Vocabulary Knowledge and Braille Reading Comprehension in Chinese Students with Blindness: Contributions of Compounding Awareness and Lexical Inferencing

Zhilin Wu , Mengyu Tian * , Qi Wang , Kaixin Li , Tong Lin , Yuexin Zhang *

Posted Date: 21 May 2026

doi: 10.20944/preprints202605.1465.v1

Keywords: students with blindness; compounding awareness; lexical inferencing; vocabulary knowledge; Chinese Braille reading comprehension

 doi:10.20944/preprints202605.1465.v1

Article

Vocabulary Knowledge and Braille Reading Comprehension in Chinese Students with Blindness: Contributions of Compounding Awareness and Lexical Inferencing

Zhilin Wu [1], Mengyu Tian [2,*], Qi Wang [3], Kaixin Li [4], Tong Lin [4] and Yuexin Zhang [5,*]

[1] Faculty of Education, East China Normal University, Shanghai 200062, China
[2] Center for Educational Science and Technology, Beijing Normal University, Zhuhai 519087, China
[3] Shenzhen Futian Special Education Resources Center, Shenzhen 518000, China
[4] Faculty of Arts and Sciences, Beijing Normal University, Zhuhai 519087, China
[5] Faculty of Education, Beijing Normal University, Beijing 100875, China
* Correspondence: mengyutian@bnu.edu.cn (M.T.); zhang.yuexin@bnu.edu.cn (Y.Z.)

Abstract

Lexical inferencing is a key contributor to reading development in sighted children, yet its role in Braille reading remains underexplored. This study investigated the developmental trajectory of lexical inferencing among Chinese primary school students with blindness and examined the relationships among compounding awareness, lexical inferencing, vocabulary knowledge, and Braille text reading comprehension. Results showed that (1) students with blindness showed lower lexical inferencing performance than sighted students at both middle and upper grade levels, although lexical inferencing improved with grade level; (2) lexical inferencing significantly predicted both vocabulary knowledge and Braille reading comprehension among students with blindness; (3) compounding awareness significantly predicted lexical inferencing in both middle-grade students and upper-grade students; (4) the relative role of compounding awareness and lexical inferencing differed by grade group. In middle-grade students, both compounding awareness and lexical inferencing contributed to vocabulary knowledge and Braille reading comprehension, with vocabulary knowledge also predicting reading comprehension. In upper-grade students, lexical inferencing remained a significant predictor of both vocabulary knowledge and Braille reading comprehension, whereas compounding awareness no longer directly predicted either outcome. These findings indicate a developmental shift in which compounding awareness is more influential in earlier stages, whereas lexical inferencing becomes the central mechanism supporting vocabulary growth and text-level comprehension in later stages.

Keywords: students with blindness; compounding awareness; lexical inferencing; vocabulary knowledge; Chinese Braille reading comprehension

1. Introduction

Reading comprehension requires the integration of multiple linguistic and cognitive processes, including word recognition, vocabulary knowledge, and the ability to infer meaning beyond explicitly stated information (Pearson et al., 2005; Lundberg, 2002; Chen et al., 2019). Although these processes have been extensively examined in sighted readers, how they function in Braille reading remains less well understood, particularly in non-alphabetic languages.

Braille is a tactile writing system in which readers move their fingers across patterns of raised dots, with each character represented by a six-dot cell arranged in two columns and three rows.

 doi:10.20944/preprints202605.1465.v1

Compared with visual print, tactile sensory input is slower and more sequential. In alphabetic Braille systems such as English, Braille characters correspond closely to printed letters, largely preserving the orthographic structure of words. English Braille contains symbols designated to represent the letters of the Roman alphabet (e.g., "⠁" represents "a," "⠃" represents "b," and "⠵" represents "z"), allowing readers to access phonological and lexical representations in ways broadly comparable to visual reading.

In contrast, Chinese Braille adopts a fundamentally different encoding principle. Chinese characters typically provide both phonological and semantic cues. For example, the character "河" (hé/, river) contains the semantic radical "氵，" which signals a meaning related to water. In contrast, Chinese Braille represents spoken syllables using Pinyin, a Romanization system for Mandarin Chinese that encodes only pronunciation. Thus, the word "河流" (river) is represented through its syllabic pronunciation rather than through visually meaningful character forms. As a result, Chinese Braille provides substantially fewer direct form–meaning cues than written Chinese characters. This challenge is further complicated by the high prevalence of homophony in Chinese. Many different Chinese characters share identical pronunciations despite having unrelated meanings. For example, "事" (matter), "市" (city), "试" (test), and "是" (to be) are all pronounced /shì/. Because Chinese Braille encodes pronunciation rather than character form, these distinctions cannot be directly recovered from orthography alone. Readers must therefore rely more heavily on morphological structure, lexical knowledge, and inferential processes to identify intended meanings during reading. Consequently, compounding awareness, vocabulary knowledge, and lexical inferencing may be particularly important for Chinese Braille reading comprehension.

Building on these characteristics of Chinese Braille, one reading-related skill that deserves attention is compounding awareness. Compounding awareness refers to the understanding of how morphemes can be combined sensibly in Chinese (Liu & McBride-Chang, 2010; Xia et al., 2022). Because Chinese contains many compound words, readers often need to use the meanings of constituent morphemes and their structural relations to construct word meaning. In Chinese Braille reading, compounding awareness is important because readers often need to construct word meaning without direct access to the character-form cues available in printed Chinese.

Vocabulary knowledge is another central component of reading comprehension. It refers to the knowledge of word meanings that individuals draw upon to comprehend others' speech, express their own ideas, and interpret written texts (Moats, 2005). Vocabulary knowledge is commonly divided into breadth and depth. Vocabulary breadth reflects the size of an individual's lexical repertoire, whereas vocabulary depth captures the extent to which individuals understand word meanings and their appropriate use in context (Ouellette, 2006; Xie et al., 2023). In this study, vocabulary knowledge was operationalized as vocabulary depth, assessed through students' ability to define word meanings. This measure was chosen because precise semantic knowledge is more directly relevant to text comprehension than simple word familiarity.

