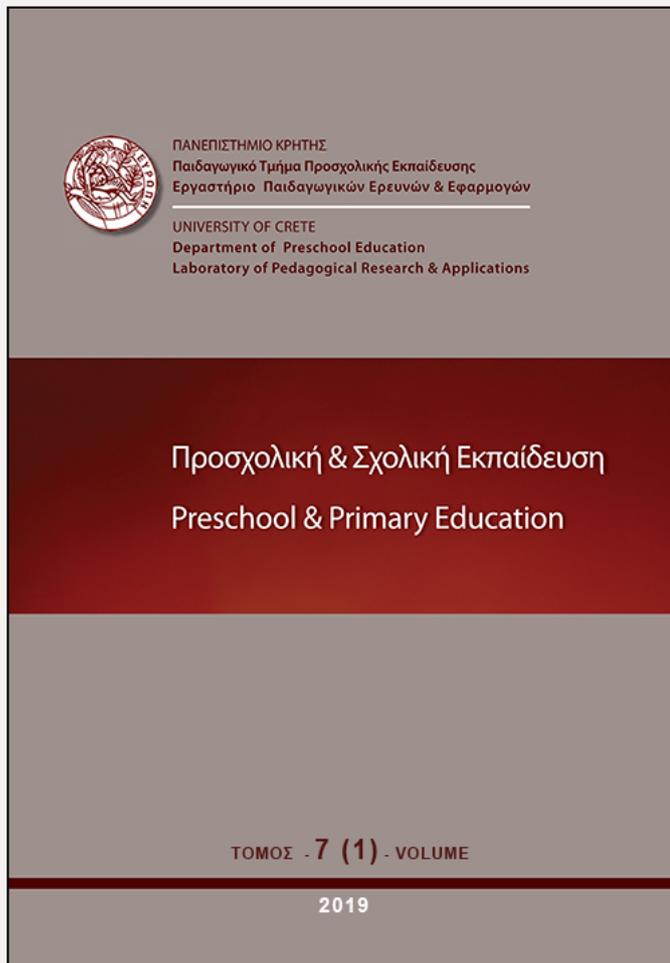


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What aspects of the home literacy environment differentiate Chinese children at risk for reading difficulties from their not at risk controls?

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Abstract: We examined what aspects of the home literacy environment (formal home literacy activities, informal home literacy activities, access to literacy resources, age of onset of literacy instruction, child's interest in reading, and parents' expectations) differentiate Chinese children at risk for reading difficulties from their not-at-risk controls. Eighteen children from Jining, China, who were at risk for reading difficulties and 18 not-at-risk controls participated in the study. Their parents also participated in the study by filling out a home literacy questionnaire, by recording the daily parent-child reading activities (diary), and by completing the Children's Title Recognition Checklist. Group comparisons revealed significant differences only in items measuring children's access to literacy resources and reading interest. Results of discriminant function analyses further showed that the home literacy environment variables could discriminate well between the children at risk for reading difficulties and their controls. Taken together, our findings suggest that to the extent environment plays a role in reading difficulties in Chinese, this should be traced to factors such as child's interest in reading and access to literacy resources.

Keywords: child's interest, Chinese, home literacy environment, parents' expectations, reading difficulties, shared book reading

Letter knowledge, phonological awareness, rapid automatized naming, vocabulary, and morphological awareness are known risk factors of reading difficulties in different languages (e.g., Hulme & Snowling, 2013; Kirby, Parrila, & Pfeiffer, 2003; Landerl et al., 2013; Lei et al., 2011). At the same time, there is evidence showing that these emergent literacy skills are predicted by ecological factors such as family's SES and home literacy environment (e.g., Chiu & McBride-Chang, 2010; Inoue, Georgiou, Parrila, & Kirby, 2018; Weigel, Martin, & Bennett, 2006; Zhang et al., 2013). Consequently, one would expect that children who are at risk for reading difficulties (identified on the basis of poor performance in emergent literacy skills such as phonological awareness and vocabulary) would also perform more poorly than controls on

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the same ecological factors. In the present study, we focused exclusively on the role of home literacy environment (HLE). Despite the volume of studies examining the role of HLE in typically-developing children (e.g., Evans, Shaw, & Bell, 2000; Hood, Conlon, & Andrews, 2008; Inoue et al., 2018; Liu, Georgiou, & Manolitsis, 2018; Sénéchal, 2006; Stephenson, Parrila, Georgiou, & Kirby, 2008), little is known about the connection between HLE and reading difficulties, particularly in non-alphabetic languages. Thus, the purpose of this study was to examine what aspects of HLE differentiate Chinese children at risk for reading difficulties from their not at-risk controls. This has important theoretical and practical implications. From a theoretical point of view, it allows us to examine how culture influences home literacy environments. From a practical point of view, it gives direction to parents on what aspects of HLE they should pay attention to in order to help their children overcome their early reading difficulties.

