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# The ABC's of Chinese: maternal mediation of Pinyin for Chinese children's early literacy skills

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**Abstract** In the present study, maternal Pinyin mediation and its relations with young Chinese children's word reading and word writing development were explored. At time 1, 43 Mainland Chinese children and their mothers were videotaped on a task in which children were asked to write 12 words in Pinyin (a phonological coding system used in Mainland China as an aid to reading Chinese characters) with help from their mothers. The videotapes were later coded on a scale (adapted from Aram & Levin, 2001) of mothers' writing facilitation techniques. Scores on this scale of maternal mediation of Pinyin uniquely explained children's reading of Chinese words, but not writing of Chinese words, after statistically controlling for maternal education and age, and children's non-verbal IQ, age, and phonological awareness. At time 2, 22 of the children from time 1 were further tested on Chinese word reading and word reading task 1 year later. After controlling for children's age and non-verbal IQ, maternal Pinyin mediation uniquely explained 6% of the variance in children's word writing and 7% of the variance in children's

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word reading performance at time 2. Results underscore the potential importance of the maternal scaffolding role for reading acquisition both theoretically and practically in a domain not previously explored (i.e., use of a common coding system (Pinyin) for learning to read, rather than word reading itself).

**Keywords** Word reading · Word writing · Pinyin · Maternal mediation

## Introduction

Phonological awareness is a foundation of literacy development among young Chinese children (e.g., Chow, McBride-Chang, & Burgess, 2005; Ho & Bryant, 1997; Shu, Peng, & McBride-Chang, 2008; Siok & Fletcher, 2001). Indeed, across orthographies, children with stronger phonological sensitivity tend to be more skilled in early reading and writing (e.g., Stanovich, 2000). Such skills are almost always measured individually in children as independent metacognitive awareness. At the same time, however, parents can also foster such sensitivity in young children (Aram & Levin, 2001, 2004). For example, by highlighting the phonological properties of the letters in a given word from an alphabetic orthography, parents may be facilitating greater literacy skills long-term (e.g., Aram & Levin, 2004). In the present study, we explored the extent to which Chinese children whose mothers highlight these same phonological properties in letters of Pinyin, a phonological coding system used to teach Chinese in Mainland China, also excel in Chinese character recognition and writing. This is interesting at least in part because Pinyin-learning is so different from reading Chinese characters. Indeed, Pinyin is a phonological coding system—an aid to learning to read, rather than reading itself in Chinese.

Chinese Pinyin is an alphabet coding system used to represent, or spell, the pronunciations of Chinese characters using both Roman alphabet letters and lexical tone transcriptions. The number of Roman letters of the alphabet used in Pinyin is approximately equivalent to those used in English; in addition, there are four tones, or pitches in speech, used to distinguish across syllables (Yiu, van Hasselt, Williams, & Woo, 1994). These are high level, rising, falling-rising, and falling, represented by the symbols of ¯(macron), ´(acute accent), ˇ(hacek), and `(grave accent), respectively. Another "neutral" tone is represented without any accent mark. A current common convention for Pinyin tone is to add the numbers of 1, 2, 3, or 4 to the end of an individual syllable to indicate the high level, rising, fall-rising and falling tones, respectively. The neutral tone is either not numbered or numbered as 0. For example, *mā* is written as *ma1*, *má* as *ma2*, *mǎ* as *ma3*, *mà* as *ma4*, and *ma* as *ma0/ma*. Despite this convention, however, young school children are still taught to use the symbols, rather than numbers, to indicate Pinyin tone in their own writing.

Because there are only around 400 syllables (without tone) but more than 3,000 commonly used characters in Chinese, tones are important for distinguishing across syllables. Thus, with tonal information included, the number of Chinese syllables expands to more than 1,200. Therefore, awareness of tonal information is an important aspect of phonological awareness in Chinese (e.g., McBride-Chang, Tong, Shu, Wong, Leung, & Tardif, 2008; Shu et al., 2008; Wang, Perfetti, & Liu, 2004).

Pinyin is formally taught in the first year of primary school (e.g., Cheung & Ng, 2003), but informally, Pinyin may be introduced to children in the initial stages of Chinese character learning by parents and teachers, even in the kindergarten years, at least in part because the system is relatively simple and regular compared with Chinese character-learning. As with any phonological coding system, there are at least two extreme ways in which the representation of an orally-presented word or morpheme can be taught in print. One is via memorization, without attention to the phonological properties represented by each letter, and one is by focusing on phonological coding (e.g., in English *d* makes the /d/ sound). The present study explored the extent to which mothers assist their children in exploiting the phonological properties of Pinyin and whether this matters for these children's early literacy skills, given that the majority of Beijing parents teach their children to read before formal schooling begins (e.g., Li & Rao, 2000).

