ground). The extent to which the meaning of a phono-semantic compound character is suggested by a semantic radical is referred to as semantic validity (Fan, 1986; Jin, 1985) or orthography-to-semantics transparency (Guan et al., 2020). Fan et al. (1984) reported that more than 65% of characters are semantically related to their semantic radicals. For instance, the semantic radical 犭 indicates the category animal and is included in characters such as 狗 /gǒu/ (dog), 猪 /zhū/ (pig), 猫 /māo/ (cat), and 猴 /hóu/ (monkey). However, some characters that are not semantically related to the animal also have the semantic radical 犭, taking 猜 /cāi/ (to guess) as an example.

There are around 800 phonetic radicals in Chinese (Hoosain, 1991). Phonetic radicals usually are stand-alone characters with independent pronunciations and meanings. For example, the phonetic radical of the character 清 /qīng/ (clear) is 青 /qīng/, which is a character that means light green and blue. It is worth noting that the relationship between radicals and characters is not the same as between letters and words in an alphabetic system. Phonetic radicals do not have systematic mappings to phonemes. The association between cues from phonetic radicals and syllable pronunciations is not systematic in the same way that letter-phoneme correspondences are. The relation between the pronunciation of the phonetic radical and pronunciation of the whole character has been referred to as regularity (Chung & Leung, 2008; Lo et al., 2007; Shu et al., 2003). Based on the consistency of pronunciation of the phonetic radical and pronunciation of the whole character, phono-semantic compound characters could be separated into three types: regular, semi-regular, and irregular characters. Regular characters have the same pronunciation as their phonetic radicals. For example, the character 蚂 /mǎ/ and its phonetic radical 马 /mǎ/ share the same initials and finals. The pronunciation information of semi-regular characters only can be derived partially from their phonetic radicals. For instance, the character 菁 /jīng/ has a different initial with its phonetic radical 青 /qīng/, and the character 杯 /bēi/ does not have the same final with its phonetic radical 不 /bù/. For irregular characters, both initials and finals of the characters differ from those of their phonetic radicals, such as the character 徘 /pái/ and its phonetic radical 非 /fēi/. According to Shu et al. (2003), regular characters account for 39% of phono-semantic compound characters. In contrast, semi-regular and irregular characters account for 26% and 15% of these compound characters, respectively (the remaining 20% of the compound characters does not belong to these three groups because the pronunciation information from the phonetic radical has been lost).

Semantic and phonetic radicals have consistent positions (or legal positions) in Chinese characters. For phono-semantic compound characters with left-right structures, semantic radicals usually are on the left side and phonetic radicals on the right side. For instance, 慢 /màn/ (slow) has a semantic radical 忄 (related to emotions and feelings) on the left and a phonetic radical on the right 曼 /màn/. For phono-semantic compound characters with top-down structures, semantic radicals often are on the top, and phonetic radicals are at the bottom, such as 草 /cǎo/ (grass) in which the semantic radical 艹 (plants) is on the top of the phonetic radical 早 /zǎo/. Semantic and phonetic radicals need to be in their legal positions to form real characters.

Chinese Language Learners

In English-speaking countries, a heritage language is a language other than English that has a particularly personal and family relevance (Fishman, 2001). Chinese heritage language learners are raised in Chinese-speaking families and can speak, or at least understand, the Chinese language (He, 2008). Research on both children and adults who are Chinese heritage language learners (Xiao, 2006; Yu, 2015) has found that these learners can master Chinese speaking and listening skills but face more challenges with acquiring reading and writing skills. This finding indicates that Chinese heritage language learners are to some extent bilingual but not bi-literate. They do not have the same literacy proficiency in Chinese that they do with the dominant language within the country in which they are living (Dai & Zhang, 2008; Koda, Zhang, et al., 2008).

Learning a heritage language differs from learning a first or second language (Montrul, 2010). A first language is a person's first acquired language. First language acquisition happens in a naturalistic setting through abundant auditory input during the interaction with caregivers

(Montrul, 2010). A second language refers to a language learned after a person's first language has been learned (Gass & Selinker, 2008). Second language acquisition involves a varying amount of input in instructed or naturalistic settings (Montrul, 2010). Chinese heritage language learners and Chinese as the first language learners have Chinese listening and speaking skills. However, Chinese heritage language learners may experience less language input than Chinese as the first language learners because heritage language acquisition happens in a bilingual environment (Montrul, 2010). Chinese heritage language learners may have better Chinese listening and speaking skills than Chinese second language learners (Xiao, 2006). Still, both Chinese heritage language learners and Chinese second language learners may transfer language errors from a dominant language to the Chinese language (Montrul, 2010). In addition, Comanaru and Noels (2009) pointed out learning motivation influences successful Chinese language learning for both Chinese heritage language learners and Chinese second language learners.

Models of Reading

Some models of reading demonstrate the procedure of reading development and answer how, and in what order reading skills are acquired, such as Chall's model of reading (1983) and the Simple View of Reading model by Gough and Tunmer (1986). The current thesis is based on the Simple View of Reading model (Gough & Tunmer, 1986) given that this model has been widely discussed in research on learning to read in Chinese and successfully applied to reading in Chinese (e.g. Ho et al., 2017; Peng et al., 2020).

The Simple View of Reading model outlines that reading comprehension is the product of decoding and linguistic comprehension (Gough & Tunmer, 1986). According to Hoover and Gough (1990), decoding is defined as efficient word recognition that is the ability to derive a representation from a printed word that allows the reader to retrieve semantic information of

the word in the mental lexicon. Linguistic comprehension refers to the ability to process semantic information at the word level and interpret sentence-level information and discourse information. Both decoding and linguistic comprehension are necessary for reading comprehension, and neither of them individually is sufficient. Chen and Vellutino (1997) argued that the influence of decoding and linguistic comprehension on reading comprehension changes throughout reading development. They found with the increase of the age or grade level, the correlations between decoding and reading comprehension decreased, and the correlations between linguistic comprehension and reading comprehension increased (Chen & Vellutino, 1997). Children in the early years of learning to read tend to use all processing resources in decoding and very little in linguistic comprehension (Foorman et al., 1997). They further argued that linguistic comprehension plays a dominant role in reading comprehension once children become more competent at automatically recognising words (decoding).

The Simple View of Reading model has been used to examine Chinese reading comprehension. Based on Hoover and Gough (1990)'s definition of decoding, decoding in the Chinese language refers to efficient Chinese word recognition, which also involves recognising characters in the word. It is helpful to clarify the difference and relationship between character and word recognition in Chinese before discussing the application of the Simple View of Reading model to Chinese reading comprehension.

Character recognition and word recognition in Chinese are different. Character recognition relates to the knowledge and skills of written Chinese including (i) orthographic knowledge, which focuses on the understanding of the conventional regularities of structure in Chinese characters (Tong et al., 2009), (ii) radical awareness, or the sensitivity to semantic radicals and phonetic radicals in a compound character, and (iii) visual-orthographic skills involving the use of print knowledge directly to make judgments about visual presentation (McBride, 2016). Word recognition then is affected by the combination of knowledge of

written and spoken Chinese, including character recognition and morphological awareness. Morphological awareness refers to the ability to reflect on and manipulate the morphemic structure of oral words (Carlisle, 1995).

Character recognition and word recognition are closely correlated (Wang & McBride, 2016). Children who can recognise more characters are more likely to be able to read more words, and may also use oral vocabulary knowledge, morphological awareness and the context to learn new characters (Wang & McBride, 2016). For example, a child does not know the character 园/yuán/ (land for growing plants or a place for public recreation) but does know the character 花/huā/ (flowers) and the oral word 花园/huā yuán/ (a garden). The child also has morphological awareness which means that they have the knowledge of how the character 花/huā/ and the character 园/yuán/ are used orally as morphemes in an oral Chinese word. They know that the character 花/huā/ is usually followed by other characters to form an oral word which has a meaning related to flowers, such as 花店/huā diàn/ (a flower shop), 花瓣/huā bàn/ (petals), and 花名/huā míng/ (the name of flowers); the character 园/yuán/ is usually placed after other characters to form an oral word which has a meaning related to an area of land for growing plants or a place for public recreation, such as 公园/gōng yuán/ (a park), 茶园/chá yuán/ (a tea garden/plantation), and 动物园/dòng wù yuán/ (zoo). Consequently, when the child encounters the word 花园/huā yuán/ in a sentence or passage but does not know the character 园/yuán/, they might first think about several familiar oral words containing the character 花/huā/. Then, they might find out 花园/huā yuán/ is the most suitable word based on the context and deduce the pronunciation of the character 园/yuán/. This is how Chinese oral vocabulary knowledge, morphological awareness and the context may support character recognition.

The application of the Simple View of Reading model to Chinese reading comprehension was examined by Joshi et al. (2012). They partially assessed decoding by character recognition tasks and concluded that the Simple View of Reading model was applicable to Chinese. They found that character recognition and linguistic comprehension explained around 25% to 42% of the variance in Chinese reading comprehension. Similar to what research has found in other alphabetic languages, Joshi et al. (2012) reported linguistic comprehension contributed more to Chinese reading comprehension at fourth grade than second grade. However, Joshi et al. (2012) reported that the effect of character recognition on Chinese reading comprehension was constant. A significant effect was found even at fourth grade in Joshi et al. (2012), different from what research has shown in other alphabetic languages. Joshi and colleagues suggested that this is because character recognition requires orthography-phonology connection and the activation of semantic information of characters. Thus, the reader would rely on semantic cues by semantic radicals to recognise characters given many homophones in the Chinese language.

Due to a high correlation between character recognition and word recognition in Chinese (Wang & MacBride, 2016), some studies on the application of the Simple View of Reading model to Chinese reading comprehension examined both character and word recognition (e.g. Ho et al., 2012, Ho et al., 2017, Peng et al., 2020). Ho et al. (2017) defined decoding as character and word recognition, and concluded that the Simple View of Reading can be used to explain Chinese reading comprehension. Peng et al. (2020) conducted a meta-analysis to investigate the Simple View of Reading in Chinese reading acquisition. They reported that character and word recognition and language comprehension had significant direct contributions to Chinese reading comprehension. It was found that character and word recognition exerted a greater impact on Chinese reading comprehension before Grade 2, and this contribution decreased to a non-significant level after Grade 2. These results differed from

Joshi et al. (2012). Peng et al. (2020) reported that the effects of linguistic comprehension on Chinese reading comprehension stayed stable across grades, in line with results in Ho et al. (2017) and Joshi et al. (2012).

Similar to alphabetic languages, decoding and linguistic comprehension are two primary components of Chinese reading comprehension. Decoding has been found to make a greater contribution to reading comprehension within the early stages of learning to read than after in alphabetic languages and Chinese language (e.g. Chen & Vellutino, 1997; Foorman et al., 1997; Peng et al., 2020). The effect of decoding on reading comprehension in Chinese may extend until the senior years of primary school (Joshi et al., 2012). The current research focuses on Chinese heritage children who are at the beginning stage of learning to read in Chinese. For these children, character recognition is an initial task which supports word recognition, and decoding plays an important role in reading comprehension at this early stage. Therefore, the current research addresses character learning for Chinese heritage children. The following section reviews models of character recognition in Chinese. In addition, some models of word recognition in alphabetic languages have been used in analysing character recognition, including a dual-route cascaded model (Coltheart et al., 2001) and connectionist models (e.g. Seidenberg & McClelland, 1989). These models of word recognition are reviewed, and their applications to character recognition are discussed in the following section.

Models of Word Recognition

Some models of word recognition have been proposed which outline the process of decoding without addressing reading comprehension. This section first introduces a dual-route cascaded model (Coltheart et al., 2001) and discusses its use in simulating Chinese character recognition. Secondly, connectionist models for alphabet languages (e.g. Seidenberg & McClelland, 1989) and Chinese are briefly presented (e.g. Xing et al., 2004; Hsiao & Shillcock,

2005; Yang et al., 2009). After that, this section demonstrates Lexical Constituency Model (Perfetti & Tan, 1999; Perfetti et al., 2005) that lays a theoretical foundation for this thesis.

Dual-route Cascaded Model

A dual-route cascaded model of visual word recognition and reading aloud comprises a lexical route and a non-lexical route (Coltheart et al., 2001). Coltheart (2006) described the dual-route theory as using three forms of word information: spelling, pronunciation, and meaning in three systems: orthographic lexicon, phonological lexicon, and semantic system within the reader's mental lexicon. According to Coltheart (2006), reading via the lexical route involves accessing a real word in memory. In other words, the lexical route means that the reader can retrieve the pronunciation of a word after retrieving the spelling from the orthographic lexicon. The reader can also retrieve a word's pronunciation after retrieving the spelling from the orthographic lexicon and the meaning(s) from the semantic system. By contrast, reading via the non-lexical route involves successively mapping the forms and the sound through which the meaning stored in memory is accessed. The non-lexical route means that a word does not exist in the reader's lexicon, but the reader can read the word by applying the knowledge of grapheme-to-phoneme correspondence rules. The cascaded processing means that as soon as there is activation at the letter level of the visual word, the activation will be passed to the spoken word lexicon, and in turn, the phoneme system (Coltheart et al., 1993). For example, when the reader reads the written word "mail", the phoneme /m/ is activated once the letter "m" is recognised, and the activation of phonemes /m/, /ei/ and /l/ doesn't have to wait for activation of all letters in the word "mail".

This dual route cascaded model has been a guide for research on character recognition (e.g. Chen & Shu, 2001; Lee et al., 2004; Wang et al., 2015). However, Chinese characters can

only be named through the lexical route (Lee et al., 2004) because there is a lack of grapheme-phoneme correspondence rules in the Chinese language within which a character corresponds to a syllable instead of phonemes. A non-lexical route is possible in recognising phono-semantic compound characters, although this non-lexical route differs from the grapheme-phoneme correspondence in the route cascaded model. Reading characters through the lexical route has been supported by research looking at the regularity and consistency effects on character recognition (e.g. Fang et al., 1986; Hue, 1992; Lee et al., 2005). Regular characters refer to phono-semantic compound characters that have the same pronunciation as their phonetic radical. Regular characters were recognised faster than irregular characters (Fang et al., 1986; Hue, 1992; Lee et al., 2005). Consistency means whether the pronunciation of a phono-semantic compound character is the same as other characters that contain the same phonetic radical. The consistency value is the relative ratio of the number of characters that share the same phonetic radical and have the same pronunciation to the whole group of characters that share the same phonetic radical (e.g. Guan et al., 2020; Lee et al., 2005). Research has found that characters with high-consistency values were recognised faster than low-consistency characters (Lee et al., 2005; Tsai et al., 2004). Faster recognition of regular characters and characters with higher consistency values indicate that learners can retrieve the pronunciation of a phono-semantic compound character through its phonetic radical. That is to say, reading characters through the lexical route is possible. However, cascaded processing in the dual-route cascaded model does not work for the Chinese language. A character's phonology is not activated until the character's orthography is fully activated. Therefore, the phonology of characters is activated via a threshold style (Perfetti et al., 2005).

Connectionist Models

According to connectionist models, words' spellings (orthography), pronunciations (phonology) and meanings (semantics) are represented by groups of neuron-like units, and the representations are distributed. That is to say, the finite set of units in each group can be used to represent a large set of patterns, which is similar to the way that an alphabet represents many words (Seidenberg, 2005). Seidenberg and McClelland (1989) proposed a connectionist triangle model of word reading, which assumes a single and uniform procedure for irregular words, nonwords and regular words to retrieve a phonological representation from an orthographic representation. The lexical procedure is not included in this triangle model, and the pronunciation of a written word is retrieved from the sublexical input-output connection (Plaut et al., 1996; Seidenberg & McClelland, 1989). In other words, when the learner read a written word, the word is the input, and the phonology is the output. When the learner learns a written word, the connection weights are adjusted after each exposure to a word. This triangle model differs from the dual-route model (Coltheart, 1985), which assumes irregular words and nonwords require separate mechanisms for their pronunciation, and there is a lexical route. In addition, the triangle model does not operate by applying grapheme-phoneme correspondence rules but by the simultaneous interaction of units (Plaut et al., 1996). Connection weights in connectionist models are sensitive to word frequency and orthography-phonology consistency. Both the degree of word frequency and consistency will affect the development of a distributed phonological representation (Jared, 1997). Frequency and consistency have a trade-off relation, which means that the detrimental effects of orthography-phonology inconsistency can be overcome by high word frequency (Plaut et al., 1996).

Connectionist models have been successfully implemented to estimate Chinese character recognition for children (Guan et al., 2020) and skilled Chinese native speakers (e.g.

Dang et al., 2019; Lee et al., 2005). Researchers also have proposed connectionist models of Chinese character recognition, (e.g. Hsiao & Shillcock, 2005; Perfetti et al., 2005; Xing et al., 2004; Yang et al., 2009). Xing et al. (2004) developed a model that correctly simulated elementary school students' development of consistency, regularity, and their interaction with frequency. They reported that characters were recognised faster and more accurate when students' age and the frequency, regularity and consistency of characters increased. However, Xing et al. (2004)'s model has been questioned because of the limited training corpus (around 300 words) and the way to simulate regularity effects (Yang et al., 2009).

Yang et al. (2009) presented a model that simulated the effects of characters' frequency, regularity, and consistency. The model was the same as observation in a behavioural study of reading aloud. They found more considerable regularity and consistency effects for low-frequency characters than for high-frequency characters. However, in Yang et al. (2009)'s model, orthographic representation of characters is based on strokes, which are the smallest graphical unit and do not represent any meaning or sound instead of semantic and phonetic radicals. This model emphasises the visual similarity of characters rather than radicals that underlie orthography-phonology and orthography-semantics correspondences. Yang et al. (2009) suggested that radicals are unlikely to be a functional unit in orthography-phonology mappings for skilled Chinese readers, even though radicals are important in learning to read characters at the early stages. Considering the lack of radical representations in Yang et al. (2009)'s model and the importance of radical awareness in learning to read characters (see page 42), Yang et al. (2009)'s model does not suit the current thesis that focuses on character acquisition for Chinese beginning readers.

Tong and McBride-Chang (2018) proposed a Graded Psycholexical Space Mapping model and argued that children's character recognition is determined by statistical learning gained through reading experience. Statistical learning refers to the ability to find out the

hidden structure of input using statistical properties. This model assumes that the development of Chinese character recognition is a process that involves competitive mapping of radicals' orthographical, phonological, and semantic information in lexical and sublexical systems. One hypothesis of this model is that the regularity of semantic and phonetic radicals is a continuous variable and can be quantified. This hypothesis differs from other models where radicals are typically categorised as opaque versus transparent semantic radicals or as regular versus irregular phonetic radicals. Tong and McBride-Chang (2018) hypothesised a graded facilitative effect of semantic and phonetic radicals on character recognition. The graded facilitative effect of semantic radicals was found in Tong et al. (2021), but the hypothesis about the graded facilitative effect of phonetic radicals still requires more research.

Lexical Constituency Model

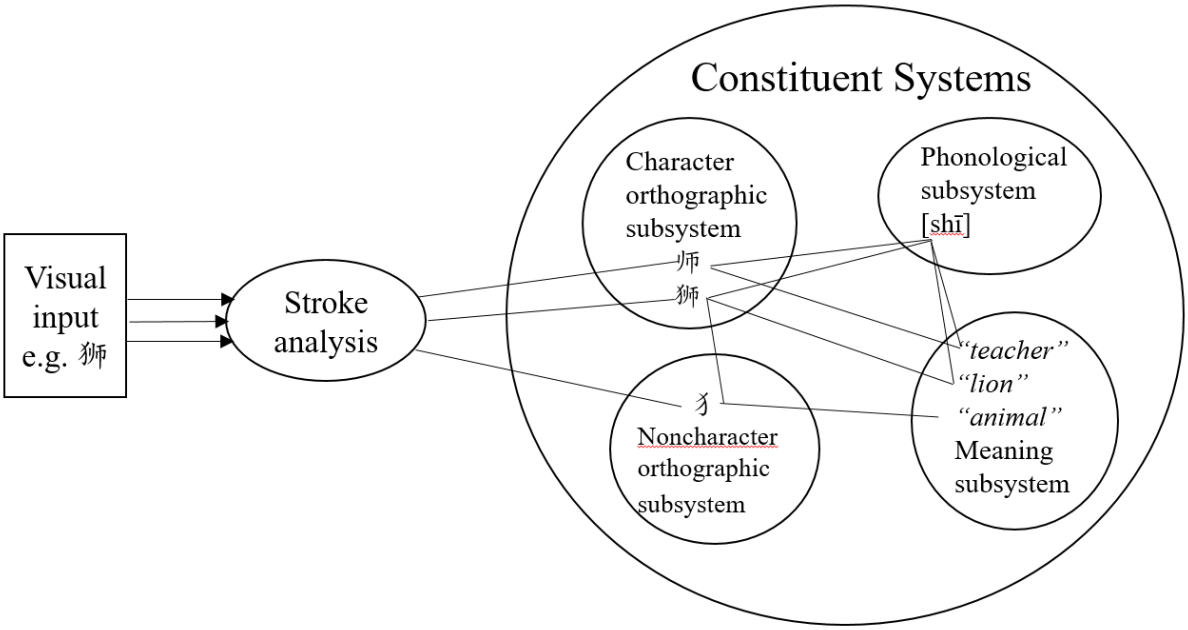
Perfetti and colleagues proposed a Lexical Constituency Model, also named the Interactive Constituency Model (Perfetti & Tan, 1998; Perfetti & Tan, 1999; Perfetti et al., 2005). This model assumes that a word is represented by its orthography, phonology and semantics (Perfetti & Tan, 1998). These word representations are also included in the dual-route cascaded model (Coltheart, 2006). However, the Lexical Constituency Model emphasises that the word representations (orthography, phonology and semantics) comprise constituent identities of the word. Written word recognition entails retrieving phonological and semantic representations from its orthographic representation (Perfetti et al., 2005). Failures at word recognition are due to the reader's incomplete word knowledge in their mental lexicon (Perfetti & Hart, 2002). The Lexical Constituency Model underlines the priority of phonology in word recognition and assumes that, given a printed word, pronunciation of the word is more determined than its meaning to correctly recognise the word (Perfetti et al., 2005). This

determinacy of phonology applies to all writing systems, including the Chinese language (Perfetti et al. 1992). Phonological information is more quickly retrieved than at least some semantic information because a Chinese character orthographic unit always matches one phonological unit and more than one meaning (Perfetti & Tan, 1999). For example, the character 日/rì/ has one pronunciation /rì/ but has more than one meaning, such as the sun and date. This claim has been supported by Perfetti and Tan (1998), who reported earlier phonological priming effects than semantic priming effects. Guan et al. (2020) also suggested that the primary mechanism of character recognition is the orthography-phonology mapping, and the secondary is characters' semantic transparency. They found that characters' semantic transparency started to show the influence when the phonetic radical did not consistently map to the character's pronunciation. However, some researchers argued that when reading characters, semantic information in the lexicon is activated at least as early and as strongly as phonological information (Zhou, X., & Marslen-Wilson, W., 2000; Zhou et al., 1999). The mapping from orthography to semantics is more efficient than the mapping from orthography to phonology to semantics (Zhou et al., 1999).

The Lexical Constituency Model has been implemented to simulate Chinese character recognition (Perfetti & Tan, 1998; Perfetti & Tan, 1999; Perfetti et al., 2005). According to Perfetti and Tan (1999), there are four separate subsystems in memory of the Chinese reader, and each subsystem consists of a set of representation units of Chinese characters. The four separate subsystems are the character orthographic subsystem containing characters and radicals that are stand-alone characters, the noncharacter orthographic subsystem that contains radicals that are not characters by themselves, the phonological subsystem and the meaning system (shown in Figure 1).

Figure 1

The Lexical Constituency Model (Perfetti & Tan, 1999)



Perfetti and Tan (1999) described that the basic features of Chinese characters are analysed once visual input is received. The detected features prompt activation of the orthographic units in the character orthographic subsystem and in the noncharacter orthographic subsystem in memory. After the orthographic units are activated, it simultaneously sends activation to the corresponding units in the phonological subsystem, meaning subsystem, and noncharacter orthographic subsystem. The activations happen in a threshold style, and the related units will be activated once reaching the threshold. This means, for instance, a Chinese character's phonology is not activated before the character's orthography is fully activated. The threshold of orthographic units in the character orthographic subsystem and the non-character orthographic subsystem relies on the frequency of encounters with printed characters and noncharacter radicals daily. The threshold of phonological units is determined by the frequency of previous successful activations of the phonology associated with the character. The threshold style differs from the cascaded manner assumed in dual-route

models (e.g. Coltheart 1985; Coltheart 2006), which assumes that the word-level phonology in an alphabetic system can be activated before a complete spelling of the word.

In the Lexical Constituency Model, Chinese characters are decomposed into radicals. A semantic radical or a phonetic radical input activates all Chinese characters that contain the radical in the same position and the radical itself if it is a stand-alone character. Perfetti and Tan (1998) examined orthographic, phonological and semantic primes' time-course of effects. They found the graphically similar prime (which shares a radical with a target character) had facilitation and then inhibition to the target character. The inhibition coincided with the onset of phonological facilitation. When the prime character shares the same radical and the same pronunciation as the target character, the prime character can facilitate the activation of the phonologic representation of the target character (Perfetti et al., 2005). For example, the recall of the pronunciation of the character 情/qíng/ would support the activation of the pronunciation of the character 晴/qíng/. However, when the prime character shares the same radical but does not have the same pronunciation as the target character, the prime character sends activation to incompatible phonology, which would inhibit the activation of the phonology of the target character (Perfetti et al., 2005). For instance, recalling the pronunciation of the character 打 /dǎ/ may inhibit children from recalling the pronunciation of the character 拢 /lǒng/. The semantic facilitation was slower than the phonological facilitation in Perfetti and Tan (1998). It was because the activation of orthography of the prime can activate the orthography of related target character; however, the connection between the semantics of the target character and that of the prime is not as strong as the connection between the orthography and phonology of the target character (Perfetti et al., 2005).

Summary

The Simple View of Reading (Gough & Tunmer, 1986) assumes that efficient word recognition explains more variances in reading comprehension during early reading development than linguistic comprehension. Word recognition is the process of activating orthography-phonology, orthography-semantic, and phonology-semantic correspondences in mental lexicon through, for example, two routes in the Dual-route Cascaded model (Coltheart, 1985) or one route in the connectionist triangle model (Seidenberg & McClelland, 1989) for alphabet languages. Likewise, Chinese character recognition relies on the activation of orthographic, phonological and semantic representations of Chinese characters, but characters can only be recognised through the lexical route in the Dual-route Cascaded model (Lee et al., 2004). Connectionist models have been successfully implemented to estimate Chinese character recognition (e.g. Dang et al., 2019; Guan et al., 2020; Lee et al., 2005). Researchers have proposed connectionist models of Chinese character recognition (e.g. Hsiao & Shillcock, 2005; Perfetti et al., 2005; Tong & McBride-Chang, 2018; Xing et al., 2004; Yang et al., 2009). The Lexical Constituency Model (Perfetti & Tan, 1998; Perfetti et al., 2005) is used as the theoretical foundation of the current thesis because this model provides assumptions about how a character's orthography, phonology and semantics are activated in the reader's mental lexicon and considers roles of radicals in character recognition. This model emphasises the threshold style of activating character representations and indicates that the frequency of exposure to orthography-phonology and orthography-semantics mappings and the regularity of orthography-phonology and orthography-semantic mappings are closely associated with the process of Chinese character recognition.

Models of Orthographic Learning

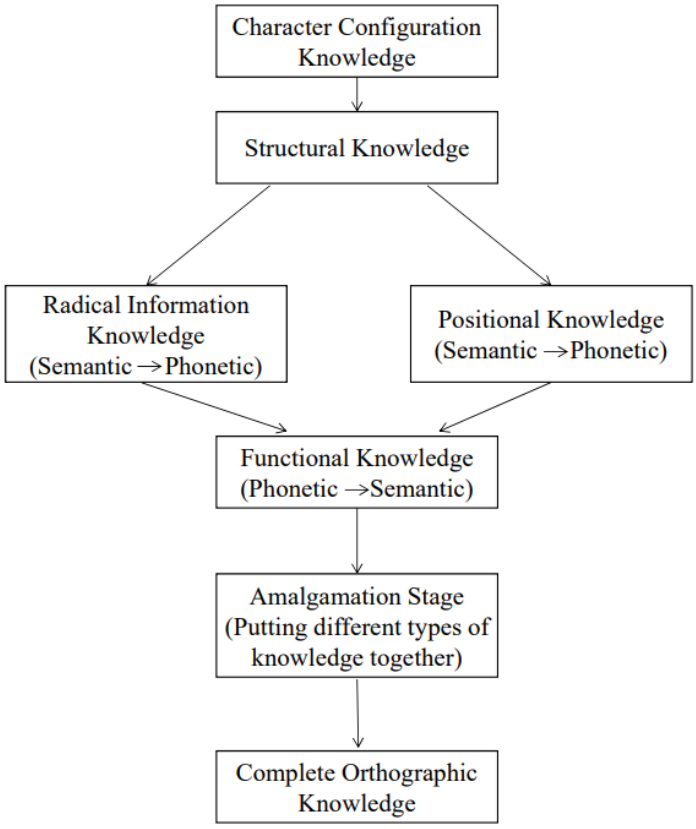
Models reviewed in the last section show how words are decoded but do not show the procedure of learning to read words. The process of moving from mapping the spelling and sound of written words at the beginning stage of learning to read to automatic word recognition at more advanced stages is called orthographic learning (Castles & Nation, 2010). Orthographic learning in alphabetic languages has often been viewed as a procedure of sequential stages or phases, such as a three-phase developmental theory of reading acquisition by Frith (1985), a four-phase theory of sight word development by Ehri (2005, 2007). Likewise, Chinese orthographic learning refers to the process of associating Chinese characters' visual features with the sound and recognising Chinese characters efficiently and automatically. Chinese orthographic learning also includes sequential stages (e.g. Ho et al., 2004). However, orthographic learning in alphabet languages and the Chinese language has also been analysed via the self-teaching hypothesis (Share, 1995), which argues that orthographic learning should be investigated by looking at how individual written words are acquired rather than developmental stages. This section will first review a staged model: a model of Chinese orthographic knowledge development (Ho et al., 2004). After that, this section will introduce the self-teaching hypothesis (Share, 1995) and its application in the Chinese language.

A Model of Chinese Orthographic Knowledge Development

Ho, Yau et al. (2003) proposed a model of Chinese orthographic knowledge development among Chinese children in Hong Kong (shown in Figure 2). Before receiving literacy education, children would have acquired some character configuration knowledge through exposure to Chinese characters in daily life. Consistent with this, Ho and colleagues found that kindergarteners could distinguish characters from other drawing patterns that were not Chinese characters. Additionally, 80% of the first-graders showed implicit structural

Figure 2

A model of Chinese orthographic knowledge development (Ho, Yau et al., 2003)



knowledge about characters: for example, a compound character could be broken down into different radicals. More than half of first-graders had developed radical knowledge and started to know the meaning of semantic radicals and the sound of phonetic radicals. However, more students knew semantic radicals than phonetic radicals in each grade of junior primary. First-graders had developed a rudimentary knowledge of radical positions, though the position knowledge for semantic radicals developed earlier than the position knowledge for phonetic radicals. By contrast, students developed functional knowledge about phonetic radicals earlier than functional knowledge about semantic radicals. Having functional knowledge means students know that radicals provide cues for phonological and semantic representations of characters. Ho, Yau et al. (2003) found that 67% of third-grade students could assemble and apply both positional and functional knowledge correctly for phonetic radicals when writing

pseudo-characters, whereas 32% of these students could do so for semantic radicals when writing pseudo-characters. Based on these data, the researchers argued that the development of complete Chinese orthographic knowledge would take the whole period of primary education.

Self-teaching Hypothesis

Share (1995) proposed the self-teaching hypothesis to understand how orthographic learning develops in alphabetic languages and the Chinese language. According to the self-teaching hypothesis, phonological decoding (print-to-sound translation) is the core of reading development, given that children who have the knowledge of print-sound association can access the spoken form of a word when seeing its written form. Whenever the child successfully identifies a new word (i.e. figuring out the sound and meaning of the new written word) through independent reading, the child has the opportunity to acquire the orthographic representations of the word on which skilled word recognition is founded. Therefore, acquiring orthographic representations depends on the frequency to which the child has been exposed to a particular word with successful recognition of its phonological and semantic representations during independent reading. The child may read some words heavily relying on phonological decoding but other words with less reliance on phonological decoding because of the frequency of being exposed to the words.

The self-teaching hypothesis has been applied to Chinese orthographic learning (Ho, 2013; Li et al., 2018; Li et al., 2020; Liu, 2018; Liu & Shiu, 2011). Phonology plays an essential role in Chinese orthographic development (Ho, 2014; Li et al., 2021). This view challenged the common assumption that orthographic processing is more critical than phonological processing abilities in Chinese. According to Share (1995), there are two potential pathways for self-teaching via phonological decoding in Chinese, including the use of Pinyin and phonetic radicals. Share (1995) stated that although phonetic radicals are not very reliable for guessing

a Chinese character's pronunciation, phonological information provided by phonetic radicals is likely to be sufficient for self-teaching if contextual information can help resolve the ambiguity of phonological decoding. This phonetic radical pathway was reported by Ho (2013) and Li et al. (2018). They found that phonetic information embedded in phonetic radicals is crucial for Chinese orthographic learning for Chinese native children. Liu (2018) reported that phonetic radicals also affected Chinese orthographic learning for Chinese second language learners, but a more prominent effect was found for Chinese advanced level students (the fourth-year undergraduates) than Chinese intermediate level students (the second-year and third-year undergraduates). However, phonological decoding via phonetic radicals may be prohibited by transparent phonological aids (including the Pinyin and Zhuyin). Previous research found that phonological decoding via the transparent phonological aid Zhuyin did not significantly contribute to Chinese orthographic learning, and argued that transparent phonological aids listed alongside Chinese characters might distract children's attention away from orthographic forms (Ho, 2013; Li et al., 2018).

Previous research has indicated the importance of semantic radicals to character learning in the self-teaching paradigm for children who are Chinese first and second language learners (e.g. Ho, 2013; Liu, 2018; Li et al., 2020). Children in Li et al. (2020) relied more on meaning cues from the semantic radical than phonological cues from the phonetic radical when they conducted an orthographic choice task. The possible reason for the semantic benefit was that the participants in Li et al. (2020) were exposed to the same semantic radical twice but different phonetic radicals within 32 target pseudo-characters. Li et al. (2020) argued that integrating information from the semantic radical with that from the phonetic radical could enhance character recognition. In addition, the findings of an orthographic choice task in Xiao (2013, as cited in Liu, 2018) demonstrated that semantic transparency of semantic radicals was significantly related to Chinese orthographic learning. Interestingly, a naming task in Xiao

(2013, as cited in Liu, 2018) indicated that transparent semantic radicals also facilitated phonological learning of compound characters, which also have been found for Chinese second language learners in Liu (2018). However, the positive effect of semantic radicals on character acquisition could be affected by phonetic regularity and contextual information (Ho, 2013; Liu, 2018; Xiao, 2013). Liu (2018) found that the semantic transparency of semantic radicals only had a significant effect on learning irregular characters among Chinese second language learners. However, Li et al. (2021) reported the null effect of semantic transparency on Chinese orthographic learning. Li and colleagues argued that the null effect was probably because target pseudo-characters were presented in context, and children may have derived the meaning of the characters based on context instead of semantic radicals.

According to the self-teaching hypothesis, the frequency of exposure to a particular written word affects the acquisition of orthographic representations (Share, 1995). Researchers have explored the effect of frequency to which the child has been exposed to a particular character on character acquisition (Ho, 2014; Liu & Shiu, 2011; Xiao, 2013, as cited in Liu, 2018). Xiao (2013, as cited in Liu, 2018) reported no effect of either three or six times of exposure on orthographic learning of Chinese characters. However, Xiao (2013, as cited in Liu, 2018) found the interaction between exposure and character type in a delayed orthographic choice task: Exposure times affected orthographic learning of simple characters and did not affect the learning of compound characters. Ho (2014) showed that Chinese third graders acquired traditional Chinese characters in independent reading with only four exposures. Liu and Shiu (2011) found that Chinese second graders quickly self-taught orthographic representations of simplified Chinese characters after six exposures.

Summary

Chinese orthographic learning has been analysed via stage models (Ho, Yau et al., 2003), demonstrating radical and character acquisition on Chinese children's different stages of Chinese reading development. Chinese orthographic learning also has been analysed via the self-teaching hypothesis (Share, 1995), which indicates that acquiring orthographic representations of a particular character depends on the frequency of exposure to the character rather than transitions between developmental stages assumed in staged models. The importance of radical knowledge development has been underlined in these two models (Ho, Yau et al., 2003; Share, 1995). Share (1995)'s models emphasise the importance of print exposure to characters during reading experience on Chinese orthographic learning. In the current thesis, the self-teaching hypothesis (Share, 1995) is used as the theoretical foundation along with the Lexical Constituency Model (Perfetti & Tan, 1998; Perfetti et al., 2005). The reason is that the frequency of exposure to Chinese characters during independent reading discussed in the self-teaching hypothesis studies can guide designing a teaching method in the current thesis.

