Name Writing in Mandarin-Speaking Children

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Abstract

Name writing plays an important role in early literacy development. Most previous studies of name writing have examined learners of alphabetic writing systems. Analyzing data from two studies with young speakers of Mandarin Chinese, we found that two-year-olds did not produce names that were recognizable as such. Three-year-olds never wrote their names correctly, but Chinese adults performed significantly above the level of chance at judging the name as a name as opposed to a single-character word. Adults were also above chance at judging whether a production was that child's name as opposed to another child's name. Some four-year-olds wrote their names correctly, producing more correct renditions of the characters in their names than of non-name characters. Whereas learners of alphabetic writing systems generally learn to write their name starting with the first letter, the Chinese children were more influenced by the visual properties of a character than by the character's position in the name.

Keywords: names; writing; name writing; literacy development; Chinese

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Writing is an important cultural tool that is transmitted from one generation to the next. Children receive explicit instruction in the use of this tool starting around the age of six in many societies. However, children in literate societies are surrounded by writing from an early age, and they begin to learn about its properties well before formal teaching begins. The child's own name appears to play a leading role in the development of literacy (Ferreiro & Teberosky, 1982), as it does in the development of spoken language (Bortfeld, Morgan, Golinkoff, & Rathbun, 2005; Mandel, Jusczyk, & Pisoni, 1995). Testifying to the role of names in early literacy development, the ability of young English speakers to write their names correlates with other important pre-literacy skills, including phonological awareness and knowledge about letters (Badian, 1998; Drouin & Harmon, 2009; Justice, Invernizzi, Geller, & Sullivan, 2005; Molfese, Beswick, Molnar, & Jacobi-Vessels, 2006; Puranik & Lonigan, 2012; Welsch, Sullivan, & Justice, 2003). Early name writing also relates to later reading and spelling skills (Badian, 1998; Ferguson, 1975; Jorm, Share, Maclean, & Matthews, 1986; Riley, 1996). In one study, in fact, name writing ability as measured at the onset of formal reading instruction accounted for variance in reading performance 10 months later above and beyond that explained by knowledge of the alphabet (Riley, 1996).

Almost all previous studies of the development of name writing have been carried out with learners of alphabetic writing systems, English in many cases. In the present study, we examine name writing in two- to six-year-old learners of Mandarin Chinese. Studies with learners of Chinese and other languages can help us to overcome the Anglo-centric and alphabet-centric bias that characterizes much research on literacy and literacy development (Share, 2008). They can help us to learn which characteristics of development are tied to a particular language and culture and which may be universal.

For children in such countries as the U.S., the Netherlands, and Israel, learning to write the

name is a protracted process. It usually begins with the first letter of the child's personal name, or first name. Three- and four-year-olds may be able to write the first letter or two of their personal names, sometimes adding symbols that are not letters of their writing system or letters that do not belong to the name (Tolchinsky-Landsmann & Levin, 1985, for Israeli children; Puranik & Lonigan, 2011, and Welsch et al., 2003, for U.S. children). By the age of 5 or 6, according to these studies, children often write their entire personal name correctly. Children tend to be better at writing their personal name than at writing other words (Levin, Both-de Vries, Aram, & Bus, 2005 for Dutch and Israeli children) or the names of their classmates (Levin & Ehri, 2009 for Israeli children). In the countries that have been studied, personal names may vary rather substantially in the number of letters they contain. The length of a name is an important determinant of a child's ability to write it (Levin & Ehri, 2009). Parents and teachers of young children in the studied cultures generally focus on children's personal names, as opposed to family names, and learning to write the family name tends to lag behind (Hildreth, 1936). Children appear to use their personal names as models for the forms of other written words (Ferreiro & Teberosky, 1982). Thus, Jack may use *J* and other letters from his name when he writes other words, even other words that do not contain the same sounds (Bloodgood, 1999; Levin, Share, & Shatil, 1996; Treiman, Kessler, and Bourassa, 2001). In one study, indeed, about half of the letters that Dutch four-year-olds used when writing words other than their names were letters from their personal names (Both-de Vries & Bus, 2008). Further testifying to the effects of own-name knowledge, Jack tends to be more knowledgeable than Ken or Christopher about the letter *J* (e.g., Justice, Pence, Bowles, & Wiggins, 2006).

It is important to determine whether the characteristics of early name writing that have been documented in learners of alphabetic writing systems hold true for learners of other systems. In Chinese, the writing system of interest here, little work has been done on young children's

name writing. The only empirical studies that we could locate on the topic were a case study that touched on a child's writing of her name (Chan, Juan, & Foon, 2008) and a study in which Hong Kong three-, four-, and five-year-olds were asked to write their names and to draw self-portraits (Chan & Louie, 1992). Most of the three-year-olds in that study appeared to produce different sorts of products in the two tasks, for example using mainly vertical and horizontal lines for their names and more circles for their portraits. However, the three-year-olds did not usually produce identifiable Chinese characters when they wrote their names. Older children were more likely to use the correct characters and the correct number of characters. A limitation of the study is that the researchers provided little quantitative information and little statistical analysis.

To fill the gaps in our knowledge of name writing in Chinese children, we examined two sets of writing data from middle-class two- to six-year-old Mandarin speakers who attended kindergarten in Beijing. The first data set came from a study by Treiman and Yin (2011) in which children were asked to write their names and three single-character words and to draw pictures of the corresponding items. Treiman and Yin's primary interest was in the distinctions that children made between writing and drawing rather than in name writing itself. In the current Study 1, we carried out new analyses of the written productions collected by Treiman and Yin, examining the name productions in detail and comparing them to the children's productions of single-character words. We also collected and analyzed a new set of writing data from Chinese kindergartners. Study 2 used a larger number of single-character words than Study 1, providing a stronger basis for comparison between children's writing of names and of other items.

