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SYSTEMATIC REVIEW

Does morphological awareness assessment matter for Chinese-English bilingual children with reading difficulties? *A systematic review and meta-analysis*

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Abstract

This meta-analysis aimed to determine whether Chinese-English bilingual children with reading difficulties (RD) have significant deficits in morphological awareness (MA), phonological awareness, and word reading, in both their first and second languages (L1 and L2). It also evaluated the influence of RD severity, age, diglossia context, and methodological design on effect sizes. The study included 29 samples ($N = 4{,}516$) from 14 studies on children with RD in L1 morphosyllabic Chinese and L2 morphophonemic English. Results showed medium effect sizes for MA ($g = -0.722$) and PA ($g = -0.625$), and a large effect size for word reading ($g = -2.042$) in L1 Chinese. In L2 English, medium to large effect sizes were found for MA ($g = -1.083$), PA ($g = -0.857$), and word reading ($g = -0.730$). Age was the only significant moderator, with larger deficits observed as age increased. These findings align with studies on monolinguals with dyslexia and bilinguals with normal abilities or disabilities, recommending MA tasks in assessments.

Keywords: morphological awareness; bilingual; reading difficulties; dyslexia; Chinese; English

Morphological awareness refers to a learner's ability to reflect on, analyze, and manipulate morphemes and the internal structure of words (Carlisle, 1995, 2000; Kuo & Anderson, 2008). It is widely recognized in the literature as a precursor to reading development across languages and writing systems (Verhoeven & Perfetti, 2017). Morphological awareness developed in one language can transfer and aid reading subskills in a second language, even among bilinguals[1] reading typologically distinct

[1]The term "bilinguals" or "bilingual children" in this study has been used generally to refer to "children who know two languages, without regard for whether they learned them in sequence or simultaneously, or whether they are still in the early stages of learning one of the two languages" (Paradis et al., 2003, p.2).

languages (Ke et al., 2021, 2023). There is emerging evidence of morphological awareness deficits in children with developmental dyslexia, characterized by severe word reading difficulties (Georgiou et al., 2023; McBride et al., 2018; Sodoro et al., 2002). For instance, in a recent meta-analysis by Georgiou et al. (2023), they found that individuals with dyslexia in languages such as Arabic, Chinese, English, Finnish, French, Greek, and Hebrew face significant challenges in morphological awareness. However, meta-analytic evidence on the diagnostic value of morphological awareness for bilingual children with reading difficulties is limited. This meta-analytic review has two objectives: first, to determine if Chinese-English bilingual children with reading difficulties (RD) have an MA deficit alongside phonological awareness (the ability to detect and manipulate language sounds, Sodoro et al., 2002) and word reading in their first and second languages (L1 and L2); second, to examine if effect sizes are influenced by moderators such as RD severity, age, diglossia context (Cantonese vs. Mandarin-speaking societies), and methodological design.

The research is expected to have three implications: Theoretically, by providing new empirical evidence on whether MA deficits co-occur in L1 and L2 reading among bilingual RD children of morphosyllabic Chinese and morphophonemic English, this study will contribute to our understanding of bilingual reading difficulties from a cross-linguistic perspective. Methodologically, it considers a range of moderators that are developmentally, contextually, or methodologically relevant. While our primary focus is on RD/dyslexia, the methodological framework and cross-linguistic perspective adopted in this study are relevant to broader disability studies (e.g., Zhang D. et al., 2023). Practically, it supports diagnostic assessment decisions for bilingual children in Chinese-speaking societies. The prevalence of Chinese dyslexia ranges from 4% to 10% in the Chinese mainland and Hong Kong (as cited in Zhang L. et al., 2023), but definitions and diagnostic criteria vary across Chinese diaspora societies like Beijing, Hong Kong, and Taipei (McBride et al., 2018). The findings will offer insights into the role of MA assessment as a diagnostic tool for Chinese-English bilingual children with reading difficulties in different Chinese-speaking societies.

Literature review

Theories linking morphological awareness to reading development

Carlisle (1995, 2000) was among the first to define morphological awareness as "conscious awareness of the morphemic structure of words and [the] ability to reflect on and manipulate that structure." Carlisle's (2000) study with English-speaking learners at Grades One, Three, and Five showed that morphological awareness was significantly associated with reading comprehension across the grade levels. One main reason perhaps is that morphologically complex words are prevalent, particularly in written texts (Nagy & Anderson, 1984).

Over the past three decades, the interest in the role of morphology in reading, both in L1 and L2, has grown (L1 theories: Carlisle, 1995, 2000; Kirby and Bowers, 2017; Levesque et al., 2021; Perfetti, 2007; Perfetti & Hart, 2002; Ziegler and Goswami, 2005; L2 theories: Chung et al., 2019; Koda, 2005, 2008). According to the Lexical Quality Hypothesis (Perfetti, 2007; Perfetti & Hart, 2002), successful reading comprehension depends on high-quality lexical knowledge represented by orthography, phonology, morphosyntax, meaning, and the binding of these four features. Kirby and Bowers (2017) later proposed that morphology is the binding agent of phonological, orthographic, and semantic features of words. For children with RD, morphological

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awareness may compensate for the weak phonological skills (as cited in Georgiou et al., 2023). According to Ziegler and Goswami's (2005) *psycholinguistic grain-size theory*, the availability of a specific processing unit during word reading depends on the orthographic consistency and availability of the spoken unit in oral language. To bypass their phonological difficulties during word reading, individuals with dyslexia may resort to larger and more consistent grain-size units such as morphemes.

Substantial empirical evidence shows that morphological awareness is a critical predictor of the three major aspects of learning to read (Verhoeven & Perfetti, 2022), namely, becoming linguistically aware, acquiring word identification skills, and learning to comprehend. In (2021), Levesque et al. attempted to illuminate precise mechanisms by which morphology impacts word reading, spelling, and reading comprehension, and they proposed that morphological decoding and morphological meaning analysis are two important pathways through which morphology predicts reading development. In the reading literature, another widely cited theory is the Simple View of Reading (SVR), which posits that reading comprehension is the product of decoding and listening comprehension (Gough & Tunmer, 1986; Hoover & Gough, 1990). Duke and Cartwright (2021, p.530) pointed out that "Morphological awareness is not named in the SVR or many other models of reading, yet research has documented the contributions of morphological awareness to reading, including through word recognition and language comprehension."

The review above is based on L1 reading literature. In L2 reading, researchers are more concerned about the mechanisms through which one can transfer L1 morphological awareness to facilitate L2 reading development. According to Koda's (2005, 2008) transfer facilitation model, there are complex interactions among L1 morphological awareness, evolving L2 morphological awareness, L2 linguistic knowledge (e.g., vocabulary knowledge), and L2 reading skills that develop subsequently. Furthermore, compared to other L1 metalinguistic resources (e.g., phonological awareness), the transfer facilitation of morphological awareness in L2 reading is constrained by L1-L2 distance. This is confirmed by Ke and Xiao's (2015) review of studies on the cross-linguistic transfer of morphological awareness between morphosyllabic Chinese and morphophonemic English, two typologically distinct languages. They found that there were small-to-moderate correlations between L1 and L2 morphological awareness in Chinese-English bilingual reading development, and that L2 exposure and task demands had notable impacts on cross-linguistic transfer. These findings highlight the complex nature of morphological awareness transfer, underscoring the importance of considering both linguistic and contextual factors when examining bilingual reading development.

Morphological awareness as a marker of Chinese and English reading difficulties

Chinese orthography is morphosyllabic, with characters representing morphemes at the syllable level (DeFrancis, 1984). In contrast, English orthography is morphophonemic, as English spelling represents word sounds while maintaining consistency in morpheme representation, even when pronunciation changes (Abbott et al., 2016). Despite these typological differences, morphological awareness is a marker of reading difficulties in learners of both Chinese (e.g., Cheah et al., 2025; Ho et al., 2002; Pan et al., 2024; Peng, 2017) and English (e.g., Siegel, 2008).

In Chinese, Ho et al. (2002) were among the first to propose that Chinese dyslexic children can have impairments in one or more of the four cognitive and linguistic

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domains, including rapid naming, orthographic processing, visual processing, and phonological processing. Building upon and expanding Ho et al.'s (2002) empirical work in Hong Kong, Peng et al. (2017) conducted a meta-analysis of 81 studies published between 1964 and 2015 to investigate the deficit profiles of Chinese children with RD, and they identified two additional domains: working memory (cognitive) and morphological awareness (linguistic). Interestingly, Peng et al. (2017) did not find any significant moderating effect of location (Hong Kong versus mainland), which was echoed by Cheah et al. (2025) in the cognitive and linguistic deficit profiles of Chinese readers across different Chinese diaspora societies (including Beijing, Hong Kong, Taipei). Cheah et al. (2025) assessed 91 children with dyslexia from Hong Kong, Beijing, and Taipei using the same set of Chinese literacy tests to identify dyslexia subtypes. Cluster analysis based on four cognitive-linguistic skills revealed four subtypes: orthographic deficit, phonological deficit, morphological deficit, and global deficit, each with distinct cognitive profiles. The distribution of these subtypes was consistent across the three regions, indicating that the nature of Chinese dyslexia is stable despite differences in literacy experiences. Cheah et al. (2025) also pointed out that different definitions and diagnostic criteria have been adopted in existing literature and highlighted the importance of assessing morphological awareness, along with orthographic processing, rapid automatized naming, and phonological awareness across different Chinese-speaking societies. In English, Siegel (2008) compared the relation of morphological awareness to reading and spelling skills of children with dyslexia, children who are typical readers, and children who are English language learners. She found that students with dyslexia had significantly lower scores than normally achieving readers on the morphological awareness tasks, and that there were no significant differences between English language learners and the English L1 students.