Previous studies have compared students with blindness and sighted students in terms of compounding awareness, vocabulary knowledge, and Chinese Braille reading (Xie et al., 2023; Chen et al., 2023), and shown that compounding awareness and vocabulary knowledge are associated with Chinese Braille reading. Compounding awareness has been found to predict Braille reading comprehension, particularly among students in Grades 3–4 (Xia et al., 2023). It has also been identified as a unique predictor of vocabulary knowledge, explaining 29% of the variance among students in Grades 1–3 and 10% among students in Grades 4–6 (Xie et al., 2023). In addition, vocabulary knowledge may mediate the relation between morphological awareness and Braille reading comprehension among students in Grades 3–6 (Chen et al., 2019). These studies establish compounding awareness and vocabulary knowledge as important correlates of Chinese Braille reading. However, they focus mainly on students' existing morphological and lexical knowledge. Less is known about how students use this knowledge to infer the meanings of unfamiliar words, especially when Braille texts become more complex in the upper primary grades.

 doi:10.20944/preprints202605.1465.v1

This question points to the role of lexical inferencing. Lexical inferencing is generally defined as the ability to make informed guesses about the meanings of unknown or unfamiliar words by drawing on available linguistic cues, world knowledge, contextual awareness, and relevant linguistic knowledge (Haastrup, 1991). In sighted Chinese children, lexical inferencing has been shown to predict text-level reading comprehension after controlling for phonological awareness, morphological awareness, and orthographic awareness, with its contribution increasing across Grades 3–5 (Cheng & Zhang, 2023). It also predicts vocabulary growth, and compounding awareness may contribute to vocabulary acquisition indirectly through lexical inferencing (Zhang, 2015). These findings suggest that lexical inferencing may provide a pathway through which children use morphological knowledge to derive the meanings of unfamiliar words, thereby supporting both vocabulary growth and reading comprehension.

Lexical inferencing is also relevant to vocabulary knowledge. When readers encounter unfamiliar words, they can use morphemic cues in the lexical form and integrate them with prior knowledge to infer meaning (Baumann et al., 2003). Repeated encounters with such words across contexts can further refine semantic representations and strengthen knowledge of their relations to other lexical items (Ricketts et al., 2011). Thus, lexical inferencing is not only a strategy for resolving immediate comprehension difficulty but also a potential route through which unfamiliar words become incorporated into the mental lexicon. These issues are especially relevant to Chinese Braille reading, yet lexical inferencing has rarely been examined in students with blindness. Existing studies have mainly focused on morphological awareness, phonological awareness, vocabulary knowledge, and reading comprehension (Chen et al., 2019; Chen et al., 2023; Xia Y et al., 2023; Xie R et al., 2023). It therefore remains unclear whether lexical inferencing contributes to vocabulary knowledge and Braille reading comprehension beyond compounding awareness, and whether its role differs between middle-grade students (Grades 3–4) and upper-grade students (Grades 5–6).

The present study examined how compounding awareness, lexical inferencing, and vocabulary knowledge are associated with Braille reading comprehension in Chinese students with blindness. We analyzed these relations separately in middle-grade students (Grades 3–4) and upper-grade students (Grades 5–6), because the contribution of these skills may change as Braille reading becomes more fluent and text demands increase. Sighted students were included as a sighted comparison group. Specifically, the study addressed four research questions. First, how does lexical inferencing performance in Chinese students with blindness compare with that of sighted students? Second, does lexical inferencing predict vocabulary knowledge and Braille reading comprehension in middle-grade students (Grades 3–4) and upper-grade students (Grades 5–6)? Third, does compounding awareness predict lexical inferencing in these two grade groups? Fourth, between compounding awareness and lexical inferencing, which shows the more salient predictive role in vocabulary knowledge and Braille reading comprehension in middle-grade and upper-grade students?

2. Materials and Methods

2.1. Participants

Following approval from the Research Ethics Committee of Beijing Normal University (IRB Number: BNU202310100034) and the acquisition of informed consent from all participants' parents, this study employed a cluster random sampling strategy across eastern, central, and western regions of China, including Beijing, Qingdao, Yantai, Tai'an, Nanjing, Taiyuan, and Yinchuan. One special education school was selected from each city (seven schools in total), yielding a sample of 107 blind students in Grades 3–6. These students completed assessments of compounding awareness, lexical inferencing, vocabulary knowledge, and braille reading comprehension. All blind participants had no additional disabilities beyond visual impairment and demonstrated functional proficiency in Braille.

 doi:10.20944/preprints202605.1465.v1

A regular primary school in Beijing served as the control site. One class was randomly selected from each grade level (Grades 2–6), resulting in 148 sighted students, all native speakers of Chinese. These students completed a paper-and-pencil group assessment of lexical inferencing.

After data screening, valid data were retained for 101 blind students and 142 sighted students. Exclusion was due to incomplete data, failure to complete the task, invalid responses, or other predefined criteria. The blind students ranged in age from 9 to 15 years and were further categorized into middle-grade (Grades 3–4; n = 44, M = 12.07, SD = 1.50) and upper-grade groups (Grades 5–6; n = 57, M = 12.79, SD = 1.15). Sighted students ranged in age from 6 to 11 years and were grouped into lower-grade (Grade 2; n = 33, M = 7.88, SD = 0.49), middle-grade (Grades 3–4; n = 73, M = 9.40, SD = 0.70), and upper-grade groups (Grades 5–6; n = 36, M = 10.97, SD = 0.17). Students with blindness were older than sighted students at the same grade level, reflecting differences in schooling trajectories and the timing of systematic Braille instruction. Students with blindness may enter school later, begin Braille learning at different ages, or experience more variable educational placements than sighted students. Therefore, the comparison between students with blindness and sighted students in the present study should be interpreted as a grade-level comparison rather than an age-matched comparison. This pattern is also consistent with prior evidence that Braille readers often show delayed or more variable reading development relative to sighted readers (Savaiano et al., 2014; Xie et al., 2023). Descriptive characteristics of the sample are reported in Tables 1 and 2.

The inclusion of blind students from Grade 3 onward and sighted students from Grade 2 onward was guided by developmental and curricular considerations. According to the Compulsory Education Chinese Language Curriculum Standards for Schools for the Blind (2016), students in Grades 1–2 primarily acquire foundational knowledge of Braille dot patterns and have not yet achieved fluent tactile reading. From Grade 3, they are expected to read and write Braille proficiently. Similarly, the Compulsory Education Chinese Language Curriculum Standards (2022) indicate that Grade 1 sighted students focus primarily on Hanyu Pinyin and basic orthographic knowledge (e.g., strokes and radicals), justifying their exclusion from the present analyses.

Table 1. Basic Information Table for Blind Students.

Middle-Grade Blind Students (Grades 3–4) (n = 44)		***n*(%)**	**Upper-grade blind students (Grades 5–6) (n = 57)**		***n*(%)**
Region	Western	5 (11.4%)	Region	Western	12 (21.1%)
	Central	9 (20.5%)		Central	8 (14.0%)
	Eastern	30 (68.2%)		Eastern	37 (64.9%)
Gender	Male	34 (77.3%)	Gender	Male	34 (59.6%)
	Female	10 (22.7%)		Female	23 (40.4%)
Experience attending mainstream school	Yes	19 (43.2%)	Experience attending mainstream school	Yes	12 (21.1%)
	None	25 (56.8%)		None	45 (78.9%)
Years of Braille learning	1–3 years	26 (59.1%)	Years of Braille learning	1–3 years	3 (5.3%)
	4–6 years	18 (40.9%)		4–6 years	54 (94.7%)
Onset of blindness	Congenital	32 (72.7%)	Onset of blindness	Congenital	38 (66.7%)
	Acquired	12 (27.3%)		Acquired	19 (33.3%)

 doi:10.20944/preprints202605.1465.v1

Table 2. Basic Information on Sighted Students.

