



Role of transcription skills in young Chinese language learners' sentence writing: a one year longitudinal study

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Abstract

The effects of transcription skills, comprising both spelling and handwriting fluency, on sentence writing among young Chinese as a second language (CSL) learners were evaluated and compared to those of reading and oral language using a one-year longitudinal study design. Various writing models postulated that transcription skills are essential in early writing development; however, studies have not yet clarified its role in CSL writing alongside other important writing component skills such as reading and oral skills. Participants included 204 primary-school-level CSL learners. These learners were evaluated in copying, spelling, character reading, oral language skills, and sentence writing at the end of the Grades 4 and 5 school year. Regression and path analysis evaluated the direct and indirect effects of the component skills on sentence writing. The results showed that, while controlling for non-verbal reasoning, (1) Time-1 transcription skills predicted sentence writing concurrently and longitudinally, but their influences at Time 2 diminished considerably for the substantial autoregressive effect of writing; (2) character reading predicted sentence writing both at Times 1 and 2, and contributed to spelling development; and (3) compared with transcription and reading, oral language skills weakly influenced writing, which was mediated largely by character reading. The findings suggest that transcription skills are vital constituents of CSL sentence writing and that reading plays a primary role in the reading–writing relationship in this stage.

Keywords Chinese as a second language writing · Transcription skills · Reading · Oral language

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Introduction

Transcription skills are important for writing development across different scripts, such as English and Chinese (Feng et al., 2019; Kent & Wanzek, 2016). As a process of transforming language representations in thought into written texts in print (Berninger et al., 1996), transcription entails spelling and handwriting fluency skills (Ding et al., 2020; Graham & Harris, 2000). While spelling is an act of producing a written symbol according to the orthographic rules/principles of a writing system (Ye & McBride, 2022), handwriting fluency involves coordinating one's spelling knowledge, orthographic representations, and fine motor skills (López-Escribano et al., 2022). As specified in developmental models of writing, efficient, automatized transcription facilitates writing by freeing up cognitive resources for higher-level processes such as planning and composing and may be especially influential for developing writers (Ahmed et al., 2022; Berninger & Amtmann, 2003; Juel et al., 1986; Kim & Schatschneider, 2017). As for the complexity of the Chinese morpho-syllabic writing system, Chinese as a second language (CSL) learners have found literacy acquisition a learning difficulty (Everson, 2002). In this regard, it is expected that transcription skills will be a major constraint in CSL writing development. However, our understanding of CSL learners' literacy developmental trajectory, particularly in writing, remains inadequate (Cheng & Chiu, 2018; Wong & Zhou, 2022). This study addresses this research gap by evaluating the role of transcription skills in young CSL learners' writing with a one-year longitudinal design. These learners' character reading and oral language skills are both significant correlates of writing, as identified in previous studies (Kent & Wanzek, 2016; Yeung et al., 2017a), so they were included to facilitate the evaluation.

Developmental relations between transcription skills and writing

Writing is a complex task of expressing our thoughts on paper that demands a wide range of knowledge and skills and is influenced by the situated social-cultural context (Graham, 2018; Ivanič, 2004). To account for the cognitive and linguistic processes involved in developing this complex skill, several models for developing writing skills—in which the role played by transcription skills in the beginning stage is underscored—have been proposed (Hayes, 2012; Rijlaarsdam, 2012). Juel et al., (1986) proposed a simple view of writing in which spelling and ideation were identified as two major component skills for text production. Spelling is supposed to free up the cognitive load necessary for the higher-order processes of writing, i.e., ideation for generating and organizing ideas. The model was related to the simple view of reading (Gough & Tunmer, 1986), in which reading is postulated as a product of decoding and listening comprehension, emphasizing the spelling–decoding relationship: they are both composed of letter–sound and lexical knowledge. This is in line with research findings regarding

a reciprocal reading–writing relationship, signifying shared linguistic knowledge and cognitive processes and the co-occurrence of the two skills (e.g., writers have to read for interpreting, analyzing, and revising) (Ahmed et al., 2014; Shanahan, 2016). Berninger et al. (2002) further elaborated the developmental model by identifying that writers rely on oral language to transform their ideas into language representations and transcription skills (consisting of both spelling and handwriting) to transcribe them into written text.

These models and studies underscore the importance of transcription skills, oral language, and reading as component skills to writing. In their meta-analysis study, Kent & Wanzek (2016) identified positive relations between these component skills and writing quality, with transcription skills demonstrating the strongest relationships in writing outcomes. Regarding correlation strength, next to transcription is reading and then oral language. Expanding on the developmental models, Kim and associates proposed the direct and indirect effects model of developmental writing (DIEW), in which spelling and handwriting fluency skills, along with discourse-level oral language, are direct predictors of writing (Kim & Park, 2019; Kim & Schatschneider, 2017) and interact dynamically with reading abilities via their effects on writing quality (Kim & Graham, 2022).

A substantial body of research has supported this developmental writing model (see the meta-analytic review by Feng et al., 2019) suggesting that efficient transcription skills lessen the demand on attentional resources, facilitate higher-order cognitive processes, and enhance the writing performance of developing writers. Recently, a large-scale study by Skar et al., (2022) found that handwriting fluency accounted for a statistically significant portion of the variance in the writing quality of primary school grade students. Intervention studies (Alves et al., 2016; Araújo et al., 2022; Wanzek et al., 2017) have also found transcription training to positively affect writing. In their review of this body of research, Graham & Santangelo (2014) and Santangelo & Graham (2016) identified the effectiveness of spelling and handwriting instruction in improving writing performance among kindergarten to Grade 12 students. These developmental models propose a shift in the contribution strength of the two major components—transcription skills and higher-order processes—in a writer's development. Transcription skills had a greater influence initially, and when writers gradually attained automaticity in the skills, the influence of the higher-order skills would increase and surpass that of transcription at later stages (Kim & Park, 2019). This developmental shift has been supported by Juel et al., (1986), who found that the major influence on writing shifted from transcription in first graders to ideation in second-graders, and Kim & Park (2019), who observed a decreasing transcription effect from Grades 1 to 3 in Korean primary students.

