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EMERGENT LITERACY AND EARLY READING SKILLS

IN CHINESE-MANDARIN:

EVIDENCE FROM KINDERGARTEN AND FIRST-GRADE CHILDREN

A DISSERTATION

Submitted to the Graduate Faculty of the
University of South Alabama
in partial fulfillment of the
requirements for the degree of

Doctor of Philosophy

in

Communication Sciences and Disorders

by

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TABLE OF CONTENTS

Page

LIST OF TABLES vi

LIST OF FIGURES vii

LIST OF ABBREVIATIONS viii

ABSTRACT ix

CHAPTER I INTORDUCTION 1

CHAPTER II REVIEW OF THE LITERATURE 5

2.1 Emergent Literacy in Chinese 5
2.1.1 Characteristics of spoken and written language of Chinese 6
2.1.2 Correlates of Chinese Early Reading 12
2.1.2.1 Phonological awareness. 13
2.1.2.2 Morphological awareness. 16
2.1.2.3 Orthographic awareness. 21
2.1.2.4 Vocabulary knowledge. 30
2.1.2.5 Rapid automatized naming. 32
2.1.2.6 The roles of multiple factors in Chinese reading development. 33
2.2 The Reading Models 40
2.3 Summary and Purpose of the Present Research 46
2.4 Research Questions 49
2.5 Research Hypotheses 50

CHAPTER III METHOD 54

3.1 Participants 54
3.2 Measurement 57
3.2.1 Phonological awareness (PA) 57
3.2.2 Morphological awareness (MA) 57
3.2.2.1 Lexical compounding awareness. 58

3.2.2.2 Receptive awareness of homophones. 59
3.2.2.3 Expressive awareness of homophones. 59
3.2.3 Orthographic awareness (OA) 60
3.2.4 Vocabulary knowledge 60
3.2.5 Rapid automatized naming (RAN) 61
3.2.6 Early reading skills 62
3.2.6.1 Chinese character naming task. 62
3.2.6.2 Word recognition task. 63
3.3 Procedures 63
3.4 Reliability 65

CHAPTER IV RESULTS 66

4.1 Descriptive Results for Chinese Children's Emergent Literacy and Early Reading 66
4.2 Group differences in Emergent Literacy and Early Reading Skills 74
4.3 Correlations among Emergent Literacy and Early Reading Skills 75
4.4 Post Hoc Analysis: Predictors in Children's Early Reading Skills 79
4.4.1 Predictors in children's character naming skill 81
4.4.2 Predictors in children's word recognition skill 82

CHAPTER V DISCUSSION 84

5.1 Summary of Research Questions and Findings Related to Hypotheses 84
5.2 Group Differences in Emergent Literacy and Early Reading Skills 87
5.2.1 Age-Related developmental changes 88
5.2.2 Chinese educational context 93
5.2.3 The role of family socioeconomic status 94
5.3 Associations among Emergent Literacy and Early Reading 96
5.3.1 Phonological awareness and early reading 97
5.3.2 Morphological awareness and early reading 99
5.3.3 Orthographic awareness and early reading 103
5.3.4 Vocabulary knowledge and early reading 105
5.3.5 RAN and Chinese children's early reading 106
5.4 The Unique Contribution of the Semantics Composite 108
5.5 Theoretical Implications 109
5.6 Practical Implications 111
5.7 Research Limitations 114
5.8 Future Research 118
5.8.1 Emergent literacy and Chinese children's two-character word reading 118
5.8.2 Longitudinal investigation on Chinese children's reading comprehension 119

CHAPTER VI CONCLUSION 133

REFERENCES 134

APPENDICES 158

Appendix A IRB Approval Letter 158
Appendix B Child and Family History Questionnaire 159
Appendix C Syllable Deletion Task 162
Appendix D Lexical Compounding Task 163
Appendix E Homophone Judgment Task 165
Appendix F Homophone Generation Task 166
Appendix G Character Judgment Task 168
Appendix H PPVT-R Scoring Sheet 169
Appendix I Rapid Number Naming Task 171
Appendix J Character Naming Task 172
Appendix K Word Recognition Task 173
Appendix L Syntax for SPSS Analysis 178
Appendix M Appendix Tables 180

BIOGRAPHICAL SKETCH 183

LIST OF TABLES

Table Page

1. Demographic information for participants in kindergarten and primary school. 56

2. Descriptive statistics for 8 emergent literacy measures and 2 early reading skills. 67

3. Multivariate ANOVA results for 10 emergent literacy and early reading measures. ...75

4. Correlation analysis with false discovery rate corrections for children in two grade groups 78

5. Group differences in correlation coefficients among emergent literacy and early reading skills. 79

6. Poisson regression analysis for children's character naming skill. 82

7. Logistic regression analysis for children's word recognition skill. 83

Appendix Table

Table M1. Correlation coefficients among emergent literacy and early reading skills in kindergarten children. 180

Table M2. Correlation coefficients among emergent literacy and early reading skills in primary school children. 181

Table M3. Correlation coefficients among emergent literacy and early reading skills in all participated children. 182

LIST OF FIGURES

Figure Page

1. Four key units of Chinese word reading 10

2. Pie charts for the distributions of mothers' and fathers' education levels.....56

3. Box plots for Chinese children's syllable deletion scores in two grade groups.....68

4. Box plots for Chinese children's lexical compounding scores in two grade groups 68

5. Box plots for Chinese children's homophone generation scores in two grade groups 69

6. Box plots for Chinese children's homophone judgment scores in two grade groups 69

7. Box plots for Chinese children's character judgment scores in two grade. groups 70

8. Box plots for Chinese children's accuracy for RAN in two grade groups.....70

9. Box plots for Chinese children's response time for RAN in two grade groups.....71

10. Box plots for Chinese children's vocabulary scores in two grade groups. 71

11. Box plots for Chinese children's character naming scores in two grade groups 72

12. Box plots for Chinese children's word recognition scores in two grade groups 72

LIST OF ABBREVIATIONS

B	Standardized Beta coefficient
CI	Confidence interval
df	Degrees of freedom
G1	The first grade of primary school
K2	The second year of kindergarten
K3	The third year of kindergarten
M	Mean
MA	Morphological awareness
OA	Orthographic awareness
PA	Phonological awareness
RAN	Rapid automatized naming
SD	Standard deviation
SE	Standard error
U. S.	United State

ABSTRACT

Huang, Yingshan, M. S., University of South Alabama, December 2023 Emergent Literacy and Early Reading Skills in Chinese-Mandarin: Evidence from Kindergarten and First-Grade Children. Chair of Committee: Brenda L. Beverly, Ph.D.

The development of emergent literacy, a precursor to formal reading, has been linked to subsequent conventional literacy skills in Chinese children. The factors important for acquiring Chinese reading skills, such as phonological and morphological awareness, have primarily been studied in primary school children rather than preschoolers. The complete picture of factors contributing to early reading skills in Mandarin-speaking Chinese preschool children remains unclear. **Objectives**: The aim of this study was to explore emergent literacy and early reading skills in preschool and early school-aged children and investigate the connections between them to address gaps in existing literature. **Methodology**: A cross-sectional design was used to collect data from a sample of 66 children, including 35 in their second year of kindergarten and 31 first-grade children. Assessments were conducted on phonological awareness (syllable deletion), morphological awareness (lexical compounding, homophone judgment, and homophone generation), orthographic awareness (character judgment), vocabulary, and rapid automatized naming (RAN) of numbers. Reading outcomes were measured by character naming and word recognition. **Results**: The MANOVA findings showed a significant grade group effect on all measures, except for RAN accuracy. Specifically,

first-grade children outperformed second-year kindergarten children in syllable deletion, lexical compounding, homophone generation, homophone judgment, character judgment, and vocabulary. Additionally, first-grade children named numbers faster than kindergarten children in RAN. The correlation and regression analyses suggest that advanced emergent literacy skills in children improve word reading, but the associations between emergent literacy and reading vary by grade level. Syllable deletion and lexical compounding are particularly important for kindergarten children at the initial stage of learning to read, while character judgment plays a prominent role in the reading development of primary school children. Homophone judgment develops early and expands progressively as children gain reading experience during their primary school years. The significance of homophone generation is minimal at preschool and early school ages. RAN response time may provide more informative insights than RAN accuracy, and the link between RAN and reading skills appears to weaken once children begin schooling. Additionally, maternal education level was a significant co-variate associated with character naming in preschool children. **Implications**: Findings carry implications for Chinese educators and parents. Incorporating metalinguistic awareness into classroom instruction can support children's early reading development. Moreover, parents are encouraged to foster a literacy-rich home environment through experiences like interactive reading and character recognition, especially for preschool children without formal literacy instructions. Further longitudinal research is recommended to predict early reading skills in a larger sample of Mandarin-speaking preschoolers and establish age-specific educational goals.

CHAPTER I

INTRODUCTION

The correlation between spoken and written language abilities is a crucial element of language acquisition and literacy development. Proficiency in spoken language, including the ability to listen and speak effectively, lays a solid groundwork for reading. Reading involves the process of obtaining information and meaning from written symbols, and primary school is a critical period for children's reading development (Wang et al., 2023). The act of reading necessitates the synchronized involvement of various mental abilities, making it a multifaceted cognitive undertaking (Tighe et al., 2015). Most research in the field of reading has focused on the alphabetic languages. Emergent literacy, also called early literacy, refers to a set of skills associated with the preschool years that lead to writing and reading. According to Whitehurst and Lonigan (1998), emergent literacy is best viewed as developing on a continuum. That is, at a young age, children's exposure to social interactions facilitates the simultaneous and interdependent development of reading, writing, and oral language skills (Whitehurst & Lonigan, 1998). Literacy can be considered as a component of social context and children could develop emergent literacy skills in the absence of formal instruction. Emergent literacy has been investigated primarily in children who speak English (e.g., Girolametto et al., 2012; Puranik & Lonigan, 2011). The elements of emergent literacy in alphabetic

languages like English, as summarized by Foorman and colleagues (2002), included print motivation, print awareness, vocabulary knowledge, phonological awareness, letter knowledge, narrative skills, emergent reading and emergent writing. For English speaking children, it has been well-established that emergent literacy skills are related to and predictive of later literacy success (Dickinson, 2011; Kuo & Anderson, 2006). However, written Chinese, being a morpho-syllabic language, exhibits significant dissimilarities when compared to alphabetic scripts like English. Unlike morpho-phonemic languages such as English where individual phonemes are represented, Chinese characters function as ideographic writing by representing spoken syllables and morphemes (Newman et al., 2011). It is possible, therefore, that different linguistic skills are needed for successful reading in Chinese compared to English. Chinese children must acquire a vast number of characters in order to attain proficiency in reading compared to English early readers who learn a finite set of letters and sounds. Additionally, Chinese children are often exposed to a literary tradition that emphasizes direct learning, memorization and rote learning (Xu, 2022), which may be different from early literacy experiences in the United States that prioritize fostering enjoyment in reading and emphasizes adult-child shared reading experiences as an opportunity for a social experience rather than a mode of instruction (Dowdall et al., 2020; Huang et al., in revision). As with English speaking children who generally begin learning code-based skills such as phonological awareness and letter/sound correspondence, in preschool and early elementary, Chinese children typically begin learning characters in kindergarten or early elementary school. Initially, they focus on learning basic strokes and simple characters, such as numbers and simple words. As they progress, they learn more

complex characters and begin to focus on reading comprehension. Emergent literacy has received some attention in Chinese languages. Multiple investigative teams have discovered that metalinguistic abilities, such as the awareness of phonological patterns and morphological structures, emerge during early childhood before formal literacy training and are connected to subsequent development of conventional literacy skills (e.g., word reading or character recognition) of Chinese children (e.g., Lin et al., 2019; McBride-Chang et al., 2008). However, most studies were conducted with children above the second grade (e.g., Hulme et al., 2019; Lin et al., 2020; Shu et al., 2008), and the ones with younger children have not included measures in other emergent literacy components, like orthographic awareness, vocabulary, and rapid automatized naming.

In school, some children have developmental dyslexia, a disorder characterized by reading skills significantly lower than expected for their chronological age despite intelligence within the normal range and given sufficient educational and social opportunities (Lyon et al., 2003). The prevalence of dyslexia among primary school students in China was found to range from 4% to 10% (Snowling, 2000), similar prevalence rates to that of children learning alphabetic language systems such as English (approximately 5–10%) (Zhang et al., 2023). However, dyslexia is generally poorly recognized in Asian populations, especially Chinese, due to the linguistic characteristics of non-alphabetic scripts (Zhang et al., 2023). An additional concern is that Chinese parents and teachers have insufficient knowledge of developmental dyslexia, believing that children's poor grades are the result of poor study efforts. If parents and educators do not recognize dyslexia signs, then timely assessment and intervention for children with developmental dyslexia may not occur. So far, there is a lack of standardized reading

assessment to identify children with developmental dyslexia in China. As suggested by studies on Chinese developmental dyslexia (e.g., Zhang et al., 2023), the primary diagnostic task should involve the naming of Chinese characters without time constraints. Variations are anticipated in the reading progress of young children, and these variations can be impacted by a range of factors. Understanding the characteristics of typically developing children in the early reading development and the contributors that promote the young children's reading development can provide valuable suggestions for identification and assessment for the reading ability of dyslexic children. So far, a comprehensive picture of what contributes to Chinese typically developing children's word-level reading skills before they formally receive specific reading instructions and how these contributors relate with each other has not yet been established. It is unclear if risk for reading difficulty could be identified for Chinese children when they enter school. The purpose of the present study is to investigate the emergent literacy skills of Chinese preschoolers and early school-aged children and explore how these skills relate to children's character reading skill. The findings can support a clearer understanding of the reading and reading-related skills development needed for literacy success for young Chinese children and offer initial implications for early detection and interventions to prevent or mitigate the occurrence of reading disabilities for Chinese children learning to read Mandarin.

CHAPTER II

REVIEW OF THE LITERATURE

2.1 Emergent Literacy in Chinese

Emergent literacy, also called early literacy, refers to the preschool years during which children develop skills that lead to writing and reading. The term emergent literacy was first introduced by Clay (1966) when she observed that Children engage in activities that mimic reading and writing by utilizing books and writing tools, despite their inability o comprehend or produce written language conventionally. That means, from a young age, reading, writing, and oral language naturally progress together and rely on each other without the need for formal teaching (Whitehurst & Lonigan, 1998). Emergent literacy has been investigated primarily in children who speak English (e.g., Girolametto et al., 2012; Puranik & Lonigan, 2011). Foorman and colleagues (2002) describe emergent literacy in alphabetic languages such as English as including the following components: (1) print motivation which involves being interested in and enjoying books; (2) vocabulary, the ability to identify and name objects and/or pictures; (3) print awareness, including noticing print, knowing how to handle a book, and knowing how to follow words on a page; (4) narrative skills such as being able to describe events or procedures and to tell stories; (5) letter knowledge which may include understanding letters are different from each other, knowing letter names and the sounds they represent,

and recognizing across environments; (6) phonological awareness, the capacity to contemplate and manipulate linguistic sound components; (7) emergent reading, pretending to read and reading environmental print; and (8) emergent writing, which includes pretending to write and emerging letter writing.

2.1.1 Characteristics of spoken and written language of Chinese

Written Chinese is a morpho-syllabic language, made up of characters that map onto spoken syllables. There is a correlation between a sound unit (the syllable), a meaning unit (the morpheme), and a writing unit (the character). In this case, characters are used to represent syllables and morphemes rather than individual phonemes as seen in languages like English, where the orthography is based on both letter-sound correspondences and meaning through morphology (Newman et al., 2011). Therefore, a prominent disparity between Chinese and English lies in the fact that Chinese characters, which serve as the fundamental units of written Chinese, symbolize sounds and phonetic hints at the syllable level. To illustrate, the inclusion of a character's phonetic radical can offer valuable indications regarding its pronunciation. All of the approximately 1,200 syllables of modern standard Chinese can be uniquely described in terms of three phonological elements: onsets, finals (i.e., rimes), and tones. Syllables can be basically divided into initials (i.e., onset) and finals (i.e., rime), equivalent of initial consonants and vowels in English. In contrast to alphabetic languages, Chinese characters are relatively unreliable in offering consistent speech-sound information at the phoneme level for character recognition (McBride, 2016). Rather, it is widely believed that the ability to

recognize syllables has a significant impact on one's proficiency in reading Chinese characters (Shu et al., 2008).

Although primarily syllabic, Chinese does have a written phonetic system, Pinyin. Pinyin serves as the official phonetic encoding system utilized in China to transliterate the sounds and tonal variations of Chinese characters into Latin scripts (Ding et al., 2015, p. 635). Pinyin, also known as "Hanyu pinyin," refers to the phonetic representation of Chinese characters using spelled-out sounds. The Chinese government officially released the Pinyin system in 1958. In primary schools across China, Pinyin is systematically taught to assist young learners in acquiring the pronunciation and tonal variations of Chinese characters. Typically, by the conclusion of their first year of schooling, children have achieved proficiency in utilizing the Pinyin system (Yin et al., 2011). Chinese Pinyin includes nearly all the letters from the English alphabet, with the exception of “v”, and it also incorporates the letter “ü” (standard Mandarin pronunciation of “ü” has both the sounds /y/ and /u/). In Pinyin, there are a total of 24 distinct sounds, which include 21 consonants and 5 vowels (or finals). In addition to these basic sounds, there are also some compound sounds and tone markings used in Pinyin to represent the pronunciation of Mandarin Chinese. Pinyin letters can be combined to form various sounds. Here are some common pinyin letter combinations: e.g., /ai/: pronounced like “eye”; /ei/: pronounced like “ay”; /iu/: pronounced like “yo”; etc. Pinyin also comprises three-letter (e.g., “iao”) and four-letter (e.g., “iang”) combinations. Chinese Pinyin has 21 onsets and 35 rimes. There is no coda in Pinyin. Generally, rimes carry tone marks. These tones are particularly important.

Tone, an integral element of Chinese syllables, is not present in English spoken language. Accurate pronunciation of tones holds significance as it differentiates the meanings of syllables that share identical phonological segments (McBride-Chang et al., 2008). Spoken Chinese has four tone marks and five tones: one flat, one rising, one that falls and then rises, and one falling, with the four corresponding tone marks as 1st ("ˉ"), 2nd (" ˊ "), 3rd ("V") and 4th ("\"). For example, these four syllables possess the phonological structure of /fu/, yet their meanings are distinguished through tone variations: /fū/ "夫" (husband), /fú/ "福" (blessing), /fǔ/ "斧" (ax), and /fù/ "父" (father). The fifth tone is neutral tone, in which case, the character is pronounced unstressed (e.g., "的" /de/). That is, there is also the possibility for a syllable to be said with no tone at all.

Chinese language differs from alphabetic languages in its inclusion of radicals, which adds a distinctive element. Radicals are individual units that are further composed of strokes to form whole characters. Specifically, A stroke is the tiniest individual element found in a Chinese character. There exist eight fundamental strokes, each consisting of a distinct line pattern drawn in one continuous motion (McBride, 2016). These are known as: dot, horizontal, erect, hook, raise, curve, slant and pressing down. Generally, Chinese characters are formed by combining various strokes into specific configurations. The majority of these characters consist of two or more radicals, which can be classified into two types: semantic and phonetic. Interestingly, around 80% to 90% of Chinese characters are compound in nature, meaning they contain both types of radicals. The meaning or semantic category of the entire character is indicated by the semantic radical, whereas the pronunciation of the entire character can be inferred from

either complete or partial information provided by the phonetic radical. In Chinese, orthographic knowledge may encompass compound characters that incorporate semantic radicals.

Morphological awareness, broadly, refers to an individual's ability to attend to, think about, and manipulate morphemes in a language (Kuo & Anderson, 2006). In alphabetical writing systems, a morpheme is generally capable of being pronounced and recognized as an individual entity conveying distinct meaning. An English morpheme can be a word such as dog, or a word element, such as the "-s" at the end of "dogs", that can't be divided into smaller meaningful parts. In terms of conceptual meaning, a Chinese word is equivalent to an alphabetic script word. Nevertheless, defining Chinese words in print presents greater difficulty compared to alphabetic orthographies. Basically, the Chinese language consists of individual characters or combinations of characters, with around 65% of words containing two or more characters (morphemes) (Tan & Perfetti, 1999). It is challenging to determine the boundaries of a word in Chinese written text due to the uniform square space occupied by each character on a page, and the absence of grouping characters based on words. In Chinese language, semantic radicals contribute to morphological structure within individual characters, while lexical compounding signifies morphological structure at the level of words (McBride, 2016). Reception of Chinese characters by primary school students is influenced by their understanding of radical composition and placement. Therefore, proficiency in radicals, demonstrating an understanding of the morphological composition of Chinese characters, has been of interest in understanding reading development for young children. The relationship

among four units of Chinese word reading, strokes, radicals, characters and words, are demonstrated in Figure 1.

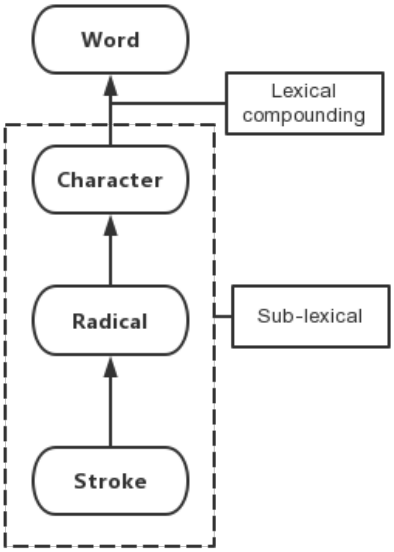

Figure 1. Four key units of Chinese word reading.

In terms of the word-level morphological structure in Chinese, the lexical compounding impacts children's reading performance beyond the character level. In particular, children need to acquire the knowledge that words consist of multiple morphemes, and the repetition of these morphemes can be observed in various words. Inflectional morphemes that indicate the grammatical property of a word are uncommon in Chinese, like the plural forms (i.e., "-s") or past tense (i.e., "-ed") suffixes in English. Put another way, there are neither morphological markers of word boundaries nor sharp distinctions between root, lexeme and word in Chinese. Rather, morphemes in Chinese

can be combined in various ways to create distinct words or concepts. Compounding words, also known as compound words or compounds, are common in Chinese.

Lexical compounding involves combining two or more morphemes to create a new word with a different meaning. For example, the word “电视” /diàn shì/ combines the characters “电” /diàn/, meaning “electricity,” and “视” /shì/, meaning “to see,” to form the word “television.” Chinese word formation heavily relies on synthesis, resulting in the integration of individual morphemes to form the overall meaning of a word. For example, in the word “书包” (/shū bāo/, book-bag, schoolbag), each morpheme is associated with a specific pronunciation, which comprises two syllables pronounced as one word (/shū/ and /bāo/), and a corresponding written form consisting of the characters “书” and “包”. In the case, the whole word means “a bag carrying books”, which integrates the individual meaning of the morpheme “书” (meaning “book”) and the morpheme “包” (meaning “bag”). This particular feature of the morphological system in Chinese facilitates the identification of individual morphemes by Chinese children, as these units are consistently presented as separate entities, whether in spoken or written form. Therefore, Chinese vocabulary, consisting of one or multiple morphemes, potentially exhibits higher semantic transparency compared to English vocabulary. Chinese youngsters can leverage this transparency to acquire new ideas or identify connections between words (Yang et al., 2018).

Another focus on Chinese morphemes are homophones, or morphemes with identical pronunciations yet distinct semantic interpretations, which are very common in Chinese due to the language's tonal nature and large number of characters. Specifically,

Chinese homophones refer to a group of morphemes, containing a morpheme that shares the same pronunciation or spelling as another morpheme, yet possesses a distinct meaning. For example, the Chinese morpheme for fish - "鱼 /yú/" is a homophone for "余 /yú/", which means surplus. Homophones can sometimes create confusion and ambiguity, especially in spoken language. It is important to pay attention to context and tone to distinguish the meanings of homophones in Chinese.

2.1.2 Correlates of Chinese Early Reading

Whitehurst and Lonigan (1998) created a framework that categorized emergent literacy components into two interdependent domains: meaning-based skills and code-based skills. Meaning-based skills involve components that facilitate children's comprehension of the significance of written text beyond the actual words, including vocabulary and narrative abilities. Code-based skills encompass elements that facilitate children's capacity to convert written text into sounds and vice versa (i.e., associations between letters and sounds) within the textual context, including familiarity with letters and awareness of phonological patterns. Both meaning-based and code-based skills support children's later literacy success. As summarized by Whitehurst and Lonigan (1998), Relevant code-based emergent literacy skills are of utmost significance during the initial phase of preschoolers' reading development, where the emphasis lies on decoding text. Conversely, as children progress to tackling more intricate texts during their school years, meaning-based emergent literacy skills may assume a greater role.

For children who speak English, it is widely acknowledged that several foundational literacy skills are associated with and can forecast future achievements in literacy (Dickinson, 2011; Kuo & Anderson, 2006). For example, emergent writing (i.e.,

scribbles) was found to progress along a continuum to conventional spelling (Puranik & Lonigan, 2014), and phonological awareness contributed to word reading (Georgiou et al., 2020) as well as print knowledge (Lonigan et al., 2009). Just like children who speak English, Chinese children's literacy skills begin developing in the preschool years. Generally, Chinese children speaking Mandarin begin formal literacy training approximately at the age of 5 and a half to 6 years old (Li & Rao, 2000). (Note that Chinese children between the ages of 3-6 participate in formal education referred to as Kindergarten). In the process of primary education, Chinese students incorporate their understanding of the structural, phonetic, and positional patterns within the Chinese language to enhance their reading and writing skills (Yin & McBride, 2015). However, reading and writing are not single constructs or skills. Reading development depends on a variety of foundational components applied in an integrated manner. These basic reading-related skills are so-called emergent literacy, emerging at an early age prior to receiving formal literacy instructions.

2.1.2.1 Phonological awareness.

Phonological awareness refers to the metalinguistic ability of consciously recognizing, discerning, and manipulating phonological elements within words (e.g., sounds and syllables) independent of meanings (Wang et al., 2021). Multiple research studies have indicated that the development of reading skills in children is significantly influenced by their phonological awareness, particularly among those who speak English (e.g., Georgiou et al., 2020; Horowitz-Kraus & Hutton, 2015; Ziegler & Goswami, 2005). Children diagnosed with developmental dyslexia often exhibit challenges in phonological processing, leading to notable struggles in word recognition and decoding abilities (Lyon

et al., 2003). The phonological characteristics of non-alphabetic languages, like Chinese, possess distinct attributes. Chinese Pinyin serves as a phonetic representation system that signifies the pronunciation of Chinese characters and emphasizes the differentiation between onset and rime in written form (Lin et al., 2020). Characters in Pinyin are frequently depicted as being divided into onset and rime, wherein the initial consonant of a syllable, such as "f" in the case of "饭 /fàn/," is considered the onset while the vowel component "an" functions as the rime. Generally, children start to receive formal instruction for acquiring the Pinyin system in the first semester of Grade 1, before they learn Chinese characters on a large scale. Word recognition involves the transformation of representations from visual word form into speech sound, the so-called orthography-to-phonology transformation. Phonological awareness tasks commonly employed in alphabetic writing systems tend to focus on phoneme-level manipulation, such as deleting, blending or isolating phonemes. However, these tasks may not be suitable for assessing the phonological processing involved in Chinese reading (Ding et al., 2015). Just as mentioned above, Chinese characters' phonology can be defined at the syllable level. The correlation between Chinese orthography and phonology can be characterized by the level of consistency, indicating whether a character shares the same pronunciation as its phonetic radicals or not. Especially when it comes to characters with low frequency, it can be inferred that the process of reading Chinese involves sub-lexical processing.

Research on phonological awareness typically incorporates a range of assessments, encompassing phonological sensitivity, syllable recognition, onset-rime identification, and phonemic awareness. These investigations have revealed a positive correlation between phonological awareness and the ability to recognize English words (e.g.,

McBride-Chang et al., 2004). The factors that contributed to the variance in Chinese character recognition were tasks related to syllable awareness, tone awareness, and rapid automatized naming (Chang et al., 2014). Between ages 3 to 6 years, there was a gradual and steady improvement observed in children's awareness of syllables and rimes (Shu et al., 2008), which suggests that children could develop syllable and rime awareness without formal instructions. However, the significance of onset and phonemic awareness in reading development was observed to be more pronounced among fifth- and sixth-grade students compared to younger learners. This could potentially be attributed to the heightened importance of phonemic awareness for older readers who are acquiring new characters and have received formal literacy instruction for Pinyin (Li et al., 2012; Lin et al., 2020). The results highlight the distinct significance of syllable awareness in facilitating early character learning among Chinese young readers, particularly at preschool and early school age.

McBride-Chang and colleagues (2004) investigated the correlation between children's reading abilities and their phonological awareness, specifically word recognition, at preschool and Grade 1 in three different geographic and cultural regions - Xian (a northern city in mainland China), Hong Kong and Toronto. Their tasks of phonological awareness were syllable deletion and phoneme-onset deletion. The findings from the three cultures indicated that there was variation in phonological awareness, but a consistent pattern emerged where higher-level phonological awareness correlated with more advanced word reading abilities in both English and Chinese. Notably, syllable awareness played a crucial role in the reading development of Chinese children compared to their English-speaking counterparts. On the contrary, this study did not find evidence

to suggest that phoneme onset level awareness plays a significant role in the early recognition of Chinese characters, even among children who are taught to read using a phonemic coding system. These results could be explained by the syllable-morpheme correspondence feature of Chinese characters. The results indicate that the development of early reading skills in Chinese may rely on distinct levels and facets of phonological awareness, as opposed to those observed in English. In addition, the performance of children from Hong Kong was notably inferior to that of children from Xian in both syllable and phoneme onset deletion tasks, suggesting that the development of children's syllable-level phonological awareness can be enhanced by Pinyin training (given in mainland China only).