HLE is an umbrella concept that captures a variety of child-parent activities related to literacy, as well as parental characteristics and parental expectations (e.g., Burgess, Hecht, & Lonigan, 2002; Storch & Whitehurst, 2002; Umek, Podlesek, & Fekonja, 2005). According to the Home Literacy Model (see Sénéchal, 2006), the HLE activities can be grouped into two broad categories that are largely independent from each other: the formal and the informal HLE activities. Formal HLE activities are code-focused and engage children directly with print through activities such as teaching letters, words, and spelling. They have been found to contribute primarily to letter knowledge and phonological awareness (e.g., Evans et al., 2000; Sénéchal & LeFevre, 2002), and through the effects of these emergent literacy skills to reading accuracy (e.g., Evans et al., 2000; Manolitsis, Georgiou, & Tziraki, 2013). In turn, informal HLE activities are meaning-focused and expose children to print incidentally through activities such as storybook reading by parents. Several studies have shown that the informal HLE activities contribute primarily to vocabulary knowledge (e.g., Evans et al., 2000; Sénéchal, LeFevre, Thomas, & Daley, 1998) and through the effects of vocabulary knowledge to reading comprehension (e.g., Roth, Speece, & Cooper, 2002; Sénéchal, 2006).

Access to literacy resources has also been found to predict children's literacy skills (e.g., Chiu & McBride-Chang, 2006; Raz & Bryant, 1990; Ruan, Zhou, & Li, 2006; van Bergen, van Zuijen, Bishop, & de Jong, 2016; Vasilyeva, Dearing, Ivanova, Shen, & Kardanova, 2018). To encourage children to explore literacy, parents need to provide access to print resources and literacy materials. Access to literacy materials has traditionally been measured by asking parents to report on the number of children's books at home (e.g., Shu, Li, Anderson, Ku, & Yue, 2002; Torppa et al., 2007) and on the frequency of visiting a library/bookstore with their child (Slates, Alexander, Entwisle, & Olson, 2012; Torppa et al., 2007).

Compared to the volume of research on HLE with typically-developing children, only a few studies have examined HLE in children with reading difficulties (e.g., Baroody & Diamond, 2012; Kirby & Hogan, 2008; Rashid, Morris, & Sevcik, 2005; Torppa, Georgiou, Niemi, Lerkkanen, & Poikkeus, 2017). Kirby and Hogan (2008), for example, compared a group of poor and good Grade 1 readers on a number of HLE aspects (assessed with a parents' questionnaire) and found that children who were good readers were read to by adults and were taught printed letters, letter sounds, and words more frequently than children who were poor readers. Parents of children who were good readers also reported a greater total number of books at home. In addition, results of discriminant function analyses indicated that the combination of family environment and SES variables (mother's and father's education) could successfully classify over 88% of the children. Based on these findings, Kirby and Hogan (2008) concluded that

“simply reading to children is not enough. It is important to engage them, direct their attention to key features of text [...], and introduce them to the mechanics of reading” (p. 126).

A few studies have also examined the role of HLE in children at risk of dyslexia (e.g., Elbro, Borstrøm, & Petersen, 1998; Hamilton, Hayiou-Thomas, Hulme, & Snowling, 2016; Scarborough, Dobrich, & Hager, 1991; Torppa et al., 2007; van Bergen, de Jong, Maassen, & van der Leij, 2014; van Bergen et al., 2011).¹ However, they provided mixed findings. For example, Scarborough et al. (1991) reported that children at familial-risk of dyslexia who were later identified as dyslexic were read to less often by fathers at the age of 24 months and by mothers at the age of 30 months (though not at other preschool testing points), compared to at-risk children who were not identified later on as being dyslexic. In contrast, Hamilton et al. (2016) found no differences between a group of children at familial-risk of dyslexia and their controls on the frequency of shared book reading. Hamilton et al. (2016) also reported no group differences in the number of books at home and in the frequency of teaching letters, words, and writing. Finally, Torppa et al. (2007) reported no group differences in shared book reading, access to literacy resources, and child’s interest in reading.

A common feature of the aforementioned studies is that they have all been conducted in Western cultures. It remains unknown if their findings generalize to a non-Western culture (e.g., Chinese). Examining the connection between different HLE aspects and reading difficulties in the Chinese culture is interesting for a number of reasons: First, it has been repeatedly shown that Chinese parents engage more frequently in their children’s learning than North American parents (e.g., Huntsinger & Jose, 2009; Huntsinger, Jose, Liaw, & Ching, 1997; Pan, Gauwain, Liu, & Cheng, 2006). For example, Huntsinger et al. (1997) found that Chinese-American parents spent more time on their children’s homework, structured their children’s time to a greater degree, and showed more encouragement for mathematics-related activities than European-American parents. If this also applies to literacy, we would expect Chinese parents of at-risk children to engage more frequently in their children’s reading development in order to give them a fair chance to succeed in a highly competitive learning environment. Hence, we should see higher scores in formal and informal HLE activities from parents of at-risk than from parents of not at-risk children (the opposite of what has been reported by Kirby and Hogan, 2008).