The developmental models of writing and the aforementioned studies informed the present study's research design and operationalization of constructs. The study adopted a design that evaluates the role of transcription skills against that of reading and oral language in primary school CSL learners' writing. Regarding operationalization of constructs, given the limited Chinese writing ability of the participating students, whose Chinese literacy competence was still at the beginning stage and comparable to grade-one level of their native Chinese-speaking counterparts, a sentence writing task was used to measure their writing skills. Children's ability

in producing meaningful and grammatically-correct sentences is a pre-requisite for them to write longer, quality texts, and an indicator of writing competence (Berninger et al., 1992; Smith et al., 2021). Studies on lexical learning found that sentence writing and composition writing have comparable facilitating effect to vocabulary acquisition (Silva et al., 2021). Sentence writing tasks were used as an outcome measure in some studies (e.g., Berninger et al., 2011; García et al., 2017). Moreover, sentence fluency was frequently adopted in writing research outcome assessments (see the meta-analysis by Graham et al., 2017). Enhancing sentence writing skills has been an important goal in intervention studies as well (Datchuk & Kubina, 2013; Smith et al., 2021). Berninger et al.'s (2011) study of sentence writing identified that transcription skills explaining Grades 2 to 4 students' sentence writing as against morphological and syntactic skills. However, Kim & Graham (2022) indicated that the measurement of writing skills adopted in a study would have implications on its findings concerning the relationships between writing and its component skills. In constructing a grammatically correct sentence with appropriate content, the influences of higher-order cognitive processes, such as ideation, may be lower relative to lower-order skills, such as transcription (Carvalhais et al., 2021; García et al., 2017). As for the predictive component skills, both spelling accuracy and handwriting fluency were evaluated at the character/word level, which, as guided by studies on the reading-writing relationship (Ahmed et al., 2014; Berninger et al., 2002), is matched with a reading task at the same linguistic level. Oral language has been operationalized as oral vocabulary and listening comprehension (Kent & Wanzek, 2016) and, therefore, the study adopted both as measures. Previous studies supported that transcription substantially influences writing development compared to other important component skills such as oral language and reading. While most of them were conducted in English, as pointed out by the review of Feng et al., (2019), Chinese literacy development researchers have identified similar writing correlates in Chinese language learners. A summary of the characteristics of the Chinese writing system is initially provided to facilitate an understanding of this body of research.

Transcription and writing development in chinese

Chinese is a morpho-syllabic language, with Chinese characters forming the basic graphic units of its writing system. Compared to alphabetic scripts, Chinese characters have complex structural properties: each is a two-dimensional, visual-spatial unit that, in most cases, both stands for a syllable and functions as a morpheme representing certain meanings; the majority (96%) are compound characters consisting of more than one radical (Su, 2001). In terms of the complexity of the writing system, handwriting skills, such as copying, help to strengthen visual-orthographic representations of Chinese characters and facilitate Chinese literacy acquisition in both word reading (Guan et al., 2011) and spelling (Lam & McBride, 2018; Ye et al., 2021; Ye & McBride, 2022). Studies on Chinese children's writing development identified that, similar to that of children of alphabetic languages (e.g., Kim & Schatschneider 2017; Rijlaarsdam, 2012), transcription skills, oral language, and reading are significant correlates of writing (e.g., Yeung et al., 2017a; Zhang et al.,

2014). However, the complex orthography also implies that transcription has a larger constraint on writing development in Chinese than in alphabetic languages, as writing Chinese characters tends to consume considerable attentional resources (Yeung et al., 2017a; Zhang et al., 2014).

In a series of studies modeling writing development in young Chinese students, Yeung et al., (2013a, 2017a, b) demonstrated the predominant role of transcription skills in Chinese written composition throughout elementary grades. Moreover, Yeung et al., (2013a) identified a bidirectional relationship between spelling and text writing development in Grades 2 to 4 students, while both Yan et al., (2012) and Zhang et al., (2014) found support for the significant influence of transcription skills on the Chinese writing quality of Hong Kong young students. Yan et al. emphasized that fluent transcription freed up Grades 1 to 4 students' cognitive resources for higher-level compositional processes, while Zhang et al., in making comparisons with 5- to 9-year-old students' L2 English writing (in which language knowledge, not transcription, was the critical correlate), suggested that the importance of transcription in Chinese revealed the effects of specific orthographic characteristics on writing development.

It should be noted that while handwriting fluency and spelling are found to be reciprocally related in development (Ding et al., 2020), their contributions to writing are different. Yeung et al., (2017a, b) found that the predictive power of the spelling accuracy of Chinese primary school students in Grades 3 to 5 was greater than their handwriting fluency. Moreover, operationalizations of the Chinese transcription skills in these studies should be noted for their relationship with the research focus. While spelling in Chinese was consistently measured by a writing-to-dictation task, in which the participants were required to write down words/texts read to them, the tasks for handwriting skills varied depending on what the researchers intended to measure. Generally, when the focus of the studies was on handwriting fluency, tasks like Chinese text copying (at the units of a word, sentence, or paragraph) were employed (Yan, 2012; Yeung, 2017a, b; Zhang et al., 2014). Contrarily, when studies focused on the knowledge and/or skills required for handwriting, either a knowledge test, such as the stroke-order knowledge test used by Yeung et al., (2013a), or a delayed copying test, in which the participants reproduced some unfamiliar Chinese characters presented to them for a short period from memory (Ye et al., 2021), were used. In this study, dictation and character/word copying tasks were used as measures for spelling accuracy and handwriting fluency, respectively.