Lately, some researchers have begun to examine the potential co-occurrence of cognitive and linguistic profiles in two languages among Chinese-English bilingual learners with or without RD (e.g., with RD: Chung & Ho, 2010; Gao et al., 2019; Zhou et al., 2014; without RD: Zang et al., 2024). For example, Zhou et al. (2014) tracked the developmental pattern of Chinese and English reading skills in Hong Kong children with and without dyslexia from six to eight years of age. They observed that children with dyslexia manifested clear difficulties in vocabulary knowledge and morphological awareness in both Chinese and English reading. In the mainland China context, Gao et al. (2019) investigated reading acquisition in a large representative sample of 1,824 Chinese-English bilingual children in Grades Four and Five from both urban and rural schools in Beijing and identified a 36% co-occurrence in reading difficulties between L1 Chinese and L2 English. In other words, L1 Chinese reading difficulty significantly increases the risk of L2 English reading difficulty. Gao et al. (2019) recommended that, in addition to the assessment of L1 reading skill, the assessment of L2 reading skills is critical in early L2 readers, as a poor reader in one language may not necessarily be a poor reader in another language. More recently, Zang (2024) conducted a study comparing the predictors of word reading between Chinese-English bilingual children and Chinese-dominant monolingual children in mainland China. They found that, in terms of Chinese word reading, both morphological and orthographic awareness emerged as significant predictors in the monolingual group, whereas in the bilingual group, only morphological awareness was significant, and the contribution of phonological awareness was insignificant in either group. The findings suggest that, for bilingual readers, morphological awareness is more influential than phonological awareness in the development of word reading ability.

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Previous meta-analyses

To date, there has been little meta-analytic evidence examining the morphological deficits in bilingual learners with RD. However, there are pertinent meta-analyses on the effectiveness of literacy intervention in remediating reading difficulties in Chinese (Ruan et al., 2024) or English (Goodwin & Ahn, 2010), morphological, oral language, and phonological deficits in monolingual readers of different languages and writing systems (Georgiou et al., 2023; Melby-Lervåg & Lervåg, 2012), and the impacts of morphological awareness on bilingual reading development among normally developing children (Ke et al., 2021, 2023) and deaf and hard-of-hearing (DHH) students (Zhang D. et al., 2023).

Ruan et al. (2024) compared the efficacy of different reading interventions on literacy outcomes for Chinese children. In particular, they found that morphological training had a significant and medium effect on improving Chinese literacy skills, which was comparable between younger and older children. Similarly, for English reading, Goodwin and Ahn (2010) reported a significant and medium impact of morphological instruction on various reading-related outcomes for children with reading difficulties, English language learners, and English L1 children. Notably, Goodwin and Ahn (2010) found that the effect sizes were larger for children with reading difficulties and English language learners.

From a cross-language and cross-writing system perspective, Georgiou et al. (2023) reviewed 40 studies covering child readers of seven languages (Arabic, Chinese, English, Finnish, French, Greek, and Hebrew). Their meta-analytic findings indicated that children with dyslexia experience significant difficulties in morphological awareness compared to their age-matched controls, and that the group differences in morphological awareness increase with age. Ke et al. (2021) also identified a significant moderating effect of age when examining morphological awareness as a cross-language shareable resource in child bilingual readers without RD. Ke et al. (2021) conducted a systematic review and meta-analysis of 34 studies and investigated the strength of associations between L1 and L2 morphological awareness and L2 reading development in child L2 learners. The correlation effect sizes between L2 morphological awareness and L2 reading comprehension are larger as age increases; yet the correlation effect sizes remain unchanged between L1 morphological awareness and L2 reading outcomes. In another meta-analysis, Ke et al. (2023) compared the correlation effect sizes between morphological awareness and reading outcomes in L1 and L2 and observed that the effect sizes are consistently larger in L2. Ke et al. (2023) conjectured that bilingual readers might rely more heavily on morphological awareness when reading in their L2 than in their L1.

In addition, Zhang D. et al. (2023) reported the first meta-analysis examining the correlations between morphological awareness and reading-related abilities among deaf and hard-of-hearing (DHH) students, revealing strong associations with word reading, vocabulary knowledge, and reading comprehension across multiple languages and educational contexts. Their findings underscore the critical role of morphological awareness as a foundational skill for literacy development in DHH learners, paralleling its significance in other populations with reading challenges, such as children with dyslexia. By highlighting the importance of morphology-based instruction for diverse learner groups, including those with sensory or learning disabilities, Zhang D. et al. (2023)'s study not only fills a notable gap in the literature on DHH students but also reinforces the broader relevance of metalinguistic skills within disability studies.

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Viewed collectively, the diagnostic value of morphological awareness assessment has been confirmed by previous empirical and meta-analytic studies for monolingual learners with reading difficulties in Chinese only, English only, or across different languages and writing systems; however, to date, there is little meta-analytic evidence evaluating morphological awareness deficits in bilingual children with reading difficulties from a cross-language perspective, as well as the moderating factors that may influence the magnitude of these deficits. Accordingly, the present research focused on four potential moderators—RD severity, age, diglossia context, and methodological design—which were theoretically and empirically motivated to account for potential sources of heterogeneity in effect sizes across studies. First, RD severity (i.e., poor readers vs. diagnosed dyslexia) was included because previous research has demonstrated that the magnitude of cognitive and linguistic deficits may differ depending on the strictness of diagnostic criteria and the severity of reading difficulties (Cheah et al., 2025). Second, age was examined as a moderator given robust evidence that the role of morphological awareness in reading development increases with age and grade level, and that deficits may become more pronounced over time (Georgiou et al., 2023). Third, the diglossia context (Cantonese-speaking vs. Mandarin-speaking societies) was considered to capture the influence of linguistic environment and instructional practices, as prior studies have suggested that dialectal and orthographic differences may impact the development and manifestation of reading-related skills (McQuade et al., 2024; Peng et al., 2017). Finally, methodological design (types of control or comparison groups) was included to address the possibility that study design choices—such as the selection of control groups—could systematically affect observed effect sizes (Goodwin & Ahn, 2010; Georgiou et al., 2023). By systematically examining these moderators, the meta-analysis aimed to provide a more nuanced understanding of the variability in morphological awareness deficits among Chinese-English bilingual children with reading difficulties. While our primary focus is on RD/dyslexia, the methodological framework and cross-linguistic perspective adopted in this study are relevant to broader disability studies, including studies of the DHH population, as they emphasize the importance of recognizing diverse learner profiles and the intersectionality of language and disability. Our results advocate for more inclusive diagnostic criteria and intervention strategies that account for the unique experiences of bilingual children with disabilities, thereby informing both research and practice in disability studies and related fields.

The present research

To reiterate, the main purpose of this meta-analytic review is to expand the existing understanding of the role of morphological awareness in diagnosing reading difficulties (RD) among Chinese-English bilingual children. It is guided by three research questions (RQs):

RQ1: What are the definitions, assessment tasks, and diagnostic criteria of RD in the selected studies of Chinese-English bilingual children?

RQ2: Do Chinese-English bilingual children with RD experience a morphological awareness deficit in addition to phonological awareness and word reading deficits in Chinese and English, respectively? If yes, what are the sizes of the deficits?

RQ3: Are the deficit sizes moderated by RD severities, age, diglossia context (Cantonese Chinese-speaking versus Mandarin Chinese-speaking societies), and methodological design?

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Three predictions are formulated based on the aforementioned literature review:

Prediction One: There has been heterogeneity in the definitions, assessment tasks, and diagnostic criteria of RD across Chinese diaspora societies (i.e., Beijing, Hong Kong, Singapore, and Taipei), yet a more standardized and consistent practice in Hong Kong.

Prediction Two: Chinese-English bilingual children with RD experience a morphological awareness deficit in addition to phonological awareness and word reading deficits in both L1 Chinese and L2 English. The effect sizes of morphological awareness and phonological awareness are larger in L2 English than those in L1 Chinese because L2 readers rely more on metalinguistic awareness.

Prediction Three: It is anticipated that age will be the only significant moderator, as morphological awareness tends to play a more crucial role at higher grade levels in both Chinese and English. In contrast, nonsignificant moderating effects are expected from factors such as the severity of reading difficulties, diglossia context, or methodological design. This is based on the understanding that morphological awareness has consistently been identified as a significant predictor of reading development in both Chinese and English, irrespective of diglossia contexts or the presence of learning difficulties among diverse learners.

Methodology

Literature search

The literature search proceeded in three major stages (as shown in Figure 1). First, an initial search was completed in May 2024. This included: (1) a Boolean search of databases (Web of Science and PsycINFO) with a combination of four *keywords* (i.e., reading difficulties OR dyslexia AND Chinese AND English) that appeared in the abstracts; and (2) a manual search was conducted by checking the references in existing meta-analyses and reviews (i.e., Ke et al., 2021, 2023; Goodwin & Ahn, 2010; Georgiou et al., 2023; McBride et al., 2018; Ruan et al., 2024). These steps yielded 12 primary studies and 25 independent samples. Second, to update the database, another manual search was conducted via Google Scholar in October 2024. As a result, two studies (Chung et al., 2022; Tong et al., 2022) with four independent samples were added. Third, an expanded search was conducted in October 2025 to ensure comprehensive coverage. This included: (1) updating the systematic database search across all five databases (Web of Science, PsycINFO, Scopus, ERIC, and LLBA); (2) manual-searching six key journals that specialize in reading research (i.e., *Annals of Dyslexia, Dyslexia, Journal of Research in Reading, Reading Research Quarterly, Reading & Writing, and Scientific Studies of Reading*), following the search strategy of a relevant prior meta-analysis (Melby-Lervåg & Lervåg, 2012); (3) conducting a forward and backward citation search on Google Scholar for all included studies; and (4) setting the study publication time between 2000 and 2025. We identified one potential study (i.e., McQuade et al., 2024), but decided that the dataset might overlap with Pan et al. (2024)'s. Therefore, no additional studies meeting the inclusion criteria were identified during the final expanded search. The final dataset thus consists of 14 primary studies (comprising 29 independent samples).