Factors Related to Chinese Orthographic Learning

Chinese orthographic learning is related to metalinguistic awareness, Chinese oral vocabulary, print exposure, contextual information, and home language and literacy environment. This section will review the relationship between these particular factors with Chinese orthographic learning.

Metalinguistic Awareness

Learning to read is fundamentally metalinguistic and requires the awareness of the basic units of spoken language and the writing system (Nagy & Anderson, 1995). Metalinguistic

awareness of the Chinese language would likely include phonological awareness, morphological awareness, radical awareness, and orthographic knowledge.

Phonological Awareness. Phonological awareness is defined as "the awareness of and access to the sound structure of a language" (McBride-Chang, 2004b, p. 24), including onset/rime awareness, syllable awareness, and phoneme awareness. Phonological awareness of Chinese also includes tone awareness (Shu et al., 2008). Mandarin Chinese has five tones that can be used to differentiate Chinese words and characters. Research has found that syllable awareness, onset/rime awareness, and tone awareness contribute to learning Chinese characters for Chinese native children (e.g., Shu et al., 2008; Shu et al., 2000; Sun et al., 2018). For example, a close association between syllable awareness and Chinese character recognition was reported among Chinese native children who were in kindergarten (Li et al., 2012) and among 9-10 years old (Pan et al., 2011). The reason could be that each Chinese character corresponds to a single syllable. Rime awareness was correlated to Chinese character recognition in primary school children (Hsuan et al., 2017; Li et al., 2012; Siok & Fletcher, 2001). Although rimes are not explicitly represented in Chinese characters, older Chinese readers would better understand the linkage between rimes and Chinese characters because phonetic radicals can imply some rimes. Tone awareness is also a critical linguistic skill in the early years of learning to read Chinese characters (e.g. Hsuan et al., 2017; Siok & Fletcher, 2001). For Chinese heritage children, the effect of phonological awareness on Chinese character learning is controversial. Wang et al. (2009) reported that Chinese onset awareness of first graders predicted their Chinese character reading. However, Lü and Koda (2017) found that phonological awareness only contributed to reading Pinyin among first and second graders.

Morphological Awareness. Another salient predictor of learning to read Chinese characters is morphological awareness which refers to "the awareness of and access to the meaning structure of a language" (McBride-Chang, 2004b, p. 69). Morphological awareness

in Chinese includes two dimensions, namely, a lexical level and a sub-lexical level (Shu & Anderson, 1997). At the lexical level, this means the ability to identify, analyse and manipulate the morphological structure of a multi-character word (McBride-Chang et al., 2003). At the sub-lexical level, this represents the ability to use the clue provided by semantic radicals in a semantic-phonetic compound character (Shu & Anderson, 1997). Sub-lexical level morphological awareness has also been referred to as radical awareness (Shu & Anderson, 1997), sub-character processing (Tong & McBride-Chang, 2010), and orthographic processing (Cheung et al., 2007). Sub-lexical level morphological awareness is included in radical awareness in this thesis (see the following section). Previous research found that morphological awareness at the lexical level has a distinct contribution to reading multi-character words (McBride-Chang et al., 2003; Shu et al., 2006; Tong, Tong, et al., 2017; Yeung et al., 2011) and Chinese character recognition in older Chinese children in primary school (Li et al., 2012). Tong et al. (2009) reported that morphological awareness at the lexical level longitudinally predicted Chinese character recognition and reading comprehension for Chinese native children. Research has not explicitly looked at the effect of morphological awareness on Chinese heritage children's character recognition. However, Zhang and Koda (2017) found that Chinese heritage children did show signs of morphological awareness after early exposure to spoken Chinese.

Radical Awareness. Radical awareness refers to the sensitivity to semantic radicals and phonetic radicals in a compound Chinese character. It has been reported that children's radical awareness is related to their Chinese character learning (Ho, Ng et al., 2003; Shu et al., 2000; Tong, Tong, et al., 2017). Ho, Ng et al. (2003) argued that the knowledge of semantic and phonetic radicals significantly correlated with learning to read Chinese characters. Children in Grade 1 had some knowledge of phonetic and semantic radicals, but children started to understand that semantic radicals provide meaning cues until Grade 3. Shu and

Anderson (1997) stated that third and fifth graders who are Chinese native speakers could use semantic radicals to derive the meaning of novel Chinese characters and recently learnt Chinese characters, but first graders could not. Children with better radical awareness in Shu and Anderson (1997) were rated as good readers by their teachers. Phonetic radical awareness at the early stages of primary school was also reported by Anderson et al. (2003): Chinese native children learned the pronunciation of new compound characters based on partial phonological information available in regular and semi-regular characters Grade 2. He et al. (2005) also confirmed that Grade 2 primary school students in China could derive pronunciation information of regular and semi-regular characters from the phonetic radical. Chen et al. (2014) found that young children were able to infer the pronunciation of a novel compound character by its phonetic radical, which was referred to as the regular orthography-to-phonology correspondence rule in Hsuan et al. (2017). Chen and colleagues also reported that children could infer the pronunciation of a novel compound character by analogy to another compound character with the same phonetic radical and a different pronunciation to the phonetic radical. This strategy was referred to as the sophisticated orthography-to-phonology correspondence rule in Hsuan et al. (2017). For example, children can read a character 炮 /pào/, by making an analogy to another character 泡 /pào/ that has the same phonetic radical 包 /bāo/. Although the adoption of the regular orthography-to-phonology correspondence rules is a default strategy, the use of sophisticated orthography-to-phonology correspondence rules is crucial for learning characters in Grades 1 and 2 (Anderson et al., 2003; Hsuan et al., 2017). It is because of the large number of irregular characters which do not share the same pronunciation with their phonetic radicals. More skilled readers will employ sophisticated orthography-to-phonology correspondence rules by using partial phonological information to read (Hsuan et al., 2017). Research has also found that radical awareness contributes to character learning for Chinese second language learners (e.g. Shen & Ke, 2007; Taft & Chung, 1999; Wang & Koda, 2013).

Wang and Koda (2013) showed that semantic transparency affected character learning: students performed better on figuring out novel characters' meanings when the meaning of characters can be inferred directly than indirectly by their semantic radicals.

However, only one study has investigated Chinese heritage language learners' semantic radical awareness. Koda and Lü et al. (2008) reported that Chinese heritage children's semantic radical awareness was underdeveloped and remained at the basic level throughout the primary school years. The results of Koda and Lü et al. (2008) show that Chinese heritage children lagged behind Chinese native children in acquiring semantic radical awareness, which was related to limited exposure to Chinese characters in Chinese textbooks. Koda and Lü et al. (2008) argued that Chinese characters taught in textbooks for Chinese heritage language learners in Grade 1 and grade 2 were insufficient for establishing semantic radical awareness and facilitating learning characters in the senior grades.

Orthographic Knowledge. It has been found that orthographic knowledge predicts learning to read and spell Chinese characters among kindergarten (Wang, 2014) and primary school children (Ho, Yau et al., 2003; Li et al., 2012; Tong et al., 2009; Yeung et al., 2011). Children with orthographic knowledge have "the ability to form, store, and access orthographic representations" (Stanovich & West, 1989, p. 404). Chinese orthographic knowledge refers to the understanding of the conventional regularities of structure in Chinese characters (Tong et al., 2009). Li et al. (2012) demonstrated that orthographic knowledge has a more significant association with Chinese character reading in older children than younger children. The findings suggest that orthographic knowledge is more important for learning Chinese characters as age and reading experience increase; however, scant research specifically looks at Chinese heritage children's orthographic knowledge.

Chinese Oral Vocabulary

It was found that Chinese oral vocabulary knowledge is related to reading Chinese characters (Ho et al., 2012; Pan et al., 2011; Zhou & McBride-Chang, 2015). A 5-year longitudinal study by Pan et al. (2011) elaborated that the ability to identify the meaning of oral presented Chinese vocabulary consistently correlates to Chinese character recognition over time. Zhou & McBride-Chang (2015) argued that for both Chinese native speakers and English-Chinese bilinguals, Chinese vocabulary knowledge is essential for Chinese character reading.

Chinese oral vocabulary knowledge is also related to reading Chinese characters among Chinese heritage children. A study by Zhang and Koda (2018) showed that Chinese oral vocabulary was a solid foundation for Chinese literacy development. Chinese oral vocabulary and emerging morphological awareness facilitated the development of print vocabulary knowledge (i.e. the ability to identify meanings from visually presented Chinese characters and multi-character words). This finding suggested that children with good vocabulary levels may out-perform those with lower levels irrespective of the teaching method used. Lü and Koda (2017) reported that, compared to phonological awareness, Chinese oral vocabulary knowledge contributed to a larger extent of Chinese character reading. Lü and Koda (2017) also found out that school-age Chinese heritage children could utilize Chinese oral vocabulary knowledge to support their character learning.

Print Exposure

Orthographic learning cannot happen without exposure to written language, and print exposure predicts skilled word recognition (Castles & Nation, 2010). The exposure to a Chinese character determines the threshold of phonological, orthographic and semantic units

in the Lexical Constituency Model (Perfetti & Tan, 1998) and affects self-teaching according to the Self-teaching Hypothesis (Share, 1995). The frequency of characters positively affected learners' performance for Chinese lexical decision and character naming tasks (Liu et al., 2007; Sze et al., 2015). The frequency in previous literature often refers to the frequency of the character in a corpus (e.g. Liu et al., 2007; Sun, 2006; Yu & Cao, 1992), whereas print exposure in this thesis refers to the frequency of encounter with a Chinese character during Chinese lessons. The frequency of a character in a corpus is not equivalent to how often children see the characters they are learning.

There is a lack of research on how the frequency of print exposure to characters in Chinese literacy instruction would affect character acquisition. However, previous research on repeated text reading can shed some light on this. Anderson et al. (2002) found a positive effect of repeated text reading on character acquisition for Chinese native children. They found reading a story eight times within 45 minutes enabled students to successfully pronounce 92% of new characters when the characters were presented in the same context as the original story and 40% of new characters when characters were introduced in isolation after an eight-week interval. Han and Chen (2010) reported that repeated reading led to character acquisition for a university-level Chinese heritage learner.

Chinese heritage children are likely to encounter Chinese characters mainly in Chinese lessons and activities at home (for example, reading Chinese books and watching Chinese movies with Chinese subtitles). Chinese native children would have more chances to see Chinese characters as they read Chinese characters in their daily lives, such as on billboards and the label of products in the supermarket. Therefore, textbooks used in Chinese lessons may play a more significant role in providing print exposure to Chinese heritage children than to Chinese native children. There is a lack of research that analyses Chinese heritage children's print exposure to characters. Only one study by Koda, Lü et al. (2008) compared the total

amount of characters that Chinese heritage children were exposed to in textbooks tailored to Chinese heritage children with the total amount of characters that Chinese native children were exposed to in textbooks for native speakers. The results showed that Chinese heritage children were only exposed to 36% of characters taught to Chinese native speakers in textbooks. Koda, Lü et al. (2008) argued that the restricted exposures to Chinese characters in the early grades are far from sufficient for developing radical awareness required for learning compound characters in the later grades.

Contextual Information

Contextual information provided by reading materials is able to support students to acquire the meaning of characters (e.g. Han, 2015; Ku & Anderson, 2001; Liu, 2018; Shu et al., 1995; Wang & Koda, 2013). Such acquisition is often incidental. Incidental word learning means students learn a word through paying attention to understand the meaning of spoken and written language within communicative activities rather than focusing on the orthographic forms of language (Huckin & Coady, 1999). Shu et al. (1995) reported that fifth-grade Chinese native children were able to figure out the meaning of unfamiliar characters by integrating word structure information and contextual clues. Shu et al. (1995) concluded that the probability of learning written words was larger when the words were surrounded by rich and informative contexts compared to contexts that contained less contextual information. Similar findings were reported by Han (2015), who examined two-character compound words. Han (2015) argued that better readers in the fourth grade relied more on contextual clues or integrated contextual clues with morphological structures of words to derive the meaning of unfamiliar words. Likewise, fourth-grade Chinese native children in Ku and Anderson (2001) incidentally learned the meaning of unfamiliar characters while reading texts. Previous research also shows the facilitative effect of contextual information on Chinese second language learners' character

acquisition (e.g. Jiang & Fang, 2012; Wang & Koda, 2013). Wang and Koda (2013) found that Chinese second language learners depended on contextual information to work out the meaning of characters, especially when semantic radicals did not provide helpful clues. Liu (2018) found that Chinese second language learners inferred the meaning of words better when words were presented within a context than when presented in isolation. Interestingly, Liu (2018) reported that Chinese second language learners used more contextual cues and less morphological structures to infer the meaning of words as proficiency levels increased. Overall, it seems that using contextual cues to infer the meaning of unfamiliar characters is a common strategy for both Chinese first and second language learners. Learning the meaning of novel characters is an indispensable part of character learning, given that written word recognition involves retrieving phonological, orthographic and semantic representations in the mental lexicon (Perfetti et al., 2005). However, the effect of contextual information on orthographic learning for Chinese heritage learners has not been discussed so far. Considering the common characteristics that Chinese heritage learners share with Chinese first or second language learners, it is likely that contextual information is also a factor closely related to character learning for Chinese heritage learners.

Home Language and Literacy Environment

Home language and the home literacy environment encompass factors related to children's language and literacy experiences at home, including parents' language use with children, home print resources, parents' educational level and social-economic status, parent-child joint reading activities, and Chinese characters or pinyin learning activities at home (Liu et al., 2018; Sénéchal, 2006; Zhang et al., 2019). Previous research found that Chinese reading activities at home contributed to reading development for Chinese native children (Lau & McBride-Chang, 2005; Shu et al., 1995; Shu et al., 2002). Shu et al. (1995) argued that the

probability of Chinese native children who read a high amount at home (8 or more books during the winter vacation) learning a written word from context was over three times greater than the children who did some reading at home (4 to 7 books), and over seven times greater than children who did little (3 or fewer books) or no reading at home. Shu et al. (2002) reported that parent-child literacy-related activities significantly contributed to first and fourth graders' reading development. However, Zhang et al. (2019) found parent-child shared book reading did not predict emergent literacy skills of Chinese native children, including RAN, phonological awareness, Pinyin knowledge and vocabulary. Zhang and the colleagues found access to literacy resources predicted children's emergent literacy skills, Chinese word reading and reading comprehension. The weak effect of shared book reading at home might be because the shared book reading at home strongly correlated with access to literacy resources, which might have masked the individual effect of shared book reading at home (Zhang et al., 2019). Zhang et al. (2019) also found that Chinese characters or pinyin learning activities at home predicted Chinese native children's Chinese reading comprehension.

The home literacy environment also plays a significant role in Chinese literacy development for Chinese heritage children. This is because instruction time of Chinese literacy activities in the community school is often limited (Xia, 2016; Zhang & Koda, 2011). Findings from Zhang and Koda (2011) revealed a significant positive correlation between parents' language usage and children's Chinese oral vocabulary knowledge and breadth, which aligned with Lü and Koda (2011). Zhang and Koda (2011) also reported that Chinese heritage children's schoolwork-related Chinese reading practice at home was positively correlated with Chinese word knowledge, while independent and shared reading of Chinese books at home unrelated to schoolwork did not significantly relate to Chinese word knowledge. According to Xiao (2008), Chinese reading materials and Chinese literacy activities at home appear to be important for Chinese heritage language learners (undergraduates). Advanced learners had

significantly more Chinese reading materials at home than beginning learners. Advanced learners also spent significantly more time on Chinese literacy activities such as character writing and book reading at home. Overall, it appears that home language and literacy environment are influential when Chinese heritage children's Chinese orthographic learning and reading development are discussed.

Summary

Chinese orthographic learning is affected by metalinguistic awareness, Chinese oral vocabulary, print exposure, contextual information, and home language and literacy environment. Among these factors, Chinese oral vocabulary lays the foundation for Chinese heritage children to learn Chinese characters (Lü & Koda, 2017; Zhang & Koda, 2018). Phonological awareness would contribute to learning characters in the early years. Morphological awareness would contribute to reading Chinese words and improving Chinese reading comprehension. Meanwhile, proficient radical awareness may accelerate the procedure of character learning for Chinese heritage children. In addition, character knowledge could be fostered by increasing print exposure to Chinese characters and providing more contextual information. Chinese language usage and Chinese literacy environment at home, such as Chinese reading materials and schoolwork-related Chinese reading practice at home, are also positively correlated with Chinese heritage children's character learning (Lü & Koda, 2011; Xiao, 2008; Zhang & Koda, 2011).

Approaches to Teaching Chinese Characters

Teaching methods in Chinese community schools also affect Chinese orthographic learning because, according to Chang (1998), most Chinese heritage language learning activities are conducted in Chinese community schools. This section firstly reviews intensive

and extensive approaches, which shows a more general picture of approaches to teaching characters for Chinese native children, Chinese heritage children and Chinese L2 learners. Then, conventional and novel approaches to teaching Chinese characters to both Chinese native and heritage children are reviewed because Chinese heritage children had been taught with a similar approach as Chinese native children (Cao, 2014). Literacy instruction in New Zealand is introduced to present the context for the current research.

Anthony (1963) formulated a framework of language teaching, which was comprised of three levels, namely, approach, method, and technique. An approach is a set of assumptions and ideas about the nature of language and language learning; a method refers to an overall plan for the presentation of language material based on the given approach; a technique means the actual implementation in the classroom, which is consistent with the selected method and approach. The approach, method and technique have hierarchical relations: techniques carry out a method that follows an approach (Anthony, 1963).

Intensive and Extensive Approaches

Based on Anthony (1963)'s framework, Li (2015) reviewed 21 well-known and effective character teaching methods and proposed a system of Chinese character teaching methods. According to Li (2015), there were two approaches, i.e. an intensive approach and an extensive approach. The intensive approach means that children intensively learn Chinese characters before learning to read texts and write in Chinese; the extensive approach means that children should learn Chinese characters from reading and writing meaningful texts in Chinese. There were six methods consistent with the intensive approach (i.e. teaching characters based on radicals, teaching characters that share the same components in clusters, teaching characters based on how they are formed, teaching characters that have related meanings in groups, teaching characters that share the same components in rhymes). Methods

that follow the intensive approach emphasise that the Chinese character's orthographic, phonological and semantic representations are unified. Also, Chinese characters should be taught in the order that can manifest regular patterns of Chinese characters, such as compound characters that are comprised of a semantic radical and a phonetic radical. After learning some groups of Chinese characters intensively, children can consolidate their knowledge of learnt characters in reading and writing practices.

By contrast, Li (2015) concluded that reading is the core of methods consistent with the extensive approach, such as using Pinyin to enable early reading, teaching characters through listening to and reading poems, rhymes, stories or short articles. These methods emphasise that teaching should be carried out from oral language to written words, from texts to individual words, from meanings to forms of Chinese characters. New characters are chosen from the texts and are usually taught while children are learning the text. In methods that follow the extensive approach, new characters are arranged mainly based on reading materials instead of regular patterns of Chinese characters.

The debate over the best way of teaching Chinese characters between intensive and extensive approaches has not been settled yet. Law (2012) thought this controversial issue is parallel to the debate over phonics teaching and the whole language approach in learning to read English words. Chang and Han (2004) compared two teaching methods that included an orthographic classified word recognition teaching method (consistent with the intensive approach) and a more conventional text-based character learning (consistent with the extensive approach). Grade 2 primary school students in Taiwan were taught using the two teaching methods. Those receiving the orthographic classified word recognition teaching method scored better in semantic radical awareness and orthographic awareness than the class taught the extensive approach.

In addition, Xu et al. (2014) compared teaching characters in a grouped condition and a distributed condition to Chinese L2 learners at the beginning and intermediate levels. In the grouped condition, unfamiliar Chinese characters sharing a semantic radical were presented in a reading text and taught together. In the distributed condition, unfamiliar Chinese characters in a reading text did not share semantic radicals. Participants were Chinese beginners and Chinese intermediate learners in university. Forty-eight unfamiliar characters were introduced during four learning sessions. In each session, the teacher guided students to comprehend two texts. Students learnt unfamiliar characters on individual computers, which consecutively displayed characters' form, sound (Pinyin, accompanied by a female native speaker's voice pronouncing the character), and meaning (English translation). Students' knowledge of 48 unfamiliar characters and semantic radical awareness were tested before and after four learning sessions. It was found that, for Chinese beginners, learning characters that shared semantic radicals led to better recall and better radical generalization than learning characters that did not share semantic radicals. However, there were no significant differences between the two types of characters for intermediate level learners. The distributed condition in Xu et al. (2014) can be argued to align with the extensive approach of teaching Chinese characters discussed above. The grouped condition is similar with the ideas of the intensive approach with the potentially important difference that the regular patterns in the Chinese characters were not explicitly taught by the teacher. However, Xu et al. (2014) demonstrated the possibility of developing orthographic knowledge of Chinese characters within texts via a radical-based grouping method.

An Integrative Approach

Considering the limitations of both the intensive and extensive approaches, Tse et al. (2007) proposed an integrative perceptual approach for Chinese native children. This approach

suggested that Chinese characters should be learnt in the text to provide a context meaningful to the learner. However, the teaching process should move from whole to parts, from text to words, words to characters, and characters to component parts. This method also suggested that characters are categorised based on their meaning, sound or component parts and are taught in clusters. Nursery rhymes, already learnt by children in school or at home, were adapted as teaching material. The adapted rhyme is comprised of Chinese characters with the same radicals, such as characters 苗 /miáo/, 花 /huā/, 草 /cǎo/, and 芽 /yá/ sharing the radical 艹 (which indicates that characters' meaning relates to plants). Tse et al. (2007) believed that structural features of target Chinese characters could be acquired by learners while reading in context. The effectiveness of the integrative perceptual approach was tested among Grade 1 and Grade 2 primary school children in Hong Kong over one year. Tse et al. (2007) found that the group who received the integrative perceptual approach and traditional textbook-based teaching significantly outperformed Chinese character knowledge and reading comprehension tests compared to the group who only received conventional textbook-based teaching.

Lee et al. (2011) also examined the effectiveness of the integrative perceptual approach with 60 Hong Kong kindergarten students. The results indicated that children taught with the integrative perceptual approach significantly improved their ability to recognise Chinese characters' form, sound and meaning after one school year. This progress was significantly better than that made by children taught via traditional methods. Although traditional characters were used in Tse et al. (2007) and Lee et al. (2011), these studies indicated that the integrative approach could be an effective alternative to traditional instructions of simplified characters (which are used in the current research) because simplified characters derive from and share similar structures with traditional characters.

Conventional Chinese Lesson

Although the debate over the intensive, extensive and integrative approaches still exists, the extensive approach has been more widely used in conventional Chinese lessons for Chinese native and heritage children. The conventional Chinese classes are teacher-centred as well as textbook-based (Tse et al., 2007). Teaching procedures generally follow a bottom-up model of learning that begins with learning how to write Chinese characters, followed by comprehending sentences, then paragraphs, and finally whole passages (Curdt-Christiansen, 2006; Tse et al., 2007; Pu, 2010). Although the teacher usually mentions to students the meaning of semantic radicals (Ho, Yau et al., 2003; Wu et al., 1999), they do not teach the function of semantic radicals systematically nor the sound of phonetic radicals (Ho, Yau et al., 2003). Teachers also do not teach how characters can be separated into semantic and phonetic radicals (Wu et al., 1999). The lack of explicit instruction on radicals means that children may not be able to develop their knowledge of orthographic regularities and radical awareness, which has been shown to be important to Chinese orthographic learning.

Techniques that teachers usually use in conventional Chinese lessons involve rote memorization (McBride-Chang, 2004a; Hancock, 2012), a 'look and say' practice (Tong & McBride-Chang, 2010), coding and decoding activities (Wang, 2004), and repetitive drills (Li, 2005). Some researchers argued that teaching methods and techniques in conventional Chinese lessons for Chinese first and heritage language learners have some limitations. Tong and McBride-Chang (2010) stated that the 'look and say' practice ignores the analysis of the components of Chinese characters. McBride-Chang (2004a) argued that rote memorization does not help Chinese first language learners effectively acquire the meaning of characters, and it reduces learning motivation. Similarly, researchers have suggested that traditional practices decrease Chinese heritage language learners' motivation and lead to students being resistant to Chinese schools (Curdt-Christiansen, 2006; Jiang, 2010; Li, 2005; Xiao, 2008).

Novel Teaching Methods

Some novel ways to teach Chinese characters to Chinese native and heritage children have been adopted and assessed by researchers. For example, Anderson et al. (2002) made an initial attempt to use a shared-book reading teaching method for Grade 1 students in China, which could be argued to be consistent with the extensive approach. The shared-book reading method designed by Holdaway (1979) was defined as a method of teaching in which a teacher and their students read aloud a text together. This method uses books with enlarged print to enable all students to view the printed text. In Anderson et al. (2002), a teacher used such enlarged-print books, read the story aloud to the whole class, and then guided students to read aloud in chorus. Students engaged with reading a large volume of text, with eight readings of a story within 45 minutes. The teacher explained the meaning of unfamiliar Chinese characters in the story to help students comprehend the story. However, the teacher did not explicitly teach the structures of these Chinese characters. There were 40 unfamiliar characters in four different stories, and students were unlikely to know any of these characters. After two weeks and eight weeks of the shared-book reading lessons, students were asked to read aloud these 40 unfamiliar characters in isolation, in words from the stories, and in words not from the stories (a new context). It was found that students pronounced 92% of characters correctly when the characters were presented in the same context as the original story after an eight-week interval. Students' recall was 40% correct when characters were presented in isolation and 50% correct when characters were presented in a new context after eight weeks. It was concluded that the shared-book reading method "would be a powerful addition to traditional Chinese literacy instruction" (Anderson et al., 2002, p.147). However, Anderson et al. (2002) did not incorporate a control group so that the advantage of the shared-book reading method over conventional instructions did not have clear evidence.

Some researchers have considered ways to teach Chinese characters to Chinese heritage learners. Lü (2017) suggested that teachers could use a "top-down" teaching approach and let students learn Chinese characters and vocabulary through reading activities because Chinese heritage learners are likely to master some vocabulary and linguistic structures. Li (2006) also recommended combining learning characters with reading practices and introducing semantic radicals and phonetic radicals of compound characters to help learners develop radical awareness. Teaching characters using texts with recurrent words such as nursery rhymes, dialogue, and stories was suggested by Chen (2018). Chen (2018) also argued that Chinese heritage learners should learn more receptive characters (i.e. the characters that students should be able to recognise) than expressive characters (i.e. the characters that students should be able to recognise and write). It is because more effort is needed to remember details in a character to write the character correctly than to recognise the character. Although researchers emphasised the importance of reading, Ma (2007) expressed the concern that reading materials suitable for Chinese heritage learners are scarce.

Literacy Instruction in New Zealand

Chinese heritage children usually attend classes in Chinese community schools or have private tutors after school or on weekends if their parents want them to learn Chinese. Unfortunately, there is a lack of research on Chinese character instruction for Chinese heritage children in New Zealand. Chinese heritage children who are 5-12 years old in New Zealand attend mainstream English-medium primary schools. It is necessary to review and consider the approaches of teaching literacy in English-medium primary schools when designing an approach of teaching Chinese literacy in Chinese community schools.

In public English-medium primary schools, English literacy programmes typically have been influenced by the whole language approach (e.g. Holdaway, 1979). For example,

handbooks published by the New Zealand Ministry of Education (1996, 2002, 2003a, 2003b) provide guidelines on literacy instruction and mention shared reading, guided reading and independent reading as effective teaching methods. Shared reading means the teacher reads aloud while children look at the text on an enlarged version of the book or individual copies; children may join in with the reading when they want to do so. Guided reading means the teacher introduces a book to children and helps them read and comprehend the story. Independent reading means children choose their books and read independently. In addition, according to a handbook by the Ministry of Education (2003b), although knowledge of phonics is significant, it is better to develop children's knowledge of letter-sound relationships in the context of book reading and story writing.

Summary

Teaching methods and techniques for Chinese characters align with the intensive approach, the extensive approach, or the integrative approach. The intensive approach emphasises orthographic regularities of Chinese characters, and the extensive approach emphasises the transition from oral language to written words. Researchers have not reached a consensus about which one of these two approaches works better for teaching Chinese characters. Considering the limitations of the intensive and extensive approaches, researchers proposed the integrative approach in which orthographic regularities are taught in meaningful texts and argued that the integrative approach would be an effective alternative to traditional instructions (Tse et al., 2007; Lee et al., 2011). In conventional Chinese lessons for all Chinese learners, the extensive approach is widely used. However, researchers have suggested that the conventional Chinese lessons may not teach characters effectively and may reduce Chinese heritage learners' motivation to learn characters (e.g. Tong & McBride-Chang, 2010; Curdt-Christiansen, 2006). Researchers proposed some novel teaching methods for Chinese first and

second language learners that have utilised reading activities. Some research has suggested that teaching characters through reading would be more effective than conventional instructions (e.g. Anderson et al., 2002). Similarly, researchers have argued that Chinese heritage learners would be benefited from a "top-down" teaching approach: i.e. learning characters via reading and in contexts (e.g. Lü, 2017a; Li, 2006). Meanwhile, the use of real texts and teaching phonics through reading and writing activities are critical principles of literacy instruction in mainstream primary schools in New Zealand, where the participants in the current research were receiving formal education.

Research Gaps and Questions

Models of word recognition and orthographic learning for the Chinese language indicate that radical awareness and frequency of exposure to the orthography-phonology correspondence and the orthography-semantics correspondence of characters play a significant role in learning and reading Chinese characters. Chinese oral vocabulary and metalinguistic awareness are also closely related to Chinese orthographic learning. According to the limited amount of research on Chinese heritage children's Chinese orthographic learning, Chinese heritage children's semantic radical awareness could be argued to be underdeveloped (Koda, Lü, et al., 2008). In addition, Chinese orthographic learning is also influenced by instructional factors because Chinese heritage children receive Chinese literacy education mainly from Chinese community schools (Chang, 1998). In conventional Chinese classes for all Chinese learners, teaching methods that follow principles of the extensive approach are commonly used: Chinese characters are introduced in texts. Researchers have argued that teaching methods and techniques in conventional Chinese class have some limitations, such as the lack of explicit instruction on the functions of semantic and phonetic radicals (Ho, Yau et al., 2003; Wu et al., 1999) and the negative effect of rote memorization on learners' motivation to learn the Chinese

language (e.g. Curdt-Christiansen, 2006; McBride-Chang, 2004a). It was also reported that Chinese characters taught in textbooks for Chinese heritage children were insufficient for the development of semantic radical awareness (Koda, Lü, et al., 2008). Researchers have proposed and examined alternative methods for teaching Chinese characters that focus on teaching characters through reading activities (e.g. Anderson et al., 2002; Shum & Liu, 2014). Teaching characters through reading activities aligns with the extensive approach and follows a "top-down" teaching procedure but does not provide explicit instruction on radicals. In contrast, an integrative approach provides reading activities and character structure instruction (Tse et al., 2007; Lee et al., 2011). Although such methods have been found to be beneficial for Chinese native children, there is a lack of research on using the integrative approach for Chinese heritage children.

The current research focuses on the development of Chinese literacy for Chinese heritage children in New Zealand. Previous literature reviewed in this chapter reveals the limitations of conventional instructions and the potential of teaching Chinese characters through reading activities. Meanwhile, learning written words through reading activities, such as shared-reading, is a commonly used teaching technique in New Zealand primary schools where Chinese heritage children receive formal education. Therefore, the present research aims to contribute to research by designing and employing a shared reading teaching method for Chinese heritage children and examining its effectiveness on the development of Chinese character recognition and reading comprehension.

The proposed shared reading teaching method in this research is underpinned by the Lexical Constituency Model (Perfetti & Tan, 1998) and the self-teaching hypothesis (Share, 1995). Greater print exposure, more contextual information and more explicit instruction on semantic and phonetic radicals are provided in the proposed method, compared to the conventional teaching method (See Methodology sections in Chapter 3 on page 66, Chapter 4

on page 100, and Chapter 5 on page 133 for details). Following the development of the teaching methods, the proposed shared reading teaching method will be examined in three studies containing different foci. Study 1 focuses on the frequent exposure of new Chinese characters' orthography, phonology and semantics in the context. The proposed shared reading method in Study 1 still aligns with the extensive approach of teaching characters. Study 2 focuses on the frequent exposure of new Chinese characters' orthography, phonology and semantics in the context, as well as explicit instruction on semantic radicals. The proposed shared reading method in Study 2 combines explicit instruction on orthographic regularities with features of the extensive approach. Study 3 focuses on the frequent exposure of new Chinese characters' orthography, phonology and semantics in the context and explicit instruction on phonetic radicals. The proposed shared reading method in Study 3 aligns with the integrative approach.

There are two main research questions that will be explored in Study 1, 2 and 3.

- Do Chinese heritage language children at the beginning level of reading in Chinese develop better knowledge of orthographic, phonological, and semantic representations of characters in the shared-reading condition or the conventional textbook-based condition?
- Do these children have better Chinese reading comprehension outcomes in the shared-reading condition or the conventional textbook-based condition?

One more question is included in Study 2 and Study 3, respectively.

- Do these children establish better semantic radical awareness in the revised shared-reading condition or the conventional textbook-based condition? (Study 2)

- Do these children establish better phonetic radical awareness in the revised shared-reading condition or the conventional textbook-based condition? (Study 3)

Chapter 3 Study 1

Introduction

Study 1 was conducted to explore a shared reading teaching method that provided frequent exposure to the orthography, phonology and semantics of characters in context. The important role that print exposure plays in character acquisition has been demonstrated in the literature reviewed in the Background Chapter (e.g. Perfetti & Tan, 1998; Share, 1995). However, Chinese heritage children have relatively limited exposure to characters not only in conventional Chinese class but also in daily life, which may disadvantage their character learning. In Study 1, a shared reading teaching method with frequent exposure to Chinese characters was proposed, and the effectiveness of the proposed shared reading teaching method on the development of Chinese character knowledge and Chinese reading comprehension for Chinese heritage children was examined. The research questions of Study 1 were:

- Do Chinese heritage language children at the beginning level of reading in Chinese develop better knowledge of orthographic, phonological, and semantic representations of characters in the shared-reading condition or the conventional textbook-based condition?
- Do these children have better Chinese reading comprehension outcomes in the shared-reading condition or the conventional textbook-based condition?

It was hypothesised that:

- Larger gains in Chinese character knowledge would be achieved in the shared reading condition compared to the textbook-based condition. This is because children in the shared reading condition will have more frequent exposure to characters' orthographic, semantic and phonological representations. Frequent

exposure can help children gain more solid knowledge of orthography-phonology and orthography-semantics correspondences of characters (Perfetti & Tan, 1998).

- Larger gains in Chinese reading comprehension would be found in the shared reading condition than in the textbook-based condition. Better character knowledge in the shared reading condition would lead to better Chinese reading comprehension since decoding is a prerequisite for reading comprehension (Gough & Tunmer, 1986). Read-aloud activities and reading comprehension practices in the shared reading condition would also promote the development of Chinese reading comprehension.

Methodology

Design

A design for Study 1 consisted of ten teaching sessions, pre-teaching tests and after-teaching tests and incorporated an experimental group experiencing a designed shared reading method and a control group experiencing the more traditional textbook-based teaching method. Participants were not assigned to groups under the random assignment criteria. Instead, participants' parents/guardians chose a group for their children. The procedure of selecting a group followed the class placement protocol of the research site.

Participants

A total of 40 students (26 girls and 14 boys) from a Chinese community school (referred to as the School) in New Zealand participated in the study. Most of the students in the School were Chinese heritage language learners who were raised in a Chinese-speaking family and understood the spoken Chinese language. Over the period when this study was conducted, the

School provided 1.5-hour lessons on Saturdays for students to learn Mandarin Chinese and simplified Chinese characters using the traditional textbook-based instructions. Students were required to accomplish a Pinyin course at the School before admittance into the Chinese classes.

Study 1 focuses on Chinese heritage language learners who were eligible to enrol in Year 1 Chinese lessons at the School when Study 1 started. The school principal provided consent for the School and their scheduled classes to form the research site. After that, students and their parents/caregivers were informed that this research would involve a new Shared Reading Class in contrast with the typical School Year 1 class. Parents and students were provided with the information sheets and consent forms in either Chinese or English. Families were invited to attend an information session where the research was introduced, and questions about the research were answered. All students whose parents provided consent and who assented to be involved in the research were included in this study.

