Developmental Trajectory of Chinese Character Recognition and Dictation in Early Primary School

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Abstract

Abstract: Chinese character recognition and dictation are two important literacy skills at the word level. This study conducted a two-year longitudinal investigation of 127 first-grade children at four time points to examine factors influencing the development of Chinese character recognition and dictation by assessing children's general cognitive ability, phonological awareness, orthographic awareness, and morphological awareness (including homophone morpheme awareness and compound morpheme awareness). Using latent growth modeling, the results showed that: (1) Chinese character recognition followed a linear developmental trend, whereas dictation exhibited a nonlinear developmental trend that was initially rapid then slowed, with both demonstrating compensatory effects; (2) Morphological awareness significantly predicted the initial level and growth rate of Chinese character recognition, but had no significant predictive effect on either the initial level or growth rate of dictation. The findings indicate that children' s initial levels of Chinese character recognition and dictation upon school entry do not determine their subsequent developmental speed, and that morphological awareness plays different roles in the development of Chinese character recognition and dictation.

Full Text

Preamble

Developmental Trajectories of Chinese Character Recognition and Dictation in Early Elementary Grades: The Predictive Role of Morphological Awareness

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Abstract

Character recognition and dictation represent two crucial literacy skills at the word level. This study conducted a two-year longitudinal investigation across four time points with 127 first-grade children to examine the factors influencing the development of these skills. We assessed children' s general cognitive ability, phonological awareness, orthographic awareness, and morphological awareness (including homophone awareness and compound morphological awareness). Using latent growth modeling, the results revealed: (1) Character recognition followed a linear developmental trajectory, while dictation exhibited a non-linear trajectory characterized by rapid initial growth followed by deceleration. Both skills demonstrated a compensation effect. (2) Morphological awareness significantly predicted the initial level and growth rate of character recognition, but showed no significant predictive effect on either the initial level or growth rate of dictation. These findings indicate that children' s initial proficiency in character recognition and dictation at school entry does not determine their subsequent developmental speed, and that morphological awareness plays different roles in the development of these two literacy skills.

Keywords: morphological awareness; character recognition; dictation

1. Introduction

In elementary Chinese language instruction, character recognition and writing constitute fundamental tasks, forming the foundation for accurate reading and written expression. The early elementary grades represent a critical period for children' s character learning. Character recognition involves an input process where characters are identified, whereas dictation involves an output process where phonological stimuli are converted into written form. These two skills engage different cognitive processing mechanisms (Verhoeven & Carlisle, 2006).

Previous research has identified the Matthew effect in reading development (Bast & Reitsma, 1998; Stanovich, 1986), wherein children with higher initial skill levels demonstrate faster subsequent growth. Consequently, many preschool education programs intentionally teach character recognition and writing, adhering to a "don' t fall behind at the starting line" philosophy that reflects the Matthew effect in practice (Ma & Chen, 2018). Empirical studies in English, Swedish, and German have similarly found that children with higher initial literacy abilities show accelerated later development, with individual differences increasing over time (Carreker et al., 2007; Kempe, Eriksson-Gustavsson, & Samuelsson, 2011; Pfost, Dörfler, & Artelt, 2012).

However, an alternative perspective posits a compensation effect in reading development (Walczyk & Griffith-Ross, 2007), where children with lower initial levels exhibit faster subsequent growth. English-language research has shown that low-achieving readers can develop comprehension and fluency skills more rapidly than their higher-achieving peers (Rasinski, 2017). These contrasting perspectives depict different developmental trajectories for children, raising the question: Which pattern characterizes the development of Chinese character recognition and dictation?