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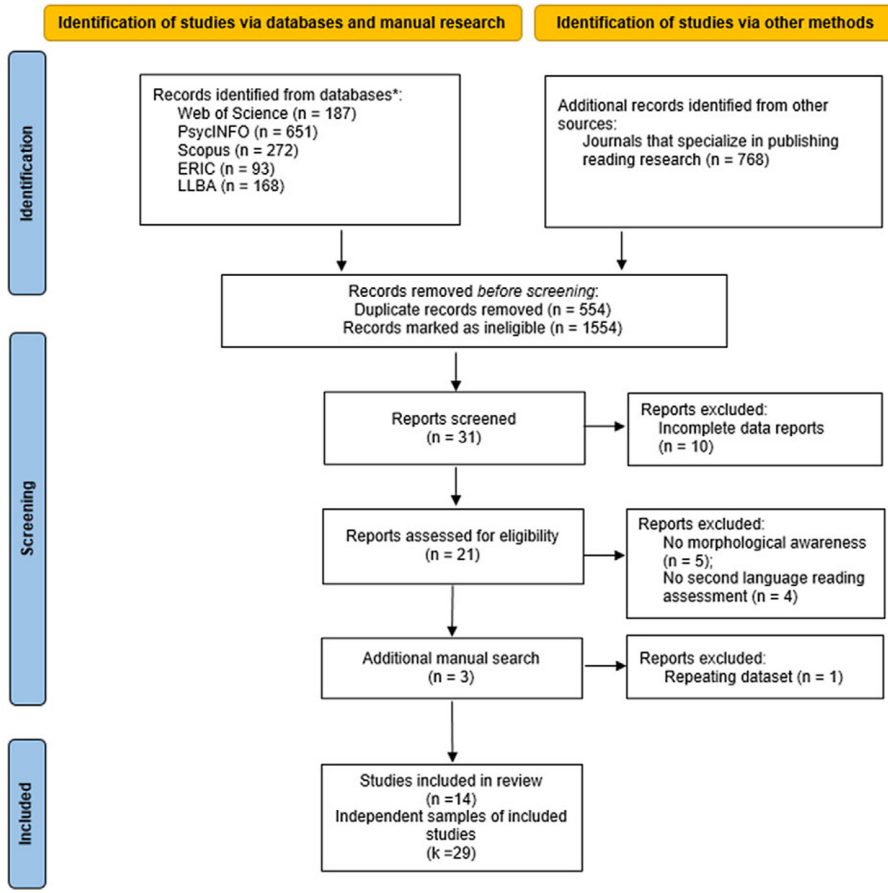

Figure 1. Literature search procedures.

Inclusion and exclusion criteria

Given the scope of this search, the selected studies must (1) include children with reading difficulties, (2) have a Chinese morphological awareness measure and another measure of either phonological awareness and word reading, (3) include reading-related measures in both Chinese and English, (4) written in English, and (5) report Hedge's *g* or provide sufficient statistical information to calculate the effect size. Review and repetitive reports were excluded. To assess study quality, we reported instrument reliability as a key indicator, following the approach of Ke et al. (2021) in their meta-analysis. As shown in Appendix 1, the mean and median reliability coefficients were all above .80, indicating that the reading measurements were reliable.

Coding and data analyses procedures

To answer RQ1, descriptive information of each independent sample was entered into an Excel file (see Table 1). Coding was first entered by the second author. The first author then recoded all cells. To answer RQ2 and RQ3, coding of the effect sizes was

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conducted by the two coders in a similar way. The intercoder reliability (Cronbach's alpha) for effect size was .90. For categorical variable coding, Cohen's kappa was .89. The first author resolved the inconsistencies by triple-checking. For studies that did not report Hedge's *g*, effect size conversion was conducted via the Campbell Collaboration calculator (Littell & White, 2018). Regarding the size of *g*, the rule of thumb is that small, medium, and large effect sizes are at or above .30, .50, and .80, respectively.

The coding of the moderator focused on four factors: (1) RD severity (two levels: poor readers vs. dyslexia); (2) Diglossia context (two levels: Cantonese-speaking vs.

Mandarin-speaking); (3) methodological design (two levels: Chinese RD vs. age-matched /reading control; Chinese RD vs. age-matched /English RD/bilingual RD); and (4) age (in years). Comprehensive Meta-analysis (CMA) Version 4 was employed to conduct subsequent analyses. The complete CMA files with coding are available at: https://osf.io/s3wz8/overview?view_only=4cf91fb65bec4fe48da0cd4e225db505.

First, publication bias was checked via three steps: (1) both published journal articles and an unpublished doctoral dissertation (i.e., Shen, 2023) were included in the meta-analysis; (2) Funnel plots for random-effects models were used to determine the presence of retrieval bias. No asymmetric funnels were identified (see Figures 2–7). (3) The results of Duval and Tweedie's (2000) trim and fill were reported in Table 2 below.

Second, potential outliers were examined for the six target outcome variables (i.e., morphological awareness, phonological awareness, and word reading in Chinese and English, respectively) and removed if the standard residuals were bigger than 2.5 in either positive or negative direction (see also Ke et al., 2021). Therefore, three independent samples from Chung et al. (2022) were removed for the outcome of Chinese morphological awareness, and Chung and Ho (2010), as well as Kalindi et al. (2015), were removed for the outcome of English word reading.

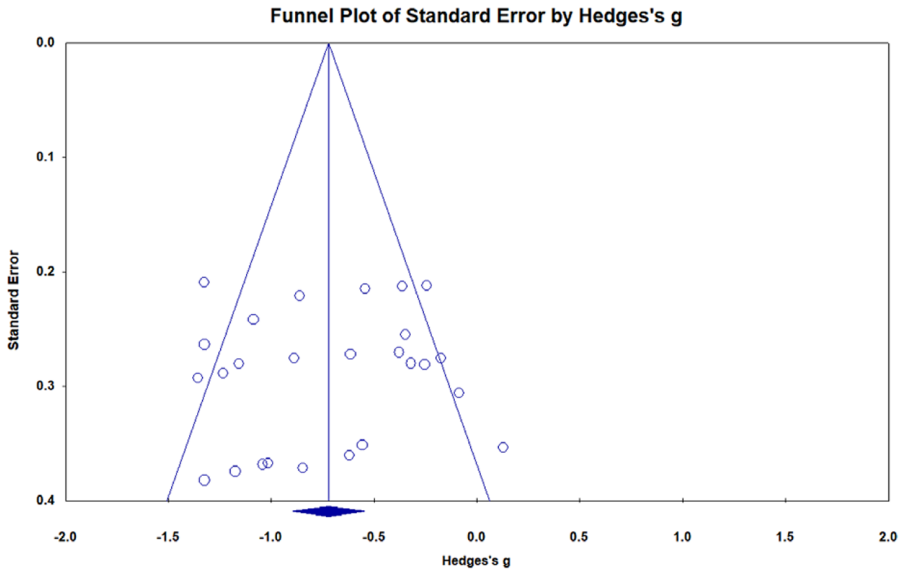

Figure 2. Funnel plot for Chinese morphological awareness.

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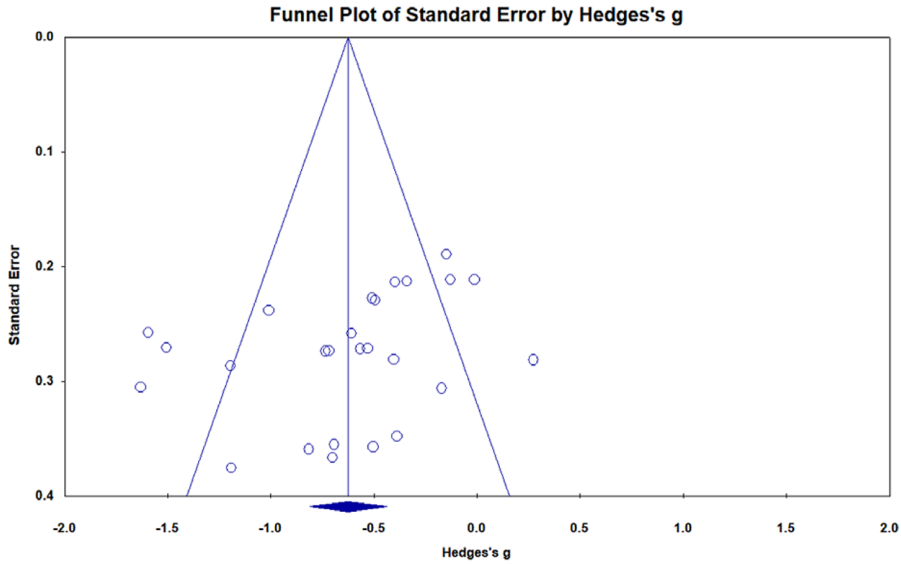

Figure 3. Funnel Plot for Chinese Phonological Awareness.

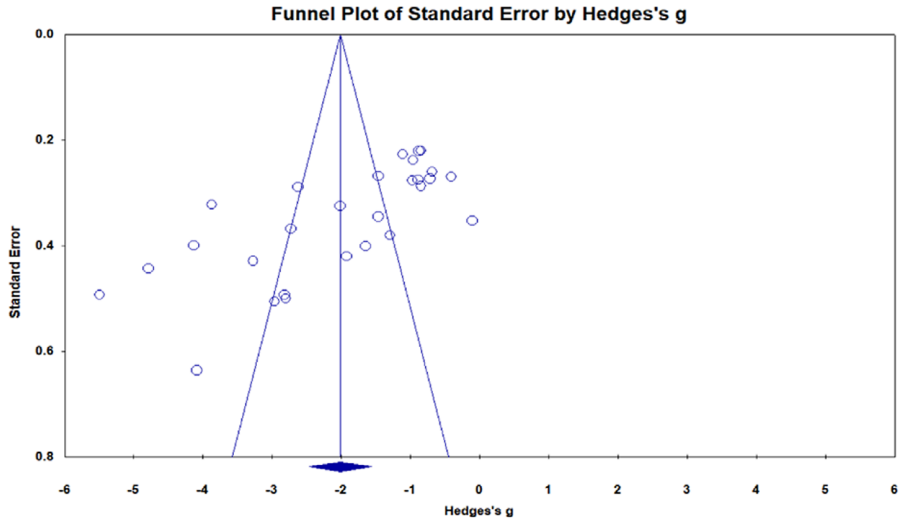

Figure 4. Funnel plot for Chinese word reading.

