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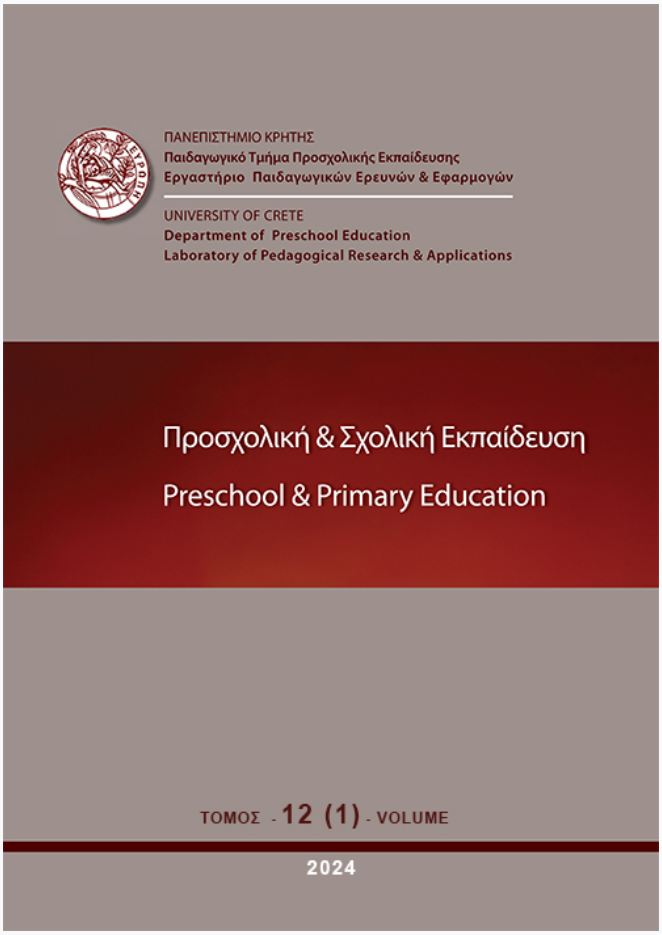

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The role of home literacy environment in reading and spelling beyond the early grades

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Abstract. Most studies on home literacy environment (HLE) have examined its role in children's language and literacy skills in the early childhood years. However, parents continue to be involved in their children's learning later on. Thus, in this study we aimed to examine if different HLE aspects (code-related HLE, meaning-related HLE, access to literacy resources, age of onset of parent-child literacy activities and child's own independent reading) predict children's reading and spelling performance in upper grades. Study 1 was conducted in China and included 111 Grade 3 children (57 girls, 54 boys; M_{age} = 9.22 years, *SD* = 0.30) and their parents. Study 2 was conducted in Cyprus and included 208 Grade 4 Greek-speaking children (114 girls, 94 boys; M_{age} = 9.77 years, *SD* = 0.39) and their parents. Results of hierarchical regression analyses in both studies showed that after controlling for the effects of parents' education and nonverbal IQ, neither code- nor meaning-related HLE activities predicted reading. In addition, they showed that access to literacy resources was a significant predictor of both reading outcomes in Study 1 and child's independent reading was a significant predictor of reading and spelling in Study 2 (with one exception when predicting passage comprehension). Taken together, these findings suggest that HLE might be important in children's reading and spelling performance, but different aspect of HLE play a role at different times. When children are in upper grades, parents may still contribute to their children's literacy skills by providing access to literacy resources and by creating an environment that allows their child to practice independent reading.

Keywords: home literacy environment, shared book reading, Greek, Chinese, reading.

Introduction

Several studies have shown that home literacy environment (HLE), an umbrella term used to encapsulate the different kinds of literacy-related activities parents engage in with their children, is a significant predictor of children's reading skills (e.g., Burgess et al., 2002; Inoue et al., 2018b, 2020; Manolitsis et al., 2009, 2011; Niklas & Schneider, 2017; Sénéchal, 2006; Silinskas et al., 2013, van Steensel, 2006; Zhang et al., 2020). Meta-analyses have also reported significant correlations between different aspects of HLE and children's language and reading skills (e.g., Bus et al., 1995; Dong et al., 2020; Liu & Li, 2022; Tan et al., 2019). For example, Bus et al. (1995) found that shared book reading correlated *r* = .32 with children's vocabulary and *r* = .28 with

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children's reading achievement. Most studies have assessed HLE when children were either in preschool or in kindergarten. This makes sense because at that age children spend most of their time at home and parents are the agents of early literacy instruction. However, parents' involvement in their children's learning does not stop in early grades. If asked, most parents will tell you that they continue to support their children's reading in some form or shape even when their children attend higher grades. Despite the established relation between HLE and children's reading skills in early grades, to date, it remains unclear if HLE continues to play a role in children's reading in later grades. In addition, it remains unclear if the effects of HLE are similar across writing systems. This is important because the characteristics of different orthographies place different demands on children and parents may respond differently in order to help their children meet these demands. Thus, the overall goal of this study was to examine whether different components of HLE predict children's reading skills in later grades in two orthographies (Chinese and Greek) representing different writing systems.