There were 20 students in the experimental group and 20 students in the control group. As well as a signed consent form, parents/guardians were asked to indicate their children's birthday, gender and home language(s). At the time of pre-testing, participants' ages in the experimental group ranged from 5 years 6 months to 9 years 10 months, while participants in the control group were from 5 years 9 months to 10 years old. Both groups had more girls than boys: 60% of children in the experimental group and 70% of children in the control group were girls. In this study, home language was defined as the language (or languages) the parents spoke to their children for everyday interactions at home. The home language did not include the language(s) that children used at home. For example, if parents talked to their child only in Chinese, the home language was coded as Chinese no matter which language children spoke to parents. Parents reported two types of the home language in this study: Chinese, or Chinese and English (see Table 1). The proportion of children who had Chinese as their home language in the experimental group was slightly larger than the proportion of children whose home

language was Chinese in the control group. However, all were using Chinese as part of their home life. Therefore, children would have experienced an oral input of Chinese and hence acquired oral vocabulary in Chinese through being exposed to the language used by their parents at home. It has been found that Chinese oral vocabulary is strongly associated with character learning (Ho et al., 2012; Pan et al., 2011; Zhou & McBride, 2015).

Table 1

Demographic information for participants in Study 1

Variable	Experimental group	Control group
Age		
Mean age in months (*SD*)	84.55 (14.70)	94.25 (16.35)
Age range in months	66-118	69-120
Gender		
Female	*n* = 12 (60%)	*n* = 14 (70%)
Male	*n* =8 (40%)	*n* = 6 (30%)
Home language		
Chinese	*n* = 12 (60%)	*n* = 10 (50%)
English and Chinese	*n* = 8 (40%)	*n* = 10 (50%)

Assessment Materials

Participants' Chinese character knowledge and Chinese reading comprehension were assessed in the pre-tests and post-tests. Chinese character knowledge was examined with a Character Listening and a Character Reading tasks (testing orthography-phonology correspondences) and a Character-Picture Matching Task (testing orthography-semantics correspondence) based on the Preschool and Primary Chinese Literacy Scale (Li, 2014). The Character Listening and Character-Picture Matching Tasks were multiple-choice tasks, and the Character Reading Task was a read-aloud task. Chinese reading comprehension was assessed

by using tasks that require the reading of individual sentences and short passages. A test at the sentence level was included because longer passages would, most likely, have been too difficult for the early learners targeted in this research. In addition, previous research has indicated that Chinese oral vocabulary knowledge is closely related to Chinese character recognition (Pan et al., 2011; Zhou & McBride-Chang, 2015; Zhang & Koda, 2018). English literacy ability may be associated with Chinese literacy ability (He, 2008; Wang et al., 2009). Therefore, Chinese vocabulary and English word recognition ability were assessed in the pre-tests to control for any differences between the two groups. Assessment measures are shown in Table 2.

Table 2
An index of assessment battery in Study 1

Variables	Measurement
Chinese character knowledge	Character Listening Task
	Character Reading Task
	Character-Picture Matching Task
Chinese reading comprehension	Chinese Sentence Comprehension Task
	Chinese Passage Comprehension Task
Chinese receptive vocabulary	Chinese Vocabulary Task
English word recognition	English Word Reading Task

Character Listening Task. The visual/auditory discrimination subscale in the Preschool and Primary Chinese Literacy Scale (Li, 2014) was used to assess the mastery of orthography-phonology correspondence of Chinese characters. If learners have the knowledge of the orthography-phonology mapping of a specific character, they would be able to recognise the Chinese character when its sound is given. The reliability of the subscale was assessed (α = .77) using samples in Singapore (Li & Rao, 2000). The task was piloted on five Year 1 students and two Year 2 students at the School. Within 20 test items in total, Year 1 students answered two items correctly, and Year 2 students answered 14 items out of 20 on average.

These results suggested that the Character Listening Task could show the development of Chinese character recognition from Year 1 and Year 2.

The task was comprised of a practice item and 20 test items. Each item had four alternatives, which were the correct character, a character that sounded similar to the correct character, a character that looked similar to the correct character, and a character that can form a compound word with the correct character. For example, for the test item 天 /tiān/ (sky), the three alternatives apart from the correct one were 田 /tián/, which has the same pronunciation as 天 /tiān/ but a different tone, 人 /rén/ which looks similar to 天 /tiān/, and 上 /shàng/ which can be combined with 天 /tiān/ to form a compound word 天上 /tiān shàng/ (in the sky).

Character Listening Task was administrated individually. For each item, the assessor read aloud a Chinese character and orally presented a word that contained the Chinese character. The word was given to help participants distinguish the test character from homophones that occur regularly in Chinese due to opaque orthography-phonology correspondences. Four Chinese characters were presented on paper at the same time to the student. Participants were asked to point to the Chinese character that they thought was the correct character spoken by the assessor. One score was given to each correct answer, with the maximum score for this task being 20. The internal consistency of this task at the pre-test was Cronbach's α = .65 (this was considered acceptable given that a number of measures of Chinese character recognition were used in the study).

Character Reading Task. The character recognition subscale in the Preschool and Primary Chinese Literacy Scale (Li, 2016) was used to develop the Character Reading Task for this study. The character recognition subscale assesses the mastery of orthography-phonology correspondence of Chinese characters, and reliability (α = .80) was reported in Li and Rao (2000). Before the current study, the researcher piloted the subscale on two students

in a Year 1 Chinese class and two students in a Year 2 Chinese class in the School. Year 1 students only recognised three items, and Year 2 students read six items correctly out of 75 items. Items were subsequently checked against the level 1 Chinese character list of a Chinese proficiency test for Chinese heritage learners, referred to as the HSC Test (H. W. Wang, personal communication, July 19, 2018). It was found that only 30 items out of 75 items belonged to the first level. To show the development of character recognition ability of participants, the researcher kept these 30 items that belonged to the level 1 Chinese character list of the HSC Test and added extra 20 items from the level 1 Chinese character list. The developed Character Reading Task was piloted on five students in Year 1 Chinese class and two students in Year 2 Chinese class by the researcher. From the total of 50 test items, five Year 1 students answered five items correctly on average, and two Year 2 students answered 21 items correctly on average. The developed Character Reading Task showed the development of Chinese character recognition from Year 1 and Year 2.

Character Reading Task consisted of 50 items (see Appendix 3.1). All items were presented on paper with groups of 10 and graded in order of difficulty from simple characters to more complex compound characters (i.e., characters with fewer strokes and radicals to characters with more strokes and radicals). For instance, the first five items were 一, 三, 个, 口, 上; and the last five items were 颜, 套, 旅, 病, 烧.

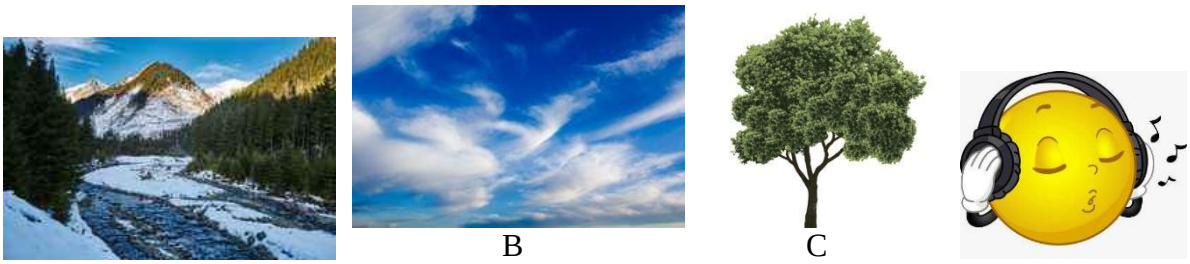
Participants were tested individually. They were asked to read aloud the 50 characters presented on paper one by one from the beginning of the list and from left to right. They were told that they could skip those characters which they did not know. The test was not timed, and self-corrections were allowed. One score was given when students read each item correctly, with the maximum score for this task being 50. The internal consistency of this task at the pre-test was Cronbach's α = .72.

Character-Picture Matching Task. The Character-Picture Matching Task was developed from the grapheme/semantic association subscale in the Preschool and Primary Chinese Literacy Scale (Li, 2016). The reliability of grapheme/semantic association subscale was assessed using Singapore samples (α = .81) (Li & Rao, 2000). In the current study, the subscale was piloted on two students in Year 1 Chinese class and two students in Year 2 Chinese class in the School. The two Year 1 students did not give any correct answer, and two Year 2 students answered three and five items, respectively. It seemed too difficult for the students, so the subscale needed to be adjusted for the current research. Therefore, the researcher added 10 items from the level 1 Chinese character list of the HSC Test (H. W. Wang, personal communication, July 19, 2018). These 10 characters represented common items or activities children encountered in daily life, such as 花 /huā/ (the flower) and 哭 /kū/ (crying) (see Appendix 3.2). This developed Character-Picture Matching Task was piloted on five students in Year 1 classes and two students in Year 2 Chinese classes. From the 35 total items, Year 1 students answered four items correctly, and Year 2 students answered 25 items correctly on average. These data indicated that the developed Character-Picture Matching Task was able to show the development of Chinese character knowledge from Year 1 and Year 2.

There were 35 items in the task. Each item was comprised of a Chinese character and four pictures. The four pictures included a correct answer, a picture that did not relate to the correct answer, and two pictures related to the correct answer. For example, for a test item 天 /tiān/, which means the sky, the correct answer would be the picture of the sky. The other three pictures showed mountains, trees and listening to music, respectively. The mountains and trees pictures are related to the sky because they all belong to nature, whereas the picture of listening to music represents a human activity that is not semantically related to the sky (shown in Figure 3).

Figure 3

Four alternatives for a test item 天 /tiān/.



A B C D

This task was presented on paper for each participant who read each test character and selected the picture representing the meaning of the given Chinese character. Each correct answer was given one score, and the total mark was the score for this task, with a maximum score of 35. This measure at the pre-test yielded a Cronbach's alpha of .79.

Chinese Sentence Comprehension Task. A Chinese Sentence Comprehension Task was developed for the current study using a sentence-picture matching task in a multi-choice format. There were 10 items, which was ordered from easier to more complex sentences. Each item was comprised of a sentence in Chinese and four pictures. Chinese characters in this task were chosen from the level 1 Chinese characters list of the HSC Test (H. W. Wang, personal communication, July 19, 2018). Similarly, Tong et al. (2009) created a sentence-picture matching task to assess kindergarteners' Chinese reading comprehension in Hong Kong, considering participants' young ages and reading experiences. However, the task in Tong et al. (2009) was presented in traditional Chinese characters and designed for Cantonese speakers, so the task was not suitable for assessing Chinese heritage language learners in the current study. The developed Chinese Sentence Comprehension Task was piloted on five students from Year 1 and two students from Year 2 Chinese classes. Year 1 students answered one out of ten items correctly, and Year 2 students gave seven correct answers on average. These results

suggested that the Chinese Sentence Comprehension Task could show the development of Chinese reading comprehension at the sentence level in Year 1 annd Year 2. All items in Chinese Sentence Comprehension Task were shown in Appendix 3.3.

Each sentence ranged from 6 to 12 characters and were short narratives describing everyday activities (such as sentences about the weather, family members and running in a park). Of the four pictures presented with each sentence, only one picture represented the meaning of the given sentence. The other three pictures included two pictures that partially represented the sentence's meaning and one picture that did not relate to the sentence. For example, for a test sentence 下雨了 (it is raining), the three alternatives other than the correct answer were a picture representing snowing rather than raining, a picture representing hot weather, and a picture representing a boy playing basketball (shown in Figure 4).

Figure 4

Four alternatives for a test sentence 下雨了 (it is raining)

A B C D

The task was administrated individually, with all items presented on paper. Each participant read sentences by themselves and circled the picture they thought represented the meaning of the given sentence. The assessor did not help read sentences and told participants that they could skip the sentences they could not read. A correct answer was given one point, and the maximum score was ten. The task produced a Cronbach's alpha score of .56 in the pre-test, potentially consistent with the relative complexity of the task for inexperienced readers.

Chinese Passage Comprehension Task. A Chinese Passage Comprehension Task was developed for the current research to measure participants' reading comprehension at the

passage level that involves character and word recognition, as well as linguistic comprehension. This task was presented in characters without Pinyin words given the assumption that if Pinyin words were provided, then the children would read the Pinyin to comprehend the passages, and not the characters that were the focus of the research. Note that it was expected that children will have learnt Pinyin before entering the class where the current study was performed. In addition, the format of presenting the reading materials in characters and each character being annotated with Pinyin was used in the control group in the current research. However, a different format was used in the reading materials for the experimental group — the reading materials presented new characters and previously learnt characters without their Pinyin words, and presented the rest of the words in Pinyin (for more details see the Teaching Sessions section on Page 82). The format used in the experimental group was not used in the passage comprehension task. It was because (i) the control group did not experience this format; (ii) To the author's knowledge, this format has not been used for any reading comprehension measures for Chinese heritage children in previous studies.

This task consisted of four short passages and 20 open-ended questions based on two scales of the Progress in International Reading Literacy Study (Mullis & Martin, 2016): i.e. (a) retrieval and straightforward inferencing, and (b) interpreting, integrating and evaluating. The developed Chinese Passage Comprehension Task was piloted on five students from Year 1 and two students from Year 2 Chinese classes. From 20 test items, five Year 1 students answered two items correctly on average, and Year 2 students answered 15 items correctly on average. These results suggested that the task could show the development of reading comprehension ability from Year 1 to Year 2. All items in the Chinese Passage Comprehension Task are shown in Appendix 3.4.

The four short passages had 27-45 words. Chinese characters in all passages were chosen from the level 1 Chinese characters list of the HSC Test (H. W. Wang, personal

communication, July 19, 2018). The 20 open-ended questions presented with the four passages included 11 retrieval and straightforward inferencing questions, and 9 interpreting, integrating, and evaluating questions (see Table 3).

Table 3

Information about the Chinese Passage Comprehension Task

Text	Topic	Text length	The number of questions	
			Retrieval and straightforward inferencing	Interpreting, integrating, and evaluating questions
1	A friend's birthday	29 characters	2	2
2	Yunyun and her brother	27 characters	3	2
3	A bunny in my family	42 characters	3	2
4	A cat wants to plant fish	45 characters	3	3

For example, a test passage talked about a friend's birthday: 今天是我朋友的生日，我写了一张生日卡片，买了一个红色的杯子给他。 (Today is my friend's birthday, I wrote a birthday card and bought a red mug for him.) The two retrieval and straightforward inferencing questions were 这段话讲了什么? (What is this text about?) and 朋友的生日是什么时候? (When is the friend's birthday?). The two interpreting, integrating, and evaluating questions were 我给他了什么? (What did the person give to the friend?) and 你觉得我会在生日卡片上写什么? (What do you think the person wrote on the birthday card?).

Participants were tested individually and were required to read passages then orally answer the questions asked by the assessor in Chinese. The assessor wrote participants' answers on an answer sheet. One mark was given when the answer was pertinent, with the maximum score being 20. The task yielded a Cronbach's alpha score of .63 for the experimental group and .41 for the control group at the post-test, suggesting that the experimental group

were more consistent in their performance. (Calculations could not be performed at pre-test as all participants were scored zero on this measure at the start of the study.)

English Word Reading Task. English word recognition ability was assessed by the Burt Word Reading Test (New Zealand Revised) (Gilmore et al., 1981a), which is the only New Zealand standardized norm-referenced word reading test for 6-13-year-old children (Tse & Nicholson, 2014). The test has high internal reliability ($\alpha > 0.95$) (Gilmore et al., 1981b).

There were 110 stimulus words presented on paper. These words increased in complexity and were divided into groups of 10. The task was administrated individually, and each participant was asked to read aloud the stimulus words from the top of the word list and from left to right. The task was not timed, and self-corrections were allowed. The test ended when ten consecutive words were misread. The assessor showed the remaining words and asked participants if they could recognise any other words. The maximum score for the test was 110. It produced a Cronbach's alpha of .99 at the pre-test with the participants in the current study.

Chinese Vocabulary Task. The Peabody Picture Vocabulary Test (Fourth Edition) (Dunn & Dunn, 2007) was used as a basis to develop a test to assess the participants' likely Chinese vocabulary levels in this research. The Peabody Picture Vocabulary Test (Fourth Edition) is a norm-referenced standardized test that assesses the learner's ability to comprehend word meanings. There are the Peabody Picture Vocabulary Test (Chinese Edition) (Gong & Guo, 1984) for Mandarin speakers in mainland China and the Peabody Picture Vocabulary Test (Revised) (Lu & Liu, 1998) for Mandarin speakers in Taiwan. However, cultural differences would make some of the test items in the Mandarin versions in mainland China and Taiwan unsuitable for Chinese heritage children living in New Zealand. Previous research has modified the Peabody Picture Vocabulary Test's original English version to assess Chinese heritage learners' Chinese oral vocabulary (Lü & Koda, 2017; Wang, Cheng et al., 2006). The current

research also used the Peabody Picture Vocabulary Test's original English version to develop a Chinese Vocabulary Task.

All items from Set 1 (for 2-year-old learners) to Set 15 (for young adults over 19 years old) in Form A were translated into Mandarin Chinese by the researcher. The translation was double-checked by two English-Chinese translators who have received Shanghai Interpretation Accreditation in China. There were 12 Chinese words in each set, with 180 words in total. Four pictures were provided for each word, including a picture representing the meaning of the spoken word and three pictures that did not represent the meaning of the spoken word.

The task was administrated according to the examiner's manual guidelines of the Peabody Picture Vocabulary Test (Fourth Edition). Participants were tested individually, and each participant listened to a word uttered by the assessor and then selected one of four pictures on the easel that best described the word's meaning. The test started with the set corresponding to the participant's age. When the participant incorrectly identified more than one item in the set in which the test started, the test continued towards the younger age sets. The test stopped at the set in which the participant only had one incorrect answer or correctly identified all items. The score was calculated by deducting the number of wrong answers from the total number of items from set 1 to the starting set. When the participant only had one incorrect answer or correctly identified all items in the set in which the test started, the test continued towards the older age sets. The test stopped at the set in which the participant incorrectly identified six items in the set. The score was calculated by deducting the number of incorrect answers from the total number of items from set 1 to the set where the test stopped. The maximum score for this task was 180. The reliability test for the current study found high internal consistency (Cronbach's α = .95).

Procedure

Pre-tests were administered at the beginning of the School year and upon the return of consent forms (completed by parent and child). Tasks in pre-tests and post-tests are shown in Table 4. Tests were carried out during after-school hours at the School or at participants' homes. Time and location of assessment were determined in collaboration with parents.

Table 4

An index of the measures at pre-test and post-test in Study 1

Measurement	Pre-test	Post-test
Character Listening Task	√	√
Character Reading Task	√	√
Character-Picture Matching Task	√	√
Chinese Sentence Comprehension Task	√	√
Chinese Passage Comprehension Task	√	√
Chinese Vocabulary Task	√	n/a
English Word Reading Task	√	n/a

Each measure was conducted individually by the researcher and four trained research assistants who were Chinese native speakers and master's students studying at a university in the same city as the School. The research assistants signed research assistant confidentiality forms and were given a training session about the assessment procedure and the assessment protocol by the researcher. The research assistants only executed assessment, and the researcher marked all answers. The pre-tests took over 60 minutes to complete and were administered over three sessions. Immediately following the ten teaching sessions, the post-tests were administered. These took a little less than 60 minutes to complete, over two sessions. Participants were able to have a break whenever they needed to during the assessment. The English Word Reading and Chinese Vocabulary measures were administered only at the pre-tests. Character Listening Task, Character Reading Task, Character-Picture Matching Task,

and Chinese Sentence and Chinese Passage Comprehension Tasks were conducted before and following the teaching sessions.

Teaching Sessions

The programme included ten teaching sessions. These sessions were carried out as part of the Chinese Saturday programme of the School in 2019. Each session lasted 1.5 hours. Participants in the experimental group were taught using the shared reading method by the researcher, whereas the control group were taught using the textbook-based method by a teacher (referred to as the Teacher) from the School. More details about the teaching sessions for the experimental and control groups will be provided later in this section.

Control Group. The Teacher was informed about the current research and understood that participants joining the control group would join her class. In this class, the Zhongwen Textbook (Year 1) would be the primary teaching material, following the curriculum in the School. The Teacher was asked to deliver the lessons the same way she usually did and was informed that her teaching would not be affected by the current research. After the ten teaching sessions, the teacher provided the details of taught characters and teaching procedures to the researcher. The ten teaching sessions covered Lesson 2 to Lesson 6 in the textbook. Each lesson included, on average, 14 target characters and a 32-character-long text (see Table 5).

In total, 71 target Chinese characters were taught during the 10 teaching sessions. In the first six lessons of the Zhongwen Textbook for Year 1 students, the majority of target characters were simple characters and had related meanings; for example, target characters in Lesson 2 were about body parts. However, not all of these target characters were included in the text used in a lesson. It was because the first six lessons focused more on recognising individual characters rather than comprehending text. In the subsequent six lessons in the textbook, all target characters were included in the texts, which were relatively longer than

Table 5
Information about teaching materials for the control group in Study 1

Session number	Lesson	Target Chinese characters (total numbers)	Length of texts (total characters)
No. 1 - No. 2	Lesson 2	人头目口耳手足大小多少我有个 (14)	35
No. 3 - No. 4	Lesson 3	日月山石田土水火木禾 (10)	38
No. 4 - No. 6	Lesson 4	上中下左来右去出入坐立走长写字它最忙 (18)	25
No. 7 - No. 9	Lesson 5	风雨云雪电天地春夏秋冬的说是色花妈 (17)	29
No.9 - No.10	Lesson 6	马牛羊鱼虫鸟草黄白绿红蓝 (12)	33

those texts used in the first six lessons. The arrangement of target characters in the Zhongwen Textbook suggested that target characters were chosen based on specific topics from the texts rather than being selected based on their regular patterns. This way of arranging characters aligns with the extensive approach of teaching Chinese, i.e., new characters are chosen from the texts and are usually taught while children are learning the text characters (see on page 53 for a detailed explanation). In addition, all reading texts in the Zhongwen Textbook were annotated with Pinyin words, although some reading or writing tasks in the textbook questions were only presented in Chinese characters.

Each lesson was taught over 2-3 sessions using the following procedure. First, the form, pronunciation and meaning of target characters were taught, and character recognition practices were conducted, such as students looking at characters and reading aloud these characters. Students then learned how to write the target characters and practised writing, such as counting stroke numbers and remembering each character's writing strokes. Students were then guided to read and comprehend the text in the lesson, with the read-aloud practice being facilitated by Pinyin words. Finally, students practised using the target characters in the Zhongwen

Workbook (Year 1), which matched with the Zhongwen Textbook (Year 1). After each session, practice in the Zhongwen Workbook (Year 1) was assigned as homework and students were asked to memorise how to write target characters at home. In the following session, the Teacher read aloud all characters taught in the last week, and students wrote the characters in their notebook by memory without looking at the textbook.

Experimental Group. Reading materials for the experimental group were stories designed by the researcher. Target characters were chosen from the level 1 Chinese character list of the HSC Test (H. W. Wang, personal communication, July 19, 2018) (see Table 6).

To ensure a random selection of target characters, the researcher separated characters in the level 1 Chinese character list into three groups by assigning the first character to Group 1, the second character to Group 2, the third character to Group 3, the fourth character to Group 1, the fifth character to Group 3, and so on. The first 25 characters from the top of the list of each group of characters were selected. This ended up with 75 characters from which the researcher chose target characters for each reading material. After that, the researcher created six children stories, with around 12 target characters per story.

The stories featured age-appropriate content and sentence structures. For example, Story 3 involved a group of goats trying to protect their friend (a rabbit) from four evil kings. This story provided a context to learn new Chinese characters such as 羊 /yáng / (goat), 兔 /tù/ (rabbit), and 王 /wáng/ (the king). Note that target characters were chosen for each story mainly based on the feasibility of using these characters in the story. That is to say, to show orthographic regularities of characters was not an aim when target characters were assigned to each story. This way of arranging target characters aligns with the extensive approach of teaching Chinese characters.

The designed narratives included two specific features. The first feature was the frequent appearance of target characters in the text. Each target character was used at least six

Table 6

Information about reading materials for the experimental group in Study 1

Session number	Story number	Story title (Pinyin words/Chinese character totals)	Brief description	Target Chinese characters (Frequency of presentation in the story)
1, 2	1	买帽子 (Buying Hats) (205/232)	A boy and his father want to buy hats.	你 (6), 和 (7), 是 (8), 他 (9), 我 (11), 儿 (17), 小 (25), 爸 (32), 大 (33), 头 (39), 子 (40)
2, 3	2	月牙木头 (A Moon-shaped Wood) (352/392)	A boy and his father are looking for a piece of wood to build a house for their bunnies.	又 (6), 牛 (6), 马 (6), 森 (6), 林 (6), 红 (7), 月 (12), 牙 (12), 有 (12), 虫 (13), 木 (21), 毛 (26)
4, 5	3	糖果火山 (Candy Volcanos) (347/446)	A group of goats help their friend a rabbit to fight with four evil kings.	飞 (6), 田 (8), 灰 (9), 山 (11), 王 (12), 南 (12), 北 (12), 火 (13), 东 (13), 西 (14), 弟 (21), 瓜 (31), 羊 (55)
6, 7	4	雪人的朋友 (Snowman's Friends) (459/370)	A snowman goes to the city, forest and Antarctica to look for new friends.	长/zhǎng/* (6), 白 (7), 在 (7), 心 (8), 见 (9), 开 (10), 朋 (10), 友 (10), 可 (12), 以 (12), 看 (17), 色 (17), 皮 (18)
7, 8	5	谁动了我的杯子(Where is My Cup) (374/562)	Two detectives (Mrs Red Bean and Mr Rice) help a cat find her lost cup.	长/cháng/ (6), 耳 (6), 猫 (7), 米 (15), 手 (16), 生 (16), 豆 (16), 雨 (19), 点 (19), 杯 (32)
9, 10	6	时间旅行(Time Travel) (366/589)	A boy receives a watch as a Christmas gift and then travels to 900 years ago and 900 years in the future.	门 (6), 节 (6), 今 (6), 几 (6), 乐 (8), 车 (7), 书 (7), 片 (10), 没 (13), 年 (13), 朵 (15), 图 (40), 日 (8)

Note: Pinyin words were given for several characters because these characters have more than one pronunciation.

times to increase print exposure to target characters. The rationale of the six-time repetition is that Liu and Shiu (2011) found that Chinese native children could acquire simplified Chinese characters after being exposed to these characters around six times. Another feature of the designed stories for the experimental group was its format. In each story, target characters that

were to be learned and characters taught in previous texts were not presented with accompanying Pinyin words; the rest of the words in the text were only presented in Pinyin words. The rationale for this is that placing phonological aids (Pinyin words) alongside Chinese characters may not contribute to learning Chinese characters because the attention can be diverted from analysing the Chinese character orthographic representation (Ho, 2014). An example of the designed story is shown in Appendix 3.5. Further details about the teaching procedure in the experimental group are shown in Table 7.

Stories were displayed on a big screen via PowerPoint in front of the whole class. Chinese characters in the stories were shown in 45 Kaiti font, and Pinyin words were in 45 Songti font, respectively. Pinyin words in black font and Chinese characters highlighted by other colours. There were two or three sentences on each PowerPoint slide. Every student had one copy of the story.

The similarities and differences in teaching sessions between the experimental and control groups are demonstrated in Table 8. As can be seen, there were two main differences between the experimental and control groups. The reading materials for the experimental group were longer and provided more exposure to target characters than the texts for the control group. The read-aloud activities took the majority of session time for the experimental group, whereas learning and practising target characters were the main part of each session for the control group. These differences were implemented to answer the research questions for this study.

Table 7

Teaching procedure in the experimental group in Study 1

Steps	Description	Purpose
Introduction	The teacher introduced the topic and asked students' prior experiences or opinions about this topic.	• To help students prepare for comprehending the text.
1st Reading	The teacher read the text aloud, pointing to each character or Pinyin word while reading. Students listened to the teacher's reading and followed along visually.	• To allow the students to understand the context within which the target characters were placed. • To provide students input about the pronunciation, form and meaning of the target characters simultaneously.
2nd Reading	Both the teacher and students read aloud the text together sentence by sentence. The teacher pointed to each character or Pinyin word while reading. Also, students were told to either look at each word that the teacher pointed to or point to each word on their own copies while reading aloud.	• To consolidate the orthography-phonology and orthography-semantics associations of the target characters.
3rd Reading	The students read the text aloud by themselves. The target characters were then explicitly taught, including the form, pronunciation and meaning of target characters, the order of writing strokes of target characters. Students read aloud words containing target characters in chorus after the teacher. If target characters are compound characters, the teacher guided students to separate the characters into radicals but did not teach the functions of radicals. Students wrote each character three times after the characters were introduced.	• To expose students to orthographic, phonological, and semantic representations of target characters again. Students were likely to get familiar with target characters by the time when the third reading was finished. • To support students to learn three representations and internal structure of target characters intentionally.

Table 8

Similarities and differences in teaching sessions between the experimental group and control group in Study 1

		Experimental group	Control group
Similarities	Session length and location	• The length of each session was 1.5 hours. All sessions were delivered at the School. • All target characters belonged to the level 1 character list of the HSC Test.	
	Target characters	• The same group of 22 target characters were taught, which were 头耳手大小我有月山田火木长雨是色马牛羊虫白红.	
		• Target characters were arranged in a way aligning with the extensive approach to teaching Chinese characters.	
	Teaching procedure	• The form, pronunciation and meaning of target characters, and the order of writing strokes of target characters were taught. Words containing the target characters were read in chorus. Character writing practices were included.	
Differences	Teaching procedure	• Top-bottom (The story was read aloud three times and discussed before characters were taught.)	• Bottom-up (Characters were taught, and practices on characters were conducted before the text were read and comprehended.)
	Teaching materials	• Six stories with on average 325 Pinyin words and 442 characters in each story	• Lesson 2 to Lesson 6 in Zhongwen Textbook and Workbook (Year 1)
		• Target characters in the story were not annotated with Pinyin words.	• The text in each lesson had around 32 characters annotated with Pinyin words.
		• Target characters were repeated at least six times in the story.	• Not all target characters appeared in the text.
	Target characters	• 72 target characters in total	• 71 target characters in total

Results

Pre-test data were analysed first to investigate any significant differences in the two groups for each measurement prior to the ten teaching sessions. Subsequent analyses were then performed to determine if students in the experimental group showed larger improvements in Chinese character knowledge and Chinese reading comprehension measures than their counterparts in the control group over the ten teaching sessions. Data were analysed using IBM SPSS (Statistics 25).

Descriptive statistics were used to show the scores for the measures at pre-test and post-test in each group. Mixed analyses of variance (ANOVAs) were conducted to determine any significant differences in the Chinese character knowledge and reading comprehension measures between the two groups over ten teaching sessions. The exception was for the Chinese Passage Comprehension Task because of the zero scores in the pre-test. Independent sample t-tests on the Chinese Passage Comprehension Task in the post-test were used instead. Lastly, Pearson product-moment correlations were performed for the experimental group to determine any associations between the change in the Chinese character knowledge and reading comprehension measures.

Any potential difference between the two groups in demographic variables was examined. Results from Chi-square tests indicated that there were no significant differences between the experimental group and the control group in terms of gender, χ^2 (1, N = 40) = .44, p = .51) and home language, χ^2 (1, N = 40) = .40, p = .53). Furthermore, an independent samples t-test showed that the difference between the two groups in age did not reach the significance level (p = .05), t (38) = 1.97, p = .06. The mean age of the control group was slightly older than the mean age of the experimental group by nine months. (Due to this potential age difference,

analyses were performed controlling for age, but these showed the same results as the main analyses presented below– see Appendix 3.6 for these analyses of covariance.)

Descriptive statistics for both groups are presented in Table 9 and Table 10. Participants in the experimental group showed better Chinese oral receptive vocabulary and lower English word recognition ability at the pre-test than the control group. The control group's better English word recognition ability may be because participants in the control group were older than the experimental group on average. All participants were schooling in English-medium primary schools. Older students would be in higher grades in primary school and, therefore, may have received more English reading instruction leading to higher levels of written word experience. Also, slightly more children in the control group had both Chinese and English as home languages compared to children in the experimental group. This difference may also have led to the control group's better performance on English Word Reading Task. To better understand the floor effect in the Chinese sentence and passage comprehension tasks, bar charts are included in Appendix 3.7 to show the number of students who were showing the floor effect.

Table 9

Scores for the measures only conducted at pre-test in Study 1

Measures	Experimental group (n = 20)	Control group (n = 20)
Chinese Vocabulary Task		
Mean (*SD*)	85.60 (40.15)	73.35 (22.39)
Range (0-180)	38-155	48-135
English Word Reading Task		
Mean (*SD*)	48.20 (24.72)	58.95 (27.65)
Range (0-110)	14-93	7-103

Table 10

Scores for the measures at pre-test and post-test in Study 1

Measures	Experimental group (n = 20)		Control group (n = 20)	
	Pre-test	Post-test	Pre-test	Post-test
Character Listening Task				
Mean (*SD*)	.60 (1.27)	4.65 (1.6)	1.20 (1.51)	4.70 (1.87)
Range (0-20)	0-5	2-8	0-5	1-8
Character Reading Task				
Mean (*SD*)	4.00 (2.31)	9.60 (3.38)	4.30 (1.92)	6.75 (1.71)
Range (0-50)	0-10	3-16	0-8	3-10
Character-Picture Matching Task				
Mean (*SD*)	.75 (1.68)	4.25 (1.97)	1.55 (1.61)	4.00 (1.41)
Range (0-35)	0-7	2-9	0-5	2-6
Chinese Sentence Comprehension Task				
Mean (*SD*)	1.10 (.85)	3.35 (.99)	1.65 (1.09)	2.80 (1.20)
Range (0-10)	0-3	2-5	0-3	0-5
Chinese Passage Comprehension Task				
Mean (*SD*)	.00 (.00)	2.45 (2.82)	.00 (.00)	1.30 (1.87)
Range (0-20)	0	0-8	0	0-6

Independent samples t-tests were used to detect any significant differences between two groups in the pre-test measures. No significant difference was found in the Chinese Vocabulary Task (t = -1.19, df = 29.77, p = .24) [2] or in the English Word Reading Task (t = 1.30, df = 38, p = .20). These results suggest that any differences between the participants in Chinese receptive listening vocabulary and English word reading skills were not significantly large compared to variability between individuals. As for other pre-test measures, no significant differences were found for the Character Listening Task (t = 1.36, df = 38, p = .13), the

[2] Note that calculations were based on equal variance not assumed due to a significant Levene's test.

Character Reading Task (t = .45, df = 38, p = .66), the Character-Picture Matching Task (t = 1.54, df = 38, p = .13) and the Chinese Sentence Comprehension Task (t = 1.78, df = 38, p = .08).

Mixed (one between and one within subjects factor) analyses of variance were carried out on each pre/post measure (except for the passage comprehension measure) to contrast the gains produced by the experimental and control groups. There was no main effect between groups overall. In terms of the Character Reading Task, there was a significant main effect of time (F (1, 38) = 122.06, p < .001, η_p^2 = .76) and a significant interaction between group and pre/post scores (F (1, 38) = 18.69, p < .001, η_p^2 = .33). The increase over time was higher for the experimental group than for the control group, suggesting the experimental group improved to a larger extent in reading characters. There were a significant main effect for time (F (1, 38) = 249.36, p < .001, η_p^2 = .87) for the Character-Picture Matching Task. The interaction between group and pre/post scores for the Character-Picture Matching Task was also significant (F (1, 38) = 7.77, p = .01, η_p^2 = .17). The experimental group demonstrated larger improvements in their knowledge of orthography-semantics correspondence than the control group. Performance in the Character Listening Task did not show a significant interaction between group and pre/post measures (F (1, 38) = 1.34, p = .26, η_p^2 = .03) although the task showed a significant main effect of time (F (1, 38) = 252.02, p < .001, η_p^2 = .87).

The analyses indicated a significant main effect of time (F (1, 38) = 128.07, p < .001, η_p^2 = .77) and a significant interaction between group and pre/post scores (F (1, 38) = 13.41, p = .00, η_p^2 = .26) on the Chinese Sentence Comprehension Task. The increase over time was larger for the experimental group than the control group. For the Chinese Passage Comprehension Task, an independent samples t-test was used to compare the two groups' post-

test scores (all students produced zero scores in the pre-test measure). This analysis indicated a non-significant difference between two groups (t = -1.52, *df* = 32.98, *p* = .14)[3].

The difference between pre- and post-test scores in each measure for the experimental group was calculated, and Pearson product-moment correlations of differences scores were analysed (results shown in Table 11). These analyses were used to investigate if relationships existed between the experimental group's improvements in Chinese character and Chinese reading comprehension measures.

Table 11

Results of Pearson product-moment correlations for the experimental group in Study 1

Variable	1	2	3	4
1. Character Listening Task				
2. Character Reading Task	*r* = *.35* *p* = .14			
3. Character-Picture Matching Task	*r* = .22 *p* = .36	*r* = .21 *p* = .37		
4. Chinese Sentence Comprehension Task	*r* = *.40* *p* = .08	*r* = .24 *p* = .31	*r* = -.20 *p* = .40	
5. Chinese Passage Comprehension Task	*r* = .03 *p* =.89	*r* = *.44* *p* = .05	*r* = *.32* *p* = .17	*r* = .12 *p* = .62

Note: Cohen's (1988) guidelines include large correlations (.50 ≤ |*r*| < 1.0), medium correlations (*r* =.30 ≤ |*r*| < .50), and small correlations (.10 ≤ |*r*| < .30). The medium correlations according to Cohen (1988)'s guidelines were italicised.