Second, although most North American parents believe it is the school’s responsibility to teach their children to read (e.g., Evans, Fox, Cremaso, & McKinnon, 2004; Evans & Koblinsky, 2017), in China, it appears to be the opposite. According to a survey by the Family Education Study Centre (2012), 60.9% of Chinese parents reported that it was their responsibility to teach their kindergarten children to read. Previous studies with preschool children in China have reported high levels of parental teaching (Li & Rao, 2000; Liu et al., 2018; Su et al., 2017).² If all Chinese parents (irrespective of their children’s reading level) are highly involved in their children’s learning and teach literacy skills, then we may fail to find any significant differences in the HLE aspects between the at-risk and the not at-risk children.

Third, Chinese parents have high expectations for their children (e.g., Li, 2003; Ng, Pomerantz, & Lam, 2007; Stevenson & Lee, 1990). This is because, in many Asian societies, good parenting is judged by how well their children do in school (e.g., Chao, 1995; Chao & Tseng, 2002; Tu, 1985). Tu (1985), for example, argued that a successful Confucian father is defined by the scholarly achievements and cultural attainments of his family. Because the children’s performance reflects on the family, we would expect Chinese parents of at-risk children to engage more frequently in formal and informal HLE activities than parents of not at-risk children.

Finally, Chinese children go to kindergarten at the age of 3 and stay in kindergarten for three years before they go to Grade 1. During these three years parents have multiple opportunities to discuss their children's performance with the kindergarten teachers. Assuming parents adjust their involvement in their children's learning as a result of teachers' feedback (e.g., Gubbins & Otero, 2018; Manolitsis, Georgiou, & Parrila, 2011; Silinskas, Leppänen, Aunola, Parrila, & Nurmi, 2010), this should be more obvious in China. Indeed, in a study that examined the cross-lagged relations between formal and informal HLE activities and Chinese reading from Grade 1 to Grade 2, Deng, Silinskas, Wei, and Georgiou (2015) found that earlier reading was negatively related to future informal HLE activities (Chinese parents reported engaging more frequently in shared book reading in Grades 1 and 2 among children with poorer reading skills). Thus, we would expect Chinese parents of at-risk children to report reading to their children more frequently than parents of not at-risk children.

The Present Study

The purpose of this study was to examine the connection between different HLE aspects and risk for reading difficulties in China. Assuming Chinese parents of at-risk children increase their involvement in order to allow their children to succeed, we should observe higher frequencies of parent teaching or shared book reading among the at-risk group than among the non-at-risk group. On the other hand, if Chinese society (and by implication parenting of Chinese children) is more similar to Western societies than was initially thought (see Liao, Georgiou, Zhang, & Nurmi, 2013; Wang & Guthrie, 2004, for a similar argument), we should observe more frequent direct teaching and shared book reading among the not at-risk children (e.g., Kirby & Hogan, 2008). We could not formulate any hypotheses in relation to children's interest in reading or access to literacy resources because both of these HLE aspects covary with family's SES (Chiu & McBride-Chang, 2010; Ninio, 1990; Su et al., 2017) and previous studies that assessed their role in reading difficulties have produced contradictory findings (see Hamilton et al., 2016; Kirby & Hogan, 2008).

Method

Participants

Our sample was recruited from a larger pool of children ($n=217$) participating in a longitudinal study examining the role of cognitive and environmental factors in reading development in Chinese (Zhang, Georgiou, Xu, Liu, Li, & Shu, 2018). From this larger sample of children, we first identified 22 third-year kindergarten children (10 girls; mean age = 70.88 months, $SD = 3.86$) deemed to be at risk for reading difficulties. The selection was based on the following criteria: (a) at least average nonverbal IQ, (b) a reading score at or below the 25th percentile on a standardized measure of Chinese word reading³ (c) performance below the 25th percentile on at least one emergent literacy skill (i.e., phonological awareness, rapid automatized naming, vocabulary, or morphological awareness), and (d) absence of sensory and/or behavioral difficulties (based on school's records). In addition, because Chinese children do not receive formal character reading instruction before they go to Grade 1, we followed the same children in Grade 1 and we reassessed them on two reading tasks: Character Recognition and Sentence Verification (see below for more information on these measures). Children were thought to be at risk for reading difficulties if they fulfilled the operational criteria set for kindergarten and also performed below

the 25th percentile in at least one of the two reading tasks in Grade 1. This left our sample with 18 children (9 girls; mean age = 70.85 months, *SD* = 3.79).⁴

In turn, 18 children (9 girls; mean age = 72.00 months, *SD* = 3.34) comprised the not at-risk group. The children in this group were recruited from the same kindergarten schools as the at-risk children and they were matched to the at-risk children on gender, age, nonverbal IQ, and parents' education and income. To be included in the not at-risk group, children should also score average on all four emergent literacy skills and on the reading tasks in kindergarten and Grade 1. All children were native speakers of Mandarin and were initially recruited from 8 kindergarten schools (4 public and 4 private)⁵ that were chosen to represent a broad range of social class levels and were located in different parts of Jining city in Southwestern Shandong province.