Home Literacy Environment and Children's Reading

According to the Home Literacy model (Sénéchal & LeFevre, 2002, 2014), the home literacy activities can be grouped into two broad categories, namely the code-related activities (often called formal HLE) and the meaning-related activities (often called informal HLE). These two types of activities have been found to be weakly related to each other (e.g., Liu et al., 2018; Manolitsis et al., 2011) and they influence children's reading following different paths. The former (operationalized with items asking parents about the frequency of teaching their children to read or write words) has been found to predict reading through the effects of letter knowledge (e.g., Hood et al., 2008; Inoue et al., 2018b) and the latter (operationalized with items asking parents about the frequency of reading stories to their children) through the effects of vocabulary (e.g., Manolitsis et al., 2013; Sénéchal & LeFevre, 2002).

Compared to the volume of research examining the role of code- and meaning-related HLE in children's literacy skills, much less research has been done on the role of age of onset of parent-child literacy activities and of access to literacy resources, despite the fact that they have also been considered as indicators of HLE (O'Brien et al., 2020; Umek et al., 2005). In regard to the age of onset of parent-child literacy activities, one would expect that the sooner parents start reading to their children the better (see Niklas et al., 2016), allowing this way cumulative effects of reading socialization and corresponding exposure to emergent literacy skills for a greater period of time. Nevertheless, it may also be the case that very young children are not developmentally ready to profit from such engagement. In this case, forcing children to participate in shared book reading or learning of letters/words may be counter-productive. With a few exceptions (see Sénéchal et al., 1996; Wirth et al., 2020), in which the age of reading onset did not correlate significantly with children's language and literacy skills, studies typically report moderate correlations with expressive and receptive vocabulary (Burgess et al., 2002; Frijters et al., 2000; Lenhart et al., 2022, phonological awareness (Burgess et al., 2002; Frijters et al., 2000), and reading (Li & Rao, 2000; Shu et al., 2002).

In addition, researchers have shown that access to literacy resources (often operationalized with the number of children's books at home) predicts reading over and above the effects of code- and meaning-related HLE activities. Notably, the inclusion of access to literacy resources in the same model with code- and meaning-related HLE has often resulted in non-

significant contributions of meaning-related HLE to emergent literacy skills and reading (e.g., Inoue et al., 2020; Liu et al., 2018; Zhang et al., 2020, 2023).

Most of the aforementioned studies assessed HLE when children were in preschool or kindergarten and examined how it predicts different literacy skills either concurrently (e.g., Frijters et al., 2000; Hassunah-Arafat et al., 2021; Liu et al., 2018; Xiao et al., 2020) or longitudinally (e.g., Griffin & Morrison, 1997; Inoue et al., 2018b; Manolitsis et al., 2011; Sénéchal, 2006; Silinskas et al., 2020b). However, parents' involvement in their children's reading does not stop in Kindergarten. The few longitudinal studies that followed children from Kindergarten to Grades 1, 2 or 3 have generally shown that the correlations between HLE and reading shift from being positive in Kindergarten to being negative from Grade 1 onward (e.g., Georgiou et al., 2021; Inoue et al., 2018a; Silinskas et al., 2013; Tanji & Inoue, 2023). As pointed out by some researchers (e.g., Inoue et al., 2018a; Manolitsis et al., 2009), parents teach more when they actually notice that their children experience early reading difficulties.

To date, only a handful of studies have assessed HLE in upper grades using samples of typically-developing children and have some important limitations (see Boerma et al., 2017; Katzir et al., 2009; Myrberg & Rosén, 2009; Shu et al., 2002; Skwarchuk et al., 2022; Tse et al., 2017; van Bergen et al., 2017). Some of these studies measured only one aspect of HLE, namely access to literacy resources (Boerma et al., 2017; Chiu & McBride-Chang, 2006; van Bergen et al., 2017). Although they found significant effects of access to literacy resources on children's reading skills, they cannot speak to the role of code- or meaning-related HLE in children's reading skills. The studies that measured more than one aspect of HLE have reported mixed findings (Katzir et al., 2019; Myrberg & Rosén, 2009; Shu et al., 2002; Skwarchuk et al., 2022; Tse et al., 2017). For example, Katzir et al. (2009) found that HLE (measured with number of children's books at home, frequency of reading to the child, frequency of child's independent reading, and frequency of child's visits to a library) was unrelated to Grade 4 Israeli children's reading comprehension. Similarly non-significant associations were reported by Skwarchuk et al. (2022) in a study with Grade 3 Canadian children and by Tse et al. (2017) in a study with Grade 4 children from Hong Kong. In contrast, Shu et al. (2002) found that both access to literacy resources at home and parent-child literacy-related activities (e.g., amount of time parents read to their children everyday) predicted Chinese children's reading ability (a composite score derived from short and long paragraph reading, a cloze test, sentence reading, and vocabulary) in Grade 4. Because Shu et al.'s reading composite score involved vocabulary and vocabulary seems to be related with meaning-related HLE even in upper grades (Skwarchuk et al., 2022), this may explain the significant contribution of HLE in Shu et al.'s study. Finally, working with a group of Grade 3 Swedish children, Myrberg and Rosén (2009) showed that the number of children and adult books at home had both a direct effect on children's reading achievement as well as an indirect effect through early home literacy activities. However, given that the questions on early home literacy activities were asking parents about their practices when their child was in Grade 1, it is hard to see how access to literacy resources in Grade 3 can influence reading achievement concurrently through activities that too place at an earlier point in time (i.e., Grade 1). Clearly, more research is needed on the role of HLE in children's reading skills in upper grades.