The results did not identify any statistically significant correlations between the measures, even though the correlation between the Character Reading Task and the Chinese Passage Comprehension Task was nearly significant, *r* (2) = .44, *p* = .053. Considering a small sample size (*n* = 20) in this research, results were also interpreted using guidelines proposed by Cohen (1988) for dividing effect sizes into small (.10 ≤ |*r*| < .30), medium (.30 ≤ |*r*| < .50) and large (.50 ≤ |*r*| < 1.0). The correlation analyses identified medium correlations between the experimental group's gains in the Chinese Sentence Comprehension Task and the gains in

[3] Note that calculations were based on equal variance not assumed due to a significant Levene's test.

the Character Listening Task. Small correlations were found between the Chinese Sentence Comprehension Task and the Character Reading Task development; between the Chinese Sentence Comprehension Task and the Character-Picture Matching Task development. In addition, the Chinese Passage Comprehension Task had medium correlations with the Character Reading Task and the Character-Picture Matching Task. The Chinese Passage Comprehension Task had a small correlation with the Character Listening Task.

Discussion

This study aimed to explore the effectiveness of a shared reading teaching method on developing the knowledge of orthographic, phonological, and semantic representations of characters and Chinese reading comprehension for Chinese heritage language children at the beginning level of reading in Chinese. It was found that children in the shared reading condition demonstrated significantly larger gains in the performance on two Chinese character tasks (Character Reading Task and Character-Picture Matching Task) and one Chinese reading comprehension task (Chinese Sentence Comprehension Task) than the textbook-based condition over time. These results suggest that the shared reading teaching method has enabled students to develop more robust knowledge about orthography-phonology and orthography-semantics associations of characters and better Chinese reading comprehension outcomes in students.

Frequent exposure to Chinese characters and rich contextual information in the shared reading teaching method appears to have contributed to the more significant growth in children's character knowledge. More frequent exposure to characters' orthographic, phonological and semantic representations simultaneously in the shared reading method may have led to children's better knowledge about orthography-phonology correspondence (measured in Character Reading Task) and orthography-semantics correspondence (examined

in Character-Picture Matching Task). The facilitation of frequent exposures to characters on character acquisition is explainable according to the Lexical Constituency Model (Perfetti & Tan, 1999). Taking the knowledge of orthography-phonology association as an example, the learner can read aloud a Chinese character as soon as the phonological unit of the character in the learner's mental lexicon is activated. The threshold of the activation of the phonological unit is determined by the frequency of encounters with the phonological representation associated with the character's orthographic representation (Perfetti & Tan, 1999). More frequent exposure to the form and the sound of a Chinese character simultaneously will lead to a lower threshold of retrieving the phonological information of the character. Likewise, more frequent exposure to the connection between the orthographic and semantic representations of a Chinese character will reduce the threshold needed to retrieve the semantic information of the character.

The shared reading method in this study allowed Chinese heritage children to be exposed to new characters' orthographic, phonological and semantic representations simultaneously. Children were exposed to or reproduced the phonological representation of characters by listening to the teacher's read-aloud or reading the story aloud by themselves. Children were exposed to the orthographic representation of characters by looking at each character while reading stories aloud. Children were exposed to the semantic representation of characters through comprehending characters within the context of the story. In addition, new characters were repeated at least six times in the story, so children in the shared reading class had at least 18 times of exposure to the three representations of new characters over three read-aloud activities. However, in the textbook-based condition, not all new characters appeared in the text. This meant that children in the textbook-based condition did not have exposure to new characters' three representations as frequently as the children in the shared reading condition. More frequent print exposure in the shared reading condition may have led to lower thresholds

of activating the phonological and semantic information of characters and fostered the development of character knowledge.

Previous empirical studies have not examined how the frequency of print exposure to characters in Chinese literacy instruction would affect character acquisition. However, the facilitative effect of print exposure on character acquisition may be implied in previous research on repeated text reading. It was found that repeated text reading positively impacted character acquisition for Chinese first and second language learners (Anderson et al., 2002; Han and Chen, 2010). Study 1 of the current research provides insight into how shared reading activities can provide frequent print exposure, thus potentially fostering character acquisition for Chinese heritage children. However, further investigation is required to explore other feasible ways of providing Chinese heritage children more exposure to new characters in Chinese lessons. More extensive data are needed to test the effect of print exposure to characters in Chinese literacy instruction on character acquisition.

The greater contextual information provided in the reading materials in the shared-reading class compared to the traditional textbooks may have supported the development of children's knowledge about characters' orthography-semantics correspondences. The average length of each reading material in the shared reading class was 325 Pinyin words and 442 characters, which was much longer than the text in the textbook-based class that was 32-characters long on average. Each time the child encountered a character in the story, the character's orthography-semantics correspondence would be activated. Furthermore, exposure to characters across slightly different sentences may have facilitated students' understanding of the meaning of a concept and increased the depth and breadth of the child's vocabulary. It was likely that the children in the shared reading class had incidental learning of characters via read-aloud activities. Then, the character knowledge acquired incidentally within the context was reinforced through explicit character instructions after three read-aloud activities. In contrast,

in the textbook-based condition, new characters were taught before reading and understanding the text. This teaching strategy provided children with limited contextual information. Therefore, the different levels of contextual information provided in the two teaching methods may have resulted in different levels of development on the knowledge about characters' orthography-semantics correspondence after the ten teaching sessions.

The potential contribution of contextual information on acquiring the meaning of novel characters for Chinese heritage children in Study 1 is consistent with previous research on Chinese native children and Chinese L2 learners. Chinese native children were able to learn more characters in rich contextual information in comparison to less informative contexts (Shu et al., 1995). Chinese L2 learners relied on contextual information to work out the meaning of characters, especially when semantic radicals cannot provide helpful semantic clues (Wang & Koda, 2013). The previous research focused on incidental learning via reading, but the current study combines incidental learning during read-aloud activities and explicit character instruction after read-aloud activities. The impact of contextual information on incidental learning of characters for Chinese heritage children still requires further investigation.

More robust character knowledge gained by children in the shared reading class may lead to better reading comprehension at the sentence level, considering that decoding plays a vital role in reading comprehension (Gough & Tunmer, 1986). Before the ten teaching sessions, children from the shared reading class and the textbook-based class in this study had equivalent Chinese oral vocabulary and home language. Correlation analyses identified medium correlations between the improvement in the Chinese Sentence Comprehension Task and the Character Listening Task, and between the improvement in the Chinese Passage Comprehension Task and the Character Reading Task for the shared reading class. The Character Listening Task and the Character Reading Task examined children's knowledge of orthography-phonology correspondence. These results indicated that, in the shared reading

class, the improvement in knowledge of orthography-phonology correspondence was correlated with the improvements in Chinese reading comprehension. That is to say, children who were able to retrieve phonological representations of characters better could better understand Chinese sentences and passages. However, the inconsistency in correlations identified in the current study suggests a need for more data before making firm conclusions.

Although children from the shared reading class demonstrated the gains in Chinese reading comprehension at a passage level over the ten teaching sessions, there was a large range in scores for the Chinese Passage Comprehension Task in the post-test with scores from 0 to 8 out of 20. A potential reason was that children did not acquire enough Chinese characters to process the passages fully. Character recognition processes still required most of the processing capacity of these relatively inexperienced learners, so fewer resources were left for processes needed to connect information across individual sentences. Moreover, open-ended questions may be difficult for some children. Ozuru et al. (2013) argued that open-ended questions are more sensitive than multiple-choice questions in readers' ability to generate relevant and accurate explanations during reading. Further consideration to such measures for these cohorts of children is needed.

Nevertheless, the results should be interpreted carefully, owing to limitations in this study. Target characters in the experimental and the control groups were not the same, which may have led to learning differences. Furthermore, the Chinese character measures in Study 1 examined general character knowledge and did not assess the development in the knowledge of taught Chinese characters. The data suggest that the experimental group showed greater gains in tasks requiring better recognition of characters rather than better recognition of those characters taught in class. In addition, Pinyin reading ability was not assessed formally at the pre-test, although school assessments were used to ensure that students had reached a certain level of Pinyin reading. Including a measure of Pinyin knowledge would enable any difference

in Pinyin reading between the groups to be identified. Pinyin reading ability might affect the participants' performance because Pinyin words were used to support learning in both groups. Previous research has found that Pinyin knowledge can be a strong predictor of Chinese character learning for children who are Chinese first and second language learners (Lin et al., 2010; Lü, 2017b). The specific effects of Pinyin words on the development of Chinese character reading is worthy of further investigation (see Ho, 2014). Lastly, the meaning and function of semantic and phonetic radicals were not taught and focused on in this study because most of the target characters were simple characters. According to Ho, Ng et al. (2003)'s model of Chinese orthographic knowledge development, the development of radical knowledge is an indispensable part of Chinese orthographic learning. Radical awareness is closely related to character learning for native Chinese children (e.g. Chen et al., 2014; Shu et al., 2000) and Chinese second language learners (e.g. Shen & Ke, 2007; Taft & Chung, 1999; Wang & Koda, 2013). Given the importance of radical awareness to character acquisition, further research on the development of radical awareness is required.

To sum up, the findings of Study 1 suggested that frequent print exposure to Chinese characters and rich contextual information in reading materials in the shared reading method facilitated Chinese heritage children's character learning. Increased character knowledge may have contributed to a larger improvement of Chinese reading comprehension at the sentence level in the shared reading condition. However, there are several limitations in Study 1, which will be considered in Study 2, including the same target characters for both experimental and control groups, measures of Pinyin knowledge, and radical awareness.

Chapter 4 Study 2

Introduction

Study 2 further explored the shared reading teaching method proposed in Study 1 by combining explicit instruction on semantic radicals because of the crucial role of radical awareness in Chinese orthographic learning (e.g. Chen et al., 2014; Ho, Yau et al., 2003). Given that semantic radicals have not been focused on in the shared reading method in Study 1, the shared reading method was revised to integrate explicit semantic instruction in Study 2. New characters in the modified shared reading method were arranged via semantic radical-based grouping, which has been used in Xu et al. (2014) and found to be effective on radical awareness development for Chinese second language learners. Study 2 aimed to examine the effectiveness of the revised shared reading method on the development of character knowledge and Chinese reading comprehension for Chinese heritage children. The research questions of Study 2 were:

- Do Chinese heritage language children at the beginning level of reading in Chinese develop better knowledge of orthographic, phonological, and semantic representations of characters in the revised shared-reading condition that combined semantic radical-based grouping and explicit semantic radical instruction, or the conventional textbook-based condition?
- Do these children have better Chinese reading comprehension outcomes in the revised shared-reading condition or the conventional textbook-based condition?
- Do these children establish better semantic radical awareness in the revised shared-reading condition or the conventional textbook-based condition?

It was hypothesised that:

- A more significant development in Chinese character knowledge would be achieved in the shared reading condition. The reason is that more frequent exposure to characters' orthographic, semantic and phonological representations and more contextual information will be provided in the shared reading condition than the textbook-based condition. Frequent exposure to characters and contextual information has been found to be closely related to Chinese orthographic learning (Liu, 2018; Perfetti & Tan, 1998; Shu et al., 1995).
- Larger gains in Chinese reading comprehension would be reported in the shared reading condition. Reading comprehension is the product of decoding and linguistic comprehension (Gough & Tunmer, 1986). Children in the shared reading condition would have greater improvement in character knowledge than children in the textbook-based condition (see the first hypothesis). Children in the shared reading condition would also outperform children in the textbook-based condition in linguistic comprehension. This is because the shared reading condition will include more read-aloud and reading comprehension activities than the textbook-based condition.
- Greater development in semantic radical awareness would be found in the shared reading condition. Only in the shared reading condition, target characters that share the same semantic radical will be taught together in one reading material, which would make it easier for children to remember and understand the function of semantic radicals. In addition, the shared reading method will contain more practice on the function of semantic radicals, i.e. guiding students to figure out the meaning of unfamiliar characters based on the clue given by

semantic radicals. This would lead to better semantic radical awareness in the shared reading condition.

Methodology

Design

Study 2 had an experimental group taught with a revised shared reading method and a control group taught with the more traditional textbook-based method. Participants' parents/guardians chose a group for their child instead of the researcher randomly assigning participants to groups. The procedure of selecting a group by parents/guardians followed the class placement protocol of the research site. Participants received ten teaching sessions, pre-tests and post-tests.

Participants

This study was carried out at the same Chinese community school as Study 1. The School provided 1.5-hour Mandarin Chinese lessons on Saturdays during the period when this study was implemented. Students in the School were taught simplified Chinese characters through conventional textbook-based instruction and required to learn Pinyin before enrolling in Chinese classes. After the school principal provided consent for allowing this study to be conducted in the School, students and their parents/caregivers were informed of this research and were provided with information sheets and consent forms in either Chinese or English. Families were invited to an information session where the researcher introduced the current study and answered questions. All students who enrolled in Year 1 Chinese lessons at the School, assented to be involved in the current study, and for whom parents provided informed consent, were recruited in this study.

There were 31 students whose parents returned the consent and assent forms for Study 2. Among these students, 19 students participated in the experimental group and 12 students in the control group. Parents/guardians were also asked to provide information about their child's date of birth, gender and home language(s). All 31 students took part in pre-tests and post-tests. However, three participants from the initial 31 cohort were excluded from the data analysis in this study because their Chinese vocabulary was very limited. Their scores in the Chinese Vocabulary Task were below 10 out of 110, in contrast to 83.89 as the mean score of the other 28 participants. These three students' parents also indicated that they did not speak Mandarin Chinese at home. These results inferred that these three students had very limited Chinese listening understanding ability, and they were very likely not able to understand what the teacher said in Chinese. They did not meet the inclusion criteria for this study, i.e. being a Chinese heritage language learner with good Chinese speaking and listening skills. Therefore, the final sample for the data analysis included 16 children in the experimental group and 12 children in the control group. Fourteen children from the experimental group in this study also participated in the experimental group in Study 1. Nine children from the control group in this study also were participants of the control group in Study 1.

Students' ages in the experimental group ranged from 5 years 11 months to 11 years of age in the final sample. Participants in the control group ranged from 6 years 2 months old to 10 years old. More girls than boys were in both groups: 69% of children in the experimental group and 59% of children in the control group were girls. Parents indicated two types of the home language in this study: Chinese only or Chinese and English. Less than half of children in the experimental group had Chinese as the only primary home language, whereas Chinese was the main home language for more than 80% of children in the control group. Demographic information is shown in Table 12.

Table 12

Demographic information for participants in Study 2

Variable	Experimental group	Control group
Age		
Mean age in months (*SD*)	91.94 (18.51)	92.17 (16.19)
Range age in months	71-132	74-120
Gender		
Female	*n* = 11 (69%)	*n* = 7 (58%)
Male	*n* = 5 (31%)	*n* = 5 (42%)
Home language		
Chinese	*n* = 7 (44%)	*n* = 10 (83%)
English and Chinese	*n* = 9 (56%)	*n* = 2 (17%)

Assessment Materials

Measurement in Study 2 included four Chinese character knowledge tasks, a semantic radical knowledge task, two Chinese reading comprehension tasks, a Chinese receptive vocabulary task, an English word recognition task and two Pinyin skill tasks (see Table 13).

Before the ten teaching sessions, participants were assessed to determine whether the experimental group and the control group had equivalent Chinese oral vocabulary and English word recognition ability. The Chinese Vocabulary Task and English Word Reading Task were the same as those used in Study 1. Participants were assessed by a Pinyin Spelling Task and a Pinyin Read-Aloud Task to investigate any difference in the level of Pinyin reading and spelling skills that the experimental and control groups showed prior to the ten teaching sessions. If differences did occur by chance, then the Pinyin scores will be used to statistically

control differences between the groups when determining changes in character knowledge over the intervention period.

Table 13

An index of assessment battery in Study 2

Variables	Measurement
Chinese character knowledge	Character Listening Task
	Character Reading Task
	Character-Picture Matching Task
	Target Character Read-Aloud Task
Semantic radical awareness	Semantic Radical Picture Matching Task
Chinese reading comprehension	Chinese Sentence Comprehension Task
	Chinese Passage Comprehension Task
Chinese receptive vocabulary	Chinese Vocabulary Task
English word recognition	English Word Reading Task
Pinyin skills	Pinyin Spelling Task
	Pinyin Read-Aloud Task

Assessment for Chinese character knowledge, semantic radical awareness and Chinese reading comprehension was also carried out at pre- and post-tests to detect any improvement over the ten teaching sessions. The Character Reading, Character Listening, and Character-Picture Matching Task and Chinese Passage Comprehension Task in Study 1 were used in Study 2 without any changes in test items (see Assessment Materials section in Chapter 3 on page 68 for descriptions of these measures). The Chinese Sentence Comprehension Task in Study 1 was extended and then used in Study 2. Tasks about target characters and semantic radical awareness were added to Study 2, i.e. the Target Character Read-Aloud Task and Semantic Radical Picture Matching Task. The following section presents the rationale, design and procedure of tasks that were added to Study 2.

Pinyin Spelling Task. A Pinyin Spelling Task measured participants' phonological coding ability of Pinyin knowledge. This task was adapted from the invented pinyin spelling measure in Lin et al. (2010), which was also used in Wang and McBride-Chang (2016). The developed Pinyin Spelling Task contained five one-syllable Pinyin words (xiā, zì, lóng, chē, and dòu) and five two-syllable Pinyin words (bān mǎ, xué shēng, nǎi niú, rú guǒ, yuè liàng). The internal consistency of the Pinyin Spelling Task in the current study was good (Cronbach's α=.88).

The test was administered individually. The researcher read aloud each word, and children were asked to write down the given words in pinyin. Three aspects of the pinyin system (i.e. onset, rime and lexical tone) were rated as either incorrect (zero scores) or correct (one score). For example, one score was given when children correctly spelt the onset /l/ of the item /lóng/, with one score for the correct rime /ong/ and one score for the correct tone (the rising diagonal line above a letter "o" in /lóng/). The maximum score for one-syllable Pinyin words was three, and the maximum score for two-syllable Pinyin words was six. Therefore, scores ranged from 0 to 45 for the task.

Pinyin Read-Aloud Task. Participants' ability to read Pinyin words aloud was tested by a Pinyin Read-Aloud Task developed by the researcher. The task consisted of 57 items comprising 12 Pinyin letters, 15 one-syllable Chinese words in Pinyin format, and 30 two-syllable Chinese words in Pinyin format (see Appendix 4.1). Based on the data collected in the current study, the internal consistency of the Pinyin Read-Aloud Task was good for this group of 28 participants (Cronbach's α=.98).

Participants were presented with the 57 items printed on A4 paper and were asked to read aloud words from the beginning of the word list from left to right. Self-corrections of any answer were permitted, and the task was not timed. Participants were encouraged to read aloud all items and were allowed to skip the items that they did not know how to read.

For the 12 items of Pinyin letters, each item was given one score for the correct answer and zero scores for incorrect or no answers. For one-syllable Pinyin word items, the score range for each item was 0-3, including one score awarded for the correct onset, rime and tone, respectively, and zero scores awarded for incorrect or no answers. For example, for a test item /tái/, one score was given when children read the onset /t/ correctly; one score was given for correctly pronouncing the rime /ai/; one score was given for saying the correct tone (the rising diagonal line above a letter "a" in /tái/). Following the same scoring criteria, the score range for each two-syllable Pinyin word item was 0 to 6. The range of scores for the Pinyin Read-Aloud Task was 0 to 237.

Target Character Read-Aloud Task. A new target Character Read-Aloud Task was added. The combination of this task and other tasks about general character knowledge aimed to provide more comprehensive evidence on any progress of character knowledge. This task included 40 target characters for the experimental and control groups (see the Teaching Sessions section on page 110 for details). Items in this task were presented in Appendix 4.2. The internal consistency of this task at the pre-test was Cronbach's α = .89.

This task required participants to read aloud Chinese characters printed on A4 paper. Participants were permitted to self-correct their answers and skip the characters that they did not know. The task was not timed. Each correct answer was given one score, and the scores ranged from 0 to 40 in this task.

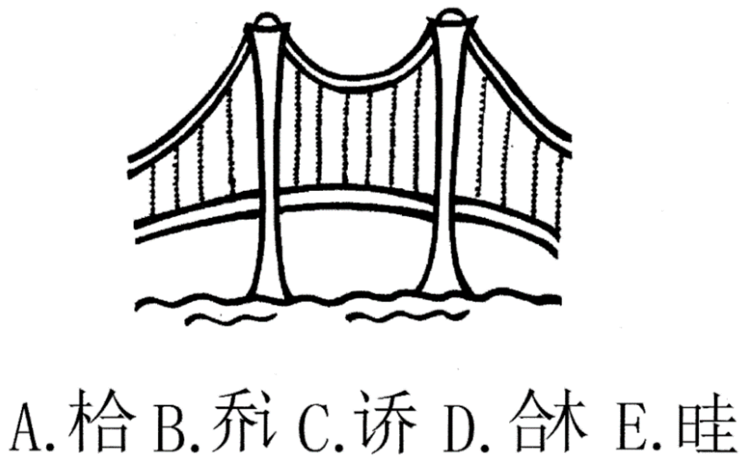
Semantic Radical Picture Matching Task. The researcher developed the Semantic Radical Picture Matching Task based upon the picture-novel character mapping task in Tong and Yip (2015). This task was added in Study 2 to measure children's awareness of the functions of semantic radicals introduced in the ten teaching sessions and to show any difference in semantic radical awareness between the experimental and control groups.

There were ten items, and these items tested children's ability to recognise ten semantic radicals, including 犭 (animal), 艹(plants), 目(eyes), 囗 (boundary), 亻 (person), 讠 (talking), 女 (female), 木(wood), 宀(house) and 扌 (hand). The ten semantic radicals were taught in the experimental and control groups (see the Teaching Sessions section on page 110 for details). The picture-novel character mapping task in Tong and Yip (2015) has items about 犭 (animal), 艹(plants), 目(eyes), 女 (female), 木(wood), and 宀(house) so the researcher decided to use these six items for the current study. The researcher developed four new items to test the radical awareness of 囗 (boundary), 亻 (person), 讠 (talking), and 扌 (hand) (see Appendix 4.3). Cronbach's α yielded .88 in the pre-test based on the data in this study.

Each item contained a picture and five pseudo-characters. The picture shows a concrete object or specific concept. For example, in the practice item, the target picture was a bridge, as shown in Figure 5. The real character representing the meaning of bridge is 桥 /qiáo/ which has the semantic radical 木 (wood) and the phonetic radical 乔 /qiáo/.

Figure 5

An example for the Semantic Radical Picture Matching Task



Pseudo-characters refer to non-existing Chinese characters that have a real phonetic radical and a real semantic radical. Of five pseudo-characters, two were the combinations of correct semantic and phonetic radicals in legal positions, such as the options A 桮 and C 诙 in the practice item. Two pseudo-characters were the combinations of correct semantic and phonetic radicals in illegal positions, such as the options B 乔 and D 舒. One pseudo-character contained semantic and phonetic radicals unrelated to the picture, such as the option E 哇 .

The task was administrated individually. The researcher introduced a short scenario: "Charlie went to a monster school to learn a monster language, but he needed help figuring out some words in the monster language. There were five patterns along with a picture. Please choose one pattern that goes best with the meaning of the picture." The researcher then presented all items one by one on A4 paper. In the example of the bridge, the researcher gave a semantic cue orally in English: *the bridge was made of wood in ancient times in China*. Participants were asked to choose a pseudo-character that they thought represented the meaning of the given picture. If participants were able to recognise semantic radicals and knew that semantic radicals provide a cue for the meaning of whole characters, they would choose the options which had the correct semantic radical. If participants were aware that semantic radicals normally appear at a certain position, they would choose the option which had the correct semantic radical in the legal position.

Answers were scored considering two aspects: recognising semantic radicals and knowing the legal positions of semantic radicals. For each item, one score in functional knowledge sub-score was given for the pseudo-character containing the correct semantic radical; one score in positional knowledge sub-score was given if the pseudo-character has the correct semantic radical in a legal position. In the example of the bridge, the option A 桮 was given two scores because it has the semantic radical 木 in a legal position. The options C 诙

and B 乔⺡were scored zero because they have the phonetic radical 乔 rather than the semantic radical 木. The option D 合休was given one score because the semantic radical 木 was in an illegal position. The option E 哇was a control option that contains neither semantic information nor phonetic information of bridge in Chinese and scored zero. Therefore, for ten test items in this measure, the maximum functional knowledge sub-score was 10, as same as the maximum positional knowledge sub-score. The total score for this measure ranged from 0 to 20.

Chinese Sentence Comprehension Task. The Chinese Sentence Comprehension Task in Study 1 was employed in Study 2, but the task had been extended by having four extra items (see Appendix 4.4). S Some participants of this study had participated in Study 1 and answered half of the items correctly in the post-test of Study 1. Adding four extra items that involve more complex Chinese characters and sentence structures aimed to avoid a ceiling effect and increase the potential to detect any improvement in sentence reading comprehension. Chinese characters in the four extra items were chosen from the level 1 Chinese characters list of the HSC Test (H. W. Wang, personal communication, July 19, 2018). The procedure of conducting this task and the scoring criteria were the same as the Chinese Sentence Comprehension Task in Study 1 (see page 73). The task produced a Cronbach's alpha score of .64 in the pre-test of Study 2.

Procedure

Pre-tests were administered upon the return of consent and assent forms. All pre- and post-tests are shown in Table 14. Assessments were carried out during after-school hours either at the School or at participants' homes based on what was best for parents. All tests were conducted individually by the researcher and a trained research assistant who was a Chinese native speaker and a master's student studying at a university in the same city as the School. The research assistant signed a research assistant confidentiality form and received a training

session about the assessment procedure and the assessment protocol by the researcher. Although the research assistant carried out assessments, all answers were coded and marked by the researcher.

Table 14

*An index of the measures at the pre-tes*t *and post-test in Study 2*

Measurement	Pre-test	Post-test
Character Listening Task	√	√
Character Reading Task	√	√
Character-Picture Matching Task	√	√
Target Character Read-Aloud Task	√	√
Semantic Radical Picture Matching Task	√	√
Chinese Sentence Comprehension Task	√	√
Chinese Passage Comprehension Task	√	√
Chinese Vocabulary Task	√	n/a
English Word Reading Task	√	n/a
Pinyin Spelling Task	√	n/a
Pinyin Read-Aloud Task	√	n/a

The pre-tests were conducted over three sessions and took around 100 minutes to complete. After the ten teaching sessions finished, the post-tests were administered at the earliest time that participants were available. It took approximately 75 minutes to complete the post-test, which were administrated over three sessions. Participants were able to have a break whenever they needed to during the assessment. The Chinese Vocabulary Task, the English Word Reading Task, the Pinyin Spelling Task, and the Pinyin Read-Aloud Task were executed only at the pre-test, but the rest of the measures in Table 14 were carried out both before and after the ten teaching sessions.

Teaching Sessions

Ten teaching sessions were carried out as lessons in the Chinese Saturday programme of the School in the second semester in 2019, with 1.5 hours for each session. Participants in the experimental group were given the shared reading method by the researcher, while the control group were taught with the conventional textbook-based method by the Teacher, a different Chinese language teacher from the one included in Study 1. The Teacher was informed about the current research by the researcher and understood that participants who self-chose to participate in the control group would join her class, where she would deliver the lessons as she usually would in the School.

This study included the same list of target characters for the experimental group and the control group. The researcher chose target characters for this study from the Zhongwen Textbook (Year 1) used in Year 1 Chinese classes at the School to align the experimental group teaching with the control group teaching. Year 1 Chinese classes would learn Lessons 8 to 11 in the Zhongwen Textbook (Year 1) during the current study period. The characters from Lessons 8 to 11 were excluded if they were already taught to the experimental group in Study 1. This was because 14 out of 16 children in the experimental group in this study also participated in Study 1. Excluding these previously taught characters from the target character list ensured that the participants would not have received any formal instructions on the target characters in Study 2 before starting this study. This selection process ended up with 40 target characters that were new to children in both the experimental and control groups in Study 2.

Control Group. The ten teaching sessions included a total of 57 Chinese characters being taught, with five or six new characters for each session (see Table 15). Two short texts were taught in Lesson 8, Lesson 9, and Lesson 10, and one text was taught in Lesson 11. The average length of the texts was 31 characters.

Table 15

Information about teaching materials for the control group in Study 2

Session number	Lesson	Target Chinese characters (total numbers)	Length of texts (total characters)
No. 1- No. 3	Lesson 8	开了真高兴车见说早你们好太阳对书包要 (18)	64
No. 4- No. 6	Lesson 9	的家这有爸妈爷奶和放回到给完把 (15)	59
No. 7- No. 9	Lesson 10	花园门前个他后外年季儿看公朵可玫菊兰 (18)	61
No. 10	Lesson 11	认方向面象猪 (6)	32

For every lesson in the textbook, the Teacher guided students to read aloud and comprehend the text before teaching characters. The purpose of read-aloud was to practice reading Pinyin words instead of characters because all characters in the text were annotated with Pinyin words. After reading the text, students were taught target characters one by one. For each character, students were taught the sound, the meaning and the order of strokes for writing the character. Students were also taught the name and meaning of semantic radicals for compound characters, but they did not have any practice on working out the meaning of a phono-semantic compound character based on its semantic radical. For example, the Teacher told students that the character 你 /nǐ/ (you, person spoken to) has a semantic radical 亻. We call this radical 亻 "single person radical" because this radical means a person. But the Teacher did not give other unfamiliar characters that have the radical 亻 and guided students to work out the meaning of these unfamiliar characters based on the radical 亻. The Teacher also used activities that focused on supporting students to remember the new characters. For example, children were asked to find the correct form of a character after the Teacher read aloud the

character, count how many strokes in each character, and write characters on the whiteboard. Students also did some practices about target characters in a workbook that matches the Zhongwen Textbook (Year 1). Homework for each session included exercises in the workbook and reading texts in the textbook. Students were also given a list of two-character words that had the target characters and asked to memorise how to write these words at home. The Teacher tested whether students could write these words at the beginning of the following session.

Experimental Group. The shared reading method in Study 2 included explicit instruction on the function of semantic radicals. The following paragraphs present the procedure of choosing target semantic radicals and creating stories, information about the designed stories, and the teaching procedures.

The researcher first analysed the internal structure of the 40 characters to choose target semantic radicals in this study (see Table 16).

Table 16

Types of target characters in Study 2

Type of characters	Target character (pinyin)	Number of target characters
Simple character	方 /fāng/	1
Phono-semantic compound character	你 /nǐ/, 们 /men/, 的 /de/, 说 /shuō/, 好 /hǎo/, 奶 /nǎi/, 阳 /yáng/, 这 /zhè/, 像 /xiàng/, 给 /gěi/, 爷 /yé/, 放 /fàng/, 到 /dào/, 完 /wán/, 把 /bǎ/ 花 /huā/, 园 /yuán/, 菊 /jú/, 认 /rèn/, 猪 /zhū/, 玫/méi/	21
Compound pictograms	高 /gāo/, 要 /yào/, 回 /huí/, 朵 /duǒ/, 面 /miàn/,向 /xiàng/,	6
Compound ideograms	兴 /xìng/, 真 /zhēn/, 包 /bāo/, 对 /duì/, 有 /yǒu/, 看 /kàn/, 公 /gōng/, 后 /hòu/, 外 /wài/, 季 /jì/	10
Other compound characters	前 /qián/, 兰 /lán/	2

There were a simple character that could not be divided into radicals and 39 compound characters containing at least two radicals. Of these 39 compound characters, there were 21

phono-semantic compound characters containing a semantic radical and a phonetic radical, six compound pictograms where the character is derived from the shape of the object that these characters represent, ten compound ideograms where the character expresses an abstract idea through the modification of a compound pictogram, and two other compound characters, which had lost those features that showed their origins following the simplification of characters (see Simple and Compound Characters section in Chapter 2 on page 19 for an explanation of these terms).

The 21 phono-semantic compound characters included 16 semantic radicals. Ten semantic radicals were selected for ten teaching sessions based on the following criteria: (1) the radical was not taught in previous Year 1 Chinese lessons; and (2) the radical contributes to the meaning of the whole character. The selected ten target semantic radicals were 犭 (animal), 艹 (plants), 目 (eyes), 口 (boundary), 亻 (person), 讠 (talking), 女 (female), 木 (wood), 宀 (house) and 扌 (hand). Seven out of ten target semantic radicals belong to the list of most common semantic radicals in Tang (2017): 扌 (hand), 宀 (house), 艹 (plants), 讠 (talking), 亻 (person), 木 (wood), and 女 (female). The orthography-to-semantics transparency rate of these common semantic radicals was above 0.80 (Tang, 2017). This means that the meaning of these seven semantic radicals is consistent with at least 80% of compound characters that have these seven semantic radicals.

The researcher then separated target characters into ten groups with four characters in each group and ensured that characters sharing the same semantic radical were in the same group to facilitate semantic radical instruction. Although the target characters were grouped based on orthographic regularities (semantic radicals), the groupings mainly aligned with the extensive approach of teaching Chinese characters. It was because not all characters in one group have the same semantic radical (See Intensive and Extensive Approaches section in

Chapter 2 on page 53 for more information). One story was created for each group of target characters, and the stories featured by age-appropriate content and sentence structures. Note that reading materials in this study had different content from the reading materials in Study 1. The average length of each story was 456 words (including 272 Chinese characters and 184 Pinyin words). For example, a story was about two boys called *Silly and Unhappy* and what kind of job they would like to do in the future. This story provided a context to learn the target characters 高 /gāo/, 兴 /xìng/ (高兴 means happy), 你 /nǐ/ (you, person spoken to) and 们 /men/ (plural marker for pronouns, and nouns referring to individuals). The target characters were repeated between 6 and 21 times in the stories. Information about the stories, related target characters and semantic radicals can be found in Table 17.

The ten stories in Table 17 followed the same format and contained the same features as the stories for the experimental group in Study 1 (see Teaching Sessions section in Chapter 3 on page 80). An example of a designed story can be found in Appendix 4.5).

The teaching procedure in this study included two alterations from Study 1: (a) the story was read aloud twice rather than three times in Study 1 (the two readings in this study were the same as the first two readings in Study 1); (b) a target semantic radical was taught after the reading aloud. These changes enabled the effectiveness of the combination of shared reading with frequent print exposure and explicit semantic radical instructions to be explored. Two read-aloud activities allowed enough time for teaching semantic radicals. After two readings, target characters were experienced in the story at least 18 times, which was larger than six, the minimum number of exposures for character acquisition (see Liu and Shiu, 2011).

After the two read-aloud activities, the researcher explicitly taught four target characters one by one, including the form, pronunciation and meaning of the characters, and

Table 17

Information about reading materials for the experimental group in Study 2

No.	Story title (Pinyin words/Chinese character totals)	Brief description	Target Chinese characters (Frequency)	Target semantic radical
1	没头脑和不高兴 (Silly and Unhappy) (198/252)	Two boys, Silly and Unhappy, talk about their dream jobs.	高 (21), 兴 (15), 你 (6), 们 (7)	亻
2	真的假的 (Who is Real) (223/262)	A person looks like Unhappy. Unhappy's classmates wanted to find out who was the real Unhappy.	说 (12), 认 (7), 真 (7), 包 (7)	讠
3	好奇奶奶 (Mrs Curiosity) (241/320)	An old lady called Mrs Curiosity who had lots of inventions.	好 (15), 奶 (22), 对 (8), 阳 (12)	女
4	爷爷的信 (Grandpa's Letter) (198/235)	Silly's grandpa, Mr Good Memory wrote a letter to his 25 years old self.	这 (6), 要 (8), 把 (6), 爷 (28)	扌
5	虫子旅店 (Bug Hotel) (188/293)	Silly designed and built some wooden hotels for bugs.	放 (6), 回 (8), 有 (6), 到 (10)	口
6	云朵小店 (A Gift from Yun's Shop) (136/220)	People got some gifts from Yun's shop when they accomplished given tasks.	朵 (11), 完 (7), 看 (9), 给 (6)	目
7	采花大盗 (Who Stole the Flower: Part 1) (137/243)	A special flower was stolen.	花 (19), 菊 (7), 园 (8), 公 (8)	艹
8	采花大盗 (Who Stole the Flower: Part 2) (168/275)	A detective found the thief, and the thief explained the reason for stealing the flower.	方 (15), 前 (6), 后 (6), 外 (7)	宀
9	木兰的秘密 (Mulan's Secret) (172/271)	It was about three secrets that Mulan did not tell others.	面 (8), 季 (6), 兰 (15), 的 (30)	木
10	小猪的玫瑰(Three Piggies Plant a Rose) (223/)344	Three piggies used different strategies to plant a rose in the winter.	猪 (24), 向 (7), 玫 (12), 象 (8)	犭

the order of writing the strokes in the characters. The researcher drew students' attention to the inner structures of the characters and identified the semantic radicals of phono-semantic compound characters. The researcher taught students the meaning and function of the target semantic radicals and presented some supplementary characters containing the target semantic radical. For example, two target characters in the first session 你 /nǐ/ (you, person spoken to) and 们 /men/ (a plural marker for pronouns and nouns referring to individuals) have the target semantic radical 亻 (people). The researcher told students that the radical 亻 (people) comes from the character 人 (people) and is usually placed on the left side of a compound character as a semantic radical to provide clues to the meaning of the whole character. The researcher also provided supplementary characters such as 他 /tā/ (he), 休 /xiū/ (to rest), and 偷 /tōu/ (to steal) and guided students to recognise the semantic radical. Children also practised working out a whole character's meaning based on the semantic radical 亻 (people). The researcher presented a novel character 住 and three options about the meaning of this character, including a) the meaning relates to females, b) the meaning relates to people, c) the meaning relates to feet. Children were asked to choose a correct option based on the semantic radical 亻 (people). Students read aloud words containing target characters in chorus after the teacher and wrote each target character three times after the characters were introduced.