Sighted Students in the Beijing Area (n = 142)		N (%)
Gender	Male	77 (54.2%)
	Female	65 (45.8%)
Grade Level	Lower Grades (Grade 2)	33 (23.3%)
	Middle Grades (Grades 3-4)	73 (51.4%)
	Upper Grades (Grades 5-6)	36 (25.4%)

2.2. Measures

2.2.1. Compounding Awareness

Compounding awareness was assessed using an adapted version of the Compounding Production Task developed by Liu and McBride-Chang (2010). This measure has been widely used in studies of Chinese-speaking children, including those with visual impairment (Chen et al., 2023; Xia et al., 2023; Xie et al., 2023). The task is designed to assess children's ability to apply morphological knowledge, particularly compounding rules, to generate novel lexical items that are not part of their existing vocabulary.

The task was administered individually in an oral format. A trained researcher presented each item verbally by posing a question or describing a scenario, and participants were asked to produce a novel compound word that matched the intended meaning. Responses were independently scored by two trained graduate students using a 4-point scale (0–3), based on the extent to which the target morpheme was correctly extracted and the structural accuracy and conciseness of the response.

For example, in response to the prompt "用叶子做的盘子是什么？" (What do you call a plate made of leaves?), the target response"yè pán" （叶盘） received 3 points. Responses such as "yèzi pán" （叶子盘） or "yè pánzi" （叶盘子） received 2 points, whereas "yèzi pánzi" （叶子盘子） received 1 point. Responses that were structurally inappropriate, omitted the target morpheme, or were incorrect or absent received 0 points. In general, more concise and morphologically appropriate forms were assigned higher scores.

The test comprised 10 practice items and 25 scored items, with a maximum possible score of 75. Items were arranged in ascending order of difficulty, and testing was discontinued if a participant failed to respond correctly to five consecutive items. Previous studies with Chinese blind students have reported good internal consistency for this task (*Cronbach's* α = 0.82 – 0.92) (Chen et al., 2023; Xia et al., 2023; Xie et al., 2023). In the present study, *Cronbach's* α was 0.79, and inter-rater reliability was high (r = 0.96).

2.2.2. Lexical Inferencing

Lexical inferencing can draw on different sources of information, including contextual cues and morphemic cues (Baumann et al., 2003; Nagy & Scott, 2000; Wysocki & Jenkins, 1987; Zhang et al., 2022). In the present study, lexical inferencing was operationalized as morpheme-based inference of unfamiliar compound word meanings. The task was adapted from Zhang (2013) and further informed by Cheng and Zhang (2022). It assessed whether students could use familiar constituent morphemes to infer the meanings of novel bimorphemic compound words. The present task did not provide contextual sentences. It was designed to focus on inference from morphemic structure, operationalizing lexical inference as students' ability to infer the meanings of unfamiliar compound words from familiar constituent morphemes. This design was appropriate for the present study because the main theoretical interest was how compounding awareness relates to the inference of unfamiliar word meanings in Chinese Braille reading. Participants were presented with 16 bimorphemic words, each followed by four definition options. The internal structure of each

 doi:10.20944/preprints202605.1465.v1

compound provided cues to both grammatical category and semantic composition, and participants were required to select the most appropriate definition.

To minimize the influence of prior vocabulary knowledge, target words were selected based on two criteria. First, they did not appear in standard Chinese language textbooks for either blind or sighted students and were of low frequency. Second, each compound consisted of two characters that were already familiar to the participants. This ensured that although the compound words themselves were likely novel, their meanings could be inferred through morphological analysis. In addition, experienced Chinese language teachers were consulted to confirm that participants had mastered the individual characters but had not yet learned the meanings of the compound words.

For example, the unfamiliar compound word "lǚ fèi"（旅费， travel expenses） consists of "lǚ" (travel) and "fèi" (expense). The response options included: (a) a person who likes to travel everywhere, (b) the money one needs to spend on travel, (c) traveling is a waste of time, and (d) traveling with friends. The correct answer is (b). Successful performance requires identification of the constituent morphemes and application of the noun–noun compounding rule.

Previous research with Chinese sighted students has reported acceptable reliability for this task (*Cronbach's* α = 0.78) (Cheng & Zhang, 2022). In the present study, internal consistency was acceptable (*Cronbach's* α = 0.71) for the sample of 101 blind students.

2.2.3. Vocabulary Knowledge

Vocabulary knowledge was assessed using a Vocabulary-Defining Task adapted from Xie et al. (2023), which itself was based on the paradigm developed by Song et al. (2015). This task evaluates the depth of lexical knowledge by requiring participants to provide explicit definitions of target words.

The task was administered individually in an oral format. Participants were presented with two-character Chinese words and asked to explain their meanings. For example, for the word "telephone," a fully correct response would be: "A device that allows people who are far apart to communicate with each other." Responses were independently scored by two trained graduate students using a 3-point scale: 2 points for a complete and accurate definition, 1 point for a partially correct response, and 0 points for an incorrect, vague, or irrelevant response.

The test consisted of one practice item and 37 scored items, yielding a maximum possible score of 74. Items were administered in a fixed order, and testing was discontinued if a participant failed to respond correctly to five consecutive items.

Previous research with Chinese blind students has demonstrated good reliability for this task (*Cronbach's* α = 0.85) (Xie et al., 2023). In the present study, internal consistency was high (*Cronbach's* α = 0.90), and inter-rater reliability was also strong (r = 0.91).

2.2.4. Braille Reading Comprehension

Braille reading comprehension was assessed using a test adapted from prior research by Chen et al. (2023), with reading materials drawn from the Progress in International Reading Literacy Study (PIRLS). Following expert review by experienced Chinese language teachers from schools for the blind, passages appropriate for middle- and upper-grade blind students were selected.

Participants completed two passages—one narrative and one expository. Each passage was followed by 10 multiple-choice comprehension questions. Each item included four response options. Students read the Braille texts tactually and recorded their responses on Braille paper. Each correct answer was awarded one point, yielding a maximum total score of 20.