Pinyin has been formally used for teaching Chinese in primary schools since 1958 in China. Literate adults in Mainland China are all typically familiar with Pinyin. Nowadays Pinyin is also used widely in adults' world. For example, one popular Chinese typing method on the computer is the Pinyin input method. In this method, adults type the words they wish to see on the computer using the Pinyin alphabet and then select the intended character from the (typically several homophonic) characters that appear on the screen as a result. Signs in Mainland China also often make use of Pinyin. Parents of kindergartners may additionally focus on Pinyin because they read children's books to their children (e.g., Li & Rao, 2000) and children's readings are routinely accompanied by Pinyin (Fredlein & Fredlein, 1994; Lee, 1993).

Given the particular importance of parents for learning to read Chinese (e.g., Li & Rao, 2000), the present research focused on mothers' facilitation of Pinyin learning among young Chinese children. We videotaped mothers' interactions of Pinyin spellings with their children and later coded these interactions using a self-created coding scale adapted from Aram and Levin (2001, 2004). Mothers may be especially important for home literacy in both Western (Meisels, 1998) and Chinese (Chao & Tseng, 2002; Ho, 1996) cultures. Moreover, different mothers may use different scaffolding strategies that may differ in qualitative ways in relation to children's writing (Aram, 2007; Aram & Levin, 2001, 2004; Lin et al., 2009). For example, maternal mediation in kindergarten was found to be predictive of children's concurrent independent word writing and recognition after controlling for sociocultural factors (Aram & Levin, 2001) and even predictive of children's literacy achievement in second grade beyond sociocultural factors and children's own achievement in kindergarten (Aram & Levin, 2004). Lin et al. (2009) also showed that the quality of maternal mediation of writing was highly associated with children's independent reading in Hong Kong kindergartners. Across these studies, mothers' more analytic and detailed mediational strategies tended to be associated with children's higher performance levels.

Using the same principles, we distinguished maternal Pinyin mediation from lower to higher levels, or from more holistic to more analytic phonological units. From initial pilot observations of 5 pairs of mother–child Pinyin writing, we saw that Chinese mothers differed widely in their mediation strategies related to the

phonological units of Pinyin. For example, during the Pinyin mediation process, some mothers holistically uttered the whole Pinyin word for the children. Others separated Pinyin into onset and rime, whereas others specifically uttered each phoneme separately to facilitate children's learning. Compared to more holistic utterances of phonological units, we view more specific utterances of phonological units as representing a higher level of mediation, because connecting particular phoneme sounds and letters may help children develop one-to-one correspondences between them. This may be particularly helpful in facilitating children's learning processes in Pinyin given that Chinese Pinyin is very consistent in its sound-letter correspondences.

For the tonal information, we observed in the pilot testing that some mothers pointed out the specific tone of the syllable or otherwise indicated the specific position of the tone. We viewed more holistic (e.g., onset-rime or no mediation; no indication of tone) as more unanalyzed, or surface-level mediation, whereas phoneme mediation or specific tone mediation was viewed as more analytic and detailed mediation because of the specificity of information mothers provided to their children in these instances. A more analytic approach to literacy mastery in mothers tends to be particularly facilitative of literacy acquisition for children, as found in relation both to alphabetic word mediation (Aram & Levin, 2001, 2004) and Chinese word mediation (Lin et al., 2009). That is, we expected that a more fine-grained quality of maternal Pinyin mediation would be positively associated with literacy acquisition in Chinese.

A particularly important question in the present study was whether maternal mediation of Pinyin writing would explain unique variance in literacy acquisition in Chinese with various measures of phonological awareness statistically controlled. Among young Mainland Chinese children, syllable awareness, tone awareness, and phoneme onset awareness have demonstrated unique associations with concurrent word recognition (e.g., Shu et al., 2008). Thus, we sought to determine whether maternal mediation of Pinyin learning would account for additional variance in children's own word reading and writing beyond these phonological awareness skills at time 1. At time 2, the correlations of Pinyin mediation to word reading and word writing 1 year later were further explored.

## Time 1

### Method

#### *Participants*

A total of 43 Chinese children (21 girls and 22 boys) from the third year of a single kindergarten (in China, kindergarten lasts 3 years, from ages 3–4 in year one to ages 5–6 in year three) and their mothers participated in the present study. The children had a mean age of 6.17 years (SD = 0.34). All children and their mothers were native Mandarin speakers from Beijing; 47% participants came from families in which the family monthly income ranged from 6,000 to 12,000 RMB (about

879–1758 USD); the average monthly family income of the 43 participants was about 10,000 RMB.[1] This monthly income indicates that these families were generally in the upper middle class range of income-earners in China.