2.1.2.2 Morphological awareness.

In general, morphological awareness encompasses the capacity to identify and manipulate the smallest units of meaning (also known as morphemes) in a specific language (Lin et al., 2019). Morpheme is a linguistic unit that cannot be decomposed any more. A morpheme in the English language can exist as either a base word (such as "car") or an altered version derived from a base word (e.g., the plural form "-s" in "cars" is also a morpheme) that has its own meaning. Accordingly, morphological awareness in the English language pertains to the recognition of morphemes within both oral and written forms of communication, as well as the relations between a base word and its corresponding derived or inflected forms (Apel, 2014). The direct impact of morphological awareness on reading comprehension has been observed in children acquiring an alphabetic language, such as English (e.g., Deacon et al., 2014). The common tasks to measure morphological awareness in English generally tapped

children's understanding the significance of prefixes and suffixes as well as the relation of base words to their inflected and derived forms (Apel et al., 2013). These tasks generally take in a variety of forms for either spoken or written language, incorporating production tasks with cloze procedure, judgment tasks, fluency tasks, blending/segmenting tasks and analogy tasks. For example, in the word analogy tasks, children are typically required to provide a derived form for a target base word (i.e., say, "funny" given "fun" following the example "mess-messy"). In Chinese, there are no inflectional morphemes, and morphemes are represented by characters. Chinese children's morphological awareness involves the ability to differentiate and manipulate the knowledge of characters, including the meaning and structure of characters, as well as how to create new words and meanings by combining characters. A lack of morphological awareness emerged as a prevalent issue among Chinese primary school children with developmental dyslexia (Shu et al., 2006). Morphological awareness in Chinese is a multidimensional construct which incorporates at least two distinct but interrelated levels. Given the high frequency of homophones and compound words in Chinese, the main area of study regarding the impact of morphological awareness on word reading has primarily centered around knowledge of lexical compounding and homophones (e.g., Liu et al., 2013; Zhou et al., 2012).

Some researchers (e.g., Tong et al., 2017) classified morphological awareness in the Chinese language into two tiers. One tier pertains to the lexical level of morphological awareness, which involves recognizing compound words, while the other tier focuses on the sub-lexical level of morphological awareness, which entails identifying character meanings through semantic cues provided by radical components.

Research has indicated that there exists a moderate correlation between the development of Chinese children's reading skills from kindergarten to the third grade of primary school and their morphological awareness, specifically in terms of lexical compounding (e.g., McBride-Chang et al., 2003; Wang et al., 2006). The recognition of compound words aids children in comprehending the definitions of unfamiliar words by utilizing morphemes that are already familiar to them, thereby playing a crucial role in the initial phase of vocabulary acquisition during the process of learning how to read. In contrast, the higher-level of morphological awareness, awareness of homophones, expands children's vocabulary by providing them with multiple meanings for a single sound. This helps them to understand different contexts and use the appropriate words accordingly. Therefore, older students benefit from developing a keen awareness of homophones, as they need to differentiate between numerous homophonic words within their extensive repertoire of spoken and written Mandarin (Chen et al., 2009; Lei et al., 2011).

The impact of morphological awareness on the early reading progress of children has been examined in longitudinal studies. For instance, Pan and colleagues (2016) conducted a longitudinal study that included children from 4 to 9 years old to assess literacy skills at both preliterate and postliterate stages. There were four literacy measures, including children's performance in character recognition, character dictation, reading fluency task and passage comprehension. Children's morphological awareness was measured using morphological construction of compounding words and morphological production of words with a target character. The findings indicated that the impact of preliterate morphological awareness on literacy skills was primarily mediated by postliterate morphological awareness. This implies that postliterate

morphological awareness played a crucial role in developing both character-level and higher-level reading abilities, including text-level fluency and comprehension. Another longitudinal study (Lin et al., 2019) explored how morphological awareness could be used to predict the ability of Chinese children to recognize characters starting in the second year of kindergarten (i.e., 4 years old). Eighty-eight Chinese children speaking Cantonese from Hong Kong were tested across two years, four times with a 6-month interval each during the period. Apart from evaluating morphological awareness through a task involving morphological constructions, the study also assessed children's phonological awareness, orthographic awareness, and visual-spatial abilities. To measure phonological awareness, participants were requested to identify and vocalize a syllable extracted from a provided word. Orthographic awareness was examined by requiring children to identify whether a written symbol was a real character. Foil symbols included pseudo-characters consisting of syllables that were legally combined, non-characters plus other non-linguistic visual symbols. The assessment of visual-spatial ability involved children's task of identifying the appropriate shape that appeared partially or completely rotated compared to five similar shapes. Data analysis was conducted using latent growth curve modeling, while controlling for nonverbal IQ, visual-spatial abilities, phonological awareness, and orthographic awareness at Time 1. The findings revealed a significant association between morphological awareness at Time 1 and character recognition at all four time points. Importantly, morphological awareness at Time 1 was found to be a significant predictor of the gradual advancement in character recognition over a span of 2 years. This period was the time children started to formally learn Chinese in Hong Kong. A positive correlation revealed that children with better initial character recognition

developed reading at a faster rate. The development of morphological awareness in early readers was proposed by the authors as a potential means to enhance reading skills among kindergarten children, both directly and indirectly.

Similarly, in a longitudinal study conducted over the course of one year (Dulay et al., 2021), an examination was carried out to explore the impact of morphological awareness and vocabulary on the recognition of characters for 160 Grade 1 Chinese children from Hong Kong. Children's receptive vocabulary was measured in a picture matching task to choose a picture which matched the meaning of a word orally presented from four choices and their expressive vocabulary was measured in a picture naming task. In addition, children were also required to complete a vocabulary definition task. Morphological awareness was found to promote children's later character recognition, and Time 1 character recognition facilitated vocabulary skills one year later. This study highlighted the significance of morphological consciousness in the initial stages of children's reading development.

Morphological awareness has also been found to differentiate readers with similar initial performances (Lin et al., 2019). Chinese children who possess stronger early morphological awareness tend to exhibit enhanced reading abilities, particularly in terms of word recognition. This could potentially be attributed to the positive impact of improved morphological awareness on vocabulary acquisition and subsequent Chinese character reading proficiency. For example, Chinese children who possess well-developed morphological awareness can effectively leverage their reading experience. This is because they have the ability to identify familiar morphemes and analyze the structure of unfamiliar words, allowing them to deduce the meanings of these new words

(Li et al., 2012). According to the findings of Shu and colleagues (2006), compared to typically developing children, Chinese children diagnosed with developmental dyslexia exhibited lower levels of morphological awareness. Morphological awareness tasks (including morphological production and morpheme judgment) were the most significant cognitive factors linked to the ability to recognize characters, dictate accurately, and comprehend written text were found to be consistent across all levels of reading proficiency.

2.1.2.3 Orthographic awareness.

Orthographic consciousness involves the comprehension that children possess regarding the established practices employed within their language's written system. In alphabetic languages such as English, particularly, orthographic awareness refers to letter positions, combinations and sequences that make a word (Apel, 2011). As stated by Apel (2011), English orthographic awareness encompasses two distinct aspects: (1) the stored grapheme representations of words, which can be assessed through exercises where participants are required to differentiate between real words and pseudo-words with similar phonetic qualities (for example, comparing "pint" and "pynt"); and (2) the stored orthographic rules about letter-sound correspondences, which could be assessed using a lexical decision task (determining the accuracy of the given letter combination's spelling. As a non-alphabetic script, written Chinese is composed of characters formed by complex orthographic rules. As previously described, specific strokes grouped form parts of characters called radicals (McBride, 2016). Compared with phonetic radicals, the number of semantic radicals is limited. There are around 800 phonetic radicals, about 200 semantic radicals, and an extensive number of distinct Chinese characters. The ability of

children to recognize Chinese characters is influenced by their capacity for image retention, as well as their understanding of the overall structure of the character and its constituent radicals that provide insight into both sound and meaning (Guan et al., 2020).

Chinese children's knowledge of Chinese character composition rules is referred to as their orthographic awareness, which includes three levels: (1) the awareness of the basic form of components that make up a single character; (2) the recognition of the position of Chinese components and their combination rules (e.g., Lam, 2006); and (3) the radical awareness. Radical awareness pertains to familiarity with the radicals of Chinese characters and their correct placement, along with comprehension of the roles played by semantic radicals and phonetic radicals in compound characters (Li et al., 2021). For example, "女" is a semantic radical related to the meaning of female. So the function of this semantic radical is to make characters that have this radical with the usual meaning related to females, such as "奶" (means "grandma"), "姐" (means "sister"), "姑" (means "aunt"). Although the semantic radical of "女" serves with the same function just as the affix "ess" in English (e.g., "waitress" versus "waiter" or "actress" vs "actor") to denoting the female gender, the difference is that "女" in "奶" belongs to a sub-lexical structure rather than an individual morpheme as "ess" in "waitress". In terms of phonetic radicals, for example, "青" /qīng/ (means "green") serves as a phonetic radical, sharing comparable pronunciations with characters incorporating it, such as "清" /qīng/ (means "clear") and "晴" /qíng/ (means "sunny"). However, sometimes the pronunciation isn't identical to the characters that share the phonetic radical, such as "青" /qīng/ in "精" /jīng/ (means "smart") and "婧" /jìng/ (means "talented women").

Another aspect of radical knowledge involves the position of the semantic and phonetic radicals. Radicals may appear in any position in a character. For example, “女” not only appears on the left side in the characters “姐”, “妈”, “她”, “好” and “姓”, but also appears at the bottom in “妾”. Both cases are legal. However, there are regularities in the positioning within characters, depending on the function of radicals. The positioning of semantic radicals in Chinese characters is typically at the top or left side, while phonetic radicals are commonly found on the right side or bottom. When these radicals are correctly placed within a character, it can be considered either a real character or a pseudo-character. However, if the radicals are positioned incorrectly or if certain components/subcomponents do not exist as legitimate elements in Chinese language, then the resulting written item would be classified as a non-character. Regardless of the level of analysis, Chinese exhibits a significantly larger number of unique symbols compared to any alphabetic writing system.

In existing studies, there are mainly three types of tasks used in the assessment of orthographic consciousness of children whose first language is Chinese. A character judgment task is the most widely used orthographic awareness test (e.g., Li et al., 2006; Qian et al., 2013). In this task, real characters, pseudo-characters and non-characters are visually presented on the computer screen or the written paper. Pseudo-characters refer to those characters in Chinese that adhere to the orthographic principles by combining radicals, whereas non-characters are characterized by their deviation from the rules of radical combination. Non-characters can be further divided into non-characters with wrong positions (such as the top-down structure incorrectly written into the left-right

structure, etc.), and non-characters with wrong components (one part of the character is replaced by another part). Participants need to determine whether the stimulus presented is a real character or not, and their performance on the character judgment test will be evaluated based on the number of accurate decisions made.

A second task is the character reversal decision task, which examines whether the participant can judge the correct direction of Chinese characters (Wang et al., 2012). About half of the Chinese characters presented in the test are left-right reversed characters. Lastly, radical awareness tasks aimed at promoting a deep understanding of radicals, encompassing tasks focused on recognizing radicals, identifying semantic associations with radicals, and discerning phonetic components within radicals (e.g., Ho, Ng, & Ng, 2003; Li et al., 2021; Zhao et al., 2012) tap orthographic awareness. Participants are either asked to recognize the sound or meaning information represented by the phonetic and semantic radicals (e.g., Ho et al., 2012) or indicate the exact position of a specific radical (i.e., up, down, left, and right) to form a legal character (e.g., Leong et al., 2008).

Chinese children's orthographic awareness is central for their reading development, as well as for learning new vocabulary (Li & Rao, 2000; Li, Peng, & Shu, 2006; McBride, 2016). Some researchers found that preschool children have developed basic knowledge that Chinese characters are written words, much the same way a young child learning English understands that a parent is reading a script, and Chinese preschoolers can distinguish characters from English words (e.g., Qian et al., 2013). Li, Peng, and Shu (2006) believed that preschool children's orthographic awareness is still in the embryonic stage, and they initially acquire orthographic awareness in the first grade of primary

school. Children aged 5 years old have not yet acquired the knowledge of radical combination rules. Specifically, children's comprehension of the function and placement of semantic radicals progresses as evidenced by their capacity to recognize, examine, and utilize semantic radicals within compound characters (e.g., Shen & Ke, 2007). Li, Peng, and Shu (2006) pointed out that although children's orthographic awareness has matured at the fourth and fifth grade, there is still a gap in the level of orthographic awareness between primary school children and college students. Thus, children's acquisition of orthographic awareness is a gradual process, but there is still a controversy in the developmental changes in preschool children's orthographic awareness for different aspects of Chinese orthography.

Li and colleagues (2021) focused on the semantic radical awareness of Mandarin-speaking preschoolers (4 to 5 years old) who are yet to undergo structured literacy training. Two experiments were conducted. Experiment 1 aimed to explore the extent to which preschool children are cognizant of the semantic radical's role in providing consistent meaning cues within phonetic-semantic compound characters. For example, they presented characters wherein the semantic radical category aligns with that of the entire character (e.g., "犭" in "猫", meaning "cat") or semantic radicals that do not align with the whole character meaning (e.g., "女" in "姓", meaning "surname"). Experiment 2 aimed to examine if preschool children utilized the semantic radical of the target character as a basis for their judgments when presented with two additional phonetic-semantic compound characters, one sharing the same semantic radical and another sharing the same phonetic radical as the target character. Children were required to judge which one was similar to the target. In addition, characters in both Experiment 1 and

Experiment 2 had structures in two kinds of configuration - left-right configuration (e.g., “沙” or “江”) or top-bottom configuration (e.g., “苗” or “若”). The findings from Experiment 1 indicated that children aged 4 and 5 had not yet developed an understanding of the consistent categorization of semantic radicals, regardless of their arrangement in left-right or top-down configurations. In Experiment 2, it was observed that children did not demonstrate awareness of the semantic radical and instead exhibited a strong inclination towards utilizing phonetic radicals for character classification. Children’s performance was better when they made judgment for characters with left-right configuration than those with other internal configurations. Authors concluded that the development of 4-to-5-year-old children’s radical awareness was synchronized to their cognitive development at the conceptual level such that they tended to categorize characters based on the shape rather than the meaning.

Yin and McBride (2015) investigated statistical learning of Chinese characters by Chinese preschoolers aged 4 to 5 years old. Statistical learning in this study was referred to the ability to detect the orthographic and phonetic regularities in the characters. Such regularities include the radical position, and the pronunciation of compound characters is similar to the pronunciation of the phonetic radical. Children were tasked with a character naming exercise, wherein they were instructed on the pronunciation of unfamiliar written characters. Random strokes, non-characters and pseudo-characters, as well as phonetic-cue conditions were stimuli for the character-learning task. Word reading (character recognition) was measured by asking children to read aloud 50 single-character words, and character writing/dictation involved writing 10 orally familiar Chinese words that were spoken twice by the investigator. The findings suggested that four-year-old children

exhibited an awareness of the consistent spelling and sound patterns present in written characters, because they recognized the left-right or top-down configurations correctly pronounced characters based on phonetic cues. Five-year-old children were found to have started to develop the knowledge of the radical position and had better performance in learning pseudo-characters than learning non-characters.

Ho, Ng and Ng (2003) examined the importance of the radical knowledge in Cantonese-speaking children's early reading development in Chinese. The developmental trajectory for semantic and phonetic radicals in compound characters were examined during the period of Grade 1 to Grade 5, and three elements related to semantic radicals (i.e., the position, function and categories) were measured. The measures consisted of four tasks: a lexical decision task involving 16 familiar characters, 16 unfamiliar characters, 16 pseudo-characters, and 16 noncharacters; a task to judge the position of radicals; a task to determine semantic relatedness where children selected a character that shared a semantic radical with the target pseudo-character; and a task to judge semantic categories using picture selection representing the meaning of the target radical. Then, a task involving the assessment of judgments, represented by a Chinese pseudo-character measured children's comprehensive knowledge of semantic radicals. Children had to select a single image out of four options that best symbolized the intended significance of the target character. In terms of phonetic radical, there were four tasks that followed the similar procedures to the measures to the semantic radical. That is, a task involving character decisions, a task assessing radical position judgments, a task evaluating phonological-relatedness judgments, and a task on naming Chinese pseudo-characters However, the answers of these tasks focused on the characteristics of phonetic radicals.

In addition, the fifth task of phonetic radical was the Chinese phonetic radical naming task. The outcome measure, children's reading ability, was examined in a Chinese/Cantonese word reading test, in which children were asked to read aloud 65 two-character words. The findings indicated that children began to develop an understanding of character structure, position, semantic category, and sound of radicals during Grade 1. However, it was not until Grade 3 that they fully grasped the function of semantic radicals. Furthermore, there was a significant correlation between all aspects of radical knowledge and children's word reading abilities. McBride (2016) compared the characteristics of literacy acquisition for preschoolers who were Chinese-speaking children and children speaking alphabetic languages. The investigation focused on how differences across languages might matter when learning to read. The significance of morphological awareness and orthographic awareness, specifically radical knowledge, was emphasized in the progress of children's reading skills in China. An examination was conducted on three components of Chinese written language - the radical, the character, and the word. Importantly there are two distinct Chinese scripts. Specifically, the script of mainland China/Mandarin is considered simplified Chinese, whereas Hong Kong uses what is considered the traditional Chinese, Cantonese. Traditional Chinese characters with more than two shapes have more strokes than the simplified characters. Traditional characters may provide more visual aids for novice readers to differentiate between characters, potentially making them easier to read than simplified characters. However, when it comes to writing, simplified characters are generally considered simpler and more straightforward to learn compared to their traditional counterparts (Chung & Leung, 2008).

Guan et al. (2020) examined the impact of character factors, such as orthographic consistency and transparency, as well as child factors like orthographic and phonological awareness, on the recognition of Chinese characters among school-aged children. In general, characters with phonetic radicals that offer more phonological information tend to exhibit higher levels of consistency, while characters with semantic radicals that provide greater semantic information tend to be more transparent. Six hundred Chinese-speaking children (100 for each of grade 1 to 6) completed a lexical decision task, and the accuracy and response time were recorded. Orthographic awareness was measured in a stroke awareness task and a radical knowledge task and then produced a summed score. For stroke awareness, children were tasked with replicating a character by executing each stroke individually. For radical knowledge, a new character was visually introduced to the children, and then children were asked to identify the phonetic and semantic radical of the character out of four choices, respectively. The findings revealed that there was a gradual improvement in both the speed and accuracy of lexical decision-making from Grade 1 to Grade 6, with the most significant increase in accuracy occurring between Grade 3 and Grade 4. The ability to make lexical decisions was influenced by both phonetic radical consistency and semantic transparency. Interestingly, the impact of consistency and transparency on response time was primarily driven by words with less consistent phonetic radicals. It is worth noting that character recognition was assessed through a lexical decision task rather than the character naming task employed in previous studies.

2.1.2.4 Vocabulary knowledge.

Reading comprehension involves understanding, analyzing, and synthesizing words, sentences, and ideas. Vocabulary knowledge generally serves as a fundamental tool for communication and learning, and vocabulary skills support word reading and comprehension. Existing studies primarily concentrate on the impact of vocabulary proficiency on the early reading progress of Chinese children during their school years. For example, a 3-year longitudinal study was carried out by Yan et al. (2021) to investigate the bidirectional association between word decoding and vocabulary in the reading development of 186 Chinese children from Grade 1 to Grade 3 (with an age range of 6.5 to 8.5 years). Children were assessed once a year to measure their decoding (character naming), vocabulary, and reading comprehension abilities. Vocabulary knowledge was tested in a vocabulary definition task. There were two reading comprehension tasks administered at the sentence level (Grade 1) and passage level (Grade 2 and Grade 3), respectively. In the sentence comprehension task, children were asked to choose one picture from four choices that corresponded to the written sentence or phrase; in the passage comprehension task, children were required to complete 18 multiple-choice questions for the provided passage. The findings revealed that reading comprehension variability across different grades could be accounted for by approximately 40% through decoding and vocabulary skills. The unique contribution of decoding decreased from 29% to 8%, whereas the contribution of vocabulary increased from 3% to 9%. Additionally, there was a reciprocal relationship between decoding and vocabulary development over time. Specifically, vocabulary skills in Grade 1 to Grade 3 predicted subsequent decoding abilities, while decoding skills only influenced later

vocabulary development during the period from Grade 2 to Grade 3. It implies that decoding plays an important role early when children start to learn reading, while vocabulary contributes more to reading development later when children have acquired basic decoding skills. The findings can be interpreted using two reading models, namely the Simple View of Reading (Gough & Tunmer, 1986) and the Decoding-Vocabulary-Comprehension (DVC) triangle model (Perfetti, 2009). Specifically, in the DVC model, vocabulary plays a dual role by directly contributing to reading comprehension and acting as a mediator for the impact of decoding on reading comprehension. This study is significant as it was the first longitudinal investigation that studied decoding and vocabulary simultaneously. However, future research is needed to include more reading comprehension measures, like passage auditory comprehension, grammar comprehension, and inference making, to get a more comprehensive understanding of contributors in Chinese children's reading development.

In another longitudinal study (Hulme et al., 2019), participants were recruited at Grade 1 (7 years old at Time 1) and were tracked for their performance in character naming, morphological construction, and vocabulary definition skills every six months (Times 2, 3, 4, and 5). The study revealed that the ability to recognize characters at an early age among 7-year-old children in mainland China, phonological awareness, and visual discrimination skills. Vocabulary and reading shared a reciprocal relationship; that is, vocabulary predicted initial character recognition and initial character recognition predicted growth in vocabulary. Vocabulary had an impact on both character recognition and morphological awareness, and relevant vocabulary knowledge could potentially exert a significant impact on the development of early reading abilities. The impact of

vocabulary knowledge on the relationship between morphological awareness and word reading in primary school students was also investigated by Tong et al., (2017), who revealed that the connection between morphological awareness and Chinese word reading was influenced by vocabulary in Hong Kong. In addition, it was discovered that vocabulary knowledge plays a significant and separate role in mediating the effects of social economic status (SES) on children's reading achievement by the end of third grade (Zhang et al., 2013). This implies that there are indirect influences of SES on reading skills through vocabulary among Chinese school-aged children. The findings from these studies suggest that the impact of children's vocabulary knowledge on reading abilities might be more pronounced in Chinese compared to alphabetic languages due to the greater semantic transparency present in Chinese orthography.

2.1.2.5 Rapid automatized naming.

Rapid automatized naming (RAN) refers to the ability to quickly name aloud a series of familiar items and is significant corelated with the ability to recognize Chinese characters and age among young readers with different levels of proficiency (McBride-Chang & Ho, 2000b). RAN is primarily associated with the capacity of children to streamline information processing for efficient recall, which can support quick and accurate whole word reading or reading fluency. RAN tests generally show four types of items: objects, colors, letters or numbers. The previous analyses of the correlation between RAN and reading in Chinese have primarily concentrated on the speed of lexical retrieval for alphabets and numerals (e.g., Shu, et al., 2003; Tong et al., 2009). Both the time children need to name the items and their accuracy are recorded. RAN was found to identify disparities in reading abilities among individuals within different regions of

China (Shu, Meng, & Lai, 2003), so that it could guide recommendations for teaching reading skills more effectively. RAN deficiency appears as one of the core deficits of developmental dyslexia in both studies of Chinese and English learners (Yang et al., 2019). Chinese dyslexic readers exhibited notable difficulties in orthographic knowledge and RAN (Ho, Yau, & Au, 2003). For example, a 6-year longitudinal study (Lei et al., 2011) investigated the early cognitive predictors of reading disabilities in Chinese children from Beijing, and growth mixture modeling was used to identify the developmental profiles for children's reading abilities. Children were divided into four categories based on their language-related abilities, as well as their accuracy and fluency in reading words: (1) the control group consisting of typically developing children, (2) a catch-up group characterized by initially lower cognitive performance but subsequent improvement in word reading skills, (3) a group with delays in both literacy-related cognitive abilities and word reading proficiency, and (4) a group with delayed language development showing relatively low performance across all tasks. Phonological awareness, morphological awareness, and RAN were identified as key factors that have a significant impact on the reading development of children in later stages. However, the specific connections between RAN and Chinese character recognition in typically developing kindergarteners and primary school children have not been definitively proven. Whether there is a strong correlation between RAN and word reading and follows a developmental pattern across ages is worthy of investigation.

2.1.2.6 The roles of multiple factors in Chinese reading development.

McBride-Chang and Ho (2000a) examined the roles of phonological awareness, vocabulary, English letter naming and RAN of objects and numbers in Cantonese-

speaking children's Chinese character recognition at 3- and 4 years old. Phonological awareness was measured in a syllable deletion task. The findings indicated that character recognition was influenced by both phonological awareness and English letter naming, even when accounting for other factors such as phonological processing skills and vocabulary abilities. Particularly, syllable deletion emerged as a primary phonological processing skill, while the predictive value of verbal memory and naming speed was significantly lower in determining unique variance in Chinese character recognition. In addition, the proficiency in recognizing Chinese characters was found to be significantly influenced by the letter knowledge of Chinese children.

In a study by Li and Shu (2009), 93 preschool children and 291 primary school children ranging from Grade 1 to Grade 3 were involved in assessments pertaining to phonological awareness, morphological awareness, RAN, visual abilities, and orthographic knowledge. Children's phonological awareness was measured in three tasks: a syllable deletion task (only for preschool children), a rime identification task (for both preschool and school-aged children) and a phoneme deletion task (only for primary school children). Children's morphological awareness was measured in a lexical compounding task (only for preschool children), a homograph judgment task (for both preschool and school-aged children) to determine whether a pair of two-character words that sounded the same had the same meaning, and a homophone generation task (only for primary school children) to generate a word that had the same or different meaning from the designated morpheme in the presented two-character word. Orthographic awareness was measured by asking children to judge whether each item was a character or not, and children's RAN for numbers was measured. Results showed that age and character

recognition were associated with phonological awareness and morphological awareness. Character recognition of preschool children mainly differed based on performance in syllable deletion and lexical compounding; however, character recognition of primary school children was closely related to their performance in rime identification, phoneme deletion, homograph judgment and homophone generation. RAN was the unique index that effectively distinguished children's character recognition skills in both preschool and school-aged children. There was no correlation between orthographic awareness and character recognition for the preschool children, indicating that preschool children had not developed a standard knowledge of Chinese characters. By contrast, after children entered primary school, their orthographic awareness and character recognition increased with grade, suggesting that orthographic awareness can serve as an important indicator of children's reading abilities.

Similarly, a cross-sectional study by Wei et al. (2014) investigated the contributions of metalinguistic awareness components in children's reading development from preschool to Grade 3. Phonological awareness for tone, onset-rime and phoneme were measured in an oddity detection task and a syllable deletion task. Morphological awareness was assessed using a test on lexical compounding and another test involving the judgment of homographs. The homograph judgment task required children to determine if two different words with a common character had identical or distinct meanings. For example, ''天 /tiān/'' was a morpheme within the composition of two-character compound words "夏天 /xià tiān/" (meaning "summer") and "蓝天 /lán tiān/" (meaning "blue sky"). Orthographic awareness was assessed by determining which option appeared more similar to a real character, using a non-character that deviated from

orthographic regularities and a pseudo-character constructed according to Chinese orthographic rules. The outcome variable, reading skill, was measured in a character naming task of 110 Chinese characters. RAN for numbers, phonological memory for nonword repetition and nonverbal intelligence were also measured. Results indicated developmental differences for the influence of orthographic awareness and morphological awareness on reading acquisition. Orthographic awareness played a dominant role in children's initial stages of learning to read (i.e., the stage of preschool and Grade 1) with its contributions decreasing with age. The significance of morphological awareness grew with the children's age, specifically from Grade 3 onwards. Phonological awareness played a significant role in predicting children's ability to recognize characters during preschool and Grade 2, but its impact was not observed in Grade 1 and Grade 3. Two skills not included in this investigation were vocabulary knowledge and syllable awareness, skills previously identified as contributors during the period of emergent literacy.

In Li and colleagues' study (2012), a comprehensive battery of metalinguistic and cognitive measures was completed by 457 Beijing children to investigate their association with word reading at preschool (K2 and K3) and early primary school (Grades 1, 2 and 3). Tasks tapped children's reading-related skills, including visual skills (visual-spatial relationships and visual memory), orthographic knowledge, phonological awareness (including syllable deletion, rime detection and phoneme deletion), RAN, and morphological awareness (including homophone judgment, lexical compounding, and word production with the target morpheme). A character naming task was employed to assess the early reading abilities of children. The findings indicated a significant

correlation between visual abilities and character recognition in preschool-aged children, whereas no such relationship was observed among primary school children. In contrast, orthographic awareness made a significant contribution to reading primarily among primary school children rather than preschool children. Both preschool and primary school children benefited from the important roles played by phonological awareness and morphological awareness in reading. However, it was observed that phonological awareness skills (such as phoneme deletion ability and rime awareness) had a lesser or negligible impact on reading for primary school children compared to their impact on preschool children. RAN served as a stable predictor for reading throughout the beginning and intermediate stages of reading development. Authors concluded that syllable awareness, knowledge of compound words, and visual skills develop before the formal instruction on characters. However, understanding of word endings (rime awareness), recognition of homophones/homographs, and familiarity with spelling patterns (orthographic awareness) require formal instruction to significantly contribute to children's reading success.

A study conducted by Wang et al. (2021) examined the impact of phonological awareness and morphological awareness, as well as the number of words containing a character and its frequency, on the development of character reading skills in Chinese preschool children. Two hundred and six kindergarten children from the second-year kindergarten (K2) were recruited, including 118 children from mainland China and 88 from Hong Kong. The children underwent two rounds of testing, with the second round taking place in their third year of kindergarten (K3). Children’s phonological awareness and morphological awareness were measured in a syllable deletion and a morphological

construction task, respectively. Nonverbal intelligence served as a control. Results showed that phonological awareness contributed to character reading at K2 only, while morphological awareness could also predict children's character reading at K3. In terms of the two character-related factors, frequency was more powerful than the number of words that contained a given character in mediating the relationships among phonological awareness, morphological awareness and character recognition. These effects of phonological awareness and morphological awareness on character recognition were more significant when the character was more frequently used and was contained in a larger number of words. The results revealed a collaborative association between metalinguistic awareness and character traits in the early stages of Chinese readers' character reading. This investigation implies that morphological awareness assumes greater significance as children gain more exposure to reading, rather than during their initial stages of learning to read. However, participants of this study came from two regions in China, mainland China and Hong Kong, with Mandarin and Cantonese as their main home language, respectively. The reliability of the findings may be compromised due to inadequate consideration of children's age appropriateness, variations in reading tasks, and lack of compatibility in test materials across the two samples.