Parents also participated in the study by providing information on their education and income, by filling out a home literacy questionnaire, by recording the daily parent-child reading activities (diary), and by completing the Children's Title Recognition Checklist (see below). The questionnaire was filled out by 34 mothers and two families where parents responded together.

Table 1 presents the descriptive statistics on the children's measures and on parents' demographic measures. In line with the selection criteria, *T*-tests revealed that the at-risk group performed more poorly than the not at-risk group on all emergent literacy skills as well as on Character Recognition (in both kindergarten and Grade 1) and Sentence Verification (in Grade 1).

Table 1 Descriptive Statistics on the Screening Measures Used in the Study

Measures	At-Risk Group <i>n</i> =18		Not At-Risk Group <i>n</i> =18		<i>t</i> (34)
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Children's measures					
Nonverbal IQ_K	8.39	3.14	10.00	3.08	1.55
Word Definitions_K	6.11	3.77	15.94	5.30	6.41***
Syllable Deletion_K	3.89	2.98	11.17	3.66	7.42***
Digit Naming_K	27.21	5.08	22.97	4.39	-2.23*
Morphological Constr_K	3.28	2.76	9.61	2.33	7.43***
Character Recognition_K	.33	.84	7.10	10.31	2.78**
Character Recognition_G1	5.36	2.02	16.35	15.38	2.91**
Sentence Verification_G1	4.36	2.80	16.65	9.74	4.89***
Parents' measures					
Mother's Education ^a	4.11	.96	4.44	.62	1.23
Father's Education ^a	4.17	1.09	4.50	.98	1.85
Family's Monthly Income ^b	2.30	.80	2.83	.92	1.97

Note. K = Kindergarten; G1 = Grade 1.

^a. Parents' education was measured on a 7-point scale: 1 = lower than third grade, 2 = fourth to sixth grade, 3 = junior high school completion, 4 = senior high school completion 5 = technical secondary school or college, 6 = completed university, 7 = completed graduate studies.

^b. Family's monthly income was measured on a 10-point scale: 1 = less than 3,000, 2 = between 3,000 and 6,000, 3 = between 6,000 and 9,000, 4 = between 9,000 and 12,000, 5 = between 12,000 and 15,000, 6 = between 15,000 and 18,000, 7 = between 18,000 and 21,000, 8 = between 21,000 and 24,000, 9 = between 24,000 and 27,000, and 10 = more than 27,000 Chinese Yuan (RMB) per month.

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

Measures

Nonverbal IQ. Nonverbal Matrices task from the Cognitive Assessment System (Naglieri & Das, 1997) was administered in kindergarten to assess nonverbal IQ. The task has been used in several previous studies in Chinese showing good reliability and validity evidence (e.g., Deng & Georgiou, 2015; Liao, Georgiou, & Parrila, 2008). Children were asked to identify the missing segment of a figure according to the figure's inherent regularity. The children were instructed to choose the correct answer from five or six candidate answers. There were 33 items arranged in increasing difficulty and the test was discontinued after four consecutive errors. A participant's score was the total number correct. Cronbach's alpha reliability coefficient in our sample was .90.

Vocabulary. Word Definitions (Thorndike, Hagen, & Sattler, 1986) was administered in kindergarten to assess vocabulary. The task was initially adapted in Chinese by Chow, McBride-Chang, and Burgess (2005) and has been used in several previous studies showing good reliability and validity evidence (e.g., Lei et al., 2011; Liu & McBride-Chang, 2010; Zhang et al., 2013). Children were given a word by the experimenter and then asked to define it. Scoring was based on the number of important semantic features included, following the manual's scoring scheme. One point was given for each feature with a maximum score of 2 for each item. A complete definition had to include the proper semantic category and one or more features. The task consisted of 2 practice items and 32 test items arranged in increasing difficulty, resulting in a total score of 64. Testing was discontinued after five consecutive incorrect responses. Cronbach's alpha reliability in our sample was .85.

Phonological awareness. Syllable Deletion from Li, Shu, McBride-Chang, Liu, and Peng (2012) was administered in kindergarten to assess phonological awareness. Children were asked to say what was left in a Chinese word after deleting one of the syllables in the word (e.g., Say /qi[4] che[1] zhan[4]/. Now say /qi[4] che[1] zhan[4]/ without /zhan[4]/ would be /qi[4] che[1]/; the number in brackets refers to the tone). To increase the task difficulty, five nonwords that conformed to the phonological constraints of Chinese but do not exist in modern Mandarin were added to the 15 real words. The task consisted of eight two-syllable items and 12 three-syllable items. Half of the two-syllable items required deleting the first syllable and the other half the last syllable. Among the three-syllable items, one-third required deleting the first syllable, one third the middle syllable, and one third the final syllable, respectively. One point was awarded for each correct answer and a discontinuation rule of five consecutive errors was applied. Cronbach's alpha reliability in our sample was .90.