Previous research with Chinese blind students in middle and upper primary grades has reported satisfactory internal consistency for this measure (*Cronbach's* α = 0.86 and 0.87) (Chen et al., 2023). In the present study, internal consistency was acceptable, with *Cronbach's* α coefficients of 0.73 for middle-grade students and 0.70 for upper-grade students.

 doi:10.20944/preprints202605.1465.v1

2.3. Data Collection and Analysis

Participation was voluntary, and informed consent was obtained from both the blind students and their primary caregivers prior to data collection. Participants were informed of their right to withdraw from the study at any time without penalty.

Background information was collected via questionnaires completed by homeroom teachers at schools for the blind. These questionnaires included information on students' level of visual impairment, the presence of additional disabilities (e.g., intellectual disability), and other demographic characteristics. All study materials were reviewed and refined by experts in special education, including researchers and experienced teachers from schools for the blind, to ensure their appropriateness for the target population.

All written materials were transcribed into Chinese Braille. Testing was administered by trained researchers, who first provided standardized oral instructions. The compounding awareness and vocabulary knowledge tasks were conducted individually in quiet rooms, with two researchers independently scoring responses in real time. Lexical inferencing and Braille reading comprehension were administered in group settings by grade level, with students completing assessments in classrooms provided by the participating schools.

To reduce fatigue effects, each testing session lasted approximately 45 minutes. Data were collected between May and June 2024 and analyzed using SPSS 26.0.

3. Results

3.1. Normality Test

A one-sample Kolmogorov–Smirnov test indicated that compounding awareness, vocabulary knowledge, and Braille reading comprehension scores for students with blindness did not significantly deviate from normality (all $p > 0.05$). Lexical inferencing scores for students with blindness were normally distributed ($p > 0.05$), whereas lexical inferencing scores for sighted students significantly deviated from normality ($p < 0.05$).

3.2. Descriptive Statistics and Group Differences

Group differences in lexical inferencing were examined using Mann–Whitney U Tests, comparing 101 students with blindness from eastern, central, and western China with 142 sighted students from Beijing (Table 3). The results indicated that students with blindness scored significantly lower than their sighted peers at both middle and upper primary grade levels ($p < 0.001$).

Gender-stratified analyses revealed a consistent pattern: male students with blindness scored significantly lower than sighted males ($p < 0.001$), and female students with blindness likewise scored significantly lower than sighted females ($p < 0.001$). Overall, lexical inferencing performance was significantly lower among students with blindness regardless of gender or grade, suggesting a robust effect of visual status.

To further contextualize these differences, cross-grade comparisons were conducted. Middle-grade students with blindness performed below lower-grade sighted students, while upper-grade students with blindness performed below both middle- and lower-grade sighted students. Although lexical inferencing improved with grade level in both groups, students with blindness consistently lagged their sighted peers, with a substantial and persistent performance gap.

 doi:10.20944/preprints202605.1465.v1

Table 3. Comparison of Lexical Inferencing between Blind and Sighted Students.

Blind Students vs Sighted Students		*n*	*M* ± *SD*	*Z-value*
Middle-grade	Blind	44	9.61±3.16	-6.44***
	Sighted	73	13.64±2.45	
Upper-grade	Blind	57	11.81±2.82	-6.31***
	Sighted	36	15.22±0.96	
Male	Blind	68	10.85±3.16	-5.24***
	Sighted	77	13.44±2.68	
Female	Blind	33	10.85±3.18	-4.88***
	Sighted	65	14.05±2.22	

Note: M = Mean, SD = Standard deviation, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$, **two-tailed.**

Descriptive statistics and group differences were examined for four variables among students with blindness in the middle and upper primary grades: Braille reading comprehension, lexical inferencing, compounding awareness, and vocabulary knowledge (Table 4).

Results indicated that upper-grade students significantly outperformed middle-grade students in Braille reading comprehension (M = 11.21 *vs*. 9.50, $p < 0.05$), lexical inferencing (M = 11.81 *vs*. 9.61, $p < 0.001$), compounding awareness (M = 47.93 *vs*. 38.75, $p < 0.001$), and vocabulary knowledge (M = 42.07 *vs*. 35.55, $p < 0.001$).

In addition, students with longer durations of Braille learning demonstrated significantly higher lexical inferencing (M = 11.26 *vs*. 9.83, $p < 0.05$) and compounding awareness (M = 45.44 *vs*. 40.17, $p < 0.05$) than those with shorter learning experience.

Table 4. Descriptive Statistics and Group Differences in Study Variables Among Middle- and Upper-Grade Blind Students.

Variable	Grade level	*n*	*M* ± *SD*	*t-value*	Years of Braille Learning	N	*M* ± *SD*	*t-value*
Braille reading comprehension	Middle Grade	44	9.50±3.11	-2.54*	1-3 years	29	10.00±3.39	-0.86
	Upper Grade	57	11.21±3.53		4-6 years	72	10.65±3.47	
Lexical Inferencing	Middle Grade	44	9.61±3.16	-3.68***	1-3 years	29	9.83±3.11	-2.11*
	Upper Grade	57	11.81±2.82		4-6 years	72	11.26±3.10	
Compounding Awareness	Middle Grade	44	38.75±10.81	-4.09***	1-3 years	29	40.17±11.71	-2.02*
	Upper Grade	57	47.93±11.49		4-6 years	72	45.44±11.92	
Vocabulary Knowledge	Middle Grade	44	35.55±8.32	-3.78***	1-3 years	29	38.43±10.36	-0.55
	Upper Grade	57	42.07±8.83		4-6 years	72	39.55±8.70	

Note: M = Mean, SD = Standard deviation, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$, two-tailed.

Descriptive statistics and group differences were examined for four variables—Braille reading comprehension, lexical inferencing, compounding awareness, and vocabulary knowledge—among middle- and upper-grade primary students with blindness (Table 5). Among middle-grade students, no significant differences were observed across gender, prior mainstream schooling experience, duration of Braille learning, or age of blindness onset ($p > 0.05$).

 doi:10.20944/preprints202605.1465.v1

In contrast, among upper-grade students, those with prior mainstream schooling experience demonstrated significantly higher vocabulary knowledge (M = 46.83) than those without such experience (M = 40.80, $p < 0.05$). No other group differences reached statistical significance.

Table 5. Descriptive Statistics and Group Differences in Study Variables Among Upper-Grade Blind Students.

Variable	Experience in Regular Schools	*n*	*M* ± *SD*	*t-value*
Braille reading comprehension	None	45	10.89 ± 3.21	-1.34
	Yes	12	12.42 ± 4.50	
Lexical Inferencing	None	45	11.60 ± 2.71	-1.07
	Yes	12	12.58 ± 3.23	
Compounding Awareness	None	45	48.71 ± 10.95	0.99
	Yes	12	45.00 ± 13.43	
Vocabulary Knowledge	None	45	40.80 ± 7.25	-2.17*
	Yes	12	46.83 ± 12.45	

Note: M = Mean, SD = Standard deviation, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$, two-tailed.