Finally, in order to investigate whether there was variability among the correlations across primary studies, a heterogeneity test (*Q* test; Hedges & Olkin, 1985) was conducted. A significant value on the heterogeneity test would provide evidence for variability among the correlations, and I^2 indicates the proportion of the heterogeneity that is real rather than due to chance. Given that three moderator variables in this study are categorical, a heterogeneity test (*Q* test) was performed based on random-effects

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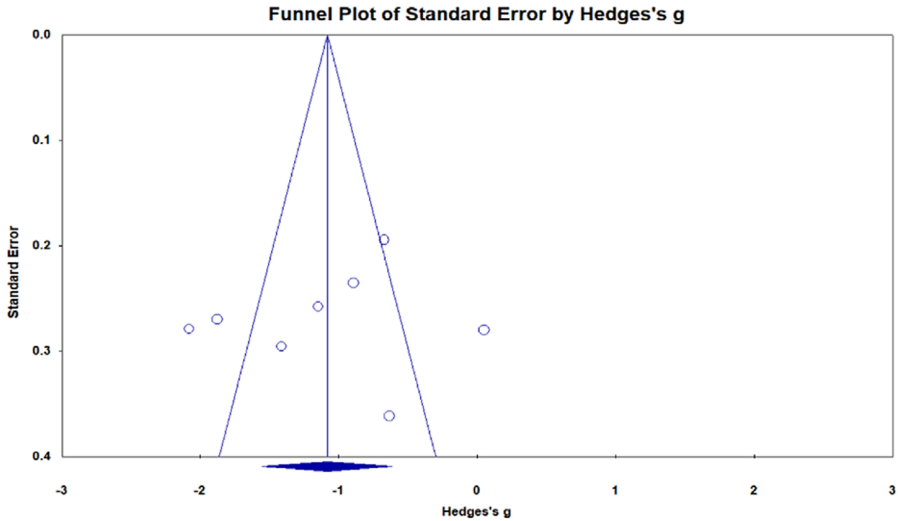

Figure 5. Funnel plot for English morphological awareness.

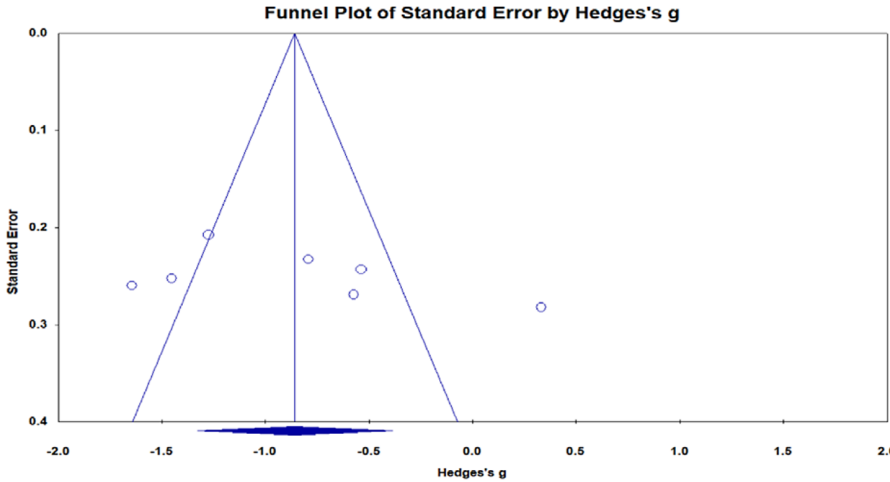

Figure 6. Funnel plot for English phonological awareness.

modeling, both within and across the subgroups created by the moderator analyses. Additional meta-regressions were run with age (in years) as a continuous variable for outcomes with at least 10 independent samples (after Ke et al., 2023).

Results

An overview of selected studies

As mentioned above, a total of 14 studies and 29 independent samples (N = 4,516) were selected from the literature. Children of the selected studies were from four Chinese diaspora societies: Beijing (k = 5), Taipei (k = 1), and Singapore (k = 1), where

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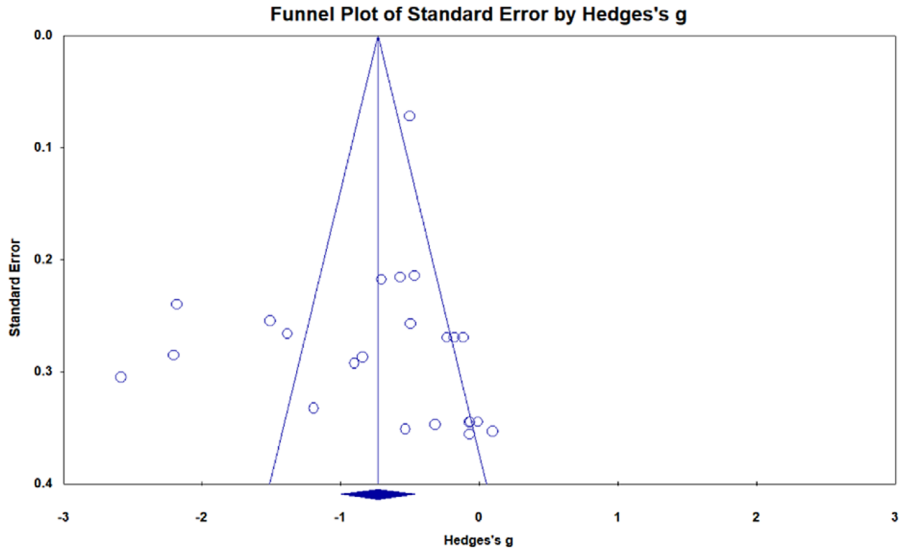

Figure 7. Funnel plot for English word reading.

Mandarin Chinese is the main medium of instruction, as well as Hong Kong (k = 22), where Cantonese Chinese is dominant. Methodologically speaking, eight samples included comparisons across dyslexia vs. age-matched or reading control groups, while 21 samples compared reading performance among groups with L1 Chinese RD/dyslexia vs. L2 English RD/dyslexia only or bilingual RD/dyslexia or age-matched control groups. The same test batteries were administered to the RD/dyslexia groups and the control groups.

RQ1: What are the definitions, assessment tasks, and diagnostic criteria of RD in the selected studies of Chinese-English bilingual children?

An initial screen of the independent samples resulted in two types of studies: Type One included studies with less severe RD (e.g., labeled by 'poor reading', 'word reading difficulties', or 'reading comprehension difficulties'), and Type Two studies involved more severe and persistent RD (i.e., diagnosed with dyslexia). Therefore, our analyses of the definitions, diagnostic criteria, and assessment tasks of RD were categorized into two types according to RD severity. As shown in Table 1 below, out of the 14 studies, only six have provided definitions of RD or dyslexia.

The results indicated that children with *RD* have been referred to as poor readers, having reading scores in the bottom 25% of all children (e.g., Cheah et al., 2023; McBride-Chang et al., 2012; Tong et al., 2018). As to the main diagnostic assessment task, word reading was used in four studies (e.g., Chung et al., 2022; McBride-Chang et al., 2012; McBride-Chang et al., 2013; Tong et al., 2015), reading comprehension in two studies (i.e., Tong et al., 2018; Tong et al., 2022), and word dictation in one study (i.e., Cheah et al., 2023). For example, in McBride-Chang et al. (2012)'s study with Hong Kong children, their criteria for selecting "poor readers" were (a) scoring in the lowest

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Table 1. Definitions, diagnostic assessment, and diagnostic criteria adopted in the primary studies

Study author(s) and publication year	Context	RD severity type[a]	Definition of RD or dyslexia	Diagnostic criteria	Diagnostic assessment task
McBride-Chang et al. (2012)	Hong Kong	One	… Hong Kong Chinese children with reading difficulties, defined as having scored in the bottom 25% of all children from a representative sample of the city across 2 consecutive years.	Our criteria for selecting "poor readers" were (a) scoring in the lowest 25% of all participants on the respective word reading test (b) consistently across the 2 most recent years of testing.	Word reading
McBride-Chang et al. (2013)	Beijing	One	We defined poor readers across samples as those at or below the 25th percentile on the Chinese word reading and/or English word reading test in each location.	Poor reading here is defined as falling in the lowest 25% of readers in a group, a fairly liberal but not unusual yardstick for distinguishing reading difficulty.	Word reading
Cheah et al. (2023)	Hong Kong	One	N.A.	Based on performances on Chinese and English dictation (criterion=below 25% in a larger sample), four groups were identified.	Word dictation
Chung & Ho (2010)[b]	Hong Kong	Two	N.A.	To be diagnosed as dyslexic in Chinese, the child's literacy composite score and at least one cognitive composite score had to be at least 1 standard deviation below the means of those of students of their respective ages in the HKT-SpLD and Gardner's (1996) Test of Visual-Perceptual Skills(nonmotor) Revised (TVPS-R).	Hong Kong Test of Specific Learning Difficulties in Reading and Writing (HKT-SpLD; Ho et al., 2000)[2]

(*Continued*)

[2]Hong Kong Test of Specific Learning Difficulties in Reading and Writing (HKT-SpLD; Ho et al., 2000) is a standardized test consisting of five domains, which include three skills subtests in literacy (Chinese word reading, one-minute reading, and Chinese word dictation), one in rapid naming (digit rapid naming), two in phonological awareness (rhyme detection and onset detection), three in phonological memory (word repetition, nonword repetition I, and nonword repetition II), and three in orthographic skills (left/right reversal, lexical decision, and radical position). Together with four subtests (visual discrimination, visual closure, visual spatial relationship, and visual memory) from Gardner's (1996) Test of Visual- Perceptual Skills(non-motor) Revised (TVPS-R), there was one composite score on literacy and six composite scores separately on naming speed, phonological awareness, phonological memory, orthographic knowledge, visual perception, and visual memory.