Clarifying this issue is essential for comprehensively understanding children' s literacy development and providing evidence-based support for instructional practice. Although character recognition and dictation involve distinct processing mechanisms (Verhoeven & Carlisle, 2006), both require morphological decomposition. Morphological decomposition theory (Verhoeven & Perfetti, 2003) posits that morphemes are represented in the mental lexicon, and that character identification and retrieval involve decomposition into morphemes—the smallest meaning-bearing units. This morphological decomposition facilitates literacy development. Character recognition involves extracting phonology and semantics from visual forms (Ehri, 2000), requiring analysis of morphemic components to perceive form-meaning relationships, with greater transparency yielding more effective decomposition (Verhoeven & Perfetti, 2011). Dictation involves converting phonological and semantic stimuli into orthographic output (Zhang, Zhang, Zhou, & Shu, 1999). Venezky (1999) noted that dictation integrates phonology and meaning, representing a comprehension process from sound to meaning that focuses on roots and derivational morphemes. Morphological decomposition during dictation promotes accurate orthographic retrieval (Verhoeven & Perfetti, 2003). Thus, both processes highlight the critical role of morphemes in character processing.

The characteristics of Chinese orthography further underscore this importance. First, Chinese is a logographic system based on form-meaning correspondence. Characters originated from pictographs representing meaning rather than sound, with structural configurations closely linked to semantic content. Second, Chinese is a morphosyllabic language where morphemes correspond to syllables, typically with a one-to-one relationship. To represent more concepts, morphemes combine through specific rules to form compound words, which predominate in Chinese vocabulary. Morphological awareness—the ability to perceive, manipulate, and apply morphemic combination rules (Carlisle, 2010)—influences Chinese character recognition, though the mechanisms remain unclear.

Both alphabetic (Apel & Lawrence, 2011; Deacon, Wade-Woolley, & Kirby, 2007; Roman et al., 2009) and Chinese studies (Anderson et al., 2009; McBride-Chang et al., 2003; Shu et al., 2006) have demonstrated morphological awareness' s significant impact on literacy across time points, supporting morphological decomposition theory (Verhoeven & Perfetti, 2003). For instance, Apel and Lawrence (2011) found that morphological awareness predicted word-level reading in English-speaking children across one year, while Shu et al. (2006)

reported that morphological awareness explained 51% of variance in Chinese character recognition. However, these studies primarily examined concurrent or longitudinal relationships at specific time points, rarely investigating developmental trajectories. Researchers (McMaster, Fuchs, Fuchs, & Compton, 2005) argue that assessing language abilities requires examining both level and growth rate, with developmental trajectories providing more meaningful insights than static measures.

The early elementary grades represent a critical period for character learning. Research (Dong, Li, Wu, Rao, & Zhu, 2014) indicates substantial growth in Chinese character recognition from school entry. A recent three-wave longitudinal study of 177 first-graders (Hui et al., 2018) found that compound morphological awareness predicted later growth rates. Cross-sectional research (Li et al., 2016) showed that morphological awareness significantly affected dictation across elementary grades, explaining 15%, 7%, and 3% of variance in low, middle, and upper grades respectively after controlling for cognitive abilities, oral vocabulary, phonological awareness, orthographic awareness, and rapid naming. However, these Chinese dictation studies (Li et al., 2016; Ning et al., 2017; Tong et al., 2009) employed cross-sectional or single-timepoint designs.

Alphabetic language research has also linked morphological awareness to dictation (Good, Lance, & Rainey, 2015; Green et al., 2003; Kemp, 2006; Nagy et al., 2003). Apel et al. (2012) found morphological awareness predicted dictation performance in both children with phonological disorders and typical children. Deacon, Kirby, and Casselman-Bell (2009) showed that morphological awareness predicted spelling two years later in English-speaking children after controlling for rapid naming and short-term memory. Pittas and Nunes (2014) found that morphological awareness did not predict Greek children' s dictation after one year but predicted performance eight months later in a longitudinal follow-up.