Children's Independent Reading

Because children in upper grades read on their own, the amount of independent reading they do may also be an important predictor of their reading skills. Although the term independent

reading is used thereafter, terms such as reading for pleasure (Sénéchal, 2006), leisure reading (Torppa et al., 2019), and a child's own reading outside school (Silinskas et al., 2013) have also been used in the literature. Studies that examined the role of independent reading on children's literacy skills have produced mixed findings (e.g., Georgiou et al., 2021; Leppänen et al., 2005; Silinskas et al., 2020a). For example, Leppänen et al. (2005) showed that Grade 1 children's independent book reading predicted children's word reading in Grade 2, even after controlling for children's word reading in Grade 1. In contrast, in a study with kindergarten children followed until Grade 2, Silinskas et al. (2020a) found that children's emergent literacy skills in kindergarten predicted children's independent reading in Grade 1, but children's independent reading in Grade 1 did not predict their reading skills in Grade 2. Clearly, more research is needed on the role of independent reading.

Study 1

In Study 1, we sought to examine the role of different HLE aspects (code-related HLE, meaning-related HLE, access to literacy resources, and age of onset of parent-child literacy activities) in Grade 3 Chinese children's reading efficiency and comprehension. Examining the relation of HLE with reading in Chinese is interesting because word recognition in Chinese is thought to be a protracted process (McBride, 2015) and requires explicit instruction even in upper grades. Unlike alphabetic orthographies like English or Greek, Chinese is a morphosyllabic language in which the basic unit, the character, represents a syllable and a morpheme (not a phoneme). In addition, although the phonetic radical that is used in about 80% of modern Chinese characters provides a clue to the character's pronunciation, it is relatively ambiguous and, in some cases, even misleading (Shu et al., 2003). It has been estimated that only 23% to 26% of the phonetic compound characters (when tone is also taken into account) can be read accurately using the phonetic radical (Chung & Leung, 2008). In practical terms, this means that beyond the regular classroom instruction, parents may also play a critical role in teaching their children new characters. This is obviously different from alphabetic orthographies in which once children "crack the code", they can read new words on their own.

In Study 1, we aimed to answer the following research questions:

1) Do code- and meaning-related HLE activities predict Grade 3 Chinese children's reading efficiency and comprehension? We expected that code-related (but not meaning-related) HLE activities would be a unique predictor of children's reading skills.
2) Do access to literacy resources and age of onset of parent-child literacy activities predict Chinese children's reading skills over and above the effects of code- and meaning-related HLE activities? Based on the findings of previous studies (e.g., Li & Rao, 2000; Shu et al., 2002; Zhang et al., 2023), we expected that access to literacy resources (operationalized with number of children's books at home) would exert a unique effect on children's reading efficiency and comprehension. We did not formulate a specific hypothesis regarding the role of age of onset of parent-child literacy activities because previous studies have reported mixed findings about its role in reading skills (e.g., Li & Rao, 2000; Niklas et al., 2016; Sénéchal et al., 1996).

Method

Participants

To select the participants for Study 1, we first sent letters describing our study to the families of 145 Grade 3 children attending two public elementary schools in Chengdu city, Sichuan province, China. One hundred and eleven of them (57 girls, 54 boys; M_{age} = 9.22 years, *SD* = 0.30) received parental consent and were invited to participate in our study. The children were native speakers of Mandarin and were coming mostly from upper-middle class families (based on mother's education [see below] and the reports of teachers). None of the children was diagnosed with any intellectual, behavioral or sensory difficulties. Immigrant children were excluded from the study. The study was approved by the Ethics Committee of the University of Alberta (Pro00027309).

The parents also participated in the study by filling out the HLE questionnaire (see below for more information). Ninety-four of the questionnaires were filled out by mothers, two by both parents, and four by grandparents (the grandparents indicated that the parents were working out of town during the period of the study and they were the primary caregivers). The mean mother's education level was similar to that reported in previous studies in metropolitan cities in China (Liu et al., 2018; Su et al., 2017) and suggests that our sample was drawn mostly from upper-middle class families (Chengdu Municipal Bureau of Statistics, 2021).

Measures

Nonverbal IQ. To assess nonverbal IQ, we administered the Chinese version of the standardized Raven's Progressive Matrices Test (Zhang & Wang, 1985). This test consisted of 60 items of increasing difficulty. Children were asked to visually inspect a pattern with a missing piece and then select among options which piece could be used to accurately complete the pattern. A participant's score was the total number correct. Cronbach's α in our sample was 0.92.