Before describing the specific issues that we investigated, we provide some background information about the literacy experiences of the children involved. Middle-class children in Beijing and other Chinese cities typically attend kindergarten starting when they are two or three years old, and elementary school begins around the age of seven. Formal literacy instruction is not

provided in kindergarten, but children have a good deal of exposure to their written names and to other characters during their kindergarten years. For example, children's full names are printed on their drinking cups, cots, kerchiefs, and so on, and posters showing common characters may appear on the walls of classrooms. Kindergarten teachers may write children's names on their art works and, as the children get older, encourage children to write their names themselves. However, kindergarten teachers do not provide formal instruction in writing. At home, middle-class Chinese parents may write young children's names for them and may teach children to write their names and some simple characters.

Our analyses were designed to shed light on both the child-level and item-level factors that are associated with early name writing in Chinese children. Age was the primary child-level factor that we investigated. We expected that younger Chinese children would produce versions of the name that were correct in some respects but not in others and that fully correct productions of the name would emerge during the later years of kindergarten. In studies of U.S. children, partial correctness has often been examined using scales that give children some credit for productions that include the correct first letter of the name and full credit for productions that include all of the correct letters (e.g., Drouin & Harmon, 2009; Molfese, Beswick, Molnar, & Jacobi-Vessels, 2006). Because we did not want to assume that Chinese children learn to write the units of their names from beginning to end, we examined partial correctness through an experiment, which we call the experiment on the recognizability of the name as the intended name. In this experiment, Chinese adults saw a child's rendition of his or her name together with the correct form of that child's name and the correct form of another name. They were asked to guess which name the child had intended to write. The adults' performance on this forced-choice task would exceed the level expected by random guessing, 50%, if children's productions were at least somewhat recognizable. We asked whether the adults performed significantly above the level expected by chance with the

productions of children of different ages and, if so, by how much.

Another characteristic of a child that may be associated with early name writing performance, in addition to the child's age, is the child's sex. Some researchers have reported that school-aged girls are superior to boys in speed and accuracy of written production (Berninger & Fuller, 1992, for U.S. children; Tseng & Hsueh, 1997, for Taiwanese children). Sex differences have been largely ignored in studies of early name writing, but one study of U.S. 4- to 5-year-olds reported a small superiority for girls (Justice et al., 2005). Another study that addressed this issue found only a nonsignificant trend in this direction, however (Haney, Bissonnette, & Behnken, 2003). We asked in the present study whether young Chinese boys and girls differed in various aspects of name writing, including the recognizability of the name as the intended name and conventional correctness.

We were interested in item-level factors as well as child-level ones, and so we investigated how certain visual properties of Chinese characters influence children's name writing performance. Many Chinese characters are more complex than the letters of the Latin and Hebrew scripts that have featured in most previous studies of name writing. Indeed, the average number of strokes (individual units such as 丶) in the characters taught in Chinese elementary schools is 9.5 (Shu, Chen, Anderson, Wu, & Xuan, 2003). We asked whether Chinese children's ability to write the characters in their names varied with the stroke count of the characters. Symmetry is another visual characteristic of Chinese characters, in addition to stroke count, that may affect children's performance. Learners of the Latin alphabet perform better on writing and copying tasks with symmetrical letter forms, such as H, than with asymmetrical forms, such as J (Treiman & Kessler, 2011). Chan and Louie (1992) mentioned that Chinese children tended to start with symmetrical characters and characters with fewer strokes when learning to write their names, but they provided no details on these points. In the present analyses, therefore, we compared children's performance

on symmetrical and asymmetrical characters.

The position of a letter in a written string is an important determinant of performance by learners of alphabetic writing systems. Thus, learners of English tend to be more knowledgeable about the leftmost letter of a word than about the middle letters, both with their own personal names (Treiman, Cohen, Mulqueeny, Kessler, & Schechtman, 2007) and with words in general (Treiman, 1993). Learners of Hebrew tend to be most knowledgeable about the rightmost letter (Levin & Ehri, 2009), given that Hebrew is written from right to left. When learning to write their personal names, children who are exposed to these writing systems tend to produce versions in which the first letter is correct before they produce versions with later letters correct. In China, the written name that children see is usually their full name: both the family name and the personal name. For example, a Chinese adult who writes a child's name on her artwork would normally write the full name. In the kindergarten where we tested, children are generally addressed in speech by their full names as well. The majority of Chinese family names are a single character and most personal names are two characters, meaning that many full Chinese names contain three characters. The family name is normally written first, on the left, and the personal name to its right. If the position of a character in the name has similar effects on Chinese children as on Western children, Chinese children should write their family name, which is first in the written name, better than their personal name. This issue has not previously been investigated, and the position of a character in the child's name was one of the item-related factors that we examined.

The final item-related issue that we investigated was how children's writing of their names compares to their writing of other words. Young learners of alphabetic writing systems tend to be better at writing their personal names than at writing other words or other names (e.g., Levin et al., 2005; Levin & Ehri, 2009). We asked whether Chinese children, too, would show higher levels of conventional correctness for characters from their own names than for other characters. Chan and

Louie (1992) could not address this question in their study of Chinese children because they did not ask children to write words other than their names.

In addition to comparing productions of names and single-character words on conventional correctness, we compared the two types of productions on other features. These comparisons were motivated by the fact that correctly written full names in Chinese, such as 吴培恩, are more complex than the single characters that are used to write monosyllabic words. The names are composed of more separate units, in many cases three, and they are spread along a line rather than occupying a roughly square-shaped space as a single character does. Chinese differs in this respect from many other written languages, in which names look quite similar to other words. The study of Chinese thus provides an opportunity to ask whether young children notice and attempt to reproduce salient visual distinctions within the domain of writing. To address this issue, we compared children's productions of their names to their productions of single-character words in visual complexity, the degree to which the productions were segmented into units, and squarishness. In addition, we carried out an experiment, which we call the experiment on the recognizability of names as names, to determine whether Chinese adults could reliably classify children's productions as names or single-character words.