The developmental studies also identified the influence of oral language and reading, both to a lesser extent than transcription, on Chinese writing. Specifically, studies from Yeung et al., (2013a, 2017a, b) consistently found influences of oral syntactic skill on writing, while Zhang et al., (2014) identified the impact of word reading. In one study by Yeung et al. (2017a), discourse-level oral narrative skills significantly contributed to writing. Studies on the reading–writing connection in Chinese supported these findings. Guan et al., (2014) found that Chinese Grades 4 and 6 students' oral skills in syntactic processing and morphological awareness contributed to their written composition, while Tong and McBride's (2016) longitudinal research identified a reciprocal relationship between oral syntactic skill and writing in 11- to 12-year-old students. Both studies found a strong reading–writing

relationship, which accounted for the contribution of oral skills to text composition; in other words, reading mediates the relationship between oral language and writing. Yeung et al., (2013b) observed that both word reading and spelling were longitudinally predicted by morphological awareness and orthographic skills in Chinese Grades 1 to 4 students. With a longitudinal design, Ye et al., (2022) found that the reading performances of Chinese kindergarteners predicted their spelling performances in Grades 1 and 2, but not vice versa. The findings suggested that the Chinese reading–writing relationship in the early stage might be uni-directional rather than bi-directional. As for matching with transcription measures at the character/word level, the present study adopted a character reading task as a reading skills measure and a vocabulary task as one of the oral skills measures. Given the importance of discourse-level oral skills and oral syntactic knowledge (Tong & McBride, 2016) and concerning studies in alphabetic languages (Kent & Wanzek, 2016), a listening comprehension test was also used.

In sum, the findings of existing studies on Chinese children’s writing development have converged with writing research conducted mostly in English (Feng et al., 2019), supporting the dominant role of transcription skills relative to reading and oral language. However, this issue has yet to be studied in the context of CSL learners, a population that has often found the complex Chinese writing system to be a major learning difficulty (Everson, 2002). The CSL research concerning literacy acquisition has largely focused on Chinese character learning among adult learners (Shen, 2013), with comparatively few studies investigating CSL learners’ literacy beyond the beginning stage, particularly in writing (Cheng & Chiu, 2018; Lu, 2022). The implications of these studies for the present proposed study are discussed in the following section.

CSL writing and its correlates

Several research studies have identified the importance of Chinese orthographic knowledge and visual-motor integration skills, such as copying, in CSL learners’ literacy acquisition. By comparing Grades 1 to 3 CSL students with their Chinese-speaking counterparts, Zhou et al., (2018) and Wang et al., (2018) found that, while similar linguistic correlates of Chinese literacy acquisition were identified in both groups of students, the CSL students relied more heavily on their phonological awareness skills. In contrast, the Chinese-speaking children used a range of skills, including reading-related orthographic and morphological knowledge and copying for spelling. This difference in the availability of reading and copying skills may have contributed to the lagging-behind literacy performances of CSL students. In contrast, the Grade 8 learners researched by Zhang et al., (2016) harnessed their radical knowledge to learn new Chinese characters. Corresponding to these findings, Wong & Zhou (2022) found that among CSL students at more advanced levels, both handwriting fluency and reading predicted spelling performance, and Chinese orthographic knowledge played a major role in their literacy performances.

As for CSL writing development beyond the spelling stage, Wong (2018) determined that at the sentence level, students’ handwriting fluency and written syntactic

awareness significantly account for the strong relationship between their sentence reading and writing. Meanwhile, Leong et al., (2018) observed that reading-related orthographic processing skills contributed uniquely to students' written composition. However, no studies have yet assessed the role of transcription skills in CSL students' writing development, considering these simultaneously against the contribution of other critical component skills as postulated by the developmental models of writing and supported by empirical studies across orthographies. Applying the developmental models of writing and referring to studies on Chinese writing development (e.g., Tolchinsky 2018), the present study addressed this research gap by evaluating the influence of transcription skills on Hong Kong's primary CSL students' sentence writing performance and comparing them with those of oral language and reading skills. Following a common practice in psycholinguistic research (Ding et al., 2020; Yeung et al., 2017b), the effect of the students' non-verbal reasoning was controlled by including Raven's non-verbal intelligence test in the assessment battery. The study adopted a longitudinal design to model the developmental relations from Grades 4 to 5 to scrutinize the effects of spelling and handwriting fluency on CSL writing both concurrently and longitudinally. The specific research questions of the study were: (1) what are the relative contributions of spelling and handwriting fluency to the CSL learners' sentence writing compared to those of oral language and character reading, year by year? (2) What are the concurrent effects of writing component skills on sentence writing when autoregressive and cross-lagged effects within and across the variables are accounted for? (3) What are the longitudinal effects of the T1 transcriptions skills on T2 sentence writing? We hypothesized that both transcription skills would predict, with different strengths in effect, sentence writing both concurrently and longitudinally, controlling for the effects of reading and oral language and considering autoregressive and cross-lagged effects. Given the reading–writing relationships supported by the writing developmental models (Berninger et al., 2002; Juel et al., 1986), we also expected the results to shed light on the reciprocal effects of sentence writing on the component skills and longitudinal relationships among the writing component skills, particularly the relations among character reading, spelling, and sentence writing.

Methods

Participants

A total of 204 ethnic minority students in Hong Kong participated. These participants were mostly South Asians and spoke different native languages such as Hindi, Urdu, and Nepali. They were recruited from five government-aided primary schools and had been studying both Chinese and English as a second language. They were assessed with a range of measures in Grade 4 (Time 1, T1) and Grade 5 (Time 2, T2) to track their Chinese language development. There were 112 boys (54.90%) and 92 girls (45.10%), and by the time of the T2 assessment, the average age was 9.43 years old (ranging from 8.64 to 11.63 with an SD of 0.55).

An account of these students' Chinese language competence and the Chinese language education they received in Hong Kong would be essential to understanding the research aim and design. CSL research to date has largely been conducted among adult participants learning Chinese as a foreign language in a higher education setting (Shen, 2013), with comparatively few studies investigating young learners in Chinese-speaking societies. The Chinese learning of Hong Kong's ethnic minority students would provide valuable information concerning CSL development. They have been learning both Chinese and English as a second language in school for four to five years, both of which are official languages in Hong Kong and taught in public schools as major subjects with ample instruction time. Compared to their native Chinese-speaking counterparts, ethnic minority students are relatively strong in English but weak in Chinese (Li et al., 2022). Thus, schools enrolling a substantial ethnic-minority student population generally use English as the medium of instruction and develop a school-based Chinese language curriculum with simpler learning materials (Tsung et al., 2010). Tailoring to the limited Chinese proficiency of the participating students, the measures we used were set at the Grade 1 difficulty level.