Similarly, a 2-year longitudinal study (Wang et al., 2014) also focused on Chinese children from both mainland China (Beijing) and Hong Kong and Explored the initial indicators of challenges in understanding written text. Children with reading comprehension scores in the bottom 25% over the course of two years were categorized into the poor comprehension groups. They were then paired with a control group consisting of children whose reading comprehension score exceeded 30%. Children in

these two groups were balanced at their mothers' education levels, age, nonverbal reasoning and Chinese word reading skills at age 4. Reading comprehension, the outcome measure, was tested in both sentence comprehension (picture matching) and passage comprehension (multiple choices). The measurement of morphological awareness for children from Beijing tapped their homophone and homograph awareness. Specifically, the task of homograph awareness involved generating two additional words using one of the characters from the given two-character words (e.g., "noodles"). The first word they were instructed to create should contain a character with the same morpheme and meaning (e.g., "bread" is called "面包" in Chinese, where "面" means "wheat flour", which has the same meaning as it does in "noodles"). The second word should include a different morpheme with different meanings although they shared the same character (e.g., "面" means face, and here "面" means face). Other predictor measures included phonological awareness (syllable deletion, phoneme deletion and tone detection), grammatical knowledge for phrases and sentences, as well as vocabulary definition. A set of separate *t*-tests revealed that children in low comprehension groups from both Hong Kong and Beijing exhibited difficulties in early word reading, although they would eventually reach the same level as their peers in subsequent years. Similarly, Chinese children in both regions were differentiated based on their reading comprehension abilities by factors such as morphological awareness, vocabulary knowledge, and phonological awareness. However, while grammatical skill and lexical tone awareness played a role in distinguishing poor readers from adequate readers in Hong Kong children, they did not have the same discriminatory effect for Beijing children. This might be explained by the fact that the tonal system in Chinese Mandarin (4 tones) is

simpler than that in Cantonese (6 tones). In addition, it is challenging to obtain a solid understanding of grammar for Hong Kong children as There exists a significant disparity in their spoken language (Cantonese) and written language (Mandarin). The results suggest that the progress of reading skills in Chinese children is influenced by features specific to Mandarin.

2.2 The Reading Models

The motivation for much of the prior research into children's reading development has been to test hypothesized factors from various reading models with children learning a non-alphabetic language. In contrast, this study is motivated by the need to develop a strong understanding of the preschool language skills that support Chinese children's successful reading development. Outcomes can facilitate emergent literacy and early reading instruction and ultimately the early identification of children at-risk for dyslexia or other reading disabilities. A brief overview of some reading models is included here.

One widely recognized model is the Simple View of Reading, which was introduced by Gough and Tunmer in 1986. According to this model, reading can be defined as the multiplication of decoding and comprehension (Hoover & Gough, 1990). Consequently, there are three distinct types of reading difficulties that may arise: an inability to decode, an inability to comprehend, or a combination of both factors. Decoding refers to the ability to associate printed words (Li et al., 2021; Sun et al., 2018; Yeung et al., 2011) and nonsense words (Byrne et al., 1992) with their sounds. Decoding of regular words is a process by which children learn to identify words and word parts. In alphabetic languages such as English, it begins with an understanding that letters

symbolize the sounds in words and progresses to the ability to understand complex word parts and syllabication principles (Zevin, 2009). Attaining proficiency in reading and spelling necessitates the formation of distinct memories for each word's orthographic, phonological, and semantic components (Su & Kim, 2014). Decoding of pseudowords was found to be one of the best predictors of word recognition that differentiated poor readers from proficient readers (Ravthon, 2004).

For Chinese children, the number of recognized characters and their story comprehension level are commonly used as two indicators of children's early reading level. These two indicators correspond to the two basic components in the Simple View of Reading. Particularly, character recognition is an important part of reading comprehension at the early stages of reading and is the foundation of word decoding. In Chinese, character recognition has been commonly measured in two tasks. One assessment involves evaluating children's ability to pronounce a list of characters out loud (Li et al., 2021; Lui et al., 2021; Sun et al., 2018). Another measure includes a task where children have to determine whether written stimuli represent real or false characters. These stimuli consist of real Chinese characters, pseudo-characters that adhere to proper orthographic rules, non-characters, and random combinations of strokes (Lui et al., 2021). Character naming is considered a word decoding task because it requires the transfer of print to sound. The lexical decision task builds on children's knowledge of Chinese orthography or what a legal character looks like but not whether children can recognize a specific character including its sound, orthography and meaning.

Chinese children's reading development has been considered using factors from an alternative reading model. The word reading model known as the Dual-Route Cascaded

(DRC) Model (Coltheart et al., 2001) proposes two distinct pathways for recognizing words: (1) a lexical route to obtain the pronunciation of a specific word directly from its complete orthographic form stored in the cognitive lexicon; and (2) a sub-lexical route to translate the orthographic forms into their corresponding pronunciations based on grapheme-to-phoneme conversion (GPC). In the lexical route, specifically, it remains unclear whether the pathway from printed word is a direct to speech production or is indirect via semantic processing (linking to the meaning of the word) and finally to speech production. The DRC model, particularly the sub-lexical route, is applicable for alphabetic languages because grapheme-to-phoneme connections are explicit. Lui and colleagues (2021) summarized the decoding process of Chinese regular words and phonologically legal nonwords as the lexical route and sub-lexical route, respectively. They indicated that the orthographic recognition stage was based on a lexical route to directly recognize known or familiar printed words corresponding to known spoken words without phonological processing. A second stage, the phonological analysis stage, consists of access to a sub-lexical route to read aloud a printed stimulus according to the text-to-speech association rules of a given language. Researchers have tried to classify Chinese developmental dyslexia using the DRC (e.g., Wang & Yang, 2014). That is, children who only have trouble reading irregular words were classified as surface dyslexia or having deficits in the lexical route. Children with challenges in pronouncing non-words were categorized as having phonological dyslexia or impairment in the sub-lexical pathway. Research indicated that Chinese children exhibited a lower prevalence of phonological dyslexia compared to surface dyslexia (Ho & Siegel, 2012).

There are several connectionist models to explain Chinese word identification, which emphasize the regularity effects in the orthography–phonology mapping. In the DVC model proposed by Perfetti (2009), reading development is viewed as the interplay between decoding, vocabulary, and comprehension skills. While both decoding and vocabulary play a role in reading comprehension, this model places greater emphasis on the significant impact of vocabulary. Specifically, vocabulary not only directly contributes to understanding texts but also acts as a mediator for how decoding affects reading comprehension. Furthermore, there exists a reciprocal relationship between decoding and vocabulary in this model; readers with larger vocabularies tend to possess stronger decoding skills, while those with proficient decoding abilities are more adept at acquiring new vocabulary from written materials. Given the unique linguistic characteristics and writing systems of Chinese, it is possible that the cognitive process involved in identifying words may differ from that of alphabetic languages like English (Rayner & Reichle, 2010). Particularly, the hierarchical elements of the morpho-syllabic writing system, including strokes, radicals, characters and words, makes the process of segmenting continuous character strings complex. As reviewed by Rayner and Reichle (2010), the Interactive-Activation (IA) model (McClelland & Rumelhart, 1981) was first introduced to analyze Chinese word reading. In this model, there are four levels of processing nodes in word identification in Chinese, including the individual strokes, radicals, characters and words. Taft and colleagues (1999) extended the IA model with phonological and semantic nodes included, allowing the pronunciations and meanings of a character to be identified. The Connection Triangle Model (Yang et al., 2006) assumes that learning to acquire the meaning of written forms of words depends on three key

aspects of word - orthography, phonology, and semantics (Chang et al., 2020). In contrast to the DRC, there are two possible approaches for achieving word recognition: one involves an indirect process where print is first converted into sound and then into meaning (i.e., orthography-to-phonology-to-semantics mapping), while the other allows direct comprehension of meaning from print (orthography-to-semantics mapping), or via a combination of these processes. Yang and colleagues (2006) summarized that there are functionally two independent pathways in the Triangle model for Chinese reading. A pathway based on lexical and semantic cues facilitates the comprehension and production of written language, while a separate pathway focuses on the conversion of orthographic symbols (such as strokes, radicals, and characters) into corresponding phonological representations (including syllables, rimes, and tones). The Triangle model of Chinese reading was also applied in studies of developmental dyslexia (e.g., Yin & Weekes, 2003). The results indicated that children diagnosed with dyslexia may exhibit distinct impairments in both pathways, varying in their degree of severity.

The hypothesis of Lexical Quality (Perfetti & Hart, 2002) proposes that the extent to which a reader can understand and interpret written material is primarily influenced by the quality of their lexical representations. Lexical representations refer to the mental representations of words including their meanings, spellings, pronunciations, and syntactic rules. Based on the Lexical Quality Hypothesis, individuals possessing superior lexical representations are capable of reading and comprehending text with greater efficiency compared to those with inferior lexical representations. This phenomenon occurs due to the fact that individuals possessing well-developed lexical representations possess the ability to swiftly and precisely identify words, thereby enabling them to

dedicate a greater number of cognitive resources towards processes associated with higher-level comprehension. This hypothesis also suggests that the quality of lexical representations is influenced by various factors including exposure to language, frequency of word use, and the quality of lexical representations. Reading instruction should focus on developing students' lexical representations particularly for high-frequency words that are critical for reading fluency and comprehension.

There have been proposals for phase-based theories aimed at elucidating the developmental sequences involved in acquiring reading skills specific to Chinese language. A novel framework for Chinese word reading (Ye & McBride, 2022) proposes distinct developmental stages. The initial stage is the pre-literacy phase, spanning from ages 2 to 3. During this period, children primarily encounter Chinese characters through environmental text, such as street signs and labels on food containers at home. Statistical learning of the visual patterns of Chinese characters could be activated by incidental exposure to environmental prints. However, their reading experiences are predominantly driven by visual-spatial and motor skills due to a lack of understanding of the writing system. The following phase involves the phonological and morphological aspects, occurring between ages 4 to 5. Children begin to comprehend the connection between spoken Chinese and written characters, recognizing that each syllable in speech corresponds to a character or morpheme in writing. Instead of simply memorizing how characters look, individuals establish a connection between sounds (language) and characters (writing). They may also realize that characters can be broken down into functional components called radicals. This stage indicates the growth of structural understanding and acquisition of fundamental radical information in which children

employ phonological knowledge along with structural segmentation for reading. The third stage is the orthographic phase typically observed at ages 6 to 7 when formal literacy instruction begins in school settings. Children learn about regularities regarding radical positions and functions such as sound or meaning representation within characters. They increasingly rely on visual-orthographic skills in reading. The fourth stage is the transition phase usually occurring at age seven or older when children's vocabulary expands.

2.3 Summary and Purpose of the Present Research

Chinese children's reading development exhibits a trajectory that is comparable to that observed in children speaking different languages, but there are some unique features that are specific to the Chinese writing system. In Chinese, characters are ideographic and are not made up of individual letters or phonemes. Instead, each character represents a specific meaning and pronunciation. This implies that in order to achieve fluent reading skills, it is necessary for Chinese children to acquire the ability of identifying and memorizing a vast number of characters. The early stages of reading development in Chinese involve learning the basic characters and their associated sounds. This commonly happens during the initial years of primary school, where young students acquire the ability to comprehend basic written materials and progressively expand their lexicon. Once children have a basic understanding of characters and their meanings, they can begin to learn how to read longer texts and understand more complex sentence structures. Reading comprehension has not yet become a key focus until children reach the later primary school years, when children are expected to understand and analyze

more complex texts. Therefore, the current investigation places emphasis on the initial phases of reading development in Chinese children, with a particular focus on their abilities to read characters and words. It is important to identify the correlates of these early reading skills, which would help young children to recognize the sounds that make up different characters and facilitate their ability to read fluently in later reading activities.

The skills that make up emergent literacy in English, which are letter knowledge, phonological awareness, morphological awareness, and vocabulary, are well-established. These emerging skills in literacy have a strong correlation with and serve as an indicator for future achievements in literacy (Dickinson, 2011; Kuo & Anderson, 2006). Because of this well-established relationship, investigators, educators, and clinicians have developed parent and teacher training programs aimed at supporting these early skills. Results from these investigations suggest that it's necessary to strengthen preschoolers' emergent literacy in both outside-in or code-based skills (i.e., vocabulary) and inside-out or meaning-based skills (i.e., phonological awareness) through developmentally appropriate activities, which are closely related to curricular goals within a developmental framework (Foorman et al., 2002; Girolametto et al., 2012). However, in Chinese, there are far too few studies on the correlated skills to draw such certain conclusions. Additionally, the correlated skills that have been investigated and determined to significantly influence Chinese literacy acquisition such as phonological awareness (e.g., Lin et al., 2020; McBride-Chang et al., 2004; Shu et al., 2008) and morphological awareness (e.g., Deacon et al., 2014; Lin et al., 2019), have primarily been investigated with primary school children after formal instruction has been initiated, not

with children in their preschool years. Much of the available research regarding the impact of metalinguistic awareness on the initial reading progress of Chinese youngsters has concentrated on children speaking Cantonese and acquiring the ability to comprehend traditional Chinese characters in Hong Kong (Dulay et al., 2021).

This investigation will contribute to a more complete picture of emergent literacy given the disparate findings and varying experimental tasks of previous investigation into the early reading skills of children speaking Mandarin. For example, phonological awareness could be measured in terms of knowledge of a variety of phonological components at different levels, including onset, rime, tone or syllable. There are few standardized tests for children's reading skills in China, which makes it difficult to assess children’s reading performance with a comprehensive score. The Report of the National Reading Panel (NRP; National Institute of Child Health and Human Development [NICHD], 2000) concluded that the most effective reading education for children in the United States who are acquiring English literacy involves explicit teaching in five key domains - phonemic awareness, phonics, fluency, vocabulary development, and comprehension. It is still unclear whether these same areas will be key for Mandarin-speaking children in China learning to read. Moreover, due to the unique characteristics of the Chinese language system, it is highly probable that the foundational skills required for reading development in Chinese differ from those in English. Two candidates for differences are syllable-level phonological awareness (e.g., McBride-Chang et al., 2005; Zhang et al., 2017) and morphological awareness of lexical compounding (e.g., McBride-Chang et al., 2005).

Systematic literacy education is introduced to children in the first grade of primary school, marking a crucial stage for their character recognition and the development of associated skills including phonological awareness, morphological awareness, Chinese character recognition, and vocabulary knowledge. Additionally, since there is some evidence suggesting that these fundamental reading-related skills start to develop during preschool years, the present study also aims to investigate these skills in preschool children and compare their performance with that of first-grade children. This dissertation, which aims to investigate emergent literacy development of Chinese preschoolers and early school-aged children, is timely and needed to support educators and speech-language professionals who wish to develop programs designed to foster the skills most important for Chinese literacy learning. Outcomes from this study could lead to prescriptive intervention goals for improving children's reading abilities and identifying those with reading difficulties.

2.4 Research Questions

1. How do Chinese children in their second year of kindergarten compare with Chinese children in first grade primary school in their performance on measures of emergent literacy and early reading skills?

2. What are the correlations among emergent literacy skills (i.e., the metalinguistic skills of phonological awareness, morphological awareness, and orthographic awareness, as well as oral language skills of RAN and vocabulary knowledge) and early reading skills (character naming and word recognition) for Chinese children in their second year of kindergarten?

3. What are the correlations among emergent literacy skills (i.e., the metalinguistic skills of phonological awareness, morphological awareness, and orthographic awareness, as well as oral language skills of RAN and vocabulary knowledge) and early reading skills (character naming and word recognition) for Chinese children in the first grade of primary school?

4. Are there differences in the emergent literacy skills that are correlated with early reading skills for the kindergarten children compared to the primary school children?

2.5 Research Hypotheses

For each of the above research questions, the following hypotheses and rationales are proposed:

1. The aim of research question one is to collect descriptive performance data given the study measures and compare children's performance between two groups. It was hypothesized that Chinese children's performance in emergent literacy as well as character naming and word recognition ability would be significantly higher for children in first grade primary school when compared to children in the second year of kindergarten. Therefore, Chinese children in first grade primary school would perform better on all measures of emergent literacy and early reading than those of Chinese children in their second year of kindergarten. A few studies have demonstrated that developmental changes in emergent literacy skills might not be linear (Guan et al., 2020). For example, the three key components of metalinguistic skills, phonological awareness, orthographic awareness and morphological awareness were found to develop with the

greatest growth during the first three years in primary school but then the development of phonological awareness slowed down, compared to substantial growth after the fourth grade for orthographic awareness and morphological awareness (e.g., Berninger et al., 2010). Therefore, findings suggest that children's growth in emergent literacy skills would not decelerate or even reach a plateau until the third grade.

2. The hypothesis for question two was that for children at the second year of kindergarten, children's performance in early reading skill of character naming would be positively correlated with phonological awareness, morphological awareness of lexical compounding, vocabulary knowledge, and RAN. However, no correlations among emergent literacy skills and word recognition were hypothesized. The contributions of phonological awareness and RAN to preschool children's character naming have been found in previous research (e.g., Li & Shu, 2009; McBride-Chang et al., 2004). In terms of preschool children's morphological awareness, lexical compounding awareness has been found to develop early, prior to character instruction, and to contribute to children's character naming (e.g., Shu et al., 2008). Homophone awareness, however, relies on formal instruction to ultimately contribute to children's reading success (Li et al., 2012). Therefore, among the three measures for morphological awareness, only lexical compounding awareness would relate to children's character naming in the second year of kindergarten. The evidence on the relationship between preschool children's vocabulary knowledge and character naming is scarce. However, since character naming involves the process of decoding Chinese print and relies on vocabulary knowledge according to the Decoding-Vocabulary-Comprehension (DVC) model (Perfetti, 2009), the impact of vocabulary on character naming is expected. Earlier studies have shown no

significant association between orthographic awareness and character naming among preschool-aged children (Li & Shu, 2009), indicating that preschool children have not yet developed a basic knowledge of Chinese characters prior to formal instructions. Another early reading skill, word recognition, involves word-level reading of Chinese print. The word recognition skills of preschool children are expected to be limited as they have not yet begun learning individual characters, which are then combined to form words. Therefore, the relationship among emergent literacy and word recognition would not be identified for children at the second year of kindergarten.

3. The hypothesis for question three was that for children in the first grade of primary school, children's performance in early reading skill of character naming would be positively correlated with phonological awareness, vocabulary knowledge, and RAN, and their performance in early reading skill of word recognition would be positively correlated with morphological awareness, orthographic awareness, vocabulary knowledge and RAN. Previous research has found that the metalinguistic skills are closely associated with Chinese children's character naming (e.g., Dulay et al., 2021; Georgiou et al., 2020; Wei et al., 2014). Children's vocabulary knowledge and RAN also have effects on character naming for children at Grade 1 (e.g., Hulme et al., 2019; Yan et al., 2021). The Connection Triangle Model (Yang et al., 2006) suggests that children's word recognition in Chinese involves their ability to integrate knowledge of morphology, orthography, and semantics. This integration typically occurs as children are exposed to a larger vocabulary after starting school. RAN, which involves children's lexical access to spoken language, is closely associated with word-reading fluency. Therefore, there would be positive correlations among word recognition and morphological awareness,

orthographic awareness, vocabulary knowledge and RAN for children at the first grade of primary school.

4. The fourth research question was whether the relationship among children's early literacy skills and early reading skills would differ at the two different ages/stages. It was hypothesized that the correlations among morphological awareness and vocabulary knowledge on character naming and word recognition for the first-grade children would be stronger than those for kindergarten children. This hypothesis could find support in previous studies that have shown the increasing significance of morphological awareness (e.g., Wang et al., 2021; Wei et al., 2014) and vocabulary knowledge (e.g., Tong et al., 2017; Yan et al., 2021) as children's reading experience expands following their enrollment in school.

CHAPTER III

METHOD

3.1 Participants

Power analysis was used to determine the sample size required to detect a meaningful effect or difference between groups in this proposed study. As summarized by a meta-analysis (Dong et al., 2020), medium correlations were found among metalinguistic awareness and children's reading performance. The power analysis suggested that a group size of 24-38 would be appropriate for detecting a medium effect size (0.35). Based on these parameters, a total of 66 children from two grade groups participated. One group consisted of 35 preschool children from the second year of kindergarten in Fuzhou, China. Children in this grade, 21 boys and 14 girls, were typically 5 years old with a mean age of 63.4 months (*SD* = 3.59) and in the second half of the academic year. In China, the second year of kindergarten is typically attended by children who are 4 ½ years old or not yet turning 5 at the start of the school year. It can be considered similar pre-kindergarten in the U.S., also known as "pre-K" or "preschool," which often serves children before they enter kindergarten. The availability and enrollment in pre-kindergarten programs can vary by state and school district. The third year of kindergarten in China is similar to traditional kindergarten in the U.S. The second group in the present study was 31 children, 17 boys and 14 girls, from Grade 1 in a

primary school in Fuzhou, China. The average age of Grade 1 children was 7 years old (M = 86.4, SD = 4.72) in the second half of the school year. Participants were recruited via two cooperating local schools, one kindergarten and one primary school in Fuzhou. Both schools were affiliated with Minjiang Normal College in Fujian Province and were housed in the same district.

Children who met the following eligibility criteria were included in this study:

1. All the participants spoke Chinese Mandarin as their main home language, as reported by their parents (Note that some children in Fuzhou City could also speak Fuzhou Dialect at home, and school-aged children do not learn English formally as a course until they reach Grade 3 in primary school).

2. Participants had language skills within normal limits according to the Child and Family History Questionnaire.

3. Participants had no hearing impairment as reported by the parents.

Demographic information, children's language background and development as well as family history were obtained across all participants and used for descriptive purposes, including: child age and gender, racial/ethnic group, parental education level and parental occupation(s). This information was collected using the Child and Family History Questionnaire (see Appendix A). There was no statistical difference in both mother's education levels and father's education levels between the two grade groups (as shown in Table 1). However, there is a notable variation in the parental educational levels of the sampled children, ranging from high school or below to college and even graduate levels. The distribution of educational levels for both mothers and fathers of the children is illustrated in Figure 2. There were no significant group differences in educational

levels, there was much variation in levels within groups that warranted parental education being considered as a control.

Table 1. Demographic information for participants in kindergarten and primary school.

Measure	K2 (n = 35)	G1 (n = 31)	t
	M (SD) Range	*M (SD) Range*	
Child's Age (in months)	63.4 (3.59) 57-70	86.42 (4.72) 70-93	22.43**
Education Level (in years)			
Mother	14.83 (2.43) 9-19	14.48 (2.19) 9-16	0.60
Father	14.63 (2.97) 9-22	14.58 (2.32) 9-19	0.07

Note: **$p < .01$.

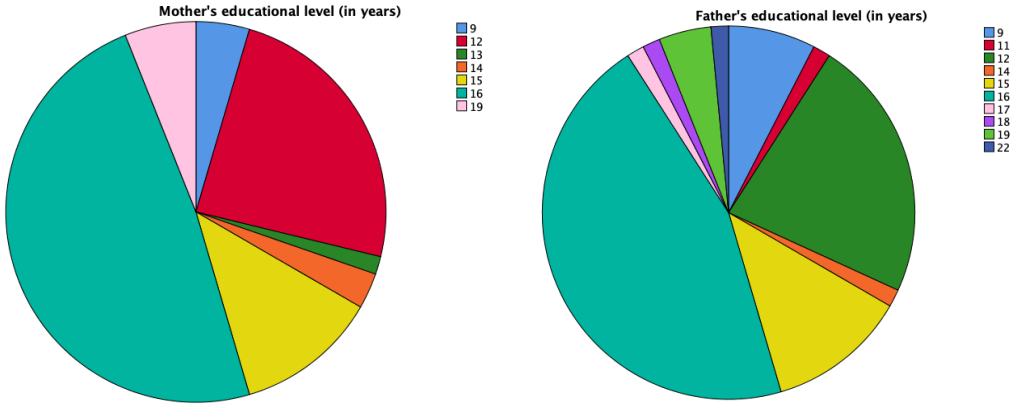

Figure 2. Pie charts for the distributions of mothers' and fathers' education levels.

3.2 Measurement

3.2.1 Phonological awareness (PA)

There were four phonological awareness tasks described in the literature, including syllable awareness task, onset-rime awareness task, phonemic awareness and tone awareness tasks (e.g., Lin et al., 2020); however, only the syllable awareness task was given, because the unique importance of syllable awareness in Chinese children's reading development at preschool age and first grade (e.g., Li et al., 2012). Following methods from previous research (e.g., Lin et al., 2020), children were presented with 15 real three-syllable Chinese words and asked to delete either the first, middle or last syllable (as shown in Appendix B). For example, the examiner stated: "幼儿园 /yòu ér yuán/, meaning kindergarten" and the child was expected to repeat exactly "/yòu ér yuán/". Then the examiner said, "Now say 幼儿园 /yòu ér yuán/ without the "儿 /ér/" deleting in "幼儿园 /yòu ér yuán/." A correct response was one in which the child deleted the target syllable and produced the remainder of the word correctly.

3.2.2 Morphological awareness (MA)

Morphological awareness in the aspect of lexical compounding (e.g., Li et al., 2012; Wang et al., 2006) and homophone knowledge (e.g., Kuo & Anderson 2006; Liu et al., 2013) have been found to be closely correlated with Chinese children's reading development from kindergarten to the first three years of primary school. Lexical compounding taps children's compound morpheme awareness and represents morphological awareness at the lexical level. Homophone awareness, which represents a

higher level of morphological awareness, taps children's knowledge and manipulation of homophones that have different meanings in both spoken and written language. Accordingly, three tasks were administered to measure young children's morphological awareness.

3.2.2.1 Lexical compounding awareness.

Due to the widespread use of lexical compounding in the acquisition of Chinese vocabulary by novice readers, which usually involves recognizing that Chinese words are comprised of two or more morphemes, the lexical compounding test was used to measure children's awareness of compound morphemes (e.g., Dulay et al., 2021; Wang et al., 2021). As shown in Appendix C, children were given a verbal description of an object or concept in three sentences, and then they were prompted to create new compound morphemes for the described object or concept. For example, "有一种果汁是用橙子做的；我们叫它橙汁。那么我们怎么称呼一种由苹果制成的果汁呢?" ("There is one type of juice made from oranges; we call it orange juice. What would we call a type of juice that is made from apples?") The test consisted of 3 trial items and 10 test items. The answers to the questions were compound morphemes that consisted of two or three morphemes, and scoring had three levels (i.e., 2, 1, 0) according to whether children have included the key morphemes and the accuracy and conciseness of the word structure. For example, 2 points for "苹果汁 (apple juice)", 1 point for "苹果的汁" or "苹果果汁" ("juice of apples"), and 0 points were awarded for the inclusion of irrelevant morphemes that did not significantly contribute to the overall meaning of the sentence.

3.2.2.2 Receptive awareness of homophones.

The investigator created a homophone judgment task to measure children's homophone awareness in written language. Children were required to circle the correct morpheme from two that share the same sound to form a word (as shown in Appendix D). For example, for the item "童/同 话", children needed to choose from the two morphemes ("童" and "同") having the same sound /tóng/ to form a correct word "童话" (means "fairy tales"). There was a total of 30 items. These items were chosen is because they are frequently used homophones in the first-grade textbook. If children could not recognize the words, they were required to guess.

3.2.2.3 Expressive awareness of homophones.

The homophone generation task was used to measure children's homophone awareness in spoken language (Li et al., 2012). As shown in Appendix E, the target morpheme was presented orally in a word, and children were initially prompted to utilize the target morpheme to create a word as an assessment of their understanding of that particular morpheme. Then they were required to list the morphemes that had the same sound as the target morpheme and use those homophones to form as many words as possible. For example, "糖果 /táng guǒ/, candy", which contains the target morpheme of "糖 /táng/", was required to be tested on the word group with the same pronunciation as "/táng/", such as "食堂 /shí táng/, canteen", "池塘 /chí táng/, pond", etc. The instructions were, "Say words that have the syllable '/táng/' with the same sounds as the morpheme '糖 /táng/' in the word '糖果 /táng guǒ/'. You can answer by using the morphemes to form as many words as you can." The test consisted of 2 trial items and 8

scored items. There was a time limit of 40 seconds for each item, and each correct answer was worth 1 point.

3.2.3 Orthographic awareness (OA)

As one of the most commonly used measures for Chinese orthographic awareness, the character judgment task is a comprehensive measure to tap children's knowledge of the basic form of components that make up a single character as well as the position and combination rules of character components. Therefore, a character judgment task (shown in Appendix F) adapted from Liu and Zhu' study (2016) was used in this study to measure children's orthographic awareness. Fifty items were visually presented, and children determined whether the item was a real character or not. Specifically, children crossed out non-characters from a list of real and nonsense characters. There was a total of 50 items, including 25 real characters and 25 non-characters. Two types of non-characters were included in the task: (1) 15 pseudo-characters that followed legal orthographic rules: either had a semantic radical and a phonetic radical in incorrect positions, or the combination of the two radicals did not form a valid character even when placed correctly; (2) 10 random stroke combinations that neither formed any radicals nor followed any orthographic conventions. All items were balanced in terms of the number of strokes and the internal figuration (e.g., singular structure, top-down structure, left-right structure, etc.). Each correct judgment was worth 1 point.

3.2.4 Vocabulary knowledge

Children's vocabulary knowledge was measured with the Chinese version of the Peabody Picture Vocabulary Test-Revised (PPVT-R; revised by Sang & Miu, 1990). PPVT-R is an individually administered norm-referenced test that could be used to

measure single-word receptive vocabulary skills for children aged from 3 years and 6 months old to 9 years old. In the test, the investigator said a word and children then pointed to a matching picture from a set of 4. Instructions presented in the test manual were followed. There were three trial tests before the formal test and a total of 120 items in the formal test. The first item, or starting point, was determined based on the child's age. Typically, the test started with the 20th question if the child is 4 to 5 years old (for kindergarten children in this study) and started with the 30th question if the child was above 6 years old (for primary school children in this study). If children could not make a choice for a specific word within 30 seconds, it would be counted as a mistake. From the starting point, 8 or more correct responses before making an error established a basal. Testing then continued forward until the child made six errors within eight consecutive items. However, if an incorrect response occurred before achieving 8 consecutive correct answers, testing would move backwards to the previous item and continue until 8 consecutive correct responses were obtained. A ceiling was reached when six out of eight items were answered incorrectly consecutively. The assessment concluded once both basal and ceiling levels had been established. A child's score was determined by the number of correct responses up to the highest achievable level. The scoring sheet for PPVT-R can be seen in Appendix G.