*Measures*

*Maternal Pinyin mediation* Six two-character words as shown in Appendix 1 were presented as pictures in a fixed order to mothers. Following Aram and Levin (2001), mothers were then told to help their children to write the Pinyin of each word "as they saw fit", without any further instructions. We did this to allow for any typical strategies to emerge in these mothers. We wanted to maximize variability in approaches by the mothers. These words were orally labeled by the experimenter when they were introduced on picture cards, but they were not labeled using print in any form (either in Chinese characters or in Pinyin). These six words were selected to be orally familiar to children but unfamiliar as written characters or in Pinyin form. These words were chosen to cover commonly used letters and at the same time to maximize opportunities for different comparisons, such as onset, rime, or lexical tone. For example, a mother could compare 蜻 (*qīng*) and 蜓 (*tíng*) by saying that they have the same rime (i.e., *ing*) but different onsets and lexical tones.

*Chinese word reading* This task included 100 Chinese characters, ranging from high frequency to low frequency. Children were asked to read aloud the Chinese characters one by one, and testing stopped when children failed to recognize 10 consecutive characters, a ceiling determined by relative difficulty levels of the characters, as shown in previous work (e.g., McBride-Chang, Cho, Liu, et al., 2005). One point was given when children pronounced the character correctly; 0 points were allotted for an incorrect response.

*Chinese word writing* Children were asked to write 10 words (3 single-character words and 7 two-character words) as shown in Appendix 2. All the selected words were orally familiar to children, and the experimenter initially dictated the word twice loudly in Mandarin for each. Throughout the task, children were encouraged to do their best to write down the characters they thought were correct. One mark was given for a correctly written character and the total score of this task was 17 points.

*Syllable deletion* In this task, a three-syllable phrase in Mandarin was orally presented by an experimenter, and children were asked to delete one of the syllables and say aloud the new phrase. For example, *dà mén kǒu* would become *dà kǒu* after deleting the second syllable. There were 16 items consisting of six initial, six medial, and four final syllables deletions. This task has been used in past research

[1] Family incoming level was measured on an 11-point scale: 1 = 3,000 or below, 2 = 3,001–6,000, 3 = 6,000–9,000, 4 = 9,001–12,000, 5 = 12,001–15,000, 6 = 15,001–18,000, 7 = 18,001–21,000, 8 = 21,001–24,000, 9 = 24,001–27,000, 10 = 27,001–30,000, and 11 = 30,001 or above.

among both Mainland Chinese children (McBride-Chang et al., 2005) and Hong Kong children (McBride-Chang & Ho, 2000; McBride-Chang & Kail, 2002).

*Phoneme deletion* This task was similar in format to syllable deletion, as mentioned above. However, each item consisted of one single-syllable word only. Thus, in this task, children were asked orally to delete a phoneme either from the initial or final position of the word. For example, *tōu* without the initial phoneme would be *ōu*. There were 15 real-word items in total with 10 items requiring initial phoneme deletion and 5 items requiring final phoneme deletion. A similar task was used in the study of McBride-Chang et al. (2008).

*Tone awareness* This task was close to the tone awareness task used by Chen, Anderson, Li, Hao, Wu, and Shu (2004). An experimenter said aloud three 1-syllable words. Of these, one word's lexical tone was different from that of the other two. Children were asked to select the word with the different tone from among these. For example, among the three words, *kuí, bó*, and *bān, bān* has a different tone and thus is the "odd one out." For each trial, the experimenter repeated the three words in order twice. There were a total of 24 items in this task, with 12 real words and 12 nonsense words. One mark was given for a correct answer.

*Non-verbal IQ* Sets A and B from Raven's Standard Progressive Matrices (Raven, Court, & Raven, 1996) were administered to measure children's non-verbal reasoning. There were 24 items for a maximum score of 24 points.

*Mothers' education and age* Information about mothers' educational levels and age was also collected. Mothers' education levels were measured on a 7-point scale: 1 = third grade or below, 2 = fourth grade to sixth grade, 3 = middle school, 4 = high school, 5 = college school, 6 = university, 7 = postgraduate.

### *Procedure*

The testing procedure consisted of two sessions. The first session included all literacy-related tasks independently completed by children, who were tested at school. The second session involved the mother-child Pinyin mediation task and took place at home. School testing typically lasted approximately 30 min with the measures of word reading, word writing, syllable deletion, phoneme deletion, and tone awareness given in this fixed order. At home, the entire Pinyin mediation process (typically lasting approximately 25 min) was videotaped and later coded by two trained coders who were blind to the study hypotheses and children's performances on literacy tests. Information about children's ages, mothers' ages and education levels were also collected at home following the Pinyin mediation videotaping.