Measures

Raven's test

Sets B and C of the Raven's Progressive Matrices Test (Raven, 1960) assessed the students' nonverbal reasoning and were used to control the effect of their non-verbal reasoning. There were 24 items, which required the students to identify a part out of six to eight options to complete a given pattern with a missing element. Each correct answer was scored as one point, and the maximum score was 24. The tests were administered at T1.

Oral language

As informed by studies on the component skills of writing (Kent & Wanzek, 2016), the students' oral language was assessed through an oral vocabulary test and a listening comprehension test at T1 and T2, respectively. The oral vocabulary test assessed the breadth and depth of their Chinese oral vocabulary with items on receptive vocabulary, expressive vocabulary, and vocabulary definitions. For receptive vocabulary, students were asked to choose from four options a picture that best fitted the meaning of an orally presented word, which were obtained from the Peabody Picture Vocabulary Test-Third Edition (PPVT-III; Dunn & Dunn 1997). For expressive vocabulary, the students were asked to name a picture of an object or scenario in Cantonese. These picture stimuli were also obtained from the PPVT-III. Each correct response in these two parts was awarded one point. For the last section, vocabulary definitions, the students were asked to provide definitions of Chinese words. The listening comprehension test was taken from a local Grade 1 standardized test (Educational Research Section of the Hong Kong Education Department,

1989; 1999) and a school-based Chinese language listening test developed by the Curriculum Development Institute of the Hong Kong Education Bureau (2011) for Grades 1 to 3 ethnic minority students. To assess the students' comprehension ability, there were multiple-choice questions on listening material contents, either simple daily conversations or short stories. The questions were set for the main points of the materials' content.

Handwriting fluency

Following the practices of measuring Chinese handwriting fluency by copying tasks (Yan, 2012; Yeung, 2017a, b), we used a character copying test similar to that of Wong (2018). Students were required to copy as many of the presented Chinese characters as possible in one minute. The presented characters were a mix of simple characters that consisted of a few strokes (e.g., 天 'sky' /tin1/) and compound characters consisting of more strokes (e.g., 湖 'lake' /wu4/). Any incorrect, unclear, or incomplete copied characters received a score of zero. A scoring criterion was provided to a rater as well. To confirm their objectivity, about 15% of the assessment (i.e., a sample of 35) was assessed by a second rater. An excellent degree of inter-rater agreement was found in both Time-1 and -2 data, as shown by a two-way random, consistent, single-measures intra-class correlation (ICC) (Hallgren, 2012): the Time-1 ICC was 0.998, with a 95% CI [0.995, 0.999], $F(34, 34) = 813.90$, $p < .001$, and the Time-2 ICC was 0.997, with a 95% CI [0.993, 0.998], $F(34, 34) = 598.36$, $p < .001$. As the test format was new to the students, they first completed a short trial test with seven items to facilitate administration. Before the study, a pilot test with thirty students had been conducted wherein two parallel test sets were completed consecutively. The correlation of the sets was 0.84, indicating good test-retest reliability.

Chinese spelling

Aligning with the practices adopted by previous studies investigating Chinese spelling (Ding et al., 2020; Wong & Zhou, 2022; Yeung et al., 2017a, b) dictation test was used to assess the students' Chinese spelling with single-character items, two-character words, and four-character phrases. All the items were of Grades 1–3 level as verified against Hong Kong's primary-education Chinese word list (Chinese Language Education Section of the Hong Kong Education Bureau, 2008). The students were required to write down the items read aloud to them. Each correct response received one point. The T1 and T2 tests had the same structure but included different items. Similar to the scoring practice of the handwriting fluency measure, a scoring criterion was provided to a rater. To confirm their objectivity, about 15% of the assessment (i.e., a sample of 35) was assessed by a second rater. An excellent degree of inter-rater agreement was found in both Time-1 and -2 data, as shown by a two-way random, consistent, single-measures intra-class correlation (ICC) (Hallgren, 2012): the Time-1 ICC was 0.999,

with a 95% CI [0.999, 1.00], $F(34, 34) = 3444.89$, $p < .001$, and the Time-2 ICC was 0.999, with a 95% CI [0.998, 0.1.00], $F(34, 34) = 2623.19$, $p < .001$.

Chinese character reading

Students' reading ability was assessed through a character reading test used in previous studies on the Chinese reading–writing relationship (Wong & Zhou, 2022; Zhang et al., 2014). The test included 100 characters as test items—50 single characters (e.g., 我) and 25 two-character words (e.g., 說話)—, which were at Grade 1 level with reference to Pan and Kang's (2003) study and a basic word list prepared for Hong Kong primary students by the Hong Kong education department (Chinese Language Education Section of the Hong Kong Education Bureau, 2008). Participants were required to read the characters one by one aloud and follow the test administrator's instructions. Each correct pronunciation received one point. The T1 and T2 tests had the same structure but included distinct items.

Sentence writing

As indicated above, since writing tasks at the paragraph or passage level were beyond the participating ethnic-minority students' Chinese-language ability, a sentence-writing task was used instead. Sentence writing is a major composition task required for the Hong Kong local Chinese-speaking Grade 1 students. This task is a picture sentence-writing test adopted from the local standardized test (Educational Research Section of the Hong Kong Education Department, 1989, 1999). For each item, students were presented with a picture and a target word and instructed to write a (some) sentence(s) using that target word. For example, they were given 害怕 ('frightened' *hohi6paa3*) to describe a picture of two children frightened by a mouse. The other three target words were 休息 ('to rest' *ljau1sik1*), 小心地 ('carefully' *lsiu2sam1dei6*), and 排隊 ('lining up' *lpaai4deoi6*). The assessment criteria were: (1) for correctness and accuracy in target word use and sentence structure, and (2) for the elaboration of content for picture description. There were four items, each with a maximum score of five. Three raters, who were first trained and engaged in pilot marking conferences, scored the writing tests. All were post-graduate students of a primary Chinese teacher certificate course and had engaged in undergraduate Chinese-language-related study. Each rater marked all three papers, and inter-rater reliability was then assessed using a two-way random, consistent, average-measures intra-class correlation (ICC) (Hallgren, 2012). An excellent degree of inter-rater agreement was found in both Time-1 and -2 data: the Time-1 ICC was 0.978, with a 95% CI [0.972, 0.983], $F(203, 406) = 45.36$, $p < .001$, and the Time-2 ICC was 0.970, with a 95% CI [0.962, 0.976], $F(203, 406) = 33.32$, $p < .001$. The averages of the ratings were used in the analysis.