3.3. Correlation Analysis

Table 6 presents the bivariate correlations among compounding awareness, lexical inferencing, vocabulary knowledge, and braille reading comprehension for 44 middle-grade and 57 upper-grade blind students. Across both grade groups, compounding awareness was positively and significantly associated with braille reading comprehension, lexical inferencing, and vocabulary knowledge (all $p < 0.001$).

Vocabulary knowledge also showed significant positive correlations with both lexical inferencing and braille reading comprehension (both $p < 0.001$), and lexical inferencing was, in turn, significantly correlated with braille reading comprehension ($p < 0.001$).

In addition, within the upper-grade group, region was significantly associated with compounding awareness ($p < 0.05$), and experience in regular schools was significantly related to vocabulary knowledge ($p < 0.05$).

Table 6. Correlations Among Variables in Middle- and Upper-Grade Blind Students.

Grade Level	Variable	1	2	3	4
Middle Grade (*n* = 44)	1 Braille reading comprehension	-			
	2 Lexical Inferencing	0.88***	-		
	3 Compounding Awareness	0.61***	0.47**	-	
	4 Vocabulary Knowledge	0.88***	0.80***	0.57***	-
	Region	0.17	0.09	0.13	-0.01
	Age	-0.10	-0.01	-0.12	-0.03
	Gender	-0.23	-0.18	-0.10	-0.12
	Years of Braille Learning	-0.11	0.04	-0.07	-0.20

 doi:10.20944/preprints202605.1465.v1

	Experience in Regular Schools	0.05	0.09	-0.07	0.27
	Age of Blindness Onset	0.02	0.13	0.00	0.03
	1 Braille reading comprehension	-			
	2 Lexical Inferencing	0.78***	-		
	3 Compounding Awareness	0.46***	0.46***	-	
	4 Vocabulary Knowledge	0.71***	0.81***	0.45***	-
Upper Grade (n = 57)	Region	0.23	0.12	0.29*	0.20
	Age	0.10	0.12	-0.007	0.09
	Gender	-0.02	0.006	0.03	-0.05
	Years of Braille Learning	-0.05	-0.07	0.02	-0.26
	Experience in Regular Schools	0.18	0.14	-0.13	0.28*
	Age of Blindness Onset	0.05	0.02	0.04	0.13

Note: $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$, two-tailed.

3.4. Hierarchical Regression Analysis

Drawing on prior research and the results of the correlation analyses, four variables—compounding awareness, lexical inferencing, vocabulary knowledge, and braille reading comprehension—were entered into a series of multiple linear regression models.

In grades 3 to 4 (Table 7), blind students' compounding awareness explained variance in braille reading comprehension ($\Delta R^2 = 0.37$, $t = 4.99$, $p < 0.001$) as well as in vocabulary knowledge ($\Delta R^2 = 0.33$, $t = 4.54$, $p < 0.001$). Meanwhile, blind students' lexical inferencing significantly explained variance in braille reading comprehension ($\Delta R^2 = 0.45$, $t = 10.11$, $p < 0.001$) and vocabulary knowledge ($\Delta R^2 = 0.37$, $t = 7.02$, $p < 0.001$). Compounding awareness did contribute to blind students' lexical inferencing ($\Delta R^2 = 0.22$, $t = 3.40$, $p < 0.01$). Vocabulary knowledge also did contribute to blind students' braille reading comprehension ($\Delta R^2 = 0.05$, $t = 4.16$, $p < 0.001$). These results suggest that both compounding awareness and lexical inferencing play a role in the vocabulary knowledge and text comprehension of Braille during the middle of elementary school.

Table 7. Multiple Linear Regression Testing of Study Variables in Middle-Grade Blind Students (n = 44).

	Outcome Variables	Step	Predictors	β	*t-value*	R^2	ΔR^2	*F*
Equation 1	Braille reading comprehension	1	Compounding awareness	0.61	4.99***	0.37	0.37	24.88***
		2	Compounding awareness	0.26	3.46***	0.82	0.45	93.55***
			Lexical Inferencing	0.76	10.11***			
		3	Compounding awareness	0.15	2.20*	0.87	0.05	92.87***
			Lexical Inferencing	0.47	4.98***			
			Vocabulary knowledge	0.42	4.16***			
		1	Compounding awareness	0.57	4.54***	0.33	0.33	20.57***

 doi:10.20944/preprints202605.1465.v1

Equation 2	Vocabulary knowledge	2	Compounding awareness	0.26	2.63*	0.70	0.37	46.79***
			Lexical Inferencing	0.68	7.02***			
Equation 3	Lexical Inferencing	1	Compounding awareness	0.47	3.40**	0.22	0.22	11.57**

Note: $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$, two-tailed.

In grades 5 to 6 (Table 8), as in grades 3 to 4, compounding awareness did contribute to blind students' lexical inferencing ($\Delta R^2 = 0.21$, $t = 3.87$, $p < 0.001$). However, when lexical inferencing entered in equation 1 and 2, compounding awareness didn't contribute to Braille reading comprehension and vocabulary knowledge. Blind students' lexical inferencing explained variance in Braille reading comprehension ($\Delta R^2 = 0.41$, $t = 7.56$, $p < 0.001$) and vocabulary knowledge ($\Delta R^2 = 0.38$, $t = 8.28$, $p < 0.001$) after experience in regular schools were controlled. These results suggest that lexical inferencing plays a unique role in vocabulary knowledge and Braille text comprehension during late elementary school (grades 5 to 6).

Table 8. Multiple Linear Regression Testing of Study Variables in Upper-Grade Blind Students (n = 57).

	Outcome Variables	**Step**	**Predictors**	***β***	***t-value***	R^2	ΔR^2	***F***
Equation 1	Braille reading comprehension	1	Compounding awareness	0.46	3.82***	0.21	0.21	14.62***
		2	Compounding awareness	0.13	1.33	0.62	0.41	43.30***
			Lexical Inferencing	0.72	7.56***			
Equation 2	Vocabulary knowledge	1	Experience in regular schools	0.28	2.17*	0.08	0.08	4.72*
		2	Experience in regular schools	0.35	3.07**	0.32	0.24	12.83***
			Compounding awareness	0.50	4.40***			
		3	Experience in regular schools	0.20	2.55*	0.70	0.38	42.09***
			Compounding awareness	0.15	1.69			
			Lexical Inferencing	0.72	8.28***			
Equation 3	Lexical Inferencing	1	Compounding awareness	0.46	3.87***	0.21	0.21	14.95***

Note: $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$, two-tailed.