Table 1. (*Continued*)

Study author(s) and publication year	Context	RD severity type[a]	Definition of RD or dyslexia	Diagnostic criteria	Diagnostic assessment task
Chung & Lam (2020)	Hong Kong	Two	N.A.	To be diagnosed with dyslexic in Hong Kong, students were required to meet the Hong Kong Test of Specific Learning Difficulties in Reading and Writing for Primary School Students [HKT-P(II); 2nd ed.; Ho et al., 2007] criterion that included at least 1 standard deviation below their respective age in the literacy scores and cognitive-linguistic scores.	The HKT-P(II) (Chung & Ho, 2010)
Chung et al. (2022)	Hong Kong	One	…reading difficulties in poor readers are defined as those scoring at or below the 25th percentile on word reading in Chinese or/and English.	Poor readers who scored in the lowest 25% of a sample on a measure of word reading were identified.	Word reading
Kalindi et al. (2015)	Hong Kong	Two	Dyslexia has been described as a specific learning difficulty marked by difficulties in the development of literacy- and language-related skills (Catts, 1991).	To be classified as manifesting dyslexia, children's literacy composite score and one cognitive composite score had to be at least one standard deviation below mean scores of their respective age in the HKT-P (II) and the Test of Visual Perceptual Skills — Revised (TVPS-R).	Word reading
Pan et al. (2024)	Hong Kong, Beijing, Taipei	Two	N.A.	In Hong Kong: Children in the group with dyslexia had been diagnosed as having dyslexia by educational or clinical psychologists using HKT-P(III) (Ho et al., 2007), a standardized test for diagnosis of dyslexia in Hong Kong.	Hong Kong: HKT-P(III); Beijing: nonverbal IQ, written vocabulary, reading fluency; Taipei: character identification, character

(*Continued*)

Table 1. (*Continued*)

Study author(s) and publication year	Context	RD severity type[a]	Definition of RD or dyslexia	Diagnostic criteria	Diagnostic assessment task
				Beijing: The children had met all three of the following requirements: First, they had scored as normal to above average in intelligence, defined as above the 50th percentile on the nonverbal IQ test. Second, their performances on the written vocabulary test had to be at least three standard deviations below the grade mean. Third, their scores on the reading fluency test also had to be below the mean scores for their grades. Taipei: Children were diagnosed as requiring special education service for dyslexia if their performance in character identification or character writing was below the fifth percentile rank of the national norm, which is almost two standard deviations below the mean, had no intellectual developmental disabilities, had no cultural disadvantages or issues of lack of educational experience, and had difficulty adjusting to life in school (New Taipei City Office of Education, 2020).	writing, IQ, education experience.
Shen (2022)	Singapore	Two	… the definition of dyslexia by the US Department of Education (2006) as a type of developmental specific learning difficulty due to deficits in language learning and cognition that affect accuracy and fluency in word reading and spelling…	Identified through the learning support programs	A lack of established assessment

(*Continued*)

Table 1. (*Continued*)

Study author(s) and publication year	Context	RD severity type[a]	Definition of RD or dyslexia	Diagnostic criteria	Diagnostic assessment task
Tong et al. (2015)	Hong Kong	One	N.A.	A classification criterion of the lowest 25% on the e-word reading test was employed to select children who were designated as poor readers in Chinese, English, or both, for the purposes of this study, in second and fifth grade.	Word reading
Tong et al. (2018)	Hong Kong	One	N.A.	…we identified poor comprehenders at age 10 by using an arbitrary cut-off of the bottom 25% of our sample in either Chinese reading comprehension, English reading comprehension, or both.	Reading comprehension
Tong et al. (2022)	Hong Kong	One	N.A.	We identified the poor comprehenders using a regression technique… the upper and lower 70% confidence intervals of the regression line were used to identify the good and poor comprehenders, respectively, while the within 25% confidence intervals of the regression line were used to identify the average comprehenders.	Reading comprehension
Wong et al. (2012)	Hong Kong	Two	Previous studies of risk for dyslexia have typically identified children by referring either to their familial risk (i.e. whether any of their first-degree relatives, that is, parents or siblings, is dyslexic or not) or the presence of early language difficulties.	They were then tested across the three literacy subtests of the Hong Kong Test of Specific Learning Difficulties (HKT- SpLD; Ho et al., 2000). Here, we refer to those 57 children who attained a literacy composite scaled score of 7 or below as the dyslexic group, whereas the other 57 at-risk children who scored at 8 or above on this battery were considered the nondyslexic group.	HKT-SpLD

(*Continued*)

Table 1. (*Continued*)

Study author(s) and publication year	Context	RD severity type[a]	Definition of RD or dyslexia	Diagnostic criteria	Diagnostic assessment task
Zhou et al. (2014)	Hong Kong	Two	N.A.	Diagnosis of dyslexia across groups was done using three literacy subtests from the Hong Kong Test of Specific Learning Difficulties in Reading and Writing (HKT-SpLD, Ho et al., 2000): Chinese Word Reading, One-Minute Reading, and Chinese Word Dictation. Based on the HKT SpLD standard, children who scored an average standard score of 7 or below across these three subtests were diagnosed with dyslexia.	Word reading, reading fluency, word dictation

[a]One: less severe RD; Two: more severe RD with diagnosed dyslexia.
[b]a review of the subtests suggested that no MA test was reported in Chung and Ho (2010). N.A. = not applicable.

25% of all participants on the respective word reading test (b) consistently across the 2 most recent years of testing.

Regarding *dyslexia*, it has been defined as a specific learning difficulty marked by difficulties in the development of literacy- and language-related skills, particularly in word reading and spelling accuracy and fluency. In the Hong Kong context, the primary studies (i.e., Chung & Lam, 2010; Pan et al., 2024) were generally consistent in their diagnostic criteria, namely, dyslexic children attained a literacy composite score of seven or below on the Hong Kong Test of Specific Learning Difficulties (HKT-SpLD, Ho et al., 2000), or at least one standard deviation below their respective age in the Hong Kong Test of Specific Learning Difficulties in Reading and Writing for Primary School Students (HKT-P(II), Ho et al., 2007). The HKT- SpLD consists of five domains: literacy (word reading, reading fluency, word dictation), rapid naming, phonological awareness, phonological memory, and orthographic skills; whereas the HKT-P-(II) measures the same five domains plus verbal working memory. Notably, in the primary studies, four used the complete standardized test (e.g., Chung & Ho, 2010; Chung & Lam, 2020; Pan et al., 2024; Wong et al., 2012); two selected standardized subtests like word reading, reading fluency, and word dictation (e.g., Pan et al., 2024; Zhou et al., 2014); and another used word reading as the main diagnostic assessment (e.g., Kalindi et al., 2015). Kalindi et al. (2015) categorized poor bilingual readers whose Chinese and English word reading performance was within the lowest 20%, and average readers who scored in the top 30%. In one study conducted in Beijing, three main assessment tools were used—nonverbal IQ, written vocabulary, and reading fluency (Pan et al., 2024)—but each tool had its own diagnostic standard: scoring above the 50th percentile, performing three standard deviations below the grade average, or falling below the mean score for the relevant grade level, respectively. In Singapore, a lack of established assessment was noted according to Shen (2023); rather, dyslexic children were identified through local learning support programs. In Taipei, as reported in Pan et al. (2024), four assessment domains were identified, including character identification, character writing, IQ, and school education experience. In Pan et al. (2024)'s study, for character identification and writing, dyslexic children were diagnosed if they scored two standard deviations below the mean.

To answer RQ1, there have been inconsistent practices in terms of the definitions, diagnostic assessment tasks, and diagnostic criteria of RD/dyslexia in the selected studies of Chinese-English bilingual children across Chinese-speaking societies. Although morphological awareness assessment was included in all primary studies, MA performance was not considered in any of the diagnostic criteria.

RQ2: Do Chinese-English bilingual children with RD experience a morphological awareness deficit in addition to phonological awareness and word reading deficits in Chinese and English, respectively? If yes, what are the sizes of the deficits?

The meta-analytic results are shown in Table 2. In L1 Chinese, there were significant differences in the means between the RD and control groups in Chinese morphological awareness (g = –0.722, 95% CI: –0.895, –0.549, k = 26, z = –8.187, p<.001), Chinese

phonological awareness (g = –0.625, 95% CI: –0.811, –0.439, k = 26, z = –6.578, p<.001), and Chinese word reading (g = –2.042, 95% CI: –2.501, –1.584, k = 28, z = –8.728, p<.001). In L2

English, there were also significant differences in English morphological awareness (g = – 1.083, 95% CI: –1.551, –0.615, k = 8, z = –4.533, p<.001), English phonological

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Table 2. Descriptive statistics for the Mean Differences Between the RD and Control Groups

Measures	k	g	S.E.	z (p)	95% CI	I^2 (%)	*Q* test (*p*)	τ^2	Adjusted effect estimate	No. of trimmed studies
Chinese MA	26	–0.722	0.088	–8.187 (<.001)	[–0.895, –0.549]	60.87	63.89 (<.001)	0.12	–0.64 [–0.82, –0.46]	To right of mean (*k* = 3)
Chinese PA	26	–0.625	0.095	–6.578 (<.001)	[–0.811, –0.439]	69.39	81.67 (<.001)	0.16	–0.75 [–0.96, –0.55]	To left of mean (*k* = 4)
Chinese word reading	28	–2.042	0.234	–8.728 (<.001)	[–2.501, –1.584]	93.11	391.96 (<.001)	1.40	–2.09 [–2.55, –1.62]	To left of mean (*k* = 1)
English MA	8	–1.083	0.239	–4.533 (<.001)	[–1.551, –0.615]	84.68	45.68 (< .001)	0.38	N.A.	0
English PA	7	–0.857	0.239	–3.585 (<.001)	[–1.326, –0.398]	84.683	39.173 (<.001)	0.34	N.A.	0
English word reading	24	–0.730	0.136	–5.381 (<.001)	[–0.995, –0.464]	86.30	167.856 (<.001)	0.36	–0.86 [–1.12, –0.60]	To left of mean (*k* = 4)

Note. MA = morphological awareness; PA = phonological awareness; N.A. = not applicable.

awareness (g = –0.857, 95% CI: –1.326, –0.398, k = 7, z = –8.857, p<.001), and English word reading (g = – 0.730, 95% CI: –0.995, –0.464, k = 24, z = –5.381, p<.001). Interestingly, the effect sizes were large for word reading, and medium for morphological awareness and phonological awareness in L1 Chinese; yet large for morphological awareness and phonological awareness, and medium for word reading in L2 English.

To answer RQ2, the results confirmed that Chinese-English bilingual children with RD experienced a significant morphological awareness deficit in addition to phonological awareness and word reading deficits in both L1 Chinese and L2 English. The size of the morphological awareness deficit was medium in L1 Chinese and large in L2 English.

RQ3: Are the deficit sizes moderated by RD severities, age, diglossia context (Cantonese Chinese-speaking versus Mandarin Chinese-speaking societies), and methodological design?