Rapid Automated Naming (RAN). Digit Naming from the Comprehensive Test of Phonological Processing (Wagner, Torgesen, & Rashotte, 1999) was administered in kindergarten to assess RAN. Children were asked to name as fast as possible six recurring Arabic numerals (2, 3, 4, 5, 7, 8; pronounced er[4], san[1], si[4], wu[3], qi[1], and ba[1]) that were repeated six times each and arranged in semi random order in four rows of nine. Prior to testing, the children were asked to name the digits in a practice trial to ensure familiarity. A child's score was the total time to name all stimuli. Wagner et al. (1999) reported test-retest reliability for kindergarten children to be .82.

Morphological awareness. Morphological Construction from Lei et al. (2011) was administered in kindergarten to assess morphological awareness. Children were asked to combine known morphemes in new ways using lexical compounding. For example, "when the sun goes down at night, we call it a sunset. What would we call it if the moon went down

at night?" The task consisted of 18 items and was discontinued after 5 consecutive errors. A child's score was the total number correct. Cronbach's alpha reliability in our sample was .88.

Reading. Character Recognition and Sentence Verification were used to assess reading ability. Character Recognition was adopted from Li et al. (2012) and was administered in both kindergarten and Grade 1. The task has been used in several studies with children of the same age as in our study showing good psychometric properties (e.g., Liu et al., 2018; Pan et al., 2017; Zhang et al., 2013). Children were asked to read aloud Chinese characters arranged in terms of increasing difficulty. The task consisted of 150 characters (see Li et al., 2012, for details on how the task was developed) and it was discontinued after 6 consecutive errors. A child's score was the total number correct. Cronbach's alpha reliability in our sample was .85 in kindergarten and .91 in Grade 1.

Sentence Verification was adopted from Lei et al. (2011) and was administered in Grade 1. The task has been used in previous studies in Chinese showing good psychometric properties (e.g., Pan et al., 2011, 2017). Children were asked to read silently simple sentences and to indicate if the meaning of each sentence was true or false by circling Y (for Yes) or N (for No) printed at the end of each sentence (e.g., *Horse is an animal.* Y - N). Because the semantic content and linguistic format of each sentence is simple and only basic comprehension is required, the task has been used in the literature as a measure of reading fluency. A 3-minute time limit was implemented. A participant's score was calculated by subtracting the number of incorrectly answered sentences from the number of correctly answered sentences. 94% of the attempted items in our study were correctly judged. Sentence Verification correlated .80 with Character Recognition in our study.

Family's SES. We asked parents to report on their highest attained education and on family's monthly income. Parental education was measured with a 7-point scale ranging from 1 = lower than third grade to 7 = completed graduate studies. Parental monthly income was measured on a 10-point scale ranging from 1 = less than 3,000 to 10 = more than 27,000 RMB per month. The average reported parents' education and income in our study (see Table 1) was similar to that reported in previous studies in mainland China (e.g., Pan et al., 2017; Zhang et al., 2013).

Home Literacy Environment (HLE). A questionnaire comprising 10 questions was sent home to be filled out by parents. The questions were sampled from Sénéchal (2006) and Kirby and Hogan (2008). Previous studies that used the same questionnaire with typically-developing children in China have reported good reliability evidence for the observed factors (e.g., Deng et al., 2015; Liu et al., 2018; Ruan et al., 2006). Cronbach's alpha reliability in our sample was .80.

Formal home literacy activities. We asked parents to indicate by using a 4-point Likert scale (0=never to 4=every day) (a) the frequency of teaching their child to read Chinese characters, and (b) the frequency of teaching their child to write Chinese characters.

Informal home literacy activities. We asked parents to indicate by using a 4-point Likert scale (0=never to 4=every day) (a) the frequency of reading a story to their child at bedtime, and (b) the frequency of reading a story to their child at other occasions.

Age of onset of literacy instruction. We asked parents to indicate by using a 6-point Likert scale (1=after 5 years old; 2=4-5 years old; 3=3-4 years old; 4=2-3 years old; 5=1-2 years old, and 6=0-1 year old) (1) how old their child was when they started reading stories to him/her, and (2) how old their child was when they started teaching him/her Chinese characters.

Access to literacy resources. We asked parents to indicate by using a 5-point Likert scale (1=never to 5=very often) how often they visit a library or a bookstore with their child. In addition, we asked parents to report how many children's books they had at home. The reported number was

subsequently recoded on a 7-point scale (1=no books; 2=1-20 books, 3=21-40 books, 4=41-60 books, 5=61-80 books, 6=81-100 books, and 7=more than 100 books) and this score was used in the analyses.

Child's interest in reading. We asked parents to indicate the frequency of reading requests by their child (1=never to 5=very often).