As mentioned earlier, learners of the Latin and Hebrew alphabets sometimes use letters from their names when writing other words, even when these letters are incorrect (Bloodgood, 1999; Both-de Vries & Bus, 2008; Levin et al., 1996; Treiman et al., 2001). In comparing children's writing of single-character words to their writing of their names, we asked whether Chinese children do the same. Consider a child whose name contains the character 恩 and who knows how to write this character. Might this child use this character, or a form similar to it, when trying to write a single-character word? Such an outcome would suggest that the name serves as a model for other words in Chinese children, as it appears to do in Western children (Ferreiro &

Teberosky, 1982). We carried out an experiment with Chinese adults to gather information about the similarity between children's productions of single-character words and the characters in their names.

To summarize, we analyzed the name writing of young speakers of Mandarin Chinese and compared it to their writing of single-character words. The analyses, which were based on experiments with Chinese adults as well as measurements of the characteristics of the children's productions, were designed to examine the child-level and item-level factors that are associated with name writing performance. Some of the analyses also allowed us to compare children's writing of their names to their writing of single-character words. Our overall goal was to shed light on name writing by young Chinese children and to examine how it is similar to and different from name writing by children from other cultures.

Method

Collection of Children's Writings

The data came from two studies in which Chinese children were asked to write their names and several single-character words.

Study 1.

Participants. The participants attended a large government-supported kindergarten in a middle-class area of Beijing. They ranged in age from 2;0 (years;months) to 6;8. The kindergarten had six classes for each year group, each with about 30 children. All classes for each year group followed similar activities according to governmental guidelines for preschool education. The children in Study 1 were from two of the classes for each year group. A total of 109 children participated, including 23 two-year-olds, 21 three-year-olds, 21 four-year-olds, 22 five-year-olds, and 22 six-year-olds. Ninety of the children (21 two-year-olds, 18 three-year-olds, 13 four-year-olds, 18 five-year-olds, and 20 six-year-olds; 42 girls, 48 boys) attempted to write their name and

at least one single-character word in the writing task. Because many of our analyses compared children's writing of their name to their writing of single-character words, we restricted our analyses to these 90 children, all but eight of whom had three characters in their full names. On average, there were 7 strokes in the family name, 8 strokes in the first character of the personal name, and 9 strokes in the second character of the personal name. The characters had as few as 1 stroke and as many as 20.

Procedure. In the writing task, the children were asked, individually, to write their own name and three monosyllabic single-character words with four strokes each: *huǒ* ('fire', 火), *rì* ('sun', 日), and *shuǐ* ('water', 水). According to a survey of eight teachers of two- and three-year-olds, these characters are among those most likely to be familiar to young children. Each character was presented in a phrase. For example, the experimenter would say, "Please write *shuǐ* ('water') as in *hē shuǐ* ('drink water')". The experimenter allowed the children to choose the order in which they would write the targets, presenting all four targets first and then asking after children had finished writing one character which character they wanted to write next. Several different types of paper (white, pink, yellow, and grid) were made available to the children, as well as several different implements (black pencil, black pen, and yellow, red, and blue crayons). The children were permitted to choose among these. Children were encouraged to write every item, but some children declined to do so.

Study 2.

Participants. This study was carried out at the same kindergarten as in Study 1 but during a different year. The participants ranged in age from 3;0 to 6;9 and were from two different classes for each year group. Two-year-olds were not included because the group-administered testing procedure and the relatively large number of items made the task challenging for children of this age. A total of 82 children, including 23 three-year-olds, 21 four-year-olds, 19 four-year-olds, and

19 six-year-olds, took part. We analyzed the data from those 64 children who attempted to write their own name and at least one other word (23 three-year-olds, 8 four-year-olds, 14 five-year-olds, and 19 six-year-olds; 30 girls, 34 boys). All but one of these children had three-character names. The average number of strokes was 7 for the family name, 8 for the first character of the personal name, and 9 for the second character of the personal name. The range was from 1 stroke to 19.

Procedure. The writing task was presented to children in groups of four. Each child was given a black pencil and a piece of white paper. Children were asked to write, in order, their name and the three single-character words used in Study 1 followed by four additional single-character words: *nǐ* (‘you’, 你), *xīng* (‘star’, 星), *tián* (‘field’, 田), and *tiān* (‘sky’, 天). These characters contain 7, 9, 5, and 4 strokes, respectively, and they were judged by the teachers in the aforementioned survey as being among the most familiar characters for young children. The experimenter pronounced each item and used it in a simple phrase, making sure that all children had finished one item before proceeding to the next one.

Analyses of Children’s Writings

The productions from each study, samples of which are shown in Fig. 1, were examined in various ways. We scored the children’s productions as correct or incorrect, and we went beyond analyses of correctness by measuring various aspects of the productions and by carrying out experiments with Chinese adults. We describe the procedures for each analysis and experiment in what follows.

Correctness of names and single-character words. Two judges scored each character of each child’s written name and each single-character word as conventionally correct or incorrect. The judges for this and the other characteristics to be described were Chinese university students or graduates who expressed interest in the research but who did not know about the children involved in the studies or about their writing. Judges were told to score a character as correct if it

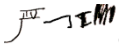
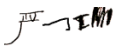
contained all of the required strokes, even if a stroke was shakily drawn, and if the strokes were in the correct positions. When the judges disagreed about the scoring of this or any other variable, a third judge was involved and the disagreement was resolved through discussion. The Cohen's kappa values for the scoring of correctness were .95 for Study 1 and .96 for Study 2 ($p < .001$ for both).

One of the item-related variables of interest was the symmetry of a character. We asked two judges to score a character as symmetrical if it was vertically symmetrical, horizontally symmetrical, or both. For example, 林 ('wood') is a symmetrical character. The kappa values for the scoring of symmetry were .94 for the characters involved in Study 1 and .95 for those in Study 2 ($p < .001$ for both).