The stories were presented on A3 paper with Chinese characters in 45 Kaiti font and Pinyin words in 45 Songti font because projecting stories on a big screen was impossible in this study. Pinyin words and characters that were taught before the current lesson were presented in black, and all target characters were identified by other colours. To make sure students could read words clearly, only one or two sentences were presented on each page, and multiple A3 sheets were required to tell the whole story. The similarities and differences in teaching sessions between the experimental and control groups are demonstrated in Table 18.

Table 18

Similarities and differences in teaching sessions between experimental group and control group in Study 2

		Experimental group	Control group
Similarities	Session length and location	• Each session lasted 1.5 hours. • All sessions were delivered at the School.	
	Target characters	• 40 characters, including 真高兴说你们好阳对包要的这有爷奶放回到给完把花园前后外季看公朵玫菊兰认方向面象猪.	
	Teaching procedure	• Top-bottom: Reading aloud and discussing the story/text before teaching characters. • The arrangement of target characters aligned with the principle of the extensive approach to teaching Chinese characters. • The teacher taught semantic radicals of compound characters. The form, pronunciation and meaning of target characters, and the order of writing strokes of target characters were taught. Words containing the target characters were read in chorus. Character writing practices were included.	
Differences	Target characters	• Some supplementary characters as examples for target semantic radicals.	• Additional target 17 characters from the textbook, including 开了车见早太书家爸妈和门个他年儿可.
	Teaching materials	• Ten stories • Each story had 184 Pinyin words and 272 characters on average. • Target characters in the stories were not annotated with Pinyin words. • Target characters were repeated at least six times in the story.	• Lesson 8 to Lesson 11 in Zhongwen Textbook and Workbook (Year 1) • The text in each lesson had around 31 characters. • The texts were annotated with Pinyin words. • Target characters appeared at least once in the text.
	Teaching procedure	• After two reading activities, four target characters and one target semantic radical were taught. • The teacher told children the name and meaning of the semantic radical, presented supplementary characters with the same semantic radical, and asked children to practice working out the meaning of a character according to its semantic radical.	• After reading the text, around six target characters were taught. • The name and meaning of the semantic radical were mentioned if the target character has a semantic radical.

The experimental group differed from the control group in two aspects that included the semantic radical-based grouping of target characters and explicit instruction on the function of ten target semantic radicals. These differences provided the contrast to answer the research questions for Study 2.

Results

Independent sample t-tests and Chi-square tests were conducted on the pre-test data to examine any significant differences between the experimental and control groups for each measurement prior to the ten teaching sessions. Descriptive statistics were used to contrast the performance of the two groups on the measures. Mixed analyses of variance (ANOVAs) were employed to determine whether there were significant differences in growth between the two groups on each measure. Pearson product-moment correlations were used to explore associations between the change in the Chinese character knowledge and reading comprehension measures in the experimental group. Data were analysed using IBM SPSS (version 26).

An independent samples t-test indicated that the experimental and control groups did not significantly differ in age: t (26) = .03, p = .97. A Chi-square test did not identify any significant difference between the experimental group and the control group in gender: χ^2 (1, N = 28) = .32, p = .57. The home language (Chinese and English versus Chinese only) was also analysed. The results showed a significant difference in participants' home language between two groups: χ^2 (1, N = 28) = 4.50, p = .03. Given that a large difference in home language between the groups may affect participants' performance in the language measures used in this study, additional analyses of pre-test scores were performed with the home language being controlled. However, these analyses showed the same results as the analyses presented below, so they will not be included here (see Appendix 4.6 on page 231 for details).

Descriptive statistics for all measures are presented in Table 19 and Table 20. Participants in the experimental group demonstrated larger Chinese oral receptive vocabulary but lower English word recognition ability before the ten teaching sessions. The experimental group was slightly better at reading Pinyin words aloud, whereas the control group was better at spelling Pinyin words. To better understand the floor effect in the Chinese sentence and passage comprehension tasks, bar charts are included in Appendix 4.7 to show the number of students who were showing the floor effect.

Table 19

Scores for the measures only conducted at the pre-test in Study 2

Measures	Experimental Group (n = 16)	Control Group (n = 12)
Chinese Vocabulary Task		
Mean (*SD*)	90.38 (39.40)	75.25 (30.80)
Range (0-180)	38-150	45-143
English Word Reading Task		
Mean (*SD*)	45.69 (22.18)	51.75 (29.14)
Range (0-110)	14-87	7-102
Pinyin Spelling Task		
Mean (*SD*)	19.06 (9.10)	24.08 (10.21)
Range (0-45)	9-40	12-41
Pinyin Read-Aloud Task		
Mean (*SD*)	122.13 (64.11)	117.42 (77.08)
Range (0-237)	24-216	26-218

Table 20

Scores for the measures at the pre-test and post-test in Study 2

Measures	Experimental Group (*n* = 16)		Control Group (*n* = 12)	
	Pre-test	Post-test	Pre-test	Post-test
Character Listening Task				
Mean (*SD*)	4.63 (1.50)	7.13 (2.31)	5.17 (2.73)	7.50 (3.06)
Range (0-20)	2-7	2-10	1-9	3-11
Character Reading Task				
Mean (*SD*)	8.13 (2.83)	9.38 (2.94)	7.92 (3.00)	9.58 (3.63)
Range (0-50)	3-13	5-14	3-13	3-15
Character-Picture Matching Task				
Mean (*SD*)	3.38 (1.41)	6.88 (2.50)	4.17 (2.86)	6.67 (3.34)
Range (0-35)	1-6	2-12	1-11	2-12
Target Character Read-Aloud Task				
Mean (*SD*)	2.44 (2.25)	18.56 (8.30)	6.33 (6.04)	18.42(10.67)
Range (0-40)	0-8	3-33	0-21	1-36
Semantic Radical Picture Matching Task: Total score				
Mean (*SD*)	.69 (1.89)	7.56 (3.01)	1.25 (2.42)	6.33 (3.03)
Range (0-20)	0-6	2-12	0-7	3-12
Semantic Radical Picture Matching Task: functional knowledge sub-score				
Mean (*SD*)	.44 (1.21)	4.50 (1.63)	.75 (1.42)	3.92 (1.44)
Range (0-10)	0-4	1-6	0-4	2-6
Semantic Radical Picture Matching Task: positional knowledge sub-score				
Mean (*SD*)	.25 (.68)	3.06 (1.61)	.50 (1.00)	2.42 (1.73)
Range (0-10)	0-2	1-6	0-3	0-6
Chinese Sentence Comprehension Task				
Mean (*SD*)	3.50 (1.16)	5.94 (2.11)	3.83 (1.85)	5.58 (2.43)
Range (0-14)	2-6	2-10	0-6	2-9
Chinese Passage Comprehension Task				
Mean (*SD*)	2.56 (2.71)	3.94 (3.36)	1.92 (1. 98)	3.17 (2.86)
Range (0-20)	0-7	0-9	0-5	0-9

Independent samples t-tests did not identify significant differences when home language was not controlled, which means the two groups of participants had equivalent performance in all pre-test measures. No significant difference was found for the Chinese Vocabulary Task (t = -1.10, df = 26, p = .28), the English Word Reading Task (t = .63, df = 26, p = .54), the Pinyin Spelling Task (t = 1.37, df = 26, p = .18) and the Pinyin Read-Aloud Task (t = -.18, df = 26, p = .86). No significant difference was found for the Character Listening Task (t = .62, df = 15.96, p = .54)[4], the Character Reading Task (t = -.19, df = 26, p = .85) and the Character-Picture Matching Task (t = .97, df = 26, p = .34). The results for the Target Character Read-Aloud Task (t = 2.13, df = 13.31, p = .053)[4] also did not have any significant difference. Also, significant differences were not detected for the Semantic Radical Picture Matching Task (t = .50, df = 26, p = .62), the Chinese Sentence Comprehension Task (t = .59, df = 26, p = .56) and the Chinese Passage Comprehension Task (t = -1.87, df = 24.60, p = .07)[4].

Mixed between-within subjects analyses of variance were performed when home language was not controlled. The aim was to examine whether the gains for each measure in the experimental group over the ten teaching sessions significantly differed from the change shown by the control group. No significant interactions between group and pre/post scores were found for any task, although there was a significant main effect of time. For the character knowledge tasks, there was a significant main effect of time (F (1, 26) = 29.36, p < .001, η_p^2 = .53) and a non-significant interaction between group and pre/post scores (F (1, 26) = .60, p = 0.45, η_p^2 = .02) for the Character Reading Task. There was a significant main effect of time (F (1, 26) = 31.39, p < .001, η_p^2 = .55) and a non-significant interaction between group and pre/post measures (F (1, 26) = .04, p = .85, η_p^2 = .00) for the Character Listening Task. Analysis identified a significant main effect of time (F (1, 26) = 32.58, p < .001, η_p^2 = .56) and a non-

[4] Note that calculations were based on equal variance not assumed due to a significant Levene's test.

significant interaction between group and pre/post scores (F (1, 26) = .91, p = .35, η_p^2 = .03) for the Character-Picture Matching Task. The results of Target Character Read-aloud Task also reported a significant main effect of time (F (1, 26) = 102.16, p < .001, η_p^2 = .80) and a non-significant interaction between group and pre/post scores (F (1, 26) = 2.10, p = .16, η_p^2 = .08). In addition, a significant main effect of time (F (1, 26) = 94.19, p < .001, η_p^2 = .78) and a non-significant interaction between group and pre/post scores (F (1, 26) = 2.11, p = .16, η_p^2 = .08) was also were found for the Semantic Radical Picture Matching Task. In terms of Chinese reading comprehension tasks, there was a significant main effect of time (F (1, 26) = 37.14, p < .001, η_p^2 = .59) and a non-significant interaction between group and pre/post scores (F (1, 26) = 1.00, p = .33, η_p^2 = .04) in the Chinese Sentence Comprehension Task, and a significant main effect of time (F (1, 26) = 12.54, p = .00, η_p^2 = .33) and a non-significant interaction between group and pre/post scores (F (1, 26) = .03, p = .87, η_p^2 = .00) in the Chinese Passage Comprehension Task.

Pearson product-moment correlations were carried out to examine if relationships existed between improvements in Chinese character, semantic radical awareness and Chinese reading comprehension measures found in the experimental group (see Table 21). Analyses did not find any significant correlations, although there were some medium-strength correlations according to guidelines proposed by Cohen (1988). The results showed that improvement in the Chinese Sentence Comprehension Task was moderately correlated with improvements in the Character Listening Task and gains in the Target Character Read-Aloud Task. Correlations of medium strength between the Chinese Passage Comprehension Task and the Character-Picture Matching Task were also identified.

Table 21

Results of Pearson product-moment correlations for the experimental group in Study 2

Variable	1	2	3	4	5	6
1. Character Listening Task						
2. Character Reading Task	*r* = - .11 *p* = .69					
3. Character-Picture Matching Task	*r* = .10 *p* = .71	*r* = .25 *p* = .35				
4. Target Character Read-Aloud Task	*r* = - .02 *p* = .95	*r* = .20 *p* = .47	*r* = .14 *p* = .61			
5. Semantic Radical Picture Matching Task	*r* = .02 *p* = .95	*r* = .03 *p* = .90	*r* = .27 *p* = .32	*r* = - .19 *p* = .48		
6. Chinese Sentence Comprehension Task	*r* = *.47* *p* = .07	*r* = - .12 *p* = .67	*r* = .08 *p* = .78	*r* = *.47* *p* = .07	*r* = - .27 *p* = .32	
7. Chinese Passage Comprehension Task	*r* = .17 *p* = .54	*r* = - .19 *p* = .47	*r* = *.46* *p* = .07	*r* = - .01 *p* = .97	*r* = - .12 *p* = .65	*r* = *.35* *p* = .18

Note: Cohen's (1988) guidelines include large correlations ($.50 \leq |r| < 1.0$), medium correlations (r $=.30 \leq |r| < .50$), and small correlations ($.10 \leq |r| < .30$). The medium correlations according to Cohen (1988)'s guidelines were italicised.

Discussion

The shared reading method was revised in Study 2 to include explicit semantic radical instruction and semantic radical-based grouping. Study 2 assessed the potential effectiveness of the shared reading method on semantic radical awareness, Chinese character knowledge and Chinese reading comprehension for beginning-level young Chinese heritage learners. The results did not identify any significant time-group interactions in any measures. It was suggested that the shared reading method in this study was not more effective for promoting semantic radical awareness, Chinese character knowledge, or Chinese reading comprehension in comparison to the textbook-based teaching method. The factors related to non-significant results and the implications of this study are discussed below.

The results of Semantic Radical Picture Matching Task showed that Chinese heritage children in the shared reading and textbook-based groups had experienced similar improvement

of semantic radical awareness. Non-significant interaction between the two groups and pre/post scores may be because explicit instruction on semantic radical knowledge was given in both the shared reading and the textbook-based classes. Children in both groups were taught the name and the meaning of semantic radicals. In the shared reading group, children were also taught how to use the semantic radical to work out the meaning of a whole character and completed related practices. For example, the researcher presented a novel character 住 and three options about this character's meaning. Then the researcher explained why one choice was right, and the others were wrong according to the semantic radical 亻. However, the Teacher did not give such instruction and practices in the textbook-based group where children were only taught that the semantic radical 亻 is called the person radical and it means people. It seems that more explicit instruction on using semantic radicals to figure out the whole character's meaning in the shared reading class did not allow children to have significantly better semantic radical knowledge than their counterparts in the textbook-based class. This null effect might be affected by the fact that seven out of ten target semantic radicals in Study 2 belong to the top 23 common semantic radicals, according to Tang (2017). The top 23 common semantic radicals comprise around 60% of characters for Chinese L2 learners (Tang, 2017). Some children might likely have seen the target semantic radicals and characters that have the target semantic radicals at home during the ten teaching sessions in Study 2. The effect of differences in teaching semantic radicals in two classes might have been attenuated. However, this study's lack of data on home literacy activities does not allow firm conclusions to be made.

In addition, the way how novel characters in the shared reading condition were arranged may also have contributed to the non-significant result. Not all four novel characters taught in each teaching session had the same semantic radical. For example, the target characters in Session 1 included 高 /gāo/, 兴 /xìng/, 你 /nǐ/ and 们 /men/, and only the characters 你 /nǐ/ and

们 /men/ have the target semantic radical 亻. This arrangement differed from the previous study by Xu et al. (2014) that compared the effect of grouping characters based on semantic radicals and presenting characters in distribution on character learning for beginning-level Chinese L2 learners. In a semantic radical-based grouping condition of Xu et al. (2014), all novel characters for one reading material had the same semantic radical. Xu et al. (2014) found that beginning-level Chinese L2 learners had better semantic radical awareness when they learnt characters in semantic radical-based groups than when they learnt characters in distribution. The different semantic radicals in each group of novel characters in Study 2 may explain the inconsistency between the null effect of semantic radical-based grouping in Study 2 and significant results in Xu et al. (2014). Further investigation is required to examine if semantic radical-based grouping has any positive impact on the development of Chinese heritage children's semantic radical awareness.

Meanwhile, the results of the Semantic Radical Picture Matching Task indicated that some Chinese heritage children in the shared reading and textbook-based groups had developed rudimentary knowledge of the function and legal positions of semantic radicals. This is consistent with the model of Chinese orthographic knowledge development for Chinese children (Ho, Yau et al., 2003): first-grade Chinese native children started to develop the knowledge of semantic radicals' meaning, function and positions. In addition, children in the shared reading and textbook-based groups generated a lower mean score of positional knowledge than the mean score of functional knowledge at the post-test for the Semantic Radical Picture Matching Task. It seems that Chinese heritage children in Study 2 had a better understanding of semantic radicals' function than legal positions. This result differed from previous findings for Chinese native children in Grade 1 (Ho, Ng et al., 2003). First-grade Chinese native children in Ho, Ng et al. (2003) had some understanding of semantic radicals' positions, but they started to understand semantic radicals' function (i.e., providing meaning

cues) since Grade 3. The differences between the Chinese native children in Ho, Ng et al. (2003) and the Chinese heritage children in the current study in their radical knowledge development was probably because Chinese heritage children have more limited exposure to characters than Chinese native children (Koda, Lü et al., 2008). It might be more challenging for Chinese heritage children to develop the knowledge of semantic radicals.

However, children's performance on the Semantic Radical Picture Matching Task in the post-test was not consistent in each group: some children scored two or three, whereas others produced scores of up to 12 out of 20. It seems that some children in both the shared reading and textbook-based classes did not understand how to use meaning cues from semantic radicals despite that the tested items (semantic radicals) were taught in both groups. This might be attributed to participants' relatively young age and low level of the Chinese language. Nevertheless, considering the small sample size in Study 2, more exploration is needed to analyse the development of Chinese heritage children's semantic radical awareness.

Children in both the shared reading and the textbook-based conditions showed growth across all tasks related to general Chinese character knowledge without significant difference. These results mean that the shared reading teaching method in Study 2 did not have significantly better effectiveness on character acquisition than the textbook-based teaching method. This finding is not in tune with Study 1, which found that the shared reading group had more significant improvements in the Character Reading and Character-Picture Matching tasks than the textbook-based group. Non-significant results in this study may relate to the different number of novel characters taught across two groups. A total of 40 characters were taught in the shared reading condition, whereas a total of 57 characters were taught in the textbook-based condition (see Teaching Sessions in this chapter on page 110). In Study 1, however, the number of novel characters taught in the shared reading condition (72 characters) was similar to that in the textbook-based condition (71 characters). Fewer target characters for

the shared reading class in Study 2 may have inhibited the potential gains that children could have had in character acquisition.

Additionally, it was hypothesised that explicit semantic radical instruction in the shared reading class in Study 2 might lead to better semantic radical awareness and then contribute to better character knowledge. However, the shared reading class failed to boost children's semantic radical awareness, and the two groups have had statistically equivalent improvement in semantic radical awareness over the ten teaching sessions. Thus, given that the shared reading class have learnt a less number of target characters and had the same level of semantic radical awareness compared to the textbook-based class, the non-significant results in character knowledge tasks are explainable.

Another factor that may be related to the non-significant results in character knowledge was home language and home Chinese literacy activities. A significant difference was identified between the two groups of participants regarding their home language (the language parents used with their children). More parents in the shared reading group reported that they spoke English and Chinese to their children (56%) than only Chinese (44%). However, only a small portion of parents in the textbook-based group reported using both English and Chinese with their children (17%), and the majority (83%) reported Chinese only. Interestingly, the Chinese Vocabulary Task showed that the mean score in the shared reading condition was higher than the textbook-based condition, even though this difference was not significant. This suggests that children taught in the shared reading method were not disadvantaged in their Chinese language knowledge.

To investigate this further, the researcher separated children in the shared reading condition into two groups according to their home language: Chinese only versus Chinese and English. It was found that, in the shared reading condition, children whose home language was only Chinese scored 123 on average in the Chinese Vocabulary Task, and children whose home

languages were Chinese and English scored 65 on average. The same comparison was performed for children in the textbook-based condition. The mean score for children whose home language was only Chinese in the textbook-based class was 79.1, and children whose home languages were Chinese and English were 56 the in Chinese Vocabulary Task. These results suggest that vocabulary levels are partially related to home language in this cohort of children: children whose parents spoke Chinese to them may understand more Chinese oral words than their counterparts.

However, a more extensive oral vocabulary would support children in understanding what the teacher said in the Chinese lessons and maybe provide access to meaning in read-aloud practice. The number of characters they learned in the teaching sessions, though, would be more likely to be affected by the number of printed words (characters) that they had seen rather than oral vocabulary. Previous research highlighted the critical role that the Chinese literacy environment at home plays in character acquisition for Chinese heritage children due to the limited instruction time in the Chinese community school (Zhang & Koda, 2011; Xia, 2016).

Home literacy activities might also have affected the development of character knowledge in Study 2. It should be noted that children in the textbook-based class outperformed their counterparts in the shared reading class on Target Character Read-Aloud Task at the pre-test, which approached significance. This difference might be attributed to character learning activities at home. Parents In the textbook-based condition might have been going through the textbook with their children, given that these target characters are in the textbook. Children in the shared reading class were unlikely to preview the lessons at home because they were not provided reading materials before each lesson started. However, whether the two groups in this study had different home Chinese literacy activities was unknown due to the lack of specific assessments of home literacy activities.

The improvement in Chinese reading comprehension has been found in both shared reading and textbook-based groups over the ten teaching sessions. No significant difference has been seen in either the Chinese Sentence Comprehension Task or Chinese Passage Comprehension Task. This result does not go along with the finding in Study 1: the shared reading class had significantly better performance in the Chinese Sentence Comprehension Task. For the shared reading group in Study 2, correlation analyses revealed medium correlations between Chinese Sentence Comprehension Task and Character Listening Task and between Chinese Sentence Comprehension Task and Target Character Reading Task. This finding implies that the improvement of orthography-phonology correspondence knowledge would facilitate the development of Chinese sentence comprehension. Correlation analyses also reported medium correlations between Chinese Passage Comprehension Task and Character Picture Matching Task, which indicated that the improvement of orthography-semantics correspondence knowledge would support the development of Chinese passage comprehension. Meanwhile, the shared reading group did not significantly outperform the textbook-based group in Chinese character knowledge and Chinese oral vocabulary. The equivalent levels of character knowledge (decoding) and Chinese oral vocabulary (a vital factor of Chinese listening comprehension) may have led to equivalent levels of Chinese reading comprehension between the two groups. However, more data is required to make firm conclusions.

In summary, the findings from Study 2 show that a revised version of the shared reading teaching method that included semantic radical-based grouping and explicit semantic radical instruction did not facilitate the development of semantic radical awareness, character knowledge and Chinese reading comprehension to a larger extent than the conventional textbook-based method. Potential reasons may include explicit instruction on semantic radical knowledge given in both groups and the different number of novel characters taught across two

groups. Some limitations may also have affected the results of this study. Chinese literacy environment was found to be closely related to Chinese heritage children's character learning (Zhang & Koda, 2011; Xia, 2016), but it was not measured and controlled in this study. There is a possibility that results in this study have been affected by Chinese literacy activities at home. In addition, the majority of participants in this study also took part in Study 1: including 14 out of 16 children in the experimental group and 9 out of 12 children in the control group. Past experience may have affected the effects of the teaching method in this study. These limitations will be considered in Study 3.

Chapter 5 Study 3

Introduction

Study 3 further examined the shared reading teaching method proposed in Study 1 by combining explicit instruction on phonetic radicals. Phonetic radicals have rarely been a focus of teaching in conventional Chinese lessons for Chinese native and heritage children even though previous research has emphasised the important role of phonetic radical awareness on character acquisition (Ho, Ng et al., 2003; Ho, Yau et al., 2003). Young children were able to work out the pronunciation of a new character based on its phonetic radical (Anderson et al., 2003; Chen et al., 2014; Hsuan et al., 2017). Phonetic radical awareness had not been considered in Study 1 and Study 2. Study 3 aimed to investigate whether the revised shared reading teaching method that combined explicit phonetic radical instructions and phonetic-radical based grouping of new characters facilitated character knowledge and Chinese reading comprehension for Chinese heritage children. There were three research questions in Study 3:

- Do Chinese heritage language children at the beginning level of reading in Chinese develop better knowledge of orthographic, phonological, and semantic representations of characters in the revised shared-reading condition that combined phonetic radical-based grouping and explicit phonetic radical instruction, or the conventional textbook-based condition?
- Do these children have better Chinese reading comprehension outcomes in the revised shared-reading condition or the conventional textbook-based condition?
- Do these children establish better phonetic radical awareness in the revised shared-reading condition or the conventional textbook-based condition?

It was hypothesised that:

- Children taught in the shared reading method would show larger improvements in Chinese character knowledge than children from the textbook-based class. This is because the shared reading method would provide more exposure to the orthography, phonology and semantic of Chinese characters simultaneously and more contextual information, which would help students strengthen the connection among orthographic, semantic and phonological representations of Chinese characters. In addition, children in the shared reading condition would have better phonetic radical awareness (see the third hypothesis below), which would make it easier to access the phonological representation of the whole character and in turn activate the semantic representation of the whole character in the children's mental lexicon.
- Greater improvement in Chinese reading comprehension would be shown in the shared reading condition as better Chinese character knowledge should lead to improved text comprehension, and the shared reading condition will involve more reading comprehension practice than typical textbook methods.
- Children in the shared reading condition would have more significant development in phonetic radical awareness. In the shared reading condition, children will be taught the most common phonetic radicals and Chinese characters sharing these common phonetic radicals. Children will also have practice on the function of phonetic radicals, i.e. working out the pronunciation of characters based on the clue from the phonetic radicals. These instructions in the shared reading condition should enhance children's awareness of phonetic radicals.

Methodology

Design

This study implemented the same research design as Study 1 and Study 2: including ten teaching sessions, pre- and post-tests, an experimental group taught with a designed shared reading method, and a control group taught with the textbook-based teaching method. Participants' parents/guardians decided which group their child would join, and the procedure followed class placement protocol of the research site.

Participants

Participants were recruited from the same Chinese community school as Study 1 and Study 2. However, there were two differences in the Saturday Chinese programme at the School between this study and the previous two studies. In the current study, the length of lessons was reduced by 30 minutes to one hour in duration. The School had to make this change because fewer classrooms were available for the Saturday Chinese programme in 2021. Additionally, face-to-face lessons were delivered in classrooms until 25 March 2021, when New Zealand went into lockdown because of the COVID-19 pandemic. All subsequent lessons were then provided online via a distant learning platform Classin. Therefore, both the shared reading method and the traditional textbook-based instruction continued online from this date.

Once a consent form for the research site was provided by the principal of the School, students and their parents/caregivers were informed of this study and were given information sheets and consent forms in either Chinese or English. They were also invited to an information session where they could ask any questions about the current study. All students enrolled in the Year 1 Chinese Saturday lessons at the School who assented to be involved in this study and for whom informed consent was also provided by parents/guardians were recruited.

There were 29 students whose parents returned the consent and assent forms for this study. Of these, 17 students joined the experimental group, and 12 students joined the control group. All of these students took part in pre-tests and two teaching sessions. However, one student from the experimental group and seven students from the control group stopped attending the Saturday Chinese programme when lessons moved online during the lock-down. Parents indicated that they did not want their children to have too much screen time or felt that online lessons were not suitable for their children. Therefore, 21 students completed all pre-tests, the ten teaching sessions (two sessions on-site and eight sessions online) and the post-tests. The experimental group had 16 children, but the control group had only five children because of the lock-down.

Parents indicated their child's date of birth and gender when they returned the signed consent forms. Children in the experimental group ranged from 5 years old to 11 years 4 months old, and children in the control group ranged from 6 years old to 7 years 11 months old. The number of girls was more than double of the number of boys in the experimental group, while the number of boys was one more than the number of girls in the control group. Parents reported their child's home language and home Chinese literacy activities in a Home Language and Chinese Literacy Activity Questionnaire (see Assessment Materials on page 135 for details). In the experimental group, half of the group had Chinese as their main home language, and the other half indicated a bilingual home language (50% English and 50% Chinese) or English as their main home language. By contrast, all children in the control group had Chinese as their main home language. The mean time that the experimental group spent on Chinese literacy activities at home was less than half of the mean time that the control group spent on Chinese literacy activities at home. Demographic information for these two groups is shown in Table 22.

Table 22

Demographic information for participants in Study 3

Variable	Experimental	Control group
Age		
Mean age in months (*SD*)	89.19 (19.91)	87.60 (9.34)
Range age in months	60-138	72-95
Gender		
Female	*n* = 11 (69%)	*n* = 2 (40%)
Male	*n* = 5 (31%)	*n* = 3 (60%)
Home language		
English 80% and above	*n* = 2 (13%)	*n* = 0 (0%)
English 50% and Chinese 50%	*n* = 6 (38%)	*n* = 0 (0%)
Chinese 80% and above	*n* = 8 (50%)	*n* = 5 (100%)
Home Chinese literacy activities		
Mean in minutes (*SD*)	50 (33.62)	132 (145.33)
Range in minutes	20-150	20-380

Assessment Materials

Measures are presented in Table 23. The tasks used in Study 3 were the same as Study 2 and were comprised of three tasks related to Chinese character knowledge, two tasks related to Chinese reading comprehension, two tasks measuring Pinyin skills, one Chinese vocabulary task and one English word recognition task. Two novel tasks measuring phonetic radical awareness were added to Study 3 to test the effect of the revised shared reading method on phonetic radical awareness. Assessments of Chinese character knowledge, phonetic radical awareness and Chinese reading comprehension were carried out before and after the ten teaching sessions. Assessments of Chinese receptive vocabulary, English word recognition, and Pinyin skills were conducted before the ten teaching sessions only. In addition, Children's home language and literacy activities at home were investigated through a questionnaire for

parents, and the questionnaire was given to parents before and after their children's ten teaching sessions.

Table 23

An index of assessment battery in Study 3

Variables	Measurement
Chinese character knowledge	Character Listening Task
	Character Reading Task
	Character-Picture Matching Task
Phonetic radical awareness	Radical Picture Matching Task
	Pseudo Character Reading and Explanation Task
Chinese reading comprehension	Chinese Sentence Comprehension Task
	Chinese Passage Comprehension Task
Chinese receptive vocabulary	Chinese Vocabulary Task
English word recognition	English Word Reading Task
Pinyin skills	Pinyin Spelling Task
	Pinyin Read-Aloud Task
Home language and Chinese literacy activities at home	Home Language and Chinese Literacy Activity Questionnaire

Radical Picture Matching Task. The Radical Picture Matching Task was developed by the researcher based upon the picture-novel character mapping task in Tong and Yip (2015). This developed task examined whether participants were aware of the pronunciation cues available from the phonetic radical and the meaning cues that can be derived from the semantic radical when processing a pseudo-character. This study focused on phonetic radical awareness rather than semantic radical awareness, but the researcher decided to measure both semantic and phonetic radical awareness. The reason was that both semantic and phonetic radical awareness had been found to be significantly correlated to learning to read Chinese characters

(Ho et al., 2003). Any change in children's semantic radical awareness may provide some information to interpret the change in Chinese character knowledge and Chinese reading comprehension ability.

In the current study, 13 items from the picture-novel character mapping task in Tong and Yip (2015) were selected where the phonetic radical had the same pronunciation as the pseudo-character. Only those items with transparent phonetic cues were used since the participants were at the very early stage of learning Chinese characters.

Each item included a picture and five pseudo-characters. For each item, the picture represented a concrete object or specific concept. Among the five pseudo-characters, two pseudo-characters had the correct semantic or phonetic radical in a legal position. The other two pseudo-characters included the correct semantic or phonetic radical, but the radical was in an illegal position. The other pseudo-character did not have either the correct semantic or phonetic radical. The task was administrated individually. The researcher introduced a short scenario: "Charlie went to a monster school to learn a monster language, but he needed help figuring out some words in the monster language. There were five patterns along with a picture. Please choose one pattern that goes best with the object on the picture." Each item was presented individually on A4 paper to the children.

For example, the target picture was a flower, as shown in Figure 6. The real character representing a flower is 花 /huā/ which has the semantic radical 艹 (plants) and the phonetic radical 化 /huà/. The researcher told the participants the sound of this monster word is /huā/, which provided a phonetic cue. The participants were asked only to choose one pseudo-character which they thought represented the flower best. If participants were able to recognise phonetic radicals and knew that they could work out the pronunciation of a whole character based on phonetic radicals, they would be likely to choose those options that included the correct phonetic radical. If participants were aware that phonetic radicals normally appear at a

certain position, they would choose the option which had the correct phonetic radical in the legal position. Likewise, if participants had some idea about semantic radicals, their choices would be likely to focus on those options that included a semantic radical related to the given picture. If participants were aware that semantic radicals normally appear at a certain position, they would choose the option which had the correct semantic radical in the legal position. However, if participants were not aware of the functions of radicals at all, their choices may be more random across the five options provided.

Figure 6

An example for Radical Picture Matching Task

This measure produced two total scores that included one for the phonetic radicals and one for the focus on semantic radicals. For the phonetic radical awareness, one score was given if the pseudo-character has the correct phonetic radical, and one score was given if the correct phonetic radical is in the legal position. For example, option C [illegible] has the phonetic radical 化 in an illegal position (one score), and option [illegible] has the phonetic radical 化 in a legal position (two scores). The other three options that do not include the correct phonetic radical were given zero scores. The phonetic radical awareness score for this task ranged from 0 to 26. In terms of semantic radical awareness score, one score was given if the pseudo-character has the correct

semantic radical, and one score was given if the correct semantic radical is in the legal position. In the example of flower, option B 苣 has the semantic radical 艹 in a legal position (two scores) and option E 隹 has the semantic radical 艹 in an illegal position (one score). The other three options that do not include the correct semantic radical were given zero scores. The range of scores was 0 to 26. Analyses of the pre-test data produced a Cronbach's α of .61 for the phonetic radical awareness score and a Cronbach's α of .57 for the semantic radical awareness score.

Chinese Pseudo-character Reading and Explaining Task. The Chinese Pseudo-character Reading and Explaining Task was developed by the researcher. This task aimed to measure whether children could reproduce the sound of a pseudo-character with the help of the phonetic radical and work out the meaning of a pseudo-character according to the semantic radical. This task included open-ended questions instead of multiple-choice questions, and therefore this task would have lower possibilities for children to get a score by random guessing.

The researcher developed 12 pseudo-characters, all of which had a left-right structure with the semantic radical on the left and the phonetic radical on the right. This was because a left-right structure has been argued to be the most frequent character structure in Chinese (Liu et al., 2010; Shu et al., 2003). The twelve phonetic radicals were chosen from the Zhongwen Textbook (Year 1). Phonetic radicals were 多 /duō/, 中 /zhōng/, 下 /xià/, 风/fēng/, 云 /yún/, 马 /mǎ/, 羊 /yáng/, 白 /bái/, 文 /wén/, 子 /zǐ/, 包 /bāo/ and 见 /jiàn/. These characters were very common simple characters. Five of the phonetic radicals were taught in the experimental group including 中 /zhōng/, 马 /mǎ/, 羊 /yáng/, 文 /wén/, 包 /bāo/, and five of them were taught in the control group including 多 /duō/, 中 /zhōng/, 下 /xià/, 风/fēng/, 云 /yún/ as target characters. The twelve semantic radicals were chosen from the Zhongwen Textbook (Year 1) that included 虫 (insect), 足 (foot), 亻 (person), 竹 (bamboo), 火 (fire), 女 (female), 日 (sun), 木 (wood), 目

(eye), 扌 (hand), 讠 (talking) and 山 (mountain). Ten out of the twelve semantic radicals were covered in teaching sessions for the experimental group including 虫 (insect), 足 (foot), 亻 (person), 竹 (bamboo),女 (female),日 (sun), 木 (wood), 目 (eye), 扌 (hand), and 讠 (talking). Ten out of the twelve semantic radicals were also covered in teaching sessions for the control group including 足 (foot),亻 (person), 火 (fire), 女 (female),日 (sun), 木 (wood), 目 (eye), 扌 (hand), 讠 (talking) and 山 (mountain). All phonetic radicals and semantic radicals were in legal positions in the pseudo-characters (See Appendix 5.1 on page 235). For example, the pseudo-character 杩 has a semantic radical 木 /mù/ (wood), indicating that the meaning of the whole character relates to the wood and a phonetic radical 马 /mǎ/ showing that the pronunciation of the whole character sounds like /mǎ/.

The task was administrated individually. Participants were introduced to a story context at the beginning of the test. The story was about a child who went to a forest and found some written words like Chinese characters. The child needed help from the participants to work out the sound and the meaning of these patterns. After the introduction of the story, participants were presented with the items one by one on PowerPoint slides on the researcher's laptop and were asked to work out the pronunciation and meaning of the given pseudo-character.

This task was scored in two dimensions, a phonetic radical awareness score and a semantic radical awareness score. If participants read a pseudo-character by the name of its phonetic radical or a Chinese character having the same phonetic radical, one score was given as the phonetic radical awareness score. If the meaning of a pseudo-character explained by participants related to the meaning that the semantic radical indicated, one score was given as the semantic radical awareness score. For each dimension, the range of score was 0 to 12. Cronbach's α in the pre-test phase was unavailable because only one participant managed to answer this task before the ten teaching sessions. After the ten teaching sessions, this measure

produced a Cronbach's α of .87 for the phonetic radical awareness score and a Cronbach's α of .66 for the semantic radical awareness score.