Despite these findings, few studies have examined morphological awareness' s predictive effect on developmental trajectories of both character recognition and dictation simultaneously. The present study addresses two questions: First, what are the developmental trajectories of character recognition and dictation? Second, how does morphological awareness influence these trajectories? Based on alphabetic language research showing Matthew effects (Carreker et al., 2007; Kempe et al., 2011; Pfost et al., 2012), we hypothesize that both skills will show Matthew effects. Drawing on morphological decomposition theory (Verhoeven & Perfetti, 2003) and research demonstrating morphological awareness' s importance in Chinese literacy (Li et al., 2016; McBride-Chang et al., 2003; Tong et al., 2009), we hypothesize that morphological awareness will influence the developmental trajectories of both character recognition and dictation. We control for general cognitive ability, phonological awareness, and orthographic awareness, which previous research has shown affect literacy development (Apel & Lawrence, 2011; Li et al., 2011; Shu et al., 2006; Tong et al., 2009).

2. Method

2.1 Participants

We recruited 149 first-grade students from two primary schools in Linfen, Shanxi Province using cluster sampling (80 boys, 69 girls). Twenty-two students were lost to attrition (approximately 15%), leaving a final sample of 127 participants. Attrition analysis revealed no significant differences between retained and lost participants in age [t(147) = -0.49, p = 0.63], general cognitive ability [t(147) = 0.52, p = 0.61], or gender [^{2}(1) = 0.02, p = 0.88]. According to teacher reports, no participants had reading disabilities. All schools used Mandarin as the language of instruction. At the beginning of first grade, children had received approximately one month of phonics instruction to support subsequent character learning. Across both grades, teachers demonstrated character stroke order on the blackboard for students to imitate, then assigned homework requiring stroke analysis to master character writing.

2.2 Measures

Morphological awareness. We assessed two components:

Homophone awareness measured children's understanding of one-sound-multiple-characters mappings using a production task (Li et al., 2011). The examiner presented a target word orally (e.g., "the 'yuè' in moonlight"), and children generated compounds (e.g., "moonbeam, lunar"). They were then asked for other characters pronounced "yuè" (e.g., "music," "read"). More homophone productions received higher scores. The task included 2 practice and 12 test items, with 1 point per correct character generated.

Compound morphological awareness assessed children' s ability to understand and manipulate morphemes within compound words using an established test (Li & Wu, 2015). The 20-item task comprised two sections: 10 items with two-morpheme compounds scored 0-2 points, and 10 items with three-morpheme compounds scored 0-3 points. For example: "What do you call a fruit shaped like an ear?" (2 points: "ear fruit"; 1 point: "ear flower fruit"; 0 points: irrelevant responses).

Character recognition. We administered a standardized test (Li, Shu, McBride-Chang, Liu, & Peng, 2012) containing 150 characters of increasing difficulty arranged in 10 rows. Children read aloud from left to right, top to bottom, until making 10 consecutive errors. Each correct character earned 1 point (maximum = 150). This individually administered test demonstrated strong psychometric properties in previous research (Li et al., 2012).

Dictation. Children wrote target characters from dictated words (e.g., "write the 'zhōng' in 'China' "). The 24-item task was group-administered, with 1 point per correct character (maximum = 24). Internal consistency across four timepoints ranged from = 0.69 to 0.75.

General cognitive ability. We used Raven' s Standard Progressive Matrices (Zhang & Wang, 1989) to assess nonverbal intelligence. This 60-item group test required children to select the missing piece to complete a pattern, with 1 point per correct response (maximum = 60). Internal consistency was = 0.93.

Phonological awareness. We administered a phoneme deletion task (Shu et al., 2006) measuring phoneme manipulation. Children deleted initial, medial, or final phonemes from 12 test items (e.g., "Say 'chā' without the 'ch' sound"). Each correct response earned 1 point (maximum = 12). Internal consistency was = 0.70.