Recognizability of names as intended names. An experiment was carried out with Chinese adults to provide objective data on the extent to which each written name was visually recognizable as the intended name. We tested the recognizability of the full names because, with younger children, it was not always clear which parts of a production were meant as which characters of the name. The participants in this and the other experiments to be described were Chinese university students who were interested in the research topic but who were not familiar with the children involved or their writing. Each participant was tested individually. After a brief introduction to the writing tasks that the children had performed, the experimenter showed the adult the name produced by a given child, rendered in black on a 210 mm × 297 mm sheet of white paper. The adult was shown two correctly written full names printed in a standard Chinese font on another sheet of white paper. One was correct version of that child's name. The other was chosen randomly from a large set of names (those of other children in the study or other children at the kindergarten who did not participate in the study) that had the same number of characters as the correct name. Different wrong answers were used for a particular name for each adult

participant. The position of the correct answer (left or right on the answer sheet) was randomized for each adult participant, as was the order in which the productions of different children were presented. The experimenter explained that the child had attempted to write his or her own name and that the child's correct name was one of the two choices. The adults were asked to choose the correct version as best they could; the spoken version of the child's name was not presented to them. The adults were given time to study the child's production and the answer sheet, rotating them as they wished. They then indicated which name they thought was the one the child had tried to produce. The adults were told whether each of their answers was correct or incorrect. To maintain their motivation, the participants were told that they would receive special recognition if they performed well. Each production was seen by 16 adult participants. Different groups of adult participants were recruited for the productions from Study 1 and Study 2.

Recognizability of names as names. To assess the extent to which the children's written names were recognizable as names, as opposed to single-character words, we carried out another experiment with Chinese adults. After briefly introducing the writing task that the children had performed, the experimenter showed the adult all but one of the single-character words as written by a given child. These served as the practice items for the adult participant for that child. One pair consisting of the child's production of his or her name and the child's production of one of the single-character words served as the mystery pair. Several different potential mystery pairs were typically available for a given child because the child wrote more than one single-character word. In these cases, pairs were formed from the name and each of the single-character words, and approximately the same number of adult participants was assigned to each pair. The adults knew the set of characters that the children had been asked to write but they were not told what each character by each child was intended to be. The adults were asked to study the practice items and to choose the production from the mystery pair that the child intended as his or her name. For

example, one child in Study 1 wrote his name as  and produced  for ‘sun’,  for ‘fire’, and  for ‘water’. The experimenter first showed the adult the practice items, for example  and  . The experimenter then showed the adult  and  and asked the adult to choose the item that the child intended as his name. The adults received feedback regarding the correctness of each judgment. The order of presentation of different children’s productions and the order of the practice items from a given child were randomized differently for each adult participant. The participants, who were tested individually, were told that the top scorers would receive special recognition. The productions were rendered in black on 210 mm × 297 mm sheets of white paper. Sixteen adults worked with the productions of Study 1 and another 16 with the productions of Study 2. None had participated in the experiment on the recognizability of names as intended names.

Characteristics of names as compared to single-character words. As described earlier, Chinese names have several visual characteristics that differentiate them from single-character words. They are more complex, they are segmented into units (often three), and they are less square. To determine whether children’s productions of their names were more complex and formed of more separate units than their production of single-character words, judges were shown children’s productions arranged in pairs and mixed randomly across age groups, one pair at a time. Each pair of productions contained the name and one of the single-character words, chosen at random, that was produced by a given child. The intended meaning of the products was not revealed to the judges, although some products were written well enough to make their identity evident. One pair of judges rated complexity, being asked to determine which product in each pair was more visually complex. Another pair of judges rated segmentation, being asked to determine which product had more separate units. For example, judges would determine which of  (the name production by a boy of 3; 7) and  （the production of ‘you’ by the same boy) was more

complex and which one had more separate units. Different judges rated complexity and segmentation. The kappa values for complexity were a relatively low .69 and .76 for Studies 1 and 2, respectively ($p < .001$ for both). Caution is therefore required in interpreting results involving complexity. The kappa values for segmentation were higher, .92 and .87 ($p < .001$ for both).

The squarishness of each production was determined by asking two judges to find the smallest rectangle that included the entire production, using two rulers, and to calculate the ratio of the shorter side to the longer side. The intraclass correlation coefficient was .90 for Study 1 and .97 for Study 2 ($p < .001$ for both). The final score was the average of the two judges' measurements.

Use of known characters from names when writing single-character words. An analysis was carried out to determine whether children who could write at least one character in their name correctly used that character when writing single-character words. This analysis included data from the 12 children (mean age 5; 9), pooling across the two studies, who wrote some but not all of the characters in their name correctly and some but not all of the single-character words correctly. This subset of children is well suited for testing whether children sometimes use a character from their name in place of another character that they do not know how to write. Two judges determined whether each child produced each incorrect single-character word as a known character from the name and whether each incorrect name character was produced as a known single-character word. There were 26 cases of the former type and 27 of the latter type, and the kappa value was 1.00 ($p < .001$).

Similarity of single-character words to known name characters. A final experiment was carried out to determine whether children sometimes produced unknown single-character words using characters or components that were visually similar to those in their names. If so, then children's productions of single-character words should be rated as looking similar to their

productions of characters from their name. For this experiment, we used the pairs of name character and single-character productions that were described above. Sixteen Chinese adults were tested in small groups. They were shown sheets of 210 mm × 297 mm white paper with two pairs of productions on each sheet. The order of the pairs was randomized across the adults. The name was on the right in half the pairs and on the left in the other half. The adults were asked to judge the visual similarity of the two productions by circling a number from 1 (not at all similar) to 5 (identical). To ensure that participants would see some items that they would rate as highly similar, there were four filler pairs containing two handwritten versions of the same character (e.g., ) in addition to the critical experimental pairs.