Home Language and Chinese Literacy Activity Questionnaire. A questionnaire on home language and Chinese literacy activities was developed based on a parents' questionnaire about home literacy environment and practices among Chinese heritage language learners in the U.S. (Lü & Koda, 2011). The questionnaire developed for the current study aimed to investigate how much exposure to the Chinese language participants have at home during the current study period. There was one question about home language and three questions about Chinese literacy activities at home. Each question was presented in Chinese and English (see Appendix 5.2 on page 236).

For the home language question, parents were asked about the percentage of Chinese, English and other languages that they spoke to the child. They were given three options: English 80% or above, English 50% and Chinese 50%, Chinese 80% or above. Parents were also asked about children's engagement in Chinese literacy activities in three questions: a) How much time does your child usually spend on homework from the School each week? b) What other activities does your child do at home in which your child can see or practice Chinese characters (such as reading Chinese storybooks, watching Chinese movies with Chinese character subtitles, etc.)? c) How much time does your child spend on the activities that you mentioned in the last question every week? Parents were asked about these Chinese literacy activities at home pre and post the ten teaching sessions. The answers to questions a) and c) were reported in minutes. The combined number of minutes that parents reported for these two questions was coded as the value for the child's language literacy activity before and after the ten teaching sessions. The answers to question b) were not included in the data analysis. The average of the pre-test and post-test scores from each parent was coded as the final value for

the child's language literacy activity to indicate the time the child would have spent on Chinese literacy activities at home each week during the ten teaching sessions.

Procedure

The pre-tests for Study 3 began once parents returned the consent and assent forms. Table 24 shows all tests given to children in the current study.

Table 24

An index of measures in the pre-test and post-test in Study 3

Measurement	Pre-test	Post-test
Character Listening Task	√	√
Character Reading Task	√	√
Character-Picture Matching Task	√	√
Radical Picture Matching Task	√	√
Chinese Pseudo-Character Reading and Explaining Task	√	√
Chinese Sentence Comprehension Task	√	√
Chinese Passage Comprehension Task	√	√
Home Language and Chinese Literacy Activity Questionnaire	√	√
Chinese Vocabulary Task	√	n/a
English Word Reading Task	√	n/a
Pinyin Spelling Task	√	n/a
Pinyin Read-Aloud Task	√	n/a

All tests were conducted individually by the researcher, and all the answers were scored and marked by the researcher. Pre- and post-tests were carried out during after-school hours at the School or at participants' homes. Time and location of assessment were determined in collaboration with parents. Post-tests were performed after New Zealand went into alert level 1 (the lowest level of alert related to the pandemic and consistent with more normal social

activities within the country), which allowed face-to-face testing of the children. Physical distancing and hygiene protocol given by the government were followed during the post-tests.

Pre-tests contained three sessions and took about 85 minutes for each participant. It took around 70 minutes to finish post-tests which was separated into three sessions. Participants were able to take a break whenever they wanted to during the assessment. As with Study 2, the Chinese Vocabulary Task, the English Word Reading Task, the Pinyin Spelling Task, and the Pinyin Read-Aloud Task were conducted before the ten teaching sessions only, but the rest of the measures in this study were conducted as both pre- and post-tests.

Teaching Sessions

Ten teaching sessions in this study were conducted as lessons in the Saturday Chinese programme at the School in the first semester in 2021, and each lesson lasted one hour. Participants in the experimental group were taught using the shared reading method by the researcher. Children in the control group were taught with the conventional textbook-based method by the Teacher, a Chinese language teacher at the School who was different from the teachers included in the previous two studies. As in Studies 1 and 2, the Teacher was informed about the current research being carried out at the School, and understood that participants in the control group would join her class. She also understood that her teaching would not be affected by the current study, and she was expected to teach her class in the way that she would normally at the School.

Control Group. The Teacher informed the researcher of the target characters that she had taught and the teaching procedure that she had used after the ten teaching sessions were finished. Lessons 2 to 5 in the Zhongwen Textbook (Year 1) were covered in the ten teaching sessions. Each lesson had approximately 15 target characters and a 32-character-long text (see Table 25). A total of 59 target Chinese characters were taught over the ten teaching sessions.

Note that the teaching material in the control group in this study overlapped with the teaching material in the control group in Study 1; therefore, more details about the texts used can be found in the Teaching Sessions section of Chapter 3 on page 80.

Table 25

Information about teaching materials for the control group in Study 3

Session number	Lesson	Target Chinese characters (total numbers)	Length of texts (total characters)
No. 1 - No. 3	Lesson 2	人头目口耳手足大小多少我有个 (14)	35
No. 3 - No. 5	Lesson 3	日月山石田土水火木禾 (10)	38
No. 6 - No. 8	Lesson 4	上中下左来右去出入坐立走长写字它最忙 (18)	25
No. 8 - No. 10	Lesson 5	风雨云雪电天地春夏秋冬的说是色花妈 (17)	29

The Teacher said she usually used 2-3 sessions to finish one lesson in the textbook, and learning to read and write characters was the main goal for Year 1 students. In the first six lessons in the Zhongwen Textbook (Year 1), most target characters were not presented in a text, although there was a short text in each lesson. Children were taught the form, pronunciation and meaning of target characters, the order of writing strokes of each character, and the name and meaning of semantic radicals for several compound characters. Children were taught to write target characters in their notebooks and practice target characters in a workbook that matches the Zhongwen Textbook (Year 1). The Teacher said about 70% of the time was used for learning and practising characters in each session. When all target characters were taught and practised, she guided children to read aloud and understand the text. Homework included

some workbook practice, memorising how to write target characters, and repeating the text aloud from memory.

Experimental Group. Reading materials for the experimental group were stories developed by the researcher. These stories differed from those used in Study 1 and Study 2. To create the stories, the researcher chose a group of target Chinese characters from a list of common phonetic radicals in Tang (2017) and from the level 1 Chinese characters list of the HSC Test (H. W. Wang, personal communication, July 19, 2018). Tang (2017) analysed 3000 characters from The Graded Chinese Syllables, Characters and Words for the Application of Teaching Chinese to the Speakers of Other Languages (Hanban/Confucius Institute Headquarters, 2010), and concluded that 96 phonetic radicals were the most frequently used. Tang (2017) also analysed the consistency of phonetic radicals and characters, i.e. whether the pronunciation of a phonetic radical is the same as the pronunciation of the character of which the phonetic radical is a component. The most frequently used 96 phonetic radicals had a phonetic radical-character consistency ranging from 0.24 to 1.00. The average consistency was 0.59. The researcher chose phonetic radicals which had a consistency of 0.60 or higher and excluded phonetic radicals which did not belong to the level 1 Chinese characters list of the HSC Test.

After that, 32 phonetic radicals were produced, and then the researcher selected Chinese characters which had these 32 phonetic radicals. However, only six out of 32 phonetic radicals were also characters found in the Zhongwen (level 1) textbook and taught as part of the School teaching methods: these were 中 /zhōng/, 方 /fāng/, 平 /píng/, 高 /gāo/, 羊 /yáng / and 包 /bāo/. Therefore, the researcher decided to replace a further six phonetic radicals (令 /lìng/, 争 /zhēng/, 卜 /bǔ/, 支 /zhī/, 共 /gòng/ and 加 /jiā/) from the 32 phonetic radicals with six phonetic radicals (including 马 /mǎ/, 文 /wén/, 同 /tóng/, 可 /kě/, 门 /mén/ and 因 /yīn/) that were Chinese

characters taught via the Zhongwen (level 1) textbook. This led to 32 phonetic radicals being chosen as the target Chinese characters for the experimental group, of which 12 were also included in the textbook that the control group would use.

Having selected the target Chinese characters, the researcher sorted the 32 target characters into ten groups and developed reading materials for each of these groups of characters. Information about stories, target characters and intervention schedule can be found in Table 26. Two stories were taught in the classroom, and a further eight stories were taught online during the COVID-19 lockdown. Stories were, on average, 404 words in length and included 127 Chinese characters and 277 Pinyin words on average. Each target character (i.e. the 32 phonetic radicals) was repeated in the story at least three times (the frequency shown in the bracket after every character in Table 26). The researcher sorted supplementary characters which had one target character (i.e. the 32 phonetic radicals) as the phonetic radical. Supplementary characters were selected with the aim of showing children the function of phonetic radicals: providing sound cues of the whole character. When the researcher created the stories, the researcher also tried to include some supplementary characters in stories to present the characters in the context.

For example, a story entitled *What Happened on Apple Trees* was about two children trying to find out why apple trees were sick. This story provided a context to learn the Chinese characters 方 /fāng/, 平 /píng/ and 主 /zhǔ/ which were presented in the story between 4 and 15 times. There were three supplementary characters (放 /fàng/, 房 /fáng / and 芳 /fāng/) for the target character 方 /fāng/, one supplementary character (苹 /píng/) for the target character 平 /píng/, and two supplementary characters (住 /zhù/ and 柱 /zhù/) for the target character 主 /zhǔ/. The supplementary characters 放 /fàng/, 房 /fáng/, 苹 /píng/ and 住 /zhù/ were also included in the story, with the frequency ranging from 1 to 10.

Table 26

Information about reading materials for the experimental group in Study 3

No.	Online/on-site	Story title (Pinyin words/Chinese character totals)	Brief description	Target Chinese Characters (Frequency)	Supplementary characters (Frequency)
1	On-site	灯下的幻想 (Imagination) (108/32)	Some animals had some magical power and became who they wanted to be.	龙 (3), 羊 (3), 马 (3)	笼, 洋 蚂, 妈
2	On-site	龙的牙齿不见了 (Where is Dragon's Tooth) (260/117)	A girl and her father saw Chinese dragon dance.	文 (3), 牙 (8), 巴 (4)	蚊 (1), 芽, 呀 (1), 吧, 爸 (4), 把 (1)
3	Online	苹果树怎么了 (What Happened on Apple Trees) (348/142)	Some apple trees got sick due to unclear reasons.	方 (15), 主 (4), 平 (11)	放 (1), 房(1), 芳, 住 (2), 柱, 苹(10)
4	Online	一元钱的梦 (One Dollar Dream) (353/132)	A girl wanted to travel around the world.	元 (8), 包 (5), 反 (3)	远 (2), 园, 抱, 饱, 饭, 返 (1)
5	Online	拯救世界的河马 (A Hippo Saved the World) (343/148)	A hippo invented a tool and solved river pollution.	交 (4), 同 (6), 可 (3), 丁 (16)	饺, 胶, 筒 (1), 河 (20), 叮, 钉, 盯 (1)
6	Online	时间当铺(Time Shop) (298/130)	There was a shop where everyone could purchase time.	分 (3), 门 (5), 半 (11), 几 (3)	份 (1), 纷 (2), 粉, 们 (6), 伴, 拌, 机 (2)
7	Online	小猪的玫瑰 (Piggies' Rose) (226/126)	Three piggies were growing a rose.	中 (3), 其 (4), 只 (3)	种/zhòng/* (4), 种/zhǒng/ (8), 钟, 棋 (4)
8	Online	没头脑的可可饼干(First Time Making Cookies) (272/162)	A boy called Silly was making cookies for the first time.	干/gān/ (10), 巨 (4), 高 (5)	赶(2), 杆, 距(1)
9	Online	真假不高兴(Who is the Real Unhappy) (202/125)	There were two boys called Unhappy, and both said they were the real Unhappy.	己 (3), 奇 (3), 正 (3)	记, 骑, 证
10	Online	青蛙搬家(Looking for a New House) (358/166)	A frog wanted to find a new house in the forest.	古 (3), 因 (4), 青 (14),	故 (6), 姑 (3), 晴 (4), 请 (1)

Note: Pinyin words were given for several characters because these characters have more than one pronunciation.

The ten stories were developed following similar criteria to that of the reading materials used in Study 1 (see Teaching Sessions in Chapter 3 on page 80). Target Chinese characters and supplementary characters were presented without their Pinyin words alongside in the story. Characters that had been taught in previous lessons were also presented without their Pinyin words. The rest of the words in the story were presented only in the Pinyin format. Therefore, Chinese characters and supplementary characters were the only new information for students. Students were not given Pinyin words for new characters so that students would focus more on the form of the new characters when they read the story. Target characters were repeated at least three times. Students, therefore, were exposed to target characters at least six times over one teaching session as each story was read aloud twice. Students received target characters' semantic information from the contexts of the story. An example of the designed stories is shown in Appendix 5.3.

As with Study 1 and Study 2, the teaching in the experimental group in Study 3 featured read-aloud activities and began with reading and comprehending the text before learning individual Chinese characters. The teaching procedure in this study was the same as the teaching procedure in Study 2, with only one difference (see Teaching Sessions in Chapter 4 on page 110). In the current study, target characters (i.e. the 32 phonetic radicals) and supplementary characters were taught after two readings in this study, unlike in Study 2, which introduced target characters, semantic radicals and supplementary characters. After reading aloud the story twice, the researcher taught each target character's meaning, sound, and form. Students read aloud words containing target characters in chorus after the teacher and wrote each target character three times. The researcher told students that each target character could be a part of a more complex Chinese character and produced the pronunciation of that complex Chinese character. Supplementary characters in Table 26 were presented as examples to

students. The researcher guided students to work out the similarity in how target characters were pronounced and how supplementary characters were pronounced.

For example, when teaching the character 主/zhǔ/ as a target character in the story *What Happened on Apple Trees*, the researcher presented the pinyin of character 主, the stroke order of writing the character 主 and phases that had the character 主 such as 主人 /zhǔ rén/ (an owner or a master) and 主要/zhǔ yào/ (primary). After that, the teacher showed the character 住 and 柱 and told students both 住 and 柱 are pronounced zhù which is similar to the sound of 主 /zhǔ/ because the phonetic radical 主 /zhǔ/ provided a clue to the sound of the complex character. The researcher also taught students to use semantic radicals to distinguish two similar characters 住 and 柱. The meaning of 住 relates to people because the radical 亻 means people, whereas the meaning of 柱 relates to wood or trees because the radical 木 infers to wood. In addition, a novel character 注 /zhù/ was provided, and the students were asked to work out the sound of character 注 according to the phonetic radical 主. By doing this, students were trained to be more aware of the function of phonetic radicals.

The stories were presented on A3 papers for the two on-site lessons and presented on PowerPoint slides for the eight online lessons via a distant learning platform called Classin. Chinese characters were in 45 Kaiti font, and Pinyin words were in 45 Songti font. All Chinese characters to be taught in the current story were accentuated by colours, with the rest of the words being presented in black font. There were only one or two sentences on each A3 paper or PowerPoint slide.

The similarities and differences in teaching sessions between the experimental and control groups can be found in Table 27.

Table 27

Similarities and differences in teaching sessions between experimental group and control group in Study 3

		Experimental group	Control group
Similarities	Session length and location	• The length of each session was 1 hour. • Two sessions were delivered online, and eight sessions were at the School.	
	Target characters	• One same target character was taught: 中	
	Teaching procedure	• The form, pronunciation and meaning of target characters, and the order of writing strokes of target characters were taught. Words containing the target characters were read in chorus. Character writing practices were included.	
Differences	Teaching procedure	• Top-bottom (The story was read aloud twice and discussed before characters were taught.) • The function of phonetic radicals was taught. The semantic radicals were taught to help children to distinguish homonyms.	• Bottom-up (Characters were taught, and practices on characters were done before the text were read and comprehended.) • The teacher did not teach any phonetic radical but taught semantic radicals.
	Teaching materials	• Ten stories designed by the researcher with on average 277 Pinyin words and 127 characters in each story • Target characters in the story were not annotated with Pinyin words. • Target characters were repeated at least six times in the story. • The arrangement of target characters aligned with the principle of the intensive approach to teaching Chinese characters.	• Lesson 2 to Lesson 5 in the Zhongwen Textbook (Year 1) • The text in each lesson had around 32 characters annotated with Pinyin words. • Target characters appeared at least once in the text. • The arrangement of target characters aligned with the principle of the extensive approach to teaching Chinese characters.
	Target characters	• 32 target characters and 50 supplementary characters.	• 59 target characters

The main differences between the two groups included longer reading materials and more read-aloud activities for the experimental group. In addition, common phonetic radicals were taught in the experimental group and the arrangement of target characters aligned with the principle of the intensive approach to teaching Chinese characters. These differences provided the contrast to answer the research questions for Study 3.

Results

Independent sample t-tests and Chi-square tests were used on the pre-test data to look for significant differences between the experimental and control groups before the ten teaching sessions. Descriptive statistics were used to compare the performance of the two groups on the measures. Mixed analyses of variance (ANOVAs) were performed to examine whether there were significant differences between the two groups in growth in each measure over the ten teaching sessions. Pearson product-moment correlations were carried out to analyse associations between the developments of Chinese character knowledge, radical awareness and Chinese reading comprehension skills in the experimental group. Data were analysed via IBM SPSS (Statistics 26).

A Chi-Square test showed no significant difference between the experimental group and the control group in terms of gender: χ^2 (1, N = 21) = 1.34, p = .25. An independent samples t-test indicated that the experimental and control groups did not differ significantly in age: t (19) = -.17, p = .87. The two groups did not significantly differ in Chinese literacy activities: t (4.14) = 1.25, p = .28. Also, the two groups did not differ significantly in home language: χ^2 (2, N = 21) = 4.04, p = .13.

Descriptive information of measures is presented in Table 28 and Table 29. To better understand the floor effect in the Chinese sentence and passage comprehension tasks, bar charts are included in Appendix 5.4 to show the number of students who were showing the floor effect.

Table 28

Scores for the measures at *the pre-tes*t *and post-test in Study 3*

Measures	Experimental group (*n* = 16)		Control group (*n* = 5)	
	Pre-test	Post-test	Pre-test	Post-test
Character Listening Task				
Mean (*SD*)	2.69 (2.36)	6.06 (2.59)	4.00 (2.12)	6.40 (1.82)
Range (0-20)	0-7	1-10	1-6	4-9
Character Reading Task				
Mean (*SD*)	3.75 (1.48)	8.13 (1.82)	4.60 (.55)	7.00 (2.12)
Range (0-50)	1-6	5-12	4-5	5-10
Character-Picture Matching Task				
Mean (*SD*)	3.31 (1.30)	11.19 (3.29)	4.40 (2.07)	8.80 (3.56)
Range (0-35)	1-6	4-17	2-7	4-12
Semantic Radical Score in RPM				
Mean (*SD*)	2.31 (2.47)	4.81 (2.61)	2.80 (1.64)	5.20 (2.49)
Range (0-26)	0-9	1-9	1-4	1-7
Phonetic Radical Score in RPM				
Mean (*SD*)	3.38 (2.96)	9.75 (2.08)	1.60 (1.52)	5.80 (2.86)
Range (0-26)	0-12	6-14	0-4	2-9
Semantic Radical Score in CPRET*				
Mean (*SD*)	.19 (.75)	6.00 (2.68)	.00 (.00)	3.80 (1.92)
Range (0-12)	0-3	2-11	0-0	1-6
Phonetic Radical Score in CPRET				
Mean (*SD*)	.06 (.25)	5.75 (3.17)	.00 (.00)	1.00 (1.41)
Range (0-12)	0-1	0-11	0-0	0-3
Chinese Sentence Comprehension Task				
Mean (*SD*)	.94 (1.18)	5.38 (2.28)	2.00 (1.41)	4.00 (1.41)
Range (0-14)	0-3	1-10	0-4	3-6
Chinese Passage Comprehension Task				
Mean (*SD*)	.00 (.00)	.88 (1.41)	.00 (.00)	.60 (.89)
Range (0-20)	0-0	0-4	0-0	0-2

Note: CPRET=Chinese Pseudo-Character Reading and Explaining Task

Table 29

Scores for the measures only conducted at the pre-test in Study 3

Measures	Experimental group (n = 16)	Control group (n = 5)
Chinese Vocabulary Task		
Mean (*SD*)	87.38 (39.72)	77.80 (24.05)
Range (0-180)	43-160	58-117
English Word Reading Task		
Mean (*SD*)	45.25 (12.83)	59.60 (26.25)
Range (0-110)	29-71	33-96
Pinyin Spelling Task		
Mean (*SD*)	24.13 (9.25)	32.00 (4.74)
Range (0-45)	5-38	26-37
Pinyin Read-Aloud Task		
Mean (*SD*)	150.25 (54.36)	165.40 (60.02)
Range (0-237)	19-207	60-208

Any significant difference between two groups in the pre-test measures was examined via independent samples t-tests. There were non-significant differences for the Chinese Vocabulary Task (t (19) = -.51, p = .62) and the English Word Reading Task (t (4.61) = 1.18, p = .30). Among other pre-test measures, significant differences were not found for the Pinyin Read-Aloud Task (t (19) = .53, p = .60), the Pinyin Spelling Task (t (19) = 1.81, p =.09), Character Listening Task (t (19) = 1.11, p = .28), the Character Reading Task (t (18.06) = 1.91, p = .07), the Character-Picture Matching Task (t (19) = 1.42, p = .17), and the Chinese Sentence Comprehension (t (19) = 1.68, p = .11). All participants failed to score on the Chinese Passage Comprehension Task before ten teaching sessions started. Significant differences were also not found in pre-tests of radical awareness. This was for the semantic radical score in the Radical Picture Matching Task (t (19) = .41, p =.69), the phonetic radical score in the Radical Picture Matching Task (t (19) = -1.27, p = .22), the semantic radical score in the Chinese Pseudo-

Character Reading and Explaining Task (t (19) = -.55, p = .59) and the phonetic radical score in the Chinese Pseudo-Character Reading and Explaining Task (t (19) = -.55, p = .59).

Mixed (one between and one within subjects factor) analyses of variance were conducted on each pre/post measure (except for the Chinese passage comprehension measure) to contrast the gains in the experimental and control groups. For Character Reading Task, there were a significant main effect of time (F (1, 19) = 70.76, p < .001, η_p^2 = .79) and a significant interaction between group and pre/post scores (F (1, 19) = 6.01, p = .02, η_p^2 = .24). The increase over time was greater for the experimental group than for the control group, which means the experimental group experienced a larger improvement in reading characters. For Character-Picture Matching Task, there was also a significant main effect of time (F (1, 19) = 55.38, p < .001, η_p^2 = .75) and a significant interaction between group and pre/post scores (F (1, 19) = 4.44, p= .05, η_p^2 = .19). The experimental group demonstrated greater improvements in the knowledge of orthography-semantics correspondence than the control group over time. The Character Listening Task did not show a significant interaction between group and pre/post scores (F (1, 19) = .97, p = .34, η_p^2 = .05) but there was a significant main effect of time (F (1, 19) = 34.02, p < .001, η_p^2 = .64). There were no main effects between groups on any of these Chinese character tasks.

Among the radical awareness tasks, the phonetic radical score in Chinese Pseudo-Character Reading and Explaining Task showed a significant interaction between group and pre/post scores (F (1, 19) = 9.85, p = .01, η_p^2 = .34). The increase over time was greater for the experimental group than the control group. This measure also showed significant main effects of time (F (1, 19) = 20.05, p < .001, η_p^2 = .51) and groups (F (1, 19) = 10.58, p = .001, η_p^2 = .36). For the phonetic radical score in Radical Picture Matching Task, there was a significant effect of time (F (1, 19) = 29.48, p < .001, η_p^2 =.61) and a significant effect between groups (F (1, 19) =1 1.70, p = .001, η_p^2 = .38), but there was not an interaction between group

and pre/post scores (F (1, 19) = 1.25, p = .28, η_p^2 = .06). For semantic radical awareness, the semantic radical score in Chinese Pseudo-Character Reading and Explaining Task showed a significant effect of time (F (1, 19) = 53.40, p < .001, η_p^2 = .74), although it did not show a significant interaction between group and pre/post scores (F (1, 19) = 2.34, p = .14, η_p^2 = .11) nor a significant effect between groups (F (1, 19) = 2.34, p = .14, η_p^2 = .11). For the semantic radical score in Radical Picture Matching Task, a significant effect of time (F (1, 19) = 5.81, p = .03, η_p^2 = .23) was found, but neither a significant effect between groups (F (1, 19) =.35, p = .56, η_p^2 = .02) nor an interaction between group and pre/post scores (F (1, 19) = 1.25, p = .28, η_p^2 = .06) was identified. Overall, analyses only identified one significant difference in the development of phonetic radical awareness between groups and did not find any significant difference in the development of semantic radical awareness between groups.

Chinese reading comprehension ability was measured at the sentence level and the passage level. For the sentence level, there was a significant interaction between group and pre/post scores (F (1, 19) = 5.98, p = .02, η_p^2 = .24) and a significant effect of time (F (1, 19) = 41.70, p < .001, η_p^2 = .69). The increase over time was higher for the experimental group than the control group. However, a significant effect between groups was not found (F (1, 19) = .05, p = .83, η_p^2 = .00). An independent samples t-test was used for the Chinese Passage Comprehension Task but the results did not indicate any significant difference (t (19) = -.41, p = .69).

Pearson product-moment correlations were used to investigate any relationships among improvements in Chinese character, radical awareness and Chinese reading comprehension measures found in the experimental group. The results are shown in Table 30. Within the Chinese character measures, it was only was found one significant correlation: the correlation between the change in Character Reading Task and Character-Picture Matching Task. Within the radical awareness measures, there was only one significant correlation as well, namely, the

Table 30

Results of Pearson product-moment correlations for the experimental group in Study 3

Variable	1	2	3	4	5	6	7	8
1. Character Listening Task								
2. Character Reading Task	r = .25 p = .35							
3. Character-Picture Matching Task	r = .04 p = .89	r = .56 p = .03*						
4. Semantic Radical Score in RPM	r = .19 p = .48	r = .71 p = .00*	r = .28 p = .30					
5. Phonetic Radical Score in RPM	r = -.03 p = .92	r = *-.44* p = .09	r = *-.38* p = .15	r = *-.49* p = .05				
6. Semantic Radical Score in CPRET	r = -.01 p = .97	r = -.06 p = .84	r = *.47* p = .07	r = .15 p = .59	r = *-.35* p = .19			
7. Phonetic Radical Score in CPRET	r = .20 p = .45	r = .65 p = .01*	r = .72 p = .00**	r = *.41* p = .12	r = -.56 p = .02*	r = *.39* p = .13		
8. Chinese Sentence Comprehension Task	r = .20 p = .47	r = .22 p = .42	r = .51 p = .05*	r = .18 p = .51	r = *-.37* p = .16	r = .78 p < .00***	r = *.39* p = .14	
9. Chinese Passage Comprehension Task	r = -.01 p = .98	r = .29 p = .27	r = .57 p = .02*	r = *.36* p = .18	r = -.50 p = .05*	r = *.48* p = .06	r = *.36* p = .17	r = *.36* p = .17

Note: RPM= Radical Picture Matching Task; CPRET= Chinese Pseudo-Character Reading and Explaining Task.
*p < .05, **p < .01, *** p < .001
Cohen's (1988) guidelines include large correlations (.50 ≤ |r| < 1.0), medium correlations (r =.30 ≤ |r| < .50), and small correlations (.10 ≤ |r| < .30). The medium correlations according to Cohen (1988)'s guidelines were italicised.

correlation between the change in the phonetic radical score in the Radical Picture Matching Task and the phonetic radical score in Chinese Pseudo-Character Reading and Explaining Task; though this correlation was negative. For the Chinese reading comprehension measures, there were no significant correlations.

Correlation analyses between the Radical Picture Matching Task and the rest of the measures in this study generated negative correlations for the phonetic radical awareness score in the Radical Picture Matching Task but positive correlations using the semantic radical awareness score in the Radical Picture Matching Task. In Radical Picture Matching Task, the change in the semantic score was significantly correlated to the change in Character Reading Task (r (16) = .71, p < .01), and was moderately associated with the Chinese Passage Comprehension Task (r (16) = .36, p = .81). The change in the phonetic radical score in Radical Picture Matching Task was significantly correlated with the Chinese Passage Comprehension Task (r (16) = -.50, p = .05). Correlations of a moderate size were also identified with the Character Reading Task (r (16) = -.44, p = .09), the Character-Picture Matching Task (r (16) = -.38, p = .15) and the Chinese Sentence Comprehension Task (r (16) = -.37, p = .16), although these correlation were negative.

By contrast, in the Chinese Pseudo-Character Reading and Explaining Task, the phonetic radical awareness score had positive correlations with all Chinese character and reading comprehension tasks, and the semantic radical awareness score negatively correlated with two character knowledge tasks (the Character Listening Task and Character Reading Task). Significant correlations were found between the phonetic radical awareness score and the Character Reading Task (r (16) = .65, p = .01), between the phonetic radical awareness score and the Chinese-Picture Matching Task (r (16) = .72, p < .01), and between the semantic radical awareness score and the Chinese Sentence Comprehension Task (r (16) = .78, p < .00).

The phonetic radical awareness score was moderately correlated with the Chinese Sentence Comprehension Task (r (16) = .39, p = .14) and the Chinese Passage Comprehension Task (r (16) = .36, p = .17). Medium-strength correlations were also found between the semantic radical awareness score with the Character-Picture Matching Task (r (16) = .47, p = .07) and with the Chinese Passage Comprehension Task (r (16) = .48, p = .06).

There were two significant correlations between the Chinese character measures and the Chinese reading comprehension measures. The change in Chinese-Picture Matching Task was significantly correlated with both the change in Chinese Sentence Comprehension Task (r (16) = .51, p = .05) and the change in Chinese Passage Comprehension Task (r (16) = .57, p = .02).

Discussion

In this study, the shared reading method was revised to include phonetic-radical based grouping and explicit phonetic radical instruction. This study aimed to explore the effectiveness of the revised shared reading method on phonetic radical awareness, Chinese character acquisition, and Chinese reading comprehension for beginning-level Chinese heritage children. Clearly, one of the main limitations in this study was the large reduction in children in the control teaching condition. Differences between the groups, therefore, may need to be interpreted cautiously – though the effects in the previous two studies in this thesis will be considered along with the findings from Study 3 in the following chapter.

The shared reading class showed more significant gains in assessments of phonetic radical awareness in the Chinese Pseudo-character Reading and Explaining Task than the textbook-based class. This result suggests that children in the shared reading condition were better at analysing the orthographic structure of a compound character, recognising the

phonetic radical, and deducing the pronunciation of the compound character based on the sound of the phonetic radical. The better phonetic radical awareness was likely achieved by the explicit explanation of the relation between phonetic radicals and compound characters and relevant practices in the ten teaching sessions. Children in the shared reading class learned commonly used phonetic radicals and supplementary characters containing the taught phonetic radicals. Children were guided to work out how to pronounce supplementary characters through the phonetic radical. After the ten sessions, children may have worked out the method of obtaining the pronunciation of a novel character according to its phonetic radical.

This study also included the Radical Picture Matching Task to test phonetic radical awareness, but significant differences have not been found in this task. The inconsistent findings between these two phonetic radical tasks may be due to the different question types and difficulty levels of test items. The 13 items in the Radical Picture Matching Task are from the picture-novel character mapping task in Tong and Yip (2015) and also included phonetic radicals that participants have not learned, whereas all phonetic radicals in the Chinese Pseudo-Character Reading and Explaining Task were either taught or covered in the textbook in this study. In addition, the Radical Picture Matching Task included multiple-choice questions, but the Chinese Pseudo-Character Reading and Explaining Task consisted of open-ended questions. More solid knowledge may be required to answer open-ended questions than multiple-choice questions because the correct answer for multiple-choice questions could possibly be chosen by guessing. Thus, the Radical Picture Matching Task would investigate more on general phonetic radical awareness, and the Chinese Pseudo-Character Reading and Explaining Task would show more about children's awareness of phonetic radicals covered by the ten teaching sessions in this study. These differences may have led to different findings in these two measures.

Interestingly, it was found that the phonetic radical awareness score in the Radical Picture Matching Task negatively correlated to all Chinese character and reading comprehension measures, but the semantic radical awareness score positively correlated to all of the Chinese character and reading comprehension measures. There was a significant correlation between the semantic radical awareness in the Radical Picture Matching Task with knowledge of orthography-phonology correspondence of characters measured in the Character Reading Task. This result means that better readers in the shared reading class tend to use meaning cues from semantic radicals to facilitate character recognition. This tendency to use semantic radicals when decoding characters was referred to as a *semantic bias* by Williams and Bever (2010), who reported that Chinese adult native speakers could use both semantic and phonetic radicals to decode characters, but they slightly preferred semantic radicals. This semantic bias was also found among Chinese L2 learners (Tong & Yip, 2015). A reason argued by Williams and Bever (2010) and Tong and Yip (2015) was the distributional differences between semantic radicals and phonetic radicals: There are around 200 semantic radicals and 800 phonetic radicals in Chinese (Hoosain, 1991), thereby the frequency of semantic radicals being higher than those of phonetic radicals. Children may have seen the semantic radicals more often than phonetic radicals in the Radical Picture Matching Task since items in this task were not limited to the radicals taught in Study 3. Thus, it is probably easier for children in the shared reading class to recognise the semantic radicals in the Radical Picture Matching Task.

However, the phonetic radical awareness score in the Chinese Pseudo-Character Reading and Explaining Task had positive correlations with all Chinese character and reading comprehension tasks, including significant correlations with the Character Reading Task and the Character-Picture Matching Task. This indicates that better phonetic radical awareness may have made it easier to pronounce compound characters in the Character Reading Task and the Character-Picture Matching Task, leading to better performance. Phonetic radical awareness

was also found to be closely associated with character acquisition for Chinese native children in precious studies (Ho, 2013, Li et al., 2018). The semantic radical awareness score in the Chinese Pseudo-Character Reading and Explaining Task, however, negatively correlated with two character tasks (the Character Listening Task and Character Reading Task) and only had a significant and positive correlation with Chinese reading comprehension at the sentence level. This finding suggests that children with better semantic radical awareness may find it easier to figure out the meaning of given sentences and choose the correct answer in the Chinese Sentence Comprehension Task. Similar results were found for Chinese native children in Ho and Ng et al. (2003), which reported significant correlations between semantic radical awareness and Chinese word reading, between phonetic radical awareness and Chinese word reading, and between semantic radical awareness and Chinese sentence comprehension. Nevertheless, larger data are needed to examine relations between radical awareness and character knowledge, between radical awareness and Chinese reading comprehension for Chinese heritage children.

Results from two out of the three Chinese character measures (the Character Reading Task and the Character-Picture Matching Task) indicated significant differences in the gains shown by the groups over the ten teaching sessions, which was consistent with the results in Study 1. This finding suggested that children in the shared reading class developed more solid knowledge about characters' orthography-phonology and orthography-semantics correspondences. More frequent exposure to Chinese characters, greater contextual information, and repeated read-aloud practices in the context in the shared reading condition may contribute to the improvement (see Discussion section in Chapter 3 on page 92 for more discussions). Moreover, better phonetic radical awareness in the shared reading class may also have promoted the improvement in character knowledge, taking into account of significant correlations between the gains in the phonetic radical awareness score in the Chinese Pseudo-

Character Reading and Explaining Task and the gains in the Character Reading Task, and Character-Picture Matching Task (see discussion above).

Similar to the results in Study 1, children from the shared reading class improved significantly more than their counterparts in the textbook-based class on the Chinese Sentence Comprehension Task. The gains in children's knowledge about characters' orthography-semantic association and semantic radical awareness may have contributed to gains in Chinese reading comprehension, taking into consideration of significant correlations between the Chinese Sentence Comprehension Task and the Character-Picture Matching Task, and the semantic radical score in the Chinese Pseudo-Character Reading and Explaining Task. Although significant differences were not identified in passage level Chinese reading comprehension measure (see also Study 1), correlations did suggest that, in the shared reading class, children's knowledge about characters' orthography-semantic correspondences was significantly associated with Chinese passage comprehension. However, these findings in Study 3 may need to be interpreted cautiously due to a limited number of participants. More implications of these findings together with those from the other two studies in this thesis will be discussed in the next chapter.

Chapter 6 General Discussion

The current research focused on teaching Chinese character acquisition and Chinese reading comprehension to Chinese heritage children in the early stages of learning to read in Mandarin Chinese. A shared reading teaching method was designed, and the effectiveness of this teaching method was examined in three studies. Study 1 and Study 3 found that Chinese heritage children taught with the shared reading method showed more significant improvement of character knowledge (orthography-phonology and orthography-semantics correspondences) and Chinese reading comprehension at a sentence level than children in the textbook-based class. Study 3 also found that Chinese heritage children taught with the shared reading method established better phonetic radical awareness than children in a textbook-based class. The findings from Study 1 and Study 3 suggest that Chinese heritage children's learning to read in Chinese may be influenced by the frequent exposures to Chinese characters, rich contextual information and the development of phonetic and semantic radical awareness. However, in Study 2, children in the shared reading class did not perform significantly better in any measure than their counterparts in the textbook-based class, potentially due to the specific combination of shared reading methods and radical awareness teaching used in this study. The overall findings are discussed in this chapter (i.e., in addition to the discussions in the individual study chapters). This is followed by instructional implications, limitations and suggestions for future research.