3.2.5 Rapid automatized naming (RAN)

Considering that the current body of evidence regarding the correlation between RAN and the early reading development of Chinese children primarily concentrates on the speed at which numbers are accessed lexically (e.g., Chow et al., 2005; Liu & Zhu, 2016; Tong et al., 2009), a rapid number-naming task was used to test children's ability of

rapid access to spoken language. Children were given a sheet of paper containing a series of five numbers: 1, 3, 4, 6, and 9. The task involved arranging these numbers randomly in five rows on the paper, resulting in a total of 25 numbers (see Appendix H). The children's objective was to quickly identify and state all the 25 numbers consecutively, starting from the first number in the first row and ending with the last number in the final row. A stopwatch was used to record the response time to the nearest hundredth second (i.e., .01). Children's accuracy of number naming was also recorded.

3.2.6 Early reading skills

The early reading skills that were targeted in the present study were part of the decoding process rather than higher-level comprehension process for more complex written materials like sentences and passages. At the early stages of reading development, the primary focus of preschool children and early school-aged children is decoding written items to make the orthography-to-phonology association. Therefore, two tasks were used to measure children's early reading skills for decoding both at the character or sub-lexical level and word level.

3.2.6.1 Chinese character naming task.

Children were asked to read aloud a list of 50 written single characters, arranged in ascending order of complexity. These characters were selected from a Chinese textbook for the first grade in primary school and the difficulty and frequency of these characters were assessed by the kindergarten teachers and teachers in the lower grades of the primary school to ensure that most children could recognize them (see Appendix I). The children had to read left to right and top to bottom. Given that characteristics of characters, for example, their stroke number, could affect children's performance in

character reading (Li et al., 2016), characters were balanced in the number of strokes, the configuration (i.e., unitary structure, top-down structure, left-right structure, or semi-/fully-enclosed structure). Each correct reading is worth 1 point.

3.2.6.2 Word recognition task.

To assess children's word level reading, not just character or a sub-lexical skill, a word recognition task was created and administered. The task was paper-and-pencil administered in the classroom. As shown in Appendix J, for each item, children saw a picture of the referent (e.g., a bowl of rice) and hear the word, "米饭" (means "rice"). Children were expected to circle the correct two-character written word from two choices (e.g., "米饭" vs. "开水", meaning "boiled water"). There was a total of 15 items, and items were selected from the most commonly used Chinese words. As with the character naming task, the word stimuli were evaluated by kindergarten and primary school teachers to ensure they were suitable for children at the initial stage of reading development. Similarly, the difficulty of these two-character words was assessed by kindergarten teachers to make them appropriate for kindergarten children to recognize.

3.3 Procedures

IRB approval (see Appendix A) was obtained prior to the study and additional permissions were obtained from cooperating schools. For participant recruitment from the cooperating kindergarten, there were two classes from the second year who participated. The final preschool sample included 31 children from Class 1 and four children from Class 2. For the cooperating primary school, four classes from the first grade were approached originally. There were approximately 55 students in one class,

and the final primary school sample were 31 students, including 4 children from Class 2, 6 children from Class 5, 18 children from Class 6, and 3 children from Class 7. Parents of children in this study signed the consent form before data collection, and then parents were asked to complete the Child and Family History Questionnaire (see Appendix B). There was an average of four days from the day of consent or participant enrollment to data collection. In the test session, the character judgment test, homophone judgment test and word recognition test were administered by the primary investigator in groups centrally in the arranged separate classroom, and children who were enrolled participated. There were two group test sessions for kindergarten children with 17 or 18 children in each session, and one group session for all the 31 children from primary school. Each group session took around 16 minutes. The primary investigator recorded herself giving the instructions, administering the task to the participants for later verification as needed. Individual tests (i.e., syllable deletion test, lexical compounding test, homophone generation test, vocabulary knowledge test, RAN test and character naming test) were administered one-to-one in a quiet classroom arranged by the school. Four university students, who were native Chinese speakers, were trained by the primary investigator to serve as witnesses, reliability raters, and assistants for administering the individual test tasks. A minimum of 20% of the individual tests were conducted by university students who were witnessed. Two trained students worked in pairs to score the same child and then the final decision was made for each test. The sequence of tests administered to each group of children was balanced to avoid test-order bias or to protect against fatigue. Specifically, the paper tests were sorted out and bound in random order, and the bound test sets were then randomly selected when each child was tested. Each set

of individual tests took about 15-25 minutes. Considering that not all parents agreed to record the test process as reported in the consent form, only the tests for children whose parent were consenting to recording were recorded.

3.4 Reliability

To ensure that the scoring of the tests was accurate, 20% of the data were randomly selected to be re-scored for reliability checks, of which 10% were checked for intra-rater reliability and the remaining 10% were checked for inter-rater reliability. Two research personnel, one English-speaking graduate student and the other a Chinese-speaking doctoral student, who were both blind to the study purposes, completed the inter-rater reliability check for group tests and individual tests, respectively. The intra-rater reliability of the group tests was conducted by re-checking the written answer sheets against the reference answers. The intra-rater of the individual tests was conducted by reviewing the recorded videos and re-checking the scoring sheets. Additionally, the investigator repeated scoring 10% of data for the purposes of inter-rater reliability. The reliability scores were counted item by item, which equals to dividing the number of total agreement items by the sum of the total agreement items number plus the total disagreement items number. The intra-rater reliability of the group tests and individual tests were 99.58% and 99.92%, respectively. The inter-rater reliability of the group tests and individual tests were 99.79% and 99.92%, respectively.

CHAPTER IV

RESULTS

SPSS 26.0 software was used to organize and analyze the data. The syntax for each statistical test is shown in Appendix K.

4.1 Descriptive Results for Chinese Children's Emergent Literacy and Early Reading

The descriptive statistics for children's emergent literacy and early reading skills in two grade groups are presented in Table 2, including the means, standard deviations, ranges and 95% confidence intervals. Additionally, box plots were used to illustrate and the performance of children on each measure of emergent literacy and early reading skill (as shown in Figures 3 to 12). These box plots provide an initial visual assessment of the distribution and central tendencies of emergent literacy and early reading skill scores among the two grade groups.

Table 2. Descriptive statistics for 8 emergent literacy measures and 2 early reading skills.

Measure	K2 (*n* = 35)		G1 (*n* = 31)	
	M (SD) *Range*	95% *CI*	*M (SD)* *Range*	95% *CI*
Syllable Deletion	7.34 (4.34) 0-14	[5.85, 8.83]	12.42 (2.26) 7-15	[11.59, 13.25]
Lexical Compounding	17.40 (3.09) 6-20	[16.34, 18.46]	19.61 (0.92) 17-20	[19.28, 19.95]
Homophone Generation	12.86 (4.80) 3-23	[11.21, 14.50]	28.48 (8.93) 12-46	[25.21, 31.76]
Homophone Judgment	18.00 (4.20) 11-28	[16.56, 19.44]	27.94 (2.65) 19-30	[26.97, 28.91]
Character Judgment	12.83 (5.44) 4-25	[10.96, 14.70]	21.26 (3.20) 14-25	[20.08, 22.43]
RAN Accuracy	23.34 (5.62) 1-25	[21.41, 25.27]	24.81 (0.54) 23-25	[24.61, 25.01]
RAN Response Time	26.11 (14.85) 8.84-91.18	[21.01, 31.21]	15.64 (10.68) 8.75-69.64	[11.72, 19.56]
Vocabulary	63.63 (17.91) 21-90	[59.48, 71.78]	91.58 (8.84) 56-105	[88.34, 94.82]
Character Naming	16.57 (16.26) 0-50	[10.99, 22.16]	48.23 (3.69) 35-50	[46.87, 49.58]
Word Recognition	13.23 (2.52) 6-15	[12.36, 14.09]	14.97 (0.18) 14-15	[14.90, 15.03]

Note: RAN = Rapid Automatized Naming. RAN reaction time is reported in seconds. K2 = the second year of kindergarten; G1 = the first year of primary school. CI = Confidence Interval [Lower Bound, Upper Bound].

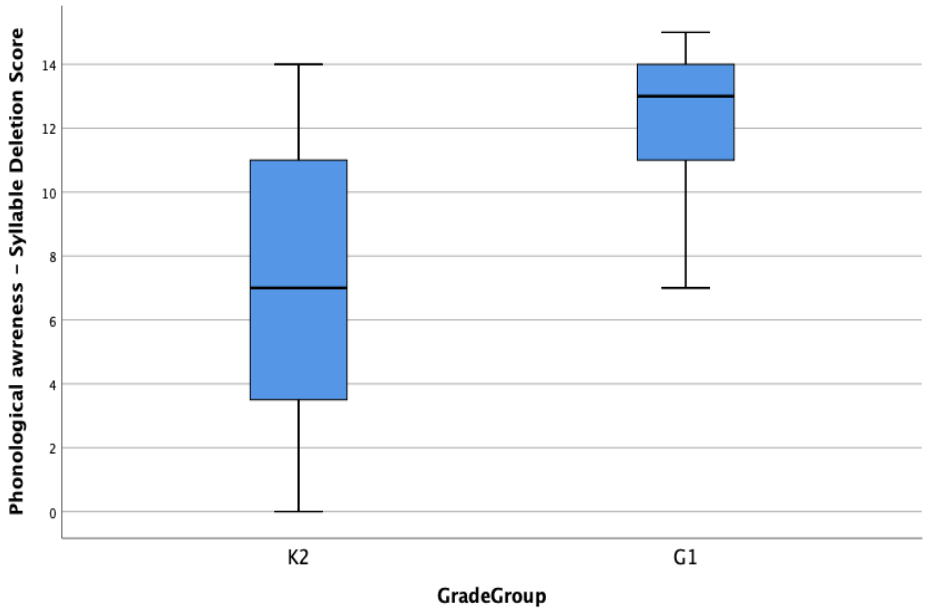

Figure 3. Box plots for Chinese children's syllable deletion scores in two grade groups.

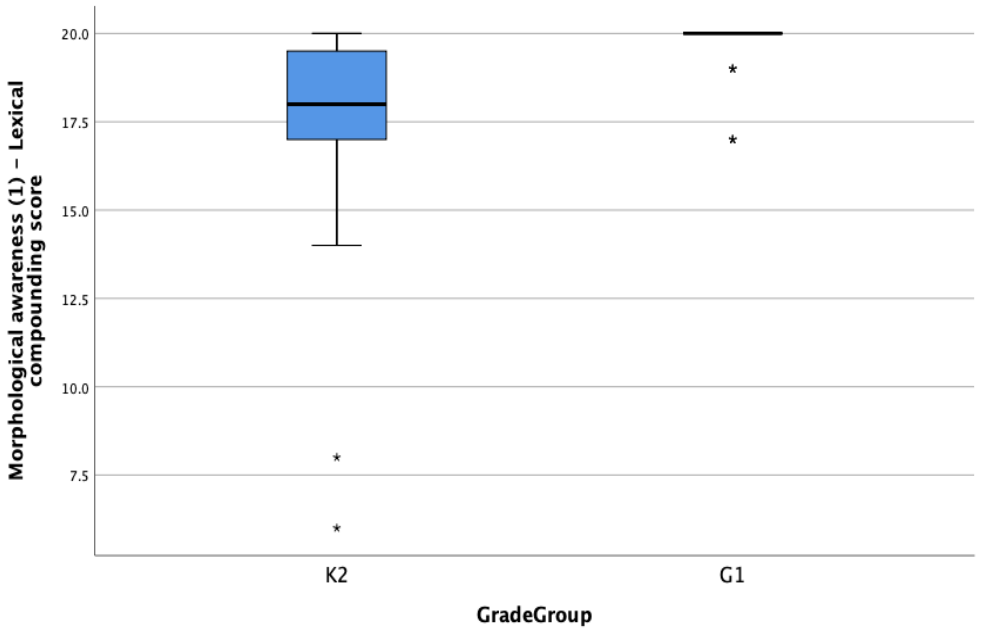

Figure 4. Box plots for Chinese children's lexical compounding scores in two grade groups.

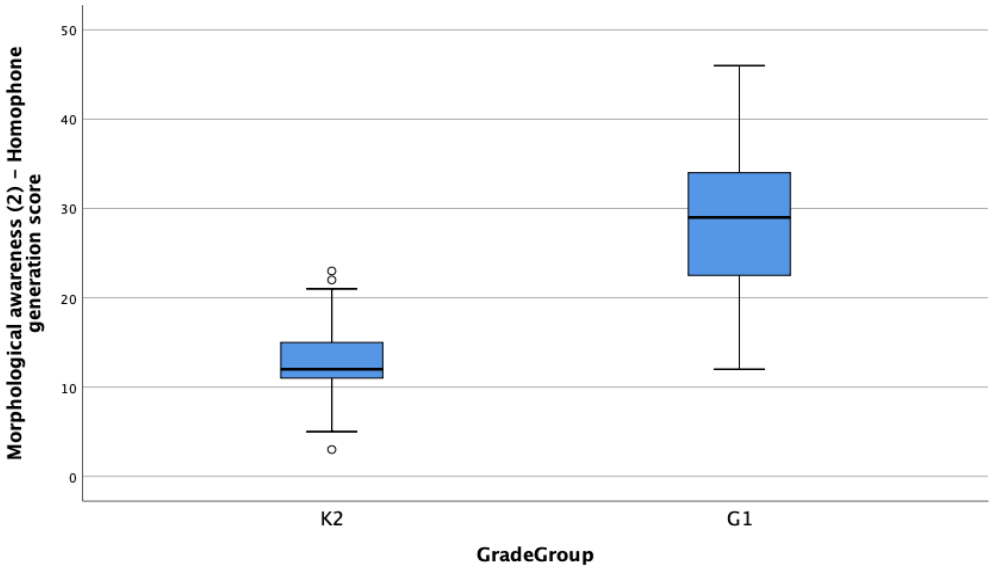

Figure 5. Box plots for Chinese children's homophone generation scores in two grade groups.

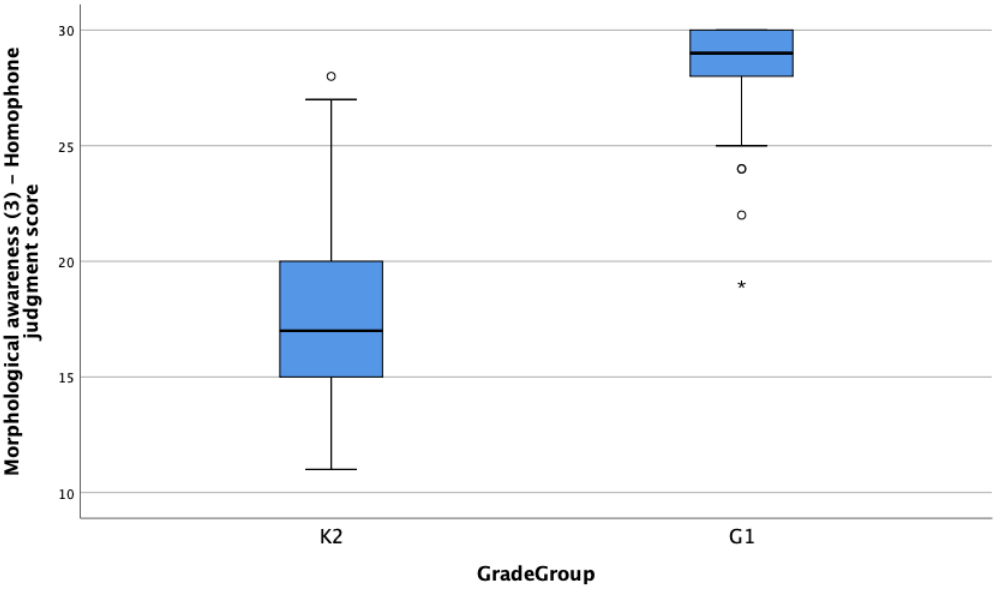

Figure 6. Box plots for Chinese children's homophone judgment scores in two grade groups.

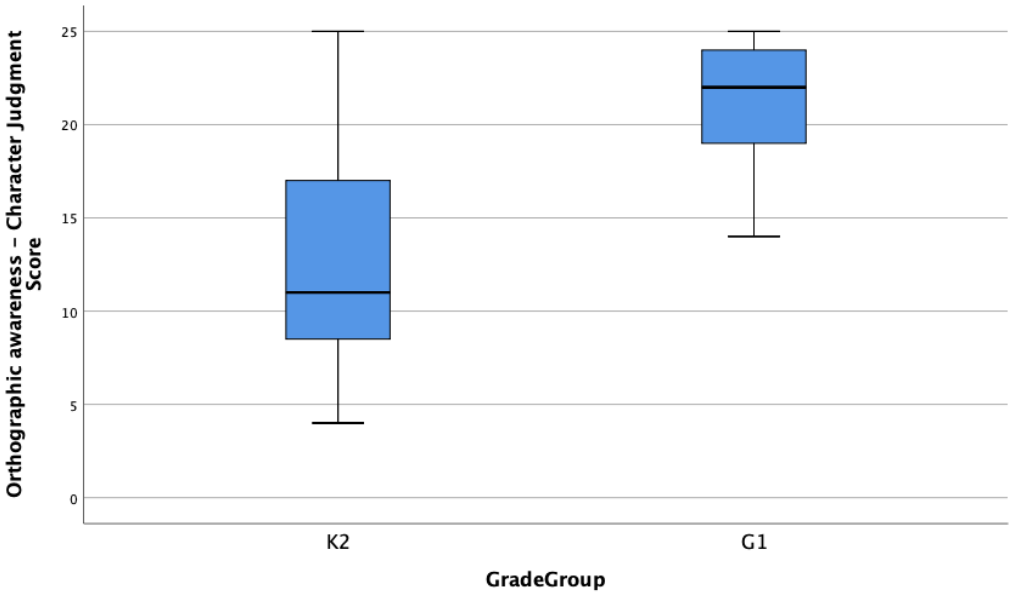

Figure 7. Box plots for Chinese children's character judgment scores in two grade groups.

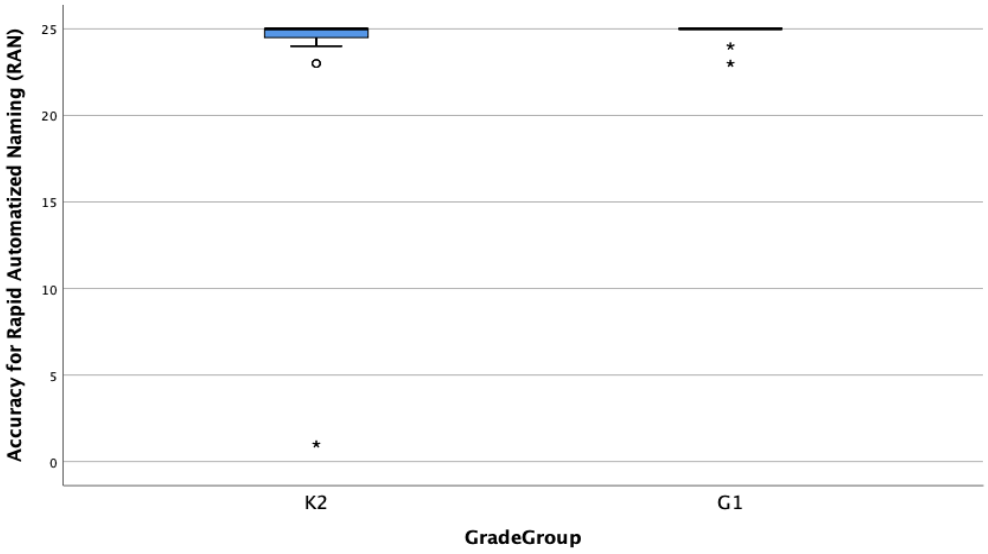

Figure 8. Box plots for Chinese children's accuracy for RAN in two grade groups.

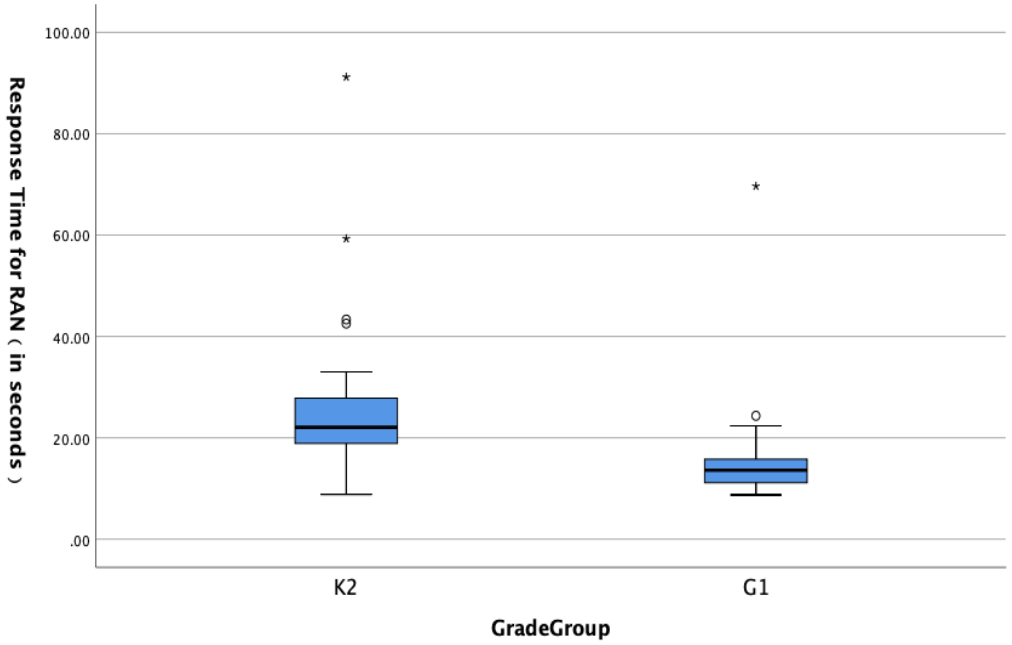

Figure 9. Box plots for Chinese children's response time for RAN in two grade groups.

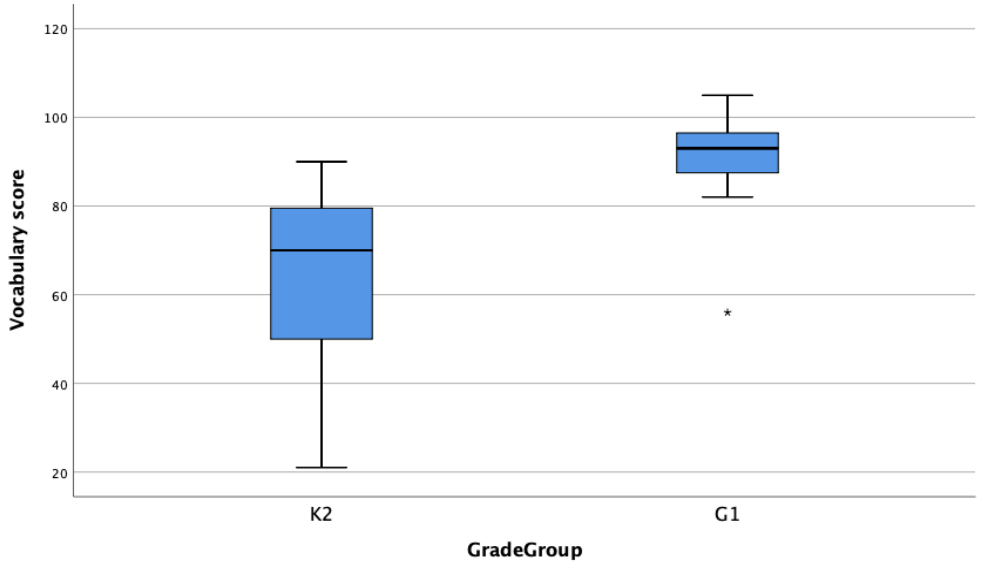

Figure 10. Box plots for Chinese children's vocabulary scores in two grade groups.

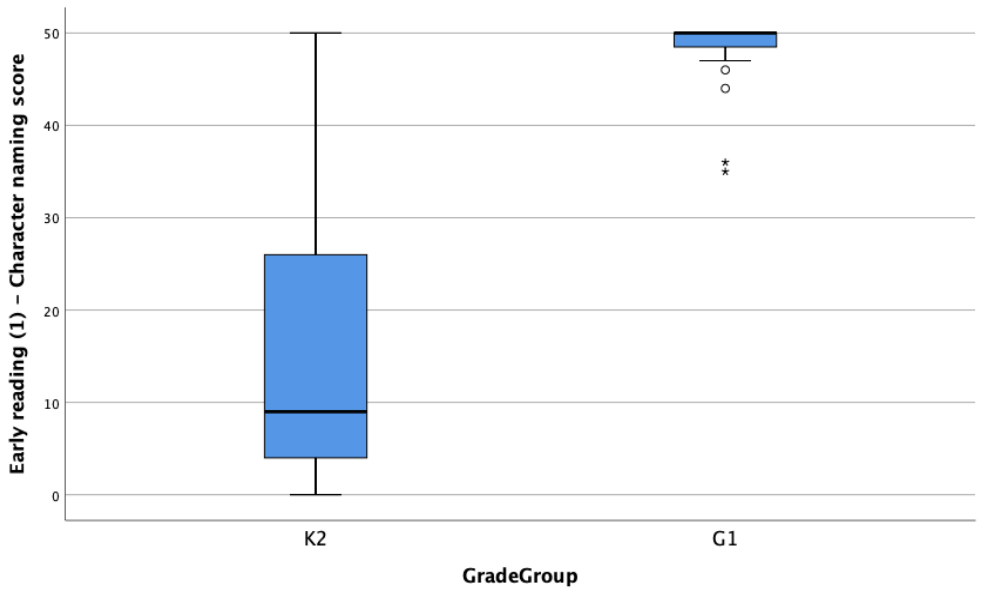

Figure 11. Box plots for Chinese children's character naming scores in two grade groups.

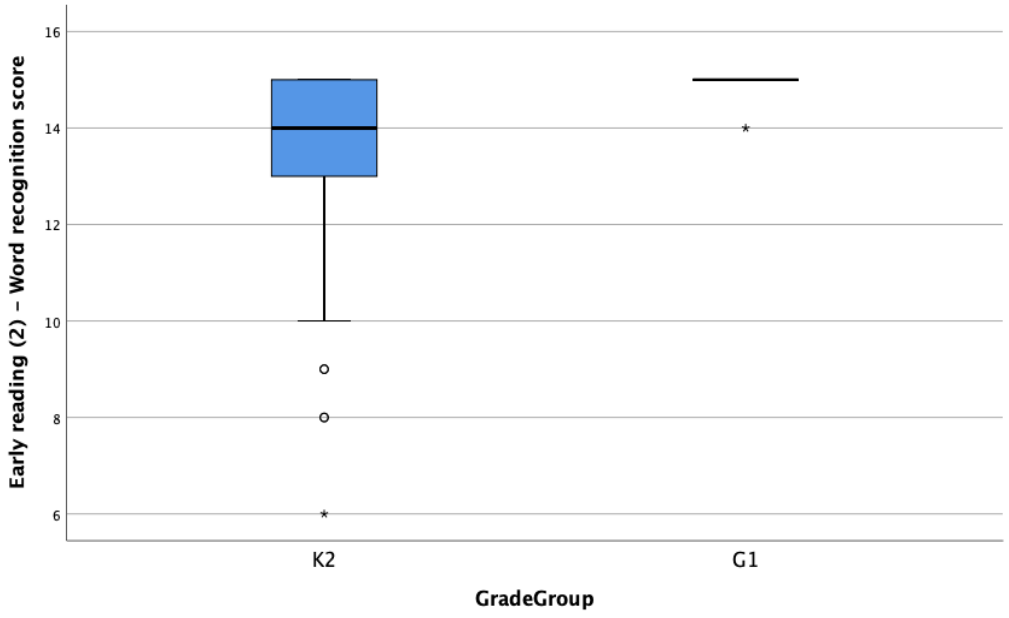

Figure 12. Box plots for Chinese children's word recognition scores in two grade groups.

Figure 3 shows children's performance in phonological awareness based on the syllable deletion task. For children at the first grade of primary school, the box plot illustrates a relatively narrow spread of syllable deletion scores, with most scores clustered closely around the median. This suggests a higher degree of homogeneity in syllable deletion scores within this grade group. In contrast, for children at the second year of kindergarten, the box plot exhibits a wider spread of scores, indicating greater variability in syllable deletion scores. In Figure 4, The majority of first-grade children achieved the highest possible scores in lexical compounding, while kindergarten children's lexical compounding scores varied. The homophone generation result was the opposite. As Figure 5 shows, although children at the first grade had notably better performance in homophone generation, their scores had a larger variation than kindergarten children. In Figure 6, children at the first grade had smaller variability than children in kindergarten, but there were 3 outliers noted below the lower whisker. Based on the data in Figure 7 and the Table 2, kindergarten children did not exhibit character judgment scores (M = 12.85, SD = 4.80) significantly higher than chance level (i.e., score = 12.5), while approximately three-quarters of the first-grade children could make 24 correct judgments out of 25 non- characters. In Figure 9, there was a large dispersion in vocabulary scores of children at the second year of kindergarten. It is obvious in Figure 11 that the performance of first-grade children in character naming was significantly higher than that of kindergarten children, and almost all got full marks. However, there were 4 first-grade children whose scores were notable below the whisker. Figure 12 illustrates that all children except one in the first- grade group got all word recognition

items correct. By contrast, there was more variability in word recognition scores of children at the second year of kindergarten.

4.2 Group differences in Emergent Literacy and Early Reading Skills

The first research question involved the comparison between Chinese children in their second year of kindergarten and Chinese children in first grade primary school on measures of emergent literacy, character naming and word recognition. Multivariate analysis of variance (MANOVA) was conducted to compare children's performance in 8 emergent literacy measures and 2 early reading skills between the two groups. MANOVA with a Bonferroni correction was chosen to control the Type I error rate when assessing multiple dependent measures simultaneously. Children's grade group served as the between-subjects variable (the second year of kindergarten-K2 versus the first grade of primary school-G1). Dependent variables were the 8 emergent literacy measures and 2 early reading measures. Additionally, the maternal education level was added as a covariate. This was because the participant description revealed a range from 9 to 19 years of education with a bimodal distribution for high school education versus a college degree. The assumption of equal variances was not met based on the small sample size and large variation within the sample data. Considering that ANOVA tests are statistically robust, data analysis continued using MANOVA.