Reading. To assess reading, we used two measures: Sentence Verification and Passage Comprehension. Sentence Verification is a measure of reading efficiency that was adopted from Pan et al. (2011). The task required children to silently read sentences as quickly as possible and judge the truthfulness of each sentence by writing an √ or an X at the end of each sentence (e.g., *The sun rises in the west …..*). The task consisted of 100 sentences that were arranged from short to long. A child's score was the total number of correct answers minus the number of incorrect within a 3 mins time limit. Cronbach's α in our sample was 0.82. In turn, Passage Comprehension was adopted from Cheng et al. (2016) and required children to first read a narrative passage and then answer 18 multiple-choice questions. The title of the passage is "*Prince Nezha Conquers the Dragon King*" (selected from *The Journey to the West* by Wu Chengen). Each multiple-choice question had four options. Children were given 10 minutes to complete the task. A participant's score was the total number correct (max = 18). Cronbach's α in our sample was 0.80.

Home Literacy Environment (HLE). We assessed four aspects of the HLE: code-related HLE, meaning-related HLE, access to literacy resources, and age of onset of parent-child literacy activities. The questions in our HLE questionnaire were adopted from previous studies (e.g., Sénéchal, 2006; Zhang et al., 2020).

Code-related HLE. To assess code-related HLE, we asked parents to indicate by using a 5-point Likert scale (1 = never to 5 = every day) (a) the frequency of teaching their child to read Chinese characters in a typical week, (b) the frequency of teaching their child to write Chinese characters in a typical week, and (c) the frequency of asking comprehension questions after

reading a story in a typical week. The score in code-related HLE was the average of the three items. Cronbach's α in our sample was 0.78.

Meaning-related HLE. To assess meaning-related HLE, we asked parents to indicate by using a 5-point Likert scale (1 = never to 5 = every day) the frequency of getting involved in parent-child reading in a typical week. We also asked them to indicate how many minutes they spent in parent-child reading in the last two days. The reported number was subsequently recoded on a 5-point scale (1 = 0 mins, 2 = 1–30 mins, 3 = 31–60 mins, 4 = 1 to 2 hours, and 5 = more than 2 hours). The score in meaning-related HLE was the average of the two items. Cronbach's α in our sample was 0.72.

Access to literacy resources (ALR). To assess ALR, 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 = none, 2 = 1–20, 3 = 21–40, 4 = 41–60, 5 = 61–80, 6 = 81–100, and 7 = more than 100 books).

Age of Onset of Parent-Child Literacy Activities. We asked parents to indicate by using a 6-point Likert scale (1 = 5 years and after to 6 = 0-1 years old) (a) how old their child was when they started teaching him/her to recognize Chinese characters, and (b) how old their child was when they started reading picture books to him/her. The score in age of onset of parent-chid literacy activities was the average of the two items.

Mother's education. Irrespective of who filled out the HLE questionnaire, responders were asked to report on mothers' highest achieved educational level by circling one of the seven provided options that ranged from finished third grade or less to completed graduate studies.

Procedure

Children were individually assessed at their school by trained graduate students and the testing lasted approximately 40 minutes. Parents filled out the questionnaire during the same time as their children's testing. The protocols were cross-checked for accuracy of scoring by two independent raters and the inter-rater reliability was 0.99.

Results and Discussion

Before conducting any analyses, we examined the distributional properties of our measures. We found an outlier at the high end of the Sentence Verification distribution and his/her score was subsequently winsorized to the next non-outlier's score plus one. Table 1 presents the descriptive statistics of our measures as well as the Pearson product moment correlations between the measures. As expected on the basis of previous studies (e.g., Inoue et al., 2018b; Liu et al., 2018; Zhang et al., 2020, 2023), code- and meaning-related HLE activities were weakly related to each other (r = .21). Access to literacy resources correlated significantly with the meaning-related HLE and with both reading outcomes. Neither the code- nor the meaning-related HLE correlated significantly with the reading outcomes.

Next, we performed hierarchical regression analyses to examine if any of the HLE aspects would predict Sentence Verification and Passage Comprehension. At Step 1 of the regression equation, we entered our control variables (i.e., mother's education and nonverbal IQ). At Step 2 of the regression equation, we entered as a block the code- and meaning-related HLE activities. Finally, at Step 3, we entered interchangeably into the regression equation the age of onset and access to literacy resources. Standardized beta coefficients from the step in which the variables were entered in the regression equation along with the R^2 changes associated with each step are presented in Table 2. The results of the hierarchical regression analyses showed first that neither

code-related HLE nor meaning-related HLE predicted Sentence Verification and Passage Comprehension. In turn, access to literacy resources accounted for 5% of unique variance in Sentence Verification and 8% of unique variance in Passage Comprehension. Finally, age of onset of literacy-related activities was a significant predictor of Passage Comprehension accounting for 5% of unique variance.