Parents' expectations. We asked parents to indicate how well they expected their child to do in reading in Grade 1 (0=not good at all; 1=not too bad; 2=average; 3=good; and 4=very good).

Diary. Because HLE questionnaires are subject to social desirability bias, we sought to obtain additional information on the frequency of parent-child shared book reading by asking parents to keep a diary with the time they had started and finished reading a story to their child. Following the work of Anderson, Wilson, and Fielding (1988) and Allen, Cipielewski, and Stanovich (1992), we used a graphical layout, in which time periods were divided into half hours ranging from 5pm to 11pm in the weekdays and from 9am to 11pm in the weekend. Parents were instructed to mark down on a daily basis the approximate time they had started and finished reading a story to their child during a specific week.⁶ If no reading took place in a given day, parents were told not to mark anything. We awarded one point for every 30-minute time period marked down. The scores from the diary correlated .74 with the scores on the two questions of the HLE questionnaire assessing informal home literacy activities.

Children's Title Recognition Checklist (CTRC). To obtain additional information on access to literacy resources we also asked parents to complete CTRC. Parents were asked to identify (by putting a checkmark) the names of titles of children's books among foils. Because CTRC is not available in Mandarin (Ho, 2014 developed one for Cantonese-speaking children), we developed one following the same criteria used in previous studies (e.g., Cunningham & Stanovich, 1990; 1991; Sénéchal, LeFevre, Hudson, & Lawson, 1996). CTRC included 30 titles of storybooks (e.g., *The Runaway Bunny*) aimed at 5- to 6-year-old Chinese children collated through interviews with children's teachers and parents, and inspection of the current bestseller lists provided by three popular websites in China (Amazon, Dangdang, and Jingdong) and four large bookstores in Jining, interspersed with 16 foils (e.g., *The Lucky Tree* derived from *The Giving Tree*).⁷ Titles that had been televised or filmed were excluded. Cronbach's alpha reliability in our sample was .72. CTRC also correlated .58 with number of children's books at home.

Procedure

All children were individually tested by the first author in March/April of the kindergarten year (8 to 9 months after the beginning of the school year) and again in January of Grade 1 (5 months after the beginning of the school year) in a quiet room at school. Testing lasted roughly 30 minutes in kindergarten and 10 minutes in Grade 1. Parents completed the HLE questionnaire, the CTRC, and the diary during the same time as their child's testing in kindergarten. Ethics approval for the study was granted by Jining's University Ethics Board and parental consent was also obtained prior to testing.

Results

Group Comparisons

Means and standard deviations on each HLE item, as well as on diary and CTRC can be found in Table 2, separately for each group. There were no missing data and the following analyses were performed with a full dataset. Because the children were nested within

classrooms, we first calculated intraclass correlations on the emergent literacy skills and on the reading tasks. The correlations ranged from .02 to .07 suggesting that the performance of the children on these measures was not influenced by their class membership.

Next, we performed *t* tests for independent samples to test for group differences on the HLE variables, diary, and CTRC. Because multiple testing may inflate Type 1 error, only *p*-values of .005 should be viewed as significant. The results showed that the two groups differed significantly on the frequency of visits to a library/bookstore and on the frequency of child's reading requests. The at-risk group obtained significantly lower scores than the control group.

Table 2 Descriptive Statistics on the Home Literacy Environment Questionnaire, Diary, and CTRC

	At-Risk Group n=18		Not At-Risk Group n=18		<i>t</i> (34)	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Frequency of reading a story						
... at bedtime	2.50	2.61	3.55	1.78	1.41	.167
... at other occasions	1.50	1.69	2.06	1.55	1.19	.238
Frequency of teaching their child						
... to recognize Chinese characters	2.50	.90	3.22	.73	2.71	.010
... to write Chinese characters	2.27	.75	2.61	.85	1.24	.221
Age of onset						
... of shared book reading	3.00	1.23	4.00	.97	2.69	.011
... of teaching Chinese characters	2.22	1.21	2.78	1.11	1.43	.162
Access to literacy resources						
Frequency of visits to a library/bookstore	1.83	.79	3.06	.93	4.24	.000
Number of children's books at home	2.50	1.24	3.78	1.51	2.76	.009
Child's interest in reading						
Frequency of child's reading requests	2.55	1.09	3.50	.78	3.21	.003
Parents' expectations						
... about child's future reading	2.05	.99	2.50	.70	1.54	.133
Diary	2.38	2.76	2.72	2.10	.40	.687
CTRC	2.33	3.86	4.89	4.71	1.77	.084

Note: CTRC = Children's Title Recognition Checklist.

Discriminant Function Analysis

Next, a discriminant function analysis was performed to determine the classification hit rate when using the HLE variables as predictors of group membership. To increase our statistical power, we first created one score for access to literacy resources by summing up the scores of the individual items that make up that aspect of HLE. We also used "frequency of teaching Chinese characters" and "age of onset of shared book reading" as representatives of formal HLE and Age of Onset, respectively, because the second item of these aspects of HLE did not produce significant group differences. Finally, we left out of the analysis informal HLE, diary, CTRC, and parents' expectations as there were no significant differences between the two groups in any of these variables.