The Pinyin mediation coding scheme as shown in Appendix 3 was developed with the principle, following Aram and Levin (2001, 2004), that unanalyzed and surface level attention to units are less informative to children than are analytic and

detailed unit analyses. Because of the unique characteristics of Chinese Pinyin, the written word segments were coded on four different dimensions (i.e., onset, rime, tone, and integration). Onset was scored as 0 or 1, indicating whether or not mothers mentioned the onset phoneme. Rime was coded on a 4-point scale (0–3) from no mention of rime (0 point) to a focus on the entire rime but no segments (e.g., 1 point for a mother who uttered *ua* for the Pinyin of *guā*) to segmenting part of the phoneme in the rime (e.g., 2 points for a mother who uttered *a* in the Pinyin of *guā*) to segmenting each phoneme in the rime (e.g., 3 points for a mother who pronounced both the *u* and *a* in the Pinyin pronunciation for *guā*). However, it should be noted that across all of our 12 Pinyin items, rimes in some syllables were composed of a single phoneme, such as z*i*, *wā* and *bo*. Thus, when a mother mediated the rime of these segments, we directly scored each based on the single phoneme utterance only (3 points). Tone was coded as 0, 1, or 2 points for no mediation on tone, retrieving the tone, or both retrieving the tone and indicating the tone position, respectively. A mother saying that the high-level tone should be marked on *a* rather than *u* of the Pinyin *guā* would be an example of tone position indication**.** Integration was coded in two categories of explanation and comparison. In the explanation category (integration_1 in Appendix 3), we coded 0 for any instance of no utterance of the whole Pinyin sound, 1 for an utterance of the whole Pinyin sound only, and 2 for an utterance of the onset, rime and tone, each separately, as well as connecting them together (for example, a mother said *g-u-ā-guā*). In the integrated comparison category, we allotted points similarly. In this scheme, a 0 was allotted for no utterance of the whole Pinyin sound, 1 point was allotted for a broad comparison of the target Pinyin sound with another (for example, a mother said "listen, *qīng* and *tíng* are different"), and 2 points were given for a specific comparison of onset, rime or tone (for example, *qīng* and *tíng* have the same rime, *ing*).

The highest score of each mediated Pinyin word was 10 points. Across the sample, 23% (10 cases) of the videotapes were double-coded and demonstrated a good inter-rater reliability intra-class correlation (ICC) = .87.

## Results

Table 1 shows the means, standard deviations, ranges, and reliabilities across all the variables included in Time 1. The means and standard deviations generally suggested relatively normal distributions of all the variables with two exceptions: One child was considered an outlier because of an extremely high reading score; thus, data from this child were not included in subsequent analyses. In addition, for the phoneme deletion task, for which the mean was only 1.59 out of 15, with a standard deviation of 3.70, 74% participants scored zero on this task. Thus the phoneme deletion task was excluded in further analyses, because of the floor effect. The maternal education level (mean = 6.17 out of 7) reflected the fact that our participants were from families with relatively high educational attainment. Internal consistency reliabilities of all variables were above .78.

**Table 1** Means, standard deviations, range, and reliability for all variables from study 1 ($N = 42$)

| Variables | Mean | SD | Range | Cronbach's Alpha |
|---|---|---|---|---|
| Chinese word reading (100) | 26.25 | 21.00 | 2–77 | .99 |
| Chinese word writing (17) | 4.31 | 2.30 | 0–10 | .78 |
| Syllable deletion (16) | 13.67 | 3.26 | 1–16 | .87 |
| Phoneme deletion (15) | 1.59 | 3.70 | 0–15 | .96 |
| Tone awareness (24) | 11.17 | 6.12 | 0–24 | .90 |
| Pinyin mediation (10) | 4.78 | 1.37 | 2.25–7.25 | – |
| Non-verbal IQ (24) | 16.02 | 4.02 | 6–24 | .80 |
| Child's age (years) | 6.17 | 0.33 | 5.69–7.41 | – |
| Mother's age (years) | 36.95 | 3.61 | 31.83–48.50 | – |
| Mother's education (7) | 6.17 | 0.76 | 4–7 | – |

We also explored the variability in the ratings for each segment separately in order to ensure that the mediation scale items appeared to work well. These are shown in Table 2. For every syllable tested, there was sufficient variability in mothers' approaches, as indicated by means, standard deviations, and ranges.

Correlations among all variables are shown in Table 3. From the correlation matrix, one can see that Pinyin mediation was significantly correlated with Chinese word reading and tone awareness, but not with Chinese word writing or syllable awareness. Chinese word reading was highly correlated with word writing, and moderately associated with syllable deletion. Interestingly, a relatively high correlation was also found between Chinese word writing and tone awareness.