Procedures

On-site data collection were conducted by a research team consisting of the researchers as leaders and undergraduate students of the Chinese language education program as members. Teachers of the respective schools helped to administer the test. Similar data collection procedures were adopted for both time points: the tests were conducted at the end of the school year (from June to July) and took approximately two hours at each school for two days. Among the assessment battery, the group tests included listening comprehension, handwriting fluency, spelling, and sentence writing tests, while the individual test included the Raven's test, oral vocabulary, and character reading tests, all of which were conducted by the research team members and monitored by the researchers. Individual tests were conducted after the group tests. All measures, except the sentence writing task, were measured by a single rater.

Analysis

Both multiple regression and path analysis were used to evaluate the relations of sentence writing and its components for a year. To address research question 1 concerning the year-by-year concurrent contributions of transcription skills relative to character reading and oral language, regression models on sentence writing at T1 and T2 with the above predictors were evaluated. Then, to address research questions 2 and 3 for evaluating the contribution of transcription considering the variables' autoregressive and cross-lagged effects, both concurrently and longitudinally, a path model was established according to two specifications. These are (1) the component skills, including spelling, handwriting fluency, character reading, and oral language (oral vocabulary in Time 1 and listening comprehension in Time 2) predicted sentence writing in both Times 1 and 2; (2) full reciprocal autoregressive and cross-lagged relationships within and between the variables across the year were specified.

Results

Descriptive statistics and correlations

Cronbach's alpha values for reliability and descriptive statistics for all measures are reported in Table 1. All measures were of satisfactory to good reliability as Cronbach's alpha values ranged from 0.81 to 0.98. As mentioned above, the reliability values for the copying tasks were test-retest reliable and those for sentence writing were intraclass correlated, indicating inter-rater agreement. All scales satisfied the normality assumption of path analysis with skewness and kurtosis values within the range of +1 and -1. Partial correlations controlling for Raven's test are reported

Table 1 Alpha values and descriptive statistics for all measures used in the study ($N = 204$)

Measures (max score)	Alpha	Range	Mean	SD	Skewness	Kurtosis
Raven's test (24)	0.85	2–23	14.46	4.84	−0.56	−0.48
Oral vocabulary T1 (64)	0.87	0–51	16.92	9.36	0.79	0.66
Spelling T1 (41)	0.95	0–41	11.17	9.37	0.94	0.29
Handwriting fluency T1 (---)	0.84 ^a	0–29	12.75	4.43	0.19	0.94
Character reading T1 (100)	0.98	0–96	29.13	22.28	0.88	−0.03
Sentence writing T1 (20)	.98 ^b	0–16	5.02	4.01	0.64	−0.27
Listening Comprehension T2 (62)	0.81	10–59	27.85	10.77	0.72	−0.04
Spelling T2 (41)	0.93	0–35	9.02	7.63	0.92	0.36
Handwriting fluency T2 (---)	.84 ^a	0–29	15.20	4.31	−0.02	0.78
Character reading T2 (100)	0.98	1–99	36.19	25.17	0.50	−0.82
Sentence writing T2 (20)	.97 ^b	0–14	4.58	4.18	0.58	−0.84

^a Test-retest correlation, ^b Inter-rater correlation

Y1: Year 1, Y2: Year 2

in Table 2. All correlations had statistical significance except between oral vocabulary and handwriting fluency in Time 1. The handwriting fluency measures of both Times 1 and 2 generally had weak associations with oral language variables. Aligning with the close decoding–spelling relationships postulated in the developmental models of writing (Juel et al., 1986; Berninger et al., 2002), correlations between character reading and spelling were strong at both time points.

Multiple regression

To address research question 1 concerning the year-by-year concurrent contributions of transcription skills relative to character reading and oral language, regressions on sentence writing by the component skills were conducted for T1 and T2. The results of the T1 and T2 regression models are presented in Table 3. The variance inflation factor (VIF) of each model predictor was examined regarding some high correlations among variables, particularly those between character reading and spelling. The VIPs ranged from 1.10 to 5.45, which indicated that multicollinearity did not unduly influence the estimates (Kutner et al., 2004). The strengths of the two transcription skills' influence differed. Spelling had a bigger contribution and remained a statistically significant predictor of writing at both T1 and T2, with a β -value of 0.58 and 0.20, respectively, while handwriting fluency's influence, with a β -value of 0.10, was comparatively small at T1 and reduced slightly at T2 to 0.08 and being marginally insignificant. Character reading was a predictor of sentence writing in T1 and T2, with a β value of 0.25 and 0.47, respectively, and its contribution was the biggest among all the variables in T2. In contrast, both oral language variables, i.e., oral vocabulary at T1 and listening comprehension at T2, had small, statistically insignificant contributions to sentence writing.