Results

We used multilevel modeling for most of the analyses. This statistical technique is useful for examining, within a single analysis, how multiple characteristics of the children and of the items that they attempted to write are associated with performance. We used the software package lme4 (Bates, Maechler, & Bolker, 2011). For binary outcome variables, such as whether an item was written correctly or incorrectly, we selected a generalized mixed-effects model with a logit link function and used the *p* values calculated by this package. For continuous outcome variables, we used the languageR package (Baayen, 2011) to estimate *p* values using posterior distributions for the model parameters obtained by Markov chain Monte Carlo sampling. Further information about these procedures may be found in Baayen (2008).

Each multilevel analysis included child as a random factor. The fixed factors in most analyses included the age of the child (in months), the sex of the child, and the study (1 or 2). Study was included as a variable in order to determine whether the same basic results held across Studies 1 and 2. If so, this would suggest that the findings are generalizable across some differences in the procedures of the two studies. We used stroke count in some analyses as a

measure of the visual complexity of a character. Other characteristics of the items were included in some analyses, as described below. Continuous predictor variables were centered prior to analysis. Items that were not attempted by a child were not included in an analysis.

Correctness of Names and Other Characters

We examined, first, whether the children's productions of the individual characters in their names were conventionally correct. A mixed model analysis was performed using the fixed factors of age, sex of the child, study, stroke count of the character, whether the character was symmetrical, and whether the character was in the initial position of the child's name (the family name) or a later position of the name (the personal name). The main effect of age ($p < .001$) reflected the fact that older children performed better than younger children. Table 1 shows the mean proportion of correct responses on individual characters for the children in each year group, pooling across the two studies. The table also shows the proportion of cases in which children in each year group wrote all the characters in their names correctly. As shown, the two- and three-year-olds never wrote the characters of their names correctly. Correct writing of individual characters and the name as a whole emerged in four- and five-year-olds, and almost all six-year-olds wrote their names correctly.

The multilevel analysis of name character writing showed, in addition to an effect of age, an effect of study. After other factors had been statistically controlled, the children in Study 1, who were asked to write fewer items and who were tested individually, produced more correct characters from their names than the children in Study 2 ($p < .001$). The number of strokes in a character also influenced correctness. The more visually complex a character, as indexed by stroke count, the less likely children were to write it correctly ($p = .026$). In addition, children produced more correct renditions of symmetrical characters ($M = .50$) than of asymmetrical characters ($M = .42$, $p = .028$) once other factors were controlled. For example, the girl aged 4;4 in Fig. 1

correctly wrote her family name, which is symmetrical, but she was not correct on the characters of her personal name, which are asymmetrical and which contain more strokes. Girls were more likely to write characters from their names correctly than were boys ($p = .047$). Overall, the proportion of correct name characters was .49 for girls and .38 for boys.

The position of the character in the name did not have a significant effect in the multilevel analysis. The mean proportion of correct responses per character was .45 for family name characters and .42 for personal name characters. That is, the children did not perform significantly better on the family name, which appears first in a Chinese name, than on the characters of the personal name. For children who had two characters in their personal names, as most did, there was no advantage for the first character ($M = .42$) over the second character ($M = .43$).

We carried out another multilevel analysis to compare children's correctness on characters from their names and single-character words. This analysis included the factors of age, study, sex, the number of strokes in the character, the symmetry of the character, and whether the character belonged to the child's name. We found effects of age ($p < .001$), study ($p < .001$), number of strokes ($p = .009$), symmetry ($p < .001$), and sex ($p = .025$), as in the preceding analysis of name character writing. After these factors were controlled, there was a significant difference between names and single-character words, such that children performed better on characters from their names ($p < .001$). Table 1 illustrates this effect, showing the mean proportion of correct responses on characters from the name and single-character words for the children in each year group. The emergence of some correct responses around the four years of age parallels the decrease that we found at this age in the proportion of children who attempted to write their name and at least one single-character word. That is, some children appear to decline invitations to write when they have learned that there is a standard of correctness that they cannot always meet.

Recognizability of Names as Intended Names

Correctness in name writing is a relatively late development, but an incorrectly written name may still be recognizable as the intended name. To determine whether this aspect of name writing develops earlier than conventional correctness, we analyzed the data on Chinese adults' ability to recognize the intended name at the trial level using the fixed factors of age, study, sex of the child, and number of strokes in the correct form of the child's full name. (Because the children's productions of their full names were used in the experiment, and because no child had a name that was completely symmetrical, symmetry was not included as a factor in the analysis.) There was a significant effect of age, such that adults performed better with the productions of older children than of younger children ($p < .001$). Table 2 shows the mean proportion of correct responses for each year group, pooling across the two studies. As the table shows, adults' performance was indistinguishable from chance (.50) with the productions of the two-year-olds. That is, the adults were unable to determine whether a two-year-old's production of his or her name was the child's actual name or some other randomly chosen name. The adults performed significantly above the level expected by chance with the productions of each of the older year groups. Once other factors were statistically taken into account, the adults performed significantly better with the names of Study 1 than those of Study 2 ($p < .001$). For both studies, however, the adults were significantly above chance with the productions of three-year-olds and each of the older year groups. After controlling for other factors, the adults performed significantly better with the productions of children whose names contained relatively few strokes than with the productions of children whose names contained more strokes ($p = .007$). To illustrate, the mean proportion of correct responses was .82 for children whose full names had fewer than the median 24 strokes as compared to .74 for children whose names contained 25 or more strokes. The adults did not perform differently with the productions of boys and girls, and a model that included the interactions among the significant variables did not perform reliably better than the model that did

not include interactions.