An initial inspection of the results revealed no violations of the assumptions of the analysis ((Box's M was non-significant ($p = .257$)), the predictor variables were normally distributed, and the correlations between the variables were modest; the highest being .442 between access to literacy resources and frequency of reading requests). Table 3 presents the standardized canonical discriminant function coefficients and the pooled within-groups correlations between the variables and the canonical discriminant functions. The result of the discriminant function analysis showed that the HLE variables (i.e., child's interest in reading, access to literacy resources, frequency of teaching Chinese characters, and age of onset of shared book reading) could significantly discriminate between the groups, Wilk's $\lambda = .625$, $\chi^2(4) = 14.91$, $p = .005$; the classification hit rate was 83.3% (see Table 4).

Table 3 Results of Discriminant Analysis of the Home Literacy Environment Variables

<i>Predictor variables</i>	Standardized canonical discriminant function coefficients	Correlations between the variables and the function
Age of onset of shared book reading	.196	.601
Access to literacy resources	.595	.887
Child's interest in reading	.320	.716
Frequency of teaching characters	.208	.605

Table 4 Discriminant Function Analysis of At-Risk and Not At-Risk Children Using the Home Literacy Variables as Predictors of Group Membership

	N	Predicted Group Membership	
		Not At-Risk	At-Risk
Not At-Risk	18	16 (88.9%)	2 (11.1%)
At-Risk	18	4 (22.2%)	14 (77.8%)

Note: Percent of cases correctly classified: 83.3%.

Discussion

The purpose of this study was to examine the connection between different aspects of HLE and reading difficulties in Chinese. Our results showed first that neither formal (direct teaching of literacy skills) nor informal (shared book reading) HLE differentiated children at risk for reading difficulties from their controls. This is in line with the findings of previous studies with children at familial-risk of dyslexia (Elbro et al., 1998; Hamilton et al., 2016; Torppa, Poikkeus, Laakso, Eklund, & Lyytinen, 2006; Torppa et al., 2007; van Bergen et al., 2011; however, see also Kirby & Hogan, 2008). There might be three explanations for the absence of a significant difference between groups on these variables. First, it may reflect social desirability bias. As pointed out by Sénéchal et al. (1998), asking parents about the frequency of shared book reading or about the frequency of direct teaching is sensitive to social desirability, and as such may reflect parents' intentions rather than actions. If parents responded based on what is valued by the society, this may have resulted in inflated scores in the group of at-risk children,

which, in turn, led to no group differences on these aspects of HLE.

The second reason may relate to the culture of our participants. More specifically, Chinese parents have been found in previous studies to engage more frequently in their children's learning than North American parents and to provide more direct teaching when they notice that their child experiences learning difficulties (e.g., Huntsinger et al., 1997; Pan et al., 2006). Given that our sample consisted of third-year kindergarten children whose parents had been receiving feedback on the performance of their children for three years, this may have led them to increase the frequency of their teaching (and subsequently what they reported in the home literacy questionnaire) in order to help their children bypass their early reading difficulties.⁸ This explanation is supported by the finding of a negative correlation between parents' expectations and frequency of reading a story at bedtime in the at-risk group only ($r = -.25$); lower parents' expectations about their child's future reading performance were accompanied by more frequent storybook reading.

Finally, it is possible that the significant differences between groups in formal and informal HLE reported in previous studies (e.g., Kirby & Hogan, 2008; Torppa et al., 2017) were a byproduct of group differences in family's SES. Kirby and Hogan (2008) found that good readers differed from poor readers not only in shared book reading and direct teaching of letters and words, but also on mother's education. Parents who are more educated and wealthier seem to start teaching their children earlier (e.g., Hemmereichs, Agirdag, & Kavadias, 2017; Ninio, 1990) and provide literacy activities of higher quality, as well as more literacy resources to their children (e.g., Ip et al., 2016; Liu et al., 2018; Vasilyeva et al., 2018). This, in turn, translates into larger gains in their children's emergent literacy skills and word reading (e.g., Crampton & Hall, 2017; Hartas, 2011; Raz & Bryant, 1990; Zhang et al., 2013). Because in our study we matched the two groups on family's SES (parents' education and income), we may have reduced our chances to find significant differences between the groups in these variables.

In contrast to formal and informal HLE, our findings revealed significant differences between groups in the questions measuring access to literacy resources (frequency of visits to a library/bookstore with their child)⁹ and child's interest in reading. Certainly, one could argue that parents do not feel as much pressure answering questions related to these aspects of HLE and therefore these questions may elicit parents' true actions. However, these findings also suggest that among parents of similar education and income, the difference maker is how much access to literacy resources they provide to their children and how much interest their children show in reading.