Table 2 Partial correlations among all measures after controlling for Raven's test (N=204)

Variables	1	2	3	4	5	6	7	8	9	10
1. Oral vocabulary T1	-									
2. Spelling T1	0.61**	-								
3. Handwriting fluency T1	0.06	0.30**	-							
4. Character reading T1	0.70**	0.87**	0.23**	-						
5. Sentence writing T1	0.45**	0.77**	0.32**	0.72**	-					
6. Listening comprehension T2	0.61**	0.62**	0.24**	0.62**	0.53**	-				
7. Spelling T2	0.62**	0.85**	0.26**	0.84**	0.71**	0.67**	-			
8. Handwriting fluency T2	0.21**	0.31**	0.38**	0.26**	0.26**	0.25**	0.27**	-		
9. Character Reading T2	0.71**	0.84**	0.26**	0.91**	0.70**	0.65**	0.86**	0.28**	-	
10. Sentence writing T2	0.55**	0.71**	0.27**	0.72**	0.66**	0.58**	0.70**	0.30**	0.74**	-

***p* < .01.

Table 3 Regression models explaining the sentence writing at Times 1 and 2

Variable	R^2	β	t	p	Variable	R^2	β	t	p
<i>Time 1</i>					<i>Time 2</i>				
	0.65			< 0.01		0.61			< 0.01
Raven's		0.01	0.22	0.74	Raven's ^a		0.05	1.16	0.25
Oral vocabulary		-0.08	-1.38	0.17	Listening comprehension		0.12	1.18	0.07
Spelling		0.58	6.23	< 0.01	Spelling		0.20	2.19	< 0.05
Handwriting fluency		0.10	2.16	< 0.05	Handwriting fluency		0.08	1.76	0.08
Character reading		0.25	2.59	< 0.01	Character reading		0.47	5.14	< 0.01

^a The Raven's test was administered in Time 1 and entered in the Time-2 regression model of sentence writing as a control variable.

Path analysis

As specified in the methods section, a path model was evaluated to scrutinize the influence of transcription skills considering the variables' autoregressive and cross-lagged effects, both concurrently and longitudinally. The results suggested specifying correlations among some error terms of the Time-2 writing component skills, i.e., the variances left unexplained by the model, for better model fit. As these component skills are closely related, the model was respecified accordingly and presented in Fig. 1. The model fits the data with the following indices: $\chi^2(7) = 2.14, p = .95, CFI = 1, SRMR = 0.005, RMSEA = 0.00, 90\% CI [0.00, 0.00],$

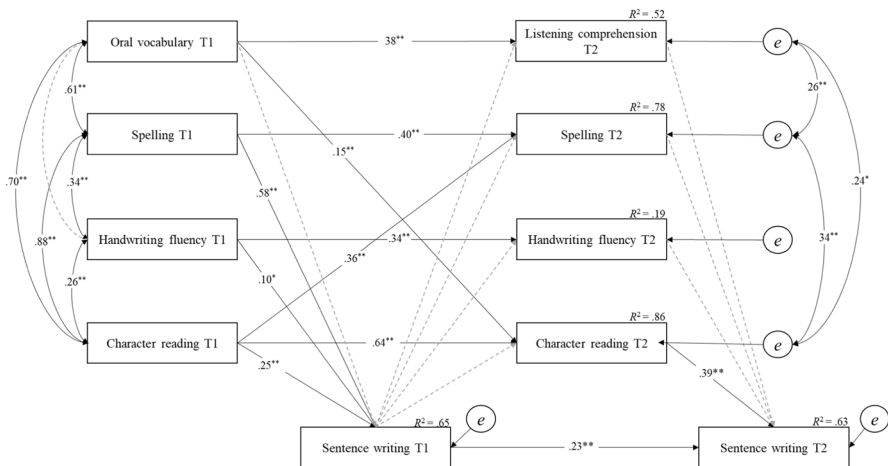


Fig. 1 Longitudinal effects between writing and its component skills in CSL learners' sentence writing. The Raven's test for intelligence was entered as control variables in the model. T1: Time 1; T2: Time 2. For clarification sake, (1) all statistically insignificant cross-lagged relationships between the predictors across time points were not shown; and (2) the statistically non-significant relationships are shown in grey, broken lines, and the respective β -values are not shown. Refer to Fig. 2 in the appendix for all the specified relationships and β -values. $^{**}p < .01, ^*p < .05$.

PCLOSE=0.99. For clarification sake, Fig. 1 only showed the specified relationships reaching statistical significance with β -values; a path model with full information is presented in the Appendix as Fig. 2. The results showed that, first, a substantial and comparable portion of the variance in writing across the year, as shown in the respective R^2 -value, 0.65 in Time 1 and 0.63 in Time 2, was accounted for in the model. To better understand the contributions of the component skills to sentence writing across the year, a bootstrap estimation approach was adopted to evaluate their direct and total effects on the model (Shrout & Bolger, 2002). The results of the bootstrapping method with 2,000 samples are presented in Table 4. Aligning with the regression results as shown in Table 3, by T1, all the component skills, except oral vocabulary, predicted sentence writing. Both transcription skills contributed to writing but with varied strengths, and character reading also had a substantial contribution. By T2, when the autoregressive effect (with a β -value of 0.23) of sentence writing was controlled, the influence of all component skills, except that of character reading, was statistically insignificant. The contribution of character reading remained substantial, with a β -value of 0.39. Although the strengths of the component skills' direct effects on sentence writing varied year by year, the longitudinal, total effects of the Time 1 component skills on Time 2 sentence writing, which included all the indirect effects across the Time 2 component skills for each of the Time 1 predictors, were all statistically significant. Spelling had a higher contribution (with a β -value of 0.30) than handwriting fluency (with a β -value of 0.08) to sentence writing. Over the year, each writing component variable demonstrated a strong autoregressive effect; however, the cross-lagged relationships among these variables, including all reciprocal effects of T1 sentence writing to its component skills in T2, were largely negligible except those between T1 oral vocabulary and T2

Table 4 Standardized regression weights of the direct and total effects of component skills on sentence writing in the path model

Path	β	SE	95%CI	P
<i>The direct effect of component skills on sentence writing in Time 1</i>				
Time-1 Oral vocabulary	-0.08	0.06	-0.21, 0.02	0.14
Time-1 Spelling	0.58	0.11	0.39, 0.81	<0.01
Time-1 Handwriting fluency	0.10	0.04	0.02, 0.18	<0.05
Time-1 Character reading	0.25	0.11	0.01, 0.45	<0.05
<i>The direct effect of component skills on sentence writing in Time 2</i>				
Time-2 Listening comprehension	0.10	0.07	-0.03, 0.23	0.14
Time-2 Spelling	0.12	0.11	-0.12, 31	0.32
Time-2 Handwriting fluency	0.07	0.04	-0.01, 0.16	0.08
Time-2 Character reading	0.39	0.10	0.20, 0.59	<0.01
<i>The total effect of Time-1 component skills on Time-2 sentence writing</i>				
Time-1 Oral vocabulary	0.09	0.04	0.02, 0.18	<0.05
Time-1 Spelling	0.30	0.06	0.19, 0.42	<0.01
Time-1 Handwriting fluency	0.08	0.02	0.04, 0.14	<0.01
Time-1 Character reading	0.36	0.07	0.22, 0.49	<0.01

character reading and T1 character reading and T2 spelling: the former was with a β -value of 0.15, and the latter was substantial with a β -value of 0.36.