Recognizability of Names as Names

Even if a child's production of his or her name is poorly written, it might have certain visual characteristics that are typical of Chinese names and so be recognizable as a name. To find out, we analyzed the data from the experiment on adults' ability to determine whether a product was a name using the factors of age, study, sex, and the number of strokes in the child's full name. There were no significant effects of study, sex, or stroke count, but there was a significant effect of child age ($p < .001$). As Table 2 shows, the adults performed better with the productions of older children than with the productions of younger children. The adults performed at the level expected by random guessing, .50, with the productions of the two-year-olds. That is, they were unable to determine whether a two-year-old child's production of his or her name was a name as opposed to a single-character word. Performance was significantly above the level expected by chance for each of the older year groups. For example, the productions of names shown in Fig.1 from children of three years and older look somewhat different from the productions of single-character words.

Characteristics of Names as Compared to Single-character Words

The adults' success in distinguishing between productions of names and single-character words for children of three years and older suggests that the children's name productions, even at this early age, have some of the visual characteristics of Chinese names. We turn now to analyses of specific visual characteristics that distinguish correctly written full Chinese names from single-character words: complexity, segmentation, and squarishness.

The data on judges' decisions about the complexity of the children's productions of their names as compared to single-character words were analyzed using the fixed factors of study, age, sex, and number of strokes in the children's names. The only significant effect was that of age (*p*

< .001). As Table 3 shows, the proportion of cases in which children's productions of their names were judged to be more complex than their productions of single-character words was higher for older children than for younger children. There was no significant difference in complexity between names and single-character words for two-year-olds. For each of the older age groups, names were judged to be more complex than single-character words. This is well illustrated by the productions made by the two girls of 3;8 in Fig.1.

The data on segmentation were analyzed in a similar manner. Again, the only significant effect was that of age ($p < .001$). The proportion of cases in which children's productions of their names were judged to be formed of more separate units than their productions of single-character words increased as a function of child age. Table 3 shows the results separately for each year group. The two-year-olds' names were not significantly more segmented than their productions of single-character words. The tendency for names to be more segmented than single-character words was statistically significant in three-year-olds and in each of the older year groups. Across pairs of items, those in which the name was judged as more segmented than the single-character word tended to be the same pairs in which the name was judged as more complex, even after controlling for child age ($r = .63$, $p < .001$). This result, together with the similar developmental pattern observed for complexity and segmentation, suggests that the two dimensions are related.

The ratio of width to length should be approximately .33 for a three-character Chinese name and about 1 for a single character. Table 4 shows the values of this ratio, here called squarishness, for the children's names and single-character words in each study. These data were analyzed using the fixed factors of age, study, sex, and stroke count of the child's full name. An additional fixed factor was item type: name or single-character word. An initial model that included these five fixed factors showed main effects of age, study, and item type. A model that included the interactions among the significant factors fit better than a model that included only

the main effects ($p < .001$), and so the more complex model was retained. This model showed a main effect of age, such that older children's productions were less square, on average, than younger children's productions ($p < .001$). There was a main effect of study, with productions less square on average in Study 2 than Study 1 ($p = .006$). The main effect of item type arose because children's productions of their names were, on average, less square than their productions of single-character words ($p = .006$). These main effects were qualified by an interaction of age and item type ($p < .001$) and an interaction of age, item type, and study ($p = .029$). The interaction between age and item type reflected the fact that older children's names were less square than their single-character words, whereas young children's were not. The interaction between age, item type, and study reflected the fact that, in Study 1, the difference in squarishness between names and single-character words reached statistical significance only for six-year-olds. In Study 2, this difference was statistically significant for five-year-olds as well as six-year-olds. Squarishness thus showed a different developmental pattern than did segmentation and complexity.

Use of Known Characters from Names in Single-character Words and Similarity of Single-character Words to Known Characters from Names

Among children who were correct on some but not all of the characters from their names and some but not all of the single-character words, there were no cases in which a child wrote a single-character word using a character from his or her name that the child produced correctly. Nor were there any cases in which a child used a single-character word in place of a character from his or her name.

In the experiment on similarity between pairs of characters, the mean similarity rating for pairs that consisted of a name character that a child wrote correctly and an incorrect single-character word was 1.50. The mean similarity rating for pairs that consisted of an incorrect name character and a correct single-character word was 1.44. The former rating should have been

significantly higher than the latter if children used visual components from their names when they wrote unknown single-character words. However, the two values did not differ significantly according to a multilevel analysis that used participants and items as random factors and pair type as a fixed factor. The mean similarity rating for filler pairs that consisted of two handwritten productions of the same characters was 3.70. As expected, this was significantly higher than the ratings for the preceding types of pairs ($p < .001$).

Discussion

Studies of writing in Chinese children have typically examined children's correctness on words other than their names and have asked how this correlates with the children's linguistic and cognitive abilities (e.g., McBride-Chang, Chung, & Tong, 2011; Tolchinsky, Levin, Aram, & McBride-Chang, 2012; Tong, McBride-Chang, Wong, Shu, Reitsma, & Rispens, 2011). But correct writing does not suddenly emerge at five or six years of age. Precursors are found much earlier in life. One of these precursors, it has been suggested, is learning to write one's name (e.g., Ferreiro & Teberosky, 1982). Most studies of early name writing have been conducted with Western learners of alphabetic writing systems. We cannot assume that writing will develop in the same way in other groups of children, however (Share, 2008). To broaden the picture, we examined the development of name writing in young speakers of Mandarin Chinese. Because we studied children as young as two years of age, most of our analyses focused not on the correctness of strokes, stroke sequences, or radicals but on more basic aspects of the children's productions, such as whether they were recognizable to adults as the intended name or whether they occupied a roughly square-shaped space, as individual Chinese characters typically do.