Table 1 Descriptive Statistics and Correlations between the Measures Used in Study 1

	1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**
1.Mother's education		.08	-.10	-.02	.13	-.13	.06	.02
2.Nonverbal IQ			-.11	-.17	.19*	.23*	.18	.24*
3.Code-Related HLE				.21*	-.08	.15	-.09	-.02
4.Meaning-Related HLE					.23*	.01	.04	-.03
5.ALR						.09	.27**	.32**
6.Age of Onset							.18	.28**
7.Sentence Verification								.65**
8.Passage Comprehension								
M	5.80	35.66	3.40	2.34	5.21	2.63	36.14	13.50
SD	.72	5.01	.72	.65	1.42	1.23	5.69	2.93

Note: HLE = Home Literacy Environment; ALR = Access to Literacy Resources. * $p < .05$; ** $p < .01$.

Table 2 Results of Hierarchical Regression Analyses

Step	**Variables**	**Sentence Verification**		**Passage Comprehension**	
		β	ΔR^2	β	ΔR^2
1.	Mother's education	.047	.03	.002	.06*
	Nonverbal IQ	.171		.241**	
2.	Code-Related HLE	-.082	.01	.007	.00
	Meaning-Related HLE	.084		.012	
3.	ALR	.228*	.05*	.296**	.08**
3.	Age of Onset	.185	.03	.252*	.05*

Note: $N = 111$. HLE = Home Literacy Environment; ALR = Access to Literacy Resources.
* $p < .05$; ** $p < .01$.

These findings suggest that it is not the activities per se that make a difference in Chinese children's reading performance in Grade 3, but the provision of literacy materials that allows children to engage in independent reading and the age of onset of parent-child literacy-related activities (see Li & Rao, 2000; Shu et al., 2002, for similar findings). An explanation for this finding might be that both access to literacy resources and age of onset influence children's vocabulary (see DeBaryshe, 1993; Zhang et al., 2023, for some evidence), which then predicts reading efficiency and comprehension. Unfortunately, we were given only 30 minutes to test each child and we could not assess children's vocabulary (we address this limitation in Study 2).

In contrast to our expectation, code-related HLE did not predict either reading outcome. This finding suggests that even in orthographies like Chinese that require a long time to master, the effects of code-related HLE are short-lived and restricted to the early grades (see Liu et al., 2018; Zhang et al., 2020, 2023). An

explanation might be that the role parents would otherwise play in this process is covered by private tutors since many Chinese parents choose to send their children to after school classes to improve their reading and/or mathematics (e.g., Guo et al., 2020). However, it is also possible that some children benefit from whole classroom instruction and neither parents nor private tutors need to be involved in their learning.

Study 2

The purpose of Study 2 was to replicate the findings of Study 1 in a sample of Greek-speaking Grade 4 children and, at the same time, address some of Study's 1 limitations (i.e., the lack of a measure of vocabulary and children's independent reading). Similar to most studies in North America, the role of HLE in Greek has been examined in Kindergarten (Manolitsis et al., 2009, 2011) or early Grade 1 (Inoue et al., 2020). Because Greek is a relatively transparent orthography, children master decoding before the end of Grade 1 (see e.g., Georgiou et al., 2008; Seymour et al., 2003). Assuming they can decode accurately any given word by the end of Grade 1, parents' role in teaching Greek children to read should be minimal. However, Greek is not as consistent in the direction of spelling (e.g., the phoneme /o/ can be spelled as <ο> <ω>, the phoneme /i/ can be spelled as <η>, <ι>, <υ>, <ει>, <οι>; see Protopapas & Vlachou, 2009), which means that code-related HLE may be predictive of spelling, but not reading.

An interesting question that was not addressed in Study 1, is whether vocabulary knowledge acts as a mediator in the relation of access to literacy resources and independent reading on children's reading (particularly reading comprehension). Previous studies have shown that access to literacy resources predicts children's vocabulary (e.g., Inoue et al., 2020; Lehr et al., 2013; Zhang et al., 2023) and through the effects of vocabulary word reading (e.g., Liu et al., 2018; Zhang et al., 2023). Unfortunately, these studies included children in early grades and we do not know if the same results would be obtained in older children.

In Study 2, we aimed to answer the following research questions:

1) Do code- and meaning-related HLE activities predict Grade 4 Greek-speaking children's reading and spelling? We expected that code- and meaning-related HLE would not predict any reading outcomes, but code-related HLE would predict spelling.
2) Do access to literacy resources and independent reading predict Greek-speaking children's reading and spelling over and above the effects of code- and meaning-related HLE? Based on the findings of previous studies (e.g., Boerma et al., 2017; Chiu & McBride-Chang, 2006), we expected that access to literacy resources would exert a unique effect on children's reading and spelling. We did not formulate a specific hypothesis for independent reading because previous studies have reported mixed findings (e.g., Katzir et al., 2009; Leppänen et al., 2005; Silinskas et al., 2020a).
3) Are the effects of access to literacy resources on children's reading and spelling mediated by vocabulary? We expected that controlling for children's vocabulary knowledge would minimize the effects of access to literacy resources on reading and spelling.