Some limitations of the present study are worth mentioning. First, our sample of at-risk children was marginally adequate and our findings should be viewed with some caution. Second, for practical reasons (i.e., there are no standardized reading tests for adults in mainland China), we could not assess parents' reading skills as was done in previous studies (e.g., van Bergen et al., 2011; 2014). Consequently, we do not know if the children in the at-risk group were also at familial risk of dyslexia. Third, the HLE questionnaire consisted of only 10 questions and some aspects of the home literacy environment were assessed with single items. Although we would like to include more questions (e.g., How often they buy or read books online), when we administered longer questionnaires in our previous studies in China we experienced several problems including low return rates or questionnaires with a lot of missing information. Fourth, we assessed child's interest in reading by asking parents to report on the frequency of their child's reading requests and not by asking the children directly. This was done because measures of child's interest in reading for participants of the same age as in our

study suffer from low reliability (Fritjers, Barron, & Brunello, 2000; Lau & McBride-Chang, 2005), which limits their usefulness. Finally, both access to literacy resources and child's interest in reading may depend on parents' availability, which we did not assess. In other words, busier parents will not likely have time to take their children to bookstores/libraries. Likewise, if parents work too many hours outside of home, their children will not have an opportunity to request that they read them a story. Parents' availability should be assessed in a future study.

Our findings have some important theoretical and practical implications. From a theoretical point of view, our findings suggest that culture may influence the aspects of HLE that are related to reading difficulties. In contrast to the finding of studies in North America in which good readers were receiving more frequent shared book reading and direct teaching of letters, sounds, and words than poor readers (e.g., Kirby & Hogan, 2008; Rashid et al., 2005), we found that, in China, it is access to literacy resources and child's interest in reading that differentiated the most between the two groups. Thus, our finding along with the findings of studies with typically-developing children (e.g., Inomata, Uno, Sakai, & Haruhara, 2016; Kim, 2009; Liu et al., 2018; Shu et al., 2002) suggest that when we discuss the role of home literacy environment in literacy acquisition we must take into account the culture in which the parent-child interactions take place. From a practical point of view, our findings suggest that if we do not assess HLE in a comprehensive manner (in most previous studies HLE was operationalized with frequency of shared book reading and number of children's books, none of which emerged as a discriminant factor in our study), we run into the risk of dismissing HLE as being irrelevant for reading difficulties. In contrast, by adding questions that assess access to literacy resources and child's interest in reading (that are also less vulnerable to social desirability bias), we increase our chances to differentiate children at-risk from not at-risk for reading difficulties. Finally, our findings suggest that parents should increase as much as possible their children's access to literacy resources (e.g., through visits to libraries/ bookstores) and to cultivate their child's interest in reading.

To conclude, our findings add to a growing body of research examining the role of HLE in reading difficulties (e.g., Hamilton et al., 2016; Kirby & Hogan, 2008; Torppa et al., 2007; van Bergen et al., 2014) and suggest that HLE is still related to reading difficulties, but it is not the usual suspects (formal and informal HLE activities) that drive their relationship when the effects of family's SES are partialled out. To the extent environment plays a role in reading difficulties in Chinese, this should be traced to factors such as child's interest in reading and access to literacy resources.

Endnotes

¹ These studies have included children with familial-risk of dyslexia.

² Although we cannot statistically test the difference in the frequency of different activities between these studies and studies conducted in North America (e.g., Hood et al., 2008; Sénéchal, 2006; Stephenson et al., 2008), the absolute values in those questions that are comparable across studies show that Chinese parents read to their children and teach them Chinese characters as frequently - in some instances even more frequently - as North American parents.

³ Although no formal reading instruction is supposed to take place in kindergarten in mainland China, several studies with Chinese kindergartners have shown that they can recognize simple characters (e.g., Liu, Georgiou, & Manolitsis, 2018; Pan et al., 2017; Zhang et al., 2013).

- ⁴ Sample power analysis using the *Sample Power* function of SPSS revealed that we needed at least 17 subjects in each group to detect significant differences with the power level set at .80 and the alpha level at .05.
- ⁵ There was an equal representation of at risk and control children from the public and private kindergartens.
- ⁶ In a pilot study we ran prior to this study, we asked parents to report the exact time they started and finished reading to their child. Parents reported that it was very hard for them to keep track of the exact time and recommended instead that we break the time into 30-minute time periods (which we did in this study). This pilot study also showed that no shared book reading took place earlier than 5pm during the weekdays and 9am during the weekend.
- ⁷ The checklist is in Chinese. A copy can be obtained upon request from the authors.
- ⁸ However, many Chinese parents (particularly those of struggling children) also send their children to private tutors. The extent to which the frequency of attending these after-school tutoring classes was counted in the parents' answers to the formal and informal HLE questions remains unclear and should be examined in a future study.
- ⁹ Number of children's books at home was marginally non-significant (because of the Bonferroni correction).

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