Hierarchical regression analyses were then conducted to further examine the unique association of Pinyin mediation to both Chinese word reading and writing. Admittedly, the sample size for these regression analyses was very small. Thus, part correlations ($sr^2$) are included in Table 4, which also shows the regression analyses, in order to demonstrate the unique association of the Pinyin mediation variable to

**Table 2** Scores of Pinyin mediation for each individual character/syllable

| Character | Mean | SD | Range |
|---|---|---|---|
| Huáng 黄 | 5.52 | 2.18 | 1–10 |
| Guā 瓜 | 6.19 | 1.85 | 1–10 |
| Qié 茄 | 4.86 | 1.59 | 2–10 |
| Zi子 | 3.81 | 2.31 | 1–10 |
| Qīng 青 | 4.33 | 1.83 | 1–8 |
| Wā 蛙 | 5.00 | 2.10 | 1–8 |
| Xuě 雪 | 4.57 | 1.80 | 1–8 |
| Jiā 茄 | 5.81 | 1.86 | 1–9 |
| Qīng 蜻 | 4.12 | 2.07 | 1–9 |
| Ting 蜓 | 4.21 | 2.10 | 1–9 |
| Luó 萝 | 4.81 | 2.20 | 1–10 |
| Bo卜 | 4.12 | 2.48 | 1–9 |

**Table 3** Correlations among all variables in study 1 ($N = 42$)

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1. Chinese word reading | – | | | | | | | |
| 2. Chinese word writing | .48** | – | | | | | | |
| 3. Syllable deletion | .29 | .23 | – | | | | | |
| 4. Tone awareness | .17 | .32* | .23 | – | | | | |
| 5. Pinyin mediation | .41** | .18 | .16 | .32* | – | | | |
| 6. Non-verbal IQ | .34* | .31* | .37* | .14 | .22 | – | | |
| 7. Child's age | .53*** | .39* | −.04 | .24 | .17 | .18 | – | |
| 8. Mother's age | −.05 | −.06 | −.30 | .15 | .16 | −.21 | .30 | – |
| 9. Mother's education | .19 | .07 | .11 | .04 | .14 | .08 | .04 | .11 |

* $p < .05$; ** $p < .01$; *** $p < .001$

**Table 4** Hierarchical regression explaining Chinese word reading and Chinese word writing in time 1 ($N = 42$) from Pinyin mediation with other variables controlled

| Step | Variables | Chinese word reading | | | | | Chinese word writing | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Beta | $t$ | $R^2$ | $\Delta R^2$ | $sr^2$ | Beta | $t$ | $R^2$ | $\Delta R^2$ | $sr^2$ |
| 1. | Non-verbal IQ | .11 | .85 | .40 | .40** | .10 | .18 | 1.12 | .23 | .23* | .16 |
| | Child's age | .53 | 4.09*** | | | .49 | .39 | 2.48* | | | .36 |
| | Mother's age | −.26 | −1.92 | | | −.23 | −.16 | −1.01 | | | −.15 |
| | Mother's edu. | .15 | 1.25 | | | .15 | .04 | .30 | | | .04 |
| 2. | Pinyin mediation | .32 | 2.53* | .49 | .09* | .30 | .10 | .61 | .24 | .01 | .09 |
| 1. | Non-verbal IQ | .07 | .49 | .43 | .43** | .06 | .04 | .22 | .28 | .28$^+$ | .12 |
| | Child's age | .55 | 4.17*** | | | .50 | .40 | 2.41* | | | .33 |
| | Mother's age | −.20 | −1.46 | | | −.17 | −.21 | −1.22 | | | −.13 |
| | Mother's edu. | .13 | 1.07 | | | .13 | .09 | .58 | | | .04 |
| | Syllable deletion | .18 | 1.29 | | | .15 | .09 | .53 | | | .08 |
| | Tone awareness | −.09 | −.66 | | | −.08 | .21 | 1.23 | | | .19 |
| 2. | Pinyin mediation | .32 | 2.42* | .52 | .08* | .29 | .08 | .47 | .28 | .001 | .02 |

$^+$ $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

word reading and word writing with other variables included. Pinyin mediation contributed 9% unique variance in explaining Chinese word reading with children's age, non-verbal IQ, maternal age, and maternal educational levels statistically controlled, and emerged as a strong correlate ($sr^2 = .30$) across final beta weights ($t = 2.53$, $p < .05$), as shown in the top half of Table 4. Moreover, even with syllable deletion and tone awareness further controlled, in the lower part of Table 4, Pinyin mediation still explained 8% unique variance in word reading ($t = 2.42$, $p < .05$), and the part correlation was $sr^2 = .29$. However, only 1% (with demographics and non-verbal IQ controlled) and 0.1% (with syllable deletion and tone awareness further controlled) unique variance, respectively, in word writing were explained by Pinyin mediation. These results suggest that analytic and detailed

Pinyin mediation may facilitate very early Chinese reading but not necessarily Chinese writing, which was close to floor (mean = 4.31 out of 17, SD = 2.30) in these very young children, probably because of lack of training in word writing.