Method

Participants

A letter describing our study was sent to the families of all 255 Grade 4 children attending seven public elementary schools in Larnaca, Cyprus. Although 224 parents consented for their child to participate, only 208 returned the HLE questionnaire and for this reason we present below the results with only 208 children (114 girls, 94 boys; M_{age} = 9.77 years, SD = 0.39). The children were native

speakers of Greek and were coming from middle-class families (based on parents' education, see below). None of the children was diagnosed with any intellectual, behavioral or sensory difficulties. The study was approved by the Ethics Committee of the University of Alberta (Pro00014828).

Parents also participated in the study by filling out the HLE questionnaire (see below). One hundred and seventy questionnaires were filled out by mothers, 12 by fathers, 22 by both parents, and four failed to indicate who completed them. Both mothers' and fathers' median and mode highest achieved education level was "finished college or an advanced institute of technology," which is similar to that reported in previous studies with parents from Cyprus (e.g., Hadjicharalambous & Demetriou, 2020; Sergiou et al., 2022).

Measures

Nonverbal IQ. Block Design from WISC-III (Wechsler, 1992; see Georgas et al., 1997, for the Greek adaptation) was used to assess nonverbal IQ. Children were asked to reproduce a series of two-color (red and white) designs within specified time limits. The task included 12 items and the maximum possible score was 69. The raw score was subsequently converted to a scaled score following the instructions in the manual. Cronbach's α in our sample was 0.86.

Vocabulary. Vocabulary from WISC-III (Wechsler, 1992; see Georgas et al., 1997, for the Greek adaptation) was used to assess vocabulary knowledge. Children were asked to provide a definition for a given word. The task consisted of 30 items. For every given response, the experimenter assigned a 0 (incorrect response), 1 (partly correct), or 2 (complete definition). The maximum score was 60. The raw score was subsequently converted to a scaled score following the instructions in the manual. Cronbach's α in our sample was 0.80.

Reading. To assess reading, we used three measures: Word Reading Efficiency (Georgiou et al., 2008), Passage Comprehension (Woodcock, 1998; adapted in Greek by Georgiou et al., 2010) and the 'Reading Ability Test' (Trigka, 2004). In WRE, children were given a list of 104 words, divided into four columns of 26 words each, and were asked to read them as fast as possible. A short, 8-word practice list was presented first to ensure children understood the instructions. A participant's score was the number of words read correctly within a 45-s time limit. Passage Comprehension required children to read 68 sentences or short passages missing a word that was important to the meaning of the sentence/passage. The children were asked to supply the missing word to accurately complete the meaning of each sentence/passage. The task was discontinued after four consecutive errors and a participant's score was the total number correct. Cronbach's α in our sample was 0.88. Finally, the 'Reading Ability Test' (Form A) (Trigka, 2004) is a Greek paper-and-pencil sentence-completion test consisting of 44 items. Children were asked to silently read a sentence with a missing word and then choose the right word among four distractors presented in a multiple-choice format to accurately complete the meaning of the sentence. The task was administered in a group setting and lasted 40 minutes. A participant's score was the total number correct. Cronbach's α in our sample was 0.92.

Spelling to dictation. To assess spelling to dictation, we used Nunes et al.'s (2006) task. Children were asked to write on a form with numbered spaces a word that was dictated to them. The examiner first read the word aloud, then read a sentence in which the target word was embedded, and then repeated the target word. The task contained 64 Greek words that were derived from the children's Grade 1–6 language textbooks. The words were ordered in terms of difficulty (depending on the number of vowel irregularities in a word and the grade from which the word was taken) and the task was discontinued after 10 consecutive errors. A participant's score was the number of correctly spelled words. Cronbach's α in our sample was 0.93.

Home Literacy Environment. Our questionnaire assessed four HLE components: code-related HLE activities, meaning-related HLE activities, access to literacy resources, and child's independent

reading. The questions were adopted from previous studies (e.g., Inoue et al., 2020; Manolitsis et al., 2009, 2011).

Code-related HLE. To assess code-related HLE, we asked parents to indicate by using a 6-point Likert scale (0 = never to 5 = every day) (a) the frequency of teaching their child to read words, (b) the frequency of helping their child in spelling, and (c) the frequency of helping their child with his/her homework. The score in code-related HLE was the average of the three items. Cronbach's α in our sample was 0.70.

Meaning-related HLE. To assess meaning-related HLE, we asked parents to indicate by using a 6-point Likert scale (0 = never to 5 = every day) (a) the frequency of reading a book to their children in a typical week, and (b) the frequency of listening to their child reading a book to them in a typical week. The score in meaning-related HLE was the average of the two questions. Cronbach's α in our sample was 0.75.

Access to literacy resources (ALR). To assess ALR, we asked parents to report on (a) how many adult books they had at home (1 = less than 100, 2 = 100-299, 3 = 300-499, 4 = 500-1000, and 5 = more than 1000) and (b) how many children's books they had at home (1 = less than 10, 2 = 10-24, 3 = 25-99, 4 = 100-199, and 5 = more than 200). The score was the average of the two questions.