As Table 3 shows, the results of MANOVA with a Bonferroni correction revealed a significant main effect of grade group for all measures except for RAN accuracy. Children in first grade primary school had higher scores on syllable deletion, lexical compounding, homophone generation, homophone judgment, character judgment,

vocabulary, character naming and word recognition when compared to the children at the second year of kindergarten. The difference in RAN accuracy was not statistically significant between the two groups. Only the response speed differed, with the older children naming the items in less time, i.e., faster. Additionally, maternal education level, the covariate, was statistically significant for character naming ($F = 12.658$, $p = .001$) but not for word recognition ($p > .05$). This finding suggests that variations in the maternal education level are related to children's performance in character naming.

Table 3. Multivariate ANOVA results for 10 emergent literacy and early reading measures.

Measure	*df*	*F*	*p*	Cohen' *d*
Syllable Deletion	1	37.084**	<. 001	1.468
Lexical Compounding	1	14.435**	<. 001	0.969
Homophone Generation	1	81.140**	< .001	2.179
Homophone Judgment	1	130.964**	< .001	2.831
Character Judgment	1	55.425**	< .001	1.889
RAN Accuracy	1	2.177	.145	0.368
RAN Response Time	1	10.899*	.002	0.809
Vocabulary	1	53.351**	< .001	1.979
Character Naming	1	138.123**	< .001	2.685
Word Recognition	1	15.512**	< .001	0.974

Note: RAN = Rapid Automatized Naming. *$p < .01$; **$p < .001$.

4.3 Correlations among Emergent Literacy and Early Reading Skills

To answer research question two, the relations among the emergent literacy measures and the two early reading skills for children in the second year of kindergarten were tested using correlation analysis. Two assumptions for Pearson's correlation analysis, bivariate normality and homoscedasticity were not met, so Spearman's correlation analysis was conducted. Spearman's correlation is a robust method for

assessing monotonic associations and is particularly useful when the assumptions of parametric correlation methods (e.g., Pearson's correlation) are not met. All the measurements for preschool children were included for analysis simultaneously.

The False Discovery Rate (FDR, Benjamini & Hochberg, 1995) was used to address the increased Type I error rate when a series of Spearman's correlations are performed. The FDR is a way to control the rate of false discoveries while allowing some flexibility in identifying significant results. It is usually represented as a percentage or a fraction and is typically set at a predetermined FDR level (commonly with a value at .05), denoted as "*q*." The Benjamini-Hochberg formula was used to calculate the Critical Value Threshold (q_i) for each *p*-value: q_i = (i / m) * FDR Level, where: *i* was the rank of the *p*-value in the ordered list, and *m* was the total number of correlation tests. Because there were 8 tests and an FDR level of 0.05 was chosen, the critical value threshold for the first-rank test with the smallest *p*-value (q_1) was set at (1/8) * 0.05 = 0.00625. Then the first *p*-value (p = .000013) was compared to the chosen threshold of 0.00625. Because the *p*-value was smaller than the threshold, the corresponding correlation coefficient was considered statistically significant. Subsequently, the same procedure was repeated for the second smallest *p*-value, and so forth, until all *p*-values of the test have been compared. The complete Spearman's correlation table is shown in Appendix K. Results addressing the research question are shown in Table 4. The outcome measure of character naming was positively correlated with four emergent literacy skills, including syllable deletion, lexical compounding, homophone judgment and vocabulary. These correlations were medium to large in size. The outcome measure of word recognition was also found to be positively correlated with syllable deletion, lexical compounding, and vocabulary.

These findings indicated that as children's skills increased in syllable deletion, lexical compounding, homophone judgment and vocabulary, then their early reading skills of character naming increased. Likewise, as children's skills of syllable deletion, lexical compounding and vocabulary increased, then their word recognition skills increased. Additionally, children's RAN response time was negatively correlated with character naming and word recognition. That is, as the RAN response time decreased, which indicated faster naming and improved RAN, children's character naming and word recognition increased. However, children's performance in homophone generation, character judgment and RAN accuracy were not statistically correlated with two early reading skills, character naming and word recognition (*ps* > .05).

To answer the third research question, the relations among the emergent literacy measures and the two early reading skills for children in the first year of primary school were tested using Spearman's correlation analysis with the FDR corrections. The SPSS syntax was the same as for the second research question. The Spearman's correlation table is shown in Appendix L. Results in Table 4 showed that children's performance in character naming were positively correlated with syllable deletion, homophone judgment, character judgment and vocabulary. Therefore, as syllable deletion, homophone judgment, character judgment and vocabulary increased, children's early reading skill of character naming increased. However, the first-grade children's performance in word recognition was not significantly correlated with any emergent literacy measures.

Table 4. Correlation analysis with false discovery rate corrections for children in two grade groups.

Outcome Measure	Measure	K2 (n = 35)	G1 (n = 31)
Character Naming	Syllable Deletion	.665**	.540**
	Lexical Compounding	.449*	.244
	Homophone Generation	.335	.235
	Homophone Judgment	.335*	.536**
	Character Judgment	.233	.472*
	RAN Accuracy	.228	-.092
	RAN Response Time	-.642*	-.116
	Vocabulary	.435*	.445*
Word Recognition	Syllable Deletion	.496*	.311
	Lexical Compounding	.410*	.415
	Homophone Generation	-.007	.276
	Homophone Judgment	.352	.231
	Character Judgment	.176	.227
	Accuracy for RAN	.298	-.070
	RAN Response Time	-.438*	-.163
	Vocabulary	.522**	.308

Note: K2 = second year of kindergarten; G1 = first year of primary school. RAN = Rapid Automatized Naming. *$p < .05$; **$p < .01$.

The fourth research question addressed differences in the emergent literacy skills that were correlated with early reading skills for the kindergarten children compared to the primary school children. Correlation coefficients that were significant for both groups were compared, specifically syllable deletion, homophone judgment and vocabulary with character naming. The one approach applied to testing the difference between correlations was to transform the correlations to Fisher Z scores. The Z scores were compared and analyzed for statistical significance by determining the observed *z* test statistic (Zou, 2007). Fisher's Z-score, also known as the Fisher transformation, is a statistical transformation used to stabilize the variance of the sample correlation coefficient when working with small sample sizes or when comparing correlation

coefficients. The following formula was used to calculate the *z*-score for each correlation coefficient (r) in both groups: $Z = 0.5 * \ln [(1 + r) / (1 - r)]$. After obtaining the Z-scores for each pair of correlation coefficients (i.e., one for the second-year kindergarten group, and another for the first-grade primary school group), a *z*-test was used to determine if the difference between the two correlations was statistically significant. An online calculator was available for computation of probability values for the difference between two correlation coefficients (Soper, 2023).

As Table 5 shows, the differences in the correlation coefficients between the two groups for character naming with syllable deletion, homophone judgement and vocabulary were not statistically significant, *p*s > .05.

Table 5. Group differences in correlation coefficients among emergent literacy and early reading skills.

Correlated Variables	K2 (n = 35)	G1 (n = 31)	*z*	*p*
Character Naming				
Syllable Deletion	.665	.540	.763	.223
Homophone Judgment	.335	.536	-.996	.167
Vocabulary	.435	.445	-.048	.481

Note: K2 = second year of kindergarten; G1 = first year of primary school.

4.4 Post Hoc Analysis: Predictors in Children's Early Reading Skills

Given high correlations among the early literacy variables (see correlation tables in Table L1 and Table L2), additional analyses based on regression were conducted to test for factors that contributed uniquely to the variance in early reading skills. Given the relatively small sample size and the large number of variables (8 emergent literacy measures), a composite variable was created for the regression purposes. One method for

forming a composite is by averaging scores from several valid measures of a construct when the constituent variables exhibit inter-correlations at a level of .39 or greater (Yoder et al., 2015). The results of Spearman's analysis for the total data set (see Table L3) showed that the intercorrelations among the three morphological awareness measures (i.e., lexical compounding, homophone judgment and homophone generation) and vocabulary ranged from .70 to .82. Therefore, a semantics composite was created to aggregate the scores of lexical compounding, homophone judgement, homophone generation and vocabulary. The RAN response time was the only variable negatively correlated with other variables or the outcome measures, so RAN response time was not combined with other variables and RAN accuracy was not entered in the analysis.

For the regression, the putative predictor variables included syllable deletion, character judgment, RAN response time and the semantics composite. Grade group and maternal education level were also included to control for the impacts of children's grade level and SES on children's early reading performance. A set of regression analyses were attempted on two dependent variables, character naming and word recognition, but the residuals for both dependent variables did not follow a normal distribution. Therefore, the basic assumptions of normality required for conducting multiple regression analysis were not met. Character naming scores were positively skewed, and word recognition scores were negatively skewed, so alternative analyses were employed to address the violations of normality assumption.

4.4.1 Predictors in children's character naming skill

For children's performance in character naming which was a positively skewed distribution, generalized linear model (GLM) with a Poisson distribution was conducted. The model aimed to identify significant predictors and their effects on character naming.

The Poisson regression model provided a reasonable fit to the data (*Deviance* = 4606.635, $df = 59$, $p < .001$). McFadden's R-squared was calculated to quantify the improvement in model fit compared to a null model (with no predictors), using the following formula: McFadden's R-squared = 1 - (Log-Likelihood Model / Log-Likelihood Null Model), where the Log-Likelihood Model is the log-likelihood value of the fitted Poisson GLM model, and the Log-Likelihood Null Model is the log-likelihood value of the null model (intercept-only model). The McFadden's R-squared value for the Poisson regression model was 0.513, indicating that the model explains approximately 51.3% of the variance in character naming compared to a null model. As shown in Table 6, the model included several predictor variables, and their effects on character naming were assessed. Syllable deletion, semantics composite, grade group and mother's education level had statistically significant positive effects on character naming. The coefficient (*B*) of each significant predictor represents the estimated log-odds change in the character naming for a one-unit change in the predictor variable, holding all other predictors constant. Character judgment and RAN response time showed no significant association with character naming (*ps* > .05).

Table 6. Poisson regression analysis for children's character naming skill.

Variable	Coefficient (*B*)	*SE*	*Wald Chi-Square*	*p*
Syllable Deletion	1.240*	.354	5.028	.025
Character Judgement	.041	.247	.028	.868
Semantics Composite	.711**	.247	8.317	.004
RAN Response Time	-.110	.089	1.544	.214
Grade Group	14.804**	3.808	15.113	< .001
Mother's Education Level	1.447**	.467	9.592	.002

Note: *SE* = Standard Error. *$p < .05$; **$p < .01$; ***$p < .001$.

4.4.2 Predictors in children's word recognition skill

For children's performance in word recognition, which was a negatively skewed distribution, a logistic regression model was conducted to investigate the factors influencing children's performance in word recognition. To conduct the logistic regression, a word recognition category variable was created to use in lieu of the scale data. The new word recognition score was an assigned value of 1 for each child's score that was greater than or equal to 14 (out of 15), meaning that the child was mostly correct on the word recognition test. A value of 0 was assigned when the child's original word recognition score was less than 14 points, more than one error out of 15 items.

Results showed that the logistic regression model provided a good fit to the data (*Chi-Square* = 29.157, $df = 6$, $p < .001$). Table 7 displays all predictor variables included in the model, along with their respective coefficients, standard errors, and *p*-values. Odds ratios are often more interpretable than coefficients. They represent the multiplicative change in the odds of the dependent variable for a one-unit increase in the predictor variable. Only one predictor, namely the semantics composite, exhibited a statistically significant positive impact on word recognition. Holding all other variables constant, an

increment of one unit in the semantics composite resulted in the odds of correct word recognition increasing by 33.1%. Other variables, including syllable deletion, character judgement, RAN response time, grade group and mother's education level were not statistically significant (*ps* > .05).

Table 7. Logistic regression analysis for children's word recognition skill.

Variable	Coefficient (*B*)	*SE*	*p*	*Odds Ratio*
Syllable Deletion	.135	.137	.922	.976
Character Judgement	-.056	.094	.324	.945
Semantics Composite	.286*	.125	.022	1.331
RAN Response Time	-.052	.061	.386	.948
Grade Group	-16.590	6305.748	.998	0
Mother's Education Level	-.024	.243	.922	.976

Note: *SE* = Coefficients Standard Error. **p* < .05.

CHAPTER V

DISCUSSION

The purpose of the present study was to investigate emergent literacy development of Chinese preschoolers and early school-aged children. A total of 66 children, including 35 preschool children from the second year of kindergarten and 31 school-aged children from the first year of primary school in the Fuzhou City of China participated. Eight measures of emergent literacy and two measures of early reading skills were tested and analyzed. Key findings, interpretations as well as significance in relation to the research objectives and the broader field of Chinese children's early reading development are discussed.

5.1 Summary of Research Questions and Findings Related to Hypotheses

The aim of the first research question was to collect descriptive performance data given the study measures and compare children's performance between two groups. It was hypothesized that Chinese children in first grade primary school would perform better on all measures of emergent literacy and early reading than those of Chinese children in their second year of kindergarten. Results supported the hypothesis. It was found that, except for RAN accuracy, children at the first grade of primary school performed better than children at the second year of kindergarten on measures of

emergent literacy skills, including syllable deletion, lexical compounding, homophone generation, homophone judgment, character judgment, response time for RAN and vocabulary as well as two early reading skills of character naming and word recognition.

The second research question posed was regarding correlations among emergent literacy skills and early reading skills of character naming as well as word recognition for Chinese children in their second year of kindergarten. It was hypothesized that for children at the second year of kindergarten, children's performance in early reading skill of character naming would be positively correlated with phonological awareness, the morphological awareness task of lexical compounding, vocabulary knowledge, and RAN. Consistent with the hypothesis, results indicated that character naming was positively correlated with syllable deletion, lexical compounding and vocabulary knowledge for children at the second year of kindergarten. Children's performance in character naming was also positively correlated with morphological awareness as measured by the homophone judgment task, which was not expected. Contrary to the original hypothesis, RAN accuracy was not significantly correlated with character naming. In terms of kindergarten children's early reading skill in word recognition, it was hypothesized that there would be no correlation among emergent literacy skills and word recognition. Consistent with the hypothesis, no significant correlations were found for word recognition with homophone generation and homophone judgment, character judgment, or RAN accuracy. Contrary to the hypothesis, kindergarten children's performance in word recognition was positively correlated with syllable deletion, lexical compounding, and vocabulary. Children's RAN response time was negatively correlated with two early reading skills, character naming and word recognition.

The third research question involved the correlations among emergent literacy skills and two early reading skills for Chinese children in their first year of primary school. The hypothesis was that for children in the first grade of primary school, children's character naming would be positively correlated with syllable deletion, vocabulary knowledge, and RAN. Results partly verified this hypothesis. Children's performance in character naming was found to be positively correlated with syllable deletion and vocabulary. Contrary to the hypothesis, no significant correlations were found among character naming and RAN, whether measured by accuracy or response time. Character naming was also positively correlated with homophone judgement and character judgment. For first-grade children's performance in word recognition, positive correlations with three morphological awareness measures, character judgment, vocabulary knowledge and RAN were hypothesized. This was not supported by the findings. None of emergent literacy skills were significantly correlated with first-grade Chinese children's performance in word recognition.

The fourth research question focused on whether the correlations among children's emergent literacy and early reading skills would differ at different grade levels. It was hypothesized that the correlations among morphological awareness and vocabulary knowledge on character naming and word recognition for the first-grade children would be stronger than those for kindergarten children. This hypothesis was not supported by the findings. No significant differences between the two groups were found in the correlation coefficients among either character naming or word recognition with any emergent literacy skills.

Additionally, a post hoc analysis was conducted to investigate whether Chinese children's emergent literacy could contribute to character naming and word recognition, respectively. A semantics composite was created by aggregating three morphological awareness measures and vocabulary. It was found that children's character naming could be positively predicted by syllable deletion and the semantics composite. Only the semantics composite served as a predictor for children's word recognition skill and could positively explain the variance in word recognition. The predicting roles of mother's education level and children's grade group in character naming, but not word recognition, were also identified.

5.2 Group Differences in Emergent Literacy and Early Reading Skills

The present study found that first-grade children had higher performance in all emergent literacy elements, except for RAN accuracy, compared to second-year kindergarten children. Additionally, first-grade children at primary school performed significantly better than second-year kindergarten children in early reading measures such as character naming and word recognition. These findings align with expectations that different early literacy skills will contribute to early reading in distinct ways at different ages or stages. In addition to age-related differences, performance between the two age groups of children can be explained by other background factors like the Chinese educational context and family socioeconomic status (SES).

5.2.1 Age-Related developmental changes

The acquisition of emergent literacy and reading skills is seen as a gradual process instead of an abrupt, all-or-nothing occurrence (Stanovich, 2000). Emergent literacy refers to the foundational skills and knowledge children acquire before formal reading instruction, including integrating orthographic, phonological, and semantic elements through distinct stages (e.g., Ehri, 2020).

In the present study, syllable-level phonological awareness of first-grade children was significantly higher than that for children in the second year of kindergarten. The progression of phonological awareness, as summarized by McBride-Chang et al. (2004), starts with a natural understanding of larger language components like syllables, which can be grasped without instruction, and gradually advances towards a comprehension of smaller language elements such as phonemes. Interestingly, children at the first grade of primary school in the present study did not respond correctly to all the syllable deletion items. This suggests that they have not fully developed their phonological awareness at the syllable level yet. Therefore, it is possible that children acquire syllable-level phonological awareness slightly later than what was concluded by McBride-Chang et al (2004).

The performance of first-grade children in morphological awareness also demonstrates their advantage in age. When compared to children in the second year of kindergarten, those in first grade showed significantly better results in lexical compounding. The finding is consistent with the developmental patterns of morphological awareness. Nevertheless, kindergarten children also performed well in lexical compounding, achieving an impressive average score of 17.4 out of a maximum

of 20 points. This indicates that children of this age have already shown a fundamental understanding of the basic structures found in compound words. Compounding morphology is the most prevalent rule for word formation in the Chinese writing system, and morphological awareness of lexical compounding involves the ability to create compound words (Zhou, 2003). Previous research indicated that syllable awareness, lexical compounding awareness, and visual skills develop early, before character instruction (Li et al., 2012). The first-grade children exhibited a significantly higher number of words generated in their morphological awareness measure of homophone generation, surpassing the kindergarten children by a substantial margin in terms of lexical diversity. Additionally, the results showed that first-grade children performed better than second-year kindergarten students in homophone judgement. This suggests that the test created by the researcher is effective in distinguishing different levels of homophone judgment ability among young readers. Significant differences observed in homophone judgment also suggest that kindergarten-aged children have not yet fully acquired homophone awareness. This finding is consistent with Li et al.'s (2012) research, which similarly highlights that homophone awareness develops later than lexical compounding skills and relies on formal instruction to ultimately contribute to successful reading outcomes.

The current study found a significant difference in the accuracy of first-grade children’s judgments on pseudo-characters and non-characters, compared to kindergarten children. The results showed that kindergarten children did not demonstrate significantly higher character judgment scores than chance level, suggesting that at this developmental stage, children have not yet fully grasped the fundamental principles of Chinese

orthography. However, first-grade children showed an average of 21.26 correct judgments (out of a total of 25 non-characters), indicating that they have developed a basic understanding of legal Chinese characters. The finding is consistent with the research conducted by Liu and colleagues (2018), which concluded that young school-age children have already understood the positions of character components. Based on the model proposed by Ho, Yau and Au (2003) for acquiring orthographic knowledge, The progression of orthographic consciousness in Chinese young readers follows a sequential progression. At the first stage, children acquire an understanding of character configuration, particularly recognizing their distinct squared shapes compared to other visual formats such as drawings. At the second stage, children gradually develop a sense of the positional arrangement of radicals, which enables them to logically construct characters. Subsequently, they start showing sensitivity towards the various functions of phonetic and semantic radicals. Ultimately, they acquire a relatively complete awareness of Chinese character orthography. The second year of kindergarten is typically when children begin to develop orthographic awareness, while first-grade students in primary school have already advanced to the next stage.

The present study investigated two important aspects of oral language development, specifically vocabulary knowledge and RAN. As expected, results revealed that first-grade children demonstrated a significant advantage in terms of their vocabulary knowledge compared to kindergarten children. Vocabulary is crucial in any language system, but it holds an even more significant role in written Chinese compared to alphabetic languages. The Chinese writing system represents words, not sounds like alphabetic languages do. When learning written vocabulary, it usually starts with

recognizing basic characters and gradually progresses to more complex ones. Eventually, children will also understand compound words made up of multiple Chinese characters. First-grade children in the present study already had a certain understanding of some complex single-character words (e.g., “驮”, which means “carrying on the back”) words and basic compound words (e.g., “障碍”, which means “obstacles”). However, kindergarten children clearly faced difficulties in comprehending vocabulary at this level. In terms of children’s performance in RAN, first-grade children showed significantly faster response times in RAN tasks compared to kindergarten children. However, there were no significant differences observed in RAN accuracy for rapid number naming between the two groups. These findings suggest that both grade groups of children were equally familiar with the naming of Arabic numbers. During the preschool years, children have already mastered counting and gradually develop recognition of numerical symbols and their corresponding quantities. However, the quicker response in rapid number naming observed among first-grade children suggests that they possess age-related advantages in numerical processing and efficient visual processing compared to their peers in kindergarten. Additionally, RAN response time reflects children’s ability to retrieve and process language-related information from memory. It establishes a link between the speed at which children can name items in a RAN task and their cognitive abilities related to language, particularly in terms of how they retrieve and process language information. This connection is relevant for assessing reading and language skills, as difficulties in RAN tasks may indicate underlying issues with language processing. Therefore, the faster response time in RAN also indicates that first-grade children have significantly enhanced language retrieval skills than kindergarten children.

Regarding two early reading skills, first-grade children at primary school demonstrated significantly superior performance compared to second-year kindergarten children in both character naming and word recognition. The first-grade participants demonstrated near perfect recognition of all 50 character-naming items and all 15 two-character word recognition items. The scores of kindergarteners showed considerable individual variation, especially in word recognition. Some children achieved a perfect score of 15, while the lowest-performing children recognized only 6 items. Given that word recognition in this study was conducted through a binary forced-choice task, the decision-making process of children might have involved an element of conjecture. According to the Connection Triangle Model of word recognition (Yang et al., 2006), word recognition relies on three crucial aspects of word - orthography, phonology, and semantics. Therefore, the observed variations in word recognition can be attributed to the age-related differences discussed earlier, including variance in phonological awareness, morphological awareness, orthographic awareness, and vocabulary knowledge.

In general, learning to read in Chinese poses challenges due to its extensive character system, which entails a gradual learning process. Children in the second year of kindergarten in the present study demonstrated developmental patterns consistent with the second stage of phonological and morphological phase according to the phase-based framework for acquiring Chinese word reading skills (Ye & McBride, 2022). They have begun to understand the connection between spoken Chinese and written characters. However, their performance in syllable deletion and homophone judgment indicates that they haven't fully realized yet that each syllable in spoken language corresponds to a character or morpheme in writing. The first-grade children in the present study have

notably reached the third stage of the orthographic phase. Their impressive accuracy in character judgment suggests that they have successfully grasped the regularities regarding compositional rules of Chinese characters and radical positions.

5.2.2 Chinese educational context

In accordance with the regulations set by the Ministry of Education of the People's Republic of China (2012), the curriculum standards for kindergarten children do not incorporate formal literacy instruction in Mainland China. Thus, the formal literacy instruction provided to first-grade children likely contributes to their superior reading skills compared to preschool children. This can be explained from two aspects. Firstly, first-grade children receive structured literacy instruction that teaches them how Chinese characters relate to sounds through phonics and character recognition. This method helps develop their reading skills, such as syllable deletion skills from kindergarten to first grade when Pinyin is introduced at the beginning of Grade 1. The well-structured literacy education in first grade could also explain the group difference in orthographic awareness. First-grade children typically receive structured education focusing on both oral and written language acquisition, enabling them to effectively distinguish between characters with disordered strokes and pseudo-characters.

The second aspect involves an increased exposure to texts. First-grade children are exposed to a wider variety of reading materials compared to preschoolers. Since the Chinese language consists of thousands of characters, decoding begins with recognizing and comprehending these characters. Acquiring skills in reading characters becomes a primary objective during the first and second grades. In contrast, Li and Rao (2005) found that only 35% of teachers in Beijing provided instruction on Chinese character

reading for kindergarteners. Consequently, limited exposure to Chinese characters may explain the lower performance in character naming among the kindergarten children in this investigation. The increased exposure to written materials and immersive language input after school entry may also contribute to the higher performance in phonological awareness observed in first-grade children compared to kindergarten, considering that phonological awareness is a fundamental code-based emergent literacy skill.

5.2.3 The role of family socioeconomic status

In the current study, although there were no significant differences in the education levels of either mothers or fathers or between the two grade groups of children, parental education varied from 9 to 19 years. Results from the post hoc analysis indicated a positive correlation between maternal education level and children's performance in character naming. Specifically, children whose mothers had higher levels of education tend to excel in Chinese character naming. The education level of mothers could impact the early reading development of Chinese children, especially for preschoolers who have not yet received formal literacy instruction. Maternal education level, as an important aspect of family socioeconomic status (SES), may influence children's reading outcomes through factors like access to age-appropriate literacy resources and a supportive home literacy environment (Liu et al., 2023). For instance, parents with higher levels of education are more likely to engage in effective literacy interactions with their children, thus enhancing their vocabulary knowledge (e.g., Liu & Chung, 2022; Liu et al., 2023; Pan et al., 2017) and word reading skills (e.g., Fung & Chung, 2020; Hemmerechts et al., 2017; Vasilyeva et al., 2018). For example, one kindergarten child in the present study confidently read aloud 47 characters during the character naming task, and then said his

mother frequently taught him to recognize characters at home. The child's mother held the highest level of education among all the mothers in the study, as she had obtained a master's degree. This also indicates that highly educated mothers place great importance on promoting literacy education for their children. Moreover, there was considerable variation in the scores of kindergarten children on the vocabulary measures, ranging from 21 to 90 correct items. This highlights the potential impact that each child's home literacy environment can have on their vocabulary learning and development. The home literacy environment is commonly divided into informal literacy experiences and formal literacy experiences (Liu et al., 2018). Informal literacy activities are meaning-based and introduce children to written materials in a casual manner, such as book reading. On the other hand, formal literacy activities are code-based and actively engage children in print-related tasks like teaching them about characters, words, and pronunciations. Both the quantity and quality of the home literacy environment play a crucial role in the initial stages of children's reading development. The research conducted by Liu and colleagues (2018) suggests that informal literacy experiences have a greater impact on vocabulary development than on phonological awareness. In contrast, formal literacy experiences show a stronger correlation with phonological awareness compared to vocabulary development.

In research, it is common practice to consider both the educational level of mothers and other socioeconomic indicators (such as income, occupation, and household assets) in order to gain a comprehensive understanding of socioeconomic status (e.g., Bradley & Corwyn, 2002; Conger & Donnellan, 2007; Zhang et al., 2020). However, the specific socioeconomic indicator that plays the most significant role in early reading development

among Chinese children remains unclear. In addition to socioeconomic factors, future research could also consider collecting other background information through parent-reported questionnaires, such as home literacy experiences and parental expectations regarding their children's literacy success.

5.3 Associations among Emergent Literacy and Early Reading

The Chinese language, which is logographic, and the English language, which is alphabetic, have fundamental differences in their writing systems, structure, and characteristics. For example, the characters in written Chinese typically represent meaningful units, such as words or morphemes, and are not inherently tied to pronunciation. In contrast, English letters primarily represent sounds and are combined to form words. Despite these differences, the connections established in English-speaking children between emergent literacy and early reading skills can also be observed in Chinese Mandarin-speaking children. In the present study, phonological awareness had the strongest correlation with character naming in both preschool and early school-aged children. Morphological awareness and vocabulary also showed moderate correlations with character naming. Additionally, first-grade children demonstrated a positive correlation between orthographic awareness and character naming. These findings support Ehri's summary (2020) that learning to read involves strengthening connections between different lexical representations stored in memory, including the phonological, orthographic, and semantic properties of words. This assumption was also proposed in the Lexical Quality Hypothesis (Perfetti & Hart, 2002). A recent meta-analysis (Dong et al., 2020) has also revealed a clear correlation between emergent literacy and reading

abilities among young Chinese readers. This suggests that advanced emergent literacy skills are associated with higher word reading skills. The association between each early literacy measure and children's early reading outcomes, however, showed inconsistent results in the present study. In other words, the relationship between emergent literacy measures and early reading skills varied. Some were closely related, while others were not. Additionally, certain emergent literacy measures were associated with the early reading skills of both grade groups, but some only influenced the reading skills of one group of children.

5.3.1 Phonological awareness and early reading

The present study found a positive link between phonological awareness, measured by syllable deletion, and two early reading outcomes: character naming and word recognition. However, the significant association between syllable deletion and word recognition was only observed among children in their second year of kindergarten rather than those in first grade. The post hoc analysis additionally found that syllable deletion significantly predicted children's performance in character naming, but it did not have an impact on word recognition. The findings from previous studies (e.g., Li & Wu, 2015; Lin et al., 2010; Lin et al., 2016; Liu, Georgiou et al., 2017), consistently support the idea that phonological awareness plays a crucial role in Chinese reading during the early stages, especially in kindergarten. However, its predictive significance gradually diminishes as children progress through higher grades (e.g., Liu, Georgiou et al., 2017; Wang et al., 2021; Yuan et al., 2022). One possible explanation is that younger and preliterate children may benefit from their knowledge of sounds in words, as it helps

them make a connection between spoken language and written text. On the other hand, as children progress beyond first grade, they increasingly rely on phonetic radicals to aid their reading of Chinese characters with growing experience.

A meta-analysis conducted by Ruan et al. (2018) found that phonological awareness remained the most influential predictor of reading proficiency, even after considering morphological awareness and RAN. Theoretical frameworks suggest that having phonological awareness supports reading development, as demonstrated by the Universal Phonological Principle (UPP) (Perfetti & Dunlap, 2008). According to this principle, when we read any written text in a specific writing system, it automatically activates the associated sounds. Proficiency in phonology is universally important for accurately decoding written text in different languages because of the essential role played by correctly connecting sounds and spelling. However, some researchers argue that compared to orthographic awareness and morphological awareness, phonological awareness has a relatively minor impact on Chinese reading skills (Liu, Georgiou et al., 2017; Tong et al., 2009; Yeung et al., 2011). They explain that while phonology is important in Chinese reading, its influence on character recognition differs from alphabetic languages due to the lack of grapheme-phoneme associations in written Chinese. The impact of phonological awareness on Chinese reading ability may depend on the size of sound units (Tan et al., 2005). In addition to syllable awareness, other units of phonological awareness such as onset, rime, phoneme, and tonal awareness have also been shown to positively correlate with Chinese reading skills (e.g., McBride-Chang et al., 2004; Shu et al., 2008; Siok & Fletcher, 2001). However, at the initial stages of learning to read for young children who are just beginning to process larger sound units

like syllables, the contribution of phoneme-level phonological awareness is limited (Li & Shu, 2009).