Discussion

The study evaluated the role of transcription skills, comprising spelling and handwriting fluency, compared to reading and oral language in young CSL learners' sentence writing. The study assumed a one-year longitudinal model design. The model explained a substantial and comparable portion of variances in the students' writing performance across the year. The results suggested that transcription skills, namely spelling and handwriting fluency, were vital for the learners' sentence writing. However, the contribution of spelling was substantial, while that of handwriting fluency was marginal. Chinese character reading was an important predictor of writing, with a strength of influence comparable to spelling. A uni-directional reading-writing relationship—in which the character reading contributed to spelling and writing rather than vice versa—was observed. The findings also suggested that oral language skills' influences on writing were mediated largely via character reading.

The major focus of this study was the role of transcription skills in the CSL learners' early writing development. Previous developmental studies in alphabetic languages have found that accurate and fluent transcription skills facilitate writing by freeing up cognitive/attentional resources for higher-level cognitive processes in writing (Ahmed et al., 2022; Feng et al., 2019). Compared with other significant writing correlates, such as reading and oral language, transcription strongly relates to writing development, particularly at the beginning stage of elementary schooling (Juel et al., 1986; Kent & Wanzek 2016; Kim & Graham, 2022). Research on Chinese writing development has found that this constraint of transcription on early writing development is also prominent in Chinese because of the complex script features of the Chinese language (Yeung et al., 2013a, 2017a). Our results largely corroborated these findings and established the importance of transcription, especially spelling, for the CSL learners' sentence writing, an important skill in writing development (Berninger et al., 1992; Graham et al., 2017; Smith et al., 2021), when controlling for oral language skills and character reading. At this early stage of their Chinese writing development, the constraints imposed by transcription were prominent, aligning with the findings of writing development studies across orthography (Juel et al., 1986; Kim & Park, 2019). As shown by the regression results (Table 3), the influences of handwriting fluency were statistically significant in T1 and reduced to insignificant with a small margin in T2. Comparatively, the spelling accuracy of the CSL students, as found by Yeung et al., (2017a, b) among native Chinese-speaking primary students, was strongly associated with sentence writing at both time points. Similar patterns of a stronger influence of spelling relative to handwriting fluency on writing development were also observed in Korean-speaking Grades 1 to 3 students (Kim & Park, 2019). However, as both skills were highly represented in their picture sentence writing, which required less in terms of generating and structuring ideas and more composing to translate ideas into words (Carvalhois et al., 2021; García et al., 2017), their influences diminished substantially when the

autoregressive effect of writing was included in the path model of Fig. 1. Nevertheless, when considering the longitudinal effect of transcription skills on writing, referring to Table 4, both T1 spelling and handwriting fluency were predictors of T2 sentence writing.

The findings suggest that the influences of the complex orthographic features of the Chinese writing system may be even more pronounced for L2 learners than for their native-speaking counterparts (Wang et al., 2018; Zhou et al., 2018). Regarding Yeung et al.'s (2017a, b) studies, in which the Grades 4 to 6 native Chinese-speaking students had not yet attained adequate spelling accuracy, these CSL learners may have more difficulty acquiring Chinese transcription skills, which could hamper their writing performance. As for the constraints of the Chinese script's features on literacy development, previous studies have also found that CSL learners' Chinese orthographic knowledge was a strong predictor of their reading (Wong, 2019, 2020) and writing (Leong et al., 2018; Wong & Zhou, 2022). As mentioned above, the prolonged learning process of Chinese literacy may also result in the relative importance of spelling over handwriting fluency (Yeung et al., 2017a, b). However, as mentioned in the Introduction, it should be noted that the two transcription skills are highly related in their course of development (Ding et al., 2020) and that the predictive power of Chinese handwriting skills tends to vary when operationalized with different measures such as the stroke order knowledge test (Yeung et al., 2013a) and delayed copying (Ye et al., 2021). The immediate copying measure adopted by the present study, similar to Yeung et al., (2017a, b), tapped on the participants' handwriting fluency and did not represent the full predictive strength of their handwriting skills.

The students' character reading was an important predictor of sentence writing. Aligning with Juel et al.'s (1986) and Berninger et al.'s (2002) identification of a close decoding–spelling relationship, it was found that character reading strongly related to spelling and contributed uniquely to sentence writing at both time points. As shown in the path model, the influence of character reading remained substantial even when the autoregressive effect of writing was considered in T2. The findings suggested that just as reading and writing share linguistic knowledge and cognitive processes (Shanahan, 2016), reading facilitates the writing development of CSL students. This aligns with the reading–writing relationship found in studies on alphabetic language learners (Ahmed et al., 2014; Kim & Graham, 2022), native Chinese language learners (Guan et al., 2014), and CSL learners (Wong & Zhou, 2022). In the process of reading acquisition, Chinese learners tend to accumulate knowledge of Chinese characters, orthography (e.g., radicals' positional regularity and linguistic functions), morphology (e.g., conventions of word compounding), and syntax, all of which facilitate their writing development (Li et al., 2019; Wei et al., 2014; Wong, 2018). Previous studies showed that Chinese writing could consolidate the learners' mental representations of characters and facilitate reading reciprocally (Guan et al., 2011; Tan et al., 2005); however, Ye et al., (2022) found that when native Chinese learners were in the early stage of literacy learning, the reading–writing relationship appeared to be uni-directional, such that the influences were predominantly from reading to writing and not vice versa. As shown in the path model, the CSL learners of the present study showed a predominant reading–to–writing

effect: character reading predicted sentence writing at both time points, and T1 character reading predicted T2 spelling and T2 sentence writing longitudinally with a strength comparable to T1 spelling. There were no statistically significant effects from spelling or sentence writing to character reading. Similar to cases of the early native Chinese-speaking primary school students from the study by Ye et al., (2022), the consolidating effects of writing (including spelling) on reading were not strong in the CSL students' literacy development in this stage.