## Time 2: Follow-up

To further explore the relationship between Pinyin maternal mediation and Chinese word reading and writing, 22 out of the original 43 participants were tested again 1 year later on the Chinese word reading and Chinese word writing tasks only. Only half of these participants' families agreed to this follow-up testing for reasons of convenience and fear of the spread of H1N1, an influenza of particular concern to parents and school officials in 2009. We compared the group of participants who agreed to follow-up testing with those who did not agree to this follow-up testing on all demographic and cognitive/literacy variables at time 1 and found that the groups did not differ on any of these measures. However, our statistical power for these analyses was limited.

### Method

#### *Participants*

The 22 children who participated at Time 1 consisted of 10 boys and 12 girls. The mean age of these 22 children at Time 1 was 6.18 years (SD = .38).

#### *Measures*

*Chinese word reading and Chinese word writing* At time 2, the reading and writing tasks administered to the children were different from those given at time 1 because we sought to make the tasks more difficult to increase variability. The time 2 Chinese word reading task included 150 Chinese single-character words and 150 two-character words. The items were presented in order of increasing levels of difficulty, based on evidence from previous studies (e.g., McBride-Chang et al., 2005). One point was allotted for each correctly read word. Thus, the possible maximum score on this task was 300.

The Chinese word writing task at time 2 included 5 single-character words and 15 two-character words. Because writing Chinese characters is a fairly independent process such that one could conceivably recall how to write one character but not the other within a single word, we scored this writing task by the individual character, rather than by the word. Thus, the maximum possible score for this task was 35. The internal consistency reliabilities for the Chinese word reading task and Chinese word writing task at time 2 were .99 and .63, respectively.

#### *Procedure*

The two literacy tasks were administered and scored by psychology graduate students at the children's own homes.

## Results

For the time 2 Chinese word reading task, the mean score was 132.8 (SD = 53.2; range = 55–252). For the time 2 Chinese word writing task, the mean score was 20.5 (SD = 3.2; range = 17–29). Compared to the relatively low mean of the children on Chinese word writing at time 1, the mean of the time 2 Chinese word writing measure was relatively high and showed adequate variability.

The correlations of the time 2 word reading and writing measures with the time 1 measures are shown in Table 5. Both Chinese word reading and writing at time 2 were highly or moderately correlated with Chinese word reading and writing in time 1. Pinyin mediation was significantly correlated with T2 Chinese word reading ($r = .43$) but not Chinese word writing ($r = .33$), though correlations for both were moderate. Time 2 Chinese word reading, but not time 2 Chinese word writing, was also significantly correlated with non-verbal IQ and children's age.

To specifically examine the effect of time 1 Pinyin mediation on time 2 Chinese word reading and word writing, hierarchical regression analyses were conducted. The regression results are shown in Table 6. Pinyin mediation contributed 7% unique variance in predicting Chinese word reading and 6% for Chinese word writing, with children's age and IQ statistically controlled. The small sample rendered these associations nonsignificant, however. When time 1 autoregressive effects of Chinese word reading or word writing were further statistically controlled in the analyses, the contribution of Pinyin mediation to time 2 Chinese word reading was only 0.1%, and the contribution of Pinyin to time 2 Chinese word writing was only 2%, as shown in Table 7. Again, these changes were not statistically significant.

## Discussion

Given the importance of maternal guidance for children's reading and writing in China (e.g., Li & Rao, 2000), in the present study, the role of maternal mediation of Pinyin for Chinese children's reading and writing development was examined. The importance of Pinyin maternal mediation for Chinese reading development, but not word writing, was clear from the results at time 1. Pinyin maternal mediation also contributed unique variance to both word reading and writing at time 2, but these associations were not significant.

At time 1, the association of Pinyin mediation to Chinese word reading was particularly striking, even with the measures of phonological awareness and other demographic variables statistically controlled. Furthermore, Pinyin mediation still (marginally—$p < .10$) explained Chinese word reading 1 year later in a smaller sample, suggesting some longer-term effects of early mother-child attention to Pinyin for subsequent Chinese reading development. More analytically-focused Pinyin mediation, defined here as a detailed scaffolding approach to teaching literacy, may be important for cultivating Chinese children's reading skills.