To summarize, the current study's findings significantly contribute to the existing evidence that syllable-level phonological awareness is a universal factor in the initial stages of reading development across different writing systems (McBride-Chang & Kail, 2002; Song et al., 2016). Phonological awareness can differentiate Chinese children who struggle with reading characters from those who excel at it. Previous studies on phonological awareness in Chinese word reading have used longitudinal research designs (e.g., Chow et al., 2005; Lei et al., 2011; Pan et al., 2016). Therefore, it is necessary to comprehensively investigate the consistent associations between phonological awareness and early reading abilities from kindergarten to upper grades of primary school.

5.3.2 Morphological awareness and early reading

In the present study, homophone judgment positively correlated with children's character naming in both preschool and early school age. The positive correlations between lexical compounding and character naming, as well as word recognition, were only identified in preschool children and not the first-grade children. Homophone generation, the third morphological awareness task, did not significantly correlate with early reading skills. These findings suggest that different elements of morphological awareness have diverse linguistic requirements and play distinct roles in the advancement of Chinese reading skills.

The lexical compounding test assessed children's morphological awareness at the word level. The exclusive association between lexical compounding and early reading was observed only among second-year kindergarten children, suggesting that it is a

fundamental aspect of Chinese word formation. It allows children to deduce the definitions of unfamiliar words by examining their internal composition, particularly in the early phases of learning how to read (Carlisle, 2000; Liu et al., 2013; Verhoeven & Perfetti, 2003). The existing evidence on the roles of lexical compounding awareness in Mandarin-speaking children's early reading skills primarily focuses on primary school children (e.g., Deacon et al., 2014; Wu et al., 2009; Xie et al., 2019). These studies found that the relationship between lexical compounding and word reading mainly emerges for older children after third grade, making it challenging to discern such a connection among younger children. This may be because lexical compounding requires more advanced reading experiences in which children flexibly analyze, select, and employ morphemes (Cheng et al., 2016). In other studies, the additional variance accounted for by lexical compounding varied notably, ranging from 1.5% of the variance to almost 10% (e.g., Chan & Siegel, 2001; Chow, et al., 2005; McBride-Chang & Ho, 2000a; McBride-Chang et al., 2003; McBride-Chang et al., 2005). However, a significant portion of these studies focused on Chinese Cantonese-speaking children in Hong Kong. Therefore, current findings provide new evidence for the close relationship between lexical compounding and early reading in Mandarin-speaking preschoolers.

The homophone generation test and homophone judgment test assessed morphological awareness at the character level. The present study introduced an investigator-designed assessment, the homophone judgment test, as an original measure of receptive homophone awareness in Chinese children. A positive correlation was found between homophone judgment and character naming in both groups of children. There was no significant difference observed in the strength of correlations between the groups.

These findings suggest that awareness of homophones develops early and expands progressively as children gain experience with written language during their primary school years (Hao et al., 2013). Given the prevalence of homophonic characters in Chinese, accurately identifying homophones is crucial for reading in Chinese. Kindergarten and first-grade children face the challenge of multiple written characters corresponding to the same syllable when learning to read. Relying solely on phonological information is insufficient for understanding the meaning of a printed character. According to multiple studies (e.g., Li et al., 2012; Xue et al., 2013), morphological awareness has been found to be a more reliable indicator than phonological awareness when it comes to predicting reading outcomes in Chinese. Additionally, being able to distinguish between two morphemes based on their orthography requires some level of orthographic awareness. This suggests that homophone judgment may not only directly impact reading but also potentially enhance orthographic awareness to improve reading accuracy.

The homophone generation test in this study was the most challenging, as it required children to produce as many words with a specific sound as possible. It assessed their ability to use homophones in spoken language. However, there was no significant correlation found between homophone generation and early reading skills for preschool or first-grade children in this study. This could be because forming words with similar sounds is difficult for young readers who haven't yet learned many Chinese characters. Homophone generation showcases linguistic creativity and allows children to explore the adaptability of the Chinese language. It is possible that homophone generation plays a more important role in later stages of reading development, as demonstrated by Wei et

al.'s research (2014) on how it contributes to Chinese reading proficiency as children mature. Older children who effectively use homophones can understand the semantic associations of these words during text reading (Cheng et al., 2016).

In summary, this study provides evidence regarding the role of word-level lexical compounding awareness in preschool children's early reading skills. Additionally, it also innovatively discovers a significant association between character-level homophone judgment awareness and early reading skills. The significance of morphological awareness in Chinese word reading can be understood from multiple perspectives. Firstly, Chinese has transparent and straightforward compounding rules, making it easier to grasp the meanings of compound words once the meaning of a morpheme is understood. This facilitates the activation of background knowledge during reading (Kuo & Anderson, 2006; McBride, 2016). Secondly, due to the close correspondence among syllables, morphemes and characters in Chinese language, children with heightened sensitivity towards morphemes have an increased likelihood of success in learning to read (Chen et al., 2009). Morphological awareness also plays a role in higher-level processes such as text comprehension by enabling children to comprehend how morphemes fit together within written text (Pan et al., 2016). However, this study did not evaluate another character-level morphological awareness called homograph awareness. Homograph awareness involves recognizing and differentiating characters that share the same written form but have distinct meanings and sometimes even different pronunciations. It primarily aids children in more advanced stages of reading comprehension by enabling them to disambiguate a character's meaning within context through considering its various semantic interpretations. Therefore, additional research is

required to investigate the connections between this increased level of morphological awareness and the reading proficiency in Chinese among older children.

5.3.3 Orthographic awareness and early reading

In the current study, orthographic awareness, as measured by character judgment, showed a positive correlation with character naming in first-grade primary school children. However, this association did not reach statistical significance for kindergarten children. This finding further supports previous evidence indicating that orthographic awareness plays a more prominent role in the reading development of primary school children compared to preschool children (e.g., Li & Shu, 2009; Li et al., 2012; Li et al., 2006). The unique features of the Chinese writing system make orthographic awareness particularly important for Chinese children. With thousands of characters to recognize, reading relies on this fundamental skill. Orthographic awareness helps children learn, recognize, and distinguish among these characters, as well as utilize radicals to decode characters and infer their meanings. The proper construction of characters and accurate combination of radicals are essential reading tasks for primary school children to understand. However, in this study, there was no significant correlation between character judgment and word recognition abilities in either kindergarten or first-grade students. This can be attributed to the inherent differences between these measures. Chinese character naming primarily assesses decoding skills at the individual character level, while word recognition involves higher-level proficiency in reading words beyond their constituent characters. Once children become proficient in understanding the compositional structures of Chinese orthography at the character level, orthographic

awareness may no longer have a distinct impact on advanced aspects of their reading performance (Wei et al., 2014).

The post hoc analysis of the present study did not validate previous research findings that identified a significant predictive role of orthographic awareness in children's early reading skills during the initial stages. Previous evidence suggested that orthographic awareness becomes a salient predictor of reading skills for children at the third year of kindergarten (e.g., Tong et al., 2009) and during primary school years (e.g., Li et al., 2012). Study differences could be attributed to differences in the measurement tasks used to assess orthographic awareness. In this study, orthographic awareness was measured through a character judgement test where children determined whether presented items were real Chinese characters or non-characters. In contrast, previous studies (e.g., Ho, Ng, & Ng, 2003; Li et al., 2021; Luo et al., 2011) included comprehension and manipulation of radical position, function, and combination rules as part of orthographic awareness. Knowledge related to radicals may hold greater significance for early reading than mere sensitivity towards character legality. A potential explanation could be that the tasks utilized in previous studies to assess radical knowledge were more responsive to variations in orthographic awareness. Additionally, the relationship between orthographic awareness and reading may involve more complex interactions rather than a simple one-way predictive association. A longitudinal study (Luo et al., 2011) suggested bidirectional influences between Chinese character reading ability and reading experiences on orthographic awareness. It is plausible that in the initial phases of reading development in children, character naming could serve as a predictor for the emergence of orthographic awareness instead. Therefore, due to

inconsistent findings on the connection between orthographic awareness and early reading skills among Chinese children, it is valuable to incorporate multidimensional measurements for orthographic awareness in future research.

5.3.4 Vocabulary knowledge and early reading

The PPVT-R (Sang & Miu, 1990) was used in the present study to assess Chinese children's receptive vocabulary skills by matching spoken words to pictures. Vocabulary knowledge showed a positive correlation with character naming in both kindergarten and first-grade children. Additionally, there were no significant group differences in the size of correlation coefficients, indicating that vocabulary played an equally important role in early reading development for both grade groups. This study extends previous research by demonstrating the impact of children's vocabulary knowledge on character reading as early as first grade (e.g., Hulme et al., 2019; Yan et al., 2021). Additionally, these findings suggest that vocabulary impacts character naming early, during the preschool years.

Chall (2013) highlighted the importance of vocabulary in different stages of reading development. In the second year of kindergarten, children are at the initial stage of learning to read without formal instruction and the core skill involves connecting spoken and written words. Therefore, vocabulary plays a foundational role in facilitating their decoding skills from the start. As first-grade children progress in their learning-to-read stage, their decoding abilities gradually improve, allowing them to expand their vocabulary and decode unfamiliar words. Consequently, acquiring vocabulary becomes essential for fostering word recognition development among young learners. Liu, Li, and Wong (2017) further elucidated how vocabulary influences children's character naming

proficiency by highlighting its supportive function in establishing semantic and phonological connections between morphological awareness and Chinese character reading ability. Longitudinal studies are needed to track how Mandarin-speaking children's vocabulary and word recognition skills evolve over time.

5.3.5 RAN and Chinese children's early reading

The present study did not find the expected associations between RAN accuracy and early reading abilities in Chinese children, as previous research has shown (e.g., Song et al., 2016; Tong et al., 2009; Yeung et al., 2013). The reason could be that there was no noticeable distinction in RAN accuracy between the two groups of children. Instead, it was observed that character naming and word recognition showed a negative correlation with RAN response time only among second-year kindergarten children. The current study did not confirm the predictive effect of RAN response time on early reading skills, contradicting prior research that consistently showed RAN's significant role in predicting Chinese reading abilities independent of phonological awareness (e.g., Arnell et al., 2009; Liao et al., 2015; Pan et al., 2011; Wei et al., 2014; Yeung et al., 2011). RAN was found to effectively distinguish character recognition skills in both preschool children and school-aged children (Lervåg & Hulme, 2009; Li & Shu, 2009; Li et al., 2012; Yan et al., 2021). However, previous studies primarily focused on using RAN to predict reading difficulties rather than exceptional reading skills in typically developing children. Therefore, this study suggests that RAN response time may be more effective in distinguishing children with reading difficulties from those with averaged reading skills, but it may not be sensitive enough to identify subtle differences in reading skills among typically developing children. Another explanation could be that RAN is more closely

linked to reading fluency rather than accuracy as assessed through the character naming task employed in this study. This aligns with Georgiou et al.'s (2022) proposal that RAN involves sequential naming similar to how words are initially processed sequentially before evolving into intra-word cascading during the reading process. In summary, this study did not find evidence supporting the predictive role of RAN response time in early reading skills of typically developing children.

Additionally, the results suggest two important findings. Firstly, the response time of RAN may serve as a more informative indicator than accuracy, showcasing its significant contribution to the early reading skills of Chinese children. The nature of the task might be a contributing factor to this. RAN tasks evaluate an individual's ability to quickly recognize and name familiar visual stimuli like letters, numbers, colors, or characters. These tasks prioritize naming speed. This explanation is supported by Tan et al.'s (2005) findings that highlight naming speed as a strong predictor across different written languages. RAN tasks involve automatic processing which includes cognitive aspects such as general processing speed, phonological processing, and speed-sensitive visual motion processing. These skills play a crucial role in orthography-to-phonology and orthography-to-semantics mappings necessary for Chinese reading development (Georgiou et al., 2009; Protopapas et al., 2013). In other words, successful word recognition, and ultimately reading fluency, consists of retrieving commonly used words at a level of automaticity.

Secondly, the link between RAN and reading abilities appears to weaken in typically developing children as they progress through their first year of school. This finding aligns with previous research. The significance of RAN tends to become less

prominent in these studies when taking other contributing factors into account (Chow et al., 2005; McBride-Chang & Ho, 2000a; McBride-Chang & Kail, 2002), particularly in longitudinal investigations (McBride-Chang et al., 2005; McBride-Chang & Ho, 2005). Therefore, it is plausible that the association between RAN and reading proficiency in early childhood diminishes as children progress in their reading abilities owing to additional factors associated with literacy development like phonological awareness and vocabulary (Mcbride-Chang & Ho, 2000b).

5.4 The Unique Contribution of the Semantics Composite

The present study combined three measures of morphological awareness and vocabulary to create a semantic composite variable that encompassed semantics. Post hoc analysis findings demonstrated the predictive capabilities of this semantic variable for Chinese character and word recognition abilities in preschool and early school-age children. Although limited research has combined morphological awareness and vocabulary knowledge as a semantic composite to examine their impact on the early reading abilities of Chinese children, previous findings illustrate the comprehensive influence of this composite on reading. Morphological awareness significantly contributes to early reading skills in both preschool-age children (e.g., Lin et al., 2019; Wang et al., 2021) and school-age children (e.g., Yeung et al., 2014). Additionally, vocabulary plays a predictive role in the early reading abilities of both alphabetic language-speaking children and Mandarin-speaking Chinese children (e.g., Nation et al., 2004; Roth et al., 2002). There is a complex interrelationship between morphological awareness and vocabulary knowledge in Chinese. Some researchers found that the direct

impact of morphological awareness on reading is negligible, as its influence primarily operates through vocabulary knowledge (Sparks & Deacon, 2015). Morphological awareness is closely linked to vocabulary acquisition, especially for compound words, and plays a significant role in integrating phonological, semantic, and syntactic representations within the linguistic system (Perfetti, Liu, & Tan, 2005).

Overall, the results of the current investigation, in conjunction with prior studies, indicate a strong correlation between morphological awareness and the early development of vocabulary while acquiring reading skills. Preschool and early-grade readers heavily rely on semantic clues during reading while expanding their vocabulary. The new finding of this study is the innovative combination of morphological awareness and vocabulary knowledge, which significantly predicts children's early reading abilities.

5.5 Theoretical Implications

From a theoretical perspective, the present study has the potential to contribute to our understanding of children's reading development in two ways. First, it can confirm the central role of metalinguistic awareness in word-level reading, shedding light on foundational aspects of children’s reading abilities. The Chinese language provides a strong framework for identifying words through its well-established phonological, orthographic, and semantic representations. Second, this study may provide a comprehensive understanding of emergent literacy by clarifying the distinct roles played by phonological awareness, morphological awareness, orthographic awareness, vocabulary knowledge, and rapid automatized naming (RAN) in early Mandarin-speaking children's reading development. It is worth noting that there have been limited

empirical efforts aimed at simultaneously assessing these diverse facets of emergent literacy abilities; therefore, further exploration is needed to unravel their unique patterns of contribution. Additionally, this research endeavor can enhance our comprehension of reading development by examining a group of young readers that includes preschool-aged children as well as those in their early school years.

The present study has confirmed aspects of widely recognized reading models and expanded specific theoretical frameworks. The significance of vocabulary in reading is highlighted by Perfetti's (2009) Decoding-Vocabulary-Comprehension (DVC) triangle model. This model perceives the development of reading as a dynamic interplay among decoding, vocabulary, and comprehension. Vocabulary not only directly contributes to comprehension but also acts as a mediator for the impact of decoding on it. Readers rely on their knowledge of vocabulary to comprehend word meanings from written text (Perfetti et al., 2005). Moreover, within the DVC model, there exists a reciprocal relationship between decoding and vocabulary. Individuals with extensive vocabularies demonstrate stronger decoding skills while proficient decoders are better at acquiring new vocabulary from text. The Lexical Quality Hypothesis (Perfetti & Hart, 2022) suggests that precise and well-defined phonological, orthographic, and morphological representations are essential for effective meaning construction during reading. This model highlights the importance of morphological awareness in Chinese reading. The present study suggests that combining morphological awareness and vocabulary could explain the variations in children's early reading skills. This finding integrates perspectives from the DVC model and Lexical Quality Hypothesis, supporting the amalgamation of morphological awareness and vocabulary into a semantically associated

factor. The rationale for the aggregated semantic composite in terms of how these two factors interact with each other and contribute to children's early reading needs further strengthening through future research.

According to the “Dual Route Model” or “Orthographic-Phonological Mapping Model,” Chinese reading can be described through two distinct routes: (1) Character recognition route, where readers identify whole characters as units without relying solely on phonological information because Chinese characters lack direct phonological cues. Instead, orthographic features are used for character recognition. (2) Phonological route, where readers may use phonological components within characters or context to derive pronunciations. The strong correlations found in this study between phonological awareness and orthographic awareness in relation to Chinese character naming further support the existence of these two pathways.

In summary, the development of Chinese reading skills involves visual processing and several other factors such as phonological awareness, morphological awareness, orthographic awareness, and vocabulary knowledge. Future research should focus on refining theories related to Chinese reading development to gain a deeper understanding of this unique writing system.

5.6 Practical Implications

From a practical perspective, this study has significant implications for the teaching and learning of Chinese reading skills. Firstly, incorporating metalinguistic awareness into classroom instruction can be an invaluable strategy for enhancing children’s reading abilities. For example, typically developing children who have stronger early

morphological awareness tend to demonstrate higher levels of initial reading proficiency and a faster rate of improvement (Lin et al., 2019). Specifically, the importance of homophone judgment highlighted in this study suggests a greater emphasis on cultivating young readers homophone awareness. In an educational setting, teachers could create activities that involve guessing words with similar sounds and matching characters with their corresponding pronunciations. These activities help establish connections between pronunciation and character forms, thereby enhancing children's understanding of homophonic characters. Another key factor in Chinese children's early reading, as shown in this study, is vocabulary. Promoting oral language skills, especially vocabulary knowledge, along with instructional methods to improve visual-orthographic copying skills can be beneficial for the initial stages of Chinese reading acquisition (Hulme et al., 2019). Given the vastness of the Chinese vocabulary, readers must have a good understanding of word meanings and usage to effectively comprehend texts. Based on the finding that semantic knowledge in the form of vocabulary and morphological awareness uniquely contributes to early reading in Chinese children, it may be advantageous to focus more on strategies for vocabulary acquisition during lower elementary grades. In teaching practice, vocabulary education for young children should not only rely on rote memorization and copying but instead incorporate morphological knowledge and lexical meanings. Additionally, phonological awareness plays a significant role in the early reading development of Chinese children and is closely linked to their proficiency in Pinyin. Pinyin knowledge is pivotal for decoding as it enables readers to accurately associate sounds with characters. Therefore, providing early exposure to Pinyin literacy education prior to school entry is recommended.

The current study emphasizes the role of socioeconomic status (SES) on early childhood reading, highlighting the importance for parents to create a nurturing home literacy environment that promotes their young children's reading development. It is recommended that families establish language-rich interactions and engage in both formal and informal home literacy activities even before their children start school. These activities include recitation, interactive reading, storytelling, and role-playing games. These activities provide ample opportunities for children to express themselves orally, enrich their vocabulary, and foster their interest in and motivation for reading. Additionally, technology advancements offer parents valuable tools such as online dictionaries and language learning apps to support their children in acquiring characters and expanding vocabulary.

The close relationship found in this study between emergent literacy and early reading abilities provides valuable insights for assessing children’s reading skills. Given that reading difficulties can appear during early childhood, it is crucial to identify and intervene early for preschoolers. Early screening for potential reading difficulties should consider children's oral language proficiency, including vocabulary knowledge and RAN response time, as well as their metalinguistic awareness of Chinese phonology, morphology, and orthography. Additionally, RAN is a valuable tool for early identification of individuals who may face reading challenges, especially dyslexia. Therefore, integrating these influential factors into a comprehensive reading assessment is essential. Alternatively, developing criterion-referenced tests suitable for educational and clinical settings seems feasible. The process of addressing children who are struggling or not learning to read can be complex and personalized. The instruction

should be customized to address the unique requirements and capabilities of individual children, taking into account the outcomes of assessments. It is important to provide specialized instructions that focus on systematic and explicit phonics instruction, which can help children decode words more effectively. Additionally, timely intervention and targeted support for children with limited RAN skills can significantly enhance their reading outcomes. The most effective way to address reading difficulties is by implementing structured intervention programs that offer targeted support for children struggling with reading.

5.7 Research Limitations

Several limitations should be considered when interpreting the results of the present study. The scale and variability of the sample pose a primary limitation. A prior power analysis indicated that the sample size of 66 was enough to achieve sufficient statistical power. However, when considering whether the results can be generalized beyond the sample, the sample in the present study does not represent the diversity of the population under investigation. The findings are specific to Fuzhou, a city in southwestern China. The lack of identification of certain connections among variables, such as the relationship between homophone generation and early reading skills, could possibly be attributed to insufficient variation in this particular group of children. Future research would benefit from a larger and more diverse sample to enhance external validity when applying these results to different regions.

In the present study, a cross-sectional analysis was used to identify correlations within the data, while longitudinal studies are better at establishing causal connections.

However, due to limitations in the cross-sectional design, definitive causal inferences regarding these relationships cannot be drawn. Future research that combines both designs will enable a more comprehensive exploration of the predictive role of emergent literacy in current and subsequent reading abilities.

Third, as there were no standardized reading assessments available for Mandarin-speaking children at the time of this study, alternative approaches were used to evaluate their emergent literacy and early reading abilities. The scores in three measures, namely lexical compounding, RAN accuracy, and word recognition, showed limited variability for first-grade children, which could be a factor in the weak correlation coefficients. The ceiling effects were observed in first-grade children's performance in lexical compounding and word recognition. It is important to consider the difficulty of these two measures in terms of both the test materials and task design. Particularly, the validity of the word recognition test as a measure of word-level decoding skill has been controversial. In this test, children had to choose the correct word from two options based on what they heard. One limitation is that each written word was accompanied by a picture and the spoken word. Thus, the word recognition task involved associating pronunciation and visual form with meaning. The forced choice involves guessing, potentially allowing preschoolers to guess correctly and resulting in a ceiling effect for these typically developing primary age school children. A two-character Chinese word naming task might be more suitable as it could evaluate core aspects of word decoding ability. Future research can focus on developing or refining measurement instruments tailored specifically to Chinese Mandarin-speaking preschoolers' and early school-age children's reading-related skills.

Fourth, the accuracy of the findings and interpretation may be influenced by various confounding factors. Previous studies (e.g., Lyon et al., 2003; Wang et al., 2021; Wei et al., 2014) have controlled for children's non-verbal intelligence. In this study, the Peabody Picture Vocabulary Test-Revised (PPVT-R) was used to assess children's single-word receptive vocabulary. PPVT-R is widely used in educational and clinical settings to reflect children's verbal intelligence, particularly in children with language disorders or developmental delays. However, it should not be considered a substitute for conventional cognitive ability tests when assessing a child's non-verbal intelligence. Another uncontrolled extraneous variable is children's experience in learning Pinyin, which typically starts at the beginning of first grade. Numerous research studies have indicated that the teaching of Pinyin has an impact on the development of phonological awareness and can act as a mediator in the correlation between phonological awareness and reading proficiency (e.g., Huang & Hanley, 1997; Leong et al., 2008; Siok & Fletcher, 2001). Failing to control for the influence of Pinyin may limit accurate conclusions about factors impacting reading in non-alphabetic writing systems. Therefore, future investigations should consider including children's proficiency in Pinyin when assessing phonological awareness development and its relationship with Chinese early reading. Additionally, it is important to consider visual perception skills. Evidence suggests a connection between recognizing Chinese characters and visual-spatial perception (e.g., Hulme et al., 2019; McBride-Chang et al., 2005; Yuan et al., 2022). Apart from these cognitive and linguistic factors, it is also worth discussing the behavioral and psychological aspects of children. Due to an abundance of tests, some children showed signs of decreased concentration and fatigue, especially when

completing the homophone generation test that required more effort. In future research, considering both timing and difficulty levels of tests by scheduling those requiring higher mental effort earlier in the sequence may be worthwhile.

Fifth, many researchers have studied the importance of radical awareness in Chinese children's orthographic proficiency (e.g., Li et al., 2021; Wang & Zhang, 2016). However, this study only assessed their receptive awareness of character structure and radical positions, so it doesn't provide insights into explicit awareness or precise knowledge about semantic and phonetic radicals. Further investigation could explore other aspects of orthographic proficiency development among children to understand the influence of this metalinguistic knowledge.

Lastly, the development of early reading is a complex process that involves more than just decoding characters and words. The focus of the present study was on examining the connections between emergent literacy and word-level reading ability. However, it failed to consider children's advanced reading comprehension skills, such as reading fluency, sentence comprehension, and text comprehension. Furthermore, it did not focus on children in middle or upper elementary school grades - a phase widely recognized for its pivotal role in developing reading skills. In future studies, using different reading outcome measures (such as reading fluency or sentence comprehension) may be beneficial to better understand how emergent literacy relates to higher grade level reading abilities where children have had more exposure to written materials.

5.8 Future Research

Studies like this one and others have provided valuable insights into factors associated with early reading development in Chinese children. However, ongoing research is still needed to investigate significant factors and relationships between emergent literacy and reading skills. The use of diverse research sources, including crosslinguistic studies, Event-Related Potentials (ERP) investigations, and eye-tracking analysis, will enhance comprehension in this field. The comprehensive understanding of children's reading development is crucial from kindergarten through primary school and should include a wider range of reading comprehension units such as characters, words, sentences, and texts. Specifically, the word-level reading outcome measure should be updated to better reflect children's decoding skills. Advanced levels of emergent literacy should also be considered as children progress in their reading experiences. Confounding variables like Pinyin knowledge, visual-spatial perception abilities, and maternal education level need to be carefully controlled for. These potential research directions aim to build upon the findings of the present study and address emerging questions.

5.8.1 Emergent literacy and Chinese children's two-character word reading

The factors associated with children's word recognition skill were fewer compared to early reading skill at the character level. It is necessary to improve the measurement of word recognition and reassess its associations with emergent literacy for children in their second year of kindergarten and first grade of primary school. Specifically, a two-character word reading test can be created to assess children's decoding skills at the word level. In this test, children will read a list of 50 to 80 written two-character words,

arranged in increasing difficulty from Chinese textbooks used in first and second grade, which would prevent limitations for first-grade students due to their current curriculum. First-grade children's word recognition is expected to positively correlate with lexical compounding, homophone judgment, character judgment, and vocabulary knowledge.

5.8.2 Longitudinal investigation on Chinese children's reading comprehension

The role of emergent literacy in children's reading comprehension can be investigated longitudinally. A sample of 300 typically developing Chinese children, currently in their second year of kindergarten, will be recruited from urban and suburban areas. The study will follow the participants for five years, collecting data annually on emergent literacy, reading comprehension ability, maternal education level, and children's knowledge of Pinyin. In addition to the aforementioned measures for emergent literacy, phonological awareness at the level of individual sounds (phonemes), morphological awareness for words with multiple meanings (homographs), and orthographic awareness of radical functions will also be included. Specifically, a phoneme deletion test will assess children's ability to remove initials or finals from spoken words. A homograph awareness test will present pairs of words containing specific homographs for determining if they carry the same meaning. The radical awareness test will ask children to identify the meaning represented by a semantic radical in a picture-matching format. Reading comprehension measures will vary across different grade levels: kindergarten children will complete a character naming task at the character level; elementary school students with more reading experience would complete word recognition tests as well as sentence and passage comprehension tests consisting of multiple-choice questions. Additionally, children's knowledge of Pinyin will be

measured through a test on recognizing Pinyin symbols to serve as the control factor. The parent-reported questionnaire will collect information on family socioeconomic status, including parental education level, parents' occupation, and family income. It also includes questions about the home literacy environment, such as home literacy resources, frequency of home literacy activities, and parental expectations for children's literacy success. Regression analysis will examine the impact of emergent literacy over time, with an expectation that phonetic awareness, homograph awareness, and radical awareness will play a more significant role in children's reading comprehension by third grade compared to earlier stages. The reading outcomes of children are also predicted to be influenced by maternal education level, home literacy environment, and parents' expectations.

CHAPTER VI

CONCLUSION

The aim of the present study was to investigate and compare the emergent literacy and early reading skills of Chinese children in their second year of kindergarten and first grade. It also examined the associations between emergent literacy and early reading skills, addressing specific shortcomings in current literature. First and foremost, it enhances our understanding of the significant role that emergent literacy plays in Chinese children's early reading skills during preschool years. Furthermore, there is a positive correlation between children's performance on the investigator-designed test for homophone judgement and their early reading skills, observed in both preschoolers and first-grade children. The novel finding is that vocabulary combined with morphological awareness emerges a significant predictor for early reading in Mandarin-speaking Chinese children.

In summary, although not devoid of limitations, the findings provide practical and theoretical implications for understanding and promoting early reading development in Chinese children. These findings highlight the influences of different emergent literacy components and suggest appropriate reading practices. Additional longitudinal research is needed to explore factors predicting early reading abilities in Mandarin-speaking children over time.

REFERENCES

Apel, K. (2011). What is orthographic knowledge? *Language, speech, and hearing services in schools, 42*. 592-603. http://doi.org/10.1044/0161-1461(2011/10-0085)

Apel, K., Diehm, E., & Apel, L. (2013). Using Multiple Measures of Morphological Awareness to Assess its Relation to Reading. *Topics in Language Disorders*, *33*(1), 42-56. https://doi.org/10.1097/TLD.0b013e318280f57b

Apel, K. (2014). A comprehensive definition of morphological awareness: Implications for assessment. *Topics in Language Disorders, 34*(3), 197-209. https://doi.org/10.1097/TLD.0000000000000019

Arnell, K. M., Joanisse, M. F., Klein, R. M., Busseri, M. A., & Tannock, R. (2009). Decomposing the relation between rapid automatized naming (RAN) and reading ability. *Canadian Journal of Experimental Psychology, 63*(3), 173-184. http://doi.org/10.1037/a0015721

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: a practical and powerful approach to multiple hypothesis testing. *J R Stat Soc B, 57,* 289-300.