Orthographic awareness. We used a standardized test (Li & Wu, 2015) assessing knowledge of Chinese character structure through three components: (1) position errors (15 items) with correct components in wrong positions (e.g., "明" written as "朋"); (2) stroke errors (15 items) with incorrect stroke patterns; and (3) pseudocharacters (45 items) with legitimate components in legal positions forming nonexistent characters (e.g., "梋"). Children identified real characters by marking "√" or "×" . Pseudocharacter scores were excluded from the total as filler items. The final score comprised position and stroke errors only (maximum = 45). Internal consistency was = 0.79.

2.3 Procedure

Testing occurred one month after fall school entry, then every six months for four waves. Dictation, general cognitive ability, and orthographic awareness tests were group-administered; remaining measures were individually tested through oral interview. Trained undergraduate and graduate students from normal universities administered all measures following standardized protocols covering training procedures, scoring methods, and child interaction strategies.

2.4 Data Analysis

We analyzed four timepoints of character recognition and dictation using Mplus software. Latent Growth Modeling (LGM) precisely modeled developmental trajectories. Missing data were minimal; full information maximum likelihood estimation handled missingness in conditional models.

We first examined unconditional LGMs for each outcome, testing whether intercept and slope were correlated. Unconditional LGMs estimate two parameters (Liu & Zhang, 2005). For character recognition, the Level 1 equation was: $R_{it} = \alpha_i + \beta_i \lambda_t + \varepsilon_{it}$, where R_{it} represents child i' s score at time t, α_i is the intercept (initial level), β_i is the slope (growth rate), λ_t is the time score, and ε_{it} is the residual. Level 2 equations treat intercept and slope as outcomes: $\alpha_i = \mu_\alpha + \xi_{\alpha i}$ and $\beta_i = \mu_\beta + \xi_{\beta i}$, where μ_α and μ_β are mean intercept and slope, and $\xi_{\alpha i}$ and $\xi_{\beta i}$ are residuals. [Figure 1: see original paper] depicts the theoretical unconditional LGM. We first tested linear models; if misfit occurred, we freely estimated the trajectory. In free estimation, the first two timepoints were fixed at 0 and 1, while the third and fourth loadings were freely estimated (Liu & Zhang, 2005; Meredith & Tisak, 1990; Wang & Bi, 2018).

We then examined conditional LGMs by entering general cognitive ability, phonological awareness, orthographic awareness, homophone awareness, and compound morphological awareness as predictors of intercept and slope. All predictors were measured at Time 1. General cognitive ability, phonological awareness, and orthographic awareness served as control variables; homophone and compound awareness served as predictor variables to examine whether morphological awareness explained individual differences in initial levels and growth rates. [Figure 2: see original paper] presents the theoretical conditional LGM.

3. Results

3.1 Descriptive Statistics

presents descriptive statistics for all variables across timepoints. Repeated measures ANOVA revealed significant development: character recognition $F(3, 378) = 748.12$, $p < 0.001$, partial $\eta^2 = 0.86$; dictation $F(3, 378) = 1854.08$, $p < 0.001$, partial $\eta^2 = 0.94$. Both showed significant main effects of time.

3.2 Unconditional Latent Growth Models

presents unconditional LGM results. For character recognition, linear growth fit the data well with slope loadings of 0, 1, 2, 3: $\chi^2(df = 5) = 9.95$, $p = 0.08$, CFI = 0.99, TLI = 0.99, RMSEA = 0.08 (90% CI = 0.00-0.16), SRMR = 0.05. Intercept and slope means were significant: 26.02, $p < 0.001$; 17.51, $p < 0.001$, indicating children began first grade with substantial character knowledge and showed significant growth. Intercept and slope variances were also significant: 488.91, $p < 0.001$; 26.76, $p < 0.001$, reflecting significant individual differences in both initial level and growth rate. The intercept-slope correlation was -0.33 ($p < 0.001$), revealing a compensation effect: children with lower initial levels grew faster.