Child's Independent Reading. We asked parents to indicate by using a 5-point Likert scale (1 = never to 5 = every day) how often their child is reading a book for pleasure (not as part of his/her homework) in a typical week.

Parents' education. We asked parents to indicate their highest achieved educational level among six options ranging from finished elementary school or less to completed graduate studies (master's or a PhD).

Procedure

Testing was completed in two sessions. In Session 1, children were individually tested at their school by trained research assistants in nonverbal IQ, vocabulary, WRE, Passage Comprehension, and Spelling to Dictation. Testing lasted approximately 45 minutes. Session 2 was conducted about a week after Session 1 and included the Reading Ability Test (administered to the whole class). Session 2 lasted about 40 minutes. Parents filled out the questionnaire during the same time as their children's testing.

Results and Discussion

Before conducting any analyses, we examined the distributional properties of our measures. The scores of a few outliers (one in nonverbal IQ, two in WRE, and two in RAT) were winsorized to the next non-outlier's score plus one in order to minimize their effect on the results. After the winsorization, all distributions became normal and the Shapiro Wilk tests of normality were all non-significant. Table 3 presents the descriptive statistics of our measures as well as the Pearson product moment correlations. Similar to the results of Study 1, code- and meaning-related HLE activities were weakly related to each other (r = .18) and meaning-related HLE correlated with ALR (r = .22). Neither the code- nor the meaning-related HLE correlated with the outcome measures. In contrast, both ALR and independent reading correlated significantly with all outcome measures, the highest correlation being between independent reading and spelling (r = .41).

Table 3 Descriptive Statistics and Correlations between the Measures Used in Study 2

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1.Parents' education		.23**	.21*	.13	.08	.48**	.35**	.27**	.29**	.27**	.26**
2.Nonverbal IQ			.34**	-.01	-.03	.22**	.35**	.24**	.33**	.41**	.31**
3.Vocabulary				.11	.08	.29**	.26**	.28**	.52**	.59**	.42**
4.Code-Related HLE					.18*	.13	.10	.01	.02	.00	.07
5.Meaning-Related HLE						.22**	.25**	.12	.05	.05	.11
6.Access to Resources							.33**	.19**	.31**	.37**	.30**
7.Independent Reading								.39**	.28**	.37**	.41**
8.WRE									.42**	.39**	.61**
9.Passage Comprehension										.57**	.44**
10.RAT											.50**
11.Spelling											
M	4.28	10.40	9.33	3.70	2.76	2.60	3.17	4.40	57.22	36.83	38.52
SD	1.03	2.38	2.70	1.01	1.08	.97	1.32	.69	12.81	7.64	11.27

Note: N = 208. HLE = Home Literacy Environment; WRE = Word Reading Efficiency; RAT = Reading Ability Test. * $p < .05$; ** $p < .01$.

Table 4 Results of Hierarchical Regression Analyses Predicting Reading and Spelling in Study 2

		WRE		Passage Comprehension		RAT		Spelling	
Step	Variable	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2
Model 1									
1.	Parents' Education	.241***	.10***	.214***	.16***	.180*	.20***	.215**	.13***
	Nonverbal IQ	.163*		.289***		.376***		.245***	
2.	Code-related HLE	-.019	.02	-.012	.01	-.027	.01	.047	.01
	Meaning-related HLE	.131		.061		.068		.108	
3.	ALR	.009	.00	.158*	.02*	.249***	.05***	.170*	.02*
3.	Independent Reading	.283***	.06***	.117	.00	.218**	.03**	.313***	.07***
Model 2									
2.	Vocabulary	.180*	.03*	.413***	.15***	.482***	.20***	.325***	.09***
3.	ALR			.113	.01	.172**	.02**	.128	.01
3	Independent Reading	.288***	.07***			.164**	.02**	.276***	.06***

Note: N = 208; WRE = Word Reading Efficiency; RAT = Reading Ability Test; HLE = Home Literacy Environment; ALR = Access to Literacy Resources. * $p < .05$; ** $p < .01$.

Next, we performed hierarchical regression analyses to examine if any of the HLE aspects would predict children's reading and spelling ability. We ran two separate models: In Model 1, we entered parents' education and children's nonverbal IQ at Step 1 as control variables. Next, at Step 2, we entered as a block the code- and meaning-related HLE. Finally, at Step 3, we entered interchangeably ALR and children's independent reading. In Model 2, we entered parents' education and nonverbal IQ at Step 1, children's vocabulary at Step 2, and at Step 3 any HLE variables that remained significant from Model 1. Standardized beta coefficients from the step in which the variables were entered in the regression equation along with the R^2 changes associated with each step are presented in Table 4. The results of Model 1 show first that after controlling for parents' education and nonverbal IQ, neither code-related HLE nor meaning-related HLE made a unique contribution to reading or spelling.

This is similar to the results of Study 1 and suggests that past the beginning stages of learning to read, the parents' contribution to their children's reading/spelling performance either through code- or meaning-related HLE activities is minimal (see Katzir et al., 2009; Skwarchuk et al., 2022; Tse et al., 2017, for a similar finding).