Berninger, V. W., Abbott, R. D., Nagy, W., & Carlisle, J. (2010). Growth in

phonological, orthographic, and morphological awareness in grades 1 to 6. *Journal of Psycholinguistic Research, 39*(2), 141-163.

Bradley, R. H., & Corwyn, R. F. (2002). Socioeconomic status and child development. *Annual Review of Psychology, 53*(1), 371-399. https://doi.org/10.1146/annurev.sych.53.100901.135233

Byrne, B., Freebody, P., & Gates, A. (1992). Longitudinal data on the relations of word-reading strategies to comprehension, reading time, and phonemic awareness. *Reading Research Quarterly, 27*(2), 141-151. https://doi.org/10.2307/747683

Carlisle, J. F. (2000). Awareness of the structure and meaning of morphologically complex words: Impact on reading. *Reading and Writing: An Interdiseiplinary Journal, 12*, 169-190.

Chall, J. S. (2013). The great debate: Ten years later, with a modest proposal for reading stages. *Theory and practice of early reading*, 29-55.

Chan, C. K., & Siegel, L. S. (2001). Phonological processing in reading Chinese among normally achieving and poor readers. *Journal of experimental child psychology, 80*(1), 23-43. https://doi.org/10.1006/jecp.2000.2622

Chang, Y.-N, Taylor, J. S. H., Rastle, K., & Monaghan, P. (2020). The relationships between oral language and reading instruction: Evidence from a computational model of reading. *Cognitive Psychology, 123*, 101336. https://doi.org/10.1016/j.cogpsych.2020.101336

Chang, Y. J., Su, F. H., Tzeng, S. J., Ko, H. W., Wu, M. L., Yang, C. C., & Yang, C. Y. (2014). The contribution of rapid automatized naming to Chinese character recognition. *Learning and Individual Differences, 34*, 43-50.

Chen, X., Hao, M., Geva, E., Zhu, J., & Shu, H. (2009). The role of compound awareness in Chinese children's vocabulary acquisition and character reading. *Reading and Writing, 22*(5), 615-631.

Cheng, Y., Zhang, J., Wu, X., Liu, H., & Li, H. (2016). Cross-Lagged Relationships between Morphological Awareness and Reading Comprehension among Chinese Children. *Frontiers in Psychology, 7*, 1379. https://doi.org/10.3389/fpsyg.2016.01379

Chow, Y.-W., McBride-Chang, C. & Burgess, S. (2005). Phonological processing skills and early reading abilities in Hong Kong Chinese kindergarteners learning to read English as a second language. *Journal of Educational Psychology, 97*(1), 81-87. http://doi.org/10.1037/0022-0663.97.1.81

Chung, F. H., & Leung, M. (2008). Data analysis of Chinese characters in primary school corpora of Hong Kong and mainland China: Preliminary theoretical interpretations. *Clinical Linguistics & Phonetics*, *22*(4-5), 379-389. https://doi.org/10.1080/02699200701776757

Clay, M. M. (1966). *Emergent reading behavior.* Unpublished doctoral dissertation, University of Auckland, New Zealand.

Coltheart, M., Rastle, K., Perry, C., Langdon, R., & Ziegler, J. (2001). DRC: a dual route cascaded model of visual word recognition and reading aloud. *Psychological Review, 108*(1), 204-256. http://doi.org/10.1037/0033-295x.108.1.204

Conger, R. D., & Donnellan, M. B. (2007). An interactionist perspective on the socioeconomic context of human development. *Annual Review of Psychology, 58*(1), 175-199. https://doi.org/10.1146/annurev.psych.58.110405.085551

Deacon, S. H., Kieffer, M. J., & Laroche, A. (2014). The relation between morphological awareness and reading comprehension: Evidence from mediation and longitudinal models. *Scientific Studies of Reading, 18*(6), 432-451. http://doi.org/10.1080/10888438.2014.926907

Dickinson, D. K. (2011). Language practices and academic outcomes of preschool children. *Science, 333*(6045), 964-967. https://doi.org/10.1126/science.1204526

Ding, Y., Liu, R.-D., McBride, C., & Zhang, D. (2015). Pinyin Invented Spelling in Mandarin Chinese-Speaking Children With and Without Reading Difficulties. *Journal of Learning Disabilities, 48*(6), 635-645. https://doi.org/10.1177/0022219414522704

Dong, Y., Peng, S.-N., Sun, Y.-K., Wu, S. X.-Y., & Wang, W.-S. (2020). Reading Comprehension and Metalinguistic Knowledge in Chinese Readers: A Meta-Analysis. *Frontiers in Psychology, 10*, 3037. https://doi.org/10.3389/fpsyg.2019.03037

Dowdall, N., Melendez-Torres, G. J., Murray, L., Gardner, F., Hartford, L., & Cooper, P. J. (2020). Shared picture book reading interventions for child language development: A systematic review and meta-analysis. *Child Development, 91*(2), 383-399. https://doi.org/10.1111/cdev.13225

Dulay, K. M., Law, S. Y., McBride, C., & Ho, C. S.-H. (2021). Reciprocal effects of morphological awareness, vocabulary knowledge, and word reading: A cross-lagged panel analysis in Chinese. *Journal of Experimental Child Psychology*, *206*, 105100. https://doi.org/10.1016/j.jecp.2021.1

Ehri, L. C. (2020). The science of learning to read words: A case for systematic phonics

instruction. *Reading Research Quarterly, 55*(S1), 45-60.

Foorman, B. R., Anthony, J., Seals, L., & Mouzaki, A. (2002). Language development and emergent literacy in preschool. *Seminars in Pediatric Neurology, 9*(3), 173-184. https://doi.org/10.1053/spen.2002.35497 05100

Fung, W.-K., & Chung, K. K. H. (2020). The role of socioeconomic status in Chinese word reading and writing among Chinese kindergarten children. *Reading and Writing, 33*(2), 377-397. https://doi.org/10.1007/s11145-019-09967-2

Georgiou, G. K., Cho, J.-R., Deng, C., Altani, A., Romero, S., Kim, M.-Y., Wang, L., Wei, W., & Protopapas, A. (2022). Cascaded processing in naming and reading: Evidence from Chinese and Korean. *Journal of Experimental Child Psychology, 220,* 105416. https://doi.org/10.1016/j.jecp.2022.105416

Georgiou, G. K., Parrila, R., & Kirby, J. R. (2009). RAN components and reading development from Grade 3 to Grade 5: What underlies their relationship? *Scientific Studies of Reading, 13*(6), 508-534. http://doi.org/10.1080/10888430903034796

Georgiou, G. K., Torppa, M., Landerl, K., Desrochers, A., Manolitsis, G., de Jong, P. F., & Parrila, R. (2020). Reading and spelling development across languages varying in orthographic consistency: do their paths cross? *Child Development, 91*(2):266-279. https://doi.org./10.1111/cdev.13218

Girolametto, L., Weitzman, E., & Greenberg, J. (2012). Facilitating emergent literacy: Efficacy of a model that partners speech-language pathologists and educators. *American Journal of Speech-Language Pathology, 21*(1), 47-63. https://doi.org/10.1044/1058-0360(2011/11-0002)

Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability.

Remedial and special education, 7(1), 6-10.

Guan, C. Q., Fraundorf, S. H., & Perfetti, C. A. (2020). Character and child factors contribute to character recognition development among good and poor Chinese readers from grade 1 to 6. *Annals of Dyslexia, 70*(2), 220-242. https://doi.org/10.1007/s11881-020-00191-0

Hao, M., Chen, X., Dronjic, V., Shu, H., & Anderson, R. C. (2013). The development of young Chinese children's morphological awareness: The role of semantic relatedness and morpheme type. *Applied Psycholinguistics, 34*(1), 45-67.

Hemmerechts, K., Agirdag, O., & Kavadias, D. (2017). The relationship between parental literacy involvement, socio-economic status, and reading literacy. *Educational Review, 69*, 85-101.

Ho, C. S. H., Ng, T.-T., & Ng, W.-K. (2003). A "radical" approach to reading development in Chinese: The role of semantic radicals and phonetic radicals. *Journal of Literacy Research, 35*(3), 849-878.

Ho, C. S. H., Yau, P. W. Y., & Au, A. (2003). Development of orthographic knowledge and its relationship with reading and spelling among Chinese kindergarten and primary school children. In *Reading development in Chinese children* (pp.51-71). Greenwood.

Ho, F. C., & Siegel, L. (2012). Identification of subtypes of students with learning disabilities in reading and its implications for Chinese word recognition and instructional methods in Hong Kong primary schools. *Reading and Writing: An Interdisciplinary Journal, 25*(7), 1547-1571.

Hoover & Gough. (1990). The simple view of reading. *Reading and Writing: An*

Interdisciplinary Journal, 2, 127-160.

Horowitz-Kraus, T., & Hutton, J. S. (2015). From emergent literacy to reading: How learning to read changes a child's brain. *Acta Paediatrica, 104*(7), 648-656. https://doi.org/10.1111/apa.13018

Huang, H. S., & Hanley, J. R. (1997). A longitudinal study of phonological awareness, visual skills, and Chinese reading acquisition among first-graders in Taiwan. *International Journal of Behavioral Development, 20*(2), 249-268. https://doi.org/10.1080/016502597385324

Hulme, C., Zhou, L., Tong, X., Lervåg, A., & Burgoyne, K. (2019). Learning to read in Chinese: Evidence for reciprocal relationships between word reading and oral language skills. *Developmental Science, 22*(1), e12745. https://doi.org/10.1111/desc.12745

Kuo, L. J., & Anderson, R. C. (2006). Morphological awareness and learning to read: A cross-language perspective. *Educational Psychologist, 41*(3), 161-180. https://doi.org/10.1207/s15326985ep4103_3

Kuo, L. J., & Anderson, R. C. (2008). Conceptual and methodological issues in comparing metalinguistic awareness across languages. In Koda, K., & Zehler, A. M. (Eds.) *Learning to read across languages* (pp. 39-67). Routledge.

Lam, H. C. (2006). Orthographic awareness in learning Chinese characters. *Unpublished doctoral dissertation, The University of Hong Kong*.

Lei, L., Pan, J., Liu, H., McBride-Chang, C., Li, H., Zhang, Y., Chen, L., Tardif, T., Liang, W., Zhang, Z., & Shu, H. (2011). Developmental trajectories of reading development and impairment from ages 3 to 8 years in Chinese children. *Journal of*

child psychology and psychiatry, and allied disciplines, 52(2), 212–220. https://doi.org/10.1111/j.1469-7610.2010.02311.x

Leong, C. K., Tse, S. K., Loh, K. Y., & Hau, K. T. (2008). Text comprehension in Chinese children: Relative contribution of verbal working memory, pseudoword reading, rapid automatized naming, and onset-rime phonological segmentation. *Journal of Educational Psychology, 100*(1), 135-149. https://doi.org/10.1037/0022-0663.100.1.135

Lervåg, A., & Hulme, C. (2009). Rapid automatized naming (RAN) taps a mechanism that places constraints on the development of early reading fluency. *Psychological science, 20*(8), 1040-1048.

Li, H., Dong, Q., Zhu, J., Liu, J., & Wu, X. (2009). The role of morpheme awareness in the development of language skills in preschool children. *Psychological Science, 32*(6), 1291-1294.

Li, H., Peng, H., & Shu, H. (2006). Emergence and development of Chinese children's orthographic awareness. *Psychological Development and Education, 1*, 35-39.

Li, H., & Rao, N. (2000). Parental influences on Chinese literacy development: A comparison of preschoolers in Beijing, Hong Kong, and Singapore. *International Journal of Behavioral Development, 24*(1), 82-90.

Li, H. & Rao, N. (2005). Curricular and instructional influences on early literacy attainment: evidence from Beijing, Hong Kong, and Singapore. *International Journal of Early Years Education, 13*(3), 235-253.

Li, H., & Shu, H. (2009). Difference of cognitive skills between good and poor readers of preschool and primary school. *Psychological Development and Education, 25*(3), 1-

8.

Li, H., Shu, H., McBride-Chang, C., Liu, H., & Peng, H. (2012). Chinese children's character recognition: Visuo-orthographic, phonological processing and morphological skills. *Journal of Research in Reading, 35*(3), 287-307. https://doi.org/10.1111/j.1467-9817.2010.01460.x

Li, H., Huang, M., Li, J., et al. (2006). A preliminary exploration of basic morphological rules knowledge in dyslexic individuals. *Chinese Journal of Clinical Psychology*, 3(1), 25-34.

Li, J., Fu, X., & Lin, Z. (2000). A study on the development of Chinese orthographic awareness in school-age children. *Acta Psychologica Sinica*, 32(2), 121-126.

Li, L., & Wu, X. (2015). Effects of metalinguistic awareness on reading comprehension and the mediator role of reading fluency from grades 2 to 4. *PloS One, 10*(3), 1-16.

Li, M., Chen, S., & Wu, S. (2021). The development of preschool children's awareness of semantic radicals in Chinese characters. *Frontiers in Communication, 6*, 685573. https://doi.org/10.3389/fcomm.2021.685573

Li, W. L., Jiang, W., Shu, H., Hong, T., & Anderson, R. (2016). The role of Pinyin in Chinese reading development. *The world of children's reading, 3*, 3-26.

Liao, C.-H., Deng, C., Hamilton, J., Lee, -C. S.-C., Wei, W., & Georgiou, G. K. (2015). The role of rapid naming in reading development and dyslexia in Chinese. *Journal of Experimental Child Psychology, 130*, 106-122. http://doi.org/10.1016/j.jecp.2014.10.002

Lin, D., McBride-Chang, C., Shu, H., Zhang, Y., Li, H., Zhang, J., Aram, D., & Levin, I. (2010). Small wins big: analytic pinyin skills promote Chinese word reading.

Psychological science, 21(8), 1117-1122. https://doi.org/10.1177/0956797610375447

Lin, D., Sun, H., & McBride, C. (2019). Morphological awareness predicts the growth rate of Chinese character reading. *Developmental Science, 22*(4), e12793. https://doi.org/10.1111/desc.12793

Lin, D., Sun, H., & Zhang, X. (2016). Bidirectional relationship between visual-spatial skills and Chinese character reading ability in Chinese kindergartners: A cross-lagged analysis. *Contemporary Educational Psychology, 46*, 94-100.

Lin, Y., Lin, Y.-J., Wang, F., Wu, X., & Kong, J. (2020). The development of phonological awareness and Pinyin knowledge in Mandarin-speaking school-aged children. *International Journal of Speech-Language Pathology, 22*(6), 660-668. https://doi.org/10.1080/17549507.2020.1819417

Liu, C., & Chung, K.-K.-H. (2022). Effects of fathers' and mothers' expectations and home literacy involvement on their children's cognitive–linguistic skills, vocabulary, and word reading. *Early Childhood Research Quarterly, 60*, 1-12. https://doi.org/10.1016/j.ecresq.2021.12.009

Liu, C., Georgiou, G. K., & Manolitsis, G. (2018). Modeling the relationships of parents' expectations, family's SES, and home literacy environment with emergent literacy skills and word reading in Chinese. *Early Childhood Research Quarterly, 43*, 1-10. https://doi.org/10.1016/j.ecresq.2017.11.001

Liu, D., Li, H., & Wong, K. S. R. (2017). The anatomy of the role of morphological awareness in Chinese character learning: The mediation of vocabulary and semantic radical knowledge and the moderation of morpheme family size. *Scientific Studies of*

Reading, 21(3), 210-224.

Liu, D., Wang, L., Xu, Z., Li, M., Malatesha Joshi, R., Li, N., & Zhang, X. (2023). Understanding Chinese children's word reading by considering the factors from cognitive, psychological and ecological factors. *Contemporary Educational Psychology, 73*, 102163. https://doi.org/10.1016/j.cedpsych.2023.102163

Liu, D., & Zhu, X. (2016). The associations of phonological awareness, morphological awareness, orthographic awareness and RAN with Hong Kong Chinese children's literacy performance at word level. *Writing Systems Research, 8*(2), 218-233.

Liu, P. D., McBride-Chang, C., Wong, T.T.Y., Shu, H., & Wong, A. M.Y. (2013). Morphological awareness in Chinese: unique associations of homophone awareness and lexical compounding to word reading and vocabulary knowledge in Chinese children. *Applied Psycholinguistics, 34*(4),755-775. http://doi.org/10.1017/S014271641200001X

Liu, Y., Georgiou, G. K., Zhang, Y., Li, H., Liu, H., Song, S., Kang, C., Shi, B., Liang, W., Pan, J., & Shu, H. (2017). Contribution of cognitive and linguistic skills to word-reading accuracy and fluency in Chinese. *International Journal of Educational Research, 82*, 75-90.

Liu, Y., Qian, Y., Song, Y., & Bi, H. (2018). Emergence and development of orthographic awareness in Chinese children aged 4-6. *Psychological Development and Education*, 34(1), 65-72.

Lonigan, C. J., Anthony, J. L., Phillips, B. M., Purpura, D. J., Wilson, S. B., & McQueen, J. D. (2009). The nature of preschool phonological processing abilities and their relations to vocabulary, general cognitive abilities, and print knowledge. *Journal of*

Educational Psychology, 101(2), 345-358. https://doi.org/10.1037/a0013837

Lui, K. F. H., Lo, J. C. M., Maurer, U., Ho, C. S. -H., & McBride, C. (2021). Electroencephalography decoding of Chinese characters in primary school children and its prediction for word reading performance and development. *Developmental Science, 24*(3), e13060. https://doi.org/10.1111/desc.13060

Luo, Y. C., Chen, X., Hélène Deacon, S., & Li, H. (2011). Development of Chinese orthographic processing: A cross-cultural perspective. *Writing Systems Research, 3*(1), 69-86. https://doi.org/10.1093/wsr/wsr008

Lyon, G. R., Shaywitz, S. E., & Shaywitz, B. A. (2003). A definition of dyslexia. *Dyslexia, 53*(1), 1-14.

McBride, C. A. (2016). Is Chinese special? Four aspects of Chinese literacy acquisition that might distinguish learning Chinese from learning alphabetic orthographies. *Educational Psychology Review, 28*, 523-549.

McBride-Chang, C., Bialystok, E., Chong, K., & Li, Y.P. (2004). Levels of phonological awareness in three cultures. *Journal of Experimental Child Psychology, 89*(2), 93-111.

McBride-Chang, C., Chow, B. W.-Y., Zhong, Y.-P., Burgess, S., & Hayward, W. (2005). Chinese character acquisition and visual skills in two Chinese scripts. *Reading and Writing, 18*, 99-128.

McBride-Chang, C., & Ho, C. S. -H. (2000a). Developmental issues in Chinese children's character acquisition. *Journal of Educational Psychology, 92*(1), 50-55.

McBride-Chang, C., & Ho, C. S. -H. (2000b). Naming speed and phonological awareness in Chinese children: Relations to reading skills. *Journal of Psychology in Chinese*

Societies, 1, 93-108.

McBride-Chang, C., & Ho, C. S.-H. (2005). Predictors of Beginning Reading in Chinese and English: A 2-Year Longitudinal Study of Chinese Kindergartners. *Scientific Studies of Reading, 9*(2), 117-144. https://doi.org/10.1207/s1532799xssr0902_2

McBride-Chang, C., & Kail, R. V. (2002). Cross-cultural similarities in the predictors of reading acquisition. *Child Development, 73*(5), 1392-1407. https://doi.org/10.1111/1467-8624.00479

McBride-Chang, C., Shu, H., Zhou, A., Wat, C. P., & Wagner, R. K. (2003). Morphological awareness uniquely predicts young children's Chinese character recognition. *Journal of Educational Psychology, 95*(4), 743-751. https://doi.org/10.1037/0022-0663.95.4.743

McBride-Chang, C., Tong, X., Shu, H., Wong, A. M.-Y., Leung, K., & Tardif, T. (2008). Syllable, Phoneme, and Tone: Psycholinguistic Units in Early Chinese and English Word Recognition. *Scientific Studies of Reading*, *12*(2), 171-194. https://doi.org/10.1080/10888430801917290

McClelland, J. L., & Rumelhart, D. E. (1981). An interactive activation model of context effects in letter perception: Part 1. An account of basic findings. *Psychological Review, 88*(5), 375-407.

Ministry of Education of the People's Republic of China. (2012). *The Chinese curriculum standards in compulsory education.* Beijing Normal University Publishing Group.

Nation, K., Clarke, P., Marshall, C. M., & Durand, M. (2004). Hidden language impairments in children: parallels between poor reading comprehension and specific language impairment?. *Journal of speech, language, and hearing research, 47*(1),

199-211. https://doi.org/10.1044/1092-4388(2004/017)

National Reading Panel (U.S.) & National Institute of Child Health and Human Development (U.S.). (2000). *Report of the National Reading Panel: Teaching children to read: an evidence-based assessment of the scientific research literature on reading and its implications for reading instruction*. U.S. Dept. of Health and Human Services, Public Health Service, National Institutes of Health, National Institute of Child Health and Human Development.

Newman, E. H., Tardif, T., Huang, J., & Shu, H. (2011). Phonemes matter: The role of phoneme-level awareness in emergent Chinese readers. *Journal of Experimental Child Psychology, 108*(2), 242-259. https://doi.org/10.1016/j.jecp.2010.09.001

Pan, J., Kong, Y., Song, S., McBride, C., Liu, H., & Shu, H. (2017). Socioeconomic status, parent report of children's early language skills, and late literacy skills: A long term follow-up study among Chinese children. *Reading and Writing, 30*(2), 401-416. https://doi.org/10.1007/s11145-016-9682-4

Pan, J., McBride-Chang, C., Shu, H., Liu, H., Zhang, Y., & Li, H. (2011). What is in the naming? A 5-year longitudinal study of early rapid naming and phonological sensitivity in relation to subsequent reading skills in both native Chinese and English as a second language. *Journal of Educational Psychology, 103*(4), 897-908. http://doi.org/10.1037/a0024344

Pan, J., Song, S., Su, M., McBride, C., Liu, H., Zhang, Y., Li, H., & Shu, H. (2016). On the relationship between phonological awareness, morphological awareness and Chinese literacy skills: Evidence from an 8-year longitudinal study. *Developmental Science*, *19*(6), 982-991. https://doi.org/10.1111/desc.12356

Perfetti, C. (2009). Decoding, vocabulary, and comprehension. In M. McKeown & L. Kucan (Eds.), *Bring reading research to life* (pp. 291-303). New York and London: Guilford Press.

Perfetti, C. A., & Dunlap, S. (2008). Learning to read: General principles and writing system variations. In *Learning to read across languages* (pp. 25-50). Routledge.

Perfetti, C., & Hart, L. (2002). The lexical quality hypothesis. *Precursors of Functional Literacy* (pp. 189-213). http://doi.org/10.1075/swll.11.14per

Perfetti, C. A., Landi, N., & Oakhill, J. (2005). The Acquisition of Reading Comprehension Skill. In M. J. Snowling, & C. Hulme (Eds.), *The Science of Reading: A Handbook* (pp. 227-247). Oxford: Blackwell.

Perfetti, C. A., Liu, Y., & Tan, L, H. (2005). The lexical constituency model: Some implications of research on Chinese for general theories of reading. *Psychological Review, 112*(1), 43-59.

Protopapas, A., Altani, A., & Georgiou, G. K. (2013). Development of serial processing in reading and rapid naming. *Journal of Experimental Child Psychology, 116*(4), 914-929. http://doi.org/10.1016/j.jecp.2013.08.004

Puranik, C. S., & Lonigan, C. J. (2011). From scribbles to scrabble: Preschool children's developing knowledge of written language. *Reading and Writing, 24*(5), 567-589. https://doi.org/10.1007/s11145-009-9220-8

Puranik, C. S., & Lonigan, C.J, (2014). Emergent writing in preschoolers: preliminary evidence for a theoretical framework. R*ead Research Quarterly, 49*(4):453-467. http://doi.org/10.1002/rrq.79

Qian, Y., Zhao, J., & Bi, H. (2013). Development of orthographic awareness in Chinese

preschool children. *Acta Psychologica Sinica*, 45(1), 60-69.

Ravthon, N. (2004). *Early reading assessment: a practitioner's handbook.* New York: The Guilford Press.

Rayner, K., & Reichle, E. D. (2010). Models of the reading process. *Wiley Interdisciplinary Reviews: Cognitive Science, 1*(6), 787-799. https://doi.org/10.1002/wcs.68

Roth, F. P., Speece, D. L., & Cooper, D. H. (2002). A longitudinal analysis of the connection between oral language and early reading. *Journal of Educational Research, 95*(5), 274-295.

Ruan, Y., Georgiou, G. K., Song, S., Li, Y., & Shu, H. (2018). Does writing system influence the association between phonological awareness, morphological awareness, and reading? a meta-analysis. *Journal of Educational Psychology, 110*(2), 180-202.

Sang, B., & Miu, X. (1990). Revision of the norms for the Peabody Picture Vocabulary Test-Revised (PPVT-R) in Shanghai urban areas. *Psychological Science Communications*, (5), 20-25.

Shen, H., & Ke, C. (2007). Radical awareness and word acquisition among nonnative learners of Chinese. *The Modern Language Journal, 91*(1), 97-111. http://doi.org/10.1111/j.1540-4781.2007.00511.x

Shu, H., Chen, X., Anderson, R. C., Wu, N., & Xuan, Y. (2003). Properties of School Chinese: Implications for Learning to Read. *Child Development, 74*(1), 27-47. https://doi.org/10.1111/1467-8624.00519

Shu, H., Mc Bride-Chang, C., Wu, S., & Liu, H. (2006). Understanding Chinese

developmental dyslexia: morphological awareness as a core cognitive construct. *Journal of Educational Psychology, 98*(1), 122-133. https://doi.org/10.1037/0022-0663.98.1.122

Shu, H., Meng, X., & Lai, A.C. (2003). Lexical representation and processing in Chinese-speaking poor readers. In C. McBride-Chang & H.-C. Chen (Eds.), *Reading development in Chinese children* (pp. 199-213). Westport, CT: Praeger Press.

Shu, H., Peng, H., & McBride-Chang, C. (2008). Phonological awareness in young Chinese children. *Developmental Science, 11*(1), 171-181. https://doi.org/10.1111/j.1467-7687.2007.00654.x

Siok, W. T., & Fletcher, P. (2001). The role of phonological awareness and visual-orthographic skills in Chinese reading acquisition. *Developmental Psychology, 37*(6)*,* 886-99.

Snowling, M. J. (2000). *Dyslexia*, 2nd Edn. Malden, MA: Blackwell.

Song, S., Georgiou, G. K., Su, M., & Hua, S. (2016). How well do phonological awareness and rapid automatized naming correlate with Chinese reading accuracy and fluency? A meta-analysis. *Scientific Studies of Reading, 20*(2), 99-123. https://doi.org/10.1080/10888438.2015.1088543

Soper, D.S. (2023). Significance of the Difference between Two Correlations Calculator [Software]. Available from https://www.danielsoper.com/statcalc

Sparks, E., & Deacon, S. H. (2015). Morphological awareness and vocabulary acquisition: A longitudinal examination of their relationship in English-speaking children. *Applied Psycholinguistics, 36*(2), 299-321.

Stanovich, K. E. (2000). *Progress in understanding reading: Scientific foundations and*

new frontiers. London: Guilford Press.

Su, X., & Kim, Y.-S. (2014). Semantic radical knowledge and word recognition in Chinese for Chinese as foreign language learners. *Reading in a Foreign Language, 26*(1), 131-152.

Sun, C., Branum-Martin, L., Peng, P., & Tao, S. (2018). Phonology, orthography, and decoding skills within and across English and Chinese. *Scientific Studies of Reading, 22*(5), 401–419. https://doi.org/10.1080/10888438.2018.1466302

Taft, M., Zhu, X., & Peng, D. (1999). Positional specificity of radicals in Chinese character recognition. *Journal of Memory and Language, 40*(4), 498-519.

Tan, L.H., & Perfetti, C. A. (1999). Phonological activation in visual identification of Chinese 2-character words. *Journal of Experimental Psychology, 25*(2), 382–393.

Tan, L. H., Spinks, J. A., Eden, G. F., Perfetti, C. A., & Siok, W. T. (2005). Reading depends on writing, in Chinese. *Proceedings of the National Academy of Sciences, 102*(24), 8781-8785. https://doi.org/10.1073/pnas.0503523102

Tighe, E. L., Wanger, R. K., & Schatchneide, C. (2015). Applying a multiple group causal indicator modeling framework to the reading comprehension skills of third, seventh, and tenth grade students. *Reading and Writing, 28*(4), 439-466.

Tong, X., McBride-Chang, C., Shu, H. & Wong, A.M.-Y. (2009). Morphological awareness, orthographic knowledge, and spelling errors: Keys to understanding early Chinese literacy acquisition. *Scientific Studies of Reading, 13*(5), 426-452, http://doi.rog/10.1080/10888430903162910

Tong, X., Tong, X., & McBride, C. (2017). Unpacking the relation between morphological awareness and Chinese word reading: Levels of morphological

awareness and vocabulary. *Contemporary Educational Psychology, 48*, 167-178.

Vasilyeva, M., Dearing, E., Ivanova, A., Shen, C., & Kardanova, E. (2018). Testing the family investment model in Russia: Estimating indirect effects of SES and parental beliefs on the literacy skills of first graders. *Early Childhood Research Quarterly, 42*, 11-20.

Verhoeven, L., & Perfetti, C. A. (2003). Introduction to this special issue: The role of morphology in learning to read. *Scientific Studies of Reading, 7*(3), 209-217.

Wang, J., & Zhang, J. (2016). The effects of category consistency and neighborhood size of the semantic radical on the semantic processing of Chinese character. *Acta Psychologica Sinica, 48*(11), 1390-1400. http://doi.org/10.3724/SP.J.1041.2016.01390

Wang, J., Meng, X., Li, H., Cui, X., Hong, T., Yang, B., ... & Xing, A. (2023). Expert opinions on the diagnosis and intervention of developmental reading disorders in Chinese. *Chinese Mental Health Journal*, 37(3), 185-191.

Wang, L., Wang, J., Liu, D., & Lin, D. (2021). The role of metalinguistic awareness and character properties in early Chinese reading. *Journal of Experimental Child Psychology*, 210, 105185. https://doi.org/10.1016/j.jecp.2021.105185

Wang, M., Cheng, C., & Chen, S. W. (2006). Contribution of morphological awareness to Chinese-English biliteracy acquisition. *Journal of Educational Psychology, 98*(3), 542-553.

Wang, X., Georgiou, G. K., & Das, J. P. (2012). Cognitive processing skills and developmental dyslexia in Chinese. *Journal of Learning Disabilities, 45*(6), 526-537.