Many of these children, when they were involved in the Pinyin mediation task, had not learned Pinyin formally in the classroom previously but had had informal

**Table 5** Correlations of T2 word reading and writing with all T1 measures ($N = 22$)

| | T1 reading | T1 writing | Pinyin mediation | Syllable deletion | Tone awareness | Non-verbal IQ | Child's age | Mother's age | Mother's education | T2 reading |
|---|---|---|---|---|---|---|---|---|---|---|
| T2 reading | .86*** | .65** | .43* | .27 | .23 | .51* | .56** | −.32 | −.06 | – |
| T2 writing | .49* | .67** | .33 | .25 | −.16 | .25 | .32 | −.13 | −.11 | .59** |

* $p < .05$; ** $p < .01$; *** $p < .001$

**Table 6** Hierarchical regression explaining time 2 Chinese word reading and Chinese word writing from Pinyin mediation with mother's age, education, children's non-verbal IQ, and age controlled ($N = 22$)

| Step | Variables | Chinese word reading | | | | | Chinese word writing | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Beta | $t$ | $R^2$ | $\Delta R^2$ | $sr^2$ | Beta | $t$ | $R^2$ | $\Delta R^2$ | $sr^2$ |
| 1. | Non-verbal IQ | .38 | 2.38* | .54 | .54** | .35 | .13 | .60 | .16 | .16 | .13 |
| | Child's age | .53 | 3.95** | | | .53 | .31 | 1.48 | | | .31 |
| 2. | Pinyin mediation | .28 | $1.77^{+}$ | .61 | $.07^{+}$ | .26 | .27 | 1.22 | .22 | .06 | .25 |

$^{+}$ $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

**Table 7** Hierarchical regression explaining time 2 Chinese word reading and Chinese word writing from Pinyin mediation with mother's age, education, children's non-verbal IQ, age, and time 1 Chinese word reading and Chinese word writing controlled ($N = 22$)

| Step | Variables | Chinese word reading | | | | | Chinese word writing | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Beta | $t$ | $R^2$ | $\Delta R^2$ | $sr^2$ | Beta | $t$ | $R^2$ | $\Delta R^2$ | $sr^2$ |
| 1. | Non-verbal IQ | .23 | 1.94 | .54 | .54** | .21 | −.06 | −.30 | .16 | .16 | −.05 |
| | Child's age | .20 | 1.52 | | | .16 | .12 | .64 | | | .11 |
| 2. | T1 Chinese word reading/ writing | .65 | 4.15** | .805 | .26*** | .44 | .60 | 2.84* | .45 | .30** | .50 |
| 3. | Pinyin mediation | .04 | .29 | .806 | .001 | .03 | .15 | .08 | .47 | .02 | .14 |

$^{+}$ $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

experiences at home and in multiple environments where they saw Pinyin used. Pinyin skills could conceivably directly increase the possibility of learning Chinese characters because of some of the correspondences between Pinyin and Chinese characters in children's readings. However, perhaps more important, Pinyin strongly clarifies the phonological makeup of the given word or character. This system makes explicit onsets, rimes, and tonal information. Access to such a complete phonological representation of a given word likely facilitates early reading across languages (Perfetti & Tan, 1998; Perfetti, Zhang, & Berent, 1992). A similar argument has been made by Lin et al. (2010), who found that invented spelling of Pinyin in 5-year-old children predicted these children's Chinese word reading 1 year later, even controlling for Chinese word reading skills at age 5.

In the present study, Chinese word writing was found to be more weakly associated with Pinyin mediation. One reason for this finding may be that Pinyin mediation focuses on letter/phoneme segments, while Chinese writing requires a stronger focus on exact strokes, components, and their spatial orders within each character, a very different process that requires concentrated practice (Tan, Spinks, Eden, Perfetti, & Siok, 2005). Moreover, at a more practical level, it is possible that the difficulty level of the writing task may influence the association. At time 1, for example, over one third of the children could produce 3 or fewer Chinese characters out of 17, indicating that the task was relatively difficult for this age group. At time 2, another version of the writing task was used, and the performance of the participants was relatively better (all 22 children got 17 or more points out of 35).

The correlation between Pinyin mediation and Chinese word writing at time 2 was actually higher (though not statistically significant) at time 2 ($r = .33$) than at time 1 ($r = .25$), suggesting that there may be a weak link between maternal mediation of Pinyin and word writing. However, our sample size was too small to examine this association in detail over time. In addition, the internal consistency reliability of our word-writing measure at time 2 was lower than .7, perhaps one reason that the writing measure was less strongly correlated with the Pinyin mediation measure than was the reading measure, even at time 2. At the same time, however, Pinyin mediation still contributed 2% and 6% unique variance in predicting T1 word writing and T2 word writing, respectively, suggesting some association between children's Pinyin practice and writing development, though again, these associations were not statistically significant. By their very nature, early literacy skills occur quickly in development, and, consequently, the "developmental window" for measuring these is short (e.g., Paris, 2005). Pinyin mastery itself might be one such early literacy skill. Indeed, most children master the Pinyin system in school within about 12 weeks (Cheung & Ng, 2003). Thus, the maternal mediation "window" for Pinyin is also likely to be short.