In contrast to the non-significant effect of code- and meaning-related HLE, child's independent reading (entered at Step 3 of the regression equation) was a significant predictor of WRE, RAT, and spelling. ALR also predicted Passage Comprehension, RAT, and spelling. This is similar to the finding in Study 1. The results of Model 2 further showed that ALR remained a significant predictor of only RAT after controlling for vocabulary, explaining an additional 2% of the variance. In turn, independent reading continued to explain 7% of unique variance in WRE, 2% in RAT and 6% in spelling.

General Discussion

The overall goal of this study was to examine the role of different HLE aspects in children's reading and spelling performance in upper grades in two orthographies (Chinese and Greek) that represent different writing systems. This allows us to draw a finer picture of the contribution of different HLE aspects to children's literacy development that goes beyond the early childhood years. The findings from both Studies 1 and 2 suggest that neither code-related HLE nor meaning-related HLE plays a critical role in children's literacy skills in upper grades. To some extent, this finding was expected because parents are no longer the main agents of instruction when their children go to school (see also Evans & Koblinsky, 2017, for evidence from a survey showing that parents feel it is the teachers' responsibility to teach their children to read in later grades). If there is a relation between code-related HLE and children's reading performance in upper grades, this will likely be negative (parents' report more teaching when their child experiences reading difficulties; see Boerma et al., 2017; Inoue et al., 2018a).

The key factors in children's literacy skills in upper grades appear to be ALR (significant in both studies) and children's own independent reading (Study 2). This suggests that there is a shift in the nature of HLE and the way it contributes to children's literacy skills in later grades (see also Tan et al., 2019, for evidence from a meta-analysis). Note that the frequency of code- and meaning-related HLE activities did not decline in upper grades and therefore we cannot blame frequency for the lack of associations with reading. For example, the mean frequency of code- and meaning-related HLE activities in Study 2 was similar to that reported in Inoue et al. (2020) with Grade 1 Greek children. Even though parents reported engaging quite frequently in code-related HLE activities (see mean score in Tables 1 and 3), this was unrelated to their children's

literacy skills. We argue here that parents play a facilitator's role more than an instructor's role when their child goes to upper grades. They provide the means for their children to develop further in reading and spelling by giving them access to more books and educational programs. This explanation is further supported by evidence showing that parents who are more educated and wealthier are more able to provide access to literacy resources to their children than parents from lower socioeconomic status, which then influences their language and literacy skills (e.g., Jiang et al., 2023; Liu et al., 2018; Singh et al., 2023). In practice, this means that parents of children in upper grades should be encouraged to provide as much access to educational material to their children as possible. If children are given access to books, then they may be more inclined to spend time reading them as opposed to children who want to read, but do not have access to books either because of their cost or because public libraries are inaccessible. This also means that governments should re-evaluate the role of public libraries to make them more accessible to children or provide incentives to children to access educational material online. Evidence from a recent meta-analysis (De Bondt et al., 2020) shows that book giveaway programs (e.g., Reach Out and Read, Imagination Library) promote children's home literacy environment (Cohen's d = 0.31), which subsequently results in children scoring higher in literacy-related skills prior to and during the early school years (Cohen's d = 0.29).

Some limitations of our study should be reported. First, any significant relations found in Studies 1 and 2 do not imply causation. Second, we collected information about the HLE by asking parents to fill out a questionnaire. As pointed out in the past (e.g., Manolitsis et al., 2011; Zhang et al., 2020), this approach is subject to a social desirability bias (i.e., parents respond based on what they think the society would like to hear and not based on what they actually do at home). The alternative would be to collect observational data, but this option is both costly and difficult to do when working with large sample sizes. Third, we collected data in both studies from a single grade level (Grade 3 in Study 1 and Grade 4 in Study 2). This means that our findings may not generalize to other grade levels. A future study should replicate our findings with older children. Fourth, we acknowledge that there were some small differences in the items used to operationalize the HLE variables between Studies 1 and 2. For example, code-related HLE was operationalized with comparable items (a and b) in both countries, but the third item differed. Despite these small differences, when we repeated our analyses using only the comparable items across the two countries the results remained the same. Finally, we did not ask parents if, and how often, they were sending their children to private tutoring or engaging them in other academic-related extracurricular activities (e.g., learning English as a second language). According to the intergenerational transfer of socioeconomic resources model (Davis-Kean et al., 2021), parents may influence their children's academic performance both through HLE activities at home as well as through activities outside the home.

To conclude, the findings of this study add to a growing body of research examining the role of HLE in upper grades (e.g., Katzir et al., 2009; Skwarchuk et al., 2022; Tse et al., 2017; van Bergen et al., 2017) by showing that the role of the most popular HLE aspects (i.e., code-related HLE and meaning-related HLE) is significantly reduced and is taken over by children's own independent reading. A practical implication of this finding is that parents of children in upper grades can still help their children's reading and spelling by providing the means (e.g., buying books, subscription to educational programs) to their children so that they can engage in independent reading more frequently.

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