As shown in Table 2 above, the Q test analyses for the six focal outcomes (i.e., morphological awareness, phonological awareness, and word reading in L1 Chinese and L2 English, respectively) indicated significant between-study variation (ps<.001) and the sizes ranged from moderate to large (I^2 between 60.87% and 93.11%). Moderator analyses were first conducted for three categorical variables, namely RD severities, diglossia context, and methodological design (as shown in Table 3).

Surprisingly, no significant effects were identified among the categorical moderators, except for two marginal effects. One was the influence of methodological design on the mean difference in L1 Chinese morphological awareness (Q = 3.80, p = .051). The effect size for the studies that compared Chinese RD vs. age-matched /reading control groups was large (g = – 0.97, k = 8, 95% CI: –1.30, –0.64), yet the effect size for those comparing Chinese RD vs. age- matched /English RD/Bilingual RD was moderate (g = –0.60, k = 18, 95% CI: –0.77, –0.42).

Regarding the influence of age, primary studies with at least 10 independent samples for a target outcome and age information were included for meta-regression analyses. As a result, four mete-regression models were examined with L1 Chinese morphological awareness (k = 26), L1 Chinese phonological awareness (k = 26), L1 Chinese word reading (k = 28), and L2 English word reading (k = 28). The results are shown in Table 4. Age was found to have a statistically significant effect on L1 Chinese word reading deficit (coefficient = –0.178, z = –1.83, p = 0.034), and a marginally significant effect on L1 Chinese morphological awareness (coefficient = –0.075, z = –1.64, p = 0.051), and L2 English word reading (coefficient = –0.155, z = –1.52, p = 0.064). Additionally, age explained about 12%, 23%, and 8% of the within-study variance, respectively.

To answer RQ3, this research explored the interrelationships between four potential moderators and six deficit outcomes in L1 Chinese and L2 English and only identified a statistically significant moderating effect of age on L1 Chinese word reading. Age was also found to have marginally significant effects on L1 Chinese morphological awareness and L2 English word reading. As children's age increased, the mean differences in L1 Chinese morphological awareness, L1 Chinese word reading, and L2 English word reading between RD groups and control groups were larger.

Discussion

This research aimed to provide meta-analytic evidence for the association between a morphological awareness deficit and Chinese-English bilingual children with RD and

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Table 3. Categorical Moderator Analyses Results

Moderator	Moderator variable	k	g	95% CI (*r*)	*Q* test
Outcome: Chinese morphological awareness					
RD severity	Poor readers	17	–0.60	–0.78, –0.41	3.49 (*p*=.062)
	Dyslexia	9	–0.94	–1.24, –0.63	
Diglossia context	Cantonese-speaking	19	–0.74	–0.95, –0.53	0.10 (*p*=.750)
	Mandarin-speaking	7	–0.68	–0.99, –0.37	
Methodological design	Chinese RD vs. age-matched/reading control	8	–0.97	–1.30, –0.64	3.80 (*p*=.051)
	Chinese RD vs. age-matched/English RD/Bilingual RD	18	–0.60	–0.77, –0.42	
Outcome: Chinese phonological awareness					
RD severity	Poor readers	18	–0.53	–0.74, –0.33	1.76 (*p*=.185)
	Dyslexia	8	–0.83	–1.23, –0.44	
Diglossia context	Cantonese-speaking	19	–0.63	–0.83, –0.43	0.001 (*p*=.980)
	Mandarin-speaking	7	–0.63	–1.07, –0.20	
Methodological design	Chinese RD vs. age-matched /reading control	7	–0.88	–1.32, –0.44	1.99 (*p*=.158)
	Chinese RD vs. age-matched /English RD/Bilingual RD	19	–0.53	–0.73, –0.34	
Outcome: Chinese word reading					
RD severity	Poor readers	19	–1.97	–2.54, –1.40	0.07 (*p*=.795)
	Dyslexia	9	–2.10	–2.87, –1.33	
Diglossia context	Cantonese-speaking	21	–2.22	–2.83, –1.61	3.40 (*p*=.065)
	Mandarin-speaking	7	–1.44	–2.00, –0.89	
Methodological design	Chinese RD vs. age-matched/reading control	8	–2.02	–2.84, –1.20	<.001 (*p*=.985)
	Chinese RD vs. age-matched/English RD/Bilingual RD	20	–2.01	–2.57, –1.45	

(*Continued*)

Table 3. (*Continued*)

Moderator	Moderator variable	k	g	95% CI (*r*)	*Q* test
Outcome: English morphological awareness					
RD severity	Poor readers	5	–1.09	–1.87, –0.32	0.02 (*p*=.904)
	Dyslexia	3	–1.04	–1.48, –0.59	
Diglossia context	Cantonese-speaking	7	–1.07	–1.62, –0.53	0.04 (*p*=.842)
	Mandarin-speaking	1	–1.15	–1.65, –0.64	
Methodological design	Chinese RD vs. age-matched/reading control	3	–1.04	–1.48, –0.59	0.02 (*p*=.904)
	Chinese RD vs. age-matched/English RD/Bilingual RD	5	–1.09	–1.87, –0.32	
Outcome: English phonological awareness					
RD severity	Poor readers	4	–0.90	–1.72, –0.07	0.03 (*p*=.868)
	Dyslexia	3	–0.81	–1.31, –0.31	
Diglossia context	Cantonese-speaking	6	–0.91	–1.45, –0.37	1.04 (*p*=.308)
	Mandarin-speaking	1	–0.54	–1.01, –0.06	
Methodological design	Chinese RD vs. age-matched/reading control	3	–0.81	–1.31, –0.31	0.03 (*p*=.868)
	Chinese RD vs. age-matched/English RD/Bilingual RD	4	–0.90	–1.72, –0.07	
Outcome: English word reading					
RD severity	Poor readers	18	–0.66	–0.10, –0.33	0.58 (*p*=.447)
	Dyslexia	6	–0.92	–1.50, –0.34	
Diglossia context	Cantonese-speaking	19	–0.73	–1.70, –0.39	0.01 (p=.918)
	Mandarin-speaking	5	–0.71	–1.01, –0.40	
Methodological design	Chinese RD vs. age- matched/reading control	6	–0.92	–1.50, –0.34	0.58 (p=.447)
	Chinese RD vs. age- matched/English RD/Bilingual RD	18	–0.66	–0.10, –0.33	

Table 4. Meta-regression modeling results

Model 1 (outcome variable: Chinese morphological awareness)							
Covariate	Coefficient	Standard error	95% lower	95% upper	z	*p*	R^2
Intercept	−0.123	0.385	−0.878	0.631	−0.32	0.374	
Age	−0.075	0.046	−0.165	0.015	−1.64	0.051	0.23
Model 2 (outcome variable: Chinese phonological awareness)							
Covariate	Coefficient	Standard error	95% lower	95% upper	z	*p*	R^2
Intercept	−0.700	0.503	−1.685	0.285	−1.39	0.082	
Age	0.008	0.061	−0.111	0.127	0.13	0.447	−0.08
Model 3 (outcome variable: Chinese word reading)							
Covariate	Coefficient	Standard error	95% lower	95% upper	z	*p*	R^2
Intercept	−0.160	0.801	−1.730	1.411	−0.20	0.421	
Age	−0.178	0.097	−0.368	0.013	−1.83	0.034	0.12
Model 4 (outcome variable: English word reading)							
Covariate	Coefficient	Standard error	95% lower	95% upper	z	*p*	R^2
Intercept	−0.490	0.838	−2.132	1.152	−0.59	0.279	
Age	−0.155	0.102	−0.354	0.044	−1.52	0.064	0.08

to explore potential moderator effects. There were three major findings: (1) across the four Chinese diaspora societies (i.e., Beijing, Hong Kong, Singapore, and Taipei), there have been inconsistent practices in the definition of RD or dyslexia, setting diagnostic criteria, and adopting diagnostic assessment tasks. Despite all 14 primary studies assessed morphological awareness, word reading, rather than morphological awareness, has been the main diagnostic assessment tool. (2) This meta-analytic review, nevertheless, has confirmed that Chinese-English bilingual children with RD experienced a significant morphological awareness deficit in addition to phonological awareness and word reading deficits in both L1 Chinese and L2 English, and that the size of the morphological awareness deficit was medium in L1 Chinese and large in L2 English. And (3), among the four potential moderators (i.e., RD severities, age, diagnostic context (Cantonese-speaking vs. Mandarin-speaking), and methodological design), only age has been found to be significant moderator because when children's age increased, the mean differences in L1 Chinese morphological awareness, L1 Chinese word reading, and L2 English word reading between RD groups and control groups were larger.

The first finding partially confirmed Prediction One, namely, there has been a more standardized and consistent practice in the definitions, assessment tasks, and diagnostic criteria of RD in Hong Kong as compared to other Chinese diaspora societies (i.e., Beijing, Singapore, and Taipei). In the Hong Kong context, two standardized tests (i.e., the Hong Kong Test of Specific Learning Difficulties/HKT-SpLD; Ho et al., 2000; the Hong Kong Test of Specific Learning Difficulties in Reading and Writing for Primary School Students/HKT-P(II), Ho et al., 2007) were used in the primary studies.

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Although both tests involved multiple literacy components, some researchers only used subtests of word reading or the word reading scores to categorize child participants into RD vs. control groups (e.g., Kalindi et al., 2015; Zhou et al., 2014). In other words, word reading assessment seemed to be the main diagnostic tool in studies of Chinese-English bilingual children with RD. However, this practice is not supported by the second finding of this meta-analytic review, which suggested that Chinese-English bilingual children with RD experienced a significant morphological awareness deficit in addition to phonological awareness and word reading deficits in both L1 Chinese and L2 English. Therefore, Prediction Two has been confirmed.