Interestingly, at both testing times, children's age and nonverbal reasoning scores (as a proxy for nonverbal IQ) were significantly correlated with Chinese word reading as well. These should be explored in future work. Both of these demographics variables may be important particularly because they might influence maternal mediation of Pinyin, with mothers directing more advanced, analytic strategies to children who have a better understanding of word or character structures (e.g., Lin et al., 2009). Chinese mothers tend to scaffold their children's early literacy learning, focusing on the strategies they think are of greatest help in fostering children's understanding (e.g., Lin et al., 2009).

In addition to these important demographic variables, there are a number of limitations of the present research to consider for future work. First, the self-developed maternal Pinyin mediation scale was first used in the present study. Although the scale showed fairly good internal consistency reliability and intra-rater reliability, future studies are needed to validate the utility of this scale for understanding literacy skills further. Second, at time 2, only 22 of 43 children were tested on the Chinese word reading and word writing tasks, for a variety of reasons beyond our control. It is possible that the effect sizes reported here might have been influenced by this small sample size. Replicating this study on larger samples is important to consider for future work. Such future work, in addition to including a larger overall sample, might also examine the performance of high achievers and low achievers separately. It is possible that maternal mediation of Pinyin might have different effects on these two groups separately over time. However, it was not possible to test for any such learning differences in this study given our relatively small sample size at time 2.

Despite these imitations, however, the present study expands our understanding of Chinese literacy acquisition by documenting actual Pinyin scaffolding of mothers on their children. Although Pinyin is similar in some ways to alphabetic scripts in which maternal mediation has already been documented (e.g., Aram & Levin, 2001, 2004), it has features that distinguish it from alphabetic writing per se. In particular,

it is a literacy tool; its mastery does not by definition imply a mastery of Chinese word reading or writing. Thus, how mothers mediate learning of Pinyin is particularly interesting for understanding home literacy development in Chinese children. In addition, the focus on lexical tone in Pinyin writing, alongside the phonemic and rime features of the system, has not been previously explored in relation to maternal mediation for early literacy development. The present study adds to the growing body of work establishing the importance of early parent-child writing for literacy acquisition (e.g., Aram & Levin, 2001, 2004; Lin et al., 2009; Neumann, Hood, & Neumann, 2008) by demonstrating that such shared writing, when phonologically sensible, is important even when the writing is not writing of the actual orthography itself.

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## Appendix 1

See Table 8.

**Table 8** Chinese Pinyin presented in the mother-child joint writing task

| Order | Chinese Pinyin | Corresponding characters | English translation |
|---|---|---|---|
| 1 | huáng guā | 黄瓜 | Cucumber |
| 2 | qié zi | 茄子 | Eggplant |
| 3 | qīng wā | 青蛙 | Frog |
| 4 | xuě jiā | 雪茄 | Cigar |
| 5 | qīng tíng | 蜻蜓 | Dragonfly |
| 6 | luó bo | 萝卜 | Radish |

## Appendix 2

See Table 9.

**Table 9** Words presented in the writing task

| Order | Chinese characters | English translation |
|---|---|---|
| 1 | 口 | Mouth |
| 2 | 八 | Eight |
| 3 | 云 | Cloud |
| 4 | 王子 | Prince |
| 5 | 公主 | Princess |
| 6 | 手指 | Finger |
| 7 | 止血 | Stanching |
| 8 | 晴天 | Sunshine |

**Table 9** continued

| Order | Chinese characters | English translation |
|---|---|---|
| 9 | 眼睛 | Eye |
| 10 | 兰花 | Orchid |

## Appendix 3

See Table 10.

**Table 10** Pinyin mediation coding schema

| |
|---|
| a. *Onset* |
| 0. Mother does not mention onset phoneme or uses English letter instead |
| 1. Mother separates the onset phoneme |
| b. *Rime* |
| 0. Mother does not mention rime or uses English letter(s) instead |
| 1. Mother says the entry rime but not any phoneme in the rime |
| 2. Mother separates part of the phoneme(s) in the rime |
| 3. Mother separates each of the phoneme(s) in the rime |
| c. *Tone* |
| 0. Mother does not mediate tone |
| 1. Mother retrieves the tone |
| 2. Mother retrieves the tone and further points out the specific place the tone should be indicated |
| d. *Integration_1* |
| 0. Mother does not utter the whole pinyin sound |
| 1. Mother utters the whole pinyin sound |
| 2. Mother utters onset, rime and tone and connects them together |
| f. *Integration_2* |
| 0. Mother does not utter the whole pinyin sound |
| 1. Mother broadly compares the target pinyin to others |
| 2. Mother specifically compares onset, rime or tone to others |

There were 12 Pinyin words in the Pinyin mediation task, and coding was based on each Pinyin segment, such as huáng. The highest score of each Pinyin word mediation was ten points

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