For dictation, the linear model was not positive definite, indicating poor fit. We therefore specified an unspecified growth curve (Liu & Zhang, 2005; Meredith & Tisak, 1990; Wang & Bi, 2018). Freely estimating the third and fourth slope loadings yielded coefficients of 0, 1, 1.33, 1.77, indicating non-linear growth. Initial fit was inadequate; modification indices suggested correlating residuals between adjacent timepoints. The final model fit well: $\chi^2(df = 1) = 0.27$, $p = 0.60$, CFI = 0.98, TLI = 0.99, RMSEA = 0.01 (90% CI = 0.00-0.17), SRMR = 0.02. Intercept and slope means were significant: 6.10, $p < 0.001$; 8.21, $p < 0.001$, showing children could write some characters at school entry with subsequent significant development. Intercept and slope variances were non-significant: 2.16, $p = 0.19$; 0.26, $p = 0.74$, indicating minimal individual differences in dictation initial level and growth. The intercept-slope correlation was -0.89 ($p = 0.002$), demonstrating a strong compensation effect: lower initial proficiency predicted faster growth.

3.3 Predictive Effects of Morphological Awareness

The conditional LGM for character recognition fit well: $\chi^2(df = 15) = 26.94$, $p = 0.03$, CFI = 0.98, TLI = 0.97, RMSEA = 0.07 (90% CI = 0.02-0.12), SRMR = 0.03. shows prediction results. Time 1 homophone awareness and compound morphological awareness significantly predicted character recognition intercept ($\beta = 0.40$, $p < 0.001$; $\beta = 0.14$, $p < 0.05$) and slope ($\beta = 0.28$, $p < 0.001$; $\beta = 0.25$, $p < 0.001$).

The conditional LGM for dictation also fit adequately: $\chi^2(df = 13) = 13.92$, $p = 0.38$, CFI = 0.98, TLI = 0.96, RMSEA = 0.02 (90% CI = 0.00-0.09), SRMR = 0.05. However, as shows, Time 1 homophone awareness and compound morphological awareness did not significantly predict dictation intercept or slope.

4. Discussion

4.1 Distinct Developmental Trajectories and Compensation Effects

Character recognition showed linear growth, consistent with three-wave longitudinal findings (Hui et al., 2018). This pattern likely reflects curriculum requirements: first and second grade textbooks mandate recognition of approximately 400, 550, 450, and 400 characters respectively, yielding roughly constant growth rates. In contrast, dictation showed non-linear growth (slope loadings: 0, 1, 1.33, 1.77), with rapid growth from Time 1 to Time 2, then deceleration. This pattern may reflect character type characteristics: early first grade focuses on simple single-component characters suitable for rote memorization, facilitating rapid dictation growth. From second grade onward, children encounter more complex compound characters with numerous components and configurations, requiring greater effort. Additionally, children begin reading simple texts, increasing learning demands and slowing dictation growth.

Both skills exhibited compensation effects, as evidenced by significant negative intercept-slope correlations. This contradicts Matthew effect findings in alphabetic languages (Carreker et al., 2007; Kempe et al., 2011; Pfost et al., 2012), possibly due to linguistic features. Alphabetic scripts have transparent grapheme-phoneme correspondences; once mastered, they facilitate word learning. Chinese orthographic transparency is lower, limiting transfer from initial character knowledge to later growth. Additionally, character recognition and dictation are highly constrained skills (Paris, 2005) with limited scope, allowing low-starting children to catch up quickly while high-starting children have less room for improvement, narrowing individual differences over time. School educational environments and resources may also accelerate progress for initially low-achieving children (Zhang, Bian, Wang, & Yuan, 2012). Finally, although low-starting children have lower initial orthographic knowledge, they may possess advantageous non-cognitive factors, such as greater motivation to improve.