Prediction Three is also confirmed since age was the only significant moderator for three deficit outcomes, including L1 Chinese morphological awareness, L1 Chinese phonological awareness, and L2 English word reading. This finding is consistent with previous meta-analyses of monolingual readers with RD across different languages (i.e., Georgiou et al., 2023) and those of bilingual readers without RD (e.g., Ke et al., 2021, 2023). Notably, no significant moderating of age on L1 Chinese phonological awareness was found, while, as children's age increased, the size of morphological awareness was larger. This may suggest that morphological awareness and phonological awareness deficits are both significant in L1 Chinese children with RD, yet morphological awareness carries more weight longitudinally. The nonsignificant moderating effects of RD severities, diglossia context, or methodological design have confirmed that morphological awareness is an important predictor of Chinese-English reading development across a diverse learner population and Chinese diaspora contexts. Yet, the lack of a significant moderating effect of diglossia context (Cantonese-speaking vs. Mandarin-speaking) on phonological awareness in neither L1 Chinese nor L2 English might be due to the mixture of Beijing, Singapore, and Taipei samples in this small-scale meta-analysis. In previous empirical research comparing bilingual reading developmental patterns in Beijing and Hong Kong alone (e.g. McQuade et al., 2024), it was conjectured that Beijing students with Pinyin training were more phonologically sensitive than Hong Kong counterparts, and that phonological awareness was a significant predictor of L2 English word reading for Beijing students whereas morphological awareness was a significant predictor of L2 English word reading for Hong Kong students.

It is also worth noting that both the present meta-analysis and Zhang D. et al. (2023) underscore the critical role of MA in literacy development among populations with reading challenges, demonstrating strong associations between MA and key reading outcomes such as word reading. A notable similarity is that both meta-analyses found MA to be a robust predictor of reading outcomes across diverse linguistic and educational contexts, and both suggest the importance of morphology-based instruction for learners with disabilities—whether RD/dyslexia or DHH. However, while Zhang D. et al. (2023) focused on DHH students and reported high correlations between MA and reading outcomes across multiple languages, this research specifically examined Chinese-English bilingual children with reading difficulties, capturing the magnitude of MA deficits relative to controls. Additionally, Zhang D. et al. (2023) reported moderating effects of language type and task characteristics, whereas the present meta-analysis identified age as a significant moderator of the deficits in L1 Chinese morphological awareness, L1 Chinese word reading, and L2 English morphological awareness.

The pronounced morphological awareness deficits observed in both L1 Chinese and L2 English among children with RD confirm that metalinguistic skills are transferable across languages, yet are also shaped by language context and exposure (Chung et al., 2019;

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Koda, 2005). Notably, the larger effect sizes for morphological awareness in L2 English suggest that bilingual learners may increasingly rely on morphological strategies when reading in an additional language (Ke et al., 2023). The moderating effect of age further implies a growing reliance on morphological processing as children encounter more complex texts, highlighting the importance of both early and sustained support. These findings call for a re-examination of current diagnostic tools and practices, which often prioritize word reading and phonological skills, and may overlook the critical role of morphological awareness assessment and instruction in supporting bilingual children with reading difficulties.

Conclusions, implications, and limitations

This meta-analysis, based on 14 primary studies and 29 independent samples with Chinese-English bilingual children with reading difficulties (RD) across four Chinese diaspora societies (Beijing, Hong Kong, Singapore, and Taipei), lends support for the diagnostic value of morphological awareness assessment for bilingual children with reading difficulties. For one, Chinese-English bilingual children with RD, regardless of their RD severity and diglossia contexts, experience a significant and moderate morphological awareness deficit along with significant phonological awareness and word reading deficits in both L1 Chinese and L2 English. Notably, in L2 English, the size of morphological awareness is larger than that of phonological awareness and word reading. For another, the size of the morphological awareness deficit is enlarged as children's age increases, which suggests that morphological awareness assessment also carries a longitudinal diagnostic value. These findings, when considered with recent meta-analyses of other populations such as DHH students (Zhang D. et al., 2023), reinforce the universal importance of morphological awareness for literacy development among diverse learners with disabilities. Practically speaking, it should be noted that the review of the primary studies has clearly suggested that although morphological awareness has been measured in all selected studies, researchers have tended to treat word reading assessment, rather than morphological awareness, as the main diagnostic tool. Based on the meta-analytic evidence of this research, it is recommended that morphological awareness should be added to the diagnostic tool, especially for bilingual reading development among children with RD.

It should be acknowledged that there are four limitations with this research, which invite further investigation. First, the sample size was relatively small. The independent sample sizes for two outcomes (i.e., English morphological awareness and phonological awareness) were below 10; thus, meta-regression modeling could not be conducted. Future meta-analyses should be replicated with a larger sample pool. Second, this research has considered factors that are developmentally, contextually, and methodologically relevant. Future research may consider analyzing potential assessment-related factors to explore whether different measures affect the sizes of the three deficits in morphological awareness, phonological awareness, and word reading, respectively. Third, this research did not include any studies published in Chinese. Future replication studies may consider incorporating publications in languages other than English. Finally, this research did not differentiate between minority bilinguals who live in societies where their L1 is a minority and must learn and use a society's L2 for survival, versus majority bilinguals for whom their L1 is the majority, but they opt to learn and use an L2 in an immersion environment to gain the benefits of bilingualism (Zang et al., 2024). The minority vs. majority bilingual categorization should be considered in moderator analysis in the future.

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References

Note. Selected studies are marked by "".*

Abbott, R. D., Fayol, M., Zorman, M., Casalis, S., Nagy, W., & Berninger, V. W. (2016). Relationships of French and English morphophonemic orthographies to word reading, spelling, and reading comprehension during early and middle childhood. *Canadian Journal of School Psychology*, *31*(4), 305–321. https://doi.org/10.1177/0829573516640336

Carlisle, J. F. (1995). Morphological awareness and early reading achievement. In L. B. Feldman (Ed.), *Morphological aspects of language processing* (pp. 189–209). Hillsdale, NJ: Lawrence Erlbaum.

Carlisle, J. F. (2000). Awareness of the structure and meaning of morphologically complex words: Impact on reading. *Reading and Writing*, *12*, 169–190. https://doi.org/10.1023/A:1008131926604

Catts, H. W. (1991). Early identification of dyslexia: Evidence from a follow-up study of speech-language impaired children. *Annals of Dyslexia*, *41*(1), 163–177. https://doi.org/10.1007/BF02648084

Cheah, Z. R. E., McBride, C., Meng, X., Lee, J. R., & Huo, S. (2025). Is Chinese dyslexia similar across Chinese societies? Evidence from Hong Kong, Beijing, and Taipei. *Reading Research Quarterly*, *60*(1), e578. https://doi.org/10.1002/rrq.578

*Cheah, Z. R. E., Ye, Y., Lui, K. F. H., McBride, C., & Maurer, U. (2023). Spelling as a way to classify poor Chinese-English literacy skills in Hong Kong Chinese children. *Annals of Dyslexia*, *73*(1), 90–108. https://doi.org/10.1007/s11881-022-00262-4

*Chung, K. K. H., & Ho, C. S. H. (2010). Second language learning difficulties in Chinese children with dyslexia: What are the reading-related cognitive skills that contribute to English and Chinese word reading? *Journal of Learning Disabilities*, *43*(3), 195–211. https://doi.org/10.1177/0022219409345018

*Chung, K. K. H., & Lam, C. B. (2020). Cognitive-linguistic skills underlying word reading and spelling difficulties in Chinese adolescents with dyslexia. *Journal of Learning Disabilities*, *53*(1), 48–59. https://doi.org/10.1177/0022219419882264

*Chung, K. K. H., Li, X., Lam, C. B., Fung, W. K., & Liu, C. (2022). What predicts first– and second–language difficulties? Testing language and executive functioning skills as correlates. *Learning Disabilities Research & Practice*, *37*(2), 85–99. https://doi.org/10.1111/ldrp.12275

Chung, S. C., Chen, X., & Geva, E. (2019). Deconstructing and reconstructing cross- language transfer in bilingual reading development: An interactive framework. *Journal of Neurolinguistics*, *50*, 149–161. https://doi.org/10.1016/j.jneuroling.2018.01.003

DeFrancis, J. (1984). *The Chinese language: Fact and fantasy*. University of Hawaii Press.

Department of Education, U. S. (2006). Assistance to states for the education of children with disabilities and preschool grants for children with disabilities. https://www.federalregister.gov/documents/2006/08/14/06-6656/assistance-tostates-for-the-education-of-children-with-disabilities-and-preschool-grants-for

Duke, N. K., & Cartwright, K. B. (2021). The science of reading progresses: Communicating advances beyond the simple view of reading. *Reading Research Quarterly*, *56*, S25–S44. https://doi.org/10.1002/rrq.411

Duval, S., & Tweedie, R. (2000). Trim and fill: A simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. *Biometrics*, *56*(2), 455–463. https://doi.org/10.1111/j.0006-341x.2000.00455.x

Gao, Y., Zheng, L., Liu, X., Nichols, E. S., Zhang, M., Shang, L., Ding, G., & Weng, X., & Liu, L. (2019). First and second language reading difficulty among Chinese–English bilingual children: The prevalence and influences from demographic characteristics. *Frontiers in Psychology*, *10*, 2544. https://doi.org/10.3389/fpsyg.2019.02544

Gardner, M. F. (1996). *Test of visual-perceptual skills (nonmotor)*. Psychological and Educational Publications.

Georgiou, G. K., Vieira, A. P. A., Rothou, K. M., Kirby, J. R., Antoniuk, A., Martinez, D., & Guo, K. (2023). A meta-analysis of morphological awareness deficits in developmental dyslexia. *Scientific Studies of Reading*, *27*(3), 253–271. https://doi.org/10.1080/10888438.2022.2155524

Goodwin, A. P., & Ahn, S. (2010). A meta-analysis of morphological interventions: effects on literacy achievement of children with literacy difficulties. *Annals of Dyslexia*, *60*(2), 183–208. https://doi.org/10.1007/s11881-010-0041-x

Gough, P.B., & Tunmer, W.E. (1986). Decoding, reading, and reading disability. *Remedial and Special Education*, *7*(1), 6–10. https://doi.org/10.1177/074193258600700104

Hedges, L., & Olkin, I. (1985). *Statistical methods for meta-analysis*. Orlando, FL: Academic Press.

Ho, C. S. H., Chan, D.W., Chung, K. K. H., Tsang, S. M., Lee, S. H., & Cheng, R.W.Y. (2007). *The Hong Kong test of specific learning difficulties in reading and writing for primary school sstudents (HKT-P[II])* (2nd ed.). Hong Kong Specific Learning Difficulties Research Team.