4. Discussion

The present study examined lexical inferencing in Chinese students with blindness and tested how compounding awareness, lexical inferencing, and vocabulary knowledge were associated with Braille reading comprehension in the middle and upper primary grades. The findings answered the four research questions in a relatively consistent pattern. First, students with blindness showed lower lexical inferencing performance than sighted students at both middle and upper grade levels, although lexical inferencing improved with grade level. Second, lexical inferencing significantly predicted both vocabulary knowledge and Braille reading comprehension among students with blindness. Third, compounding awareness significantly predicted lexical inferencing in both middle-grade students and upper-grade students. Fourth, the relative role of compounding awareness and lexical inferencing differed by grade group. In middle-grade students, both compounding awareness and lexical inferencing contributed to vocabulary knowledge and Braille reading comprehension, with vocabulary knowledge also predicting reading comprehension. In upper-grade students, lexical inferencing remained a significant predictor of both vocabulary knowledge and Braille reading comprehension, whereas compounding awareness no longer directly predicted either outcome. These results suggest that compounding awareness is broadly involved in Braille reading during the

 doi:10.20944/preprints202605.1465.v1

middle grades, while lexical inferencing becomes the more salient and stable predictor of vocabulary knowledge and text comprehension in the upper grades.

4.1. Comparison of Lexical Inferencing Between Chinese Primary School Students with Blindness and Sighted Peers

The present study found that lexical inferencing improved with grade level among both Chinese students with blindness and their sighted peers, likely reflecting increased language exposure, accumulated Braille reading experience, and more advanced morphological awareness. As tactile reading skills develop through extensive reading and language practice, students with blindness gain access to a broader range of lexical and syntactic information, which may support the gradual improvement of lexical inferencing ability.

Despite these gains, students with blindness in the middle and upper primary grades continued to perform significantly below their sighted peers and even below younger sighted students. This pattern suggests that visual experience plays an important role in lexical inferencing. Visual–linguistic dual coding facilitates conceptual understanding and lexical processing (Paivio, 1986), whereas the absence of visual input may constrain the development of rich lexical representations and semantic networks in students with blindness (Landau & Gleitman, 1985).

The delayed development of lexical inferencing may also be related to characteristics of Chinese Braille. Braille reading is generally less efficient for information extraction (Emerson, 2009), and Chinese Braille is further characterized by a high prevalence of homophones and strong phonological–orthographic consistency (Chen et al., 2023). Consequently, students with blindness may require greater memory and inferential effort during reading, making them more vulnerable to cognitive load in tasks requiring the integration of multiple sources of information.

4.2. Effects of Grade Level, Years of Braille Learning, and Mainstream School Experience on Chinese Primary School Students with Blindness

The present study found that Braille reading comprehension, compounding awareness, and vocabulary knowledge among Chinese primary school students with blindness improved with grade level. Students with longer Braille learning experience also demonstrated significantly higher levels of compounding awareness, consistent with previous research (Chen et al., 2023; Xie et al., 2023). Prior studies suggest that increased exposure to complex texts facilitates more rapid and accurate processing of morphemic information (Wang & Zhang, 2021; Ku & Anderson, 2003). As tactile Braille reading proficiency develops, students gain access to a wider range of texts, which may strengthen their understanding of morphemes and compounding structures, thereby promoting the development of compounding awareness (Kuo & Anderson, 2006).

The present study further found that in the upper primary grades, students with mainstream school experience demonstrated significantly higher levels of vocabulary knowledge. This finding suggests that mainstream school experience may facilitate the cumulative development of reading-related abilities among students with blindness. Compared with specialized schools for the blind, mainstream schools generally provide richer language input, greater lexical diversity in classroom instruction, and more opportunities for peer interaction. Through increased exposure to contextualized language use and authentic social communication, students with blindness may develop more refined semantic representations, with these advantages becoming more evident at higher grade levels.

4.3. Relationships among Compound Morphological Awareness, Lexical Inferencing, Vocabulary Knowledge, and Braille Reading Comprehension

The present study found that lexical inferencing significantly and positively predicted both vocabulary knowledge and braille reading comprehension among middle- and upper-grade blind students. According to the Reading Systems Framework proposed by Charles Perfetti and Joseph

 doi:10.20944/preprints202605.1465.v1

Stafura (2014), lexical inferencing is closely related to vocabulary knowledge during the integration process from word recognition to text comprehension. Readers with stronger lexical inferencing are generally better able to recognize unfamiliar words and integrate word meanings into text representations, thereby facilitating the comprehension of unfamiliar or complex vocabulary. In the present study, lexical inferencing refers to the process of using constituent morphemes to infer the meanings of unfamiliar words (Cheng & Zhang, 2023), reflecting an individual's understanding of linguistic rules and semantic transfer. Blind students with stronger lexical inferencing may demonstrate greater morphological sensitivity, enabling them to efficiently recognize braille symbol patterns and associate them with previously acquired morphemic knowledge. This process helps them understand how identical Braille symbols may vary across different combinations and contexts, thereby enhancing unfamiliar word comprehension. For example, when identifying the braille word "⠸⠴⠐⠶⠒" ("旅费", travel expenses), students who can recognize the morphemic components "⠸⠴⠄" ("旅", travel) and "⠐⠶⠒" ("费", expense) and integrate their meanings may infer that the word refers to expenses incurred during travel. Moreover, stronger lexical inferencing abilities may help blind students process unfamiliar words more efficiently during Braille reading, facilitating information integration and improving comprehension of complex sentences and passages without frequent disruptions caused by unfamiliar vocabulary.

The present study found that compounding awareness significantly and positively predicted lexical inferencing among both middle- and upper-grade blind students. This finding is consistent with previous studies on Chinese print reading among sighted children. In Chinese, compound words constitute a major proportion of the lexicon, and the meanings of whole words are often highly transparent to the meanings of their constituent morphemes, which facilitates children's inference of whole-word meanings from morphemic information. According to the morphemic decomposition theory, when encountering complex or unfamiliar words, children can use compound morphological awareness to decompose and integrate constituent morphemes and thereby infer word meanings.

Similarly, Chinese Braille contains many compound words, and blind students learn braille word-segmentation and connected-writing rules from the early stages of Braille learning. As a result, blind students with stronger compound morphological awareness may recognize Braille symbol patterns more efficiently, analyze word structures, and infer unfamiliar word meanings during Braille reading. For example, when reading the braille word "⠠⠺⠒⠘⠒" ("日食", solar eclipse), students who understand the meanings of the morphemes "日" (sun) and "食" (eat) may infer that the word relates to an astronomical phenomenon involving the sun. Combined with contextual and prior knowledge, they may further infer the meaning of "solar eclipse".

4.4. Differential Contributions of Compounding Awareness and Lexical Inferencing

Hierarchical regression analyses further suggested potential differences in the developmental mechanisms of vocabulary knowledge and Braille reading comprehension between middle- and upper-grade blind students. Specifically, compounding awareness and lexical inferencing jointly contributed to vocabulary knowledge and braille reading comprehension among middle-grade blind students, whereas lexical inferencing played a more prominent role among upper-grade blind students. This may be associated with the developmental characteristics of compounding awareness across different stages of reading development in blind students.