4.2 Differential Effects of Morphological Awareness on Character Recognition and Dictation

Morphological awareness significantly predicted character recognition intercept and slope, supporting and extending cross-sectional findings (Apel & Lawrence, 2011; Shu et al., 2006). Children with strong homophone awareness can better differentiate homophones by meaning, enabling more efficient lexical representations of phonology and semantics (Perfetti, 2007), which facilitates character recognition development. As children' s vocabulary expands, they encounter more polysemous characters requiring contextual interpretation. Compound morphological awareness helps children analyze internal word structures to learn new meanings (Carlisle, 2010; Verhoeven & Perfetti, 2011). For example, encountering "scissors," a child unfamiliar with "剪" but familiar with "刀" can infer it denotes a cutting tool. This morpheme analysis enriches character knowledge and accelerates later mastery.

However, morphological awareness did not predict dictation intercept or slope. This may reflect developmental factors: first and second grade dictation involves primarily simple characters accessible through direct retrieval without requiring morphological analysis. As children develop and encounter more complex characters, individual differences in morphological awareness may exert greater influence (Nunes, Bryant, & Bindman, 1997). Research on Chinese spelling errors (Shen & Bear, 2000) indicates that young children rely on rote memorization, gradually incorporating morphological strategies with increased language experience. Our four-wave study spanning first to second grade may have captured only the early phase where mechanical retrieval dominates (Bialystok, McBride-Chang, & Luk, 2005). By upper elementary grades, when relevant cognitive skills mature, children may increasingly apply morphological awareness to dictation. Although some studies (Apel et al., 2012; Deacon et al., 2009; Pittas & Nunes, 2014) found morphological awareness predicted dictation levels, our findings suggest it does not predict dictation *trajectories*, which may be influenced by other factors such as working memory.

5. Conclusions

5.1 Character recognition demonstrates linear growth, while dictation shows non-linear (fast-then-slow) growth, with both exhibiting compensation effects.

5.2 Homophone awareness and compound morphological awareness significantly predict character recognition intercept and slope, but do not significantly predict dictation intercept or slope.

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The effects of morphological awareness on character recognition and dictation in low-level grades

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Abstract: Character recognition and dictation are two important skills for literacy at the word level. Because Chinese is a logographic script and characters are visually complex, reading and spelling character are more difficult than learning alphabet language. The development of character recognition and dictation in Chinese has unique characteristics. Many cross-sectional researches investigated how morphological awareness contributed to logographic and alphabet language learning, and its influence on the development of character recognition and dictation. However, few studies explored the relationship between morphological awareness and the development of character recognition and dictation over time.

The present four-wave longitudinal research was conducted in two Mandarin Chinese primary schools for two years, with a sample consisting of 127 first grader students. A battery of measures, including nonverbal IQ, phonological awareness, orthographic awareness, morphological awareness (homophone awareness, compound word production) were administered in order to investigate the influential factors of character recognition and dictation development in children. The analysis included an unconditional latent growth model to examine the growth trajectory of character recognition and dictation, and a conditional latent growth model to examine the contribution of morphological awareness to the growth of character recognition and dictation

The results of the unconditional latent growth model showed that: (1) the developmental trajectory of character recognition showed linear growth it grew at a constant speed. The developmental trajectory of dictation showed non-linear growth, and the growth took place at a fast pace in the beginning and at a slower pace in the latter half of the development trend. Instead of Matthew effect, a compensation effect existed in both character recognition and dictation development, and the standardized correlation coefficients of intercept and slope for character recognition was -0.33 significantly, and for dictation was -0.89 significantly. (2) Homophone awareness and compound word production predicted significantly the children' s initial level($\beta = 0.40$, $p < 0.001$; $\beta = 0.14$, $p < 0.05$ respectively) and the growth rate of character recognition ($\beta = 0.28$, $p < 0.001$; $\beta = 0.25$, $p < 0.001$ respectively), but not the growth rate in dictation.

These results suggest that the growth trajectories were different for character recognition and dictation, and the later growth rates of character recognition and dictation were not decided by initial growth levels. The role of morphological awareness was more significant on the development of character recognition than on the development of dictation from Grade 1 to Grade

Key words: Morphological awareness, Character recognition, Dictation