To the author's knowledge, the current research was the first empirical study that incorporated frequent exposure to Chinese characters' orthography, phonology and semantics into Chinese literacy instruction for Chinese heritage children. The current research illustrated the feasibility of designing reading materials where unfamiliar characters can be repeated frequently and using the designed reading materials in read-aloud activities in Chinese lessons. Using such materials in read-aloud activities can provide Chinese heritage children relatively

frequent exposure to Chinese characters' orthography, phonology and semantics simultaneously. The importance of exposure to these three representations of characters has been underlined in the Lexical Constituency Model (Perfetti & Tan, 1999; Perfetti et al., 2005) and the self-teaching hypothesis (Share, 1995).

According to Lexical Constituency Model (Perfetti & Tan, 1999), the character's phonology, orthography, and semantics are interconnected constituents of word identification. Recognising a written word entails the retrieval of its phonological and semantic forms from an orthographic form. The absence of any one of these three representations leads to an underspecified identity (Perfetti et al., 2005). The orthography-phonology mapping plays a core role in character recognition (Perfetti & Harris, 2013). Due to the lack of grapheme-phoneme correspondence rules in the Chinese language, the phonologic representation of a character is not activated before the orthographic representation of the character is fully activated (Perfetti et al., 2005). The activation of a character's phonologic and semantic representations happens in a threshold manner. The frequency of encountering a character's orthography-phonology and orthography-semantics correspondences determines the threshold of retrieving the pronunciation and meaning of the character (Perfetti & Tan, 1999). Similarly, the self-teaching hypothesis (Share, 1995) has highlighted the importance of exposure to characters' orthography, phonology and semantics. Orthographic learning relies on the frequency to which the child has been exposed to a particular character with successful recognition of its orthographic, phonological, and semantic representations. The self-teaching hypothesis (Share, 1995) also emphasises that orthography-phonology mapping is the core of reading development.

In the current research, providing frequent exposure to Chinese characters' orthography, phonology and semantics simultaneously in the shared reading condition allowed children to encounter orthography-phonology and orthography-semantics correspondences repeatedly,

which would be expected to lead to lower activation thresholds. Given that Chinese heritage children often have limited exposure to Chinese characters in daily life, the current research explored whether the frequent exposure to three representations of characters in Chinese lessons would facilitate character knowledge development for this cohort of children. In Study 1, children in the shared reading class had at least 18 exposures to novel characters over the three read-aloud activities. This frequency of exposure was higher than the six exposures that were reported for Chinese native children to improve recognition of simplified Chinese characters in Liu and Shiu (2011). The level of exposure to novel characters in the shared reading condition in Study 1 was also higher than that experienced in the textbook-based class. Explicit instruction on new characters was provided in both the shared reading and the textbook-based conditions. Therefore, one interpretation of the results in Study 1 is that more exposure to characters' orthography, phonology and semantics simultaneously in shared reading activities promoted the development of character knowledge (orthography-phonology, orthography-semantics correspondences) for Chinese heritage children. This finding is in alignment with the facilitative effect of frequent exposure to characters suggested in both the Lexical Constituency Model (Perfetti & Tan, 1999; Perfetti et al., 2005) and the self-teaching hypothesis (Share, 1995).

The positive finding of frequent exposure in Study 1 was supported by Study 3 but not Study 2. The inconsistent findings among these studies may suggest that although frequent exposure to characters can improve children's character learning, this positive effect is likely influenced by additional factors. The ways how target characters were grouped in the reading materials were different in Study 2 and Study 3, which may have affected the facilitative effect of frequent exposure to characters on character acquisition. Novel characters having the same semantic radicals were allocated in the same reading material in Study 2, whereas novel characters containing the same phonetic radicals were placed in the same reading material in

Study 3. Perfetti and Tan (1998) found that characters with similar orthography (i.e. sharing the same semantic or phonetic radical) can have either facilitation or inhibition effects. If the prime character shares the same radical and the same pronunciation as the target character, the prime character can facilitate the activation of the phonologic representation of the target character. The inhibition effects will occur if the prime character shares the same radical but does not have the same pronunciation as the target character. In the current research, novel characters that were allocated in the same reading material in Study 2 shared the same semantic radical but did not share the same pronunciation. For example, 好 /hǎo/ and 奶 /nǎi/ have the same semantic radical 女 (female) but different pronunciations. This way of arranging novel characters may have produced the inhibition effect proposed by Perfetti and Tan (1998) and reduced the positive benefits of more frequent exposure to novel characters' orthography, phonology and semantics in the shared reading condition compared to the textbook-based condition. In Study 3, since novel characters that share the same phonetic radical have the same pronunciation (with the same or different tones), the activation of one character's phonological representation would facilitate the activation of the phonological representation of another character. The Target Character Read-Aloud Task, however, was not included in Study 3, so more data are needed for further clarifications on this facilitation effect.

Studies 2 and 3 also varied in terms of their focus on teaching the different types of radical awareness: semantic radicals were the focus in Study 2, whereas phonetic radicals were the focus in Study 3. Differences in the improvement of radical awareness were reported in Studies 2 and 3, which may also have influenced the positive effect of frequent exposure to characters on character acquisition. Children in the shared reading condition in Study 3 developed significantly better phonetic radical awareness than children in the textbook-based class, according to their performance in the Chinese Pseudo-character Reading and Explaining Task. More gains in phonetic radical awareness in the shared reading condition were likely

attributed to explicit instruction on phonetic radicals (see Discussion in Chapter 5 on page 158 for more discussion). However, significant differences between the two conditions were not found in semantic radical awareness in Study 2. Potential reasons include the way of arranging novel characters in reading materials for the shared reading condition and instructions on semantic radicals given in both the shared reading and traditional teaching conditions (see Discussion in Chapter 4 on page 123 for more discussion). This explanation suggests that the effects of explicit teaching may outweigh the effects of repeated exposure when it comes to semantic radicals, but further investigation is needed.

Moreover, findings in Study 3 suggest that both phonetic and semantic radical awareness were closely related to the improvements in character acknowledge (see Discussion in Chapter 5 on page 158). In the shared reading condition in Study 3, improvements in phonetic radical awareness measured in the Chinese Pseudo-Character Reading and Explaining Task were significantly correlated to gains in measures of orthography-phonology correspondence (Character Reading Task) and orthography-semantics correspondence (Character-Picture Matching Task). These findings suggest that phonological decoding through phonetic radicals may be closely associated with Chinese orthographic learning and is in concordance with previous studies on Chinese native children (Ho, 2013, Li et al., 2018). Study 3 also reported that improvements in semantic radical awareness measured in Radical Picture Matching Task related to gains in orthography-phonology correspondence measured in Character Reading Task. This finding suggests that semantic radicals may also have facilitated the learning of phonological representations of characters. The positive effect of semantic radicals on phonological learning of compound characters has been reported for Chinese native children (Li et al., 2020; Xiao, 2013, as cited in Liu, 2018) and Chinese second language learners (Liu, 2018).

Compared to Study 3, the lack of phonetic radical awareness may be a reason for non-significant results in Study 2. For both Chinese heritage children and Chinese native children, learning a character requires them to connect the character's orthographic representation to the phonological and semantic representations stored in their mental lexicon. However, the orthography-phonology mapping may play a core role in character recognition (Perfetti & Harris, 2013; Share, 1995), leading to the use of semantic radicals being more of a secondary mechanism. The orthography-phonology correspondence was also found to be the primary strategy of character decoding for Chinese native children (Guan et al., 2020) and benefit learning the meaning of characters (Li et al., 2021). If this is the case, then children in Study 3 might be able to first work out the phonology of a given character based on their experience of the usefulness of phonetic radicals. Once the phonology was matched to different semantic representations, because of large numbers of homonyms in Chinese, the homonyms were screened based on clues provided by the semantic radical and the correct orthography-phonology-semantics mapping was achieved. For example, when the character 蚂 /mǎ/, which belongs to 蚂蚁 /mǎ yǐ/ (ants) is given, children could first come up with the possible pronunciations of the character 蚂 including /mā/, /má/, /mǎ/, or /mà/ based on the phonetic radical 马 /mǎ/, and then work out that the character 蚂 might relate to the insect according to the semantic radical 虫 (insect, worm). Combining these clues, children could think about a word 蚂蚁 /mǎ yǐ/ (ants) and work out that the character 蚂 should be pronounced as /mǎ/. By contrast, children in Study 2 might only realise that a given character (without a context) related to a general meaning based on the semantic radical but found it difficult to retrieve the accurate semantic representation from their mental lexicon when phonological clues were not accessible. For example, children in Study 2 would only know the meaning of character 蚂 associated with the animal.

The current research has instructional implications for teaching Chinese characters to Chinese heritage children. The current research provides empirical data to support the proposal to use reading activities to teach Chinese heritage children Chinese characters (Chen 2018; Li, 2006; Lü, 2017). Findings in the current research imply that the combination of shared reading activities and instruction on new characters can be an alternative teaching method to the conventional textbook-based teaching used with Chinese heritage children. During the shared reading activities, the teacher guided students to read aloud material in chorus two or three times. These read-aloud activities served as a scaffold for Chinese heritage children to gradually match the form of unfamiliar Chinese characters in reading materials with the sound and meanings that were already stored in their mental lexicon. Explicit instruction on new characters (such as strokes and radicals) was given after read-aloud activities in the shared reading method to consolidate children's knowledge of characters and radicals. However, given the limited sample size in the current research, it is needed to conduct more semi-experimental research to examine the effectiveness of the combination of shared reading activities and instruction on new characters.

The current research demonstrated a way to design reading materials for Chinese heritage children. Reading materials used in reading activities should be tailored for Chinese heritage children and to Chinese heritage children's interests, such as stories and nursery rhymes (Lü, 2017a), but suitable reading materials are scarce (Ma, 2007). Reading materials in the shared reading class of the current research were fantasy stories designed by the researcher. These reading materials had two features. The first feature was the format of words in the designed story. Target characters that were to be learned, along with characters taught previously, were not presented with accompanying Pinyin words. Presenting characters without Pinyin words aimed to keep children's attention to the orthographic representation of characters because Ho (2014) argued that phonological aids could divert students' attention

and may not contribute to learning Chinese characters. The rest of the words in the story were only presented in Pinyin words which were children's previous knowledge. Therefore, the target characters in the story were very likely to be the only new information for Chinese heritage children when they read the story. Another feature was the frequent appearance of target characters in the story. Target characters were repeated at least three times to provide frequent print exposure to target characters. When the teacher guided children to read aloud the story, the frequent appearance of target characters allowed children to encounter orthography-phonology and orthography-semantics correspondences repeatedly, which may lead to lowering activation thresholds. The findings of the current research suggest that reading materials with these two features would suit Chinese heritage children. These two features can be considered when the teacher designs reading materials for Chinese heritage children. However, it may take a great amount of time and energy for the teacher to make sure that target characters appear repeatedly, and the words are presented in the suitable format (i.e. Pinyin words or characters) when they design stories. It would be interesting to explore whether any educational technology can be used to support the procedure of designing stories. Further investigations are also needed to see if other types of reading materials (for example, informative texts, poetry and nursery rhymes) are suitable for Chinese heritage children and how to provide repeated exposures to new characters in these reading materials.

The shared reading method in the current research differs from a shared-book reading teaching method for Year 1 Chinese native children in Anderson et al. (2002). The lesson in Anderson et al. (2002) involves the teacher and children reading aloud a story eight times within 45 minutes. The story was presented in Chinese characters without Pinyin words. The teacher explained the meaning of unfamiliar Chinese characters in the story to help the comprehension of the story but did not explicitly teach these Chinese characters (such as the form and radicals of these characters). The shared reading method in the current research

includes explicit instruction on characters and radicals, and the stories were presented in both characters and Pinyin words (see the previous paragraph). Comparatively, the shared-book reading teaching method in Anderson et al. (2002) focused more on incidental learning of Chinese characters; the shared reading method in the current research combined the incidental learning and intentional learning of Chinese characters. The current research did not use the shared-book reading teaching method in Anderson et al. (2002) because of the differences between Year 1 Chinese heritage children and Year 1 Chinese native children. One reason is that Year 1 Chinese heritage children often do not have much knowledge of Chinese characters, and it would be difficult for them to read stories without any support from Pinyin words. Another reason is that incidental learning may take a long time for Chinese heritage children, given that they often have one Chinese lesson per week and have limited input of Chinese characters in their daily life. Different shared reading teaching methods are needed for Chinese heritage children and Chinese native children at the early stage of learning to read Chinese. However, the shared-book reading teaching method in Anderson et al. (2002) may be suitable for Chinese heritage children when they have learned some characters and had some experience in reading in Chinese. It would be interesting to examine incidental character learning in shared reading activities for Chinese heritage children at senior levels of Chinese classes (Year 4 and above).

Apart from the benefit of using shared reading activities in Chinese lessons for Chinese heritage children, the current research also implies that teaching common phonetic radicals along with semantic radicals may facilitate character learning for Chinese heritage children who are at the early stages of learning to read Chinese. Conventional Chinese lessons for Chinese heritage children usually include instruction on semantic radicals but not phonetic radicals. However, given that semantic radicals only indicate a general meaning that the character may relate to, such as 虫 (insect, worm) and 亻 (people), children may find it

challenging to recognise an unfamiliar character only based on a clue given by the semantic radical. If children learn common phonetic radicals that have relatively high phonetic radical-character consistency and semantic radicals, clues from both radicals and children's Chinese oral vocabulary may better support them to work out the pronunciation and meaning of the unfamiliar character. As we have discussed in previous paragraphs, the facilitative effect of the combination of semantic and phonetic radicals may be one of the reasons that in Study 3, Chinese heritage children in the shared reading condition showed greater improvement of character knowledge than children in the textbook-based condition. It would be worthwhile to consider adding common phonetic radicals to lists of Year 1 target Chinese characters for Chinese heritage children and guiding students to use these common phonetic radicals and semantic radicals to recognise unfamiliar characters. With this strategy of character recognition, they may be able to recognise more characters in a short period of time compared to the number of characters they may learn in conventional Chinese lessons. Using this strategy to learn characters rather than only relying on rote memorisation, Chinese heritage children may be motivated to continue character learning. Study 3 in the current research presented a way to teach common phonetic and semantic radicals, i.e. inserting common phonetic radicals and compound characters that have these phonetic radicals in designed stories and providing explicit instruction on phonetic and semantic radicals after read-aloud activities. Future studies can explore other ways to introduce common phonetic and semantic radicals to Chinese heritage children in reading activities, such as using nursery rhymes.

Based on the findings of the current research, it is recommended (i) to use shared reading activities, (ii) to provide frequent exposure to novel characters' orthography, phonology, and semantics, (iii) and to explicitly teach common radicals, especially phonetic radicals, when teaching Chinese heritage children who are at the early stages of Chinese

literacy learning. Future research is suggested to test teaching methods that provide frequent exposure to new characters and develop children's radical awareness.

Nevertheless, the findings need to be carefully interpreted due to some limitations of the current research. To begin with, the sample size in each study was limited, which may have affected the results. Participants in Study 1 and Study 2 were also overlapped, leading to the potential influence of past experience in Study 1 to learning performances in Study 2. Some influential factors were considered in the current research including the School, the length of each session, teaching procedure, teaching materials, the level of target characters, learners' Chinese language levels before the research, learners' age, Pinyin levels, and Chinese literacy practices at home. However, other factors such as the attributes of teachers, learners' learning motivation, and parents' attitude towards their children's learning may also have affected learning performance but were beyond the focus of this research. A larger sample size is recommended in future research to make sure the two approaches to literacy teaching are as similar as possible.

The age range in each group was wide even though independent t-tests showed non-significant differences between the two groups in each study. Children of different ages may have different cognitive skills (such as attention, short term memory) and learning skills (such as self-control, communication skills) which may affect Chinese learning. However, it is not uncommon to see children of different ages in the same Chinese class in Chinese community schools in New Zealand since children are often allocated to classes based on their Chinese language levels rather than their age. Larger samples may be able to control age, but this will likely require data from multiple schools. Additionally, future studies could add tasks measuring a range of learning-related skills that might influence character learning, then statistically control these factors, but this would require more testing than could be accomplished in the current research context.

Additionally, this thesis focused on character recognition rather than Chinese word recognition. It is not clear if any difference in character recognition between the shared reading and textbook-based groups is associated with subsequent differences in word recognition between the two groups. Future studies are suggested to measure character recognition and Chinese word recognition through tasks such as a character read-aloud task and a Chinese word read-aloud task, and explore the effect of shared reading activities on promoting Chinese heritage children's character and Chinese word recognition. In addition, children in the shared-reading groups read words containing new characters in chorus during the ten teaching sessions. A limitation of these choral word reading activities is the possibility of certain children not reading the words aloud. However, these choral word reading activities aimed to support character learning by giving examples of how new characters could be used in words. Future studies are suggested to include more word learning activities (such as, making sentences with given words and comparing synonyms) and focus on both character learning and word learning in the proposed shared reading method.

Moreover, due to a lack of standardised measures in Chinese literacy for Chinese heritage children, some measures in the current research were either revised from measures for Chinese native children or self-developed by the researcher. Some of the self-developed measures would benefit from further development to increase their reliability: e.g., both the Chinese Sentence Comprehension Task and the Chinese Passage Comprehension Task did not show high internal consistency scores. In future research, it is worthwhile to develop standardised measures on Chinese character acquisition and Chinese reading comprehension for Chinese heritage children. Measures specifically designed and normed for Chinese first language learners may not be appropriate for studies of Chinese heritage children. Chinese heritage children are likely to develop Chinese literacy at a slower speed than Chinese native children because of the relatively smaller amount of Chinese language input in their daily lives

and their less frequent Chinese lessons. This slower pace of acquisition, as well as the potential effects of learning the read more quickly in another language (i.e., English in the context of New Zealand), may mean that different skills or strategies develop at different rates among heritage learners compared to native learners. Additionally, the Chinese reading comprehension tasks used in the current research showed floor effects. Such floor effects may be avoided if future studies consider using a mixture of Pinyin and characters in their comprehension tasks (this might follow the same format as the reading materials presented to the experimental group in the current research). Children may then be able to read the Pinyin words and familiar characters to get the context of the text, and then work out unfamiliar characters and more detailed information in a sentence/passage.

Home Chinese literacy environment was considered and measured in Study 3 to monitor any potential influence of literacy activities at home on character learning. However, this factor was not considered in Study 1 and Study 2. Previous research argued that home Chinese literacy environment closely relates to learning to read Chinese for Chinese heritage children, given that instruction time of Chinese literacy in the Chinese community school is often limited (Xia, 2016; Zhang & Koda, 2011). Schoolwork-related reading practice at home was found to be positively correlated with Chinese word knowledge (Zhang & Koda, 2011). Home Chinese literacy environment may also have affected character learning in the current research. For example, children who regularly read Chinese books by themselves or with parents and practised writing characters at home may have acquired more novel Chinese characters compared to children who had fewer literacy activities outside of Chinese lessons. The difference in character acquisition outside of the Chinese class may have affected the gains in character acquisition shown in the current research. This is because the character knowledge measures in the current study investigated the development of general character knowledge. (Only Study 2 included a measure for target Chinese characters.) It is suggested that future

studies on Chinese language teaching measure the Chinese literacy environment at home and monitor any effects that home Chinese literacy environment would have on learning to read Chinese in the classroom.

Future research can explore more ways that combine Chinese reading at home with Chinese character instruction in the classroom given relatively limited teaching hours (1-2 hours) of Chinese lessons in the Chinese community school for Chinese heritage children. One possible way is to give children reading materials as homework, and the reading materials contain characters taught in the previous lesson. Reading activities not only could provide more exposure to taught characters to consolidate children's character knowledge but also may engage children into learning to read the Chinese language. Again, further research showing how this can be achieved within the context of heritage learners' day-to-day activities would increase the practical benefits of the methods discussed in the current thesis.

It would also be worthwhile for future studies to research effective ways to combine shared reading with character writing to promote Chinese heritage children's character learning. Character writing is beneficial to learning to read Chinese because character writing requires more orthographic awareness and the retrieval of characters' representations from memory. Although the shared reading method in the current research included character writing practices, the practices were the same as the writing practices normally used in the textbook-based class; i.e. copying each new character several times and paying attention to the order of strokes. In Study 2 and Study 3 in the current research, new characters were grouped in reading materials according to either semantic radicals or phonetic radicals in order to support the development of radical awareness. It would be interesting to explore how to attract students' attention to radicals in character writing practices. For example, the character writing practice sheet could contain some probing questions such as "Can you write another character you learnt in this lesson that has the same radical?" Future research could investigate if the combination of

writing practices and shared reading activities that focus on the development of radical awareness is beneficial for Chinese heritage children's character acquisition.

It is also suggested to further examine the effect of semantic radical-based grouping on the development of semantic radical awareness for Chinese heritage children. Xu et al. (2014) had found that grouping characters based on semantic radicals and presenting these characters in the same reading material facilitated the development of semantic radical awareness for beginning-level Chinese second language learners, whereas the facilitative effect of semantic radical-based grouping was not found in Study 2 in the current research. Not all novel characters in each group had the same semantic radical in Study 2, differing from Xu et al. (2014) in which all novel characters in each group shared the same semantic radical. It would be interesting to see if semantic radical-based grouping supports the development of semantic radical awareness for Chinese heritage children when all novel characters in each group share the same semantic radical.

More investigation is needed to determine if learning Chinese through reading activities can promote Chinese heritage children's motivation to learn the Chinese language. The difficulty of character learning and the gap between Chinese culture and the culture of the country where Chinese heritage children are living would make it challenging to promote Chinese heritage children's motivation to learn the Chinese language (Lü, 2017). For example, there has been evidence/arguments suggesting that practices in conventional Chinese lessons can decrease Chinese heritage language learners' motivation (Curdt-Christiansen, 2006; Jiang, 2010; Li, 2005; Xiao, 2008). It would be interesting to explore the impact of different teaching methods on Chinese heritage language learners' motivation. This might include further comparisons of traditional textbook methods with a shared reading model, as used in the current research, but may also consider different materials/books used in a shared reading class.

In summary, the current research examined Chinese character acquisition and reading comprehension among Chinese heritage language learners at their early stages of learning to read Mandarin Chinese. The research focused on a newly developed teaching method that involved classroom shared reading activities. Individual studies also considered the effects of frequency of exposure to Chinese characters during shared reading activities and explicit instruction on phonetic and semantic radicals. The findings of this research suggest that Chinese heritage language learners can benefit from frequent exposure to the orthography, phonology, and semantics of novel characters provided in shared reading activities. However, additional research is needed to examine the effectiveness of using shared reading activities to teach characters for Chinese heritage children, to find out more ways to include frequent exposure of new characters in the text and to look for more ways to introduce common phonetic and semantic radicals in shared reading activities.

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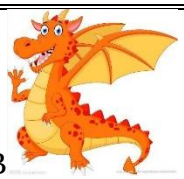
Appendix 3.1 Character Reading Task

Please read aloud the following characters. 请读出下面的汉字。

一	三	个	口	上
父	士	太	才	可
斤	多	北	未	美
它	早	步	我	黄
周	舍	明	杯	思
功	怎	别	厉	猫
间	迟	忽	呼	抄
容	图	幼	备	胜
然	带	裳	整	装
颜	套	旅	病	烧

Appendix 3.2 Character-Picture Matching Task

Please read characters and choose a picture that represents the meaning of the given characters. 选择代表汉字含义的图片。

1. 手	A 	B 
	C 	D 
2. 花	A 	B 
	C 	D 
3. 肉	A 	B 
	C 	D 
4. 床	A 	B 

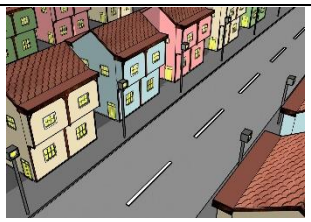
	C 	D 

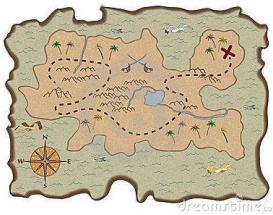
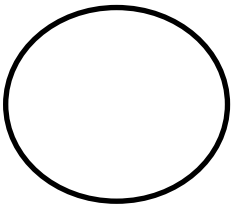
5. 笑	A 	B 
	C 	D 

6. 站	A 	B 
	C 	D 

7. 笔	A 	B 
	C 	D 

8. 唱	A 	B 
	C 	D 

9. 桥	A 	B 
	C 	D 

10. 圆	A 	B 
	C 	D 

Appendix 3.3 Chinese Sentence Comprehension Task

Please read sentences and choose a picture that represents the meaning of the given sentences. 阅读句子并选择最能展现句子意思的图片。

1. 我家有四口人。


A


B


C

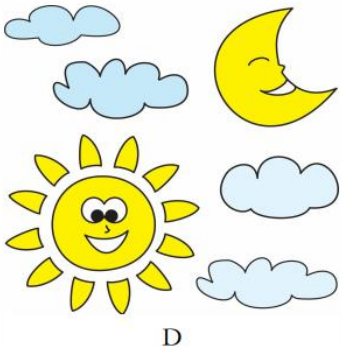

D

2.我妈妈的生日是 10 月 15 日。

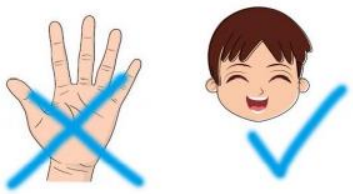
A

B

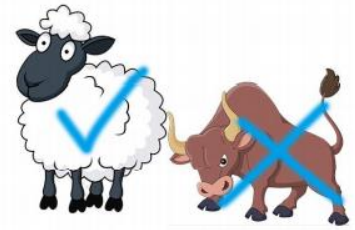

C


D

3. 这不是一只羊，而是一头牛。

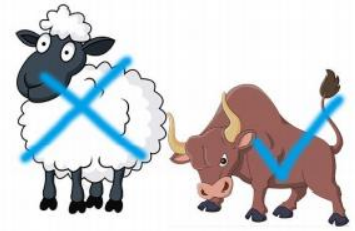


A



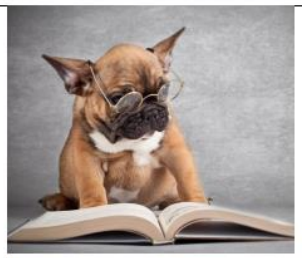
B

C



D

4. 我的同学爱看书。



A

B

C

D

5. 那个人把门打开了。

A

B

C

D

6. 这个苹果又大又红。

A

B

C

D

7. 那支笔在桌子上面。

A

B

C

D

8. 他们在公园里跑步。

A

B

C

D

9. 因为夏天来了，海边的人很多。

A

B

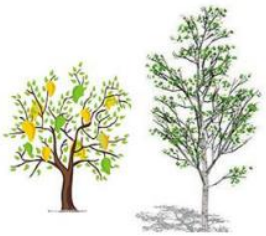
C

D

10. 左边的树比右边的树高。

A

B



C

D

Appendix 3.4 Chinese Passage Comprehension Task

Please read passages and answer questions you heard. Questions will be asked in Chinese, but you can answer orally in Chinese or English. 阅读并回答你听到的问题。你可以用英文或中午口头作答。

Passage 1: 今天是我朋友的生日，我写了一张生日卡片，买了一个红色的杯子给他。

(Today is my friend's birthday. I wrote a birthday card and bought a red mug for him.)

Questions:

1. 这段话讲了什么？ (What is the text about?)

2. 朋友的生日是什么时候？ (When is the friend's birthday?)

3. 我给他了什么？ (What did the person give to their friend?)

4. 你觉得我会生日卡片上写了什么？ (What do you think the person wrote on the birthday card?)

Passage 2: 云云是我的学生，她爱看书，她有一个弟弟叫小雨，可是他不爱看书。

(Yunyun is my student. She likes reading. She has a younger brother called Xiaoyu, but he does not like reading.)

Questions:

5. 这段话讲了什么？ (What is the text about?)

6. 这个女孩叫什么名字？ (What is the girl's name?)

7. 小雨是谁？ (Who is Xiaoyu?)

8. 云云和小雨有什么不同？ (Based on the text, what is the difference between Yunyun and her younger brother?)

9. 这段话中“我”是谁？ (Based on the text, what does the person do that wrote the text?)

Passage 3: 我家养了一只小兔子。它是白色的，有两只长耳朵。它吃草，也吃南瓜叶子。它总是一动不动，在门口晒太阳。(We have a bunny. It is white and has two long ears. It eats grass and pumpkin leaves. It always stays in front of the door, enjoys the sunshine and doesn't move.)

Questions:

10. 这段话讲了什么？ (What is the text about?)

11. 小兔子是什么颜色的？ (What is the colour of the bunny?)

12. 小兔子的耳朵是什么样的？ (What is the feature of the bunny's ears?)

13. 这段话告诉我们小兔子吃什么？ (What does the bunny eat?)

14. 这段话告诉我们小兔子经常做什么？ (What does the bunny always do?)

Passage 4: 人们把花生种在地里，到了秋天，收了很多花生。小猫看见了，它把小鱼种在地里。它想：到了秋天，就有很多小鱼啦！ (People planted peanuts in the ground. They got a lot of peanuts in autumn. A kitten saw it and planted baby fish in the ground. The kitten thinks: there will be much fish in autumn.)

Questions:

15. 这段话讲了什么？ (What is the text about?)

16. 人们把花生种在哪儿？ (Where did people plant peanuts?)

17. 人们什么时候收花生？(When did the plant produce a lot of peanuts?)

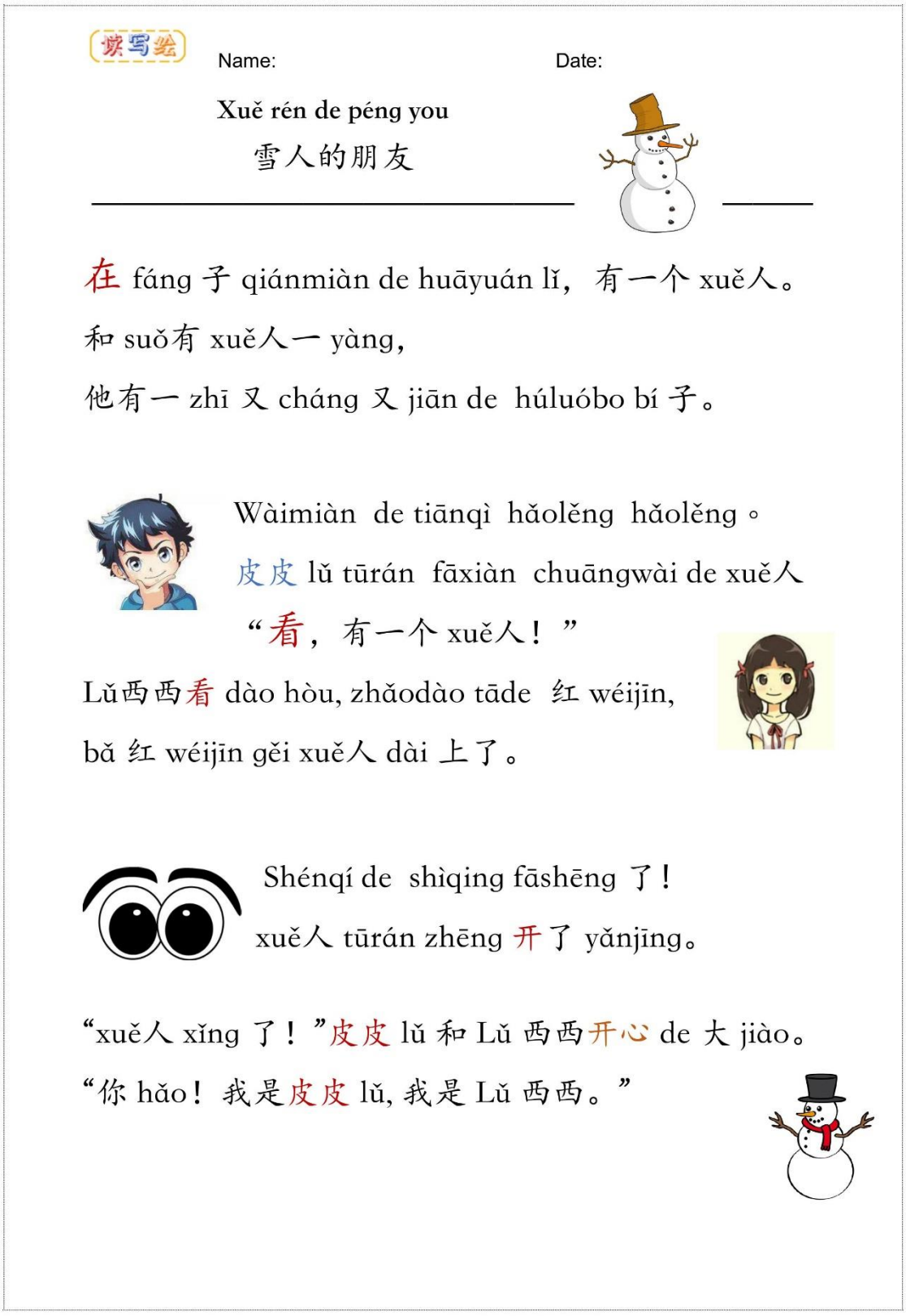
18. 小猫做了什么？ (What did the kitten do?)

19. 为什么小猫要种小鱼？ (Why did the kitten plant baby fish?)

20. 你觉得这只小猫聪明吗？为什么？ (Do you think the kitten is clever? Why?)

Appendix 3.5 Reading Materials in the Experimental Group in Study 1

For example, the 4th reading material for the shared reading class in Study 1.



拼写绘 Name: Date:

Xuě rén de péng you

雪人的朋友

在 fáng 子 qiánmiàn de huāyuán lǐ，有一个 xuě人。

和 suǒ有 xuě人一 yàng，

他有一 zhī 又 cháng 又 jiān de húluóbo bí 子。

Wàimiàn de tiānqì hǎoléng hǎoléng。

皮皮 lǔ tūrán fāxiàn chuāngwài de xuě人

“看，有一个 xuě人！”

Lǔ西西看 dào hòu, zhǎodào tāde 红 wéijīn,

bǎ 红 wéijīn gěi xuě人 dài 上了。

Shénqí de shìqing fāshēng 了！

xuě人 tūrán zhēng 开了 yǎnjīng。

“xuě人 xǐng 了！”皮皮 lǔ 和 Lǔ 西西开心 de 大 jiào。

“你 hǎo！我是皮皮 lǔ, 我是 Lǔ 西西。”

读写绘

“你 menhǎo，我是 xuě人！我 jiào _____ 。”

不一 huìr，tiān kuài hēi 了，

皮皮 lǔ 和 Lǔ 西西 děi huíjiā 了。

Duì 不 qǐ xuě人，fáng 子 lǐmiàn tàirè 了！你不可以 jìnqù。

皮皮 lǔ shuō。

xuě人 pà rè，dàn 是 xuě人 yě pà méi 有朋友，

xuě人有 diǎnr 不开心。

Dì 二天，xuě人 duì 皮皮 lǔ 和 Lǔ 西西 shuō

“我 děi zǒu 了，我 xiǎng 看看 qítā dìfang。”

皮皮 lǔ sònggěi xuě人一个 dìtú，

“Qù 看看 ba！

你 huì rènshi hěnduō xīn 朋友！

zhù 你开心！”

Xuě人 dǎ 开 dìtú，xiàng 东 zǒu，qù chéngshì 看看，

读写坛

在 chéngshì, xuě人看见 hěnduō chē，hěnduō 人，hěn duō fáng 子。

他看见了，  他看见了 

他看 zhe 看 zhe “Duang!”不小心 zhuàng dào 了 lùdēng zhù 子上。xuě人不开心 ☹

“我 yàoqù一个 méi 有 lùdēng zhù 子 de dìfang。”

Xuě人 wǎng 北 zǒu，qù了森林， 

在森林看见 sloth, 在 shù上 shài tàiyang。

“你 hǎo，我是 xuě人，我 men 可以 zuò朋友 ma？”

Méi 有 huídá，liǎng fēnzhōng 以 hòu,

 sloth mànmàn de zhēng 开 yǎnjīng，

mànmàn de shuō: “Dāngrán 可以”

“Tàihǎo la！”

“Dàn 是我 shuōhuà hěnmàn，

你 yě 可以 mànmàn de shuōhuà ma?”