According to the stages of reading development theory proposed by Chall (1983), braille reading development is similar to print reading development in sighted children with respect to the developmental stages involved (Steinman, 2006). During the "learning to read" stage, blind students typically rely more on decoding skills based on metalinguistic awareness (Wormsley, 2000). As children progress through elementary school, the development of compounding awareness gradually plateaus with increasing age and grade level (Zhang et al., 2023). At the same time, improvements in braille tactile reading ability and cognitive development enable blind students to move from "learning to read" to "reading to learn".

 doi:10.20944/preprints202605.1465.v1

At this stage, more cognitive resources are allocated to processing and analyzing unfamiliar words. This process involves not only relatively basic processes, such as retrieval, but also higher-order cognitive skills, including inferential integration, which gradually become more important for word meaning construction (Zhao et al., 2024). Consequently, the role of compounding awareness may weaken or even become non-significant. In addition, the dynamic relations hypothesis of the direct and indirect effects model of reading suggests that foundational reading-related skills, including metalinguistic awareness, may play different roles across stages of reading development, reflecting the dynamic and complex nature of reading development (Kim,2020). Consistent with this view, Xia (2023) found that compound morphological awareness significantly predicted braille sentence and passage comprehension among Chinese blind students in Grades 3–4, whereas this predictive effect was no longer significant among students in Grades 5–6.

5. Limitations and Implications

Despite its contributions, this study has several limitations. First, the sample was geographically limited, as blind participants were mainly recruited from special education schools in eastern China and sighted students from a single school in Beijing, which may restrict the generalizability of the findings. Future studies should include more diverse samples across regions and educational settings. Second, the measurement of lexical inferencing requires further refinement. Due to practical constraints, the task did not assess students' ability to infer word meanings from extended textual contexts. Future research should employ more ecologically valid assessments within authentic reading situations. Third, contextual and individual difference factors, such as family language environment, instructional practices, and reading strategies, were not fully considered. Including these variables may provide a more comprehensive understanding of Braille reading development. Finally, the cross-sectional design does not allow causal inferences or examination of developmental changes. Longitudinal studies are needed to investigate developmental trajectories and evaluate the effectiveness of interventions targeting morphological awareness and lexical inferencing across grade levels.

Despite these limitations, the findings offer cautious practical implications for schools for the blind. First, the results highlight the importance of enriched language environments and early instruction. Students with mainstream schooling experience showed stronger vocabulary knowledge, suggesting the value of high-quality language input and interactive learning contexts. The findings also emphasize the importance of early and systematic Braille instruction for supporting foundational reading skills and strategic reading development. Second, compounding awareness appears to play a foundational role, particularly in the middle primary grades. Teachers may design morpheme segmentation and recombination activities based on everyday contexts to help students understand compound word structures and word-formation rules. Auditory training that highlights morphemic boundaries during reading may also strengthen students' sensitivity to word structure. In addition, braille cards containing individual morphemes can be used to encourage students to construct different compound words, thereby enhancing morphological awareness and supporting later vocabulary and text comprehension. Third, the present study found that middle- and upper-grade blind students showed weaker lexical inferencing abilities than sighted students. Therefore, schools for the blind should incorporate explicit lexical inferencing training into language instruction through multisensory approaches integrating auditory, tactile, and semantic cues. For example, teachers may guide students to infer word meanings based on constituent morphemes or encourage them to combine learned morphemes to generate new words and sentences. Such activities may strengthen deep semantic processing and promote independent vocabulary learning.

 doi:10.20944/preprints202605.1465.v1

Author Contributions: Conceptualization, Wu.Z., Zhang.Y. and Tian.M.; methodology, Wu.Z. formal analysis, Wu.Z.; investigation, Wu.Z.; data curation, Wu.Z., Wang.Q; writing—original draft preparation, Wu.Z., Wang.Q., Lin.T., Li.K.; writing—review and editing, Zhang.Y. and Tian.M.; supervision, Zhang.Y. and Tian.M.; project administration, Zhang.Y. and Tian.M.; funding acquisition, Zhang.Y. and Tian.M. All authors have read and agreed to the published version of the manuscript.

Funding: Mengyu Tian is supported by grants from National Natural Science Foundation of China [32400891] and the Fundamental Research Funds for the Central Universities.

Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki and approved by the Research Ethics Committee of the Faculty of Education, Beijing Normal University (protocol code: BNU202310100034).

Informed Consent Statement: Informed consent was obtained from all subjects involved in this study.

Data Availability Statement: The data are currently not publicly available due to participant privacy, but they are available from the corresponding author upon reasonable request.

Acknowledgments: We would like to thank Xinchun Wu, Haomin Zhang, Meng Guo, Jiayi Lv, Peng Peng, Siqi Huang, Shumin He, and all participants for their support in the process of data collection.

Conflicts of Interest: The authors declare no conflicts of interest.

References

Nagy, W. E., & Scott, J. A. (2000). Vocabulary processes. In M. L. Kamil, P. B. Mosenthal, P. D. Pearson, & R. Barr (Eds.), *Handbook of reading research* (Vol. 3, pp. 269–284). Lawrence Erlbaum Associates Publishers.

Lundberg, I. (2002). The child's route into reading and what can go wrong. *Dyslexia (Chichester, England)*, *8*(1), 1–13. https://doi.org/10.1002/dys.204

Chen, H., Wu, X., Sun, P., Xie, R., Feng, J., & Zhao, Y. (2019). *The effect of morphological awareness on reading comprehension of elementary blind children: Mediating role of vocabulary knowledge*. In Proceedings of the 22nd National Academic Conference of Psychology (pp. 616–617). Beijing Key Laboratory of Applied Experimental Psychology, Faculty of Psychology, Beijing Normal University, & Center for Children's Reading and Learning.