Wang, Y., McBride-Chang, C., & Chan, S. F. (2014). Correlates of Chinese kindergarteners' word reading and writing: The unique role of copying skills? *Reading and Writing: An Interdisciplinary Journal, 27*, 1281-1302. https://doi.org/10.1007/s11145-013-9486-8

Wang, L. C., & Yang, H. M. (2014). Classifying Chinese children with dyslexia by dual-route and triangle models of Chinese reading. *Research in developmental disabilities*, *35*(11), 2702-2713.

Wei, T.-Q., Bi, H.-Y., Chen, B.-G., Liu, Y., Weng, X.-C., & Wydell, T. N. (2014). Developmental changes in the role of different metalinguistic awareness skills in Chinese reading acquisition from preschool to third grade. *PLoS ONE, 9*(5), e96240. https://doi.org/10.1371/journal.pone.0096240

Whitehurst, G. J., & Lonigan G. J. (1998). Child development and emergent literacy. *Child Development, 69*(3), 848-872.

Wu, X., Anderson, R. C., Li, W., Wu, X., Li, H., Zhang, J., et al. (2009). Morphological awareness and Chinese children's literacy development: an intervention study. *Scientific Studies of Reading, 13*(1), 26-52. http://org.doi/10.1080/10888430802631734

Xie, R., Zhang, J., Wu, X., & Nguyen, T. P. (2019). The relationship between morphological awareness and reading comprehension among Chinese children. *Frontiers in Psychology, 10*, 54. http://doi.ort/10.3389/fpsyg.2019.00054

Xu, J. (2022). Memorization is not rote learning: rethinking memorization as an embodied practice for Chinese students. *Journal of Multilingual and Multicultural Development*, 1-17. https://doi.org/10.1080/01434632.2022.2134878

Xue, J., Shu, H., Li, H., Li, W., & Tian, X. (2013). The stability of literacy-related cognitive contributions to Chinese character naming and reading fluency. *Journal of Psycholinguistic Research, 42*, 433-450. http://doi.org/10.1007/s10936-012-9228-0

Yan, M., Li, Y., Sun, X., Zhou, X., Hui, Y., & Li, H. (2021). The roles of decoding and vocabulary in Chinese reading development: Evidence from a 3-year longitudinal study. *British Journal of Educational Psychology, 91*(1), 300-314. https://doi.org/10.1111/bjep.12365

Yang, J., Zevin, J. D., Shu, H., McCandliss, B. D., & Li, P. (2006). A "Triangle Model" of Chinese Reading. In *28th annual conference of the cognitive science society, Mahwah, NJ.*

Yang, Y., Huang, C. R., Dong, S., & Chen, S. (2018). Semantic transparency of radicals in Chinese characters: an ontological perspective. In *Proceedings of the 32nd Pacific Asia Conference on Language, Information and Computation*.

Yang, Y., Ma, J., Tan, K., et al. (2019). Rapid naming deficits in Chinese children with developmental reading disorders. *Studies of Psychology and Behavior,* 17(5), 652-661.

Ye, Y., & McBride, C. (2022). A Dynamic Interactive Model of Chinese Spelling Development. *Educational Psychology Review, 34*(4), 2897-2917. https://doi.org/10.1007/s10648-022-09684-3

Yeung, P.S., Ho, C. S., Chan, D. W., & Chung, K. K. (2014). What are the early indicators of persistent word reading difficulties among Chinese readers in elementary grades? *Dyslexia, 2*0(2), 119-145.

Yeung, P. S., Ho, C. S.-H., Chik, P. P.-M., Lo, L.-Y., Luan, H., Chan, D. W.-O., & Chung, K. K.-H. (2011). Reading and spelling Chinese among beginning readers:

What skills make a difference? *Scientific Studies of Reading, 15*(4), 285-313. http://doi.org/10.1080/10888438.2010.482149

Yeung, P. S., Ho, C. S. H., Wong, Y. K., Chan, D. W. O., Chung, K. K. H., & Lo, L. Y. (2013). Longitudinal predictors of Chinese word reading and spelling among elementary grade students. *Applied Psycholinguistics, 34*(6), 1245-1277. https://doi.org/10.1017/S0142716412000239

Yin, L., Li, W., Chen, X., Anderson, R., Zhang, J., Shu, H., & Jiang, W. (2011). The role of tone awareness and pinyin knowledge in Chinese reading. *Writing Systems Research, 3*(1), 59-68.

Yin, L., & McBride, C. (2015). Chinese kindergartners learn to read characters analytically. *Psychological Science, 26*(4), 424-432. https://doi.org/10.1177/0956797614567203

Yin, W.-G., & Weekes, B. S. (2003). Dyslexia in Chinese: Clues from cognitive neuropsychology. *Annals of Dyslexia, 53*, 255–279.

Yoder, P., Watson, L. R., & Lambert, W. (2015). Value-Added Predictors of Expressive and Receptive Language Growth in Initially Nonverbal Preschoolers with Autism Spectrum Disorders. *Journal of Autism and Developmental Disorders, 45*(5), 1254-1270. https://doi.org/10.1007/s10803-014-2286-4

Yuan, H., Segers, E., & Verhoeven, L. (2022). Predictors of early Mandarin Chinese character reading development. *Children, 9*(12), 1946. https://doi.org/10.3390/children9121946

Zevin, J. (2009). *Word recognition, encyclopedia of neuroscience*. Academic Press, 517-522. https://doi.org/10.1016/B978-008045046-9.01881-7

(https://www.sciencedirect.com/science/article/pii/B9780080450469018817)

Zhang, L., Xia, Z., Zhao, Y., Shu, H., & Zhang, Y. (2023). Recent Advances in Chinese Developmental Dyslexia. *Annual Review of Linguistics, 9*(1), 439-461. https://doi.org/10.1146/annurev-linguistics-030421-065648

Zhang, L., Yin, L., & Treiman, R. (2017). Chinese children's early knowledge about writing. *British Journal of Developmental Psychology, 35*(3), 349-358.

Zhang, S.-Z., Inoue, T., Shu, H., & Georgiou, G. K. (2020). How does home literacy environment influence reading comprehension in Chinese? Evidence from a 3-year longitudinal study. *Reading and Writing, 33*(7), 1745-1767. https://doi.org/10.1007/s11145-019-09991-2

Zhang, X., Mao, R., Sun, Y., & Wang, Y. (2018). A study on the predictive role of elementary school students' reading-related cognitive factors in reading comprehension ability. *Modern Special Education (Higher Education Research)*, 8, 38-56.

Zhang, Y., Tardif, T., Shu, H., Li, H., Liu, H., McBride-Chang, C., Liang, W., & Zhang, Z. (2013). Phonological skills and vocabulary knowledge mediate socioeconomic status effects in predicting reading outcomes for Chinese children. *Developmental Psychology, 49*(4), 665-671. https://doi.org/10.1037/a0028612

Zhao, J., Bi, H., & Yang, Y. (2012). Rapid naming and orthographic processing skills in Chinese children with developmental reading disorders. *Chinese Journal of Mental Health, 26*(1), 36-40.

Zhou, J. (2003). On the composition, structure, and status of words. *Chinese Language,* (2), 148-155.

Zhou, Y. L., McBride-Chang, C., Fong, C. Y.-C., Wong, T. T.-Y., & Cheung, S. K. (2012). A comparison of phonological awareness, lexical compounding, and homophone training for Chinese word reading in Hong Kong kindergarteners. *Early Education and Development, 23*(4), 475-492.

Ziegler, J., & Goswami, U. (2005). Reading acquisition developmental dyslexia and skilled reading across languages: A psycholinguistic grain size theory. *Psychological Bulletin, 131*(1)*,* 3-29.

Zou, G. Y. (2007). Toward using confidence intervals to compare correlations. *Psychological Methods, 12*(4), 399-413. https://doi.org/10.1037/1082-989X.12.4.399

APPENDICES

Appendix A. IRB Approval Letter

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INSTITUTIONAL REVIEW BOARD
April 27, 2023

Principal Investigator:	Yingshan Huang		
IRB # and Title:	IRB PROTOCOL: 23-098		
	[2021663-3] The correlates of Chinese children's early reading skills		
Status:	APPROVED	Review Type:	Full Committee Review
Approval Date:	April 27, 2023	Submission Type:	New Project
Initial Approval:	April 27, 2023	Next Report Due:	April 27, 2024
Review Category:	Full Board		

This panel, operating under the authority of the DHHS Office for Human Research and Protection, assurance number FWA 00001602, and IRB #00000286 or #00011574, has reviewed the submitted materials for the following:

1. *Protection of the rights and the welfare of human subjects involved.*
2. *The methods used to secure and the appropriateness of informed consent.*
3. *The risk and potential benefits to the subject.*

The regulations require that the investigator not initiate any changes in the research without prior IRB approval, except where necessary to eliminate immediate hazards to the human subjects, and that **all problems involving risks and adverse events be reported to the IRB immediately!**

Subsequent supporting documents that have been approved will be stamped with an IRB approval and expiration date (if applicable) on every page. Copies of the supporting documents must be utilized with the current IRB approval stamp unless consent has been waived.

Notes:

EBR full board review was conducted and has determined that this study is minimal risk:

45 CFR 46.110 (6): Collection of data from voice, video, digital, or image recordings made for research purposes

Generated on IRBNet

Appendix B. Child and Family History Questionnaire

中国儿童早期阅读能力的相关因子研究

美国南亚拉巴马大学 言语与听力病理学学院 黄滢珊

儿童发展与家族病史调查问卷

请尽可能准确完整地填写问卷。您所提供的信息将会被保密。问卷调查结果将汇总并用于科学研究，个人身份信息将予以保密。

孩子姓名：_____ 出生日期：_____

性别：_____ 民族：_____

父母姓名：_____ 手机号码：_____

家庭住址：_____

I. 言语发展

几岁时您的孩子：说出单字 _____

说出双字词 _____

您是否能理解您的孩子说的话吗？_____

他人是否能理解您的孩子说的话吗？_____

USA Institutional Review Board	
Approved:	04/27/2023
IRB Number:	23-098/2021663-3

如果以上两题任何一个答案为否，请说明：_____

_____

II. 发育史

您在怀孕、临产和/或分娩期间遇到过什么困难吗?（例如，早产、Rh 不相容、毒血症、药物/酒精滥用、接触传染病等）如果答案为是，请说明:

_____

_____

您的孩子有任何健康问题或医学疾病吗？如果是，请说明：

_____

您的孩子是否曾被诊断为智力或发育障碍，如孤独症、唐氏综合症或威廉姆斯综合症？如果是，请说明：

_____

您的孩子有听力问题吗？如果有，请说明：_____

_____

您的孩子是否接受过言语治疗、作业治疗或物理治疗？如果是，请说明：_____

_____

您是否担心过您孩子的行为问题？如果是，请描述：_____

_____

III. 家族病史

USA Institutional Review Board
Approved: 04/27/2023
IRB Number: 23-098/2021663-3

家庭成员是否经历过言语、语言和/或学习困难?

_____

你家里说的主要语言是什么? _____

您家里还经常使用其他语言或方言吗? _____

IV. 父母信息

请描述您的职业及头衔:

母亲: _____

父亲: _____

请**圈出**父母的最终教育年限。例如，如果高中毕业请圈出“12”；如果是本科毕业请在“高中后”一行圈出“4”。

母亲: 1 2 3 4 5 6 7 8 9 10 11 12

高中后: 1 2 3 4 5 6 7 8 9 10

学位: _____

父亲: 1 2 3 4 5 6 7 8 9 10 11 12

高中后: 1 2 3 4 5 6 7 8 9 10

学位: _____

USA Institutional Review Board	
Approved:	04/27/2023
IRB Number:	23-098/2021663-3

Appendix C. Syllable Deletion Task

There are 15 real three-syllable Chinese words. Please read out each word as you hear, and then delete either the first, middle or last syllable for each word according to instructions. For example, please say "幼儿园 /yòu ér yuán/", and say "幼儿园 /yòu ér yuán/" without the "儿 /ér/" . The answer is "幼园 /yòu yuán/.

No.	Words	Syllable Deletion Task	Answer	Score
1	动 物 园	Delete "物" (2nd syllable)	动 园	
2	笔 记 本	Delete "笔" (1st syllable)	记 本	
3	小 可 爱	Delete "爱" (3rd syllable)	小 可	
4	巧 克 力	Delete "克" (2nd syllable)	巧 力	
5	公 交 车	Delete "公" (1st syllable)	交 车	
6	洗 发 水	Delete "发" (2nd syllable)	洗 水	
7	电 动 车	Delete "车" (3rd syllable)	电 动	
8	圆 珠 笔	Delete "圆" (1st syllable)	珠 笔	
9	向 日 葵	Delete "葵" (3rd syllable)	向 日	
10	红 领 巾	Delete "领" (2nd syllable)	红 巾	
11	暴 风 雨	Delete "雨" (3rd syllable)	暴 风	
12	文 具 盒	Delete "文" (1st syllable)	具 盒	
13	蛋 炒 饭	Delete "炒" (2nd syllable)	蛋 饭	
14	游 泳 池	Delete "泳" (2nd syllable)	游 池	
15	手 电 筒	Delete "笔" (3rd syllable)	手 电	

Appendix D. Lexical Compounding Task

Based on a scenario that describes an object or concept, create a new word by lexical compounding to name a corresponding new object. There are three trial items before the formal test.

No.	Scenario	Example Word	Question	Answer
Example 1	有一种果汁是用橙子做的。我们叫它橙汁。 There is one type of juice made from oranges; we call it orange juice.	橙汁 Orange juice	那么用苹果做的果汁叫什么？ What would we call a type of juice that is made from apples?	苹果汁 Apple juice
Example 2	种植物的园子，我们叫它植物园。	植物园	那么住动物的园子叫什么？	动物园
Example 3	有一种盒子是用来装文具的，我们叫它文具盒。	文具盒	那么用来装首饰的盒子叫什么？	首饰盒
1	有一种水是用红糖泡的，我们叫它红糖水。	红糖水	那么用盐泡的水叫什么？	盐水
2	有一种书是由图画构成的，我们叫它图画书。	图画书	那么由故事构成的书叫什么？	故事书
3	有一种包子是用豆沙做的，我们叫它豆沙包。	豆沙包	那么由芝麻做的包子叫什么？	芝麻包
4	有一种裙子是用白纱做的，我们叫它白纱裙。	白纱裙	那么用真丝做的裙子叫什么？	真丝裙
5	有一种豆子是红色的，我们叫它红豆。	红豆	那么黄色的豆子叫什么？	黄豆
6	教语文的课，我们叫它语文课。	语文课	那么教数学的课叫什么？	数学课
7	有一种地是种西瓜的，我们叫它西瓜地。	西瓜地	那么种花生的地叫什么？	花生地
8	用来展览美术的场馆，我们叫它美术馆。	美术馆	那么用来展览文物的场馆叫什么？	文物馆

9	有一种树是能长出香蕉的，我们叫它香蕉树。	香蕉树	那么能长出椰子的树叫什么？	椰子树
10	有一种工厂是制造玩具的，我们叫它玩具厂。	玩具厂	那么制造鞋子的工厂叫什么？	鞋子厂/鞋厂

Appendix E. Homophone Judgment Task

Circle the correct Chinese character in parentheses to form the word, just as the example shows.

Example:（做　坐 ）下

1. （昨　作）业	2. 可（以　己）	3. （近　进）出
4. 时（后　候）	5. 发（牙　芽）	6. （家　加）人
7. 觉（的　得）	8. （衣　一）服	9. （石　十）头
10. （禾　和）好	11. （力　立）气	12. 自（己　几）
13. （巴　八）月	14. 树（木 目）	15. （不　布）要
16. 说（话　画）	17. 朋（有　友）	18. （古　谷）代
19. 现（在　再）	20. （飞　非）机	21. （升　生）活
22. 对（比　笔）	23. 公（园　元）	24. （东　冬）天
25. （工　功）人	26. （明　名）亮	27. （是　士）兵
28. （香　乡）水	29. （个　各）子	30. 下（语　雨）

Appendix F. Homophone Generation Task

Please use the target morpheme to form a word and then use the homophones that have the same sound to form as many words as possible. For example, speak out the words that have the morpheme ‘糖 /táng/’ in the word ‘糖果 /táng guǒ/’ (“吃糖”), then use the morphemes sounding /táng/ to form as many words as you can (“池塘 /chí táng/”, “食堂 /shí táng/”, “唐朝 /táng cháo/”, etc.)

	Use the target morpheme to form words	Use the homophones that have the same sound to form words
1. 和平 /hé/	和气，和解，	禾：禾苗 河：河水，河流 合：合并，合作， 何：几何，如何 荷：荷花，荷叶
2. 方向 /xiàng/	向往，朝向	像：好像，就像 象：大象，象牙 相：相片，照相
3. 原来 /yuán/	原料，原因，平原，	园：公园，花园 圆：圆形，圆圈 元：一元钱，元帅 员：队员，员工 源：水源，来源，源泉
4. 作业 /zuò/	作品，作文，	做：做事， 坐：坐下 座：座位，座号，座椅
5. 工人 /gōng/	工作，工程	公：公平，公正 功：功能，练功 宫：皇宫，宫殿 弓：弓箭
6. 力气 /lì/	用力，力量，能力	立：立正，站立，建立 利：锋利，胜利， 丽：美丽，艳丽，亮丽 例：例子，举例 历：历史，经历
7. 长短 /cháng/	长江，长绳，	常：经常，时常，通常 尝：尝试，品尝

		肠：香肠，肉肠，小肠 偿：赔偿，补偿
8. 着急 /jí/	心急，急匆匆，急忙	级：年级，级别，班级 及：及时，来得及 集：集中，集合，集体 吉：吉祥，吉利

Appendix G. Character Judgment Task

Please circle out non-characters from a list of 50 items.

𠃌	书	𠃊	𠃋	定
这	阢	𠀀	办	地
𠀁	下	𠀂	𠀃	会
法	𠀄	𠀅	𠀆	包
方	总	𠀇	作	𠀈
宝	𠀉	可	𠀊	元
𠀋	行	𠀌	问	中
𠀍	𠀎	伙	是	日
要	收	人	的	𠀏
加	纠	国	𠀐	西

Appendix H. PPVT-R Scoring Sheet

序号	内容	答案序号	是否正确	序号	内容	答案序号	是否正确
1	汽车	4		39	潜艇	4	
2	母牛	3		40	香肠	4	
3	球	1		41	采	2	
4	小孩	1		42	倒	1	
5	手指	4		43	沙锅	2	
6	鸡	2		44	信号	1	
7	热水瓶	2		45	豆荚	3	
8	钥匙	1		46	鹰	3	
9	蜜蜂	4		47	风镜	3	
10	风扇	2		48	搓	2	
11	叶子	3		49	栏杆	1	
12	吹	4		50	一群	4	
13	拖拉机	4		51	帆	4	
14	孔雀	2		52	羚羊	2	
15	女孩	2		53	演说家	2	
16	河流	1		54	升起	4	
17	罐头	4		55	宣誓	3	
18	裙子	1		56	豁口	3	
19	鼓	1		57	刻度	3	
20	信封	1		58	通讯	2	
21	指挥	3		59	柜台	1	
22	皇后	3		60	袋鼠	2	
23	徽章	1		61	胶囊	1	
24	放映机	3		62	事故	3	
25	打结	4		63	体育场	1	
26	鞭子	1		64	挖掘	1	
27	捉	4		65	绿洲	1	
28	转盘	2		66	警戒	2	
29	车厢	4		67	垄沟	4	
30	教师	2		68	蜂巢	2	
31	挖	1		69	阻挡	3	
32	箭	3		70	攻击	4	
33	木棍	2		71	化学家	4	
34	装配	3		72	障碍	2	
35	缝	1		73	家庭用具	3	
36	船长	1		74	驮	2	
37	网	4		75	学者	4	
38	漏斗	4		76	礼节	4	

序号	内容	答案	是否正确	序号	内容	答案	是否正确
77	旅行	2		115	建筑	3	
78	同心圆	3		116	奔泻	3	
79	旋管	2		117	私语	3	
80	争论	1		118	任性	2	
81	上钩	1		119	图案	2	
82	华表	1		120	盘旋	2	
83	浸泡	1					
84	运输	1					
85	横梁	1					
86	同胞	1					
87	平衡	1					
88	商标	4					
89	雕塑	1					
90	窗帷	1					
91	失望	3					
92	切线	3					
93	沉思	4					
94	绝技	1					
95	犬	1					
96	奇迹	1					
97	鉴定	2					
98	北极	3					
99	惊讶	3					
100	两栖类	1					
101	巧妙	3					
102	清晰	3					
103	恐怖	1					
104	象形文字	2					
105	畏怯	3					
106	出纳	1					
107	致意	3					
108	幽灵	2					
109	项	1					
110	溪谷	3					
111	遗传学	2					
112	雄辩	1					
113	约束	4					
114	诱饵	4					

Appendix I. Rapid Number Naming Task

Please name all the following 25 numbers as quickly as possible, beginning with the first number in the first row and ending with the last number of the last row.

1	**3**	**4**	**6**	**9**
6	**9**	**1**	**3**	**4**
4	**1**	**3**	**9**	**6**
3	**6**	**9**	**4**	**1**
9	**4**	**6**	**1**	**3**

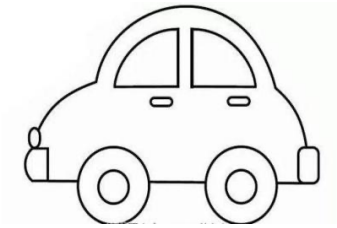
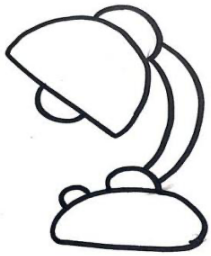
Appendix J. Character Naming Task

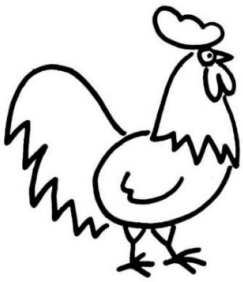
Please read aloud the following characters one by one.

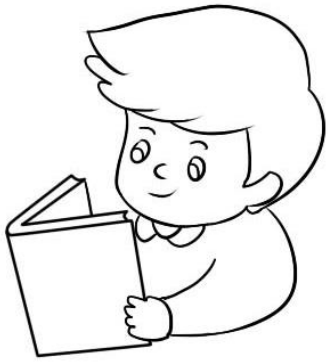
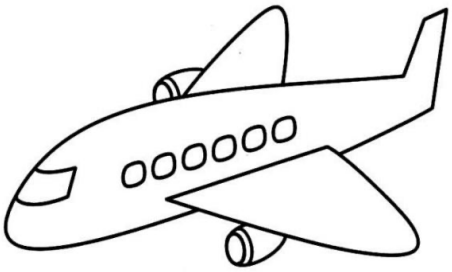
一	十	木	公	写
他	电	叫	风	四
长	右	边	田	母
有	画	好	来	走
回	我	话	学	没
年	远	放	向	右
爸	回	面	园	房
次	爬	知	色	给
丽	很	真	亮	站
家	晚	答	意	别

Appendix K. Word Recognition Task

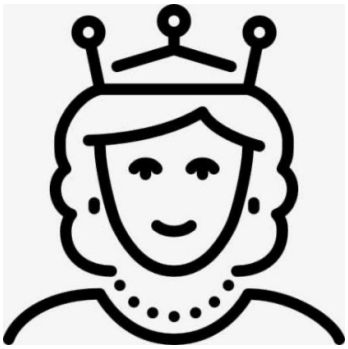
You will hear a list of 15 words and each word corresponds a picture to depict what the word means. For each word, please circle the correct two-character written word you hear from two choices.

1.	
米饭	雪人
2. 	
山羊	汽车
3. 	
台灯	苹果

4.	
生日	雨衣
5.	
医生	写字
6. 	
面包	公鸡

7.	
白云	书包
8. 	
看书	耳朵
9. 	
小鸟	飞机

10.

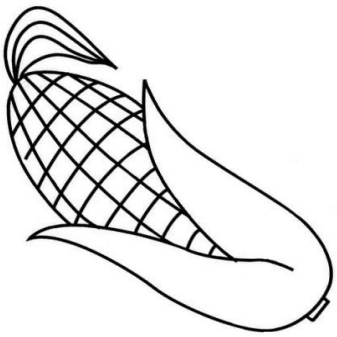


女王	双手

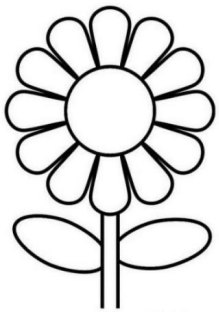
11.

洗手	衣服

12.



小河	玉米

13.	
月亮	跑步
14.	
下雨	大象
15. 	
西瓜	花朵

Appendix L. Syntax for SPSS Analysis

1. **The Syntax for MANOVA with a Bonferroni correction**

```
GLM SyllableDeletion LexicalCompounding
HomophoneGeneration HomophoneJudgment
CharacterJudgment
    RANaccuracy RANrt Vocabulary CharacterNaming
WordRecognition BY GradeGroup WITH MotherEducation
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /EMMEANS=TABLES(GradeGroup)
WITH(MotherEducation=MEAN) COMPARE ADJ(BONFERRONI)
  /PRINT=DESCRIPTIVE ETASQ OPOWER HOMOGENEITY
  /CRITERIA=ALPHA(.05)
  /DESIGN=MotherEducation GradeGroup.
```

2. **The Syntax for the Spearman's Correlation Analysis**

```
GET
  FILE='/Users/yh33/Desktop/PhD/Dissertation/Data
analysis/SPSS analysis/K2 data.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
NONPAR CORR
  /VARIABLES=SyllableDeletion LexicalCompounding
HomophoneGeneration HomophoneJudgment
    CharacterJudgment RANaccuracy RANrt Vocabulary
CharacterNaming WordRecognition
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

3. **The Syntax for the Generalized Linear Model (GLM)**

```
* Generalized Linear Models.
```

```
GENLIN CharacterNaming BY GradeGroup
(ORDER=ASCENDING) WITH MotherEducation
SyllableDeletion
    CharacterJudgment RANrt SemanticsComposite
  /MODEL SyllableDeletion CharacterJudgment
SemanticsComposite RANrt GradeGroup MotherEducation
    INTERCEPT=YES
 DISTRIBUTION=NORMAL LINK=IDENTITY
  /CRITERIA SCALE=MLE COVB=MODEL PCONVERGE=1E-
006(ABSOLUTE) SINGULAR=1E-012 ANALYSISTYPE=3(WALD)
    CILEVEL=95 CITYPE=WALD LIKELIHOOD=FULL
  /MISSING CLASSMISSING=EXCLUDE
  /PRINT CPS DESCRIPTIVES MODELINFO FIT SUMMARY
SOLUTION.
```

4. **The Syntax for the Logistic Regression Model**

```
LOGISTIC REGRESSION VARIABLES WordRecogCategory
  /METHOD=ENTER GradeGroup MotherEducation
SyllableDeletion CharacterJudgment RANrt
    SemanticsComposite
  /CONTRAST (GradeGroup)=Indicator
  /PRINT=GOODFIT
  /CRITERIA=PIN(0.05) POUT(0.10) ITERATE(20)
CUT(0.5).
```

Appendix M. Appendix Tables

Table M1. Correlation coefficients among emergent literacy and early reading skills in kindergarten children.

Variables	1	2	3	4	5	6	7	8	9	10
1 Syllable Deletion	1									
2 Lexical Compounding	.391*	1								
3 Homophone Generation	.389*	.374*	1							
4 Homophone Judgment	.300	-.025	-.207	1						
5 Character Judgment	.299	.276	.322	.154	1					
6 Accuracy for RAN	.268	.317	.078	.106	-.249	1				
7 Response Time for RAN	-.513**	-.209	-.269	-.318	-.131	-.106	1			
8 Vocabulary	.162	.343*	.392*	.080	.115	.224	-.229	1		
9 Character Naming	.665**	.449**	.335*	.335*	.223	.258	-.642**	.435**	1	
10 Word Recognition	.496**	.410*	-.007	.352*	,176	.298	-.438**	.522**	.652**	1

Note: RAN = Rapid Automatized Naming. *Correlation is significant at the .05 level; **Correlation is significant at the .01 level.

Table M2. Correlation coefficients among emergent literacy and early reading skills in primary school children.

Variables	1	2	3	4	5	6	7	8	9	10
1 Syllable Deletion	1									
2 Lexical Compounding	.404*	1								
3 Homophone Generation	.475**	.240	1							
4 Homophone Judgment	.440*	.360*	.199	1						
5 Character Judgment	.295	.286	233	-.362*	1					
6 Accuracy for RAN	-.060	.293	-.112	-.126	-.187	1				
7 Response Time for RAN	-.151	-.519**	-.148	-.091	.013	-.248	1			
8 Vocabulary	.083	.102	-.029	-.419*	.315	.074	.196	1		
9 Character Naming	.540**	.244	.235	.536*	.472**	-.092	-.116	.445*	1	
10 Word Recognition	.311	.415*	.276	.231	.227	-.070	-.163	.308	.292	1

Note: RAN = Rapid Automatized Naming. *Correlation is significant at the .05 level; **Correlation is significant at the .01 level.

Table M3. Correlation coefficients among emergent literacy and early reading skills in all participated children.

Variables	1	2	3	4	5	6	7	8	9	10
1 Syllable Deletion	1									
2 Lexical Compounding	.577**	1								
3 Homophone Generation	.681**	.585**	1							
4 Homophone Judgment	.665**	.498**	.621**	1						
5 Character Judgment	.555**	.511**	.612**	.665**	1					
6 Accuracy for RAN	.199	.352**	.128	.142	-.012	1				
7 Response Time for RAN	-.594**	-.551**	-.574**	-.640**	-.464**	-.250*	1			
8 Vocabulary	.575**	.586**	.674**	.699**	.627**	.216	-.524**	1		
9 Character Naming	.772**	.615**	.736**	.827**	.676**	.199	-.704**	.781**	1	
10 Word Recognition	.619**	.585**	.467**	.622**	.535**	.234	-.559**	.682**	.731**	1

Note: RAN = Rapid Automatized Naming. *Correlation is significant at the .05 level; **Correlation is significant at the .01 level.

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Huang, Y. (2016). The setting of the psychology course in the curriculum system of occupational therapy. *Education Teaching Forum*, (18), 222-223. [Chinese]