The students' oral language skills were measured using oral vocabulary and listening comprehension tasks in T1 and T2, respectively. These operationalizations of the construct aligned with the developmental models postulating the use of oral language to support idea generation in the writing process (Berninger et al., 2002; Kim & Park, 2019; Kim & Schatschneider, 2017) and were similar to those in the studies of alphabetic languages (Kent & Wanzek, 2016). As shown in the regression and path analyses, the direct effects of both oral skills on sentence writing at the two-time points were negligible when the effects of the learners' transcription skills, character reading, and writing itself were considered. However, the T1 oral vocabulary had a direct effect on T2 character reading and a total effect on T2 sentence writing. The results were comparable to those found among the native Chinese students in Guan et al.'s (2014) and Tong and McBride's (2016) studies; reading skills mediated the influence from oral language to writing. Our results underscored the idea that oral language provides support for literacy acquisition and development in both L1 and L2 learners (Bialystok, 2007; Janaideh et al., 2020; NICHID Early Child Care Research Network, 2005); however, the particular paths and strengths of the contributions vary depending on the model specifications of different studies. The weak contributions from oral language may also relate to the construct operationalization of this study, which did not cover discourse-level oral narrative skills. The narrative skills were strongly associated with writing and were identified to have stronger predictive power in English-speaking (Kim & Schatschneider, 2017) and Chinese-speaking children (Yeung et al., 2017a).

Conclusions and limitations

Addressing the paucity of research on CSL writing development, this study evaluated the role of transcription skills in young CSL students' sentence writing, considering their character reading and oral language skills. The results of this one-year longitudinal study supported the importance of transcription skills in CSL sentence writing, especially in spelling, as postulated by the developmental writing models (Berninger et al., 2002; Juel et al., 1986; Kim & Schatschneider, 2017) and as established by a substantial amount of cross-cultural research (Feng et al., 2019; Kent & Wanzek, 2016). The influence of the complex Chinese writing system on literacy development, as found by studies among native Chinese speakers (Yeung et al., 2017a, b), was observed, as shown by the larger contribution of spelling accuracy over handwriting fluency. As Ding et al., (2020) indicated, the findings suggested that both spelling and handwriting fluency practices (e.g., copying) would benefit CSL learners' writing development. Teachers may use both to consolidate their students' character knowledge and therefore support effective writing. However,

adequate instructional time should be given to oral language and reading, which, as the findings suggested, are foundational for CSL writing development. Particularly, the learners' character reading may uniquely contribute to their sentence writing and facilitate its development directly and indirectly via spelling.

The present study's findings should be interpreted with caution given the following limitations. First, as mentioned above, the operationalizations of various constructs, such as handwriting fluency and oral language skills, might implicate how an individual's respective abilities influenced writing. For a better representation of the abilities, future studies may include the delayed copying task of Ye et al., (2021) and expressive oral narrative tasks (Yeung et al., 2017a) in their test battery of handwriting fluency and oral language skills, respectively. It should also be noted that the skills required for the picture sentence writing task differ from those required in passage-level writing tasks. The relationships of the component skills to the latter type of tasks may differ from those identified in the present study. Second, the Chinese language learning context of the ethnic minority students in Hong Kong may have characteristics disparate to those elsewhere; therefore, generalizing the findings to other contexts should be done cautiously. Lastly, the present study was limited by the one-year design in evaluating the longitudinal, dynamic relationships between CSL writing and its component skills. Future studies may include more waves of data in tracking the learners' development to better model the dynamic relations among the variables and identify developmental patterns.

Appendix

See Fig. 2

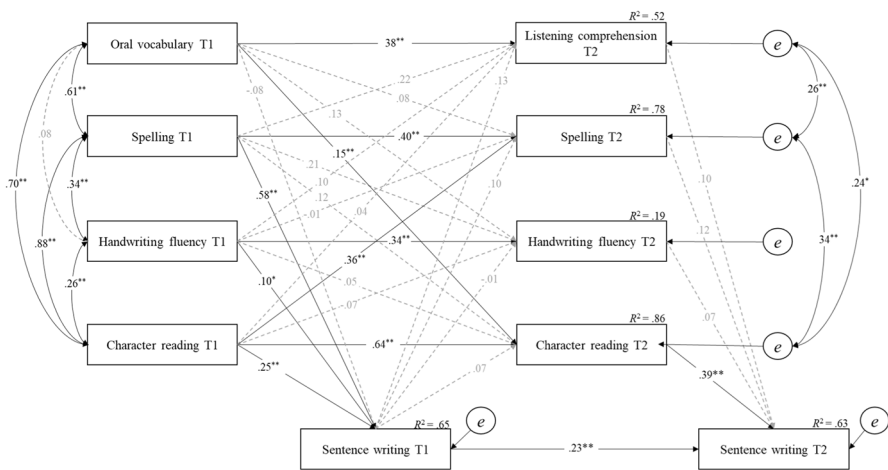


Fig. 2 Longitudinal effects between writing and its component skills in CSL learners' sentence writing (with all specified relationships and β -values shown). The Raven's test for intelligence was entered as control variables in the model. T1: Time 1; T2: Time 2. The statistically non-significant relationships are shown in grey, broken lines. ** $p < .01$, * $p < .05$.

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Data availability The authors are not authorized to make the data and material for public view/use.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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