Perfetti, C. (2007). Reading ability: Lexical quality to comprehension. *Scientific Studies of Reading*, *11*(4), 357–383. https://doi.org/10.1080/10888430701530730

Liu, P. D., & McBride-Chang, C. (2010). What is morphological awareness? Tapping lexical compounding awareness in Chinese third graders. *Journal of Educational Psychology*, *102*(1), 62–73. https://doi.org/10.1037/a0016933

Xia, Y., Xie, R., Wu, X., Zhao, Y., Sun, P., & Chen, H. (2023). The role of phonological awareness, morphological awareness, and rapid automatized naming in the braille reading comprehension of Chinese blind children. *Learning and Individual Differences*, *103*, 102272. https://doi.org/10.1016/j.lindif.2023.102272

Moats, L. C. (2005). How spelling supports reading. *American Educator*, *6*(12–22), 42. https://www.aft.org/sites/default/files/Moats.pdf

Ouellette, G. P. (2006). What's meaning got to do with it: The role of vocabulary in word reading and reading comprehension. *Journal of Educational Psychology*, *98*(3), 554–566. https://doi.org/10.1037/0022-0663.98.3.554

Xie, R., Xia, Y., Wu, X., Zhao, Y., Chen, H., Sun, P., & Feng, J. (2023). Role of compounding awareness in vocabulary knowledge among Chinese children with blindness and sightedness. *Research in Developmental Disabilities*, *136*, 104469. https://doi.org/10.1016/j.ridd.2023.104469

Haastrup, K. (1991). *Lexical inferencing procedures, or, talking about words: Receptive procedures in foreign language learning with special reference to English* (pp.39-40). Gunter Narr Verlag.

Cheng, X., & Zhang, H. (2023). Contributions of metalinguistic awareness and lexical inference to reading comprehension in upper-elementary Chinese students. *Journal of Research in Reading*, *46*(1), 86–103. https://doi.org/10.1111/1467-9817.12415

 doi:10.20944/preprints202605.1465.v1

Zhang, H. (2015). Morphological awareness in vocabulary acquisition among Chinese-speaking children: Testing partial mediation via lexical inference ability. *Reading Research Quarterly, 50*(1), 129–142. https://doi.org/10.1002/rrq.89

Baumann, J. F., Edwards, E. C., Boland, E. M., Olejnik, S., & Kame'enui, E. J. (2003). Vocabulary tricks: Effects of instruction in morphology and context on fifth-grade students' ability to derive and infer word meanings. *American Educational Research Journal, 40*(2), 447–494. https://doi.org/10.3102/00028312040002447

Ricketts, J., Bishop, D. V. M., Pimperton, H., & Nation, K. (2011). The role of self-teaching in learning orthographic and semantic aspects of new words. *Scientific Studies of Reading, 15*(1), 47–70. https://doi.org/10.1080/10888438.2011.536129

Chen, H., Zhao, Y., Wu, X., Sun, P., Feng, J., Xie, R., & Wang, H. (2023). Effects of phonological awareness and morphological awareness on blind students' reading comprehension. *British Journal of Psychology, 114*(2), 415–429. https://doi.org/10.1111/bjop.12630

Savaiano, M. E., Compton, D. L., & Hatton, D. D. (2014). Reading comprehension for braille readers: An empirical framework for research. *International Review of Research in Developmental Disabilities, 46*, 177–205. https://doi.org/10.1016/B978-0-12-420039-5.00004-6

Ministry of Education of the People's Republic of China. (2016, December 1). *Notice on the issuance and implementation of the compulsory education curriculum standards for schools for the blind (2016 edition), schools for the deaf (2016 edition), and schools for students with intellectual disabilities (2016 edition)*. Available online: http://www.moe.gov.cn/srcsite/A06/s3331/201612/t20161213_291722.html (accessed on 1 December 2016).

Ministry of Education of the People's Republic of China. (2022, March 25). *Notice on issuing the compulsory education curriculum plan and curriculum standards (2022 edition)*. Available online: https://www.gov.cn/zhengce/zhengceku/2022-04/21/content_5686535.htm (accessed on 25 March 2022).

Wysocki, K., & Jenkins, J. R. (1987). Deriving word meanings through morphological generalization. *Reading Research Quarterly, 22*(1), 66–81. https://doi.org/10.2307/747721

Zhang, H., Zhang, J., Han, C., & Zhou, X. (2022). Integrating morphological and contextual cues in lexical inferencing among fourth-grade Chinese students. *Applied Psycholinguistics, 43*(4), 805–827. https://doi.org/10.1017/S0142716422000157

Zhang, D. (2013). Linguistic distance effect on cross-linguistic transfer of morphological awareness. *Applied Psycholinguistics, 34*(5), 917–942. https://doi.org/10.1017/S0142716412000070

Song, S., Su, M., Kang, C., Liu, H., Zhang, Y., McBride-Chang, C., Tardif, T., Li, H., Liang, W., Zhang, Z., & Shu, H. (2015). Tracing children's vocabulary development from preschool through the school-age years: An 8-year longitudinal study. *Developmental Science, 18*(1), 119–131. https://doi.org/10.1111/desc.12190

Paivio, A. (2008). *Mental representations: A dual coding approach* (pp.21). Oxford university press.

Landau, B., & Gleitman, L. R. (1985). *Language and experience: Evidence from the blind child* (pp.53). Harvard University Press.

Emerson, R. W., Holbrook, M. C., & D'Andrea, F. M. (2009). Acquisition of literacy skills by young children who are blind: Results from the ABC braille study. *Journal of Visual Impairment & Blindness, 103(10),* 610–624. https://doi.org/10.1177/0145482X0910301005

Wang, C., & Zhang, Q. (2021). Word frequency effect in written production: Evidence from ERPs and neural oscillations. *Psychophysiology, 58*(5), e13775. https://doi.org/10.1111/psyp.13775

Ku, Y. M., & Anderson, R. C. (2003). Development of morphological awareness in Chinese and English. *Reading and Writing, 16*(5), 399–422. https://doi.org/10.1023/A:1024227231216

Kuo, L., & 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

Perfetti, C., & Stafura, J. (2014). Word knowledge in a theory of reading comprehension. *Scientific Studies of Reading, 18*(1), 22–37. https://doi.org/10.1080/10888438.2013.827687

Chall, J. S. (1983). *Stages of reading development*. McGraw-Hill.

Steinman, B. A., LeJeune, B. J., & Kimbrough, B. T. (2006). Developmental stages of reading processes in children who are blind and sighted. *Journal of Visual Impairment & Blindness, 100*(1), 36–46. https://doi.org/10.1177/0145482X0610000106

 doi:10.20944/preprints202605.1465.v1

Wormsley, D. P., & D'Andrea, F. M. (1997). *Instructional strategies for braille literacy* (1st ed.). American Foundation for the Blind Press.

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

Zhao, Y., Wu, X., Chen, H., Peng, Sun., & Haolan, Wang. (2024). Mechanisms underlying the effects of morphological awareness and rapid automatized naming (RAN) on the reading abilities of Chinese children: An analysis of mediating effects across different stages. *Acta Psychologica Sinica, 56*(1), 70–82. https://link.cnki.net/urlid/11.1911.B.20231123.0944.006

Kim, Y. G. (2020). Hierarchical and dynamic relations of language and cognitive skills to reading comprehension: Testing the direct and indirect effects model of reading (DIER). *Journal of Educational Psychology, 112*(4), 667–684. https://doi.org/10.1037/edu0000407