读写坛

“我 shìshi”

“你可以 mànmàn de dúchū下 miànde jù子 ma？”

一个大一个小，一 zhī lǎohǔ 一 zhī māo。

一 biān duō 一 biān shǎo，一 qún gē 子一 zhī niǎo。

小白 tù 白又白，liǎngzhī ěrduo shù qǐ lái，

ài chī luóbo 和 qīngcài，

bèngbèng tiàotiào zhēn 可ài。

“Xièxiè你，朋友，

我 men xiūxi 一 huìr, shài shài tàiyang ba！”

xuě人 shuō，“我不可以 shài tàiyang，

我 pà rè，朋友 zài 见，zhù你开心！”

Xuě人看见 jǐng 长，tù 子 jǐng 长 Judy

“你 hǎo，我是 xuě人。

我 men 可以 zuò 朋友 ma？”

读写坛

Tù 子 jǐng 长 Judy shuō “Dāngrán 可以，dàn 是我 hěn máng。”

“我可以 bāng 你。”

Tù 子 jǐng 长 Judy shuō:

山羊 nǎinai wàngjì 了小 bǎoxiāng de yàoshi，

我 men zhèng 在 bāng tā。

红色 bǎoxiāng 白色 bǎoxiāng jīn 色 bǎoxiāng

红色 yàoshi 

白色 yàoshi 

jīn 色 yàoshi

【有 jǐ tiáo xiànsuǒ】

- Yàoshi de yán 色和小 bǎoxiāng de yán 色 dōu 不一 yàng
- 红色 bǎoxiāng de yàoshi 不是 jīn 色 de
- 白色 bǎoxiāng de yàoshi 不是红色 de
- jīn 色 bǎoxiāng de yàoshi 不是白色 de

你 de dá àn:

“Tàihǎo 了！ Xièxie 你!”

读写坛

“Judy jǐng 长，东 chéng chūshì 了！”

“我马上 qù！”

tù 子 jǐng 长 Judy tàimáng 了，

xuě人 shuō：“朋友 zài 见，zhù你开心！”

xuě人 zhǐhǎo wǎng 南 zǒu

“Zhèlǐ huì 有我 de xīn 朋友 ma？”

Xuě人 dào 了南 jí，

看见了一 qún lán 色小 qǐ é

他 men 在 huáxuě。

“你 menhǎo！我 men 可以 zuò朋友 ma？”

“Dāngrán 可以！”

Xuě人和 lán 色小 qǐ é 一 qǐ wán，xuě人 hěn 开心

Rúguǒ 你 xiǎng wèn，xuě人 guòdé hǎoma？

☺ 是 de ，他 guòdé hěnhǎo。

Rúguǒ 你 xiǎng wèn，我是 zěnme zhīdào de ne？

☺ 一 zhī jīn 色 de 大 niǎo 在南 jí 看见了 xuě人，

飞 lái gàosù了皮皮 lǔ，皮皮 lǔ 又 gàosù 了我。

Appendix 3.6 Analyses with Age Controlled in Study 1

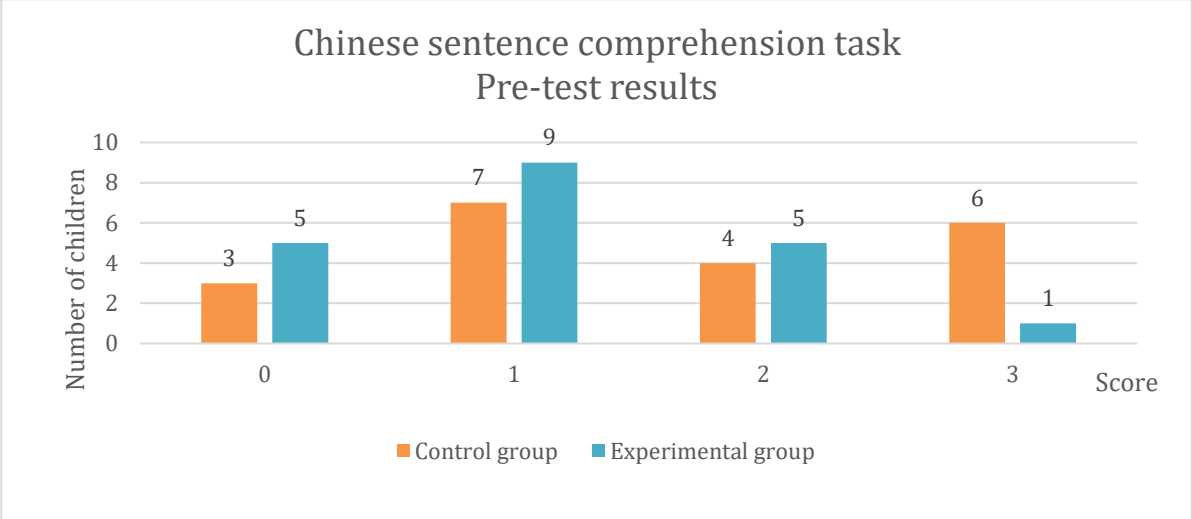
Due to the potential difference in age, correlation, general liner model and mixed ANOVA analyses were performed controlling for age. The correlations between age and other pre-test measures demonstrated that age and the English Word Reading Task were significantly correlated ($p < .001$). Age also had a significant correlation with the Chinese Sentence Comprehension Task ($p = .00$), with the Character Listening Task ($p = .03$) and with the Character Reading Task ($p = .04$). These significant correlations were positive, suggesting that any effect on these measures will be reduced if age is regarded as a control variable.

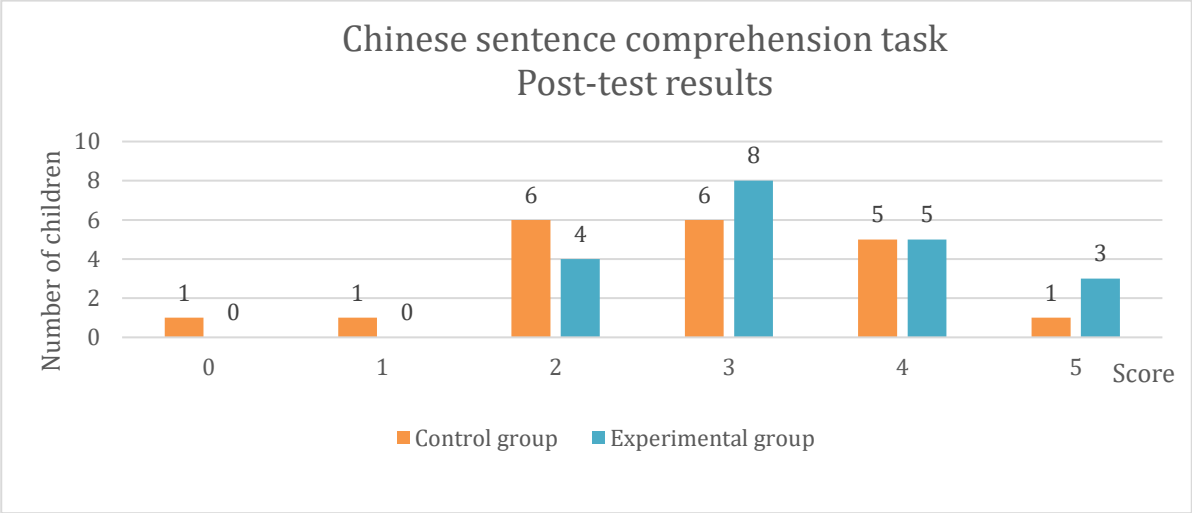
Results from a general linear model analysis indicated that, with age controlled, there were no significant differences between the groups for the mean score of the English Word Reading Task, F (1, 37) = .00, $p = .97$. Significant differences were not found in the Chinese Vocabulary Task either, F (1, 37) = 3.64, $p = .06$, although the differences were nearly significant. In addition, no significant differences between the two groups had been found in Chinese character knowledge measures, namely, Character Listening Task, F (1, 37) = .59, $p = .45$; Character Reading Task, F (1, 37) = .03, $p = .87$; and Character-Picture Matching Task, F (1, 37) = 1.22, $p = .28$. In terms of the Chinese Sentence Comprehension Task, no significant differences had been observed either, F (1, 37) = .81, $p = .37$. However, participants were not able to read the passages in the Chinese Passage Comprehension Task to a level to be able to answer the questions about those passages because they had just started to learn to read Chinese characters. Therefore, scores for this task were zero for all participants, which mean analyses could not be performed for this measure at this stage. Those results suggested that the two groups had statistically equal performances for pre-intervention tasks when their age variable was controlled.

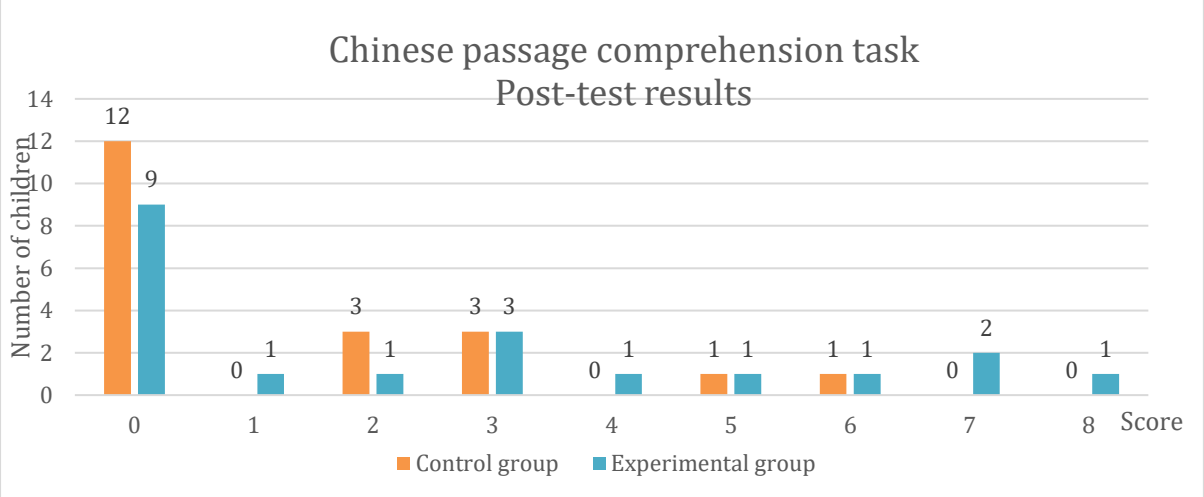
Mixed ANOVA analyses with age controlled reported that there were significant differences between two groups for two Chinese character knowledge measures, namely the Character Reading Task, F (1, 37) = .15.34, p < .001; and the Character-Picture Matching Task with F (1,37) = 6.39, p = .02. Significant differences were also found in the Chinese Sentence Comprehension Task, F (1, 37) = 11.76, p = .00. On top of that, the change of scores for the Character Listening Task did not have significant differences between the two groups, F (1, 37) = .80 and p = .38. There were not any significant differences for the Chinese Passage Reading Task as well, F (1, 37) = 1.91 p = .18.

Based on the results above, the researcher decided not to control age because the differences in age between the two groups were still at a non-significant level (p = .06), and the effect of teaching sessions had been shown in three out of five given tasks even when age was controlled.

Appendix 3.7 Results of Chinese Reading Comprehension Tasks







Appendix 4.1 Pinyin Read-Aloud Task

Please read aloud the following Pinyin words. 请读出下面的拼音。

k	m	a	h	p	g
f	u	c	t	i	s

rè	tái	chǒu	niú	guō
huí	luò	qiē	xué	zhāi
zuò	shuài	wèi	yān	yún

ān quán	dié zi	lín jū	bǐ sài	gōng yuán
liú xuè	jǐn zhāng	wǎn huì	míng xīng	qún zi
fù xí	chǒng wù	hǎi tún	kě néng	nǚ rén

guò nián	mén yá	rèn shi	huó pō	shēng yīn
sā huǎng	tíng chē	hòu tou	má què	wán jù
yǎn yuán	bān jiā	xǔ duō	yǔ shuǐ	zhèng hǎo

Appendix 4.2 Target Character Read-Aloud Task

Please read aloud the following characters. 请读出下面的汉字。

方	公	后	兰	兴
回	花	们	有	包
的	爷	向	前	对
你	把	面	看	高
好	朵	外	要	到
阳	奶	完	真	园
认	这	给	玫	季
说	猪	像	放	菊

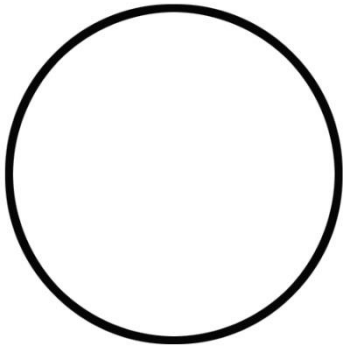
Appendix 4.3 Semantic Radical Picture Matching Task

A child, Charlie, is learning a monster language at a monster school. He needs help to figure out how to spell the words presented by the following pictures in the monster language. Can you help him? You will see a picture and hear a word that describes this picture in the monster language. You will be given five written words in the monster language.

Please choose a word that you think represent the meaning of the given picture.

Items developed by the researcher:

1. Sound: /yuán/



A. 圃 B. 哐 C. 阋 D. 门贝 E. 迈

2. Sound: /tíng/

A. 佸 B. 刮 C. 仉 D. 猝 E. 彰

3. Sound: /shuō/

A.玎 B.兑衤 C.讥 D.裣 E.儿讠

4. Sound: /bào/

A.拍 B.刨纟 C.自扌 D.仟毛 E.绝

Appendix 4.4 New Items in Chinese Sentence Comprehension Task

11. 他一边吃东西一边看电视。

A

B

C

D

12. 马路旁边的路灯亮了。

A

B

C

D

13.香蕉被猴子吃完了。


A


B


C


D

14.他最喜欢的玩具是一把蓝色的手枪。


A


B


C


D

Appendix 4.5 Reading Materials in the Experimental Group in Study 2

For example, the 2nd reading material for the shared reading class in Study 2.

读写绘 Name: Date:

zhēn de jiǎ de
真的假的

Jīn 天是小 xué de zuìhòu 一天，学校 lǐ chūxiàn 了 liǎng 个一 mú 一 yàngde 不高兴，同学们 juéde hěn qíguài。 Nǎ 一个是我们认 shi de 不高兴 ne?

Liǎng 个不高兴 dōu 说：

“我是真 de，你们认 shi 我。”

“我是真 de，你们认 shi 我”

Dào dǐ shéi 是真 de? 我们认不 chūlái. 同学们 qù zhǎo 土 dòu 老师。

土 dòu 老师说：“Tīng 说不高兴长大 yǐhòu xiǎng zuò chú 师，你们 gēn 我学学 zuò miàn 包 ba! shéi zuò dé hǎo，shéi jiù 是真 de 不高兴。”

同学们说：“Duì，shéi zuò dé hǎo，shéi jiù 是真 de 不高兴！”

读写绘

土 dòu 老师说：“你们 xūyào miànfěn 和水，lìngwài，你们 hái yào jiā 上一个 tèbié de 东西：一个心 qíng。”

Liǎng 个不高兴同 shí wèn：“是 shénme？”

土 dòu 老师说：“不高兴。”

土 dòu 老师 jìxù 说：“Zuò miàn 包 shí，xiǎng xiǎng 看你们不高兴 de shí hòu，你 de 心 qíng jiùhuì zài miàn 包 lǐ la！”

不高兴们说：“我们 shì shi 看 ba！”

Wei 了 biàn 认 liǎng 个不高兴，土 dòu 老师 gěi 他们一个白色 mào 子  和 huáng 色 mào 子  。

不高兴们开 shǐ zuò miàn 包，dài 白色 mào 子 de 不高兴  zhǐ yòng 了五 fēn zhōng，miàntuán jiù zuò hǎo 了，他 bǎ miàntuán fàngjìn 了 kǎoxiāng。

可是，dài huáng 色 mào 子 de 不高兴  háizài mànmàn de róu miàntuán，一 biān róu，一 biān 小 shēng 说 zhe shénme，看 qǐ lái tèbié 生 qì。

三个小 shí hòu，不高兴们 de miàn 包 kǎo hǎo 了。土 dòu 老师说："大 jiā dōu lái chángchang ba！"同学们 cháng 了 miàn 包 hòu 说：

我们认 wéi dài 白色 mào 子 de 不高兴是真 de，yīn wèi 他 zuò de gèng tián，gèng hǎochī！

Ahem, ahem

土 dòu 老师说："Dài huáng 色 mào 子 de 不高兴 cái 是你们认 shi de 不高兴。"

Shénme?!

"Zhè 个心 qíng miàn 包 yīnggāi 是 kǔde，yīnwèi fàng 了不高兴 de 心 qíng ya! 可是 dài 白色 mào 子 de 不高兴不 zhī dào 心 qíng 是 shénme。"

Yīnwèi 他是一个 jīqì 人。

Appendix 4.6 Analyses with Home Language Controlled in Study 2

When the home language variable was controlled, significant differences were not found in all pre-test measures (see Table 31)

Table 31

Results of General Linear Model when home language was controlled in Study 2

Measures	*df*	*F*	*p*	η_p^2
Chinese Vocabulary Task	1, 24	4.02	.06	.14
English Word Reading Task	1, 24	.25	.62	.01
Pinyin Spelling Task	1, 24	.98	.33	.04
Pinyin Read-Aloud Task	1, 24	.54	.47	.02
Character Listening Task	1, 24	.21	.65	.01
Character Reading Task	1, 24	.11	.75	.00
Character-Picture Matching Task	1, 24	1.10	.31	.04
Target Character Read-Aloud Task	1, 24	1.77	.20	.07
Semantic Radical Picture Matching Task	1, 24	.00	.97	<.001
Chinese Sentence Comprehension Task	1, 24	.33	.57	.01
Chinese Passage Comprehension Task	1, 24	1.63	.21	.06

Pearson Correlation tests were performed to identify any associations between the home language variable and other pre-test tasks (see Table 32). Analysis found that participants' home language was significantly associated with performances in the Chinese Vocabulary Task (r = .47, p = .01) and the Target Character Read-Aloud Task (r = .47, p = .01) in the pre-test. Therefore, the nearly significant results in the Target Character Read-Aloud Task without controlling home language probably relate to the significant difference in home language. However, the researcher decided not to control the home language variable because the home

language variable only had a significant association with the Target Character Read-Aloud Task among other Chinese character and reading comprehension tasks. Besides, the mean scores of two groups in the Target Character Read-Aloud Task were not significantly different when the home language was not controlled, t (13.31) = 2.13, p = .053.

Table 32

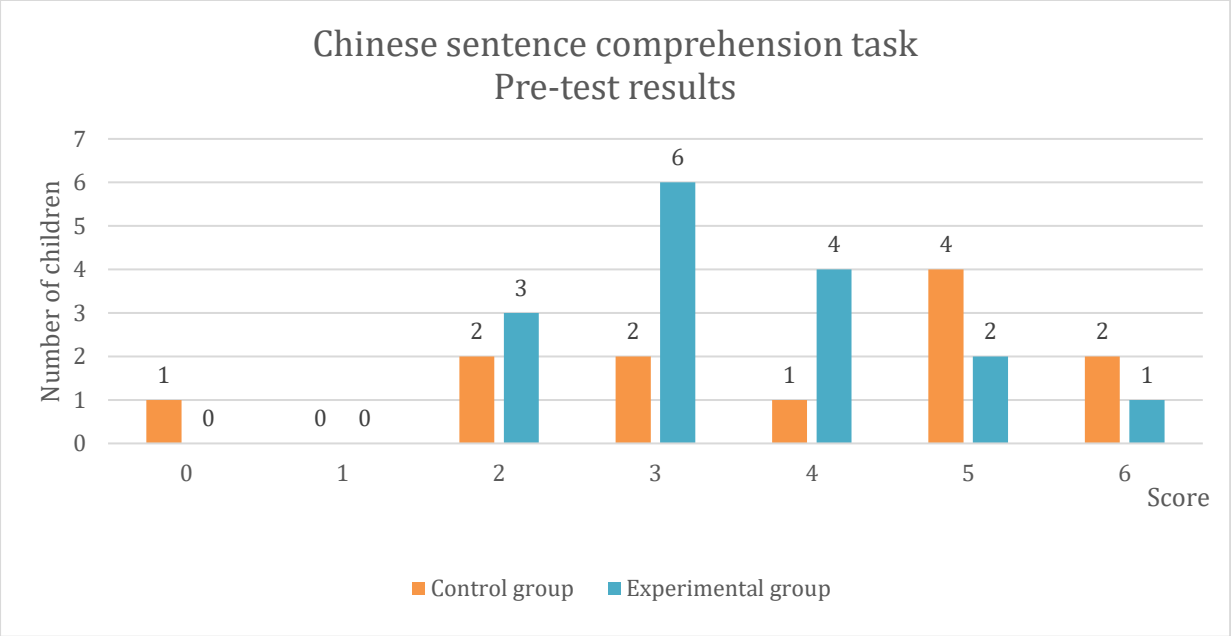
Pearson correlations of home language and other pre-test measures in Study 2

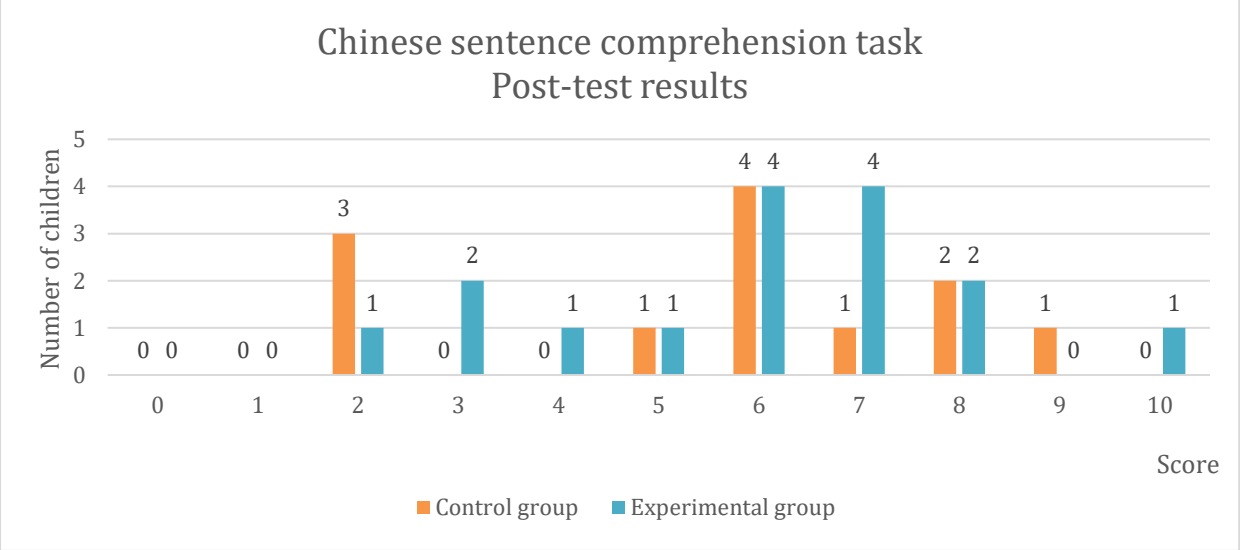
	HL	CV	EW	PS	PR	CL	CR	CP	TCR	SR	CSR	CPR
HL	-	.47*	.10	.28	.11	.09	.35	.27	.47*	.36	.00	.31

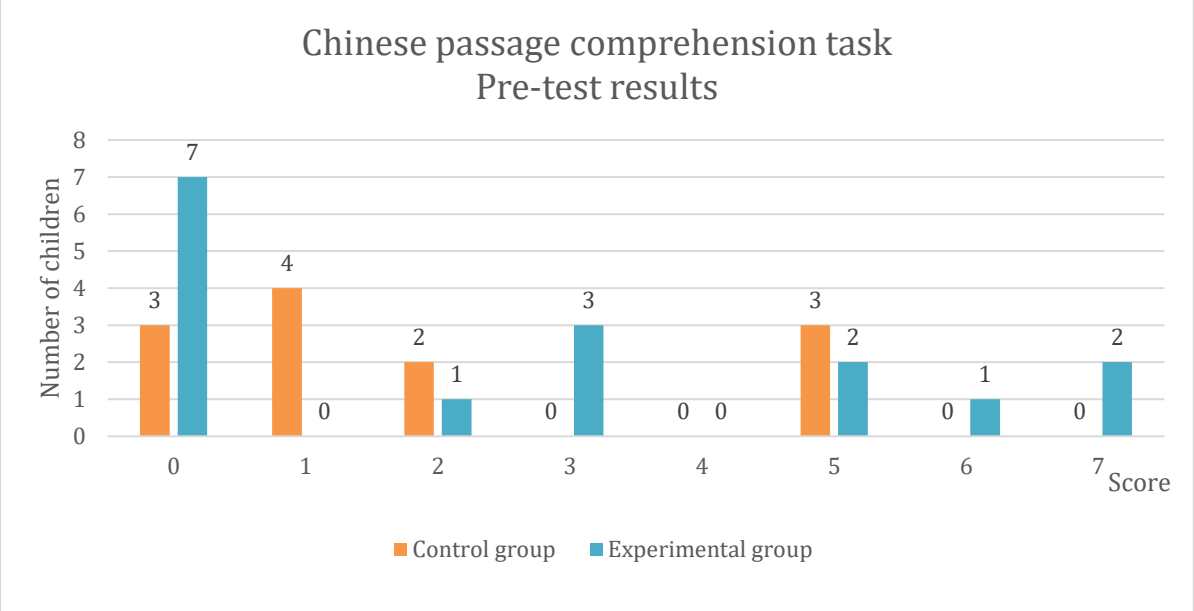
Note. HL= Home Language; CV = Chinese Vocabulary Task; EW= English Word Reading Task; PS= Pinyin Spelling Task; PR= Pinyin Read-Aloud Task; CL= Character Listening Task; CR= Character Reading Task; CP= Character-Picture Matching Task; TCR= Target Character Read-Aloud Task; SR= Semantic Radical Picture Matching Task; CSR= Chinese Sentence Comprehension Task; CPR= Chinese Passage Comprehension Task.

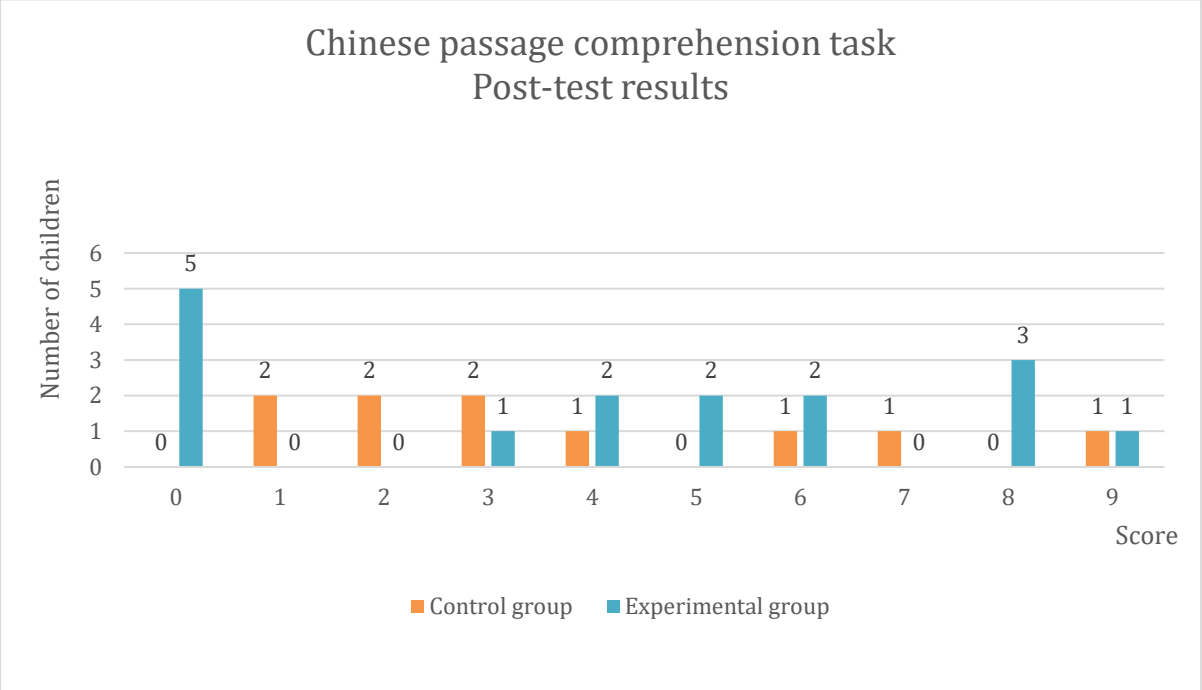
* $p < .05$ (2-tailed) ** $p < .01$ (2-tailed)

Appendix 4.7 Results of Chinese Reading Comprehension Tasks






Chinese passage comprehension task
Pre-test results
Number of children
8
7
6
5
4
3
2
1
0
3
7
4
0
2
1
0
3
0
0
3
2
0
1
0
2
0
1
2
3
4
5
6
7
Score
Control group
Experimental group


Chinese passage comprehension task
Post-test results
Number of children
6
5
4
3
2
1
0
0
5
2
0
2
0
2
1
1
2
0
2
1
2
1
0
0
3
1
1
0
1
2
3
4
5
6
7
8
9
Score
Control group
Experimental group

Appendix 5.1 Chinese Pseudo-character Reading and Explaining Task

A child Jack went to a forest and found some written words which looked like Chinese characters. Jack wants to work out the sound and the meaning of these patterns. Can you help? What do you think about how to read these words, and what do these words mean? Please say your answers aloud.

 1.	 2.	 3.	 4.
 5.	 6.	 7.	 8.
 9.	 10.	 11.	 12.

Appendix 5.2 Home Language and Chinese Literacy Activity Questionnaire

Please answer the questions below. 请回答下面的问题

1. What language do you use when you talk to your children? How much per cent of the time do you use the language(s)? 您对您的孩子说话时用什么语言？该语言大概占多少比例？

   A. English 80% or above 英文 80%及以上

   B. English 50% and Chinese 50% 英文 50%，中文 80%

   C. Chinese 80% or above 中文 80%及以上

2. How much time does your child usually spend on homework from the School each week? 每周您的孩子大约花多长时间完成中文学校的作业？

   About _____minutes. 大约_____分钟。

3. What other activities does your child do at home in which your child can see or practice Chinese characters (such as reading Chinese storybooks, watching Chinese movies with Chinese character subtitles, etc.)? 您的孩子在家做哪些和中文相关的活动？做这些活动时，您的孩子能看到或者练习汉字，例如阅读中文故事书、看有中文字幕的中文电影等。

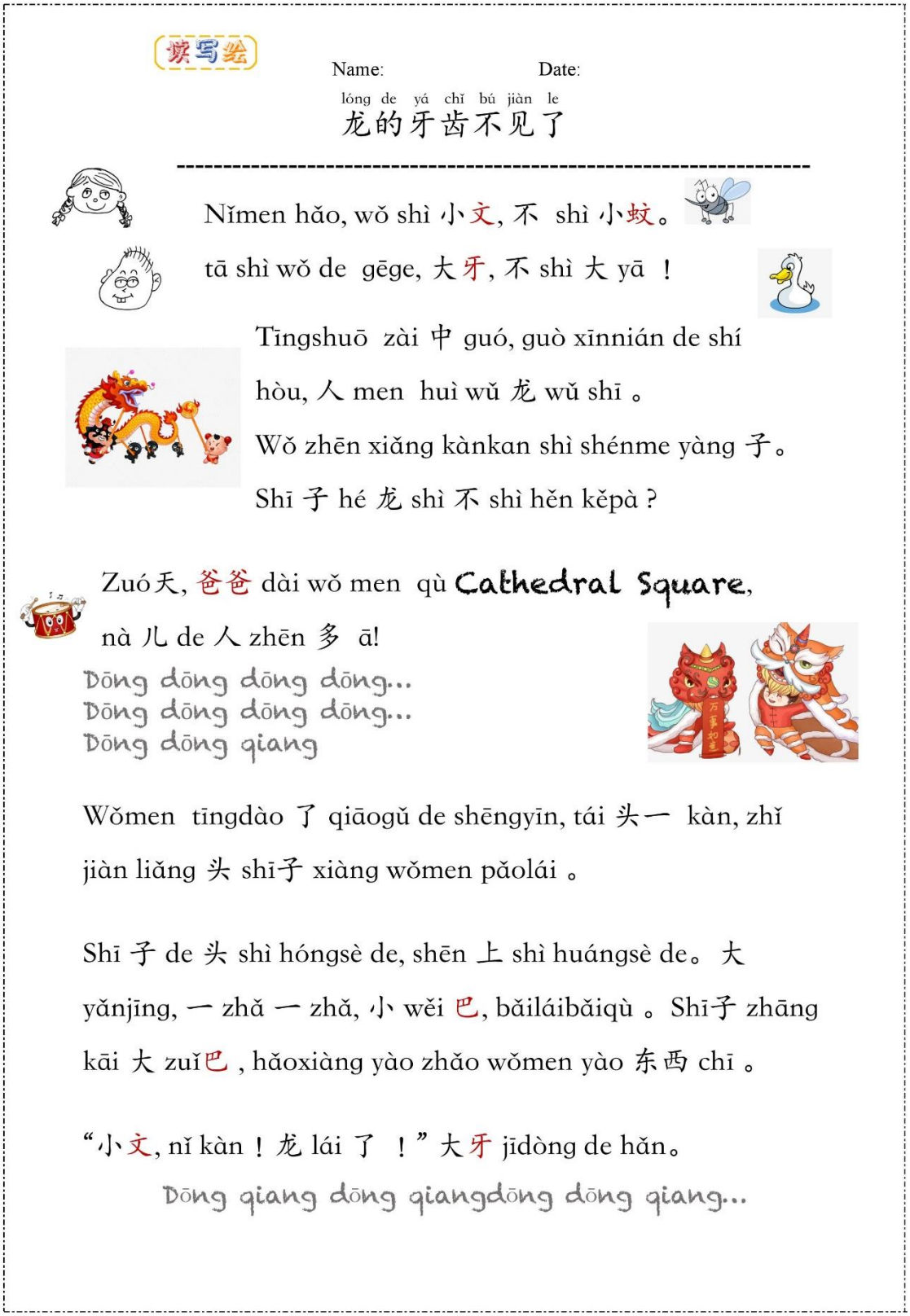
   _____.

4. How much time does your child spend on the activities that you mentioned in the last question every week? 每周您的孩子花多长时间进行上述的活动？

   About _____minutes. 大约_____分钟。

Appendix 5.3 Reading Materials in the Experimental Group in Study 3

For example, the 2nd reading material for the shared reading class in Study 3.



练写绘

Name: Date:

lóng de yá chǐ bú jiàn le

龙的牙齿不见了

Nǐmen hǎo, wǒ shì 小文, 不 shì 小蚊。

tā shì wǒ de gēge, 大牙, 不 shì 大 yā !

Tīngshuō zài 中 guó, guò xīnnián de shí hòu, 人 men huì wǔ 龙 wǔ shī 。

Wǒ zhēn xiǎng kànkan shì shénme yàng 子。

Shī 子 hé 龙 shì 不 shì hěn kěpà ?

Zuó天, 爸爸 dài wǒ men qù Cathedral Square,

nà 儿 de 人 zhēn 多 ā!

Dōng dōng dōng dōng...
Dōng dōng dōng dōng...
Dōng dōng qiang

Wǒmen tīngdào 了 qiāogǔ de shēngyīn, tái 头一 kàn, zhǐ jiàn liǎng 头 shī子 xiàng wǒmen pǎolái 。

Shī 子 de 头 shì hóngsè de, shēn 上 shì huángsè de。 大 yǎnjīng, 一 zhǎ 一 zhǎ, 小 wěi 巴, bǎiláibǎiqù 。Shī子 zhāng kāi 大 zuǐ巴 , hǎoxiàng yào zhǎo wǒmen yào 东西 chī 。

“小文, nǐ kàn ！龙 lái 了 ！”大牙 jīdòng de hǎn。

Dōng qiang dōng qiangdōng dōng qiang...

填写绘 Name: Date:

一 tiáo huángsè de jù龙， zhāngzhe 大 zuǐ巴, chángcháng de shēn 子 niǔláiniǔqù, 一 huì 儿 xiàng 上一 huì 儿 xiàng 下, hǎoxiàng suíshí jiù huì 飞 huí dào 天上 qù.

大 jiā dōu gēn zhe 龙 hé shī 子 xiàng qián zǒu 。“āi 呀!” tūrán, wǒ cǎi dào 了一个东西, chà diǎn 儿 shuāijiāo。Shì 一个 báisè de 东西, 下 miàn cū 上 miàn jiān。

“Zhè shì shénme ？” 小文 wèn 

“Zhè hǎoxiàng shì 一个大牙 chǐ !”

爸爸 shuō :“龙 de 牙 chǐ ”

“龙 de 牙 chǐ diào lā ！” Wǒ hé gēge gǎnkuài zhuī 上 qù , dànshì gǔ shēng 太大, wǔ 龙 de shūshu tīng 不 jiàn wǒ men de shēngyīn。

大牙 pǎo dé 飞 kuài , 一下子把龙 de wěi 巴 zhuài zhù 了。

Wǔ 龙 de shūshu men 一个 jiē一个 de shuāi zài 了 dì 上。Zhè shí gǔshēng tíng 了,

Wǒ hé 大牙 yì 口 tóng shēng de shuō: “龙 de 牙 chǐ diào la !”

Appendix 5.4 Results of Chinese Reading Comprehension Tasks