Ho, C. S. H., Chan, D., Tsang, S. M., & Lee, S. H. (2000). *The Hong Kong specific learning difficulties behaviour checklist (for primary school pupils).* Hong Kong Specific Learning Difficulties Research Team.

Ho, C. S. H., Chan, D. W. O., Tsang, S. M., & Lee, S. H. (2002). The cognitive profile and multiple-deficit hypothesis in Chinese developmental dyslexia. *Developmental Psychology*, *38*(4), 543–553. https://doi.org/10.1037//0012-1649.38.4.543

Hoover, W.A., & Gough, P.B. (1990). The simple view of reading. *Reading and Writing*, *2*(2), 127–160. https://doi.org/10.1007/BF00401799

*Kalindi, S. C., McBride, C., Tong, X., Wong, N. L. Y., Chung, K. H. K., & Lee, C. Y. (2015). Beyond phonological and morphological processing: Pure copying as a marker of dyslexia in Chinese but not poor reading of English. *Annals of Dyslexia*, *65*, 53–68. https://doi.org/10.1007/s11881-015-0097-8

Ke, S., Miller, R. Zhang, D. & Koda, K. (2021). Crosslinguistic sharing of morphological awareness in biliteracy development: A systematic review and meta-analysis of correlation coefficients. *Language Learning*, *71*(1), 8–54. https://doi.org/10.1111/lang.12429

Ke, S., & Xiao, F. (2015). Cross-linguistic transfer of morphological awareness between Chinese and English. *Language Awareness*, *24*(4), 355–380. https://doi.org/10.1080/09658416.2015.1114624

Ke, S., Zhang, D. & Koda, K. (2023). *Metalinguistic awareness in second language reading development*. Cambridge University Press. https://doi.org/10.1017/9781108979801

Kirby, R. J., & Bowers, P. N. (2017). Morphological instruction and literacy: Binding phonological, orthographic, and semantic features of words. In K. Cain, D. L. Compton, & R. K. Parrila (Eds.), *Theories of reading development* (pp. 437–461). Amsterdam, Netherlands: John Benjamins.

Koda, K. (2005). *Insights into second language reading: A cross-linguistic approach*. New York, NY: Cambridge University Press.

Koda, K. (2008). Impacts of prior literacy experience on second-language learning to read. In K. Koda & A. M. Zehler (Eds.), *Learning to read across languages: Cross- linguistic relationships in first- and second-language literacy development* (pp. 68– 96). Routledge.

Kuo, L. J., & Anderson, R. C. (2008). Conceptual and methodological issues in comparing metalinguistic awareness across languages. In K. Koda, & A. M. Zehler (Eds.), *Learning to read across languages* (pp. 51–79). Routledge.

Levesque, K. C., Breadmore, H. L., & Deacon, S. H. (2021). How morphology impacts reading and spelling: Advancing the role of morphology in models of literacy development. *Journal of Research in Reading*, *44*(1), 10–26. https://doi.org/10.1111/1467-9817.12313

McBride, C., Wang, Y., & Cheang, L. M. L. (2018). Dyslexia in Chinese. *Current Developmental Disorders Reports*, *5*, 217–225. https://doi.org/10.1007/s40474-018-0149-y

*McBride-Chang, C., Liu, P. D., Wong, T., Wong, A., & Shu, H. (2012). Specific reading difficulties in Chinese, English, or both: Longitudinal markers of phonological awareness, morphological awareness, and RAN in Hong Kong Chinese children. *Journal of Learning Disabilities*, *45*(6), 503–514. https://doi.org/10.1177/0022219411400748

*McBride-Chang, C., Shu, H., Chan, W., Wong, T., Wong, A. M. Y., Zhang, Y., Pan, J., & Chan, P. (2013). Poor readers of Chinese and English: Overlap, stability, and longitudinal correlates. *Scientific Studies of Reading*, *17*(1), 57–70. https://doi.org/10.1080/10888438.2012.689787

McQuade, M., Pan, D. J., Ho, J. C. S., Ong, J., Ng, M. C. Y., Meng, X., & McBride, C. (2024). Chinese Students Learning English as a Second Language. *Education Sciences*, *14*(2), 180. https://doi.org/10.3390/educsci14020180

Melby-Lervåg, M., & Lervåg, A. (2012). Oral language skills moderate nonword repetition skills in children with dyslexia: A meta-analysis of the role of nonword repetition skills in dyslexia. *Scientific Studies of Reading*, *16*(1), 1–34. https://doi.org/10.1080/10888438.2010.537715

Nagy, W. E., & Anderson, R. C. (1984). How many words are there in printed school English? *Reading Research Quarterly*, *19*, 304–330. https://doi.org/10.2307/747823

New Taipei City Office of Education (2020). *Supplementary guidelines of new Taipei city learning disabilities identification and subtype analysis.* Retrieved November 30, 2021, from Special Needs of New Taipei City https:// sec.ntpc.edu.tw/p/405-1004- 6174,c891.php

Paradis, J., Crago, M., Genesee, F., & Rice, M. (2003). French-English bilingual children with SLI: How do they compare with their monolingual peers? *Journal of Speech Language and Hearing Research*, *46*(2), 404–404. https://doi.org/10.1044/1092-4388(2003/009)

* Pan, D. J., Meng, X., Lee, J. R., Ng, M. C. Y., & McBride, C. (2024). The cognitive- linguistic profiles and academic performances of Chinese children with dyslexia across cultures: Beijing, Hong Kong, and Taipei. *Annals of Dyslexia*, *74*, 222–242. https://doi.org/10.1007/s11881-024-00301-2

Peng, P., Wang, C., Tao, S., & Sun, C. (2017). The deficit profiles of Chinese children with reading difficulties: A meta-analysis. *Educational Psychology Review*, *29*, 513–564. https://doi.org/10.1007/s10648-016-9366-2

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

Perfetti, C. A., & Hart, L. (2002). The lexical quality hypothesis. In L. Vehoeven, C. Elbro, & P. Reitsma (eds.), *Precursors of functional literacy* (pp. 189–213). John Benjamins.

Ruan, Y., Maurer, U., & McBride, C. (2024). Effectiveness of Reading Interventions on Literacy Skills for Chinese Children with and Without Dyslexia: a Meta-analysis of Randomized Controlled Trials. *Educational Psychology Review*, *36*(80). https://doi.org/10.1007/s10648-024-09915-9

*Shen, P. (2023). *An investigation on cognitive-linguistic skills of English-Chinese bilingual learners with and without dyslexia in Singapore* (Unpublished doctoral dissertation). University College London.

Siegel, L. S. (2008). Morphological awareness skills of English language learners and children with dyslexia. *Topics in Language Disorders*, *28*(1), 15–27. https://doi.org/10.1097/01.adt.0000311413.75804.60

Sodoro, J., Allinder, R. M., & Rankin-Erickson, J. L. (2002). Assessment of phonological awareness: Review of methods and tools. *Educational Psychology Review*, *14*, 223– 260. https://doi.org/10.1023/A:1016050412323

*Tong, X., Deng, Q., & Tong, S. X. (2022). Syntactic awareness matters: Uncovering reading comprehension difficulties in Hong Kong Chinese-English bilingual children. *Annals of Dyslexia*, *72*(3), 532–551. https://doi.org/10.1007/s11881-022-00268-y

*Tong, X., McBride, C., Shu, H., & Ho, C. S. H. (2018). Reading comprehension difficulties in Chinese–English bilingual children. *Dyslexia*, *24*(1), 59–83. https://doi.org/10.1002/dys.1566

*Tong, X., Tong, X., & McBride-Chang, C. (2015). A tale of two writing systems: Double dissociation and metalinguistic transfer between Chinese and English word reading among Hong Kong children. *Journal of Learning Disabilities*, *48*(2), 130–145. https://doi.org/10.1177/0022219413492854

Verhoeven, L., & Perfetti, C. (2022). Universals in learning to read across languages and writing systems. *Scientific Studies of Reading*, *26*(2), 150–164. https://doi.org/10.1080/10888438.2021.1938575

Verhoeven, L., & Perfetti, C. (Eds.). (2017). *Learning to Read across Languages and Writing Systems*. Cambridge University Press.

*Wong, S. W., McBride-Chang, C., Lam, C., Chan, B., Lam, F. W., & Doo, S. (2012). The joint effects of risk status, gender, early literacy and cognitive skills on the presence of dyslexia among a group of high-risk Chinese children. *Dyslexia*, *18*(1), 40–57. https://doi.org/10.1002/dys.1434

Zang, X., Wong, Y. K., & Lau, K. L. (2024). Predictors of Chinese reading in Chinese monolingual and Chinese–English bilingual children in Mainland China. *Reading and Writing.* https://doi.org/10.1007/s11145-024-10552-5

Zhang, D., Ke, S., Anglin-Jaffe, H., & Yang, J. (2023). Morphological awareness and DHH students' reading-related abilities: A meta-analysis of correlations. *Journal of Deaf Studies and Deaf Education*, enad024. https://doi.org/10.1093/deafed/enad024

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

*Zhou, Y., McBride-Chang, C., Law, A. B. Y., Li, T., Cheung, A. C. Y., Wong, A. M. Y., & Shu, H. (2014). Development of reading-related skills in Chinese and English among Hong Kong Chinese children with

and without dyslexia. *Journal of Experimental Child Psychology*, *122*, 75–91. https://doi.org/10.1016/j.jecp.2013.12.003

Ziegler, J. C., & Goswami, U. (2005). Reading acquisition, developmental dyslexia, and skilled reading across languages: a psycholinguistic grain size theory. *Psychological Bulletin*, *131*(1), 3–29. https://doi.org/10.1037/0033-2909.131.1.3

Appendix 1. Instrument Reliability Information (Cronbach's Alpha) Reported in Independent Samples

Tasks	Mean	Median	Range
Chinese MA (k = 26)	.83	.85	.69, .98
Chinese PA (k = 26)	.86	.89	.51, .98
Chinese word reading (k = 28)	.97	.98	.89, .99
English MA (k = 8)	.80	.82	.69, .86
English PA (k = 7)	.85	.82	.80, .95
English word reading (k = 24)	.95	.96	.87, .98

Notes. Reliability is Cronbach's alpha, except for Shen (2022) which reported a Spearman-Brown coefficient. MA = morphological awareness.

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