Our analyses were designed to shed light on the properties of children and of items that affect name writing performance and to compare children's writing of names and single-character words. We begin by discussing characteristics of the children that influenced name writing

performance. Not surprisingly, children of different ages wrote their names in markedly different ways. Chinese two-year-olds, although exposed to their full names on their lockers, kerchiefs, cots, and other locations, showed no ability to write it, or none that we could discern here. Their productions were never considered by adults to be correct, and they were not recognizable as the child's name as opposed to some other name. It is possible that Chinese two-year-olds show some knowledge about their written name in recognition tasks, as some U.S. two-year-olds do (Villaume & Wilson, 1989). However, we found no signs of this knowledge in the children's productions. Beginning around their third birthday, for the middle-class Chinese children studied here, children's productions of their names started to be recognizable as the intended name. Although the three-year-olds' productions were never fully correct, Chinese adults performed significantly above the level expected by chance in an experiment assessing recognizability of the name as the intended name. Starting around four years of age, some children wrote their names using all of the required strokes in the correct positions. Almost all of the children did this by six years of age. Although a few four-year-olds and many five-year-olds produced all the strokes in their full names, the characters were not always correctly spaced. Based on the results on squarishness, it appears that spacing, even more than correctness of strokes, is a late development in learning to write the name. Correct spacing may require a degree of fine motor control that is beyond the capabilities of younger kindergartners.

The sex of the child influenced some aspects of performance. Boys were on average poorer than girls at writing the characters of their names correctly, using all of the required strokes. However, boys were similar to girls in their knowledge of the visual properties of names, in that they were not significantly worse at producing renditions that were recognizable by adults as their name as opposed to another name or at using more segmented and more complex forms for their names than for single-character words. The results of Treiman and Yin (2011) also show that boys

were no worse than girls at distinguishing writing from drawing. Boys' poorer fine motor abilities, which are apparent from infancy (Nagy, Kompagne, Orvos, & Pal, 2007), may mean that they drop or misplace some strokes from characters even while maintaining the general form. Sex differences in writing have been observed in some studies of Chinese and U.S. children, but the issue has not been extensively investigated and the previous results are mixed (Berninger & Fuller, 1992; Haney et al., 2003; Justice et al., 2005; Tseng & Hsueh, 1997). Given this, future studies should continue to address the issue.

Performance was influenced by characteristics of items as well as characteristics of participants. Children were more likely to write a character correctly if it was symmetrical than if it was not, and this held true for characters in children's name and also for other characters. While effects of symmetry have previously been reported for young learners of the Latin alphabet (Treiman & Kessler, 2011), we know of no investigations on this topic with young Chinese children. Children's relatively poor performance on asymmetrical forms probably reflects the need to make decisions about orientation. This may lead to errors, as when U.S. children write *b* for *d* or when Chinese children write  (not a real character) for ('snow').

Visual complexity, as indexed by stroke count, also influenced the performance of the Chinese children. Children produced more correct renditions of name characters and other characters that contained few strokes than of those that contained many strokes. Moreover, the names produced by children whose names contained fewer strokes were more easily recognized by adults as the intended name. The number of strokes in a Latin letter appears to have some influence for young learners of English (Treiman & Kessler, 2011). However, the effects of stroke count may be small for learners of this and other alphabetic scripts because their letters have few strokes, on average (Changizi & Shimojo, 2005), and show relatively little variation in this respect.

The position of a character in a child's name did not appear to influence performance.

Although the characters of a Chinese full name are written from left to right, our participants did not perform significantly better on the first character, the family name, than on the later characters. That is, the Chinese children showed little sign of the serial position effect that would have been anticipated based on previous studies with learners of alphabetic systems (e.g., Treiman, 1993). For Chinese, visual attributes of an individual character, including its complexity and symmetry, may be more important determinants of performance than the position of the character in the name. Indeed, informal observations suggest that Chinese parents vary in which character of the name that they choose to teach children first. They may begin with the first character of the personal name, if that is a visually simple character, or with whichever character is simplest. In the U.S., in contrast, parents and teachers almost uniformly begin with the first letter of the child's personal name. It may be that children usually learn about the first segment of their name before they learn about the later segments in writing systems that are composed of units that are fairly similar to one another in visual complexity. When there are major differences, as among the characters of Chinese, these may outweigh effects of the position of a unit in a written string.

We turn now to the comparisons between children's writing of names and of other words. Names look different from single-character words in Chinese: They are more complex, more segmented, and less square. Our results show that children began to make some distinctions between names and single-character words starting around the age of three. Thus, adults performed above the level of chance when asked whether a production of a child of three or older was a name or a single-character word. We suspect that the adults did not do this just by recognizing the single-character word as one of the words that children had been asked to write and choosing the other item as the name, because the single characters that we used occur as components of Chinese names. An adult who saw a production that contained all or part of the character for 'sun', for example, could not be sure whether it was a single character or part of a

name without additional clues. Further supporting the idea that children of around three years and older have learned about some of the visual differences between names and single-character words, their productions of these two types of items differed in complexity and segmentation. The Chinese two-year-olds did not differentiate between names and single-character words, however. This latter result is of interest given that these same two-year-olds produced some distinctions between writing in general and drawing (Treiman & Yin, 2011). For example, their writings tended to be smaller than their drawings and their drawings tended to be more curved.

Previous studies suggest that children learn at an early age about some of the visual properties that characterize writing in general. By around three years of age, for example, Chinese and Western children produce smaller scribbles for writing than for drawing, having observed writing tends to be small (Chan & Louie, 1992; Levin & Bus, 2003; Treiman & Yin, 2011). Our results suggest that it takes another year or so for children to learn about an important visual distinction within the class of writing—the distinction between names and single-character words in Chinese.

Studies of learners of alphabetic writing systems have found that children tend to perform better on their own names than on other words (Levin et al., 2005). By four to six years of age, our Chinese participants showed the same pattern. Specifically, they did better at writing the characters from their names than at writing other common characters. At least at this point in development, our results suggest, the name plays a leading role in writing development in Chinese in that it is written more accurately than common single-character words. However, the Chinese children's knowledge about the characters in their name did not appear to influence their writing of other words in the way that Western children's knowledge about the letters in their name influences their writing of other words (Bloodgood, 1999; Both-de Vries & Bus, 2008; Levin et al., 1996; Treiman et al., 2001). Thus, our Chinese participants did not use characters that they knew

from their names when writing other words. Nor did the children's productions of single-character words look especially similar to their productions of known characters from their names. The number of children who could be included in the relevant analyses was fairly small, but if these results hold up in future studies they may point to important differences between the early writing of Chinese children and Western children. Chinese children may notice at an early age that writing includes many characters, none of which appears all that often. Thus, these children may not often reuse characters that they have seen in their names. Learners of alphabetic writing system, on the other hand, may notice that words are made up from a small set of letters and that these letters repeat often. Having learned some letters from their names, children may use them frequently, and sometimes inappropriately, when writing other words.

Our main conclusions about the child-level and item-level factors that influence Chinese children's name writing performance and about the similarities and differences between children's productions of their names and of single-character words held for both of the data sets that we analyzed. That the two sets of data generally yielded similar results points to the robustness of the findings across differences in the procedures of a writing task.

Further research is needed to examine the robustness of the findings with respect to variations in the participant population. Children with less literacy experience than the middle-class children studied here may develop the ability write their names more slowly, and it will be of interest to determine whether they show the same general patterns. Another topic for future research with Chinese children is the link between early name writing and concurrent and later literacy skills. As discussed earlier, such links have been found in learners of alphabetic writing systems (Badian, 1998; Drouin & Harmon, 2009; Ferguson, 1975; Jorm et al., 1986; Justice et al., 2005; Molfese et al., 2006; Puranik & Lonigan, 2012; Riley, 1996; Welsch et al., 2003).

Our results suggests that some of the phenomena that have previously been observed in the

early name writing of learners of alphabetic writing systems reflect properties of those writing systems and cultures; they are not universal. Phenomena that do not seem to generalize to learners of Chinese include early learning of the first segment of the name and frequent use of components from the name when writing other words. Other phenomena are found among learners of Chinese as well as learners of alphabetic writing systems. Learning to write the name is a protracted process in both groups, and some of the major milestones are acquired at similar ages in middle-class children who have extensive exposure to print.

An important similarity in writing development across cultures may be an early priority for form, or what writing looks like, over function, or how writing relates to language (Lehtonen & Bryant, 2005; Tolchinsky, 2003). Before children receive systematic literacy instruction, they begin to learn about some of the salient formal properties of writing, including about the visual differences between writing and drawing. As the present results show, children also learn about some of the more obvious visual differences between different types of writing, including the differences between names and single-character words in Chinese. Early learning about form is also seen in the fact that Western children spell words in ways that reflect some knowledge about the frequency of letters and letter groups before their spellings represent the sounds in the corresponding spoken words (Pollo, Kessler, & Treiman, 2009).

In order to make best use of the tool that writing provides, children in China and other countries must learn to write conventionally. Recent studies have shed light on the cognitive and linguistic skills that are associated with ability to produce conventional writing (e.g., McBride-Chang et al., 2011; Tolchinsky et al., 2012; Tong et al., 2011). However, correct writing of characters or words does not emerge full-blown. Learning about one's written name plays an important role in the early development of literacy, and the present findings contribute to an understanding of that process.

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Table 1

Proportion of Individual Characters from Name, Full Names, and Single-Character Words Judged as Correctly Written, Pooling Across Studies

Year group	Individual characters from name	Full name	Single-character words
2	.00	.00	.00
3	.00	.00	.00
4	.36	.19	.18
5	.67	.50	.56
6	.97	.92	.92

Table 2

Proportion of Correct Responses in Experiments Assessing Recognizability of Full Name as Intended Name and Recognizability of Full Name as a Name, Pooling Across Studies

Year group	Recognizability of name as intended name	Recognizability of name as a name
2	0.51	0.50
3	0 .56**	0.63***
4	0.88***	0.83 ***
5	0.92***	1.00 ***
6	1.00***	1.00***

significantly different from chance (.50) by a binomial test,** $p < .005$, one tailed

***significantly different from chance (.50) by binomial test, $p < .001$, one tailed

Table 3

Proportion of Names Judged as More Complex and More Segmented than Single-Character Words, Pooling across Studies

Year group	Complexity	Segmentation
2	0.48	0.47
3	0.69***	0.68**
4	0.90***	0.90***
5	0.95***	0.95***
6	1.00***	1.00***

*******significantly different from chance (.50) by binomial test, $p < .001$, one tailed

Table 4

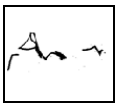
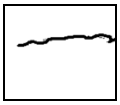
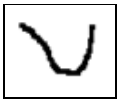
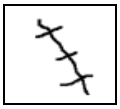
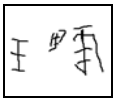
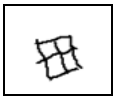
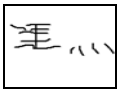
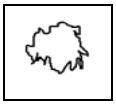
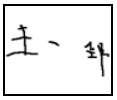
Mean Values of Squarishness for Full Names and Single-Character Words In Studies 1 And 2

Year group	Study 1		Study 2	
	Name	Single-character word	Name	Single-character word
2	0.69	0.70	--	--
3	0.69	0.67	.55	.46
4	0.70	0.74	.52	.71
5	0.65	0.74	.48[a]	.73
6	0.39[a]	0.71	.46[a]	.75

[a]significantly different from single-character words according to paired *t*-test, $p < .001$, one tailed

Figure 1

Sample Productions of Names and Single Characters

Child age (sex)	Name	Single character
2;4 (boy)		 fire (火)
2;8 (girl)		 sun (日)
2;9 (girl)		 water (水)
3;7 (boy)		 you (你)
3;8 (girl)		 fire (火)
3;8 (girl)		 field (田)
4;4 (girl)		 field (田)
4;5 (boy)		 star (星)
4;5 (boy)		 sky (天)

Note. Children's real names are not disclosed for privacy reasons.